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An Experimental Investigation for Enhancing Concrete Properties using Coconut Coir and Polypropylene Fibre , Partial Replacement of Fly Ash with Cement

Er. Abhishek Dhiman[1], Er. Jainender Sharma[2], Er. Abhilesh kant Sharma[3]

[1]M.Tech Scholar, Civil Engineering, Sri Sai University Palampur(H.P.) India
[2]H.O.D, Civil Engineering, Sri Sai University Palampur(H.P.) India
[3]Assistant Professor, Civil Engineering, Sri Sai University Palampur(H.P.) India

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Abstract - *Plain concrete is resistant in compression but weak in tension, resulting in the formation of cracks in the structure. The use of fibres in concrete can help to lessen and avoid internal micro cracks in concrete caused by tensile strains. Also in India, there is also a high demand for construction materials, with cement being one of the most common materials used in construction. The harmful gases emitted from the cement kiln during the manufacturing process are extremely harmful to the health of living beings. To avoid such health problems, it is necessary to either stop using toxic materials or replace them with environmentally friendly materials that have similar properties to cement. The goal of this project is to improve the properties of concrete by introducing hybrid fibres and controlling the effect of cracks. Fly ash is substituted with cement in a 20 percent ratio, coconut coir and polypropylene fibres (in 1:1.5) are added in quantities of 0, 1, 1.5, and 2% by weight of cement. Coconut coir and polypropylene fibres have lengths of (1-2)cm and (2-3)cm, respectively. The results suggest that combining fly ash with hybrid fibres in concrete increases the concrete's compressive strength. Adding coconut coir, polypropylene fibre, and fly ash separately yields no noticeable results.*

Key Words*: Fly Ash, Coconut coir fiber, Compressive strength, Flexural strength, Polypropylene fiber, Split Tensile strength.*

1.INTRODUCTION

Fly ash is a type of industrial waste that has cementation characteristics and may be used to substitute cement in some applications. Fly ash has been shown to improve the compressive strength and workability of concrete in prior studies. Apart from fly ash, waste materials like coir and polypropylene fibre are abundant in the environment. Polypropylene fibres are synthetic fibres that are produced as a byproduct of the textile industry. They have a low specific gravity and are inexpensive.

The use of polypropylene fibres increases tensile and flexural strength by reducing heat fractures along plastic shrinkage cracks.

Chemically, they are inert and non corrosive. The use of such fibres has the benefit of lowering building costs and eliminating the requirement for trash disposal in landfills. The use of these fibres in concrete results in a solid waste management technique that is successful.

1.1 LITERATURE REVIEW

Majid Ali et al., 2009 coconut fibres and cord ferroconcrete beam below dynamic loading in earthquake-prone region, properties of CFRC structural members is investigated. Natural fibre (coconut fibre) of length 7.5 cm and 3 percent by weight of cement are accustomed in preparing CFRC beams. A fibre of diameter 1cm and durability of 7.8 MPa is due to reinforcement.

Alida Abdullah, 2011 conducted an experiment in which had taken cement and sand with 1:1 ratio and 0.55 as a water-cement ratio. Used coconut fibres as reinforcement in the concrete mix and replaced with the composition of sand by weight 3%, 6%, 9%, 12%, 15% respectively for 7, 14 and 28 days. Reported that density of mix reduced with increase in fibre. Moisture content gave maximum value at 3% fibre content, and a similar trend occurs at 14 and 28 days. observered that water absorption increased with increasing fibre content in the mixture.

Roohollah et al (2012) We're investigating that Fiber addition was seen to enhance the physical and mechanical properties of lightweight concrete (LWC). Compared to Unreinforced LWC, polypropylene (PP) reinforced LWC with fiber proportioning 0.35% and12 mm fiber length, caused30.1% increase in the flexural strength. Increased fiber availability in the LWC matrix, in addition to the ability of longer Polypropylene fibers to bridge on the micro cracks, is suggested as the reasons for the enhancement in mechanical properties.

R. Naga Lakshmi, 2013 conducted an experimental study to assess the strength characteristics of concrete of M25 grade with partial replacement of cement with flyash and coconut shell in coarse aggregates. Results from the test indicates that compressive strength, split tensile strength and flexural strength of the concrete reduced with increasing proportion of the coconut shell replacement.

Praveen et al (2013) Were the effects of variation of polypropylene fibers ranging from 0.1% to 0.4%along with 0.8% fibers on the behavior of fibrous concrete? The mechanical properties of the concrete such as Compressive and tensile strength have been founded. The result the addition of polypropylene fiber has a little effect on the Compressive strength, but there was increase in the tensile strength with increase in fiber volume fraction. As per investigation increase of 47%of split tensile strength and 50% of flexural strength is the result were ultimate load mainly depended on percentage volume fraction of fiber.

Parbhane et al (2014) There were investigated that the workability and tensile strength of concrete increased to some extent as the coir increased. Concrete cubes produced by 1%, 2%, 3%, 4% &5% addition attained 28 days tensile strength of 2.68, 2.90,3.11, 3.25, 2.33 respectively.

Nandish S C et al (2015) This study describes the enhancement in the strength of the conventional concrete by the addition of fibers. Coconut fibers and polypropylene fibers are used to increase the strength of the concrete.. Slump test was carried on fresh concrete while compressive strength, split tensile strength and flexural strength were carried on hardened concrete. These tests are carried out to determine the mechanical properties of concrete up to 7, 28, 56 and 90 days for compressive strength, 28 days for split tensile strength and flexural strength. A notable increase in the flexural and tensile strength was found.

Bhupendra Kumar et al (2015) This research paper discusses the comparative study between Fly ash based coconut fiber concrete with plain cement concrete of M40 grade. This research paper deals use of the agricultural and industrial waste material into concrete, which enhanced the properties of concrete and make environment eco-friendly. The diameter of coconut fiber is varies between 0.25 to 1.0 cm and length is taken as 4 cm

K. Murali et al (2018) The present study has illustrated that addition of coconut fiber and coir fiber to concrete enhances the properties of concrete. Utilization of agricultural waste material in concrete enhances the properties of concrete. To study this phenomenon concrete made of fly ash, coconut fiber and coir fiber for M40 was done and evaluated.

1.2 EXPERIMENTAL WORK

Methodology

To achieve the objectives of the work various experiments are performed are:

1. Compressive Strength Test for Concrete
2. Split Tensile Strength Test for Concrete
3. Flexural Strength Test for Concrete

Materials

The following materials were used for preparing the concrete mix.

ACC cement of 53 grade.

1. Fine aggregate i.e. sand
2. Coarse aggregate
3. Fly Ash
4. polypropylene fibers
5. Coconut coir fiber
6. Water

1. Coconut coir fiber: Fibres were obtained from local temples, washed, sun dried, and dust removed before being analysed. Except for water treatment, coconut fibres do not require any pre-treatment. Fibre from Coconut absorbs a lot of water. As a result of this attribute, the Coconut fibres were soaked in water for 24 hours before to use.

Fig.1 Coconut Fiber

2. Polypropylene Fibre: Polypropylene fibres are synthetic fibres that are produced as a byproduct of the textile industry. They have a low specific gravity and are inexpensive. Polypropylene used in this work is collected from market.

Fig.2 Polypropylene Fiber

3. Fly Ash Fly ash is a residue generated in combustion and comprises the fine particles that rise with the flue gases. Ash that does not rise is called bottom ash. In an industrial context, fly ash usually refers to ash produced during combustion of coal. Fly ash is a heterogeneous material.

Fig.3 FlyAsh

2. RESULTS AND DISCUSSIONS

TABLE 2.1: COMPRESSIVE STRENGTH OF CONCRETE AFTER 7 DAYS AND 28 DAYS

S.No	Designation	Compressive strength in 7days N/mm²	Compressive strength in 28days N/mm²
1	M0	21.73	34.7
2	M1	23.37	35.3
3	M2	24.17	35.8
4	M3	24.93	37.9
5	M4	23.93	36.5

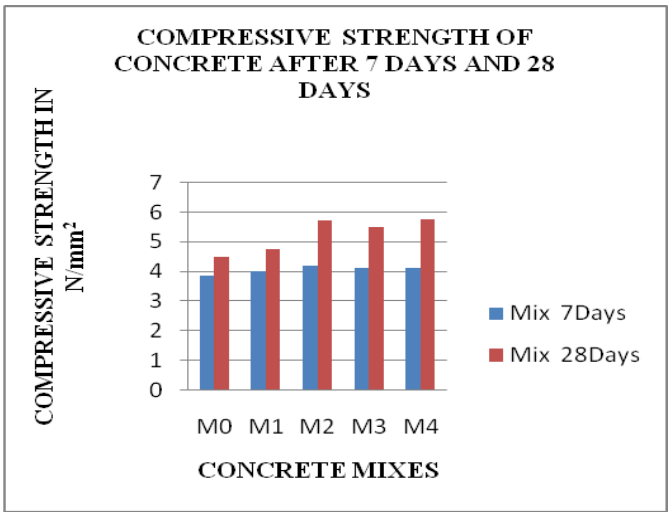

CHART2.1.: Bar Chart of Compressive Strength of Concrete

The graphs show the compressive strength results at 7 days and 28 days, indicating that the mix values continue to rise. The maximum compressive strength value at 7 days is 24.93 kN/mm² at 1.5% coconut coir, 2.25 percent polypropylene Fiber, and 20% FlyAsh, whereas the maximum compressive strength value at 28 days is 37.9 kN/mm² at 1% coconut coir, 2.25 percent polypropylene Fiber, and 20% Fly Ash.

TABLE 2.2: SPLIT TENSILE STRENGTH OF CONCRETE AFTER 7 DAYS AND 28 DAYS

S.No	Designation	Split tensile strength in 7days N/mm²	Split tensile strength in 28days N/mm²
1	M0	1.69	2.67
2	M1	1.86	2.71
3	M2	1.96	2.91
4	M3	2.61	3.67
5	M4	2.30	3.17

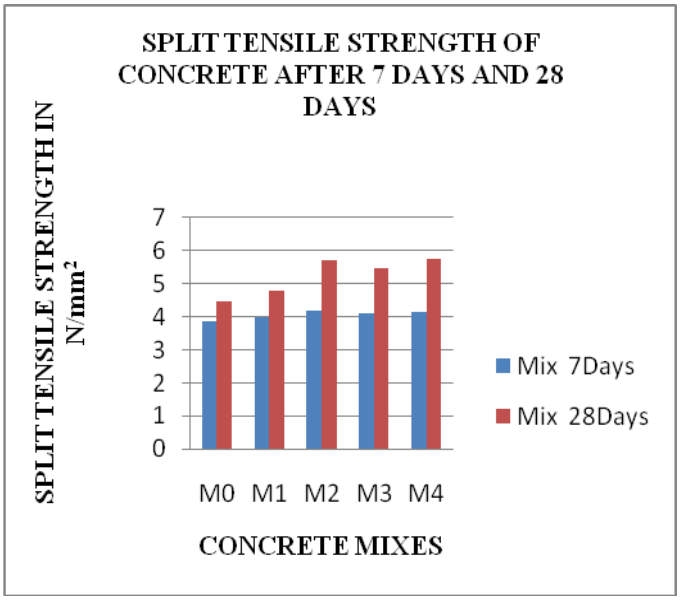

CHART 2.2: Bar Chart of Split Tensile Strength Of Concrete

The graphs show the results of split tensile strength at 7 days and 28 days, indicating that the mix values are increasing. The maximum value at 7 days is 2.61 kN/mm² at 1.5 percent coconut coir, 2.25 percent polypropylene Fiber, and 20% FlyAsh, whereas the maximum value at 28 days is 3.67 kN/m² at 1.5 percent coconut coir, 2.25 percent polypropylene Fiber, and 20% Fly Ash.

TABLE 2.3: FLEXURAL STRENGTH OF CONCRETE AFTER 7 DAYS AND 28 DAYS

S.No	Designation	Flexural strength in 7days N/mm²	Flexural strength in 28days N/mm²
1	M0	2.54	4
2	M1	2.8	4.07
3	M2	2.94	4.37
4	M3	3.93	5.51
5	M4	3.45	4.75

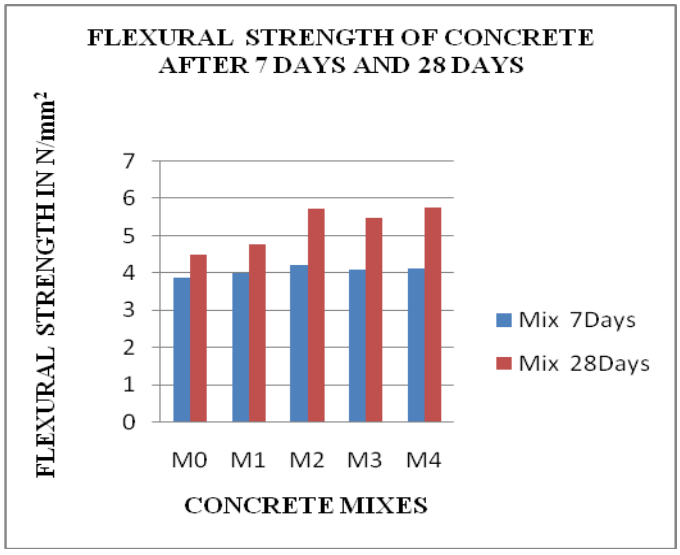

CHART2.3: Bar Chart of Flexural Strength of Concrete.

The graphs show the results of flexural strength at 7 days and 28 days, indicating that the mix values are increasing. The maximum value at 7 days is 3.93 kN/mm² at 1.5 percent coconut coir, 2.25 percent polypropylene Fiber, and 20% FlyAsh, whereas the maximum value at 28 days is 5.51 kN/mm² at 1.5 percent coconut coir, 2.25 percent polypropylene Fiber, and 20% Fly Ash.

3. CONCLUSIONS

1. The low density of coconut fibre minimises the weight of fibre reinforced concrete.

2. At the mix3, the concrete's compressive strength, split tensile strength & flexural strength reach their maximum levels.

3. Because the strength of the specimens is reduced when fibres are added to the concrete, it may be concluded that the fibre should not be utilised in excess of 1.5%(coconut coir) and 2.25%(polypropylene fiber).

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BIOGRAPHIES

ABHISHEK DHIMAN, pursuing M.tech in Structural Engineering, and B.tech in Civil Engineering from Sri Sai University Palampur, (H.P.) India.

Er. Jainender Sharma, working as H.O.D in the Department of Civil Engineering, Sri Sai University Palampur, (H.P.) India. He published more than 15 papers in both International and National journals and conferences. His area of research is Material, Concrete, Special concrete.

Er. Abhilesh Kant Sharma, working as Assistant Professor in the Department of Civil Engineering, Sri Sai University Palampur, (H.P.) India. He published more than 15 papers in both International and National journals and conferences. His area of research is Material, Concrete, Special concrete.