Manufacturing of Paver Block by Partially Replacement of Aggregates with Plastic

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MANUFACTURING OF PAVER BLOCK BY PARTIALLY REPLACEMENT OF AGGREGATES WITH PLASTIC

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ABSTRACT*:** The aim of this project is to partially replace ***fine aggregate and coarse sggregate with non-recyclable plastic waste (polythene bags, less than 40 microns) in paver blocks and to reduce the cost of paver blocks when compared to that of conventional concrete paver blocks. At present nearly 56 lakh tonnes of plastic waste is produced in India per year. The degradation rate of plastic waste is also a very slow process. Hence the project is helpful in reducing plastic waste as well as reusing it to make objects for efficient and optimum utility. In this project we have used plastic waste in different proportions with ***fine aggregate and Coarse aggregate*** .The paver blocks were prepared and tested and the results were discussed. In many developing countries low-density polyethylene (LDPE) sheets, bags and water sachets are a major waste problem because local collection and recycling systems do not exist. As a result, LDPE has no value and is dumped causing aesthetic, environmental and public health issues. The application of this technology is an example of a community-driven waste management initiative that has potential to impact on the global plastics waste crisis because it can transform waste LDPE and other readily available types of plastics into a valuable local resource.
Unko

***Keywords*: LDPE (Low density polythene), paver blocks, optimum utility, waste management.**

INTRODUCTION:

Paver block paving is versatile, aesthetically attractive, functional, and cost effective and requires little or no maintenance if correctly manufactured and laid. Most concrete block paving constructed in India also has performed satisfactorily but two main areas of concern are occasional failure due to excessive surface wear, and variability in the strength of block. Natural resources are depleting worldwide at the same time the generated wastes from the industry and residential area are increasing substantially. Sustainable development for construction involves the use of Unconventional and innovative materials, and recycling of waste materials in order to compensate for the lack of natural resources and to find alternative ways of conserving the environment. Plastic waste used in this work was brought from the surrounding areas. Currently about 56 lakh tonnes of plastic waste dumped in India in a year. The dumped waste pollutes the surrounding environment. As a result it affects both human beings and animals in direct and indirect ways. Hence it is necessary to dispose of plastic waste properly as per the regulations provided by our government. The replacement of plastic waste for cement provides potential environmental as well as economic benefits.

[1]

MATERIALS:

Aggregate

Various properties of aggregates can influence the perfor-
mance of concrete; therefore various considerations have
to be kept in mind while selecting the material. Aggregates
used in present study, were tested for their specifc gravity
and other properties and results have been tabulated.

Cement

Ordinary Portland cement of 43 – grade was used as it
satisfied the requirements of IS: 8112 and results have been tabulated

Mixing and Curing Water

IS: 456 – 2000 (Cl. 2.20) water, used for mixing and cur-
ing of concrete. Permissible limits for solids in water are as per IS: 456 – 2009. The maximum permissible limit of
Chloride content in water for RCC work has been reduced
from 1000mg per litre in IS: 456 – 1978 to 500mg per
litre in IS: 456 – 2000. In addition to these requirements
acidity and alkalinity for water has to be considered.

Plastic

Plastics that cannot be degraded further is been Powdered into fine particles. These plastics con-sits mainly of Low Density Polyethylene (LDPE).

Note
The above material i.e. cement sand and aggregate is brought from the store
Heeco Store

Cement supplier in Mumbai, Maharashtra
Shop No. 12, Harbour Crest, R Naik Rd, below Kokan Bank, Mazgaon, Thakkar Estate, Byculla, Mumbai, Maharashtra 400010.

TESTING OF MATERIAL

A. Testing of cement

Field observation of cement
1 Cement colour. - Grey
2 Presence if lumps. - free from hard lumps
3 smoothens test. - smooth feeling when rubbed
4 Temperature - cool
5 Water sinking test - float for few time before sinking
6. Finess test - 95.10%
7. Compressive strength - for M20 it is found that 39.98 MPa and 44.87 MPa

B. Testing of Coarse aggregates

1.Water absorption test

According to the IS : 1124 (1974) standard for test for determination of water absorption

Water absorption for coarse aggregate =[(A-B)/B]×100
Where,
A= weight of saturated surface dry sample taken = 896 g
B= weight of oven dried sample. = 893 g

Water absorption for coarse aggregate = [(A-B)/B]×100
= [(896-893)/893]×100
= 0.3%

2. Crushing test

Aggregate crushing test as per IS : 2386. Part (iv)

The aggregate crushing value = (B/A)×100

Where,
A= weight of oven dreid aggregate passing 12.5 mm IS sieve and retained on 10mm IS sieve
B= weight of aggregate after compressed and sieved on 2.36 mm Is sieve.

Sr. No.	Sample no.	I	II	III
1.	Weight of oven dried sample (A) in gms	3095	3085	3150
2.	Weight of fraction passing 2.36 mm (B) sieve in gms	586	582	570
3.	Aggregate crushing value	18.93	18.86	18.09
4.	Average crushing value	(18.93+18.86+18.09)/3 = 18.62%		

Note:
The aggregate crushing value for cement concrete pavement shall not exceed 30%. The aggregate crushing value for wearing surfaces shall not exceed 45%.

3. Impact value

Aggregate impact test as per IS: 2386 (Part IV) – 1963

The aggregate impact value = (B/A)×100
Where,
A= weight of oven dreid aggregate passing 12.5 mm IS sieve and retained on 10mm IS sieve
B= weight of aggregate after crushing and sieved on 2.36 mm Is sieve.

Sr. No.	Sample no.	I	II	III
1.	Weight of oven dried sample (A) in gms	3095	3085	3150
2.	Weight of fraction passing 2.36 mm (B) sieve in gms	637	613	594
3.	Aggregate impact value	20.58	19.87	18.85
4.	Average impact value	(20.58+19.87+18.85)/3 = 19.76%		

Note:
Impact value <20% Exceptionally Strong.

4. Sieve analysis of coarse aggregate

Fineness modulus of Coarse aggregate (2000 gm)				
Sr	Siev	Weight	%wt ret in	Cumul

. N o.	e size in mm	retaine d In gm	gm= (wt ret/T. wt)×100	ative% of wt ret in gm
1.	40	40	2	2
2.	20	820	41	43
3.	10	440	22	65
4.	4.75	400	20	85
5.	2.36	200	10	95
6.	1.18	40	2	97
7.	0.60	00	00	97
8.	0.30	40	2	99
9.	0.15	20	1	100
10.	T. wt	2000		683

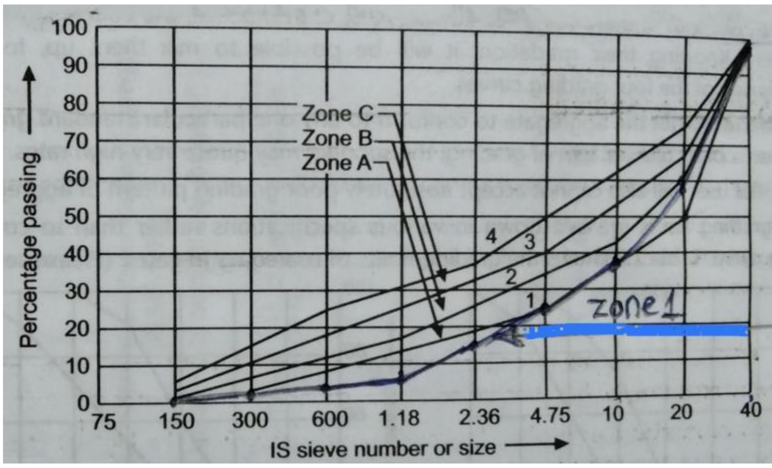
Therefore,
Fineness modulus = 683/100
= 6.83

Note :
FMof coarse aggregates smaller than 38.1 mm range from 6.75 to 8.00.

5. Grading of coarse aggregate

As per I.S. 383-1970 for the grading of coarse aggregate.
The aggregate falls in zone I
Here,
Percentage passing = 100 - cumulative weight retained in gm
Therefore,

Sieve size In mm	**40**	**20**	**10**	**4.75**	**2.36**	**1.18**	**0.60**	**0.30**	**0.15**
Cum wt ret in gm	**2**	**43**	**65**	**85**	**95**	**97**	**97**	**99**	**100**
% passing	**98**	**57**	**35**	**15**	**5**	**3**	**3**	**1**	**0**



Grading curves for coarse aggregate

3. Testing of fine aggregate

1. Sieve analysis for fine aggregate

Fineness modulus of fine aggregate (500 gm)				
Sr. No.	**Sr. No.**	**Weight retained In gm**	**%wt ret in gm= (wt ret/T. wt)×100**	**Cumulative% of wt ret in gm**
1.	4.75	10	2	2
2.	2.36	40	8	10
3.	1.18	90	18	28
4.	0.60	110	22	50
5.	0.30	140	28	78
6.	0.15	70	14	92
7.	> 0.15	40	-	-
8.	T. wt	500	-	260

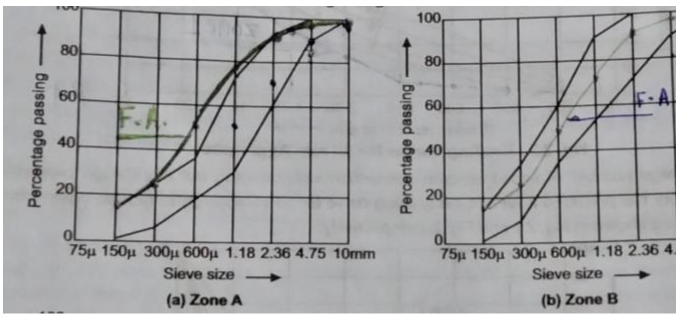
Therefore,
Fineness modulus = 260/100
= 2.60

Note :
Fine aggregates range from a FM of 2.00 to 4.00

2. Grading of fine aggregate

As per I.S. 383-1970 for the grading of coarse aggregate.
The aggregate falls in zone I
Here,
Percentage passing = 100 - cumulative weight retained in gm
Therefore,

Sieve size In mm	**4.75**	**2.36**	**1.18**	**0.60**	**0.30**	**0.15**	**> 0.15**
Cum wt ret in gm	**2**	**10**	**28**	**50**	**78**	**92**	_
% passing	**98**	**90**	**72**	**50**	**22**	**8**	**-**



Grading curves for fine aggregate

From the above graph it is found that fine aggregate falls under zone II.

3. Water absorption test of fine aggregate

According to the IS : 1124 (1974) standard for test for determination of water absorption

Water absorption for fine aggregate = [(A-B)/B]×
Where,
A= weight of saturated surface dry sample taken = 975 g
B= weight of oven dried sample. = 963 g

Water absorption for fine aggregate = [(A-B)/B]×100
= [(975-963)/893]×100
= 1.24%

Note:
Water absorption shall not be more than 2% per unit by weight

4. Determination of silt content of fine aggregate

Sr. No.	**Description**	**Sample 1**	**Sample 2**	**Sample 3**
1.	**Vol of sample(V1) ml**	**96**	**96**	**96**
2.	**Vol of silt (V2) ml**	**4**	**4**	**5.1**
3.	**% of silt (V2/V1)×100**	**4.16**	**4.16**	**5.31**
4.	**Average**	**(4.16+4.16+5.31)/3 = 4.54%**		

As per IS 383-1970 the percentage of silt content should be less than 6%

Plastic properties:

Sr No.	Description	Result

1	Specific gravity	0.912-0.923si
2	Water absorption	0.5%
3	density	1130kg/m3
4	Melting point	150c

MIX RATIO:

1. Replacement of coarse aggregate with plastic

block is casted using partial replacement of coarse aggregate in this experiment. Here we used M20 concrete mix. For Paver blocks using 0%, 10%, 20% and 30% of coarse aggregates are Replaced by respective Percentage of aggregate.

PROPORTIONS:

Sr. No.	Replacement%	Cement	F.A	C.A	Plastic	Water (ml)
1.	0	1.50	2.25	4.50	0	8.25
2.	10	1.50	2.25	4.05	0.45	8.25
3.	20	1.50	2.25	3.60	0.90	8.25
4.	30	1.50	2.25	3.15	1.35	8.25

2.Replacement of fine aggregate with plastic

Paver block is casted using partial replacement of fine aggregate in this experiment. Here we used M20 concrete mix .For Paver blocks using 0%, 10%, 20% and 30% of plastic coarse aggregates are Replaced by respective Percentage of aggregate.

PROPORTIONS:

Sr. No.	Replacement%	Cement	F.A	C.A	Plastic	Water (ml)
1.	0	1.50	2.25	4.50	0	8.25
2.	10	1.50	1.80	4.50	0.45	8.25
3.	20	1.50	1.35	4.50	0.90	8.25
4.	30	1.50	0.90	4.50	1.35	8.25

PREPARATION OF TEST SPECIMENS:

Plastic wastes are heated in a metal bucket at a temp of above 150˚. As a result of heating the plastic waste melt. The materials that is fine and coarse aggregate and cement in proportion at molten state of plastic and well mixed. The metal mould is cleaned through at using waste cloth. Now this mixture is transferred to the mould. It will be in hot condition and compact it well to reduce internal pores present in it. Then the blocks are allowed to dry for 24 hours so that they harden. After drying the paver block is removed from the mould and ready for the use.

CASTING AND CURING:

Usually M20 concrete is used for most constructional
works, hence in this project M20 concrete is taken and
waste plastics is used as replacement of Coarse and Fine aggregate. Palstic such as 0%,10%, 20% and 30%
was added in percentage, in order to replace the same amount of coarse and fine aggregates.Found and coarse aggregates, cement and waste plastics to determine their physical properties.
Paver blocks (Interlocking Paver Block) of size 250 mm X 120 mm X 60 mm (Paver Block) and 200 mm X 100 mm X 65 mm
were casted and tested for 7, 14 and 28 days strength.

TESTING OF SPECIMENS:

1.Compressive strength for paver blocks:

Paver blocks (Interlocking Paver Block) of size 250 mm X 120 mm X 60 mm (Paver Block) and 200 mm X 100 mm X 65 mm were casted. The maximum load at failure reading was taken and the average compressive strength is calculated using the following equation. Compressive strength (N/mm2) = (Ultimate load in N / Area of cross section (mm2))

A .compressive strength of paver block after partially replacment of fine aggregate with plastic

Sr. No.	%replacement of F.A With plastic	Comp strength @7 days	Comp strength @14 days	Comp strength @28 days
1.	0%	18.18	23.89	25.56
2.	10%	14.67	18.04	20.44
3.	20%	12.93	14.67	15.90
4.	30%	7.82	8.99	9.64

B. compressive strength of paver block after partially replacment of coarse aggregate with plastic

Sr. No.	%replacement of C.A With plastic	Comp strength @7 days	Comp strength @14 days	Comp strength @28 days
1.	0%	15.11	24.25	28.82
2.	10%	16.12	24.25	30.11
3.	20%	18.31	27.06	31.18
4.	30%	17.98	22.21	26.54

2. Water absorption test of paver block

In this the bricks first weighted in dry condition and they are immersed in water for 24 hours. After that they are taken out from water and they are wipe out with cloth. Then the difference between the dry and wet bricks percentage are calculate.

A. Paver block partially replaced of fine aggregate with plastic

Sr. No.	%replacement of F.A With plastic	Sample 1	Sample 2	Sample 3	Avg
1.	0%	3.12	3.19	3.07	3.13
2.	10%	0.62	0.69	0.64	0.65
3.	20%	0.51	0.53	0.58	0.54
4.	30%	0.42	0.43	0.46	0.44

B. Paver block partially replaced of coarse aggregate with plastic

Sr. No.	%replacement of C.A With plastic	Sample 1	Sample 2	Sample 3	Avg
1.	0%	3.12	3.19	3.07	3.13
2.	10%	0.53	0.59	0.58	0.56
3.	20%	0.43	0.44	0.49	0.45
4.	30%	0.38	0.42	0.43	0.41

3. Heat resistance test:

Since the paver block is made of plastic it is required to know its heat resistance. Hence palstic paver block is placed in oven for 2 hours.

Paver block	Temprature (°C)	Remarks
Ordinary paver block	50	No change
	100	No change
	150	No change
Paver block partially replaced fine aggregate with plastic	50	No change
	100	No change
	150	Melts
Paver block partially replaced coarse aggregate with plastic	50	No change
	100	No change
	150	Melts

RESULT:

1. optimum content of plastic is found to be 20% for paver block when 20% of sand is replaced with plastic.

2. And it is found that the compressive strength increases gradually upto 20% replacement of plastic with coarse aggregate and decreases at 30% replacement of plastic with coarse aggregate.

CONCLUSION:

From the result we found that optimum contents of plastic is 20%
So we can cast a paver block of M2o grade concrete.
This pavement blocks can be used in heavy foot traffic areas or street.

PROJECT CONCLUSION:

1.The recycled plastic aggregates can be used up to 15% replacement of fine aggregates in the concrete mixture.and 20% replacement of coarse aggregate in the mix
2. The use of waste plastic in cement based composite can significantly reduced cost of construction through partial replacement of aggregates.
3. The lightweight paver blocks can be used as Pavements , roofing Pavements
4. Due to its lightweight, non corrosive and weather proof capability.
5. The used of waste plastics in constructions will grossly reduced rate of solid waste accumulation in the environment and income will be generated from its utilization.

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