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# REPLACEMENT OF NATURAL SAND WITH MANUFACTURING SAND IT EFFECTS ON CONCRETE PROPERTIES

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## ABSTRACT

Manufactured sand is a term used for fine aggregate processed from crushed rock or gravel. Due to booming of construction activities in our country, natural sand resources are increasingly depleted and its cost is becoming increasingly high. This project was, therefore, conducted to study the influence that manufactured sand have in compressive strength , split tensile strength of concrete and to assess the prospects of using m-sand as 0% , 30% , 50%, 70% and 100% replacement of natural sand by using M30 grade concrete. Tests will be conducted on the samples and the results of various properties in the concrete are collected and then compared to identify the optimum values. The percentage replacement of natural sand with m-sand where the desired properties of the concrete considering the economical factors is obtained.

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# INTRODUCTION

**Sand** is a granular material composed of finely divided mineral particles. Sand has various compositions but is defined by its grain size. Sand grains are smaller than gravel and coarser than silt. Sand can also refer to a textural class of soil or soil type; i.e., a soil containing more than 85 percent sand-sized particles by mass. The composition of sand varies, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non- tropical coastal settings is silica (silicon dioxide, or $SiO_2$), usually in the form of quartz. Calcium carbonate is the second most common type of sand, for example, aragonite, which has mostly been created, over the past 500 million years, by various forms of life, like coral and shellfish. For example, it is the primary form of sand apparent in areas where reefs have dominated the ecosystem for millions of years like the Caribbean. Somewhat more rarely, sand may be composed of calcium sulfate, such as gypsum and selenite, as is found in

places like White Sands National Park and Salt Plains National Wildlife Refuge in the U.S. Sand is a non-renewable resource over human timescales, and sand suitable for making concrete is in high demand. Desert sand, although plentiful, is not suitable for concrete. 50 billion tons of beach sand and fossil sand is used each year for construction.

Sand is highly variable, depending on the local rock sources and conditions. The bright white sands found in tropical and subtropical coastal settings are eroded limestone and may contain coral and shell fragments in addition to other organic or organically derived fragmental material, suggesting that sand formation depends on living organisms, too.[8] The gypsum sand dunes of the White Sands National Park in New Mexico are famous for their bright, white color. Arkose is a sand or sandstone with considerable feldspar content, derived from weathering and erosion of a (usually nearby) granitic rock outcrop.

Some sands
contain magnetite, chlorite, glauconite, or gypsum. Sands rich in magnetite are dark to black in color, as are sands derived from volcanic basalts and obsidian. Chlorite-
glauconite bearing sands are typically green in color, as are sands derived from basaltic lava with a high olivine content. Many sands, especially those found extensively in Southern Europe, have iron impurities within the quartz crystals of the sand, giving a deep yellow color. Sand deposits in some areas contain garnets and other resistant minerals, including some small gemstones.

Sand from rivers are collected either from the river itself or its flood plain and accounts for the majority of the sand used in the construction industry. Because of this, many small rivers have been depleted, causing environmental concern and economic losses to adjacent land. The rate of sand mining in such areas greatly outweighs the rate the sand can replenish, making it a non-renewable resource.

What is manufacturing 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.

## 1. LITERATURE REVIEW:

**Sher Afghan Khan and Akshatha B A :**

The natural sand which excavated from river bed is used to produced conventional concrete. Depletion of natural sand cause the environmental problem and hence sand excavating is restricted by government which resulted in shortage and drastically increase in its cost. In order to fulfill the necessity of fine aggregates, an alternative material like M sand can be used in concrete. M sand is obtained by crushing the rocks. In this paper, conventional mix 1:2.32:2.82 (M20) with water to binder ratio is maintained as 0.55 wasused in this present study. Here the River Sand is partially and fully replaced with M Sand with different percentages like 0%, 45%, 50%, 55% and
100%.
Fresh and hard concrete properties were studied with natural sand substitute by M-Sand. Properties of concrete in fresh state such as workability and in hardened state such as compression test, split tensile test and flexural test were considered in this study.

**Mr. Akshay S Chougale1, Prof. Chetan S patil2:-**

Concrete is widely used material in the world. Concrete is versatile material and it is composition of cement, sand, aggregate and water. Aggregate occupy 70 to 80% of total volume of concrete and it affect fresh and hardened properties of concrete, out of this fine aggregate consumes 20 to 30% of the volume. Sand is most widely used as fine aggregate in concrete. The river bed is main source as sand, hence natural resources are getting depleted due to over exploitation. The manufacturing sand which is available in various queries and it alternative material to natural sand in concrete. The scope of present work to investigate the effect of durability properties of manufacturing sand with grade of M20 and M40 grade of concrete with replacement natural sand to manufacturing sand from 0%,50%,70% and 100% on concrete properties. Here various hardened and durabilitytest conducted for concret.

## METHODOLOGY

N AT U R A L S A N D

- Available naturally at river beds.
- Moisture is trapped between the fineparticles for concrete purposes.
- Low concrete strength compared to Msand.

- Bonding is weak because of its Excessivepresence of flaky, sharp and angular grains.
- 3-20% silt content.

M A N U FA C T U R E D S A N D

- Made of on factories under supervision.
- Moisture is only available in water-washed M sand.
- High concrete strength compared to riversand.
- The sand particles of M sand are in cubicform. This makes the bond stronger.
- Zero slit content.

The methodology will be adopted for the projectwork.

- Literature Survey
- Collection  Material
- Mix Proportions
- Casting of Specimens
- Testing of Results
- Conclusion

**METERIALS AND METHODS**

The raw material utilized in concrete are subjected to several experiments to determine their properties and to decide their usability in concrete. Concrete is a synthetic material, which is made up of cement, coarseaggregates, fine aggregate and water. In this experiment additionally I have added an artificial admixture (super plasticizer) to enhance some of the properties of concrete. The material utilized are cement, M-sand, recycled aggregate, coarse aggregate and artificial admixture. In order to check the use of demolished waste as coarse aggregates in concrete in recently constructed project, the mechanical properties for the recycle aggregate were determined, with specific gravity, water absorption, abrasion resistance,

Aggregate Impact Value and AggregateCrushing Value.

 Cement

them together. Cement is seldom used on its own, but rather to bind sand and gravel together

 Fine aggregate

 Admixture –

SP 430

 Water

 Coarse aggregate

 Recycled aggregate

Super plasticizer Conplast

**Fine aggregate**

Fine aggregates are essentially any natural sand particles won from the land through the mining process. Fine aggregates

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consist of natural sand or any crushed stone particles that

In this analysis, control mix was designed as per IS10262:1986 to reach a target compressive strength of 30 MPa. The casted cubes are test for7, 14, 28 days Compressive strength, Split tensile strength and 14, 21, 28 days Flexural strength test. The wet mixture was filled into the mould in 3 layers with the help of solve the mix is compacted with twenty-five blows of 4.5 kg rammer on level and rigid platform. The number and size ofsamples are determined by the specific of the tests. The excess mixture was scraped off and also the mould leveled using a straight edge. The mould and its content were left for twenty four hours before the removal of the mould. Identification marks were inscribed on the

specimen for simple referencing.

**Cement**

A cement is a binder, a chemical substance used for construction that sets,hardens, and adheres to other materials to bind are ¼" or smaller. This product is often referred to as 1/4"' minus as it refers to the size, or grading, of this particular aggregate.

**Coarse aggregate**

Coarse aggregates are any particles greater than 0.19 inch, but generally range between 3/8 and 1.5 inches in diameter. Gravels constitute the majority of coarse aggregate used in concrete with crushed stone making up most of the remainder.

**Recycled aggregate**

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Recycled concrete aggregate is the term usedto describe the material produced from crushed construction and demolition waste, primarily consisting of concrete but also including aggregate materials such as sand, gravel, slag, and crushed stones.

## METERIALPROPERTIES

**Table1.PropertiesofCement.**

| S. No. | Property | Cement |
|---|---|---|
| 1. | Initial setting time | 44minutes |
| 2. | Final setting time | 620 minutes |
| 3. | Consistency | 33% |
| 4. | Specific Gravity | 3.15 |

Fine Aggregate.

Natural river sand (ZoneII) isused as a FineAggregate. It is passes through the 4.75mm IS sieve and then used for making of Concrete.

**Table2.Properties of Fine Aggregate.**

| S.No. | Property | FineAggregate |
|---|---|---|
| 1. | Finenessmodulus | 2.52 |
| 2. | Specificgravity | 2.70 |

Course Aggregate.

The Course Aggregate is properly sieved and 12.5mm,20mm aggregates were used for Concrete.

**Table3.PropertiesofCoarseAggregate.**

| S.No. | Property | Coarse Aggregate |
|---|---|---|
| 1. | Fineness modulus | 2.52 |
| 2. | Specific gravity | 2.7 |

**Table1.Properties of Coarse Aggregate.**

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| S.No. | Property | DCA |
|---|---|---|
| 1. | Specific gravity | 2.66 |
| 2. | Water absorption | 1.6% |

**CONCRETE MIX DESIGN STIPULATION**

1. Grade designation: — M30
2. Type of cement: — OPC 43 grade
3. Maximum nominal size of aggregate: — 20mm
4. Minimum cement content: — 320 Kg …….…. (From Table 5 of IS 456:2000)
5. Maximum water-cement ratio: — 0.45 …… (From Table 5 of IS 456:2000)
   Degree of Workability: — 100mm slump / 0.92 compacting factor
6. Exposure condition: — Sever
7. Method of concrete placing: — Pumping
8. Degree of supervision: — Good
9. Type of aggregate: — Crushed angular aggregate

Maximum cement content: — 450 kg/m
Chemical admixture type: —Super plasticizer



**5. CONCRETE TESTING**

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**SLUMP TEST**

Concrete slump test or slump cone test is to determine the workability or consistency of concrete mix prepared at the laboratory or the construction site during the progress of the work. Concrete slump test is carried out from batch to batch to check the uniform quality of concrete during construction.

**HARDENED CONCRETE TEST**

**Mechanical strength**

In the case of concrete it is also called as compressive strength of concrete. The strength of concrete is decided based on the requirement of theconstruction. The strength of concrete may vary from low to high strength concrete (20 MPa – 50 MPa).

**Durability**

It is the ability to resist weathering action, chemicalattack, abrasion , or any other process of deterioration, degradation. Durable concrete will retain its original form, quality and serviceability when exposed to its environment.

**COMPRESSIVE STRENGTH TEST**

**Compressive Strength Definition**

Compressive strength is the ability of material orstructure to carry the loads on its surface withoutany crack or deflection. A material under compression tends to reduce the size, while in tension, size elongates.

**Compressive Strength Formula**

Compressive strength formula for any material is the load applied at the point of failure to the cross-section area of the face on which load was applied.

**Compressive Strength = Load / Cross-sectionalArea**

**Procedure: Compressive Strength Test ofConcrete Cubes**

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For cube test two types of specimens either cubes of 15cm X 15cm X 15cm or 10cm X 10cm x 10cmdepending upon the size of aggregate are used. Formost of the works cubical molds of size 15cm x 15cm x 15cm are commonly used.

This concrete is poured in the mold and appropriately tempered so as not to have any voids. After 24 hours, molds are removed, and test specimens are put in water for curing. The top surface of these specimen should be made even and smooth. This is done by placing cement paste and spreading smoothly on the whole area of the specimen.

These specimens are tested by compression testingmachine after seven days curing or 28 days curing.Load should be applied gradually at the rate of 140kg/cm2 per minute till the Specimens fails. Load atthe failure divided by area of specimen gives the compressive strength of concrete.

**SPLIT TENSILE STRENGTH TEST**

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Testing machine shall meet the followingrequirements:

- Firstly, it shall conform to the requirements of Test Method C 39/C 39M.
- Secondly, testing machine should be able to apply the load continuously and withoutshock.
- Thirdly, it should be able to apply loads ata constant rate within the range 0.7 to 1.4 MPa/min (1.2 to 2.4 MPa/min based on IS5816 1999) splitting tensile stress until thespecimen fails.

*Fig.1:Split cylinder testing machine*

**FLEXURAL STRENGTH TEST**

Flexural test evaluates the tensile strength of concrete indirectly. It tests the ability of unreinforced concrete beam or slab to withstand failure in bending. The results of flexural test on concrete expressed as a modulus of rupture which denotes as (*MR*) in MPa or psi. The flexural test onconcrete can be conducted using either three point load test (ASTM C78) or center point load test (ASTM C293). The configuration of each test is shown in Figure-2 and Figure-3, respectively. Testmethod described in this article is according to

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ASTM C78.

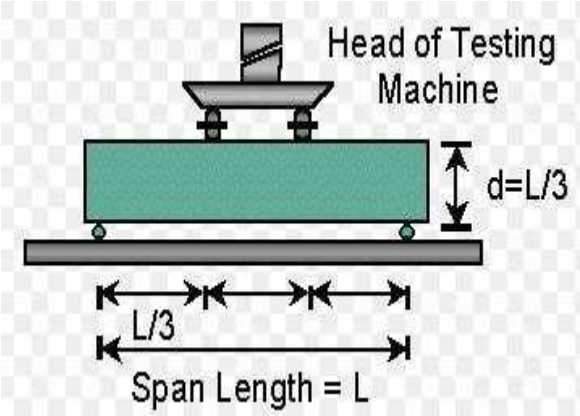


**Fig.2: Three-Point Load Test (ASTM C78)**

## RESULTS

TESTINGOFCONCRETECUBES

The concrete cubes after casting is allowed for 7 days and 14 days curing. After curing, to determine the ultimate compressive load by using Compression Testing Machine (CTM).

From the ultimate load, the compressive strength is obtained by the following formula, **Compressive**

Strength = Ultimate load/Area(N/mm$^2$)

SLUMP TEST

To determine the workability of concrete mix by slump test conducted by as per IS 1199-1959.This allows the concrete to subsideand the slump shall be measured immediately by determining the difference between the height of the mould and highest point of the specimen being tested. The test results are given in the table.

| **SL.NO** | **M-SAND%** | **SLUMP (mm)** |
|---|---|---|
| 1 | 0 | 32mm |
| 2 | 30 | 29mm |
| 3 | 50 | 25mm |
| 4 | 70 | 21mm |
| 5 | 100 | 18mm |

| **M-SAND%** | **DAYS OFTESTING** | **COMPRESSIVEST RENGTH OFCONCRETE(N/mm$^2$)** | | |
|---|---|---|---|---|
| 0 | 7 | 13.56 | 13.95 | 13.75 |
| | 14 | 19.26 | 19.02 | 18.95 |
| 30 | 7 | 14.02 | 14.25 | 14.36 |
| | 14 | 19.85 | 19.65 | 19.88 |
| 50 | 7 | 14.55 | 14.95 | 14.78 |
| | 14 | 19.88 | 20.55 | 20.75 |
| 70 | 7 | 10.55 | 10.35 | 10.12 |
| | 14 | 14.80 | 15.25 | 15.15 |
| 100 | 7 | 9.79 | 9.65 | 10.09 |

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HARDENED CONCRETETESTCOMPRESSIVESTRENGTHTEST

It has performed on standard compression testing machine of **2000KN capacity,** as per IS :516-1959 and thecastingofconcretecubesof**size150mmx150mmx150mm**ofcompressivestrength for7daysand 14 days.

SPLITTENSILESTRENGTHTEST

lit tensile strength = $2P/(\pi DL)(N/mm^2)$

FLEXURALSTRENGTH TEST

It has performed on standard flexural testingmachine of **2000KNcapacity,**asper IS:516- 1959 and the casting of concrete beam of **size**

| **SL .NO** | **M-SAND%** | **7 DAYSOF TESTING** | **14DAYS OF TESTING** |
|---|---|---|---|
| 1 | 0 | 2.77 | 2.91 |
| 2 | 30 | 2.32 | 3.15 |
| 3 | 50 | 2.01 | 2.36 |
| 4 | 70 | 2.12 | 2.52 |
| 5 | 100 | 2.16 | 2.35 |

## CONCLUSION

The above studies helps to meet the construction Industry strategic goal of environmental study such that Manufactured sand (MS) can replace natural sand in concrete mix. Using less natural sand leads to a decrease in river dredging and the disruption ofriver environments. As mentioned the areas used for aggregate mining can be reclaimed and developed for new purposes such as residential, commercial or recreational usage. The results of thehardened properties of the mix have shown that the concrete mix with proportion of manufactured and naturals and achieved a almost Similar compressive strength almost at all tested age of concrete. Manufactured sands are made by crushingaggregate to sizes appropriate for use as a fine aggregate. During the crushing case the manufactured sand have irregular shapes and more fine particles contributing to improved compressivestrength, compared to natural sand control mix. Due to the irregular particle shape of the

**500mm x 100mm x 100mm**

For determine flexural strength for 7 days and14 days.

TESTINGOFBEAM

| SL.NO | DMC% | 7 DAYS OF TESTING | 14 DAYS OF TESTING |
|---|---|---|---|
| 1 | 0 | 7.1 | 7.86 |
| 2 | 30 | 6.6 | 6.9 |
| 3 | 50 | 5.78 | 6.46 |
| 4 | 70 | 5.18 | 5.51 |
| 5 | 100 | 4.98 | 4.90 |

manufactured sand, in addition to the reduced amount of water cement ratio, manufactured sand is more important for high strength concrete mixes. Analysis made on the influence of manufactured sand in the cost of the concrete revealed that no significant cost variation is observed for mixes with fully replacement of the manufactured sand with natural one. 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. Manufactured sand offers a viable alternative to the natural sand if the problems associated with the workability of the concrete mix can be resolved by using super plasticizer.

The addition of super plasticizer to a concrete mix with manufactured sand allows the mix to have a better workability. The Manufactured needs to use clean washed coarse aggregates generally 6 mm to
10 mm size for getting good quality of crushed sand having combination of fines with somepercentage of 2 mm to 4 mm coarse particles for producing effective concrete mix. Environment friendly approach is most important aspect and is touched due to understanding of earth life balance along with pollution free society. The requirement of cement has been observed to be very reasonable for all the mixes. The same content of cement was adequate for the same grade of mix with different admixtures. The mechanical properties of M. Sand depend upon the source of raw material. Hence the selection of quarry is very important for obtaining quality fine aggregates. This study shows minimumvoid content in M. Sand as compare to natural sandwhich further gives lesser drying shrinkage & less cavitations in structure, provide high durability in all types of concrete work.

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