Grenze International Journal of Engineering and Technology, Jan Issue

Experimental Study on Properties of Paver Block using Coconut Fibre & Nylon Fibre

Dr.M.Harikaran[1], R.Vijayan[2], P.Senthil kumar[3], R.S.Suganth[4], R.Nithishkumar[5] and V.Vijay[6]
[1-6]Assistant Professor, Department of Civil Engineering, Muthayammal Engineering College, Rasipuram-637408, Tamilnadu, India
Email: mhk91karan@gmail.com

***Abstract*—Paver block are extensively used worldwide in pathways because of its toughness and strength. Mechanical properties can be improved in concrete by adding fibres. Coconut fiber is a natural fiber extracted from the outer husk of coconut. Similarly nylon fibre is a synthetic polymer kind of fibre which is extensively used in concrete, we have proposed to use nylon fibre and coconut fibre in proportion of 0.2%, 0.4%, 0.6%, and 0.8 % to the volume of concrete to manufacture paver block and Results obtained from the paver block are compared to assess the performance of both the fibres. M40 grade of Paver block was designed and the specimens were tested for Compressive strength, water absorption test and abrasion test. Specimens are tested at the end of 14 and 28 days and results are compared.**

***Index Terms*— *Paver* block, toughness, Coconut fiber, polymer, nylon fibre, Compressive strength water absorption and abrasion.**

I. INTRODUCTION

Paver block or Paving block is one of the most popular flexible surface treatment options for exterior pavement applications [1]. These blocks are aesthetically pleasing, comfortable to walk on, extremely durable, and easy to maintain. Concrete blocks are mass manufactured to standard sizes. Hence, they can be easily interchanged. A typical concrete block has two surfaces - one is smooth, and the other is a rough surface. The concrete paving blocks are most suitable for heavy-duty applications, able to support substantial loads and resist shearing and braking forces. Aim of our project is to add the nylon fibre and coconut fibre in certain ratios to the paver block to ascertain the possibility of improvement in mechanical properties of the paver block. As we all know fibres have the capability to improve the mechanical property of concrete. Hence the addition is made to the concrete used for paver block and results obtained from adding nylon fiber, coconut fibre are compared to find out the best percentage of addition as well as the best fibre [2].

II. LITERATURE REVIEW

[1] An Experimental Investigation of Paver Block by Using coconut Fiber with Partial Replacement of Cement N.Sudha1, T.Sivaranjani2, M.Swetha3, S.Vaishnavi4, P.Vasuki5international Research Journal of Engineering and Technology (IRJET) Coconut fiber is a natural fiber extracted from the outer husk of coconut and used in products such as floor mats, doormats, brushes and mattresses. Coconut fiber was added in proportion of 0.1%, 0.2%, 0.3%, and 0.4% in paver block. Coconut fiber was added as a

Grenze ID: 01.GIJET.9.1.644

partial replacement of cement in paver block. Then the paver block is tested for compressive strength. The result showed more strength as compared to paver blocks.

[2] Incorporation of Flyash and Coir Fiber in Paver Block Manufacturing. Deepa P S, Nasifa R, Saleena J S, Sruthi S L International Journal of Engineering Research & Technology (IJERT) This paper aims to develop paver blocks using fly ash and coir fiber. Different mix proportions of 10%, 20%, 30%, 40% and 50% are prepared using cement replaced by fly ash and 0.3 % of coir fiber. This project indicated that fly ash and coir fiber can be effectively used as cement replacement. The paver blocks developed are tested for their compressive, flexure and water absorption.

[3] Recycled Plastic and Coconut Fibre used in Concrete Paver Block, M. Achitra1, R. Ambika Rajasree2, R. Vijayalakshmi Pandit3, V.Saranya4, International Journal of Engineering Science and Computing. Coconut fibres were added in proportions of 0.5%, 1.0%, 1.5% and 2.0% in volume of concrete. The compressive strength, flexural strength and water absorption were determined at the end of 7 and 28 days. Test results indicate that addition of coconut fibre gradually increases flexural strengths and water absorption at 7 and 28 days.

[4] Experimental Investigation Paver Block Natural Fiber, T.Subramani1, J.Karthick Rajan2, International Journal of Application or Innovation in Engineering & Management.In this study the compressive strength, water absorption and flexural of paver squares were controlled by including coconut fiber in the best 20mm thickness. Coconut filaments were included extent of 0.5% in volume of cement. The compressive strength, flexural strength and water absorption were resolved toward the finish of 7, 14 and 28 days.

[5] Experimental Investigation Paver Block Natural Fiber, T.Subramani1, J.Karthick Rajan2, International Journal of Application or Innovation in Engineering & Management. In this study the compressive strength, water absorption and flexural of paver squares were controlled by including coconut fiber in the best 20mm thickness. Coconut filaments were included extent of 0.5% in volume of cement. The compressive strength, flexural strength and water absorption were resolved toward the finish of 7, 14 and 28 days.

III. MATERIAL USED & ITS PROPERTIES

A. Cement

Cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is used to bind sand and gravel (coarse aggregate) together. We have used 53 grade OPC Cement for our study [3].

TABLE I. PROPERTIES OF CEMENT

S. No.	Test	Result
1	Specific Gravity	3.13
2	Fineness Test	93%
3	Initial setting time	30 Mins

B. Fine Aggregate

Fine aggregates consist of natural sand or any crushed stone particles that are ¼” or smaller. This product is often referred to as 1/4’” minus as it refers to the size, or grading, of this particular aggregate. We have used M-Sand for our study [4].

TABLE II. PROPERTIES OF FINE AGGREGATE

S. No.	Test	Result
1	Specific Gravity	2.3
2	Water absorption	1%
3	Size	Passing through 4.75mm
4	Fineness Modulus	5.5

C. Coarse Aggregate

The size of 20mm is used in our study which will restrain the materials and gives more toughness to the concrete [5].

TABLE III. PROPERTIES OF COARSE AGGREGATE

S. No.	Test	Result
1	Specific Gravity	2.59
2	Water absorption	0.092%
3	Fineness Modulus	2.9

D. Coconut Fibre

The coconut fibres of size 4 cm length and diameter of 0.01 mm is used. These fibres are defined by aspect ratio. Coconut coir has about 48% of lignin which adds strength and elasticity to the cellulose based fibre walls [6].

E. Nylon Fibre

Nylon is a generic designation for a family of synthetic polymers composed of polyamides (repeating units linked by amide links). Nylon fibers are exceptionally strong and elastic and stronger than polyester fibers. The fibers have excellent toughness, abrasion resistance, and are easy to wash, and to dye in a wide range of colors [7]. The filament yarns provide a smooth, soft, and lightweight fabric of high resilience.

Fig.1 Nylon Fibre

F. Mix Ratio

M40 grade of concrete is designed for paver block and the quantities are derived per cubic meter are as follows.

TABLE IV. MIX PROPORTION FOR PAVER BLOCK BY WEIGHT

Cement	Fine aggregate	Coarse aggregate	W/C Ratio
400kg/m^3	660kg/m^3	1168kg/m^3	0.4

Mix Ratio is 1:1.65:2.92

G. Casting Specimens

Specimens are casted with the addition of 0.2%, 0.4%, 0.6% and 0.8% addition of Coconut fibre and nylon fibre to the conventional concrete specimen [8]. M40 grade of paver block is designed and the Specimens are subjected to water curing, they will be tested for their mechanical properties. Compressive strength Test, Abrasion test and water absorption test are conducted in the specimens at 14 and 28 days [9].

IV. TESTING OF SPECIMENS

A. Compressive strength Results

Fig.2 Compressive strength test of paver block

TABLE V. COMPRESSIVE STRENGTH

Description	Coconut Fibre (N/mm²) (14 Days)		Nylon fibre(N/mm²) (28 Days)	
	14 Days	28 Days	14 Days	28 Days
Conventional Specimen	32.68	40.57	32.68	40.57
0.2% Addition	33.52	42.79	32.58	41.10
0.4% Addition	34.65	43.98	33.79	42.10
0.6% Addition	36.12	46.23	35.12	44.34
0.8% Addition	35.10	44.79	34.09	42.56

Compressive strength results show that addition of coconut fibre and nylon fibre increases strength of the paver block at 14days and 28 days when compared to the conventional specimen [10]. There is gradual increase in compressive strength of the specimen till the addition of 0.6% of fibre content. Beyond 0.6% addition of fibre content there is reduction in the strength of paver block specimen. When comparing the results obtained from the nylon fibre and coconut fibre, results indicate that addition of coconut fibre provides best results than nylon fibre.

B. Abrasion Resistance Test Results

TABLE VI. ABRASION RESISTANCE TEST

Description	Coconut Fiber (N/mm²) (14 Days)		Nylon fibre (N/mm²) (28 Days)	
	14 Days	28 Days	14 Days	28 Days
Conventional Specimen	2.87	3.58	2.87	3.58
0.2% Addition	2.85	3.42	2.75	3.42
0.4% Addition	2.80	3.22	2.60	3.12
0.6% Addition	2.79	3.12	2.59	3.0
0.8% Addition	2.94	3.25	2.14	3.15

Results indicate that 0.6% addition of fibre provide less abrasion resistance when compared to other specimens including conventional specimen [11]. On comparing the results from nylon fibre and coconut fibre, specimen with nylon fibre provides better abrasion resistance in the addition of 0.6%. 0.8% addition of fibre provides increase in weight loss of the specimen.

C. Water absorption Test Results

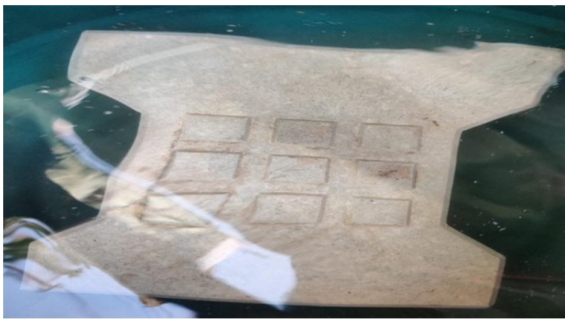

Fig.3 Water absorption Test

Results show that there is a gradual decrease in percentage of water absorption in the addition of 0.2%, 0.4 coconut fibre as well as nylon fibre [12]. 0.6% addition of fibre show lowest water absorption in paver block.

TABLE VII. WATER ABSORPTION TEST

Description	Coconut Fibre (N/mm^2)		Nylon Fibre(N/mm^2)	
	14 Days	28 Days	14 Days	28 Days
Conventional Specimen	2.56	3.24	2.56	3.24
0.2% Addition	2.12	2.98	2.05	2.78
0.4% Addition	2.45	2.62	2.35	2.50
0.6% Addition	1.89	2.32	1.69	2.18
0.8% Addition	2.14	3.45	2.07	3.23

V. RESULT AND DISCUSSION

- On comparing the results of paver block specimen with the addition of nylon fibre and Coconut fibre in different proportions it is found out that 0.6% addition of fibre provide better compressive strength, flexural strength.
- Abrasion resistance and water absorption results are also better 0.6% addition in both the fibre. Coconut fibre yields better strength in Compressive strength while addition of nylon fibre yields better strength in all other parameters.

VI. CONCLUSION

- Mechanical properties of paver block of grade M40 gade was analysed using the addition of nylon fibre and coconut fibre in percentages of 0.2%, 0.4%, 0.6% and 0.8%.
- Properties of nylon fibre and coconut fibre are found out. Fibre were cut into sizes of 5cm.
- On comparing the results of M40 grade paver block specimen with the addition of nylon fibre and Coconut fibre in different proportions it is found out that 0.6% addition of fibre provide better Compressive strength.
- Abrasion resistance and water absorption results are also better 0.6% addition in both the fibre. Coconut fibre yields better strength in Compressive strength while addition of nylon fibre yields better strength in all other parameters.

REFERENCE

[1] Habib Musa Mohamad, Nurmin Bolong, Ismail Saad, Lillian Gungat, Janus Tioon, Rosman Pileh and Mark Delton "Study of performance enhancement of concrete by Replacing coarse aggregete as tyre rubber" International Journal of GEOMATE, May, 2022, Vol.22, Issue 93, pp.9-19 ISSN: 2186-2982 (P), 2186-2990 (O)

[2] A. Ananthi, M. Shabnam Sulthan and V. Vinitha "Study on the Effects of Polypropylene Fiber in Concrete Paver Blocks" International Journal of Construction Engineering and Planning eISSN: 2456-2335 Vol. 3: Issue 2, 2017

[3] M.Harikaran "Study of performance enhancement of concrete by Replacing coarse aggregete as tyre rubber" International Journal of Scientific & Engineering Research Volume 9, Issue 3, ISSN 2229-5518, March-2018

[4] M.Harikaran and N Balasundaram "Deflection Behaviour of RC Beams using Reshaped Waste Tyre Rubber as Partial Replacement of Coarse Aggregate" International Journal of Recent Technology and Engineering (IJRTE), ISSN: 2277-3878, Volume-8 Issue-2, July 2019

[5] M.Harikaran and N.Balasundaram "Performance enhancement of concrete by replacing coarse aggregate with tyre rubber: A Study" Eco. Env. & Cons. 25 (2) : 2019; pp. (702-705), ISSN 0971–765X, January 2019

[6] Structure Design Section, National Engineering Services Pakistan (NESPAK), "Coconut fibre: A versatile material and its applications in engineering" Journal of Civil Engineering and Construction Technology Vol. 2(9), pp. 189-197, 2 September, 2011

[7] Dr.Chinta S.K and Rajesh Kumar singh "Processing Problems Of Polyester And Its Remedies" International Journal of Engineering Research & Technology (IJERT), Vol. 1 Issue 7, ISSN 2278-0181, September - 2012

[8] Shreeshail.B.H , Jaydeep Chougale , Dhanraj Pimple , Amar Kulkarni "EFFECTS OF COCONUT FIBERS ON THE PROPERTIES OF CONCRETE" International Journal of Research in Engineering and Technology eISSN: 2319-1163, pISSN: 2321-7308, March 2020

[9] M.Harikaran and N.Balasundaram "Evaluation of Concrete Using Reshaped Waste Tyre Rubber as Partial Replacement of Coarse Aggregate" International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-7, Issue-6S5, April 2019

[10] Cong Bang TRUONG “Study on Fly Ash Based Interlocking Concrete Paver Block Using Chopped Fibers” IOP Conf. Series: Materials Science and Engineering 988 (2020) 012060, December-2020
[11] Zoran J. Grdic, Gordana A. Toplicic Curcic, Nenad S. Ristic, Iva M. Despotovic “Abrasion resistance of concrete micro-reinforced with polypropylene fibers” Construction and Building Materials 27 (2012) 305–312
[12] Shreeshail.B.H , Jaydeep Chougale , Dhanraj Pimple , Amar Kulkarni “Effects of coconut fibers on the properties of concrete” International Journal of Engineering and Technology, eISSN: 2319-1163 | pISSN: 2321-7308, December 2014
[13] R.Vijayan, T.R.Neelakantan August 2021 “A study on suitability of pond ash and Fly ash in Concrete as a replacement to fine Aggregate and Cement for Sustainable Development” Ecology Environment and Conservation 27,(August Suppl Issue)2021, Page no (S109-116)
[14] Sudharsan, N. and Sivalingam, K. Potential utilization of waste material for sustainable development in construction industry. International Journal of Recent Technology and Engineering-2019