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ASSESSING THE EFFECTIVENESS OF BAMBOO IN ENHANCING THE STRENGTH OF CONCRETE STRUCTURES: A REVIEW STUDY

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ABSTRACT
The usual practice is to use steel in order to bolster the strength of concrete. The high expense and limited availability of steel have caused people to become increasingly anxious about discovering substitute materials for reinforcement. Due to various uncertainties, bamboo has not been extensively utilized in reinforcing concrete despite its historical usage in construction, particularly in impoverished nations. A readily available and economical material, bamboo can be found effortlessly. Instead of steel, it can be employed as a reinforcement material for concrete. The environment is experiencing accelerated harm as a result of uncontrolled infrastructure development. Throughout their entire lifecycle, construction materials such as steel, cement, plastic, and metal necessitate considerable energy consumption and give rise to environmental pollution. The estimation of energy and CO2 conservation can be achieved by incorporating advanced technologies, including bamboo fibers and waste materials from industries and mining, into engineering practices.
Keywords: Bamboo, Reinforced Cement Concrete (RCC), Steel Replacement, Advanced Techniques.

INTRODUCTION

Concrete has gained popularity in building projects as it is inexpensive, readily available, and possesses the ability to withstand fires. However, alone is not sufficient in all scenarios as it lacks durability when exposed to tension or elongation. To put it differently, the typical practice is to utilize steel in order to bolster the durability of concrete [1]. Steel is very strong, which pairs well with the weakness of concrete. However, we should only use a little bit of steel because it is expensive and requires a lot of energy to make. So, finding a cheaper, eco-friendly, and energy-efficient replacement for this is a big problem worldwide, especially for developing countries [2]. To solve these problems, bamboo can be used instead of steel bars in concrete for cheap buildings. Bamboo, a plant commonly encountered in nature, can be identified. It is not very expensive, and you can find it in many places. The most important thing about bamboo is that it is very strong, whether you want to stretch it or press it together. a high level of resistance to being stretched or pulled [3].

Instead of being referred to as a tree, bamboo is commonly described as an extremely large species of grass. With the majority of its growth occurring within the initial year, the plant attains full growth status by the fifth year. With the passage of time, bamboo develops increased strength [4]. From approximately 3 to 4 years old, it achieves its highest level of strength, but subsequently experiences a decline. Bamboo, an environmentally beneficial plant, absorbs a significant amount of nitrogen and carbon dioxide from its surroundings [5]. In order to minimize our energy consumption and CO2 emissions, it is crucial that we opt for natural materials when constructing buildings. Bamboo presents itself as an excellent substitute for steel due to its strength and numerous advantages for both the environment and society. In certain areas, bamboo has been a traditional material for constructing items for a significant amount of time [6].

Besides the problems with energy and the environment, bamboo can be used instead of heavier materials for building lightweight structures. Using bamboo instead of steel is advantageous when creating a structure that is not heavy. This technology can be utilized by countries with limited resources or finances to construct lightweight structures for new buildings [7]. The increasing populace in developing economies necessitates the construction of numerous residential buildings. India needs environmentally friendly, affordable, sustainable, and practical structures to meet the demands of its fast-growing population and rapid economic growth. When we use bamboo instead of steel and cement for building things, it helps us save a lot of money [8].

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People are currently looking very hard for materials and ways to make things that do not pollute the environment and use less energy. Researchers and industries are now focusing on using materials like bamboo, soil, and waste from industries, mining, and agriculture for engineering purposes [9]. Around the world, people are working together to find a safer alternative to asbestos cement, which can be harmful to our health. Waste materials are being transformed into alternative types of cement through their innovation and application. These cements are used to make composites that are strengthened with fibers [10].

The amount of energy utilized in the production of bamboo was compared to that consumed in manufacturing 1 cubic meter of popular construction materials such as steel or concrete. Researchers discovered that in order to use steel, 50 times more energy is required compared to using bamboo [11]. Bamboo is very strong and can hold up to 370 million Pascals of force. This means that bamboo is a good option instead of steel for tasks that require pulling or stretching force. The reason bamboo is preferred is because its strength, in relation to its weight, surpasses that of steel by sixfold [12].

The process of producing reinforced concrete often includes the incorporation of steel into the concrete mixture to enhance its strength. This helps balance out the weaknesses of concrete and steel. Concrete is really good at being strong when being pushed together, but not so good at being pulled apart [13]. Steel, on the other hand, is the opposite. It's great at being pulled apart, but not as strong when being pushed together. Furthermore, the traditional method of using steel and concrete in construction is very popular worldwide. However, this has caused a shortage of materials and higher costs because we are running out of natural resources [14]. The hurdles faced have contributed to substantial advancements in the construction sector, culminating in the adoption of modern concrete techniques such as incorporating waste and local resources for concrete production or enhancement [15-16].

Bamboo finds its main application in the construction of homes and other buildings. A study suggests that about one billion people around the world live in houses made of bamboo. Bamboo is used in construction for many things like props, foundations, framing, scaffolding, flooring, walls, roofs, and trusses [17]. Bamboos are used to make a grid and put in soft clay to fix deformation issues in embankments. In the countryside of India, bamboo is commonly used to make mud walls stronger [18].

Bamboo is a type of natural material that is found in large amounts and is easy to use in rural areas of developing countries. Bamboo plants mostly grow in warm areas, like the tropics and subtropics. They can be found from the lowest parts of the land all the way up to the tops of mountains covered in snow [19]. Some types of bamboo can even be found in cooler areas. The primary requirement for individuals residing in rural regions is a dwelling such as a shelter or a residence. Because remote areas do not have much steel and it is expensive to get it there, it is hard to use steel in construction [20]. Additionally, people in remote areas do not make a lot of money, and the high prices of these materials make it difficult for them to build a nice home [21].

In construction and demolition, technology has made big changes. There are new methods and better equipment now. The materials used have also changed, even though they have been used for a long time. Because of these reasons for cost-effective and environmentally-friendly construction, using bamboo instead of steel for reinforcing concrete can be a good alternative [22]. Easy access and affordability of this material are available for people living in isolated regions. By incorporating bamboo into concrete as a reinforcement material, there is the potential to decrease the reliance on steel reinforcement [23].

Analytical studies have demonstrated that bamboo is a suitable replacement for wood and numerous materials, serving as a viable option for construction and various other undertakings. Processed in manufacturing facilities, bamboo possesses the potential to produce affordable construction materials and components suitable for both supportive and non-supportive applications [24]. Bamboo is a really old material that people have been using for a long time to build things. The bamboo stem is used to make a wide variety of things, from things we use at home to things we use in industries [25].

Bamboo is often used for making bridges, scaffolding, and homes. However, it is mostly used as a temporary material for the outside of buildings. In many crowded areas of warm climates, some types of bamboo provide a low-cost and abundant material that can be used for building houses that are affordable [21]. As science and technology improve, and there is not enough wood available, we need new ways to process bamboo so that it lasts longer and can be used more effectively for making things like buildings [15]. Research has been conducted on the important characteristics and how to make different types of bamboo products. Bamboo has many special benefits because it can grow really fast and produce a lot, and it also grows up quickly. In addition, bamboo is very easy to grow and it doesn't cost much, so it's a cheaper option [19].

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PROPERTIESE OF BAMBOO

When considering plants like Dendrocallamus Giganteus, it is usually found that their pulling strength is roughly 120 MPa, their squashing strength is about 55 MPa, and they demonstrate a measure of stiffness denoted as young's modulus, which amounts to 14 GPa [8]. By examining the figures for steel, characterized by an impressive ultimate strength of 410 MPa, a yield strength of 250 MPa, and a Young's modulus of 200 GPa, it becomes apparent that bamboo has the potential to serve as a viable substitute for steel [11-12]. Concrete does not possess the same strength as bamboo. Bamboos are lightweight in comparison to steel and concrete. And it is also stronger but lighter than steel and concrete. Bamboo can be easily damaged by termites, unlike other materials [13-14-15].

REVIEW STUDY OF BAMBOO

M. M. Rahman, M. H. Rashid, M. A. Hossain, M. T. Hasan and M. K. Hasan (2015) The focus of this paper is to analyze whether bamboo can be effectively utilized as a reinforcement agent in concrete applications. To examine this, we experimented with the resilience of bamboo through the implementation of three and five sections. In this test, we use bamboo sticks that have different shapes and sizes. In order to gauge the effectiveness of bamboo as reinforcement, a test is conducted to measure the flexural strength of beams with bamboo reinforcement. In this experiment, we compared beams made of bamboo, both single and double reinforced, to a regular concrete beam. The length of all the beams was 750 mm, while their width and depth measured 150 mm.

Harish Sakaray, N.V. Vamsi Krishna Togati, I.V. Ramana Reddy (2012) In this paper, we tried to find out if bamboo can be used to make concrete stronger. We studied different characteristics of bamboo, such as its physical and mechanical properties, to understand its potential as a reinforcement material. The researchers used the same standards to evaluate the bamboo types as they did for steel. This study looks into the strength and flexibility of a certain type of bamboo called Moso. It examines how well it can handle being stretched or squished, its ability to absorb water, the force it can withstand when being cut or bent, and how well it sticks together. Bamboo is extremely strong, almost like mild steel, but it is very light, similar to carbon fiber. In this study, we looked at two different kinds of Moso Bamboo samples. The first specimen type displays a node positioned at the middle, while the second specimen type showcases nodes located one-quarter distance from each end. Tests were done on bamboo to see how it holds up under different types of forces. The tests were done using special machines, and the results were compared to how steel performs under the same forces.

Purushottam Kumar, Phalguni Gautam, Simardeep Kaur, Mohit Chaudhary, Anam Afreen, Tanuja Mehta (2021) This article talks about using bamboo instead of steel to strengthen concrete. It looks at how well bamboo holds up under pressure, and how it affects the structure of the concrete. Many scientists agree that bamboo has really impressive physical characteristics. The similar outcomes between bamboo and steel in strength tests make the former an advantageous subject of study. This could change the construction industry.

Ajinkya Kaware, Prof. U.R. Awari, Prof. M.R. Wakchaure (2013) In terms of resilience, the review identifies Dendrocallamus strictus and bamboos vulgaris schard as the top contenders, as they exhibit unmatched strength when subjected to pulling or pressing. There are two issues with using bamboo for building things. One is that it soaks up water easily, and the other is that it has a lot of moisture in it. To avoid these problems, bamboo must be dried or processed correctly. The main topic discussed in this paper pertains to the results obtained from conducting tests on bamboo columns and beams, examining their level of durability and strength.

Sandeep Bhardwaj, Rupali Sharma, Rajender Kumar (2014) In smaller buildings and structures, bamboo has the potential to replace steel. This is good for the environment, lasts a long time, and doesn't cost much. We talked about how bamboo material can be used in bridges, concrete reinforcement called bambcrete, and replacing structural steel in industrial buildings. We talked about the latest progress in bamboo and the characteristics of bamboo materials.

Khosrow Ghavami (2005) Brazil has been the site of several fruitful research endeavors on bamboo, particularly at PUC-Rio, since 1979. These programs have been conducted to expand our understanding of this versatile plant. Vegetable fibers can be used on their own or added to things like soil or cement to make them stronger. This paper shows what researchers have found out about the structure of bamboo and how it changes in different sections. These studies helped us understand how bamboo behaves when it is mixed with other materials. This article talks about bamboo being used to make concrete beams stronger, using a special type of concrete that doesn't need to be removed after it dries. It also talks about using bamboo in columns.

P. O. Awoyera, J. K. Ijalana, O. E. Babalola (2015) This study looked at how steel and bamboo fibers affect strong concrete. Concrete cubes, beams, and cylinders that were made with different amounts of steel and bamboo fibers were tested for how strong they were when compressed, bent, and pulled apart. We tested sixty-three cubes

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that were 10cm x 10cm x 10cm, fourteen beams that were 10cm x 10cm x 50cm, and cylinders that had a diameter of 10cm and a length of 15cm. The findings showed that when concrete had 1. 0% bamboo fibre added to it, it resulted in the largest increase in flexural strength (81% stronger) and splitting tensile strength (101% stronger). It was determined that the presence of bamboo fiber does not have a substantial effect on the strength of high strength concrete. The use of steel fibres in concrete significantly enhances its compressive, flexural, and splitting tensile strengths, surpassing those achieved with bamboo fibre-reinforced concrete.

Atul Agarwal, Bharadwaj Nanda, Damodar Maity (2014) Different types of adhesives, like Tapecrete P-151, Sikadur 32 Gel, Araldite, and Anti Corr RC, were used to see how well they could stick together bamboo and concrete in a composite structure. After comparing different options, we chose the best adhesive to make bamboo reinforced beams and columns. The experiments check how much weight the columns can hold, how much they bend sideways, and how they break. They test different types of columns: simple ones, ones made of steel, and ones reinforced with bamboo. Moreover, a two-point load test is conducted on beams to observe how they react when subjected to bending. These tests show that bamboo, when treated correctly, can be used instead of steel to strengthen beams and columns.

Alvin Harison, Akash Agrawal, Ashhad Imam (2017) In these situations, it's a good idea to use low-cost housing and bamboo as a building material to help reach our goal. Many researchers are trying to find ways to build things that are good for the environment and affordable. In order to focus on this topic, a test was done to see if bamboo could be used instead of steel. In this research paper, the robustness of bamboo-reinforced concrete is thoroughly discussed. It looks at how strong the concrete is when squeezed, pulled apart, and bent.

Yang Wei, Shaocong Yan, Kang Zhao, Fenghui Dong, Guofen Li (2020) The findings indicate that both reinforced beams and prestressed reinforced beams break because the bottom bamboo fibers stretch and break. There is no significant breaking in the top part where the beam is being squeezed. The reinforced beams can support more weight if they have more reinforcement and are pre-stressed. The bearing capacity is more significantly influenced by the diameter of the reinforced bars rather than the prestressing. The stiffness of reinforced beams gets stronger as we add more reinforcement to them and can be improved by up to 36. 80% compared to beams without reinforcement. The reinforcement used to strengthen the bamboo scrimber beams does not have a big impact on how stiff they are at first, but it does help them bend in the opposite direction and reduces how much they actually bend. The methods to calculate the stiffness and strength of reinforced bamboo beams are explained by looking at how the strain and stress are spread across their cross-section. These models are able to make accurate predictions for both teams that have reinforcement and beams that have been pre-stressed. Utilizing steel-reinforced bamboo scrimber beams, one can construct bamboo structures that possess remarkable durability and robustness, capable of withstanding significant weights over extended areas.

Anurag Nayak, Arehant S Bajaj, Abhishek Jain, Apoorv Khandelwal, Hirdesh Tiwari (2013) According to the findings, the bottom bamboo fibers undergo stretching and breaking, leading to the failure of both reinforced beams and prestressed reinforced beams. There is no significant breaking in the top part where the beam is being squeezed. The reinforced beams can support more weight if they have more reinforcement and are pre-stressed. The bearing capacity is more significantly influenced by the diameter of the reinforced bars rather than the prestressing. The stiffness of reinforced beams gets stronger as we add more reinforcement to them and can be improved by up to 36. 80% compared to beams without reinforcement. The reinforcement used to strengthen the bamboo scrimber beams does not have a big impact on how stiff they are at first, but it does help them bend in the opposite direction and reduces how much they actually bend. The methods to calculate the stiffness and strength of reinforced bamboo beams are explained by looking at how the strain and stress are spread across their cross-section. These models are able to make accurate predictions for both beams that have reinforcement and beams that have been pre-stressed. Utilizing steel-reinforced bamboo scrimber beams, one can construct bamboo structures that possess remarkable durability and robustness, capable of withstanding significant weights over extended areas.

Richard Moran, Jose J. García (2019) We have formulated three innovative techniques for connecting bamboo beams and columns, allowing for the efficient transfer of force and torsional motion. Each joint consists of five thin steel clamps that are fastened around the culms. The culms are connected with small steel angles and plates in various arrangements. Steel clamps are very versatile and prevent things from breaking too soon. Basic tests that do not change and show stiffness, strength, and flexibility had results between 73. 4 and 2308 kNm/rad for stiffness, between 3. 4 and 52 kNm for strength, and between 3. 6 and 172 for flexibility in the three different designs. The stiffness and strength of these connections were higher than traditional mortar-injected bolted connections by at least 29% and 250%. During the tests, the connections showed loops with squeezed parts, but

there was no weakening of their strength. This is a common feature in timber connections. This study suggests that clamp moment connections can be a good option to make bamboo structures stronger and more versatile.

Satjapan Leelatanon, Suthon Srivaro, Nirundorn Matan (2010) The findings revealed that short columns strengthened with untreated bamboo can withstand the necessary axial load as required by ACI318-05. However, these columns have low flexibility, and one in particular, reinforced with 1. 6 percent of bamboo, showed brittle behavior similar to plain concrete columns. This was believed to happen because the water was absorbed and the bond between the concrete and bamboo became weaker. On the other hand, columns reinforced by bamboo that has been treated with a substance called Sikadur-31CFN to make it resistant to water, showed higher strength and flexibility compared to columns reinforced by bamboo that was not treated. The findings also indicated that 1. 6% of the steel reinforcement in the column can be replaced with 3. 2% of treated bamboo reinforcement without impacting its behavior, strength, and flexibility.

Vittoria F. Parrella, Luisa Molari (2021) The study of how this structure moves in space is being conducted through the use of a computer model. The seismic tests show that when the exoskeleton structure is securely attached, it can effectively control the movement and bending of the main structure. This also helps to lessen the strain on the inside of the structure. The findings of this research could give us helpful initial understanding. More research is needed to apply the findings to various earthquake-prone areas. The suggested method for strengthening buildings against earthquakes can also be combined with a layer of insulation to save energy.

Chun-Lin Wanga, Ye Liua, Xiaolong Zhenga, Jie Wub (2019) We studied how the initial force, the shape and size of the energy dissipaters, and the number and arrangement of them affected the earthquake performance of the precast concrete connection. We measured the connection strength, the ability to absorb energy, and the ability to return to its original position. We looked at how putting weight on precast concrete connections over and over again affects how well they hold up during an earthquake. We also checked if we can use the precast parts again and if the suggested ways of keeping them secure are reliable. The test results indicated that the suggested precast connection performed well under pressure, had strong self-adjusting abilities, and did not weaken during the experiments. The way the energy dissipater curved at the end was talked about during the tests.

J.J García, C. Benítez, L. Villegas, R. Morán (2017) Our focus of study involves the implementation of small steel circles in the bonding of bamboo stalks. The thin rings can adjust to the bumps on the culm when they are tightened because they are made of two semi-rings. So, the ring puts pressure on the culm and makes it squeeze together. This stops it from splitting. Additionally, even after small cracks, the ring prevents the parts from breaking apart, which causes flexible ways of breaking.

S. Karthik, P. Ram Mohan Rao, P.O. Awoyera (2017) The results of the tests indicated that bamboo possesses both strength and flexibility. The research found that using fly ash, GGBS, and m-sand together in concrete makes it stronger, both in compression and when it is stretched. When pressure is applied, bamboo reinforced concrete (BRC) made with alternative materials (fly ash, GGBS, and m-sand) performed much worse than BRC made with traditional materials. Furthermore, BRC made with regular materials became stronger and more flexible compared to SRC. This increase in strength equated to a gain of 6.5%.

I.A. Khattab, M.F. Shaffei, N.A. Shaaban, H.S. Hussein, S.S. Abd El-Rehim (2014) The study discovered that the fixed bed exhibited superior performance compared to the fluidized bed in terms of substance removal and operational efficiency. The study looked at how the electrolyte in electrolytic cells affects certain factors like type and concentration. It found that the electrolyte greatly affects these factors as well as the rate of removal. Using table salt (NaCl) gave better results than using sodium sulfate (Na2SO4). The text is saying that in 2014, Elsevier B. V was responsible for creating and managing something. on behalf of the Egyptian Petroleum Research Institute means that someone is speaking or acting on behalf of the institute.

J. Atanda (2015) Bamboo has long been incorporated into building practices. People have been using it for many years to build mud houses and small huts in villages. Bamboo is a strong and bendable material that is good for making buildings. This material has been used for floors, walls, roofs, reinforcing concrete, and supporting structures. It is not heavy and can be easily carried from one place to another. This paper will look at how bamboo helps the environment and what makes it special. In Nigeria, not many people use bamboo. So, this study will look into bamboo and how it can be used in Nigeria. We will also explore how it can be helpful for the environment in Nigeria.

Sajad Hussain Mir (2013) The main focus of this study is to explore approaches that can decrease the overall cost of constructing buildings. Nowadays, it is very expensive to buy the materials needed to build a house. This makes it very difficult for an average person to afford and build their dream home. By employing bamboo in building projects, the costs associated with obtaining raw materials can be greatly diminished. This study looked

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at how people are doing economically and whether bamboo can be used for building houses. After researching extensively, it was found that this low-cost, durable, and visually appealing material should be used for construction.

Sri Murni Dewi, Ming Narto Wijaya, Christin Remayanti N (2017) The aim of this study is to investigate whether the inclusion of bamboo fiber can enhance the strength of cracked bamboo reinforced concrete. In order to reach this goal, a bunch of tests were done. With measurements of 15 cm by 20 cm on the top and a height of 160 cm, the concrete beam takes the form of a rectangular shape. It is made stronger with the addition of bamboo and pumice stone. The bamboo was covered with sand to make the surface rough. The bamboo that skewers producers get from Malang is called Ori bamboo. The fiber that was used came in different lengths. The fiber is painted and sand is added to stop it from absorbing moisture. This also makes it heavier so that it doesn't float when mixed with concrete. The findings indicated that using bamboo fiber can make cracks in concrete smaller and decrease how much it bends, while also helping the concrete handle more weight after it has cracked. The quantity of fiber in concrete affects how easy it is to work with and the overall quality of the concrete. However, bamboo fabric can stop cracks from getting bigger and spreading.

Prof. Satish Pawar (2014) This article discusses the versatility of bamboo as a building material, showcasing its potential utilization in diverse areas of a construction project, including the floor, roof, beams, walls, and columns. Using bamboo instead of steel reinforcement is becoming more important now because it is cheaper and better for the environment. Bamboo is a type of tree that naturally grows in many areas of the country. Even though it can be damaged by the environment and bugs, its lifespan can be increased by taking care of it and treating it, so it lasts longer. An improved type of bamboo can be used instead of steel to withstand pulling forces in reinforced concrete structures, and it also helps to reduce the amount of cement needed in construction. Cement and steel are the most commonly used and energy-intensive materials in construction.

N L Rahim, N M Ibrahim, S Salehuddin, S A Mohammed, M Z Othman (2020) In this study, we examined how well bamboos can be used instead of regular materials in reinforced concrete. We have tested the strength of bamboos by pulling them apart to find out how much stress they can handle before breaking. The test showed that bamboo is similar to steel and can be used instead of steel to make concrete stronger. However, bamboos absorbed a lot of water and did not stick well to the surface of concrete. In this study, we used a substance that keeps water out to make things stronger. We tested a bamboo beam that measured 150 mm x 150 mm x 750 mm to see how strong it is as reinforcement. The test showed that bamboo is a good option to use instead of other materials in building cheap houses.

Madhura Yadav, Arushi Mathur (2021) This study explores using bamboo as a good material for building things efficiently. It also looks at existing information on how bamboo can be used in construction. Bamboo is a type of material that can be used in buildings for many different things, both inside and outside. Some examples include the foundation, flyovers, homes, tall buildings, large structures and the inside of airports and recreational buildings.

MATERIAL USED

BAMBOO

Bamboo, which is readily available and easily manageable, is a common natural resource in the rural locales of developing nations [7]. Bamboos are mainly found in warm and humid places, like tropical and subtropical regions. They can grow anywhere from the beach to high up in snowy mountains, and some types can even survive in cooler areas. Bamboo is mainly used for building houses and other structures [14]. A study suggests that about one billion people worldwide live in homes made of bamboo. Bamboo has been used in building things like props, foundations, framing, scaffolding, flooring, walls, roofs, and trusses [17].

The shape problems of embankments are rectified by connecting bamboos into a grid formation, which is subsequently inserted into pliable clay. In the countryside of India, people often use bamboo to make mud walls stronger. Bamboo is often called a very big type of grass instead of a tree [21]. The plant grows the most in its first year and reaches full size by the fifth year. As time goes by, bamboo becomes stronger. Around the ages of 3 to 4 years old, it reaches its strongest point, but after that, it starts getting weaker [22]. Bamboo is a plant that is good for the environment because it takes in a lot of nitrogen and carbon dioxide from the air around it [24].

CEMENT

When you mix water with cement, it forms a sticky substance similar to glue. Once it is dry, it becomes firm and sturdy. A sticky material known as cement can be found in its natural state. Cement is a robust and viscous substance that aids in prompt bonding between elements [12]. We combined water, large rocks, and small rocks

to form cement. In building things, we use different kinds of cement depending on what we need for the specific project or if there are any unique design problems [14]. Even though there are many types of man-made cements, Portland cement is the most widely used and is seen as the basis for comparing all other modern cements. Creating Portland cement is a simple process that only requires common materials. The term mortar refers to the substance utilized in the construction of walls [18]. Consists of a combination of cement and extremely finely crushed components. Cement, sand, and small stones are combined to create concrete, which is commonly employed in construction projects. Concrete stands out as the most commonly employed material worldwide, surpassing any other substance [25]. Many people rely heavily on concrete and water. A prevalent method in the creation of calcium oxide involves processing limestone, a type of rock comprised of calcium carbonate [26]. Nevertheless, it can be discovered in alternative objects such as chalk, shells, and mud. Essentially, the sentence suggests that individuals lean towards using soil or silt because they are already broken down into smaller pieces. Silica is obtained by using a particular type of rock called iron-bearing alumina-silicates [27].

AGGREGATE

The proper functioning of concrete necessitates more than just water and Portland cement. To make concrete work correctly, you need to add some extra things to water and Portland cement [14]. Aggregates like sand, gravel, and crushed stones are very important in making concrete even though they don't chemically react with other concrete materials. To make a good concrete mix, it is necessary to use clean rocks and sand without any dirt or trash [19]. It is very important that these things are clean and do not have any bad chemicals, because they can make the concrete break down [25]. Concrete utilizes two different kinds of materials: small and large particles are both employed in its composition. Together, they make up the most important parts of concrete. Small rocks can go through a filter that is 3/8-inch in size [26]. These little things are usually made from sand or crushed rocks that happen naturally. Anything that is more than zero. The term 19 inches is used interchangeably with coarse aggregate, indicating its large size [27].

WATER

In the study, water samples were collected from a stream that remained unblocked and had a consistent flow. Due to the lack of dirt or pollution, the water appeared remarkably clean and transparent to our eyes. The acidity level should be maintained at a minimum of 6, which is of utmost importance [25-26-27].

CONCLUSIONS

1. The incorporation of bamboo in building structures is being initiated through this study, paving the way for eco-friendly alternatives in construction.
2. The utilization of bamboo, similar to other natural resources, can lead to concerns regarding durability that remain incompletely comprehended.
3. In case of replacement requirements, the new bamboo exoskeleton design simplifies the process of replacing individual bars or grid members.

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