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A Comparative Study on River Sand and M-Sand

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ABSTRACT

Now a days the construction industry in the India is facing one of the major problems that is natural fine aggregate. And court announced that totally band on excavation of fine aggregate from rivers because they effect on environment and changing the river direction. Cement, sand and aggregates are basic needs for any construction industry. Sand is a primary material used for preparation of mortar and concrete and which plays a major role in mix design. Now a day's considering the erosion of rivers and environmental issues, there is a scarcity of river sand. The non-availability or shortage of river sand will affect the construction industry. Hence there is a need to find the new alternative material to replace the river sand, such that excess river erosion and harm to environment is prevented. Many researchers are finding different materials to replace the river sand and one of the major materials is manufactured sand (M-SAND/Artificial/Robo sand). Finding the compressive strength that concrete cube will explained in this project. This project will also explain the requirements, properties, uses, quantity& quality of manufactured sand, difference between river sand and manufactured sand, tests on manufactured sand, advantages & disadvantages of manufactured sand and the places where the manufactured sand is available etc.

INTRODUCTION

In the ever increasing construction industry, concrete forms the basic building block. Concrete consists mainly of three raw materials apart from water. These are cement, coarse aggregate and fine aggregate. Out of these raw materials, cement and coarse aggregate can be easily manipulated to match the needs of how concrete should be made. While as sand, which amounts to about 35% by volume of concrete, is mainly obtained from natural sources like river beds and the quality and texture of sand cannot be controlled. Sand is mainly obtained by mining it from River beds by sand dragging which causes various environmental issues as it disrupts the natural habitat of these rivers. Sand mining is causing depletion of sand from the river beds at an alarming rate.

With the world-wide decline in the availability of construction sands along with the environmental pressures to reduce extraction of sand from rivers, the use of manufactured sand as a replacement is increasing. With the ban on sand mining implemented by different states, and with the increasing demand for river sand for construction work, many civil engineers have expressed the need to promote use of

manufactured sand in the construction industry. As per reports, manufactured sand is widely used all around the world and technicians of major projects around the world insist on the compulsory use of manufactured sand because of its consistent gradation and zero impurity. There is a need for 'clean sand' in the construction from the point of view of durability of structures. Indiscriminate mining and quarrying is posing threat to the environment. As the demand for Natural River sand is surpassing the availability, has resulted in fast depletion of natural sand sources. Manufactured sand is the answer for this problem especially when some states have already banned the use of river sand for construction. There is a need to study shape characteristics of manufactured sand, effect of micro fines on concrete characteristics such as modulus o of elasticity, shrinkage, creep etc. concrete mix proportioning by resorting to particle packing approach is the need of the hour when it comes to use of manufactured sand as a replacement to natural river sand.

LITERATURE REVIEW:

NimithaVijayaRaghavan and A S Wayal (2013) tentatively demonstrated that substitution of regular sand by manufactured sand (or M-sand) when contrasted with reference blend i.e., 0% substitution, uncover higher compressive qualities. In different outcomes 50% replacement with admixture the compressive quality increments by 5.7% and 100% substitution of natural sand by M-sand, the compressive quality increments by 7.03%, which is maximum. The fine aggregates or sand utilized is typically gotten from normal sources exceptionally river beds or waterway banks. Presently a-days because of consistent sand mining the common sand is draining at a disturbing rate. Sand dragging from waterway beds have prompted a few ecological issues. Because of different ecological issues, Government has prohibited the dragging of sand from waterways. This has prompted a shortage and noteworthy increment in the cost of normal sand. There is an earnest need to locate a contrasting option to river sand. The main long-haul trade for sand is M-sand. M-sand was utilized as fractional substitution of fine aggregates. The bulk density of M-sand was 1.75 kg/m3, specific gravity and fineness modulus was observed to be 2.73 and 7.66, separately. The percentage of particles going through different sieve was compared and natural sand and it was observed to be similar. They concluded as, concrete mix ends up noticeably harsh with increment in extent of M- sand and that the natural sand can be completely replaced by M-sand.

Shreeshail.B.H (2014) in according to the objectives set in the study and the experimental work carried out in the laboratory, the following conclusions were drawn. As the fiber content was increased, the mix became more cohesive. Workability decreased as the fiber content increased. As compared to normal concrete, slump decreased 30% for 1% fiber content. Similarly slump value decreased for 2% and 3% fiber content. As compared to normal concrete, compaction factor value decreased 5% for 75 AR and 10% for 125AR for 1% fiber content. As compared to normal concrete, time taken to change the shape from cone to cylinder increased 75% for 75 AR and 100% for 125AR for 1% fiber content in even bee test. Similarly, there was increase in time for 2% and 3% fiber content. There was decrease in flow for 2% and 3% fiber content the compressive strength, Split tensile strength and Flexural strength has a increasing trend up to 2%. Later, strength decreased with the increase in fiber content. CFRC with 2% fiber content has higher compressive strength, split tensile strength and Flexural strength as compared to that of PC. Optimum results were found when 2% of coir by weight of cement fibers were used, there was 6% and 13% increase in compressive strength as compared to normal concrete for 75AR and 125 AR respectively. Split Tensile Strength increased up to 12% for 75 aspect ratio and 29% for 125 aspect ratios with 2% fiber. Modulus of Rupture increased up to 45% for 75 aspect ratio and 50% for 125 aspect ratios with 2% fiber. This reduces total production of cement content there by resulting in less emission of CO2.Thus the coir is found effective in reducing environmental pollution.

METHODOLOGY:

- The material properties have to be studied.
- Nominal mix design is carried out for M15 (i.e., mix proportion is 1:2:4) grade concrete using different water cement ratios such as 0.4, 0.45, 0.5…etc. for zero slump.

- Concrete cubes for all trials will be casted to study the compressive strength of concrete by using m sand
- Cubes size of 150mm*150mm are used for testing.
- The tests are conducted on concrete with partial replacement of fine aggregate with various percentages of m sand (100%).
- Zero slump is selected for this experiment.

REASONS FOR THE USE OF M SAND:

- Manufactured sand is an alternative for river sand. Due to fast growing construction industry, the demand for sand has increased tremendously, causing deficiency of suitable river sand in most part of the word.
- Due to the depletion of good quality river sand for the use of construction, the use of manufactured sand has been increased. Another reason for use of M-Sand is its availability and transportation cost.
- Since manufactured sand can be crushed from hard granite rocks, it can be readily available at the nearby place, reducing the cost of transportation from far-off river sand bed.
- Thus, the cost of construction can be controlled by the use of manufactured sand as an alternative material for construction. The other advantage of using M-Sand is, it can be dust free, the sizes of m-sand can be controlled easily so that it meets the required grading for the given construction.

PROPRTIES OF M-SAND:

Greater Durability: The physical and chemical properties in M Sand are balanced and can withstand any harsh climatic conditions. It has the ability to overcome the defects in concrete like segregation, honeycombing, corrosion of reinforcement steel, voids, capillary, bleeding etc.

Higher Strength: M Sand has smooth surface texture and free from elongated and flaky particles as it is shaped by using VSI shaping machine. The cubicle shaped particles provide greater durability, higher strength and long life to the concrete.

Quality of Concrete - We often experience concrete bleeding and segregation that can lead to concrete cracking when pouring concrete and compaction. Also, honeycomb formation occurs after the concrete hardens. Those quality issues do not occur when M sand is used in concrete.

Material Quality – In its manufacturing process the quality of the sand can be controlled so, the quality of the particles are well balanced.

Impurities - M sand does not contain silt particles or other marine impurities such as mica and silica, which can affect the quality of concrete.

Greater Workability: The cubical shape and proper gradation (particle should be from 150 microns to 4.75 mm in proper proportion) give good flexibility to mortar producing excellent workability. The crusher dust is flaky and angular in shape which is troublesome in working. There is no plasticity in the mortar which makes it even difficult for the mason to work, whereas the cubical shape with grounded edge and superior gradation gives good plasticity to mortar providing excellent workability.

Reduce Construction Defects: Use of M sand in concrete reduces voids,

Bleeding, segregation, etc. as it has optimal initial and final setting time with excellent fineness properties

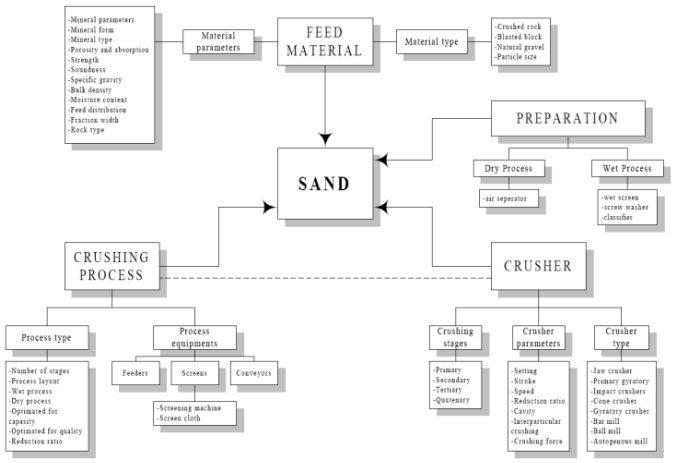
- Shape – Cubical
- Gradation – Controlled.
- Particle passing 75 micron – up to 15 percent
- Impurities – Absent
- Grading Zone – II (FM 2.6-3)
- Specific Gravity – 2.5-2.9
- Water Absorption – 2-4 percent
- Soundness – Relatively Sound (Ex. < 5).
- Alkali-Silica Reactivity – 0.001-0.008

Difference between M Sand and River Sand

Sr.No.	M-Sand	River Sand
1	M-Sand manufactured in a factory	This naturally available on river banks
2	The source of Crushed sand is a quarry. It is manufactured by quarry stones, Crushing rocks, or larger aggregate pieces into sand size particles in a factory or quarry.	This is naturally available and extracted from the riverbanks or river beds.
3	The shape of Crushed sand is angular and cubical and has a rough texture and hence, better for concrete.	The shape of natural sand is rounded and has a smooth surface.
4	No moisture content.	Moisture is generally present between the particles. Hence,

		it affects the assumptions of concrete mix design and quality of concrete.
5	This sand highly recommended for RCC purposes and brick/block works.	River sand is recommended for RCC, plastering and brick/block work.
6	Particle passing 75 microns: Up to 15% (IS: 383-1970)	Particle passing 75 microns: Up to 3% (IS: 383-1970)
7	M-sand specific gravity is approximate 2.73 (Depend on parent rock.)	River sand specific gravity is approximate 2.65 (Depend on rocks in the catchment area.)
8	M-sand dry density of 1.75 kg/m^3	Naturally Sand dry density of 1.44 kg/m^3
9	M-sand is manufactured to conform to zone II.	this sand mostly conforms to zone II and zone III
10	This is less adulteration.	This is a high probability of adulteration because of acute shortage. Natural sand adulteration with saline sea sand is common in coastal areas.
11	M-sand less damage to the environment as compared to natural sand.	This river sand is harmful to the environment. It reduces the groundwater level and rivers water gets dried up.
12	M sand price Near About Rs 900/Ton	River sand price Near About Rs 480/Ton

MANUFACTURING PROCESS:



It is produced by the crushing of granite rocks. Coarse hard rock deposits are crushed in crushers and the crushed material is segregated in different fractions. The sand obtained through this process is further refined by removing fine particles and impurities through sieving and washing.

The preparation of manufactured sand consists of basic process;

concretes used are lime-based concretes such asPortland cement concrete or concretes made with other hydraulic cements, such as calcium aluminate cements. However, asphalt concrete, which is frequently used for roadsurfacesis also a type of concrete where the cement material is bitumen, and polymer concretes are sometimes used where the cementing material is a polymer.Famous concrete structures include the Hoover Dam, the Panama Canal and the Roman Pantheon. The earliest large-scale users of concrete technology were the ancient Romans, and concrete was widely used in the Roman Empire. The Colosseum in Rome was built largely of concrete, and the concrete dome of the Pantheon is the world's largest unreinforced concrete dome. Today, large concrete structures (for example, dams and multi-storey car parks) are usually made with reinforced concrete.

After the Roman Empire collapsed, use of concrete became rare until the technology was redeveloped in the mid-18th century. Today, concrete is the most widely used human-made material (measured by tonnage).

- Extracting
- Aggregate crushing
- Screening and sorting
- Air classifying
- Storage and handling

The manufacturing process for M sand takes place in three stages:

- First stage- crushing stones of varying sizes into aggregates using vertical shaft impact (VSI) crushers.
- Second stage- the material is then fed into a Rotor actor for crushing the aggregates into sand to the desired grain size.
- Final stage- the process of screening, to remove dust particles and washing of sand for eliminating minute particles, is carried out.
    - **FEATURES OF M SAND:**

S.NO	FEATURES	M SAND
1	Colour	Grey
2	Particle Shape	Cubically shaped
3	Manufacturing Process	International technology-controlled

		manufacturing process through imported machines
4	Gradation	As per IS 383-1970 zone II
5	Suitability Of Concreting	Recommended for usage in concrete and masonry works worldwide by concrete technologists.

Advantages of Manufactured Sand

- M Sand has higher Fineness Modules Index compared to the natural river sand, which gives good workability for concrete.
- M sand is free from silt and clay particles which offer better abrasion resistance, higher unit weight and lower permeability.
- Less disruptive to the environment, as it reduces sand mining from river beds.
- Perfect grading and cubical shape of M Sand gives high strength and great durability to concrete
- More cost-effective than river sand due to low transportation cost and consistency in availability.

Disadvantages of Manufactured Sand

- Due to its smooth and angular textures, leads to more water and cement requirement to achieve the expected workability, thereby increase in overall costs.
- If the M Sand contains a large number of micro fine particles, it can affect the strength and workability of concrete.

VASTU SHASTRA:

Now a day's VaastuShastra is more popular, followed by so many persons for constructing a house. As per Vaastushastra the Building material must be free from traces of human body or animal body. The River sand contains bones of human beings and animals. The shells are also one kind of bone. It is not easy to take out all such things present in the river sand. The best solution for this is to use manufactured sand of good quality.

TESTS TO BE PERFORMED:

Fineness modulus test

Specific gravity test

Bulk density test

Compressive strength test

Fineness modulus test:

Fineness modulus of sand (fine aggregate) is an index number which represents the mean size of the particles in sand. It is calculated by performing sieve analysis with standard sieves. The cumulative percentage retained on each sieve is added and subtracted by 100 gives the value of fineness modulus. Fine aggregate means the aggregate which passes through 4.75mm sieve. To find the fineness modulus of fine aggregate we need sieve sizes of 4.75mm, 2.36mm, 1.18mm, 0.6mm, 0.3mm and 0.15mm. Fineness modulus of finer aggregate is lower than fineness modulus of coarse aggregate.

Types of Sand	Specific Gravity value
Normal Sand	2.65-2.67
Silty Sand	2.67-2.70
Inorganic Clay	2.70-2.80
Sands with iron	2.75-3.00
Organic Sands	< 2.00

RESULT: Fineness modulus of M-Sand = 305/100 =3.05

Fineness modulus of River Sand = 310/100 =3.10

Specific gravity test:

Mainly *Specific Gravity* is the ratio of the density of a substance to the density of a reference substance at a fixed temperature. Similarly, it is the ratio of the mass of a substance to the mass of a reference substance. And the theme is also the same for the fine aggregate sand. Specific Gravity of sand is the ratio of the density or mass of sand to the density or mass of a reference substance.

But in both of the state's density or mass, the volume should be the same. If the volume does not remain the same the specific gravity has no existence then. Because the mass or density will be changed of the substance or reference substance.

Standard Value of Specific Gravity of Sand

The considerable specific gravity is around 2.65 for sand. Which is mainly the ratio of the weight of the given volume of aggregates to the weight of an equal volume of water. But normally in the road construction ranges from about 2.5 to 3.0 with an average of about 2.68. This is mainly composed of quartz have a specific gravity ranges from 2.65 to 2.67. Inorganic clay generally ranges from 2.70 to 2.80. Soils with large amounts of organic matter or porous particles have

specific gravities below 2.60. Some range as low as 2.00. Tropical iron-rich laterite, as well as some lateritic soils, usually have a specific gravity of between 2.75 and 3.0 but could be higher. Water absorption shall not be more than 0.6 per unit by weight.

RESULT: Specific gravity of M-Sand is 2.92

Specific gravity of River Sand is 2.65

Bulk density test:

The bulk density values determined based on this test can be used for many methods of selecting proportions for concrete mixtures. Added to that, the evaluation of the percentage of voids between particles in fine, coarse, or mixed aggregates is dependent on the bulk density. It is worth knowing that, aggregates in stockpiles contain absorbed and surface moisture (the latter affecting bulking), while this test method determines the bulk density on a dry basis.

RESULT: Bulk density of M-Sand = 2 kg/m^3

Bulk density of river Sand = 2.1 kg/m^3

Compressive strength test:

The compressive strength of concrete is determined in laboratories for every batch in order to maintain the desired quality of concrete during casting. The strength of concrete is required to calculate the strength of the members. Concrete specimens are a cast and tested under the action of compressive loads to determine the strength of concrete. In very simple words, compressive strength is calculated by dividing the failure load with the area of application of load, usually after 28 days of curing. The strength of concrete is controlled by the proportioning of cement, coarse and fine aggregates, water, and various admixtures. The ratio of the water to cement is the chief factor for determining concrete strength. The lower the water-cement ratio, the higher is the compressive strength% of replacement=100%

7th day			14th day			28th day		
Crushing load (KN)		Compressive strength(N/mm^2)	Crushing load (KN)		Compressive strength(N/mm^2)	Crushing load (KN)		Compressive strength(N/mm^2)
Trial 1	Trial 2		Trial 1	Trial 2		Trial 1	Trial 2	
650	650	28.89	800	930	38.445	1350	1300	58.89
900	700	35.55	910	860	39.33	1250	1110	51.56

Cube dimensions (mm*mm) =150*150

CONCLUSION:

From the above results, we need to know that the replacement of 100% M-SAND in the place river sand in concrete gives the higher strength than river sand. So, here we concluded that the M-Sand is the best alternative for river sand.The study on compressive strength of M Sand and River sand will clearly indicates that the M Sand offers same property of River Sand. The various Tests like specific Gravity, Compression Strength test will give same or greater value than River sand. The most important durability test has to be conducted to analyze the cracking effect of M Sand. The M Sand Mortar cubes also have similar property and gives same workability and strength while plastering. Therefore M sand can be effectively used in Construction As a replacement of River Sand. And to preserve the Water bodies for future, and to Promote the Eco-friendly construction processes.

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Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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