ISSN:2348-2079

Volume-5 Issue-1

International Journal of Intellectual Advancements and Research in Engineering Computations

# Experimental investigation on GGBS paver block with addition of polyester triangular fibre

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***Abstract*: In this experimental investigationcompressive strength and water absorption of paver block were evaluated by replacing portion of cement with the GGBS (Ground Granulated Blast Furnace Slag). Polyester Triangular fibers were also incorporated along with the GGBS to further enhance the mechanical properties. Different proportions of Polyester Triangular fiber starting from 0.4% and 0.5% by weight of materials. 20% to 35% by weight of cement was replaced with the GGBS. By test testing the specimen optimum fibre and GGBS content find out.**

**Keywords: Compressive Strength, GGBS, Polyester Triangular fibers, Water Absorption, Paver Block**

## I INTRODUCTION

Concrete is a mixture of cement, water and aggregates, with or without admixture. Consequently, pavements in which non-interlocking blocks are used are designed as concrete block pavement. The concrete paver blocks laid on a thin, compacted bedding material which is constructed over a properly profiled base course and is bounded by edge restrains/kerb stones. Many number of such applications for light, medium, heavy and very heavy traffic conditions are currently in practice around the world. The recommended dimensions and thickness of paver block shall be 50mm and maximum 120mm. In this project the paver block designed medium traffic category for recommended grade designation is M40 and recommended minimum paver block thickness is 80mm.Concrete block paving is versatile, attractive, functional and cost effective and requires little or no maintenance if correctly manufactured and lay. Recently in concrete paver block fibres are introduced to increases strength, durability and reduction in cracks. Instead of using fibre used in paver block to increases the properties of paver block. The concrete paver block maintenance is low and economic when compared with other pavements. GGBS is obtained by product of iron and steel making from a blast furnace in water or steam, to produces glassy, granular product that is then dried and ground into a fine powder. GGBS is used as a direct replacement of Portland cement. Replacement levels for GGBS vary from 10% to 85%. Typically up to 50% is used in most instances.

### A. LITERATURE REVIEW

RounakHussain [1] explained about laboratory investigation on optimum level of GGBS. The production of cement results in emission of many greenhouse gases in atmosphere, which are responsible for global warming. Hence, the researchers are currently focused on use of waste material having cementing properties, which can be added in concrete as partial replacement of cement, without compromising on its strength and durability. This will result in decrease of cement production thus reduction in emission in greenhouse gases, in addition to sustainable management of the waste. The alkaline liquid used in geopolymerisation was the combination of sodium hydroxide (NaOH) and sodium silicate (Na2SiO3).

B.A.V.Ramkumar, J.VenkateswaraRao [2] explained about the investigations of GGBS characteristics. In this experimental investigation compressive strength, flexural strength and water absorption of paver block were evaluated by replacing portion of cement with the GGBS (ground granulated blast furnace slag). Glass fibers were also incorporated along with the GGBS to further enhance the mechanical properties. Different proportions of glass fiber starting from 0.1% to 0.4% by weight of cement in the paver block were added. The optimum fiber content from test results was found to be 0.2% by weight of cement. 10% to 40% by weight of cement was replaced with the GGBS. G.Navya; J.VenkateswaraRao [3]explained about durability, increases strength and reduction in strength. In this experimental investigation the compressive strength, water absorption and flexural strength of paver blocks were determined by adding Polyester fibers in the top 20mm thickness. Polyester 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 were determined at the end of 7 and 28 days.

## II. MATERIAL SPECIFICATION

### A. Cement

Cement is a binding material in concrete which binds the other material to forms a compact mass. In this project work, OPC 43 grade cement is used for experimental study.

**Table 2.1 Properties of Cement**

| | |
|---|---|
| **Finess value** | 8.8% |
| **Consistency** | 30% |
| **Initial setting time** | 27 min. |
| **Specific gravity** | 3.15 |

### B. Water

Water conforming to the requirements of IS 456-2000 is found be satisfactory for making concrete. In the present investigation, portable drinking water available in the industrial company was used for mixing and curing the paver block.

C. Coarse Aggregate

Locally available crushed stone aggregates of nominal size 10mm .wherever possible size of aggregate 10mm used in the project.

| Description | Test result | Permissible limits as per IS:383-1970 |
|---|---|---|
| Specific gravity | 2.66 | Minimum 2.5 |
| Unit weight (kg/m$^3$) | 1600 | 1600-1800kg/m$^3$ |

**Table 2.2 Properties of Coarse Aggregate**

D.Fine Aggregate

A concrete with better quality can be made with sand consisting of rounded grains rather than angular grains. River or pit sand must be used but not used sea sand as it contains salt and other impurities. In this study, river sand has been used as fine aggregate.

| Description | Test result | Permissible limits as per IS 383:1970 |
|---|---|---|
| Specific gravity | 2.61 | Minimum 2.5 |
| Fineness modulus | 3.24 | |
| Unit weight of sand (kg/m$^3$) | 1600 | 1600-1800 kg/m$^3$ |

**Table 2.3 Properties of Fine Aggregate**

E. GGBS

GGBS was obtained by grinding the quenched blast furnace slag to fine powder. Ground Granulated Blast Furnace Slag is obtained from JSW plant. The specific gravity of GGBS is 2.775.

| S.No | Description | Percentage of Content |
|---|---|---|
| 1 | CaO | 30-50% |
| 2 | $SiO_2$ | 28-38% |
| 3 | $AL_2O_3$ | 8-24% |
| 4 | MgO | 1-18% |

**Table 2.4 Properties of GGBS**

F. Polyester triangular fibre

The specification for polyester triangular fibre as follows below:

| | |
|---|---|
| **Specific gravity** | 1.34-1.39 |
| **Aspect ratio** | 342 |
| **Diameter** | 0.035mm |
| **Density** | 0.90kg/Cu.m |
| **Colour** | White |
| **Length** | 12mm |

**Table 2.5 Properties of Polyester Fibre**

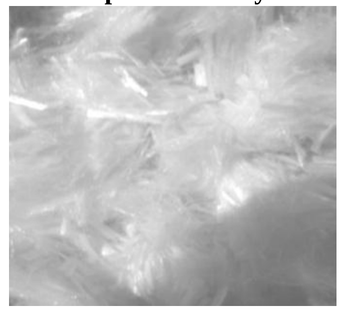


**Fig 2.1 Polyester Triangular Fibre**

III. MIX PROPORTION

In this study, control mix M was designed as per IS 10262:2009 for M40 grade. Polyester triangular fibre was initially added 0.4% and 0.5% by weight of concrete. Optimum polyester triangular fibre and GGBS. GGBS was replaced for cement in percentages 20 to 35. The details of the mix proportions of 72 paver blocks were given in following table 3.1. Each mix proportion for 8 paver blocks.

| → Materials / Mix ↓ | Cement (kg) | Fine Aggregate (kg) | Coarse Aggregate (kg) | Water (liters) | GGBS (kg) | Polyester Triangular fibre(g) |
|---|---|---|---|---|---|---|
| M | 5.552 | 7.402 | 12.337 | 2.221 | 0 | 0 |
| $MPF_{0.4}G_{20}$ | 4.442 | 7.402 | 12.337 | 2.221 | 1.110 | 101.164 |
| $MPF_{0.4}G_{25}$ | 4.164 | 7.402 | 12.337 | 2.221 | 1.041 | 101.164 |
| $MPF_{0.4}G_{30}$ | 3.886 | 7.402 | 12.337 | 2.221 | 1.249 | 101.164 |
| $MPF_{0.4}G_{35}$ | 3.609 | 7.402 | 12.337 | 2.221 | 1.457 | 101.164 |
| $MPF_{0.5}G_{20}$ | 4.442 | 7.402 | 12.337 | 2.221 | 1.110 | 126.455 |
| $MPF_{0.5}G_{25}$ | 4.164 | 7.402 | 12.337 | 2.221 | 1.041 | 126.455 |
| $MPF_{0.5}G_{30}$ | 3.886 | 7.402 | 12.337 | 2.221 | 1.249 | 126.455 |
| $MPF_{0.5}G_{35}$ | 3.609 | 7.402 | 12.337 | 2.221 | 1.457 | 126.455 |

(MPF- Mix polyester triangular fibre & G-GBBS)

**Table 3.1 Mix Proportion Details**

Paver blocks were casted conforming to the mix proportion and recommendations laid down in IS: 15658:2006. The paver blocks were casted control mix M, and mix with $MPF_{0.4}G_{20}$, $MPF_{0.4}G_{25}$, $MPF_{0.4}G_{30}$, $MPF_{0.4}G_{35}$, $MPF_{0.5}G_{20}$, $MPF_{0.5}G_{25}$, $MPF_{0.5}G_{30}$, $MPF_{0.5}G_{35}$. The paver blocks were cured in 7 days. For determining compressive strength, paver blocks were tested in compressive testing machine. The compressive, water absorption tests were conducted as per IS: 15658:2006.

Now a result in polyester triangular fibre and GGBS was determined.

**Fig 3.2 Compressive strength test**

IV. RESULTS & DISCUSSION

A. Compressive Strength

The compressive strength values of the conventional concrete paver block & paver block with GGBS and polyester triangular fibres were presented in figure 4.1.

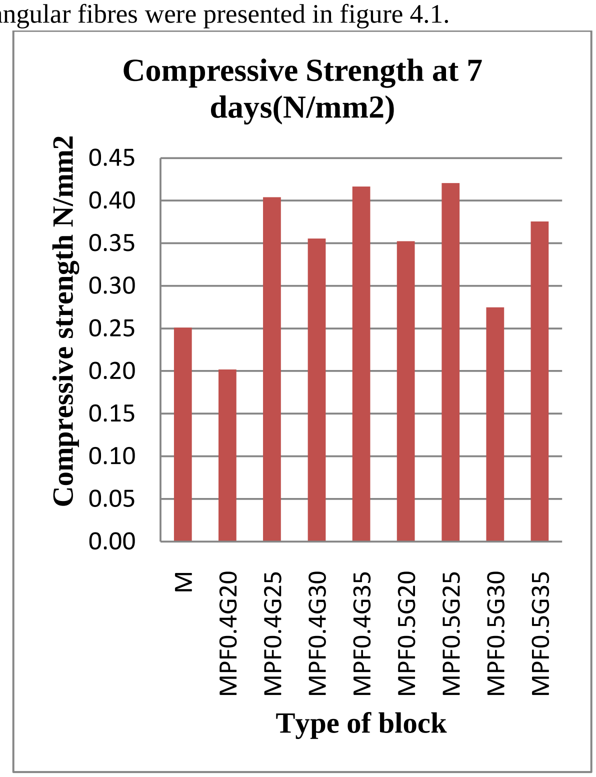
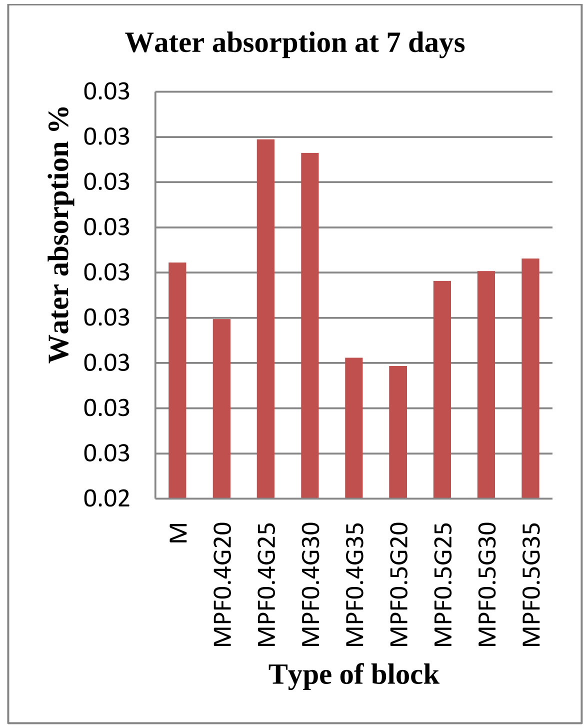



**Fig 4.1 Compressive strength at 7 days for paver block without and with GGBS and fibres**

From fig 4.1 it is observed that the compressive strength of concrete paver block is increasing with the increase in GGBS and fibre content compared to conventional paver block at 7 days. It is observed that 25% of GGBS and 0.5 % of fibre maximum strength was attained.

B. Water Absorption

The water absorption values of the conventional concrete paver block & paver block with GGBS and polyester triangular fibres were presented in figure 4.2.




**.Fig 4.2 Water absorption at 7 days for paver block without and with GGBS and fibres**

From 4.2 shows the variation of water absorption at 7 days for control mix M, and mix with $MPF_{0.4}G_{20}$, $MPF_{0.4}G_{25}$, $MPF_{0.4}G_{30}$, $MPF_{0.4}G_{35}$, $MPF_{0.5}G_{20}$, $MPF_{0.5}G_{25}$, $MPF_{0.5}G_{30}$, $MPF_{0.5}G_{35}$. Along with optimum GGBS and fibre $MPF_{0.5}G_{25}$.The graph illustrates that water absorption at 7 days decreases with the increase in GGBS and fibre content

V. CONCLUSION

1. Compressive strength of paver block increases by GGBS, addition of polyester triangular fibre and optimum content of GGBS and fibre inclusion was 25% & 0.5%.
2. A test result at 7days curing period with optimum GGBS and polyester triangular fibre indicates an increase of 66% in compressive strength.
3. There are 7.87% decrease in Water absorption at mix $MPF_{0.5}G_{20}$ replacement of cement with GGBS and additionally added polyester triangular fibre at 7 days.

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