# EXPERIMENTAL STUDY ON STRENGTH OF CONCRETE WITH PARTIAL REPLACEMENT OF E WASTE AND CONSTRUCTION& DEMOLITION WASTE AS COARSE AGGREGATE

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***Abstract:*** *India is a developing nation. Therefore, when the population grows quickly, more electronic waste is produced. Electronic waste (E- waste) Management Rules, however, are not being properly implemented in the current environment. It has quite substantial environmental effects. Electronic equipment has a finite life span and eventually emits radiation that is dangerous to anyone nearby. E-waste is used in place of construction materials in the civil industry, and Construction Demolition (C&D) waste is also employed to cut costs.*

*This research work focuses on utilization of Electronic waste and construction demolition waste as partial replacement of coarse aggregate in Concrete and also determine the compressive strength & split tensile strength. We used Printed Circuit Board plate as ingredient in concrete. Also investigating the Changes in the properties of concrete & replaced the aggregate with 5%, 7.5% and 10% of E-waste by weight and Fixed percentage of C&D waste by weight in concrete*

**Key words: substantial environmental effects, radiation, Printed Circuit Board plate**

## 1.INTRODUCTION

Electronic garbage, sometimes known as e-waste, refers to outdated electrical or electronic equipment's-waste includes used electronics that are intended for recycling through material recovery, refurbishment, reuse, resale, salvage, or disposable-waste processing done informally in developing nations can have a negative impact on human health and cause environmental contamination. Due to population growth, construction activities, and alterations in lifestyle, there is an increase in the amount of plastic garbage in municipal solid waste. Electronic garbage, often known as E-waste, is made up of obsolete, broken-down electronics including TVs, refrigerators, radios, and computers that have reached the end of their useful lives. An estimated 50 million tonnes of e-waste are created annually around the world. India generates roughly 1, 46,180 tonnes of electronic garbage annually. According to the Environmental Protection Agency, about 15–25% of electronic trash is recycled, with the remainder ending up in landfills or burning incinerators. Because electronic equipment contain harmful pollutants including lead, mercury, cadmium, and beryllium, etc., handling electronic waste in underdeveloped countries poses major health and pollution issues.

Construction and demolition trash is left over after a building has been demolished. In India, the construction sector produces between 10 and 12 million tonnes of garbage per year. In India, recyclable materials including bricks, wood, metal, and books are recycled. About 50% of all debris, including concrete and masonry waste, is not recycled. This issue is solved by recycling construction and demolition debris and using some of it as a coarse aggregate in concrete.

## 2.LITERATURE REVIEW

**1.Prasanna et al (2014)** investigated substituting coarse aggregate with e-waste by 5%, 10%, 15%, and 20% in one batch, and they also prepared another batch with the same ratio of Ewaste and 10% fly ash. When 15% of the coarse aggregate is substituted with e-waste, the concrete strength is determined to be optimal..From this investigation I used to substituting coarse aggregate with e waste by 5%,7.5%,10%.

**2.Amiya Akram et al (2015)** investigated shredded e-plastic and fly ash as a partial replacement for coarse aggregate in two batches, one with e-plastic alone and one with eplastic + fly ash. They substitute coarse aggregate with eplastic by 5%, 10%, and 15% in one batch. They examine the concrete's compressive and flexural strengths. They discovered that adding E-plastic to concrete increases compressive strength but decreases flexure strength since the specimen breaks without making a sound in the flexure strength test because it became less brittle.From this investigation I have realiseed that I can add up some fly ash with e waste.

**3.(2010) Shini Shanmugam et al.**Printed circuit boards (pcbs) have about 30% metals and 70% nonmetals, according to Wastelands. In its polished condition, it contains a large quantity of silica. Following that, it creates the ideal supplementary material of fine aggregate in concrete, and it may also minimise the structure's dead weight. Because pcbs are slow in nature, they are a required component in all electrical equipment. It lends meaning to its inert character, which is not involved in any additional reaction with the concrete matrix. These have a lower variation in strength characteristics.From this investigation I found New solutions for reusing nonmetals reclaimed from waste printed circuit boards.

**4.Dawande et al. (2016)** investigated the usage of recovered E-waste material as a coarse aggregate substitute in concrete. E-waste aggregate use contributes to the creation of lightweight concrete. In this study, coarse aggregate was substituted up to 25% by E-waste material, with fly ash partially substituting cement in M40 grade concrete, and attributes such as workability, compressive strength, and flexural strength were investigated.from this investigation I realsied that e waste in coarse aggregate also contributes in light weight concrete

**5.Subramani and Kumaran (2015)** evaluated a study on concrete that included overburned brick ballast and concrete debris due to its availability. The primary goal of this research effort was to establish the characteristics of concrete by substituting overburnt brick ballast material and concrete waste for natural coarse aggregate. As a partial substitute for natural coarse aggregate, inclusion of 25%, 50% (M15, M25) was employed. When 50% of the concrete debris was present, the compressive strength was found to be optimal. It was also discovered that increasing the quantity of concrete waste and crushed brick fine aggregate effects the hardened qualities of concrete.

**6.Patel and Patel (2016)** studied the influence of destroyed garbage and conducted a comparative assessment of its mechanical characteristics. In varied percentages of 25%, 50%, 75%, and 100%, recycled concrete aggregates were utilised in concrete to replace nominal concrete aggregates. The compressive strength was found to be optimal with a 50% substitution of recycled coarse material.

**7.Hedge et al., (2018)** seek to repurpose destroyed concrete. The destroyed rubbish had been taken from a college construction site. Demolished debris was used to replace coarse aggregates in varying quantities of 10, 20, 30, 40, 50, and 100. Cubes, cylinders, and beams were cast for various mix proportions and cure times of 7, 14, and 28 days. The compressive strength was found to be greater than 30 N/mm2 after up to 30% replacement of new coarse aggregate. The compressive strength was 27.11 N/mm2 when replaced by 50%, which is greater than the goal strength of 26.6 N/mm2.As a result, concrete up to 50% replacement is more appropriate for ordinary building operations.

**8.Reema et al. (2020)** investigated the usage of destroyed debris to substitute coarse aggregates in varied percentages. The examples were cast with 10%, 15%, and 20% recycled coarse aggregate replacement and examined in the laboratory after 7 and 28 days. When compared to conventional concrete, demolished concrete had reduced bulk density, higher workability, crushing strength, impact value, and water absorption value. The use of recycled coarse aggregate up to 20% had no effect on the functional requirements of demolished concrete, which dropped as the proportion of RCA (recycled coarse structure) increased, according to the estimated test results. The results showed that the compressive strength and split tensile strength aggregate) in concrete were higher in comparison to conventional concrete.

These findings suggested that partial replacement of connstuction demoltion waste and e waste might be a viable option for use as a new aggregate in concrete building. Despite the fact that a number of studies have been undertaken for the partial replacement of coarse aggregates with e waste and c&d waste ,my research will contribute to the current studies.

## 3.OBJECTIVES OF THE EXPERIMENT

- The main objective of the experiment is to find the compressive strength and split tensile test by using partial replacement of e waste and construction & demolition waste. To minimise the use of coarse aggregate by partially replacing it with E-Waste, construction& demolition waste. To improve the most environmentally friendly cement alternative.
- To reduce over all construction cost by partially replacing e waste, construction and demolition waste as coarse aggregate
- To identify that E- waste can be disposed by using them as construction material.
- To identify construction demolition waste can also used for construction purpose
  Such as coarse aggregate and fine aggregate
- To develop and improve the technology for E-waste management.

- To study the properties of coarse aggregates.
- To study the physical properties of E-waste & C&D waste
- To Increase awareness about proper management of E-waste Management.
- To limit the amounts of toxic substances in certain electronic product.
- To reduce the pollution due to recycling of e-waste in the in - organized section.

## 4. MATERIALS AND METHODOLOGY

### 4.1 Cement

Ordinary Portland Cement, grade 53, in accordance with IS:12269:1987 (part1).and specific gravity 3.15 was utilised to cast all of the special specimens. Cement has been tested for its fineness using a 9 µ sieve, for specific gravity using Le Chatlier's equipment, and for beginning and final setting times using Vicat apparatus.

| S. No. | Property | Value Obtained Experimentally | Requirements asper IS codes |
|---|---|---|---|
| 1. | Normal Consistency | 35% | IS 4031-1988(part-4) |
| 2. | Specific gravity | 3.12 | 3.15 |
| 3. | Fineness of Cement | 5.9% | 10% |
| 4. | Initial setting time<br>Final setting time | 47 min<br>469 min | As per 12269 - 2013<br>30 min. Minimum<br>600 min. Maximum |
| 5 | Soundness test | Expansion 8 mm | |

**Table 1: Properties Of Cement**

### 4.2 E-Waste

A byproduct of making silicon metal or ferrosilicon alloys is silica fume. Concrete is one of silica fume's best applications. A 5%, 10%, or 15% replacement of cement by silica fume is used. Testing on silica fume includes measuring its fineness using sieve analysis and its specific gravity using Le-chatlier's equipment.

### 4.3 Fine Aggregate

Sand is obtained from a reliable source and conforms with IS code 2386-1986(part3) for fine aggregates. It should be devoid of dangerous substances, hard, clean, and organic contaminants. The fine aggregate, an inert material that makes approximately 60 to 75 percent of the weight of the mortar, needs to be chemically and physically inert. For grading zone II, fine aggregates with particle sizes that should not be larger than 2.36 mm and less than 150 mm are suitable.

### 4.4 Construction And Demoiltion Waste

A local C&D waste recycling facility, which is in charge of recycling the concrete from infrastructure components, provided all the recycled materials utilised in this study, which were made from waste concrete

### 4.5 Water

According to IS 456:2000, the specimens were cast and preserved using potable water.Any natural or harmful chemicals that might degrade the mortar's qualities should be removed from the water used in mixing. Use of salt water is inappropriate. Both drinking water and distilled water work well for concrete curing and mixing.

## 5.TESTS TO BE CONDUCTED FOR THIS EXPERIMENT

### 5.1 Compressive Strength Of Concrete

- Compressive strength refers to a material's or structure's ability to withstand loads on its surface without breaking or deflecting.When a material is compressed, its size tends to decrease, and when it is stretched, its size elongates.
- The load applied at the point of failure to the cross-section area of the load-applied face elongates, and this is the compressive strength formula for any material..
- Compressive Strength = Load / Cross-sectional Area

**Test procedure**

- There are two sorts of cube test specimens: either 15 cm x 15 cm x 15 cm cubes.
- Depending on the size of aggregate used, or 10cm X 10cm X 10cm. Cubical moulds of 15 cm x 15 cm x 15 cm are typically used for most works.
- This concrete is poured into the mould and appropriately tempered to prevent voids. These moulds are removed after 24 hours, and test specimens are then submerged in water to cure.
- These specimens' top surfaces ought to be level and smooth.

- After 7 or 28 days of curing, these specimens are evaluated using a compression testing equipment.
- Until the specimens fail, a load should be applied progressively at a rate of 140 kg/cm2 per minute.
- Concrete's compressive strength is calculated by dividing the load at failure by the specimen's surface area.

**5.2 Split Tensile Test**

One of the fundamental and crucial characteristics of concrete that significantly influences the size and degree of cracking in buildings is its tensile strength. Additionally, because concrete is brittle, it is particularly weak under strain. It is thus not anticipated to withstand the direct stress. As a result, fractures form in concrete when tensile pressures are greater than its tensile strength. In order to establish the load at which the concrete members may crack, it is important to measure the tensile strength of concrete.

In addition, one approach for figuring out concrete's tensile strength is to fracture a concrete cylinder.The method is based on ASTM C496 (Standard Test Method of Cylindrical Concrete Specimen), which is comparable to other codes like IS 5816 1999.

**Procedure For Split Tensile Test**

1. After curing, remove any water from the specimen's surface.

2. To ensure that the specimen's two ends are on the same axial location, draw diametrical lines on them using a marker.

3. Determine the specimen's dimensions.

4. Place the specimen on the lower plate while retaining the plywood strip.

5. Align the specimen such that the vertical, above the bottom plate, lines indicated on the ends are visible.

6. Place the second piece of plywood above the specimen, then lower the top plate until it touches the plywood strip.

7. Continuously apply the load without shock at a rate of around 14–21 kg/cm2/minute (equivalent to a total load of 9.0 to 14.85 tonnes per minute).

8 Write down the breaking load (P).

## 6.RESULTS AND DISCUSSIONS

### 6.1 Result Of Compressive Strength Of Test Specimen & Conventional Concrete.

The results of the M20 concrete specimen were then determined using the nominal mix. 3, 7, and 28 days after the material has been cured are used for testing. The results of the compressive strength testing of the test specimen are displayed in table 2 below, compressive strengtrh of test specimen showing best results than compressive strength of conventional concrete

| **TYPE OF CONCRETE** | **DAYS OFCURING** | | |
|---|---|---|---|
| | **At 3days** | **At 7days** | **At 28days** |
| Conventional concrete in (Mpa) | 8.38 | 13.57 | 18.85 |
| Replacementof coarse aggregate content by E- waste and C&D waste in (Mpa) | 9.07 | 14.14 | 19.63 |

**Table 2 : Results Of Compressive Strength Of Test Specimen & Conventional Concrete**

### 6.2 Result of Split Tensile Strength Of Test Specimen & Conventional Concrete

The results of the M20 concrete specimen were then determined using the nominal mix. 3, 7, and 28 days after the material has been cured are used for testing. The findings of the test specimen's split tensile strength are displayed in the table 3 below.The test specimen showing best result than conventional concrete in split tensile test.

| **TYPE OF CONCRETE/DAYS OF CURING** | **At 3 Days Strength In (Mpa)** | **At 7days Strength In (Mpa)** | **At 28days Strength In (Mpa)** |
|---|---|---|---|
| Conventional concrete | 1.71 | 1.54 | 1.375 |
| Replacement of coarse aggregate content by E-wasteand C&D waste | 2.13 | 1.768 | 1.571 |

**Table 3: Results Of Split Tensile Strength Of Test Specimen & Conventional Concrete**

## 7.COCLUSION

The following are the findings from a research on concrete for various coarse aggregate replacements (5%, 7.5%, and 10%) using a mix of E waste and C&D waste

### 7.1 Benifits.

- According to the study, concrete's self-weight decreases when the proportion of E-trash and C&D trash grows. As a result, it may be used to make lightweight concrete.
- The compressive strength & tensile strength is greater when we compare to conventional concrete.
- It has been noted that when e-waste is added to concrete, its workability increases as the percentage of electronic trash in the concrete rises. It has been shown that the workability of concrete made from electronic trash enhanced with the addition of fly ash. Fly ash and electronic waste concrete has even greater workability than standard concrete alone.

### 7.2 Future Aspects

- The government can conduct various programmes, such as buy-back arrangements, take-back systems, or exchange schemes, to encourage people to channelize their E-waste.
- E-waste replacement of up to 5-6% is appropriate for road construction.
- Facilities for treating C&D waste are being built under a Private Public Patnershp model .
- More collection centres ,Recycling units of E waste and C&D waste should be established

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