EXPERIMENTAL STUDY ON SHEAR BEHAVIOUR OF RC BEAM STRENGTHENED BY AFRP SHEET

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Abstract

Reinforced concrete structural components are found to exhibit distress, even before their service period is over due to several reasons. Such unserviceable structures require immediate attention, enquiry into the cause of distress and suitable remedial, measures. This study aims at addressing the issue of repurposing of an existing structure which may require addition of strength at economical rates. This study looks at the improvement in shear strength using different arrangement of Aramid fiber on RC beams experimentally. 18 beams are casted (9 beams with M20 Grade and 9 beams of M25 Grade concrete) with 45° and vertical strip arrangement of Aramid fiber to study the impact of the arrangement on shear strength. This study concludes that vertical strip arrangement (48.66% increase in shear strength) performs better than the 45° strip arrangement (36% increase in shear strength) to improve the shear strength of RC beams.

Keyword: Shear strengthening, AFRP Sheet ,RC beams, Shear capacity.

1.INTRODUCTION

Video The Experimental study on the Shear is a complex phenomenon and both the shear strength and failure are influenced by many factor the shear capacity and the associated failure modes of concrete beam depend mainly on the configuration of Aramid Fiber fabric wrapped to the beam to the Shear strengthening this paper demonstrates both experimentally and analytically the shear strength of concrete beams wrapped with different configurations of AFRP fabric&which will provide guidelines for shear strengthening using AFRP fabric and a database for further research in field.

The focus on this study is about the methods shear strength in RC beam. And provide mix design for concrete Total 18 beams shall be caste of 150x150x700 mm. A pilot study will be done on trial mix for attaining the required shear strength according to the M20, M25grades of the concrete. Prepare Control specimen and carry out Shear test as per codel provision when the cracks occur. RC beam in shear strengthening is the detail investigation from analysis that made up for some cases. A good assessment is shown the best result of analysis from the investigation. The general of investigation of AFRP sheet apply RC beam will shear test on beams so that the solution for the shear strength can be solve by the suitable technique for further work. A good and accurate assessment method will give an idea on what is the best shear strengthening technique to be used.

2. MATERIAL PROPERTIES AND MIX PROPORTIONS

A. Materials

Cement

Ordinary Portland Cement of 53 Grade manufactured by J.K. Laxmi cement company was used in concrete mixes corresponding to 15-8112. The specific gravity of cement is 3 .15

Send

Natural river sand is used as fine aggregate. As per IS: 2386 (Part III)-1963,the bulk specific gravity in oven dry condition and water absorption of the sand are 2.65 and 1.70% respectively

Aggregate

Crushed stones of maximum size 20 mm are used as coarse aggregate. As per IS:2386 (Parl Ill)-1963 [6], the bulk specific gravity in oven dry condition and water absorption of the coarse aggregate are 2.85 and 0.80% respectively

Water

Portable water was used to prepare the concrete mix and for the curing

Aramid fiber

Aramid Fiber is also known as keveler fiber. Aramid fiber is also high strength, tough and highly oriented organic fiber derived from polyamide incorporating into an aromatic ring structure. Aramid is used in bullets resistance jacket. This fiber is quite abrasive and under repeated loading they can abrade against each other by weakening the sheets. Aramid fiber is a family of synthetic products characterized by strength some five times stronger than steel on an equal weight basis and heat-resistance and high tensile strength. Physical properties of Aramid fiber are given in Table 1.

Table 1. Physical properties of AFRP Sheet

Item	Data	Unit
Width	1	m
Thickness	0.3	mm
Breaking strength	2400-3600	N/mm^2
Elongation	3.50	%
Price	1350 + GST	INR

Admixure

An epoxy resin with hardner was used to glue the AFRP sheet on beam.

Table 2. Physical of coarse aggregate (20 mm)

Test	Result
Finesse modulus	2.52
Conforming zone	II
Specific gravity	2.65
Water absorption	1.70%
Bulk density	1.20

Table3.Properties of coarse aggregate (10mm)

Test	Result	Unit
Specific gravity	2.65	-
Water absorption	0.85	%
Impact value%	14.10	%
Flakiness index	27.70	%
Elongation index	19.80	%
Bulk density	1.5	gm/cc

Table4.Properties of Sand

Test	Unit	Unit
Specific gravity	2.83	-
Water absorption	0.95	%
Impact factor	16.50	%
Flakiness index	28	%
Elongation index	22.80	%
Bulk density	gm/cc	%

B.Mix Design

A standard mix M20 and M25 grade was calculated as per Indian Standard (IS10262-2019), For cash binder content ,the W/C ratio were 0.45 and 0.50 respectively were determined by trial mixtures. The mix design is given in Table 5

Table5.Mix design for M20 and M25 grade of concrete

Grade	M20	M25
Mix ratio		
Water (kg)	177	191.6
Cement (kg)	402.27	383.2
Coarse aggregate (kg)	1221	1143.18
Fine Aggregate (kg)	695	691.63
W/C ratio	0.44	0.50

C. Casting Procedure

For preparing concrete, a batch mixer was used. firstly, all the materials are weighted on weighting scale as per

quantity of mix design. Then coarse aggregates, fine aggregates, cement ,were mixed with $\frac{1}{2}$of the mixing water for some time until proper mix. And add other $\frac{1}{2}$water and run batch mixture for proper mixing

Fig 1 Casting of beam

For Shear strength, test were conducted on 150x150x700 mm beam rnouldsafter 28days of proper curing. 3 specimens were casted and tested for each combination

Fig. 2 De-Mouldingand Curing

Wrapping types for Shear Strengthening of RC Beam

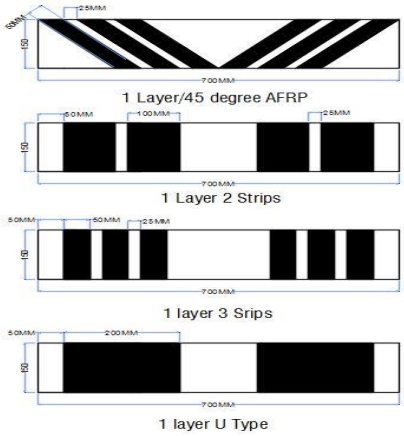


Fig. 3 Type of Wrapping patterns in beam

D. Experimental Work

A. Beam Reinforcement Details

HYSD Fe415 is use for steel reinforcement work,10 mm diameter are use as longitudinal steel and 8rum diameter are used as shear reinforcement @110mm centre to centre

8 mm shear reinforcement @ 110 mm

Fig 4 Beam Reinforcement details

B. Testing of beam

For testing of beam universal testing machine (UTM) is used, load is applied for ultimate load for control specimen. After the cracking the all beams beam are Shear strengthened with different pattern of AFRP sheet with the help of hardener and resin (1:3) ratio

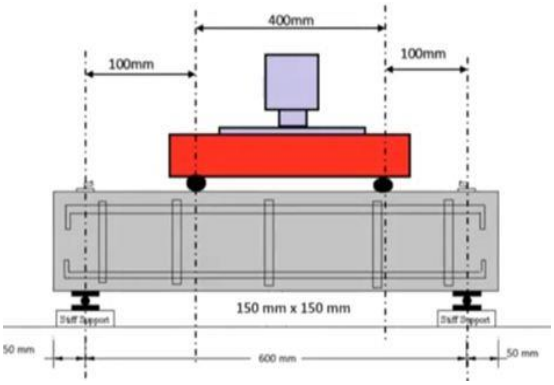


Fig 5 Four Point loading Testing setup UTM for Shear Test

Fig 6 Four point loading Testing setup UTM and shear test of control specimen M20 & M25

Fig 7 Applying resin and AFRP sheet 45° degree on beam M20 & M25

Fig 7 Four point loading for Shear test of 45° Degree Strip-wrapped Beam M20 & M25(AFRP sheet)

Fig 8 Applying resin and AFRP sheet Vertical Strip on beam M20 & M25

Fig 9 Four point loading for Shear Test of Vertical Strip-wrapped Beam M20 & M25 (AFRP sheet)

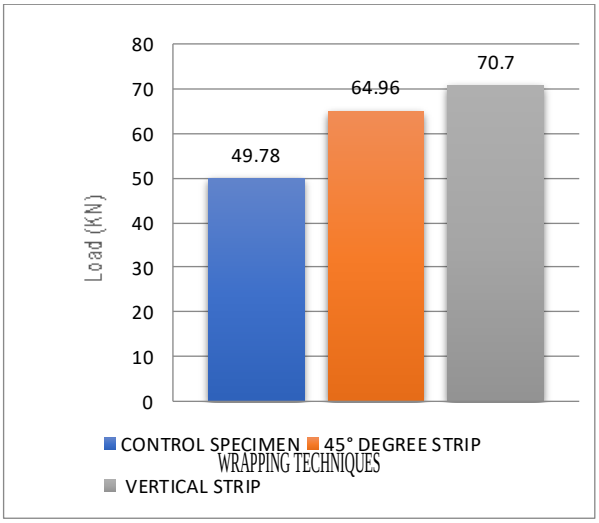
E. Testing Results

After Shear strengthened of beam the test is carried out and results are list down below tables

Table-6. Load carrying capacity of AFRP Sheet for M-20

Beams M-20(AFRP Sheet)

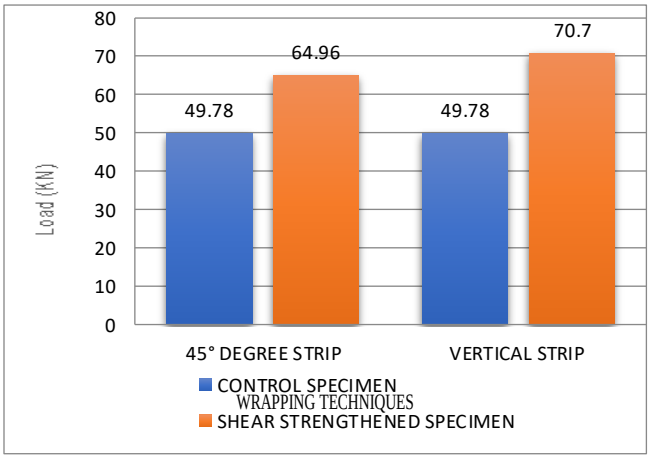
Name	SPI (kN)	SP2 (kN)	SP3% (kN)	Average (kN)
Control Specimen	53.05	47.50	48.80	49.78
45° Degree Strip	66.20	68.40	60.30	64.96
Vertical Strip	70.55	73.22	68.34	70.70



Graph.1 Ultimate load of Control specimen & Shear Strengthened specimen with AFRP Sheet for M-20

Table -7. Increasing of load carrying capacity of AFRP Sheet

Sr.no	Pattern	M-20		% Increasing of load
		Control Specimen (kN)	Shear Strengthened Specimen (kN)	
1	**45° Degree Strip**	49.78	64.96	30.49
2	**Vertical strip**	49.78	70.70	42.02



Graph.2 Comparison Ultimate load of Control specimen & Shear Strengthened specimen for M-20 (AFRP)

Table-8. Shear Strengthened with AFRP Sheet for M-20

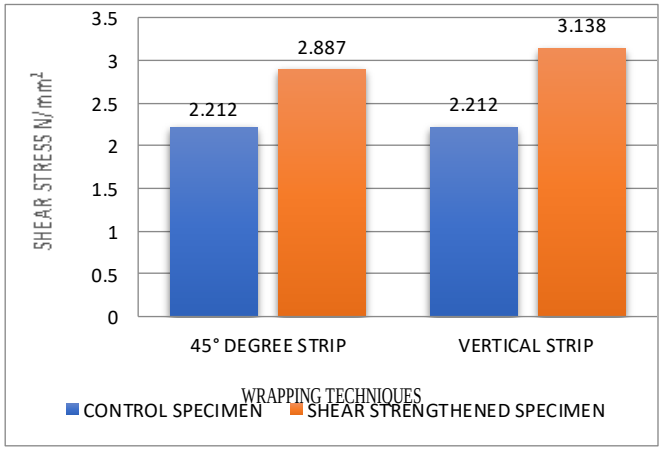
Name	SPI (N/mm^2)	SP2 (N/mm^2)	SP3% (N/mm^2)	Average (N/mm^2)
Control Specimen	2.357	2.111	2.168	2.212
45° Degree Strip	2.942	3.040	2.680	2.887
Vertical Strip	3.135	3.254	3.027	3.138

Name	SPI (kN)	SP2 (kN)	SP3% (kN)	Average (kN)
Control Specimen	60.35	59.60	55.45	58.46
45° Degree Strip	77.60	81.20	79.80	79.53
Vertical Strip	85.75	88.80	86.20	86.91

Table-9. Load carrying capacity of AFRP Sheet forM25

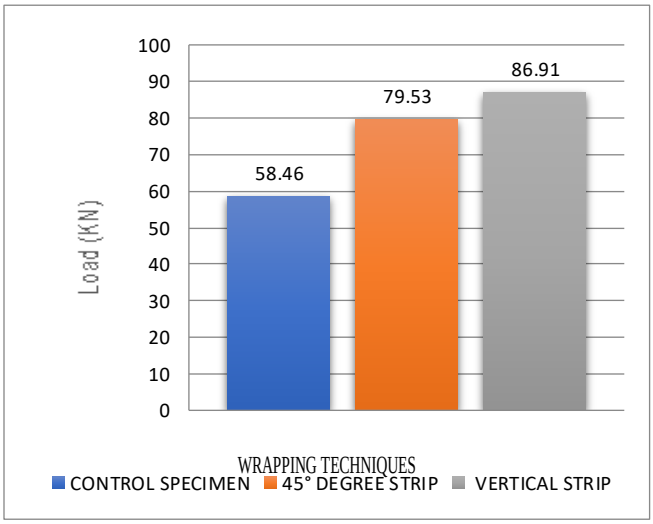
M-25(AFRP Sheet)

Sr. no	Pattern	M-25		% Increasing of load
		Control Specimen (kN)	Shear Strengthened Specimen (kN)	
1	45° Degree Strip	58.46	79.53	36.04
2	Vertical strip	58.46	86.91	48.66



Graph.3 Comparison Shear Stress of Control specimen & Shear Strengthened specimen with AFRP sheet for M-20.

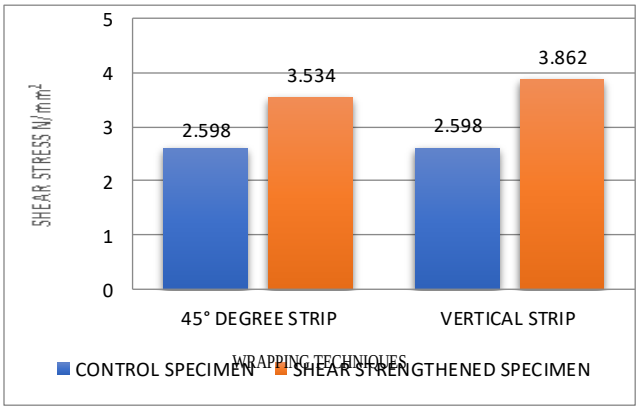
Table-10. Increasing of load carrying capacity of AFRP Sheet



Graph.4 Ultimate load of Control specimen & Shear Strengthened specimen with AFRP Sheet for M-25

Table-11. Shear Strengthened with AFRP Sheet for M-25

Name	SPI (N/mm²)	SP2 (N/mm²)	SP3% (N/mm²)	Average(N/mm²)
Control Specimen	2.682	2.648	2.464	2.598
45° Degree Strip	3.448	3.608	3.546	3.534
Vertical Strip	3.811	3.946	3.831	3.862



Graph.6 Comparison Shear Stress of Control specimen & Shear Strengthened specimen with AFRP sheet for M-25

3.CONCLUSION

After this experiment results show that AFRP sheet are use as Shear Strengthened material. Using AFRP sheet for Shear Strengthened results show that the ultimate load carrying capacity and Shear strength are increasing in, 45° Degree strip Wrapping is 30% - 36.04% for M-20, M-25 grade of concrete, compare with control specimen. Using AFRP sheet for Shear Strengthened. results show that the ultimate load carrying capacity and Shear strength are increasing in Vertical strip, Wrapping is 40% - 48.66% for M-20, M-25 grade of concrete, compare with, control specimen. AFRP sheet Vertical strip, Wrapping give a good result in ultimate load carrying capacity and shear strength compare. to 45° Degree strip Wrapping respectively. In case of structures where repurposing requires additional strength at economical rates, this study of AFRP sheet for addition of shear strength may be very useful.

4.FUTURE SCOPE

After This study was carried out on, Sear strengthening of beam using AFRP sheet but the same material can be use for flexural . Strengthening, and Retrofitting of beam, column And slab. This experiment was-carried out on reinforcement without corrosion but same can be check with corroded - reinforced bar

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