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A Study on Sustainable Concrete By Using Recycled Concrete Aggregate and Waste Glass

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ABSTRACT

Sustainable and affordable building materials are a developing concern in the construction sector. This abstract outlines a creative method for creating a cost-effective concrete mix that uses discarded glass as the fine aggregate and recycled coarse aggregate (RCA) as the main coarse material. The goal is to investigate whether using recycled materials instead of traditional aggregates is feasible while both addressing environmental issues and lowering construction costs. The proposed concrete mix's mechanical qualities, financial ramifications, and environmental impact were all compared through laboratory experiments, a thorough assessment of the literature, and comparative analysis. The scrap glass came from glass bottles and other abandoned containers, while the RCA came from crushed concrete waste. The experimental studies assessed different concrete mix proportions while taking into account various replacement amounts for RCA and waste glass. Along with other crucial qualities like workability, density, and durability, the mechanical properties including compressive strength, tensile strength, and flexural strength were evaluated. The test outcomes were contrasted with a control concrete mixture made up only of common aggregates. The results of the research show that using waste glass as fine aggregate and recycled coarse material in the making of concrete can substantially reduce building costs. The mechanical performance of the concrete was not significantly affected by the use of the RCA and waste glass in place of normal aggregates. Additionally, using these recycled materials lowers the amount of waste that is transported to landfills and helps conserve natural resources. Economic concrete mixtures that use waste glass as fine aggregate and recycled coarse material have enormous potential for green building techniques. This method is appealing for large-scale construction projects due to the lower material cost and positive environmental effects. To make sure the best mix proportions are employed, it is necessary to take the specific application into account as well as the engineering requirements. This study supports continuing initiatives to advance affordability and sustainability in the building sector. As well as studying further strategies to improve the engineering features of recycled aggregate-based concrete, future research could concentrate on examining the long-term performance and durability of the suggested concrete mix.

INTRODUCTION

Though it contributes substantially to the growth of worldwide economic benefits, the building industry also has an enormous adverse impact on the environment. Concerns include the overuse of natural resources, especially aggregates, which are essential components in concrete. Alternative strategies that address sustainability and cost-effectiveness are gaining popularity as the demand for construction materials rises.

This introduction emphasizes a study on the use of waste glass as the fine aggregate and recycled coarse aggregate (RCA) as the principal coarse material in the manufacturing of concrete. With an emphasis on the financial advantages and environmental ramifications, the goal of this study was to determine whether it was feasible to substitute recycled materials and waste glass for conventional aggregates. Utilizing recycled materials and waste glass throughout the concrete-making process aids in waste control and environmental preservation. Waste from construction and demolition projects that would often end up in landfills can instead be used to make recycled coarse aggregate. The non-biodegradable and environmentally problematic waste glass can also be successfully recycled and used as a replacement for fine aggregate in concrete. This method lessens the carbon footprint associated with the typical mining and processing of aggregate while also preventing waste from ending up in landfills and preserving natural resources.

Recycled aggregates, such as RCA, have been studied in the past when used in concrete compositions. According to research by Siddique and Kaur (2011), using RCA in concrete mixes can be a practical way to lessen the demand for natural aggregates. By repurposing construction and demolition waste, their study found that the concrete has mechanical qualities equivalent to those of regular concrete while having a much lower environmental impact.

Waste glass has also come to light as a potential replacement for traditional fine aggregate in the making of concrete, in addition to recovered coarse material. In their 2018 study, Aliabdo et al. looked into the possibility of using waste glass powder in place of some fine aggregate. According to their research, waste glass powder increased the concrete mix's workability and produced acceptable mechanical qualities. This study brought to light the possibility of using recycled glass instead of natural sand in concrete production.

These earlier studies served as inspiration for the current research, which intends to further examine the economic viability of using recycled coarse aggregate as the main coarse aggregate and waste glass as the fine aggregate in the manufacturing of concrete. The goal is to create a cost-effective concrete mix that addresses environmental concerns by keeping waste out of landfills while simultaneously lowering construction expenses.

Laboratory testing is used in this study's technique to assess the mechanical qualities of the suggested concrete mix. In comparison to a control mix made solely of conventional aggregates, a comparative analysis will be done to evaluate the financial implications and environmental impact of the recycled aggregate and waste glass-based concrete mix.

OBJECTIVES

1. To assess the technical feasibility of using recycled coarse aggregate and waste glass as aggregate replacements in concrete production.
2. To determine the optimal mix proportions of recycled coarse aggregate, waste glass, cement, water, and additional admixtures or additives to achieve desired concrete properties.
3. To evaluate the mechanical properties of the recycled aggregate and waste glass-based concrete, including compressive strength, tensile strength, and flexural strength, and compare them with a control concrete mix composed entirely of conventional aggregates.
4. To analyze the cost implications of utilizing recycled coarse aggregate and waste glass in concrete production

By achieving these goals, this study hopes to advance green building practices by offering industry-level advice on the use of recycled coarse aggregate and waste glass as aggregate replacements in concrete production. This will promote the construction industry's financial viability and environmental responsibility.

LITERATURE REVIEW

Due to its potential to address the environmental issues and cost-effectiveness related to conventional concrete production, the use of recycled coarse aggregate (RCA) as the primary coarse aggregate and waste glass as the fine aggregate has received a lot of attention in recent years. This section gives a literature review, which offers a thorough summary of earlier studies and research done in this area.

The research that looked at the usage of recycled coarse aggregate in concrete mixtures comes first in the review of the literature. Recycled aggregate concrete can attain mechanical properties that are comparable to those of traditional concrete, according to Siddique and Kaur's (2011) investigation into its characteristics. Their research showed that using RCA can lessen the need for natural aggregates and prevent the depletion of scarce resources. Siddique and Kaur also highlighted the advantages for the environment of recycling buildings and demolition trash, adding to sustainable waste management techniques.

Waste glass has also come to light as a potential replacement for traditional fine aggregate in the making of concrete, in addition to recovered coarse material. In a study conducted by Aliabdo et al. (2018), waste glass powder was investigated as a potential partial replacement for cement and fine aggregate in concrete. They found via their research that waste glass powder can improve the workability of concrete mixes while preserving acceptable mechanical qualities. This study demonstrated the possibility of using waste glass to reduce the use of natural sand resources and redirect glass trash from landfills.

The literature analysis also examines the difficulties and restrictions related to using waste glass and recovered coarse aggregate in concrete manufacturing. Potential problems include decreased workability, greater water absorption, and inferior strength qualities when compared to traditional concrete, according to certain research. Researchers have, however, suggested several approaches to deal with these difficulties, such as optimizing the mix design, using the proper admixtures, and carefully deciding on the source and caliber of recycled materials.

Another important topic covered in the literature is the viability from an economic standpoint of using waste glass and recycled aggregate in the making of concrete. Numerous studies have emphasized the potential financial benefits of recycling materials because they are frequently less expensive than traditional aggregates. The availability of materials, their processing, their transportation, and the suggested concrete mix's overall affordability in comparison to traditional concrete should all be taken into account during the cost study.

Previous Studies and Their Findings:

Siddique and Kaur (2011):

- Studied the properties of recycled aggregate concrete.
- Found that recycled aggregate concrete can achieve comparable mechanical properties to conventional concrete.
- Demonstrated that incorporating recycled coarse aggregate helps reduce the demand for natural aggregates, contributing to sustainable waste management practices.

Aliabdo et al. (2018):

- Investigated the utilization of waste glass powder as a partial replacement for cement and fine aggregate in concrete.
- Showed that waste glass powder can enhance the workability of concrete mixes while maintaining acceptable mechanical properties.
- Highlighted the potential for reducing the consumption of natural sand resources and diverting waste glass from landfills by incorporating waste glass in concrete.

Kou and Poon (2014):

- Conducted research on the use of recycled aggregate from construction and demolition waste in concrete production.
- Found that the incorporation of recycled aggregate reduced the compressive strength and elastic modulus of concrete, but the reduction was within acceptable limits.
- Suggested that optimizing the mix design, using appropriate admixtures, and ensuring proper quality control can mitigate the potential drawbacks of using recycled aggregate.

Tam et al. (2007):

- Investigated the mechanical properties and durability of concrete made with recycled concrete aggregates.
- Found that the mechanical properties, such as compressive strength and flexural strength, of concrete with recycled concrete aggregates were slightly lower than those of conventional concrete.
- Noted that the water absorption and chloride ion penetration resistance of concrete with recycled concrete aggregates were generally higher, indicating the need for proper mix design and additional measures to enhance durability.

Topçu and Canbaz (2004):

- Examined the influence of using recycled concrete aggregate on the fresh and hardened properties of concrete.
- Found that the incorporation of recycled concrete aggregate slightly reduced the workability and mechanical properties of concrete.
- suggested that the use of appropriate proportions of recycled concrete aggregate and supplementary cementitious materials can mitigate the potential negative effects on concrete performance.

Concluding Remarks

The combined results of this earlier research show that using waste glass and recovered coarse aggregate in concrete manufacturing is technically feasible. They shed light on the advantages, drawbacks, and mitigation tactics that may come with using these recycled materials. The results of these studies serve as the basis for further investigation and the creation of an industry-level technique to maximize the use of waste glass and recycled aggregate in cement while taking into account costs, environmental effects, and performance.

RESEARCH METHODOLOGY & MATERIAL DETAIL

Material Sourcing and Characterization:

a. Identify sources of recycled coarse aggregate (RCA) from crushed concrete waste. Ensure that the RCA meets relevant quality standards and has undergone proper processing and sieving to remove contaminants in the size of less than 20mm

b. Source waste glass from discarded glass bottles, containers, or industrial glass waste. Sort and clean the glass to remove any impurities or non-glass materials in sizes less than 4.75mm

Mix Proportioning and Design:

a. Determine the desired characteristics and requirements of the concrete mix, considering factors such as strength, durability, workability, and density.

b. Conduct preliminary tests to determine the optimal mix proportions of RCA, waste glass, cement, water, and any additional admixtures or additives. The mix design should aim for a balanced combination of recycled materials and conventional components. By using different proportions of RCA and waste glass.

c. Consider the specific application and engineering requirements to tailor the mix design accordingly.

Sample Preparation and Testing:

a. Prepare concrete samples using the determined mix proportions, including control samples with conventional aggregates for comparison.

b. Perform a comprehensive range of tests on the concrete samples, including compressive strength, tensile strength, flexural strength, workability (e.g., slump test), density, and durability (e.g., water absorption, chloride ion penetration). Follow relevant international or industry standards for conducting these tests.

c. Assess the mechanical properties of the recycled aggregate and waste glass-based concrete, comparing them with the control mix results. Evaluate the influence of various replacement levels of RCA and waste glass on the performance of the concrete

Cost Analysis and Economic Evaluation:

a. Determine the cost implications of using recycled coarse aggregate and waste glass in concrete production. Compare the cost of these materials to conventional aggregates, considering factors such as transportation, processing, and availability.

b. Conduct a life cycle cost analysis, considering the potential savings in material costs. Assess the overall economic feasibility and potential cost savings of implementing the proposed concrete mix on an industry scale.

Materials Description

In the building business, cement is a key component of building materials and is utilized extensively. It is a fine powder that serves as a binder, bringing aggregates together to create cement-based products like mortar and concrete. When cement and water are combined, a chemical process known as hydration occurs, creating a solid material.

Because of the importance of cement, the Indian Standards have set guidelines to follow for the make-up of cement. For the experimental program of this research study, normal Portland Cements are used.

In this work, Ordinary Portland cement (OPC) of brand Khyber (43 grade) confining to IS 8112- 1989 was used throughout the investigation. The specific gravity was 2.96 and the fineness was 2800 cm2/gather typical chemical composition of ordinary Portland cement of 43 grades is as under:

Table 1: Typical composition of Ordinary Portland cement.

CHEMICAL	WEIGHT BY PERCENTAGE
Tri-calcium silicate -C3S	55
Di-calcium silicate -C2S	18
Tri-calcium aluminate -C3A	10
Tetra-calcium Alamino ferrite -C4AF	8
Calcium sulphated hydrate -CSH2	6

Aggregate

There are mainly two types of aggregates; coarse aggregates and fine aggregates.in this research, we use crushed recycled concrete aggregate, and for fine aggregates, we will use grounded waste glass for fine aggregate. Coarse aggregates will add volume to the concrete and fine aggregates will improve permeability and we can use less cement to get the desired strength. coarse aggregates are mainly larger than 4.75mm while fine aggregates are smaller than 4.75mm in size.

If only coarse aggregates are used, they will increase the voids between the concrete and increase the permeability of water. With this, it will not give the required strength as when the water is evaporated due to sunlight it will create a honeycombed structure which will untimely reduce the strength of concrete. For reducing honeycombing and reducing the amount of cement used we use fine aggregates to make it denser as it occupies the voids formed due to coarse aggregate. When fresh aggregates are used for preparation of concrete it will get the water from the surrounding environment. In this experiment, coarse aggregates are washed with clean water to remove the dust surrounding them.

The aggregates that are oven-dried will increase the water-cement ratio as they will absorb a significant amount of water to fill the internal voids present in these particles. the increase in water cement ratio will reduce the strength of the concrete. Saturated dry aggregates will use aless water-cement ratio as their internal voids are filled with water hence, they will increase the strength of concrete. For this research, the water content for the aggregate was prepared under saturated surface drying (SSD) conditions to avoid any possible under or overestimation of water amount. As when the water-cement ratio is increased it will decrease the strength of the concrete.

Recycled concrete aggregate

The concrete crushed from demolished buildings is referred to as recycled concrete aggregate (RCA) and is used in place of natural aggregates when creating new concrete. It is a green and sustainable strategy that encourages the recycling of construction waste and lowers the need for new resources. Crushing and screening the demolished concrete to create pieces of different sizes is how recycled concrete aggregate is made. In numerous concrete applications, such as road base, sub-base, and the creation of new concrete mixtures, these fragments can therefore be utilized in place of natural aggregates.RCA has many advantages. First off, keeping concrete scraps out of landfills lessens the environmental impact of building. As less virgin aggregate needs to be extracted and processed, it also conserves natural resources. Utilizing RCA can also help reduce greenhouse gas emissions and energy use in the process of making new concrete. However, using recycled concrete aggregate may come with some difficulties. The origin of the demolished concrete and the processing techniques used, for example, can affect the quality and qualities of RCA. For RCA to be suitable for a given application and achieve the necessary performance standards, it must be properly characterized and tested. The use of recycled concrete aggregate in concrete mixtures has been the subject of growing research and development in recent years. This includes researching how it affects the long-term performance, durability, and mechanical characteristics of concrete. Recycled concrete aggregate can be successfully used to create long-lasting concrete structures with suitable design and quality control procedures.

Fig 1 Recycled concrete aggregate

Waste Glass

Recent years have seen a substantial increase in interest in the use of waste materials in the manufacturing of concrete as a result of the growing emphasis on environmentally friendly building techniques. Waste glass, which is produced by a variety of industries and households, presents a possible alternative for fine aggregate in concrete. The successful recycling of waste glass can be seen in a variety of applications, including as a cullet in the production of glass, a raw material for the manufacture of abrasives, in sandblasting, as a pozzolanic additive, in road beds, pavement, and parking lots, as raw materials to produce glass pellets or beads used in reflective paint for highways, to produce fiberglass, and as fractionators for lighting matches and firing ammunition.

Glass waste creates environmental problems because it builds up in landfills from sources like the production of glassware, bottles, and construction demolition waste. However, using discarded glass as a fine aggregate in concrete not only offers a sustainable method for getting rid of it but also may improve the quality of the concrete. Utilizing scrap glass can reduce the need for conventional fine aggregates, conserve natural resources, and lessen the environmental impact of producing concrete. Waste glass can affect a variety of qualities, including workability, strength, and durability when used as a fine aggregate in concrete. Results from earlier investigations in terms of enhanced workability and enhanced strength qualities have been encouraging.

The discarded glass materials employed in this experimental study were sourced from neighborhood stores and govt Polytechnic College Awantipora construction site disposals. Empty bottles and pure, transparent glass windows were the main sources of these materials. The entire quantity was cleaned of all contaminants and dirt before being crushed into various particle sizes in crushing equipment.

The representative waste glass samples were then subjected to a subsequent sieve analysis using the same standard process, and per the IS standards, the samples were categorized as fine aggregates. The sieve studies showed that the majority of the fine waste glass material had a pretty good gradation pattern with particle sizes ranging from 4.75 mm to 150 microns.

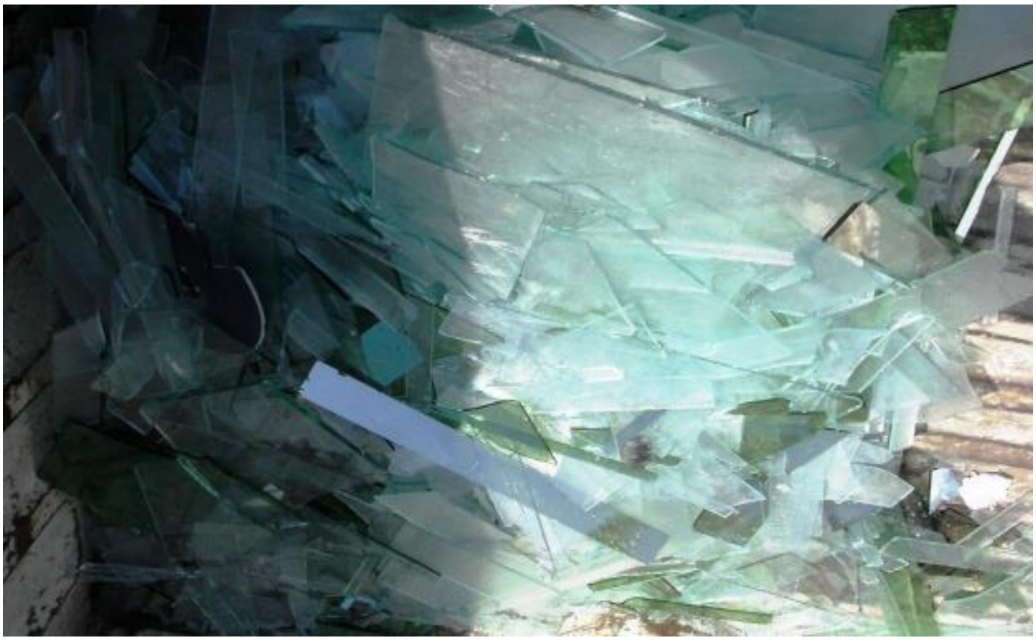

Fig 2 Shows waste glass materials as collected before crushing and sieving

Fig 3: Shows sieving of waste glass after crushing

Fig 4: Shows waste glass after sieving and cleaning

Table 2: Typical chemical composition of waste glass materials

Composition	Percentage by mass
Silica (SiO_2)	20.2-72.5
Calcium oxide (CaO)	9.7-61.9
Alumina (Al_2O_3)	0.4-4.7
Iron oxide (Fe_2O_3)	0.2-3.0
Magnesium oxide (MgO)	2.6-3.3
Sodium oxide (Na_2O)	0.19-13.7
Potassium oxide (K_2O)	0.1-0.8
Sulfur trioxide (SO_3)	0.43-0.9

Water

Water is an essential ingredient in the creation of concrete since it is responsible for the hydration process, which fuses the cement granules and creates a solid matrix. The performance, strength, and longevity of the finished concrete building can be greatly influenced by the nature and characteristics of the water used in its production. Therefore, it's crucial to make sure the water used to produce concrete adheres to certain norms and specifications. Water must be present in adequate quantities to allow the reaction to proceed fully, but if too much water is introduced, the strength of the concrete will be reduced. The ratio of water to cement is a significant idea since, in addition to the concrete mix recipe, the amount of water utilized would also affect the strength of the concrete.

More specifically, if there was insufficient water provided, the reaction would not be able to be completed and some of the cement would harden and join with other dry cement, shortening the hydration process. On the other hand, if too much water were supplied, the cement would be in a slurry solution while it was being hydrated, which would reduce the likelihood of cement bonding with aggregates. As a result, the cement component would still be in a slurry solution and lack strength once the hydration process is finished.

Water is used to start the hydration reaction, in which cement interacts with water to create a product that resembles rock. Additionally, the reaction is exothermic, meaning that heat is produced throughout the chemical processes. This is significant information since the heat emitted from particularly massive structures, such as concrete dams, may cause issues. Concrete mixing requires potable water, which is essentially water that has no discernible taste or odor. Water with a total dissolved solids content of less than 2000 ppm can be used. Thus, regular tap water was used to mix concrete throughout the testing program with care taken to ensure that contaminants were not present. Water used for mixing and curing is fresh potable water, conforming to IS: 3025 – 1964 part 22, part 23, and IS: 456 – 2000.

EXPERIMENTAL WORK

For the testing program, a series of standard compressive tests were conducted with variable amounts of recycled concrete aggregate as coarse aggregate and waste glass as fine aggregate with a water-cement ratio of 0.45. The reference samples for comparison were also castes with natural aggregate and river sand. All tests were conducted at 7 days and 28 days compressive strength accompanied by slump tests for each case of a sample. Tables 3.5 and 3.6 summarize the entire testing plan conducted within this research and note that each group in this list comprises four samples for conducting the compressive strength and the slump tests.

The major purpose of separating each testing group into four samples is to ensure that the output data points have the highest level of credibility possible and that the samples meet the minimum three-sample requirement specified by the Indian standards.

After evaluating the testing cases from the perspectives of data quality and completeness, a total of 75 testing data points were selected. The following are the reasons for excluding some of the data points:

- Samples with improper treatment and/or testing procedures.
- Tests with very abnormal outcomes.

Mix Design

The process of choosing the ratios of cement, aggregates, water, and admixtures to produce the required qualities of the concrete mixture is known as mix design in the construction industry. To give concrete the proper strength, workability, and durability, it is necessary to choose the right components, establish their quantities, figure out the water-cement ratio, and make concrete as economical as possible.The purpose of designing can be seen from the above definitions, as two-fold. The first objective is to achieve the stipulated minimum strength and durability. The second objective is to make the concrete most economically. The grades of concrete used in the present investigation are ordinary grade concrete and standard grade concrete. The mix proportions of ordinary grade and standard grade are designed as per IS: 10262-1982. The mix we used in this study is the nominal mix M25 with the general mix proportion of 1:1:2.

Mixing Of Concrete

The mixing of concrete was done using an electric mixer. The materials were placed in uniform layers one over the other in the order – coarse aggregate, fine aggregate, and cementitious material. Dry mixing was done to get a uniform color. After the dry mixing water was added to the materials to make concrete. Mixing was done for about 20min and then the samples were cast and left for 24hrs. Soon after mixing slump test and compaction factor apparatus were used to test the workability of fresh concrete under IS:10510-1983

Casting And Curing

The concrete made was according to mix design and then the cubes of size 150mm x 150mm x 150mm were casted in accordance to IS: 516-1999. After the casting was complete the samples were moulded after 24 hrs and then placed in temperature temperature-controlled curing tank containing clean fresh water. After curing is done for 7 days cubes are placed under shade.

Casting

The cube mould plates should be disassembled, and cleaned thoroughly, and all bolts should be securely fastened. Then, all of the mould’s faces should be covered in a thin layer of oil. The cube's side faces must be parallel, which is crucial.

Compaction By Hand

The compaction of concrete in the mould is done in layers and each layer should be compacted by not less than 35 strokes by a tamping rod. The bottom layer must be rodded through to its depth and the strokes must reach the underlying layer. The sides of the mould should be tapped to fill any voids left by the tamping bar.

Compaction By Vibrator

When compacting concrete by vibration, each layer should be vibrated until the desired condition is reached using an electric or pneumatic hammer, a vibrator, or a suitable vibrating table. By removing air gaps and assuring greater consolidation of the concrete mixture, vibration is used to improve the compaction process.

Curing

After casting is complete the cubes should be stored in a shade at a place free from vibration at normal temperature for 24 hrs covered in wet straw or gunny bags. After 24hrs the cubes are moulded and placed in a temperature-controlled curing tank containing fresh clean water at the temperature of 27±2 ℃ for 7 days or 28days of testing. The cubes should be tested in saturated and surface-dried conditions. Extra cubes must be cast, stored, and cured in conditions identical to those of the structure to accurately represent the strength of the concrete in that structure.

They must then be tested at the requisite age.

Fig 5. Curing tank with concrete cubes

RESULTS AND DISCUSSION

The main goals of this chapter are to assess the fresh concrete's workability and figure out the hardened concrete's compressive strength. These factors are essential for analyzing and evaluating the success of adding discarded glass elements and recycled concrete aggregate to concrete mixtures. Addressing uncertainties and potential sources of error during the data analysis process is crucial for ensuring the correctness and dependability of the results

For accurate output results, it is essential to comprehend the causes of errors. Uncertainties in the measurements can be caused by variables in the material qualities, testing methods, and environmental conditions. These causes of error can be located and taken into account so that the data analysis process can be properly handled and more precise results can be reached.

It is possible to find out a lot about the acceptability of waste glass and recycled concrete aggregate elements in the concrete mix by assessing the workability of fresh concrete, including its flowability, cohesiveness, and ability to be compacted. The overall strength and durability of the concrete using waste glass and recycled concrete aggregate can also be determined by calculating the compressive strength of hardened concrete.

This chapter strives to create a thorough understanding of the performance and viability of employing waste glass materials and recycled concrete aggregate in concrete by taking into account workability and compressive strength. The potential advantages and drawbacks of using waste glass and recycled concrete aggregate can be successfully assessed by rigorous data analysis and appropriate handling of uncertainties, advancing sustainable and environmentally friendly concrete construction techniques.

Laboratory experiments were conducted on the strength characteristics of concrete made by utilizing recycled concrete aggregate as coarse aggregate and waste glass as fine aggregate. the recycled aggregate was used in proportions of 40% 70% and 100% as replacement of coarse aggregate by weight and waste glass was used as fine aggregate for preparing M25 concrete mix. The nominal mix for M25 is 1:1:2 is used. These mixes are made with a W/C ratio of 0.5 in addition to suppressing the alkali-silica reaction, an alkali-silica inhibitor was used. a total of 75 test specimens of size 15x 15x 15cm were made and tests were performed on them to determine the compressive strength of each. There is a tendency of the reaction between the alkali in cement and silica in glass known as the Alkali-silica reaction. This reaction results in the formation of silica gel which has a tendency to swelland ultimately exerts pressure on the concrete resulting in cracking the concrete. To mitigate the alkali-silica reaction, we have used barium hydroxide as an alkali-silica reaction suppressant. The specimen was tested for compressive and durability tests at different ages and the strength was compared with normal concrete of the same nominal mix. The result concluded using recycled concrete aggregate as coarse aggregate does not affect the strength when the size of the aggregate was 12mm. The use of waste glass affects workability as it makes the concrete mix harsh. This paper recommends the use of recycled concrete aggregate and waste glass for preparing concrete which is both economical as well as has no or very little effect on strength.

It is crucial to highlight that the focus of this research study is on particular features of waste glass components' inclusion in hardened concrete compressive strength. The scope of this study does not, however, take into account some factors that might affect the compressive strength of concrete, such as different mixes of coarse and fine recycled aggregate, the effect of different admixtures, and the unique characteristics of waste glass materials. It was chosen specifically to exclude these factors to keep the research's forecasts and recommendations simple and reliable. The researchers want to offer precise and targeted insights into the potential use of recycled concrete aggregate in concrete mixtures by focusing the study's scope on a few key variables.

Coarse Aggregate

Recycled concrete aggregate from a local demolition site was collected and crushed in the size of about 20mm According to IS: 383-1970, the aggregates underwent testing. The outcomes are displayed in Table 13 below:

Table No. 3: Sieve Analysis of Recycled Concrete Aggregates(20mm).

Weight of sample taken =2000 gm					
S. No	**IS-Sieve (mm)**	**Mass Retained (gm)**	**Cumulative massretained**	**Cumulative %age mass Retained**	**Cumulative % mass passing through**
1	40	0	0	0	100
2	20	143	143	7.15	92.85
3	10	1730	1873	93.65	6.35
5	4.74	125	1998	99.9	0.1
6	2.36	0	1998	99.9	0.1
7	1.18	0	1998	99.9	0.1
8	600µ	0	1998	99.9	0.1
9	300µ	0	1998	99.9	0.1
10	150 µ	0	1998	99.9	0.1
11	Below150µ	2	2000	100	0
	Total			**Σ800.2**	

Fineness Modulus of Fine Aggregates = 800.2/100
= 8.002

Table No. 4: Physical Properties of RCA Aggregates.

Parameters	**Value**
Type	Crushed
Color	Grey
Shape	Angular
Nominal Size	20 mm
Specific Gravity	2.45
Total Water Absorption	1.5%
Fineness Modulus	8.00

Fine Aggregate

The crushed waste glass was used as a partial replacement of fine aggregate. Waste glass was crushed to a fine powder and then sieve analysis as per Indian Standard Specifications IS: 383-1970 was conducted. the results are displayed in the table.

Table No. 5: - Sieve Analysis of Fine Aggregates.

Weight of sample taken =1000 gm					
S. No	**IS-Sieve (mm)**	**Mass Retained (gm)**	**Cumulative mas Retained**	**Cumulative % mass Retained**	**Cumulative % passing through**
1	4.75	1	1	0.1	99.9
2	2.36	20	21	2.1	97.7
3	1.18	78	99	9.9	90.1
5	600µ	154	253	25.3	74.7
6	300µ	266	519	51.9	48.1
7	150 µ	423	942	94.2	5.8
8	Below150µ	58	1000	100	0
	Total	1000		**Σ283.5**	

Fineness Modulus of Fine Aggregates = 283.5÷100
= 2.835

CONCLUSION

Investigating alternative materials and methods in the construction business is not only a need but a choice in a world where environmental sustainability is of utmost importance. To create sustainable concrete, waste glass and recycled concrete aggregate (RCA) were used as important ingredients in this thesis. This research has produced important insights that highlight the practicality and variety of advantages of sustainable concrete practices through a thorough investigation. The following conclusions can be derived from the above research.

1. Marginal reduction in strength is observed at replacement of natural aggregate by 75-100% by recycled concrete aggregate and 30-40% replacement of natural sand by waste glass.
2. Recycled concrete aggregate and waste glass can be effectively used as replacements for natural coarse aggregate and sand respectively.
3. Optimum replacement of natural aggregate by RCA by 100% and sand can be effectively replaced by 30% by waste glass.
4. With the increase in RCA and waste glass, average weight decreases by 5% for a mixture with 40% waste glass and 100% content thus making waste glass concrete lightweight.
5. With the increase in RCA the water abortion in concrete decreased.
6. The workability of the mix increases with increase with increase of waste glass as fine aggregate.
7. The use of recycled aggregate can make the concrete more economical as it’s not a useful product.
8. Use of recycled concrete aggregate can help in replacing natural coarse aggregate which is limited in nature.
9. One of the main conclusions of this study is that using waste glass and RCA in the construction of concrete can significantly reduce its negative environmental effects. This strategy significantly decreases the demand for natural resources by keeping waste from building and demolition out of landfills and by lowering the need for virgin aggregates.

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