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Strength characteristics of Concrete Paver Blocks embedded with PET Fibres

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Abstract— **Experiments were carried out on 240 mm x 120mm x 80 mm zigzag paver blocks for M 30 grade. Waste bottles were simply cut into fibres and used in the manufacturing of paver blocks. Plastic fibres from mineral water bottles were added (0.4%, 05%, and 0.6%) by weight of block as reinforcement. The size of the chopped Polyethylene Terephthalate (PET) fibre is 10mm length, 2mm width and 0.3mm thickness. Quarry dust was used as a fine aggregate. The paver blocks were tested for Density, Compressive strength and Flexural strength test. Blocks with 0.4% of plastic fibres showed a better strength.**

Index Terms— **Concrete paver blocks; M30 grade; cement; PET fibres; Quarry dust**

I. INTRODUCTION

Disposal of waste plastic materials such as Polyethylene Terephthalate (PET), Poly propylene (PP), etc…. is a biggest challenge as repeated recycling of PET bottles pose a potential danger of being transformed to carcinogenic materials. Thus, the utilization of waste plastic materials in concrete paver block would be an alternative solution to reduce environmental pollution. Now-a-days using concrete paver block is becoming popular they are used for paving of approaches, decorative method for creating paths and parking area. Paver block is an alternative to both flexural and rigid pavement in various countries.

Concrete paver blocks are made with concrete basically consisting of cement, fine aggregate, coarse aggregate, water, chemical pigments etc…. The function of fine aggregate is to assist in producing workability and uniformity in nature. The river deposits are the most common source of fine aggregate. Now-a-days the natural river sand has become scarce and costly. So we are forced to think of alternative materials, the quarry dust may be used in the place of river sand fully or partially. A comparatively good strength is expected when sand is replaced partially or fully with or without concrete admixtures.

One of the method to satisfactorily address plastic solid waste management and the environmental issues to suitably accommodate plastic waste in some form(fibre) during the process of making paver block. Approximately 3 or 4 bottles have been used for making a single block.

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Fig 1: Paver Blocks

II. LITERATURE REVIEW

Divya Sasi, Examined the impact and strength properties of concrete in replacing some portion of concrete by quarry sludge got from a nearby crusher unit. The research work has been incorporated a test examination on strength properties of cement made with 2.5% to 20% substitution of cement by quarry dust of under 75 micron particle size. The tests include compressive strength, splitting tensile strength and flexural strength on samples. Results demonstrated that up to 7.5 % substitution of cement by quarry dust there was no reduction in compressive strength, splitting tensile strength and flexural strength.

G. Navya et al (2010), In this study, the compressive strength, water absorption and flexural strength of paver blocks have been determined by adding Coconut fibers in the top 20 mm thickness. Coconut fibers were added in proportions of 0.1%, 0.2%, 0.3%, 0.4% and 0.5% in volume of concrete. The compressive strength, flexural strength and water absorption had been determined at the end of 7 and 28 days. Test results indicated that addition of coconut fiber by 0.3% in paver block attained maximum compressive strength. Test results indicated that addition of coconut fiber gradually increased flexural strengths and water absorption at 7 and 28 days.

Fernando. P., et al., (2012), In their study observed that, synthetic fibres such as polypropylene, glass, nylon and PET fibers were added for concrete cracking control. The PET fibres diameter had been 25-30 micon and length-15 mm. The fibres were added at three different volumes of fractions 0%, 0.05%, 0.10% w/c-0.6. After 40 days, as the PET fibre ratio increased, cracking length and number of crack decreased, 0.10% of the added PET fibres have been given good results. The experimental results have shown that the addition of short polypropylene fibres to the mortar mixture was more at restraining considerably crack formation due to plastic shrinkage.

R. C. Yeole et al., (2014), studied the parametric experiment for producing paving blocks using waste steel aggregates (the form of rounded bearings of size 6.35 mm). Waste steel bearings had been added in concrete of paver blocks in various percentages. Rubber pads have been also used below the paver blocks. Impact strength of paver blocks with various

percentages of waste steel aggregates and using rubber pads had been investigated. The impact strength was observed to have increased by 50% than ordinary paver blocks.

Sharda Sharma, (2014), in a stud observed that, water proofing superplasticizer had been used in M 35 mix design with adding 2 % of superplasticizer by weight of cement in the construction of concrete blocks pavements. Superplasticizer had been added 0.5 %, 1.0 %, 1.5 % and 2.0 % by weight of the cement in construction of the concrete pavement blocks. The effect was observed in the workability of M 35 mix design considering w/c ratio on 0.35, 0.40, 0.45, 0.50, and 0.55. The use of superplasticizer also helped in reduction of water percentage in concrete mix while comparing with conventional mix design without using superplasticizer.

S. Revathi et al., (2015), observed that, waste products like groundnut husk ash has been used for the production of paver blocks. Density of paver blocks have been within the range of 1888-2202 kg/m^3. Density values decreases with increase in groundnut husk ash. Groundnut husk ash had been suitable in making paver blocks as the water absorption is less than 7%. The paver blocks prepared using M40 grade of concrete can be used for light traffic commercial vehicles in places like pedestrian plazas, shopping complexes, ramps, car parks, housing colonies, office complexes, rural roads with low volume traffic, farm houses, beach sites, tourist resorts local authority footways, residential roads, etc…

III. Material and Methods

Material:

Cement, fine aggregate, coarse aggregate, PET fibres and water.The type of Cement is OPC 53having a specific gravity of 3.11. Quarry dust as a fine aggregate having a specific gravity of 2.6 and water absorption as 1%. Coarse aggregate of size 12 mm natural gravel having a specific gravity of 2.7 and water absorption as 0.5%. PET fibres having a size of 10mm length, 2mm breadth and 0.3 mm thickness as shown in figure 2. Water with 8.61pH has been used. Water-cement ratio was adopted as 0.45.

Fig 2: PET Fibres

Table1: Properties of PET fibres

Properties	Values
Molecular formula	$(C_{10}H_8O_A)_n$
Density	1.38 g/cm (20°)
Melting point	250°c - 260°c
Boiling point	350°c
Thermal conductivity	0.15 to 0.24 $Wm^{-1}k^{-1}$
Specific heat capacity, c	1.0KJ/(Kg. K)
Tensile strength	55 – 75 MPa
Elastic limit	50 – 150%

Methodology:

Mix proportion:

Table 2: Mix proportions of paver blocks

Materials	Quantity in kg/m^3			Ratio		
Cement	351.1			1		
Fine aggregate	396.95			1.3		
Coarse aggregate	1011.71			2.88		
Plastic	7.03 %	8.80 %	10.56 %	0.4%	0.5%	0.6%
Water cement ratio	158.08			0.45		

Mixing, Casting and Curing:

Figure 3 in the following section shows the mixing, casting and curing of concrete paver blocks. The mixing of raw materials were done by machine mixing to obtain homogeneous mixing of quantity. Compaction was done by using vibrating machine to obtain good compaction. Finally, the blocks were smoothened, finished and leveled with metal trowel. The blocks were cured for 7, 14 and 28days. The blocks were tested at 7, 14 and 28 days for density, compression and flexural test.

Fig 3: Mixing, Casting and Curing of Paver Block

Compressive Strength

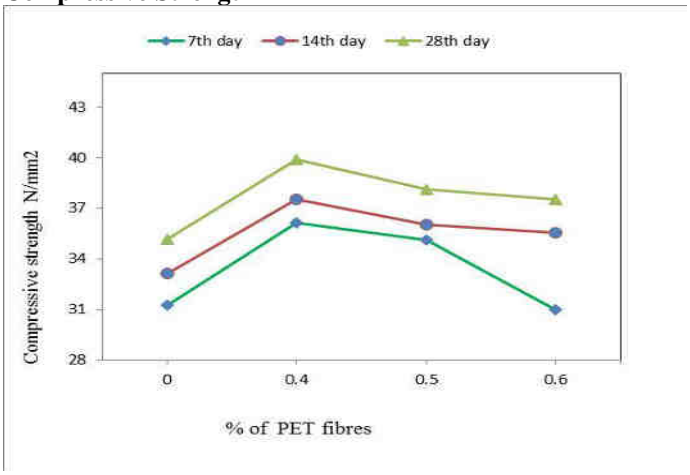

Fig 4: Compressive strength of Paver Blocks

Fig 4 shows the compressive strength of paver blocks. The compressive strength for M30 mix is 31.25 N/mm2 (at 7th day), 33.12 N/mm2 (at 14th day), 35.162N/mm2 (at 28th day) and then the compressive strength was increased to 15.2% when the plastic was added as 0.4%[36.12 N/mm2 (at 7th day), 37.52 N/mm2 (at 14th day), 39.88 N/mm2 (at 28th day))] and decreases with increasing plastic such as for 0.5% and 0.6% compressive strength was found to be [35.11 N/mm2 (at 7th day), 36.02 N/mm2 (at 14th day),38.11N/mm2 (at 28th day)] and [31N/mm2 (at 7th day), 35.54 N/mm2 (at 14th day) 37.54N/mm2 (at 28th day)] 12% and 0.8% respectively.

Flexural Strength

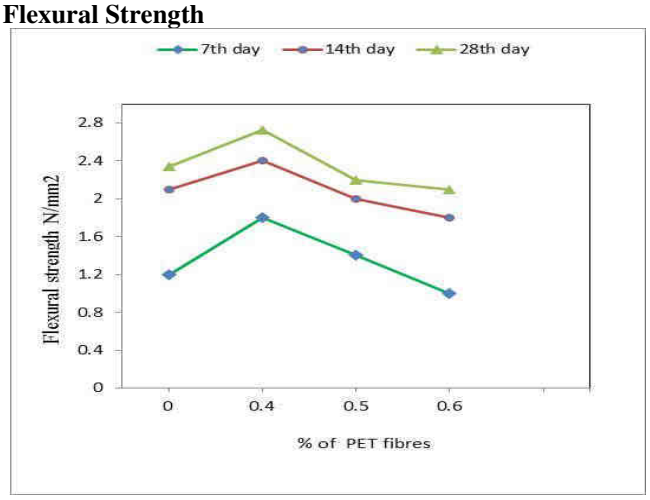

Fig 5: Flexural strength of Paver Blocks

The flexural strength for M30 mix was 1.2 N/mm2 (at 7th day), 2.1N/mm2 (at 14th day), 2.34N/mm2 (at 28th day) and then the flexural strength was increased to 50% when the plastic was added as 0.4%[1.8 N/mm2 (at 7th day), 2.4N/mm2 (at 14th day), 2.73N/mm2 (at 28th day) and decreases with increasing plastic such as for 0.5% and 0.6% flexural strength was found to be [1.4N/mm2 (at 7th day), 2N/mm2 (at 14th day), 2.2N/mm2 (at 28th day)] and [1N/mm2 (at 7th day), 1.8 N/mm2 (at 14th day), 2.1N/mm2 (at 28th day)] 12% and 0.8% respectively.

Density:

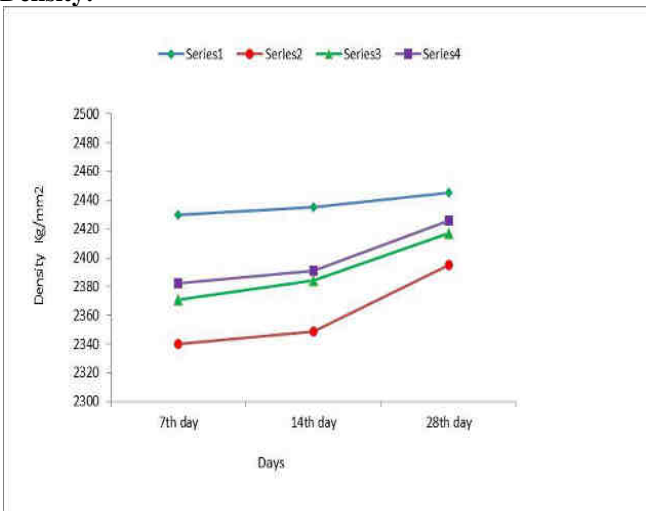

Fig 6: Densities of Paver Blocks

The minimum density achieves when the percentage of PET fibres were added as 0.4% by weight of concrete paver blocks.

CONCLUSION

The percentage of PET fibres were added to concrete paver block in 0.4, 0.5, and 0.6 ratios in effective manner. The paver block tested for Density, Compressive and Flexural test. Test results showed that 0.4% of PET fibres in concrete blocks achieved good Density, compressive and Flexural strength. There is no significant increase in strength of paver block after 7 days. The compressive strength was increased to 15.2% and the flexural strength was increased to 50% when the plastic fibre was added as 0.4%.

REFERENCES

[1] Fernando Pelisser, Oscar, Rubem Klegues Montedo, Philippe Jean Paul Gleize, Humberto, Ramos Roman, Mechanical Properties of Recycled PET Fibers in Concrete, Volume 96, pp. 409-414, 2012

[2] Lavanya G, Vasanthakumar P, Experimental study on Paver Blocks utilizing Pet Fibres, International Journal of Advanced Engineering Research and Technology (IJAERT) Volume 4, Issue 4, 2016

[3] Mohammed A A, Modeling the Mechanical Properties of Concrete Containing PET waste aggregate, Constr. Build. Mater. 150 (2017) 595–605

[4] Irwan J M, Asyraf R M, Othman N, Koh H B, Annas M M K, Faisal S K, The Mechanical Properties of PET Fber Reinforced Concrete from Recycled Bttle Wastes, Adv. Mat. Res. 795 (2013)347–351

[5] Navya G, Venkateswara Rao J, Experimental Investigation on Properties Concrete Paver Block with the Inclusion of Natural Fibers, International Journal of Engineering Research and Applications, Volume.4, pp. 34-38 (2014)

[6] Revathi S, Kumutha R, Vijai K, Properties of Paver Blocks with Groundnut Husk Ash as Fine Aggregates, International Research Journal of Engineering and Technology, Volume 02, 2015

[7] Sharda Sharma, Analysis of Workability on Construction of Interlocking Concrete Pavement Blocks (ICBPs) Using Superplasticizer as a mixture, International Journal of Science and Research (IJSR) volume. 3 (2014)

[8] Yeole R C, Varma M B, Comparison of Mix Designs of Paver Blocks using Waste Rounded Steel Aggregates and Rubber Pad, International Journal of Emerging Technology and Advanced Engineering, Volume 4, (2014)

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