Strength Analysis of Concrete Using Demolished Waste Material as Replacement of Coarse Aggregates

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Abstract- *This experimental investigation examines the use of crushed concrete for construction. The appropriate disposal of destroyed concrete is essential since it takes up a lot of space. Only a portion of this trash has been turned into something valuable. The present study's main focus is on repurposing demolished concrete to reduce construction costs and deal with housing challenges in low-income areas throughout the world. Numerous experiments were conducted to determine the material's mixing capabilities prior to producing new concrete. To get the necessary aggregate sizes, the leftover concrete from the demolition is sorted using sieves. This investigation suggests that the shattered concrete may have originated from a building site where superior concrete was being made. The investigative analysis has been refined to identify the cause of recycled concrete's compressive strength for the study at days 7 and 28. The compression strength concrete that was thusly investigated was compared to standard concrete strength. The study's results showed that, after 28 days, concrete with up to 50% of its coarse aggregate replaced with damaged concrete had achieved compressive strengths comparable to those of regular concrete.*

Keywords- Demolished Concrete, conventional concrete, compressive strength, Slump test, M 20 Grade.

I. INTRODUCTION

A considerable quantity of solid waste is produced each year as a consequence of the creation and disposal of rubbish. This has led to the development of waste recycling as a key priority in order to lessen rubbish and to moderate the undesirable effects of construction activities on the environment. Thus, recycling has become a typical component in the development industry. The trash produced during the construction, renovation, or destruction of any sort of structure, including buildings, roads, and bridges, is known as construction and demolition (C&D) waste. Common waste materials include Portland cement concrete, asphalt concrete, wood, drywall, asphalt shingles, metal, cardboard, plastic, and soil. It is now gaining the most attention as concerns about the effects of this waste material on the environment have escalated. When building, protecting, or demolishing a structure, builders, contractors, and developers should consider where to place the debris. Research, trials, and studies are being carried out to uncover new ideas on how to find solutions, taking into consideration where else to deposit these garbage and what can be done to limit their disposal to landfills, as most people do for environmental preservation and economical advantage. It is crucial to think about possible solutions since the environmental problem with trash disposal to landfills is becoming worse. [9] Recycling is a crucial step in supplying the construction industry with an advantageous supply of material. Concrete recycling is a technique that combines building waste, residual recycled coarse aggregates, and supplies for paving roads. Concrete recycling enables waste to be reused while maintaining cost savings. The environmental preservation of the environment was not given much consideration when recycled coarse aggregate structural material was dumped in landfills and dumping pits in the past. The concrete produced from such a combination has a lower density since the recycled coarse particles are lighter than the native aggregate. The recycled coarse aggregates, on the other hand, are more effective at absorbing water than the natural aggregate. Concrete constructed from recycled coarse aggregates may be utilized in places where extra strength is not required, such as in reinforced concrete pavements and low-rising constructions.

II. MATERIALS AND METHODOLOGY

Cement: O.P.C. 43 grade was used, and its physical characteristics were evaluated in accordance with IS: 4031- Part 4 - 1988 before beginning to confirm to various standards in accordance with IS: 8112 - 1989, as shown in table 1.

Table 1: Tests on Cement

Sr. No.	Properties	Value
1.	Standard consistency	33%
2.	Initial setting time	45 min
3.	Final setting time	385 min
4.	Fineness	2%
5.	Specific gravity	3.15

Fine Aggregates: To this experimental inquiry, natural sand purchased from a market in the immediate area is being used as fine aggregate. Table 2 presents the findings of the tests conducted on the fine aggregate.

Table 2: Tests on Fine Aggregate.

Sr. No.	Properties	Value
1.	Zone	II
2.	Specific gravity	2.5
3.	Fineness	3.76
4.	Water Absorption	0.59%
5.	Surface texture	smooth

Coarse Aggregates: Table 3 tests the characteristics of coarse aggregate and displays the results.

Table 3: Tests on Coarse Aggregate

Sr. No.	Properties	Value
1.	Zone	II
2.	Specific gravity	2.5
3.	Fineness	3.76
4.	Water Absorption	0.59%
5.	Surface texture	smooth

Recycled Coarse Aggregate: The 20mm crushed recycled coarse aggregates were sourced from adjacent building projects that were in the area. Table 4 lists the characteristics of R.C.A. after testing.

Table 4: Tests on Recycled Coarse Aggregates

Sr. No.	Properties	Value
1.	Specific gravity	2.36
2.	Fineness Modulus	7.70
3.	Water absorption	2.40%
4.	Particle shape	angular
5.	Impact value	19.18%
6.	Los Angles abrasion value	25.55%

Water: Due to its involvement in the chemical process involving cement and water, water is crucial in the creation of concrete. Water causes a gel to develop, aiding in the improvement of concrete strength. Portable water was employed in this experimental research to mix the concrete and cure the cast cubes.

METHODOLOGY

Concrete that substitutes recycled coarse aggregates for other coarse aggregate sources is estimated using concrete specimen testing. Concrete is a mixture of cement, water, fine, and coarse particles. Recycled coarse aggregates are used to replace concrete by changing the replacement ratio. With the aim of obtaining the optimal level, recycled coarse aggregates are used as a partial component of coarse aggregate in the ranges of 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, and 100%. For the compression test, 66 150x150x150mm cubes of recycled coarse aggregates and several variation mixtures were cast. After casting for 24 hours, the concrete cubes are unsealed and allowed to cure in a tank with portable water. On days 7 and 28 after curing, the cubes are taken out and evaluated as necessary in order to be ready for the compression test on day 28. then compare M20 design combines the benefits of control cubes.

MIX DESIGN

Concrete mix design is the process of choosing suitable concrete ingredients and figuring out how much of each there should be in order to produce concrete that is as strong, long-lasting, and workable as feasible. The mix ratio for the concrete is shown in Table 5. (1:1.66:3.10).

Table 5: Mix Proportions of Concrete Materials

Percentage Recycled coarse aggregates	Weight of Cement (kg/m^3)	Weight of C.A. (kg/m^3)	Weight of Recycled coarse aggregate (kg/m^3)	Weight of Water (kg/m^3)	Weight of F.A. (kg/m^3)
0%	384	1190.89	0	192	640.3
10%	384	1071.801	119.089	192	640.3
20%	384	952.712	238.178	192	640.3
30%	384	833.623	357.267	192	640.3
40%	384	714.534	476.356	192	640.3
50%	384	595.445	595.445	192	640.3
60%	384	476.356	714.534	192	640.3
70%	384	357.267	833.623	192	640.3
80%	384	238.178	952.712	192	640.3
90%	384	119.089	1071.801	192	640.3
100%	384	0	1190.89	192	640.3

III. WASTE MANAGEMENT

In place of natural coarse aggregates, demolished trash is combined with the concrete. This waste must be disposed of safely, which requires a lot of room, costs money, and pollutes the environment. Recycled coarse aggregates can only be utilized safely in the construction industry. Concrete costs, required area, and environmental pollution are all decreased when R.C.A. is utilized as a substitute material in concrete. Recycled coarse aggregates have already been shown to be an acceptable cement alternative by several academics. In this experimental study, recycled coarse aggregates are used in concrete as a replacement for natural coarse aggregates. For the purposes of this study, M20 grade concrete is prepared, and tests are carried out using various replacement coarse aggregates made from demolition waste at varying percentages, including 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, and 100% in concrete that has been made with recycled coarse aggregates.

IV. RESULTS AND DISCUSSION

In this research, several tests are used to determine the strength and other properties of the concrete cubes that have been cast. The major objective of the inquiry is to increase the concrete's established strength at various testing days after curing.

Slump Cone Test:

The workability test findings, which were derived from the slump test, were obtained by substituting various amounts of recycled coarse aggregates created from demolition waste for the natural coarse aggregates. The findings of the research indicate that workability somewhat diminishes when recycled materials replace natural coarse aggregates in construction projects. The slump values in proportion to the replacement percentages of recycled coarse aggregates are shown in Table 6 and Figure 1.

Table 6: Slump value of Concrete Mix

Percentage Replacement	Slump Value
0%	93
10%	92
20%	92
30%	90
40%	87
50%	86
60%	85.5
70%	82.8
80%	82
90%	81
100%	80

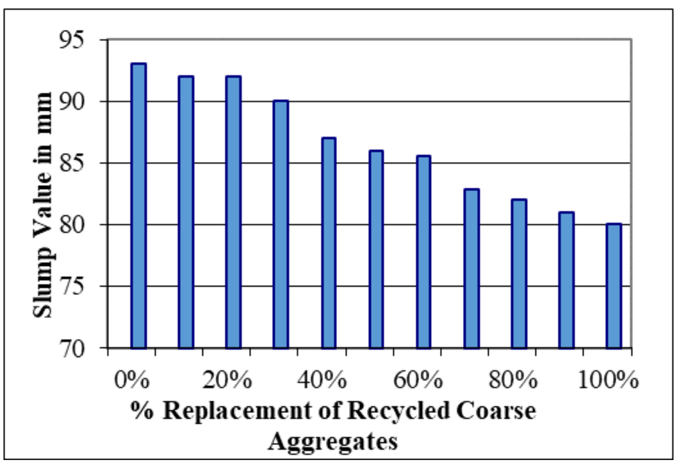

Figure1: Slump values Variations

Compressive Strength Test:

Table 7 displays the overarching findings of a compressive strength test conducted on concrete in which natural coarse aggregates were substituted with varied percentages of recycled materials. A graph very much like the one in Graph may be used to graphically demonstrate the variation in compressive strength that occurs when varying the amount of recycled coarse aggregates that are used in lieu of natural coarse aggregates. Table 7 and Figure 2 provide the findings of compressive strength testing conducted at ages 7 and 28 respectively.

Table 7: Compressive Strength on Concrete M20 Cubes

Percentage Recycled coarse aggregates	7- days	28- days
0%	19.55	29.18
10%	19.52	29.03
20%	19.44	28.84
30%	19.34	28.4
40%	18.92	27.92
50%	18.4	26.58
60%	17.44	25.33
70%	16.99	24.47
80%	15.84	23.44
90%	14.5	22.5
100%	14.29	22.4

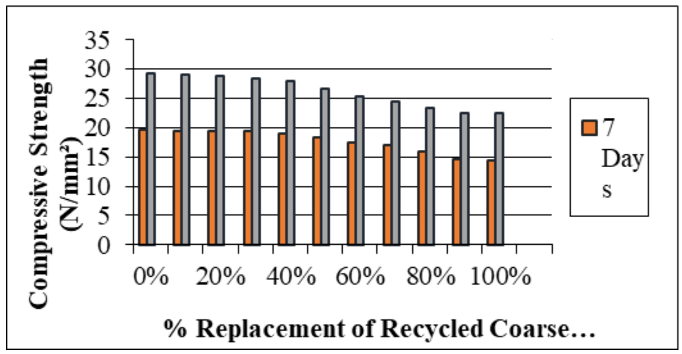

Figure 2: Compressive Strength Variations

V. COST ANALYSIS

This research contrasts modified concrete produced by substituting 10% to 100% of natural coarse particles with recycled coarse aggregates with conventional concrete produced from 1 m3 of M20 grade concrete with O.P.C. 43 grade. The material ratios for mix 1:1.66:3.10 and the manufacturing costs for all concrete mixes are shown in Table 8.

Sr. No.	Concrete Mix	Coarse Aggregates (Rs.)	Recycled Coarse Aggregates (Rs)	Fine aggregates (Rs.)	Cement (Rs.)	Total cost for $1m^3$ concrete (Rs)
1.	0%	893.17	0	1280.60	2457.6	4621.11
2.	10%	803.85	21.20	1280.60	2457.6	4553.00
3.	20%	714.53	42.40	1280.60	2457.6	4484.87
4.	30%	625.22	63.59	1280.60	2457.6	4416.75
5.	40%	535.90	84.79	1280.60	2457.6	4348.63
6.	50%	446.58	105.99	1280.60	2457.6	4280.51
7.	60%	357.27	127.19	1280.60	2457.6	4212.40
8.	70%	267.95	148.38	1280.60	2457.6	4144.27
9.	80%	178.63	169.58	1280.60	2457.6	4076.15
10.	90%	89.32	190.78	1280.60	2457.6	4008.04
11.	100%	0	211.98	1280.60	2457.6	3939.92

VI. CONCLUSION

- The current experimental research shows how well demolition trash may be used as a substitute for certain natural aggregates in the construction industry.
- By employing recycled aggregate in construction, less expensive excavation and less energy-intensive raw material transportation are needed. As a result, the negative effects of trash on the ecosystem are swiftly reduced.
- Destroyed concrete is a kind of debris that is introduced in place of the concrete's naturally existing coarse particles.
- When comparing M20 grade concrete to standard concrete, using demolition trash from previously damaged concrete leads in a 50% reduction in the need of natural aggregate. It is the best option for concrete, saving 340.60 rupees per m3.
- Why By using concrete made from demolished aggregates to construct roads, truck-related pollution may be reduced.
- • • According to IS: 2386, a test on aggregates from demolished buildings produced favorable results when compared to natural coarse aggregates.

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