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Engineered Cementitious Composite

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Abstract: *Engineered Cementitious Composites or ECC is a cement composite with reinforced fiber, having high ductility and strong cracking width control. Ordinary concrete is almost incapable of bending and has a strength of only 0.1% which makes them brittle and hard. This lack of bending is a major cause of failure under stress and has been a contributing factor in the development of special materials. This feature is able to display highly improved flexibility. The fibers used ECC are micromechanically designed. To maximize performance, a High Range Water Reduction (HRWR) agent must be added to ECC. In contrast, no coarse aggregates are used in ECCs, which has a relatively high powder content. Cement materials, such as fly ash, silica fume can be used in addition to cement to increase adhesion content. The purpose of cement composites is designed to develop a durable and flexible material.*

Keywords – *concrete, earthquake resistant structure, fiber, strain capacity, sustainability*

I. INTRODUCTION

Engineered cementitious composites (ECC) is a composite compound of reinforced mortar reinforced with specially designed short strands. Traditional concrete faces catastrophic failure when pressured by earthquakes or common overuse. The ECC remains intact and is safe to use in up to 5% of severe cases. Fractures of traditional concrete and will not carry a load of 0.01% of tensile strain. In this paper, in order to overcome the need for concrete in the future and to improve fiber materials, Poly Vinyl Alcohol Fiber is used to reduce cement content and improve flexibility. It has high aspect ratio, high durability, high modulus elasticity, good chemical compatibility with Portland cement, good contact with water and no health risks. To increase the performance of concrete super plasticizer is used. The compressive strength and flexibility of the cubes and slabs (two different thicknesses) are determined and the bending properties of the concrete are assessed during the flexibility test.

Engineered Cementitious Composites abbreviated as ECC is a class of cement composites with reinforced ductile fiber, characterized by high cracking and strong cracking control. Ordinary concrete is almost incapable of bending and has a strength of only 0.1% which makes them brittle and hard. This lack of bending is a major cause of failure under stress and has been a contributing factor in the development of luxury materials i.e., flexible concrete. This feature is able to display highly improved flexibility. Flexible concrete is reinforced with micromechanically designed polymer fibers. ECC is made of the same basic ingredients as conventional concrete but with the addition of a High-Level Water Reduction (HRWR) agent is required to transfer good performance. However, wage aggregates are used in ECCs, the powdered content of the ECC is relatively high. Cement materials, such as fly ash, silica fume, etc., can be used in addition to cement to increase adhesion content. In addition, the ECC uses low values, usually 2% in volume, in short, continuous threads.

II. OBJECTIVES

a) The objectives of the work are to prepare different mix proportions by incorporating different volume of fly ash
b) To compare the strength parameters of ECC samples with the parameters of conventional concrete. To compare the results of flexural behavior of the ECC with conventional concrete and comparison of bending phenomenon.
c) Develop ECC mix designs implementing locally available materials; Evaluate ECC mix designs mechanical properties (ultimate tensile strength and strain, flexural strength, compressive strength.
d) Characterize ECC cracks (obtain crack width distribution), Identify key parameters affecting ECC properties; and to perform feasibility study for implementation.

III. METHODOLOGY

3.1 Material

a) Cement

We have used Ordinary Portland cement (OPC) of grade 53(Ultratech cement) conforming to IS 8112-1989 [12]. The specific gravity of OPC cement is 3.15.

b) Fine Aggregate (Sand)

Fine aggregate is a naturally occurring granular substance composed of rocks that are well separated from mineral substances. The positive aggregate passed through a 2.36mm filter and had a gravitational force of 2.68. the grading area of good integration was sinners III as specified in IS 383-1978 [13].

c) Super Plasticizer

It is a mixture added during mixing. The greatest effect is achieved when a super plasticizer is added after adding 50-70% water. It is a water-reducing agent and is used to increase performance.

d) Flyash

Fly ash is produced at the Thermal power station. Class F fly ash is used to reduce costs. Replacement of fly ash ash is between 30-75%

e) PVA Fiber

Poly vinyl alcohol fiber is suitable for reinforcing cement mixtures .it has high strength and elastic modulus. From 25-40GPa. Fiber elongation is about 6-10%. The fiber length is 12mm. The strongest fiber strength is 880-1600MPa. PVA fiber is a strong bond and cement matrix is one of the remarkable characters.

f) Water

Generally, water fit for drinking is fit for making concrete.

3.2 Mix Design

The construction of concrete mixes involves a preparation process in which the mixture of ingredients creates the required strength and durability of the concrete structure. Because all the ingredients in a mixture contain different properties, it is not an easy task to form a large concrete mix. It is imperative that all ingredients be tested to determine their physical properties and carrying capacity of the project site. Ingredients to be tested: water, fine mix (sand), coarse material, cement, chemicals, hardening, and soil. The values of the physical properties obtained after the test will be used as the basis for all consideration of the design of the concrete mix. This will ensure that the structure will be noisy and prevent mixing failure. It is important to note that compound ingredients may vary from one project site to another, so the physical properties should be assessed for the requirements specified in each area.

3.2.1 Engineered Cementitious Concrete

The hybrid design of the ECC Concrete is basically based on Micromechanics which is a branch of material used at the integration level that captures the mechanical interaction between the fiber, the motor matrix, and the optical fiber-matrix connector. (Laboratory-based) Therefore, conventional hybridization methods such as the IS method and other ECC blending methods do not work and the diagnostic and error method is much better than the ECC. Therefore, the appropriate mixture of ingredients given in previous studies was set as guidelines for determining the proportion of different ingredients in concrete.

3.3 Testing of Concrete

This works with the testing and testing process for a new and stronger concrete template. The test was performed by testing the cubes, beams, slabs and cylinders for 7, 21, 28 days. Cubes and cylinders were tested on a pressure test machine (CTM) and the beams and slabs were tested on Universal Testing Machine (UTM). Examination to test new concrete: Loose cone test and solid concrete test: Compressive (Cube) test, Flexural Test (Beam), Split Tensile (Cylinder) test 25 25 Concrete mix of Portland cement, water and and to cover that. it contains stones and sand. Generally, concrete is strong in pressure but weak in grip.

3.4. Costing

Cost analysis was performed to determine the feasibility of using the ECC as a new future for infrastructure. As shown in the tables a few of the ECC items tested in this study have high levels, which makes them attractive to the use of infrastructure. However, its cost compared to conventional concrete is higher (2.8 to 4.1 times as shown in the Tables. costs without taking into account the profound impacts of ECC structures on pedestrian construction, construction, and operation. fly-ash use is introduced and provides improved safety due to high ductility

TABLE 1.1 Mix Proportion for conventional concrete

Materials	Proportions (kg/ m³)
Cement	300
Water	165
Fine aggregates	647
Coarse aggregate	1281
Super plasticizer	0.9

TABLE 1.2 Mix Proportion for ECC

Materials	Proportions (kg/ m³)
Cement	566/555/544
Water	314
Fine aggregate	503
Fly Ash	691/705/720
PVA Fiber	26
Super Plasticizer	6.3

TABLE 1.3 Costing of conventional concrete

MATERIAL	QUANTITY	UNIT	RATE (₹)	AMOUNT (₹)

Cement	6	Bags	350	2100
Fine Aggregate	0.448	CU.M	2650	1187
Coarse Aggregate	0.885	CU.M	1300	1150
Super Plasticizer	0.9	Kg	160	144.00
				4581.7

TABLE 1.4 Costing of ECC

MATERIAL	QUANTITY	UNIT	RATE (₹)	AMOUNT (₹)
Cement	6	Bags	350	2100
Fine Aggregate	0.448	CU.M	2650	1187
Coarse Aggregate	0.885	CU.M	1300	1150
Super Plasticizer	0.9	Kg	160	144.00
				4581.7

Fig 1 PVA fiber

IV. CONCLUSION

Result to be obtained from this experiment is to show compressive and flexural strength of PVA-ECC is influenced by the fibers, contributing more to the flexural strength than compressive strength.
Beams loaded in flexure will show higher bending or ductility. The addition of PVA fibers into ECC concrete has positive effect on the durability and mechanical performance. The ECC has the properties of tensile strain-hardening behavior and excellent crack dispersion capacity which make it better than the conventional concrete and FRC. water absorption values reduced with addition of PVA fibers into the ECC concrete. It ECC, which exhibits excellent properties in ductility and damage tolerance, was developed for applying to the seismic resistant structural elements. The ECC employed in this research is the PVA fiber reinforced mortar designed using micromechanical concepts.

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