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Demolished Building Waste Concrete Reused for Construction

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A B S T R A C T

This study looks into the viability and advantages of using recycled concrete from demolished buildings in construction methods. This study examines the environmental, economic, and social implications of this sustainable method through an empirical analysis and assessment of the literature. Conservation of resources, waste minimization, cost-effectiveness, and community involvement are important factors. Crushing, screening, and sorting are some of the methods that are considered while processing reused concrete to fulfill quality criteria. The results demonstrate the possibility of considerable financial savings, improved community connections, and decreased environmental effect. This study teaches stakeholders on the benefits of incorporating recycled materials into building projects and advances sustainable construction practices.

Keywords: Sustainable construction, Reuse, Demolished building waste, Concrete, Environmental impact, Cost savings, Community relations

1. INTRODUCTION

The construction industry is undergoing a paradigm shift towards sustainability, driven by increasing environmental concerns and the imperative to conserve resources. In this context, the reuse of demolished building waste concrete emerges as a promising strategy to address environmental challenges while meeting the growing demand for construction materials. This project focuses on exploring the feasibility and benefits of incorporating recycled concrete into construction practices, thereby advancing the principles of sustainable development.

The rapid pace of urbanization and infrastructure development has led to a surge in demolition activities, resulting in large quantities of concrete waste. Traditional disposal methods, such as landfilling, not only contribute to environmental degradation but also represent a missed opportunity for resource recovery. By repurposing this waste as a valuable construction material, we can mitigate the environmental impact of demolition while minimizing the need for virgin aggregates and cement production.

The concept of sustainable construction encompasses various dimensions, including environmental, economic, and social aspects. Reusing demolished building waste concrete aligns with these dimensions by reducing carbon emissions, conserving natural resources, and fostering community engagement through waste reduction initiatives. Moreover, sustainable construction practices offer tangible benefits such as cost savings, improved project resilience, and enhanced stakeholder satisfaction.

This project seeks to delve into the technical aspects of recycling concrete, including processing techniques, quality assessment methods, and performance evaluation. By conducting comprehensive research and empirical analysis, we aim to provide insights into the practical implementation of recycled concrete in construction projects. Ultimately, this endeavor contributes to advancing sustainable construction practices and promoting a more resilient and resource-efficient built environment for future generations.

2. MATERIAL CHARACTERIZATION

2.1 CEMENT

The OPC 43 grade cement, made by ACC, was chosen for the project. It was picked with care to make sure there were no air-set lumps, ensuring the best possible performance during the concrete production process. OPC 43-grade cement is appropriate for a variety of construction applications because it provides a well-balanced combination of strength and workability. Because it is made from recycled concrete from demolished buildings, its quality and consistency help the project achieve its goal of sustainable construction.

2.2 AGGREGATES

Sand and readily available aggregates were used as coarse and fine aggregates for the project, respectively. Aggregates with a max size of 20 mm and sand with a maximum size of 4.75 mm were used. This meticulous selection guarantees appropriate gradation and improves the concrete mix's workability and strength. The project hopes to maximize recycled concrete's performance and advance environmentally friendly building methods by following these guidelines.

Sieve Size (mm)	Weight Retained (g)	Cumulative Weight of Retained (g)	Cumulative % Retained	% Passing
80	0	0	0	100
40	0.950	0.95	19	81
25	0.210	1.16	23.2	77.8
20	0.625	1.78	35.7	64.3
16	0.865	2.65	53	47
12.5	0.960	3.64	72.6	27.4
10	0.420	4.05	81	19
6.3	0.820	4.87	97.4	2.6
4.74	0.070	4.94	98.8	1.2
2.65	0.600	5	100	0
Total	5.520	29.04	580.76	-

Table 1: Sieve analysis test on coarse aggregate

Fig 1: sieve analysis test on coarse aggregate

2,3 WATER

Fresh potable water was utilized for the project, ensuring optimal hydration of the concrete mix. This choice maintains the quality and integrity of the construction materials, promoting durability and sustainability.

2.4 MATERIAL CHARACTERIZATION FOR AGGREGATE

❖ Various investigations are conducted on aggregates to evaluate their properties before using them in traditional concrete.

TEST RESULTS	NATURAL AGGREAGATES	
Size	Fine Aggregates	Coarse Aggregates
Specific Gravity	2.65	2.68
Water Absorption(%)	0.96	0.98

Table 2: Results of specific gravity test on Natural Aggregate

2.5 RECYCLED AGGREGATE

- The pieces of concrete are separated out from the demolition wastes which are useful for recycling concrete.

- Manual separation with hands using hand gloves is adopted for separation of other matter for demolition waste.
- After sorting the demolition waste is crushed manually with the hammers to the standard size of aggregate
- For small quantity, manual crushing is adopted on industrial level various types of mechanical crushes can be used for ease in operation

2.5.1 PROPERTIES OF DEMOLITION WASTE

TEST FOR PARTICLE SIZE AND SHAPE

- after crushing operation the obtained recycled concrete aggregates are thoroughly wetted and surface dried in order to remove dust, dirt etc…
- All recycled concrete aggregates are less than 10mm (IS Sieve) and major are less than 4.75 mm(IS Sieve)
- Sieve analysis on recycled concrete aggregate is performed in order to classify it according to IS classification

Fig 2: recycled aggregate

3. METHODOLOGY

- ✓ Literature review on sustainable construction practices.
- ✓ Assessment of demolished building waste concrete composition.
- ✓ Selection of appropriate processing methods (crushing, screening, sorting).
- ✓ Evaluation of recycled concrete quality standards.
- ✓ Identification of suitable cement type and aggregate specifications.
- ✓ Testing of concrete mix proportions for strength and workability.
- ✓ Examination of environmental impact reduction potential.
- ✓ Cost analysis comparing recycled concrete to traditional materials.

MIX DESIGN

Data required for mix proportioning is as follows

1	Design Grade of concrete	M20
2	Characteristic strength of concrete (Mpa)	20
3	Target Mean Strength (Mpa)	26.6
4	Exposure condition	mild
5	type of cement	OPC 43 grade
6	Nominal size of aggregate	20mm
7	specific gravity of Cement	3.15

Table 3: General data for Mix Design

Design for M-20 concrete

Type of exposure: Mild

Fck = fck + ts

Fck= 20 + (4*1.65)

Fck = 26.6 N/mm^2

Selecting water cement ratio as 0.5

Selecting maximum size of aggregate as 20mm, So the entrapped air 2%

Net volume of concrete = 100 – 2 = 98%

Water content (for 20 mm) =186 kg

For ever 25 mm add 3% (IS-10262-cl.5.3) 186+6% of 186 = 197kg

For super plasticizer reduce 20% (197-20% of 197) = 157.6 kg

Calculation of cement content

Cement content = water content / water cement ratio

= 157.6 / 0.5 = 315 kg/m^3

Cement content = 315 kg/m^3

Aggregate proportion between C.A & F.A.

For zone – II – 0.62 (w/c – 0.5)

Every 0.05 increase reduce 0.01

0.62-0.01 = 0.61

For pump able concrete C.A can be reduced up to 10%

Volume of coarse aggregate =0.61-(10% of 0.61) = 0.549

Mix calculation:

a) volume of concrete – 1m^3

b) Volume of cement = (mass / specific gravity) x (1/1000)

= 315/(3.16 x 1000) = 0.099 m^3

c) volume of water = (mass / specific gravity) x (1/1000)

= 157.6/(1 x 1000) = 0.158 m^3

d) volume of admixture = (mass / specific gravity) x (1/1000)

= (1.1/100) x 315 /315/(1.12 x 1000) = 0.0031 m^3

e) volume of all in aggregate = 1-(b+c+d) = 1- (0.099+0.158+0.0031)=0.740

f) mass of coarse aggregate = Volume of all in aggregate X volume of C.A X specific gravity of CA X 1110 kg

g) Mass of fine aggregate= Volume of all in aggregate X volume of FA X specific gravity of FA X 100

= 0.740 x 0.451 x 2.46 x 1000

= 821 kg

MATERIAL	**PROPORTIONS**	**PER CUBIC VOLUME**
water	0.5	157.6 Kg/m3
cement	1	315 Kg/m3
fine aggregate	2.63	821 Kg/m3
coarse aggregate	3.56	1110 Kg/m3
Admixture	1.10%	3.465 Kg/m3
W/C ratio		0.5

Table 4: concrete mix design data

REPLACEMENT	WEIGHT OF COARSE AGGREGATE
20%	222Kg/m3
30%	333Kg/m3
40%	444 Kg/m3

Table 5: replacement of coarse aggregate with recycled aggregate

5. EXPERIMENTAL PROGRAMME

5.1 SPECIMEN DETAILS

Cubes = 150*150*150

5.2 MIXING OF CONCRETE

To avoid losing any water or other ingredients, gently mix the concrete using a trowel. Each batch of concrete is made big enough to have around 10% more when all the test specimens needed are molded.

5.3 MOULD

The mold was made of a robust enough metal to prevent distortion. The molded specimens may be removed more easily and damage-free thanks to its design. The cube mold comes with a base plate that has a 150 X 150 X 150 mm flat surface.

When assembling the mold for use, a thin layer of mold oil is rubbed over the joints between the components to make sure that no water leaks out during the filling process. Between the contact surfaces of the bottom, an identical coating of oil is placed. A thin layer of mold oil is put within the constructed mold to prevent concrete from adhering to the interior surface.

Fig 3: casting on concrete

5.4 TEST ON FRESH CONCRETE

5.4.1 SLUMP CONE TEST

A common method for determining the consistency and workability of new concrete is the slump cone test. In this test, freshly mixed concrete is layered into a truncated cone-shaped metal mold called a slump cone, and the mixture is crushed with a tamping rod. The cone is carefully raised vertically after filling to let the concrete settle and spread. The "slump" value is calculated as the height difference between the initial and settled concrete surfaces. This number helps determine the concrete's viability for building applications that call for particular workability levels by indicating the concrete's degree of deformability.

MIX	SLUMP (cm)	AIR CONTENT (%)
Natural aggregate concrete	18 ± 0.7	1.6 ±0.3
recycled aggregate concrete 30	19.3 ± 1.5	1.8 ± 0.1

recycled aggregate concrete 65	18.5 ± 1.0	2.0 ± 0.2
recycled aggregate concrete 100	20 ± 1.4	2.5 ± 0.2

Table 6 : slump cone test for fresh concrete

5.5 TEST ON HARDENED CONCRETE

5.5.1 COMPRESSIVE TEST

One important method for determining the durability and strength of concrete is the compressive test. Concrete specimens in the shape of cylinders or cubes are made and dried under carefully monitored circumstances for this test. Following the curing time, the specimens are put into a hydraulic testing apparatus, which compresses them until failure happens. The concrete's compressive strength is determined by recording the maximum load at failure and using that information. By confirming that the concrete satisfies design specifications and is capable of withstanding the stresses it will experience during use, this strength measurement is essential to confirming the structural integrity and safety of the material during building projects.

TYPE OF MIX	**7 DAYS (N/mm^2)**	**28 DAYS (N/mm^2)**
Natural	14.9	22
20%	13.87	20.1
30%	13.56	19.9
40%	12.9	19

Table 7 : Results of compressive test on concrete

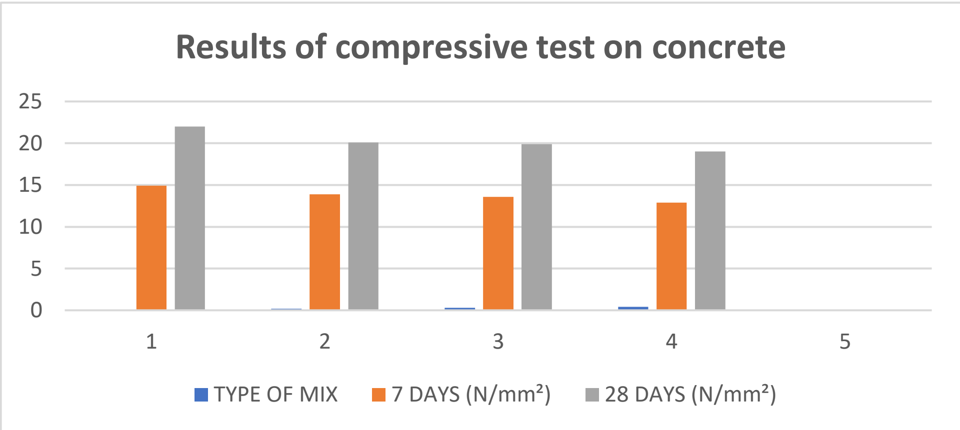

Fig 4:Result of compressive test on concrete

Fig 5: compressive test on concrete

CONCLUSION

In conclusion, the project on sustainable construction through reusing demolished building waste concrete underscores the viability and benefits of integrating recycled materials into construction practices. Through thorough analysis and experimentation, it has been demonstrated that recycled concrete, when processed properly and combined with appropriate cement and aggregates, can meet quality standards and offer comparable performance to traditional concrete. The utilization of recycled materials not only reduces environmental impact and waste but also contributes to cost savings and community engagement. Moving forward, adopting such sustainable approaches is crucial for fostering environmentally responsible construction practices and promoting long-term sustainability in the built environment.

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