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Experimental investigation on pervious concrete paver block by using waste material

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Abstract : Paver blocks is a exterior flooring on flat surfaces. By using a pervious concrete ground water table can be recharged. It focuses on tackling the increasing concerns of flooding in urban areas and controlling the storm water runoff. The fundamental target of this examination is to build the quality and penetrability of pervious cement and reduction the expense of pervious cement by supplanting concrete with different waste. Now a days there is rise in the degree of pollution due to more production of waste materials. This paper describes the literature which is based on pervious concrete and various industrial waste materials such as ground granulated blast furnace slag (GGBS), fly ash, mild steel waste (MSW) is partially replaced by cement, sand and aggregates in concrete.

Keywords : pervious concrete, aggregates , permeability, compressive strength , replacement

I. INTRODUCTION

The normal procedures of the water cycle have been generally modified by human improvement and development rehearses. In the characteristic state, storm water tumbles to the earth and gets consumed into the soil and vegetation where it is separated, filtered, stored, evaporated, and redispersed into the regularly streaming cycle. The current condition of this cycle has diminished this procedure because of the tremendous impenetrable asphalts which have fixed the earth's natural filter. Unfortunately, this water once drained from the pavements surface has to end up somewhere downstream and typically causes negative impacts to ecosystems resulting in habitat loss.

Pervious concrete give an alternative in contrast to the conventional impervious pavements and because of their permeable nature; these environmental consequences can be minimized or even forestalled. Pervious concrete is a unique and effective solution to reduce the runoff from paved areas and recharging the ground water. Pervious cement can remove storm water more quickly than traditional cement. It is directly recharging the ground water so it eliminates the need of retention pond, swales and storm water management devices. It is also eliminate costly

Storm water detainment vaults and channeling frameworks. Along these lines diminish development costs, wellbeing issues and support cost. The waste administration issue has just gotten extreme on the planet. The issue is aggravated by the quickly expanding measures of mechanical squanders of a perplexing sort and organization. Vitality assumes a critical job in the development of creating nations like India. With regards to low accessibility of non-sustainable power source assets combined with the prerequisites of huge amounts of vitality for building materials like concrete, the significance of utilizing mechanical waste can't be disparaged. Many research associations are accomplishing broad work on squander materials concerning the practicality and natural reasonableness. India is a creating nation and security is still in a formative stage. In doing as such, pervious cement can bring down in general venture costs on a first-cost premise.

Solid clearing squares has been broadly utilized in numerous nations including India for at some point as a specific critical thinking procedure. Paver square clearing is adaptable, tastefully appealing, utilitarian and practical. Entomb locking paver gives better execution and it is likewise accessible in various shapes, sizes, shading and example. Concrete paver square is a superior choice in street development in any event, for non-traffic, light traffic, medium and substantial traffic territories. The development, transportation, establishment

and upkeep of these squares are simple and replaceable in extremely brief timeframe. It ought to be developed as porous asphalt for water waste. Security, Frictional obstruction, slide opposition, adaptability and impermeability are to be guaranteed for asphalt to give better dependability.

II. LITERATURE REVIEW

Compressive strength and flexural strength of Pervious Concrete and they found Hypo Sludge is a better innovative supplementary cementitious construction material which is used in concrete, so it can save the paper industries waste disposal costs and produce a greener concrete for construction. They concludes that hypo sludge can be innovative supplementary cementitious Construction Material in Pervious Concrete but judicious decisions are to be taken by engineers.(Er. Siddharth Talsania, Dr. Jayeshkumar Pitroda (2016,)

Role of pervious concrete on the basis of experimental investigation that construction and performance of a pervious concrete overlay constructed at the low-volume road. The pervious concrete overlay has performed well to date, with only localized surface pavement distress, and overall good performance and durability. Flow characteristics of the pavement provide good mitigation of splash and spray, and reduction of hydroplaning. Noise characteristics of the overlay indicate noise levels well below those of traditional concrete pavement surfaces. Although the overlay has only been in service for 10 months and one winter season, these early results provide optimism for the use of pervious concrete in overlay wearing course applications. Vernon R. Schaefer, John T. Kevern, Bernard Izevbekhai, Kejin Wang, Heath E. Cutler, and Paul Wiegand (2010)

Pervious concrete can be successfully utilized when designed, performed and maintained properly. However, pervious concrete has some performance issues mainly lower strength and durability due to its porous structure and risk of loss hydraulic conductivity due to clogging by debris and suspended solid matter. Pervious concrete in general is suitable for low – volume road applications like parking lots, driveways or sidewalks. However, this is a big space here for research of the technological aspects in order to take advantages and eliminate the disadvantages of this material, as pervious pavement seems to be a perspective construction element for sustainable urban areas. Pervious concrete as a sustainable solution for pavements in urban areas. Marek Kovac, Alena Sicakova

Decrease in the amount of percolation of rainwater and thereby the untimely effect on ground water table is one of the cautionary impacts of large scale concrete floors. Now with the proper study and implementation of porous concrete at these open spaces can simultaneously cater to the need of aesthetics and preservation. Pervious concrete blocks can have sufficient strength to carry loads at the site. The feasibility of its use is limited to places with good supportive drainage, if it receives a moderate to heavy rainfall. Also by the use of recycled aggregate, demolished concrete waste don't become a burden to the environment. Hence the pervious concrete block with recycled aggregate is a sustainable construction material. Mubashir.V , Vyshak Ram. , Athul.K. ,Jaritha. , Afsana Meheri. , Gokul. May (2018)

III. EXPERIMENTAL METHDOLOGY

Size of Mould:

Fig1:- Mould of area 305.2 cm^2

The concentric basil mould this mould is in the form of steel screwed type mould.

Table no. 1:- Material used

Sr. No.	Material used	Type
1.	Cement	53 grade OPC
2.	Sand (Conventional mix)	Passing - 4.75 mm Retained from 0.075 mm.
3.	Aggregate	Coarse type retained on 4.75 mm. sieve
4.	Aggregate (pervious mix)	Coarse type retained on 10 mm. sieve

Waste Materials:

1. Ground Granulated Blast furnace Slag

Fig2:- GGBS

It is (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. GGBS is used to make durable concrete structures in combination with ordinary portland cement

2. Mild Steel Waste (MSW)

Fig3:- MSW

As steel is an alloy of iron and carbon, it requires a lot of energy to produce heat during the production process. However, the most beneficial feature of steel is that it is 100% recyclable and is long lasting, thereby making it an ideal environmental performer to remain in use for many decades. When mild steel is heated at an temp of 800˚ to 1500˚C. Then to reshape the mild steel in required shape the bar is hammered with required no. of blows. Then in the form of chips mild steel waste is obtained.

3. Fly Ash (FA)

Fig4:- Fly Ash

Fly ash or flue ash, also known as pulverized fuel ash, is a coal combustion product that is composed of the particulates Ash that falls to the bottom of the boiler's combustion chamber is called bottom ash.

1. Mixing

Fig5.:- Mixing of materials

2. Casting of blocks :

In mould conventional concrete mix is put in a outer portion and pervious concrete mix is placed in inner portion using a trowel.

Fig6:- Pervious concrete paver blocks

3. Properties

Thickness and porosity are the significant properties to contemplate, as they identify with quality and penetrability. The generally stated porosity go for the depleted cement is somewhere in the range of 15% and 30%, contingent upon the compaction strategy utilized, notwithstanding the extents of the blend. The thickness of the pervious cement fluctuates between 1600 kg/m3 and 2000 kg/m3. The penetrability relies upon the material size and the laying forms. Pervious solid framework is constrained by the dirt penetration rate and the Water stockpiling limit accessible in the pervious concrete and total sub base under the pervious cement.

IV. Mix Design

M20 grade concrete mix design is used for casting the blocks. 9 no. of type of cubes are casted.

Table 2:- Mix design for $1m^3$ for conventional concrete

Mix Number	% of material used	Grade of concrete	Cement (Kg)	Aggregate (Kg)	Sand (Kg)	Water (Liter)	W/C ratio
M1	0% Waste Material	M20	403.20	1276.80	693.00	201.60	0.50
M2	Fly ash 10%	M20	362.88	1276.80	693.00	201.60	0.50
M3	GGBS10% (with cement)	M20	362.88	1276.80	693.00	201.60	0.50
M4	GGBS 15%(with sand)	M20	403.20	1276.80	589.03	201.60	0.50
M5	MSW 5%	M20	403.20	1212.96	693.00	201.60	0.50
M6	MSW 20%	M20	403.20	1021.44	693.00	201.60	0.50
M24	Fly ash 10% , GGBS 15%	M20	362.88	1276.80	589.03	201.60	0.50
M12345	Fly ash 10%,GGBS10% (with cement), GGBS 15% (with sand), MSW 5%	M20	322.56	1212.96	589.03	201.60	0.50
M12346	Fly ash 10%, GGBS10%(with cement), GGBS 15% (with sand), MSW 20%	M20	322.56	1021.44	589.03	201.60	0.50

Estimation of quantity (sample calculation)

For paver block,

For volume 1 m^3

Ratio= 1:1.5:3 (Cement, sand, aggregate)

1) Cement = 1 / (1 + 1.5 + 3)X 1.57

= 0.28m3 = 0.28 x 1440 = 403.2 kg

2) Sand = 1.5 / (1 + 1.5 + 3)X 1.57

= 0.42 = 0.42 X 1650

= 693 kg

3) Aggregate = 3 / (1 + 1.5 + 3)X 1.57

= 0.85 = 0.85 X 1500

= 1275 kg

4) Water = 403.20 X 0.50

= 201.6 lit

Table 3 :- Mix design for pervious concrete for 1 m^3.

Mix Number	% of material used	Grade of concrete	Cement (Kg)	Aggregate (Kg)	Sand(Kg)	Water	W/C ratio
M1	0% Waste Material	M20	403.20	1276.80	693.00	201.60	0.50
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V. TESTING

1. Permeability test

Fig :- permeability test on paver block

Permeability test is performed on paver blocks. These results depend mainly on the shape and size of aggregate. When concrete mix have greater compaction permeability gets reduced. Other factors that affect permeability are density and voids. While a greater density implies a lower permeability, a greater void content implies greater permeability. As a result, mechanical properties are affected. A litre of water is poured from block and percolation rate is measured, about 60% of percolation rate is obtained.

2. Compressive strength test

Compressive strength of concrete cube test provides an idea about all the characteristics of concrete. Compressive strength of concrete depends on many factors such as water-cement ratio, cement strength, quality of concrete material, quality control during production of concrete etc.After 28 days of curing of paver blocks in curing tank removed and kept it for 1-2 hours in atmosphere for surface dry, block was tested under compression testing machine and compressive strength is calculated.

$$Compressive\ Srength\ \left(in\frac{N}{mm2}\right) = \frac{Total\ Load\ Applied}{Cross\ Sectional\ Area}$$

Fig :- Compression testing on paver block

VI. RESULTS

Table no 4 :- Compression test results

Mix no.	Compression Strength 28days N/mm^2
M1	5.43
M2	3.98
M3	3.72
M4	4.56
M5	4.76
M6	4.36
M24	4.30
M12345	4.86
M123456	4.95

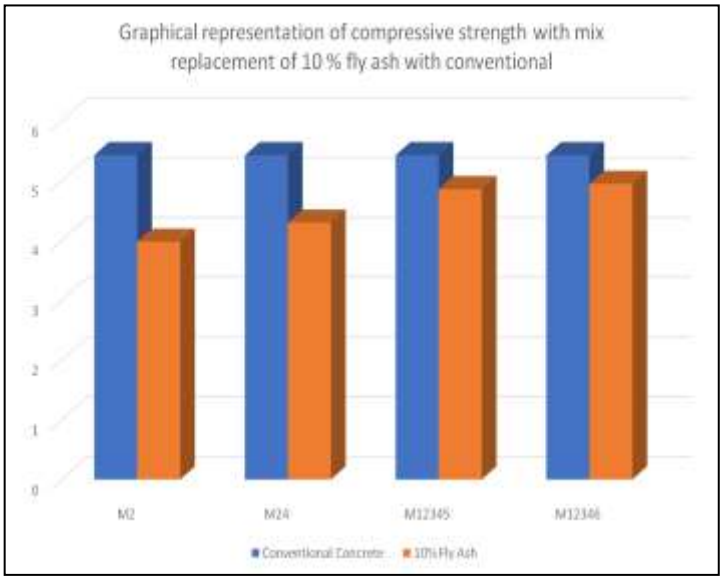

Fig:- Comparison of replacement 10% fly ash mix with conventional concrete mix

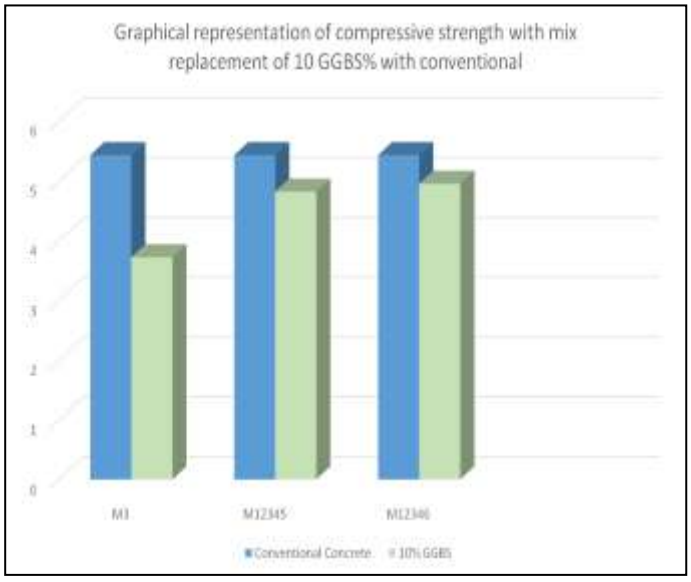

Fig:- Comparison of replacement 10% GGBS with conventional concrete mix

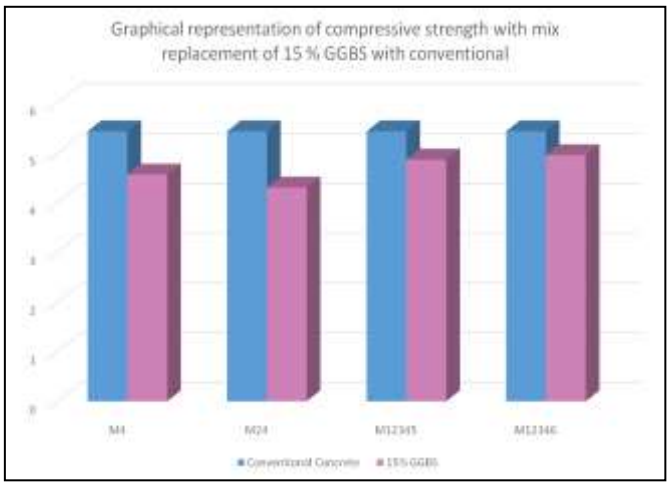

Fig:- Comparison of replacement 15% GGBS mix with conventional concrete mix

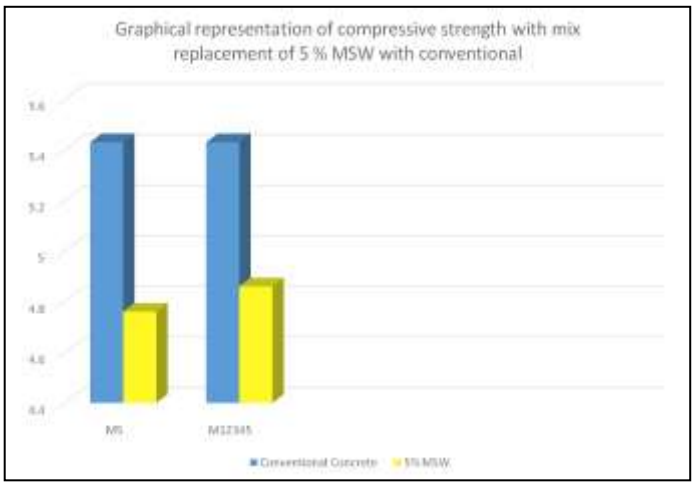

Fig:- Comparison of replacement 5% MSW mix with conventional concrete mix

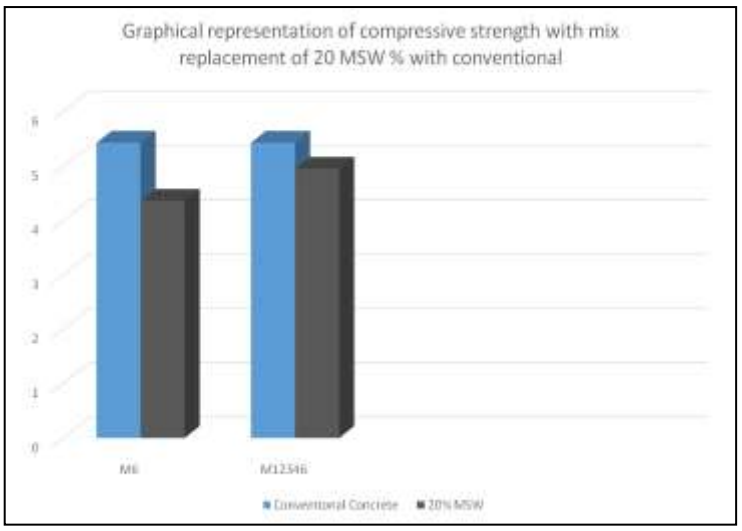

Fig:- Comparison of replacement 20% MSW mix with conventional concrete mix

VII. CONCLUSION

Research on the utilization of waste materials is essential considering how, squander materials is perseveringly developing with the growth in individuals and expanding urban movements. Usage of present day squander demolish the exchange issue of these waste materials.

This paper centers around effective use of porous paver squares structure and execution with exceptional accentuation on storm water the board, water quality advantages, and ID of information and information holes. The paper gives an outline of the ebb and flow practice and plan strategies, talks about the potential use of porous for condition insurance, condenses the examination progress recorded in the writing identified with blended structure, hydrologic execution, upkeep, water quality advantages and investigates the future course in porous asphalt application. The penetrable cement paver hinder by utilizing waste material, uses squander from the enterprises that can be dangerous to the earth. The permeable concrete paver block by using waste material, utilizes waste from the industries that can be hazardous to the environment.

The trial results demonstrates that compressive strength of Fly ash 10% , GGBS10% (with cement), GGBS 15%

(with sand), MSW 20% increased with compared to other mix and nearby to the conventional concrete.

VIII. ACKNOWLEDGEMENTS

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