IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Review Study On Hybrid Jute–Glass Fiber Reinforced Composites Material For Improve Strength And Sustainability

B S Seema[1], Assistant Professor

Y M Vijayakumar[2], Professor

Vinay Hiremath[3] PG Scholar

ABSTRACT

This research looks at how well a new type of composite material works. It is made by combining natural jute fibers with strongglass fibers. The goal is to create a material that is both strong and environmentally friendly. Different ways of mixing the fibers and treating them with heat and radiation were tested. The results showed that the material became stronger, could bend better, resisted impacts more, and did not soak up much water or crack easily. The best results came fromsamples that had glass fibers on the outside. In the end, this mix of jute and glass fibers is a good, low-cost option for making strong and lightweight building materials.

Keywords: NaturalJuteFibers Glass Fibers Hybridcomposite Construction Durability Strength

Introduction

Today, there is a need for materials that are both strong and good for the environment. Jute fiber, which comes from plants, is low-cost, light, and eco-friendly. But on its own, jute is not very strong and doesn't resist water well. Glass fiber, which is man-made, is very strong and doesn't absorb water. When jute and glass fibers are mixed together, they forma new material that is both strong and long-lasting. Studies show that this hybrid material works better than using just jute or glass alone. It is stronger, lasts longer, and resists damage better. These materials have been tested in things like concrete and plastic mixes, and they help reduce cracks and improve strength. Experts also found that heating or using radiation on these materials can make them even better. In short, combining jute and glass fibers is a smart and eco-friendly way to make better materials for buildings, vehicles, and more.

LiteratureReview

1. S.H. Mahmud et al., (2025) this study looks at how mixing jute (a natural fiber) and glass (a man- made fiber) can make stronger and longer-lastingmaterials. Different ways of layeringthejute and glass fibers were tested, and gamma radiation was used to improve the materials even more. The results showed big improvements: strength when pulling (tensile strength) increased by 7–56%, bending strength by 5–53%, and impact strength by 199–387% compared to materials made with only jute. After using gamma radiation, the strength improved even more — tensile strength went up by 15–69%, and bending strength by 11–65%. Because glass fibers

don't absorb water, water resistance also got better. The best results came from materials with glass fibers on the outside layers. Overall, this method offers a smart and eco-friendly way to make stronger and longer-lasting building materials.

2. Akash Gupta et al., (2024)this study focuses on how well jute–glass fiber composites perform when mixed with polyester resin. The materials were made using both natural jute fiber and man- made glass fiber. Tests and computer simulations (called Finite Element Analysis or FEA) showed that adding glass fiber to jute fiber made the material much stronger. Out of all the combinations tested, one mix (called S2) had the best results: Highest tensile (pulling) strength: 259 MPa, Highest bending strength: 155.07 MPa, Highest shear (cutting force) strength: 84.76 MPa. The stiffness of the material, called Young's modulus, was highest in the glass fiber/polyester mix (S1) at 6.44 GPa, and lowest in the jute fiber/polyester mix (S5) at 3.86 GPa. The test results matched well with the computer model results, combining jute and glass fibers makes the material stronger and longer-lasting. This makes it a good choice for making car parts and other lightweightproducts.
3. Md. Mahadi Hasan at el., (2024) they carried out, Mixing natural and synthetic fibers in hybrid composites improves both their strength and physical properties. This makes them a strong and useful material. When glass fibers and woven jute were used on the outer layers, the composite showedbetterimpactresistance—upto378kJ/m²—andhadhigherstiffness(Young'sandbending strength), over 10 GPa. These hybrid materials also swelled less when exposed to moisture—only about 5.7% and 3.1%—showing better water resistance. This shows how the way fibers are placed and shaped matters a lot. Under the microscope, the material showed cracks in the resin (matrix) before the fibers broke. This means the fibers were strong enough to carry most of the load. By combining synthetic and natural fibers, the result is a material that is lightweight but still strong, and a good alternative to traditional materials like wood or plastic. Overall, the smart choice and arrangement of fibers help create materials with properties that can be adjusted for different engineering-uses.

4. Luciana P. Maciel, et al., (2024) this study looks at how to strengthen reinforced concrete (RC) beams using jute, glass, and a mix of jute–glass fiber-reinforced polymers (FRPs). Seven beams were tested using U-shaped fiber wraps on the outside. These included regular beams (control), synthetic fibers (like CFRP and GFRP), natural fibers (JFRP), and hybrid (jute–glass) fibers. The hybrid jute–glass fiber performed well in resisting shear forces, nearly as good as the synthetic ones. The results showed smaller cracks, better load-carrying ability, and more control over how much the material stretches (strain). Even jute fiber alone (JFRP) showed good results. Thefindings followed international guidelines (ACI 440.2R and fib Bulletin 90), matching well with theory. Overall, this study shows that hybrid FRPs are a strong and eco-friendly option for strengthening concrete beams.
5. Raushan Kumar, et al. (2024) this study found that replacing some cement with silica fume (up to 15%) improves concrete's strength and resistance to wear. The best results came when 10% of the cement was replaced with silica fume. This worked well for concrete made with both natural and recycled aggregates. To make the concrete even more durable, 2% glass fibers (by volume) were added. After 28 days, the concrete with both silica fume and glass fibers showed better strengthand resistance to surface wear. The study also found that flexural strength (bending strength) is a better way to measure wear resistance than compressive strength. This was shown by a strong link ($R^2 = 0.8534$) between flexural strength and abrasion resistance. In short, adding silica fume and glass fibers makes concrete stronger and more resistant to damage from wear.
6. LysaBenaddache, et al., (2024) this study looks at using jute fabric with epoxy to strengthen concretebeams,asagreenerandcheaperalternativetosyntheticfiber-reinforcedpolymers(FRPs). Researchers tested 30 concrete beams that were already cracked. They changed the number of jute fabriclayers(1to 3),usedheattreatment,andtrieddifferent waysof applyingthefabric(bottomor U-shape). They also compared jute to glass fibers. The results showed that heat-treated jute fabric, especially with 2 or 3 layers, made the beams 85–120% stronger than those with no reinforcement. Heatingthejuteimproved howwell it bonded withthe

epoxy, makingthe beams stronger. Overall, jute composites performed almost as well as glass FRP but cost less and are better for the environment. This shows that jute is a good, eco-friendly choice for strengthening concrete structures.

7. Muhammad Basit Khan, at el., (2023) this study looks at using jute fiber (JF) in concrete to make it stronger and more eco-friendly. Jute fiber was added in amounts of 0%, 0.10%, 0.25%, 0.50%, and 0.75% by weight. The concrete was tested in both fresh form (slump test) and hardened form (checking compressive, tensile, and flexural strength), along with water absorption for durability. The best results came with 0.10% jute fiber. At this level, compressive strength increased by 6.77%, split tensile strength by 6.91%, and flexural strength by 9.63%. Compared to other fibers, jute fiber also lowered the carbon footprint and improved the eco-efficiency of the concrete. A model usingResponse Surface Methodology(RSM) was also created to help predict howjute fiber will affect concrete in the future. Overall, adding jute fiber is a smart and sustainable way to make concrete stronger and more environmentally friendly.
8. S. M. Asaduzzaman and G. M. Sadiqul Islam (2023) this study looks at how jute fiber—a natural and low-cost material found in large amounts in Bangladesh—can make concrete stronger and more crack-resistant. To improve the results, jute fibers were treated with an alkali solution and used in two lengths: 20 mm (J20) and 25 mm (J25), in small amounts (0.1% to 0.4% by volume). The results showed a 25% increase in tensile strength (resistance to pulling) and up to 7% increase in compressive strength. Most importantly, jute fiber helped reduce cracking caused by drying. It reduced the crack area by 61% and the crack width by 62% under controlled tests. These results show that jute fiber is a low-cost, especially in dry or hot climates where cracking is common.
9. G. M. Sadiqul Islam and S. M. Asaduzzaman (2023) this study explores how adding jute fiber to concrete can make it more flexible and resistant to cracking. Jute fibers (20 mm and 25 mm long) were added in small amounts (0.1% to 0.4% by volume). To improve bonding with the concrete, the fibers were treated with an alkali solution. The results showed that splitting tensile strength increased by 25% and compressive strength improved by 7%. Most importantly, jute fibers greatly reduced early-age cracking caused by drying. They reduced maximum crack width by 62% and total crack area by 61%. This proves that jute is a good natural fiber for improving concrete, especially in hot and dry areas. With further improvements, jute fiber could be even more useful in structural construction.
10. Pooja P. Waghmare et al.,(2022) This study looked at how adding glass and jute fibers affects concrete strength. The best Compressive strength was seen when 0.75% glass fiber was added, while 0.5% jute fiber gave the best strength improvement fromjute. However, using too much jute fiber reduced the strength because it absorbs water. When 5% jute fiber and 5% glass fiber were used together, the concrete's overall strength improved. Glass fiber especially helped increase flexural (bending) strength, with 0.75% being the best amount. Jute fiber is natural and eco- friendly. It helps increase strength but doesn't work as well in high amounts because it soaks up water. The study found that using both fibers in the right amounts makes concrete stronger and supports sustainable building by using waste materials.
11. Jawad Ahmad ET AL.,(2022) This review looks at using jute fibers (JTF) as a low-cost and eco- friendly way to make concrete stronger. Jute fibers help improve the strength and durability of concrete, similar to synthetic fibers. However, they can reduce the workability (flow or ease of mixing) of concrete, which can make it harder to use. The best amount of jute fiber is usually 1%to 2%, depending on the fiber's size. Using too much jute fiber can hurt performance because the mix becomes harder to workwith andthefibersdon't spread evenly.Thereisn'tmuch research yet on how jute fiber concrete performs over a long time. The study highlights the need for more research to find the best ways to use jute fiber for better concrete performance.
12. N. Sultana,et al. (2022) This study looks at how natural jute fiber can improve the strength of Jute Fiber Reinforced Concrete Composites (JFRCC). To find the best mix, researchers used two tools: Response Surface Methodology (RSM) and the Crow Search Algorithm (CSA). They tested different fiber lengths, fiber

amounts, and water-to-cement (W/C) ratios using a special planning method called Box-Behnken Design. The best results were found with: 6 mm fiber length, 0.2% fiber volume, 0.55 W/C ratio with this mix, the concrete reached a tensile strength of 3.5 N/mm² and a compressive strength of 35.1 N/mm². When tested in real life, the results were very close— within 5% of the predicted values. This shows the model works well for improving concrete with jute fibers, confirming that jute is a good, sustainable material for making stronger concrete.

13. Hongwei Song et al.,(2021) This study looks at adding jute fibers (JFs) to cement-based materials (cementations composites or CCs) to make them stronger and more eco-friendly. The results show that using jute fibers that are 20 mm or shorter and in amounts up to 0.5% works best. At these levels, the concrete becomes stronger in compression, tension, and bending. The fibers help createa better structure by reducing empty spaces (porosity) and stopping cracks from spreading.
14. However,usingtoomuchjutefibercancauseproblems,likeairgapsandweakerconcrete,because the fibers don't spread well and need more water. Treating the fibers before mixing helps them stickbetterto the concrete.Jutefibers also make the concrete more flexible andless likelyto break suddenly. Although the results are promising, more research is needed to use this method successfully in real-life construction.
15. S Tiwari, at el., (2020) this study looks at using natural jute fiber to strengthen different types of concrete mixes—M25, M30, and M40—by adding 0.5%, 1.0%, and 1.5% fiber. As more jute fiber was added, slump values dropped, meaning the concrete became less workable or harder to pour. When tested in acidic conditions, the concrete showed lower compressive strength compared to normal conditions, meaning it is somewhat affected byacids. Still, addingjute fiber improved both compressive and tensile strength in all mixes, with gains of about 10–15%. The best balance between strength and workability was found at 1% fiber content. In conclusion, jute fiber helps make concrete stronger and more durable, and it's a low-cost, natural option for eco-friendly construction.
16. Babar Ali, et al., (2020) this study compares recycled concrete (RC) with naturalconcrete (NC) to see how adding silica fume and glass fiber can improve their strength and durability. Two types of concrete were made, each with 0.5% glass fiber and different amounts of silica fume (0%, 5%, and 10%). The results showed that using 0.5% glass fiber and 10% silica fume greatly improved the performance of recycled concrete. Glass fiber helped increase flexural strength (bending strength) and split tensile strength (pulling strength). Silica fume improved compressive strength, reduced waterabsorption,andmade theconcrete moreresistanttochloride attack(whichcausescorrosion). The most important finding: adding 0.5% glass fiber made recycled concrete 8–9 times more flexible (tough) than plain natural concrete. This shows that combining glass fiber and silica fume is a great way to make strong, long-lasting, and eco-friendly concrete.
17. Ajmal Paktiawal and MehtabAlam(2020) This review paper looks at how alkali-resistant glass fiber (ARGF) can improve concrete, especially by reducing cracks and improving strength after cracking. Concrete naturally tends to crack and breakeasily, so ARGFis added to make it stronger and more flexible. The study examines how the type, size, and amount of ARGF affect both fresh concrete (like workability) and hardened concrete (like strength, durability, and resistance to earthquakes). The results show that the type and amount of ARGF have a big effect on concrete performance. Also, when ARGF is used together with silica fume, the concrete becomes even tougher, stiffer, and better at carrying heavy loads. In summary, ARGF makes concrete more durable, strong, and long-lasting, especially when used with other materials like silica fume.
18. S. A. Yildizel, et al.,(2018) This study looked at adding waste glass fibers to roller-compacted concrete (RCC) to improve its performance and help the environment. The researchers tested important properties like abrasion resistance, compressive strength, flexural strength, andresistance to freezing and thawing. The results showed that adding 2% waste glass fibers made the concrete much more resistant to wear and scratching. It also made the concrete stronger in compression and bending, which is good for structural use. The concrete also handled freezing and thawing better, showing it is more durable in tough weather. Overall, using waste glass fibers in

RCC is a smart, eco-friendly way to make concrete stronger while recycling industrial waste.

19. J.D.Chaitanyakumar,atel.,(2016) thisstudytestedhowaddingglassfiberstoM20gradeconcrete affects its strength and durability. Glass fibers were added in amounts of 0.5%, 1%, 2%, and 3% of the cement weight. These fibers are known for their high tensile strength and fire resistance. The results showed that adding up to 1% glass fiber improved the concrete's workability and increased its tensile, flexural, and compressive strength. The fibers also helped reduce cracking under different types of loads. However, adding more than 1% did not bring further benefits and even caused performance to drop slightly. So, 1% glass fiber is the best amount for getting strong, workable concrete. This shows that glass fiber is a useful and modern additive for making better- quality concrete in today's construction projects.
20. M. ShrikantHarle (2014) Glass Fiber Reinforced Concrete (GFRC) performs much better than regular concrete. Studies show that after 28 days: Compressive strength increases by 20–25%, Flexural strength increases by about 22%, Split tensile strength increases by around 23%GFRC keeps good workability up to 1% glass fiber. Adding more than that may reduce how easily the concrete can be mixed and poured. Alkali-resistant glass fibers make the concrete more durable over time, especially against acid attacks. GFRCalso controls cracking better and improves overall toughness, making it great for tough construction jobs. Although GFRC costs a bit more at the start, its longer life and higher strength can reduce total costs. Because of these benefits, GFRC is a strong choice for modern, high-performance concrete projects.
21. Komal Chawla and Bharti Tekwani (2013) this study looked at using Cem-fill alkali-resistant glass fibers (14 microns thick, aspect ratio 857) in structural concrete at amounts between 0.33% and 1% by weight. Compared to regular concrete, adding glass fibers greatly improved performance. After 28 days: Flexuralstrength increased by5.19%, Compressive strengthincreased by up to 37%. The concrete also became tougher and more flexible (better ductility), which means it resistedcracksbetter.Unlikesteelfibers,glassfibersdon't trust,sotheyareagoodalternativefor fiber-reinforced concrete. Overall, adding glass fibers helps solve the common problems of regular concrete—low tensile strength and tiny cracks—making it stronger, more durable, and longer- lasting.

Conclusion

After reviewing various journalpapers, it is evidentthat combining jute and glass fibersresultsinsignificant improvementsinstrength,durability,andwaterresistance.Thesehybridcompositeseffectivelymergetheeco- friendly nature of jute with the high performance of glass fibers, making them highly suitable for both structural and non-structural applications. Overall, this combination offers a sustainable, cost-effective, and reliable alternative to traditional construction materials.

Authors information's

1. Seema B S (Corresponding author-1): Working as an Assistant Professor. Department of Civil Engineering, Adichunchanagiri Institute of Technology, Chikkamagaluru affiliated to VTU Belgaum.
2. Dr. Vijaya Kumar Y M (Corresponding author-2): working as an Professor, Department of Civil Engineering, Adichunchanagiri Institute of Technology ,Chikkamagaluru Affiliated to VTU Belgaum
3. VinayHiremath : PG Scholar Department of Civil Engineering Adichunchanagiri Institute of Technology Chikkamagaluru affiliated to VTU Belgaum

Acknowledgement

We are Thank full to our beloved Principal and management of AIT Chikkamagaluru for support extended throughout the work. Ialso thank all thosewho directly or indirectly assisted in the successful completion of paper.

Appendix

Author contribution: All authors reviewed the manuscript

Funding: the authors have not disclosed any funding.

Data availability: Not applicable

Declarations the authors declare no competing interests.

References

[1] S.H.Mahmud,S.C.Das,A.Saha,T.Islam,D.Paul,M.W.M.Akram.S.M.Jahan.Z.I.M.Mollah A. R., Gafur, and A.Khan (2025).Effects of radiation treatment and glass fiber hybridization on the performance of sustainable natural fiber-based hybrid (jute/glass) composites. Published by Elsevier Ltd. https://doi.org/10.1016/j.nxsust.2025.100104,January 2025.

[2] Akash Gupta, Shad Mohammad Shohel, Manjeet Singh, and Jasminder Singh Study on mechanical properties of natural fiber (Jute)/synthetic fiber(Glass) reinforced polymer hybrid composite by representative volume element using finite element analysis: A numerical approach and validated by experiment. Published by Elsevier B.V. July 2024, https://doi.org/10.1016/j.hybadv.2024.100239

[3] MdMahadiHasan ,MdAshraful Islam, Tareq Hassan (2024) Analysis of jute-glass fiber reinforced epoxy hybrid compositehttps://doi.org/10.1016/j.heliyon.2024.e40924, 4 December 2024 Published by Elsevier Ltd.

[4] L.P. Maciel,LeãoJúnior, P.S.B, M.J.M. Pereira Filho, W.R. El Banna, R.T. Fujiyama, M.P. Ferreira, Lima Neto, A.F.Experimental Analysis of Shear-Strengthened RC Beams with Jute and Jute–Glass Hybrid FRPs Using the EBR Technique. Buildings 2024, 14, 2893. Published on September 12, 2024. https://doi.org/10.3390/buildings14092893

[5] R. Kumar, L. Gupta, A. Kumar, and others Concrete made of glass fiber and silica fume is resistant to abrasion. Multiscale and Multidiscip.Model.Both exp. and dep. 7, 5149–5169, https://doi.org/10.1007/s41939-024-00512-5, 2024

[6] Benaddache, L., Belkadi, A.A., Kessal, O. et al.A comparison of glass fiber reinforcement and externally bonded heat-treated jute for the repair of pre-cracked high performance concrete beams. https://doi.org/10.1007/s43452-024-00899-5Archiv.Civ.Mech.Eng 24, 82 (2024).

[7] Khan, M.B. ; N. Shafiq ; A. Waqar ; Radu, D. ; C. Cismaș ; Imran, M. ; H. Almujibah ; O. Benjeddou Environmental Assessment of the Effects of Jute Fiber on the Fresh and Hardened Characteristics of Concrete. https://doi.org/10.3390/buildings13071691Buildings 2023, 13

[8] S.M.Asaduzzaman& G.M.Sadiqul Islam (2023) Using Jute Fiber to Improve Fresh and Hardened Properties of Concrete, Journal of Natural Fibers, 20:2, 2204452, DOI: 10.1080/15440478.2023.2204452, https://doi.org/10.1080/15440478.2023.2204452

[9] G.M.Sadiqul Islam & S.M.Asaduzzaman (2023) Using Jute Fiber to Improve Concrete's Fresh and Hardened Properties, Journal of Natural Fibers, 20:2, doi: 10.1080/15440478.2023.2204452, https://doi.org/10.1080/15440478.2023.2204452

[10] Pooja P.Waghmare, Dr.S.G.Makarande and Professor R.K.Kakpure in 2022 Experimental investigation into the effects of adding glass and jute fibers to concrete on its properties. InternationalJournal of Advanced Research in Science, Communication and Technology (IJARSCT) Volume 2, Issue 2, April 2022.

[11] Jawad Ahmad, Mohamed MoafakArbili, Ali Majdi, FadiAlthoey, Ahmed Farouk Deifalla, and Cut Rahmawati are the individuals in question. Performance of concrete reinforced with jute fibers (natural fibers) Journal of Engineered Fibers and Fabrics Volume 17: 1–17 © The Author(s) 2022 DOI:10.1177/15589250221121871 journals.sagepub.com/home/jef

[12] N.Sultana,S.M.ZakirHossain,Md Shah Alam,M.M.A.Hashish,M.S.Islam(2020). An experimental investigation and modeling approach of response surface methodology coupled with crow search algorithm for optimizing the properties of jute fiber reinforced concrete https://doi.org/10.1016/j.conbuildmat.2020.118216 0950-0618/ 2020 Elsevier Ltd.

[13] A comprehensive overview of jute fiber reinforced cementitious composites https://doi.org/10.1016/j.cscm. 2021.e00724 published by Elsevier Ltd. on October 4, 2021, by Hongwei Song, Jing Liu, Kaiyu He, and Waqas Ahmad 2214-5095/© 2021 The Author(s).

[14] S Tiwari, R P Pathak, and A K Sahu Study of Jute Fiber Reinforced Concrete's Mechanical Properties and Durability https://iopscience.iop.org/article/10.1088/1757-899X/961/1/012009IOP Conf. Ser.: Mater. Sci.

[15] Babar Ali, Hisham Hafez, RawazKurda, Hawreen Ahmed, Liaqat Ali Qureshi, Hussein Mohammed and Ali Raza Enhancing the Hardened Properties of Recycled Concrete (RC) by combining the efforts of Fiber Reinforcement and Silica Fume, due out on September 16, 2020 Materials 2020, 13, 4112 (www.mdpi.com``/journal/materials); doi:10.3390/ma13184112

[16] AjmalPaktiawal, MehtabAlam(2020). A Review of Experiments on the Effect of Alkali Resistant Glass Fiber on Cement Concrete Performance The July 2020 issue of theInternational Journal of Recent Technology and Engineering (IJRTE) (online),ISSN: 2277-3878

[17] S.A.Yildizel, O.Timur, and A.U.Ozturk (2018) Abrasion resistance and mechanical properties of waste-glass-fiber-reinforced rollercompacted concrete DOI 10.1007/s11029-018-9736-6 Mechanics of Composite Materials, Vol.54, No.2, May, 2018 (Russian Original Vol.54, No.2, April-May of 2018)

[18] J.D.Chaitanyakumar, G.V.S.Abhilash, P.Khasim Khan, G.Manikantasai, V.Taraka ram (2016),Experimental Studies on Glass Fiber Concrete American Journal of Engineering Research (AJER) e-ISSN: 2320-0847 p-ISSN : 2320-0936Volume-5, Issue-5, pp-100-104 www.ajer.org .

[19] S. Harle. (2014) "The Properties of Glass Fiber Reinforced Concrete." International Journal Of Engineering And Computer Science ISSN:2319-7242 Volume 2 Issue 12 Dec,2013 Page No. 3544-3547

[20] KomalChawlaandBhartiTekwaniStudiesOfGlassFiberReinforcedConcreteCompositesISSN2319 – 6009 www.ijscer.comVol.2, No.3, August 2013, IJSCER Reserved in all respects