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EFFECTS OF ELECTRONIC WASTE IN MANUFACTURING OF BUILDING MASONRY AND PAVING COMPONENTS

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ABSTRACT

This study used to focus the minimize the usage of cement in the construction projects. During the cement production, the emission of$CO_2$is high and pollute the environment is huge. To control this problem, the Electronic waste collected from Electronic waste plant is used to replacement for cement in the construction of building components. In this work, the impact of Electronic waste on compression strength of non-structural elements were analyzed and studied. Preparation of Interlocking block, Cement bricks and Solid blocks with various mixes of cement proportion replaced by 10% to 20% of Electronic waste and testing on compression testing machine. Electronic waste replaced specimens are compared with control mix sample in the interlocking block, and cement bricks with the results of the compressive strength test.OPC replaced by electronic waste materials reducing the cement cost and reduces the environmental problems during the cement manufacturing. By using Electronic waste building components decrease the cost of construction of the project and also save the natural resources by replacing of waste in construction projects and reduce the hazards which causing environment when compared to the usage of normal materials in construction projects.

Keywords: Electronic waste, Interlocking blocks, Structural building components, Cement Bricks, Sustainable materials, Compressive strength.

INTRODUCTION

Concrete is a construction material. Concrete composed of cement, fine aggregates, coarse aggregates, and water. A chemical reaction called hydration takes place which hardens the paste and gains strength.

In India, electronic waste is creating in an enormous amount, since it has risen as a monster and because of modernization of way of life. Electronic waste is also known as E-waste for the electronic items nearing the finish of their valuable life. To prepare new structural elements using conventional and e-waste masonry or paving components like Paver block and Cement bricks. Paver blocks improve functional performance, appearance, durability and water-tightness, structural integrity and so on. This paper investigates the behavior of different paving elements under static loading and then its strength is found out.

EXPERIMENTAL

Cement

Cement is a finely powdered grey in color. Cement is a mixture of gravel, sand or crushed stone and water to make concrete. The mixture of cement and water form a mixed paste that binds with different materials altogether which made the concrete hard. The compressive strength of concrete affected by changes in cement quality. The mostly used cement is named Ordinary Portland cement. The type of cement depends upon the requirements of the performance.

Fine Aggregate

The fine aggregates used for the work locally collected. Collected fine aggregate conformed to Specifications of Indian Standard IS: 383-1970. The sand was sieved by 4.75mm sieve and avoiding the retaining particle. The conducted tests for fine aggregates are sieve analysis, water absorption, bulk

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density, specific density and fineness modulus. The specific gravity accounts for fine aggregate used is 2.67 and it indicates that the sand conforms to Zone II.

Coarse Aggregate

Coarse aggregate is the materials which are retained at 4.75mm on IS sieve. Coarse aggregate is nothing but crushed stone materials. The coarse aggregates were washed to remove dust and dirt. Maximum size of 20mm aggregates used. The coarse aggregates were confirmed to the specification of Indian standard and tested as per IS: 383-1970. The Fineness modulus and specific gravity value found out to be 7.20 and 2.70.

E-Waste

E-waste obtained from waste electronic devices is crushed to fine material with an average particle size less than 1mm. Its specific gravity was determined by Pycnometer method and the value is 1.66.

Fig.-1: E-waste material

Design Mix

Mix design for paver block and brick was carried out as per IS 10262-2009 and IS 15658-2006. The design characteristic strength was taken as 25Mpa and coining to a ratio of 1: 1: 2 along with a water-cement ratio of 0.45. Cement bricks 1 part of cement and 5 part of fine aggregate along with 0.45 of water-cement ratio.

RESULTS AND DISCUSSION

Casting of Specimen

Compressive strength test was carried out to determine the characteristic of conventional and paving components with E-waste. The mold dimension of paver blocks is 270×120×60mm and 250×200×60mm. For cement bricks, the mold dimensions are 200×100×100mm as shown in figure 2. Compressive strength test was taken at the days of 3,7 and 28 respectively to assess the rate of gaining strength.

Fig.-2: Moulds for Paver Blocks and Cement Bricks

Paver Block

Paver block is a solid paving element, without reinforced pre-cast cement concrete paving units used in the surface of pavements, with a cross-section of 50mm minimum of the horizontal direction, aspect ratio

(l/d) not greater than four which is used in footpath and road for a better look, easy laying and finish. Paver blocks which placed into one another on some or vertical faces, other names are called Interlocking or Denated or Inter-connected paver blocks.

Fig.-3: Cast Specimen

Fig.- 4: Demoulded Specimen

Fig.-5: Compressive Strength Test

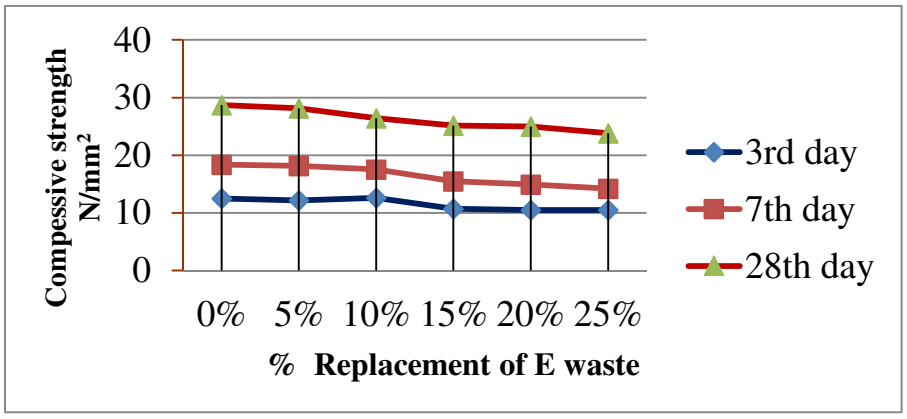

Fig.-6: Graphical Variation of Compression Strength Results

Cement Bricks

Cement bricks are a mixture of cement and sand in the ratio of 1:5. Molded into conventional shape and cured; used as backing brick and where there is no danger of attack from acid or alkaline conditions. The addition of sand to the cement results in a material that does not undergo large variation in loss of humidity and absorption by volume. Due to its low permeability, cement bricks contain high compression strength and durability compared to the normal bricks which made of clay and mud. Cement bricks have good waterproofing features, facilitate conservation and resisting humidity.

Fig.-7: Cement Bricks

Table-1: Compressive Strength Test Results for Paver Blocks

Mix Type	Replacement of E-Waste in %	Compressive Strength (N/mm^2)		
		3rd day	7th day	28th day
Control Concrete	0	12.52	18.4	28.73
Paver Blocks	5%	12.19	18.17	28.15
	10%	12.63	17.53	26.42
	15%	10.75	15.5	25.17
	20%	10.53	14.92	25.01
	25%	10.49	14.2	23.8

Table-2: Compressive Strength Test for Bricks

Mix Type	Replacement of E-Waste in %	Compressive Strength (N/mm^2)		
		3rd day	7th day	28th day
Control concrete	0	2.8	3.9	5.6
Bricks	5%	2.63	3.86	5.29
	10%	2.5	3.78	5.1
	15%	2.17	3.04	4.2
	20%	2.01	2.86	3.71
	25%	1.92	2.37	3.4

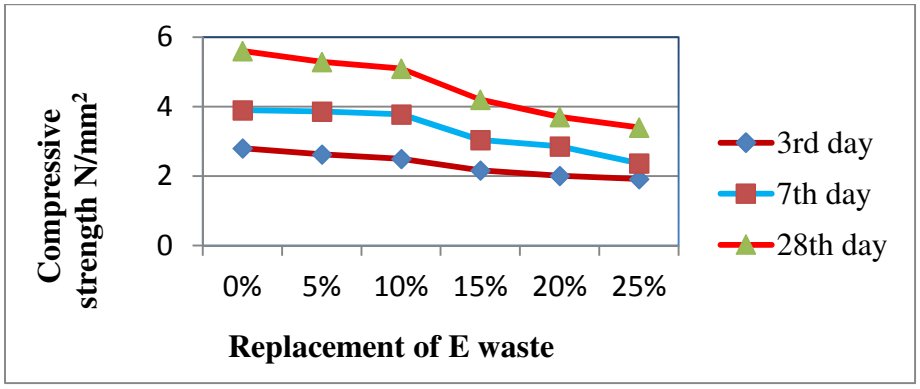

Fig.-8: Graphical Variation of Compression Strength Test Results for Bricks

CONCLUSION

- From the experimental investigation, it is found that E-waste is an alternative material for cement in the production of concrete.
- The optimum replacement of cement by E-waste is possible for up to 20%.
- While using E-waste we can reduce cost up to 10% to 20% in purchasing of cement
- E-waste in concrete that can reduce the construction cost for a building and also environmental problems.

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