

# Experimental Study On Strength Improvement Of Concrete Paver Blocks By Using Copper Slag And GGBS

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## ABSTRACT

*This study is mainly focused on the use of copper slag as a replacement for fine aggregate and GGBS as a replacement for cement. Paver blocks are commonly used as decorative method of creating a pavement. The main benefit is that the bricks can be separately lifted up and replaced. It does not require a lot of maintenance. Concrete is a combination of cement, aggregate and water. In this experiment CONCRETE BLOCK PAVEMENT (CBP) are formed from individual solid blocks that fit closely next to one another to form a pavement surface. CBP is placed with a variety of spaces and pattern. The block which is used in this project has a space of BI-ARC and having a dimension of 260x110x80mm (or) 26x11x8 cm. In this study of improvement of paver block compressive strength test, impact strength test and water absorption test are conducted in M40 grade concrete. Different portion of copper slag is replaced with fine aggregate in the percentage of 10%, 20%, 30% and a portion of GGBS is replaced with a constant of 30%. In future, there is going to be a time when there will be scarcity for cement and fine aggregate (sand). So, we have adopted GGBS and copper slag in concreting method to produce paver block which doesn't require cement and fine aggregate.*

**Keywords:** GGBS, Copper Slag, Paver Blocks, M40, Bi-Arc

## INTRODUCTION

India is a developing country so, construction of roadways and buildings play an important role. Nowadays paver blocks are used in outdoor purposes and also used in street roads and other construction places. Interlocking concrete block pavement (ICBP) technology has been introduced in India in construction, a decade ago,

for specific requirement namely foot paths, parking areas etc..

Concrete paver blocks were first introduced in Holland in the 50's as replacement of paver bricks which had become scarce due to the post-war building construction boom. These blocks were rectangular in shape and had more or less the same size as the bricks. During the last few decades the blocks have moved from no

interlocking to interlocking blocks . nowadays various shaped paver blocks are being introduced to aesthetic appearance and to lay the blocks in different shapes.

## LITERATURE REVIEW

**G.Pragna,et.al(2017)** investigated the replacement of GGBS with cement and fly ash with fine aggregate and addition of glass fibre to know the variation in the strength of the paver block when compared to the conventional paver blocks .the percentage was chosen between 15% to 60%.The experimental tests conducted are compressive strength, flexural strength and water absorption test.The optimum result was obtained at 30%.

**Tamil Selvi,et.al(2014)** investigated the various replacement of copper slag with the fine aggregate from 0%,20%,40%,60%,80%,100%. The maximum compressive strength is obtained from 40% replacement of fine aggregate at 7 and 28 days. The test conducted are compressive strength, flexural strength, rebound hammer test.

**K.Kalingari,et.al(2017)** investigated the use of industrial wastes such as copper slag, fly ash, phosphogypsum and sludge as replacement for fine aggregate to know the variation in the strength of paver block when compared with the conventional paver blocks .the percentage of cement added was 70% and fly ash 30%.The test conducted for the compressive strength, flexural strength ,tensile splitting strength and water absorption test.

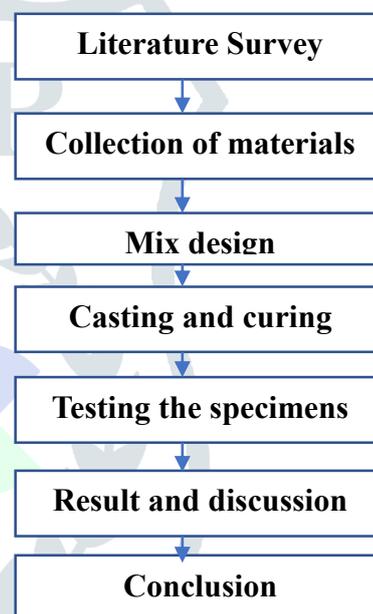
**S.Kalaiselvi,et.al (2017)** investigated the use of copper slag as partial replacement for paver block .The proportions taken are 10%,20%,30%,40%,50% and 60%.It was observed that optimum content of copper slag that can be used as replacement material is 30% .The test conducted were weight density test and compressive strength.

**C.Banupriya,et.al(2016)** investigated the partial replacement by using fly ash and GGBS to know the strength of the paver block .The volume used for fly ash and GGBS were 65%,70%,75% and 80%. The test conducted was compressive

strength test. The optimum result was obtained at 75%.

**V.Revathi,et.al(2014)** investigated the use of alkali activated bottom ash and GGBS blend together to form a paver blocks .Various mixes were proposed based on the combination of BA-GGBS. The percentage ration was selected as 100:0,75:25,50:50,25:75 and 0:100. It was observed at end the optimum strength were obtained at the ratio 25:75 for M30 and 75:25 for M35. The paver blocks showed incredible compressive strength under steam curing .

## METHODOLOGY



## MATERIALS USED

### Cement

Ordinary Portland cement (OPC) of 53 grade was used after the conformation to IS: 12269-1999 for the casting the paver blocks. The specific gravity of cement after the test was found to be 3.1.



### Fine aggregate

The sources of fine aggregates for paving blocks are river sand or, alternatively, artificial sand by crushing rocks. Fine aggregates were used conforming to IS 383 2002. The specific gravity of fine aggregate (sand) is 2.54.



### Coarse aggregate

Making sure of the availability crushed coarse aggregates of nominal size 10mm were used in this work. The coarse aggregate passing through 12.5mm was used. The specific gravity for coarse aggregate is 2.66.



### Water

The water added to the concrete paver block controls the properties of the concrete both fresh and hardened concrete. The water-cement

ratio is defined as the amount of water absorbed by the aggregate to the amount of cementitious material to the weight of the concrete .

### GGBS

Ground-granulated blast-furnace slag (GGBS or GGBFS) is obtained by quenching molten iron slag (a by-product of iron and steel-making) from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder. Two major uses of GGBS are in the production of quality-improved slag cement, namely Portland Blast furnace cement (PBFC) and high-slag blast-furnace cement (HSBFC), with GGBS content ranging typically from 30 to 70% and in the production of ready-mixed or site-batched durable concrete. The specific gravity of the GGBS after the test was found to be 2.75.



### Copper slag

Copper slag is a by-product of copper extraction by smelting. During smelting, impurities become slag which floats on the molten metal. Slag that is quenched in water produces angular granules which are disposed of as waste or utilized .Copper slag is mainly used for surface blast-cleaning. Abrasive blasting is used to clean

and shape the surface of metal, stone, concrete and other materials. In this process, a stream of abrasive grains called grit are propelled toward the workpiece. Copper slag is just one of many different materials that may be used as abrasive grit. Rate of grit consumption, amount of dust generated, and surface finish quality are some of the variables affected by the choice of grit material. The specific gravity of the copper slag after the test was found to be 3.

GGBS	-	30%	30%	30%
Copper slag	-	10%	20%	30%

## RESULT AND CONCLUSION

### Compression strength test

	7 days test	28 days test
Conventional Block	43.43 N/mm <sup>2</sup>	45.46 N/mm <sup>2</sup>
Combination 1	49.30 N/mm <sup>2</sup>	55.04 N/mm <sup>2</sup>
Combination 2	53.07 N/mm <sup>2</sup>	55.65 N/mm <sup>2</sup>
Combination 3	50.175 N/mm <sup>2</sup>	37.10 N/mm <sup>2</sup>



### Mix design

M40 grade concrete

Opc 53 grade cement

Specific gravity of cement =3.1

Specific gravity of fine aggregate =2.54

Specific gravity of coarse aggregate (10mm)=2.66

Specific gravity of copper slag =3

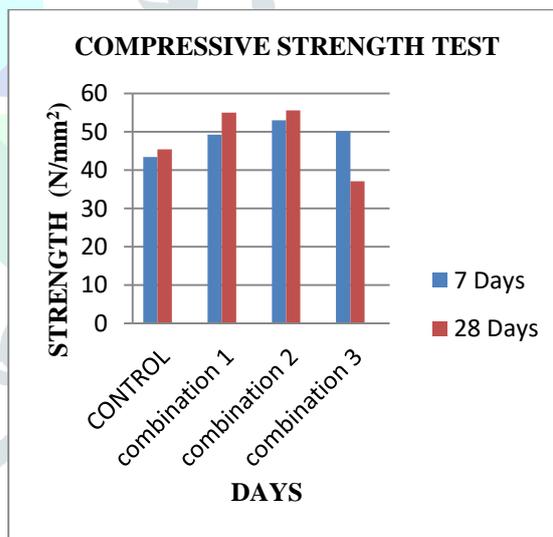
Specific gravity of GGBS =2.75

Water cement ratio=0.4

Mix ratio=1:1.4:1.39

### COMBINATION

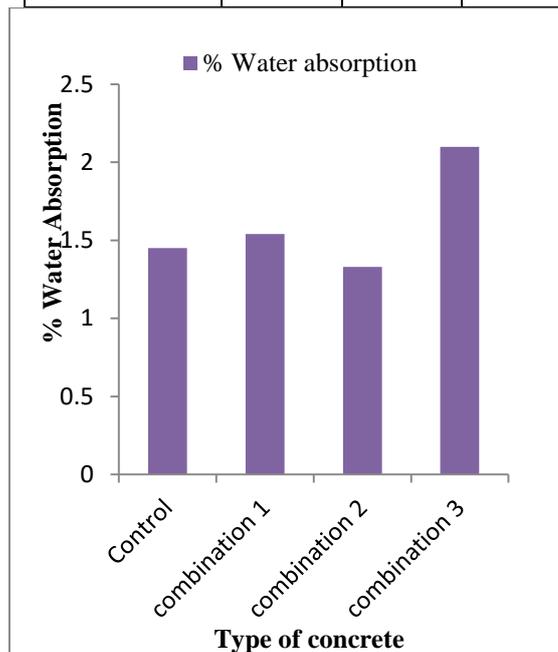
	Paver block -I	Paver block -II	Paver block -III	Paver block -IV
Cement	100%	70%	70%	70%
F.A	100%	90%	80%	70%
C.A	100%	100%	100%	100%



### Water absorption test

Type of Concrete	Dry weight (W <sub>1</sub> )	Wet weight (W <sub>2</sub> )	% of Water Absorption
Control	5.079	5.153	1.45
Combination 1	4.996	5.073	1.54
Combination 2	5.181	5.250	1.33

Combination	5.186	5.295	2.1
3			



## CONCLUSION

In this research which is based on the replacement of cement and fine aggregate with GGBS and copper slag in concrete paver blocks. This materials used exhibited good results in compression and water absorption . The results obtained varied based on the percentage of copper slag which was replaced with fine aggregate .the optimum result for compression and water absorption of paver block was obtained at 20% . The cost of paver block with the materials used is not very high and will produce highly durable blocks .

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