Experimental Study on Use of Foundry Sand in Paver Blocks

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Abstract: Now days, interlocking concrete pavements become popular, prepared by special dry mix precast piece of concrete, commonly used for paving of approaches, paths and parking area. In today's era, Industrial by-products disposal is becoming unattractive worldwide due to its associated negative economic and environmental impacts. For this purpose various industrial wastes such as fly ash, copper slag, plastic waste, hypo sludge etc are selected for improvement in its physical and chemical properties. In this paper, Paver blocks are prepared using M30 grade mix proportions as per IS specifications. Foundry sand, a byproduct of ferrous and nonferrous metal casting industries is used as a partial replacement of sand via 0%, 5%, 10%, 15% and 25%; for determining the change in compressive strength, water absorption, and flexural test .For getting better results, 0.3% of synthetic fiber is added to total volume of concrete for 10% and 15 % foundry sands and results are compared with nominal paver block

Keywords: Concrete Paver Blocks, Compressive Strength, Foundry Sand, Synthetic fiber, Tensile Strength, Water Absorption.

I. INTRODUCTION

Depending upon the requirements and following IS 15658:2006, for different road traffics, such as light, medium, heavy and very heavy traffic, different paving applications is used. Paver blocks are more advantageous as it reduces storage place, reduces extra cost, eliminates laborious construction work and lastly gives smooth finishing. For the tests, Several Zig zag Paver blocks was casted of size 245 x 120 x 60 mm for measuring Compressive strength, flexural strength of each proportion.

II. MATERIALS

Cement: Ordinary Portland cement (OPC) of 53 grade is used for casting of paver blocks as per IS: 8112 (1989). Physical properties of OPC are given in Table 1.

Table 1 : Physical Properties of Ordinary Portland Cement

Sr No	Properties	Test Results
1	Specific gravity	3.10
2	Consistency limit	31%
3	Setting time in minutes (a) Initial setting time (b) Final setting time	 30 minutes 600 minutes

Coarse aggregate: Locally available Crushed stones size between ≤ 12 mm was used in experimental study. The aggregates were tested as per IS: 383-1970.

Fine Aggregates: -. The sand was sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm. It was conformed to grading zone II .Sieve analysis and physical properties of fine aggregate were tested as per IS: 383-1970.

Water: Potable tap water was used for the preparation of paver blocks and curing of specimens.

Foundry Sand: In India, several types of metal industries prefer sand as a casting system. In casting process, they use, recycle and reuse the sand several times but after sometime it is discarded from the foundries which are known as waste foundry sand.

Synthetic fiber: Synthetic fibers are manufactured from man-made materials that can withstand the long-term alkaline environment of concrete. The benefits of using synthetic fiber include reduction in plastic settlement cracks, shrinkage crack, increased impact and abrasion resistance etc. Figure 1 shows the synthetic fiber.

Fig 1 : Synthetic Fiber

III. MIX DESIGN

The M30 mix design was calculated according to IS 10262:2009 and IS 15658:2006. The design mix proportion considered for 0% replacement considering conventional concrete is 1:2.05:2.75 having a water cement ratio of 0.45. The percentage share of foundry sand and synthetic fiber in each mix are shown in Table 2

Table 2 : Details of mix proportions

TYPES	CEMENT (in %)	FINE AGGREGATE (in %)	COARSE AGGREGATE (in %)	FOUNDRY SAND (in %)	SYNTHETIC FIBERS (by total vol. of concrete)
TYPE N	100	100	100	0	0
TYPE A	100	95	100	5	0
TYPE B	100	90	100	10	0
TYPE C	100	85	100	15	0
TYPE D	100	75	100	25	0
TYPE E	100	90	100	10	0.3
TYPE F	100	85	100	15	0.3

Paver blocks of zigzag type moulds having size 260×120×60mm were used for the experimental work. Moulds were cleaned and oiled from inner surfaces. Then the moulds were filled and compacted and were open manually with the help of spanner after 24 hours of casting. The Table 3 shows the number of paver blocks used for experimental work

Table 3: Sample numbers used in experimental work

Type of Tests	Total No. of block	No. of blocks for 7 days testing	No. of blocks for 28 days testing	Remarks
Compression Test	06	03	03	7 x 6 = 42
Flexure Test	06	03	03	7 x 6 = 42
Total =				**84**

IV. EXPERIMENTAL WORK

Compression Test: Paving blocks were tested for compressive strength. Compressive strength of paver blocks shall be specified in terms of 28 days compressive strength. The compressive strength of concrete paver blocks made using different proportions of Foundry sand is shown Table 4. The figure 2 shows the graphical representation for 7 and 28 days.

Table 4: Compressive strength values for 7 and 28 days

Description	Ultimate Load in kN (7 days)	Ultimate compressive strength for 7 days in N/mm^2	Ultimate Load in kN (28 days)	Ultimate compressive strength for 28 days in N/mm^2
TYPE N	723	23.1	1544	49.5
TYPE A	589	18.85	1188	38.05
TYPE B	633	20.30	1607	51.48
TYPE C	686	22.00	1200	38.46
TYPE D	597	19.10	1084	34.73
TYPE E	568	18.18	1218	39.01
TYPE F	845	27.07	1360	43.58

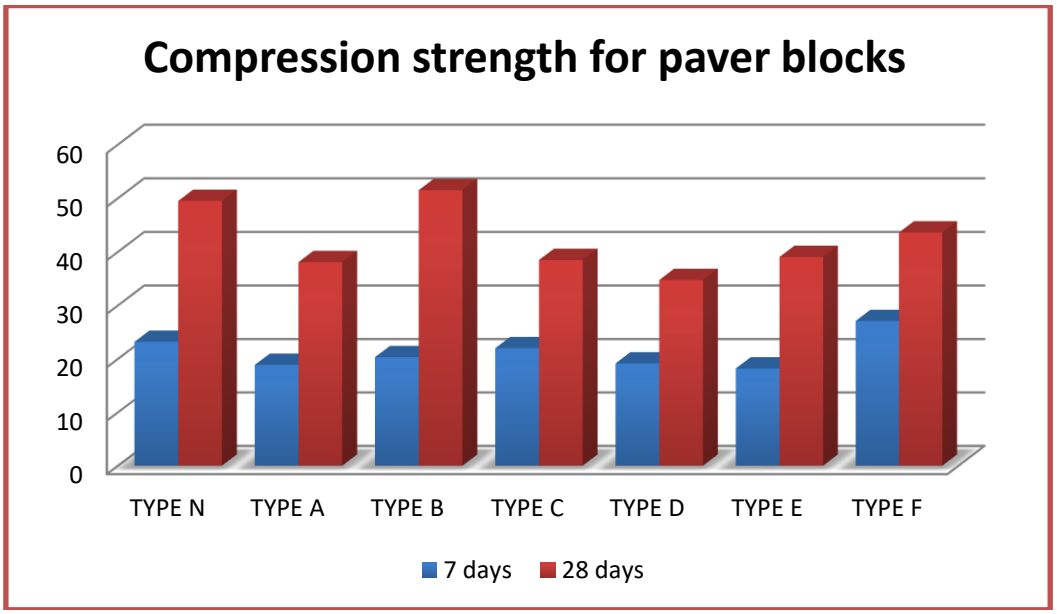

Fig 2 : Graphical representation for compressive strength values for 7 and 28 days

Flexure Test: Tensile strength of paver concrete paver blocks made using different proportions of Foundry sand is shown Table 5. The figure 3 shows the graphical representation for 7 and 28 days.

Table 5: Flexure strength values for 7 and 28 days

Description	Flexural strength for 7 days in N/mm^2	Flexural strength for 28 days in N/mm^2
TYPE N	3.01	4.81
TYPE A	2.11	3.31
TYPE B	3.43	4.01
TYPE C	2.868	3.76
TYPE D	3.17	3.81
TYPE E	3.07	4.112
TYPE F	2.94	4.072

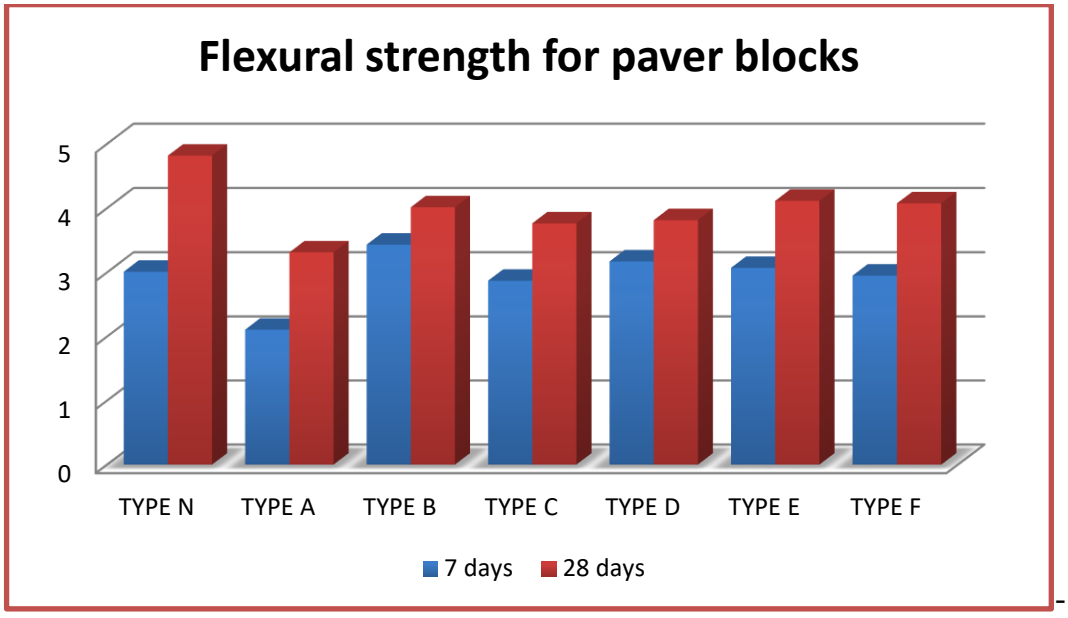

Fig 3 : Graphical representation for tensile strength values for 7 and 28 days

Water absorption Test: The water absorption of three average concrete paver blocks made using different proportions of foundry sand is shown in Table 6 The paver blocks containing 0% foundry sand have the lowest water absorption while the blocks containing more amount of foundry sand have the highest water absorption

Table 6: Average values of water absorption concrete paver blocks

Description	Wet weight in kg	Dry weight in kg	% Water absorption
TYPE N	4130	4188	1.40
TYPE A	4010	4045	2.19
TYPE B	4246	4319	1.69
TYPE C	4250	4337	2.02
TYPE D	4150	4249	2.32
TYPE E	4320	4412	2.10
TYPE F	4127	4228	2.38

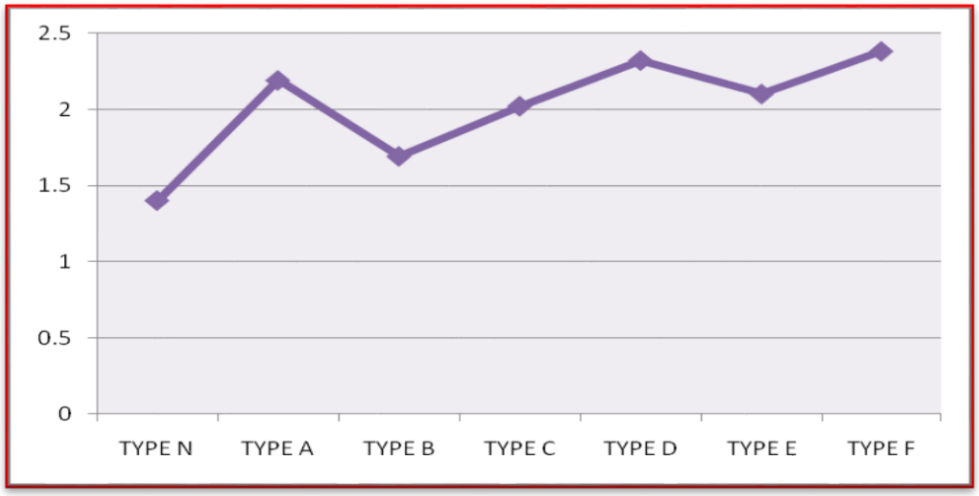

Fig 4: Graphical representation for water absorption values

V. CONCLUSIONS

Study has been carried out on M30 grade concrete paver blocks, where test like water absorption, compression test and flexural tests were carried out on standard concrete and various proportions.

1. It has been observed that in case of compression test, for 10% replacement of foundry sand gives maximum compressive strength and also addition of 0.3% of synthetic fibre, the compressive strength increases to some extent.
2. The values for nominal concrete paverblock, the flexural strength comes to be maximum and in addition of synthetic fibre , it also gives little more flexural strength.
3. Study shows that water absorption values for standard concrete paver block gives minimum value and as the percentage of foundry sand is increasing, more the value of water absorption is coming. Inspite of adding synthetic fiber there is no vast difference

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PHOTO GALLERY

REFERENCES

[1]. Mithun and N. T. Chethan Kumar, "Hyposludge Paver Blocks" International Journal of Advanced Technology in Engineering and Science, Vol.No.4, Issue No.7, July 2016.

[2].P.Sharma and M. Sharma "Utilization of Quarry Dust in Cement Concrete Paver Blocks for Rural Roads", International Research Journal of Advanced Engineering and Science.

[3].B.Shackel. "Design & Construction of Interlocking Concrete Block Pavements", Elsevier Applied Science, London, pp 229-230,1990.

[4].Deepak .S and Ram C "Effect on Compressive Strength of Paver Block by Partial Replacement of Cement with Fly Ash" , International Journal of Science Technology & Engineering , volume 2 , Issue 11 , May 2016.

[5].Momani E et al, "Utilization of Green Waste Foundry Sand in Concrete Paver Blocks",Journal of Multidisciplinary Engineering Science Studies,Vol. 2 Issue 10, October – 2016

[6].IS 15658: 2006, Precast concrete blocks for paving- Specification.

[7].IS 7245 : 1974 Specification for concrete pavers

[8].IRC SP:63-2004, Guidelines for use of interlocking concrete block pavement, Indian road congress

[9].IS 456:2000 Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards; New Delhi.

[10]. Amritkar, S.S., Chandak, S.N., Patil, S.S. & Jadhav, R.A., 2015. "Effect of waste foundry sand (wfs) on the mechanical properties of concrete with artificial sand as fine aggregate" International Journal of Engineering Research & Technology (IJERT)

[11].Khatib, J.M., B. Baig, Menadi, B. & Kenai, S., 2011. "Waste foundry sand usage in concrete. Innovation in civil engineering and construction materials", 137 (1), 1-6.

[12].Siddique, R. & Dhanoa, G.S., 2013. "Design & development of concrete using waste foundry sand as partial replacement of fine aggregate". In University, H. ed. Hokkaido University Collection of Scholarly and Academic Papers : HUSCAP.

[13] Salokhe, E.P. & Desai, D.B., ND. "Application of foundry waste sand in manufacture of concrete". IOSR Journal of Mechanical and Civil Engineering (2278-1684), 43-48.

[14] Utsav T et al. "Experimental Study on use of Hypo sludge in Paver blocks"International journal of modern trends in engineering and research Volume 04, Issue 5, May– 2017