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Study of Compressive Strength in Concrete Block by Partial Replacement of Marble Dust and Kota Chips

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Abstract: Natural river sand takes millions of years for its formation and is not renewable. As a substitute to natural sand, artificial sand is used as a replacement. In this paper the performance of concrete is assured by partially replacing the natural sand with marble dust and Coarse aggregate by kota stone chips which is a waste product of building construction material. The experimental study is carried out for compressive strength of concrete by partially replacing artificial sand by marble dust and coarse aggregate as kota stone chips. Tests over carried out on cubes to studies the mechanical properties of concrete using, marble dust and kota stone chips and compare with normal concrete. Natural sand and coarse aggregate were Replaced with some percentages. Test results showed a nominal increasing strength and durability properties of concrete by the addition of waste marble dust and kota stone chips as a partial replacement of natural sand and coarse aggregate

Keywords— Building waste material, marble dust, kota chip

I INTRODUCTION

The waste material engendered in the open areas can cause hazardous environmental complications. Hence, utilization of these waste materials in the construction industry can be a solution to prevent these problems. In the process of cutting and polishing of natural stones a large amount of stone dust are generated. Stone wastes generated from marble/granite/kota stone lays a great impact on both the environment and humans. Thus, stone industries producing large amount of stone waste are responsible for generating many environmental issues. Production of cement and its use has rapidly increased, which has increased utilization of supplementary materials on regular basis in the form of solid segment.

Marble Dust

The waste generated from the marble industries during the process of cutting and polishing of marble stone is increasing day by day all over the world. So, the reuse of the marble waste is necessary because this marble waste results in the accumulation of landfills, environmental and pollution problems. These problems can be reduced by considering the marble waste as a non-primary aggregate in structural concrete. This research describes the feasibility of using marble waste in concrete production by partial replacement of coarse aggregate. The aim of the research is to replace the recycled marble waste aggregate (RMWA) by weight of natural aggregate according to the range of 0%, 20%, 40%, 60% and 80%. The investigation was carried out on different concrete mixes and was tested in terms of workability and compressive strength test. The slump test result shows that as the percentage of RMWA increases. the workability increases due to the smooth surface of recycled marble waste aggregate. From the compressive strength test results it was concluded that as the percentage of RMWA increases the strength significantly decreases. The reason for the reduction of compressive strength was the smooth surface of RMWA which results in the weak bond

Fig. 1 Marble crush

Kota Stone Chip

Kota stone is a fine grained variety of lime stone quarried at kota district , rajasthan , India . Kota stone industry generates both solid waste and stone slurry. During the process of cutting, in that original stone waste mask is lost by 25-30% in the form of dust. The study concerns mainly on the possible use of stone waste in construction industry, which would reduce both environmental impacts and the production cost. Concrete works in the construction industry are particularly important as it is not only responsible for consuming natural resources and energy but also its capacity to absorb other industrial waste. The main objective of this investigation is to increase the compressive strength of concrete blocks and decrease the cost of concrete blocks by replacing aggregates with the Kota stone chips.

Fig. 2 Kota Stone Chips

II METHODOLOGY

A total of four series of concrete specimens including the control specimen were prepared in order to examine the effect of substituting marble dustand kota stone chips (0, 20, 40 and 60% by weight) in place of sand to investigate the basic strength properties of concrete.

Ordinary Portland cement (OPC), grade 53 confirming to IS 8112:1989 was used throughout the investigation. The marble dust obtained as an industrial byproduct directly from the deposits of marble factories is used as a sand replacement material.

The coarse aggregate used in this investigation have a maximum size of 20 mm with grading confirming to IS-383-1970. The natural river sand passing through 4.75mm sieves is used throughout the process.

The design of concrete mix is done as per guidelines of IS 10262: 2009 with a grade of M30 concrete. The mixing of concrete is done using a standard mechanical mixer. The mixing is to be done for two minutes for all the ingredients to feed inside the mixer.

Compaction of all the specimen was done by using shake table vibrator. The top surface of concrete is leveled and finished smooth. After six hours, the specimen detail and date of concreting will be specified on top surface to identify it properly.

III MATERIAL USED

Cement: Ordinary Portland cement of 53 grades is used.

Table No. 1 Physical Properties of Cement

Test conducted	*Result*
Specific gravity	*3.15*
Standard Consistency, %	*38*
Initial setting time, min.	*35*
Fineness, %	*2*

Aggregate: Natural Sand as fine aggregate and coarse aggregate of 20mm size is used.

Table No. 2 Physical Properties of Aggregate	
Test conducted	*Result*
Specific Gravity of Fine Aggregate	*2.95*
Specific Gravity of coarse Aggregate	*2.86*

Water: Ordinary potable water was used for mixing.

IV RESULT AND DISCUSSION

Casting of cube having size 150mm×150mm×150mm concrete blocks specimen with ordinary Portland cement and Fine aggregate and course aggregate partially replaced by marble dust and kota chips accordingly at 0%, 20%, 40%, 60%. Level is cast individually during casting the blocks are made in hand press machine. After making the specimens are removed from mould and subjected to water curing for 7, 14, 28 days. After curing the specimen are tested for compressive strength using compression testing machine of 2000KN capacities. The compression test is carried out on specimens at the end of 7 days, 14days, and 28days of curing.

During entire process i.e. from casting of cube to testing of cube following conditions were observed

- *As proportion of replacement increases the workability of concrete decreases*
- *Nature of failure of cube during testing was like disintegration of concrete i.e cube breaks into small, loose particles.*
- *Cracking pattern of cube during testing was radial.*
- *As the proportion of replacement of increases compressive strength of block decreases.*
- *Following pictures were taken during the entire process i.e from casting of block and testing of block.*
- *Various Solid concrete block mix proportions for 10 blocks per batch is shown in following table*

Table 3 Mix Proportions of Solid Concrete Blocks

Solid Concrete Block Mixes	*Cement (Kg)*	*Fine Aggregate (Kg)*	*Coarse Aggregate (Kg)*	*Marble Dust (Kg)*	*Kota Stone Chips (Kg)*
0%	*20*	*30.20*	*58.80*	-	-
20%	*20*	*24.16*	*47.04*	*6.04*	*11.76*

40%	*20*	*18.12*	*35.28*	*12.08*	*23.52*
60%	*20*	*12.08*	*23.52*	*18.12*	*35.28*

Table 4 Compressive Strength of Cube

Partial Replacement (Marble Dust & Kota Stone Chips)	*Compressive Strength (N/mm2)*		
	7 Days	*14 Days*	*28 Days*
0%	*22.44*	*29.06*	*30.13*
20%	*20.04*	*25.02*	*26.17*
40%	*10.75*	*14.13*	*16.80*
60%	*8.84*	*11.33*	*13.06*

After testing concrete blocks it is observed that compressive strength of block slightly decreases up to a certain limit, as the proportion of replacement increases the strength of block decreases accordingly.

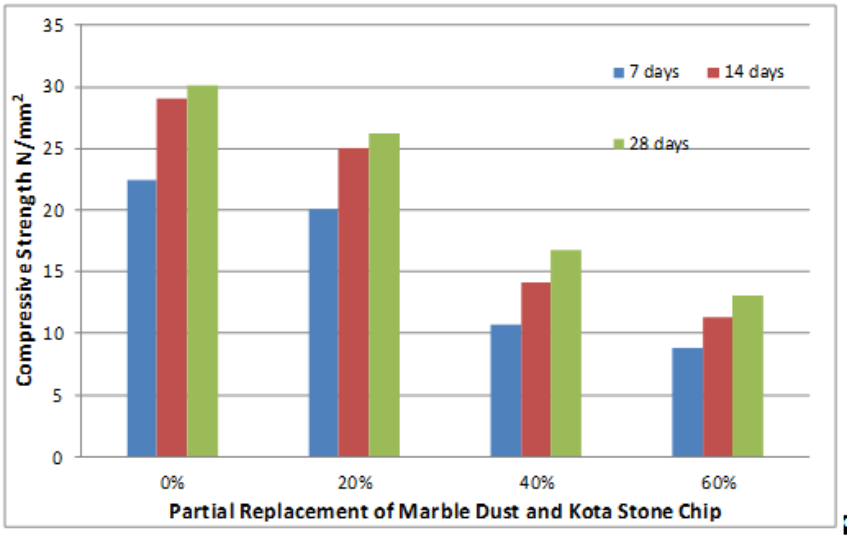

Fig. 3 Comparison of Compressive Strength of Different batches

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