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INVESTIGATION ON BENDABLE CONCRETE

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ABSTRACT

With the exception of coarse aggregates, bendable concrete has all the components of ordinary concrete and is reinforced with polymer fibres. Sand, cement, water, fibres, and admixtures are all present. ECC is 37 percent less expensive than normal concrete, uses 40 percent less energy, and emits 39 percent less carbon dioxide. Large amounts of industrial waste, especially fly ash, are incorporated into ECC. The same materials as conventional concrete, excluding the coarse aggregate, are used to make flexible concrete. It has the exact same appearance as regular concrete, but under extreme strain, ECC concrete permits the specifically coated network of cement fibre to glide with the cement, preventing the rigidity that leads to brittleness and breaking. The crucial element is that ECC is engineered, which entails using microfiber reinforcement in addition to the concrete itself. In order to create flexible concrete and compare it to regular concrete, a literature review was done in these cases. The ideal percentage of fly ash partial replacement of cement and various percentages of Recron 3S fibre incorporation were tested in an experiment for M30 concrete. By substituting 0%, 10%, 20%, and 30% of Recron 3S fibre for fly ash, respectively, and 0%, 1%, 2%, and 3% of cement, fly ash was partially replaced. Traditional concrete cubes and cylinders were cast, and they underwent 7- and 28-day tests. ECC differs from typical concrete in that it has a strain capacity of 3 to 7 percent as opposed to 0.01 percent for ordinary Portland Cement (OPC). Because ECC behaves less like a brittle glass and more like a ductile metal (like OPC concrete), it can be used in a wide range of applications. Victor Li, a professor at the University of Michigan, created Engineered Cementitious Composite (ECC).

***Keywords**: ECC, bendable concrete, compressive strength, split tensile strength.*

1. INTRODUCTION

A reinforced ultra-ductile mixture is used to create bendable concrete in order to increase ductility and crack-control effectiveness. In the current work, bendable concrete is created using a mixture of cement, sand, fibres (Recron fibres), fly ash, water, and an additive (SP 1040). The concrete samples were cast, cured for seven days, and their strengths were calculated after 28 days. Increased tensile strength, crack control, increased flexibility, and decreased permeability are the key benefits of ECC. Concrete has always been a brittle substance that cracks easily when subjected to tensile pressure. A revolutionary form of concrete that is more ductile than regular concrete has just been created by researchers. Regular concrete will crack when subjected to a tensile load. Scientists have therefore been working to make concrete more ductile—that is, more likely to flex rather than break—for a very long time. According to studies (Gandhiya, 2015), Engineered Cementitious Composite (ECC) is 40 times lighter and 50 times more flexible than conventional concrete. Additionally, ECC is perfect for key components in seismic zones due to its exceptional energy absorption properties.

2. OBJECTIVES

The objectives of this study are as follows

a) To use flyash and cement as efficiently as possible.
b) To use Recron 3s fibers to maximize the use of concrete.
c) To assess the concrete's compressive and split tensile strength.

3. MATERIALS

The properties of cement are presented in Table 1.

Table 1 Physical properties of cement

S. No.	Property	Cement (53 grade)
1	Specific gravity	3.146
2	Fineness	9.92%

3.1 FLY ASH: - Sand, stone, and water are among the several natural resources needed for the production of concrete. Another crucial element in the creation of concrete is cement, which bonds the particles together when combined with water. Scientists have thus begun evaluating the suitability of several additional cementing materials, including fly ash. Fly ash is a by-product of the coal combustion process. Fly ash will reduce the amount of cement used while also obviating the need for waste management costs. Fly ash has gained popularity as a binder substitute in the construction sector due to its pozzolanic activity, low water requirement, less bleeding, and low heat evolution.

3.2 RECRON 3S FIBRE: Recron 3s fibre was employed as a secondary reinforcing material. It increases water, abrasion, and impact resistance while preventing shrinkage fractures. Making concrete homogenous increases the material's ductility, flexural strength, and capacity to absorb more energy. Recron 3s fibres that are evenly dispersed decrease segregation and bleeding, resulting in a more uniform mix. By boosting strength and lowering permeability, this increases durability. Recron 3s makes the structure, plaster, or component stronger right away by preventing micro shrinkage cracks from developing during hydration. Additionally, cracks will emerge, sometimes quickly, when the weights placed on concrete approach those that lead to failure. Plaster and concrete are treated with Recron 3s to guard against cracking brought on by volume changes such as expansion and contraction. Recon 3s reduces the development of minute shrinkage fractures during hydration, increasing the inherent strength of the building, plaster, or component. Furthermore, cracks will spread swiftly as the stresses placed on concrete get closer to the point of collapse. Recron 3s avoids cracking brought on by volume change since 1 kg of it has millions of fibres that support mortar and concrete in all directions (expansion and contraction). cut lengths of 6 mm or 12 mm

4. EXPERIMENTAL INVESTIGATIONS

4.1 Compressive strength results

The compressive strength conducted in compression testing machine for the cast and cured specimens and the results are furnished in table 2.

Table 2: Compressive strength of concrete with Fly ash as partial replacement ofcement in concrete by adding Recron 3s fibre

CEMENT SAND RATIO	FLYASH	RECRON 3S FIBRE	7 days N/mm^2	28days N/mm^2
N.C			22.35	32.05
1.1.5	0%	0%	23.14	33.21
	10%	1%	24.37	34.90
	20%	2%	25.28	36.23
	30%	3%	24.75	35.64

4.2 Split Tensile strength results

The cylindrical specimens (150 mm diameter x 300 mm height) were tested for determining the split tensile strength at ages 7 and 28 days. A cylindrical sample is placed horizontally between the loading surface of a compression testing machine, and a load is applied until the cylinder fails along the vertical diameter.

Table 3: Split tensile strength of concrete with Fly ash as partial replacement ofcement in concrete by adding Recron 3s fibre.

CEMENTSAND RATIO	FLYASH	RECRON3S FIBRE	7days N/mm^2	28days N/mm^2
N.C			2.19	3.15
1.1.5	0%	0%	2.61	3.74
	10%	1%	2.64	3.79
	20%	2%	2.74	3.81
	30%	3%	2.65	3.76

5. CONCLUSION

In this study, the concrete ingredients like cement are partially replaced by Fly ash and Recron 3s fibre. Fly ash are varied different percentages of 0,10,20 and 30% and Recron 3s fibre is varied with different percentages like 0,1,2 and 3 %.

1. The normal concrete of M25 grade of concrete the compressive strength result for 7 and 28 days is 22.35N/mm2 and 32.05 N/mm2.
2. The normal concrete of M25 grade of concrete the Split tensile strength result for 7 and 28 days is 2.19 N/mm2 and 3.15 N/mm2.
3. At 0% replacement of cement by Fly ash and 0% Recron 3s fibre with ratio of 1:1.5 motar the achieved compressive strength of concrete is 23.14 N/mm2 and 33.21 N/mm2 for 7days and 28days.
4. At 0% replacement of cement by Fly ash and 0% Recron 3s fibre with ratio of 1:1.5 motar the achieved Split tensile strength of concrete is 2.61N/mm2 and 3.74 N/mm2 for 7days and 28days.
5. At 20% replacement of cement by Fly ash and 2% Recron 3s fibre the achieved compressive strength of concrete is 25.28N/mm2 and 36.23 N/mm2 for 7days and 28days.
6. At 20% replacement of cement by Fly ash and 2% Recron 3s fibre the achieved Split tensile strength of concrete is 2.74 N/mm2 and 3.81 N/mm2 for 7days and 28days.

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