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Use Of Waste Concrete As A Reuse Ingredient In Plastering Work

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Abstract: Construction and demolition activities in India contribute significantly to the generation of waste debris, with an annual output of approximately 10-12 million tons. Although retrievable materials like bricks, wood, metal, and tiles undergo recycling in the country, a major portion of the waste, specifically concrete and masonry waste (constituting over 50% of the total), remains recycled. Despite occasional regulatory efforts, the lack of a comprehensive manual for effective Debris management exacerbates the situation.

This presentation represents a pioneering study aimed at laying the groundwork for the development of a practical manual addressing C&D waste management. It specifically focuses on processed concrete fine aggregates (RFA) obtained from C&D waste and explores their application in plaster construction. In addition to providing a concise overview of the engineering properties of processed aggregates, the study offers insights into the impact of these aggregates on both the fresh and hardened properties of concrete and plaster.

The research demonstrates that processed aggregates sourced from on-site tested concrete specimens exhibit favorable qualities, contributing to the production of high-quality concrete. This has the caliber to significantly mitigate environmental pollution stemming from construction and demolition waste. Notably, one promising avenue for the utilization of waste concrete is in plastering applications. The plastering process typically involves substantial quantities of sand, cement, and water, which, if not managed properly, can have adverse environmental effects. Alternative approaches may lead to undesirable outcomes and increased life cycle costs.

Key terms: concrete waste, construction and demolition, reuse/recycle, plaster material

I. INTRODUCTION

Concrete, with its roots dating back centuries, saw an early version resembling it used by the Minoan civilization around 2000 BC. The Romans, during the early stages of their empire around 300 BC, stumbled upon the creation of concrete by mixing sandy volcanic ash with lime mortar, resulting in a durable and water-resistant substance.

The construction and demolition activities of today generate a substantial amount of solid waste annually, prompting a focus on waste recycling as a crucial strategy to curtail environmental impacts. Concrete constitutes more than half of this waste. Given that the construction industry is a significant consumer of various raw materials, maintaining large material inventories becomes essential for sustaining growth. Aggregates, a vital component in construction, have experienced a 5% increase in demand, exceeding 21 billion tons in 2007, with growing countries such as China and India leading the surge.

With the shortage and rising costs of raw materials, there is a growing trend towards utilizing unconventional sources like , empty palm fruit bunch, swine manure, silica fume citrus peels, animal fat, fly ash, foundry sand, glass, plastic, and carpet as well as concrete aggregates in construction. This study aims to provide an initial assessment of the current practices in the construction industry, highlighting strengths and weaknesses, to inform the development of effective policies regarding the use of waste and processed materials in construction.

India's construction industry, known for its high employment intensity and significant capital outlay, constitutes approximately 50% of the capital expenditure in successive 5-year plans. The sector continues to witness a growing trend in projected investments. According to the Central Pollution Control Board, India generates around 48 million tons of solid waste annually, with the construction industry contributing to 25% of this volume. The specific waste generated by the construction industry is estimated to range from 12 to 14.7 million tons per annum.

Recycled aggregates, sourced from various structures like demolished buildings, airport runways, bridge supports, and concrete roadbeds, play a crucial role. Concrete produced using these recycled aggregates is termed recycled aggregate concrete. This type of concrete exhibits distinct characteristics that can influence the original concrete, including strength, particle size distribution, and water absorption capabilities. The recycling of demolished concrete waste not only safeguards natural resources but also contributes to the reduction of environmental pollution.

II. LITERATURE REVIEW

In the study conducted by **Mamery Sérifou et al. (2013),** an experimental program was implemented, focusing on two variables: the possibility of utilizing fresh concrete waste as recycled aggregates in concrete, involving the replacement proportions of fine and coarse aggregates at 0%, 50%, and 100% by mass. Various mechanical properties, including compressive and tensile strengths, were tested, revealing a positive correlation between the percentage of aggregate replacement and concrete properties.

Asif Husain et al. (2013) emphasize that the use of dismantled aggregate in fresh concrete not only aids in reducing solid waste on landfill sites but also contributes to environmental improvements. The study highlights a dual benefit: a decrease in mining activities and a reduction in air pollution resulting from aggregate production and transportation. The research concludes that dismantled concrete is a valuable material for recycling, promoting environmental sustainability and cost-effectiveness in concrete production.

Ali Mohd et al. (2013) conducted a comparative analysis on the basic properties of concrete made with natural aggregate and various proportions of recycled aggregate. The study aimed to determine the sustainability, strength, and other important properties of concrete using recycled aggregate as a substitute for natural aggregate. The analysis provides a comprehensive understanding of the factors influencing the compressive strength of concrete containing recycled aggregate.

Md. Safiuddin et al. (2013) underscore the significant potential for recycling demolished concrete in value-added applications to maximize economic and environmental benefits. Despite the inconsistent quality of recycled concrete aggregate (RCA) obtained from demolition, the study suggests that proper materials selection and mix design can facilitate the use of RCA in high-quality concretes, such as high-strength and self-consolidating concretes.

Shahiron Shahidan et al. (2013) offer a brief overview of recycled aggregates (RA) produced from construction and demolition waste, emphasizing their use in concrete construction. The study explores the impact of recycled aggregates on the fresh and hardened properties of concrete, with treated recycled aggregates exhibiting good quality concrete. The paper also discusses the influence of aggregates of varying sizes on compressive strength, split tensile strength, and water absorption of concrete.

Goudappa Biradar et al. (2015) highlight that recycled aggregates obtained from concrete specimens result in high-quality concrete. The study investigates various surface treatment methods to improve the quality of recycled coarse aggregate, suggesting that recycled aggregate can be used in mix designs for structural concrete elements, contributing to economic and sustainable practices.

Vikas Srivastava et al. (2015) present experimental investigations on the partial replacement of cement, fine aggregate, and coarse aggregate with different parts of demolished waste. The study evaluates the impact on the strength and workability of concrete, indicating a marginal effect on strength up to 10% replacement of cement by demolition waste powder.

Abbas G. Fathifazl et al. (2016) explore the environmental benefits of using green concrete (GC) in the construction industry. The recycling of old concrete as coarse aggregates and replacing cement with fly ash or slag is highlighted as a strategy to save fresh minerals, reduce landfill disposal, and minimize ecological degradation caused by aggregate quarrying.

K. Sreenivasa Sudheer et al. (2017) conducted experiments to search for an alternative to cement and investigated the durability properties of concrete with the replacement of cement with calcium betonies. The study observes an increase in the strength of betonies-mixed concrete with age, although compressive strengths were lower after 28 days of water curing. The durability properties were studied through sulfate and alkali attacks, revealing weight losses in both cases.

Andrey Anatolievich Shubin et al. (2017) report on the use of fiber-reinforced concrete units, highlighting their ability to maintain volume integrity even in the presence of cracks. The study emphasizes the increased crack resistance of such samples, noting equivalent physic-mechanical properties to reinforced concrete structures. The cost-effectiveness of using metal chips as filler is also emphasized, contributing to the overall reduction in product cost.

III. RESEARCH METHODOLOGY

3.1 Collection Of Raw Materials

In the context of our research, the gathering of raw materials for plastering, including experimental components, was conducted systematically. The plaster material under investigation constitutes a uniform blend of well-graded ingredients, comprising natural sand or crushed sand, Portland cement, and a portion of crushed concrete sand. This mixture is meticulously prepared in powdered form, creating a ready-to-use plaster material by adding a specified amount of water to the powdered mix.

The natural sand, an essential component, is sourced from riverbeds. The acquired sand undergoes a thorough cleaning process using a sieve with a size of 1.50 mm to eliminate any foreign materials known in the industry. Subsequently, it is sieved with an appropriate mesh size until achieving the required fineness for use in plaster. This treatment is essential to enhance the workability of the material. In one implementation of our invention, natural sand is incorporated within the range of 12-18% w/w. The selection of natural sand adheres to the particle size distribution criteria specified for grading Zone IV.

Portland cement, a readily available standard material in the market, serves as a fundamental binding agent widely utilized in the construction sector. In the formulation of the ready-mix plaster in our current invention, Portland cement is directly incorporated as binding material.In one specific implementation of this invention, usage of Portland cement falls within the range of 11-17% w/w.

The most cost-effective and straightforward method of acquiring a replacement for natural sand involves the crushing of waste concrete to produce artificial sand with the desired size and grade, devoid of impurities. The utilization of crushed sand has emerged as a viable alternative to natural sand, meeting the necessary technical, commercial, and environmental criteria. Consequently, obtaining the correct type and high-quality concrete on-site is crucial, as sand constitutes the primary matrix of mortar. When fine particles are appropriately proportioned, the resulting sand will exhibit fewer voids

In this scenario, research initiatives were initiated to explore cost-effective and readily available alternative materials to substitute for natural sand. However, acknowledging the unavoidable necessity of using natural sand, especially in certain circumstances, experimentation is planned. Specifically, mortar mixes with a ratio of 1:4 will be designed, incorporating varying replacements of natural sand with artificial sand. The focus of this experimentation lies in assessing the mechanical properties, particularly the cube compressive strength.

3.2 Basic Test Conduction

This information is used to classify the soil and to predict its behavior. The method generally used to find the grain size distribution is:

Sr.No.	Name of the test	Result	Unit	Requirements	Test Method
1	Specific gravity	**2.69**	-	-	IS 2386 P: 3 -1963
2	Water Absorption	**3.30**	%	-	IS 2386 P: 3 -1963
3	Dry Loose Bulk Density (DLBD)	**1.70**	kg/lit	-	IS 2386 P: 3 -1963
4	Material finer than 75 µ	**3.80**	%	Max 5% as per IS 1542:1992	IS 2386 P: 1 -1963

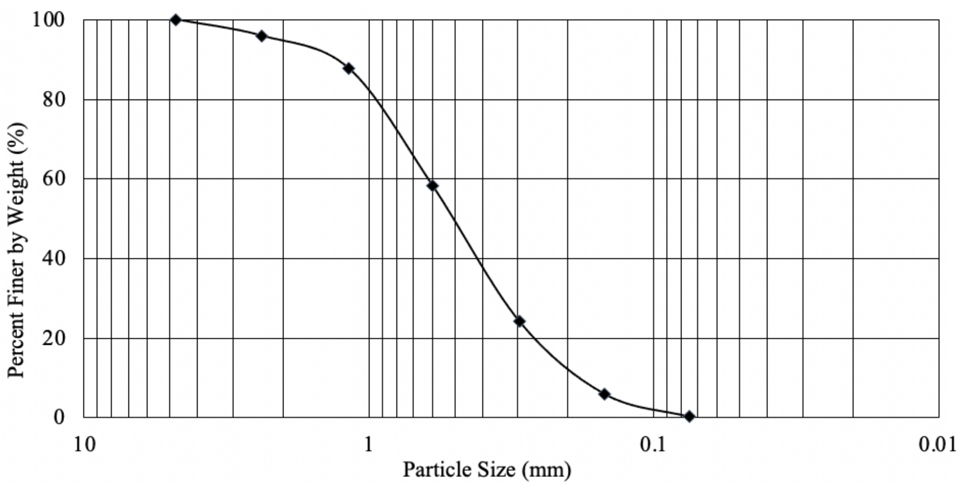
Physical properties of fine aggregate for plaster

Sr.No.	Seive Size (mm)	Percent Passing (%)	Percentage passing as per table 1 IS 1542 :1919 Grading of Sand for Internal Wall or External Wall or Celling Plaster
1	10	**100.00**	100
2	4.75	**100.00**	95-100
3	2.36	**99.25**	95-100
4	1.18	**91.22**	90-100
5	600 µ	**80.48**	**80-100**
6	300 µ	**55.08**	20-65
7	150 µ	**3.56**	0-15

Sieve analysis of fine aggregate for Plaster

Sieve analysis which is used for particle sizes larger than 0.075 mm in diameter

The grain size analysis test is performed to determine the percentage of each size of grain that is contained within a soil sample, and the results of the test can be used to produce the grain size distribution curve.



Particle size distribution curve

STRONGTECH
THE CONSTRUCTION MATERIAL TESTING LABORATORY

Test Report: Fine Aggregate (Plaster Sand)

Report No: ST230515-10-005

Client Name	Prasad Jitendra Rajput
Project / Site Details	Strongtech Laboratory Lohegaon, Pune
Sample Description	Plaster Sand
Date of report	09-11-2023
Date of Receipt	07-11-2023
Date of Testing	08-11-2023
References	A) IS: 2386-1963 (Part 1&3) B) IS: 383-2016

A) Physical properties of fine aggregates for concrete

Sr.	Name of The Test	Result	Unit	Requirements	Test Method
1.	Specific Gravity	2.69	-	-	IS: 2386-1963
2.	Water Absorption	3.30	%	-	IS: 2386-1963
3.	Dry Loose Bulk Density	1.70	Kg/lit		IS: 2386-1963
4	Material Finer than 75 micron	3.80	%	Max 5% as per IS 1554: 1992	IS: 2386-1963

Observations and calculations

B) Sieve analysis of fine aggregate for concrete

Sr.No.	Sieve Size (mm)	Percent Passing	Grading of sand for internal wall or external wall or ceiling plaster
1.	10	100	100
2.	4.75	100	95-100
3.	2.36	99.25	95-100
4.	1.18	91.22	90-100
5.	600 micron	80.48	80-100
6.	300 micron	50.08	20-65
7.	150 micron	3.56	0-15
Remark	For crushed sands the permissible limit on 150 micron IS Sieves is increased to 20%. This does not affected 5% allowances permitted in 6.3 applying to other sieve sizes.		
Note	The test report and result related to particular specimen sample of the materials as delivered received and tested in the laboratory.		

Authorized Signatory

Rajaram Pujari
(Director)

Sieve analysis Report

3.3 Finalization Of Mix To Use

Plastering involves the application of a plastic material, known as plaster, onto uneven surfaces and rough walls during the construction of buildings and other structures. This plaster is a blend of cement or lime concrete, sand, and an appropriate amount of water.

Mix Ratio of Mortar	General Usage Recommended
1:3	• As its a rich mortar mix, and it is used where external walls are prone to severe climatic conditions. • It is also used for repair works.
1:4	• Used for Ceiling and external walls
1:5	• Brickwork Mortar and for Internal Plaster
1:6	• For Internal Plaster (fine sand is available)

Mix Ratio Of Mortar

In the initial stage, a 1:4 mix ratio is commonly applied before plastering, incorporating a higher amount of water. This mixture is spread on the surface of the wall or roof to be plastered, forming a preliminary layer. Subsequently, a 1:6 mix ratio is typically employed to create a layer with minimal water, akin to wet sand. Using a straight edge, the plaster is worked to achieve the desired thickness.

For internal plastering of bricks, the recommended cement and fine aggregate mix ratio is 1:6 (1 Cement: 6 Fine Aggregate), while for external plastering, a mix ratio of 1:4 is advised. It is important to note that plastering should not exceed 12 or 15 mm in thickness on a brick wall. Similarly, on concrete surfaces, it is advisable to avoid plastering beyond 6 mm thickness in a single application.

3.4 Mixing

The mix ratio of plaster refers to the proportion of the volume of cement to the volume of sand used in the mixture. For instance, a plaster mix ratio of 1:4 implies that it comprises one part cement and four parts sand by volume. As the quantities of cement and sand vary with the mix ratio, this ratio is a crucial factor in determining the overall quantities.
In our specific case, we have chosen a 1:4 ratio, indicating one part cement, 1/2/4 parts of crushed concrete sand, and 2/3 parts of natural sand or crushed sand, depending on the percentage of crushed concrete sand utilized.
The proportions for various mix percentages of mortar with crushed concrete are as follows:
For 25% (1.1.3): 1 part cement, 1 part crushed concrete sand, 3 parts natural sand, with 20% water.
For 50% (1.2.2): 1 part cement, 2 parts crushed concrete sand, 2 parts natural sand, with 20% water.
For 100% (1.4): 1 part cement, 4 parts crushed concrete sand, with 20% water.
Samples were prepared by adding water to the dry mortar received. The water quantity was adjusted according to the dry sample. The specimen size was 70.6 x 70.6 x 70.6 mm, and the curing condition involved normal water bath curing. For each cube, 800 gm of material was required, including normal mortar cube (200 gm of cement + 600 gm of sand), 25% mix mortar cube (200 gm of cement + 400 gm of sand + 200 gm of concrete sand), 50% mix mortar cube (200 gm of cement + 300 gm of sand + 300 gm of concrete sand), and 100% concrete sand mortar cube (200 gm of cement + 600 gm of concrete sand).

3.5 Final Test

Masonry columns and foundations, particularly in residential and other masonry structures, play a crucial role in supporting the loads imposed on them. In load-bearing masonry construction, understanding the compressive strength requirements is paramount to ensure the structure's ability to withstand applied loads. Masonry walls, for instance, must possess adequate compressive strength to endure the loads from the floors above.
For the testing of compressive strength, the following apparatus is employed:
7.06 cm cubes moulds (with a 50 cm² face area)
Equipment for gauging and mixing mortar
Vibrator
Compression testing machine, and others as necessary
The procedure for determining the compressive strength of mortar involves the following steps:
Combine 200 gm of cement with 600 gm of standard sand in a mix ratio of 1:4 by weight.
The standard sand can be either River sand or Crushed Sand & Concrete Crushed Sand.
Ensure that the sand grains exhibit an angular shape, approximating a spherical form, with minimal presence of elongated and flattened grains. The standard sand should pass through a 1.18 mm IS sieve and be retained on a 90 microns IS sieve, adhering to specified particle size distribution.
Mix the cement and sand in a dry condition using a trowel for one minute, then gradually add water.
The quantity of water should be (p/4+3)% of the combined weight of cement and sand, where 'p' represents the percentage of water required to achieve standard consistency, determined earlier.
Continue mixing until the mixture attains a uniform color. The mixing time should not be less than 3 minutes and not exceed 4 minutes.
Immediately after mixing, place the mortar in the cube mould and prod it with a rod.
Prod the mortar 20 times in about 8 seconds to ensure the elimination of entrained air.
This method ensures a systematic approach to determining the compressive strength of mortar, a critical parameter in evaluating the structural integrity of masonry elements.

Utilizing a vibrator, the period of vibration should extend to 2 minutes, maintaining a specified speed of 12000±400 vibrations per minute. Following this, position the cube moulds in an environment with a temperature of 27±2°C and 90% relative humidity for a duration of 24 hours. After this incubation period, extract the cubes from the moulds and promptly immerse them in clean water until testing.

Retrieve the cubes from the water just before the testing process. During testing, position the cubes on their sides without any additional packing. The rate of loading should be a uniform 350 kg/cm2 per minute. Ensure that the testing is conducted on three cubes, and report the average value as the test result for both the 7-day and 14-day compressive strength assessments.

IV. RESULTS AND DISCUSSION

The test results obtained for the compositions 1, 2, 3 & 4 are as shown below in Table.

Table: Results of tests for the ready-mix plaster composition of the present application

Sr. No.	Id Mark	Size of Cubes			C/s Area of Cubes (mm^2)	Volume of Cubes (cm^3)	Weight (gm)	Compressive	
		L	W	H				Load (KN)	Strength (N/mm^2)
1	-	70.6	70.7	70.6	4991.4	352.4	879	167.7	33.60
2	-	70.6	70.6	70.9	4984.4	353.4	912	175.4	35.20
3	-	70.6	70.8	70.7	4998.5	353.4	878	172.9	34.60

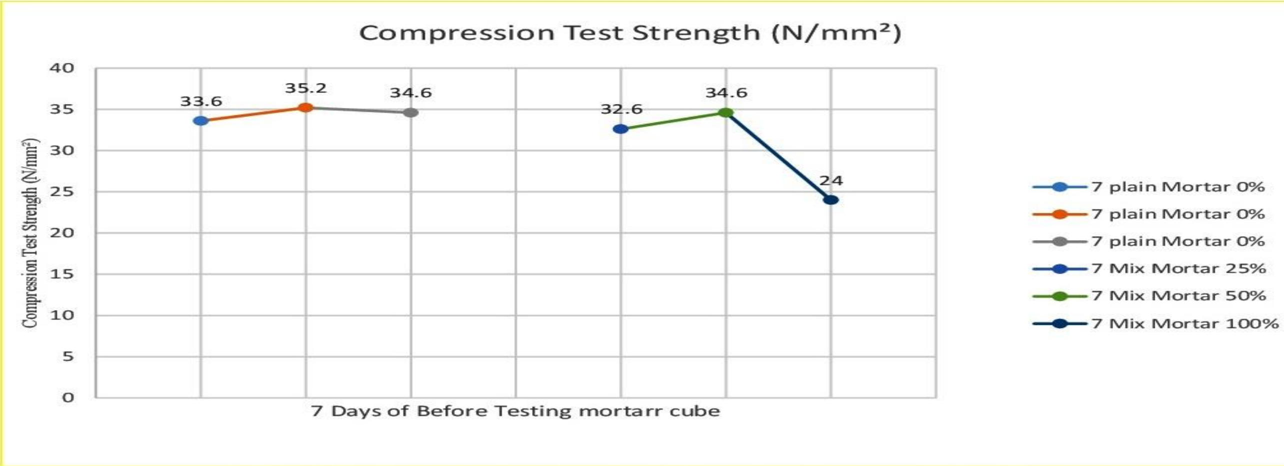
Compression Test for 7 Days for plain Mortar

Sr. No.	Id Mark	Size of Cubes			C/s Area of Cubes (mm^2)	Volume of Cubes (cm^3)	Weight (gm)	Compressive	
		L	W	H				Load (KN)	Strength (N/mm^2)
1	25%	70.5	70.6	70.6	4977.3	351.4	884	162.3	32.60
2	50%	70.6	70.3	70.7	4963.2	350.9	879	171.7	34.60
3	100%	70.3	70.6	70.9	4963.2	351.9	881	119.1	24.00

Compression Test for 7 Days for Concrete MIX Mortar

The findings reveal that the recycled mortar, formulated with 25% and 50% replacement of natural sand with waste concrete crushed sand, exhibits strength levels comparable to the reference mortar cube. However, as the replacement level exceeds this threshold, a notable decrease in strength is observed. Up to a replacement level of 50%, the mortar demonstrates nearly equivalent properties to those obtained with the utilization of waste concrete crushed sand as a substitute for natural sand.

At 7 days, the strength of recycled mortar stands at approximately 92%, 98%, and 68% concerning the reference mortar, for replacement levels of 25%, 50%, and 100% using waste powder concrete crushed sand.



Compression Test for 7 Days for Concrete MIX Mortar

The cubes exhibit comparable strength up to a mix of 25% to 50% concrete sand when compared to plain mortar cubes. However, a significant drop in strength is evident when using a 100% mix of crushed concrete sand. This decline can be attributed to the absence of natural sand in the mix, which is essential for binding the components of the cube together. Consequently, it is safe to assume that utilizing 100% crushed concrete sand is not feasible.

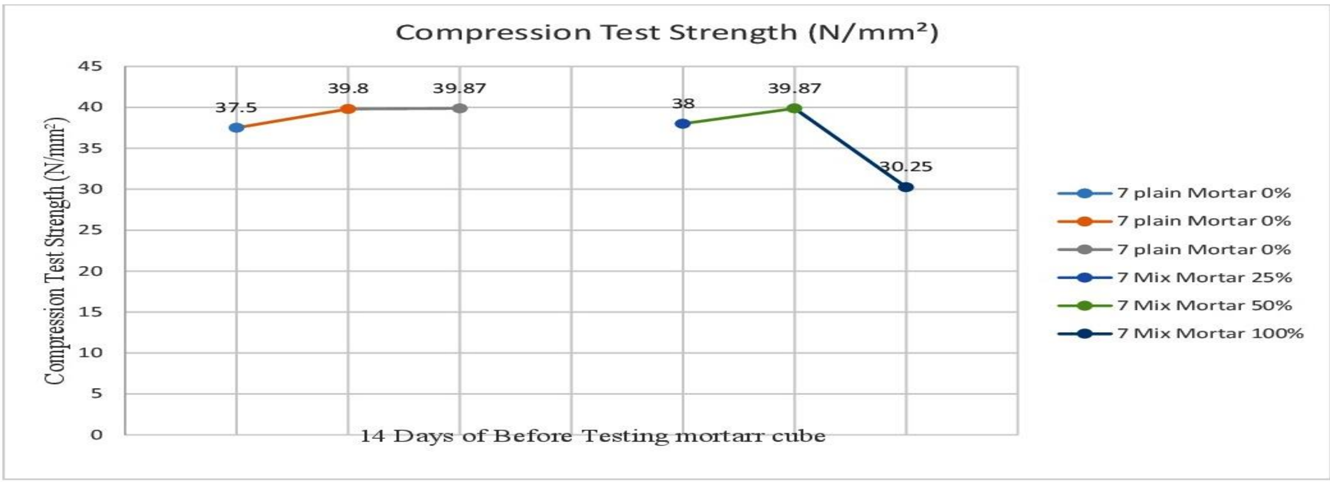
Sr. No.	Id Mark	Size of Cubes			C/s Area of Cubes (mm²)	Volume of Cubes (cm³)	Weight (gm)	Compressive	
		L	W	H				Load (KN)	Strength (N/mm²)
1	-	70.6	70.7	70.6	4991.4	352.4	879	187.2	37.50
2	-	70.6	70.6	70.9	4984.4	353.4	912	198.4	39.80
3	-	70.6	70.8	70.7	4998.5	353.4	878	199.3	39.92

Compression Test for 14 Days for plain Mortar

Sr. No.	Id Mark	Size of Cubes			C/s Area of Cubes (mm²)	Volume of Cubes (cm³)	Weight (gm)	Compressive	
		L	W	H				Load (KN)	Strength (N/mm²)
1	25%	70.6	70.7	70.6	4991.4	352.4	879	189.7	38.00
2	50%	70.6	70.6	70.9	4984.4	353.4	912	198.7	39.78
3	100%	70.6	70.8	70.7	4998.5	353.4	878	151.2	30.25

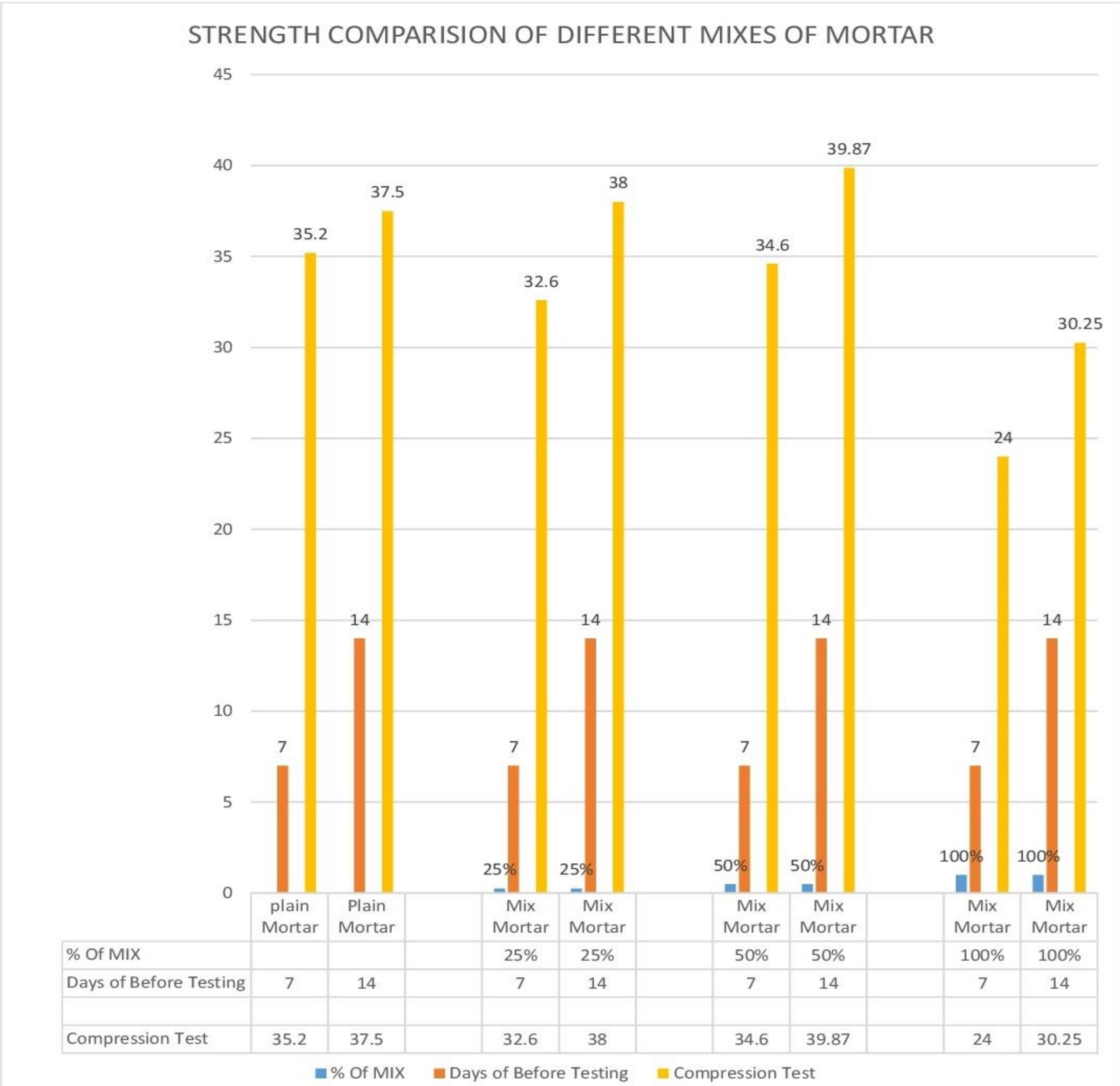
Compression Test for 14 Days for Concrete MIX Mortar

The examination indicates that the recycled mortar, incorporating 25% and 50% replacement of natural sand with waste concrete crushed sand, achieves a strength comparable to the reference mortar cube. However, beyond this replacement level, a noticeable decline in strength is evident. Up to a replacement level of 50%, the mortar closely approximates the properties obtained when waste concrete crushed sand replaces natural sand. At 14 days, the strength of recycled mortar is approximately 95%, 99%, and 75% concerning the reference mortar for replacement levels of 25%, 50%, and 100%, respectively, using waste powder concrete crushed sand.



Compression Test for 14 Days for Concrete MIX Mortar

The strength of the cubes remains relatively consistent up to a 25% to 50% mix of concrete sand compared to the plain mortar cube. However, a sudden drop in strength is evident when utilizing a 100% mix of crushed concrete sand. This decline can be attributed to the absence of natural sand in the mix, which is essential for cohesion within the cube components. Consequently, it is reasonable to infer that the complete substitution of natural sand with crushed concrete sand at a 100% level is not feasible.



Strength comparision of different mixes of mortar

This study yields several significant findings:

The water requirement for achieving consistent workability in recycled concrete sand rises proportionally with the increase in the percentage of concrete crushed sand use, regardless of the type of replacement—be it Cement or Natural sand or crushed sand.

The strength of reused concrete sand experiences minimal impact, maintaining stability up to a 10% replacement of cement with demolition waste powder. However, as the demolition waste powder content surpasses this threshold, a decline in strength is evident, particularly with a 100% replacement.

Substituting regular natural sand or crushed sand with crushed particles from demolition waste concrete is feasible up to 25% and 50% without significantly compromising strength and workability.

Replacement of natural sand in plaster with waste concrete crushed sand, up to 25% and 50%, is also achievable without substantial compromise to strength and workability.

Notably, in some instances, the 14-day strength of concrete mix equals or exceeds that of the natural sand mix in mortar.
Full replacement, at 100%, of natural sand or crushed sand is unattainable as the desired strength and workability are not achieved.
The substitution of natural sand with waste concrete proves more suitable in terms of strength, workability, cost, and environmental impact.

Recycling concrete emerges as a crucial practice, contributing to sustainable development by conserving natural resources and curbing the disposal of demolition waste from old concrete.

V. CONCLUSIONS

Implementing the recycling of waste concrete stands as a crucial step in mitigating the deposition of construction and demolition waste in landfills.

Waste concrete constitutes a substantial proportion of the annual construction debris generated.

This research delved into the strength and advantages of creating natural and recycled concrete crushed sand specifically for plaster applications.

The test outcomes revealed that the compressive strength of recycled concrete crushed sand is comparable to that of natural sand mortar mix.

The production expenses associated with recycled concrete aggregates proved to be more economical compared to their natural counterparts.

Notably, the long-term cost of producing one tonne of fine manufactured aggregate was 49% higher than that for fine recycled concrete aggregate. Additionally, the environmental costs linked to the production of recycled concrete aggregates were significantly lower than those for natural aggregates.

Consequently, the widespread adoption of commercial production of recycled concrete aggregates derived from waste concrete is advocated as a cost-effective and environmentally friendly approach for the construction industry.

VI. ACKNOWLEDGMENT

I extend our heartfelt gratitude and appreciation to all those who have contributed to the successful completion of this project on the utilization of waste concrete in plastering work. This endeavor would not have been possible without the collective efforts and support of several individuals and organizations.

VII. REFERENCES

1. Mamery Sérifou,1,2 Z. M. Sbarta\, 1 S. Yotte,3 M. O. Boffoué,2 E. Emeruwa,2 and F. Bos1, A Study of Concrete Made with Fine and Coarse Aggregates Recycled from Fresh Concrete Waste, 15 July 2013

2. Ali Mohd, Mohd. Asif, Vikas Kumar, Karunesh Bali, Faizan Hafeez Khan, Dr. Arvind Dewangan, Comparative Analysis of Concrete Using Recycled Aggregate , August 2018

3. Md. Safiuddina,1, Ubagaram Johnson Alengaramb,2, Md. Moshiur Rahmanb,3 , Md. Abdus Salamb,4, and Mohd. Zamin Jumaatb,5, USE OF RECYCLED CONCRETE AGGREGATE IN CONCRETE: A REVIEW, 22 December 2013

4. Shahiron Shahidana*, Mohamad Azim Mohammad Azmib , Kumanan Kupusamyc Sharifah Salwa Mohd Zukid , Noorwirdawati Alie, Utilizing Construction and Demolition (C&D) Waste as Recycled Aggregates (RA) in Concrete, 2017

5. Vikas Srivastava, Mohd Monish, Raushan Ranjan and P. K. MehtaDemolition, Waste in Concrete, 2015

6. Abbas, G. Fathifazl, O.B. Isgor, A.G. Razaqpur, B. Fournier, S. Foo, Environmental Benefits of Green Concrete, 2016

7. K. Sreenivasa Sudheer1* , P. Praneet Sai Kumar2 , M. Achyutha Kumar Reddy3 & V. Ranga Rao4,A Study on Durability of Concrete by Partial Replacement of Cement with Bentonite, 2017

8. Andrey Anatolievich Shubin, Pavel Kirillovich Tulin and Irina Vitalyevna Potseshkovskaya, Research of the Effect of the Concrete Reinforcement Structure on the Stress-Strain State of Structures, Number 8 (2017)

9. G.Lalitha, C.Sashidhar, C.Ramachandrudu, Experimental Research on Strength Properties of Concrete (M60) Partially Fine Aggregate Replaced with Waste Crushed Glass, November 2019

10. Archis Churi, A. P. Biswas, Selection Model For Plaster Materials On Construction Sites Using AHP, SEPTEMBER 2019

11. Boris Vasilyevich Zhadanovsky a , Vladimir Evgenievich Bazanov b*, Rational Organizational and Technological Solutions for Plastering, 5, May, 2020

12. Eric A. Ohemeng*, Stephen O. Ekolu, Comparative analysis on costs and benefits of producing natural and recycled concrete aggregates: A South African case study, 16 October 2020

13. Ganesh D. Awchat1*, Madhav B. Kumthekar2, Cost-benefit Analysis of Using Recycled Coarse Aggregate in Plain and Fibre Reinforced, Published: 2021.08.16,

.