Utilization of Coconut Fibre Waste in Manufacturing of Paver Blocks

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Abstract: Paver blocks are playing a vital role in the construction field. Utilizing coir fiber waste as sustainable materials in the production of paver blocks. Coir fiber waste is derived from the husk of coconuts. They have properties that can enhance the performance and sustainability of traditional concrete paver blocks. This paper aims to develop paver blocks using coir fiber waste. Different mix proportions of fine aggregate replaced by coir fiber in 0.5%,0.6% and 0.7% by weight. The research focuses on several key aspects: The optimal mix design for coir fiber into concrete, and the environmental impact analysis of using these materials in comparison with conventional methods. Also we selected this project from niral thiruvizha to solve the problem of a coconut coir industry, which is generating nearly 50kg of coconut coir waste per day.

Keywords- strength of paver Block , coir fibre waste, fine aggregate, fly ash.

1. INTRODUCTION

In today's quest for sustainable construction materials, the utilization of coconut fiber presents an innovative solution for crafting durable and environmentally friendly paver blocks. Coconut husks, typically discarded as waste, harbor a wealth of untapped potential. By repurposing these fibrous husks into paving elements, we not only reduce environmental impact but also harness a renewable resource for construction purposes.

The process begins with the collection and extraction of coconut fibers, which are then meticulously cleaned and dried to ensure optimal quality. Once prepared, the fibers are mixed with a natural binding agent, such as latex or a synthetic binder suitable for outdoor use. This mixture is then combined with aggregate materials like sand or gravel to enhance the strength and durability of the paver blocks.

The resulting coconut fiber paver blocks offer a sustainable alternative to traditional paving materials, boasting not only exceptional strength but also eco-friendly credentials. By diverting coconut husks from landfills and repurposing them into valuable construction components, we mitigate waste and reduce our reliance on finite resources. Moreover, these paver blocks can contribute to sustainable urban development initiatives by promoting greener infrastructure solutions. Embracing coconut fiber as a raw material for paver blocks epitomizes the fusion of innovation and sustainability in the construction industry, paving the way for a greener and more resilient built environment.

2. EXPERIMENTAL INVESTIGATION

2.1 ORDINARY PORTLAND CEMENT (OPC)

Cement is a binding material used in construction that sets, hardens, and adheres to other materials to bind them together. In this present study, Ordinary Portland Cement (OPC) of grade 43 is used for all concrete mixes. The specific gravity of cement is found as 3.15 and the standard consistency was 30%. The initial setting time was found to be 30 min and the final setting time was found to be 480 min. The cement used in this study is fresh and without any lumps.

2.2 FINE AGGREGATE

In this study, Bhavani River sand has been used as a fine aggregate. The sand was washed and screened at site to remove deleterious materials and tested as per the procedure given in IS: 2386-1968. Locally available river sand is confirmed to zone III of table 4 of IS 383– 1970 was used. The specific gravity of sand is 2.6. For increased workability and for economy as reflected by use of less cement, the fine aggregate should have a rounded shape.

Table 2.1Test on Fine aggregate

Properties	Value
Fineness modulus	2.63
Bulk density	1640 kg/m3
Water absorption	1.15%

2.3 COARSE AGGREGATE

Coarse aggregate used for this investigation is angular and is obtained from nearby quarry. The aggregate passing through 20 mm sieve and retained on 10 mm sieve is used to increase the strength. The specific gravity of coarse aggregate was found to be 2.60.

Table 2.2 Test on Coarse aggregate

Properties	Value
Fineness modulus	6.45
Bulk density	1680 kg/m^3
Water absorption	1.25%

2.4 FLY-ASH

Fly ash obtained from Mettur Thermal Power station was used in this investigation. This fly ash is classified as class F low calcium fly ash. The physical and chemical properties of fly ash is given in table 2.4

Table 2.3 Physical requirement of Fly Ash

S. No	Characteristics	Requirements	
1	Fineness – specific surface in m^3 / kg	320 (min)	250 (min)
2	Lime reactivity – average compressive strength in N/ mm^2	4 (min)	3 (min)
3	Compressive strength @ 28 days in N/ mm^2	Not less than 80 % of the strength of PCC	
4	Drying shrinkage	0.15 % (max)	0.10 %(max)
5	Soundness	0.80 %(max)	0.80 %(max)

3. TEST ON MATERIALS

3.1 SPECIFIC GRAVITY OF CEMENT

S.No	Description	
1	Weight of Bottle W_1	49.2g
2	Weight of Bottle + cement weight W_2	101.9g
3	Weight of Bottle + cement + kerosene weight	160.7g
4	Weight of Bottle + kerosene	128.4g
5	Specific gravity of cement = $(W_2-W_1)/ ((W_2 - W_1)-(W_3 - W_4)) \times 0.79$ = (101.9–49.2)/((101.9–49.2)-(160.7 – 128.4)) x 0.79	3.15

3.2 SPECIFIC GRAVITY OF FINE AGGREGATE

S.No	Description	
1	Weight of pycnometer W_1	635g
2	Weight of pycnometer + cement weight W_2	1365g

3	Weight of pycnometer + cement + kerosene weight	1965g
4	Weight of pycnometer + kerosene	1520g
5	Specific gravity of cement = $(W_2 - W_1)/((W_2 - W_1)-(W_3 - W_4))$ = (1365–635)/ ((1365–635)-(1965 – 1520))	2.6

3.3 SPECIFIC GRAVITY OF COARSE AGGREGATE

S.No	Description	
1	Weight of pycnometer W_1	635g
2	Weight of pycnometer + cement weight W_2	1315g
3	Weight of pycnometer + cement + kerosene weight	1950g
4	Weight of pycnometer + kerosene	1520g
5	Specific gravity of cement = $(W_2 - W_1)/((W_2 - W_1)-(W_3 - W_4))$ = (1315–635)/ ((1315–635)-(1950 – 1520))	2.82

3.4 FINENESS MODULUS OF FINE AGGREGATE

Sieve size	Weight retained (kg)	Percentage retained	Percentage passing	Cumulative percentage retained
4.75mm	15	1.5	98.5	1.5
2.36mm	69	6.9	91.6	8.4
1.18mm	179.6	17.96	73.64	26.36
600 micron	76.3	7.63	66.01	33.99
300 micron	143.6	14.36	51.65	48.35
150 micron	447	44.7	6.95	93.05
Base plate	62.3	6.23	0.72	99.28

Sum of cumulative percentage retained = 211.65

Fineness modulus = 211.65/100 = 2.11

3.5 IMPACT TEST ON AGGREGATE

S.No	Description	
1	Weight of the cylindrical cup (W_1)	800g
2	Weight of cup + aggregate (W_2)	1142g
3	Weight of aggregate (W_3)	344g
4	Weight of aggregate passing through 2.36mm sieve (W_4)	38g
5	Aggregate Impact value = (W_4/ W_3) x 100	11.6%

3.6 WATER ABSORPTION

S.No	Description	
1	Weight of wet weight	1000g
	Weight of dry weight	990 g
3	Water absorption = ((Wet weight – dry weight)/ dry weight) x 100 = ((1000 – 990)/990) x 100	1.01%

4. PAVER BLOCK

4.1 IMPORTANCE OF M30 MIX DESIGN IN PAVER BLOCKS:

M30 mix design plays a crucial role in the production of high- quality paver blocks. Mix design refers to the process of determining the proportions of ingredients (cement, aggregates, water, and admixtures) to achieve the desired properties and performance of concrete. Here's why M30 mix design is important specifically for paver blocks:

STRENGTH AND DURABILITY: M30 mix design specifies a concrete mix with a characteristic compressive strength of 30 megapascals (MPa) at 28 days of curing. This level of strength is essential for paver blocks to withstand heavy loads, foot traffic, and environmental conditions without cracking or failing prematurely.

UNIFORMITY AND CONSISTENCY: Proper mix design ensures uniformity and consistency in the properties of concrete, including strength, workability, and durability. This consistency is crucial for producing uniform and high-quality paver blocks that meet design specifications and performance requirements.

WORKABILITY: M30 mix design takes into account the workability requirements of concrete for paver block production. The mix should have sufficient workability to facilitate proper compaction and placement of concrete within the molds, ensuring uniform density and surface finish of the finished blocks.

DIMENSIONAL STABILITY: A well-designed concrete mix, such as M30, helps achieve dimensional stability in paver blocks, minimizing shrinkage and deformation during curing and service life.

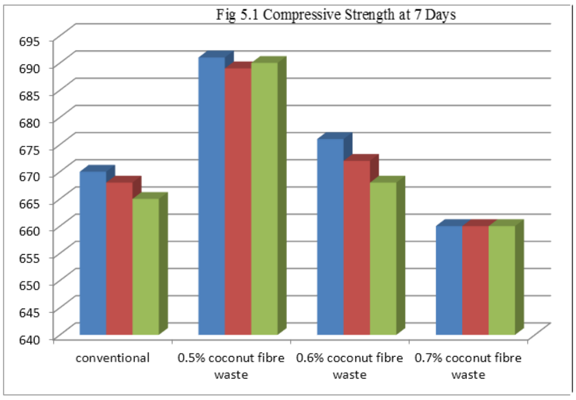
ABRASION RESISTANCE: Paver blocks are subjected to abrasion and wear over time, especially in high- traffic areas. The use of an appropriate mix design, such as M30, can enhance the abrasion resistance of concrete, ensuring long-term durability and performance of paver blocks in outdoor environments.

WEATHER RESISTANCE: Paver blocks are exposed to various weather conditions, including freeze-thaw cycles, moisture, and UV radiation. M30 mix design incorporates materials and proportions that enhance the weather resistance and durability of concrete, reducing the risk of deterioration and surface degradation over time.

COST-EFFECTIVENESS: While M30 mix design specifies a higher strength concrete mix, it also considers cost-effectiveness by optimizing the use of materials without compromising performance. This helps minimize material waste and production costs while maximizing the quality and longevity of paver blocks.

5. RESULTS AND DISCUSSIONS

5.1 COMPRESSIVE STRENGTH:



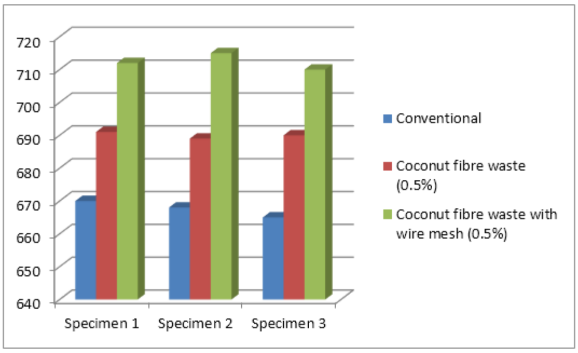


Fig 5.2 Compressive Strength at 7 Days

6. CONCLUSION

- I hereby conclude that the coconut fibre waste and chicken mesh are increasing the Compressive strength of the paver block by 5% and 7% respectively.
- In this project, replacing 0.5% coconut fibre waste is cost effective.
- On the other hand it is also a process of reusing the coconut fibre. waste.
- Coconut fibre waste present in the paver blocks is making it more sustainable.
- Finally, the results are showing that the strength of the paver blocks are increased.

7. REFERENCES

[1] M. Dugarte, A.A. Sagüés, R. G. Powers, I. R. Lasa, Evaluation of Point Anodes for Corrosion Prevention in Reinforced Concrete", Paper No. 07304, 14 pp., Corrosion/2007, NACE International, Houston, 2007**.**

[2] Jennifer L. Kepler, David Darwin, Carl E. Locke, Jr., Evaluation of Corrosion Protection Methods for Reinforced Concrete Highway Structures, University of Kansas Center for Research, INC., Lawrence, Kansas, May 2000,

[3] M. Z. Jumaat, M. M. Rahman and M. A. Alam, Flexural strengthening of RC continuous T beam using CFRP laminate, International Journal of the Physical Sciences Vol. 5(6), pp. 619-625, June 2010

[4] B.Kamashwari, K.Kumar, S.Sivakumar, Effect of reinforcement corrosion on flexural behavior of concrete beams, Amrapali, Technical Journal of Civil Engineering, Vol-I july-sep. 2010.

[5] Leema Rose, K. Suguna and P.N. Ragunath, Strengthening of Corrosion-Damaged Reinforced Concrete Beams with Glass Fiber Reinforced Polymer Laminates, Journal of Computer Science 5 (6): 435-439, 2009.

[6] IS : 10262 -1982 , Recommended Guide Lines for Concrete Mix Design, Bureau of Indian Standards, New Delhi.

[7] IS: 456-2000, Indian Standard Plain and Reinforced Concrete Code OF Practice, 4th Revision, Bureau of Indian Standards, New Delhi.

[8] A.R.Santhakumar, Concrete Technology, Third impression2009, oxford university press, New Delhi.

[9] A.S.S.Sekar, V.Saraswathy and G.T.Parthiban, Cathodic Protection of Steel in Concrete Using Conductive Polymer Overlays, Int. J. Electrochem. Sci., 2 (2007) 872 – 882.

[10] M.S. Shetty, Concrete Technology Theory and Practice, Chand (S.) & Co Ltd, India.

[11] Loganathan.P.,Thirugnanam.G.S., “Experimental study on mechanical properties and durability properties of hybrid fibre reinforced concrete using steel and banana fibres”, Journal of Structural Engineering, Volume 44, Issue 6,2018 pp 577-585.

[12] Loganathan.P.,Thirugnanam.G.S., “Experimental study assessing the strength and crack resistant characteristics of sisal fibre reinforced concrete”, International Journal of Advanced Science and Engineering Research, Volume1, Issue1,2016, pp734-744

[13] Loganathan.P.,Thirugnanam.G.S., “An Experimental Investigation on Behavior of Banana Fibre with Natural Rubber composite Concrete”, International Journal of Applied Engineering Research, Volume10, Issue 38,2015 pp 28712-28717.

[14] Loganathan.P.,Thirugnanam.G.S., “Experimental investigation on corrosion prevention in R.C Slabs”, International journal of advanced science and engineering research,Volume 4, Issue 02,2019, pp162-171

[15] Loganathan.P.,Thirugnanam.G.S.,“An experimental investigation on sisal fibre reinforced concrete with different mix proportions”, Volume 3,Issue 2,2018, pp 56-61.

[16] Loganathan.P.,“Seismic Behaviour of RC Interior Beam-Column Joints”Journal Proceedings of National E-Conference on Recent Advances in Civil Engineering,Volume1, Issue1/2020, pp257-260,Guru Nanak Institutions, Ibrahimpatnam, Hyderabad ISBN 978-81-947249-1-9,

[17] Loganathan.P.,Subramanian.P.,“Experimental investigation of R.C beam column joint strengthening by FRP wrapping”, Journal of the gujarat research Society,volume 22 issue 01,2020 pp08-16.

[18] Loganathan.P.,A.Fathima Darras Gracy.,“Experimental investigation on soil stabilization using textile effluent and fly ash” journal studies in indian place names (ugc care journal), volume 40, issue74,2020,pp273-277.