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An Experimental Study to Design Paver Blocks without Water & Without cement

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Abstract: A large no. of constructional waste is found in construction industries such as stone dust, waste concrete, waste bricks etc. In this experiment we have used some constructional waste and some other materials to make complete replacement of cement and water in paver blocks. The Paver Blocks were prepared and tested and we have found good results from these Paver Blocks.

1. INTRODUCTION

Recently we have found various alternative materials used in the place of cement such as fly ash, marble powder, sugarcane bagasse, rice husk etc. In this experimental study we have used stone dust, sand, Glass Fiber , resin and some other chemicals which are necessary with resin. Stone dust is a byproduct from the stone crushing process in sites. To replace the water we have used resin .To replace the amount of cement completely we have used sand and stone dust powder. Along with all these materials we have used Glass Fiber to attain tensile strength and bonding of particles in Paver Blocks. Paver Blocks prepared with a % variation of Glass Fibers as 5%, 10% and 15%.

2. AIM

The aim of this project is to completely replace the amount of cement and water and to make maximum use of constructional waste.

3. OBJECTIVES

1. To determine the suitability of constructional waste in the development of paver blocks.
2. To evaluate the compressive strength of paver blocks.
3. To produce paver blocks without using cement and water but with the help of other materials.

4. LITERATURE REVIEW

1. E. Gifty et al. (2019), Investigated the strength properties of paver block made with Recycled concrete aggregate. In their study they found that the mechanical properties of paver blocks, cubes and cylinders were increased with the addition of construction and demolition (C & D) waste.The micro structural properties like water absorption for paver blocks were also identified.

2. P. Jeganmurugun et al. (2021), Experimented Photocatalytic effect on paver block and concluded that the maximum compressive strength was attained for mix proportion M30 grade of concrete paver block in 7 and 28 days is 23 & 30.81 N/mm^2. The average percentage value of hydro carbon absorbed by TiO2 surface

coating method was 83.41% and TiO2 mixed with concrete was 84.51% As expected, TiO2 treated paver block effectively absorbed the pollution emitted by the vehicle.

3. Aaryakant Soni et al. (2022), utilized waste plastic in manufacturing of paver block (plastic waste LDPE) they found that the compressive strength of modified pavement block is as equal as conventional block. The cost of construction will be reduced and also helps to avoid the general disposal technique of waste plastic namely, filling & incineration which have certain burden on ecology. By using plastic in pavement blocks reduces the weight up to 15%. Its showing good heat resistance. As compressive strength obtained is low when compared to concrete paver block it can be used in garden areas, pedestrian path and cycle wat etc. It can also be used in light traffic and non-traffic areas.

4. Prof. P. A. Shirule ^a* et al. (2012), utilized marble dust powder as partial replacement of cement in paver blocks from their experiment they concluded that the compressive strength of cubes is increased with addition of waste marble powder up to 10% replace by weight of cement and further addition of waste marble powder decreases the compressive strength. The split tensile strength of cylinder is increased with addition of waste marble powder up to 10 % replacement by weight of cement and further addition of waste marble powder decreases the spit tensile Strength. They found the optimum % of replacement of cement with marble powder is 10% by weight of cement for both cubes and cylinders.

They have also put a step to minimize the cost of construction by using marble dust powder which is cheap and freely available. They also mentioned for saving environment pollution by cement production as their main objective in construction industry.

5. Shilpa Agrawal et al. (2021), Investigated strength of paver block using Dolomite as partial replacement of cement and addition of polyester fiber in different proportion. In their study they investigated that the 10% of dolomite powder substitute by cement and addition of 0.1% of polyester fiber by weight of cement at 28 days achieved maximum strength for compressive, flexural and split tensile strength. The values obtained from 28 days for compressive, flexural and split tensile strength are 38.18, 3.05 and 2.04 respectively.

6. Esubalew Kasaw et al. (2021), Experimented incineration of textile sludge for partial replacement of cement in concrete production different sludge ash to cement ratio were used to make sludge ash integrated concrete, the properties of concrete were compared with the blank sample. The characteristics of concrete is influenced by % substitution increases, and decrease in compressive strength and absorption of water increases, 20% replacement of cement provides a sound replacement. The leaching test revealed a very low amount of heavy metals released from

the cube samples at this amount of replacement. Sludge ash can be used in concrete cube without posing a significant risk of heavy metal pollution.

7. Koli et al. (2016), Manufactured concrete paving block by using waste glass material. They investigated the density of concrete decreased with increase in waste glass content and making light weight concrete. The unit weigh of fine aggregate is also decreasing by use of waste glass content. Water absorption is also deceased with increase in waste glass content. A decrease in flexural strength can also be seen. Increase in compressive strength by increase in glass % from 15% to 30% glass replacement and after 45% glass replacement strength decreased. Due to internal voids strength reduced. A decease in cost of paver block is observed.

8. Joshi Rohit R.^1 et al. (2015), A comparative study on compressive strength of blocks made by waste paper sludge as partial replacement of with cement, concluded that the mix proportion suitable for partial replacement of waste paper sludge is 5% to 10% strength obtained is 24.97% increased as compared to 20% & 30% replacement in 28 days. Water absorption increased by increasing waste paper sludge content. Weight of block also increased by 2.94% in waste paper sludge ratio 0% to 10% and weight decreasing 1.01% in waste paper sludge ratio 10% to 30%. Workability decreased by increase in waste paper sludge. Maximum use of waste paper sludge can be made with cement provides a solution to disposal of waste paper sludge and also

helps in controlling harmful emission of pollutants by burning the waste paper.

9. Pradeepa et al. (2020), investigated the properties of paver blocks by partial replacement of cement by plastic waste in their study they found that utilization of waste plastic in paver block shows good heat resistance with only slight loss of compressive strength. They concluded that waste plastic can be safely disposed if it is used to make paver blocks.

10. E. Anjali Reddy (2015), investigated the effect of partial replacement of cement by Rice Husk Ash using Nylon Fiber in concrete paver block, from their study they found that the optimum % of nylon fiber to add is 0.3% of cement, providing maximum strength when compared to conventional concrete paver block and with other nylon fiber paver block (0.1%
,0.2%, 0.4%, 0.5%). We can replace 20% of cement by using Rice Husk Ash with nylon fiber gives maximum strength.

11. Deori^2 et al. (2016), utilized jute fiber in cement concrete paver block and in their study, they found that a steady decrease in workability of concrete. No uniform pattern is observed in density. Increase in density as jute fiber is increased interlocking, permeability, and durability and good strength is observed.

5. MATERIALS AND METHODOLOGY

MATERIALS USED

A) Coarse Aggregates:

STONE DUST - In this project naturally available Stone dust from stone crushing sites is used it is a combination of stone dust and stone particles having size range from 1mm to 5mm. (IS-Code-383-1970)

Table No.1- Properties of Stone dust

S. No.	Properties	Value
1	Colour	Grey
2	Form	Powder & Particles
3	Specific Gravity	2.50g/cm^3
4	Moisture Content	0.5%

B) Fine aggregate:

(a) SAND - Natural River Sand is used in this experiment is from Narmada River of size 1mm passing through sieve. (IS-Code-383-1970)

Table No.2- Properties of Sand

S. NO.	Properties	value
1	Grain shape	Rounded
2	Specific Gravity	2.65 (g/cm^3)
3	Physical State	Solid
4	Max. Void Ratio	0.970

C) FIBER GLASS:

Fiber glass used in the experiment is E- glass fiber having diameter 1-4mm. It comes in the form of chopped strand Mat (csm300 gsm) having length 1-4 inches. It acts as reinforcement in both tension and compression. It is strong and durable.

Table No.3- Properties of Fiber Glass

S.No.	Property	Value
1	Colour	white
2	Tensile Strength	> or =50 N/150mm
3	Elongation	1.6 %
4	Material	Fiber Glass
5	Quality	E-Glass fiber
6	Cut length	6 -12 mm
7	Diameter	1 – 4 mm

D) RESIN:

Resin used in the experiment is the pure form of polyester resin which is acting as a binding agent locally available in the hardware shop.

Table No.4 -Properties of Resin

S. No.	Properties	Value
1	Colour	Clear
2	State	Liquid
3	Elongation	3.3%
4	Function	Binding

E) DRYER CATALYST:

A catalyst as dryer to support resin property named as ***"methyl ethyl chloride peroxide"*** is also used in this experiment. Catalyst can be used 3-5% of resin.

Table no.5 -Properties of Catalyst

S.No.	Properties	Value
1	Colour	Clear
2	Form	Liquid
3	Low Viscous	Yes
4	Fast Curing	Yes
5	Specific Gravity	0.95(g/cm^3)

F) ACCELERATOR:

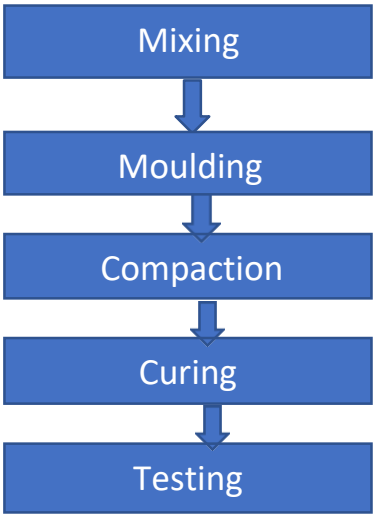
An accelerator is a ***"cobalt benzene mixture"*** is used in this experiment with resin to improve resin property. It can be used between 0.5 - 3% with resin.

Table No.6 - Properties of Accelerator

S.No.	Properties	Value
1	Colour	Brown/Pale yellow
2	Form	Liquid
3	Molecular Formula	C6H5Co+

Manufacturing of Paver Blocks: -

Manufacturing of paver blocks shown below with the help of flow diagram-



A hexagonal shape Mould is used in this experiment to make Paver Block having size 13x6x5cm.Simple Hand mixing process is used in this experiment and variation of Fiber Glass % is made by the total weight of paver block to identity the strength of Paver Blocks. Sand, stone dust powder, resin, catalyst and accelerator are mixed together with a Percentage variation of Fiber Glass is like 5%, 10%and 15%. To dry the blocks simply sundried process is used and observation is taken after 7, 14 and 28 Days by Testing the blocks. Total 12 paver blocks have been made and tested.

Table no. 7-Mix Proportion for a Standard Paver Block: -

S. No.	Material	Amount
1	Sand	1 Kg
2	Stone Dust	800gm
3	Resin	800ml
4	Catalyst	3-5% by total weight of material mix
5	Accelerator	0.5-3% by total weight of material mix

Table no. 8-Mix Proportion for Other Paver Blocks: -

S. No.	Paver Block Nomenclature	Description
1	So	Standard
2	SoGF5%	Standard+5%Glass Fiber
3	SoGF10%	Standard+10%Glass Fiber
4	SoGF15%	Standard+15%Glass Fiber

6. Test Performed on the Paver Blocks are*:* -

(A) **Vane Shear test: -** This Test is used to find the shear strength of soil. This test is performed to find shear strength of mixture of Paver Block. It is a cheaper and quicker method. This test can be conducted in field as well as in laboratory. In this experiment the Vane Shear test result observed is ***"150mm".***

(B) Initial and Final Setting Time: - Initial setting time is the time when paste/mixture starts hardening. Final setting time is the time when paste/mixture get sufficiently hard. Initial and final setting time both are calculated with the help of apparatus named Vicats Apparatus. Initial and final setting time observed are ***20-25 minutes*** and ***2-4 hours*** respectively.

(C) Water absorption test: - For the water absorption test the Paver block was dipped in the water for 24 hours. After 24 hours the blocks are taken out and wiped off with cloth and weight of the specimen in wet condition was recorded as W2. The percentage of water absorption was calculated as: -

Water absorption (%) = (W2 –W1) /W1 *100

Water absorption observed is 0.1-0.3% by the total weight of Paver Block.

(D) Compressive Strength Test: - Compressive Strength test on Paver Blocks was conducted after 7,14 and 28 days.

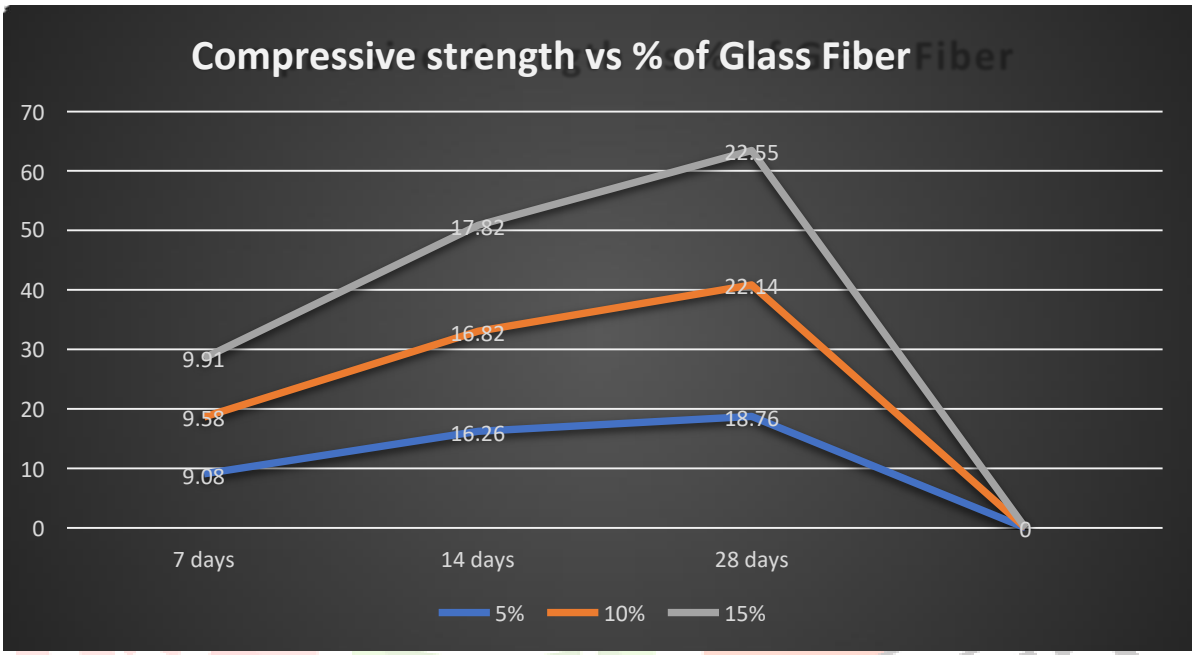
Table no. 9- Compressive Strength

S.No	Paver Block	Compressive Strength(N/mm^2)		
		7 days	14 days	28 days
1	So	8.05	13.01	16.09
2	SoGF5%	9.08	16.26	18.76
3	SoGF10%	9.58	16.82	22.14
4	SoGF15%	9.91	17.82	22.55

7. RESULT & DISCUSSION

- Vein Shear Test reading observed is nearly 150mm.
- Initial setting time observed is 20-25 minutes and Final setting time observed is 2-4 hours.
- Water Absorption test obtained very less amount nearly 0.1-0.3%.
- Compressive Strength test were performed on Paver Blocks after 7, 14 and 28 days showed good strength with % variation of Glass Fiber.
- Glass Fiber used in the experiment is providing tensile strength to Paver Blocks.
- Strength is increased by the use of Glass Fiber and resin.

Graphical representation of Compressive strength Vs % variation of Glass Fibers in no. Days



8. CONCLUSION

- The paver blocks made with waste materials have shown good results with Glass Fiber.
- Resin used in the place of water as binding material have shown good compaction in paver blocks.
- Glass Fiber can be used up to 15% giving maximum strength.
- Increase in Density of Paver block is seen by the use of Glass Fiber and Resin.
- Resin helped in proving a smooth and finished surface.
- These paver blocks can be used in light traffic area.
- These types of Paver Blocks will be very useful in Gulf Countries where water is a problem as to minimize the use of water resin can be used in the place of water.

9. REFERENCES

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