Utilization of Recycle Aggregate in Cement Concrete Paver Blocks for Heavy Traffic

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Abstract— Concrete paver blocks are versatile, attractive, cost effective and functional, blocks for construction of pavement if paver blocks are correctly manufactured and laid then paver blocks required very less maintenance. In India as per Indian standard paver blocks can be used for roadways. Paver blocks is divided in different traffic categories by Indian standard i.e. very heavy traffic, non-traffic, Light-traffic, medium traffic and heavy-traffic. Wastes of demolished building is generally used in landfills, these waste contain waste of bricks and concrete. These demolished building wastes which is also known as recycle aggregates are increasing gradually, Many engineers are working on these wastes to make it effectively useable. One of best uses of this waste is to use it as a coarse aggregate in concrete. In this project coarse aggregate is replaced by recycle aggregate which contain wastes of concrete from demolished i.e. wastes from beam, column and slab upto 100% at an interval of 10% in M 50 concrete of paver blocks for heavy traffic. Recycle aggregate which passes from 10mm IS sieve and retained on 4.75mm IS sieve was used. For this project test like compressive strength and flexural test was performed on paver blocks and to evaluate workability of fresh concrete slump cone test was performed. The study indicated that compressive strength, flexural strength and workability of concrete is required but aggregate enough to be used as paver blocks for heavy traffic.

Key words: Compressive Strength, Flexural, Strength, Paver Blocks, Workability, Recycle Concrete Aggregate, Concrete

I. INTRODUCTION

Construction and demolitions are the approaches that work parallel. In India, the destroyed building rubble generally goes to waste in landfills. After few years building and demolition waste will be more than half of the National total waste in most nations of the world so recycling of these concrete waste materials like rubble from building demolition can provide a resolution to the current problem. Landfills are getting more and more difficult to find, are too far off from the demolition web site, or are overly high priced to defend. At the equal time assets of deliver of appropriate aggregate for making concrete are constantly getting used. The recycling of construction demolition waste substances into new buildings can provide a solution to those issues. Grinding bolstered concrete buildings can reduce the volume of land filled debris by means of more or less 80%. Whilst extent reduction itself is useful, recycling the waste creates a product that can be used for fill, bank stabilization, pavement for trails and other functions, thereby lowering in addition environmental burdens by substituting recycled aggregates for herbal aggregates. Reusing is the human movement of processing the used clothes for utilization in growing new products. Using herbal combination is developing more and more excessive with the superior improvement within the base region. In parliamentary law to reduce down using natural combination, recycled concrete mixture may be carried out because the replacement substances. Recycled concrete mixture is made from damaged down, graded inorganic debris processed from the fabrics that have been carried out in the structures and demolition particles.

Cement concrete tiles and paving blocks are precast solid products made out of cement concrete. The product is made in various configurations and dimensions viz. square, rectangular and circular blocks of various dimensions with designs for interlocking of adjacent tiles blocks. The raw substances required for manufacture of the product are Portland cement and aggregates which are to be had locally in each a part of the country programs. For this reason, the units may be installed in urban and semi-urban regions, near the marketplace. A number of face-lift is being given to roads, footpaths alongside the roadside. Concrete use paving blocks are best materials on the footpaths for easy laying, higher appearance and end. Whereas the tiles find significant use outside the large construction houses, masses of these materials also are used in flooring inside the open areas of public workplaces and industrial buildings, residential residences and also for roadways.

We all know paver block for pavement required high compressive strength and to increase the compressive strength of paver blocks various efforts have been made. In this particular study M50 paver blocks have been created of 100 mm thickness for heavy traffic with varying percentage of Recycle Aggregate (0 to 100%).

II. METHODOLOGY

For this research paver block of zig-zag shape having length 200 mm, width 120 mm and thickness 100 mm along with area 29231 mm^2. Portland pozzolana cement (fly ash based) is used in this project, which confors to specification given under IS 1489: 1991 (Part –I). General tap water which conforms specification given under IS 456. Natural crushed coarse aggregate is used along natural river sand. Locally collected demolish building concrete waste is used as recycle aggregate and water reducing admixture is used. Mix design of concrete is done by IS specification (IS 10262: 2009), grade of concrete used is M50. Mix designation of concrete mix is given in table 1. Mixing and casting is also done by IS specification, curing is done at room temperature in clean water. Workability of fresh concrete is checked and paver blocks are checked for compressive strength and flexural strength.

S. No.	Mix Name	Mix Designation	
		Natural Aggregate	Recycle Concrete Aggregate
1	CC	100%	0%
2	A1	90%	10%
3	A2	80%	20%
4	A3	70%	30%
5	A4	60%	40%
6	A5	50%	50%

7	A6	40%	60%
8	A7	30%	70%
9	A8	20%	80%
10	A9	10%	90%
11	A10	0%	100%

Table 1: Mix Designation of Concrete

III. Experiments and Results

A. *Properties of Materials*

Properties of concrete materials need to be identified for a truly perfect blend design of concrete, for this assignment numerous test is finished on materials like cement, high-quality and coarse aggregates and their cease result is given in table 2. Recycle concrete aggregate is likewise used in this project and their bodily houses is also examined in laboratory and their give up result is given in table 3.

S. No.	Property	Value	
Cement	Fineness	3.82%	
	Initial Setting Time	41 min	
	Final Setting Time	197 min	
	Specific Gravity	3.14	
	Soundness	2 mm	
	Compressive Strength	7 Days	24.56 MPa
		28 Days	37.84 MPa
Fine Aggregate	Specific Gravity	2.6	
	Bulking	30.21%	
	Water Absorption	0.92%	
	Bulk Density	1590 Kg/m^3	
	Gradation	Sieve No.	Percentage Passing
		10 mm	100
		4.75 mm	100
		2.36 mm	97.32
		1.18 mm	78.57
Coarse Aggregate	Crushing Value	14.90%	
	Impact Value	11.21%	
	Abrasion Value	12.54%	
	Specific Gravity	2.62	
	Water Absorption	0.64%	
	Bulk Density	1680 Kg/m^3	
	Flakiness and Elongation Index	11.86%	
	Gradation	Sieve No.	Percentage Passing
		40 mm	100
		20 mm	92.25
		10 mm	9.64
		4.75 mm	1.23

Table 2: Result of physical tests on materials

S. No.	Test	Recycled Aggregate
1	Water Absorption	4.52%
2	Specific gravity	2.8
3	Crushing value	22.54%
4	Impact value	18.40%
5	Fineness Modulus	2.67

Table 3: Properties of Recycle Aggregate

B. *Workability*

Table – 4 and Graph-1 and a pair of shows workability of concrete when recycle concrete mixture is changed natural combination. It has been found that recycle concrete combination decreases workability of the concrete. Slump cone take a look at is executed for workability and urban which is prepared for workability does no longer incorporate admixture. Manipulate concrete blend, that is, CC mix gives one zero five mm hunch which decreased to 92 mm when 10% of combination is replaced and it goes on reducing to fifty-four mm whilst coarse mixture is absolutely replaced by way of recycle concrete mixture.

Mix	Slump (mm)
CC	105
A1	92
A2	85
A3	80
A4	78
A5	73
A6	65
A7	64
A8	60
A9	55
A10	54

Table 4: Workability of Concrete

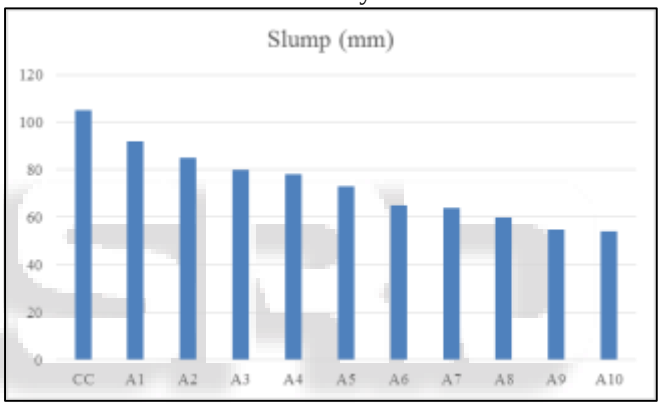

Fig. 1: Graph 1 Workability of Concrete

C. *Compressive Strength Test*

Compressive power of paver blocks is evaluated and their result is given in table 5 and graph- 2 -3. Paver blocks made of control mix possess 59.89MPa compressive strength after 28 days of curing and which offers a touch decrement goes to 47.34MPa while 10% of the aggregate combination is replaced, decrement maintains and goes all the way down to 45MPa. Eleven while natural combination is absolutely replaced. As in step with IS 15658: 2006 compressive energy of paver blocks is need to be corrected and specification says that 100 mm paver blocks need to be elevated by 1.24. Corrected compressive power of paver blocks is given in table 6 and graph 4, 5 and 6.

Mix	Compressive Strength (MPa)	
	7 Days	28 Days
CC	46.5	59.89
A1	45.1	58.34
A2	44.55	55.66
A3	43.92	55.1
A4	43.11	54.12
A5	42.85	54.12
A6	35.31	53.26
A7	34.21	51.42
A8	32.62	48.6

A9	32.45	47.92
A10	30.1	45.11

Table 5: Compressive Strength of Paver blocks

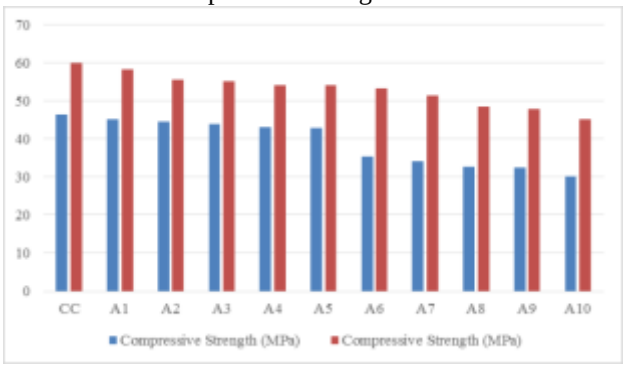

Fig. 2: Graph 2 Compressive Strength of Paver blocks (Bar Graph)

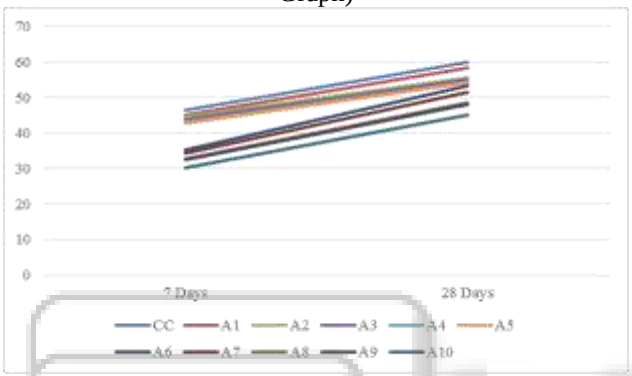

Fig. 3: Graph 3 Compressive Strength of Paver blocks (Line Graph)

Mix	Corrected Compressive Strength (MPa)	
	7 Days	28 Days
CC	57.66	74.26
A1	55.92	72.34
A2	55.24	69.02
A3	54.46	68.32
A4	53.46	67.11
A5	53.13	67.11
A6	43.78	66.04
A7	42.42	63.76
A8	40.45	60.26
A9	40.24	59.42
A10	37.32	55.94

Table 6: Corrected Compressive Strength of Paver blocks

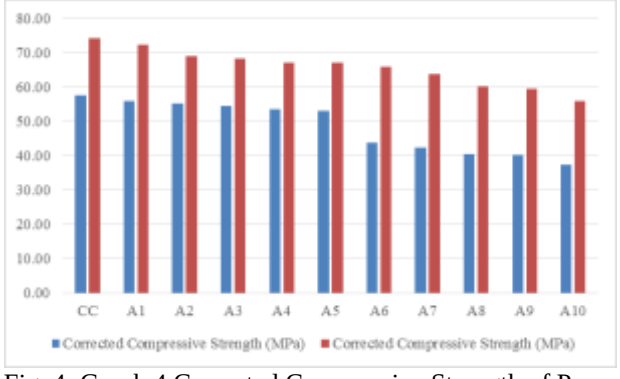

Fig. 4: Graph 4 Corrected Compressive Strength of Paver blocks (Bar Graph)

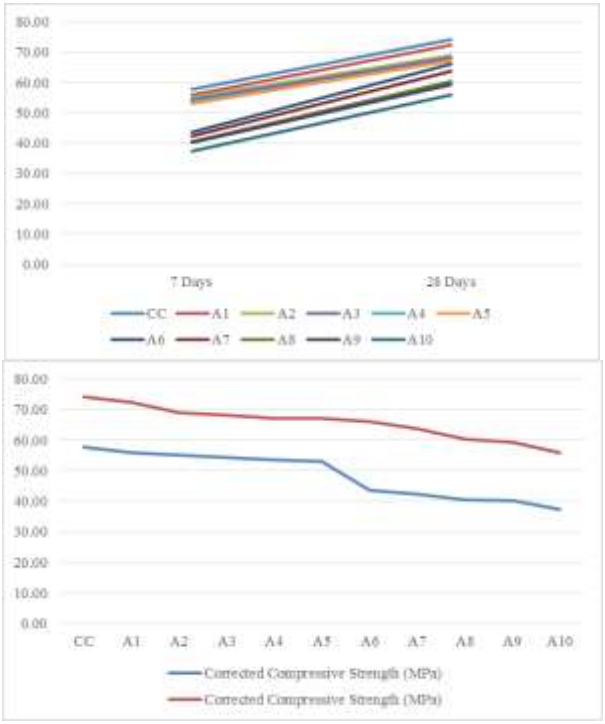

Fig. 5&6: Graph 5 & Graph 6 Corrected Compressive Strength of Paver blocks (Line Graph)

D. Flexural Strength Test

Flexural strength of paver blocks is evaluated and their result is given in table 7 and graph 7. Paver blocks made up of Control mix posses 5.57 MPa compressive strength after 28 days of curing and which gives a little decrement goes to 5.12 MPa when 10% of the natural aggregate is replaced, decrement continues and goes down to 4.70 when natural aggregate is completely replaced.

Mix	Flexural Strength (MPa)	
	7 Days	28 Days
CC	5.59	6.42
A1	5.57	6.26
A2	5.47	6.12
A3	5.43	6.24
A4	5.45	6.18
A5	5.37	6.11
A6	4.87	6.06
A7	4.80	5.88
A8	4.74	5.72
A9	4.67	5.68
A10	4.50	5.51

Table 7: Flexural Strength of Paver Blocks

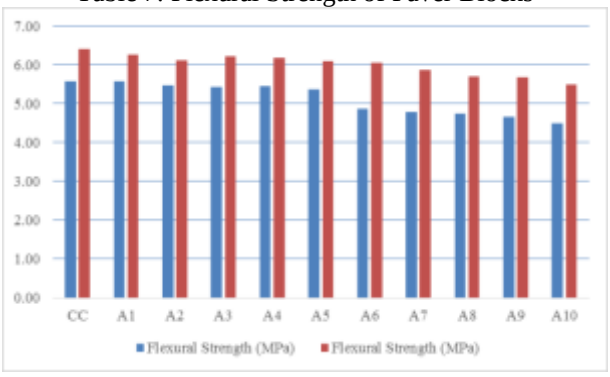

Fig. 7: Graph 7 Flexural Strength of Paver Blocks (Bar Graph)

IV. CONCLUSION

Current study is all about determination of properties of paver blocks manufactured with recycle concrete aggregate. Following conclusion is carried out from this research project

- Compressive strength of the concrete paver blocks is goes down or decreased when recycle concrete aggregate is replacing natural aggregate but from this study it has been concluded that 100% of the natural aggregate can be replaced by recycle concrete aggregates. As per IS 15658 it is clearly specified that for heavy traffic i.e. traffic of Bus stands, industrial areas, roads constructed on expansive solis, service stations, floor of factories, industrial pavements etc. give compressive strength 50 MPa of more than 50 MPa and current research clearly shows that when natural aggregate is replaced by recycle concrete aggregate in concrete of paver blocks, it clearly shows that initial 7 mix gives compressive strength more than 50 MPa but after correction (multiplication of 1.24 in compressive strength as per IS 15658) all mix gives compressive strength of more than 50 MPa, so for paver blocks of heavy traffic we can completely replace natural aggregate by coarse aggregates.
- Flexural strength of the paver blocks is also decreased when recycle concrete aggregate is replacing natural aggregates in concrete for paver blocks, as per IS 15658, it is specified that for heavy traffic i.e. traffic of Bus stands, industrial areas, roads constructed on expansive solis, floor of factories, service stations, industrial pavements etc. minimum breaking load should be 6 kN after 28 days of curing and we calculate flexural strength with 6 kN load then calculated flexural strength is 2.25 MPa and current study shows that all mixes of recycle concrete aggregate for paver blocks gives flexural strength which is more than 2.25 MPa, hence we can say that 100% recycle concrete aggregate is acceptable in concrete of paver blocks for heavy traffic.
- Recycle concrete aggregate also decreases the workability of concrete which is going to be used for manufacturing of paver blocks but for the concrete mixes of paver blocks admixture can be used to make mix workable.

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