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Use of Dimensional Stone Waste in Rigid Pavement

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Abstract—*With recent infrastructural development in urban India, trend of using paved surface around the building or on road sides is increasing. Traditional Concrete paving blocks are the most suitable, economical and locally available material for such paving surface. They are widely used on footpaths, garden pathways, courtyard paving, bust stand sheds, parking areas and in industry for working area. At the same time, amount of construction waste generated is also increasing with increased infrastructural development. Kota and Granite stone industry waste is one of the construction wastes which is left unused by industries or only used for filling low lying areas etc. In this study attempt has been made to use Kota and Granite stone industry waste as replacement for course aggregate used for manufacturing of traditional concrete paving blocks. Varying percentage of Kota and Granite stone waste aggregates is considered and paving blocks are tested for water absorption, compressive strength and splitting tensile strength. The results shown that maximum 50 % of replacement of traditional aggregate with kota stone waste aggregate is possible for optimum results. In this paper material used for the study, methodology adopted, results of various tests and summery results are given. Using waste material is reducing the cost of manufacturing and also solving the problem of disposal of construction waste and thus helping in protecting environment.*

Keyword*: Concrete paving block, Kota and Granite stone waste, compressive strength, splitting tensile strength, and water absorption.*

1. INTRODUCTION

Cement paving blocks have main use of aggregate. Where potentially cement concrete paving blocks used in pavement, footpaths, and gardens, passengers waiting sheds, bus stops, industry and other public places. With recent construction development in India, demand of paving blocks is increasing rapidly. [1] Whereas amount of different types of aggregate waste forming is also increasing. Therefore control of waste disposal shall be given top priority, while, on the other hand, recycling of waste effectively Cement concrete paving blocks should be made out of aggregate waste. The product is made in various sizes and shapes viz. rectangular, square, and round blocks of different dimensions with designs which can give maximum strength [3] the raw materials require for as main component should be more valuable. Products which use dimensional stone waste materials could contribute more effectively to conserve the environment in terms of both reducing waste and protection of nature. Stone waste products can be used in construction sector as well as in other sectors also. [4]

We used waste products as in rigid pavement block materials. Usage of dimensional stone waste materials in concrete presents several benefits saving mineral resources of the country such as aggregate and sand derived from mines, reducing environmental pollution, also a positive impact on the country's economy because of the high cost of waste storage. [6]

2. MATERIAL & METHODOLOGY

Material used for this study is traditional material such as cement, sand and aggregate along with additional waste material from Kota and Granite stone industry. 43 grade Ordinary Portland Cement is used with local sand available and 10-20 mm size range aggregate are used. Kota stone industry waste is procured from the Kota stone cutting industry from Balaji Enterprises, Kota and Granite stone industry waste from Sheri Ganesh Granite. [10]

Kota and Granite stone is used in different parts of construction of home. Some of genuine advantages with usage of Kota stone for construction are their permanence and durability where as Granite have also various properties like hardness and strength etc. Because of increased use of Kota and Granite stone in house construction, amount of waste Kota and Granite stone strips and pieces remains unused at site or in kola and Granite stone cutting industry. [6]

Table 1: Properties of Material

S.N.	TEST NAME	KOTA STONE	NATURAL AGGREGATE	GRANITE
1.	WATER ABSORPTION	1.05	1.19	0.98
2.	FLAKINESS INDEX	13.36	8.05	15.79
3.	ELONGATION INDEX	12.09	6.48	14.53
4.	SP. GRAVITY	2.69	2.61	2.79
5.	CRUSHING VALUE	22.82	28.7	19.21

6.	IMPACT VALUE	16.23	23.5	11.78

In Rajasthan so many industries producing such Kota and granite stone waste. So we have decided to use this waste for preparing concrete paving blocks. We have procured this waste free of cost and taken it to crusher plant for making aggregate out of it. [8]This crushed aggregate of waste Kota and granite stone is used in different proportion mixed with other material for casting concrete paving block. Specific gravity, water absorption, flakiness and elongation index, crushing and impact value of Kota and granite stone Waste is tested and test results are given in

For carrying out study of Concrete Paver Block which in cube and beam casted by using Kota and granite stone waste systematic experimental study has been carried out. For this different lab test on material and concrete paving block are undertaken. [9] It was decided to cast cosmic type of paver block using different proportion of various materials. The size of cube was taken 0.15*0.15*0.15m^3 and the size of beam is 0.5*0.1*0.1m^3. The prepared sample kept for drying for 24 hours and then kept for curing for 28 days in the curing tank. It was decided to study first the manufacturing of traditional Concrete Paving block. Various literatures are referred to study, engineering properties, applications and uses of Concrete Paving block. [10]

3. EXPERIMENTAL WORK

Table 2 and 3 shows below the mix proportion for the concrete using Kota stone industry waste used for casting three cubes to check the compressive strength of cubes and three beams for flexural strength of beams respectively. Nominal mix proportion 1:1.5:3 is considered for calculation of dry material required for casting of three samples of cubes and three sample of beams. In this mix proportion the stone waste used as kola stone waste aggregate. Cement, fine aggregate and water are kept as the constant and the percentage of the Kota stone and granite stone aggregate is increased in the percentage as 0%, 25%, 50%, 75%, 100% as replacement of coarse aggregate so as to prepare 27 cubes and 27 beams blocks.

Table 2: Mix Proportion and Their Compressive Strength

MIXTURE	CEMENT Kg	SAND Kg	AGGREGATE Kg	KOTA STONE Kg	COMPRESSIVE STRENGTH N/mm^2
K-0	4.5	6.8	13.6	0	19.997
K-25	4.5	6.8	10.227	3.409	21.11
K-50	4.5	6.8	6.818	6.818	22.37
K-75	4.5	6.8	3.409	10.227	23.84
K-100	4.5	6.8	0	13.6	24.97

Table 3 Mix Proportion and Their Flexural Strength

MIXER	CEMENT Kg	SAND Kg	AGGREGATE Kg	STONE Kg	FLEXURE STRENGTH N/mm^2
K-0	6.81	10.22	20.05	0	3.48
K-25	6.81	10.22	15.33	5.11	3.73
K-50	6.81	10.22	10.22	10.22	4.02
K-75	6.81	10.22	5.11	15.33	3.95
K-100	6.81	10.22	0	20.05	3.89

Table 4 and 5 shows the mix proportion using granite stone industry waste used for casting of three cubes to check the compressive strength and 3 beams for flexural strength.

4. RESULT AND DISCUSSION

5.1 Compressive Strength

The graph was plotted using the test result obtained and the discussion pertaining to respective test is discussed below. Figure 1 show the graph between % Kota stone waste aggregate, granite stone waste aggregate and compressive strength. From this graph it is seen that minimum compressive strength is found 19.997 N/mm^2 at 0% for normal aggregate and maximum compressive strength is 24.97 N/mm^2 at 100% for Kota stone waste aggregate and 25.62 N/mm^2 at 100% for granite stone waste aggregate. In this waste and proportion the compressive strength is increased from 0% to 100% gradually.

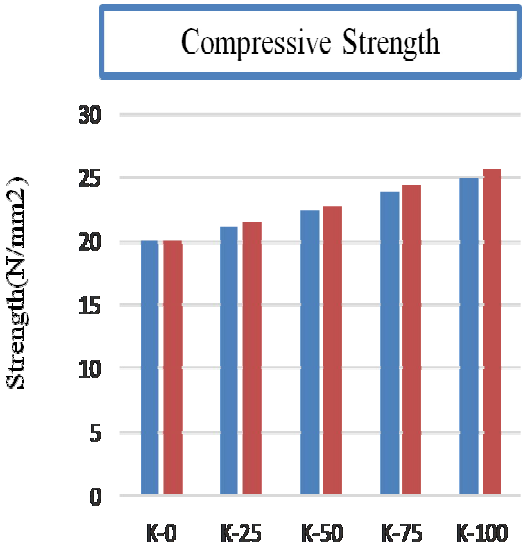

Figure 1 Compressive Strength Result

5.2. Tensile strength result

Figure 2 show the graph between % Kota stone waste aggregate, granite stone waste aggregate and flexure strength.

From this graph it is seen that minimum flexure strength is found 3.48 N/mm^2 at 0% for normal aggregate and maximum flexure strength is 4.02 N/mm^2 at 50% for Kota stone waste aggregate and 4.13N/mm^2 at 50% for granite stone waste aggregate .flexure strength is varying for the varying proportion of the mixture as shown in the graph.

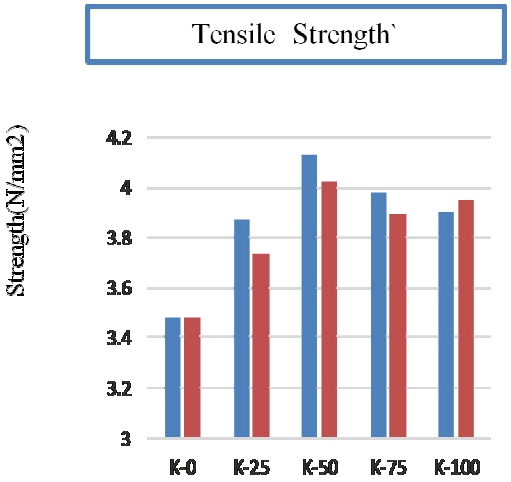

Figure 2: Tensile Strength Results

5. CONCLUSION

Result based on the experimental study conducted for various properties of concrete paving blocks are compared. From the graphical representation it is clearly seen that percentage of kota stone increased then the compressive strength also increased as at 0% compressive strength for both kota stone waste and granite stone waste minimum 19.997 N/mm^2 for normal aggregate . but the maximum value found for both kota stone waste aggregate and granite stone waste aggregate at 50% is 24.97 N/mm^2 and 25.62N/mm^2 . And as increasing Kota stone waste and granite stone waste the compressive strength also gradually increased.

For flexure strength of aggregate the optimum results found at 50% for both kota stone waste aggregate and granite stone waste aggregate is 4.02 N/mm^2 and 4.13 N/mm^2 respectively. for both kota stone waste aggregate and granite stone waste aggregate flexure strength increased till 50% gradually and then till 100% reduced gradually as shown in graph .

From the overall study we came to know that the Kota stone waste and granite stone waste gives satisfactory result for the compressive strength 24.97 N/mm^2 and 25.62 N/mm^2 respectively and flexure strength also found the optimum result at 50% is 4.02 N/mm^2 and 4.13 N/mm^2 respectively. Therefore both Kota stone stone waste and granite stone waste with the 50 to 60 % replacement of disposal of Kota and granite stone industry waste. Only the limitation in this study is cost require for loading, unloading and crushing of Kota and granite stone industry waste in small quantity is not comparatively advisable because it does not give sufficient cost saving in manufacturing cost of concrete paving block. From the result we can conclude that technically Kota and granite stone waste shall be used for manufacturing of concrete paving block. Further investigation can also be made by using fly ash as replacement of fine aggregate along with Kota and granite stone industry waste to further reduce the cost of paving block.

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