International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 05 | May 2019 www.irjet.net p-ISSN: 2395-0072

COMPARATIVE ANALYSIS OF RIVER SAND, M-SAND AND QUARRY SAND

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Abstract - *Concrete plays a critical role in the construction industry. Natural sand is an essential material utilized for the planning of cement and furthermore plays an important role in the design of mixes. The supply of river sand is inadequate and its continued supply is uncertain, use of Manufactured Sand (M-Sand) and Quarry Dust Sand as a substitute for river sand become inevitable. To overcome from this crisis, fully replacement of sand with M-Sand and Quarry Dust can be an economic alternative. In this project determine the concrete's strength and durability by using M-Sand and Quarry Dust as sand and comparing with the conventional mix. Wide range of 28 days of healing are considered the design mix in the present study of M40 grade concrete with fully replacement of M-Sand and Quarry Dust respectively have been considering for investigation. The compressive strength (cube), split tensile strength (cylinder) and flexure strength (beam) testing of concrete. Finally, the study concluded that the Manufactured sand concrete worked better than normal concrete.*

Key Words: *Artificial sand concrete, Conventional concrete, Compressive strength, split tensile strength, Flexure strength*

1. INTRODUCTION

1.1 General

Concrete is the most expanded usage of structural development material in structural building industry because of its high structural strength and stability. The concrete industry is searching for valuable cementations material or mechanical result with the objective of reduction the exhalation of carbon dioxide which is harmful to environment. Cement is the real concrete constitution that is delivered by natural raw materials such as stone rock, clay, chalk and so on. In the ongoing past, there's been a huge amount increment in the use of concrete mineral admixtures like fly ash and copper slag etc. In the meantime, the river sand acquired from waterway beds has been utilized primarily in the process of fine aggregate in the production of concrete. Because the supply of River sand is insufficient and its continuous supply is uncertain, use of Manufactured Sand (M-Sand) and Quarry Dust Sand as a substitute for Natural Sand has been inevitable.

The role of the fine aggregate is to assist in generating workability and uniformity in the mixture. Now the natural sand of the river has become limited and very expensive. Hence, we are forced to think about alternative materials. The Quarry dust can be fully or partly used in place of river sand.

If sand is partially or completely replaced with or without concrete admixtures, a comparatively good strength is expected. It is proposed to explore the ability to replace sand with local crusher waste without sacrificing concrete strength and workability.

The construction of buildings and other concrete structures plays the right role in meeting the concern of globalization and a large quantity of concrete is used. River sand has become highly expensive and also limited, which is one of the constructions used in the production of traditional concrete. There is a great trade for alternate materials from industrial waste in the background of such a bleak atmosphere.

1.2 Aim of the project

The target of this study is a detailed review about waste and recycled materials that can be utilized effectively as a sand replacement in concrete. Options for waste management and the impact of waste materials on concrete's fresh and hardened properties.

- To study the basic properties of river sand, M-Sand and Quarry dust sand.
- To study the combined effect of M-Sand, Natural Sand and Quarry sand. To recommended the complete replacement of M-Sand and Quarry sand in the conventional concrete.

2. OBJECTIVES

The objectives of the project are:

- 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 at beginning period.
- Primary goals are to lower the cost of the building by reducing cost of concrete.

- Secondary goals to show that natural sand can be replaced by a manufactured sand and quarry sand.
- To determine the effect of substitution of sand by M-Sand and Quarry dust sand on properties of concrete. And to study workability of fresh concrete.
- To study compressive strength and split tensile strength and flexural strength of hardened concrete.

3. MATERIAL USED

3.1 CEMENT

Ordinary Portland cement of 53 grade available in local market is utilized in the investigation. The cement utilized different properties have been tested as per IS:4031-1988 and found confirmation to different specifications as per IS:12269-1987. The tests result on Ordinary Portland Cement are indicated in the Table 3.1.

Table -3.1 Physical Properties of Ordinary Portland Cement

S.NO	PROPERTIES	TEST VALUES
1	Normal consistency	28.20%
2	Specific gravity	3.15
3	Setting time Initial setting time Final setting time	 33 min 385 min
4	Fineness of cement	1.68%

3.2 COARSE AGGREGATE

The machine is used as a coarse aggregate with crushed annular granite metal of an average size of 20mm. It should be free of dust-free, clay particles, organic matter etc., The coarse aggregate with different properties are tested as shown in table. The coarse aggregate grading or particle size distribution showed nearly an average size of 20mm as per IS:383-1970 and detailed analysis of sieves specified in the table 3.2

Table-3.2 Physical Properties of Coarse Aggregate

S.NO	PROPERTIES	TEST VALUES
1	Specific gravity	2.70
2	Bulk density	2700 kg/m^3
3	Crushing value	17.2%
4	Impact value	12.50%
5	Fineness modulus	6.67%
6	Water absorption	1.00%

3.3 FINE AGGREGATE

The locally available natural sand and machine-made Manufactured sand are utilized as fine aggregate. It is supposed to be free of clay, slit, organic impurities and so on., The sand is being tested for different properties like specific gravity, bulk density etc., In accordance with IS:2386-1963. The fine aggregate distribution of the examination or particle size demonstrates that it is near evaluating zone II or IS:383-1970.

3.3.1 RIVER SAND (RS)

The natural fine aggregate is the river sand which is the most commonly utilized natural material for the fine aggregates that is utilized, but the recent social factors that created a shortage of the material created a great problem in the construction sector. For the studied the river sand of zone II is utilized in all the references.

3.3.2 MANUFACTURED SAND (MS)

M-Sand confirming to zone II as per IS:383-1970 is utilized. It was tested as per Indian Standard Specification. The manufactured sand utilized, is brought from local supplier.

3.3.3 QUARRY DUST SAND (QS)

Quarry dust is a waste material collect from stone quarries while the stone crushes, stone crusher dust that is abundantly available from crusher units at a low-priced in many areas, maintain practical option for concrete river sand.

Table-3.3 Physical Properties of Fine Aggregate

S.NO	PROPERTIES	TEST VALUES		
		RS	MS	QS
1	Specific gravity	2.6	2.8	1.8
2	Fineness modulus	2.25	2.4	2.56
3	Buckling	23.7%	25.24%	-
4	Water absorption	2%	4%	0.6%

3.4. WATER

Water utilized for mixing and healing must be clean must be free of harmful volumes of oils, acids, alkalis, salts, organic materials or other materials. Concrete may be deleterious. Versatile water is utilized for blending just as curing of concrete as prescribed in IS:456-2000.

3.5. MIX PROPORTION:

Table-3.4 Mix proportion

Cement	Fine aggregate	Coarse aggregate	Water
450	644	1114	180
1	1.43	2.47	0.4

4. TESTS CONDUCTED & RESULTS

4.1 SLUMP TEST

The workability is one of the concrete's parameters that disturb the strength and durability and finished surface appearance. Concrete workability is based on the water cement ratio and the water ingestion limit if the aggregates. If additional water results in bleeding or aggregate segregation. The test for concrete workability is performed by the Indian Standard IS 1199-1959 which allows the test procedure to use different cases in which we used slump cone tests to estimate concrete workability. We estimated the concrete cone status for different water cement ratios and recorded the values for normal concrete. Then the same procedure is performed with sand being completely replaced by the concrete with river sand, M-Sand and Quarry Dust Sand.

Fig.4.1 True Slump

Fig.4.2 Shear Slump

Fig.4.3 Collapse Slump

4.2 COMPRESSIVE STRENGTH

At the beginning, i.e. at 7 days the concrete's strength made of manufactured sand and quarry sand is less than that of common sand. But as the days of curing increases, the concrete's strength of cubes made of M-Sand and Quarry sand are found more or less equal. As compressive strength is the main property of the concrete that is considered in design, we can replace of natural sand by either manufactured sand and quarry sand completely in making concrete. The results obtained for compressive strength for 28 days study period for complete reinstatement of sand by each of two M-sand and quarry sand are specified in the table 4.1.

Table-4.1 Compressive Strength of Concrete Cube

S.NO	CONCRETE MADE OF	COMPRESSIVE STRENGTH N/mm²	
		7 days	28 days
1	CC	27.10	61.32
2	MS	28.90	63.56
3	QS	23.12	50.22

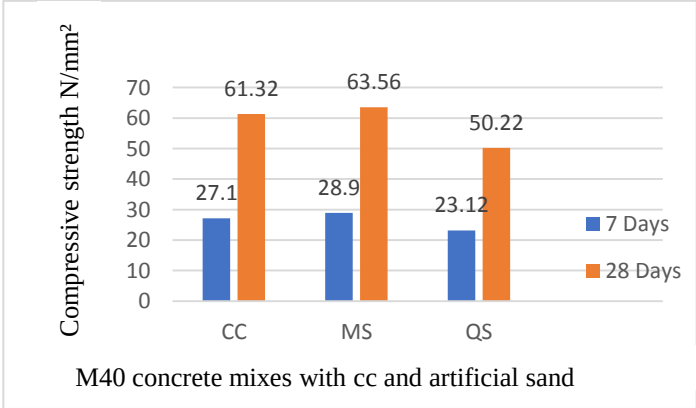

Chart 4.1: Analogy of compressive strength

Fig.4.4 Compressive Strength Test

4.3 SPLIT TENSILE STRENGTH

Similar to compressive strength, the flexural strength and split tensile strength were also higher for the complete replacement of sand either with quarry dust and M-sand. The development in compressive strength, tensile strength split and flexibility for M-Sand is perhaps due to the sharp edges which provide stronger bond with cement compared to river sand in rounded shape.

Table-4.2 Split Tensile Strength of Cylinder

S.NO	CONCRETE MADE OF	SPLIT TENSILE STRENGTH N/mm²
1	CC	5.12
2	MS	5.41
3	QS	4.78

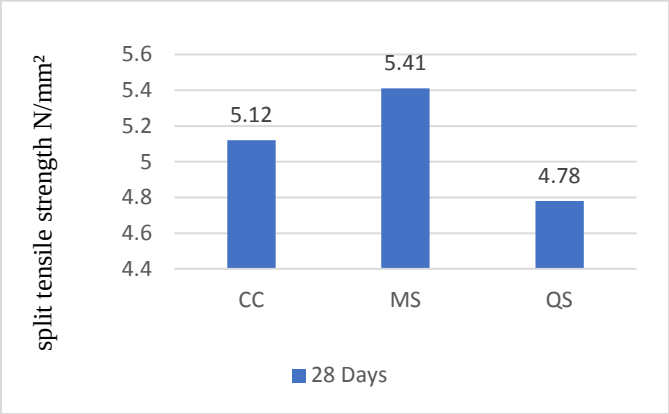

Chart 4.2: Analogy of Split Tensile Strength

Fig.4.5 Split Tensile Strength Test

4.5 FLEXURE STRENGTH OF CONCRETE

Flexure strength, also referred to as rupture module, or bending strength, or transverse rupture strength is a property of materials, explain as the stress in a material close to it results in a bending test. The flexure strength is the highest stress accomplished within the material at its moment of yield.

Table-4.3 Flexure Strength of Beam

S.NO	CONCRETE MADE OF	FLEXURE STRENGTH N/mm²
1	M-Sand	5.29

Fig.4.6 Flexure Strength Test

5. CONCLUSIONS

Based on the findings and then analysis, the following conclusions have been arrived. The cubes of concrete have been cast at 100 percentage if M-Sand content. The ratio of water cement for this work was taken as 0.40. cubes were tested for 7 days and 28 days to resolve M40 concrete's compressive strength drawn from the current investigation.

- The fine aggregate replacement with M-Sand and Quarry Sand is more cost economical.
- With 100% replacement of natural sand with manufacture sand, the strength criteria can be fully established.
- The compressive strength of 28 days for M40 concrete mix with 100% River sand replacement by M-sand yield compressive strength of 63.56 N/mm².

- 100% replacement is reasonable where there is low workability requirement. And where there is high workability requirement, partial replacement can be made keeping in view the strength and economy.

- For big projects like highways, establishing a plant leads to economy as they require large amount of fine aggregate.

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