

EXPERIMENTAL STUDY ON THE HIGH STRENGTH ARAMID KEVLAR FIBER REINFORCED IN CONCRETE BEAM AND STRUCTURAL RETROFITTING OF FIBER RC BEAM USING SYNTHETIC STEEL FIBER.

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ABSTRACT - Retrofitting is the modification of the existing structure to make them more resistance to seismic activity, ground motion etc. And many of the existing structures of the of reinforced concrete structure throughout the world are in urgent need of Rehabilitation , due to various factor like corrosion lack of detailing , failure of bonding between beam-column joint etc. But using the ARAMID KEVLAR FIBER FABRIC STRIPES REINFORCEMENT (AKFFR). And SYNTHETIC STEEL FIBER (SSF) are using for a wrapping of structure. These material used to our structure are very strong and seismic activity resistance.

NOTE: - Now in this paper in present and experimental study on (AKFFR) Aramid Kevlar fiber fabric reinforced concrete beam retrofitted with various type of fibre like synthetic steel fiber (SSF). This study in investigate the behaviour of concrete beam after retrofitting using of synthetic steel fiber and Aramid Kevlar fiber(AKFFR)etc.

1. INTRODUCTION

Structures deteriorate due to problem associated with reinforced concrete. Natural disasters like earthquake have repeatedly demonstrated the susceptibility of existing structure to seismic effects and rehabilitations of deteriorated structure are important in high seismic region. Thus retrofitting and strengthening of existing reinforced concrete structure has become one of the most important challenges in civil engineering. An engineer often faces problems associated with retrofitting and strength enhancement of existing structure. Like how to make a strong structure. Because Concrete is the most widely used man-made construction material in world. It is obtained by mixing cementing materials, water and aggregates, and sometimes admixtures is required proportions. Concrete has high compressive strength, low cost and also have good flexibility strength. And how to change in use to structure, design code regulations, and seismic retrofitted are some of the causes that lead to the need for rehabilitation retrofitting of existing structures. Complete replacement of existing structure may be not be a cost effective solution and it is likely to become an increased financial burden if upgrading is a viable alternative. In such occasions, repair and rehabilitation are most commonly used solution.

Reinforced corrosion and structure deterioration in reinforced concrete (RC) structure are common and prompted many researchers to seek, alternative materials and rehabilitation techniques. While many solution have been investigates over the past decades, there is always a demand to search to search for use of new technologies and material to upgrades to deficient structure, in this content, strengthening with synthetic steel fiber (SSF) because these to ours structure beam-column are make a strong joint and structure load taking capacity is increased.

The main purpose of the retrofitting is to be upgrade the resistance of a damaged building while repairing. So that it become safer under future earthquake. Now involving of (SSF) and (AKFFR) like, increased the lateral strength, and also increased the compressive and flexural strength. Thus used to ours structure joint like beam and column joint are more than earthquake resistance as comparisons to used of normal material.

2. METHODOLOGIES AND EXPERIMENTAL PROGRAM

This study is mainly material collection, **material testing, mix design casting of cubes and beam At last the final stage the, compressive strength, and flexural strength tests** were conducted.

Table 1: - of some testing: -

Testing	Value	
Specific gravity of cement	3.86	
Specific gravity and water absorption of coarse aggregate	1.22	
Initial and final setting time of cement	initial	Final
	45 minutes	184 minutes

3. MATERIALS USED

Ordinary Portland cement (OPC) of grade 43 satisfying the requirements of IS: - 8112-1989 was used for investigation. The cement are using before doing some test like specific gravity of cement, record the initial and final setting time of the cement etc. these testing explanations showing in testing table(2.1). The coarse aggregate are also used in the material or in this investigation. And Normal River clear sand is used in this investigation. Because normal river clear sand easily providing for me and they are minimum water absorption as compression to other curser sand, and in all of the concrete material in only 26% of water are used. Used the material ratio **M30** (1: .75: 1.5).

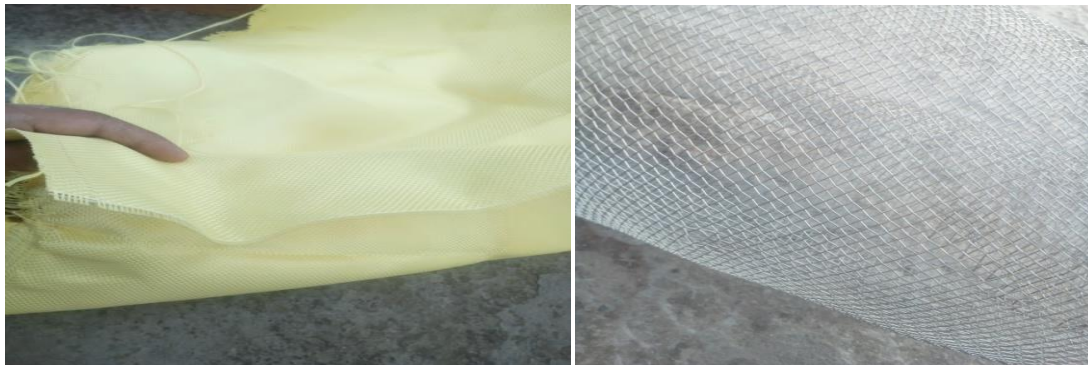


FIG.1 ARAMID KEVLAR FIBER

RETROFITTING SYNTHETIC STEEL FIBER

Extra materials are used like Aramid Kevlar Fiber Fabric (AKFFR) in the way of reinforced strips in cubes and concrete beam and synthetic steel fiber are also used for concrete beam retrofitted (or) wrapping. It was tested for its physical properties as per Indian Standard Specification. IS: 456: 2000 and 2386 (Part III) - 1963 (Reaffirmed 1990) Indian Standard methods of test for aggregates for concrete.

4. CASTING OF CUBES

The moulds are prepared using plywood. The dimensions of all the specimens were identical and cross sectional dimension were 150mm X 150mm X 150mm. And we were casting the 21 cubes for 7 days testing and 21 cubes are more casting for 28 days testing. But most of the important part in this casting of cubes in %age of the extra added material. First of the three cubes are normal casting and now next one is cubes are casting with added extra material in different-2 stages of %age. Like 2%, 4%, 6%, 8%, 10%, 12%, and 14% etc.



FIG.2 PROCESS OF CUBES CASTIG.

5. TESTING OF CUBES

In this process in we are find out the compressive strength of concrete cubes in 7 days and 28 days. Because these to we are actual value are find out of the cement concrete and extra added material compressive strength value are find out.



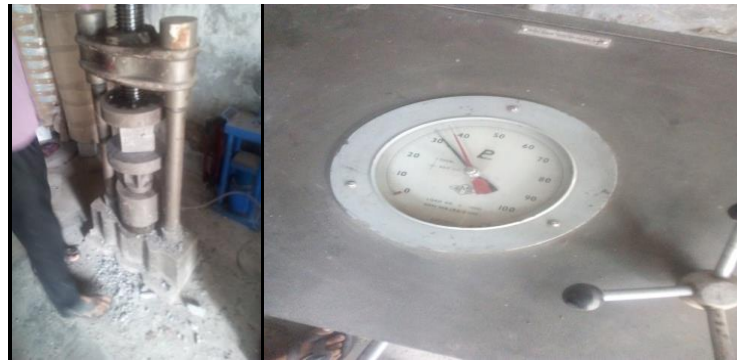
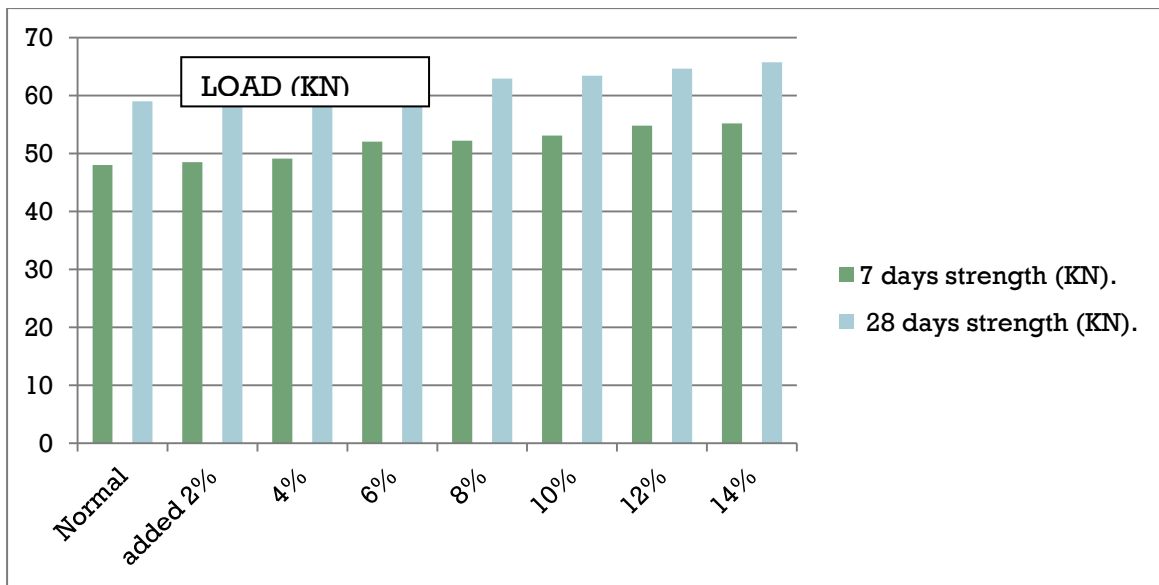


FIG.3 PROCESS OF CUBES TESTING.



% age of added material

FIG.4: - 7 DAYS AND 28 DAYS CURED COMPRESSIVE STRENGTH LOAD GRAPH.

TABLE.2: - 7 DAYS AND 28 DAYS CURED CUBES COMPRESSIVE STRENGTH TEST.

These investigations in we are looking of cubes compressive strength load value after 7 days and 28 days. With the used of material like aramid Kevlar fiber fabric reinforced strips.

Grade of concrete	%age of extra material added aramid fiber	Dimension the cubes(mm x mm x mm)	Minimum Average compressive strength of (KN) at 7 days	Specific characteristic compressive strength(KN) at 28 days
M30	Normal	150X150X150	48	59
	2%	150X150X150	48.5	59.80
	4%	150X150X150	49.10	60.4
	6%	150X150X150	51	61.70
	8%	150X150X150	52.20	62.90
	10%	150X150X150	53.10	63.40
	12%	150X150X150	54.80	64.60
	14%	150X150X150	55.20	65.70

6. CASTING OF BEAM

The moulds were prepared using plywood. The dimension of all the specimens was indentation. The length of beam was 450 mm and cross sectional dimension were 150mm x 150 mm.

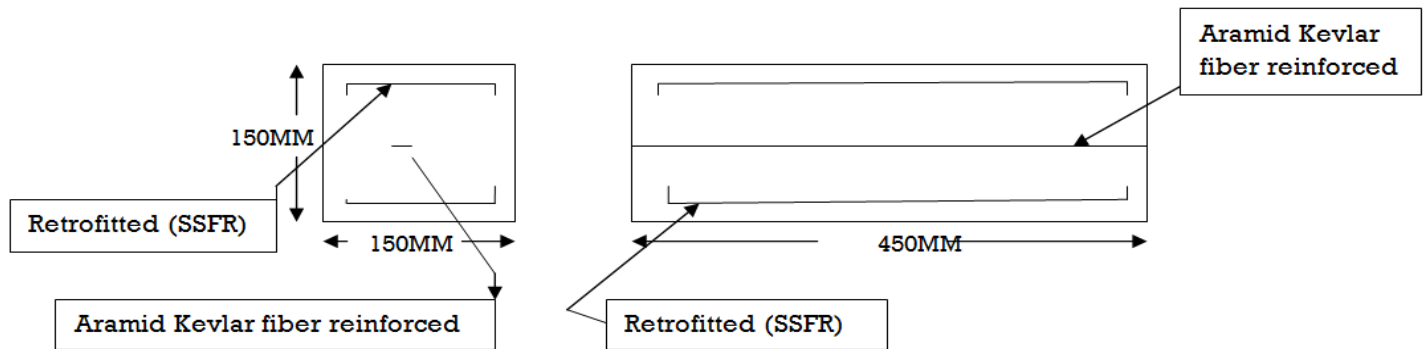


FIG. 5: - RETROFITTING AND REINFORCED DETAILING OF THE BEAM.

7. RETROFITTING OF BEAM

The full technique around the two side of the beam is used as the method of retrofitting. And it to be bonded with the beam wrapping of the retrofitted synthetic steel fiber, like first of all taking a sample of beam moulds and measuring the all side of dimension and after process they are 12mm filling of beam moulds with concrete and now used the retrofitting synthetic steel fiber.



FIG 6: - RETROFITTING AND REINFORCED DETAILING OF THE BEAM.

Now again half of the filled beam mould and used the reinforced of the aramid Kevlar fiber strips. According to requirement like 2%, 4%, 6%, 8%, 10%, 12%, and 14% etc. after the (AKFFR) used the also one more time filled the beam mould in upper case and used the retrofitting synthetic steel fiber. Now beam retrofitted making process are complete, full explain with the help of fig.



FIG 7: - RETROFITTING AND REINFORCED DETAILING OF THE BEAM.

These processes are the retrofitting of beam. Now beam are allowed to dry for 24 hour's, and the using are fibre cutting according to size.

8. EXPERIMENTAL STUDY OF BEAM

The control beam and the retrofitted beam were tested for flexural strength. The testing procedure for the all of the specimen was same. The beams were cured for a period of the 7 days and 28 days. The surface of control beam is cleared and washed for clear visibility of cracks; the surface of retrofitted beam is cleaned with cotton. The two-point of the load are arrangement is used for testing is beam. This has a advantage of a substantial region of nearly uniform moment coupled with very small shear, enabling the bending capacity of the central portion to be assessed the load is transmitted through a load cell.



FIG 8: - EXPERIMENTAL TEST SET UP.

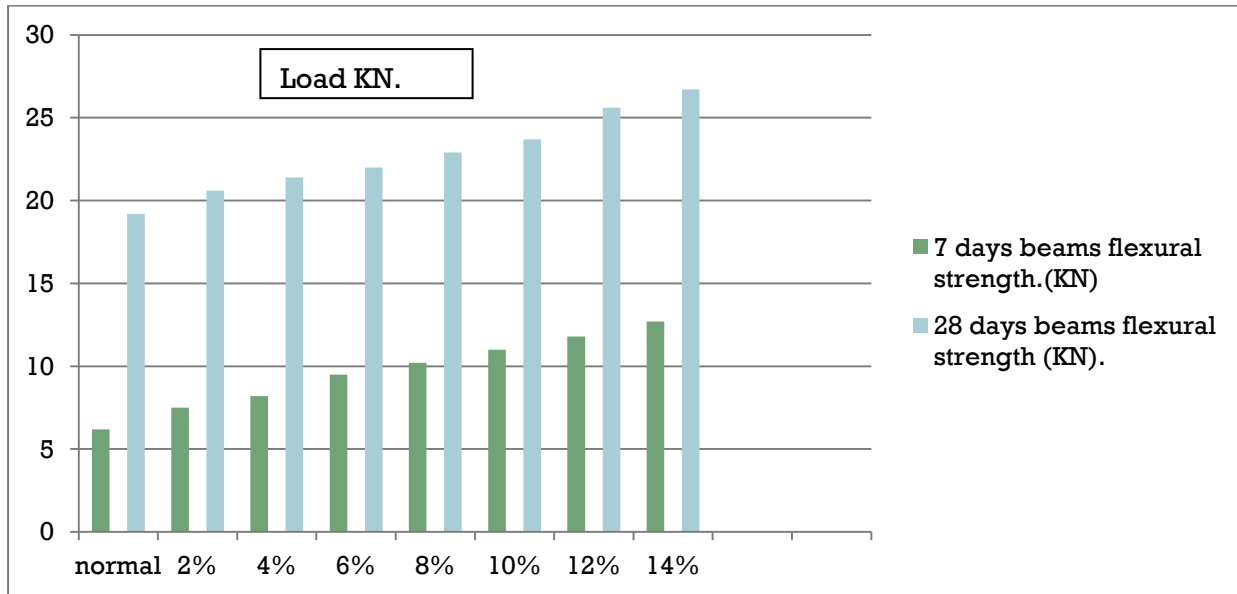
The test beam was supported on roller bearings acting as supports. The specimen was placed over the two steel rollers bearing leaving 50mm from the ends of the beam. The remaining 450mm was divided in three equal part of 150mm as shown in figure. Two point loading arrangement was done; as shown in fig. Loading was done by hydraulic jack. Dial gauge was used for recording the deflection of the beam the deflection of the beam were noted till the appearance of the first crack using dial gauge the dial gauge was removed after the appearance of the crack and load was further applied till fracture load



FIG 9: - BEAMS.

From the table and graph it is clear that the (SSF) retrofitted beam and (AKFFR) reinforced have better load deflection characteristics' then the control specimen.

FIG. 10: - CURED 7DAYS AND 28 DAY AVERAGE FLEXURAL STRENGTH TEST RETROFITTED BEAMS N/MM2 GRAPH.



% age of added material cured 7 days and 28 days.

TABLE 3: -CURED 7 DAYS AND 28 DAYS FLEXURAL STRENGTH TESTS OF RETROFITTED BEAMS (KN).

Grade Of Concrete	Retrofitted(SSF) And Extra Added Material(AKFFR)	Dimension Of Beam (mm X mm X mm)	Minimum Average Cured 7 Days Flexural Strength (KN).	Maximum Average Cured 28 Days Flexural Strength (KN).
M30	Normal	150 x150 x 450	6.19	19.20
	2%	150 x150 x 450	7.50	20.60
	4%	150 x150 x 450	8.2	21.40
	6%	150 x150 x 450	9.5	22
	8%	150 x150 x 450	10.2	22.90
	10%	150 x150 x 450	11	23.70
	12%	150 x150 x 450	11.80	25.60
	14%	150 x150 x 450	12.70	26.70

Retrofitting of beam enhances the ultimate load capacity of the beam. In different-2 %age in different load capacity. Like in load taking capacity in 2%, 4%, 6%, 8%,10%, 12%, 14, etc. Cured of 7 days and 28 days cured load capacity.

From the above results and graphs following observations are made:

Sr. No	Beam cured description	Increase in strength gap (KN) comparing with plain cement concrete and retrofitted beam with added extra material
1	Increase the strength gap (KN) of 7 days retrofitted as compression to plain cement concrete.	6.51 KN.
2	Increase the Strength gap (KN) of 28 days retrofitted and plain cement concrete.	7.5 KN.

Also the strength of beam full wrapped from the two sides is greater than the plain cement concrete beam.

Therefore, from the above the result of the beam wrapped at two sides gives a better result so from economic point of plain cement concrete beams.

CONCLUSIONS

The following conclusions are drawn based on the experiments of aramid kevlar fiber reinforced beams before and after retrofitting with synthetic steel fiber (SSFRC).

- ☑ The load-carrying capacities of Aramid Kevlar fiber reinforced in beams were increased considerably by retrofitting with synthetic steel fibre.
- ☑ increasing the fibre content improved the load load-carrying capacities of beams both before and after retrofitting.
- ☑ The initial stiffness of the beams was restored by retrofitting with synthetic steel fibre.
- ☑ Retrofitting with synthetic steel fiber provided a ductile behaviour until the synthetic steel fiber sheets on the tension faces of the beams ruptured, after which the load dropped suddenly.
- ☑ Retrofitting using (SSFRC) sheets prove to be economical since its cost is high and increased in ultimate load capacity.
- ☑ The deflection of the beam are minimized due to full wrapping technique around all the two side down surface and upper surface of the beam.
- ☑ The initial cracks in the strengthened beam appear at higher load compared to the un-strengthened control beam.
- ☑ The increase in ultimate load capacity is least for beam retrofitted with synthetic steel fiber sheets.
- ☑ Even though the beams retrofitted with synthetic steel fiber sheet have the maximum ultimate load capacity the cost of the material is high.

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