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An Examination the Use of Sugarcane Bagasse Ash as Cement Partial Substitutes in Concrete

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ABSTRACT- The strength and shrinkage of concrete that is combined with sugarcane bagasse ash particles are influenced by the size of the particles, as analyzed in this research article. A higher amount of water is required when utilizing Sugarcane Bagasse Ash (ScBA) in concrete. The strength of the mixture created with fine ScBA can be comparable to or greater than that of standard concrete. The ScBA waste produced from sugarcane contracts substantially as a consequence of the presence of minute components within it. In this study, the researchers utilized a material known as Sugarcane Bagasse Ash (ScBA) to substitute cement in concrete. The experiment involved testing the effectiveness of ScBA (at different percentages: 0%, 5%, 10%, 15%, and 20%) in strengthening M20 concrete over a period of 28 days. They compared it to regular concrete. The extent to which it could resist pressure and strain without snapping was measured. The reason behind burning Sugarcane waste (ScBA) for fuel is its ability to produce significant amounts of heat. Cement can be supplemented with the remaining ash after it has been burnt.

KEYWORDS: Compressive strength Concrete, Split Tensile Strength, Durability, Sugarcane Bagasse Ash, Workability.

I. INTRODUCTION

Cement is very important for making concrete. Creating this thing makes a lot of pollution called CO2. Many people know that having too much CO2 in the air can harm nature. People are trying to make less of a gas called CO2 come from factories. Using different materials instead of some parts of cement is the best way to cut down on the amount of CO2 that cement factories release [1]. When we use things that weren't used before in farming and making things, it makes concrete better. Instead of buying new things, we should find ways to use things that have already been thrown away. To Rephrase wants to make really good concrete and protect the environment when getting rid of it [3]. This info is about research done by a group of authors. Using pozzolans for making concrete is beneficial for the environment as they can replace a large amount of cement. Making new concrete better when it's still wet and when it's hard. Using pozzolans instead of cement to make concrete is more environmentally friendly [4-5].

When people burn the things left over after making sugar and bagasse plants in a special way, they create a type of ash that contains a substance called amorphous silica. Scientists checked how ash affects concrete in various regions worldwide [6]. They discovered that adding some ash to concrete can make it stronger and stop water from getting inside. Bagasse ash has special properties that can help it become a type of cement called pozzolan. This is because it has a lot of a substance called silicate inside [7]. This stuff makes concrete stronger by working together with cement to get rid of extra lime. The amount of silicate in ash varies depending on how it was burned and the kind of soil it was from. It is used to help sugarcane grow better [8].

Optimization is finding the best result you can with the rules you have to follow. People make choices to either have a really good outcome or a very small impact. People all around the world want to make sure they don't harm the earth. People are trying to find cheaper things to make a building material [9]. It is really important that the stuff is eco-friendly and made from things that were used before and then recycled. Using trash to make building materials is good for the environment and finances. It also reduces pollution. You can choose to mix it in different amounts, or not mix it at all. You can mix in 5%, 10%, 15%, or 20% of the cement's weight [10]. We will test how strong and long-lasting concrete is when we add bagasse ash. We will check how thick it is, how quickly it sets, and how easy it is to use. We will check how much weight it can carry and how long it can last [11].

Sugar factories create a type of fuel called bagasse by using sugarcane. They use this fuel to operate their machinery and make electricity. Ash waste is leftover material that is made after bagasse is produced. People often throw their garbage in open areas, which harms the environment [12]. We need cement to build strong structures and keep them steady. Making cement hurts the environment by letting out a lot of CO2. Between 5-8% of all the CO2 that is released globally comes from the cement used in building things like buildings [13-14]. This happens because the substances in cement mix together and make something called calcium hydroxide that isn't good. When two things come together, it makes something called calcium silicate hydrate [15]. This problem happens when cement reacts with other things and makes a bad substance called calcium hydroxide. A

study by It Rephrase found out how much bagasse ash can be added to cement, and if it can replace some of the cement [17].

II. SUGARCANE BAGASSE ASH (SCBA)

Sugarcane Bagasse Ash (ScBA) is a residue that remains after sugarcane is crushed to extract juice and has different properties that make it useful in various applications. Sugarcane is very important for people to survive in hot and humid countries. This thing is really important for making a lot of sugar at once [1]. When we extract juice from sugarcane, what's left is called sugarcane bagasse. Sugar cane bagasse ash is made by burning what's left over from sugar cane. The ScB is making a mess by littering in public areas and creating huge piles of trash. Barroso says that for every one ton of sugarcane, 280 kilograms of bagasse waste is made [3]. What happens to the leftover sugarcane (called bagasse) can affect both money and nature? People all over the world are trying to find better ways to deal with trash. Handling means how you move, control or take care of an object [6]. Disposed- off means throwing something away in the right way, like putting it in the garbage or recycling it. An application is a computer program that is made to do one special job [8]. Using waste materials to make concrete is important for taking care of the environment. Sugarcane leftovers called bagasse ash can be used in concrete instead of cement. Sugarcane is a very important plant in South Asia and is grown to make money. Sugar production is very important and can't be emphasized enough [13]. (Shown in figure 1).

Figure 1: Sugarcane Bagasse Ash

A. *Properties of Sugarcane Bagasse Ash (ScBA)*

Two distinct sections, the outer layer and the inside layer, make up the sugar cane plant that has a towering height. The exterior is made up of elongated and slender fibers, while the interior consists of shorter fibers. The fiber content of bagasse consists of both kinds [6]. The tissues of sugarcane are composed of cellulose, which makes up around one-third of its mass. The cellulose and hemicellulose content in sugarcane byproducts accounts for 40-50% and 25-35%, respectively [8]. The remaining portion contains substances such as wax and lignin. A defined arrangement characterizes cellulose, while hemicellulose is unstructured and incorporates sugars like xylose and glucose. The object consists of three components that can interact with other entities [13]. The third part stands out in terms of strength compared to the other two. The strong part is in a different place compared to the other two. The linking of molecules, both inter- and intramolecular, is facilitated by the robust bonding action of hydroxyl groups [15-16]. (Shown in Table 1).

Table 1: Chemical Composition of Sugarcane Bagasse

Material	Percentage
Ash	1-5
Lignin	14-23
Hemicellulose	19-33
Cellulose	26-47

B. *Applications of Sugarcane Bagasse Ash (ScBA)*

- Improve the cost-effectiveness and quality of building supplies.
- The amount of silica present in this substance is 87%, which is significantly higher in comparison to cement that contains only 22% silica.
- In comparison to cement, the substance has a lesser weight, Cement is much heavier.
- The expense of pozzolanic material, a valuable element, is approximately equivalent to that of fly ash.
- The material known as Sugarcane Bagasse ash (ScBA) is characterized by its lightness.
- Bagasse ash has the potential to serve as a beneficial fertilizer for agriculture.
- The utilization of bagasse ash can lead to the creation of pottery.
- Working with fresh concrete becomes less challenging because of this.
- Using 10% SCBA instead of the regular material can make things stronger in three ways - by making it better at compression, better at stretching, and better at bending, this happens after 7 & 28 days.

C. *Sugarcane Bagasse Ash (Scba) Production*

The sugarcane production of India is almost as high as that of Brazil. They put 44,000 tons of Bagasse ash in a big pile every day. There is a method of reusing this waste. The generation of electricity is carried out by co-generation plants by utilizing paper and other materials with a high energy content [5]. The high fiber content of pulp renders it a suitable material for producing electrical energy. Scientists have studied how to add something to concrete to make it stronger and more durable [7]. They found that this thing also made the concrete easier to work with and reduced the amount of heat produced. It's a good substance to add to concrete. Research has shown that SCBA can be used in many different types of concrete, including ones that can easily flow and compact on their own, ones that foam up, and ones that are very strong [9]. Sugarcane is a helpful crop for places with warm weather. It can help solve the problem of reusing crops in the agriculture industry. Big leftovers from factories can be burned to make sugar [12].

Sugarcane bagasse is the leftover waste from extracting juice from sugar cane. It can be used for good things in a safe place, along with the waste from burning it. When sugarcane is burned, there is leftover ash called SCBA. This ash can be added to concrete instead of using as much cement, which can make the concrete cheaper [14].

SCBA is a useful product that helps reduce harm to the environment by reducing waste and its effects on the environment. They are placed in certain places. This material called pozzolan is grown in 74 countries around the world, mainly in areas between 400N and 32. 50S It is made from different waste materials like silica fume, rice husk ash, fly ash, met kaolin and ground granulated blast furnace slag. These materials are very useful because they can help in construction [16-18].

III. OBJECTIVE

A. Objectives for this research and investigation

- To ascertain whether Sugarcane Bagasse Ash (ScBA) can be employed as a viable option to increase the strength of concrete.
- To determine if concrete quality will be affected by using Sugarcane Bagasse Ash (ScBA).
- Figure out the limits on how good Sugarcane Bagasse Ash (ScBA) can be because of the way cement reacts with it.

IV. MATERIAL AND METHODOLOGY

A. Cement

The addition of water causes cement to form a paste-like consistency, resembling glue. Once it dries, it transforms into a rigid and tough substance. Cement is a type of substance that is naturally sticky. Cement is a strong and sticky substance that helps to hold things together quickly. A mixture of water, sizable rocks, and miniature rocks was merged to generate cement [3]. In construction, the utilization of diverse types of cement is dependent on the specific job requirements or unique design issues. Even though there are many different types of man-made cements, Portland cement is still the most commonly used and is looked at as the basis for comparing all other modern cements [5]. The manufacturing of Portland cement is an uncomplicated process that requires only typical substances. The substance called mortar, which is employed in wall-building, is comprised of cement and finely ground material. An aggregate of cement, sand, and gravel is utilized in construction, known as concrete. The usage of concrete surpasses that of almost every other material around the globe [12-14]. Concrete and water aside, there is no other substance that people rely on as frequently. Calcium oxide usually comes from limestone (which is calcium carbonate), but it can also be found in other things like chalk, shells, and mud. This sentence means that people prefer to use soil or silt because they are already finely divided. However, they also use a type of rock called iron-bearing alumina-silicates to get silica [16]. Natural substances with a sticky property are typically referred to as "cement". Making Portland cement is very simple and only needs easy-to-find ingredients. The process of creating calcium silicates involves a thorough mixing of various components. To make good cement, you need to use materials that are very pure and consistent chemically. Even though there are many different types of man-made cements, Portland cement is still the most commonly used and is looked at as the basis for comparing all other modern cements [19]. (Shown in fig 2)

Figure 2: Cement

B. Aggregate

Concrete needs more than just water and Portland cement to work. Aggregates are stuff like sand, gravel, or crushed stones that don't react with the other materials needed to make concrete but are still very important [3]. To make a good concrete mix, you need to make sure that the rocks and sand you use are clean. They can't have any dirt or harmful chemicals in them because that could make the concrete break down [5]. There are two types of things that go into concrete: fine and coarse. Together, they make up most of the concrete. Most small grains in fine rocks can go through a filter that is 3/8-inch in size. These small grains are usually made of sand or crushed stone that is found naturally. Anything bigger than 0. 19 inches is called a big piece of stuff called coarse aggregate [12]. They're usually about the size of a pencil or a small rubber ball. Rocks that break cleanly in only two directions are not as strong or long-lasting. We have to remove the bad things like scraps, mud, soil, or natural stuff from the sand and gravel. Most of the big rocks used in concrete are called gravel [16]. Aggregates are used in concrete to make it stronger and more durable. They help to increase its resistance to damage and wear and tear. Their powerful shape can impact the concrete in many ways. When you mix things, they might come apart and be less helpful because they turn into smaller pieces. Rocks which are fragile can split in two different directions [19]. (shown in Fig 3).

Figure 3: Aggregate

C. Sugarcane Bagasse Ash (ScBA)

Sugarcane is of utmost significance for sustenance in countries with hot and humid climate. This source is essential for manufacturing sugar on a large scale. When sugarcane juice is taken out, what remains is referred to as sugarcane bagasse [5]. Sugarcane bagasse ash is produced by burning residual sugarcane material. The ScB is causing a big problem by throwing trash in open spaces and making big piles of garbage. According to Barroso, 280 kilograms of bagasse waste is produced from every ton of sugarcane. The handling of leftover sugarcane material (known as bagasse) has the potential to impact both the economy and environment. Around the world, individuals are striving to identify efficient approaches for handling this waste [8]. Handling pertains to the manner in which an object is physically manipulated, relocated, or overseen. Disposed-off means getting rid of something properly, usually by putting it in the trash or recycling it. A program or software designed for a specific task is called an application [13]. The utilization of waste materials for concrete production is significant for environmental sustainability. Sugarcane bagasse ash is a waste material from the sugar industry that can be used in concrete instead of cement. Sugarcane is an important crop in South Asia, and is also known as a valuable cash crop. The importance of sugar production cannot be overstated [15]. (shown in Fig 4). To conduct our experiment, we utilized a specialized sieve with tiny openings of "300µm" to collect ScBA. After going through a filter with tiny holes that only let things 300 millionths of a meter (or microns) or larger through, both the sugarcane bagasse ash and other materials were left behind on the filter [9]. The ScB is causing a big problem by throwing trash in open spaces and making big piles of garbage. The utilization of waste materials for concrete production is significant for environmental sustainability. Sugarcane bagasse ash is a waste material from the sugar industry that can be used in concrete instead of cement [17-18].

Figure 4: Sugarcane Bagasse Ash

D. Mix Design

The concrete mix design was done by utilizing IS 10262 for M-25 review/Grade of concrete.

Table 2: Mix design of concrete

S.No.	Material	Mix Design
1.	Admixture	Sugarcane Bagasse Ash
2.	Type of Aggregate	Crushed angular Aggregate
3.	Workability	65mm (Slump)
4.	Water Cement Ratio	0.60
5.	Aggregates Size	20mm
6.	Cement Grade	OPC43
7.	Grade	M25

Water Cement Ratio: 0.6

V. RESULT AND DISCUSSION

A. General

Laboratory test results conducted on the sample are briefly summarized in this section. We tested different materials like cement, sand, aggregates, and Sugarcane Bagasse Ash. We also tested both wet and dry concrete(shown in fig 5 and 6)..

B. Slump Test Investigation

Table 3: The Slump Value of all Mixtures is represented

S.No.	MIX	Percentage	Slump Value
1.	ScBA	0%	90 mm
		5%	61 mm
		10%	52 mm
		15%	48 mm
		20%	21 mm

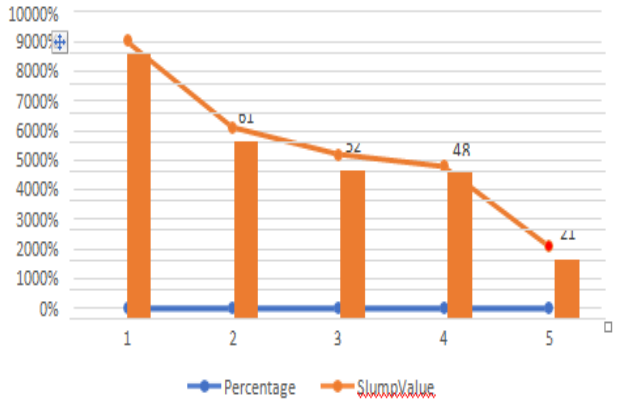

Figure 5: Slump Value

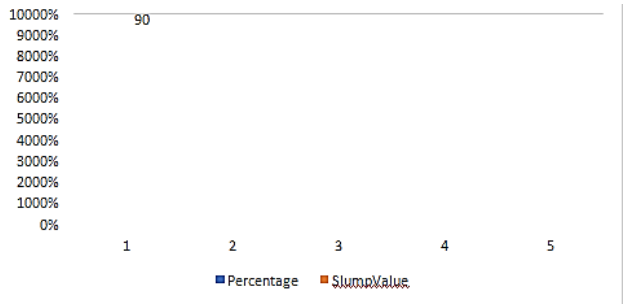

Figure 6: Column Graph 1.2 lump value

C. *Compaction Factor Test Investigation*

Table 4: Determine the Compaction Factor Test

S.No.	MIX	Percentage	Compaction factor
1.	ScBA	0%	0.92
		5%	0.88
		10%	0.85
		15%	0.81
		20%	0.78

In table 4, the concrete value compaction factor under supervision is 0.92. When the proportion of concrete overlaid with ScBA is raised from 5% to 20%, the value of the compaction factor falls from 0.92 to 0.78(shown in fig 7 and 8).

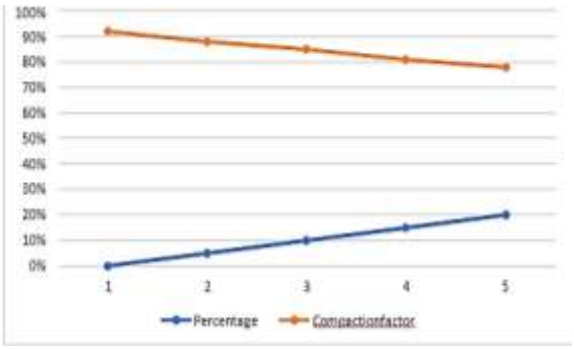

Figure 7: Compaction Factor Investigation

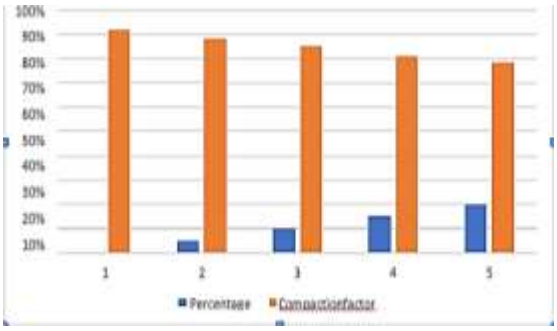

Figure 8: Compaction Factor Test Investigate

D. *Aging and Compressive Strength*

The M25 Grade concrete has strength of 33.80 N/mm2 after 28 days. Table no 5 below shows the compressive strength.

E. *Compressive strength of control concrete in N/mm2*

Table 5: shows the compressive strength

Grade of Concrete	7days	28days
M25	24.8	33.80

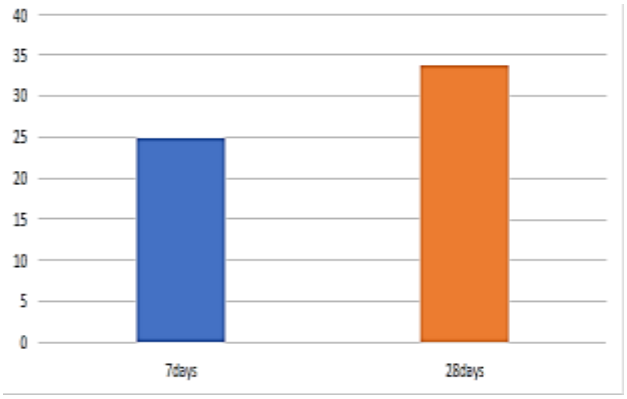

Figure 9: 1 for 7 and 28 Days of Compressive Strength N/mm2

F. *Impact of Age on Control Concrete's Split Tensile Strength*

Category M25 After 28 days, the control concrete has a flexural rigidity of 2.80 N/mm2. The graph of compressive strength versus cement replacement percentage introduces the special table strength statistics. Tensile strength of fracture in control concrete in Newton-Meters (N/mm2). (shown in fig 10,11 and 12)..

Table 6: Shows the Tensile Strength in 7days and 28 Days

Grade of Concrete	7days	28days
M20	1.92	2.60

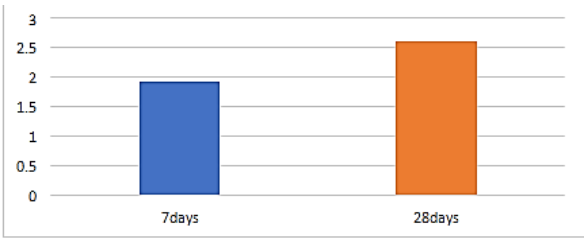

Figure 10: 1 for 7 and 28 Days of Split Tensile Strength

G. *Impact of Concrete with Various ScBA Contents on Compressive Strength*

Table 7: Compressive strength of ScBA Concrete

MIX	%of cement Replacement	Cube Compressive Strength N/mm2	
		7 Days	28 Days
ScBA	0%	21.2	29.4
	5%	20.7	28.7
	10%	19.8	28.2
	15%	19	22.1
	20%	16.8	18.1

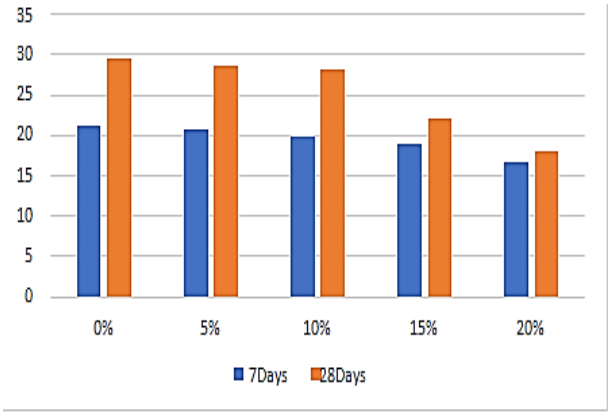

Figure 11: 2 for 7 and 28 days to compressive Strength

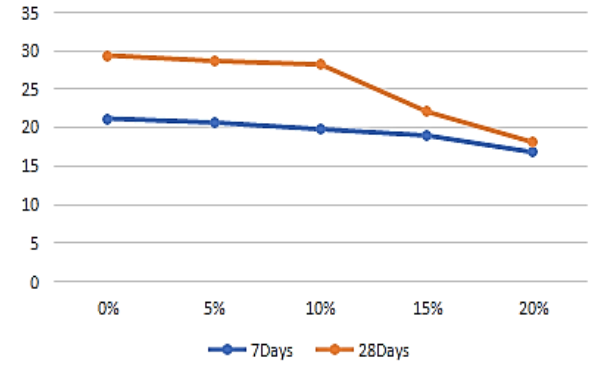

Figure 12: 1 for 7 and 28 Days Compressive Strength

H. Impact on Concrete with Different ScBA Contents on Split Tensile Strength

In table 8, we are showing the Spilt Tensile Strength of (ScBA) Concrete and shown in fig 13 and 14.

Table 8: Spilt Tensile Strength of (ScBA) Concrete

MIX	%of cement Replacement	Split Tensile Strength N/mm2	
		7 days	28 days
ScBA	0%	2.70	3.70
	5%	2.50	2.90
	10%	2.10	2.20
	15%	1.40	1.80
	20%	1.10	1.60

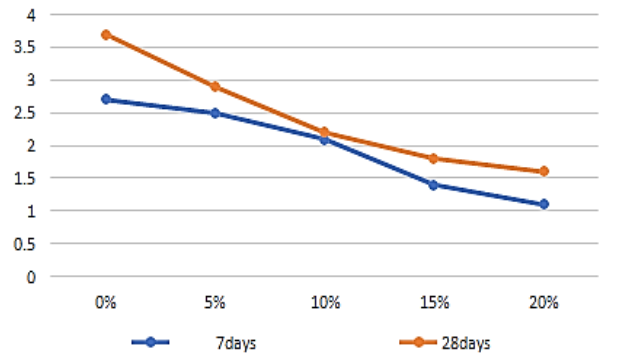

Figure 13: 1 for 7 and 28 days of Split Tensile Strength

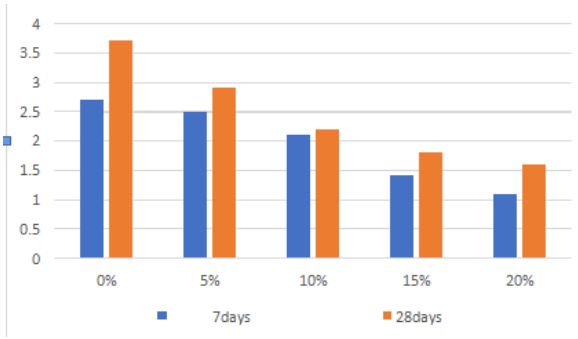

Figure 14: for 7 and 28 days of Split Tensile Strength

VI. CONCLUSIONS AND RECOMMENDATIONS

The subsequent elucidations encapsulate essential conclusions and recommendations discovered in this research:

A. Conclusions

- The utilization of bagasse ash in producing m25 grade concrete was examined. Cement was mixed with bagasse ash to produce a new substance suitable for creating concrete.In order to improve the bagasse ash and cement amalgamation, researchers conducted a series of experiments to analyse the results.
- The method opted for comprises various phases. First and foremost, it is essential to determine the objective of our concrete. Then, we select particular aspects that will alter the performance of the concrete.
- Our objective is to obtain information by experimenting with mixtures involving these components. With this information, we make a plan that will make the concrete as strong as possible.
- The way this mix operates is comparable to standard concrete. There is a possibility of decreased functionality in the concrete if more bagasse ash is incorporated into the cement mix.

B. Recommendations

- The findings of this study propose recommendations for future projects that researchers, stakeholders, and practitioners should consider.
- The utilization of bagasse ash in cement combinations could potentially serve as an effective replacement for cement, based on the findings of this study. It is cost-effective, secure, easy to carry and environmentally friendly.
- Companies that make cement and sugar, and the government should learn about the right amount of bagasse ash to mix with cement. Their efforts should extend to promoting the regular production and usage of it.
- The mixture's potency, formed of bagasse ash and cement, can be assessed by examining how it interacts with water and acid.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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