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Review Paper on Strength Properties of Concrete by Utilizing a Sandstone Cutting Waste

Vishwendra Singh[1], Pushpendra Kumar Kushwaha[2], Mithun Kumar Rana[3]

[1]M. Tech. Research Scholar, Civil Department, RKDF College of Engineering, Bhopal (M. P.),402026 India
[2]Assistant Professor, Civil Department, RKDF College of Engineering, Bhopal (M. P.), 402026 India
[3]Assistant Professor, Civil Department, RKDF College of Engineering, Bhopal (M. P.), 402026 India

ABTRACT

The development of infrastructure to fulfil the demands of the expanding population is a challenge for the entire planet. There is a huge need for concrete. The need for aggregates rises quickly as a result of the production of concrete, and the natural resources used to make aggregates are disappearing at an alarmingly rapid rate. All concrete mixtures were created in accordance with the guidelines outlined in IS 10262-2009. In addition to replacing the fine aggregates with 10%, 20%, 30%, 40%, 50%, and 100% sandstone cutting waste (SCW), In terms of compressive strength, flexure strength, and tensile strength, concrete's mechanical properties when combined with SCW have yielded promising results. In comparison to the control concrete, the strength of the concrete samples increased to an ideal level of 30% replacement of sandstone cutting wastes.

The test findings for SCW replaced concrete show better resistance to chloride, carbonation, and shrinkage at an ideal replacement level of 30%. Up to the ideal level of 25–30% SCW replacement levels, the weight loss caused by acid and sulphate attack on SCW substituted concrete was essentially identical to that of control concrete.

Key word - water absorption, sandstone cutting wastes. compressive strength, flexure strength, and tensile strength, environment and human health

1. 1 Introduction

Concrete, a commonly used building material worldwide, is primarily composed of cement, coarse aggregates, fine aggregates, and water. The demand for concrete has increased as a result of the sharp increase in construction activity that has occurred over the past few decades. The constant mining and extraction of the raw materials required to manufacture concrete has contributed to the depletion and degradation of their natural resources in addition to the accumulation of stone and slurry wastes. Stone cutting-related occupational exposure to dust affects employees' baseline respiratory health condition and the quality of life for individuals living nearby in addition to being disposed of close to the mining zone. Use of sustainable waste products is required in substitution of conventional fine and coarse aggregates in concrete due to the alarming rate at which natural resources are depleting, issues with waste disposal, and health dangers. 70%–80% of the major volume of concrete is made up of coarse and fine aggregates, which are used as primary components.

1. 2 Literature survey & background

Overview In order to meet the need of the expanding population, infrastructure development and housing construction are increasing daily over the world. As a result, concrete production is likewise expanding quickly. The aggregates' order is the result of it. Additionally, the building industry and scholars are challenged by the ban on river sand in the majority of countries to investigate alternatives. Earth has a lot of stone trash, and many local governments and government authorities are concerned about how to dispose of this debris. This garbage disrupts the ecosystem, poses health risks, and costs the state money. The majority of stone wastes are recyclable and can help concrete's qualities. The mechanical and durability properties of concrete could benefit from the stone wastes. 2.1 Literature Review on Quarry Waste Apparently, N. According to Almeida et al. (2007), natural stone slurry may be utilised in concrete mixes as fine aggregates or micro-filters, which enhances the mechanical properties of the concrete. Many industrial by-products can also be made from natural stone slurry. According to a 2017 research by Mary Ann Q. Adajar et al., natural sand was substituted for waste from the aggregate quarry. The test results demonstrated that fine aggregates may be utilised in a concrete mixture in place of waste from an aggregate quarry, yielding strength values adequate for structural applications. Idrees et al. (2006) found that adding marble powder and quarry dust in place of sand increased compressive strength by up to 12.5% before waning with additional replacement. In addition, Idrees et al. (2006) showed that using Marble Powder and Quarry Dust in place of sand increased compressive strength by up to 12.5% before it started to decline with more replacement. Also, Dino et al. (2012)'s examination into granite waste found that it is possible to ensure that mining operations progress sustainably and produce profits for the businesses engaged in such operations. 7 As reported by Celik T. According to et al.'s (1996) research, increasing the amount of crusher dust in concrete by up to

10% increased its compressive and flexural strengths. Similar to this, it was found that the water permeability of concrete decreased as the proportion of dust content increased. based on study by Rodrigues R. structural concrete can often absorb marble-cutting sludge at replacement rates of up to 10% without affecting its mechanical performance, according to et al. (2015). Additionally, concrete with plasticizers performed mechanically better than concrete without plasticizers. Apparently, Sarbjeet S. according to et al. (2016), up to 40% of granite cutting waste may be utilised to partially replace sand in concrete for enhanced stability at 0.35 and 0.40 w/c. substituting 25% of river sand with granite cutting waste also increased compressive strength at 0.30 w/c. Sankh et al. (2014) found that adding quarry dust in place of some of the sand improved the compressive strength of the concrete. Due to quarry dust's capacity to absorb water, concrete's workability decreases as quarry dust content rises. The optimal ratio varied from 55% to 75% when quarry dust was used in place of the sand. According to Trilok et al. (2019), the inclusion of fly ash combined with quarry dust might achieve a 100% replacement of sand. They also stated that the dust from stone processing (20–60%) could build structural concrete up to 30% and materials for paving. Even more progress can be made in the economic and sustainability indices by using stone processing dust as fine aggregate. According to the results, employing slurry sludge as a water supply for making concrete has minimal effect on compression strength but significantly affects slump values. It is feasible to infer from this research that it is advantageous to use stone-cutting slurry sludge in the production of concrete up to a maximum of 25% of the total water volume. Crushed stone sand can make concrete with properties (compressive and flexural strength) equivalent to those of natural sand, according to Mundra et al. (2016). When utilised as fine aggregates in concrete, crushed stone sand preserves the ecological balance while also saving money. The literature evaluations cited above show that various forms of quarry waste, such as crushed stone sand, marble cutting waste, 8 granite cutting waste, quarry dust, and stone slurry, can partially replace sand. The bulk of the wastes mentioned above have shown greater mechanical and durability characteristics when compared to quarry waste based on its chemical and physical composition. The shape, size, and surface roughness of the particles have a significant impact on the properties of freshly formed and cured concrete. 2.2 Analysis of Workability Gopala et al. (2015) looked into the effects of sandstone dust or fines on workability characteristics in concrete with a constant w/c ratio of 0.45. He found that because sandstone dust absorbs a lot of water, adding sandstone penalty leads the slump value to decrease. At 10% replacement, the slump value was 55 mm, at 50% replacement, it was 22 mm, and at 100% replacement, it was nil. In contrast to sandstone fines with clay cement, which have a high water absorption, subarkose (CBKT Sample Code) has a moderate to medium water absorption but lowers slump as the number of fines increases. Both lethanite and sublitheranite reduce the slump values. Apparently, Sanjeev K. et al. (2017) found that as coarse particles were added to concrete at intervals of 20% from 0 to 100%, the workability of new concrete decreased. The research also included a super-plasticizer to maintain the required workability of different concrete mixtures.

Flexural Strength. Modi et al. (2018) showed improved flexural strength after 28 days with up to 30% replacement of sandstone dust in both M 20 and M 25 grade of concrete, compared to control mix concrete manufactured with natural sand. Additionally, it is simple to use in RCC projects. P.S. Kumar et al. (2007) reported on the flexural behaviour of high-performance reinforced concrete (HPC) beams using crushed sandstone aggregates. Because sandstone aggregates allow for uniform stress distribution in concrete and higher peak flexural strengths in the beams, they came to that conclusion. Santosh Kumar et al. (2017) investigated the properties of concrete made using thin quartz sandstone particles rather than natural sand. The flexural strength at 7 and 28 days was discovered to be higher than the intended mean strength of concrete but lower than that of standard concrete. The water-to-cement ratio in the mix design was 0.42. The objective mean strength of M 30 grade concrete can be raised by up to 30% by replacing quartz sandstone. According to Arif et al. (2018), one of the tiny particles utilised in concrete is sandstone slurry. Flexural strength decreases as proportion of slurry content rises. S. Kumar et al. (2016) investigated in their preliminary studies if the 28-day flexural strength of concrete beams was affected by the inclusion of additional quartz sandstone aggregates. A minor decrease in flexural strength of up to 40% replacement was seen compared to control concrete. The flexural strength loss was just 1.7% and 1.5%, respectively, for 0.4 and 0.45 w/c ratios. In mix designs with w/c ratios of 0.40 and 0.45, the quartz sandstone aggregate can be employed as up to 40% of the original material. According to the literature study, the flexural strength of sandstone waste concrete was found to be equivalent to and slightly stronger than control mix concrete at a certain quantity of replacement.

Split Tensile Strength Yilmaz et al. looked at how different sandstone particles affected the tensile strength of concrete sample in 2012. Accordingly, the splitting tensile strengths of concrete made with subarkose aggregates are 40–50% higher than those of concrete made with subarkose–arkose, sublitharenite–litharenite, and arkose aggregates. Sandstone dust substitution in concrete has been shown by Modi et al. (2018) to boost split tensile strength by up to 30% at 28 days for M 20 and M 25 grade (70,30) mixes, supporting its application in RCC constructions. Meng et al. (2006) found that the sedimentary features of clastic rocks have a substantial influence on their mechanical qualities. The studies revealed that as the proportion of detritus materials or quartz exceeds 50% or 40%, respectively, the tensile strength of clastic rocks substantially rises. The literature review, as previously indicated, shows that the tensile strength is influenced by the interactions between the phases of cement paste and the amount of quartz in the sandstone. Tensile strength of sandstone increases with quartz content, a sign of better cement paste quality and less porosity in the concrete matrix at particular replacement levels. A bigger porosity and more clay impurities in the sandstone waste may result in a lower tensile strength, according to some research.

1.3 Objectives of the work

Research Goal In place of river sand, the research project intends to maximise the use of sandstone cutting waste as fine aggregates in concrete.

1.4 Conclusion

The building business is one that consumes a lot of natural resources, such as river sand and cement, which is the main raw material in RCC construction and releases greenhouse gases that have led to an imbalance in the environment. Due to the scarcity of these natural resources, it is now more important than ever to discover new materials. The aforementioned documents represent a step towards using stone mining and cutting waste in the construction sector. These publications demonstrate the need to assess the chemical makeup of these wastes initially.

Their use must be determined based on their chemical makeup. Sandstone and granite quarry debris are both high in silica and hence have the potential to partially replace cement and sand in concrete and mortar. These stone cutting waste chips can be ground down to aggregate size and substituted for coarse and fine aggregates in concrete, mortar, or as a component in masonry units. Stone cutting waste from calcareous stones like limestone and marble could be used in place of binder in some cases.

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