Experimental Study of Concrete by Partial Replacement of Coarse Aggregate by E-Waste

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Abstract – The E-Waste generation is a serious issue now a days in whole world. Recently the government of India has banned the use of plastic as it is hazardous to the human being and also cannot be disposed or reused easily. By generation of astounding 1.85 million tonne of E-waste annually, India has become the 5th largest e-waste producing country in the world. It consists of PCB boards, computer, TV, etc. It is helpful by using the E Waste rather than the naturally occurring of stone metal.

In this paper the analysis of high grade concrete is been done i.e. M35 by adding non-metallic E-Waste (Plain PCB boards) in proportion of 0%, 5%, 10% & 15% respectively.

Keywords:- E-Waste, M-sand, concrete, Compressive Strength, Split Tensile Strength, Flexural Strength,cutting E-Waste.

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1. INTRODUCTION

Electronic waste or E-waste describes discarded electrical and electronic scrap component such as CPUs contents potentially harmful components such as lead , beryllium, Mercury etc. It have more than thousands of different types about 70% Mercury & Cadmium comes in Land fill from E-waste. To overcome this problem we have recycled E-waste as coarse aggregate.

E –waste was cut in various sizes and sieve through 10mm, and 20mm.Then various tests were carried out on it i.e. crushing value, abrasion value, impact value and water absorption it was positive. Finally it can use to replace coarse aggregate in concrete in various percentage i.e. 5%, 10%, 15% & Specinen Cube (150x150x150) , Cylinder (300x150) , Beam (700x150x150) are Casted.

1.2 Scope of work :-

1. By landfilling the burden on earth is increasing.Also with the storage of landfills capacity and an increased concern about environmental quality, diverted waste treatment methods are desired. To divert the end of life of E-waste rather than incineration & landfilling.
2. By making the efforts by using the E-Waste in the concrete as a Coarse aggregate.

2. MATERIALS USED:-

Raw materials required for the concreting operations of present work are cement, fine aggregate, coarse aggregate, e-waste and water.

2.1 Cement:

By using cement as a binding material in the concrete where the strength and durability are significant important. The ordinary Portland cement of 53 grades conforming to IS: 12269-1987 is used to manufacture the concrete. Also some tests were conducted such as consistency test, setting time test, specific gravity test.

Sr. no	Properties	IS Code (IS 8112: 1989)
1.	Specific Gravity	3.12
2.	Consistency	33
3.	Initial setting time	Not less than 30 minutes
4.	Final Setting time	Not more than 600 minutes.

Table 1: - Properties of Cement.

2.2 Aggregate:

The size of aggregates used is 20mm and the grain size of sand is used. The aggregate tests are performed and results are as follows.

2.2.1 Fine aggregate:

The size which is less than 4.75mm is called as fine aggregate. Manufactured sand is used as fine aggregate. Before using that, it can be properly cleaned by sieving and washing to eliminate the impurities.

Sr. no	Characteristics	Value
1.	Type	crushed (M-sand)
2.	Specific Gravity	2.68
3.	Total Water Absorption	1.02%
4.	Fineness Modulus	2.508
5.	Grading zone	III

Table 2: - Properties of fine aggregates

2.2.2 Coarse Aggregate:-

Coarse aggregate can be rounded shape or angular shape. Aggregate of size greater than 4.75mm in size. Aggregates balance the shrinkage and volume changes of concrete are used.

Sr. no	Characteristics	Value
1.	Type	crushed
2.	Maximum Size	20mm
3.	Specific Gravity	2.813
4.	Total Water Absorption	3.67%
5.	Fineness Modulus	7.656

Table 3: - Properties of Coarse Aggregates.

2.3 Water:

Water plays an important role in mixing, laying, and compaction, setting and hardening of concrete. Water influences the strength development and durability of concrete. The clean drinking water must be used in the concrete. Guidance of examine the suitability of the available water for construction can be obtained from the following specified data in IS 456-2000.The pH value of water should be generally not be less than 6.

2.4 E-waste:

The e-waste was collected from PCB Manufacturing company in Pune (Ropes tech Private Ltd. Pune) In this project these e-wastes were cut by using PSB cutting Machine and used in the place of 20mm coarse aggregates. Size of E-Waste is ranging from 10mm to 20 mm.

Sr. no	Characteristics	Value
1.	Type	cutting
2.	Maximum Size	20mm
3.	Specific Gravity	1.1
4.	Total Water Absorption	0%
5.	Fineness Modulus of bigger size E-Waste (Above 20mm)	7.67
6.	Fineness Modulus of medium size E-Waste (20mm)	8.193
7.	Fineness Modulus of smaller size E-Waste (Below 20mm)	9.165

Table 4: - Properties of E-Waste.

Fig1. Cutting of E-waste

3. PROCEDURE:-

3.1 Batching

Batching was done method of weight batching by using weighing balance having accuracy 0.1gm.

3.2 Mixing

Mixing of concrete was done by using mixer of 40 lit. capacity according to the grade of M35 with water cement ratio 0.4 Percentage of e-waste added in the concrete as a replacement of coarse aggregate.

3.3 Casting of cube, Cylinder & Beam.

As per requirement for testing Specimens for 7days, 14days, 28days test for M35 grade of Concrete with different percentage.

% of E-Waste	0%	5%	10%	15%
Cubes	9	9	9	9
Cylinder	6	6	6	6
Beams	3	3	3	3
Total	**18**	**18**	**18**	**18**

Table 5: - Details of Casting.

4. RESULTS AND DISCUSSIONS

4.1 Workability of Fresh Concrete

For calculating of workability of fresh concrete slump cone test was adopted result are shown below table.

Grade of Concrete	Slump In MM	Workability
M35	52.5	Low

Table 6:- Slump Cone result.

4.2 Compressive Strength Test (IS 1343-1980) :-

Compressive strength test was conducted to calculate compressive strength developed in concrete containing e-waste at the age of 7, 14, 21 days respectively. Square mould having size 150X150X150 mm casted for testing. Tests was done on compressive testing machine (CTM) having loading capacity 2000KN.

Mix proportion of E-waste	0%	5%	10%	15%
7 Days	31.16	26.99	29.61	30.16
14 Days	31.18	24.64	31.28	27.32
28 Days	39.81	43.31	43.03	34.76

Table 7: - Compressive strength of concrete (in N/mm^2)

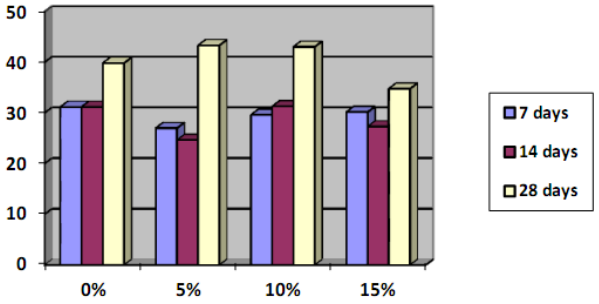

Fig 2. Compressive Strength Result

Fig.3 compressive strength

4.3 Split Tensile Strength (IS 516-1959) :-

The split tensile strength of concrete is one of the basic and important properties. This test on concrete cylinder is a method to determine the tensile strength of concrete. The concrete is very weak in tension due to its brittle in nature and is not expected to resist the direct tension. The concrete develops cracks when subjected to tensile forces. Thus, it is necessary to determine the tensile strength of concrete to determine the load at which the concrete members may crack.

Mix proportion of E-waste	0%	5%	10%	15%
7 Days	2.18	2.43	2.23	2.332
28 Days	3.547	2.73	3.21	3.35

Table 8: - Split Tensile Strength of concrete (in N/mm^2)

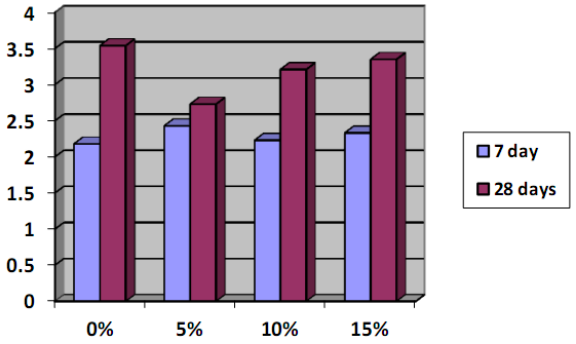

Fig4. Split Tensile Strength Result

Fig 5. Split Tensile strength

4.4 Flexure Strength (IS 516-1959) :-

Modulus of rupture, which is the measure of flexural strength of concrete, is measured for the Prisms of dimensions 700mm x 150 mm x 150 mm are casted and are tested for 7 days and 28 days and the results are represented in table below.

Mix proportion of E-waste	0%	5%	10%	15%
28 Days	3.83	3.12	3.49	3.06

Table 9: - Flexural Strength of concrete (in N/mm^2)

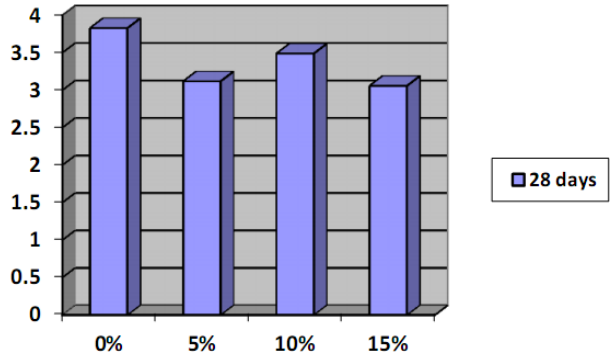

Fig6. Flexural Strength result

Fig7. Flexure Strength

5. CONCLUSION

This study shows an alternative method of application of the E-waste used in concrete. The modern world due to great development in technologies and designs huge amount of E-Waste produces. The growing concern of resource depletion and global pollution has challenged engineers to seek and develop new material relying on wastes. One of the challenging hazardous waste material is Electronic waste (E-waste) in this report it shows the result of compressive strength, split tensile strength and flexural strength.

1. It is identified that e-waste can be partially dispose in concrete as a coarse aggregate.
2. Rather than cutting the E-waste is more suitable to acquire the strength in concrete instead of Shredding
3. Due to crushing of E-Waste the crushing strength is been reduced so the shredding i.e. Cutting of E-waste must be preferred.
4. The addition of E-waste shows increase in compressive strength up to 10% replacement.
5. The use of E-waste in concrete is possible to improve its mechanical properties and can be one of the economical ways for their disposal in environment friendly man
6. E-waste collected from PCB Manufacturing Company has low as compared to stone metal cost hence this project is cost effective i.e. Economical.

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