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"PERFORMANCE OF MANUFACTURED SAND IN CONCRETE AT ELEVATED TEMPERATURE"

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Abstract: The huge quantity of concrete is consumed by construction industry all over the world. In India, the conventional concrete is produced by using natural sand obtained from riverbeds as fine aggregate. Dwindling sand resources poses the environmental problem and hence government restrictions on sand quarrying has resulted in scarcity and significant increase in its cost. This study presents the effect of the use of manufactured sand as fine aggregate in concrete.

Index Terms - Sand Mining, RC Structures subjected to high temperature, Test on In gradients, Compressive Strength test results.

I. INTRODUCTION

Among its many advantages, cement concrete's beauty, strength, and longevity make it the most utilized construction material globally. The need for concrete manufacturing has surged due to the growth in infrastructure construction. The widespread use of natural sand in concrete and mortar results in a relatively high worldwide consumption rate. To keep up with the fast expansion of their infrastructure, emerging nations often have a hefty need for natural sand. As a result, emerging nations like India are experiencing a scarcity of high-quality natural sand. Depletion of natural sand deposits poses a severe danger to both civilization and the environment; this is especially true in India. Fine aggregate is a necessary ingredient in concrete and cement mortar because it influences the concrete's performance and durability. Pure sand from a river or a quarry is the fine aggregate most often utilized.

Nowadays, high-quality sand has to be brought in from far away. An improved alternative to river sand is the man-made kind, made with the right machinery. The sand's gradation is crucial; the particles should be between 150 microns and 4.75 mm in size. The amount of voids in the sand is determined by the proportion of small particles. A less amount of cement will be needed. You may save money by using this sand. Since river sand is insufficient to fulfill the ever-increasing demand of the construction industry, the need for produced fine aggregates to be used in concrete is on the rise. Natural River sand has shot up in price and isn't assured to be consistently available due to its scarcity. Because of its improper grading, high silt content, and organic impurities, river sand in many regions of the nation might reduce the steel's durability in concrete. In contrast, produced sand is free of these contaminants. The use of synthetic or artificial sand in concrete and mortars raises concerns among many Indians regarding their quality. For many years, both in India and elsewhere, manufactured sand has been a staple in the concrete industry.

II. REVIEW OF LITERATURE

a. Aditya Kumar Tiwari 1, Sandeep Singh 1 et al (4) (2022) have studied the "Effects of Elevated Temperature on the Residual Behaviour of Concrete Containing Marble Dust and Foundry Sand"

The purpose of the experiment was to determine whether heating the concrete will affect any remaining properties, such as the flexural, compressive, tensile, static, and dynamic elastic moduli, water absorption, mass loss, and ultrasonic pulse velocity. At 2000 C, 4000 C, 6000 C, 8000 C, and 10000 C, the typical behaviour of concrete exposed to fire was examined.

Important findings are as under;

Based on the test results for both concrete mixes (with and without replacement), the following conclusions may be drawn:

(i) Concrete samples containing 10% marble dust and 20% foundry sand as cement showed increases in compressive strength of 10.7%, 11% decrease, and 21.5% and 16.3% increases during annealing and quenching at elevated temperatures up to 400 ◦C, respectively. The samples were also found to contain fine sand and foundry sand. The compressive strengths of the annealing and quenching instances dropped by 54.8 and 52.5 percent, respectively, as the temperature rose from 600 °C to 1000 °C. This is caused by the disintegration of C-S-H gel, voids, and empty water capillaries, which results in the production of small fractures in both regular and marble dust and foundry sand concrete.

b. Anup Krushnarao Chitkeshwar et al., (2022) have carried out the experiment by "Concrete with Manufactured Sand and the Effects on the Property of Durability"

This article investigates the durability properties of manufactured sand concrete. Other minerals, including zinc oxide, are added to the concrete by weight in addition to cement. The percentage of m-sand that can be used in place of river sand might range from 25% to 100%. Water permeability, acid attack, seawater, and sulphate attack tests, among others, have been administered to the concrete in order to determine its durability. The findings for the durability gained are satisfactory when half of the river sand is replaced with m-sand.

They Concluded That,

The creation of concrete mixes utilizing produced sand, Alco fine, and zinc oxide is the focus of the current study. The concrete's durability has been evaluated via a battery of experimental testing. The four tests that make up the durability evaluation are the acid attack, water absorption, sea water assault, and sulphate attack tests. Tests performed on the various concrete mixtures led to the following findings.

(i) There is a maximum observed proportion of 50% manufactured sand in concrete at which the test findings remain valid; nevertheless, strength values continue to decrease beyond this percentage.

(ii) Mix M-5 had the greatest proportion of values for durability, while Mix M-3 had the lowest results for strength loss and weight loss.

(iii) The results show that when 10% Alco fine is substituted with 0.5% zinc oxide, the resistivity increases.

(iv) When compared to ordinary concrete, the weight decreases when m-sand is used as a substitute for more than 50% of the sand.

c. D ANUPAMA KRISHNA1, R S PRIYADARSINI1, et al., (2021) have carried out the experiment by "High temperature effects on different grades of concrete"

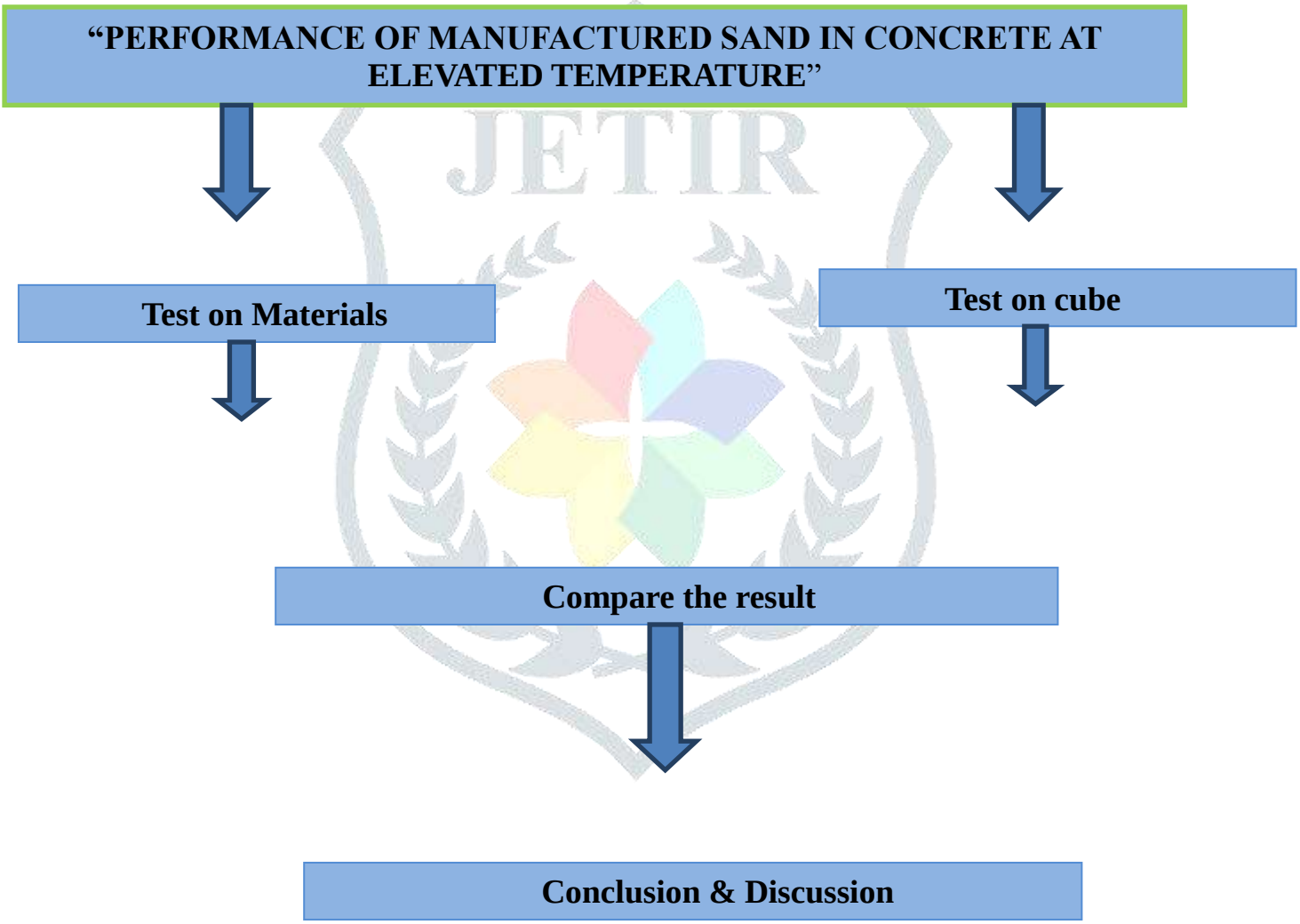
All buildings made of concrete are at risk of fire at some point. Only the concrete's residual qualities, after being heated, can tell you how strong it is. When it comes to the residual qualities of concrete, one of the major elements is the manner of cooling after exposure. It is essential to consider the compressive strength, tensile strength, elastic modulus, and stress-strain response of concrete while constructing fireproof constructions. The effects of exposure to high temperatures on three different classes of concrete—M20, M45, and M60—are examined in this article. After being heated to temperatures ranging from 100 to 900 degrees Celsius, the specimens were cooled using a variety of techniques. Between 400 and 600 degrees Celsius, mechanical characteristics degraded the most. It was discovered that high strength concrete was more susceptible than conventional strength concrete. We created and discussed mathematical models that show how various mechanical characteristics of concrete vary.

They Concluded that:

(i) As the temperature increases, the mechanical qualities of the concrete that were taken into account in this research generally deteriorate. Between 400 and 600 degrees Celsius, the rates of decrease of all characteristics were most pronounced.

III. EXPERIMENTAL METHODOLOGY

METHODOLOGY OF THE PROJECT



IV. RESULTS AND DISCUSSION

- **RESIDUAL COMPRESSIVE STRENGTH OF CONCRETE MIXES AT ELEVATED TEMPERATURES**

Mix Type	Temperature exposed to	Compressive strength (MPa)	Average compressive strength (MPa)	Residual Compressive strength (Factor/Co-eff.)
Mix 1	Ambient	29,31,28	29.33	1
	200	36,32,35	34.33	1.17
	400	31,24,28	27.67	0.94
	600	20,2420	21.33	0.72
	800	8,8,10	8.67	0.3
Mix 2	Ambient	31,32,27	30	1
	200	34,35,35	34.67	1.15
	400	27,28,31	28.67	0.96
	600	23,23,22	22.67	0.76
	800	8,9,11	9.33	0.31
Mix 3	Ambient	32,31,30	31	1
	200	36,37,33	35.33	1.14
	400	28,29,30	29	0.94
	600	26,22,24	24	0.78
	800	12,10,10	10.67	0.35
Mix 4	Ambient	34,31,36	33.67	1
	200	38,39,39	38.67	1.15
	400	34,31,32	32.33	0.96
	600	29,25,26	26.67	0.8
	800	11,10,12	11	0.32
Mix 5	Ambient	35,36,36	35.67	1
	200	37,41,40	39.33	1.1
	400	31,30,32	31	0.87
	600	25,24,24	24.33	0.68
	800	11,13,9	11	0.3
Mix 6	Ambient	37,36,36	36.33	1
	200	41,37,41	39.67	1.1
	400	34,31,32	32.33	0.89
	600	26,27,23	25.33	0.7
	800	14,11,12	12.33	0.34

Table 4.1 Consolidated results of compression tests for 7 days

Temp. (^{0}C)	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Mix 6
Ambient	1	1	1	1	1	1
200	1.17	1.15	1.14	1.15	1.1	1.1
400	0.94	0.96	0.94	0.96	0.87	0.89
600	0.72	0.76	0.78	0.8	0.68	0.7
800	0.3	0.31	0.35	0.32	0.3	0.34

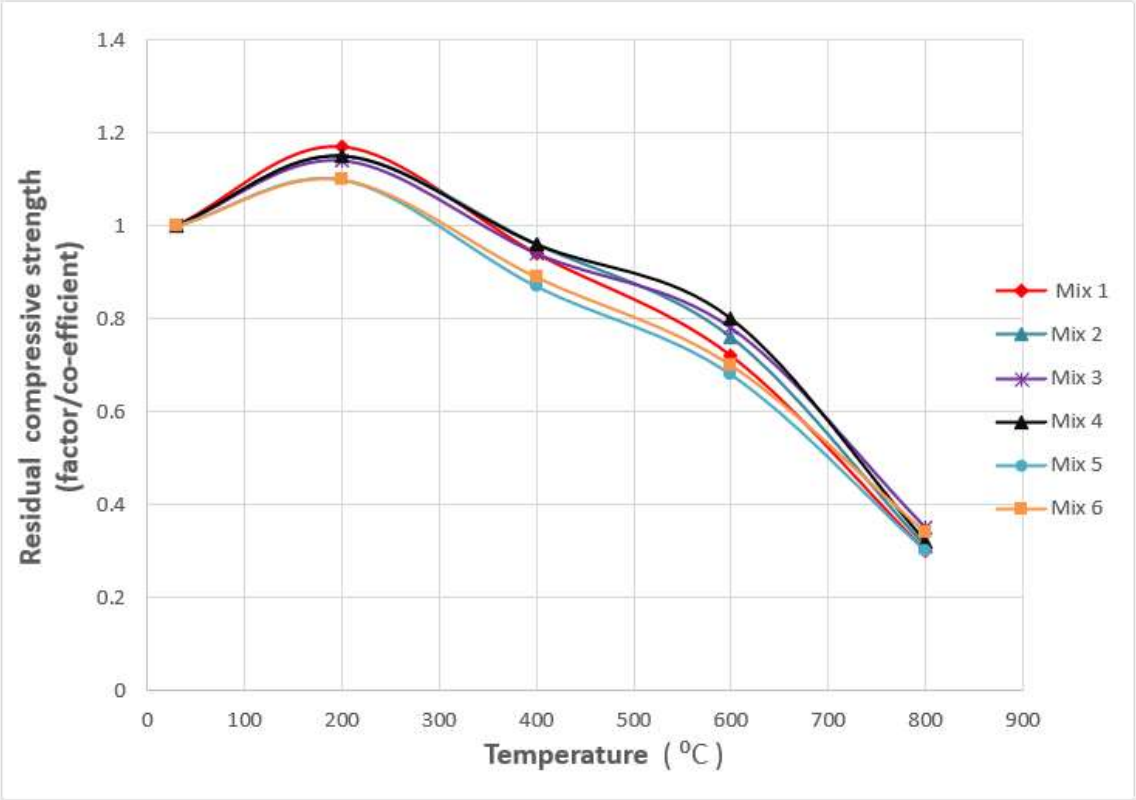


FIG.4.2 VARIATION OF RESIDUAL COMPRESSIVE STRENGTH V/S TEMPERATURE

V. CONCLUSIONS

- Using synthetic sand in lieu of natural sand in concrete reduces its workability at any percentage, thus it's important to add the right amount of admixture to keep the water-binder ratio constant and provide adequate workability.
- When using synthetic sand in place of natural sand in concrete, the compressive strength of the finished product increases by 17% after 7 days of curing and by 16.78% after 28 days, respectively.
- The cost of manufactured sand is 55 /- per cubic feet which is same as that of Natural sand but reveal good compressive strength.
- Since the demand for fine aggregates is increasing manufactured sand can act as the alternative for natural sand.
- No significant change in residual compressive strength upon addition of manufactured sand is observed when subjected to elevated temperature.

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