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Experimental investigation on paver block with partial replacement of m-sand by steel slag

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ABSTRACT

In this experimental investigation compressive strength and water absorption of paver block were evaluated by replacing portion of M-Sand with the steel slag. Steel slag is an industrial by product obtained from the steel manufacturing industry and hundreds of tons of it are produced every year all over the world in the process of refining metals. The main aim of the study is to produce interlocking paver blocks from industrial waste. The main reason for the use of industrial wastes is to reduce the landfill problem and also to control the depletion of the natural resources. Various mixes with different proportions of these industrial wastes were casted and tested.

Keywords: Compressive Strength, Steel slag, Water Absorption, Paver Block.

INTRODUCTION

Concrete is a mixture of cement, water and aggregates, with or without admixture. Consequently, pavements in which interlocking blocks is a system of individual shaped blocks arranged to form a continuous hardwearing surface overlay. Over the past two decades paving composed of concrete blocks has become a feature of our towns and cities. It is to be found in commercial residential and industrial areas in the paving malls, plazas, parking areas and bus stops. Paving blocks are fully engineered products, manufactured in factory conditions, ensuring consistency and accuracy. In this project the paver block designed medium traffic category for recommended minimum paver block thickness is 50mm. Laid with an edge restraint over a granular bedding course, individual blocks interlock to act compositely which can distribute large point loads evenly. Recently in concrete paver block fibers are introduced to increases strength, durability and reduction in cracks. Instead of using m-sand 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. Steel slag is a byproduct from steel industry; primarily slag consists of calcium, magnesium, manganese and aluminum silicates in various combinations. Steel slag is used as a direct replacement of M-Sand. Replacement levels for Steel slag vary from 10% to 30%.

LITERATURE REVIEW

The Steel for the metal-casting industry generate by-products such as used steel slag. Applications of steel slag, which is nonhazardous, sound, environmentally safe for sustainable development. In this study, the partially replacement of M-sand in paver block by steel slag for determining the change in the compressive strength of paver blocks and water absorption of paver block. Partial replacement of M-sand in different percentage as like 0%, 10%, 15%, 20%, 25%, 30%, and 35%. The compressive strength, determined at the end of 7 and 28 days and water

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absorption test has been determined at 28 days.
KEYWORDS: Various Test, Ordinary Portland Cement (OPC) Steel slag, Paver Block.

The partially replacement of fine aggregate in paver block by used steel slag for determining the change in the compressive strength of paver blocks and cost of paver block. Partial replacement of fine aggregate in different percentage as 0%, 10%, 15%, 20%, 25%, 30% and 35%. The compressive strength has been determined at the end of 7 and 28 days and water absorption test has been determined at 28 days. The Compressive strength of Paver Block was found to be increasing with replacement of steel slag. Up to 35% replacement of fine sand by steel slag gives slightly high compressive strength was found to be optimum.

He concrete consist of cement, sand, Aggregate and water. Out of which the aggregate percentage is 60 to 70 % in concrete and from the above observation. From the above observation it is possible to use the steel slag in concrete mix up to 35 % weight of fine aggregate. Looking in to above aspect we come to the conclusion that steel slag is in cement concrete mix increase the % in slag to increase the strength of concrete.

MATERIAL SPECIFICATION

Cement

Cement is a binding material in concrete which binds the other material to forms a compact mass. In this project work, OPC 53 grade cement is used for experimental study.

Table 2.1 Properties of Cement

TESTS	RESULTS
Fineness value	9
Consistency	31%
Initial setting time	32minutes
Specific gravity	3.15

The values obtained for cement will be confirming IS 3813:1970.

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.

Coarse Aggregate

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

Table 2.2 Properties of Coarse Aggregate

Description of test	Test result obtained	Permissible limits as per IS:383-1970
Specific gravity	2.66	Minimum 2.5
Unit weight (kg/m ³)	1680	

Fine Aggregate

A concrete with better quality can be made with sand consisting of rounded grains rather than angular grains. River or M-sand sand must be used

but sand from sea which contains salt and other impurities. In this study, M-sand has been used as fine aggregate.

Table 2.3 Properties of Fine Aggregate

Description of test	Test result obtained	Permissible limits as per IS 383:1970
Specific gravity	2.73	
Fineness modulus	4.66	Minimum 2.5
Unit weight of sand (kg/m ³)	1600	

Steel slag

The solid material which is generated by the interaction of impurities and flux during the making and refining of steels is called steel slag. In

modern practice, sand is typically recycled and reuse through many production cycles. The specific gravity of Steel slag is 3.2 to 3.6.

Table 2.4 Properties of Steel slag

S.No	Description	Percentage of Content
1	CaO	47.88%
2	SiO ₂	16 %
3	AL ₂ O ₃	1.22%
4	FeO	26.3%

**Fig 2.1 Steel slags**

Paver Block

Paver block is mainly used for decorative purpose. It is also used in parking, lawns etc., In

this we used rubber mould. The rubber mould is of size 19 x 24 x 5 (cm).

**Fig 2.2 Paver block**

MIX PROPORTION

In this study of development of paver blocks from industrial wastes the design was determined to achieve target strength. M-sand was partially

replacement by steel slag and it was added by 0%, 10%, 15%, 20%, and 25%.

Table 3.1 Mix Proportion

Mix	Cement (kg)	Fine Aggregate (kg)	Coarse Aggregate (kg)	Water (liters)	Steel slag (g)
A ₀	1.60	4.20	9.35	2.20	0
A ₁	1.60	3.78	9.35	2.20	0.42
A ₂	1.60	3.57	9.35	2.20	0.63
A ₃	1.60	3.36	9.35	2.20	0.84
A ₄	1.60	3.15	9.35	2.20	1.05
A ₅	1.60	2.94	9.35	2.20	1.26
A ₆	1.60	2.73	9.35	2.20	1.47

EXPERIMENTAL METHODOLOGY

Compressive strength test

Paver blocks were casted conforming to the mix proportion and recommendations laid down in

IS: 15658:2006. The paver blocks were casted control mix .The paver blocks were cured for 7 and 28 days. For determining compressive strength, paver blocks were tested in compressive testing machine. The result was obtained as follows.



Fig 4.1 Compressive strength test

Table 4.1 Compressive Strength Result

Mix	At 7 Days (N/mm ²)	At 28 Days (N/mm ²)
0%	26.25	36.60
10%	25.33	34.64
15%	28.19	35.08
20%	29.15	35.52
25%	30.25	38.59
30%	28.96	37.28

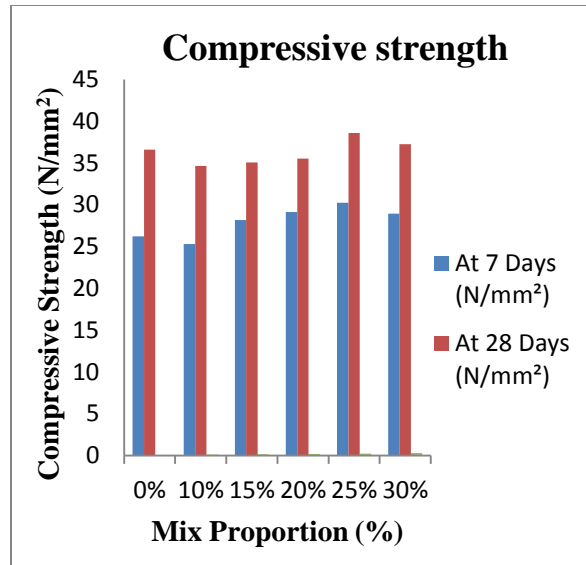


Fig 4.1 Compressive strength result

WATER ABSORPTION RESULT

The water absorption tests were conducted as per IS: 15658:2006. The water absorption values

of the conventional concrete paver block & paver block with Steel slag was determined.

Fig 4.2 Compressive strength result

Mix	At 7 Days	At 28Days
0%	3.71	3.15
10%	3.65	3.24
15%	4.42	3.38
20%	4.16	3.29
25%	4.35	3.42
30%	4.52	3.49

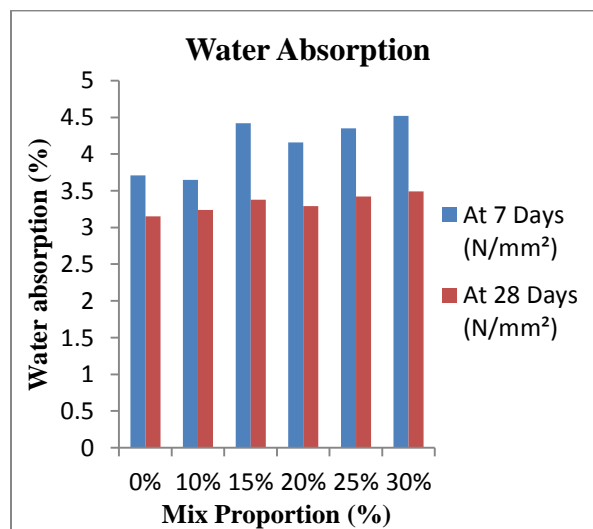


Fig 4.2 Water Absorption result

RESULTS & DISCUSSION

- Based on various researches it is observed that replacement generally gives higher strength compared to conventional concrete paver block.
- The compressive strength of paver block increases with certain percentage of steel slag.
- So we can make concrete paver block effective and environment friendly.
- The compressive strength of steel slag paver block increases with 20% when compared with conventional paver block.
- As the steel slag contains more fine particles which increase the fineness of the concrete paver block.

CONCLUSIONS

- Compressive strength of paver block increases by Steel slag, addition of optimum content of steel slag inclusion was 10% to 30%.
- A test result at 7days curing period with optimum steel slag indicates an increase of % in compressive strength.
- There are % decrease in Water absorption when replacement of fine aggregate with steel slag at 7 days.
- At optimum inclusion of steel slag there was decrease in cost by % compared to conventional paver block.

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