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Experimental Study on Shear Strengthening of RC T-Beams with Web Openings using FRP Composites

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Abstract: Shear collapse of reinforced concrete (RC) individuals is cataclysmic and happens abruptly with no guidance ahead of time of pain. In a few events existing RC pillars have been seen as lacking in shear and needing fortifying. Regular shear reinforcing technique, for example, outer post tensioning, part broadening alongside inside transverse steel, and fortified steel plates are expensive, requiring broad hardware, time, and noteworthy work. On the other hand, the moderately new elective fortifying method utilizing propelled composite materials, known as fiber reinforced polymer (FRP), offers noteworthy favorable circumstances, for example, adaptability in configuration, simplicity of establishment, diminished development time, and improved toughness. The general goal of this examination was to explore the shear execution and disappointment methods of RC T-pillars reinforced with remotely fortified GFRP sheets. So as to accomplish these goals, a broad trial program comprising of testing eleven and full scale RC pillars was done. The factors researched in this examination included steel stirrups, shear range to-profundity proportion, GFRP sum. The trial results demonstrated that the commitment of remotely fortified GFRP to the shear limit is noteworthy and relies upon the variable examined. The disappointments of fortified pillars are started with the deboning disappointment of FRP sheets followed by fragile shear disappointment. Be that as it may, the shear limit of these shafts has expanded when contrasted with the control pillar which can be additionally improved if the deboning disappointment is forestalled. An inventive strategy for dock method by utilizing GFRP plates has been utilized to forestall these untimely disappointments, which therefore guarantee full use of the quality of FRP. A hypothetical report is likewise proposed by utilizing ACI rules for figuring the shear limit of the fortified bars.
Keyword: RC T-Beams, FRP Composites

I. INTRODUCTION

Shear fortifying of strengthened solid shaft is essential to get a definitive flexural limit with malleable conduct. Remotely reinforced CFRP cover has been utilized as one of the most well-known fortifying strategy for shear when contrasted with other accessible materials. In any case, untimely disappointment of CFRP shear strips was seen as the significant shortcoming of the framework. It was because of lacking fortified region of CFRP shear strip when contrasted with CFRP flexural cover since the profundity of strengthened solid bar is littler when contrasted with length. In this way, untimely deboning of CFRP overlay is normal on account of shear reinforcing.

A. Background and Motivation

Numerous cataclysmic events, quake being the most influencing of all, have delivered a need to expand the current wellbeing levels in structures. The information on comprehension of the quakes is expanding step by step and in this manner the seismic requests forced on the structures should be modified. The plan strategies are additionally changing with the developing exploration in the zone of seismic designing. So the current structures may not fit the bill to the present prerequisites. As the total substitution of such inadequate structures prompts causing a gigantic measure of open cash and time, retrofitting has become the worthy method of improving their heap conveying limit and expanding their administration lives.

Retrofitting is uncommonly used to identify with the seismic update of offices, for example, on account of the utilization of composite coats for the restriction of segments. Retrofitting is making changes to a current structure to shield it from flooding or different risks, for example, high breezes and seismic tremors. The support, restoration and redesigning of basic individuals, is maybe one of the most urgent issues in structural designing applications. In addition, countless structures built in the past utilizing the more seasoned plan codes in various pieces of the world are fundamentally risky as per the new plan codes. Since substitution of such insufficient components of structures acquires an enormous measure of open sum and time, reinforcing has become the worthy method of improving their heap conveying limit and expanding their administration lives.

The retrofitting is perhaps the best choice to make a current deficient structure safe against future plausible seismic tremor or other ecological powers.

There are numerous different components, considered in dynamic for any retrofitting system. This ends up being a superior alternative taking into account the financial contemplations and prompt asylum issues as opposed to substitution of structures. Since substitution is expensive and basic conduct additionally may change and it might cause bother moreover. There are a few circumstances where a common structure would require retrofitting or recovery. Coming up next are a few reasons that may require retrofitting

1) Building which are structured considering gravity stacks as it were.
2) Development exercises in the field of Earthquake Resistant Design (EQRD) of structures and different structures result into change in plan ideas.
3) Lack of auspicious corrections of codes of training and measures.
4) Lack of amendments in seismic zone guide of nation.
5) In instances of adjustments in structures in seismic inclined zone for example increment in number of story, increment in stacking class and so on.
6) In instances of weakening of Earthquake (EQ) powers safe degree of building for example decline in quality of development material because of rot, fire harm, and settlement of establishments.
7) The nature of development really accomplished might be lower than what was initially arranged.
8) Lack of comprehension by the fashioner.
9) Improper arranging and mass appropriation on floors.

B. Objective

1) To study the structural behavior of reinforced concrete (RC) T-beams with a transverse hole under static loading condition.
2) To study the contribution of externally bonded Fiber Reinforced Polymer (FRP) sheets on the shear behavior of RC T-beams.
3) To know the suitability of the FRP composites as repair materials for deteriorated RC Structures.
4) To examine the effect of different parameters such as steel stirrups, number of layers, different shear span to effective depth ratio etc. on enhancement of load carrying capacity and load deflection behavior.
5) To investigate the effect of a new anchorage scheme on the shear capacity of the beam.

II. REVIEW OF LITERATURE

Saira P.N et al. research the upgrades in the auxiliary conduct of the RC bars retrofitted with different kinds of FRP, for example, glass strands, coir filaments, banana filaments, jute strands and cotton strands. A definitive burden was seen as high for bars retrofitted with FRP composite than control pillar. Modulus of crack likewise is discovered high for RC bars retrofitted with filaments, for example, glass, banana, jute, cotton, coir comparing to extreme burden. This demonstrated the utilization of both normal and fake FRP was viable if there should be an occurrence of flexural fortifying of structures. The heap redirection conduct was better for bars reinforced with FRP contrasted with the control pillars.
SAMER BARAKAT et al. to contemplate and break down the parameters that most impact the shear conduct of RC individuals reinforced with EBFRP. The examination of this accessible information affirmed Predictions of the ACI configuration model for S-fortified, U-wrapped and W-wrapped EBFRP RC bars. that the shear issue includes various parameters, which are connected and interfacing, for example, the properties of FRP and the presence of the inner shear fortification among others. This paper endeavors to recognize and survey the most significant variables that impact the shear disappointment of EBFRP reinforced RC pillars by assembling and dissecting recently detailed test information in the writing. These information are ordered in a refreshed database depicted in this.
Md Ashraful Alam et al. The primary target of this examination is to offer a structure rule for shear fortifying of fortified solid bar utilizing CFRP cover by wiping out deboning disappointment. The proposed technique forestalled the total detachment of CFRP cover albeit a miniaturized scale deboning was seen before disappointment of the bar. Reinforced pillar with proposed configuration didn't show the untimely disappointment. The strains of shear connection and CFRP cover were seen as perfect except if the overlay deboned. Along these lines, the proposed plan rule, in light of the bond quality of cement and strain similarity, could be utilized for shear reinforcing of RC pillar utilizing CFRP overlay.
Rui Guo et al. This paper examines the shear fortifying impact of various fortified cement (RC) pillars reinforced by a support layer which joins carbon fiber strengthened polymer (CFRP) framework and polymer concrete mortar (PCM).A aggregate of ten RC shafts, including three sorts of examples as Series An and seven sorts of examples as Series B, were arranged and researched. Contrasted with the example with a fortification layer just in the web, better exhibitions of examples strengthened in both the web

and rump locales are gotten as far as the subsequent solidness and a definitive shear limit, reconfirming that the CFRP lattice PCM layer utilized for the full sectional support of RC shafts with an I-formed profile is vital. Neighborhood deboning disappointment for the most part happens at the FRP matrix solid interface preceding the crack of the CFRP lattice. What's more, utilizing the compelling strain of the FRP bar to anticipate the successful/genuine strain for the CFRP matrix can be viewed as secure, yet is fairly over-prescient.

Kamal G.Sharobim et al. This paper presents test examination for eight pillars in two sets every one segment of control shaft and three bars reinforced by the three distinct techniques without changing its measurements. The bars were tried under four point loads. Extreme burdens, load-avoidance bends, breaking and squashing designs for reinforcing bar had been contrasted and those of the RC bars without fortifying in shear and flexure stresses. Reinforcing by utilizing SFRC didn't accomplish the point of the hunt. The outcome demonstrated that pillars reinforced utilizing CFRP had expanded in load limit about 24% and 27% in shear and flexure stresses receptivity, while the bars fortified utilizing SFRC were the least and didn't accomplish the point of paper.

Sivagandan.M et al. This paper likewise clarifies about the impact of GFRP on the control of avoidance, splits engendering and disappointment design. At last utilization of U wraps with one and two layer of GFRP invigorates the like that of the control bars without openings. is for the most part focused on fortifying methods of RC T-Beam with web opening in shear area utilizing glass fiber strengthened polymer (GFRP) i.e., U-Wrap and face wrap. From the trial results it is seen that, the heap conveying limit decline in the reinforced pillar with opening contrast with control bars and was expanded if there should arise an occurrence of Strengthened bars contrasted with unstrengthen shafts. The nearness of openings prompts decline in solidness and improves in diversion of pillars contrasted with control bar. The principle points of interest in the fortifying procedure by GFRP wrapping are it has low self-weight, high solidarity to weight proportion, simple to move, simple to introduce and requires less time. These are a portion of the impediments in this framework is generally less affordable and pot life of leave will be less so the wastage will be more.

Sainath B Tole et al. Studies are done to reinforce the RC T-Beams in shear by holding FRP sheets remotely, that being said the presentation of bars with FRP coats under shear are not seen completely. Along these lines this investigation gives a degree to investigate the possibility to fortify the T-Beams which is lacking in shear utilizing FRP reinforced remotely. This undertaking remembers analyze for CFRP retrofitted RC T-Beams utilizing four-direct stacking toward bomb in shear. Shafts were casted with various setups and contrasted and the control T-Beams. The outcomes show that there is an improvement in shear limit when retrofitted with CFRP wraps. Instances of stacking, geometrical arrangements, flexure bars and braces, RC T-pillars fortified utilizing fiber strengthened polymer (FRP) textures exposed to joined shear and torsion. The shear and torsion conveying limits were expanded up to 71% more than the control example, just as expanding the solidness of the bars in the wake of splitting when contrasted with that of the control bar. Reinforcing expanded the deformability of the bar and saved its honesty up to disappointment.

P. Vijaya Kumar et al. This paper exploratory examination was done on RC bars to check the shear conduct by contrasting control RC pillars and reinforced RC shafts. To watch the shear conduct considered RC Beams were made feeble in shear and afterward Retrofitted. Different research works are being done to know the shear conduct of different strengthened basic components. The shaft is frail in shear is because of some extra flat powers acting which is corresponding to pillar surface will create some weight on the bar. The solid was flopped in pressure zone for the retrofitted bar due to solidified FRP. It is anything but difficult to keep up a directed uniform thickness of epoxy gum all through the bouncing length. Reestablishing the sheer amount of shaft utilizing GFRP was surpassed the ordinary system.

El-Samny M.K. et al. study portrays the consequence of a test examination on the reaction of making opening in fortified solid pillars after and before throwing utilizing steel wire work, steel points, steel lashes, steel stirrups framework and support shafts around the opening. The bars were instrumented and tried under two-point load. The trial program comprised of testing thirteen just bolstered fortified rectangular bars. The fundamental parameters of study are the various techniques for fortifying. introduced tentatively the impact of presenting opening in the shear zone on the flexural, shear limit and conduct of fortified solid bar. Distinctive regular methods of reinforcing around the openings were utilized. The outcomes were contrasted with a tried shaft that that was pre-strengthened around the openings just as a control bar without opening. Contemplated the conduct of fortified cement (RC) bars with huge openings fortified by remotely fortified carbon fiber-strengthened polymer CFRP overlays. A sum of six just bolstered shafts comprising of two strong pillars and four bars with openings were thrown and tried under four-point twisting. Each shaft had a huge opening set evenly at mid-length. Test parameters incorporated the initial shape and size just as the reinforcing setup for the CFRP overlays.

T. P. Meikandaan et al. Trial examinations on the flexural and shear conduct of RC shafts fortified utilizing persistent glass fiber strengthened polymer (GFRP) sheets. Foundation rot brought about by untimely crumbling of structures and structures has prompted the examination of a few procedures for fixing or reinforcing purposes. One of the difficulties in reinforcing of solid structures is choice of a fortifying technique that will upgrade the quality and functionality of the structure while tending to constraints, for example, constructability, building activities, and spending plan. Basic fortifying might be required because of a wide range of circumstances.

III. RESEARCH METHODOLOGY

The goal of the test program is to consider the impact of remotely fortified (EB) fiber strengthened polymer (FRP) sheets on the shear limit of fortified solid T-pillar with a transverse opening in shear range under static stacking condition. Eleven number of fortified solid T-bars are thrown and tried up to disappointment by applying even four-point static stacking framework. These pillars were separated into 2 gatherings assigned as An and B. The distinction between two gatherings was in transverse steel support. Out of eleven quantities of pillars, four bars were not fortified by FRP and in that two shafts were considered as a control bars and two bars were strong bars without transverse opening, while all other seven bars were reinforced with remotely reinforced GFRP sheets in shear zone of the bar. The factors explored in this exploration study included steel stirrups (i.e., shafts with and without steel stirrups), shear length to profundity proportion (i.e., a/d proportion 2.66 versus 2), and end stay (i.e., U-wrap with and without end grapple).

A. *Test Specimens*

Each of the eleven strengthened solid T-bars had a range of 1300 mm, 150mm wide web, 350mm wide spine, 125mm profound web, 50mm profound rib and successful profundity of 125mm. The course of action of fortification of bars under gathering A comprises of 2numbers of 20mm φ and 1number of 10mm φ HYSD bars as strain support, four bars of 8mm φ are likewise given as hang up bars and with no shear fortification. The course of action of fortification of shafts under gathering B comprises of 2numbers of 20mm φ and 1number of 10mm φ HYSD bars as strain support, four bars of 8mm φ are likewise given as hang up bars and 8mm φ bars are given as shear fortification at 200 mm dispersing.

B. *Material Properties*

1) *Concrete:* For conducting experiment, the proportions in the concrete mix are tabulated in Table 3.1 as per IS: 456-2000. The water cement ratio is fixed at 0.55. The mixing is done by using concrete mixture. The beams are cured for 28 days. For each beam six 150x150x150 mm concrete cube specimens and six 150x300 mm cylinder specimens were made at the time of casting and were kept for curing, to determine the compressive strength of concrete at the age of 7 days & 28 days are shown in table 3.2.

Table 3.1 Nominal Mix Proportions of Concrete

Description	Cement	Sand (Fine Aggregate)	Coarse Aggregate	Water
Mix Proportion (by weight)	1	1.67	3.33	0.6
Quantities of materials for one specimen beam (kg)	44.4	74.11	147.85	22.5

The compression tests on control and strengthened specimen of cubes are performed at 7 days and 28 days. The test results of cubes are presented in Table 3.2.

Table 3.2 Test Result of Cubes after 28 days

Specimen Name		Size of Cube Specimen	Size of Cylinder Specimen	Average Cube Compressive Strength (MPa)	Average Cylinder Compressive Strength (MPa)
Group A	Solid beam	150x150x150	150φ x300	35.23	25.15
	CBA	150x150x150	150φ x300	35.88	20.93
	SBA2-1	150x150x150	150φ x300	36.5	21.86
	SBA2-2	150x150x150	150φ x300	34.87	23.72
	SBA2-3	150x150x150	150φ x300	36.47	20.46
	SBA4-1	150x150x150	150φ x300	37.86	26.82

Group B	Solid beam	150x150x150	150φ x300	30.83	21.08
	CBB	150x150x150	150φ x300	32.56	22.75
	SBB2-1	150x150x150	150φ x300	31.89	20.74
	SBB2-2	150x150x150	150φ x300	35.4	23.5
	SBB2-3	150x150x150	150φ x300	36.77	24.87

2) *Cement:* Concrete is a material, for the most part in controlled structure, which can be made into a glue as a rule by the expansion of water and, when formed or poured, will set into a strong mass. Various natural mixes utilized for a following, or affixing materials, are called concretes, yet these are named cements, and the term concrete alone methods a development material. The most generally utilized of the development concretes is Portland concrete. It is somewhat blue dark fueled got by finely crushing the clinker made by unequivocally warming a private blend of calcareous and argillaceous minerals. Portland Slag Cement (PSC) Konark Brand was utilized for this examination. It is having a particular gravity of 2.96.
3) *Fine Aggregate:* Fine total/sand is an aggregation of grains of mineral issue got from breaking down of rocks. It is recognized from rock just by the size of the grains or particles, yet is particular from muds which contain natural material. Sand is utilized for making mortar and concrete and for cleaning and sandblasting. Sands containing a little mud are utilized for making molds in foundries. Clear sands are utilized for separating water. Here, the fine total/sand is going through 4.75 mm strainer and having a particular gravity of 2.64. The reviewing zone of fine total is zone III according to Indian Standard details May be: 383-1970.
4) *Coarse Aggregate:* Coarse totals are the squashed stone is utilized for making concrete. The business stone is quarried, squashed, and evaluated. A great part of the squashed stone utilized is stone, limestone, and trap rock. The coarse totals of two evaluations are utilized one held on 10 mm size strainer and another evaluation contained totals held on 20 mm size sifter. The greatest size of coarse total was 20 mm and is having explicit gravity of 2.88 evaluating affirming to IS: 383-1970.
5) *Water:* Water fit for drinking is commonly viewed as useful for making the solid. Water ought to be liberated from acids, soluble bases, oils, vegetables or other natural polluting influences. Delicate water produces more fragile cement. Water has two capacities in a solid blend. Right off the bat, it responds artificially with the concrete to frame a concrete glue wherein the dormant totals are held in suspension until the concrete glue has solidified. Besides, it fills in as a vehicle or grease in the blend of fine totals and concrete. Common clean convenient faucet water is utilized for solid blending in all the blend.
6) *Reinforcing Steel:* High return Strength Deformed (HYSD) bars affirming to IS 1786:1985. The longitudinal steel fortifying bars were distorted, high return quality, with 20 mm and 10 mm breadth. The stirrups were produced using disfigured steel bars with 8 mm breadth. Three coupons of steel bars were tried and yield quality of steel fortifications utilized in this trial program is resolved under uniaxial strain understanding with ASTM details. The confirmation stress or yield quality of the examples are arrived at the midpoint of and appeared in Table 3.5. The modulus of flexibility of steel bars was 2 × 105 MPa.

IV. EXPERIMENTAL SETUP

A. Group-A

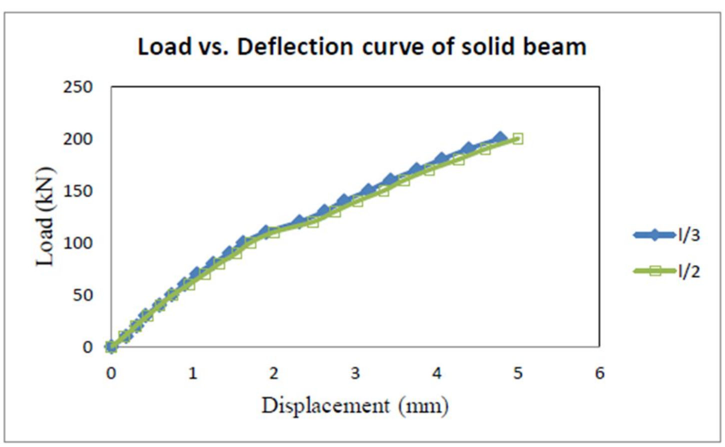

Figure 5.3 Load vs. Deflection Curve for Solid beam A

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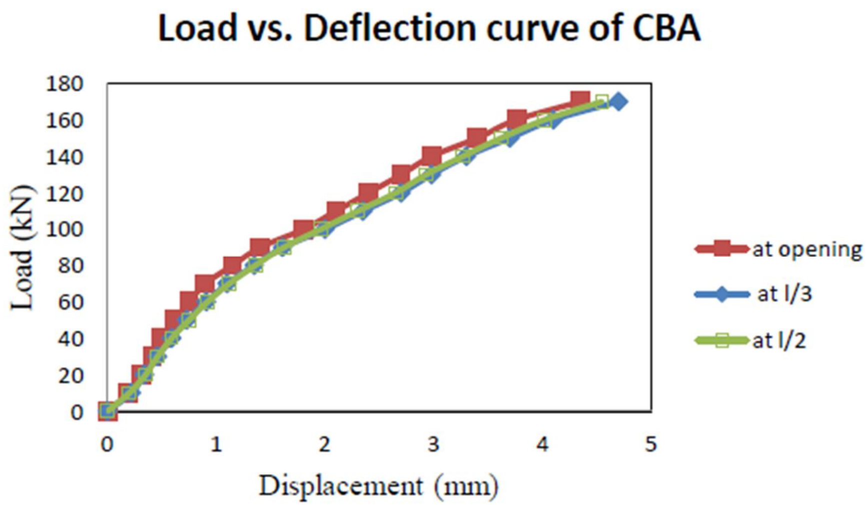


Figure 5.4 Load vs. Deflection Curve for CBA

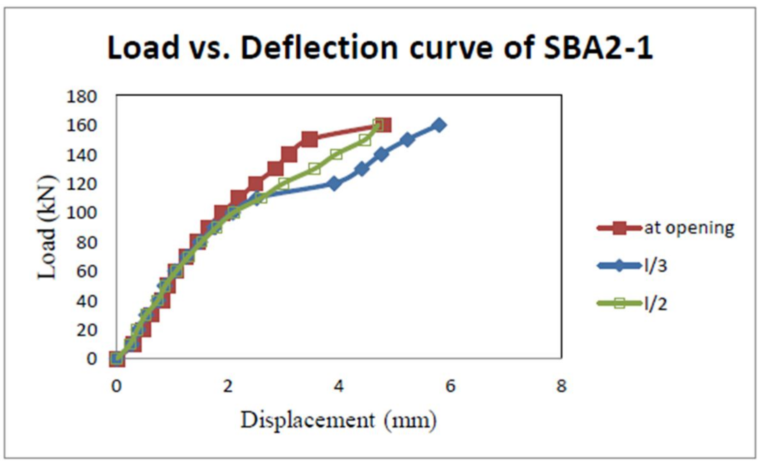


Figure 5.5. Load vs. Deflection Curve for SBA2-1

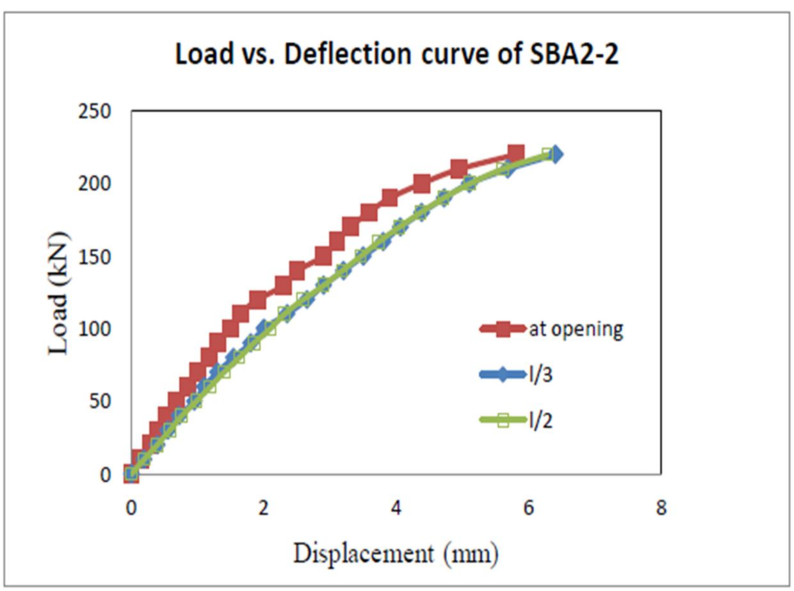


Figure 5.6 Load vs. Deflection Curve for SBA2-2

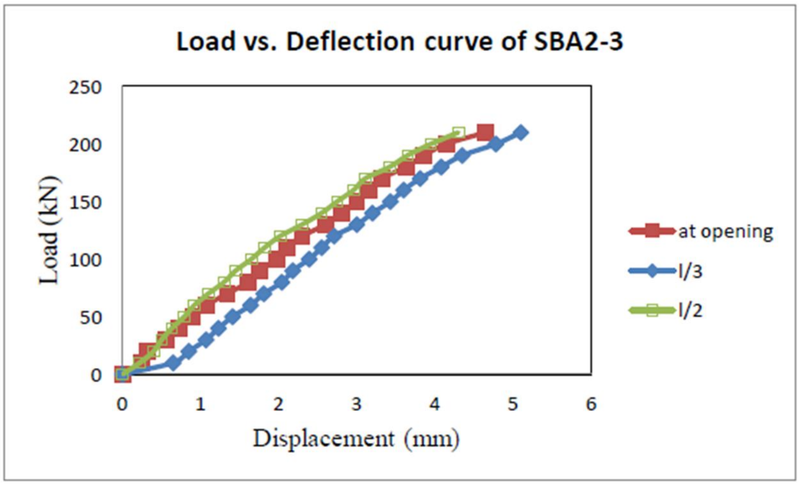


Figure 5.7 Load vs. Deflection Curve for SBA2-3

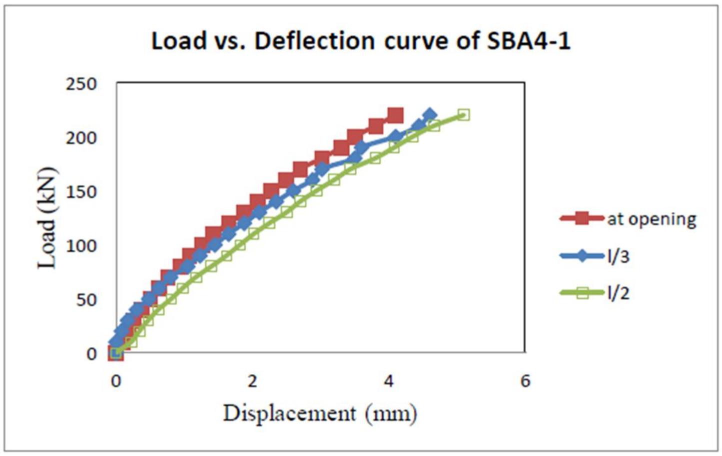


Figure 5.8. Load vs. Deflection Curve for SBA4-1

B. Group-B

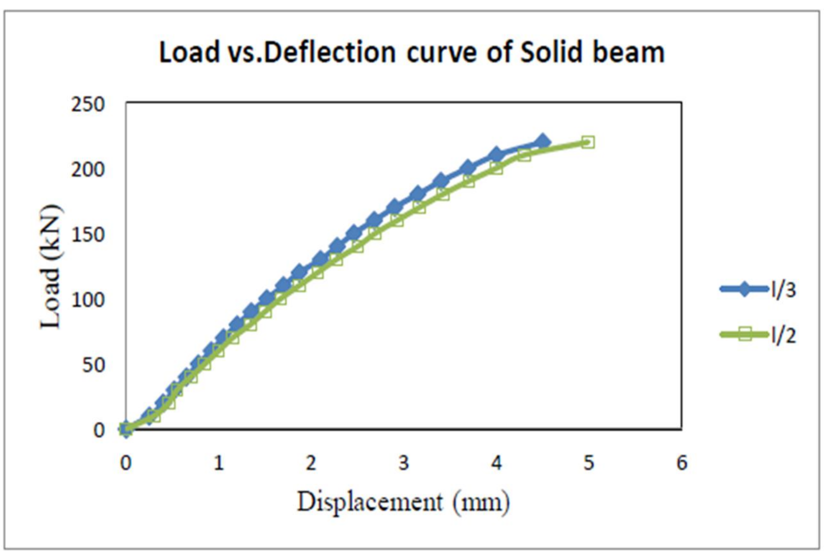


Figure 5.9 Load vs. Deflection Curve for Solid beam B

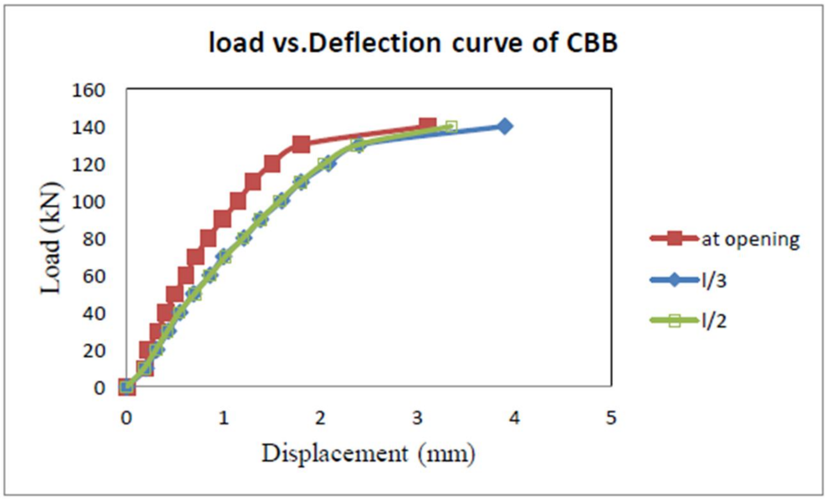


Figure 5.10. Load vs. Deflection Curve for CBB

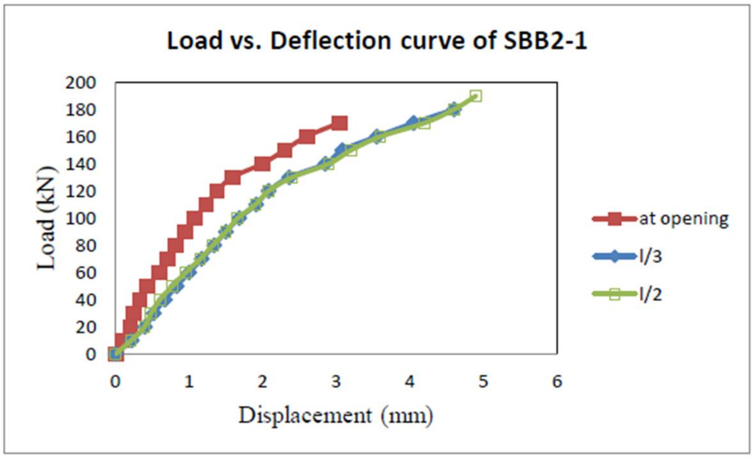


Figure 5.11 . Load vs. Deflection Curve for SBB2-1

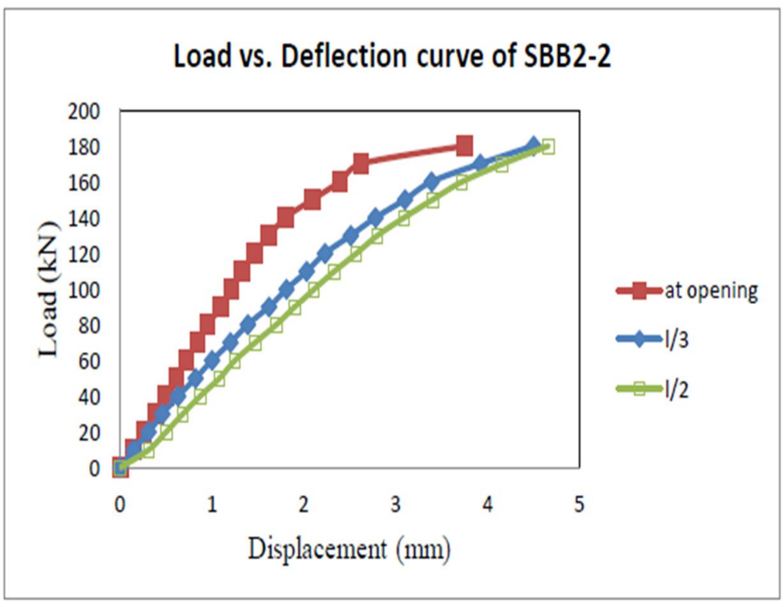


Figure 5.12. Load vs. Deflection Curve for SBB2-2

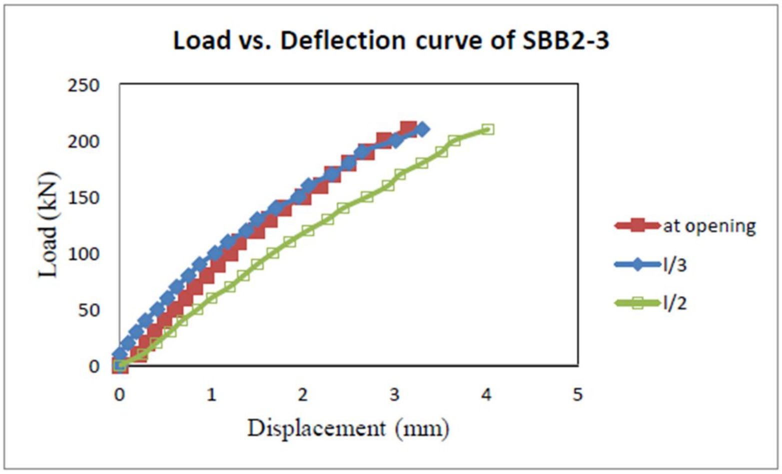


Figure 5.13 Load vs. Deflection Curve for SBB2-3

The diversion profile for the control shaft CBA and pillars SBA2-1 (fortified with two layers persistent U-wrap on opening side), SBA2-2 (reinforced with two layers constant U-wrap on the two sides with spine jetty framework) and SBA4-1 (fortified with four layers nonstop U-wrap on the two sides with rib safe haven framework) are introduced in figure 4-23. From the figure 4-23, it is seen that SBA2-2 and SBA4-1 performs very much contrasted with CBA and SBA2-1. The decrease in mid-range avoidance of the pillar SBA4-1 contrasted with CBA and SBA2-1 are 20.39% and 31.91% individually under the applied heap of 160 KN.

V. CONCLUSION

In this exploratory examination the shear conduct of RC T-pillars fortified by GFRP sheets are considered. The test outcomes represented in the current examination indicated that the outside reinforcing with GFRP composites can be utilized to build the shear limit of RC T-pillars, however the effectiveness shifts relying upon the test factors, for example, fiber directions, wrapping plans, number of layers and harbor conspire.

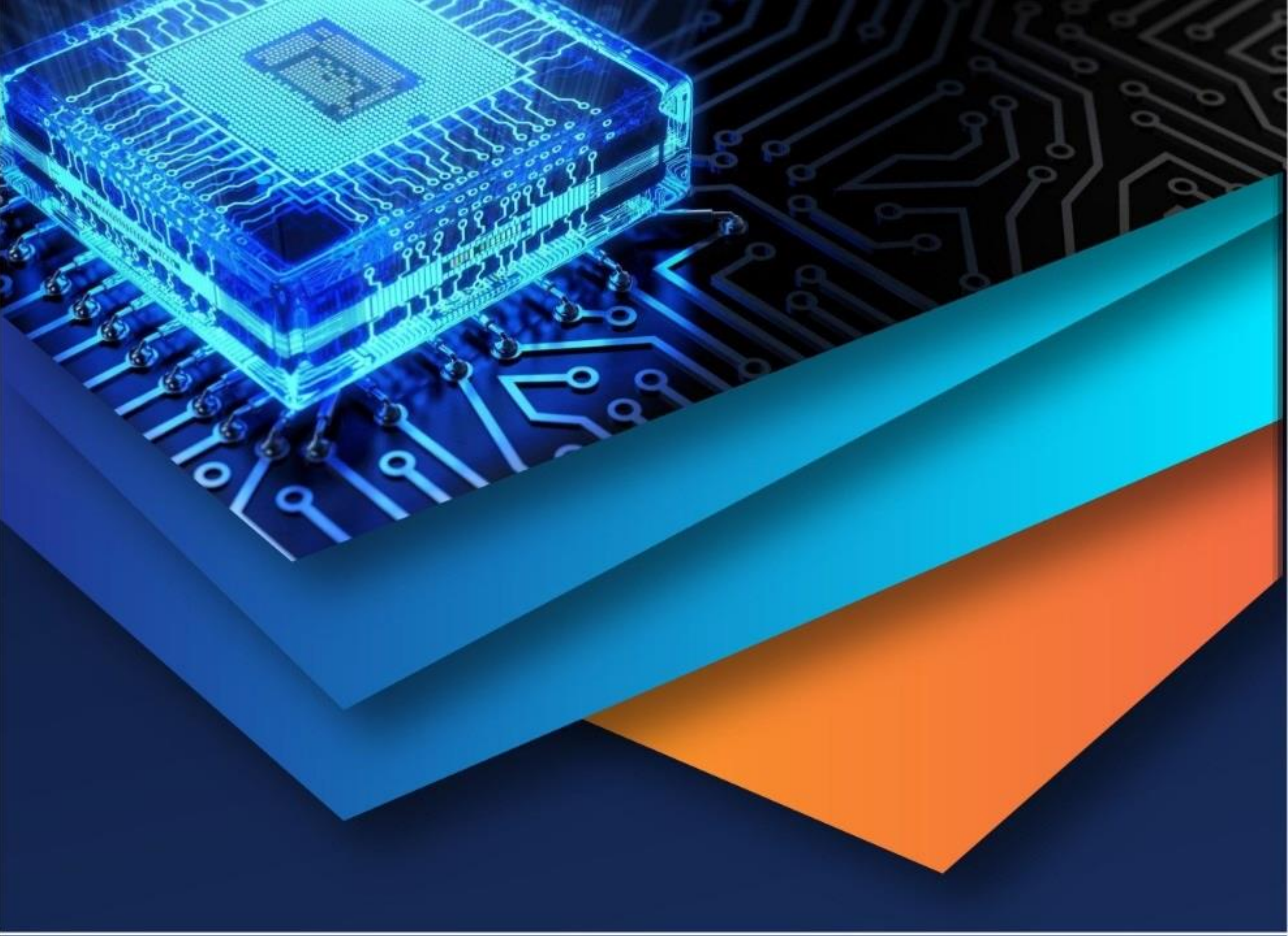
In light of the trial and hypothetical outcomes, the accompanying ends are drawn:

A. The test outcomes affirm that the reinforcing strategy of FRP framework is relevant and can expand the shear limit of T-bars.
B. The test confirmation of the spine port framework shows the adequacy in expanding the shear limit of RC pillars.
C. Existing proof plainly demonstrates that the port framework can make FRP fortifying considerably progressively alluring and efficient for solid fix and reinforcing.
D. The test outcomes demonstrates that the commitment of GFRP benefits the shear ability to a more noteworthy degree for bars without steel shear support than for shafts with satisfactory steel shear fortification.
E. The commitment of remotely fortified GFRP support to the shear limit is affected by the shear length to-profundity proportion (a/d) and it increments with a lessening in a/d proportion.
F. The utilization of harbor framework wipes out the deboning of the GFRP sheet, and thusly brings about a superior use of the full limit of the GFRP sheet.

REFERENCE

[1] Saira P.N “Experimental Study of Retrofitted RC Beams Using FRP” International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163 Issue 09, Volume 4 (September 2017)
[2] SAMER BARAKAT “Shear Strengthening Reinforced Concrete Beams with Externally bonded Fiber-Reinforced Polymer: Updated Data Base” International Journal of Theoretical and Applied Mechanics http://www.iaras.org/iaras/journals/ijtam Volume 1, 2016
[3] Md Ashraful Alam “Design Guideline for Shear Strengthening of Reinforced Concrete Beam Using CFRP Strip to Eliminate Deboning Failure” Indian Journal of Science and Technology, Vol. 10(37), DOI: 10.17485/IJST/2017/v10i37/116283, October 2017 ISSN (Print) : 0974-6846 ISSN (Online) : 0974-5645
[4] Rui Guo “Experimental Study on Shear Strengthening of RC Beams with an FRP Grid-PCM Reinforcement Layer” applied Sciences 2019, 9, 2984; www.mdpi.com/journal/applsci
[5] Kamal G.Sharobim “Strengthening of RC Beams Exposed To Shear And Flexure Stresses by Different Methods” IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 21, Issue 3, Ser. II (May - June 2019), PP 06-16 www.iosrjournals.org

[6] Sivagandan. M "Experimental Investigation on the Study of RC-T Beam with Opening Strengthened with GFRP" International Journal of Engineering Science and Computing, October 2017
[7] Sainath B Tole "Experimental Study on Shear Behavior of FRP Retrofitted T-Beams" International Journal of Engineering Science and Computing, November 2016
[8] P. Vijaya Kumar "Strengthening of Shear Deficient Beams Using GFRP" International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-7, Issue-6C2, April 2019
[9] El-Samny M.K. "Experimental and Analytical Study of Strengthening Reinforced Concrete Beams with Openings" International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 7 (2018) pp. 4934-4950 © Research India Publications. http://www.ripublication.com
[10] T. P. Meikandaan "Experimental Study on Strengthening Of RC Beams Using Glass Fiber" International Journal of Civil Engineering and Technology (IJCIET) Volume 9, Issue 11, November 2018
[11] Aadil Mansuri "Behaviour of Strengthened RC Beams in Shear "International Journal of Engineering Development and Research2017 IJEDR | Volume 5, Issue 2 | ISSN: 2321-9939Haya
[12] H. Mhanna "Shear Strengthening of Reinforced Concrete Beams Using CFRP Wraps" ICSI 2019 the 3rd International Conference on Structural Integrity Procardia Structural Integrity 17 (2019) 214–221 Science Direct



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