Experimental Investigation on Bendable Concrete by Using Admixtures

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Abstract— **Engineered cementitious composites (ECC) also called as Bendable concrete is an easily moulded mortar based composite reinforced with specially selected short random fibres. Traditional concrete suffers catastrophic failure when strained in an earthquake or by routine overuse. ECC remains intact and safe to use at tensile strains up to 5%. Traditional concrete fractures and may not carry a load at 0.01 % tensile strain. In this paper, to overcome the demand for concrete in future and to develop the fibre materials, the Recron 3S Fibre and AR glass fibre are used so as to reduce the cement content and to enhance flexibility. It has high aspect ratio, high ultimate tensile strength, relatively high modulus of elasticity, good chemical compatibility with Portland cement, good affinity with water and no health risks. The compressive strength and flexural strength of cubes and slabs (two different thicknesses) is determined and also the bendability characteristics of the concrete are checked during flexural strength test.**

Keywords— ECC **(Engineered Cementitious Composites) or Bendable concrete, Recron3S fibre and AR glass fibre (Alkali Resistance) Super plasticizer (polycarboxylate).**

I. INTRODUCTION

Conventional concrete are almost unbendableand having a strain capacity of only 0.1% making them highly brittle and rigid. This lack of bendability is a major cause for failure under strain and has been pushing factor in the development of an elegent material, bendable concrete also know as Engineered Cementitious Composite abbrivated as ECC. This material is capable to exhibit considerably enhanced flexibility. A bendable concrete is reinforced with micromechanically designed polymer fibres.

II. LITERATURE REVIEW

V.Rajesh et.al studied that fracture controlled failure is exhibited by the ECC under flexural loading, and a bend a bend is obtained because of crack controlling nature. In the Bendable Concrete for the mixes having 30% replacement of cement with fly ash the best mix which is obtained at Cement/Sand ratio 1:0.5 and having 3% volume of fibers. In the Bendable Concrete for the mixes having 30%replacement of cement with fly ash the best mix is obtained at Cement/Sand ratio 1:0.7 and having 3% volume of fibers

R.Patil et.al. proved that engineered Cementitious Composite material concrete gives more flexible strength than convectional concrete. Convectional concrete has % of strain capacity but ECC concrete has strain capacity of 3-5%.

R. Kishore Kumar. Et.al. studied that compression and flexural strength of bendable concrete is done and the values are compared with convectional cubes is done the values are compared with convectional cubes and slabs. Therefore it is proved that the bendable concrete is more strength than the convectional concrete. and it is more flexible so that it resists cracks and acts as more efficient in seismic regions and temperature were performed for LFC and density of 650 and 1000 kg/m³.

III.METHODOLOGY

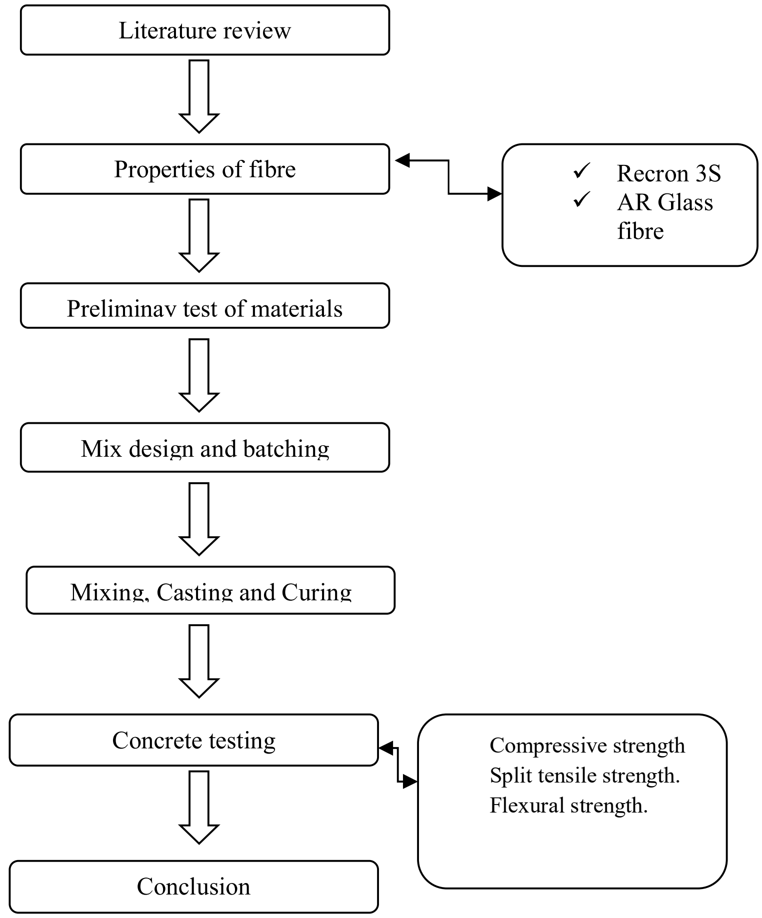

Fig.1 Methodology Flow chart

A. Preliminary Test on Materials

i. Cement

Ordinary Portland Cement (OPC) of 53 Grade having specific gravity of 3.16 is used.

ii. Fine aggregate

River sand belongs to Zone II having specific gravity of 2.668 is used.

iii. Water

Locally available potable water is used.

iv. Foaming agent

Liquid chemical foaming agent is used .

B. Mix Design and Batching

We designed a mix for M25 grade concrete for the following datas.

a) Grade designation : M25
b) Type of cement : OPC 53 grade
c) Minimum cement content : 320 kg/m^3
d) Maximum water-cement ratio : 0.40
e) Exposure condition : Moderate
f) Method of placing : Manual
g) Degree of supervision : Good
h) Type of aggregate : fine aggregate
i) Maximum cement content : 450 kg/m^3

C. Mixing, Casting and Curing
Mixing

Mix the cement and fine aggregate on proper mixing that fibres are mixing in the dry mortar then water tight non-absorbent platform until the mixture is thoroughly blended and is of uniform colour. And the Superplastizier are also added on the mortar when water adding. Add water and mix it until the concrete appears to be homogeneous and of the desired consistency and mix the bacteria with the concrete, timing for hand mixing is 10 – 15 minutes.

Fig 2. Adding and Mixing of concrete

Casting
The casting involves, casting of cube of size 150mmx150mmx150mm , Cylinder of diameter 150mm and length 300mm, and slab size 600mmx200mmx60mm.

Curing
Curing of concrete panel is done by completely immersing it in water.

IV. EXPERIMENTAL INVESTIGATION

A. Compressive Strength Test
A total of 36 cubes were tested for Compressive Strength under UTM. Compressive strength of 7 days, 14 days and 28 days curing were tested.

S.No	Grade	Name	Proportion (%)	Load (kN)	Compressive Strength (N/mm^2)	Average Strength (N/mm^2)
1.	M25	Normal Concrete	0	447	19.87	20
2.	M25		0	452	20.08	
3.	M25		0	450	20.04	
1.	M25	Fibre Concrete	1	529	23.51	23.78
2.	M25		1	542	24.08	
3.	M25		1	534	23.70	
1.	M25	Fibre Concrete	1.5	817	36.31	36.58
2.	M25		1.5	823	36.84	
3.	M25		1.5	829	36.57	
1.	M25	Fibre Concrete	2	729	32.40	32.53
2.	M25		2	735	32.53	
3.	M25		2	732	32.67	

Table.1 Compressive strength of Cubes at 7 days

S.No	Grade	Name	Proportion (%)	Load (kN)	Compressive Strength (N/mm^2)	Average Strength (N/mm^2)
1.	M25	Normal Concrete	0	580	25.77	26.00
2.	M25		0	589	26.17	
3.	M25		0	586	26.04	
1.	M25	Fibre Concrete	1	568	25.44	25.42
2.	M25		1	576	25.60	
3.	M25		1	572	25.42	
1.	M25	Fibre Concrete	1.5	876	38.93	39.07
2.	M25		1.5	882	39.20	
3.	M25		1.5	879	39.07	
1.	M25	Fibre Concrete	2	755	33.56	33.87
2.	M25		2	768	34.13	
3.	M25		2	763	33.91	

Table.2 Compressive strength of Cubes at 14 days

S.No	Grade	Name	Proportion (%)	Load (kN)	Compressive Strength (N/mm^2)	Average Strength (N/mm^2)
1.	M25	Normal Concrete	0	656	29.16	29.11
2.	M25		0	652	28.97	
3.	M25		0	657	29.20	
1.	M25	Fibre Concrete	1	669	29.73	29.60
2.	M25		1	662	29.42	
3.	M25		1	667	29.64	
1.	M25	Fibre Concrete	1.5	1027	45.64	45.51
2.	M25		1.5	1022	45.42	
3.	M25		1.5	1023	45.47	
1.	M25	Fibre Concrete	2	912	40.53	40.36
2.	M25		2	909	40.31	
3.	M25		2	905	40.22	

Table.3 Compressive strength of Cubes at 28 days

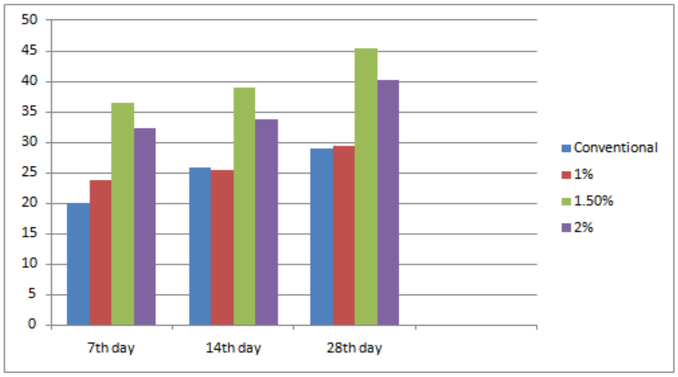

Fig 3.Flow chart on Compressive strength

Fig 4. Compressive strength of cubes

B. Split Tensile Strength Test

A total of 36 Cylinders were tested for split tensile strength including all the specimens. In this test, concrete cylinder is subjected to compression load along two axial lines which are diametrically opposite. The test was carried out by placing cylindrical specimen horizontally (using plates) along the loading surface of compression testing machine.

S.No	Grade	Name	Proportion (%)	Load (kN)	Tensile Strength (N/mm^2)	Average Strength (N/mm^2)
1.	M25	Normal Concrete	0	168	2.38	2.48
2.	M25		0	175	2.48	
3.	M25		0	182	2.58	
1.	M25	Fibre Concrete	1	220	3.11	2.97
2.	M25		1	210	2.97	
3.	M25		1	248	3.51	
1.	M25	Fibre Concrete	1.5	255	3.61	3.82
2.	M25		1.5	282	3.99	
3.	M25		1.5	273	3.86	
1.	M25	Fibre Concrete	2	244	3.45	3.65
2.	M25		2	262	3.71	
3.	M25		2	268	3.79	

Table.4 Tensile strength of Cubes at 7 days

S.No	Grade	Name	Proportion (%)	Load (kN)	Tensile Strength (N/mm^2)	Average Strength (N/mm^2)
1.	M25	Normal Concrete	0	175	2.48	2.58
2.	M25		0	183	2.59	
3.	M25		0	188	2.58	
1.	M25	Fibre Concrete	1	278	3.93	3.85
2.	M25		1	265	3.75	
3.	M25		1	273	3.86	
1.	M25	Fibre Concrete	1.5	284	4.02	3.99
2.	M25		1.5	276	3.91	
3.	M25		1.5	286	4.05	
1.	M25	Fibre Concrete	2	258	3.65	3.74
2.	M25		2	269	3.81	
3.	M25		2	265	3.74	

Table.5 Tensile strength of Cubes at 14 days

S.No	Grade	Name	Proportion (%)	Load (kN)	Tensile Strength (N/mm^2)	Average Strength (N/mm^2)
1.	M25	Normal Concrete	0	202	2.86	2.97
2.	M25		0	211	2.99	
3.	M25		0	217	3.07	
1.	M25	Fibre Concrete	1	286	4.05	4.10
2.	M25		1	298	4.22	
3.	M25		1	286	4.05	
1.	M25	Fibre Concrete	1.5	312	4.42	4.44
2.	M25		1.5	316	4.47	
3.	M25		1.5	314	4.44	
1.	M25	Fibre Concrete	2	292	4.13	4.19
2.	M25		2	308	4.36	
3.	M25		2	288	4.08	

Table.6 Tensile strength of Cubes at 28 days

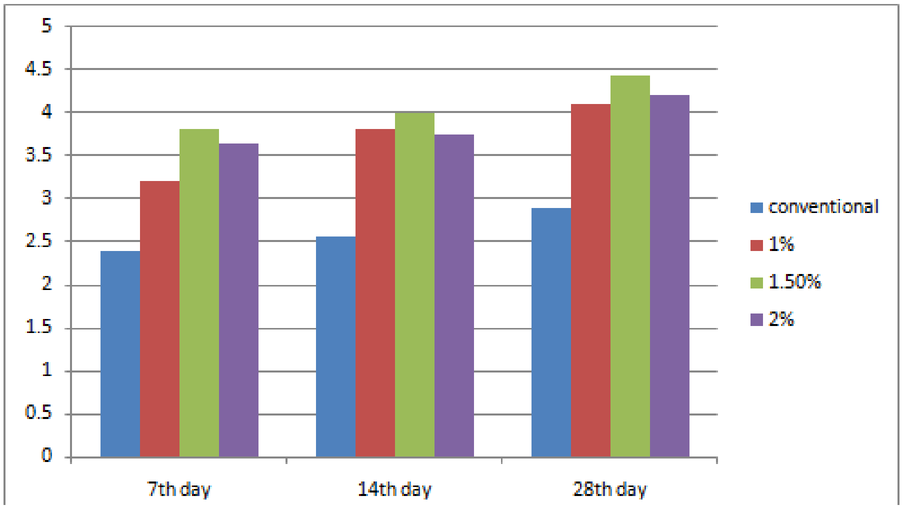

Fig 5.Flow chart on Tensile strength

Fig 6.Split Tensile Strength of cylinder

C. **Flexural Strength Test For Slab**

Flexural strength is one measure of the **tensile** strength of concrete. It is a measure of an unreinforced concrete beam or slab to resist failure in bending

Fig. 7 Flexural test of specimen

S.No	Grade	Name	Proportion (%)	Load (kN)	Flexural Strength (N/mm^2)	Average Strength (N/mm^2)
1.	M25	Normal Concrete	0	10	8.33	8.33
2.	M25		0	9	7.50	
3.	M25		0	11	9.17	
1.	M25	Fibre Concrete	1	16	13.33	13.33
2.	M25		1	15	12.50	
3.	M25		1	17	14.17	
1.	M25	Fibre Concrete	1.5	20	16.67	16.67
2.	M25		1.5	19	15.83	
3.	M25		1.5	21	17.50	
1.	M25	Fibre Concrete	2	13.5	11.25	11.67
2.	M25		2	14.5	12.08	
3.	M25		2	14.0	11.67	

Table.7 Flexural strength of Slab at 7 days

S.No	Grade	Name	Proportion (%)	Load (kN)	Flexural Strength (N/mm^2)	Average Strength (N/mm^2)	Deflection (mm)
1.	M25	Normal Concrete	0	10	8.33	9.17	5
2.	M25		0	12	10.0		
3.	M25		0	11	9.17		
1.	M25	Fibre Concrete	1	19	15.83	15.83	7
2.	M25		1	18	15.00		
3.	M25		1	20	16.67		
1.	M25	Fibre Concrete	1.5	24	20	18.83	10
2.	M25		1.5	19	15.83		
3.	M25		1.5	23	19.17		
1.	M25	Fibre Concrete	2	17	14.17	15	8
2.	M25		2	19	15.83		
3.	M25		2	18	15.0		

Table.8 Flexural strength of Slab at 28 days

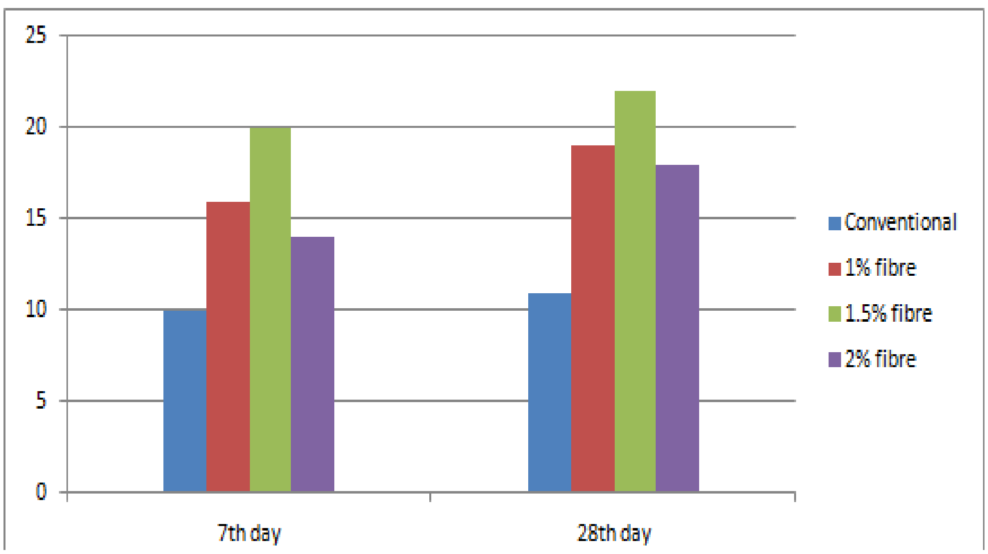

Fig. 8 Flow chart on Flexural strength

V. Conclusion

The Experimental investigation shows that the split tensile and compression strength of ECC is increased at 1.5% proportion. It also proves that conventional concrete obtains twice the strength when compared to normal concrete.

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