Section A-Research paper

Evaluation on Mechanical properties and Abrasion resistance ofPrecast Paver blocks using Copper Slag

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HIGHLIGHTS

- Assessment on the influence of Copper Slag in Unipaver blocksof M40 Grade with partial replacement of fine aggregate.
- Evaluation on Mechanical properties, water absorption and abrasion resistance on Paver blocks.
- Concluded that a small increment in cost compared to standard paver block but increases the characteristic of concrete paver block and life span of paver block and reduce the maintenance.

Abstract

Paver blocks are flexible pavement surfacing options used for exterior pavement application which is more durable with low maintenance. In this investigation, an attempt is made to exploit the waste from copper industry in the form of slag. At present more than enough, copper slag has been extracted as a waste material from the copper industry. The present study is aimed to utilize Copper Slag in Paver blocks as a supplementary material for fine aggregate and to study its feasibilityon thebehaviour of paver blocks. Usage of Copper slagas a replacement of fine aggregate substantially reduces the river sand consumption. Experimental investigations are carried out by the replacement of sand in 10%, 20% and 30% of copper slag for M40 grade of concrete to meet the Medium traffic requirements of paver blocks and the mechanical properties are analyzed using compression test and split tension test andalso water absorption test and abrasion tests arecarried out as per IS15658:2006. The test results proved that the use of CopperSlag in Paver blocks exhibits desirable mechanical properties, abrasion resistance and water absorption. The present study affirms that Copper Slag can be used as an effective alternative material in interlocking Paver blocks.

Keywords
Unipavers, Compression test, Copper Slag, Split tension test, Abrasion resistance, Water absorption.

1. Introduction

Due to acute demand in mineral wealth, it becomes imperative for the progress of innovative and environment-friendly materials.There has been continuous research process involved in waste generation from industries for the alternative use for sand, since most of the industrial wastes contain silica[1].Copper slag is a by-product of copper extraction by smelting and it is non-hazardous, non-toxic and non-leachable material, high bulk density, less drying shrinkage of paver block which avoids ground frost, copper slag reduces construction depth and energy demand,thereby expediting its suitability in many of the construction applications[2].Recently the Concrete paver blocks had been maneuvered on its way because of the major benefits such as low maintenance, durable and hard wearing, environmental friendly and environmental sustainability, abrasion resistance, safer and the best aesthetics than other materials[3]and it has been proved to give satisfactory results when used as a replacement material for fine aggregate [15].State-of-the-art reviews of block paver technologies designate to have admirable Engineering properties, very good aesthetic appearance and low life cycle and maintenance costs[20].

Pavers may be classified based on the shape, quality of the material, grades of concrete used and the traffic requirements. There are different grades of precast paver blocks namely, M30, M35, M40, M50, M55[5,23]. Out of which M40 grade is selected for the present study, which falls under the Medium traffic category. The principal objective of the present study is to replace the fine aggregate with copper slag in 10%, 20% and 30% and to study the mechanical properties, abrasion resistance and water absorption.

2. Review of Literature

JaykumarSoni et al. [1] conducted an assessment on the applicability of Fine Copper Slag in Road fill application and concluded the possibility of usage of fine copper slag in the subgrade layer. Caijun Shi et al. [2]reported that copper slag exhibited similar mechanical properties as same as conventional fine aggregate and also proved to have indistinguishable engineering characteristics when used in concrete. Sumit Nandi &Ransinchung[3] revealed that the Reclaimed Asphalt

Pavement (RAP) blocks have proved to be effective for medium, heavy, and very-heavy traffic applications. Sai Rahul et al. [4] recommended that the replacement of conventional fine aggregates with brick wastes in making Recycled Aggregate Paver Blocks leads to exploitation of Construction and Demolition waste. Arjun Siva Rathan et al. [5] carried out an assessment on pervious interlocking Paver blocks (PIPB) and affirmed that the PIPB can be more operative for low volume roads, urban heat island and pavements with drainage problems. Ravindra K. Dhir et al [6]investigated the utilization of Copper Slag in Road Pavement Applications have proved to have remarkable workability and compressive and flexural strengths.

Osman Gencel et al. [7]studied the properties of concrete paving blocks made with waste marble and concluded that Waste marble is well employableas a replacement ofconventional aggregate in the concrete paving blocks. Agyeman et al. [8] carried out an investigation to explore the potential of using plastic waste and recommended that the paving blocks made from the recycled plastic waste should be used in non-traffic areas. Bukola Oni et al. [9] reported that utilization of fibresin reinforced pervious concrete pavement brick unfavourably impacts the compressive and splitting tensile strength, while the flexural strength was found to increase moderately. Laura Moretti et al.[10]recommended correction factor for hexagonal pavers for pedestrian areas by carrying out theoretical analysis of stone pavers.

Gyanendra Kumar et al. [11] examined the influence of coarse recycled concrete aggregates (CRCA) from construction & demolition waste can replace up to 60% natural aggregates in Paver blocks. Saleh Alsayed& Mohammad Amjad[12] studied the influence of Riyadh area aggregates in concrete and indicated that the crushed aggregate concrete possesses has high compressive strength, more porosity and less water absorption when compared to natural aggregate concrete. ArunchaitanyaSamabangi&ArunakanthiEluru[13] investigated the fresh properties of concrete by utilizing Industrial copper Slag waste as a sustainable material in high strength SCC and observed that the strength was found to be increasedwith increase in Copper Slag content. Khalifa Al-Jabri et al. [14] examined the use of copper slag as a replacement of sand in high performance concrete and it is recommended that HPC with 40% weight of Copper Slag resulted in good strength and durability properties. BipraGorai et al. [15] studied thephysico-mechanical characteristics of copper slag and concluded that copper slag can be utilised to make the products like cement, fill, ballast, abrasive, aggregate, roofing granules, glass, tiles ,etc.,

RavindraDhir et al. [16]showed that the Copper Slag as Concrete Sand had been proved forits potential use in self-compacting, high-strength and high-durability concrete. Nabil Hossiney et al. [17]studied that recycled asphalt pavement (RAP) aggregates provides paving industry more sustainable and environmental benefits thereby reducing the consumption of Portland cement and natural aggregates. Chi Sun Poon & Dixon Chan [18]investigated the inclusion of blended recycled concrete aggregate and crushed clay brick as aggregates in paving blocks and observed that it resulted in less density,reduction incompressive strength and tensile strength of the paving blocks. Ruijun Wang et al.[19] performed studies on durability and compressive strength of Copper Slagas substitute of sand in concrete and found that the particle size and replacement ratio of CS in concrete preparation should be below 10 mm and 40%, respectively. BharathiMurugan et al. [20]reported that the use of crumb rubber particle size ranging from 0.075 mm to 4.75 mm can be used to partially substitute the fine aggregates in the production of Rubberized Concrete Blocks (RCBs).

Eventhough adequate studies have been conductedon the utilization of Copper Slag in pavements as replacement of sand, very limited researchworks have targeted on the precast interlocking paverblocks with Copper Slag and hence the present study exclusivelyfocuses on investigating the mechanical properties, abrasion resistance and water absorption on precast interlocking paver blocks by the utilization of Copper slag as replacement of sand.

3. Materials

3.1 Cement

The binder constituent used for the production of paver blocks is Portland Pozzolana Cement with a specific gravity of 2.9.

3.2 Fine aggregate

River sand is used as fine aggregate with a specific gravity of 2.6 and the gradation of the sand is determined by sieve analysiswhich conforms to Zone III [21].Fig.1shows the grain size distribution of the fine aggregate plotted for particle size versus percentage finer, which indicates that the sand used for the present study is fine sand.

3.3 Coarse aggregate

The coarse aggregate from quarry with a specific gravity of 2.6 is used. The size of coarse aggregate to be used for paver blocks should be less than is 12.5mm [23] and in the present study, coarse aggregate of 10mm is used.

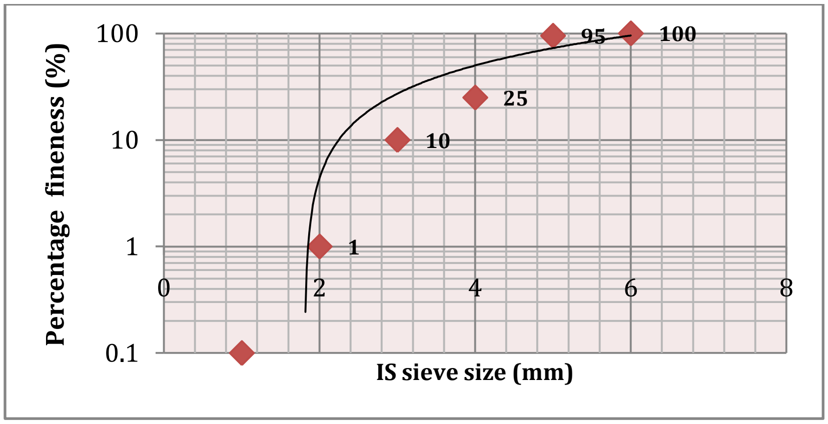


Fig. 1 Grain size distribution of the fine aggregate

3.4 Copper slag

Copper slag is an industrial by-product obtained during the matte smelting and refining of copper. It is an industrial by product abundantly available near copper producing industries having similar physical and chemical properties of sand, considered as an alternative to the river sand[15]. The Specific gravity and water absorption of copper slag is 3.7 and 0.4% respectively. Copper slag when used for construction had proved to increase the workability, compressive strength and flexural strength.

3.5Water

The potable water free from salts is used for material mixing and curing conforming to the requirements of IS:456-2000[22].

4. Experimental programme

The preliminary tests on raw materials are carried out to check the physical properties of the materials used in the constructions of paver blocks. The materials were tested for specific gravity andit was found clear that the materials used in this investigation conforms to the specifications as per the codes. The methodology adopted for the present study is shown in Fig. 2.

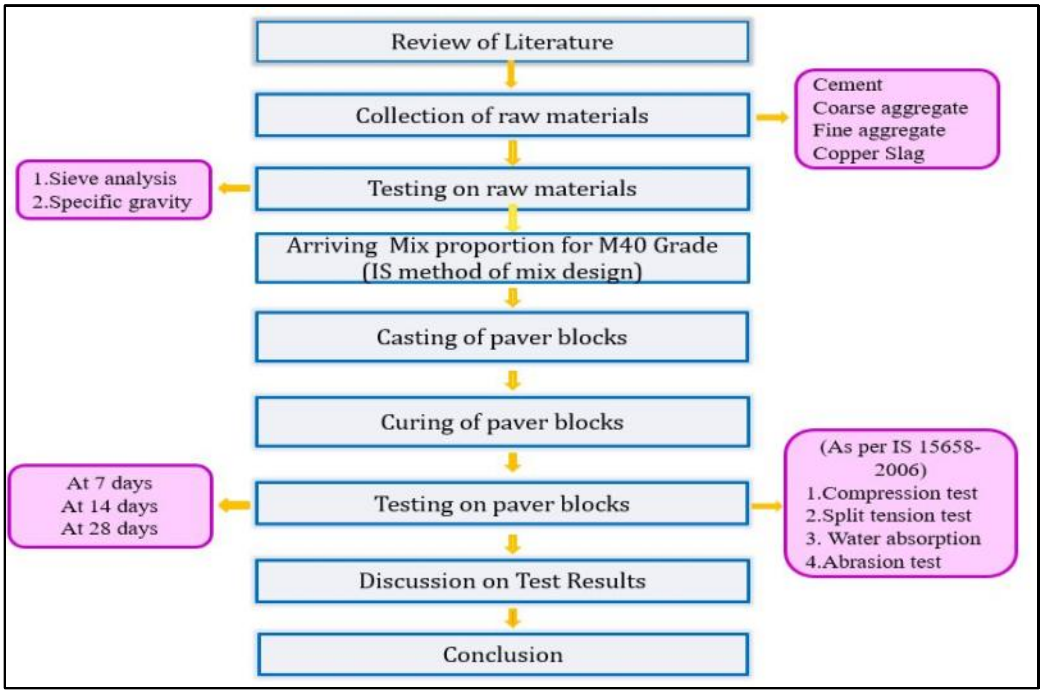


Fig.2 Methodology for the Present study

4.1 Mix Design

The mix proportion is arrived for M40 grade of paver blockusing a w/c ratio of 0.45 as per IS:10262-2019 method of mix design[24]. The Mix proportionfor M40 grade paver block is shown in Table 1. The specimens are cast by replacing fine aggregate with 10%, 20% & 30% of copper slag. Control specimen, replacement of fine aggregate with 10%, 20% & 30% of copper slag specimens are designated as NS, CS10, CS20 and CS30 respectively.

Table 1

Mix proportion for M40 Grade

Grade of Paver Block			M40
Materials	**Cement**	**Fine Aggregate**	**CoarseAggregate**
Mix-ratio	1	1.19	1.34

4.2.Unipavers

Block paving is one of the most prominent flexible pavement surfacing options, widely usedfor exterior pavement applications. Interlocking Pavers are available in different sizes, shapes, colours, textures and patterns. In the present study, the paver blocks selected is Unipaver (Zig-Zag shaped). Unipavers are typically used as a decorative solutionof creating a pavement. The main benefit of pavers over other materials is that individual paver allows easy replacement;without disturbing the other blocks. The length and height of Unipavermould used in the present study are 260 mm and 80 mm respectively with a plan area of 0.0299 sq. m.

4.3 Specifications for precast Paving blocks

As per IS15658-2006, Paver blocks are generally used in two areas i.e. traffic and non-traffic areas. Non-traffic areas are defined as areas where no vehicular traffic occurs, that cover pedestrians, parking and garden areas , whereas traffic areas cover light to very heavy traffic [11, [23].The grade designation of the paver blocks is ascertained based on their compressive strength. In the present study, M40 grade is selected for the present investigation which deals with medium traffic applications of City streets, small and medium marketroads, low volume roads, utility cuts onarterial roads, etc.

4.4 Specimens for each test

The specimens are cast based on the specimen requirements as per IS 15658 – 2006[23] and shown in Table 2

Table 2

Specimen Details as per IS 15658 – 2006

Tests on Paver Blocks	Number of Specimens cast
Compression test	24
Split tension test	24
Water absorption test	24
Abrasion resistance test	24
Total number of specimens	96

The requirement of the quantity for casting of the paver block is calculated as per IS 15658:2006 – Precast concrete blocks for paving [23]and IS 10262: 2019 – Concrete mix proportioning codal provisions[24].The Quantity requirement per mould of Unipaver is given in Table 3.

Table 3

Quantity requirement per Unipavermould

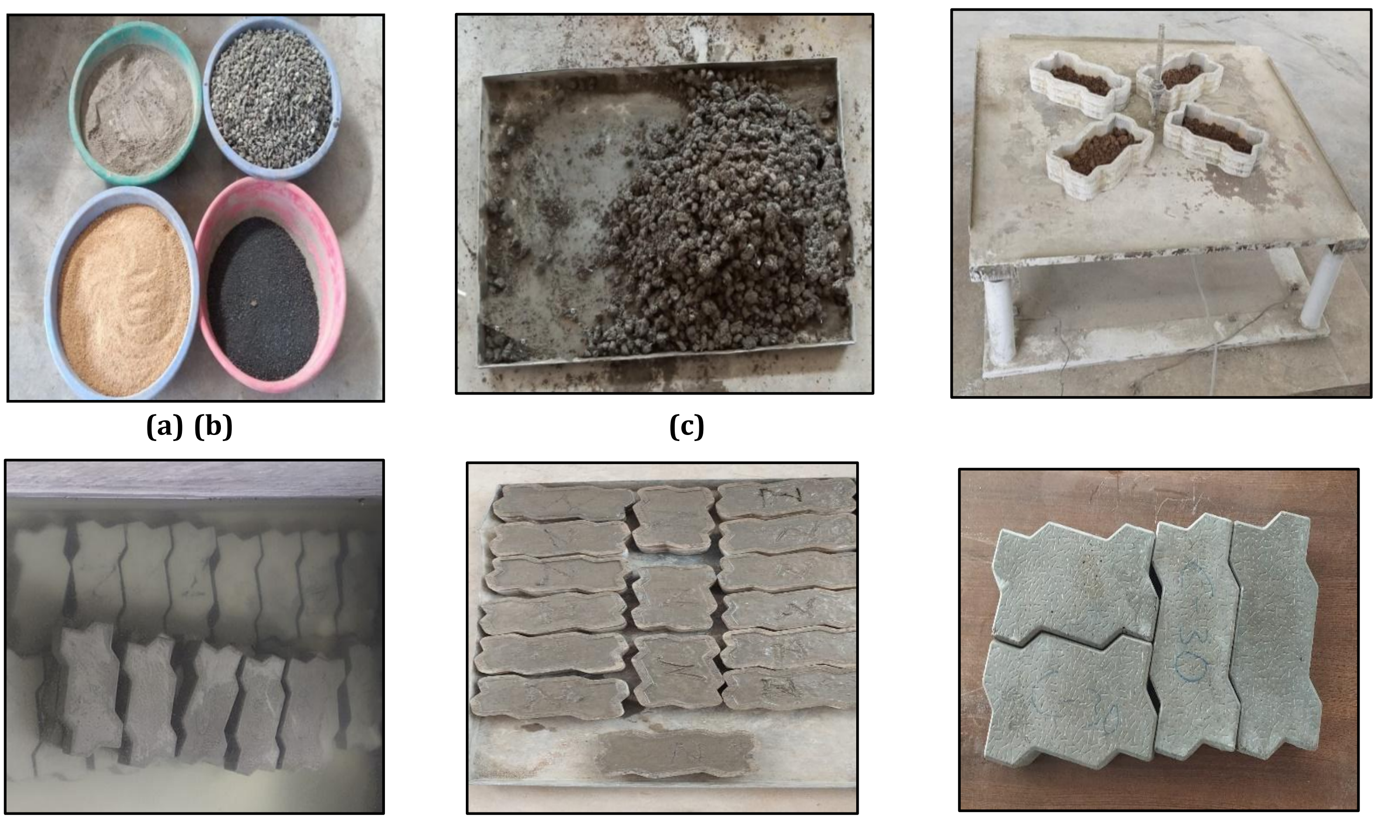
Material	Quantity
Cement	1.02 kg
Coarse aggregate	1.2 kg
Fine aggregate	1.37 kg
Water content	0.42 lit.

The Quantity requirement for paver block specimens of NS, CS10, CS 20 and CS30 areshown in Table 4.

Table 4
Quantity requirement for all paver block specimens

Specimen	Material requirements				
	Cementin kg	**Coarse aggregate in kg**	**Fine Aggregatein kg**	**Waterin lit.**	**Copper Slag in kg**
NS	24.48	28.8	32.88	10.08	-
CS 10	24.48	28.8	30.71	10.08	3.288
CS 20	24.48	28.8	26.30	10.08	6.576
CS 30	24.48	28.8	23.02	10.08	9.864

After arriving the mix proportions as per IS 10262 :2019, the paver blocks of Unipaver shapes are cast as per the sampling requirements of IS 15658: 2006. About 96 specimens are cast for conducting the various tests to assess the mechanical properties, abrasion resistance and water absorption of paver blocks. The casting process of paver blocks is shown in Fig. 3. After the day of casting of specimens, the paver blocks aredemoulded and are allowed for curing and further it was used for testing at 7, 14 and 28 days.



(a) (b) **(c)**

(d) **(e)** **(f)**

Fig. 3 Casting Process of Paver block specimens (a)Materials for casting specimens (b) Mixing of raw materials (c) Table vibrator for compaction (d)Curing of specimens (e) Paver block specimensbefore demoulding(f)) Paver block specimens after demoulding

5. Test results and discussion

The tests of the paver block specimens are carried out to examine the mechanical properties, abrasion resistance and water absorption of paver block for NS, CS10, CS20 and CS30 Specimens. All the tests are carried out in accordance with the codal provisions of IS 15658:2006 [23]. The tests results are discussed below:

a. Compression test
b. Split tension test
c. Water absorption test
d. Abrasion resistance test

5.1 Compression test

Compression testing is one of the most significant tests used to determine the material's behavior or response under crushing loads and to measure the plastic flow behavior and ductile fracture limits of a material. Each test is carried out for 3 paver block specimens at 7, 14 and 28 days. The paver block specimens are tested at 7, 14 and 28 days.The testing procedure adopted as per IS 15658 – 2006[23] is described as follows. The blocks are stored for 24hours in water maintained at a temperature of 20 ± 5°C. The bearing plates of the testing machine are wiped clean. The specimens are aligned with those of the bearing plates.The paverblock specimenin the compression testing machine is shown in Fig.4. The load is applied without shock and increased continuously at a rate of 15 N/mm²/min until no greater load can be sustained by the specimen or delamination occurs. The maximum load applied to the specimen is noted.

Fig. 4 Compression test on paver block specimen

The Compressive strength is calculated using the equation (1) as per IS 15658 : 2006. For the estimation of the compressive strength, a correction factor (S) of 1.18 is applied for 80 mm paverblock[5,23].

$Corrected\ compressive\ strength\ =\ C\ x\ S$

Apparent compressive strength (C) = $\frac{Maximum\ \ Load\ \ in\ N}{Plan\ \ Area\ \ in\ mm^2}$(1)

Where, C- Apparent compressive strength, S - Approximate correction factor for thickness

Table 5

Compression test results

Specimens	**Average compressive strength in MPa**			**Statistics for 28 days testing (MPa)**			
	7 Days	**14 Days**	**28 Days**	**No. of Samples**	**Mean**	**Standard Deviation**	**Variance**
NS	26.56	34.31	38.54	3	38.54	4.87	23.73
CS10	27.09	35.64	38.81	3	38.81	5.09	25.91
CS20	27.62	36.56	39.85	3	39.85	3.76	14.17
CS30	28.41	37.47	41.04	3	41.04	6.20	38.47

Paver block strength should be specified in terms of 28 days compressive strengthas per IS: 15658-2006 [23].The test results of compression test are given in Table 5and comparison of strengths at 7, 14 and 28 days is shown in Fig.5.FromTable 5, it is found that the category of CS30 records the highest Compressive strength of 41.04MPa when compared toother category blocks. The difference in Compressive strengthbetween CS10 and NS, CS20 and CS10, CS30 and CS20 are 0.27 MPa, 1.04 MPa and 1.19 MPa respectively.The percentage increase in the compressive strengths between CS10 &NS at 28 days testing was observed to be 0.34% , that between CS20 & CS10 is found to 3.29% and between CS30 & CS20 is found to be 6.09% . Therefore, it is confirmed that the compressive strength increases with the increase in the replacement with copper slag. The increase in copper slag replacement of sand increasestheconcrete strength, which could be due to theinterlocking of the angular CS particles[6,19].

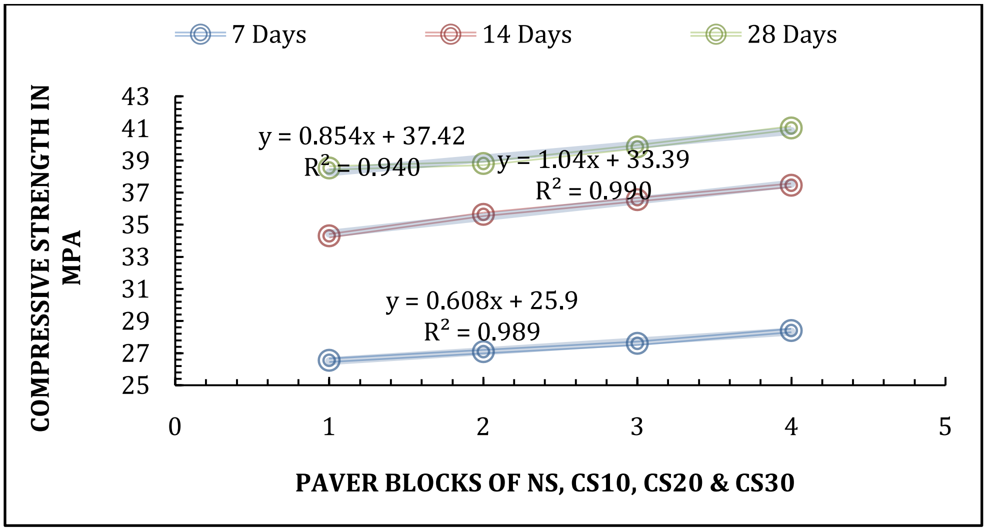


Fig.5 Comparison of Compression test results at 7,14 & 28 days

As per IS: 15658-2006, individual paver block strength should not be less than 85 percent of the specified strength. The minimum average (specified) strength of paver blocks was determined using the equation (2). The individual paver blocks strength at 28 days was computed as 85% of the minimum average strength and it is highlighted in Table 6. From Table 6, it is noteworthy that the individual paver block strength of NS, CS10, CS20 and CS30 specimens meet out the requirement as per IS15658 – 2006. The individual paver blocks strength at 28 days in comparison with the Minimum average strength is depicted in Fig.6.

$$Minimum\ average\ 28\ days\ strength \quad = f_{ck} + (0.825 * \text{Standard deviation}) \qquad (2)$$

Table 6
Individual paver blocks strength at 28 days

Specimens	Individual paver blocks strength at 28 daysin Mpa		
NS	33.15	39.85	42.62
CS10	33.15	40.25	43.01
CS20	35.91	40.25	43.41
CS30	35.52	39.86	47.75

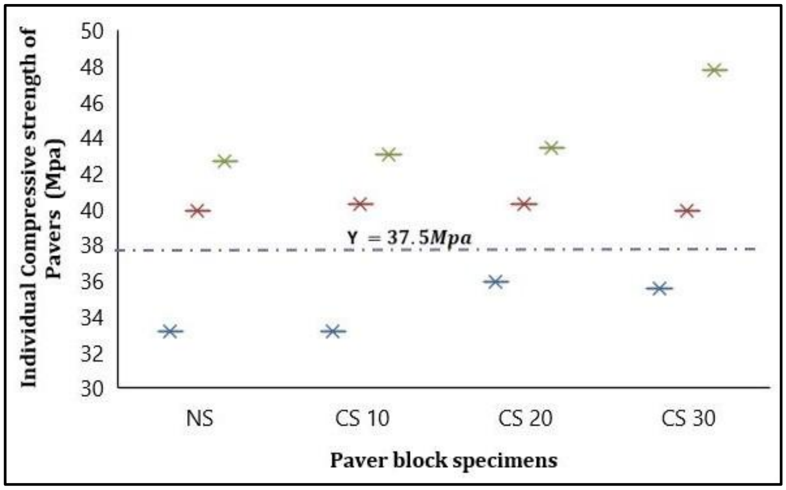


Fig. 6 Comparison of Individual Compressive strength of all paver block specimens with Specified strength

5.2 Split tension test

Tensile strength is a key property of concrete because concrete structures are highly susceptible to tensile cracking due different kinds of effects and applied loading itself. However, tensile strength of concrete is very low in compared to its compressive strength.For conducting split tension test, the specimen kept under curing are taken out and dried in air for about 1 hour and then tested to find the split tensile strength at 7,14 and 28 days using compression testing machine. The splitting apparatus is mounted between loading heads of a compression machine and a paving block is placed within the two semi-circular units, after which the sample is split in two halves under indirect tensile stress[23,9]. The paver block specimen in the compression testing machine for finding the split tensile strength, specimen during and after testingis shown in Fig. 7.Table 7highlights the split tension test results of all specimens.

The split tensile strength is calculated using the equation (3), the comparison of test results are shown in Fig. 8.

Area of failure, $S = l\ x\ t$

Tensile splitting strength, $T = 0.637\ x\ k\ x\ (P/S)$ (3)

Where, S - Area of the failure, in mm² - Mean of two measurements of the failure length, one at the top and one at the bottom of the specimen, in mm , T - Tensile splitting strength in Mpa, P - Failure load.

(a) (b)(c)

Fig. 7 Split tensile test on paver block specimen (a) Split tension test arrangement on Paver block specimen (b) Split tensile Failure of Specimen (c) Specimen after failure

Fig. 8 depicts the average split tensile strength for paver block at different percentages (10%,20%&30%) at 7,14&28 days and it can be noted that the split tensile strength is found to get increased with addition of copper slag when compared with control specimen.

Table 7

Split Tension test results

Specimens	Average Split Tensile strength in MPa			Statistics for 28 days testing in MPa			
	7 Days	14 Days	28 Days	No. of Samples	Mean	Standard Deviation	Variance
NS	1.1	1.41	1.66	3	1.66	0.30	0.09
CS10	0.84	0.97	3.91	3	3.91	0.30	0.09
CS20	0.61	1.61	1.99	3	1.99	0.40	0.16
CS30	1.43	1.1	4.37	3	4.37	0.40	0.16

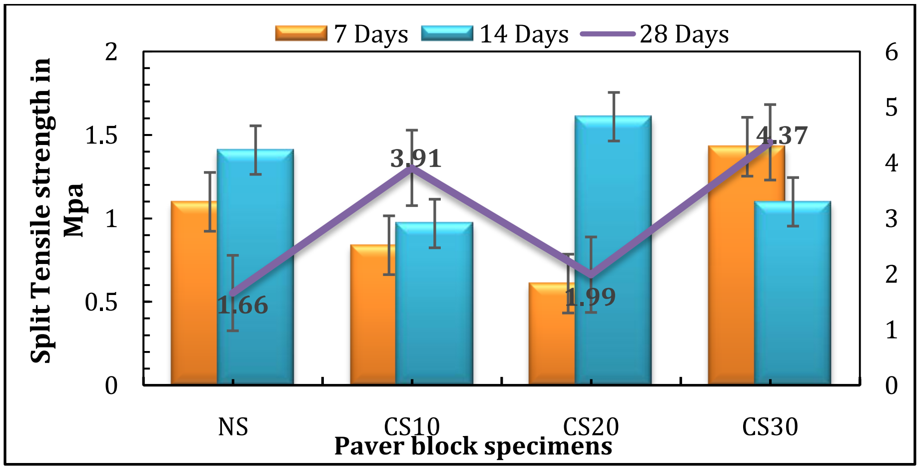


Fig.8 Comparison of Split tensile strength results of pavers

The Compressive strength of concrete does not have any direct relationship with Split Tensile strength. But higher compressive strength concrete shows higher tensile strength, but the rate of increase of split tensile strength is of decreasing order[16].Nevertheless, it was observed that there was a relationship between the compressive strengths and the transverse breaking loads or the tensile splitting strengths ofthe paving blocks are shown in Fig.9[18].

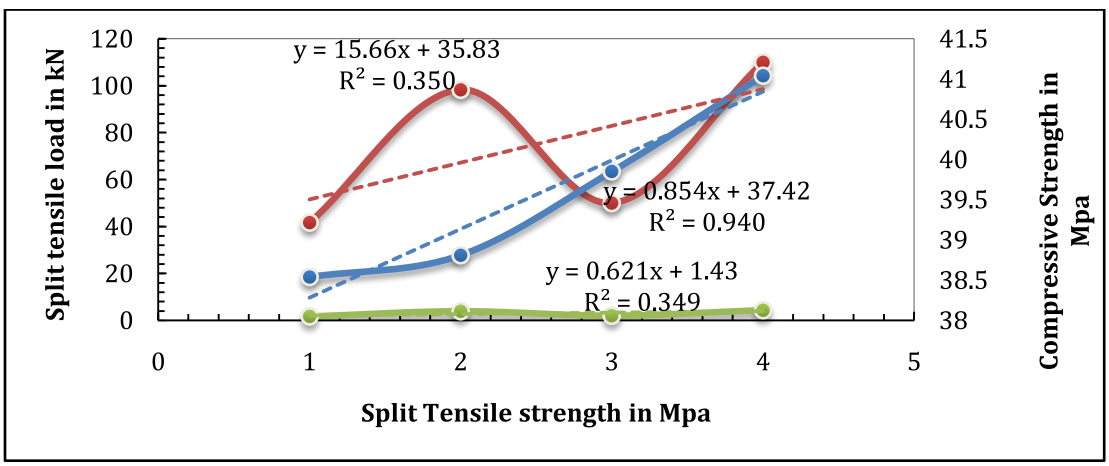


Fig.9 Relationship between 28-day compressive strength(MPa), tensile splitting strength (MPa)&Split tensile loads (kN).

5.3Water absorption test

Water absorption gives an idea on the internal structure of the aggregate which helps in determining the pore structure and strength of aggregates. Aggregates having more absorption are more porous in nature and are generally considered unsuitable, until it is found acceptable based on strength, impact and hardness tests. The desired specification of water absorption for 28 days curing as per IS 15658 : 2006 should be less than 7% for individual blocks[23].

The paver block specimens selected as per the sampling procedure as per IS 15658 : 2006. All paver block specimens were completely immersed in water at room temperature for 24 hours. The specimens to be testedarethen taken out from water and allowed to drain for 1min by placing them on a coarser wire -mesh. Visible water on the specimens is then removed with a damp cloth. The specimen is immediately weighed and the weight for each specimen is noted (W_w). Subsequent to saturation, the specimens are dried in a ventilated oven at 110°C for about 24 hours. The dry weight of each paver block specimen (W_d) was recorded. The percentage of water absorption was calculated using the equation (4) and the average percentage of water absorption of NS, CS10, CS20 and CS30 specimens were calculated and shown in Table 8. From Table 8, it is observed that the percentage of water absorption of paving block isnoted to be increased for both CS10 and in 4.9% and 2.3%. But the water absorption results of all paver blockspecimens are found to be within the limits of 7% as per IS 15658 : 2006[23].The comparison of water absorption test results is shown in Fig. 10.

$$W_{Percent} = \frac{W_w - W_d}{W_d} x\ 100 \qquad (4)$$

Where,W_w - Wet weight of paver block, W_d- Dry weight of paver block.

Table 8

Water absorption of paver blocks

Specimen	**Dry weight,W_d in kg**	**Wet weight,W_w in kg**	**%Water Absorption**	**Average water absorption in %**
NS	3.985	4.015	0.75	2.35
	4.04	4.2	3.9	
	4.02	4.13	2.4	
CS10	4.08	3.860	5.3	4.91
	3.835	4.105	7.04	
	4.04	4.14	4.91	
CS20	4.205	4.235	2.4	2.1
	4.180	4.320	3.3	
	4.12	4.24	2.9	
CS30	4.260	4.290	1.7	2.3
	4.135	4.265	3.1	
	4.125	4.04	2.06	

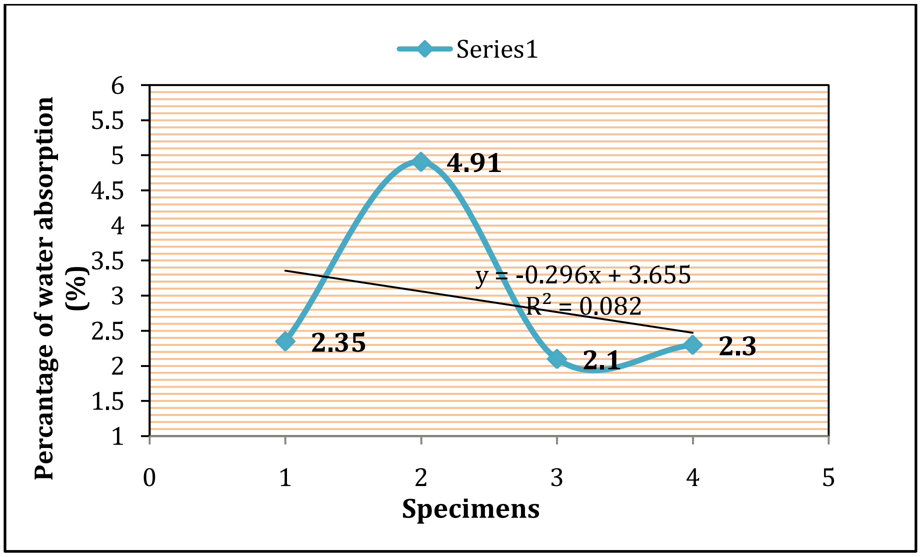


Fig.10 Comparison of Water absorption test results

From Table 8 and Fig. 10, it isnoted that the water absorption performance of concrete is closely related to its pore structure,as concrete is innately a porous medium[12] andthe physical property of Copper Slag is a glassy structured appearance with very low water absorption[13] and it is evident that as Copper Slag content increases, percentage of water absorption decreases[14].

5.4. Abrasion resistance test

Abrasive resistance of construction materials including mortar and concrete with cement binders is very important for their service life. Due to the movement of traffic, the surface of the paver blocks will be subjected to wearing action. In order to find the abrasion resistance of the paver block, Dorry's abrasion testing machine was used. The square shaped specimens measuring 70 mm is cut out from the paver block specimens with a height of 40mm and is tested to determine the abrasive wear after allowing 16 cycles with 22 revolutions per cycle through a grinding disc with abrasive powder of 20 g which was placed before each cycle. The paver block specimens for abrasion test and abrasion testing machine areshown in Fig. 11&Fig.12. The abrasive resistance test results were tabulated in Table 9.Abrasion wear of paving blocks is also characterized by Compressive strength [7, 8].

Fig. 13 depicts the relationship between the compressive strength and the abrasive wear in terms of loss in volume loss of the paving blocks. FromFig.13, it is observed that addition of copper slag to the paver blocks increases its wear resistance.The utilization of aggregates having high density and hardness have major influence on thestrength and abrasion resistance of concrete[17].The inclusion of Copper Slag as replacement of fine aggregate having higher density and hardness compared to natural aggregate had directly shown a good improvement in the strength and abrasion resistance of the paver blocks.

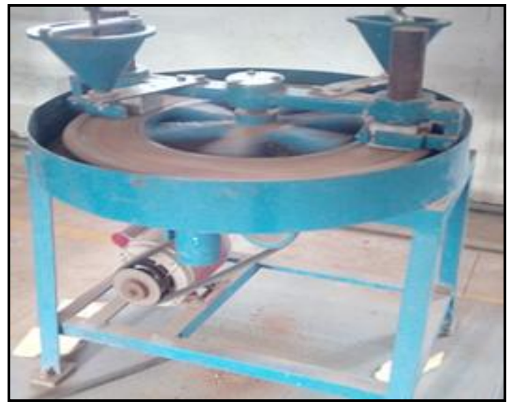


Fig. 11 Paver block Specimens for Abrasion test **Fig.12** Abrasion test on paver blocks

Table 9

Abrasion test results on Paver blocks

Specimen	Loss in Mass of specimen	Density of the specimen	Volume of specimen	Average Loss in Volume of
NS	2.01	$2.7082x10^{-3}$	742.2	742.21
	2.04	$2.7089x10^{-3}$	753.07	
	1.99	$2.721x10^{-3}$	731.35	
CS 10	1.86	$2.8095x10^{-3}$	662.04	659.37
	1.87	$2.8135x10^{-3}$	664.65	
	1.82	$2.7939x10^{-3}$	651.42	
CS 20	1.81	$2.8334x10^{-3}$	638.81	640.3
	1.81	$2.8308x10^{-3}$	639.4	
	1.83	$2.8404x10^{-3}$	644.28	
	1.79	$2.8759x10^{-3}$	622.41	621.36

CS 30	1.77	$2.8791x10^{-3}$	614.78	
	1.8	$2.8713x10^{-3}$	626.89	

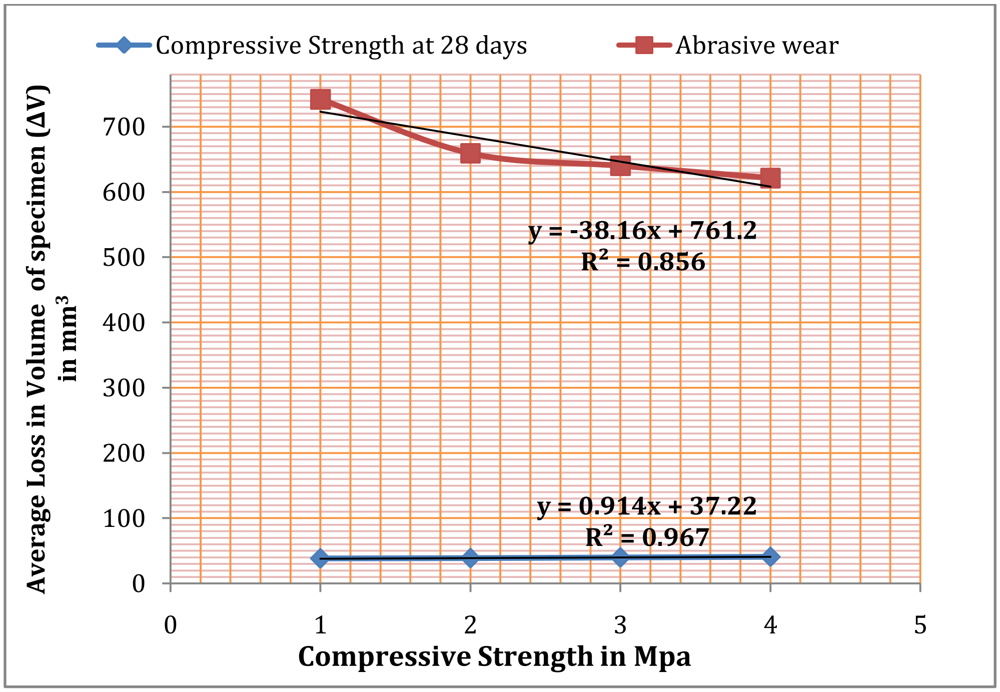


Fig. 13 Relationship between the compressive strength and abrasive wear

6. Conclusions

The Civil Engineering construction industry demands the opening the door for alternative materials in replacing sand, as sand sources become scarce and the price of sand is expected to increase. The present investigation is expected to develop a novel Paver Block with Copper Slag for replacement of sand. Since Copper slag is an economical, established and the most customarily accepted alternative to the natural aggregate, here a study on the influence of Copper Slag in Paver blocks to test the mechanical properties and abrasion resistance of paver blocks are carried out and the following conclusions are drawn from this investigation.

i) The tests results on compression showed that the strength of paver block specimens for CS specimens when compared to NS is gradually increasing with addition of Copper slag and also the individual paver block strength is also met out with 85% specified strength as per IS 15658 – 2006.

ii) From the split tension test results, the specimens with 10% and 30% replacement of fine aggregate is found to be increased by 57.67% and 62.62%, but for CS20, the split tensile strength is found to get decreased by 49.47%.

iii) The water absorption test results are very much remarkable, since all paver block specimens fall below 7% which is the maximum limit as per IS 15658: 2006. This is because of the reason that the Copper Slag is a glassy textured material, with very low water absorption.

iv) Also the Abrasive resistance of the blocks is strongly influenced by Copper Slag Content, with increase in replacements of CS, the wear loss is found to be decreased.

v) By the addition of Copper slag, it is evidentthat the mechanical properties like Compressive strength and Split tensile strength,water absorption and wear resistance has been improved.

vi) A small increment in cost when compared to standard paver block can increase the characteristic of concrete paver block and life span of paver block and reduces the maintenance.

This study demonstrates that the Copper Slag can be exploited in the production of precast concrete paving blocks which will facilitate to control the waste slag and revitalize the land sustainably. With reference to theresults on mechanical properties, paver blocks with Copper Slag can be used in areas for medium traffic applications of City streets, small and medium market roads, low volume roads, utility cuts on arterial roads, etc.

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