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STUDY ON RECYCLED E WASTE IN REINFORCED CONCRETE BEAM UNDER GRADUAL LOADING CONDITIONS

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ABSTRACT

The rapid growth of populations and usage of electronic products are increasing day by day in world wide. Especially developed countries and developing countries like United Nations India. Also the construction field also reached top of the core in last 2 to 3 decades. So that demand of cements, fine aggregate and coarse aggregate could be increased. Lagging of construction raw materials affects the growths of the construction field.to rectify these problems, the alternative construction materials could be use in constructions. The electronic wastes are used in concrete means to solve the quantity of E waste and also the demand of concrete raw materials. Here the E wastes are used in concrete as a coarse aggregate and the size of electronic waste are 12.5mm (crushed). E wastes are added in concrete at the percentages of 0%,5%,10%,15%.18% and 20%. The reinforced concrete beams are casted at M40 and M50 grade of concrete. This research paper described the performance of electronic wastes in various percentages at high performance concrete under the various loading conditions. Deflections and stiffness of the electronic waste reinforced concretes are determined. Finally the results show the behavior and performance of electronic wastes in reinforced concrete beams.

Key words: Electronic waste, stiffness of RC beam, high performance E waste concrete.

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1. INTRODUCTION

In this modern world the electronic products act a main role in all industries, business sectors, educational institutions, information technology field etc. the demand and usage of electronic products should be high similarly wastage of electronic products also high. Also the upcoming products like Smartphone's, led TV's, laptops are the major factor in production of

electronic wastes. So that the technical development involved in the electronic product production rates.

In 2006, 50 million metric tons of E wastes are discarded in world wide. This survey was estimated by united nations. According to this survey report, the electronic waste such as mobile phones, computer and laptops should be more than 500 percent in worldwide within next decade.

Each year 2 million tons of electronic wastes are produced by United Nations. But according to 2010 survey the china already crossed 2.3 million tons of E waste domestically. United States placed in second after china. To resolve this problem the wastes should be reuse and recycle. So that the electronic wastes are recycling and reusing at the way of construction field. In construction side demand of raw materials also is a one the effect. So the E wastes are using as a coarse aggregate in concrete mean we can rectify the problems.

2. PROPERTIES OF RAW MATERIALS

Cement:

Fineness of cement = 8%

Standard consistency of cement = 30%

Initial setting time of cement = 36min

Specific gravity of cement = 3.1

Aggregates:

Specific gravity of fine aggregate = 2.80

Specific gravity of coarse aggregate = 2.71

E – Waste:

Table 1 Properties of plastics

Properties	Values
Specific gravity	1.07
Size	12.5 mm
Shape	Angular(Crushed)
Colour	Black

Figure 1 Crushed E waste

3. EXPERIMENTAL RESULTS

Figure 2 Testing of RC Beam

Table 2 Load Vs deflection results for M40 Grade of Beam

Load (N)	Deflection (mm)					
	0%	5%	10%	15%	18%	20%
0	0	0	0	0	0	0
2452.5	0.24	0.22	0.26	0.24	0.17	0.11
4905	0.45	0.47	0.5	0.48	0.33	0.24
7357.5	0.61	0.78	0.72	0.75	0.67	0.43
9810	0.8	0.97	0.95	1.05	0.98	0.67
12262.5	0.97	1.22	1.18	1.63	1.14	0.83
14715	1.2	1.48	1.44	1.98	1.48	0.96
17167.5	1.44	1.7	1.65	2.4	1.74	1.11
19620	1.6	1.92	1.85	2.85	2.03	1.25
22072.5	1.8	2.15	2.09	3.26	2.29	1.5
24525	2.1	2.32	2.35	3.75	2.62	1.74
26977.5	2.3	2.55	2.59	3.98	2.88	1.94
29430	2.42	2.85	2.78	4.2	3.13	2.11
31882.5	2.64	3.05	3	4.75	3.54	2.19
34335	2.84	3.3	3.25	5.05	3.89	2.53
36787.5	3.07	3.55	3.5	6.35	4.17	2.75
39240	3.3	3.78	3.72	7.6	4.66	2.94
41692.5	3.5	3.92	3.9	8.55	5.01	3.15
44145	3.69	4.15	4.1	8.98	5.38	3.59
46597.5	3.9	4.32	4.28	9.55	5.72	3.83
49050	4.14	4.55	4.45	10	5.99	4.17

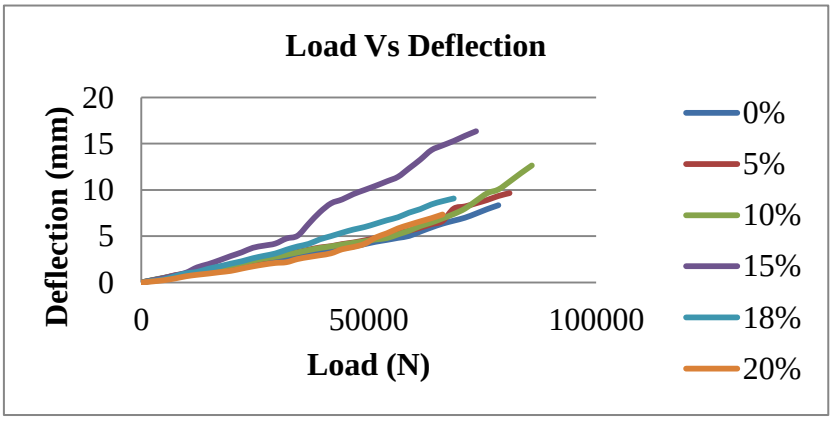

Figure 3 Load Vs Deflection curve for M40 Grade concrete

Table 3 Load Vs Stiffness results for M40 Grade of Beam

Load (N)	Stiffness (N/mm)					
	0%	5%	10%	15%	18%	20%
0	0	0	0	0	0	0
2452.5	10218.75	11147.73	9432.692	10218.75	14426.47	22295.45
4905	10900	10436.17	9810	10218.75	14863.64	20437.5
7357.5	12061.48	9432.692	10218.75	9810	10981.34	17110.47
9810	12262.5	10113.4	10326.32	9342.857	10010.2	14641.79
12262.5	12641.75	10051.23	10391.95	7523.006	10756.58	14774.1
14715	12262.5	9942.568	10218.75	7431.818	9942.568	15328.13
17167.5	11921.88	10098.53	10404.55	7153.125	9866.379	15466.22
19620	12262.5	10218.75	10605.41	6884.211	9665.025	15696
22072.5	12262.5	10266.28	10561	6770.706	9638.646	14715
24525	11678.57	10571.12	10436.17	6540	9360.687	14094.83
26977.5	11729.35	10579.41	10416.02	6778.266	9367.188	13905.93
29430	12161.16	10326.32	10586.33	7007.143	9402.556	13947.87
31882.5	12076.7	10453.28	10627.5	6712.105	9006.356	14558.22
34335	12089.79	10404.55	10564.62	6799.01	8826.478	13571.15
36787.5	11982.9	10362.68	10510.71	5793.307	8821.942	13377.27
39240	11890.91	10380.95	10548.39	5163.158	8420.601	13346.94
41692.5	11912.14	10635.84	10690.38	4876.316	8321.856	13235.71
44145	11963.41	14014.29	10767.07	4915.924	8205.39	12296.66
46597.5	11948.08	14035.39	10887.27	4879.319	8146.416	12166.45
49050	11847.83	10780.22	11022.47	4905	8188.648	11762.59
51502.5	11705.11	10729.69	11075.81	4928.469	8110.63	10597.22
53955	11729.35	10684.16	11240.63	4936.414	8029.018	10161.02
56407.5	11702.8	10543.46	10847.6	4939.361	8001.064	9658.818
58860	11701.79	10510.71	10510.71	4769.854	7796.026	9447.833

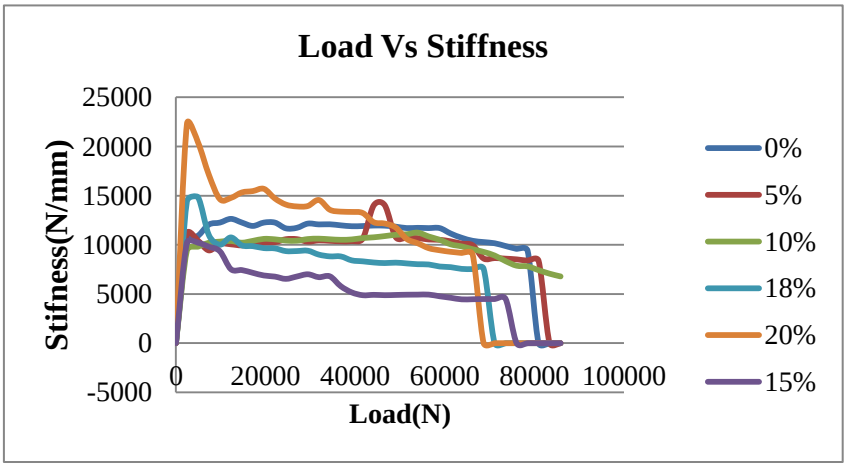

Figure 4 Load Vs Stiffness curve for M40 Grade Concrete

Table 4 Load Vs Deflection results for M50 Grade of Beam

Load (N)	Deflection (mm)					
	0%	5%	10%	15%	18%	20%
0	0	0	0	0	0	0
2452.5	0.23	0.21	0.12	0.21	0.15	0.11
4905	0.44	0.37	0.21	0.38	0.32	0.29
7357.5	0.61	0.5	0.29	0.62	0.53	0.47
9810	0.7	0.61	0.66	0.89	0.75	0.71
12262.5	0.96	1	0.88	1.03	0.95	0.98

14715	1.2	1.18	1.08	1.21	1.1	1.18
17167.5	1.41	1.39	1.25	1.48	1.28	1.39
19620	1.56	1.6	1.71	1.71	1.59	1.62
22072.5	1.79	2.01	2.02	1.95	1.88	1.9
24525	1.98	2.24	2.25	2.19	2.02	2.17
26977.5	2.36	2.46	2.38	2.34	2.31	2.46
29430	2.61	2.62	2.73	2.71	2.71	2.87
31882.5	2.72	3.02	2.94	2.93	2.98	3.09
34335	3.11	3.26	3.15	3.14	3.19	3.6
36787.5	3.3	3.42	3.31	3.48	3.42	3.88
39240	3.44	3.61	3.68	3.72	3.75	4.27
41692.5	3.64	4	3.9	3.95	3.92	4.38
44145	3.95	4.26	4.1	4.2	4.09	4.59
46597.5	4.2	4.5	4.29	4.55	4.28	4.92
49050	4.41	4.82	4.68	4.84	4.69	5.03
51502.5	4.62	5.34	5.26	5.31	4.93	5.32
53955	5.07	5.9	5.74	5.72	5.37	5.71
56407.5	5.72	6.37	6.23	6.18	5.92	5.98
58860	6.17	6.92	6.72	6.57	6.28	6.14
61312.5	6.58	7.34	7.15	6.88	6.59	6.35
63765	7.18	7.98	7.55	7.25	6.75	6.7
66217.5	7.78	8.46	7.99	7.48	7.01	6.97
68670	8.25	9.1	8.39	7.73	7.28	7.35
71122.5	8.96	9.47	8.82	7.98	7.55	7.82
73575	9.4	10.04	9.23	8.11	7.83	8.28
76027.5	9.94	10.47	9.75	8.35	8.37	_
78480	10.45	10.98	10.19	8.62	8.72	_
80932.5	10.75	11.42	10.7	8.88	_	_
83385	_	11.86	11.15	_	_	_
85837.5	_	_	11.65	_	_	_
88290	_	_	12.09	_	_	_

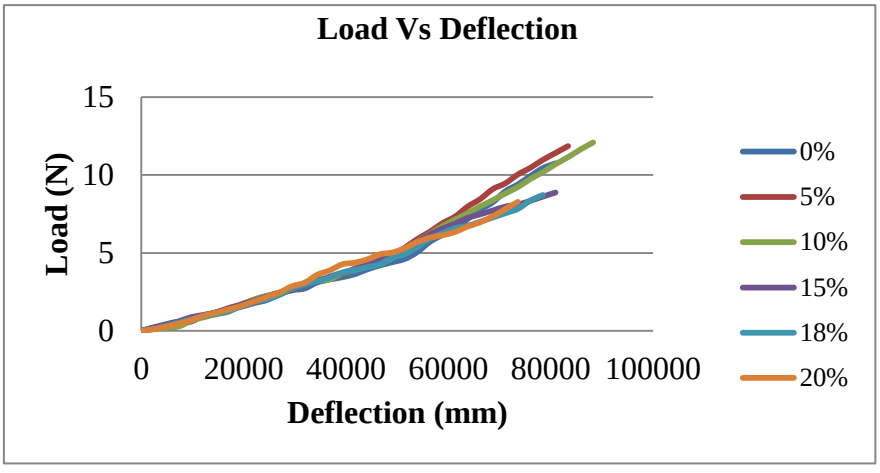

Figure 5 Load Vs Deflection curve for M50 Grade concrete

Table 5 Load Vs Stiffness results for M50 Grade of Beam

Load (N)	Stiffness (N/mm)					
	M1	M2	M3	M4	M5	M6
0	0	0	0	0	0	0
2452.5	10663.04	11678.57	20437.5	11678.57	16350	22295.45
4905	11147.73	13256.76	23357.14	12907.89	15328.13	16913.79
7357.5	12061.48	14715	25370.69	11866.94	13882.08	15654.26
9810	14014.29	16081.97	14863.64	11022.47	13080	13816.9
12262.5	12773.44	12262.5	13934.66	11905.34	12907.9	12512.76
14715	12262.5	12470.34	13625	12161.16	13377.27	12470.34
17167.5	12175.53	12350.72	13734	11599.66	13412.11	12350.72
19620	12576.92	12262.5	11473.68	11473.68	12339.62	12111.11
22072.5	12331.01	10981.34	10926.98	11319.23	11740.69	11617.11
24525	12386.36	10948.66	10900	11198.63	12141.09	11301.84
26977.5	11431.14	10966.46	11335.08	11528.85	11678.57	10966.46
29430	11275.86	11232.82	10780.22	10859.78	10859.78	10254.36
31882.5	11721.51	10557.12	10844.39	10881.4	10698.83	10317.96
34335	11040.19	10532.21	10900	10934.71	10763.32	9537.5
36787.5	11147.73	10756.58	11114.05	10571.12	10756.58	9481.314
39240	11406.98	10869.81	10663.04	10548.39	10464	9189.696
41692.5	11453.98	10423.13	10690.38	10555.06	10635.84	9518.836
44145	11175.95	10362.68	10767.07	10510.71	10793.4	9617.647
46597.5	11094.64	10355	10861.89	10241.21	10887.27	9471.037
49050	11122.45	10176.35	10480.77	10134.3	10458.42	9751.491
51502.5	11147.73	9644.663	9791.35	9699.153	10446.76	9680.921
53955	10642.01	9144.915	9399.826	9432.692	10047.49	9449.212
56407.5	9861.451	8855.181	9054.173	9127.427	9528.294	9432.692
58860	9539.708	8505.78	8758.929	8958.904	9372.612	9586.319
61312.5	9318.009	8353.202	8575.175	8911.701	9303.87	9655.512
63765	8880.919	7990.602	8445.695	8795.172	9446.667	9517.164
66217.5	8511.247	7827.128	8287.547	8852.607	9446.148	9500.359
68670	8323.636	7546.154	8184.744	8883.571	9432.692	9342.857
71122.5	7937.779	7510.296	8063.776	8912.594	9420.199	9094.949
73575	7827.128	7328.187	7971.289	9072.133	9396.552	8885.87
76027.5	7648.642	7261.461	7797.692	9105.09	9083.333	_
78480	7510.048	7147.541	7701.668	9104.408	9000	_
80932.5	7528.605	7086.909	7563.785	9114.02	_	_
83385	_	7030.776	7478.475	_	_	_
85837.5	_	_	7368.026	_	_	_
88290	_	_	7302.73	_	_	_

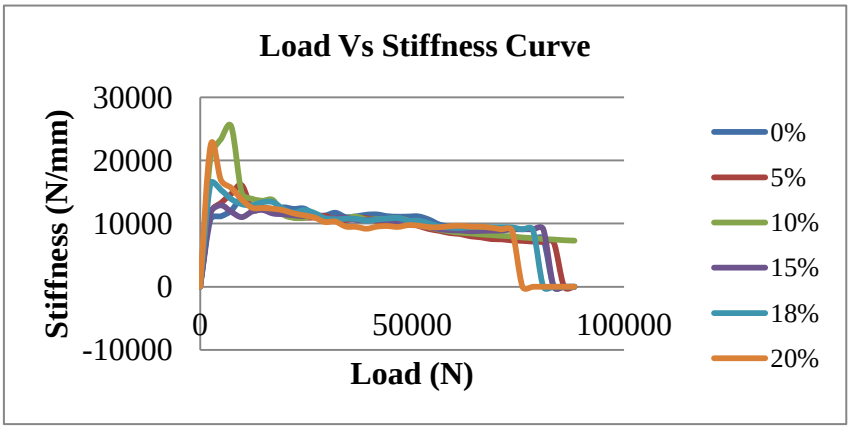

Figure 6 Load Vs stiffness curve for M50 Grade Concrete

4. CONCLUSIONS

- The high performance of M40 grade of concrete was casted and tested by adding the electronic waste at various percentages.
- The maximum deflection of M40 grade beam was 16.35mm under the 73kN loading conditions at 15% of E waste in concrete.
- The average stiffness value for the E waste high performance concrete was 10887.7 N/mm
- For M50 grade of RC beam got the minimum deflection value 0.12mm at the 10% of E waste in concrete.
- Initial crack of 15% of E waste M40 grade beam was 26.9kN and ultimate load was 73.57kN.
- The maximum stiffness value for the M40 grade beam was 7562.77 N/mm
- While adding E waste up to 15% in M50 grade of concrete beam its carrying a ultimate load was 80.53kN and deflected 8.8mm.

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