Use of Iron Slag in Paver Block

Abhishek Kumar
Madan Mohan Malaviya University of Technology, Gorakhpu

Abstract— In these days the make use of concrete Paver Block in road pavement is broadly used. Such a moment concrete Paver Block is improved option in road building as compared to the conservative road which is complete by bitumen with gravel in a cost vision of point and better fitness. India is a increasing country so at this time the construction of road and building plays an important position. At the present days nearly all of the work related with construction or roadway is complete by cement concrete design mix. In this theory I have design paver block by with Cement Concrete mixture of Design Mix M20 which is complete of 10mm Coarse Aggregate, OPC 43 Grade Cement with Fine Aggregate and paver block is of measurement 200 x 160 x 80 mm. In this procedure use the partial substitute of Cement by Iron Slag in percentage of 0%, 5%, 10%, 15%, 20%, 25%,30%And 40% respectively and also, supplementary Gypsum constantly 2% by mass of cement in total mix of Cement Concrete. Super plasticizer is use as an admixture which is added 2% by weight of cement constantly in the production of concrete combination. The purpose of this admixture is in the direction of reduce the water cement ratio. The Paver Block curing procedure is done for 28 days respectively to discover its compressive strength. The main point of this thesis is to make use of waste products similar to Iron Slag for the making of Paver Block which will of use in construction.

Key words: Coarse Aggregate, Fine Aggregate, OPC 43 Grade Cement, Iron Slag, Compressive Strength, Flexural Strength, Paver Block

I. INTRODUCTION

Interlocking Concrete Block Pavement (ICBP) have been broadly used in many countries used for quite some time as a particular problem-solving technique used for providing pavement in area where conservative types of construction be less tough due to many ready and environmental constraint. ICBP technology has be introduced in India in construction, a decade ago, used for specific condition that is footpaths, parking areas etc. other than now being adopted broadly in different uses anywhere the conventional construction of concrete using bituminous mix otherwise cement concrete technology is not possible or desirable. Concrete paver blocks be first introduce in Holland in the fifties as substitute of paver bricks which had turn out to be scarce outstanding to the post-war building construction report. These block were rectangular in shape and have more or less the similar size as the bricks. through the past five decades, the block shape have steadily evolve from non-interlocking to partly interlocking to fully interlocking to increase interlocking shape. as a result, the pavement in which non-interlocking block are use are designated since Concrete Block Pavement (CBP) otherwise non-interlocking CBP, and those within which partially, fully or increase interlocking block are used be designated since 'Interlocking Concrete Block Pavement (ICBP). The method of utilizing interlocking paver block is exceptionally old. The first time through street utilizing paver block was built as a part of 5000 B.C. by the Minoans. Around 2000 years prior, with the assistance of work and military group the first time through roman developed pavement streets. Since, this procedure is proceeded for developing pavement streets. Concrete Paving Blocks were initially fabricated in the Netherlands in 1924. It was most likely World War II that prompted the development of concrete blocks as a paver material. Concrete block pavement (CBP) was presented in The Netherlands in the mid 1950s as a trade for prepared earth block streets. The general overall pattern towards beautification of city pavements, the increasing expense of bitumen's as a paver material and the fast increment in development and upkeep cost have urged originators to substitute paver material, for example, concrete blocks. The quality, toughness and aesthetically satisfying surface of pavers have made CBP perfect for some business, civil and modern applications. In 1960 German grew high proficiency machinery for the development of interlocking paver block. Producing innovation immediately took after by nations like South Africa New Zealand, Australia, Europe and England in the 1970's.At present Germany is the main nation in the creation interlocking paver block i.e. close around 100 million square meters. In 1970's century interlocking paver block innovation took after by Canada and spread to the United States. In 1994, North American gives yield of 160 million square feet interlocking paver block. Interlocking pavements are movable and adaptable pavements. Here, Flexible pavement implies that loads are similarly conveyed all through the base area by point to point contact. Whenever the burden is connected completely over the area of paver block the segment gets spoiled yet all of a sudden when the load is expelled its return's to its unique position . Such type of pavements gives advantage over rigid pavement, which bear to break all the more promptly ought to the base move from burdens or normal settlement because of climate. Interlocking paver blocks are profoundly impervious to abrasion, freeze ¬ thaw cycles, chemicals and spills of oil and fuel, deicing salts, which can actually soften black-top. Interlocking cement paver blocks are prepared for prompt use after establishment, there is no importance for curing or dry of the surface and they are rapidly and effectively repaired with no exceptional equipment or materials.

For as long as 50 years, huge research exercises for the advancement and refinement of CBP method have been going on numerous on in numerous nations like India Argentina, Australia, Canada, France, The Netherlands, UK and USA. In interlocking concrete block pavement, the blocks make up the wearing surface and they are a important burden spreading segment of the pavements. Paver block is proposed for us as the wearing surface on mud paver framework. In that capacity they are subjected to person on foot and light or overwhelming vehicular activity.

Paver block is created from the concrete mix of cement, aggregate, sand and water. Now and again utilize the added substances, for example, super plasticizer.

II. OBJECTIVE AND SCOPE

The object of this study is given below-

1) At this point Paver Block is manufactured by use design mix M20 and makes the paver block more tough and successful.
2) Fractional replacement of Cement is perform by Iron Slag in given percentage of (0 to 40) % with increase of 5% and create the Paver Block cheaper.
3) 10mm Coarse Aggregate is use by which it become cheaper and giving the equal strength as given by with 20mm or additional Coarse Aggregate.
4) Learning the Compressive Strength of Paver Block in 28 days respectively.

III. NEEDS OF THE RESEARCH

1) In the direction of enhance the property like workability, Compressive Strength, Flexural Strength and too add to its durability and concrete ultimate by using Iron Slag in concrete.
2) The plan of this work is to revision the use of Iron Slag waste material to manufacture concrete Paver Blocks.
3) Decide the engineering goods of Iron Slag based Paver Block and measure up to them with conservative Paver Block.
4) To observation on the fitness and control of Paver Block in construction of pavements

IV. MATERIAL USED

A. Cement

the span of the examination. It was crisp and with no irregularities. The physical properties of the concrete as decided from different tests complying with Indian Standard IS: 8112:1989 are recorded in Table Standard Portland Cement (OPC) of 43 Grade (JAYPEE) from a solitary parcel was utilized over 3.1. Concrete was deliberately put away to forestall decay in its properties because of contact with the dampness. The different tests directed on concrete are introductory and last setting time, particular gravity, fineness and compressive quality.

Sr. No.	Characteristics	Values Obtained Experimentally	Values Specified By IS 8112:1989
1	Specific Gravity	3.15	-
2	Standard Consistency, percent	29	-
3	Initial Setting Time, minutes	87	30 (minimum)
4	Final Setting Time, minutes	201	600 (maximum)
5	Compressive Strength 3 day 7 days 28 days	 24.8 N/mm2 37.5 N/mm2 47.6 N/mm2	 23N/mm2(minimum) 33N/mm2(minimum) 43N/mm2(minimum)

Table 1: Properties of Ordinary Portland Cement 43 Grade Concrete

3.2.2 Specific Gravity of Cement

M_1 = Mass of Empty Bottle = 590 gram

M_2 =Mass of Bottle+ Mass of Cement= 890 gram

M_3 = Mass of Bottle+ Mass of Cement+ Mass of water= 1671 gram

M_4 = Mass of Bottle + Mass of Water = 1466 gram

Calculation.

G = 3.156

B. Sieve Analysis of Cement Test

Sample taken of Ordinary Portland cement Grade 43= 100 gram

Sieve used= 90 micron

After sieving it for 15 minutes in Sieve Shaker Machine residue remains= 7 gram

Therefore, on the basis of theory residue weight should not exceed more than 10% by weight of

$$\text{sample taken} = \frac{\text{Residue Sample}}{\text{Total Sample Taken}} \times 100$$

(7÷100) ×100

7% (Residue)

C. Iron Slag

Slag is a by-item produced amid assembling of pig iron and steel. It is delivered by activity of different fluxes upon gangue materials inside the iron mineral amid the procedure of pig iron making in impact heater and steel fabricating in steel liquefying shop. Principally, the slag comprises of calcium, magnesium, manganese and aluminum silicates in different mixes. The cooling procedure of slag is capable principally to generate diverse sorts of slags required for different end-use customers. In spite of the fact that, the concoction arrangement of slag may stay unaltered, physical properties differ generally with the changing procedure of cooling.

Sr. No.	Property	Observed value
1	Fineness modulus	2.10
2	Specific gravity	2.7

Table 2: Physical properties of Iron slag

V. M20 MIX-DESIGN FOR PAVER BLOCKS

The over value gives the ratios used for conservative mix design of Paver blocks. within this experiment i.e. manufacture of Paver Blocks cement be replaced by the Iron Slag with 5%, 10%, 15%, 20%, 25%,30%and40%. The property of replacement of cement through Iron Slag at various percentages has be measured with Compressive Strength analysis with Flexural Strength analysis. A trail mix proportion used for cement which be replaced by different percentage of Iron Slag has be shown below.

A. M20 Mix-Design for Paver Blocks

Calculation of amount of material for M20 (standard) 1:1.5:3

Volume of Paver block= (200 ×160 ×80)

= 2250 c m^3

= 0.0025 m^3

: 3 Paver block = 0.0025 ×3 =0.0075 m^3

We know that-

For 100 m^3 Concreting, we required 152 m^3 dry mix material

For100 m^3 , required 152m^3

: Amount of cement =152/1+1.5+3=27.63 m^3

For 100 m^3 we required27.63 m3

: 0.0075 =27.63/100×0.oo75
=0.00207
We know that, volume of 1bag cement is 0.035 m^3 = 0.00207/0.035=0.05475 bag
We know that.weigt of 1bag cement is 50 kg
: = 0.05475×50=2.7375 kg cement
And sand 1.5 ×2.7375= 4.10625 kg
And gravel =3×2.7375=8.2125 kg
Take water cement ratio=w/c =0.4

Sr. No	Cement	Percentage of Iron slag	Iron Slag	Sand	gravel	Water cement ratio
1	2.7375	0	-	4.10625	8.2125	1.095
2	2.600	5	0.1368	4.10625	8.2125	1.095
3	2.46375	10	0.27375	4.10625	8.2125	1.095
4	2.3271	15	0.4104	4.10625	8.2125	1.095
5	2.1903	20	0.5472	4.10625	8.2125	1.095
6	2.0535	25	0.684	4.10625	8.2125	1.095
7	1.9167	30	0.8208	4.10625	8.2125	1.095
8	1.6431	40	1.0944	4.10625	8.2125	1.095

Table 3: Mix Proportions for Trial in % age

VI. Experimental Process

A. Casting

1) The moulds be used for manufacture of concrete Paver Block since per IS: 15658-2006 method of tests used for Strength of concrete.
2) Paver blocks mould of 200×160×80 mm magnitude.
3) First of all decide the number of example to be present taken during concreting.
4) Previous to casting of material shuttering oils be supposed to be use inside the mould accurately.
5) Assemble the all material inside the pan by the mixing properly.
6) Mix up the all material into the pan.
7) Utilize of vibrating machine/table in compact concrete to a void formation of air void in concrete.
8) submerge the sample in water at a temperature of 27o C for 14 days and 28 days in that order.
9) As a final point check its compressive strength since per when IS: 15658-2006.

Fig. 1: Casting concrete Paver block (RRB Plant)

B. Curing Process

Curing is a development where a concrete sampling or concrete structure is cure under water meant for different no. of days used for different specimen. Designed for example paver block is cure for 15 to 21 days with then its compressive strength resolve being checked.

C. Testing Process

The test is carried out with specimens on different curing age. The test was initiate at 28 days of time of the concrete mix.

Fig. 3: Cross Section of Concrete Paver Block specimen after Curing

VII. Results and Discussion

A. Test Procedure and Results

In this research i.e. development of Paver Blocks concrete was supplanted by the Iron Slag with 5%, 10%, 15%, 20%, 25%, 30%, and 40%. The impacts of substitution of cement by Iron Slag at different rates have been considered by Compressive Strength investigation and Flexural Strength examination. A trail mix extent for cement which was supplanted by different rate of Iron Slag has been demonstrated.
In this study, to make concrete, bond and fine aggregate were initially mixed dry to uniform shading and afterward coarse aggregate was included and mixed with the mix of concrete and fine aggregates. Water was then included and the entire mass mixed. The inside surface of the molds and the base plate were oiled before cement was set. Following 24 hours the examples were expelled from the molds and put in clean new water at a temperature of 270 20C. The examples so cast were tried following 7, 28 and 56 days of curing measured from the time water is added to the dry mix. For testing in pressure, no padding material was put between the example and the plates of the machine. The heap was connected pivotally without stun till the example was squashed. Consequences of the compressive quality test on cement with changing extents of iron slag substitution at the age of 28.

Sample Sr.No.	Compressive Strength of paver block in N/mm^2
1	22.81
2	23
3	22.62
Average Value	22.81

Table 4: Compressive Strength of paver block in N/mm2 after 28 days with 0% Iron Slag

Sample Sr.No.	Compressive Strength of paver block in N/mm^2
1	23.43
2	23
3	22.8
Average Value	23.3

Table 5: Compressive Strength of paver block in N/mm2 after 28 days with 5% Iron Slag

Sample Sr.No.	Compressive Strength of paver block in N/mm^2
1	23.75
2	22.65
3	23.64
Average Value	23.34

Table 6: Compressive Strength of paver block in N/mm2 after 28 days with 10% Iron Slag

Sample Sr.No.	Compressive Strength of paver block in N/mm^2
1	25
2	25.2
3	25.3
Average Value	25.16

Table 7: Compressive Strength of paver block in N/mm2 after 28 days with 15% Iron Slag

Sample Sr.No.	Compressive Strength of paver block in N/mm^2
1	21.87
2	21.6
3	22
Average Value	21.82

Table 8: Compressive Strength of paver block in N/mm2 after 28 days with 20% Iron Slag

Sample Sr.No.	Compressive Strength of paver block in N/mm^2
1	20.62
2	20.65
3	20
Average Value	20.42

Table 9: Compressive Strength of paver block in N/mm2 after 28 days with 25% Iron Slag

Sample Sr.No.	Compressive Strength of paver block in N/mm^2
1	19.06
2	19.3
3	19.25
Average Value	19.20

Table 10: Compressive Strength of paver block in N/mm2 after 28 days with 30% Iron Slag

Sample Sr.No.	Compressive Strength of paver block in N/mm^2
1	15.62
2	14.83
3	15.9
Average Value	15.25

Table 11: Compressive Strength of paver block in N/mm2 after 28 days with 40% Iron Slag

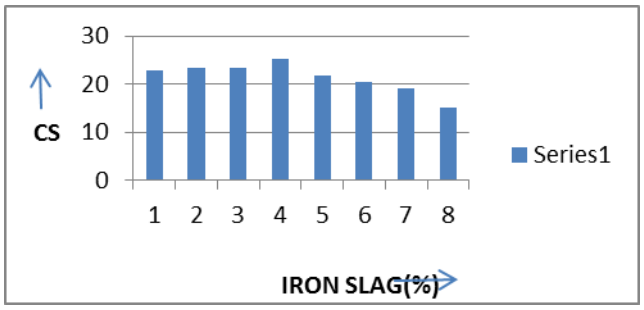

Fig. 4: Graph 4 Concrete paver block with 0% to 40 % Iron Slag in in compressive strength in N /mm

VIII. CONCLUSION

The quality and toughness attributes of concrete mixes have been processed in the present work by supplanting 0%,5%,10%,15%,20%,25%, 30% and 40%iron slag with the sand.As the praise of present study, taking after conclusions are drawn.

1) inside this Compressive Strength study of Paver Block through 0%, 5%, 10%, 15%, 20%, 25%, 30%,and40% iron slag are tested and chart shown that at 30% iron slag is incompletely replaced through OPC 43 grade give elevated strength as compared to conservative mix i.e., be 0%. Next at 30% iron slag give economic value as compare to conservative mix i.e., is 0%.
2) The Compressive Strength with Flexural Strength increase through the increase in Fly Ash contented up to 30% substitute, the values are suitable according to IS 15658:2006.
3) substitute of cement through Iron slag up to 25% by heaviness has a negligible result on the decrease of any physical and mechanical property like compressive force, flexural strength etc.
4) Present is limitation in adding of iron slag in concrete to continue the workability of material.
5) There are 10-20% reductions in cost with the addition of 25% fly ash in concrete.
6) Apply of Iron slag in Paver block can explain the disposal trouble; reduce cost with produce a greener ecological Paver Blocks used for pavement.
7) Environmental things of Iron Slag and removal problems of Iron Slag can be reduced during this research.
8) The Compressive quality tends to increment with expansion rates of iron slag in the mix.
9) The early age quality addition is higher when contrasted with later ages if 30% of fine aggregate is supplanted by iron slag.

REFERENCE

[1] International Journal of Civil and Structural Engineering Volume 1, No 4.
[2] Concrete Technology – M.S. Shetty
[3] Concrete Technology:- M. L. Gambhir
[4] R. C. Yeole "Comparison of Mix Designs of Paver Blocks using Waste Rounded Steel Aggregates and Rubber Pad"
[5] Ganesh Tapkire and Pramod Patil "Recycled plastic used in concrete paver block".

