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To Improve Mechanical Properties of Concrete Paver Blocks

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Abstract : *In India total quantum of waste from construction industry is estimated to be between 12 to14 million tonnes per annum out of which 7 to 8 tonnes are concrete and brick waste. Construction, demolition, innovation generated large amount of concrete waste. This waste is either dumped or it is delivered towards landfill. This concrete waste can be qualitatively reused for manufacturing of various concrete blocks. In this report , we represent the concept of sustainable use of concrete waste in concrete which can be used in manufacturing of interlocking paver blocks , After crushing , this concrete waste can be used as a replacement of coarse and fine aggregate in one stage as half replacement in paver block by considering is specification. In this project by considering suitable material, size, shape, mix design, etc. and by accepting Specific casting methodology and by performing various specific tests, we are going to cast interlocking paver blocks*
Keywords: *Concrete Waste, Crushing, Reusing, Paver Blocks.*

I. Introduction

Presence of C & D waste and other inert material like drain silt, dust and grit is significant. Non inert construction waste is directly put to use for land filling. Recycled aggregates are obtained by crushing of concretes from demolition of structural components in many structures such as old buildings, concrete pavements, bridges and structures at the end of their service life. C & D waste needs to be focused upon in view of (i) the potential to save natural resources (stone, river sand, soil, etc) and energy (ii) its bulk which is carried over long distances for just dumping, (iii) its occupying significant space at landfill sites. Utilization of C & D waste is quite common in industrialized countries but in India so far no organized effort has been made. The utilization of the C & D is necessary in upcoming years in growing industries.

II. Literature Survey

2.1 A.Dakwale & R. R. Ralegaonkar "Development of sustainable construction material using C & D waste". Construction and demolition waste eco bricks of size 230 mm x 90 mm x 90 mm are developed for six different compositions. Amongst the various trials carried out the brick with ratio of binder, fine aggregate and coarse aggregate as 1: 2.75: 2.25 exhibit compressive strength and water absorption within the limits of IS with minimum self-weight.

2.2 M.C. Nataraja & Lelin Das."Study on strength properties of paver blocks made from unconventional Material". In this investigation, various properties such as compressive split tensile, bending strength and water absorption of paver blocks consisting of crushed granite, unconventional materials such as Kadappa and broken paver for various percentage replacement of coarse aggregate are studied as per 1S 15658: 2006. Broken paver aggregate is not suitable in making paver blocks as water absorption is more than 7 ()%0. However, 50% replacement bf paver aggregate with natural aggregate can be used.

2.3 A.Rathode, Jayeshkumar Pitroda. "Study on recycled aggregate as substitute to natural aggregate for sustainable development in India" In this study, M65 concrete mixtures was prepared with water to binder ratio of 0.5 and recycled aggregate was used as 0%, 20%, 50% and 100% by weight replacements of natural aggregates. For each concrete mixture, 100mm cubes where casted to determine the compressive strength of concrete. The compressive strength were measured at the ages of 1, 4, 7, 28 and 90 days. Adding RCAs to concrete resulted in increased water demand,.reduction in workability and reduced strength compared to the controlled sample.

2.4 D.W. Gawatre,Rohit S. Chhajed,Nikhil Agarwal ."Manufacture Of Paver Block Using Partial Replacement Of Construction And Demolition Waste" In this study, M35 concrete mixtures was prepared with water to binder ratio of 0.36 and recycled aggregate was used as 50% by weight replacements of natural aggregates. For each concrete mixture, 80 mm thick interlocking paver blocks where casted to determine the compressive strength of concrete.The compressive strength were measured at the ages of 7,14, 28 days.After 28 days compressive strength were found to be 35.63 MPa. But average tensile split tensile strength was obtained as 1.5 MPa which was not satisfactory.

2.5 D.N Patil J. R. Pitroda. "Development of low cost paver blocks by replacing PPC with used foundry sand". Foundry sand generated from metal casting industry is replaced in different percentages like 1.0%. 20%, 30%, 40% and 50%.Compressive strength, flexural strength has been determined at the end of 7,14and 28 days and water absorption test has been determined at 28 days.Even after 50% replacement of cement, they got compressive strength 23.48 Nimm2 and water absorption is 2%.Cost optimization can be achieved when cement is replaced in different percentages by used foundry sand. At 50% replacement of cement, the cost of paver block is 20.13% lower than standard mixed proportion.

III. Methodology

3.1 Materials:

Materials which used for the making of concrete cylinders are:

1.1.1 CEMENT (AS PER IS12269:53) Cement is described as a material with adhesive and cohesive properties which make it capable of bonding Mineral fragments into a compact whole. It embraces large variety of cementing materials. For construction purposes the Meaning of the term cement is restricted to the bonding material used with stones, sand, bricks, building blocks, etc. The principal constituents of this type of cement compounds of lime, so that in building and civil engineering we are connected with calcareous cement. The cements have property of setting in under water by chemical reaction releasing heat of hydration. So called as hydraulic cement.

1.1.2 **AGGREGATE** :

A. Aggregates- Materials obtained after crushing manually and by machine was inspected and aggregate passing from 12mm and retained on 4.75 were used as coarse aggregate.

B. Grit-when crushing was done ,aggregate of various sizes were obtained .out of that,materials passing from 4.75mm and retained on 2 mm IS sieve were used as fine aggregate.

1.1.3 HARDENER: Liquidous material named SP-500 was used to avoid curing and to improve binding.

1.1.4 WATER [IS 456-2000] Is the key ingredient, which when mixed with cement, forms a paste that binds the aggregate together. The water needs to be pure in order to prevent side reactions from occurring which may weaken the concrete, the role of water is important because the water to cement ratio is the most critical factor in the production of "perfect" concrete.

3.2 TESTS ON CEMENT

3.2.1 STANDARD CONSISTENCY TEST [IS 4031-part-5(1988)] Standard consistency of cement test is defined as the standard consistency of a cement paste is defined as that consistency which will permit the vicat plunger to penetrate to a point 5 to 7mm from the bottom of the vicat mould. A) Initial and final setting time: Initial setting time duration is required to delay the process of hydration or hardening. Final setting time is the time when the paste completely loses its plasticity. It is the time taken for the cement paste or cement concrete to harden sufficiently and attain the shape of the mould in which it is cast. Result:

Standard consistency of cement we get = 36%

Initial setting time of cement = 32 minutes

Final setting time of cement = 10 hrs

3.2.2 TESTS ON AGGREGATE

Test performed on Aggregate as per IS 2386-1963

SR NO	Test Performed	Results of site aggregate	Results of debries aggregate
1	Water Absorption Test	3%	8%
2	Aggregate Impact Value	24.69%	50.79%
3	Specific gravity of Fine Aggregate	`2.7	2.33
4	Aggregate Crushing Value	-	13.25%

3.3 CONCRETE MIX DESIGN [IS 15658(2006)] –

Recommended grades of paver blocks to be used for construction of pavements having different traffic categories are given in IS 15658-2006 Since zero slump concrete is used in production of paver blocks, the quality of blocks produced will depend upon various parameters like the capacity of compaction and vibration of machine, grade of cement used, water content, quality of aggregates used, their gradation and mix design adopted, additives used, handling equipment employed, curing methods adopted, level of supervision, workmanship and quality control achieved, etc.

1: 1.93: 1.83

3.4 CASTING AND TESTING:

Fig. Casting of Blocks

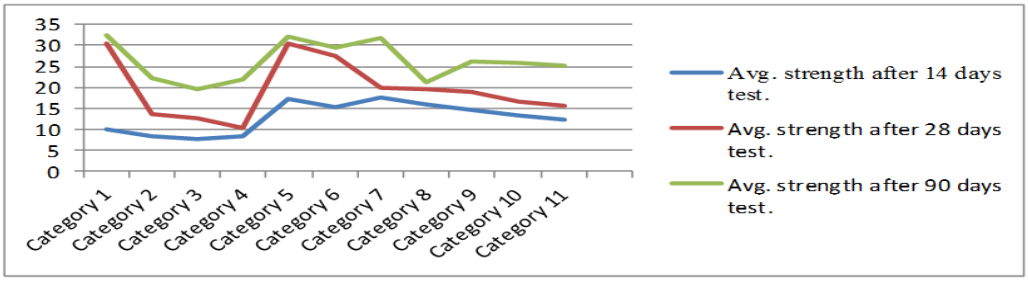
Fig. Testing of Blocks

Testing Result

Compression Test Result:

Serial no	% of replacement of debries	Compressive strength 14 day	Average Compressive strength 14 days	Compressive strength 28 days	Average Compressive strength 28 days	Compressive strength 90 days	Average Compressive strength 90 days
1	0	10.5	10.0	32.0	30.33	32.5	32.5
		9.5		30.0		31.0	
		10.0		29.0		34.0	
2	10	8.00	8.5	12.5	13.5	24.0	22.33
		9.0		13.0		20.0	
		8.5		15.0		23.0	
3	20	7.5	7.66	12.5	12.66	17.5	19.66
		7.5		13.0		22.0	
		8.0		12.5		19.5	
4	30	8.5	8.5	10.5	10.5	22.5	22.0
		9.0		11.0		21.5	
		8.0		10.0		22.0	
5	40	16.5	17.36	30.0	30.33	33.0	32.0
		17.6		29.0		32.0	
		18.0		32.0		31.0	
6	50	15.0	15.33	28.0	27.67	29.5	29.5

		16.0		27.0		29.0	
		15.0		28.0		30.0	
7	60	18.0	17.53	22.0	20.0	30.0	31.83
		17.6		20.0		32.5	
		17.0		21.0		33.0	
8	70	16.0	15.83	19.5	19.5	21.0	21.16
		15.5		20.0		22.0	
		16.0		19.0		20.5	
9	80	14.5	14.66	20.0	19.0	25.5	26.33
		15.0		19.0		27.0	
		14.5		18.0		26.5	
10	90	14.0	13.33	16.0	16.5	26.5	26.0
		13.0		17.0		25.5	
		13.0		16.5		26.0	
11	100	12.0	12.0	16.0	15.5	27.0	26.33
		11.5		15.0		26.5	
		12.5		15.5		25.5	



Water absorbion test & Flexure Strength Test-

Sr.no	% of replacement of debries	Sample no	Water absorption %	Average Water absorption %	Flexure strength (N/mm^2)	Average flexure strength (N/mm^2)
1	0	1	3.37	2.97	4.68	3.96
		2	2.94		3.25	
		3	3.61		3.96	
2	10	1	5.86	4.29	2.09	1.91
		2	4.27		1.59	
		3	2.74		2.07	
3	20	1	4.28	4.46	2.01	2.26
		2	5.61		2.40	
		3	3.50		2.38	
4	30	1	3.68	3.02	1.93	2.16
		2	3.23		2.0	
		3	2.7		2.56	
5	40	1	3.36	3.77	4.68	4.50
		2	4.43		4.12	
		3	5.54		4.71	
6	50	1	3.43	5.56	4.53	4.57
		2	3.66		4.68	
		3	4.59		4.50	
7	60	1	4.34	3.99	4.37	4.34
		2	3.42		4.34	
		3	4.24		4.32	
8	70	1	3.93	3.80	4.20	4.29
		2	3.91		4.31	
		3	3.58		4.37	
9	80	1	2.39	4.75	3.94	3.84
		2	5.60		3.65	
		3	6.27		3.96	
10	90	1	7.78	8.39	3.87	3.29
		2	7.79		3.65	
		3	9.62		3.87	
11	100	1	9.97	9.33	3.71	3.54
		2	8.18		3.50	
		3	9.84		3.43	

Abrasion resistance test.

Sr.no	% of replacement of debries	Initial density	Final density	Difference	Average
1	0	186.28	176.28	10	7.87
		186.31	185.64	0.64	
		203.87	190.88	12.99	
2	10	165.55	160.35	5.2	2.57
		180.18	177.84	2.34	
		172.51	172.51	0.17	
3	20	222.0	218.1	3.69	2.99
		212.21	209.37	2.84	
		226.19	223.95	2.24	
4	30	168.63	165.66	2.94	2.54
		171.70	168.23	3.47	
		175.90	175.0	0.92	
5	40	183.54	181.77	1.77	2.33
		189.47	186.18	3.29	
		190.19	188.85	1.34	
6	50	143.61	143.26	0.35	5.59
		154.20	145.69	8.51	
		147.87	139.96	7.91	
7	60	194.97	189.94	4.53	7.06
		195.79	183.03	12.76	
		203.04	199.14	3.9	
8	70	195.82	190.57	5.25	7.46
		202.59	194.77	7.82	
		193.51	184.19	9.37	
9	80	158.48	146.30	12.18	12.42
		149.23	137.68	11.55	
		161.66	148.66	13.0	
10	90	186.66	180.07	6.49	8.68
		178.71	169.15	9.56	
		192.0	181.99	10.1	
11	100	162.93	156.67	6.26	6.49
		159.21	150.09	9.12	
		241.27	237.18	4.09	

IV. Conclusion

1 Impact value and crushing value obtained for aggregates obtained from concrete waste were 14.6% and 13.25% which are way better than requirements as per IS recommendations.

2 Maximum compression strength of interlocking paver blocks obtained was 30.33MPa after 28 days with 40% debries.

3 Maximum flexure strength of interlocking paver blocks obtained was 4.57MPa after 28 days with 50% debries.

4 Minimum water absorption of interlocking paver blocks obtained was 3.02% after 28 days with 40% derbies.

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