

Eco-Friendly Light Weight Concrete Incorporating e-Waste & Corn Cob

Ravindra N. Patil¹, Gaurav S. Sanap², Rohit D. Suryawanshi³

Saurabh R. Mahajan⁴, Avikshit Vaidya⁵, Vaibhav Nagare⁶

Professor, Department of Civil Engineering, Sandip Institute of Engineering and Management, Nashik,
Maharashtra, India.¹

Students, Department of Civil Engineering, Sandip Institute of Engineering and Management, Nashik,
Maharashtra, India.^{2, 3,4,5,6}

ABSTRACT: the indiscriminate infrastructural growth is leading to rapid environmental degradation. Concrete is most widely used constructional material all over the world in view of its compressive strength, high mouldability, structural stability & economic consideration. The processing of "ELECTRONIC WASTE" causes serious threats to human health, pollution problem due to improper disposal. It contains some very serious contaminants such as Lead cadmium, Beryllium & Brominates flame retardants. Also high demand of natural resources due to rapid urbanization & disposal problem of agricultural waste have created opportunities for use of agro waste (CORN COB) in the construction industry. This experimental investigation is aimed to utilized "E- WASTE" & "CORN COB" which is use as partial replacement to coarse aggregates on strength criteria of M-30 grade concrete to increase its mechanical properties & to make the concrete light weight. Different properties of fresh concrete in harden concrete reviewed. There are maximum number of experiments have been conducted using various agro waste, but still more examinations are required for other waste such as CORN COB in concrete.

There is less research work reported on CORN COB use as substitution, so it is felt that further detailed investigations are required.

KEYWORDS: E- waste, Corn cob, concrete, compressive strength, durability.

I. INTRODUCTION

New electrical and electronic products have become an integral part of our daily lives providing us with more comfort, security, easy and faster acquisition. Due to technological growth, there is a high rate of obsolescence in the electronic equipments which leads to one of the fastest growing waste streams in the world. This waste stream consists of end of life electrical and electronic equipment products. The European Union (EU) defines this new waste stream as „Waste Electrical and Electronic Equipment“ (WEEE). Since there is no definition of the WEEE in the environmental regulations in India, it is simply called „E-waste“. E-waste describes loosely discarded, surplus, obsolete, broken, electrical or electronic devices. Rapid technology change, low initial costs have resulted in a fast growing surplus of electronic waste around the globe. Several tones of E waste need to be disposed per year. Traditional landfill or stockpile method is not an environmental friendly solution and the disposal process is also very difficult to meet EPA regulations. 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.

A corn cob is the central core of Maize (i.e. Corn). It is the part of the ear on which the kernels grow. The ear is also considered a "cob" or "pole" but it is not fully a "pole" until the ear is shucked, or removed from the plant material around the ear. When harvesting corn, the corncob may be collected as part of the ear (necessary for corn on the cob),

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or instead may be left as part of the corn stover in the field. The innermost part of the cob is white and has a consistency similar to foam plastic. Corn cob has properties such as

- Thermal insulation,
- Light in weight,
- Sound proof.

II. RELATED WORK

E-waste can be used as partial replacement for coarse aggregate in concrete to improve its properties. Many studies have been reported on the strength and durability properties of concrete. Therefore, present study is important and its findings will be very useful in concrete technology area, wherein, coarse aggregates are to be replaced with electronic waste product in making structural grade concrete.

From the total literature review, no one author was used corn cob in concrete as replacement for the coarse aggregate or as any ingredient in concrete. For production of light weight concrete which is to be use in various types of construction corn cob plays an important role. Therefore there is scope to find out optimum percentage of corn cob for the partial replacement of coarse aggregate. In the present research, experimental investigations can be carried out to investigate the effect of corn cob as partial replacement of coarse aggregate on the strength and durability properties of concrete.

III. EXPERIMENTAL DETAILS

3.1. Materials

1. *Cement* The cement used in all mixtures was commercially available 53 grade Ordinary Portland Cement conforming to IS 12269-1987 was used in this study. The specific gravity of cement was 3.15. The initial and final setting time were found as 90 minutes and 250 minutes respectively.
2. *Fine aggregate* Locally available river sand passed through 4.75mm IS sieve is used as fine aggregate. The specific gravity of sand is 2.71 and fineness modulus of 3.59.
3. *Coarse aggregate* The Coarse aggregate are obtained from a local quarry is used. The coarse aggregate with a maximum size 20mm having a specific gravity 2.61 and fineness modulus of 4.59.
4. *E-waste* The E-wastes like printed circuit board are used. The PCB was crushed by using Jaw crusher. The size of E-waste taken is <20mm. The specific gravity of aggregates is 1.565 and fineness modulus of 3.10.
5. *Corn cob* The corn cob used is taken from local farms. The size of corn cob taken is <20mm. The specific gravity of aggregates is 0.347 and fineness modulus of 4.10.

3.2. Experimental Program

The mix design is produced for maximum size of aggregate is 20mm conventional aggregate and e-waste and corn cob aggregates. The variation of strength of hardened concrete using e-waste and corn cob as partial replacement of conventional aggregate is studied by casting cubes and cylinders until 40%. The concrete was prepared in the laboratory using mixer. The cement, fine aggregate and coarse aggregate and solid wastes are mixed in dry state and then the calculated water quantity is added and the whole concrete is mixed for 5 minutes, the concrete is poured in the moulds which are screwed tightly. The concrete is poured into the moulds in 3 layers by poking with tamping rod for cubes of 150×150×150 mm Size, cylinders of 150×300 mm size and beams of 500×100×100 mm size was tested for compression split tensile and flexural strengths. The cast specimens are removed after 24 hours and these are immersed in a water tank. After a curing period of 7 and 28 days the specimens are removed and these are tested for compression, split tensile and flexural strengths tests. The results are compared with conventional concrete.

3.3. Concrete Mixes

Normal mixes concrete and modified with various E-waste and corn cob contents as listed in Table 1 are prepared. By considering the use Ewaste and corn cob in the mixes as much as possible and achieve suitable workability was attempted and strength criteria of Grade M30 concrete mix was analyzed.

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Table 1: Mix Specifications

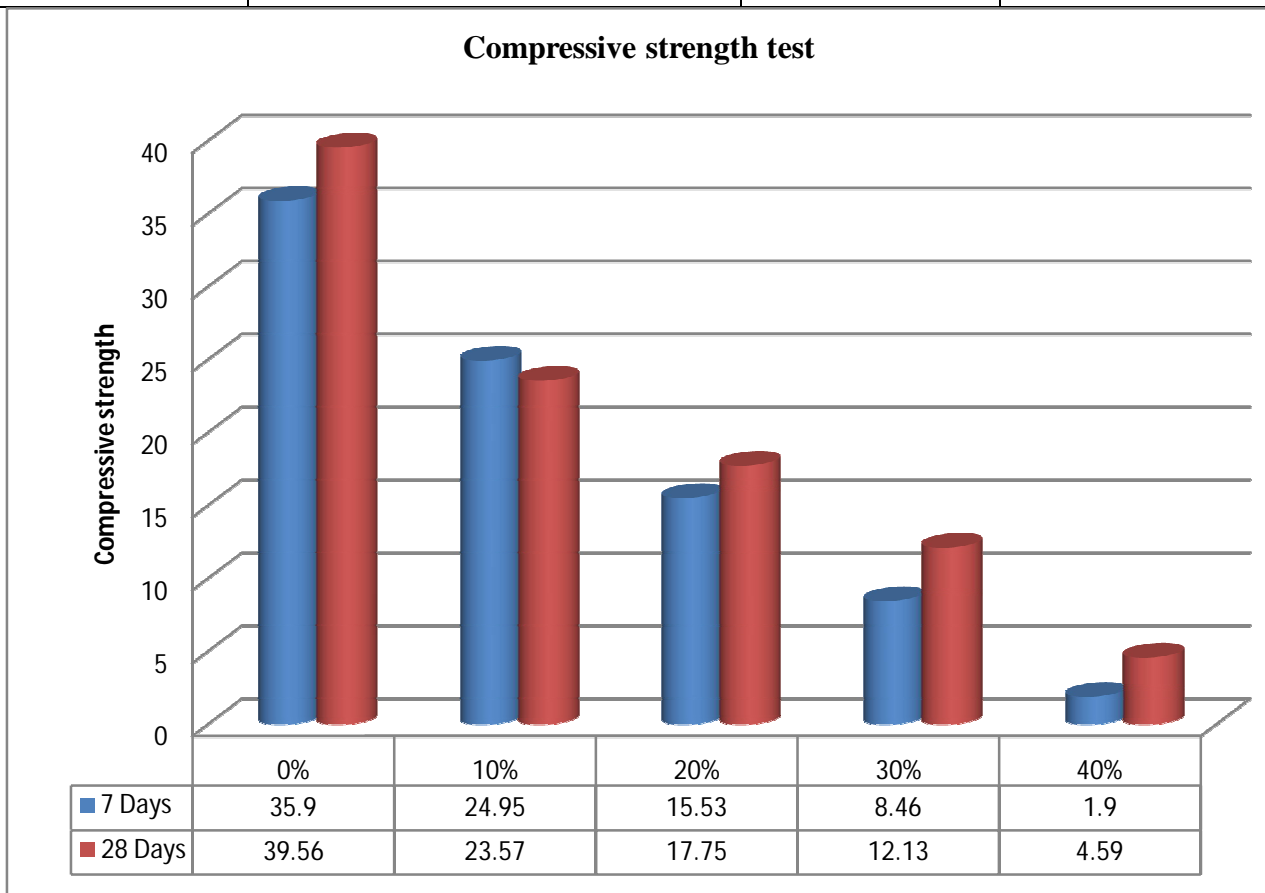
Mix Specification	Normal Mix	M1	M2	M3	M4
Proportion of E-waste	0%	5%	10%	15%	20%
Proportion of Corn cob	0%	5%	10%	15%	20%

III.RESULTS AND DISCUSSIONS

I] Compressive strength of normal concrete& E-waste, corn cob modified concrete for 7&28 days on specimen cube N/mm²

Table 2: Compressive strength test

Sr. No.	% Replacement	7 Days	28 Days
1	0	35.9	39.56
2	10	24.95	23.57
3	20	15.53	17.75
4	30	8.46	12.13
5	40	1.9	4.59



II] Split tensile strength of normal concrete& E-waste, corn cob modified concrete for 7&28 days on specimen cylinder N/mm²

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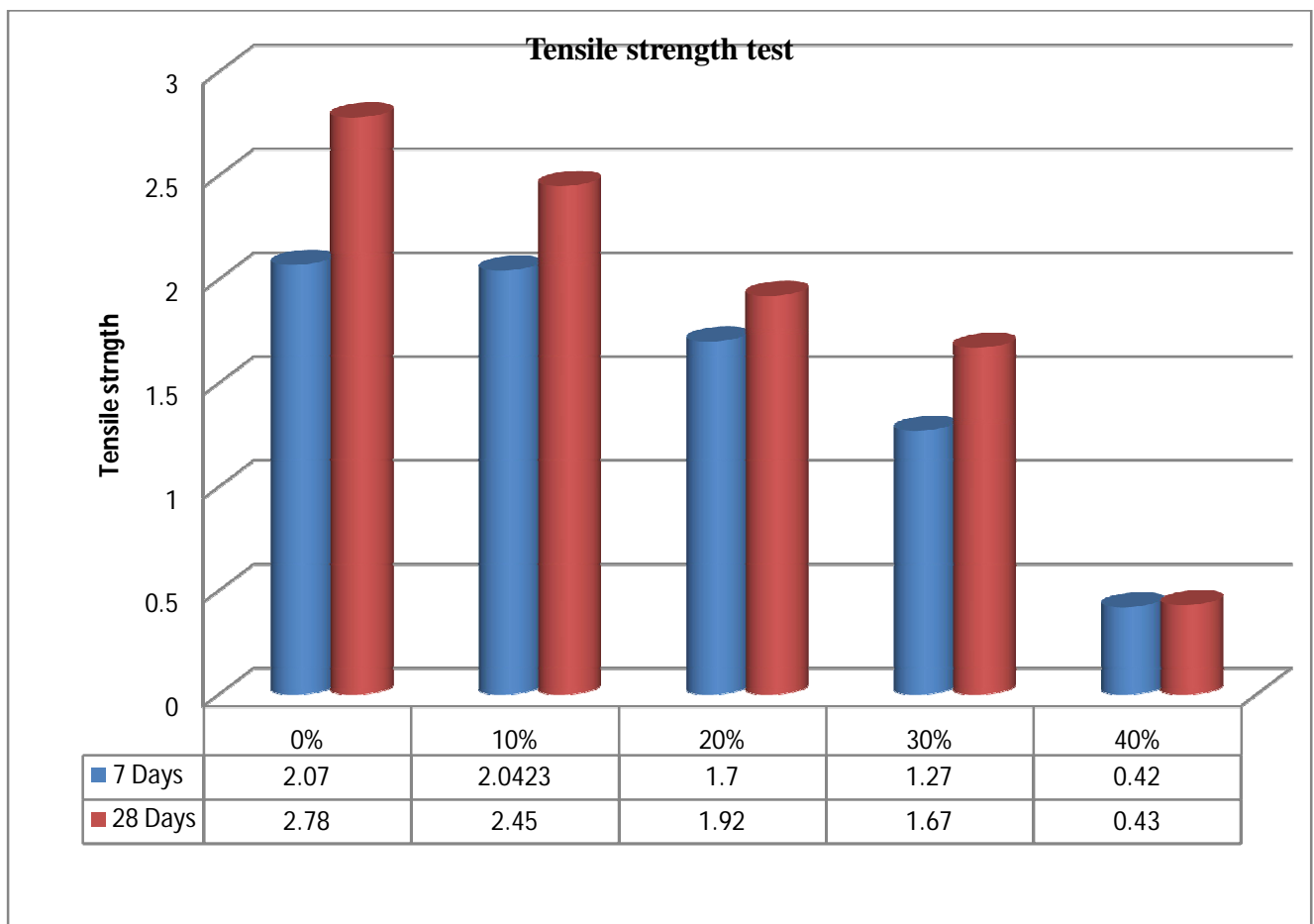
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Table 3: Tensile strength test

Sr. No.	% Replacement	7 Days	28 Days
1	0	2.07	2.78
2	10	2.0423	2.45
3	20	1.7	1.92
4	30	1.27	1.67
5	40	0.42	0.43



III] Flexural strength of normal concrete & E-waste, corn cob modified concrete for 7&28 days on specimen beam N/mm^2

Table 4: Flexure strength test

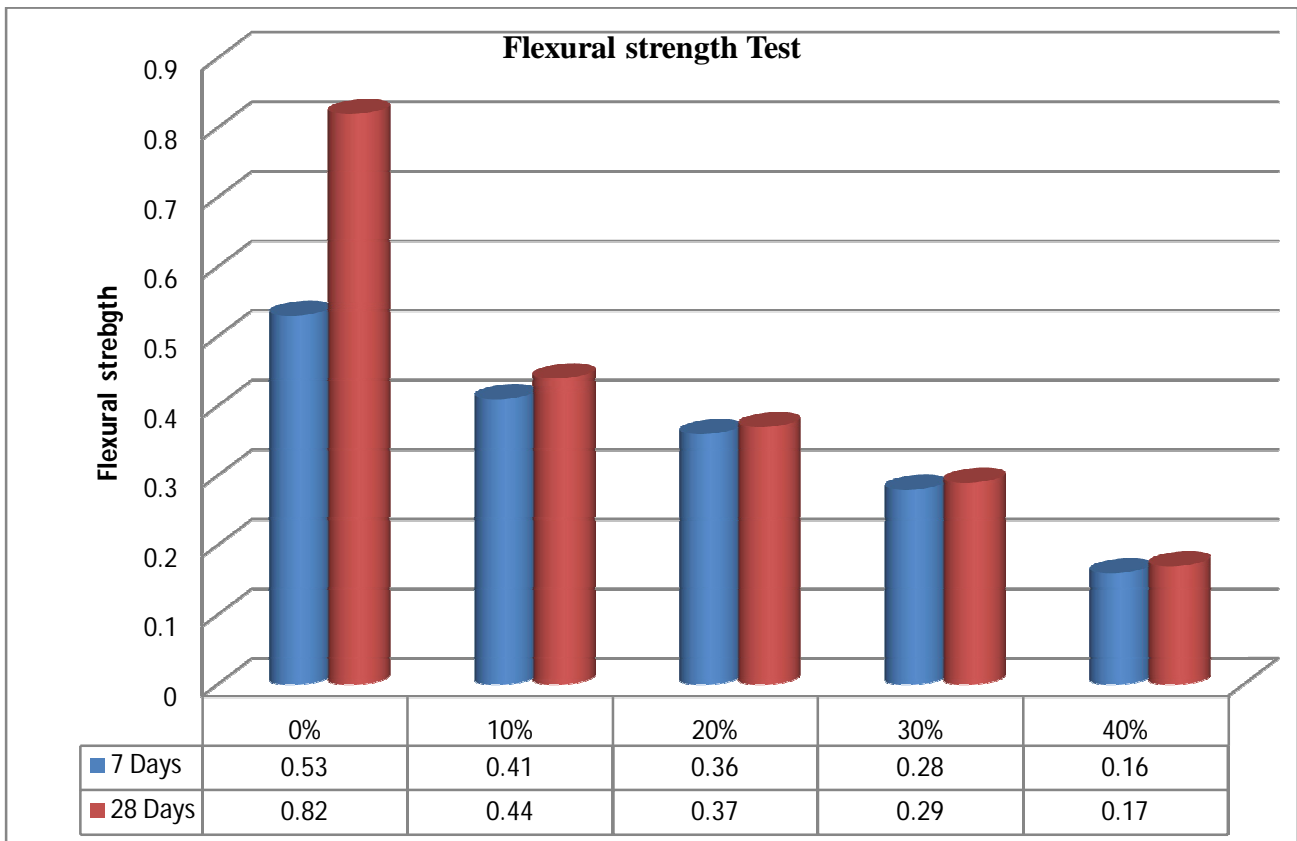
Sr. No.	% Replacement	7 Days	28 Days
1	0	0.53	0.82
2	10	0.41	0.44
3	20	0.36	0.37
4	30	0.28	0.29
5	40	0.16	0.17

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IV] Strength vs. weight for normal and modified concrete cubes:

From the following graph it is cleared that density for cubes at 28 days of curing was less than that of modified concrete.

Table 5: Strength vs. weight for cubes

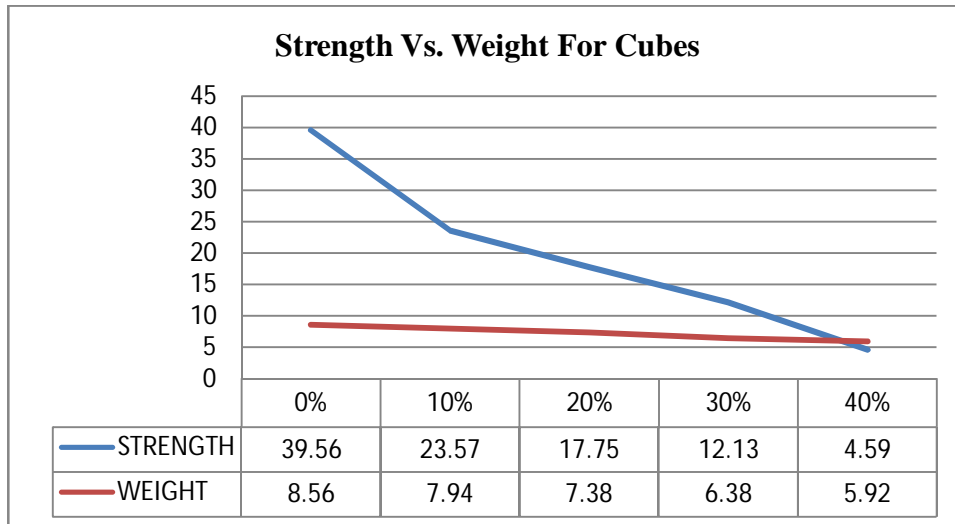
Sr. No.	CODE	REPLACEMENT	STRENGTH(N/mm ²)	WEIGHT(Kg)	WEIGHT-STRENGTH RATIO
1	NC	0%	39.56	8.56	21.63
2	M1	10%	23.57	7.94	33.68
3	M2	20%	17.75	7.38	41.56
4	M3	30%	12.13	6.38	52.59
5	M4	40%	4.59	5.92	128

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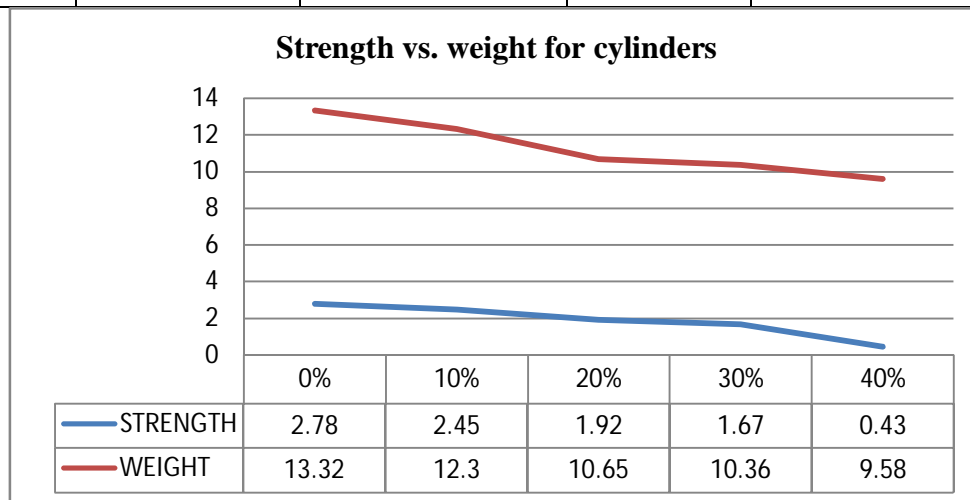


V] Strength vs. weight for normal and modified concrete cylinders:

From the following graph it is cleared that density for cylinders at 28 days of curing was less than that of modified concrete.

Table 5: Strength vs. weight for cylinders

Sr. No.	CODE	REPLACEMENT	STRENGTH(N/mm ²)	WEIGHT(Kg)	WEIGHT-STRENGTH RATIO
1	NC	0%	2.78	13.32	479.13
2	M1	10%	2.45	12.3	502.04
3	M2	20%	1.92	10.65	554.68
4	M3	30%	1.67	10.36	620.35
5	M4	40%	0.43	9.58	2227.90



VI] Strength vs. weight for normal and modified concrete beams:

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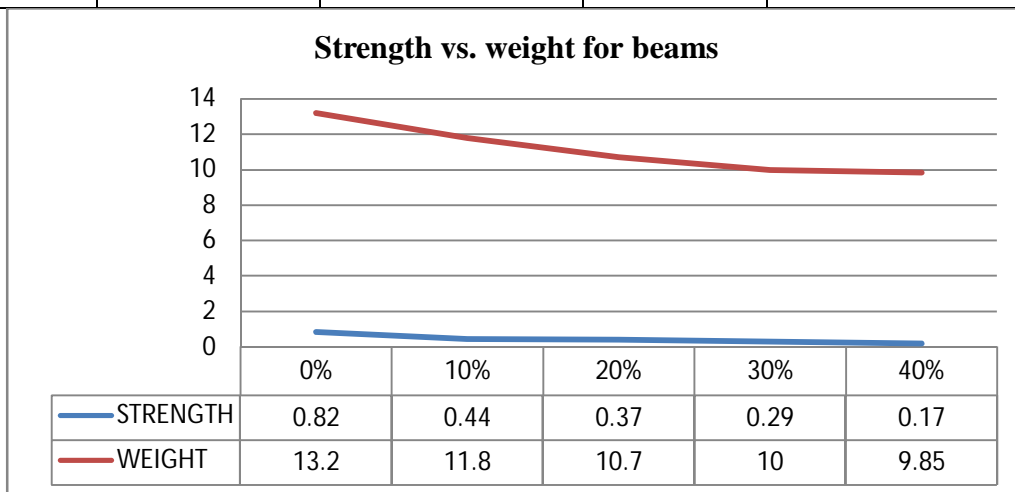
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From the following graph it is cleared that density for beams at 28 days of curing was less than that of modified concrete.

Table7: Strength vs. weight for beams

Sr. No.	CODE	REPLACEMENT	STRENGTH(N/mm ²)	WEIGHT(Kg)	WEIGHT- STRENGTH RATIO
1	NC	0%	0.82	13.2	1609.75
2	M1	10%	0.44	11.8	2681.81
3	M2	20%	0.37	10.7	2891.89
4	M3	30%	0.29	10	3448.27
5	M4	40%	0.17	9.85	5635.29



IV.CONCLUSION

This study intended to find the effective ways to reutilize the E-waste and corn cob as coarse aggregate. Analysis of the strength characteristics of concrete containing E-waste and corn cob gave the following results.

1. Various tests conducted on E-waste & corn cob and results compared with coarse aggregates are satisfactory as per IS 2386.
2. Due to use of E-waste & corn cob as partial replacement of coarse aggregate in construction, energy & cost of coarse aggregates is significantly saved.
3. It is identified that ewaste can be disposed by using them as construction materials.
4. E-waste and corn cob can be used effectively up to 10% replacement of coarse aggregates. This in turn directly reduces the impact of waste material on environment.
5. The experimental results show that the flexural strength and split tensile strength of normal concrete and modified concrete is approximately same up to 10-20% replacement by e-waste and corn cob.
6. Results of all the tests at 30% and 40% replacement of e-waste and corn cob with fine aggregate gets fall down.
7. Has been concluded 10% of E-waste and corn cob aggregate can be incorporated as coarse aggregate replacement in concrete without any long term detrimental effects and with acceptable strength development properties.
8. Weight-Strength ratio goes on increasing with increase in e-waste, corn cob replacement to coarse aggregates.
9. Reduction in weight of various concrete specimens is the important point to achieve light weight concrete.

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REFERENCES

- [1] Lakshmi.R and Nagan.S “Studies on Concrete containing E plastic waste” International Journal of Environmental Sciences Volume 1, No 3, 2010, 270-281.
- [2] S.P.Kale and H.I.Pathan “Recycling of Demolished Concrete and E-waste” International Journal of Science and Research (IJSR) Volume 4 Issue 1, January 2015, 789-792.
- [3] P.Krishna Prasanna and M.Kanta Rao “Strength Variations in Concrete by Using E-Waste as Coarse Aggregate” international Journal of Education and applied research, Vol. 4, Issue Spl-2, Jan - June 2014, 82-84.
- [4] P. Gomathi Nagajothi and Dr. T. Felixkala “Compressive Strength of Concrete Incorporated with E-fiber Waste” International Journal of Emerging Technology and Advanced Engineering, Volume 4, Special Issue 4, June 2014, 23-27.
- [5] Salman Siddique, Sikandar Shakil and Mohd. Shadab Siddiqui “SCOPE OF UTILISATION OF E-WASTE IN CONCRETE” International Journal of Advance Research In Science And Engineering, Vol. No.4, Special Issue (01), March 2015, 776-780.
- [6] D.W.Gawatre, Vivek S.Damal, Saurabh S.Londhe, Ajinkya B.Mane, Hrishikesh Ghawate and BE Students @ Sinhgad Academy of Engineering, Pune-4, “Environmental Issues of Plastic waste use in Concrete” International Journal of Innovative Research in Advanced Engineering (IJIRAE), Issue 5, Volume 2 (May 2015), 114-117.
- [7] Suchithra S, Manoj Kumar, Indu V.S M. Tech Student, Assistant Director, Dept. of Civil Engineering, Kerala Highway Research Institute Sree Buddha College of Engineering, Pattoor “ STUDY ON REPLACEMENT OF COARSE AGGREGATE BY E- WASTE IN CONCRETE” International Journal of Technical Research and Applications, Volume 3, Issue4 (July-August 2015), 266-270.
- [8] Rajiv Gupta, Harish Puppulab, Nakka Rajesh “Application of Recycled Coarse Aggregates and E-Waste for Pavements with Low Traffic” IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume 12, Issue 2 Ver. II (Mar - Apr. 2015), 64-70.
- [9] Mr. Aditya Gavhane, Mr. Dinesh Sutar, Mr. Shubham Soni and Mr. Praveen Patil Utilisation of E - Plastic Waste in Concrete International Journal of Engineering Research & Technology (IJERT), Vol. 5 Issue 02, February-2016, 594-601.
- [10] Ravindra N. Patil “Cement Concrete Properties Incorporating Waste Foundry Sand” IJETT ISSN: 2350 – 0808 | April 2015 | Volume 2 | Issue 1 | 221
- [11] Prof. Ravindra Patil “Mechanical Properties Of Concrete Incorporating Recycled Aggregate and Glass Aggregate”, International Journal of Recent Trends in Engineering & Research (IJRTER) Volume 03, Issue 01; January - 2016 [ISSN: 2455-1457]
- [12] IS-456 - 2000-Plain and Reinforced Concrete Code of Practice
- [13] IS-516-1959 -Methods of tests for Strength of concrete.
- [14] IS-12269 - 1987- Specifications for 53 grade OPC.
- [15] IS 2386 (Part 1, 3 & 4) - 1963, Method of testing of aggregates for concrete.
- [16] IS 1199-1959 - Method of sampling and analysis of concrete.
- [17] IS 7320-1974 - Specification for concrete slump test apparatus.
- [18] IS 5816-1970- Method of test for split tensile strength of concrete cylinders.
- [19] IS 579-1959 - Method for strength of concrete.
- [20] IS 10262-1982 - Recommended guidelines for mix design.

BIOGRAPHY

Prof. Ravindra N. Patil¹ is a professor at Sandip institute of engineering and management, Nashik. He has an experience of more than 5 years in the field. He has published 2 papers in the field of Concrete Technology. His research interests are Recycled aggregate concrete, Durability of concrete and High Performance concrete.

Gaurav S. Sanap², **Rohit D. Suryawanshi**³, **Saurabh R. Mahajan**⁴, **Avikshit Vaidya**⁵, and **Vaibhav Nagare**⁶ Are presently carrying out under graduate research work in Civil Engineering. They are undergraduate students of civil engineering at Sandip institute of engineering and management, Nashik.