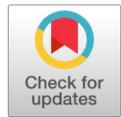


# Utilisation of E-Waste, Fly Ash in Manufacturing of Paver Blocks and Tiles

Aniket Ravindra Ingole, Nilesh Naresh Sonole, Chirag Ramesh Thakur



**Abstract:** E-Waste that is increasing day by day turning into a major threat to public health and successively pollutes the setting. India ranks fifth in the world for e-waste generation; about a pair of million a lot of e-waste is generated associate rally and an unrevealed quantity of e-waste is foreign from alternative countries around the world. The aim of this project is to exchange cement with e-waste and fly ash in paver block, tiles and to chop back the worth of paver block and tiles compared thereto of convention concrete paver blocks and tiles. Use of concrete paver block and tiles square measure presently day after day turning into standard; they are used for paving of approaches, strategies and ton and collectively the pre-engineering building and pavements. Throughout this project, we've used e-waste in various proportions with quarry dirt and ash, coarse combination, compound, and metal-containing material and cement. This can be often one in every of the foremost effective ways that to avoid the buildup of e-waste which can be a non-degradable waste. This as an alternative saves the quanta of sand and clay that ought to be got eliminate from the dear stream beds. The e-waste getable in surplus quantity and thence the worth issue comes down. Collectively Coloring agents are added to the mixture to comprehend desired shades. Thence throughout this project, an endeavor is formed to review regarding the properties of the paver blocks and tiles that are ready-made pattern e-waste. The paver blocks and tiles were prepared and tested and so the results were mentioned.

**Index Terms:** E-waste, Fly ash, Paver blocks, Tiles, Construction.

## I. INTRODUCTION

Pavement in construction is an out of doors floor or superficial surface covering. Paving materials embody asphalt concrete, stone like flag, cobble, and sets, artificial stone, bricks, tiles, and typically wood. In architecture pavements are a part of the onerous scape and are used on sidewalks, road surfaces, patios, courtyards. Paver block technology has been introduced in India in construction a decade past for a selected demand particularly path and parking areas etc. currently paver block is being adopted extensively in several use. Natural resources area unit depleting worldwide at the constant time the generated wastes from the business and resident area unit increasing significantly.

Manuscript published on 30 August 2019.

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The property development for construction involves the employment of Non-normal and innovative materials and the use of waste materials therefore on compensating the shortage of natural resources and to hunt out various routes protective the setting. E-waste used during this work was brought from the surrounding areas. The drop waste pollutes the surrounding setting. as a result of the result, it affects every folk at giant and animals in direct and indirect ways in which within which, therefore, it necessary to dispose of the plastic waste properly as per the laws provided by our government. The replacement of e-waste for cement provides potential environmental in addition to economic blessings. During this investigation numerous properties like compressive strength, Efflorescence test, Hardness test, fire resisting test and water absorption of paver blocks consisting of e waste, unconventional materials like fly ash and fine combination of varied proportion replacement are used. Cement concrete tiles and paving blocks are formed solid product created out of cement concrete. The merchandise is formed in numerous sizes and shapes like square wave, Colorado, star, petro, bell, 4 squares, cosmic and wave of various dimensions with styles for lay lockup of adjacent tiles blocks. The raw materials needed for manufacture of the merchandise are Portland cement and aggregates that are obtainable domestically in each a part of the country. These pavements are less liable to rutting, Minimum fatigue or thermal cracking, low uncovering because of wet and offers nice sturdiness, very little or no impact on process and conjointly produces eco friendly construction and prices less. Paved surface or pavement is that the sturdy surface material ordered down on a locality supposed to sustain conveyance or traffic, like road or walk method.

## II. MATERIALS USE

### A. Water

Water is a very important ingredient of environmental-friendly paver blocks and tiles using e-waste and fly ash because it is concerned within the chemical process with cement. Potable water ought to be used for mixing the cement, sand and e-waste. It ought to be free from organic matter and also the pH price ought to be between 6.5 and 7.5.

### B. Fly ash

Fly ash (FA) obtained from Thermal powerhouse, Wardha district, geographic area state of India confirming to IS: 3812-1981 utilized in mineral admixture in dry powder type the physical and chemical properties got Table-1

TABLE I PROPERTIES OF FLY ASH

S. NO.	PROPERTIES	VALUE
1	Specific Gravity	2.02

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2	Physical Form	Powder form
3	Class	F
4	Silicon dioxide (SiO <sub>2</sub> )	54.93%
5	Aluminum oxide (Al <sub>2</sub> O <sub>3</sub> )	23.50%
6	Ferric oxide (Fe <sub>2</sub> O <sub>3</sub> )	4.56%
7	Calcium oxide (CaO)	3.85%
8	Magnesium oxide (MgO)	2.92%

### C. E-waste

Electronic waste is also represented because the discarded electronic equipments like mobile phones, computers, social unit appliances that fail or aren't any fitter for its originally meant use. Everyday advancements in technology have resulted in fast growing surplus of electronic waste around the globe. E-waste was collected from dump yard at Yavatmal.

### D. River sand

Sand is of course occurring granular material that consists of mineral particles and finely divided material. The organization of sand shifts relying upon the local shake conditions and sources; anyway the premier constituent of sand in inside mainland settings and non-tropical beach front district is silicon dioxide (SiO<sub>2</sub>) at interims the kind of quartz. The second ordinarily used sand is that the carbonate, as an example mineral, that has largely been created, over the past 0.5 billion years, by numerous varieties of life, like coral and shellfish. Sand is currently utilized in all the development method. The properties of the River sand were obtained by various tests conducted in our college laboratory including Standard proctor test.

TABLE II PROPERTIES OF RIVER SAND

Sr. NO	EXPERIMENTS	RESULTS
1	Natural Water Content (%)	10.5
2	Specific Gravity	2.43
3	Unit Weight (g/cc)	1.63
4	Fineness modulus	2.85

### E. Cement

Portland bond is that the principal regular very bond commonly uses the world over as a fundamental element of solid, mortar, stucco, and non-forte grout. It had been created from totally various kinds of water driven lime in England at interim the inside nineteenth century, and normally starts from a stone. It's a fine powder, made by warming rock partner degreed dirt minerals in an exceptional home machine to make clinker, crushing the clinker, and including little measures of different materials. Normal cement (OPC) confirming to IS: 8112-1989 cement used. Table three provides the properties of cement used.

TABLE III PROPERTIES OF CEMENT

SR. NO.	DESCRIPTION OF TEST	RESULTS OBTAINED	REQUIREMENT OF IS: 8112-1989
1	Specific gravity	3.15	3.15
2	Initial setting time	70 minutes	Min. 30 minutes
3	Final setting time	280 minutes	Max. 600 minutes
4	Fineness	413.15m <sup>2</sup> /kg	Min. 225 m <sup>2</sup> /kg

### F. Coloring agents

Various coloring agents like Red chemical compound, Red Iron chemical compound, Iron Oxide, Yellow chemical compound, Black Iron chemical compound, Talc, Talc

Powder, bath powder, Concrete colours , Blue oxide, inexperienced chemical compound, Organic and Inorganic Pigments, Kaolin , atomic number 25 oxide, Micaceous Iron chemical compound, transparent substance powder, lampblack square measure used for coloring paver blocks and tiles.



Fig 1 oxides used for coloring

### G. Coarse Aggregate

Coarse mixture shall go with the need of IS 383 as for as doable crushed mixture shall be used for making certain adequate sturdiness. The mixture used for production of block shall be Sound and free from soft and alveolate particle the nominal maxi size of coarse aggregate utilized in Production of paver block shall be 10 mm.

## III. CONTROL MIX DESIGN

So as to discover the paver blocks and tiles that they have high compressive quality with different blend extents are made and they are tried utilizing compressive testing machine. The blend extent were in the proportion of (1:1:2, 1:1:3, 1:1:4, 1:1:5, 1:1:6, 1:1:7) These are the proportion which speaks to the E-waste, Fly ash, concrete individually. In first step we should collect the e waste from various electronic equipments such as computers, laptops, mobiles, televisions etc. Next step the collected e-waste is cleaned with high pressure air and extra components such as capacitors, resistors, switches are removed, then this e-waste are cut with help of cutter in size of 5-10 mm. These pieces of e-waste are added to various proportion of cement, sand, aggregate, fly ash along with water. Red oxide and other coloring agents are added (less than 10% of the total weight) to impart color. These mixtures are then poured in to the paver block and tile mould and they are compacted using mechanical vibrators. Before setting the blend into the shape, the sides of the form are oiled to simple evacuation of paver squares and tiles. Total six paver blocks and six tiles were constructed.

## IV. TESTING PROCEDURES

To know the standard of e-waste, ash paver blocks and e-waste, ash tiles following tests are performed. In these tests some square measure performed in a laboratory and therefore the rest square measure on the field.

### A. Compressive test

This is done to comprehend the compressive quality of the paver blocks and tiles. This can be conjointly known as the pulverizing quality of paver blocks and tiles.

Regularly 6 examples of paver squares and tiles square measure taken to a research facility for testing and tried one by one. Amid this investigate a paver blocks and tiles square example is set on pounding machine and connected weight until it breaks. The last weight at that paver squares and tiles is pounded is contemplated. Each of the six paver blocks and tiles examples square measure tried one by one and normal outcomes are taken as paver blocks and tiles compressive/smashing quality. The e-waste, fly ash paver blocks and tiles of different proportions square measure tried one by one and amid this, the high pressure is found and examination made between the e-waste, fly ash and conventional paver blocks and tiles.

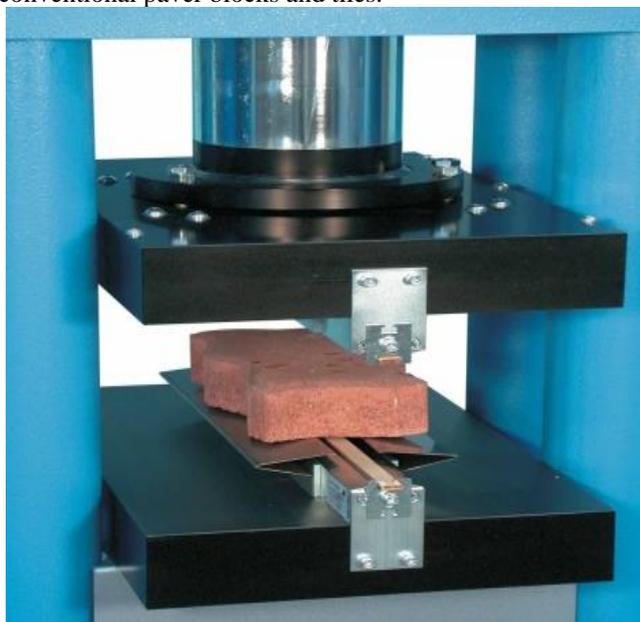


Fig 2 Compressive test

TABLE IV COMPARISON OF COMPRESSIVE STRENGTH OF E-WASTE, FLY ASH PAVER BLOCKS POSSESSING VARIOUS RATIOS

MIX DESIGNATION	E WASTE, FLY ASH, CONCRETE RATIO	COMPRESSIVE STRENGTH(N/mm <sup>2</sup> )
M1	1:1:2	29.25
M2	1:1:3	34.28
M3	1:1:4	40.10
M4	1:1:5	37.25
M5	1:1:6	34.55
M6	1:1:7	31.21

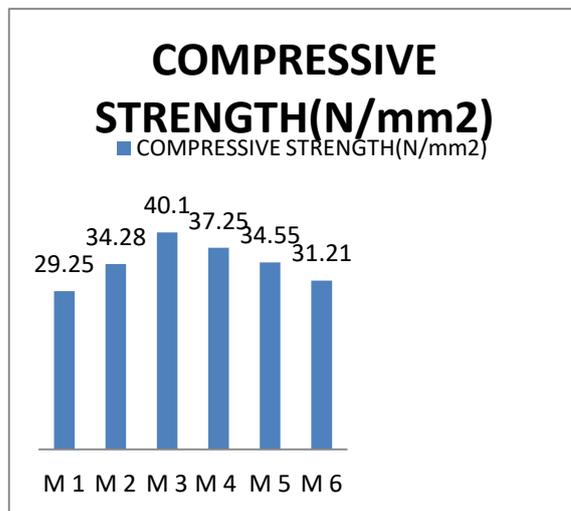


Fig 2 compressive strength of paver blocks

TABLE V COMPARISON OF COMPRESSIVE STRENGTH OF E-WASTE, FLY ASH TILES POSSESSING VARIOUS RATIOS

MIX DESIGNATION	E WASTE, FLY ASH, CONCRETE RATIO	COMPRESSIVE STRENGTH(N/m <sup>2</sup> )
M1	1:1:2	19.28
M2	1:1:3	21.22
M3	1:1:4	25.39
M4	1:1:5	23.89
M5	1:1:6	21.28
M6	1:1:7	19.55

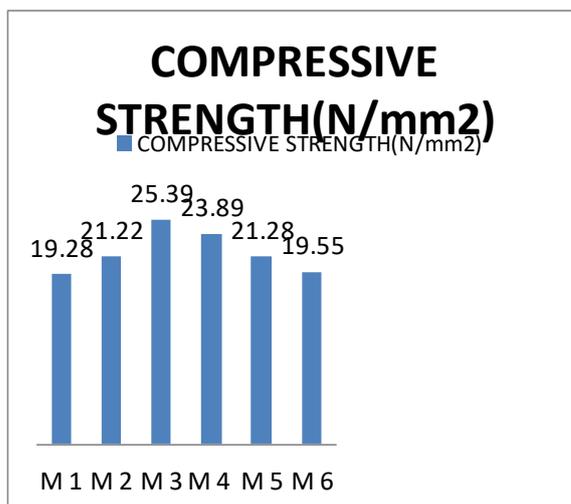


Fig 3 compressive strength of tile

TABLE VI COMPARISON OF COMPRESSIVE STRENGTH OF E-WASTE AND FLY ASH PAVER BLOCK WITH ITS COUNTERPART

SI.NO	TYPE OF PAVER BLOCKS	COMPRESSIVE STRENGTH(N/mm <sup>2</sup> )
1	Ordinary	30.1
2	Fly ash	35.2

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3	e-waste and fly ash tiles	40.1
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TABLE VII COMPARISON OF COMPRESSIVE STRENGTH OF E-WASTE AND FLY ASH TILES WITH ITS COUNTERPART

SI.NO	TYPE OF BRICK	COMPRESSIVE STRENGTH(N/mm <sup>2</sup> )
1	Ordinary	20.98
2	Fly ash	22.96
3	e-waste and fly ash tiles	25.39

### B. Water absorption test

In this the paver blocks and tiles area unit initial weighted in dry condition and that the area unit immersed in water for 24 hours. Subsequently, they're taken out from the water and that they are wiping out with artifacts. Then the distinction between the dry and wet bricks proportion area unit calculated. Water absorption for various types of paver blocks

TABLE VII WATER ABSORBTUON FOR VARIOUS PAVER BLOCKS

Sr. no.	TYPE OF BRICK	WATER ABSORPTION
1	ordinary	3.012
2	Fly ash	2.886
3	e-waste and fly ash	1.10

TABLE VIII WATER ABSORPTION FOR VARIOUS TYPES OF TILES

Sr. no.	TYPE OF BRICK	WATER ABSORPTION
1	ordinary	3.548
2	Fly ash	2.845
3	e-waste and fly ash	1.50

### C. Efflorescence test

The presence of alkalis in paver blocks and tiles is harmful and that they type a gray or white layer on the paver block and tiles surface by gripping wetness. To search out the presence of alkalis in paver block and tiles this take a look at is performed. During this take a look at a paver block and tiles is immersed in water for 24 hours then it's taken out from the water and allowed to dry in shade. The e-waste, ash paver block, and tiles have low alkali content and then a touch white patch is made over the surface.



Fig 3 water absorption test on paver block



Fig 4 water absorption test on tiles

### D. Fire resistance test

The e-waste is very prone to hearth however just in case of paver blocks and tiles the presence of sand imparts insulation. There's no modification within the structural properties of a block of bricks up to 180 °C on top of that visible cracks area unit seen and therefore the blocks and tiles deteriorate with an increase in temperature.

### E. Hardness test

In this take a look at a scratch is created on a paver block and tile surface with a steel rod (any onerous material are often used) that was tough to imply the bricks or blocks were onerous. This shows the paver block and tiles possess top quality.



Fig 5 various shapes of paver blocks

### E-Tiles



Fig 6 various types of tiles

## V. CONCLUSION

The e waste, fly ash paver blocks and tiles possess additional benefits that embrace value potency, Removal of waste product so abolishing the land demand downside for merchandising plastic. The natural resources consumed for the producing of Paver blocks and tiles are greatly less compared to its counterparts. The producing value can be reduced any by replacement the stream sand with fly ash or different e waste product. A. The concrete includes cement, sand, combination, and water. Out of that, the mixture share is 65% to 70% you bored with concrete and from the higher than observation,

it's computer to use the 25% e wastes and ash in concrete that doesn't have an effect on the properties of concrete.

B. From the higher than observation, it's potential to use the e-waste in concrete false impression to 20% the burden of coarse combination.

C. type was higher than observation we tend to return to the conclusion that e-waste and ash are in cement concrete combine increase the half in e-waste and fly ash to decrease the strength of concrete.

D. By mistreatment, the e-waste and ash in the concrete combine to reduce the burden of the cube up 15%.

E. From the higher than observation, it's potential to use the e-waste and ash in concrete and bonding admixture in concrete and conjointly increase the half of e-waste and fly ash in concrete.

F. Lastly, we tend to powerfully conclude the employment of e-waste and ash in concrete that is that the best choice for the disposal of e-waste and ash & ultimately reduce the e-waste and fly ash pollution within the surroundings.

## ACKNOWLEDGMENTS

The authors are appreciative to Dr. Reena Panawane, Head of Civil building office at Jawaharlal Darda Institute of Engineering and Technology for their profitable help and giving testing results to do this exploration work.

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