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Replacement of Sand by Quarry Dust in Concrete

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Abstract: ***The role of quarry dust in the construction of building and other structures to eliminate the demand of nature sand by using quarry waste to replace the use of natural sand. We are investigating the potential of using quarry waste and its effect on the strength and workability of concrete. Initially cement concrete cube was studied with various proportion of cement concrete +quarry dust (M20 & M25). The experimental result showed that the additional of quarry dust as fine aggregate ratio of 30%, 40% and 50% was found to enhance the compressive properties. The compressive strength of concrete cubes at the age of 7 and 28 days were obtained at room temperature.***

These raw materials of concrete, i.e., river sand and gravel, are also struggling to cope with the rapidly growing demand in many areas around the globe. The sources of good quality river sand and gravel are depleting very fast. According to United Nations Environment Program (UNEP) report, "Sand-rarer than one thinks", published in March2014, sand and gravel has now become the most widely used natural resource on the planet after water. These are now being extracted at a rate far greater than their renewal. Crushed sands, fine aggregate produced from stone crushing, has become very popular in areas where natural sand is not abundantly available or where there is scarcity in the supply of natural sand. The Mumbai-Pune express highway was a project, where there is a difficulty in procurement of natural sand. This made the construction company to use crushed sand for making approximately 20 lakh cum of concrete necessary for the construction. However, such type of sands contains a large amount of micro-fines, i.e., particles finer than 75 microns, which can have an adverse effect on properties of concrete. So proportioning of different raw materials at the time of mix design is very important, when crushed sand is used in concrete

The availability of sand at low cost as a fine aggregate in concrete is not suitable and that is the reason to search for an alternative material. Quarry dust satisfies the reason behind the alternative material as a substitute for sand at very low costIt is found that 40% replacement of fine aggregate by quarry dust gives maximum result in strength than normal concrete and then decreases from 50%. The compressive strength is quantified for varying percentage and grades of concrete by replacement of sand with quarry dust.

Keywords: ***Quarry Dust, workability, compression strength, flexural strength.***

I. INTRODUCTION

Concrete, the single most widely used building material around the globe, is a heterogeneous composite that consists of combination of readily available basic building materials including cement, water, coarse aggregate, fine aggregate, and in some cases, admixtures, fibres or other additives, according to the need. When these ingredients are mixed together, they form a fluid mass that is easily moulded into any shape. Over time, when it is cured sufficiently, the cement forms a hard matrix which binds the rest of the ingredients together into a durable stone-like material, called concrete. Humans have been using concrete in their pioneering architectural feats for millennia. Due to the ongoing boom in the housing sector and other developmental activities in the construction field, the demand of concrete is increasing with a very rapid pace all over the world. Worldwide, some 12 billion tons of concrete is being produced each year, as per a report published by United Nations Environment Program. Such volumes require vast amount of natural resources for aggregate and cement production. For instance, cement consumption around the world has multiplied three-fold in last 20 years, from 1.37 billion tons of cement in 1994 to 3.7 billion tons in 2012, mainly due to the rapid economic growth in Asia. Interestingly, China consumed about 58% of the total cement production in 2012.

Physical disturbances due to human activities also lead to interruption in nesting/breeding activities. For example, in the National Chambal Sanctuary, mining of sand adversely affected ghariyals, who use sand banks for nesting and basking. They lay eggs under the sand beds, which were destroyed by sand mining related activities. The problem of environmental impacts associated with excessive sand mining has now become so serious that existence of river ecosystems is threatened in a number of locations, damage being more severe in small river catchment. As a result, many governments all over the world have banned sand mining from the rivers.

A. Objectives

1) To achieve a specified compressive strength for a specified grade.
2) To maintain workability of concrete mix throughout work.
3) To achieve durability.
4) To achieve economy by selecting appropriate concrete ingredients.
5) To obtain maximum possible yield per bag of cement.
6) To avoid honeycomb and bleeding.
7) To comply with various standards.
8) To reduce wastage of concrete by correct proportioning.
9) Due to presence of silt and clay in natural sand, if the natural sand is not properly processed at that point there will be harm in concrete in the beginning period.
10) Primary goal is to reduce the cost of the building by reducing the cost of concrete.
11) Secondary goal is to show that natural sand can be replaced by quarry dust sand.
12) To determine the effect of substitution if sand by quarry dust sand on properties of concrete and to study the wokability of fresh concrete.
13) To study compressive strength and split tensile strength of hardened concrete.

B. Scope Of Project

1) Construction Projects that use quarry dust have proven to be cheaper than those that depend wholly on sand.
2) The dust come at cheaper cost and lesser pressure on market demand for sand. Partial replacement of sand with this dust will make good concrete that is well desired in residential construction.
3) As compared to sand and cement, the quarry dust is easily available. It requires less processing and it being a byproduct of quarrying, it is very accessible at large quantities for a cheaper cost.
4) Quarry dust has been proposed as an alternative to river sand that gives additional benefit to cement during construction.
5) In areas where constructors use this dust, there is a significant reduction of air pollution by the dust.
6) Quarry dust is very volatile and its inhalation can cause respiratory problems. Inclusion of the dust in construction projects will solve the problem of disposal of this dust.

II. LITERATURE REVIEW

1) Vijayalakshmi et. al. (2013) investigated the effect of replacement of river sand with granite powder on workability of concrete at a replacement level from 0% to 25%. They observed that there is a decrease in workability of concrete with increase in substitution rate. Very poor workability was observed in the concrete mixtures with 20% and 25% substitution rate. They concluded that this decrease in workability is due to the difference of particle size distribution, particle shape and surface texture between river sand and granite powder. Granite powder was very fine as compared to natural sand with 90% particles finer than 50 micron, which increased the specific surface area of fine aggregate, consequently increasing the water demand.
2) Singh et. al. (2016) investigated the effect of replacement of natural sand with granite cutting waste on workability of concrete at a replacement level form 0% to 40%. They observed that there is a significant decline in the workability of concrete with the increase in replacement of natural sand with granite cutting waste. They concluded that this decline in workability of concrete is due to the enhanced friction between the concrete particles as a result of the fact that granite cutting waste has relatively more angular and rough surface texture as compared to river sand.
3) Manaseeh Joel [2010] Slump, compressive and indirect tensile strength tests were performed on fresh and hardened concrete. Twenty eight days peak compressive and indirect tensile strength values of 40.70 N/mm2 and 2.30 N/mm2 respectively were obtained with the partial replacement of river sand with 20% CGF, as against values of 35.00N/mm2 and 1.75N/mm2 obtained with the use of river sand as fine aggregate. Basedon economic analysis and results of tests, river sand replaced with 20% CGF is recommended for use in the production of concrete. Conservation of river sand in addition to better ways of disposing wastes from the quarry sites are some of the merits of using CGF.
4) Jeyaprabha et. al. (2016) investigated the effect of incorporation of granite dust as a replacement of natural sand on compressive strength of mortar. They investigated the effect of 15% replacement of natural sand with granite dust at an age of 3, 7, 14 and 28 days of curing. They observed that there is an appreciable increase in compressive strength of mortar with incorporation of

granite dust as replacement of natural sand at all ages. the enhancement of compressive strength of granite dust mortar as compared to river sand mortar for curing period of 3, 7, 14 and 28 days is 48%, 57%, 61% and 43%, respectively. They concluded that the enhancement of compressive strength of mortar with addition of granite dust as replacement of natural sand may be due to the filling effect of granite dust due to its high fineness as compared to natural sand.

5) Ganesha Mogaveera. G. Sarangapani and Anand V. R. [2011] [3] have studied the effect of Partial Replacement of Sand by Quarry dust in Plain Cement Concrete for different mix proportions. They have concluded that sand can be replaced effectively by means of quarry dust up to 20% to 25%.

III. RESULT

A. Specimen 1

Conventional concrete with 100% river sand as fine aggregate

	7 DAY	28 DAY
Date of casting	09/02/2021	09/02/2021
Date of testing	16/02/2021	08/03/2021
Loading	130 KN	270 KN
Compressive strength	13 N/mm^2	27 N/mm^2

B. Specimen 2

Concrete with sand replaced by quarry dust by 50% as fine aggregate

	7 DAY	28 DAY
Date of casting	09/02/2021	09/02/2021
Date of testing	16/02/2021	08/03/2021
Loading	120 KN	210 KN
Compressive strength	12 N/mm^2	21 N/mm^2

C. Specimen 3

Concrete with sand completely replaced by quarry dust as fine aggregate

	7 DAY	28 DAY
Date of casting	09/02/2021	09/02/2021
Date of testing	16/02/2021	08/03/2021
Loading	120 KN	210 KN
Compressive strength	12 N/mm^2	21 N/mm^2

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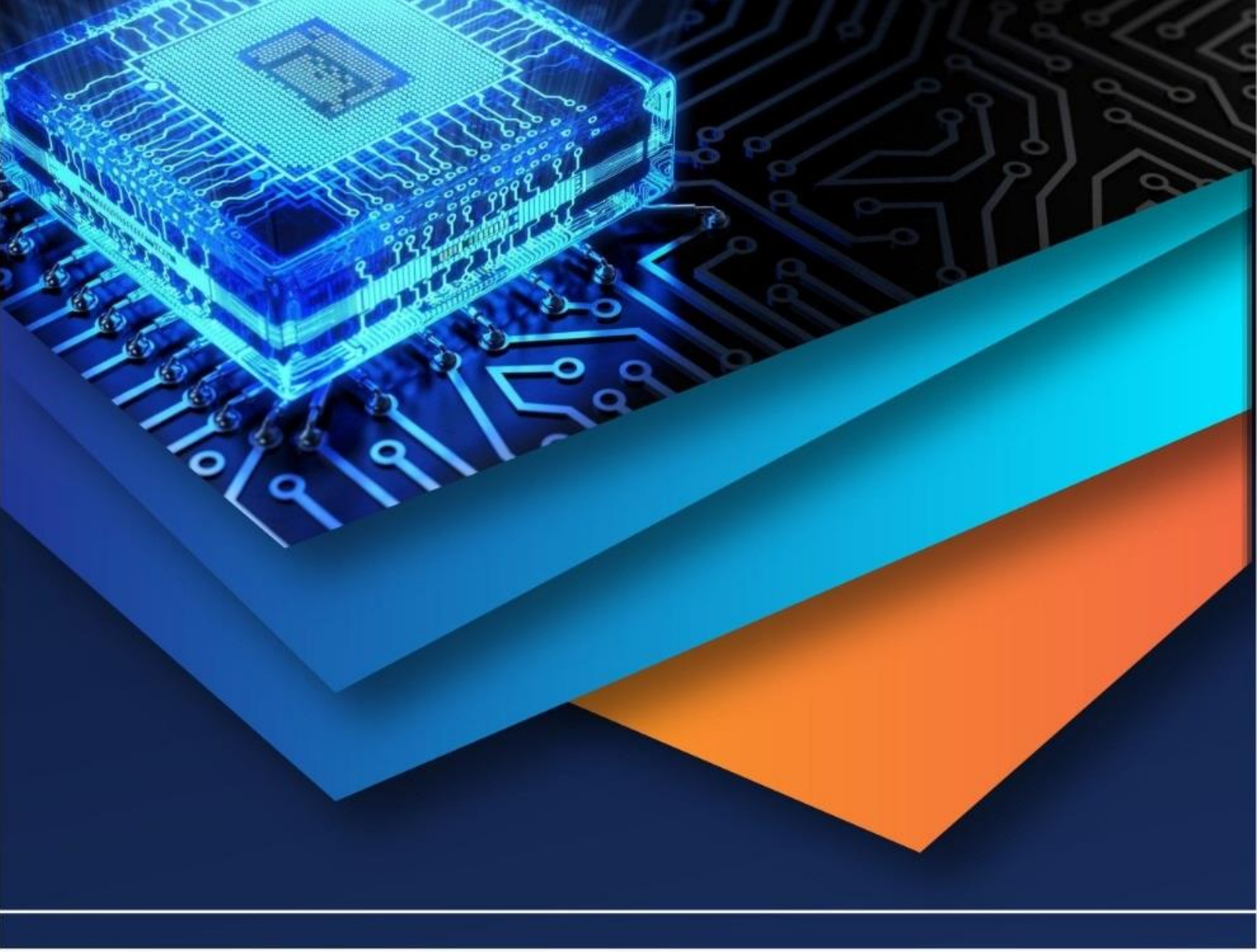

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