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CRACK BEHAVIOUR OF FIBER REINFORCED CONCRETE DEEP BEAM WITHOUT STIRRUPS

Chirag g. amin [1], Tushar n. Patel[2],

[1] *M.E. structure Department of civil engineering, Sardar vallabhbhai Patel institute of technology, vasad-388306*
[2] *Assistant professor, Sardar vallabhbhai Patel institute of technology, vasad-388306*
[3]*Department name*

Abstract — *The present work is deal with experimental study of crack behavior of fiber reinforced concrete deep beam without stirrups. For this investigation, the test beam specimen of 150mm in width,500mm,600mm in depth and 1000mm in length. The shear span to depth ratio (a/d) is varied in the range 0.6 and 0.5.all the beam specimens are tested one-point loading Upto first crack load, crack patterns, modes of failure and crack width are studied in experimentally. The empirical formula used in shear strength of specimens and central deflection are recorded concisely and precisely*.

Keywords- *R.c deep beam, crack, steel fiber, polyester fiber, concrete, a/d ratio.*

I. INTRODUCTION

Deep beam has its depth equal or less compared to its length while normal beam has depth very less compare to its length. As per Indian Standard Code IS 456: 2000[2] (page no. 51, clause no. 29.1) a beam shall be termed as deep beam when the ratio of effective span to overall depth, ℓ/D is less than: 2.0 for a simply supported beam and 2.5 for a continuous beam. ACI-ASCE committee 426 classified a beam with a shear span-to-depth ratio a/D less than 1.0 as a deep beam. the shear-span-to-depth ratio has more influence on the shear capacity than the span-to-depth ratio and as the former increases, the shear strength decreases. the more effective the horizontal web reinforcement and the less effective the vertical web reinforcement. Reinforced concrete deep beams have useful application in the cases of water tanks, bunkers &silos. RCC deep beam very few research works have been done to study crack behavior of fibers reinforced concrete deep beam particularly using steel fibers and polyester fiber. The addition of steel fiber of reinforced concrete beam is known to increase its shear strength.

The research in the high strength concrete field showed that cube strength is less important than fracture energy for the description of the material behaviors of structure elements.it is well known that use of steel fibers raised the ductility of concrete and the fracture energy. This phenomenon is transferable to the shear strength of concrete. In failure modes of addition of fiber in a suitable percentage and geometry produces a significant increase in shear strength and in some cases can also change the failure mode from share to flexure. The mechanical properties of SFRC and polyester fiber are influenced by the type of fiber, aspect ratio, and volume of fraction of fibers and the size of the aggregate. Deep beams behave entirely different from normal beams.

II. Experimental program

The test specimens were cast using cement, fine aggregate, course aggregate, water, steel fibers and polyester fiber. The material, in general, confirmed to the specification laid down in the relevant Indian standard codes. From grading of fine and course aggregate, sieve analysis was carried out. ordinary Portland cement of 53-grade confirming to IS 12269-2013 was used through the experimental work, the maximum size of course aggregate 20mm and fineness modulus was 2.78. Circular corrugated type steel Fibre length 30mm, dia 0.75mm, aspect ratio 60mm, reinforced steel of grade fe-415was used as tensile reinforcement. Triangular Polyester Fiber Specific gravity 1.35, Aspect ratio 240, Diameter 0.05mm, Density 0.90 Kgs /m³.

A. Concrete mix design

The concrete mix was designed in accordance with the Indian standard method of concrete mix design. The concrete mix was prepared for M-20 grade of concrete.

Table 1. Mix proportion

Proportion	Water	Cement	Sand	Coarse Aggregate
By weight(kg/m³)	168.6	351.2	836.4	687.7
By weight for 1 bag of cement,	24 lit/bag	50	119 kg/bag	98 kg/bag

B. Test specimens

the test specimen consists of 6 nos. deep beams. The beams are divided into two series having different depth of 500mm and 600mm with three beam in each series. The width and span of all the beam are constant of overall span 1000mm, effective span of 900mm and width of 150mm. (a/d) has kept 0.6, 0.5.the all beams were rectangular in section.

Table 2. specimen

specimen	**size**
cube	15Omm × 150mm × 150mm
beam	1000mm × 500mm × 150mm
	1000mm × 600mm × 150mm

III. Result and discussion

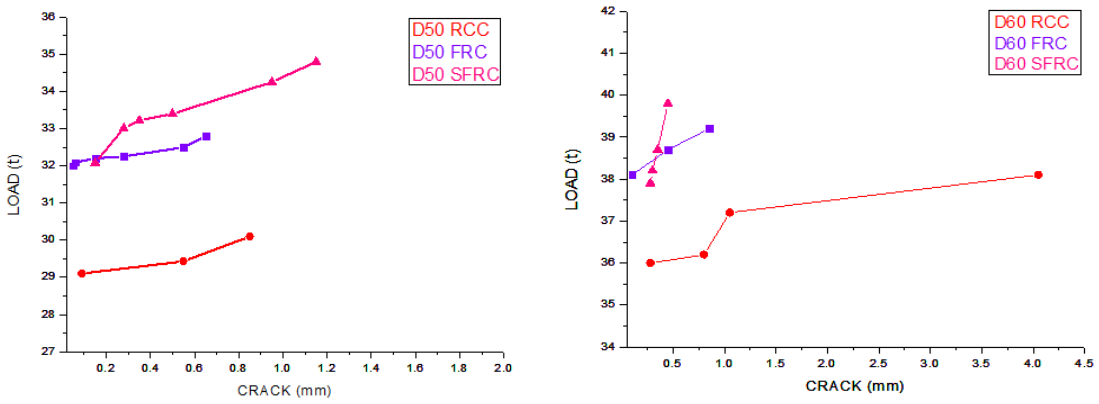
The result obtained from experimental investigation are tabular in table. from the result obtained, the effect of various parameter on compressive strength of concrete, crack pattern, crack width and modes of failure are observed. Test result of cube for compressive strength.

Table 3. compressive strength of steel fiber.

Steel fiber					
Sr.no	Identity	Fiber content	Grade	Load (KN)	Crushing strength(N/mm²)
1.	Cube1	0%	M-20	510.6	22.67
2.	Cube2	0.5%	M-20	478.8	21.28
3.	Cube3	0.75%	M-20	482.6	21.44

Table 4. compressive strength of polyester fiber

polyester fiber					
Sr.no	Identity	Fiber content	Grade	Load (KN)	Crushing strength(N/mm²)
1.	Cube1	0%	M-20	480.3	21.33
2.	Cube2	0.25%	M-20	456.5	20.28
3.	Cube3	0.5%	M-20	460.2	20.45



a) LOAD VS CRACKWIDTH GRAPH D50 b) LOAD VS CRACKWIDTH GRAPH D60

Fig.1. LOAD VS CRACK WIDTH

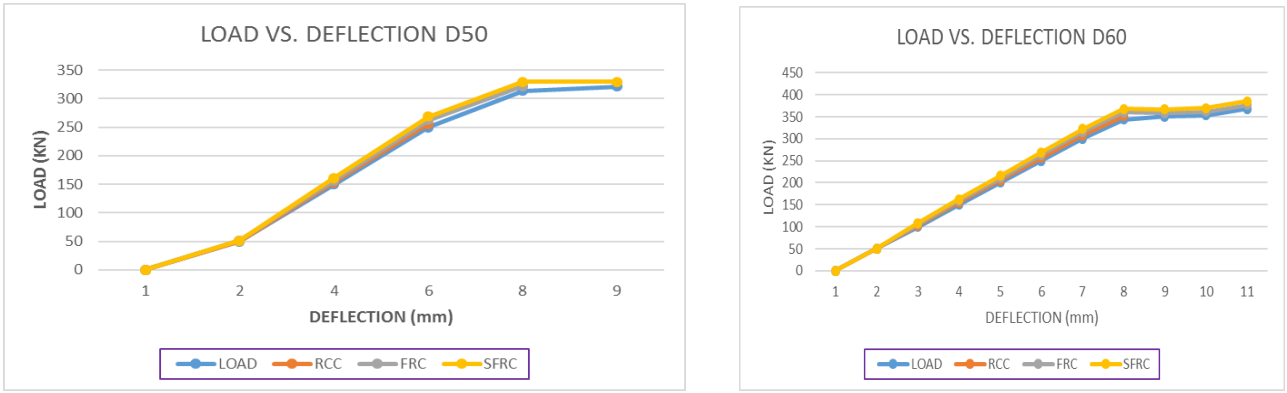


Fig.2 LOAD VS DEFLECTION IN FIRST CRACK LOAD

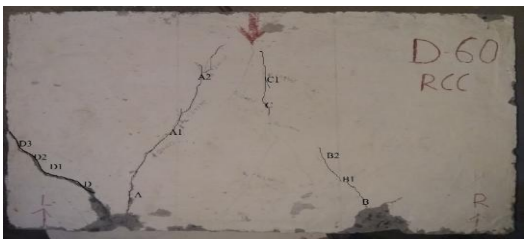
C. Crack behavior of deep beam

D50 RCC

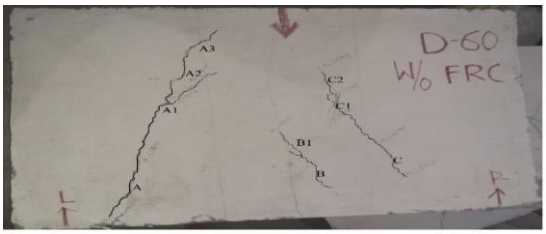
D50 FRC

D50 SFRC

Fig.3 D50 Crack pettern and failure of deep beam



D60 RCC



D60 FRC

D60 SFRC

Fig.4 D60 Crack pettern and failure of deep beam

IV. Conclusion

1). first crack load observed higher value both FRC and SFRC of deep beam without web reinforcement as compared to RCC beam.
2). This show that the fiber provides resistance or strength against crack. This show that the steel fibers are more effective than polyester fiber.
3). Diagonal shear cracking load observed higher value in case FRC and SFRC compared RCC.Failure of deep beams was mainly due to diagonal cracking and it was line joining the loading point and support.
4). fibers play important role as crack arrestor and delay in propagation of crack due to unplanned dispersion of fiber through the concrete.
5). fiber provide more effective resistance to cracking as it controlled greater tensile strength and high modulus of elasticity.

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