Flexural Behaviour of Double Layered E Waste Concrete Beams

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Abstract - *Recycling waste solid materials is one of the most challenging problems worldwide with the unprecedented growth of the world population. In several countries, plastic is being burned and used as fuel, which may result in serious hazards. Plastic dumped in sanitary landfills is a significant environmental hazard and results in possible contamination. Reinforced Cement Concrete (RCC) structures are usually reinforced with steel bars which are subjected to corrosion at critical temperatures and atmospheric conditions. Also the cost of steel reinforcement plays a significant role in any RCC construction. The rising prices of steel and their unavailability throughout the year have brought the contractors and engineers into a great trouble. Test results showed the compressive strength of recycled concrete with 0-15% aggregate replacement by e waste at the end of 28 days has been found to be marginally lower than that of conventional concrete. Which proportion going to give the maximum strength is found out by checking the flexural strength of the concrete elements.*

***Key Words*: e waste, Double layer Concrete Beams, flexural Strength, Compressive strength, Tensile strength.etc..**

1. INTRODUCTION

Civilization produces lot of e-waste which are non degradable and they affects of environment [1]. Electronic Waste is the term used to describe old, end-of-life electronic appliances such as computers, laptops, TVs, DVD players, mobile phones, mp3 players etc[2]. Which have been disposed off by their original users [3]. While there is no generally accepted definition of e-waste, in most cases, e-waste comprises of relatively expensive and essentially durable products used for data processing, telecommunications or entertainment in private households and businesses[4]. Industry is growing at a 25% compounded annual growth rate. The e-waste inventory based on this obsolescence rate and installed base in India for the year 2005 has been estimated to be 146180.00 tones [5]. This is expected to exceed 15, 00,000 tons by 2015[6]. There is a lack of authentic and comprehensive data on e-waste availability for domestic generation of E-waste and the various State Pollution Control Boards have initiated the exercise to collect data on e-waste generation [7]. Due to increase in population, urbanization, development activities, and changes in life style, there is an enormous rise in the generation of E-wastes (Plastics) which in turn makes the solid waste management as one of the major environmental concern worldwide[8]. These are disposed in an uncontrolled manner, because of the noticeable rapid depletion of sites available for E-waste disposal, causing major environmental problems [9]. At present the disposal of waste plastic has become a major waste management problem in the world [10] .In this work, focus has been given on the strength of flexible pavement and disposal of plastic in eco-friendly way [11].

II. MATERIALS AND METHODS

MATERIALS

E waste is main important material used in this project. Locally available nearly riverbed sand is used as fine aggregate. The maximum size of the coarse aggregate that may be used in cement concrete is 20mm size aggregates.

E waste is added in the concrete at the different percentages of 0%, 5%, 10%, and 15%.

M20 & M30 grade concrete is used in this project. OPC is used; Chettinad brand cement is used. The coarse aggregates are replaced by percentage of E waste. Fine aggregates which was locally available and passing through 4.75mm IS sieve is used. Coarse aggregates which was locally available and passing through 20mm IS sieve is used.

TESTING METHODS

The properties of materials such as Specific gravity, water absorption and other Properties are tabulated on Table 1.

Table 1: Properties of Coarse Aggregate & E waste

Properties	Natural Coarse Aggregate	E waste
Specific Gravity	2.74	2.9
Water Absorption	1.2%	0.2%

The experimental analysis was carried out in the concrete mixtures and the mixtures with full replacement of natural coarse aggregate with E waste.

The concrete cubes were casted in moulds of dimensions (150 mm x 150 mm x 150 mm) by hand and after 24 hours, the concrete cubes were consequently cured in water for 7 days and 28 days. The E waste is mixed with concrete at 0%, 5%, 10% and 15% respectively by weight by the method of replacement. The samples were mixed thoroughly and compressive strength test was done.

The concrete cylinders were casted in the moulds of dimensions (150 mm x 300 mm) for split tensile test for 28 days; concrete columns that are considered to as short columns are casted on moulds of dimensions (150 mm x 300 mm) for compressive strength test for 28 days.

All beams (100mm x 150mm in cross section and 1600mm in length) were tested as simply supported beams under three points loading over an effective span of 1400mm.The load shall be applied at a rate of loading of 400kg/min for the 15 cm specimens and at a rate of 180kg/min for the 10cm specimens. The loads were applied at a distance of 533mm on either side of the mid span of the beams of 1600mm length. The loads were monitored through a high accuracy load cell with a load sensitive of 0.1 tonnes. For this case, mid span deflection was measured using dial gauges of least count 0.01mm. The parameters such as initial cracking load, ultimate load and the deflected shape of the specimens were noted.

III. MIX DESIGN

The mix design of M_{20} & M_{30} grade concrete was calculated using IS 456-2000 and IS 10262-2009.

IV.RESULTS

COMPRESSIVE STRENGTH OF CONCRETE CUBES

The compressive strength test results for concrete cubes containing fully replaced coarse aggregate with e waste was tabulated in the Table 3 and shown in Fig: 2. Thus, there was an increase in the compressive strength of the concrete up to 5% when compared to the normal (plain) concrete and then the compressive strength decreases in both 7 days and 28 days. The compressive strength of the concrete cubes was increased from 17.86 N / mm^2 to 28.66 N / mm^2 at 7 days and 20.8 N / mm^2 to 31.6 N / mm^2 in 28 days compressive strength of concrete cubes.

SPLIT TENSILE TEST OF CONCRETE CYLINDERS

The split tensile strength test results for concrete cylinder containing fully replaced coarse aggregate was tabulated in Table 5 and shown in Fig: 3. Thus there was an increase in split tensile strength of the concrete up to 5% when compared to normal concrete in 28 days. The tensile strength of the concrete cylinder was increased from 1.33N / mm^2 to 1.37 N / mm^2 at 7 days and 2.65 N / mm^2 to 3.63 N / mm^2 in 28 days compressive strength of concrete cubes.

FLEXURAL STRENGTH OF CONCRETE RC BEAMS

The compressive strength test results for concrete RC beams containing fully replaced coarse aggregate was tabulated in Table 6 and shown in Fig: 4. Thus there was an increase in flexural strength of the reinforced concrete columns up to 5% when compared to normal concrete in 28 days. The compressive strength was increased from 44.80 N / mm^2 to 47.29 N / mm^2.

Fig 1: Reinforcement Used

Fig 2: Initial Crack Formation non e waste RCC beam

Fig 3: Initial Crack Formation e waste RCC beam

Table 4: Compressive Strength of Concrete Cubes

E waste %	Compressive Strength 7 days (N/mm²)	Compressive Strength 28 days (N/mm²)
0%	12.24	20.4
5%	15.41	25.69
10%	10.56	17.6
15%	8.73	14.55

Table 3: Split Tensile Strength on Concrete Cylinders

E waste %	Tensile strength (N / mm²) 7 days	Tensile strength (N / mm²) 28 days
0%	1.33	2.65
5%	1.37	3.63
10%	1.15	2.02
15%	1.01	1.94

Table 6: Flexural Strength of RCC Beams

E waste %	Flexural Strength 28 days (N/mm²)
0%	44.9
5%	47.29
10%	44.6
15%	43.25

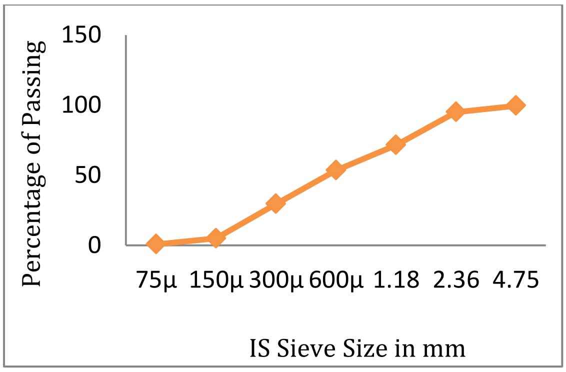

Fig 3: Sieve Analysis of Coarse Aggregate

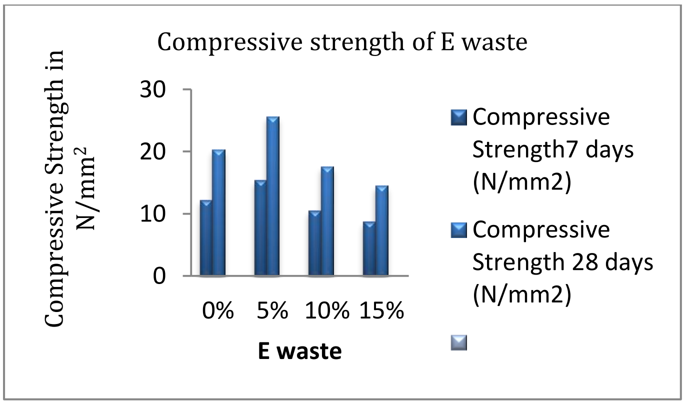

Fig 4: Compressive Strength of Concrete Cubes

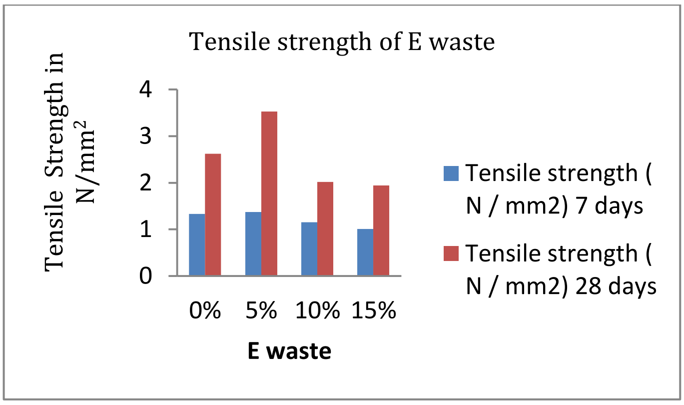

Fig 5: Tensile Strength of Concrete Cylinder

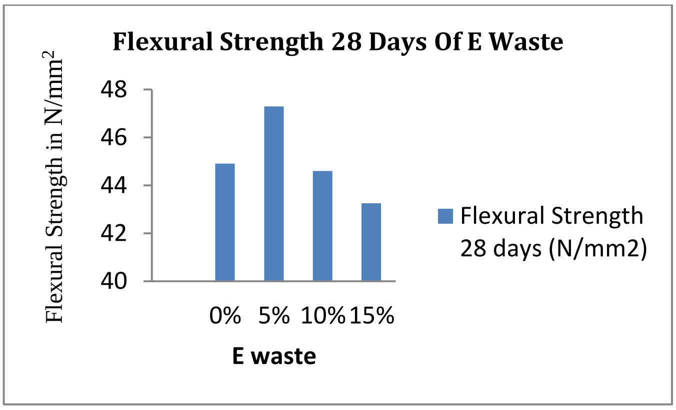

Fig 6: Flexural Strength of RCC Beams

3. CONCLUSIONS

From the various investigations on the reinforced columns using E waste, the following conclusions were made.

a) From the various investigations on the prism using aggregate and e waste, the following conclusions were made.

b) There was a gradual increase in the compressive strength of both prism and cubes due to the usage of e waste.

c) At an addition of 5% of e waste to the concrete, there was a good strength both in RCC beam, cylinder and cubes.

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