Experimental Study on Ductile Behaviour of Fibre Reinforced Concrete

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Abstract- *Concrete is a very strong and versatile moldable construction material. It consists of cement, sand and aggregate (e.g., gravel or crushed rock) mixed with water. The cement and water form a paste or gel which coats the sand and aggregate. When the cement has chemically reacted with the water (hydrated), it hardens and binds the whole mix together. The initial hardening reaction usually occurs within a few hours. It takes some weeks for concrete to reach full hardness and strength. Concrete can continue to harden and gain strength over many years. Concrete is the second most widely used substance after water and over six milliard tons of concrete is produced each year. Concrete is specified to different applications like a new construction, repair, rehabilitation and retrofitting. Concrete building components in different sizes and shapes include wall panels, doorsills, beams, pillars and more. Post tensioned slabs are a preferred method for industrial, commercial and residential floor slab construction. It makes sense to classify the uses of concrete on the basis of where and how it is produced, together with its method of application, since these have different requirements and properties The fiber Reinforced concrete is the concrete made with the hydraulic cement, containing fine, coarse aggregate and discontinuous fiber or concrete incorporating relatively short, discrete and discontinuous fibers*

I. INTRODUCTION

Fiber-reinforced concrete or Fibre-Reinforced Concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers each of which lend varying properties to the concrete. In addition, the character of fiber-reinforced concrete changes with varying concretes,fiber materials,geometries, distribution, orientation, and densities. The concept of using fibers as reinforcement is not new Fibers have been used as reinforcement since ancient times. Historically, horsehair was used in mortar and straw in mud bricks. In the 1900s, asbestos fibers were used in concrete. In the 1950s, the concept of composite materials came into being and fiber-reinforced concrete was one of the topics of interest. Once the health risks associated with asbestos were discovered, there was a need to find a replacement for the substance in concrete and other building materials. By the 1960s, steel, glass (GFRC), and synthetic (such as polypropylene) fibers were used in concrete.

The fiber Reinforced concrete is the concrete made with the hydraulic cement, containing fine, coarse aggregate and discontinuous fiber or concrete incorporating relatively short, discrete and discontinuous fibers

Among characteristic of fibers that has influence on the response of the composite are type of fiber, length of fiber, the volume fraction of fiber and the bond of the fiber with the matrix. We enlist the proven steps to publish the research paper in a journal.

II. IDENTIFY, RESEARCH AND COLLECT IDEA

There are various factors which affects the durability of fiber reinforced concrete such as temperature, weathering, corrosion, freezing and thawing etc. are discussed. Durability of concrete element is the ability of the member to resist aggressive environment, accidental event, and impact effect and maintain the structural integrity. Effect of Extreme Temperature and Fire on Durability of FRC. Generally, concrete has a reasonable resistance to severe temperature because of its low thermal conductivity, great heat capacity, and it is not burn easily while exposed to fire. Concrete constituents for example specific aggregate types and cement clinker are not influenced by high temperature both chemically and physically. However, there are others concrete constituents that affected by temperature changes such as hydration product. It is influenced by loss of water, micro-cracking, and damage by differential expansion. The addition of steel fiber, synthetic fiber, or combination of both to concrete enhances structural concrete elements resistant against substantial temperature and fire. Regarding concrete spalling, when concrete exposed to fire, excess water inside concrete, which used to provide workability during construction, changes to steam pressure. If the pressure inside concrete is not released and surpass concrete tensile strength, explosive spalling will occur. The concrete spalling depends on the amount of free water and its distribution while concrete element is exposed to fire. The damage caused by spalling may penetrate concrete to about 6 cm. Spalling is a serious problem because it may exposed steel reinforcement to high temperature.

III. RESULTS AND DISCUSSIONS

The concrete slump test measures the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete, and therefore the ease with which concrete flows. It can also be used as an indicator of an improperly mixed batch. Slump value of M40 grade of concrete is 0 to 25 mm minimum. But you can design it upto 50 to 200 mm as per your requirement. High slump is required in heavy reinforced concrete, pumpable concrete and when the site is far from the mixing plant etc. According to IS:456:2000, the slump value for concrete is used to determine the workability or consistency of the concrete mix. The slump value is measured by filling a slump cone with concrete and then measuring the height of the concrete that falls out of the cone after it is lifted up.

Table 3:1 Compressive strength of Steel Fiber concrete and control concrete with different Age of Testing

Age of Testing	**Cement :Steel Fiber**	**Compressive Strength in N/mm2**
7 days	12.5:87.5	14.56
	15:85	15.13
	17.5:82.5	13.95
	Control concrete	14.62
14 days	12.5:87.5	32.92
	15:85	34.15
	17.5:82.5	33.13
	Control concrete	33.85
28 days	12.5:87.5	48.45
	15:85	50.16
	17.5:82.5	48.55
	Control concrete	49.75
56 days	12.5:87.5	49.65
	15:85	51.15
	17.5:82.5	49.25
	Control concrete	50.15
90 days	12.5:87.5	48.68
	15:85	53.14
	17.5:82.5	50.41
	Control concrete	52.12

Table 3:2 Flexural strength of Steel Fiber concrete and control concrete with different Age of testing

Age of testing	**Cement :Steel Fiber**	**Flexural strength in**
		N/mm2
7 days	12.5:87.5	4.15
	15:85	5.68
	17.5:82.5	3.12
	Control concrete	4.23
14 days	12.5:87.5	4.08
	15:85	5.73
	17.5:82.5	3.41
	Control concrete	4.55
28 days	12.5:87.5	3.85
	15:85	6.75
	17.5:82.5	4.56
	Control concrete	5.75

Table 3.3 Ductility of Steel Fiber Reinforced Concrete and Conventional Concrete with Conventional reinforcement

Age of testing	Proportion Cement: Steel fiber	Ultimate load, P_u	Yield point load, P_y	Ductility P_u /P_y
7 days	12.5:87.5	77.25	70	1.1
	15:85	86.5	71.25	1.21
	17.5:82.5	82.25	69	1.19
	Conventional concrete	84.45	70.75	1.2
14 days	12.5:87.5	153.5	135.5	1.13
	15:85	172	139.75	1.23
	17.5:82.5	163.5	135	1.21
	Conventional concrete	168.5	138	1.22
28 days	12.5:87.5	202.5	169	1.2
	15:85	217.75	173	1.26
	17.5:82.5	211.25	171.75	1.23
	Conventional concrete	215.5	171	1.26
56 days	12.5:87.5	208.55	172.5	1.21
	0.684027778	227.5	176.5	. 1.30
	17.5:82.5	217.5	173	1.26
	Conventional concrete	221.75	172	1.3

Discussion:

At the initial days of curing, SFRC with cement and Steel Fiber proportions **15:85** has shown Ductility greater than that of conventional concrete. At 28 and **56** days of curing, both SFRC and conventional concrete has shown the similar values of ductility

Table 3.4 Ductility of Steel Fiber Reinforced Concrete and Conventional Concrete with Conventional reinforcement

Age of testing	Proportion Cement: Steel Fiber	Ultimate load, P_u	Yield point load, P_y	Ductility P_u /P_y
7 days	12.5:87.5	116.75	88.5	1.31
	15:85	129	88	1.47
	17.5:82.5	122.75	88.5	1.39
	Conventional concrete	127.75	89.5	1.43
14 days	12.5:87.5	228.75	169.5	1.35
	15:85	258	174.25	1.48
	17.5:82.5	246	168	1.46
	Conventional concrete	253.75	171.75	1.48
28 days	12.5:87.5	301.75	210.5	1.43
	15:85	325.75	215.5	1.51
	17.5:82.5	316.75	213.75	1.47
	Conventional concrete	324	213	1.52
56 days	12.5:87.5	316.75	215	1.47
	15:85	341.25	220.25	1.55
	17.5:82.5	325.75	216.75	1.5
	Conventional concrete	332.25	214.25	1.55

Comparison of Ductility of SFRC and Conventional Concrete

Discussion:

At the initial days of curing, cement and Steel Fibers proportions 15:85 and 17.5:82.5 has shown Ductility greater than that of conventional concrete. But the ductility of conventional concrete has shown a progressive increase upon increase in age of concrete and finally at 56 days of curing both CC and SFRC15:85 has shown the same ratio of ductility

Comparison of Ductility

Discussion:

At all the periods of curing, the Fiber Reinforced concrete obtained from cement fly ash proportion 15:85 has consistency shown a ductility very much similar to the conventional concrete specimen

IV. CONCLUSION

In the present study, the commercial synthetic fibers incorporation into concrete structures for making a new type of advanced composite material generally called as synthetic fiber reinforced concrete/composite (SFRC) is reported. At the initial days of curing, SFRC with cement and Steel Fiber proportions 15:85 has shown Ductility greater than that of conventional concrete. At 28 and 5 6 days of curing, both SFRC and conventional concrete has shown the similar values of ductility. At the initial days of curing, cement and Steel Fibers proportions 15:85 and 17.5:82.5 has shown Ductility greater than that of conventional concrete. But the ductility of conventional concrete has shown a progressive increase upon increase in age of concrete and finally at 56 days of curing both CC and SFRC15:85 has shown the same ratio of ductility. At all the periods of curing, the Fiber Reinforced concrete obtained from cement fly ash proportion 15:85 has consistency shown a ductility very much similar to the conventional concrete specimen. Consequently, the study on the relationship between Conventional Concrete and Fiber reinforced concrete structure and mechanical properties in SFRC advanced materials was carried out.

REFERENCES

[1] S. Furlanetal, "Shear behavior of fiber reinforced concrete beams", Cement and concrete composites, Volume 19, Issue 4.

[2] R. S. Pendyalaetal, "Experimental study on shear strength of high strength concrete beams", ACI Structural Journal, Volume 97, Issue 4.

[3] R. Narayananetal, "Use of steel fibres as shear reinforcement", ACI Structural Journal, Volume 84, Issue 3.

[4] MK Johnsonetal, "Shear strength of reinforced concrete beams with stirrups", Materials and structure.

[5] M. Hamratetal, "Shear behavior of RC beams without stirrups made of normal strength and high strength concretes", Advances in structural engineering

[6] Sagarika sankpaletal, "Experimental and theoretical investigation on the shear of steel fibre reinforced concrete beams", International journal of Engineering and Techniques, volume 7, Issue 2.

[7] Antonie E Naamanetal, "Engineered Steel Fibers with Optimal Properties for Reinforcement of Cement Composites", Journal of Advanced Concrete Technology, volume 1, No.3.

[8] Job Thomasetal, "Mechanical Properties of Steel Fiber reinforced Concrete", ASCE Journal of Materials in Civil Engineering, volume 19, Issue 5.

[9] May Gamiletal, "A review on graphene reinforced cement composite: technical approach for ecofriendly construction", Journal of Construction Materials, 2019.