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Experimental Study on the Structural Retrofitting of RC Beam Using Synthetic Steel Mesh Fiber and High Strength Aramid Kevlar Fiber Reinforced in Concrete Beam

Dheeraj Kumar[1], Sourabh Lalotra[2]
M.Tech. Student[1], Asst. Prof[2].
Dept. of civil (Structure Design).
From "Sri Sai College of Engineering and Technology Badhani PTK."(P.B.)India

Abstract:- Seismic retrofitting is the modification of the existing structure to make them more resistant to activity of seismic like, failure of soil with ground motion earthquakes etc. Because many of the 19th and 18th centuries in existing structures throughout the world is in urgent need of Rehabitation, because due to various factor like corrosion of lack detailing, failure of bonding between in the beam and column joint etc. But using the ARAMID KEVLAR FIBER REINFORCED (AKFFR). And SYNTHETIC STEEL MESH FIBER (SSMF) are using for a wrapping of structure. Because this material used to our structure strength like 'compressive and flexural strength is increased and seismic activity or earthquakes resistance.

I. INTRODUCTION

In the recent of the years repair and existing retrofitted Structures such as many types of buildings structures, like bridges, dams, flyovers etc, and they also most important challenges in civil engineering. Because we are looking most of the time only in India 19th and 18th century in manufacturing structures repairing is not to be easy at on the present time. Because first of all this types of building structures repairing cost is very high and impactful. So that is the reason all civil engineer protected the existing structure with the help of retrofitting. Because existing and non- existing structures retrofitting to we are makes a very strong structure, and these to also increase the load carrying capacity, increased compressive strength and flexural strength of the structures, and lose of some ductility due to using retrofitting. Now it is obtain by cementing materials mixing, sand, aggregates water and some more admixtures materials added. Because concrete compressive strength is very high, low cost and flexibility strength is too good. So how to change the use of structure, code design regulation, and seismic retrofitting is some of the causes that lead to the need for rehabitations of existing structures retrofitting. Because existing structure fully replacement is not to be cost effective solution because it is only become an increased financial load or burden. But using the retrofitting with synthetic steel mesh fiber and aramid kevlar fiber reinforced in concrete to we makes a very strong strength structures, and existing structure strength is also the increased and low cost, time limited and most of the important beams and columns joints more than earthquakes resistance as comparisons to used the "NC" normal materials.

II. MATERIALS USED

43 grade (OPC) Ordinary Portland cement satisfying the requirements of IS: 8112-1989 is used in the 'this investigation with the ratio of **M30** (1: .75: 1.5). But before using the cement material doing some test like initial and final setting time of cement testing and specific gravity of cement tested. These testing fully explanations' showing in table of the testing 3.1. Course aggregates are also used in this investigation in the size of 12MM to 16 mm' and also used the normal local river clear sand in this investigation 'because sand to filling a concrete void space' this type of sand water absorption capacity is very low, so that is the reason all of the concrete mixing material in only limited water are used. Cement material ratio of is used M30 (1: .75: 1.5). Aramid kevlar fiber reinforced 'synthetic steel mesh fiber used in two sided retrofitting bottom and top of the all specimens.

Fig 1:- Aramid Kevlar Fiber Synthetic Steel Mesh Fiber

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III. METHODOLOGIES AND EXPERIMENTAL PROGRAM

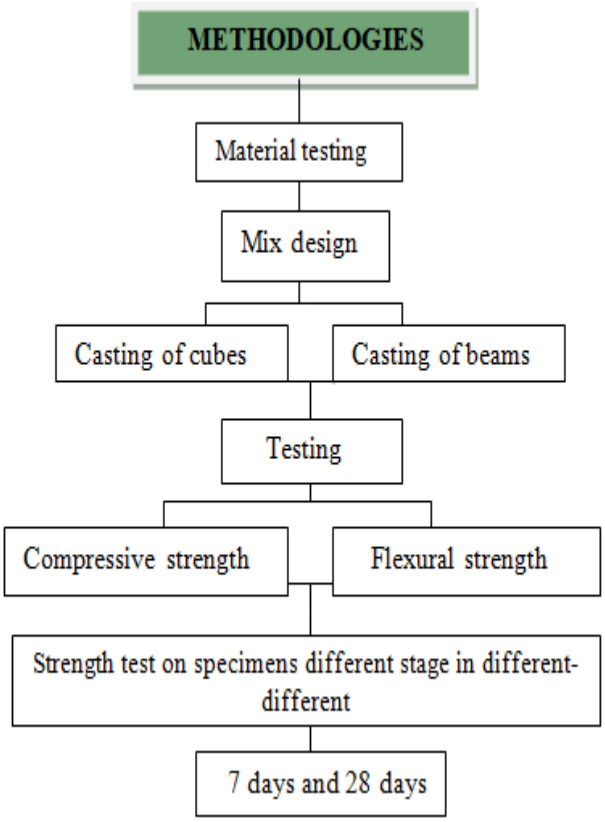

Fig 2:-

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

Table 1:- Materials properties

This study is mainly material collection of added the extra material used like synthetic steel mesh fiber (SSMF) used for concrete beams retrofitting or wrapping and aramid kevlar fiber (AKFR) in the way of small pieces of reinforced in concrete beams and cubes. Tested for physical properties as per Indian standard specification IS: 456:2000 method of tested for concrete and course aggregates.

IV. CASTING OF CUBES

The moulds are prepared using the plywood. 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 casting for 0% and now next one is more cubes are casting with added extra material in different-different stages of %age. Like 0%, 2%, 4%, 6%, 8%, 10%, 12%, 14%, 16% an18%etc.

Fig 3:- Cubes Casting Process.

V. TESTING OF CUBES

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

Fig 4:- Cubes Testing Process.

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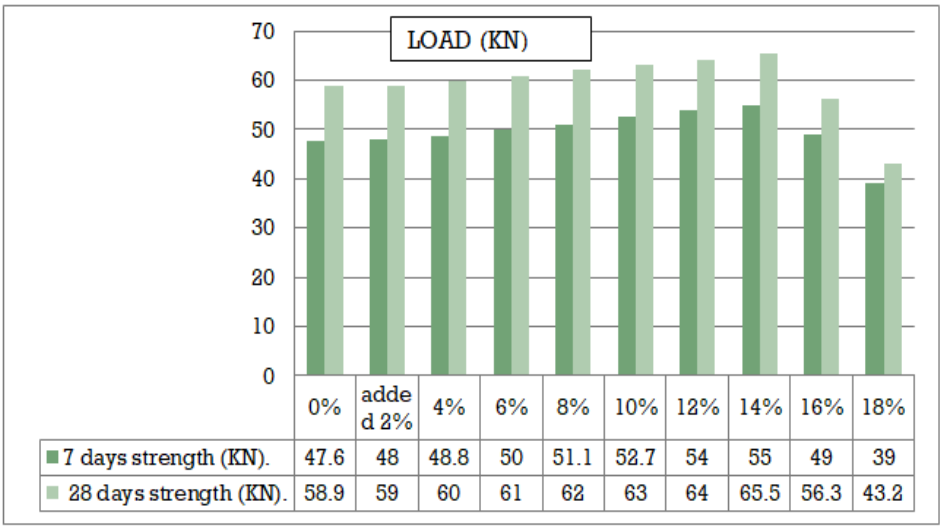

Fig 5:- 7 Days And 28 Days Cured Compressive Strength Load Graph (Kn).

This investigation in we are looking cubes compressive strength load value after 7 and 28 days. With the used of material like aramid Kevlar fiber fabric mixed reinforced in concrete and synthetic steel mesh fiber retrofitted materials.

Grade of Concrete	Extra %Age of Added Material Aramid Fiber	Dimension of Cubes(MM X MM X MM)	Compressive Strength of (KN) At 7 Days	Compressive Strength(KN) At 28 Days
M30	0%	150X150X150	47.60	58.90
	2%	150X150X150	48	59
	4%	150X150X150	48.89	60
	6%	150X150X150	50	61
	8%	150X150X150	51.10	62
	10%	150X150X150	52.70	63
	12%	150X150X150	54	64
	14%	150X150X150	55	65.50
	16%	150X150X150	49	56.3

Table 2:- 7 Days And 28 Days Cured Cubes Average Compressive Strength Tests (KN).

VI. CASTING OF BEAM

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

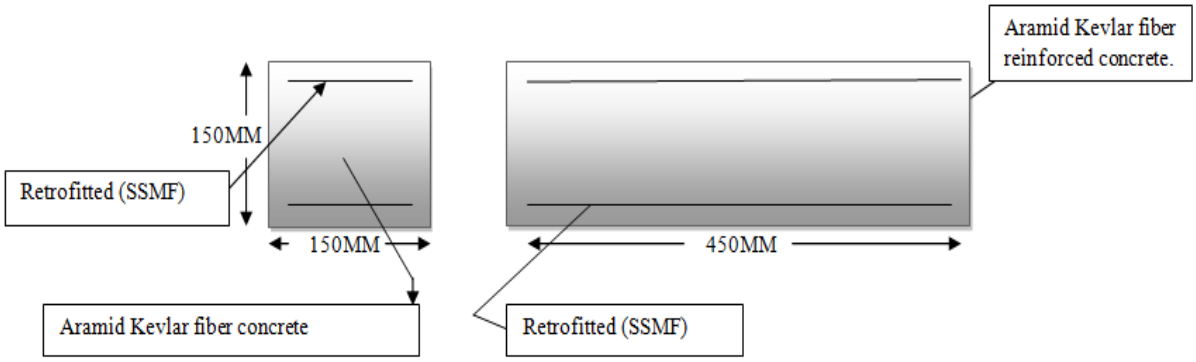

Fig. 6:- Retrofitting And Reinforced Detailing Of The Beam.

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VII. RETROFITING OF BEAM

In this process in 'I was apply the full covered technique for beam or concrete beam retrofitting in two side of the beams' like bottom and top of the beam surface, and they are totally bonded with wrapping of the retrofitting synthetic steel mesh fiber 'like 'I was taking the 1st of all beam plywood moulds and measured all the sides for retrofitting. Now very first cutting the synthetic steel mesh fiber fabric for using beam retrofitting in the bottom of beam surface. After this process, now I was again fill the beam moulds and now one time more apply retrofitting process in top of the surface of beam with the help of the synthetic steel mesh fiber.

Fig 7:- Retrofitting And Reinforced Detailing Of The Beam.

And also used the concrete reinforced of aramid Kevlar fiber reinforced. According to the requirement like 0%, 2%, 4%, 6%, 8%, 10%, 12%, and 14%, 16%and 18% etc. after the beam mould in upper case and used the retrofitting synthetic steel mesh fiber. Now beam retrofitted making process is complete, full explain with the help of fig. This is the process of the beam retrofitting.

Fig 8:- Reinforced Detailing Of The Beam And Retrofitting.

VIII. EXPERIMENTAL STUDY OF BEAM

The retrofitted beam and control were tested of flexural strength. Procedure of the all testing specimen was same. The beams specimens cured for period of the 7 days and 28 days. Now first of all beam surface controlled holder wash and cleared cleaned for clear cracks visibility' and retrofitted beam or wrapping beam clear cleaned with cotton. Now after that arrangement of the two-point load is used for the beams specimens testing. Because it has an advantage of the substantial region of nearly uniform moment coupled with very small shear 'bending capacity in beam central portion it to be load is transmitted through a load cell.

Fig 9:- Experimental Test Set Up.

Now retrofitted tested beams was supported on roller bearing supports. Placed the specimen of retrofitted beam over the two steel roller bearing and leave the 50 mm from beam both of the ends. Remaining 450mm is divided in the three equal part of beam like' 1st part 150 mm, 2nd 150mm.and 3rd one is also 150mm. They are fully explained in setup machine of beam. Now after that arrangement was done of the two points loading. As shown in arrangement fig. Loading is applied by hydraulic jack. Dial gauge was used for recording the deflection of the beam 'the deflection of the retrofitted beam were noted till the crack using the dial gauge, now removed after seen the crack and load was further applied till fracture load on the retrofitting of the beam or wrapping of the beam.

Fig 10:- Beams.

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

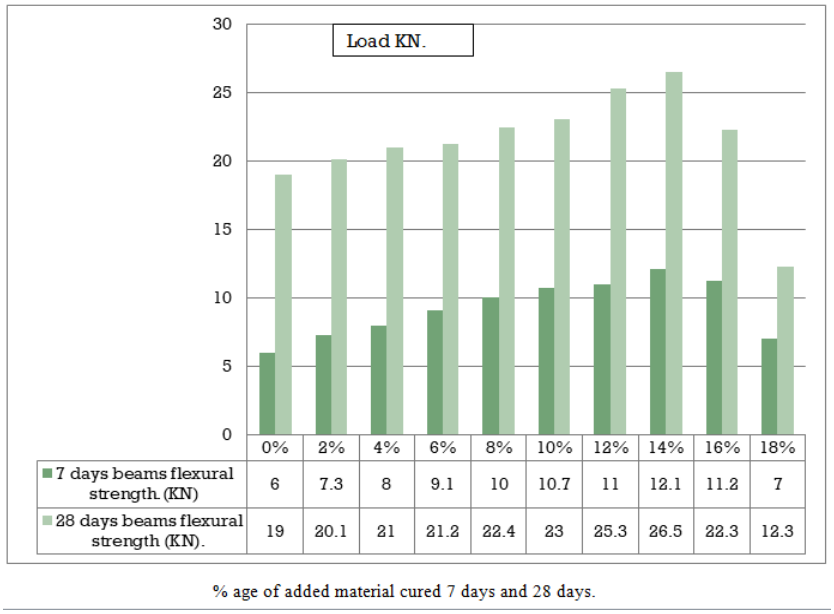

Fig 10:- Cured 7days And 28 Day Average Flexural Strength Test Retrofitted Beams (Kn) Graph.

Grade Of Concrete	Retrofitted(SSMF) And Extra Added Material(AKFFR)	Dimension of Beam (mm X mm X mm)	Cured 7 Days Flexural Strength (KN).	Cured 28 Days Flexural Strength (KN).
M30	Normal	150 x150 x 450	6.	19
	2%	150 x150 x 450	7.30	20.10
	4%	150 x150 x 450	8	21
	6%	150 x150 x 450	9.10	21.20
	8%	150 x150 x 450	10	22.40
	10%	150 x150 x 450	10.70	23
	12%	150 x150 x 450	11	25.30
	14%	150 x150 x 450	12.10	26.50
	16%	150 x150 x 450	11.2	22.3
	18%	150 x150 x 450	7	12.3

Table 3:- Cured 7 Days And 28 Days Maximum Average Flexural Strength Tests Of Retrofitted Beams (KN).

Retrofitting of beam is the increased ultimate load capacity of the retrofitted beam. In different-different %age in different load capacity. Like load taking capacity in 0%, 2%, 4%, 6%, 8%, 10%, 12%, 14, 16% and 18% etc. Cured 7 days and 28 days cured of load capacity.

From the 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. Under the used 14% of added material.
1	Increase the strength gap (KN) of 7 days retrofitted as compression to plain cement concrete. Under the used 14% of added material.	6.10 KN.
2	Increase the Strength gap (KN) of 28 days retrofitted and plain cement concrete. Under the used 14% of added material.	7.5 KN.

Table 4

Also the retrofitted beams full strength from the two sides 'and two sides in greater then the cement concrete beam. From above the result of beams are wrapped at two sides bottom of the beam and top of the beam surface gives a better result so from economic point of plain cement concrete retrofitted beams is also high.

IX. CONCLUSION

The conclusions are based on totally experiments investigation of aramid kevlar fiber (AKFR) reinforced in concrete beams before and after retrofitting with synthetic mesh steel fiber (SSMF).

- Increased the compressive strength gap in 7 days and 28 days retrofitted as comparison to plain cement concrete in 7 days 7.2 KN. And in 28 days 6.7 KN. Overall compressive strength gap from 7 days normal to 28 days maximum 27.7 KN.
- Increased the flexural strength gap in 7 days and 28 days retrofitted as comparison to plain cement concrete in 7 days 6.51 KN and in 28 days 7.5 KN. Overall flexural strength gap from 7 days normal to 28 days maximum 20.51 KN.
- Retrofitting structure behavior and understanding is very important because 'aramid kevlar fiber reinforced (AKFR) arrangement can actually make the situation worse structures.
- The load carrying capacity is increased with the using of Aramid Kevlar fiber in retrofitted beams and retrofitting with synthetic steel mesh fibre (SSMFF).
- The fibre content is Increasing and improved the load-carrying capacities of retrofitting beams both after and before retrofitting with (SSMFF).
- The retrofitted beam was restored initial stiffness of retrofitting beams with the help of synthetic steel mesh fibre fabric.
- Retrofitting with synthetic steel mesh fiber to lose some ductility behaviour of the concrete beam. Synthetic steel mesh fiber fabric sheets on tension faces of the beams ruptured' after which they are dropped the load suddenly.
- Synthetic steel mesh fiber (SSMFR) retrofitting using on the concrete beams to increased ultimate load capacity. But sheets prove to be economical and its cost is high.
- The full retrofitted technique around the two sides like down of the surface and upper of surface retrofitted beam because these to we are minimized the deflection of the beams.
- The obtain ultimate load capacity is at least for beam retrofitted with synthetic steel mesh fiber sheets.
- Beams retrofitted with synthetic steel mesh fiber sheet have the maximum ultimate load capacity but the cost of the material is high.

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