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# Interlocking Pavers Using Waste Kadapa Stone

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**Abstract:** *The high consumption of raw material in the construction field is reducing the natural resources for the construction of buildings and damaging the environment. With recent developments in the infrastructure of India, the trend of using pavers around the Buildings, Roadsides, etc...has been rapidly increased. Especially for the places like Footpath, Parking Area, bus stops, Parks, Garden Pathways, Courtyards etc.... So we can replace natural resources with new materials which are abundant in environment such as Waste Kadapa Stone Chips, Quartz Sand, Fly ash (organic in nature), Gypsum, and Waste Kadapa Stone Powder. By partial replacement of cement with Waste Kadapa Stone Powder, Fly ash, and Gypsum, adding these components by 50% replacement to the cement. And completely replacing the Fine & Coarse Aggregate. This has been cast and tested for 3, 7, 14 and 28 days. Fresh and hardness of the concrete is tested by Compressive Testing Machine and Workability Test. The result is compared with normal concrete properties.*

**Keywords:** *Waste kadapa stone chips and powder, Quartz Sand, Fly Ash, and Gypsum.*

## I. INTRODUCTION

Mainly in the places of Kadapa, Yerraguntla, Mydukur etc. The mostly available stone is kadapa stone. Localised use this stone as Flooring for the Houses, Footpaths, and Garden areas etc... When they get it from the quarry, it is generally in irregular shape which they used to transform it into a proper shape for efficient use. In this process there is a lot of waste comes out from the polishing shop. Wastes are Kadapa Stone Powder and kadapa stone chips. By using this waste we made Interlocking Paver Blocks. 100% replacement of the aggregate by Kota stone waste aggregate is decreased with 5.83 Mpa by comparing to 0% replacement of the Kota stone waste aggregate<sup>[5]</sup>. And 100% replacement of fine aggregate river sand by Quartz sand.

## II. OBJECTIVE

- A. To make concrete as "Green Concrete".
- B. To reduce the cost of the material.
- C. To dump the waste material.
- D. To make the innovative construction material.
- E. To reduce the weight of the concrete.

## III. LITERATURE REVIEW

Rajendra D&H Gokulram (2017) observed the properties of materials and mix design paver blocks with waste kadapa stones, hardened state characteristics and influence of various parameters on hardened state concrete and utilization of various materials in structure. Waste kadapa stone were partially replaced as coarse aggregate in 20% 40% 60% respectively. And fly ash was partially replaced with cement by 20% respectively. Those are casted and tested for 7&28 days. A fixed water cement ratio 0.4. Test results were up to the mark with respect to conventional materials.

Deshpande B.C and P Darade M.M (2015) studied the effect of fly ash as partial replacement to cement and dust as partial replacement in fine aggregate on various pavement blocks. Examined on M-30 grade of concrete by replacing cement with some of its weight by fly ash. To find out Compressive strength and Flexural strength.

Patel Vikas Kumar and Singh V.V (2017) noticed that dumping of waste material can be used as construction materials like glasses, copper slug, foundry sand, industrial waste fiber, plastic waste etc.. Can be partially replaced as fine aggregate and coarse aggregate, which increase in compressive strength of the paver blocks. Construction materials can recycle the materials in the paver blocks.

Saiyed Farhana, Parmar Bhumika and Prajapati Jayesh (2013) inventive concept for manufacturing of green concrete by using the stone chips as coarse aggregate, foundry sand as the fine aggregate. As per IS 10262:2009 has investigated the mix proportion of concrete, by partial replacement of coarse aggregate to reduce the cost of the concrete per cubic meter. It is eco-friendly and innovative construction material.

Kolimi Shaiksha Vali and Abdul Rahim (2017) perceived about cuddapah stone aggregate were getting almost equal strength to the normal aggregate. By replacing the fly ash and cold bonding fly ash making the concrete light but them providing lesser strength. When increasing in fly ash aggregate with the normal aggregate, the compressive and split tensile strength has decreased.

P.V Khanve and A.S Rathi (2016) recognized that replacing the Kota stone with 50 to 60 % gives the optimum result while comparing to the other proportions. When the 17 % of Kota stone is used in mix proportion gives the same result as given by normal concrete. Kota stone has the less water absorption material and has good compressive strength.

M.C. Nagaraja and Lelin Das (2014) identified that the broken paver aggregate are absorption of water content is more than 7%, so they material is not suitable for the paver blocks. By partial replacement of broken paver aggregate, kadapa aggregate and normal aggregate gives the better strength as the natural aggregate. Kadapa stone is better than granite aggregate in water absorption limit.

Potu Kartheek Yadav and B. Balakrishna Bharath (2017) analyzed that by replacing the 30% of Sabbath stone partially in normal concrete by adding the chemical admixture it has given 25% higher strength than the normal concrete. By increasing the Sabbath stone percentage in normal concrete resulted in decreasing of its strength.

**A. Experimental Investigation**

Details of Fine Aggregate

S. No	Sieve Size	Percentage retained
1	4.75mm	0 %
2	2.36mm	0.10 %
3	1.18mm	21.70 %
4	600µm	50.50 %
5	300 µm	25.80 %
6	150 µm	1.60 %
7	PAN	0.30 %

Experimental Results (Consolidated Results)

S. No	Materials	Properties	Results
1	Cement	Specific Gravity	3.18
		Fineness	94 %
		Consistency	28 %
		Initial Setting Time	10 mins
2	Quartz Sand	Specific Gravity	2.16
		Water Absorption	1.20 %
3	Kadapa Stone Chips	Specific Gravity	2.06
		Water Absorption	4.60 %

**IV. METHODOLOGY**

**A. Description about Materials**

Concrete is the mixture of Cement, Sand and Coarse Aggregate. These are the natural resources what we are using presently in the construction field. Due to high consumption of the natural resource we are finding alternatives to them. Nowadays our infrastructure has been developing rapidly, the construction materials usage also increased rapidly. For that purpose we used alternative material for the protection of environment (to save river sand etc). Presently usage of INTERLOCKING PAVER has been increased in the urban areas around the Building, Parking areas and Road sides etc. So we replaced the conventional materials. Complete replacement of River Sand (FA) and Course Aggregate with the respective materials Quartz Sand and Kadapa Stone Chips. Partial replacement of cement with Kadapa Stone Powder, Gypsum and Fly ash. The size of Fine Aggregate (Quartz sand) can be used for making paver is I.S. Sieve 600microns and 1.18mm. Quartz sand is reach in silica. One of the advantages of using silica when it is mixed with pozzolona by its chemical and physical properties it has very High Strength and more durable. The water absorption percentage is 1.2%. The size of Coarse Aggregate (Waste Kadapa Stone Chips) used for paver is I.S. Sieve 6.7 mm and 4.75 mm. The water absorption percentage is 0.46%. The mean aggregate impact value is 9.35% of the same sieve size. The HARDNESS of the average value of two Los Angeles abrasion test is 15.2% of the same sieve size. The Specific Gravity of the Aggregate is 2.45. In this project mix ratio of the concrete is 1:1.52:1.45. The grade of the concrete is M<sub>30</sub>. We kept the mixing proportion of concrete is constant but we have changed the mixing proportion in cement. We have done the compressive test on the paver blocks and strength is greater than the normal concrete.

**B. Methods**

- 1) Grade of Concrete - M<sub>30</sub>
- 2) Mix Proportion - 1:1.52:1.45
- 3) Mode of Mixing - Manual Mixing
- 4) Type of Cement - Ordinary Portland Cement

5) Shape of Model - Paver blocks with alternating plain and curved/corrugated vertical faces

Details of M<sub>30</sub> Concrete Mix Design

M-30 CONCRETE MIX DESIGN		
As per IS 10262-2009		
Stipulations for Proportioning		
1	Grade Designation	M <sub>30</sub>
2	Type of Cement	OPC 43 grade confirming to IS- 8112
3	Maximum Nominal Size	10mm
4	Minimum Cement Content	340kg/m <sup>3</sup>
5	Maximum Water Cement Ratio	0.486
6	Workability	25mm (Slump)
7	Exposure Condition	Severe
8	Degree of Supervision	Good
9	Type of Aggregate	Crushed Flaky Aggregate
10	Maximum Cement Content	390kg/m <sup>3</sup>
11	Chemical Admixture Type	Nil
Target Strength for Mix Proportioning		
1	Target Mean Strength	38.25 N/mm <sup>2</sup>
2	Characteristic Strength @ 28 days	44.18 N/mm <sup>2</sup>

Selection of Water Cement Ratio

Selection of Water Cement Ratio		
1	Maximum Water Cement Ratio	0.50
2	Adopted Water cement Ratio	0.48
Selection of Water Cement		
1	Maximum Water content	211.12 Lit.
Calculation of Cement Content		
1	Water Cement Ratio	0.48
2	Cement Content (211.12/0.48)	439.83 kg/m <sup>3</sup> > 340 kg/m <sup>3</sup>
Proportion of Volume of Coarse Aggregate & Fine Aggregate Content		
1	Vol. of Coarse Aggregate	637.83 Kg
2	Adopted Vol. of Coarse Aggregate	637.83 Kg
3	Adopted Vol. of Fine Aggregate	668.81 Kg

Details of Mix Calculations

Mix Proportions for One cum of Concrete

1	Mass of Cement in kg/m <sup>3</sup>	439.83
2	Mass of Water in kg/m <sup>3</sup>	211.12
3	Mass of Fine Aggregate in kg/m <sup>3</sup>	668.81
4	Mass of Coarse Aggregate in kg/m <sup>3</sup>	637.83
5	Water Cement Ratio	0.48

Details Of Test Specimens

According to the following table Mix Ratio has been followed for M-30 grade of concrete for the paver blocks

Material	Normal Concrete	Sample-I	Sample-II	Sample-III
Mix ratio	1:1.52:1.45	1:1.52:1.45	1:1.52:1.45	1:1.52:1.45
Cement	1 kg	0.5 kg	0.6 kg	0.5 kg
Fly Ash	0 kg	0.15 kg	0.1 kg	0.1 kg
Gypsum	0 kg	0.2 kg	0.1 kg	0.1 kg
Kadapa Stone Powder	0 kg	0.15 kg	0.2 kg	0.3 kg
Fine Aggregate (Quartz Sand)	1.52 kg (River Sand)	1.52 kg	1.52 kg	1.52 kg
Coarse Aggregate (Kadapa Stone Chips)	1.45 kg (Kankar)	1.45 kg	1.45 kg	1.45 kg
Water Cement Ratio	0.48	0.48	0.48	0.48

V. RESULT

Compressive strength values are taken as an average of 3 blocks for each sample

Type of sample	Compressive Strength(N/mm <sup>2</sup> ) for following days of curing			
	3 days	7 days	14 days	28 days
Normal Concrete	14.45	22.34	29.61	37.26
Sample-I	16.45	26.47	34.86	41.64
Sample-II	16.50	26.83	32.57	44.18
Sample-III	12.68	25.17	19.06	35.77

Type of sample	Flexural Strength(N/mm <sup>2</sup> ) for following days of curing			
	3 days	7 days	14 days	28 days
Sample-I	340.24	483.42	669.32	799.47
Sample-II	361.89	508.43	593.52	848.43
Sample-III	290.16	516.21	366.00	686.88

VI. CONCLUSION

After following all standard procedures (casting, curing and compression strength test) properly we got compressive strength more than targeted strength. Kadapa stone powder and chips along with Quartz sand produce desired result. Our all set objectives were successfully achieved (except weight reduction). Strength considerably increased. We saved river sand which in return saves natural river discourse. Stone wastes were efficiently used with proper strength and also disposal of waste which is really a grave concern nowadays is reduced.

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