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Utilization of industrial waste materials in the construction of interlocking paver blocks for medium traffic areas

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Abstract - *Using of recycled aggregates for the construction of interlocking paver block of 80mm thickness. The recycled aggregate is used as a replacement for the fine aggregate. Which makes it possible in reducing its cost and also its strength for the required limits. The concrete is designed for M-40 grade concrete and targeted strength is 48 MPA. The recycled aggregate is added in the ratios from 10%, 20% and 30%. The paver blocks are constructed for M-40 grade concrete, the concrete is prepared in different ratios of mix design by replacing fine aggregate with recycled aggregate for the standard mix design and it is checked for its workability by slump cone test. Then they are cured for 7-days and 28-days, then certain tests are conducted on a hardened concrete like compression test and based on the strength and its and cost analysis the perfect paver block can be adopted which is economical in initial and also in maintenance cost.*

Key Words: Recycled aggregate, interlocking paver blocks, slump cone test, curing, cost, economical, compression strength.

1. INTRODUCTION

India is renowned for its diverse network of roadways that connect individuals from various social classes. In India, roads have existed for more than 5000 years. Road building was a priority for Ashoka and Chandragupta in early Indian history. Roads in India were planned as early as 2500–3500 BC, according to excavations at Indus Valley settlements. The Mauryan kings also constructed some excellent roadways. The Nagpur plan divides roads into 4 main categories: National Highways, State Highways, District Roads and Village roads. Expressways were added as an additional category. A good quality pavement is required for the safe, economical and comfortable travelling. Today increase the density of vehicles on the highways and passengers travel from one place to other, required good quality pavement for long life. Rigid pavement is the best option for the good quality pavement for long life. Because of the flexible pavement having low life compare to rigid pavement. Rigid pavement is suitable at heavy rainfall area and water logged area. Low maintenance cost reduces the lifecycle cost for the rigid pavement. So, rigid pavement best choice over the flexible pavement. Further, it can be used alternative materials in concrete for rigid pavement. By improving its strength and lifespan, alternative materials such fly ash, granular slag, copper slag, crumb rubber, GGBS, building and demolition waste materials like marble powder, and recycled aggregate can lower the initial cost of rigid pavement.

1.2 MATERIALS USED

There are different materials used in a concrete for the construction of paver block such as cement, fly ash, coarse aggregate, fine aggregate, recycled fine aggregate, m-sand for M-40 grade concrete. the below table 2.1 shows some the tests performed on the materials mentioned above.

Table -1 : MATERIAL CHARACTERISATION

SL NO.	MATERIALS	CHARACTERISATION			
		SP GRAVITY	INITIAL SETTING TIME	BULK DENSITY	Fineness
1.	Cement	3.12	40 MIN	-	4.5 %
2.	Fly-ash	-	-	-	-
3.	Coarse aggregate	2.71	-	1635 Kg/m^3	-
4.	Fine aggregate	2.62	-	1842 Kg/m^3	-
5.	Recycled Aggregate	2.69	-	-	-

1.3 OBJECTIVES OF STUDY

- To evaluate ICPB's applicability under conditions of moderate traffic.

- To evaluate the properties of concrete using industrial by products as an alternative material in both the fresh and hardened states.
- ICPB manufacturing using different materials which are economical in initial construction stages as well as in maintenance cost.
- The objective is complete replacement of concrete with recycled aggregate with additives like m-sand to make a low cost and light weighted paving block which have high strength, which is versatile, aesthetic and durable and hence environment friendly.
- To compare the costs of regular paving blocks and those made of recycled aggregate.
- Promote trash to energy alternatives.
- Make sure the handling of solid waste is efficient and effective.

1.4 SCOPE OF STUDY

- They weigh very little when we compare them to the conventional paver blocks.
- They are fire resistive and they do not absorb water compared to standard paver blocks.
- In the event of failure, they only deform rather than disintegrate. They appear adaptable and may work in any setting. They can be made quickly.
- Concrete's strength and other attributes are dependent on substantial resources like fly ash from nuclear power plants, marble powder from stone businesses, and copper slag provided from industries, among other significant materials.
- The methods used and concrete materials used in this work, which will be discussed in the next sections, are largely responsible for the results obtained.

2. MIX PREPERATION

The mix is prepared using mixers for the designed grade of concrete that is M-40 grade concrete and it is as shown in fig-1.

2.1 BLENDING OF CONCRETE

Fig 1 concrete mixing

The dry blending is performed before mixing the water. After complete mix until uniform color is obtained than water is added to the mix in parts the w/c ratio maintained is 0.45. after the complete mix test is carried on the freshly prepared concrete.

2.2 Mould preparation and vibration

After the proper concrete mix then mix is transferred the moulds and kept on a vibrator for the removing of the air voids for the proper bonding between the concrete mix. The vibration of the concrete is as shown in fig 2 and fig 3 shows the hardened concrete after 24 hrs of setting.

Fig 2 concrete vibrator

Fig 3 Hardened concrete

2.3 Curing

Curing is an important process carried out after the hardening of concrete for 24 hrs. The mix is kept for the curing for 7-days and 28-days. Then cured paver block are removed and surface is dried and tests like compression test carried out. The fig 4 shows curing of paver blocks

Fig 4 curing of paver blocks

3. TEST CONDUCTED

Different types of tests are conducted on the freshly prepared concrete and also on hardened concrete for 7-days and 28-days such as slump cone test on freshly prepared concrete and compression test on hardened concrete.

3.1 Slump cone test

Slump cone test is performed on freshly prepared concrete to know its workability of the concrete.

Table 2 SLUMP VALUES

SL NO.	MIX DESIGNATION	SLUMP VALUE (mm)
1.	MP0	50
2.	RA1	55
3.	RA2	56
4.	RA3	56
5.	RA4	57

The slump cone test is conducted on every mix design the slump values show that the mix is properly blend to form well uniformed concrete mix and can be used for the construction of paver block as per table 2.

3.2 Compression test and cost analysis

The compression test on the hardened paver blocks after 7-days and 28-days will provide us the complete strength of the paver blocks it can sustain. This helps to know where the paver blocks can be easily applied at which type of traffic it can be used.

Table 3 compression test values

Sl No.	**MATERIALS**	**COMPRESSION STRENGTH N/mm²**
1.	MP0	48.00
2.	RA1	39.90
3.	RA2	40.60
4.	RA3	53.30
5.	RA4	50.80

From the table 3 we can see the compression values from the compression test conducted and the values will help in providing knowledge on the paver blocks about where they can be used. Here we can see the MP0 (standard paver blocks) is having low strength when compared to recycled aggregate mix at 30% replacement of recycled aggregate with fine aggregate(RA3). Then RA3 can be used as a replacement for standard paver blocks for the medium traffic areas.

4. COST ANALYSIS

The cost analysis of the paver blocks is necessary for the purpose of economy and it should be economical both in construction as well as in maintenance.

Table 4 cost analysis

Sl No.	MATERIALS	COST PER PAVER BLOCK (Rs)
1.	MP0	12.00
2.	RA1	12.18
3.	RA2	12.10
4.	RA3	12.02
5.	RA4	11.94

The cost analysis will help in analyzing its cost for the construction also for the maintenance cost as per table 4 we can see the cost of standard paver block is 12.00 Rs and that of recycled aggregate at 30% replacement is 12.02.

4. CONCLUSIONS

As per the conclusion we can be able to select the paver block for the construction based on its compression value and by its cost analysis

- The compression strength of the conventional paver block is less when compared to the recycled aggregate at 30% replacement of fine aggregate with recycle aggregate.
- Based on the compressive strength we can select the paver block with 30% replacement of fine aggregate with recycled aggregate as a replacement for the conventional paver block.
- The use of this paver block with recycled aggregate as a replacement for the conventional paver block will help in maintaining the ecosystem and also helps in maintaining waste material usage.
- The compressive strength of conventional paver block is 48 N/mm^2 and compressive strength of 30% replaced recycled aggregate paver block is 53.30 N/mm^2.
- Based on these values it makes it possible to choose appropriate paver blocks.
- But the cost analysis also an important factor to be looked after.
- The cost of one conventional paver block is 12.00 Rs and the cost of 12.02 Rs.
- Based on its cost and by its compressive strength we can select the paver block of recycled aggregate with 30% replacement of fine aggregate with fine aggregate.
- This paver block can be used for the medium traffic as per IS 15658: 2006 table 1. These paver blocks can be used in City streets, small and medium market roads, low volume roads, utility cuts on arterial roads.

REFERENCES

i. In their 2012 article "PAVER BLOCKS USING Scrap MARBLE POWDER," Osman Gencel et al. discussed the use of waste marble in paver block production.

ii. Rafeeullah, Waleed Ahmad, M. sagheer Aslam "MARBLE POWDER INTERLOCKING PAVER BLOCKS" (2020).

iii. Khandve P. V. Rathi A. S "Concrete Paving Block Using Marble Stone Industry Waste".

iv. Mansi M. Soni Jayesh R. Mangroliya" Performance of Copper Slag on Strength as Partial Replacement of Fine Aggregate in Concrete" [2018].

v. S.Kalaiselvi, S.Prabhakaran, Jagadeesan.K "An Experimental Investigation on Partial replacement of Copper Slag as Fine Aggregate in Paver Block" [2017].

vi. C Manivel, Aravind P V, Mohammed Adil Bin Baseer, Muhammed Safad T, Krishnalal C S, (2020).

vii. Faculty of Civil Engineering, Universiti Teknologi Malaysia" [AWAM-2007] "Properties of Crumb Rubber Concrete Paving Blocks with and without Facing Layer".

viii. Rohit Soni, Deepak Mathur "An Experimental Study on Using of Commercialized Crumb Rubber in Interlocking Concrete Paver Block" [International Journal of Recent Research and Review, Vol. XIII, Issue 2, June 2020 ISSN 2277 – 8322].

ix. Leela Bharathi S M[Prof], P. Kirubagharan, R. Gowtham, Albert Duraisingh, Akshai B Nair[students] "Experimental study on behaviour of paver block using crushed rubber powder" Karpagam University [2017].

x. Chi SunPoon and DixonChan "Paving blocks made with recycled concrete aggregate and crushed clay brick" [2005].

xi. E.Gifty, N.Harini Devi, P.Meena, S.Gunasekar "Strength Property Study on Paver Block Made with Recycled Concrete Aggregates"[2019].

xii. Manuel Contreras-Llanes, Maximina Romero, Manuel Jesús Gázquez and Juan Pedro Bolívar "Recycled Aggregates from Construction and Demolition Waste in the Manufacture of Urban Pavements"[2021].

xiii. S.Yamini Roja, J.Jayashree and V.Jeevanantham "BEHAVIOUR OF PAVER BLOCKS BY REPLACEMENT OF FINE AGGREGATE WITH M-SAND AND CRUMB RUBBER WASTE" ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614.

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