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# TO CONDUCT A COMPRESSIVE STRENGTH TEST TO EXAMINE THE STRENGTH OF THE AGGREGATE FROM THE DESTROYED CONCRETE

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## Abstract

Over the course of the past several decades, the recycling of waste goods has become an increasingly essential method for the production of new products that are acceptable for the environment that is sustainable. The increase in population has led to an increase in the need for new building, which is the reason why the infrastructure business in India has become the second largest market for the country, after agriculture. This experimental inquiry demonstrates that the concrete that has been destroyed and retrieved from the site may be used to produce concrete of a high quality. During the seventh and twenty-eighth days, the experimental research was carried out in order to evaluate the compressive strength of recycled concrete. Comparative analysis was performed between the compressive strength that was observed and the strength of standard concrete. The results of the tests shown that the compressive strength of recycled concrete (with coarse aggregate replacement of up to fifty percent by destroyed concrete) at the end of twenty-eight days is equivalent to that of conventional concrete on the same day.

***Keywords: Recycled coarse aggregates, Concrete mix design, Mechanical properties, Durability characteristics, Workability.***

## 1. INTRODUCTION

In this research the planned concrete is exposed to compressive strength test to evaluate the strength and other characteristics of the casted concrete. The primary objective of the research is to monitor the developed strength obtained by the concrete at different testing days following curing. Generally good casting and curing of concrete will improve the strength of the concrete.

In this Study the casted cubes of concrete are examined to evaluate the strength and other characteristics of the casted concrete cubes. The main aim of the research is to optimize the established strength obtained by the concrete at various testing days from curing.

### 1.1.Research Objectives

- To evaluate the mechanical properties (compressive strength, tensile strength, and flexural strength) of concrete mixes containing varying percentages of recycled coarse aggregates.
- To assess the durability characteristics (abrasion resistance, permeability, and chemical resistance) of concrete with recycled coarse aggregates compared to traditional concrete mixes.
- To investigate the workability and fresh properties (slump, flow, and compacting factor) of concrete mixes incorporating recycled coarse aggregates to ensure they meet construction requirements.

## 2. LITERATURE REVIEW

**Nassar et al., (2012)** investigated Recycled concrete incorporating molten glass is strength and durability as partial substitution for cement. Experimental research on the novel concept of the use of milling waste glass to partially substitute cement for the recycled aggregates showed that waste glass is estimated to undergo pozzolanic responses by cement hydrates, forming secondary calcium silicate hydrate (C–S–H) when molten to microparticulate size. The resulting concrete is a partially replaced waste glass. These reactions cause a positive alteration in the structure and interfacial transition areas in recycled concrete of the hydrated cement paste. The test findings are designed to enable the wide-ranging recycled aggregation use, and the diversion into the use of high-value recycled aggregate concrete containing milling wastes glass. mixed waste-coloring glass.

**Wagih et al., (2013)** Researched potential for replacing natural coarse aggregate (NA) with recycled concrete aggregates in reinforced concrete (RCA). Research on the property of RCA takes place through abrasion and grading of concrete waste collected from different sites and sites of destruction in the region of Cairo. The aggregates utilized were: sand from a variety of sources, dolomites and concrete. The cast consists of eight classes with a total of 50 concrete mixes. Groups have been created to study the effect of recycled coarse aggregates on quality/content, cement, super plasticizers and Silica Fume. Tests were conducted for: compressive power, strength division and elastic module. The results showed that the concrete scrap may be transformed into a viable recycled unit and utilized in concrete production with characteristics suited to most structural concrete applications in Egypt. The property of 100 percent recycled RCA aggregated concrete was significantly reduced in relation to NAC, whereas the RAC property was not significantly altered by 75 percent NA and 25 percent RCA. Combination concrete recycled (RAC).

**Aiyewalehinmi et al., (2016)** Investigates the engineering characteristics of the Arakale Road, Akure, of destroyed concrete aggregate waste. The aim is to recycle and decrease the quantity of materials from building waste into sites and trash dumps. The research found that about 15 to 20% of building waste materials are disposed of and dumped in Akure deposits. A total of 96 (48) concrete cube samples were coated, cured and crushed at the 0.55.0, 0.60 and 0.65 water/cél. ratios of four distinct mixes. The results show that the compressive strength of the aggregates used in day 28 was at a lower percentage of water/cementitious ratio (16.89N/mm2, 19.93N/mm2), whereas on day 28 the compressive strength of the aggregates used were virtually the same than that of Virgin aggregate at a higher percentage of water/amentia (18.07, 18.37). It demonstrates that the aggregates utilized may achieve the same compression power as virgin aggregates with greater water/cement levels.

**Bassam et al., (2020)** The micro and lifespan of this reclaimed concrete. In terms of concrete production, RA provides an organic alternative to the on-going deterioration of natural aggregates. The mechanical characteristics of RA may improve the cement matrix. Because to their RA porosity, they have lesser weight than natural aggregates. For the same reason, RA may significantly reduce the working ability of concrete. The RA use increased the compressive capacity of HPC. The RA increased both divisional forces and bending forces, thereby reducing the improved replacement ratios. A potential application of HPC production appears to be RA. This article contains many recommendations for future investigation of this problem.

## 3. MATERIAL AND METHODS

The objective of the experiment was to assess the strength of concrete produced using fine particles and destroyed concrete in order to study several key factors such as concrete oppressiveness Cube made from concrete components and recycled, destroyed concrete replaced by various ratios of coarse aggregate alternatives. The working parameters such as a drop cone test have been investigated in a fresh condition. Stress tests such as compressive force have been investigated under toughened conditions. This research was conducted for the mixed design of the M20 and the IS 10262:2009 concrete grade. The compression test was performed in 66 cubes 150 to 155 to 150 mm, the cubes cast.

The project's research is based entirely on experimental work. The entire process, i.e. step by step procedures of the experimental work, is framed in this part of the dissertation. During experimental work, the following stages are taken: We must first lay the foundations in order to build a structure. Likewise, in line with "INDIAN STANDARDS CODE" IS 10262:2009, the mixing specification for concrete grades M20 is being drafted. In the development of mixing designs for M20 grade concrete, many physical features such as basic gravity, nominal scale, water absorption capacity, fineness modulus and others are required. Other criteria, including sun and water exposure, material mixing procedures, etc., should also be taken into account in accordance with Indian Code IS 456:2000. After establishing the consistency between different materials in an appropriate proportion, it is time to choose goods. Products that comply with the various conditions of IS 383:1970 and cement 43- degree OPC are selected according to the "INDIAN STANDARDS" method. Selected materials are combined according to the mix specification in a preset proportion to produce the necessary power. Betons are collected and analyzed according to IS 1199:1959. IS 2386 (Part 1) describes procedures for the testing of concrete aggregates in 1963. For aggregate shape and size in particular important concrete tests, such as the slump cone test, take place after the mixture has been produced to measure the concrete's physical characteristics. Then the standard forms are cleaned and oiled, measuring 150 mm x 150 mm. Beton is poured in the molds and many shaped reinforcements are added. After a period of 24 hours Clear concrete cubes from molds, use a water-resistant dye to identify them and cure in a cure tank filled at 27 2 0C for 28 days with standard water. After the 28-day processing, time is right for a final examination to establish the actual quality of the concrete, that is compression strength testing according to IS 516:1959 for concrete testing "INDIAN STANDARDS CODE"

### 3.1.Materials Used

- **Cement:**

Ordinary 43 grade Portland cement from the local market was evaluated and tested according to IS: 4021-part 4 – 1988 for physical and chemical characteristics and confirmed in compliance with different IS specifications: 8112 – 1989. The characteristics of cement are shown in Table 1. Ordinary Portland cement

was utilized in this research (OPC 43 grade).

**Figure 1:** Cement

The properties of cement used are given in Table1.

**Table 1:** Properties of cement

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

| | | |
|---|---|---|
| 5. | Fineness | 2% |

- **Fine Aggregate:**

The fine aggregate utilized in this scientific study was river sand devoid of natural pollutants. The sand was dried out properly and devoid of extraneous materials, with a specific gravity of 2.6. The finished product was seven at 4.75 mm. The fine aggregate grading area was Zone II according to an IS criterion

**Figure 2:** Fine Aggregate

Table 2 lists the properties of fine aggregate. (According to IS: 383-1970)

**Table 2:** Properties of fine aggregate

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

- **Coarse Aggregate:**

The concrete consists of a rough compound. They may take the form of natural gravel or irregular broken stone. Gross aggregates are materials too broad for a 4.75mm sieve. It measures up to 20 mm.

**Figure 3:** Coarse aggregate Properties

Coarse aggregate are given below in table 3.

**Table 3:** Properties of coarse aggregate

| Sr. No. | Properties | Value |
|---|---|---|
| 1. | Specific gravity | 2.94 |
| 2. | Fineness Modulus | 7.07 |
| 3. | Water absorption | 0.40% |
| 4. | Particle shape | angular |
| 5. | Impact value | 11.42% |
| 6. | Los Angles abrasion value | 8.32% |

Water: Water plays an essential function in concrete production since it interacts with cement in a chemical process. Because of the presence of water, the gel has shape that helps to improve concrete strength. Almost any consumable natural water without a noticeable smell or flavor may be utilized as a combination of water. Water is also usually excellent from lakes and waterways of aquatic creatures. In certain instances, drinking water is enough to be mixed.

Recycled Coarse Aggregate: The broken-down Crude aggregates recycled Rough 20mm size aggregate rounded from the local construction area. A crushed sound and purified waste concrete with a typically overall contamination of at least 95% by weight is less than 1% of the bulk weight of the RCA. The same tests needed in the assessment of standard aggregates for recycled concrete aggregates made from all but lowest grade original concrete may be anticipated.

**Figure 4:** Recycled coarse aggregates

The physical properties of Recycled coarse aggregates are shown in Table 4.

**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% |

**Design Mix**

In order to examine the impact of destroyed concrete waste substitution as a substitute for rough aggregates on concrete strength, specimens with various percentages of demolished concrete had been produced (by weight). Concerning the impact of demolished concrete replacement on the strength of regular concrete, concrete mixes with various sands of denounced concrete were produced as a partial or whole substitute for coarse aggregates. Beton mixes with various dimensions of destroyed concrete have been produced. The proportions (by weight) applied to concrete compositions of destroyed concrete were as follows: 0% (for control blends), 10%, 20%, 30%, 40%, 60%, 70%, 80%, 90% and 100%. The proportions were: 80%. For this research, the Mix ratio of M20 with a water-cement ratio of 0.40 was selected. In this total of 66 cubes of 150x150x150mm standard size were cast, healed and tested in accordance with IS code 516- 1959 over 7-28 days. The main aim of preserving the tests over a lengthy 7-28-day cure time is to notice any adverse impact on the compressive strength of the concrete by using destroyed concrete as a coarse aggregate. Table 5 shows the percentage selected for the research in accordance with IS 10262-2009.

| | | |
|---|---|---|
| M20 Mix Designs as per IS-10262-2009 | | |
| CONCRETE MIX DESIGN M20 Mix Designs as per IS-10262-2009 | | |
| As per IS 10262-2009 | | |
| **A-1** | **Stipulations for Proportioning** | |
| 1 | Grade Designation | M20 |
| 2 | Type of Cement | OPC 43 grade confirming IS: 8112 |
| 3 | Maximum Nominal Aggregate Size | 20 mm |
| 4 | Minimum Cement Content | 320 kg/m³ |
| 5 | Maximum Water Cement Ratio | 0.5 |
| 6 | Workability | 80-100 mm (Slump) |
| 7 | Exposure Condition | Severe |
| 8 | Degree of Supervision | Good |
| 9 | Type of Aggregate | Crushed Angular Aggregate |
| 10 | Maximum Cement Content | 450 kg/m3 |
| **A-2** | **Test Data for Materials** | |
| 1 | Cement Used | OPC 43 grade |
| 2 | Sp. Gravity of Cement | 3.15 |

| | | |
|---|---|---|
| 3 | Sp. Gravity of Water | 1 |
| 4 | Sp. Gravity of 20 mmAggregate | 2.94 |
| 5 | Sp. Gravity of 10 mmAggregate | 2.93 |
| 6 | Sp. Gravity of Sand | 2.5 |
| 7 | Water Absorption of 20mm Aggregate | 0.97% |
| 8 | Water Absorption of 10mm Aggregate | 0.83% |
| 9 | Water Absorption ofSand | 1.23% |
| 10 | Sieve Analysis ofIndividual CoarseAggregates | Separate Analysis Done |
| 11 | Sieve Analysis ofCombined CoarseAggregates | Separate Analysis Done |
| 12 | Sp. Gravity of Combined CoarseAggregates | 2.94 |
| 13 | Sieve Analysis of FineAggregates | Separate Analysis Done |
| **A-4** | **Selection of Cement Ratio Water** | |
| 1 | Maximum Cement Ratio Water | 0.5 |
| 2 | Adopted Water Cement Ratio | 0.5 |
| **A-5** | **Selection of Content** | |
| 1 | Maximum Watercontent (10262-table-2) | 0.5 |
| 2 | Estimated Water content for 80-100 mmSlump | 0.5 |
| **A-6** | **Calculation of Cement Content** | |
| 1 | Water Cement Ratio | 0.5 |
| 2 | Cement Content (192 / 0.50) | 384 kg/m³ |

| | | |
|---|---|---|
| **A-7** | **Proportion of Volume of Coarse Aggregate & Fine Aggregate Content** | |
| 1 | Vol. of C.A. as per table 3 of IS 10262 | 62.00% |
| 2 | Adopted Vol. of Coarse Aggregate | 65.00% |
| 3 | Adopted Vol. of Fine Aggregate (1-0.62) | 38.00% |
| **A-8** | **Mix Calculations** | |
| 1 | Volume of Concrete in m³ | 1 |
| 2 | Volume Cement in m³ (Mass of Cement) / (Sp. Gravity of Cement)x1000 | 0.122 |
| 3 | Volume of Water in m3 (Mass of Water) / (Sp. Gravity of Water)x1000 | 0.192 |
| 4 | Volume Admixture of @ | Not used |

**Mix Proportion Calculations:**

The mix calculations per unit volume of concrete is as follows Volume of concrete = 1 m³

$$\textbf{Volume of cement} = \frac{Mass\ of\ Cement}{Specific\ gravity\ of\ cement} \times \frac{1}{1000}$$

$$\frac{384}{3.15} x \frac{1}{1000} = 0.122m^3$$

$$\textbf{Volume of water} = \frac{Mass\ of\ water}{Specific\ gravity\ of\ water} x \frac{1}{1000}$$

$$\left(\frac{192}{1}\right) x \left(\frac{1}{1000}\right) = 0.192m^3$$

**Volume of all in aggregate**

**= [1-(0.122+ 0.192)]**

**= 0.686 m³**

**Mass of coarse aggregate**

**= 0.686 x 0.62 x 2.8 x 1000**

**= 1190.89 kg**

**Mass of fine aggregate**

**= 0.674 x 0.38 x 2.5 x 1000**

**= 640.3 kg**

## 4. RESULT AND DISCUSSION

### 4.1.Compressive Strength Test

The total compressive strength of concrete, replacing the natural ground particles with recycled aggregates at a variable proportion, as shown in Table 6 Variation in compressive strength at various percentages of substitution by recycled aggregates of natural ground aggregates may be represented as a graph. Table 6 and Figure 5 demonstrate the effects of compression at 7 and 28 days of age.

**Table 6:** 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 |

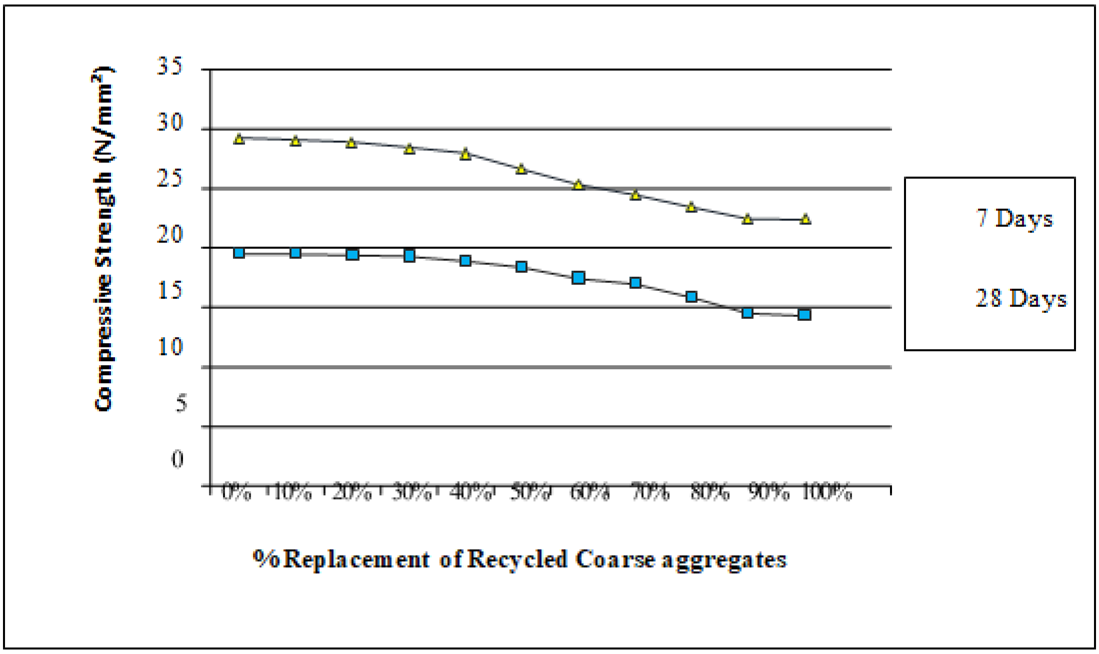


**Figure 5:** Compressive Strength Variations

### 4.2.Waste Management

As a substitute ingredient for natural coarse aggregates, recycled gross aggregates are incorporated in the concrete. Safe waste handling requires a significant quantity of costly and environmentally harmful space. The only area where coarse recycled aggregates may be securely used is the construction industry. It reduces waste, provides space and lowers the material cost when used as a replacement component in concrete. Many studies have previously shown that coarse recycled aggregates may be utilized as a concrete replacement. The recycled coarse aggregates were utilized in this experiment as substitutes for natural coarse concrete aggregates. The tests on various replacements of ground aggregates using demolitive waste such as 0%, 10%, 20%, 40%, 60%, 80%, 90% and 100% concrete with coarse aggregates are ready for recycling and tests are conducted for several types of substitutes for the grade M20.

## 5. CONCLUSION

When the percentages of waste aggregates that are destroyed rise, the compressive strength of the concrete in which the coarsely aggregate is substituted with demolished wastes falls. The cube was replaced with destroyed waste add-ons that provided strength closer to the strength of standard concrete cubes up to 50 percent of the gross aggregate. The compression strength of concrete, i.e. 26,58 N/mm2, is closest to the desired mean strength of 26,6 N/mm2 at 50 percent substitution. the study investigated the feasibility of incorporating recycled coarse aggregates in concrete production. The mechanical properties, durability characteristics, workability, and fresh properties of concrete mixes containing varying percentages of recycled coarse aggregates were thoroughly evaluated. The results indicate that the use of recycled coarse aggregates has the potential to meet the required standards for construction materials, with comparable or even improved performance in certain aspects when compared to traditional concrete mixes. The economic and environmental analysis revealed potential cost savings, waste reduction, and sustainability benefits associated with using recycled coarse aggregates in concrete production. However, challenges such as sourcing consistent quality of recycled aggregates and managing variability in properties need to be addressed to ensure the reliable performance of concrete mixes.

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