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Replacing Certain Amount of Course Aggregate with Waste kota-stone chips & Make the Eco Friendly Paver Block

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Abstract - In both developed and developing countries waste management problem has already become serving. Energy plays a crucial role in the growth of developing countries like India.Commonly we use concrete paver block in road pavements & various other works. Concrete paver block is a better option in road construction when compared to the conventional road which is made by bitumen and gravel. As India is a developing country, construction of roadways and buildings plays a vital role. Kota stone is an excellent building stone. It is mainly used throughout India, especially at railway stations and government offices, pathways, corridors, driveways, balconies, commercial buildings. The use of waste kota stone chips in concrete pavement block is a partial solution to the environment and ecological challenges associated with the use of waste kota stone chips. The aim of this research is to reduce the cost of paver block and also to reduce the environmental pollution & storage problems. Use of waste kota stone chips in an environment is considered to be a big problem due to its presence in large quantities. This problem is computed by rapidly increasing amount of industrial waste of a complex nature and composition concrete. Presently large amount of Kota-Stone are generated as a waste during the process of cutting and polishing. Waste kota Stone chips can be used for reducing the cost of concrete by replacing it with Certain amount of course aggregate. Stone waste as aggregates are the materials for the future. The aim of this research is to replace the certain amount of course aggregate by kota-stone waste chips accordingly in the ratio of (60:40) where 60% course aggregate and 40% kota stone respectively by weight for m-20 grade concrete.Using I shape dog bone shaped paver block moulds and M20 grade of concrete mix are used. The compression strength test is carried out to evaluate the mechanical properties for 7, and 28 days.
Keywords: concrete paver block, waste kota stone chips, M20 grade.

1. Introduction

During the process of cutting, in that original kota Stone mass is lost by 20- 25% in the form of waste chips. The kota Stone cutting plants are dumping the chips in any nearby pit or vacant spaces, near their unit although notified areas have been marked for dumping. This leads to serious environmental and pollution and occupation of a vast area of land. So it is necessary to dispose the kota Stone waste quickly and use in the construction industry.Concrete paving blocks has been extensively used in many countries including India for quite some time as a specialized problem solving technique. Paver block paving is versatile, aesthetically attractive, functional and cost effective. Inter locking paver gives better performance and it is also available in different shapes, sizes, colour and pattern. Concrete paver block is a better option in road construction even for non-traffic, light traffic, medium and heavy traffic areas. The construction, transportation, installation and maintenance of these blocks are easy and replaceable in very short time. Waste kota stone chips is used in this research to reduce the environmental pollution & storage problem of kota stone. Use of kota-stone waste in various engineering applications can solve the problem of disposals of kota stone waste and other purposes. Kota Stone waste can be used in concrete to improve its strength and other durability factors. Kota Stone waste can be used as a partial replacement of course aggregate or replacement of fine aggregate and as a supplementary addition to achieve different properties of concrete. The use of the replacement materials offer cost reduction, energy savings, arguably superior products, and fewer hazards in the environment. Concrete is a composite construction material composed of cement, aggregate (generally a coarse aggregate made of gravels or crushed rocks such as limestone, or granite, plus a fine aggregate such as sand) water, here we use certain amount of course aggregate by kota-stone waste chips accordingly in the ratio of (60:40) where 60% course aggregate and 40% kota stone respectively. The objectives are to mix these materials traditionally to make concrete that is easy to Transport, place, compact, finish and to give a strong and durable product.

2. Methodology for Construction of paver block

(A)Required materials for Construction of paver block.
(B)Collection of materials
(C)Properties of materials kota stone
(D)Grade of concrete
(E)Preparation of specimen

(F)Test on paver block

(A) Required Materials Construction of paver block.

The materials which are to be used for concrete mix are ordinary Portland cement (43grade), fine aggregate, waste kota stone chips is partially replaced in aggregate in the ratio 60% aggregate and 40% kota stone, and water.

Cement: Cement is a binder material, a substance that sets hardens and adheres to other materials, binding together. The most common cement used is an ordinary Portland cement. Here we use the Ordinary Portland cement of 43 grade. Cement of 43 grades conforming to IS: 8112-1989 is being used.

Fine aggregate: The river sand is used for the this investigation. Those fractions from 4.75 mm to 150 micron are termed as fine aggregate. The fine aggregate was sieved by using 4.75 mm sieve to eliminate deleterious and oversized particles. The river sand is used in combination as fine aggregate conforming to the requirements of IS: 383-1970. The river sand is wash and screen, to eliminate harmful materials and over size particles. Properties of fine aggregate are Specific gravity, Grading zone, Fineness modulus, 2.60, Zone II (IS 383:1970), 2.80 respectively.

Coarse aggregate:
Aggregates are the most important constituents in concrete. The fractions from 20 mm to 4.75 mm is called as coarse aggregate.We use aggregate and waste kota stone chips mix in ratio 60% aggregate and 40% respectively. 20mm coarse aggregates & 10 mm waste kota stone chips are used in this work. The IS 15258: 2006, Hence, 20mm coarse aggregates are used in this work. One of the most important factors for producing workable concrete is good gradation of aggregates. Good grading implies that a sample fractions of aggregates in required proportion such that the sample contains minimum voids. Samples of the well graded aggregate containing minimum voids require minimum paste to fill up the voids in the aggregates. Minimum paste is mean less quantity of cement and less water, which are further mean increased economy, higher strength, lower shrinkage and greater durability.

Figure-1 Sieve analysis

Table-1: Properties of coarse aggregate

Description	Value
Size	20 mm
Crushing	23.5% (<30%)
Impact value	17.8%

Waste kota Stone chips

Kota Stone is a material with fine-grained variety of limestone, quarried at Kota district. kota know as industrial city and also know as education city in India. Hundreds of mines are located in or near the town of Ramganj Mandi and in the Kota district. The principle waste coming into the kota-stone industry is the stone itself, specifically in the forms of overburden, screening residual, stone fragments. For this work we used10 mm waste kota stone chips. Kota Stone wastes are generated as a waste during the process of cutting and polishing. It is estimated that 175 million tons of quarrying waste are produced each year, The disposals of these waste materials acquire large land areas and remain scattered all

around, spoiling the aesthetic of the entire region. It is very difficult to find a use for all scrap of kota stone and fines produced. Kota Stone waste can be used in concrete to improve its strength and other durability factors. Kota stone competes in the market because of its lower cost and longer durability. It is used throughout India, especially at railway stations and government offices.

Water: Water is an important ingredient of concrete as it chemically reacts with cement. The water which is used to make concrete should be free from impurities and should have pH between 6 and 8 & free from salt. For this work we used clean drinking water which is available in the water supply system.

Figure-2 Material for use

(B)Collection of materials

The materials which are required are collected and the property of each one is determined in laboratory. The concrete grade chosen was M20 grade. Hundreds of mines of kota stone are located in or near the town of Ramganj Mandi and in the Kota district. Waste kota stone chips are collected from Ramganj Mandi.

(C)Properties of materials kota stone

Physical & Chemical properties of kota stone

Table-2: Physical Properties of Kota stone

S.No.	Properties	Kota stone chips (10 mm)
1.	Specific gravity	2.73
2.	Impact value	20.36%
3.	Loss angeles value	18.3%
4.	Compressive strength	21.75 kg/sq mm
5.	Abrasion value	18.12
6.	Water abrasion	0.31- 0.32
7.	Density	2.5-2.65 kg/m3
8.	Weathering impact	Resistant
9.	Porosity	Quite low
10.	Toughness	Hard

Table-3 Chemical Properties of kota Stone

S. No.	Chemical constituent	Percentage of weight
1.	Calcium oxide	38.86%
2.	Magnesium oxide	1.09%
3.	Aluminum oxide	2.20%
4.	Silica	22.67%

(D)Grade of Concrete

A M20 grade was designed as per Indian Standard method (1:1.5:3) and the same was used to prepare the test samples. The mix proportion is done in Table 4.Mixing of concrete

Table-(4) ratio of concrete for paver block m20(1:1.5:3)

1	1.5	3
Cement	Sand	(Aggregates & Kota stone)
5 Kg	7.5 Kg	8 Kg Aggregate + 7 Kg waste kota-stone chips

(E) Preparation of Specimen

Mould: The plastic moulds having dog bone shaped interlocking paver blocks in 80 MM are used for casting paving block. They were made in such a manner as to facilitate the removal of the moulded specimen without any damage. The area of one mould is 31000mm2.

Weighing: The proportions or materials are taken by weight. The procedure we adopted was by weighing of the material as it is more accurate in comparison with volumetric method. Weight taken in weight machine of all material used.

Oiling in pavement block mould

Oiling is done in mould causes early removable of block. Not wear and tear in edge of block. Not problem associate remove the block.Then filling the mixture of concrete in mould and use plate vibrator. Then proper finishing work done.

Figure-3 Oiling of Mould

Mixing: After weighing all the ingredients which are to be used are taken for mixing process. The mixing process can done either by machine mixing.

Figure-4 Mixing all material in a mixer machine.

Vibrating: vibrating of concrete was done after placing the mixed concrete in the paver mould. the vibration work is carried out by vibrator plate apparatus. The concrete should be properly vibrated approx 30-60 sec. and confirms that the concrete becomes denser, as it improves strength of concrete.

Drying and curing: The casted concrete was allowed for drying for 24 hours in normal atmospheric temperature. After that, the concrete is demoulded and the blocks are cured with water to permit complete moisture for 28 days. Water in the curing tanks is changed every 7 to 10 days. After curing, the blocks are dried in natural atmosphere.

Figure-5 Curing

(F)Testing of paving blocks

The test procedures are conducted in this paver block experiment.

Compressive strength test:

The compressive strength of concrete paver block is one of the most important and useful properties of concrete. It was determined by using CTM (Compression testing machine). The CTM equipped with two steel bearing plates for holing the specimen. The specimen was placed between the steel plates. The specimen after dried, placed on the CTM. The load was gradually applied till the specimen undergoes failure.

Figure-(6) I Shape Interlocking paver block

The dimensions and plan area of the specimens were determined**.** The maximum load applied on the specimen was noted in N.

Figure-7 Testing of specimen at CTM

Compression strength $= \frac{Applied\ load}{Plan\ area} = \frac{N}{mm^2}$

Table-5: Compressive strength test for conventional concrete

Curing days	Applied load (KN)	Compressive strength (N/mm2)
7 Days	450	14.41
28 Days	615	19.83

Conclusion

From this study, the following conclusions can be drawn. The main aim of this research is to replace the certain amount of course aggregate with kota-stone waste chips accordingly in the ratio of (60:40) where 60% course aggregate and 40% kota stone respectively by weight for m-20 grade concrete. Make the Specimen by using I shape dog bone shaped paver block moulds and M20 grade of concrete. The compression strength test of paver block is 19.83 which is approx to 20 N/mm2 . Use of waste kota stone chips make it eco friendly & economical. It is the better use of waste kota stone chips. Waste utilization making it more environmental friendly. Utilization of kota Stone waste and its application are used for the development of the construction industry, & Material sciences. It is the possible alternative solution of safe disposal of kota Stone waste.

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