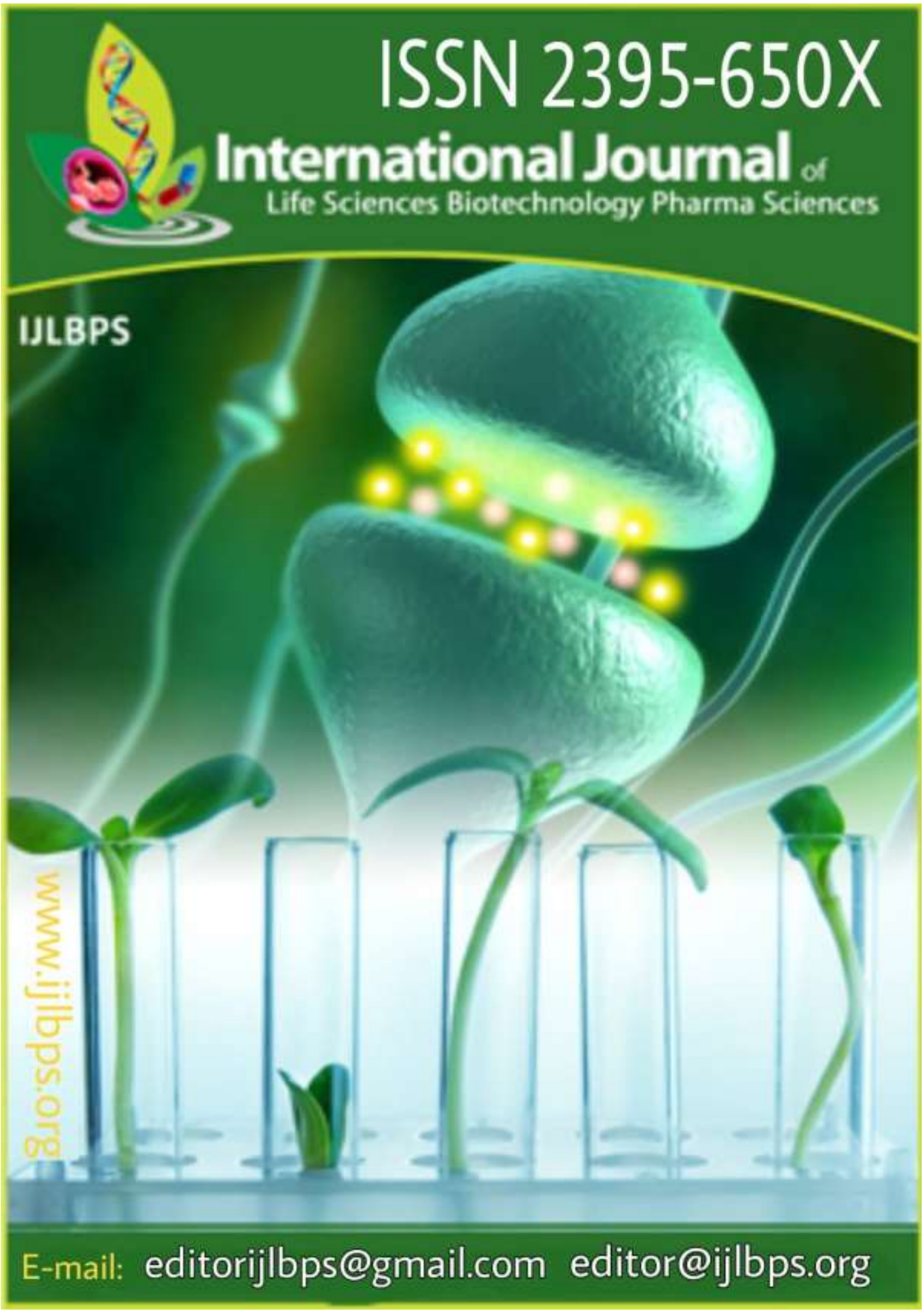
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# STUDY ON TORSIONAL BEHAVIOR OF RC T- BEAMS STRENGTHENED WITH GLASS FRP

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**Abstract:**
There are a number of factors that need the repair or rehabilitation of existing structures, such as increased loads, deterioration due to age or faulty building materials and craftsmanship, or possibly seismic retrofitting. T-beams are comparable to rectangular beams in terms of torsion analysis and design, except that the influence of concrete on the flange is not taken into account. The flange widths of controlled beams were adjusted in order to examine the effect of flange width on torsion resistance. Two more variables being investigated are the orientation of the fibers and the configurations of the strengthening. In trials, GFRP-strengthened beams are compared to control beams that have not been strengthened. According to the study, the torsional behavior of all the GFRP-enhanced T-beams examined was significantly improved. In a test, reinforced GFRP reinforcement shafts are put up against unfortified controls. According to the study, the GFRP reinforcements of the T-bars appear to have undergone a drastic change in tensional behavior or have fallen. In this study, we also take a closer look at fiber arrangements and orientations.

**Keywords:**These qualities include GFRP, T-beam, torsional strength, and shear flow. GFRP.

## 1.0Introduction

Strengthening is facilitated by reducing the amount of glass fiber used in these polymercomposites.

Resistance from crew members in addition to force's size Post-tensioning and additional supports are among the procedures utilized to strengthen the structure. Methods like section expansion can be used as well. In this study, the use of externally bonded reinforcement boosted both strength and serviceability. In the durability testing of glass fiber reinforced polymers, GFRC moderate deep beam5 and GFRC moderate deep beam6 are used. According to the researchers, glass fiber was added to fairly deep beams without stirrups in order to increase strength, shear stress, and ductility. When it comes to construction, concrete is an excellent choice because of its high compressive strength but low tensile strength. Reinforcing bars can be used to boost a material's tensile strength. Fibers can improve concrete's tensile strength and ductility by increasing its homogeneity and consistency. Steel, glass, carbon, and hemp are just a few of the many fibers that can be used into concrete. Fiber reinforced polymer composite materials have shown to be an effective alternative in the construction of new structures and the restoration of old ones. Repair using externally bonded FRP reinforcement is a very helpful strengthening technique because of how simple and quick it is to install.Glassfiber:

GRP is an industrial term that denotes one ofthecompositematerials,whichiscalledGlass fiber-reinforced polymers. GRPs can be used to control corrosion in oil fields, ships, chemical factories, and other industrial facilities. Because of their superior performance, fiber-glass reinforced thermosetting polymers have overtaken metallic materials in corrosive applications.

Figure:Glass fiber

GlassFiberReinforcedConcrete:

GFRC products can be made with a variety of glass fibers, each of which has a specific function. The glass fiber used in GFRC must be resistant to alkali in order to keep it from degrading. Glass strands are commonly used for reinforcing components like veneer plates and other exterior claddings.

Fiberformation:

Glass fiber is made by extruding silica-based or other formulation glass into fibers of a small diameter suitable for textile processing. Despite the fact that the method of heating and drawing glass into thin threads has been around for millennia, textile applications for these fibers are a comparatively recent invention.

Limitations:

•It increases the tensile strength of theconcrete.

•Toexaminethepropertiesofexternallywrappedconcretestructures under static and dynamicload.

**•Itincreasesthedurabilityoftheconcrete.**

**AdvantagesofFRP:**

There are no seams or voids in this material. • The material is capable of absorbing concrete's surface imperfections. • Steel plate would need to be pre-bent to the necessary radius in order for the material to follow the curve profile.

**DisadvantagesofFRP:**

• The risk of fire, vandalism, or accidental damage is the biggest downside of using fiber composite materials to enhance structures externally.

• The potential of soffit reinforcement being hit by above-height vehicles is a particular concern for bridges over roadways.

2.0Literaturereview

S.AlAraimiandR.A.Siddiqui[1]GlassFiber reinforced plastic composites are commonly used in the construction of swimming pools, oil pipelines, and storage tanks because of their strong corrosion resistance. Researchers in the Sultanate of Oman studied the effects of weathering on the mechanical properties of GRP in the region. The tensile and three-point bend specimens were exposed to the open atmosphere for varying lengths of time under direct sunlight (open atmosphere).

SudeepDeshpandeetal.[2]on hybrid fiber-reinforced polymer, bone and coconut powder were tested for their filler effects (HFRP). E-glass fiber, jute fiber, and epoxy resin are used to manufacture HFRP. The volume fractions of coconut and bone powder were evaluated at 0%, 10%, 15%, and 20%, respectively. In order to measure mechanical properties such ultimate tensile strength, flexural strength, inter-laminar shear strength, tensile modulus, impact strength, and hardness, the composites were built by hand using a layup technique.

andcomparedwithunfilledHFRPcomposites.

PritishShubham et al. [3] - The effects of varying ash amounts and changing fly ash particle surfaces were investigated using aminopropyletriethoxy silage coupling agent. This resulted in better thermal stability and damping capabilities, however silane alteration of the surface led in a decrease in these properties. Salinization increases strength as compared to fly ash at the same concentration.

K Devendra et al. [4] investigated the mechanical properties of E-glass fiber reinforced epoxy composites with different amounts of fly ash, aluminum oxide, magnesium hydroxide, and hematite powder. A study was done to see how various fillers affected tensile strength, hardness and impact strength. The greatest ultimate tensile strength of the composite with 10% magnesium hydroxide filling was found to be 375.36 Mpa in the tests.3.0Methodology

On the basis of these investigations, it can be concluded that Glass Fiber Reinforced Polymer Composites can either reduce or increase a member's resistance to external forces. There are a number of ways to increase the section's strength and serviceability: external bonded reinforcement, post-tensioning work, and auxiliary supports. In Carried out inquiry on Glass Fiber Reinforced Concrete Moderate Deep Beam, the durability tests of glass fiber reinforced polymers are reported. Finally, they found that the addition of glass fiber considerably increased the shear stress and ductility of the reinforced intermediate deep beam without stirrups.. In this research, plain concrete was compared toConcrete of M30 grade acquired great strength by employing glass fiber of two lengths (6 &1 2mm). Compression, split tensile, and other tests flexural strength test) is to be done on theconcrete with the addition of glass fibers ofvariouspercentages(0.25%,0.50%,and0.75%) tototal weight ofthe concrete.

**Materials:**

Concreteisaconstructionmaterialcomposedofportlandcementandwatercombined with sand, gravel, crushed stone,or other inert material such as expanded slagor vermiculite. The cement and water form apastewhichhardensbychemicalreactionintoastrong,stone-likemass.

ReinforcementMaterials (GlassFibers):Fiber is often a long, thin filament with a diameter somewhere between 10 tm and 100 tm. The length-to-diameter ratio can be anywhere from a thousand to an infinite number. The fibers in the FRP are responsible for carrying the load and providing structural features like as strength, thermal stability, stiffness, and more. There are other mats, thin sheets of glass fiber, available. An arrangement of both long and short fibers (for example, those between 25 and 50 millimeters in length) in random order, with the fibers being bound together. The density of these mats is about 0.5 kg/m2 and their breadth ranges from 5 cm

Figure:Glassfibers

Medium high performance composites can be made by using these fibers in the naval and industrial sectors. Their distinguishing feature is that they have a lot of power.

Cement:

Regular Portland cement 53 grade was used to build the experimental programmer. The equipment's physical characteristics were assessed in accordance with IS standards.

**GlassFibers:**

Glass fiber, sometimes known as fiberglass, is made from a very fine glass fiber. Thick, light, and highly durable describe this piece of gear. Glass fibers are the most popular synthetic material since they are chemically inert and water-resistant. Fine fibrils of rectangular cross-section are formed from continuous cylindrical monofilaments that can be sliced to predefined lengths or cut as films and tape. At least 0.1% by volume, glass fibers in concrete can prevent plastic shrinkage and subsidence cracking.

**SpecimenPreparation:**

There were no differences in the dimensions of the specimens. During the casting process, a vibrating table was employed to aid in the consolidation of the concrete. Specimens were demoded for a single day before being preserved in lime-saturated water. The beams were taken out of the curing tank after 28 days and allowed to air dry in the laboratory, as is standard procedure there. A minimum of one week of drying time was required before any testing, surface preparation, or spraying could begin. Using externally bonded FRP demands a thorough preparation of the surface to be reinforced. All of these conditions must be met: the surface must be dry and clear of grease, debris, and loose items.

**ControlBeamswithNoGFRP:**

Without the GFRP covering, six beams were subjected to quasi-static loading. The data presented here will serve as a basis for future comparisons and will be kept on file for future use. GFRP and stirrups were not used in the testing of one beam (beam C-NS). This beam showed a typical shear failure with a 45° crack.

Figure: Surface preparation usingpneumaticconcretechisel.

The beam was left in the laboratory for a few days before applying the Sprayed GFRP to ensure that the surface was entirely dry. (2) A pneumatic concrete chisel was used to roughen the concrete surface. Sandblasting, on the other hand, left a smoother finish.

**ExperimentalSet-upforTestingofBeams:**

A four-point static loading system is used to test each beam specimen at the Structural Engineering Laboratory of the Department of Civil Engineering, NIT Rourkela. For both series, control beams of the 28-day curing period are evaluated by gradually increasing the load until they fail. In the same way, following a 28-day curing time, reinforced beams are strengthened by gluing BFRP fabrics to the concrete surface, which is then allowed to cure for a minimum of three days before being tested with increasing loads until failure occurs. Detailed information about the test setup is depicted in Figure. A 500kN load cell with a hydraulic jack is utilized to measure the load during testing. The four-point static loading system is shown in this diagram. Steel rollers mounted on steel plates bedded in cement place the spreader beam above the test specimen, resulting in a flat, level surface.

**Figure: Experimental Setup of the ControlBeamR1C**

**Figure:backpatternatface-1**

**TestProcedure:**

The substance will decompose as a result of weathering, which includes moisture, temperature, UV radiation, and other factors. The quality of the fiber-matrix interface determines the mechanical properties of a composite. We put the regular GRP samples through their paces after they'd been out in the elements for a while. Following exposure to the natural environment, the tensile strength of GRP (MPa =145 psi) was evaluated, and the average findings were plotted as follows: When GRP was exposed to longer periods of time, its tensile strength gradually decreased. The beams selected the following images:

**StrengtheningofBeams:**

The concrete surface was roughened and cleaned with an air blower to achieve a firm bond between the composite fabric and the concrete. Following manufacturer's directions, the epoxy resin was mixed and applied to the desired surface. In order to mix the materials, a plastic container was employed. When this was done, the epoxy glue was applied to the concrete surface, and the cloth was cut to fit.

RESULTSThePlastics, rubber, paints, and lacquers are all degraded in the sun by the same free radical action. GRP exposure in a natural environment has showed similar benefits over a long period of time. In the course of normal use and exposure to the elements, the material will weaken and eventually disintegrate. Fibers, for example, are a component. The quality of the fiber-matrix contact is what determines a product's performance. composite's mechanical properties. Following exposure to the elements, the typical GRP samples were tested. The GRP tensile strength (MPa =145 psi) was tested following exposure to the natural environment, and the average results were displayed as shown in the graph: GRP's tensile strength degraded with time in an interesting manner. Among the figures selected by the beams were the following.

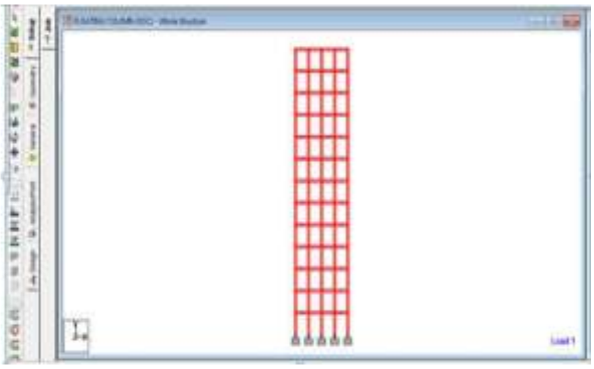


**Figure: Whole structure of the concretebuilding**

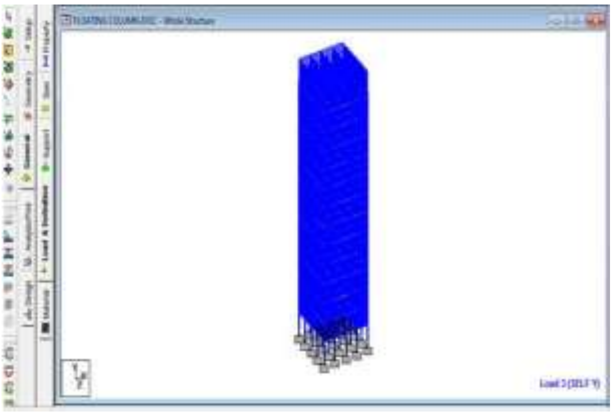


**Figure: shows Dead load acting onbuilding**

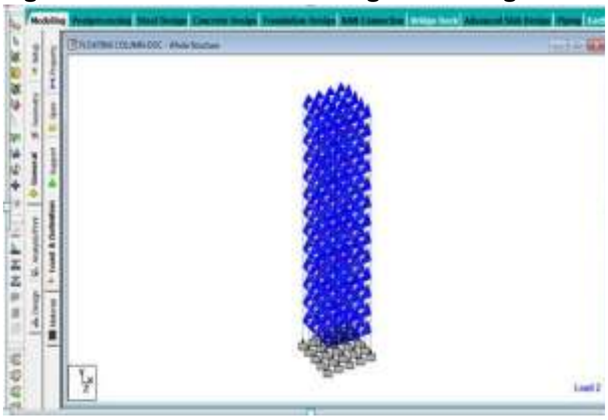
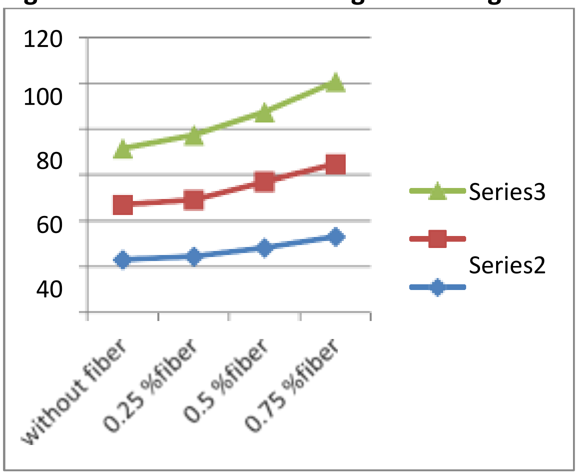


**Figure: shows Live load acting onbuilding**




Graph: Compressive strength of concrete

Splittensilestrengthofconcrete:

Plain concrete prisms with dimensions of 500 mm x 100 mm x 100 mm were cast using M30 grade concrete. Various percentages of conventional concrete and glass fiber concrete were incorporated into the samples. A 24-hour cure in the mold was followed by a few days in water to cure the samples. After drying, the specimens' flexural strength was tested..

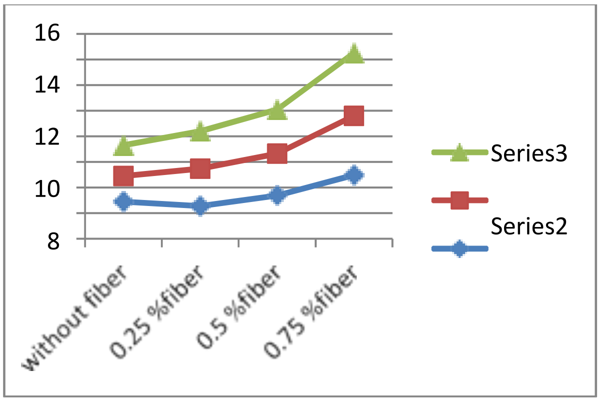
**Flexuralstrengthtest:**

Plain concrete prisms with dimensions of 500 mm x 100 mm x 100 mm were cast using M30 grade concrete. Various percentages of conventional concrete and glass fiber concrete were incorporated into the samples. A 24-hour cure in the mold was followed by a few days in water to cure the samples. After drying, the specimens' flexural strength was tested.

There are various instances in which a beam is subjected to flexure, notably in the event of tension. Flexural strength, or modulus of rupture, is a term used to describe this property

**Figure:Flexuralstrengthtest**

Plain concrete prisms with dimensions of 500 mm x 100 mm x 100 mm were cast using M30 grade




concrete. Various percentages of conventional concrete and glass fiber concrete were incorporated into the samples. A 24-hour cure in the mold was followed by a few days in water to cure the samples. After drying, the specimens' flexural strength was tested.

Graph: Flexural strength of concreteResearchers are looking into the behavior of concrete's seven, 14 and 28-day tensile strengths, as well as its maximum nominal aggregate size of 20 millimeters (mm). On this day, the three values of compressive (tensile/flexural) as well as the three values of tensile were plotted, and an overall improvement in strength was seen with fiber addition (compressive). It's easy to observe how things are moving forward.

an increase in strength as fiber content is increased The maximum effective concentration is 0.5 percent. We can detect a 0.25 percent decrease in initial strength and a rise in overall strength as the fraction of fibers increases. Maximum strength is attained with a 0.75% dilution. It is possible to get optimum strength with a single fiber by using just 1 percent of the material. It is easy to see the gradual increase in strength as the percentage of fiber increases. The magic strength level is 0.75 percent. The magic power level is set at 0.75 percent. At 1% strength, a single fiber adds maximal strength, whereas numerous fibers are required for this.

**Conclusion**

Researchers found that when two lengths and characteristics were incorporated into a concrete mix, it produced the following results. The compressive strength of concrete increases with an addition of glass fibers of 0.50 percent by weight, whereas the compressive strength decreases with each additional glass fiber ( it is been evaluated by studying research paper and journals on this addition). Split tensile strength of material concrete is superior to that of plain concrete. 0.5 to 0.75 percent more flexural strength than regular concrete can be achieved by using material concrete. As an external reinforcement for T-shaped RC beams, the use of BFRP composites can considerably enhance their shear capacity. In

It is under higher stresses that the strengthened beams begin to crack than do the control beams. Premature failure is more likely to occur when BFRP composites are just linked to webs. The shear strength of the BFRP sheet-strengthened beam is higher than the shear strength of the BFRP strip-strengthened beam. Reinforcement of beams using U-wraps configurationisfoundtobemoreeffectivethanth eside-wrapconfiguration.

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