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Features of Manufactured Sand Concrete Compared to Ordinary Concrete

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Abstract

The term "Strength and Durability of Concrete through Using Manufactured Sand" is used in this paper. It is described as the concrete's capacity to withstand weathering, chemical assault, and abrasion while preserving its desirable technical qualities throughout this process. The terms "strength" and "durability" refer to two independent aspects of concrete quality. They must be treated as two distinct ideas. A concrete with a higher strength does not always imply a concrete with a greater durability rating. At the same time, a concrete with superior durability is not required for a high-strength concrete. Strength should be provided solely as a need for the structure to be able to withstand the weights applied, not as a performance indication for durability. The use of a low/lower Water/Cement ratio or the use of particular types of additives that help achieve a higher strength, such as Super plasticizer, may be shared by high strength concrete and durable concrete. However, these are just a handful of the numerous principles that may be employed to develop a long-lasting concrete. In terms of durability performance indicators such as water absorption, compressive strength, split tensile strength, rebound hammer testing, and other durability testing parameters, a concrete of 25 MPa can be more durable than a concrete of 40 MPa or 50 MPa. We also substituted M-Sand with Ultra Tech OPC 53 to improve the strength and longevity of the concrete. M-Sand and River Sand are being compared to see which has the best strength and durability. To learn more about manufactured sand (M-Sand), which is being used as a river sand

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alternative in concrete building. Crushed hard granite stone is used to make manufactured sand. Since manufactured sand is made from firm granite rocks that are easily available in the area, transportation costs from a distant river sand deposit are reduced. As a result, the usage of produced sand as a construction material can help to keep building costs down. Another benefit of utilising M-Sand is that it is dust-free, and the sizes of the m-sand can be readily regulated to achieve the needed grading for the given structure.

***Keywords**: - M- sand, split tensile test, concrete, durability, granite stone*

INTRODUCTION

STRENGTH AND DURABILTY CHARACTERISTICS OF CONCRETE

In the modern globe, the globe is witness to exceedingly challenging civic labour in the establishment of frameworks and innovations. Concrete is by far the most precious material in the construction industry. In terms of volume, cement concrete is the most widely produced material in human history, and it is also the most important element in the building industry. The expenditure on concrete manufacturing is currently increasing as a result of the present decline in global wealth. Conventional manufacturing equipment is becoming too expensive to operate.. Ordinarily, concrete is composed of a combination of cement, sand, and aggregate. Fine aggregate is an essential component of concrete because the qualities of the aggregate have an impact on the durability and appearance of the finished concrete product. Natural river sand is the fine material that is most commonly used in construction. Fine aggregate is a critical raw material in the production of building cement, and the characteristics of fine aggregate, ranging from workability to strength and durability, can have an impact on the qualities of concrete. River sand, on the other hand, is not a naturally replenishable resource. In a few places, river sand has been overused, putting the stability of riverbanks at risk, as well as causing ecological problems and compromising the safety of bridges. However, due of the high cost of transportation, river sand obtained from natural sources is more expensive than other types. The search for suitable river sand options has proven to be quite important. According to published literature, alternative alternatives for river

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sand include manufactured sand, recycled aggregates, industrial byproducts (such as a few types of slag and bottom ash), and so on. Among these commodities, artificial sand is receiving a lot of attention these days as a possible substitute for river sand. In any event, as a result of the increased usage of concrete in a greater variety of construction projects, the need for natural or river sand has increased. In order to meet the demands of the building sector, excessive quarrying of sand from riverbeds is taking place, resulting in the depletion of sand resources. The solution to this problem is manufactured sand, particularly in light of the fact that certain jurisdictions have essentially prohibited the use of river sand for building. It is produced by crushing rock fragments to produce a fine aggregate with an uneven surface roughness compared to river sand particles and with an increased angularity. It is used in concrete, asphalt, and other applications. Manufactured sand squished from stone or rock, also known as machine-made sand or crushed-stone sand, has been used as a substitute for natural sand in the production of concrete.

Cement

It is a binder, which is a substance used in construction that sets, hardens, and attaches to other materials in order to hold them together as a single unit. Sand and gravel (aggregate) are used to bind the cement together rather than as the primary component of the cement mix. Cement combined with fine aggregate is used to make mortar for masonry, while cement mixed with sand and gravel is used to make concrete. Cement is the most frequently used material on the globe and is second only to water in terms of global use as a resource. When used in building, cement is primarily made of inorganic materials, such as limestone or calcium silicate. Cements can be classified as either hydraulic or non-hydraulic, based on their ability to set in the case of moisture (see hydraulic and non-hydraulic lime plaster).

MANUFACTURED SAND (M-SAND)

Manufacturered sand (M-Sand) is a replacement for river sand in the manufacture of reinforced concrete. Crushing hard granite stone yields manufactured sand, which is used in construction. Construction material made from crushed sand is cubical in shape with grounded edges and has been cleansed and graded for use in construction projects. It is smaller than 4.75mm in size and is known as manufactured sand (M-Sand). Manufactured sand can be used in place of river sand as a substitute. With the rapid

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expansion of the building sector, the demand for sand has skyrocketed, leading to an acute scarcity of adequate river sand in most of the world's most populous countries. In response to the loss of high-quality river sand for construction purposes, the usage of synthetic sand has grown significantly in recent years. Another justification for the usage of M-Sand is the availability of the material and the low cost of shipping.

River Sand

Sand is a granular substance made up of finely fragmented rock and mineral particles that may be found in nature. It is distinguished by its particle size, which is finer than gravel and coarser than silt. The term sand can also refer to a textural class of soil or a specific soil type; for example, a soil having more than 85 percent of sand-sized particles by mass is considered to be a sand soil.

The composition of sand varies depending on the local rock sources and conditions, but silica (silicon dioxide, or SiO2) has become the most key component of sand in inland continental settings and non-tropical coastal settings. Quartz is the most common form of silica in inland continental settings and non-tropical coastal settings. Calcium carbonate sand is the second most frequent form of sand on the planet.

Superplasticizer

Super plasticizers (SPs), also known as high range water reducers, are additives that are used in the production of high-strength concrete, among other applications. Plasticizers are chemical compounds that allow for the manufacturing of concrete with approximately 15% less water content than is otherwise possible.

Super plasticizers allow for a decrease in water content of up to 30% or more when used properly. These additives are only used in small amounts (a few percent of the total weight of the product). Concrete curing is slowed down by the use of plasticizers and super plasticizers.

MATERIAL TEST

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Coarse Aggregate - Determination Of Water Absorption And Specific Gravity (As Per Is: 1124 – 1974)

Tab 1.1 Water Absorption and Specific Gravity for Coarse Aggregate Testing

Surface Dry Weight of the Sample,g	**20mm**	**I**	**II**	**Average**
	B	**893.16**	**930.7**	
Quatity of Water added to 1000ml Measuring Cylinder	**C**	**680.00**	**668.00**	
Weight of Oven dry sample,g	**A**	**891.8**	**929.0**	
Apparent Specific gravity SG=A/(1000-C)		**2.787**	**2.798**	**2.793**
Water Absortion,% = (B-A)/A*100		**0.153**	**0.183**	**0,168**
Apparent Porosity (B-A)*100/(1000-C)		**0.425**	**0.512**	**0.469**

FINE AGGREGATE - SIEVE ANALYSIS RESULTS

Table:- 2 Determination of Water Absorption and Specific Gravity testing of Fine Aggregate

2.WATER ABSORPTION AND SPECIFIC GRAVITY		**1st**	**2nd**
(as Per cl.2.4 method of 2386(III)-1963)		**509.16**	**558.94**
Weight of the saturates surface dry sample gms	**A**	**509.16**	**558.94**
Weight of the sample + Pycnometer + Water gms	**B**	**1639.52**	**1694.5**
Water of the Pycnometer with water in gms	**C**	**1316.7**	**1339.26**
Weight of the Oven dry sample in gms'	**D**	**507.94**	**557.18**
Water absorption in %	**100 (A-D)/D**	**0.2402**	**0.3159**
Average Water absorption in %		**0.28**	**2.7353**
Specific gravity	**D / [A-(B-C)]**	**2.7259**	**2.7353**
Average Specific gravity		**2.73**	

MIX – DESIGN

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Design Calculation - Design M25 - As per IS 10262 2009

Step – 1 Determination of Target Strength for Mix Proportion

$f_{ck}' = f_{ck} + 1.65\ S$

f_{ck}' = 31.6 Mpa (or) 31.6 N/mm^2

Step – 2 Selection of Water Cement Ratio

- From Table 5 of IS 456

Maximum Water – Cement ratio = 0.45

Higher value to be adopt 0.475 < 0.50

Step – 3 Selection of Water Content

Estimate water Content for 100 mm slump = 181 litre

Step – 4 Water Adjustment for using Admixture

Step – 5 Calculation of Cement Content
Water Cement ratio = 0.475

Cementitious Material (Cement + Super plasticizer) content => 294

From Table 5 of IS 456 , Minimum Cement content for Severe = 300 ; 294 < 300 , Hence Ok

Cementitious Material Content = 300 x Water Content = 152

Super plasticizer 20 – 30 % => Cement = Saving of Cement while using Super plasticizer Admixiture

Step – 6 Proportion of Volume of Coarse Aggregate and Fine Aggregate Content

Volume of Coarse Aggregate to 20 mm size aggregate and Fine aggregate for Water-Cement ratio => Volume of C.A = 0.5625

Volume of Fine Aggregate = 0.4375

Step – 7 Mix Calculation

The mix Calculation per unit volume of concrete shall be as follow's

a. Volume of Concrete = 1 m^3

b. Volume of Cement = $\frac{\text{Mass of Cement}}{\text{Specific gravity of Cement}} \times \frac{1}{1000}$
= 0.102 m^3

c. Volume of Water = $\frac{\text{Mass of Water}}{\text{Specific Gravity of Water}} \times \frac{1}{1000}$
= 0.152 m^3

d. Volume of Chemical Admixture = $\frac{\text{Mass of Admixture}}{\text{Specific Gravity of Admixture}} \times \frac{1}{1000}$
= 0.003

e. Volume of All Aggregate =

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[a – (b+c+d)] = 0.743

f. Mass of Fine Aggregate = e x Volume of Fine Aggregate x Specific gravity of fine aggregate x 1000= 890

g. Mass of Coarse Aggregate = e x Volume of Coarse Aggregate x Specific gravity of Coarse Aggregate x 1000 = 1145

Mix Design Value

a) Cement = 321.3 kg/m^3
b) Fine Aggregate = 890 kg/m^3
c) Coarse Aggregate = 1145 kg/m^3
d) Super Plasticizer = 3 kg/m^3
e) Water = 152.2 kg/m3

Compressive Strength of Concrete *- Cube Test - Results of Concrete Cube Test*

a. Test for Compressive Strength of Concrete Cubes with M-Sand

(See table)

Tab 2.1 a) Test for Compressive Strength of Concrete Cubes with M-Sand

Age of the Cube	length (mm)	width (mm)	Load at failure (kN)	Compressive Strength (N/mm)	Average Compressive Strength (N/mm²)
7 Days	153	152	385.4	16.6	18.3
	153	151	458.2	19.8	
	152	150	423.6	18.6	
14 Days	150	151	596.1	26.3	25.2
	152	152	554.8	24.0	
	152	150	572.9	25.1	
28 Days	149	151	650.3	28.9	30.1
	150	150	720.0	32.0	
	152	151	672.9	29.3	

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b) Test for Compressive Strength of Concrete Cubes with River Sand

Tab 2.2 Test for Compressive Strength of Concrete Cubes with River Sand

Age of the Cube	length (mm)	width (mm)	Load at failure (kN)	Compressive Strength (N/mm)	Average Compressive Strength (N/mm²)
7 Day's	151	152	438.9	19.1	18.8
	151	152	411.8	17.9	
	152	150	443.6	19.5	
14 Day's	151	152	609.9	26.6	27.7
	151	151	622.7	27.3	
	151	150	664.1	29.3	
28 Day's	150	150	694.1	30.9	30.9
	149	150	728.4	32.6	
	149	149	647.0	29.1	

4.2) Split Tensile Strength of Concrete

Results of Test

a) Test for Splitting Tensile Strength of Concrete Cylinder's with M-Sand

Tab 2.3 Test for Splitting Tensile Strength of Concrete Cylinder's with M-Sand

Age of the Cube	length (mm)	width (mm)	Load at failure (kN)	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm²)
7 Days	300	149	117.8	1.7	1.8
	300	150	136.8	1.9	
14 Days	300	150	150.0	2.1	2.1
	300	150	149.9	2.1	
28 Days	300	150	197.5	2.8	2.9
	300	149	200.5	2.9	

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b) Test for Splitting Tensile Strength of Concrete Cylinder's with River Sand

Tab 2.4 Test for Splitting Tensile Strength of Concrete Cylinder's with River Sand

Age of the Cube	length (mm)	width (mm)	Load at failure (kN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
7 days	300	150	134.6	1.9	1.7
	300	150	109.6	1.5	
14 Days	300	150	170.9	2.4	2.3
	300	150	149.5	2.1	
28 Days	300	150	176.5	2.5	3.0
	300	149	236.8	3.4	

CONCLUSION

To summarise, concrete durability should be stated using "Durability-Based Thinking" rather than "Strength-Based Thinking," and not the reverse. Strength and durability are two entirely different ideas that should be treated as two entirely separate notions. They may share a few design criteria from time to time, but they are still two distinct conceptual frameworks. The concrete's long-term durability is not the work of a single individual. It is the obligation of all parties involved in the project to do this. It is the consultant's obligation to define the durability performance indicators using durability-based ideas rather than strength-based concepts in order to grantee a durable concrete as a result of using durability-based ideas rather than strength-based ideas (Designed Product). As a result, it is the obligation of the concrete provider to employ suitable mix design and production techniques in order to provide a long-lasting concrete (Delivered "On-site" Product). In order to achieve better strength, we are employing M-Sand in conjunction with an admixture such as Super plasticizer while simultaneously decreasing the W/C ratio. It is the contractor's obligation to use the necessary building techniques, such as casting, compaction, finishing, and curing methods, in order to provide a long-lasting concrete as a result of the project (Finished Product). It is the owner's obligation to

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perform adequate maintenance, preventative, and corrective operations in order to ensure a long-lasting concrete structure (In-Service Product). Specificing a greater strength in order to achieve a more durable concrete is an incorrect engineering technique in the construction industry. Strength should not be considered as a performance indicator for long-term durability. The specification of 40 MPa for a concrete that only requires a design strength of 25 MPa is not a suitable or recommended engineering practise since the additional 15 MPa will not be used to create a concrete with a superior durability performance. Extra costs incurred in order to achieve an unnecessarily high 15 MPa can be put to good use in concepts geared toward long-term durability, such as: the use of cementitous additives such as silica fume and Super Plasticizer, either in conjunction with cement or separately. Limiting the W/CM ratio to a certain value. Construction procedures such as concrete casting, compaction, and finishing are made simpler by specifying an acceptable amount of workability in the concrete. This also prevents incorrect practises by the workforce, such as the addition of excess water on-site.

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