EXPERIMENTAL INVESTIGATION ON EFFECT OF DEMOLISHED AGGREGATE IN PAVING BLOCK

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ABSTRACT-In India, total quantum of waste from construction industry is estimated to be between12 to 14 million tons per annum, out of which 7 to 8 million tones are concrete and brick waste. 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 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 aggregates in two stages as complete and half replacement in paver blocks by considering IS specification. In this project, by considering suitable materials, 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. From present study concluded that the The partially replaced demolished aggregate in paving block gives higher strength.

KEYWORDS*:*Paver Block, Sustainable, demolished aggregate.

1. INTRODUCTION

In India there is large amount of use of concrete which is made from natural material like river sand, course aggregate from demolition of mountains by stone crusher and artificial material like cement. Indian buildings in 2013 have generated more than 626 million tonnes of solid waste which is 52 times more than official estimate. A great part of this waste is being used illegally for dumping and filling up urban water bodies. From the large amount of solid waste generated from various industries, construction and demolition waste contributes in large amount.

Construction and demolition waste is the waste which is generated from various activities like residential construction work, road work, renovation work, demolition, etc.

Construction and Demolition Waste:

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.

Steps to make reuse from C & D waste:

- C & D waste canbe recycled and reused in construction and minimize environmental degradation and pressure on land. Small steps in Delhi have been taken to reuse the recycled aggregates in RMC, pavement blocks, kerb stones and concrete bricks.
- Processed C & D waste can be used for road and embankment construction.
- Finer grade can be moulded into blocks and slabs with appropriate binder.

Paver Block

Concrete paver block were first introduced in Holland in the fifties as replacement of paver bricks. These blocks were rectangular in shape and had more or less the same size as the bricks. During past five decades, the block shape has steadily evolved from non-interlocking to partially interlocking to fully interlocking to multiply interlocking shapes.

Interlocking concrete block pavement (ICBP) consists of a surface layer of small element, solid unreinforced precast concrete paver blocks laid on a thin, compacted bedding material which is constructed over properly profile base coarse. Concrete paving block is versatile, aesthetically attractive, functional and cost effective and requires little or no maintenance if correctly manufactured and laid Interlocking concrete paving block technology has been introduced in India in construction, a decade ago, for specific requirement like footpaths, parking areas, gardens, etc.

Fig No 1:Concrete Paver Block

A properly design ICBP gives excellent performance when applied at location where conventional systems have lower service life due to number of geological, traffic, environmental and operational constraints. Many number of such applications for light, medium, heavy and very heavy traffic conditions are currently in practice around the world.

2. Methodology

In this project, we have presented the concept of sustainable use of concrete waste in concrete which can be reused in manufacturing of interlocking paver blocks. Manufacture of paver blocks is made in two layers, one is top layer having specified thickness and another is bottom layer. In our project, we have decided the thickness of paver block as 75mm having 10mm top layer thickness and 65mm bottom layer thickness. Shape of paver blocks plays an important role in interlocking, so paver block of zigzag shape is manufactured in our project.

Concrete waste was collected from the nearby demolished site and was crushed through machinery and manually.After crushing of the concrete waste which was collected, aggregates obtained were used as a replacement of coarse and fine aggregates as partial (50%) and completelyreplacement in top and bottom layer of paver blocks by considering IS specification. Selected grade of concrete for paver block casting was M-30.

Recommended grades of paver block to be used for construction of pavements having different traffic categories are given in table below.

Table No 1: Recommended grades of paver blocks for different categories (IS 15658-2006)

Sr. No	Grade designation of paver blocks	Specified compressive strength of paver blocks of 28 days (N / mm^2)	Traffic Category	Recommended Minimum paver block thickness (mm)	Traffic examples of application
1	M-30	30	Non-traffic	50	Building promises, landscapes, public gardens, domestic drives, embankment slopes, monument premises, etc.
2	M-35	35	Light-traffic	60	Pedestrian plazas, shopping complexes ramps, car parks, housing colonies, rural roads, farm houses, residential roads, etc.
3	M-40	40	Medium-traffic	80	City streets, small and medium market roads, low volume 4roads, u5tility cuts on arterial roads, etc.
4	M-50	50	Heavy-traffic	100	Bus terminals, industrial complexes, mandi houses, roads on expansive soils, factory floor, service stations, industrial pavements, etc.
5	M-55	55	Very heavy-traffic	120	Container terminals, ports, dock yards, mine access roads, bulk cargo handling areas, airport pavements.

3. Material Used:

Materials used in making paver block are as bellow:

i. CEMENT:

Ordinary Portland Cement 53 grade cement which is available in local market by confirming to IS 12269: 2013.

Test performs on cement:

a) Consistency: Testing was done as per IS code 12269- 2013. This test was done by Vicat's apparatus as per IS code 5513 - 1976.

b) Initial Setting Time: This Testing was done as per IS code 12269- 201.

c) Final setting time: This Testing was done as per IS code 12269- 2013.

d) Fineness of cement: This Testing was done as per IS code 4031 - 1988{Part -I}.

Table No 2: Test Results of Cement.

Sr. No.	Test performed	Results
1.	Fineness of cement.	5 %
2.	Standard consistency of cement.	36 %
3.	Initial setting time.	32 minutes.
4.	Final setting time.	600 minutes.

ii. 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.

Test performed on Aggregate as per IS 2386-1963.

a) **Specific gravity of aggregate**-IS code 2386 (part III)-1963
b) **Water Absorption test**-Test Done As Per IS Code 2386 (Part III)-1963
c) **Aggregate Impact Value Test-** IS code 2386 (part IV)-1963
d) **Aggregate Crushing Test**- IS code 2386 (part IV)-1963

Table No 3: Test Result on Aggregate.

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	`3.2	2.33
4	Aggregate Crushing Value	-	13.25%

iii. Crush sand:

When crushed through machine, lot of powder form was obtained which included all mix ingredients from concrete waste material passing from 2mm IS sieve was taken as crush sand.

iv. Hardener:

Liquidous material named SP-500 was used as suggestedby the plant in-charges which is used to avoid curing and to improve binding.

v. Water:

Potable water was used in this studyshould be free from deleterious matter and shall fulfil the requirement as per IS 456:2000.

vi. Admixtures:

a) Hardener:

Liquidous material called as laquor was used to avoid curing and to improve binding.

CONCRETE MIX DESIGN:

The mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete certain minimum strength and durability as economically as possible. For proportioning in connection with a concrete mix, four factors are important, namely (a) Water/Cement ratio, (b) Cement Content, (c) Gradation of aggregates and (d) Consistency. Our effort is to maintain the water cement ratio to get the good strength by controlling the proportion of grade or mix design. Any change in proportion amount or human error will create unbalance in mix design and it will effect on water content and the cost of paver block.

FINAL MIX PROPERTION

Cement : 427.77 kg
Water : 154 kg
Fine aggregate : 1158.72 kg
Coarse aggregate : 1113.28 kg
Water-cement ratio : 0.36

1: 2.71: 2.60

4. RESULTS AND DISCUSSIONS

i. Compression Strength Test

The compression strength of paving block has been checked as mentioned in IS 15658-2006specification.

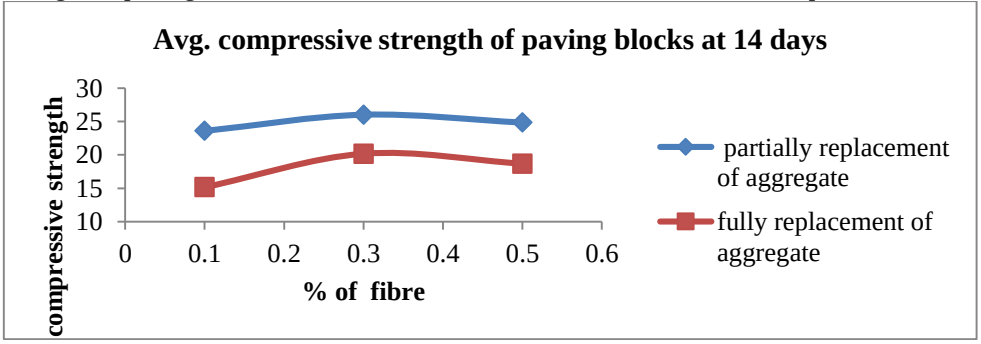

Fig No 2: Average Compressive strength of paving blocks at 14 days.

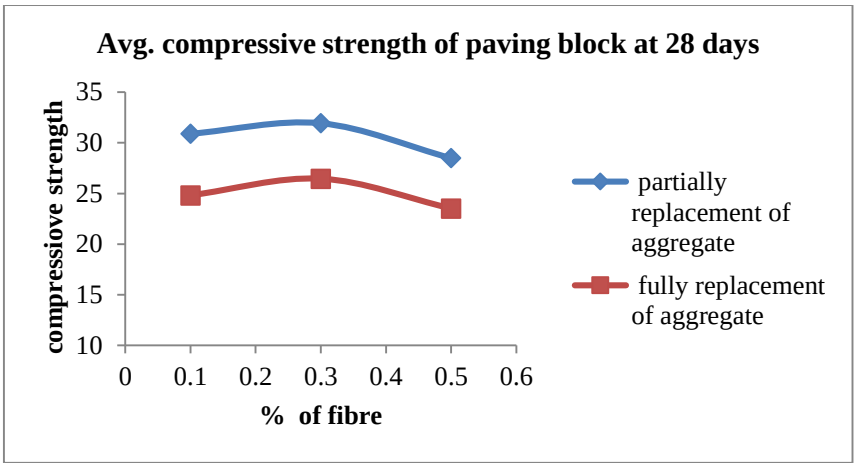

Fig No 3: Average Compressive strength of paving blocks at 28 days.

The Average Compressive strength of paving block at 28 days is 22.67% & 31.20% higher than avg. Compressive strength of paving block at 14 days of partially and fully replaced aggregate respectively.

ii. Flexure Strength Test:

Flexural Strength test of paving block has been conducted as per IS 15658-2006specification.

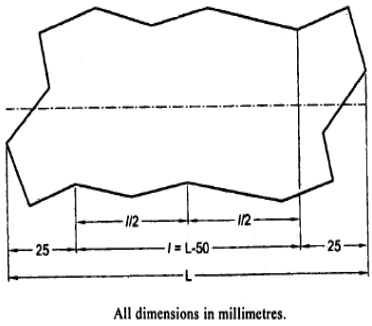

Fig No 4: loading of common irregular shapes of paving block for flexural strength/breaking Load test

Fig No 5: longitudinal view of loading test specimen for flexural strength

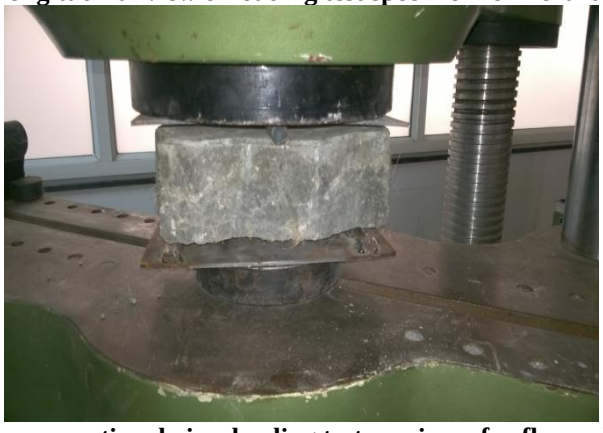

Fig No 6: cross sectional view loading test specimen for flexural strength

Fig No 7: failure of specimen during Flexure Strength Test

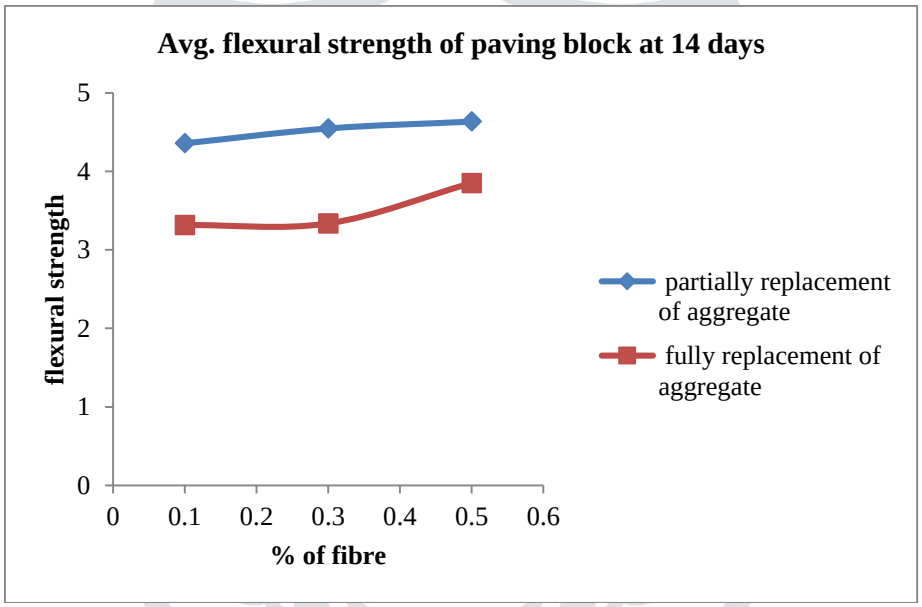

Fig No 8: Average Flexural Strength of paving blocks at 14 days.

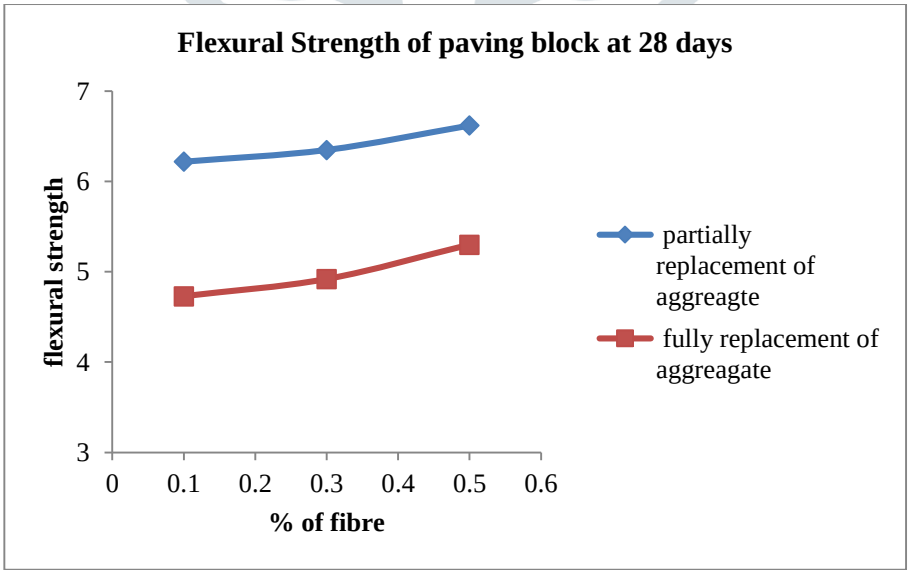

Fig No 9: Average Flexural Strength of paving blocks at 28 days.

From Figs its clearly shows that flexural strength of paving block of partially replaced has good result as compare to fully replaced demolished aggregate.

iii. SPLIT TENSILE STRENGTH TEST:

Fig No 10:Split tensile Strength Test Setup

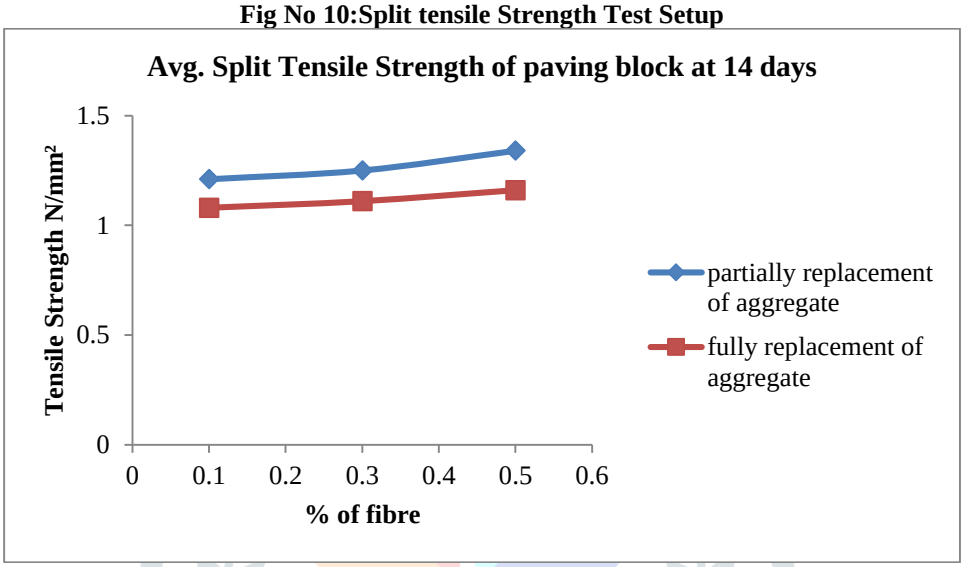

Fig No 11: Average Tensile Strength of paving blocks at 14 days.

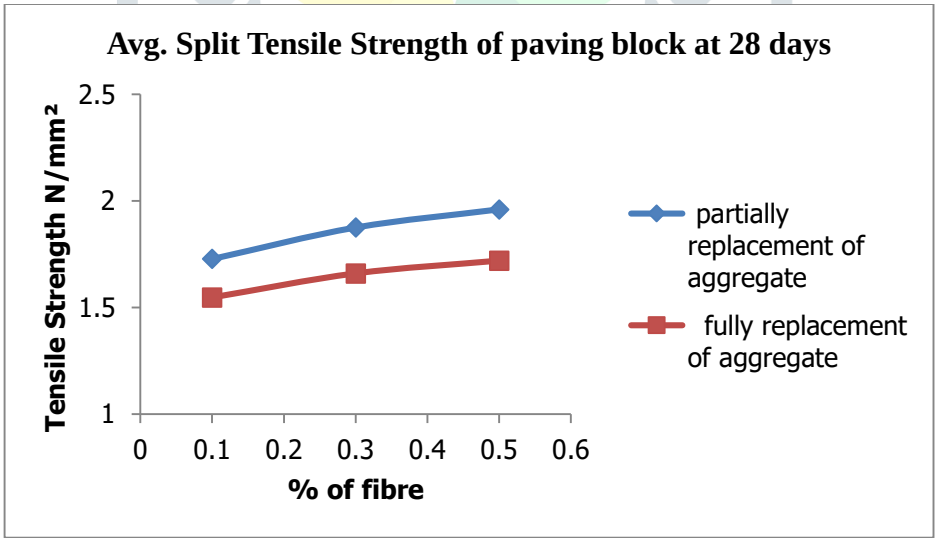

Fig No 12: Average Tensile Strength of paving blocks at 28 days.

From fig shows the paving block of partially replaced demolished aggregate has higher value of Average split tensile strength over fully replaced demolished aggregate.

The Average Spilt tensile strength of paving block of partially replaced demolished aggregate 14 and 28 days are 15.51% and 14% higher than fully replaced demolished aggregate respectively.

5. CONCLUSION

In present investigation an attempt has been made to study the effect of demolished aggregate in paving block. The conclusion drawn from Experimental investigation presented in this chapter.

- Partially replaced demolished aggregate paving block has higher compressive strength as comparing to fully replace demolished paving block at both 14& 28 days.

- The flexural and spilt tensile strength of partially replaced aggregate paving blockshows good results over fully replaceddemolished aggregate.
- Demolished aggregate do not carry much loads after once used in Construction.

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