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Study on Compressive Strength of Concrete by Partial Replacement of Fine Aggregates with Tandur Tile Dust Powder (TSP)

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Abstract:

Tandur Stone is a polished limestone available in Tandur town, Telangana State, India. Tandur Stone Powder is the powder that is being obtained upon the crushing of Tandur stones which is lying as a waste at Tandur town outskirts. In this investigation some proportion of sand that is fine aggregate is replaced with Tandur Stone dust Powder alone by 0%, 20%, 30%, 40% and 50%. In this experimental investigation, parameters like, compressive strength of M20 and M30 grade concrete along with water cement ratio of 0.45 and 0.5 for both the mix designs are compared. Standard cubes of 150mm x 150mm x 150mm are considered for 28 days Compressive Strength. The result shows that the replacement of fine aggregate by 40% gives more strength than other replacement proportions for both the mix designs and for both the water cement ratios. At water cement ratio of 0.45 the obtained strength is 40.29 N/mm2 and 40.18 N/mm2 for M20 and M30 designs respectively, at water cement ratio of 0.5 the obtained strength is 37.74 N/mm2 and 38.33 N/mm2 for M20 and M30 designs respectively. From this research the replacement of tandur stone dust powder with fine aggregate attains better results than the direct use of fine aggregate.

Key Words: Fine Aggregate, Stone Dust Powder, Mix Design, Water Cement Ratio and Compressive Strength.

INTRODUCTION:

Construction industries of developing countries are in stress to replace natural sand in concrete by an alternate material either partially or completely without compromising the quality of concrete. On the other hand, the advantages of utilization of by products or aggregates obtained as waste materials are pronounced in the aspects of reduction in environmental load & waste management cost, reduction of production cost as well as augmenting the quality of concrete. In the past good attempts have been made for the successful utilization of various industrial by products (such as fly ash, silica fume, rice husk ash, foundry waste) to save environmental pollution. At present the cost of sand and stone are higher because the material has been reducing day by day and the pumping of sand from the river banks has been increasing which affects the environment and create environmental problems. In this context, fine aggregate has been replaced by tandur tile dust. As a result reasonable studies have been conducted to find the suitability of by product i.e. tandur tile dust in conventional concrete. However, recycled concrete aggregate, fly ash, blast furnace slag, as well as several types of

manufactured aggregates have been studied by many researchers. High % dust in aggregates increases the fineness. The total surface area of aggregate particles. The surface area is measured in terms of specific surface, i.e. the ratio of the total surface area of all the particles to their volume. The present study is intended to study the effects of tandur dust addition in conventional concrete and to assess the rate of compressive strength development for different tandur tile dust to coarse aggregate ratio. This research has aimed to study about compressive strength of the concrete using tandur tile dust as fine aggregate to replace sand. The main objective is to provide more information about the effects of various proportion of dust content as partial replacement of crushed stone fine aggregate on workability, air content, compressive strength, tensile strength, absorption percentage of concrete

MATERIALS AND METHODS:

Concrete is a composite material which is made up of filler and a binder. Typical concrete is a mixture of fine aggregate (sand), coarse aggregate (rock), cement, and water. Aggregates are chemically inert, solid bodies held together by the cement. Aggregates come in various shapes, sizes, and materials ranging from fine particles of sand to large, coarse rocks. Because cement is the most expensive ingredient in making concrete, it is desirable to minimize the amount of cement used. 70 to 80% of the volume of concrete is aggregate in order to keep the cost of the concrete low. The selection of an aggregate is determined, in part, by the desired characteristics of the concrete. Water is a transparent and nearly colorless chemical substance that is one of the main constituent of Concrete which available abundantly on Earth's streams, Lake Sand oceans and the fluids of most living organisms. Cement is a binder, a substance used for construction that sets, hardens and adheres to other materials, binding them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together. Cement is used with fine aggregate to produce mortar for masonry, or with sand and gravel aggregates to produce concrete. Here we replaced fine aggregate with tanduru dust powder from 0%, 20%, 30%, 40% and 50% with the use of M20 and M30 mix design procedures to determine the compressive strength of concrete at 0.45 and 0.5 water cement ratios.

Fine Aggregate replaced with Tandur Stone Dust Powder (TSP):

Tandur tile dust, a by-product from the crushing process during construction activities. Tandur tile dust was obtained from telangana, India. As already discussed, TSP, a product of limestone, readily available in plenty of quantity at Tandur town outskirts as a waste is used in this project to replace sand partially. TSP is basically obtained upon crushing of Tandur stone (limestone) while polishing Tandur stones and finishing the stones which are shown in below figure.

Concrete Tests:

Various Concrete mixes was prepared with the help of selected mix proportions of M20 & M30 with partial replacement of TSP. Before that various physical properties of cement, Fine Aggregates and Coarse Aggregates are tested and the Sieve analysis of Fine Aggregates and Coarse Aggregates are also estimated. Mix designs for each set having different combinations are carried out by using IS 10262-2009 method. The mix proportions obtained for normal M20 and M30 grade concrete is 1:1.5:3 and 1: 0.75: 1.5 with water cement ratios used 0.45 & 0.50. The concrete tests are divided into two categories, one is Workability and second one is Compressive Strength analysis. With reference to the above mentioned mix design we prepared specimens (Cubes) to test at an age of 28days.

RESULTS AND DISCUSSIONS:

With reference to the above chapters, we conducted experiments on compressive strengths with the replacement of various proportions of sand or fine aggregate with tandur stone dust powder (TSP). The cubes are casted for the replacements of 0% TSP, 10% TSP, 20% TSP, 30% TSP, 40% TSP and 50% TSP to determine the strength of concrete. The compressive strengths are determined for each and every specimen casted at the 28days basis, and are compared to know, the impact of with replacement of fine aggregate from 10% to 50% and without replacement of fine aggregate (0%). The obtained Compressive strength results are denoted in Table.1 for M20 and M30 with water cement ratio of 0.45 and 0.5. The obtained compressive strength results are plotted in Figure.1. for M20 and M30 with water cement ratio 0.45 and Figure.2. Denotes the compressive strength results of M20 and M30 with water cement ratio 0.5.

Table.1. Compressive Strength Results

Compressive Strength Results N/mm^2				
At the Age of 28 Days				
% TSP	M20		M30	
	0.45	0.5	0.45	0.5
0% TSP	37.93	25.98	30.16	30.96
20% TSP	37.93	37.93	38.37	32.29
30% TSP	37.92	36.92	38.22	38.22
40% TSP	40.29	37.74	40.18	38.33
50% TSP	39.5	32.79	39.27	33.27

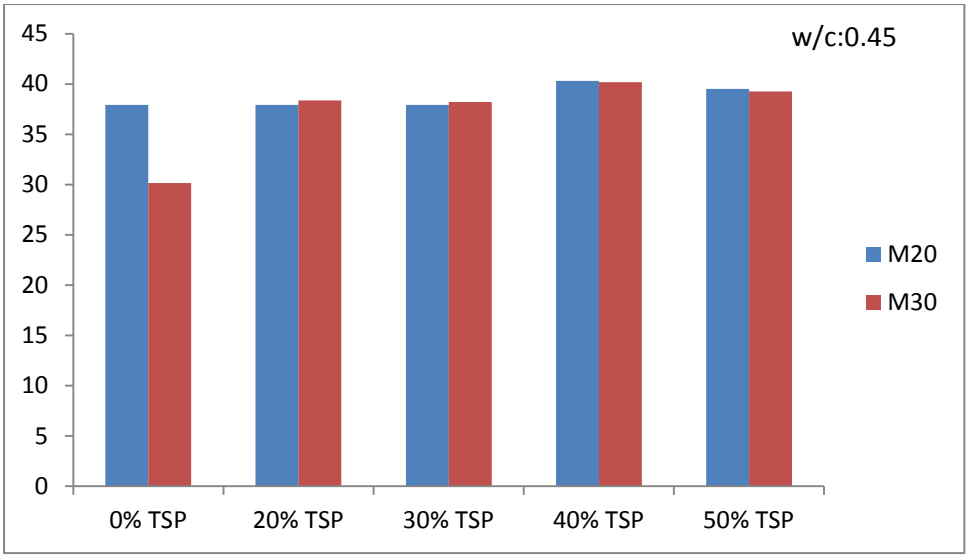

Figure.1. Compressive Strength of M20 and M30 with w/c:0.45

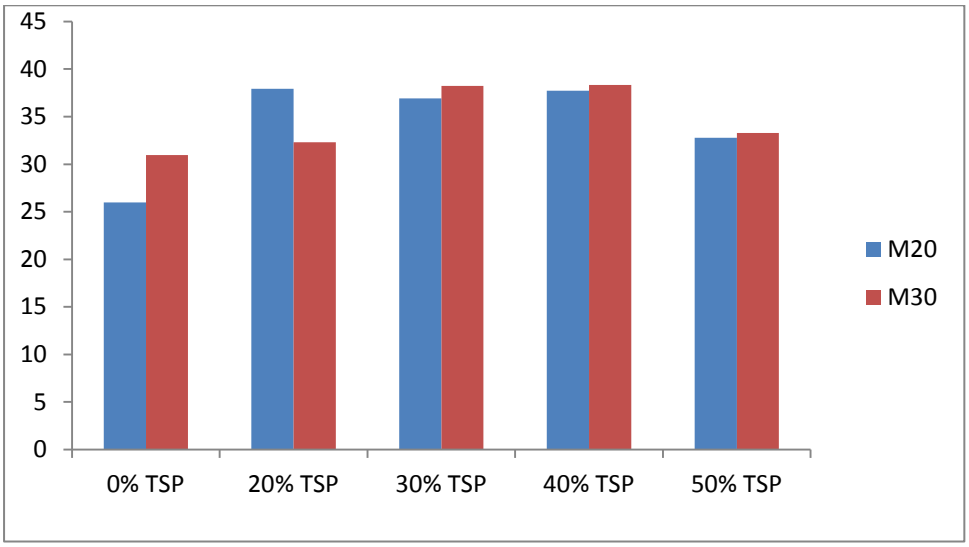

Figure.2. Compressive Strength of M20 and M30 with w/c:0.5

Variation of compressive strength with conventional concrete and tandur tile dust concrete is shown in the figure. It is observed that the variation is about 10-15% increment of compressive strength for tandur tile dust concrete (40%) when compared to conventional concrete. It is noticed that, as the percentage of tandur tile dust increases, the compressive strength values increases. The partial replacement of Tandur tile Dust with sand gave a 28 days peak compressive strength at 40% replacement level and decreases for 50% replacement. The graph shows that the compressive strength relation for both conventional concrete and tandur tile dust concrete, at the age of 28days for M20 and M30 grade of concrete for different w/c ratios of 0.45 and 0.5. Increase in compressive strength associated with partial replacement of sand with tandur tile dust can be attributed to frictional resistance's component's contribution to compressive strength arising from the rough and irregular nature of tandur tile dust particles that fills the voids between the gravel and sand particles while cement binds the components together. Strength obtained with the use of only river sand as fine aggregate and river gravel as coarse aggregate is

dependent more on the bonding strength of cement that fills the voids between the coarse aggregate and the river sand particles as its frictional resistance contribution to strength is less due to smooth and rounded nature of river gravel and sand particles used as coarse and fine aggregate respectively.

CONCLUSIONS:

The concept of replacement of natural fine aggregate by tandur tile dust highlighted in the present investigation could boost the consumption of generated tile dust, thus reducing the requirement of land fill area and conserving the scarcely available natural sand sustainable development. Thus this reduces the burden of dumping excess waste of tile dust on earth and hence environmental pollution. From the results of experimental investigations conducted it is concluded that the tandur tile dust can be used as a replacement for fine aggregate. It is found that 40% replacement of fine aggregate by tandur tile dust give maximum result in strength than conventional concrete and then decreases for 50%. The results proved that up to 40% replacement of fine aggregate by the quarry dust induced higher compressive strength and the workability of concrete decreases as replacement increases. Thus the environmental effects and waste can be significantly reduced. Also the cost of fine aggregate can be reduced a lot by the replacement of this waste material. It is found that the strength of concrete is more for w/c of 0.45 when compared with w/c of 0.5. As the quantity of water increases the compressive strength decreases when replaced with tandur tile dust. This is due to the water absorption property of tandur tile dust. The result shows that the replacement of fine aggregate by 40% gives more strength than other replacement proportions for both the mix designs and for both the water cement ratios. At water cement ratio of 0.45 the obtained strength is 40.29 N/mm2 and 40.18 N/mm2 for M20 and M30 designs respectively, at water cement ratio of 0.5 the obtained strength is 37.74 N/mm2 and 38.33 N/mm2 for M20 and M30 designs respectively. From this research the replacement of tandur stone dust powder with fine aggregate attains better results than the direct use of fine aggregate.

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