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SUSTAINABILITY APPROCH FOR CONCRETE PAVER BLOCK USING GLASS INDUSTRIAL WASTES

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ABSTRACT

As now a day's disposal of solid waste is becoming a major problem and therefore some percentage of the waste in the form of fly ash and glass powder is used to reduce the pollution caused by these elements. The aim of this project is to minimize the use of Ordinary Portland Cement (OPC) by the replacement of fly Ash (FA) and Glass Powder (GP) in varying proportions and to reduce the effect of solid waste generated due to its daily increasing disposal problems. As a civil engineer thinking of the environment and its adverse effects due to modernization and thinking of the future generations we got the inspiration of using such solid waste in construction field. That's why formation of interlocking paving block along with fly ash and glass powder as an aggregate is an attempt made by us and various tests such as compressive strength, abrasion resistance test, water absorption test etc. are conducted and compared with ordinary paver blocks units in present study. Trial mixes was prepared of fly ash with glass powder and their results was studied. OPC cement was replaced by 25% with the FA and GP combinations (0%, 25%, 50%, 75%, and 100%). Total 104 Specimens are tested by compression testing machine after 7 days & 28 days curing. 54 no's of specimen for Abrasion.

KEYWORDS: Concrete blocks, Glass powder, interlocking blocks.

INTRODUCTION

During the past five decades, the block shape has steadily evolved from non-interlocking to partially interlocking to fully interlocking to multiply interlocking shapes. Consequently, the pavements in which non-interlocking blocks are used are designated as `Concrete Block Pavement (CBP)' or non-interlocking CBP, and those in which partially, fully or multiply interlocking blocks are used are designated as `Interlocking Concrete Block Pavement (ICBP)' Hence an attempt is made to reuse the solid waste created, keeping in the mind significance of the nature along with civilization, globalization of the world.

The block joints are filled using suitable fine material. A properly designed and constructed CBP/ ICBP gives excellent performance when applied at locations where conventional systems have lower service life due to a number of geological, traffic, environmental and operational constraints. Many number of such applications for light, medium, heavy and very .heavy traffic conditions are currently in practice around the world.

LITERATURE REVIEWS

The compressive strength, flexural strength, splitting tensile strength and abrasion resistance of the paving block samples in the FG replacement level of 20% are 69%, 90%, 47% and 15 % higher as compared with the control sample respectively. It is reported in the earlier works the replacement of FG by FA at level of 20% by weight suppress the alkali-silica reaction (ASR) in the concrete. The test results show that the FG at level of 20% has a potential to be used in the production of paving blocks. The beneficial effect on these properties of CG replacement with FA is little as compared with FG [1]. Utilization of fly ash generated by captive power plant of NALCO(National Aluminum Company), Angul, Orissa along with varying dosages of super plasticizer. The various Mix Design as per Bureaue of Indian Standards (BIS) methods were made by replacement of cement from 10% to 40% by fly ash. The super plasticizer helped for compensating the loss in early age strength by reducing the water cement ratio and increasing the workability of the mix. The 28 days target strength of the Mix was achieved with a replacement of 30% of fly ash with the cement [2]. Owing to the present scenario use of paver blocks is increasing day by day. On the other hand due to increase in industrialization generation of material waste is also increasing rapidly. Disposal of such material waste is a major problem as it may contain harmful chemicals which may affect Environment Therefore use of material waste in manufacture of paver blocks proves to be a good alternative. In his study he replacing Fine Aggregate (sand) with Material Waste like Silica Flumes, Foundry Dust, Abrasive Waste (Emery) and Fly Ash in different proportion and showed that is use of material waste in manufacturing of paver blocks & making the Paver Blocks Economic without compromising with Strength Parameters [3].

MATERIALS USED

Cement : Ordinary Portland cement 53 Grade
Coarse Aggregate: Granite conforming IS: 383-1970 Manufactured Aggregate: Crushed sand of Zone II conforming IS: 383-1970
Water: Potable water conforming IS: 456-2000
Mineral Admixtures: Fly ash (FA): Dirk P60 Conforming IS: 3812 part 1
Microfine Ground Granulated Blast furnace Slag:

Cementitious Materials and Combination

OPC was replaced 25% by combination of FA and GGBS. Combination was proposed with the combination of FA and GGBS as mentioned in Table 1.

Table 1: Percentage combination of Cementitious materials

Sr.no	Cemetitious material (%)			Combination (FA + GP = 100%)	
	OPC	FA	GP	FA	GP
A1	25	0	75	0	100
A2	25	18.75	56.25	25	75
A3	25	37.5	37.5	50	50
A4	25	56.25	18.75	75	25
A5	25	75	0	100	0
CM	100	0	0	0	0

Fig. 1 Mixing of Materials

Fig. 2 Concrete blocked casted.

RESULTS

Various testing was conducted on block and Graphs are prepared.

Workability (Slump Cone)

Workability test was conducted on sample by slump cone test for initial time of 10min, percentage difference analyses results compared with control mix are shown in Graph 1 and Graph 2:

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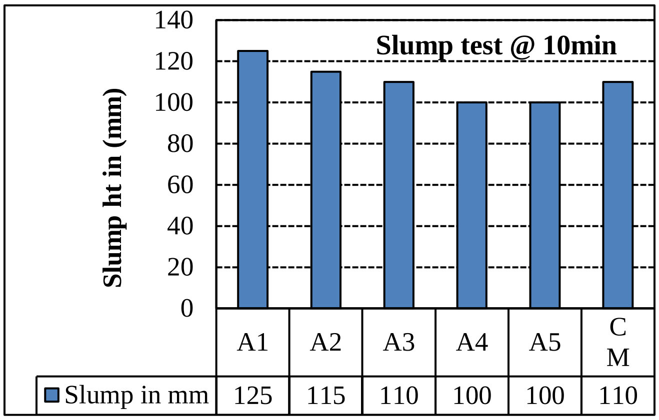
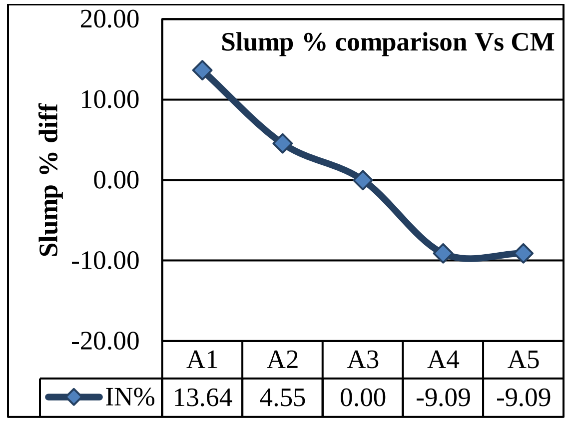


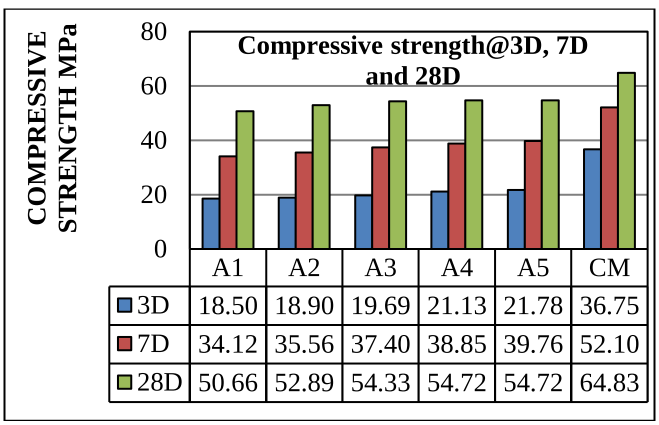
Graph 1 Slump cone @ 10min



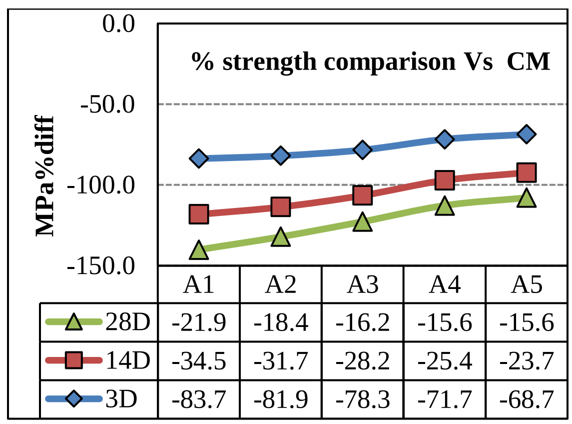
Graph 2 Slump cone vs CM (% difference)

Compressive Strength

Compressive Strength test was conducted after 3D, 7D & 28D results, percentage difference analyses results compared with control mix are shown in Graph 3 and Graph 4:



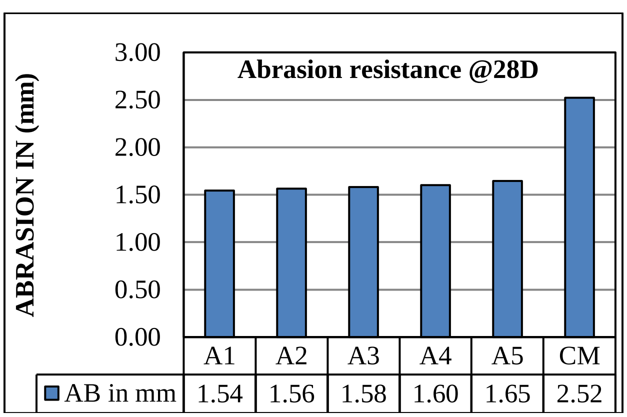
Graph 2 Compressive Strength @ 3D, 7D & 28D



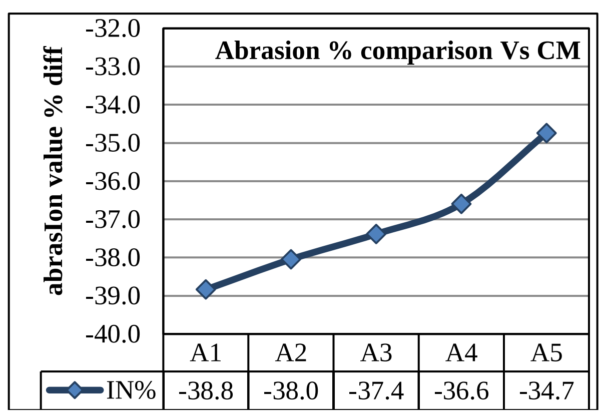
Graph 3 Compressive Strength vs CM(% difference)

Abrasion resistance

Abrasion resistance test was conducted after 3D, 7D & 28D results, percentage difference analyses results compared with control mix are shown in Graph 4 and Graph 5:



Graph 4 Abrasion resistance 28D



Graph 5 Abrasion resistance vs CM(% difference)

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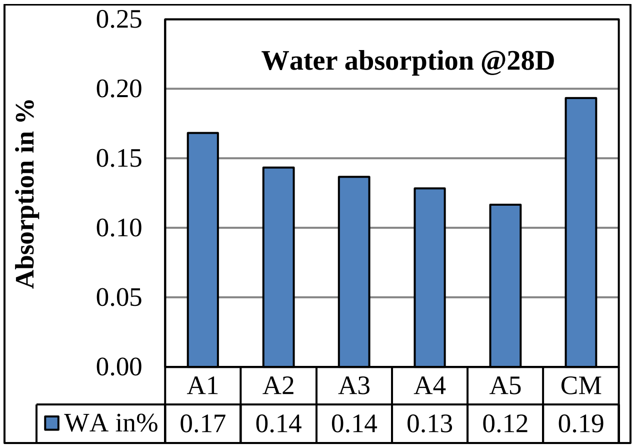
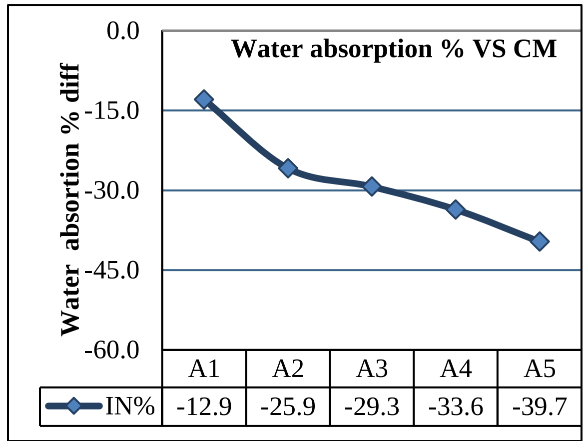
Water Absorption

Water absorption test was conducted after 28D results, percentage difference analyses results compared with control mix are shown in Graph 6 and Graph 7:



Graph 6 Water absorption @ 28D



Graph 7 Water absorption vs CM (% difference)

DISCUSSION AND CONCLUSION

As per testing and results final discussion and conclusion are as follows:

Workability (Slump Cone)

- The slump height is 110mm which is good for control mix but when OPC (75%) is fully replaced with glass powder it gives better results in slump height which is more than the height of slump in control mix. And at the same time when the quantity of fly ash is increased in glass powder, the height of slump goes on decreasing as compared to the control mix.
- When OPC (75%) is replaced by 100% of glass powder with 0% of fly ash the slump increases up to 13.64 % which is more than the height of slump of control mix.
- When OPC (75%) is replaced with 75% of glass powder with 25 % of fly ash the slump is increased up to 4.55% which is more than the height of slump of control mix.
- When OPC (75%) is replaced with 50% of glass powder with 50% fly ash there is no change in the slump when compared with control mix.
- When OPC (75%) is replaced with 25% of glass powder with 75% of fly ash the slump goes on decreasing up to 9.09%
- When OPC (75%) is replaced with 0% glass powder with 100% of fly ash the slump goes on decreasing up to 9.09%.
- With increase in percentage of glass powder, slump value increases compared to control mix and vice versa.

Compressive Strength (3D, 7D and 28D)

- Compressive strength after 3D, 7D & 28D's goes on increasing.
- When OPC (75%) is replaced by glass powder with fly ash, compressive strength value does not have much difference compared to control mix.
- When OPC (75%) is replaced with 100% of glass powder with 0% of fly ash the compressive strength goes on decreasing as follows :

3D	7D	28D
-68.67	-23.68	-15.59

- When OPC(75%) is replaced with 75% of glass powder with 25% of fly ash the compressive strength goes on decreasing as follow :

3D	7D	28D
-71.69	-25.44	-15.59

- When OPC(75%) is replaced with 50% of glass powder with 50% of fly ash the compressive strength goes on decreasing as follow :

3D	7D	28D
-78.31	-28.21	-16.19

- When OPC (75%) is replaced with 25% of glass powder with75% of fly ash the compressive strength goes on decreasing up to 7D & increases by 0.2% up to 28 days.

3D	7D	28D
-81.93	-31.74	-18.42

- When OPC (75%) is replace with 0% of glass powder with 100% of fly ash the compressive strength goes on decreasing up to 7D & increases 0.2% up to 28 days.

3D	7D	28D
-83.73	-34.51	-21.86

- It is observed that compressive strength at 3days, 7days and 28days increases with increasing quantity of fly ash. Compressive strength increases due to CHS (carbohydrate silicate gel).
- From above all observations it is concluded that compressive strength increases with increasing amount of glass powder with fly ash.

Abrasion resistance

- The Abrasion was much higher in control mix, there is more restrictions to abrasion with increasing percentage of replacement of OPC (75%) of glass powder.
- As compared to control mix the replacement of OPC (75%) of 100% glass powder with 0% fly ash, the Abrasion value decreases up to 38.8%, the replacement of OPC (75%) of 75% glass powder with 25% fly ash, the Abrasion value decreases up to 38%, replacement of OPC (75%) of 50% glass powder with 50% fly ash, the Abrasion value decreases up to 37.4%, the replacement of OPC (75%) of 25% glass powder with 75% fly ash, the Abrasion value decreases up to 36.6%, the replacement of OPC (75%) of 0% glass powder with 100% fly ash, the Abrasion value decreases up to 34.7%.
- It is seen that with increasing percentage of glass powder the abrasion value is lowered, this is due to high toughness of glass powder.
- We are using 10 µ glass powder. This glass powder has no sharp edges. This will not harm tyres of vehicles. In Fig 4 the quantity of water absorption is same as required for normal concrete but when OPC (75%) is replaced with glass powder and fly ash it decreases. But when quantity of glass powder is increased as compared to fly ash the amount of water absorption goes on increasing but not more than value of control mix.

Water Absorption

- When OPC (75%) is replaced with glass powder and fly ash it decreases. But when quantity of glass powder is increased as compared to fly ash the amount of water absorption goes on increasing but not more than value of control mix.
- As compared to control mix when OPC (75%) is replaced with 100% of glass powder with 0% fly ash the amount of water required for the mix should be decreased up to 12.9% as compared to water absorption required for control mix, when OPC (75%) is replaced with 75% for glass powder with 25% fly ash the amount of water required for the mix should be decreased up to 25.9% as compared to water absorption required for control mix, when OPC (75%) is replaced with 50% of glass powder with 50% fly ash the amount of water required for the mix should be decreased up to 29.3% as compared to water absorption required for control mix, when OPC (75%) is replaced with 25% of glass powder with 75% fly ash the amount of water

required for the mix should be decreased up to 33.6% as compared to water absorption required for control mix, when OPC (75%) is replaced with 0% of glass powder with 100% fly ash the amount of water required for the mix should be decreased up to 39.8% as compared to water absorption required for control mix.

- As the percentage of fly ash decreases and the percentage of glass powder increases it is observed that there is increase is water absorption which is less than control mix. This is due to increase in void ratio with increasing amount of glass powder.

CONCLUSION

And hence the aim of our study to reduce the OPC content and to use the solid waste such as FA & GP is proving to be successful and which proves to be helpful for the increasing environmental concerns in this modern world. Therefore a good amount of solid waste generated can be used so that its disposal problem can be reduced to a greater extent even with reduced amount of cement whose production causes a great emission of CO_2 causing pollution and various environmental problems. So we hope that the use of FA & GP as a cementitious material will increase in the coming years so that the depletion of natural environment can be controlled and the future generation can have a pollution free environment.

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