ISSN 2229-5518

"STRENGTH OF CONCRETE CONTAINING DIFFERENT TYPES OF FINE AGGREGATE"

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Abstract— Common river sand is expensive due to excessive cost of transportation from natural sources. Also large-scale depletion of these sources creates environmental problems. As environmental transportation and other constraints make the availability and use of river sand less attractive, a substitute or replacement product for concrete industry needs to be found. River sand is most commonly used fine aggregate in the production of concrete poses the problem of acute shortage in many areas. Whose continued use has started posing serious problems with respect to its availability, cost and environmental impact? An attempt has also been made for strength studies on concrete made up of grit when compared with the concrete made up of Artificial Sand and Natural Sand. Use of grit as a fine aggregate in concrete draws serious attention of researchers and investigators.

Index Terms— Artificial Sand, depletion of sources, environmental transportation, fine aggregate, Grit, Natural Sand, replacement product.

1 INTRODUCTION

Currently India has taken a major initiative on developing the infrastructures such as express highways, power projects and industrial structures etc. To meet the requirements of globalization, in the construction of buildings and other structures concrete plays the rightful role and a large quantum of concrete is being utilized. River sand, which is one of the constituents used in the production of conventional concrete, has become highly expensive and also scarce. In the backdrop of such a bleak atmosphere, there is large demand for alternative materials from industrial waste.

The utilization of Grit which can be called as dust of quarry rock has been accepted as a building material. As a result of sustained research and developmental works under-taken with respect to increasing application of this industrial waste. The level of utilization of Grit in the industrialized nations like Australia, France, Germany and UK has been reached more than 60% of its total production. The use of manufactured sand in India has not been much, when compared to some advanced countries.

This paper presents the feasibility of the usage of Grit as hundred percent substitutes for Conventional Concrete. Tests were conducted on cubes and beams to study the strengths of concrete made of Grit as a waste material, artificial sand and natural sand. Studies were done for concrete with Grit, artificial sand and compared with the Conventional Concrete.

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2 METHODOLOGY

Assessment is made on the existing mix design methods and test results of concrete produced using manufactured sand. Tests were conducted using river sand, manufactured sand and a combination of both with equal amounts of cement, coarse aggregate and water and with variable amounts of admixtures. A cost comparison of concrete produced using partial or full replacement of the Natural Sand with Manufactured Sand was made. The results were presented in graphical form and interpretation and discussion were made on the research findings. Based on the findings conclusions are drawn and recommendations are forwarded.

2.1 Fine Aggregate

TABLE 1
SEIVE ANALYSIS OF FINE AGGREGATES

Sieve size	Fine aggregate (% passing)	Remark
4.75 mm	100	
2.36 mm	100	Conforming to
1.18 mm	93	grading zone III
600 micron	60	of table-k IS 289-
300 micron	12	1970
150 micron	2	

After carrying this sieve analysis for Grit, Concrete Mix Design is prepared for M20 grade of concrete by initial testing on ingredient. The proportions are 1:1.425: 3.10. Table 2 shows the comparative compressive strength of the concrete block tested after 28 days. Table 3 showing split tensile strength where as Table 4 is showing results for flexural strength of concrete.

TABLE 2

COMPARITIVE COMPRESSIVE STRENGTH

Sr no	Sample	No	Load at Failure KN	3 Days MPa	Load at Failure KN	7 Days MPa	Load at Failure KN	28 Days MPa
1	Natural Sand	1	498	22.13	610	27.11	810	36.00
		2	526	23.37	625	27.77	838	37.24
		3	540	24.00	648	28.80	860	38.22
		Mean	----	23.17	----	27.89	---	37.15
2	Artificial Sand	1	590	26.22	620	27.55	891	39.6
		2	610	27.11	680	30.22	885	39.33
		3	575	25.55	665	29.55	901	40.04
		Mean	----	26.29	----	29.10	---	39.65
3	Grit	1	605	26.88	675	30.00	934	41.51
		2	638	28.35	691	30.71	951	42.26
		3	595	26.44	679	30.17	912	40.53
		Mean	----	27.22	----	30.29	---	41.43
4	Ar.S. (50%) + N.S(50%)	1	544	24.17	615	27.33	940	41.77
		2	568	25.24	640	28.44	890	39.55
		3	557	24.75	660	29.33	870	38.66
		Mean	----	24.72	----	28.36	---	39.97

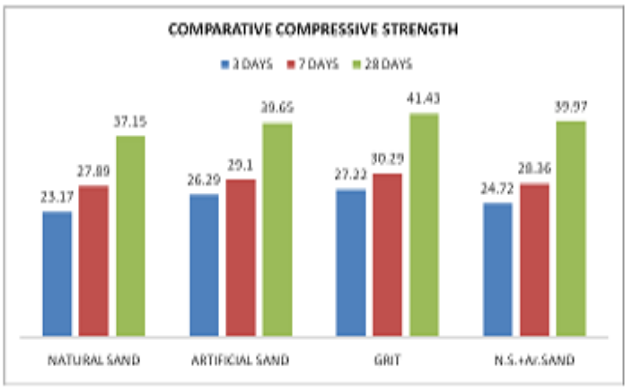

Fig. 1. Comapritive Compressive Strength

TABLE 2

COMPARITIVE COMPRESSIVE STRENGTH

Sr No	Sample	No	Load at Failure KN	28 Days (MPa)
1	Natural Sand	1	540	6.87
		2	470	5.98
		3	490	6.23
		Mean	----	6.36
2	Artificial Sand	1	520	6.62
		2	495	6.30
		3	530	6.74
		Mean	----	6.55
3	Grit	1	588	7.48
		2	540	6.87
		3	551	7.01
		Mean	----	7.12
4	Ar.S.(50%) + N.S.(50%)	1	530	6.74
		2	518	6.69
		3	490	6.23
		Mean	----	6.55

3 TEST RESULTS SPLIT TENSILE STRENGTH:

TABLE3

TEST RESULT FOR BEAM STRENGTH AND DEFLECTION

Sr. No	Sample	No	Load at Failure (KN)	Deflection (mm)	28 Days (MPa)
1	Natural Sand	1	28	2	5.80
		2	27.5	2	5.70
		3	29	2.3	6.08
		Mean	----	----	5.86
2	Artificial Sand	1	32	3	6.63
		2	30	2.5	6.22
		3	34	3.4	7.05
		Mean	----	----	6.63
3	Grit	1	29	2.2	6.01
		2	30	2	6.22
		3	31	2	6.42
		Mean	----	----	6.21
4	Ar.S.(50 %) + N.S. (50%)	1	26	3	5.39
		2	32	3	6.63
		3	28	2	5.80
		Mean	----	----	5.94

3.1Flexural Test on Concrete Beam

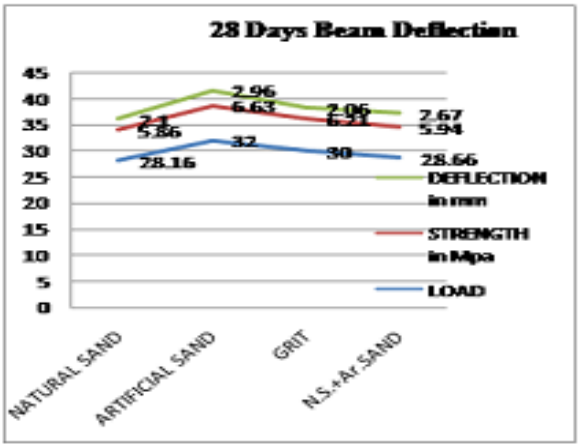

Fig.2. ComapritiveGraph of Deflection, Compressive Strength and Load

3.2 Practical Problems and Remedies

Concrete does not give adequate workability because particle shape is not spherical but cubical or flaky. This can be controlled by proper shape and gradation, use of plasticizers etc.

Higher water absorption removes free water also greater surface area results in faster evaporation by which concrete tends to set quickly. Use of retarding plasticizers, protecting the green concrete from drying can cover these problems. Concrete tends to segregate due to flaky shape, lack of adequate fines, segregation of particles while transportation and Unloading.

Segregation during transportation can be prevented by spraying water, blending with natural sand, use of fibers to increase cohesion. Sometimes Concrete gives lower strength because of flaky particles or higher fines increase water demand, higher water demand translates in to higher water cement ratio. Controlling the quality of incoming material by visual inspection and regular sieve analysis solve such problems. Lower workability, lower slump retention, and inadequate vibration, segregation of concrete also managed by use of plasticizers, retarders and fly ash, complete compaction and finishing as early as possible.

4 DISCUSSIONS

From above test results, we came to know that Grit has proven to be highest compressible strength fine aggregate as compared to Natural Sand, Artificial Sand & combination of Natural Sand & Artificial Sand.

In case of Beam the ultimate load for Artificial Sand is found to be maximum of 32KN with deflection 2.96mm and that of Grit with minimum ultimate load of 30KN with deflection 2.60mm.

Grit gives maximum compressive strength 41.43MPa as compared to Natural Sand, Artificial Sand & combination of Natural Sand & Artificial Sand, which found to be 5% more with 100% replacement of Natural Sand in conventional concrete mix.

In case of cylinder for Tensile strength, Grit has given maximum Tensile strength 7.12 MPa, which is quite more than other.

5 CONCLUSION

From the above results and discussion we conclude that among the above four fine aggregate samples like Natural Sand, Artificial sand, Grit & Combination of both N.S.& Ar.Sand; Grit gives the maximum compressive strength.

Though grit and artificial sand gives nearly same results, grit is more preferable than artificial sand as it's more economical.

Grits of various types obtained from various sources affects the strength and durability of concrete while comparatively more uniqueness is achieved in case of artificial sand.

The use of manufactured sand in the construction industry helps to prevent unnecessary damages to the environment and provide optimum exploitation of the resources.

Manufactured sands are made by crushing aggregate to sizes appropriate for use as a fine aggregate. During the crushing process the manufactured sand have irregular shapes and more fine particles contributing to improved compressive strength, compared to natural sand control mix.

Due to the irregular particle shape of the manufactured sand, in addition to the reduced amount of water cement ratio, manufactured sand is more important for high strength concrete mixes.

Manufactured sand offers important economic advantages in regions where the availability of natural sand is scarce or in cities where transportation cost is high.

The use of manufactured sand in the construction industry helps to prevent unnecessary damages to the environment and provide optimum exploitation of the resources.

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