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A PATH FOR HORIZING YOUR INNOVATIVE WORK

MANUFACTURE OF PAVER BLOCK USING PARTIAL REPLACEMENT OF CONSTRUCTION AND DEMOLITION CONCRETE WASTE

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Abstract: In India, total quantum of waste from construction industry is estimated to be between 12 to 14 million tonnes per annum, out of which 7 to 8 million tonnes are concrete and brick waste(7). Construction, demolition, renovation generates large amount of concrete waste. This waste is either dumped or it is diverted towards landfill. This concrete waste can be qualitatively reused for manufacturing of various concrete blocks. In this paper, we present the concept of sustainable use of concrete waste in concrete which can be reused in manufacturing of interlocking paver blocks. After crushing, this concrete waste can be used as a replacement of coarse and fine aggregates as partial (50%) replacement in top and bottom layer of paver blocks by considering IS specification. In this project, by considering suitable materials, size, shape, mix design etc. and by accepting specific casting methodology, we have casted interlocking paver blocks and performed various specific tests as per I.S recommendations.

Keywords: Concrete Waste, Crushing, Interlocking Paver Blocks, Compression strength, Flexural strength, Split tensile strength

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INTRODUCTION

Recycled coarse buildings, bridges, concrete pavements etc. aggregates are obtained by crushing of Concrete paving block is versatile, concrete waste from demolition of structural aesthetically attractive, functional and cost components in many structures such as old effective and requires little or no maintenance if correctly manufactured and laid. Paver block are solid, unreinforced precast cement concrete paving units used in the surface course of pavements.(6) Interlocking concrete paving block technology has been introduced in India in construction, a decade ago, for specific requirement like footpaths, parking areas, gardens, etc.

We all know that the basic requirement of paver blocks is high compressive strength and low water absorption, so in order to achieve the same conventional results we have replaced the course aggregate and fine aggregate partially (50%) in top and bottom layer because of environmental considerations and growing trend in reusing waste products.

Basic tests on cement were performed. Coarse aggregates in bottom layer are replaced by crushed concrete waste in proper proportion. To increase compressive strength in paver block the effective use of angular shape aggregates are used for interlocking. Fine aggregate is also replaced by sieve analysis of crushed concrete waste which is passing from 4.75 mm and retain on 600 micron sieve.(1)

2. MATERIALS USED: –

1. Cement- Ordinary Portland Cement 53 grade cement which is available in local market by confirming to IS 8112:2009.(9)

2. Grit- Material passing from 4.75mm and retaining on 2mm IS sieve.

3. Aggregates- Materials passing from 12mm and retaining on 4.75mm.

4. Crush Sand- Material passing from 2mm IS sieve.

5. Hardener- Liquidous material used to avoid curing and to improve binding.

6. Water- Free from deleterious matter and shall fulfil the requirement as per IS 456:2000.(11)

2.1. Test on materials-

a) Cement: Tests performed on Cement.

Table No. 1: Test results of cement.

Sr. No.	Test performed	Results
1.	Fineness of Cement	2.86 %
2.	Standard Consistency of Cement	26 %
3.	Initial setting Time	32 minutes.
4.	Final setting time.	600 minutes.

b) Aggregates:

Table No. 2: Test results of aggregates.

Sr. No.	Test performed	Results
1.	Specific gravity of coarse aggregate.	2.13
2.	Water Absorption Test	5.21 %
3.	Impact value test.	14.6 %
4.	Aggregate crushing Test	13.25 %
5.	Specific gravity of Fine aggregate.	2.63

3. TEST ON PAVER BLOCK (7)

1. Compressive strength test- This strength of paver blocks are determined in accordance to IS 15658:2006. As per IRC:SP:63:2004 minimum compression strength of a single block should be above 30MPa.
2. Flexural strength test- This strength can be expressed in terms of flexural stress or in the form of breaking load specified by IS 15658:2006. For a single block it should be above 4.5MPa.
3. Split tensile strength test- This strength is determined by testing according to IS 15658:2006. None of the individual results shall be less than 2.9MPa.

4. METHODOLOGY:

4.1 Mix Proportion (11)

Mix proportion for M35 grade of concrete was made by using IS 10262:2009 from results obtained for specific gravity of coarse and fine aggregates, water to cement ratio of 0.36, calculations for volume of various materials was made and final proportion of concrete mix design was obtained as 1:2.45:1.685.

4.2 Casting of interlocking paver blocks-

Paver blocks of suitable dimensions like thickness of 80mm and plan area 30039mm2 and by designed concrete mix proportion, using rubber moulds are casted. For proper mixing and compacting, table vibrator was used. Concrete paver block contains cement, coarse and fine aggregate in bottom layer and in the top layer a mixture of cement, crush sand and grit (4.75mm pass & 2mm retain). In this project, partial (50%)

3 Replacement of coarse and fine aggregates by aggregates obtained from crushed concrete waste was made.

For compression strength, test was conducted after 14 days and 28 days on the set of four and eight blocks respectively as per IS(15658:2006). Similarly for water absorption, test on 4 blocks was performed.(7)

For tensile splitting and flexural strength, each of 8 blocks were casted and tests were conducted.

5. TEST RESULTS

1] Compression strength test. (28 Days):

Table No. 3: Results of compression

Sr. No.	Weight (Kg)	Load (KN)	Comp. Strength (N/mm^2)	Average (N/mm^2)	
1	5.691	945.5	37.14	35.63	
2	5.830	893.9	35.11		
3	5.870	907.3	35.64		
4	5.747	893.0	35.08		
5.	5.762	897.7	35.33		

6.	5.865	903.9	35.47		
7.	5.730	917.8	36.08		
8.	5.713	895.78	35.16		

2. Split tensile strength test, (28 Days)

Table No.4: Results of split tensile strength test

Sr. No.	Failure Load (N)	Mean Failure Length (mm)	Mean Failure Thickness (mm)	Splitting Tensile Strength (N/mm^2)	Average (N/mm^2)	
1	48500	250	80	1.817		
2	45900	245	82	1.717		
3	35400	247	83	1.297		
4	36800	250	81	1.15		
5	52100	252	82	1.89	1.5	
6	56500	252	83	2.03		
7	26200	251	83	0.94		
8	30200	250	81	1.12		

3. Flexural strength test. (28 Days)

Table No. 5: Results of flexural strength test.

Sr. No.	Thickness (mm)	Breaking Load (kN)	Flexural Strength (N/mm^2)	Average (N/mm^2)	
1	80	8.880	3.7		
2	80	6.420	2.7		
3	80	8.280	3.4		
4	80	9.300	3.8	3.4	
5	80	8.400	3.4		
6	80	6.720	2.8		
7	80	8.700	3.5		
8	80	8.940	3.7		

6. ADVANTAGES:-

1. Sustainable use of construction concrete waste.
2. Avoiding dumping problems of concrete waste.
3. Results obtained are comparatively similar to standard blocks as studied in various research papers.
4. Use of paver blocks gives good aesthetic view.
5. Economy can be achieved for large scale use.

7. DISADVANTAGES:-

1. Transportation cost of concrete waste will be more if site is at far distance.
2. Heavy machinery is required for proper crushing of concrete waste.
3. There is no standard mix design, hence require proper proportion of ingredients.

8. CONCLUSIONS:-

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. Average characteristic compression strength of interlocking paver blocks obtained was 35.63MPa which is more than design standards for M35.
3. Minimum breaking load for a single sample out of eight samples was 6.420KN, which is still more than that required for Regularly Trafficked Roads.
4. Average tensile splitting strength was obtained as 1.5MPa which is not satisfactory.
5. Finally we can conclude that the paver blocks prepared using M35 grade of concrete and 50% replacement of aggregates can be used for pedestrian plazas, car parks, office complexes, rural roads with low volume traffic, residential roads, housing colonies,etc.

9. FUTURE SCOPE:-

Construction and demolition waste issue remains unaddressed in the light of growing construction activities. Proper collection and disposal methods are not applied in the practical world because of which such waste finds its way to illegal road side and empty dumping site.

In a view of above, we appeal to all municipal authorities of big cities in India to establish such plants where C & D waste of city can be gathered, sorted and by ensuring the technical and economical feasibility of the material, various products like paver's blocks, tiles, kerb stones, divider blocks, etc can be manufactured and used for public work.

Municipal Corporation of Pune has already started planning of such type of plant.

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