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A Comparative Investigation on Utilization of Limestone Dust as a Partial Replacement of Cement and Limestone Chips for Fine Aggregates

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ABSTRACT
During Recent days as there is seen an expandable rise in Construction Works the use of River Sand is also increasing significantly at a rapid rate and due to its fixed amount of availability there is a need to find the replacement of River Sand or Fine Aggregates. So here we are partially replacing the River Sand with Limestone Chips and Ordinary Portland Cement with Limestone Dust to see its properties. The study is done to determine the Compressive Strength Test. The use of Ordinary Portland Cement of 43 grade has been made. The samples of concrete (Cubes) were made for two different Grade i.e. M20 and M25 with variable mix Percentages of Limestone Chips (i.e.10%,20%,30% and 40%) while the Limestone Dust is replaced by 10% of OPC for every mix prepared. The different Design Mixes were Prepared. The results after tests were compared to that of Conventional Concrete and determination of the concrete mixes were made if they are suitable to use for structural members of buildings and related structures.

Keywords *—Cluster, Crime Rate predict, K means cluster*

I. INTRODUCTION

Irregularities are not avoidable in construction of Buildings [1]. This paper is about studying the Structural Characteristic of concrete mixes using various combination of Limestone Dust with Cement and Limestone chips as Fine Aggregates. Limestone's are sedimentary rocks, formed by remains exampleshells or skeletons, remained for a huge amount of time [2]. The major constituent found in limestone is calcium carbonate and it may also contain magnesium, iron or manganese too, which affects the whiteness and hardness of Limestone [3-4]. Here the Chemical Composition of Limestone that was collected from Nandini Mines, Jamul, Bhilai was known to be Sio2 – 12.45%, Cao- 45.15% and Mgo – 0.46%. It is one of the main ingredients that are used in construction industry but also has many uses in day to day life [5]. On comparing with normal concrete with same amount of water/cement ratio and cement types, the concrete having high content of limestone powder with considerable particle size distribution aids to in general improve characteristic strengths [6]. Concrete those are made with limestone dust as partial replacement of OPC in concrete can take lime stone dust for up to 10% without affecting concrete strength adversely [7]. Concrete that is made with limestone dust as partially replacement of cement in concrete can take lime stone dust up to 20% without affecting concrete strength adversely [8-9]. Concrete with the use of various combinations of lime stone chips and lime stone dust as replacement of OPC and River sand [10]. Different Design Mixes were done for production of higher compressive strength, tensile strength and good workability for M20 and M25 mix proportions [11-12]. Mainly compressive strength that ranges between 21.06 - 35.2N/mm2 for concrete mix was considered. Different mixes were prepared for partially replacing River Sand with Limestone Chips for 10%, 20%, 30% and 40%, and Limestone Dust is replaced by Ordinary Portland Cement for 10% and the results were compared with that of Conventional Concrete..

II. SIGNIFICANCE OF THE WORK

Nowadays as the Construction Industry is growing at a massive rate the demand for Construction Materials is also increasing, so there is need to find new materials to achieve new goals [13]. According to the studies done the replacement of some part of River Sand (fine aggregate) with Limestone Chips and Ordinary Portland Cement with Limestone Powder shows same Compressive Strength properties. The main aim of this study is to reduce the use of River Sand and Cement and to achieve good environment conditions as per future prospects.

Figure 1. Used Materials

III. EXPERIMENTAL WORK

In this study the Limestone Chips and Limestone Dust are forms of waste materials of Crusher mines. The Limestone Dust is replaced by 10% quantity of Ordinary Portland Cement for every mixes prepared and the Limestone Chips are replaced for varying percentages for 10%, 20%, 30% and 40%.These mixes were prepared for M20 and M25 grades of concrete. For every kind of mix 3 samples were made and for both the grades Nominal Mixes were also made to Compare. In total 60 samples were prepared and tested for 7 and 28 Days compressive strength tests.

- Cement – Ordinary Portland Cement (Ultratech OPC) was used. Different tests were performed like Initial setting time, Final setting time, Consistency test and Soundness test.
- Coarse Aggregate – Normal Crusher Stones passing 20mm Sieve were taken into account for the study.
- Fine Aggregates – (A). River Sand was taken for the study passing 4.75 mm Sieve and tests like specific gravity using Picnometer and Sieve Analysis were done. (B). Limestone Dust was collected from the Baloda-Bazar District of Chhatisgarh and Sieve Analysis is performed. The Limestone Dust passing 90 micron Sieve were taken for replacement with Cement.
- Water – Water plays a vital role in making concrete as it the reason behind Chemical reaction between the materials. Water having PH-7 is used for mixing and curing purposes.

IV. METHODOLOGY

The Cubes were casted for M20 and M25 grade of Concrete for which Mix Designs were done and the ratio for M20 is (1:2:3.64) and for M25 it is (1:1.73:3.27). Then after calculating the weight of materials.

1. Take the weighted materials i.e. Fine Aggregate and Coarse Aggregate along with the Limestone Chips for which it has to be replaced and Cement replaced with Limestone Dust in a Pan.
2. Dry mix the materials thoroughly.
3. Mix all the materials side by side and by turning it over each other and then make a hollow at the centre.
4. Add Appropiate quantity of water by measuring and mix the dry mixture thoroughly.
5. Now put the mixture in oil polished Cube Moulds for 1/3 part.
6. Now after temping 25 times fill the 2/3 of the mould and repeat the process.
7. Now completely fill the mould and level it then put on Table Vibrator then keep for 24 hours.
8. After 24 hours take the specimen out of the mould and keep for Curing in curing tanks.
9. After 7 & 28 Days the specimens will be taken out of curing tanks and Compressive Strength tests will be performed.

V. RESULTS AND DISCUSSION

For Limestone Dust to be replaced in all Mixes by 10% of Cement Content and Limestone Chips by 10%, 20%, 30% and 40% of River Sand. The 7 Days Compressive Strength increments then Nominal Mix for M20 grade was between 16% to 50% and for 28 Days it is between 0% to 12%. As same for 7 days Compressive Strength for M25 Grade was between 0% to 6% and for 28 Days it is between 0% to 8%. It is also Observed that the highest Compressive Strength for all grades was obtained when River Sand is replaced by 30% Limestone Chips and Cement by 10% Limestone Dust.

Table 1. Experiment Investigation on Compressive Strength of M20 of M20 Concrete with different % Mix

% age Mix (Cement partially replaced by Limestone Dust)	% age Mix (River Sand partially replaced by Limestone Chips)	7 Days Compressive Strength (MPa)	28 Days Compressive Strength (MPa)
0%	0%	13.23	21.67
10%	10%	15.45	19.01
10%	20%	15.90	22.56
10%	30%	19.90	24.34
10%	40%	18.32	22.76

Table 2. Experiment Investigation on Compressive Strength of M25 Concrete with different % Mix

% age Mix (Cement partially replaced by Limestone Dust)	% age Mix (River Sand partially replaced by Limestone Chips)	7 Days Compressive Strength (MPa)	28 Days Compressive Strength (MPa)
0%	0%	20.48	25.67
10%	10%	21.23	27.45
10%	20%	19.90	23.67
10%	30%	21.67	26.56
10%	40%	18.76	22.32

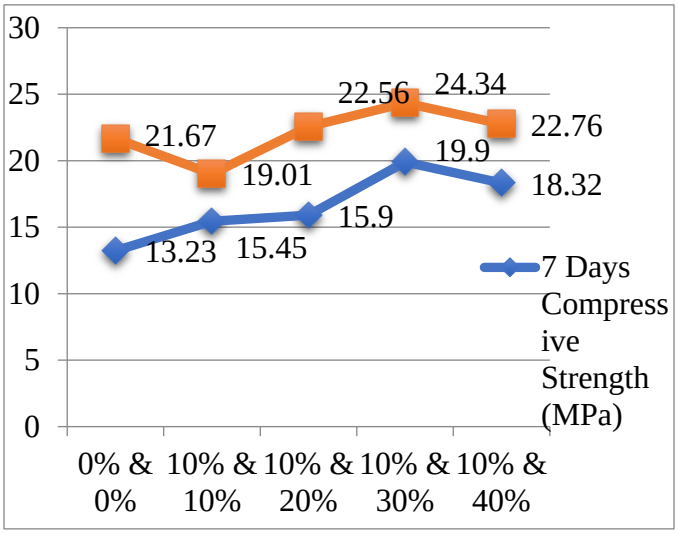

Figure 2. Compressive Strength of M20 Concrete with different % age Mix (Cement partially replaced by Limestone Dust & Limestone Chips) for 7 and 28 Days

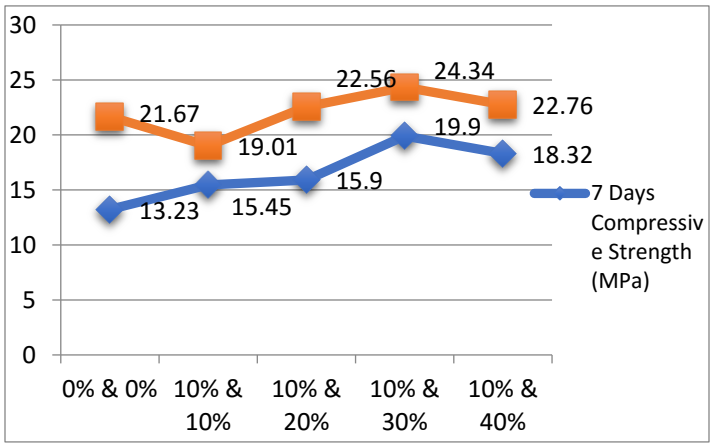

Figure 3. Compressive Strength of M25 Concrete with different % age Mix (Cement partially replaced by Limestone Dust & Limestone Chips) for 7 and 28 Days

VI. CONCLUSION

Compressive Strength test were done for concrete mixes at age of 7 and 28 days for Limestone Dust to be partially replaced by Cement by 10% for all mixes and Limestone Chips to be replaced partially by River Sand by 10%, 20%, 30% and 40%. The tests result was compared to Conventional Concrete result and it is seen that the mix with 10% and 30% replacement was suitable for making Concrete and in use of Structural Members of building structures. The costs of building construction can also be reduced as the Limestone Dust and Limestone Chips are waste materials of quarries and due to high demand the cost of River sand is also increasing rapidly.

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