

## Use of Artificial Sand in Construction

**S Radhakrishnan 1\*, Dr. K G Selvan 2 and Dr S Senthil Kumar 3**

- 1\* Research Scholar , PRIST school of business, PRIST University, Thanjavur 613403  
([srk1960@yahoo.in](mailto:srk1960@yahoo.in))
2. Associate Dean, PRIST School of Business, PRIST University, Thanjavur 613403  
([drcsrv@gmail.com](mailto:drcsrv@gmail.com)) and
3. Asst. Professor, Faculty of Management, SRM University, Kattankolathur,  
Kancheepuram Dist, 603203 ([danikapan@yahoo.co.in](mailto:danikapan@yahoo.co.in))

### Abstract

Construction Industry is the fast growing industry in the country now. Its contribution to National Income is increasing year after year. It is also a major source offering employment opportunities to people of all walks of life.

The Government's thrust to develop infrastructure and also the Road Development activities taking place all over India ensure that construction industry is to be given its due importance for the overall economic development of the nation.

Besides above, construction activities are going on in full swing in residential apartments. The higher disposable income of people and the easily available credit facilities enable people to own an apartment for themselves. This leads to substantial construction activities, especially in the outskirts of the city.

In addition to major companies, a number of small and medium level builders are also very busy with various projects on hand.

### Key Words

Natural Sand; Man Made Sand; Robo Sand; Concrete Mix; Quarry Dust

### Scope of Research

Visits to the Construction Sites and availability of Secondary Data

### Visit Details

Details	Figures
No. of Sites visited	6
Officials Discussed with	10
Owner Builder	2

Project Engineer *	1
Supervisor **	2
Site In Charge ***	5
Workers strength	126
Male (Includes *, ** and ***)	85
Female	41

**Note:** The strength of 85 Male comprises Maistry (Chief of Masons), Masons, Carpenter, Plumber and also the 8 “officials” as indicated above (asterisked) . All the Female are only Helpers (Sithal).

### **Discussion**

Sand is the most indispensable thing in construction. No construction can ever take place, anywhere, without sand. The quality of sand determines the quality of construction. A superior quality sand ensures that the structure is strong enough for decades.

The fast depletion of sand from River bed is taking us to a gloomy future. The requirements are on the increase whereas the availability of sand by nature is fixed. The spiraling price of sand and also the restricted availability of same result in a telling effect in construction.

It was observed in sites that the delayed availability of sand has virtually halted the work. The sand cannot be used for the work straightaway, unlike cement. Once sand is delivered, it has to be dried up to the required level and only then can it be used. This also takes easily one day – provided it is a sunny day. Otherwise, at least two days are required to bring the sand to the expected level.

If there is a compromise in the drying of sand, the quality of construction will become questionable.

### **Sand is becoming Costlier**

First and foremost is the availability of sand. The indiscriminate looting of sand is simply wiping out the riverbeds. Supply is fast shrinking.

The unmindful mining of sand is also causing severe environmental problems.

Second thing is distance. Longer the distance of the site, higher the transportation costs. This ultimately leads to the price per truck load becoming dearer.

Even for the builders who are prepared to pay any price for the sand, availability is the major concern and it is forcing them to carry out the activities in a slow manner or accept a halt for a couple of days, till the sand is delivered at the site.

The necessity has now come to explore an alternative to sand to carry on the construction activities without hassle or halt.

## **Artificial Sand is a boon to construction sector**

The shrinking availability has forced invention of artificial sand. The river sand has some impurities and the shape is also not uniform. With the latest technology, artificial sand can be manufactured from stones and rocks. The shapes can also be made uniform as per our choice. Very high quality can be ensured.

The artificial sand produced by proper machines can be a better substitute to river sand.

It is also widely believed that artificial sand is possessing similar qualities of good quality river sand in easily mixing with cement and giving a good quality finish.

The artificial sand produced by proper machines can be a better substitute to river sand. The sand should be sharp, clean and coarse. The grains should be of durable material and the grain size should be such that it should give minimum voids.

The Civil Engineers and Architects feel that the quality of river sand nowadays is not up to the mark and contains impurities such as coal, bones, shells, mica and silt etc., making it inferior for use in concrete.

As such it is necessary that as a long term solution, it is necessary to use artificial sand for construction purposes. It is informed that The V S I Crushers (Vertical Shaft Impactor principle) manufacture excellent quality man made sand.

### **[ 1 ]**

Elaborate studies have been conducted by Civil Engineering Experts on the workability of tensile strength and compressive strength of concrete prepared by replacing natural sand with artificial sand at different replacement levels (0% to 100%).

Their efforts of using quarry dust as a replacement of natural sand proved very encouraging. Quarry Dust is a byproduct, formed in the processing of granite stone which is broken down into a coarse aggregate of different sizes.

The extensive experiments conducted by them proved that artificial sand can be used as a 100% replacement to natural sand.

### **[ 2 ]**

Some further studies proved that the strength of concrete increases with artificial sand. A good quality concrete made from the artificial sand having cubicle particles and sharp edges give higher tensile strength. Similarly, rounded sand particles give more compression strength to

concrete. It was recommended that to achieve both the effects, the sand particles should be cubicle with grounded edges.

This perfection can be accurately brought in, in the artificial sand.

The naturally available river sand is also varying in quality and purity from place to place. The river sand in many parts of the country is not graded properly and has excessive silt and organic

impurities and these can be detrimental to durability of steel in concrete, whereas the manufactured sand has no such impurities.

While there is a nagging doubt about the quality of manufactured sand in our minds, it is to be also noted that manufactured cement has been in use in India and abroad for quite some time.

It is gratifying to note that the Pune – Mumbai expressway was completely built using artificial/manufactured sand.

### **General Requirements of Manufactured Sand**

- All the sand particles should have higher crushing strength
- The surface texture of the particles should be smooth
- The edges of the particles should be grounded
- The ratio of fines below 600 microns in sand should not be less than 30%
- There should not be any organic impurities
- Silt in sand should not be more than 2% for crushed sand
- In manufactured sand, the permissible limit of finds below 75 microns shall not exceed 15%

### **Manufacturing of sand process involves three stages.**

Crushing of Stones into aggregates by VSI

Then feed it into Rotopactor (Sand Making Machine) to crush the aggregates into sand to required grain size (as fines)

Screening is done to eliminate dust particles and Washing of sand eliminates very fine particles present within.

The end product is the artificial sand which can be used in concrete and construction.

### **Behaviour comparison of Manufactured Sand & River Sand when used in Concrete**

<b>Sl No</b>	<b>Property</b>	<b>River Sand</b>	<b>Manufactured Sand</b>	<b>Remedies</b>

1	Workability and its retention	Good & Good retention	Less & Less retention	Control of fines and apply water absorption correction, use of plasticisers.
2	Setting	Normal	Comparatively faster	Apply water absorption correction, use retarders
3	Compressive Strength	Normal	Marginally Higher	As shown above
4	Permeability	Poor	Very Poor	
5	Cracks	Nil	Tend to surface crack	Early curing and protection of fresh concrete

[ 3 ]

### Appreciable Awareness for M Sand

Agriculturist and former MLA Mr M Appavu made a PIL filed in Madras High Court seeking a direction to the authorities to ban river sand mining and mandate compulsory use of M Sand (Manufactured Sand) as an alternative material for construction activities and to cancel the licence to various sand quarries.

A Division Bench comprising Justice Huluvadi G Ramesh and Justice R Mahadevan, which disposed of the PIL said that it is for the authorities to do the needful on the representation made by the petitioner.

Accordingly, a Committee has been formed and it submitted its report, after an extensive study, recommending various measures.

One of the major recommendations of the committee was to encourage Research Programmes to find out alternative materials for sand and in pursuance of the same, PWD has issued circular permitting the use of crushed stone sand as an alternative material to natural sand and also standardize the usage of the said crushed stone sand in construction activities. **(Tamil Nadu Government can save river beds by mandating artificial sand – Deccan Chronicle)**

[ 4 ]

### A Brief Comparison of Parameters between M Sand (or Robo Sand) and River Sand

Parameters	M Sand	River Sand
Process	Manufactured in factory. Artificially manufactured	Naturally available on river banks.

Shape	Angular and rougher texture. Angular aggregates demand more water. This can be compensated with cement content.	Smoother texture with better shape. Demands less Water.
Moisture Content	Moisture is available only in water washed M Sand.	Moisture is trapped in between the particles which is good for concrete purposes.
Concrete Strength	Higher concrete strength compared to river sand used concrete.	Lesser compared to M Sand used concrete.
Quality	Better quality control since manufactured in a controlled environment and the best M Sand has to adhere to IS Standards and has to pass Zone 2 requisites.	No control over quality since it is naturally occurring. Same river bed sand can have differences in slit contents.

[ 5 ]

#### List of a few Suppliers of M Sand in Chennai

Sl No	Name of the Suppliers	Contact Details
1	Grabnpay Ecommerce P Limited	08048616627
2	Sri Ganapathy Enterprises	08071647097
3	SGP Shri Enterprises	08048571312
4	SSV Blue Metals & Agencies	08048581575
5	Ashok Enterprises	09444079582
6	Vardhaman Infra	09940550505
7	M Sand	09381006238
8	Maximus Group	09444906288
9	Janci Rani Transport	09841161011
10	Thirumalai Traders	09444058465

[ 6 ]

#### Advantages and Disadvantages of Manufactured Sand

##### ADVANTAGES

- More Cost Effective than Natural Sand
- Compliant with the Quality Standards Prescribed

- Less Disruptive to the Environment
- Lesser Impurities
- Good Working Properties
- Consistency in Supplies with more Manufacturers coming into Business.
- Excellent Strength
- Better workability
- Economical

## **DISADVANTAGES**

- Workability issues. M sand being coarser and angular texture, requires more water and cement, leading to increased costs.
- The larger proportion of micro fines may affect the strength of the concrete

[ 7 ]

## **Wider Studies for Artificial Sand**

The need for M Sand is keenly felt, of late. This gives rise to enthusiastic researches in the field for Man Made Sand.

### **Copper Slag**

A study carried out by the Central Road Research Institute (CRRI) has shown that Copper slag can be used as a partial replacement for sand as fine aggregate in concrete up to 40% in pavement grade concrete without any loss of cohesiveness and the compressive and flexural strength of such concretes is about 20% higher than that of conventional cement concrete of the same grade.

### **Granulated Blast Furnace Slag**

According to the report of the Working Group on Cement Industry for the 12<sup>th</sup> Five Year Plan, around 10 million tonnes Blast Furnace Slag is being generated in the country from iron and steel industry.

According to M C Nataraja in his study published in the International Journal of Structure & Civil Engineering Research in May 2013, from the test results, Granulated Blast Furnace Slag (GBFS) can be used as an alternative to natural and from the point of view of strength. Use of GBFS up to 75% can be recommended.

Adding to this, Meenakshi Sudarvizhi of KLN College of Information Technology, Tamil Nadu, in her paper published in the International Journal of Civil and Structural Engineering in 2011 says that a mix of copper slag and ferrous slag can yield higher compressive strength of 46.18 MPa as a 100% replacement of sand.

### **Quarry Dust**

About 20 – 25% of the total production in each crusher unit is left out as waste material.

According to Chandana Sukesh in his study published in International Journal of Innovative Technology and Exploring Engineering in May 2013, ideal percentage of the replacement of sand with the quarry dust is 55 – 75% in case of compressive strength.

He further says that if combined with Fly Ash (another industrial waste), 100% replacement of sand can be achieved.

[ 8 ]

Researches are going on to find out the use of construction and demolition waste as a replacement for natural sand.

## **Conclusion**

The need for Artificial Sand is keenly felt by the Society, especially by the Construction Industry.

Given the demand for construction and the full swing activities going on and also going by the fast depletion of river sand by both Legal and Illegal mining, the situation will take a worse turn, soon enough, if artificial sand is not used to the maximum extent possible.

All the sites visited were using only River Sand.

The Builders are prepared to wait for river sand but are unwilling to use M Sand.

Even the Civil Engineer Builder is only preferring river sand to artificial sand. He ascribes customer preference as the reason for this. Though he is fully aware of artificial sand, he is unwilling to use the same.

One builder said that he is prepared to use Robo Sand as a 100% replacement to natural sand, in one of the projects, – but not now or in the near future, but only later, after all the test results confirm on this. His decision is really appreciable.

Masons are against artificial sand. Also, they are not eager to know about Artificial Sand. They have their own apprehensions about the suitability of that as a replacement for river sand.

## **Recommendations**

As it is scientifically proved beyond doubt, the Government should popularize the use of Artificial Sand.

It must issue orders to Government Agencies such as PWD that all the construction activities of PWD and the activities for PWD should be only by use of artificial sand.

Since natural sand is in construction for ages, it is necessary that the misgivings and doubts of the overall Society, particularly the Builders, on the use of artificial sand must be clarified and misunderstandings removed.

Some builders are interested to substitute M sand, but they have some nagging doubts about the efficacy of same as a substitute for river sand. It is the responsibility of the Government to do the needful in this regard.

Initially the construction industry showed resistance for use of fly ash bricks, but later on understood the advantages of fly ash bricks and started trying in their projects. Similarly, the genuine fears of builders must be convincingly removed from their mind. This is possible only by Government.

As the Government is encouraging cashless transactions with Digital Trading, it should show similar enthusiasm in popularizing use of artificial sand.

While issuing Planning Permit, the Authorities should get an undertaking from the builder that he would use artificial sand in the construction. Alternatively, the builders who use artificial sand should be given some concession in the fees payable to the Plan Approval Authorities.

If the Construction is only for Two Floors, ie, Ground Floor and First Floor, it should be made mandatory that the builders should use only artificial sand.

As Government has exclusive Export Promotion Zones, the same way it should also have a separate wing for Artificial Sand Promotion Zone. The Member Companies should be given concessions and rebates, as a measure of promoting the business.

More than issuing orders, inserting Ads will do a lot. It should be a mindful learning than a forceful ruling. The concept will become really popular and gain the acceptance intended for, only when it is popularized at grass root levels. That is, the concept should gain acceptance at villages.

Even the uneducated masses should know about artificial sand and its substitutability for natural sand. Once this is achieved, nothing else is needed – for, the people themselves will ask for M Sand and support the concept.

## **References**

- [1] Artificial Sand Making Machines, Jaw Crushers, Cone Crushers ... [www.artificialsand.com](http://www.artificialsand.com) (as per information of Akash Ganga Constructional Machines Pvt Ltd, Satara 415004, Maharashtra).
- [2] Study of Replacement of natural sand by artificial sand in concrete [www.internationaljournalsrg.org/IJCE/2016/Special-Issue/.../IJCE-ICSTSD-P126.pdf](http://www.internationaljournalsrg.org/IJCE/2016/Special-Issue/.../IJCE-ICSTSD-P126.pdf) (Akshay A Waghmare, Akshay G Kadao, Ayushi R Sharma, Sunil G Throve – International Conference on Electrical, Electronics and Optimization Techniques (ICEEOT) – 2016.
- [3] Use of Manufactured Sand in Concrete and Construction An Alternate ... [www.nbmcw.com/concrete/28675-use-of-manufactured-sand-in-concrete-and-constr..](http://www.nbmcw.com/concrete/28675-use-of-manufactured-sand-in-concrete-and-constr..) (Use of Manufactured Sand in Concrete and Construction An alternate to River Sand by G Sreenivasa, General Manager (Business Development), Ultra Tech Cement Limited, Bangalore)
- [4] Tamil Nadu Government Can Save river beds by mandating artificial sand (Deccan Chronicle) <http://m.dailyhunt.in/news/india/english/decan+chronicle-epaper-deccanch/tamil+nadu+govt+can+save+river+beds+by+mandating+artificial+sand-newsid-64556588>
- [5] M Sand Vs River Sand – Material tree . <https://www.materialtree.com/blog/m-sand-vs-river-sand>
- [6] M Sand in Chennai, Tamil Nadu| Manufactured Sand Suppliers ... <https://dir.indiamart.com>
- [7] The Pros and Cons of Manufactured Sand – The Screed Scientist [www.ScreedScientist.com/the-Pros-and-Cons-of-manufactured-Sand/](http://www.ScreedScientist.com/the-Pros-and-Cons-of-manufactured-Sand/)
- [8] Concrete Without Sand? – Down to Earth [www.downtoearth.org.in/blog/concrete-without-Sand-41849](http://www.downtoearth.org.in/blog/concrete-without-Sand-41849)