

# Study on High Strength Concrete Using M-Sand

Rakesh P

M.E Scholar, Department of Civil Engineering,  
Sengunthar Engineering College (Autonomous), Tiruchengode, India  
[rakeshpmestr2026@scteng.co.in](mailto:rakeshpmestr2026@scteng.co.in)

Pavalan V 

Professor, Department of Civil Engineering,  
Sengunthar Engineering College (Autonomous), Tiruchengode, India  
[vpavalan.civil@scteng.co.in](mailto:vpavalan.civil@scteng.co.in)  
<https://orcid.org/0000-0002-8315-3277>



## Publication History

Manuscript Reference No: IJIRAE/RS/Vol.13/Issue03/AEMR26.MRAE10087

Research Article | Open Access | Double-Blind Peer-Reviewed | Article ID:IJIRAE/RS/Vol.13/Issue03/AEMR26.MRAE10087

Received:22,February 2026, Revised: 01, March 2026, Accepted: 16,March 2026,Published Online: 25, March 2026.

<https://www.ijirae.com/volumes/Vol13/iss-03/08.AEMR26.MRAE10087.pdf>

**Article Citation:** Rakesh,Pavalan(2026),Study on High Strength Concrete Using M-Sand, IJIRAE: International Journal of Innovative Research in Advanced Engineering, Volume 13, Issue 03 of 2026 pages 140-144

**Doi:->** <https://doi.org/10.26562/ijirae.2026.v1303.08> **BibTeX Key:** Rakesh@2026Study

IJIRAE papers should be cited as IJIRAE (International Journal of Innovative Research in Advanced Engineering, AM Publications, India 2025, ISSN 2349-2163, <https://doi.org/10.26562/ijirae.2026.v1303.08> The journal's official abbreviation is IJIRAE. Orcid: <https://orcid.org/0009-0004-9398-7488>

About the License: Copyright©2026 copyright by the authors. This article is an open access and license under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Abstract:** This study investigates the performance of high- strength concrete produced using manufactured sand (M-sand) as a replacement for natural river sand. The increasing demand and limited availability of river sand have encouraged the use of alternative materials in concrete production. The objective of this research is to evaluate the mechanical properties of concrete prepared using M-sand. Experimental tests including compressive strength, modulus of elasticity, and flexural strength were conducted. The results indicate that concrete prepared with M-sand exhibits slightly higher strength compared to conventional concrete made with natural sand. Therefore, M-sand can be considered a sustainable and economical alternative for modern construction practices.

**Keywords:** Manufactured sand, High-strength concrete, Compressive strength, Flexural strength.

## I. INTRODUCTION

High-strength concrete is defined as concrete having compressive strength greater than M55 grade according to IS 456:2000. In modern construction practices, high- strength concrete is widely used in high-rise buildings and infrastructure projects due to its superior mechanical performance and durability. The production of high-strength concrete requires careful selection of ingredients such as cement, aggregates, water, and admixtures. Among these, fine aggregates play a crucial role in determining the strength and durability of concrete. Natural river sand has traditionally been used as fine aggregate in concrete. However, the continuous extraction of river sand has resulted in environmental concerns and scarcity of good quality material. Manufactured sand (M-sand), produced by crushing hard granite rocks, has emerged as a viable alternative. M-sand possesses better gradation and is free from impurities such as silt and organic matter.

## II. LITERATURE REVIEW

Adams Joe et al, (2013) investigated the effect of M- Sand in high performance concrete. Were experimentally investigated the effect of M-sand in structural concrete by replacing river sand and developed high performance concrete. Concluded that the M-sand can be used as a replacement for fine aggregate,50% replacement of fine aggregate by M-sand give maximum result in strength and durability aspects that the conventional concrete and also proved that of the replacement of 50% of fine aggregate by M-sand induced higher compressive strength, higher tensile strength, higher flexural Strength. Elavenil,(2013) arrived a solution and alternative to rivers and in concrete manufacturing by studying a well processed manufactured and as partial or full replacement to river sand is investigated. Shape characteristics of manufactured sand, effect of micro fines on concrete characteristics such as modulus of elasticity, shrinkage, creep etc. Concrete mix is also studies and finally concluded that the compression strength for 7 days and 28 days various from 23.8 N/mm<sup>2</sup> to 54.2N/mm<sup>2</sup> and 33N/mm<sup>2</sup> to 69N/mm<sup>2</sup>.

Gopinath et al,(2013) investigated on strength of concrete by partially replacing the fine aggregate using M-Sand.M25 concrete is used as control mix with M-sand and super plasticizer and glass fibre in various percentages is investigated. Strength modified concrete is compared with normal concrete. The results show that the significant improvement in the strength and workability of modified concrete. The referred the concrete mix is designed as per IS 456-2000 and SP 23[3-6]. Finally concluded that the compressive strength obtained for M-sand for 28 days is 26.66 N/mm<sup>2</sup>, for the 50% replacement of natural sand with M-Sand. Huajian Li et al,(2016)studied the effect of granite dust on mechanical and few durability properties of manufactured sand concrete. Granite dust were mixed into manufactured sand concrete as supplementary cementitious material to replace fly ash in different proportions.

Concluded the early strengths of manufactured sand concrete decreased with the fly ash replacement, but the compressive strengths, bending strengths and elastic modulus increased in the later stage, when the replacement ratio was 20%, compared with pure cement concrete. The 56 days chloride penetration resistance of the modified concretes was enhanced remarkably. Jaishankar, (2016) studied the concrete mixes with normal river sand were replaced by M-sand by a constant percentage and cement was replaced by metakolin in various percentages such as 5%,10%,15% and 20%. Concrete specimens containing metakolin were studied for their compressive, tensile and flexural strengths according to Bureau of Indian Standards. Finally concluded the compressive strength values were increased with metakaolin content if cement was replaced with metakaolin up to 15%. The comparison of the compression strength test result at 7,14, and 28 days, and was observed that MK 15 (15%MK & 50% M-sand) showed maximum strength compare to other replacement percentage. Jayaraman et al,(2012) studied on optimization of fully replacement of natural sand by M-sand. In high performance concrete with Nano-Silica. The optimization of fully replacement of manufactured sand by natural sand with Nano-silica in high performance concrete. The ordinary Portland cement is partially replaced with nanosilica by 0.75% and natural sand is fully replaced with manufactured sand and concluded that the addition of Nano-Silica leads to a significance increase in the characteristic strength and durability of concrete. Replacement of cement with 0.75% of nanosilica gives more strength than the M- sand mix and also the durability has been increased compared to the M-sand mix. The work ability decreases with the addition of Nano-silica compared to the conventional mix and the M -sand mix. The penetration level of chlorides and acids are less in Nano concrete compared to that of conventional and M-sand mix. Jose Ravindra Raj,(2014) investigated on high strength concrete made using manufactured sand, with coconut shell and steel fibre.

The combined effect of 50% manufacturing sand as fine aggregate replacement and coarse aggregate with 50% coconut shell and steel, sisal fibres as reinforcement for high strength concrete. Finally concluded that the 15% of silica fume, 50% manufacture sand and 50% coconut shell with 2% steel fibres has increased both strength and the tensile strength of high strength concrete. Kah Yen Foonget al, (2015) studied on enhancement of the mechanical properties of lightweight oil palm shell on concrete using rice husk ash and manufactured sand. The study explores the use of rice husk ash (RHA) and manufactured sand (M-sand) as replacements for cement and fine aggregate, respectively, in lightweight oil palm shell concrete (OPSC). The first stage of the study, the effect of various cement replacement levels, with RHA (5%, 10%, 15%, and 20%) and 100% sand replacement with M-sand and quarry dust(QD), on the compressive strength of OPSC was investigated and concluded that the highest compressive strength of OPSC of about 51.49 MPa was achieved with the use of 15% RHA and M-sand. In the second stage the variables of RHA(0 and 15%) and M-sand (0, 50%, and 100%) were used to investigate their combined effects on the mechanical properties of OPSC. It was found that the combination of 15% RHA and 100% M-sand gave the best performance of OPSC in terms of mechanical properties, such as compressive, splitting tensile, flexural strength, and Young's modulus.

Krishna Rao et al,(2016) investigated the effect of M-sand on abrasion resistance of roller compacted concrete containing GGBS (Ground Granulated Blast Furnace Slag). The cement was partially replaced by GGBS from 0% to 60%, fine aggregates of three combinations were used. River sand (100%-series A), M-sand (100%- series B) and combination of river sand and M-sand (50% each –series C). Concluded that the strength values increased up to 50% replacement level from 7 days in comparison with control mix concrete, this is due to the fact that the GGBS is contributing the later strength of the concrete. Li Beixing et al,(2009) studied on effect of limestone fines content in manufactured sand on durability properties of low-and high-strength concrete. The effect of lime stone fines content in manufactured sand on compressive strength, chloride ion permeability and freeze-thaw resistance of both low-and high-strength concretes is investigated. The abrasion resistance of concretes and sulphate attack of mortars were also tested. Concluded that the incorporation of up to 15% limestone fines as a partial replacement for fine aggregate in low-strength MS concrete and 10% limestone fines for in high-strength MS concrete improved compressive strength. The abrasion resistance of MS concretes showed an improvement at 7% and 10% limestone fines, and more than 10% of limestone fine considerably increased the abrasion loss. Magudeaswaran et al,(2016) investigated the high performance concrete composite using M-sand. The performance of concrete in terms of workability of manufactured sand, industrial waste and using admixture in concrete and concluded that the mix of 10% silica fume with M-Sand achieved a maximum of 32% increase in compressive strength when compared with control mix at 28 days. The tensile strength of mix 10% silica fume with M-Sand was found to increase to a maximum of 30% when compared with control mix. There is an increase in flexural strength with the addition of M-Sand and the mix of 10% silica fume, 20% fly ash with M-Sand achieved a maximum flexural strength of 30 % higher than the control mix. Nimitha Vijayaraghavan,(2013) studied on effect of manufactured Sand on compressive strength and workability of concrete. The partial and full replacement of natural sand by manufactured sand is compared. The compressive strength and workability of manufactured sand concrete with natural sand concrete in varying proportions are considered. Concluded the 50% replacement with admixture the compressive strength increases by 5.7% and 100% replacement of natural sand by crushed sand by 7.03%, which is maximum. Nithyambigai,(2015) investigated the partial replacement of manufactured sand and fly ash in concrete. The strength of concrete mix at 28 days and 56 days are found by replacing with 25% and 50% of M-sand on fine aggregate and 25% and 50% of fly ash for cement. For M35 grade of cement concrete the maximum replacement level of fly ash and M-sand were 50%. Prakash Nanthagopalan et al,(2011) investigated the fresh and hardened properties of self-compacting concrete produced with manufactured sand. An attempt was made to understand the influence of paste volume and w/p ratio (water to powder ratio) on the properties of self-compacting concrete (SCC) using M-sand. Low and medium strength (25–60 MPa) SCCs were achieved by using M-sand.

Finally concluded that relatively higher paste volume is essential to achieve the required flow for SCC using M-sand, as compared to river sand, and successfully found the possibility of using manufactured sand in producing SCC.

Priyanka et al,(2012) investigated on the properties of concrete containing manufactured sand. The effect of water cement ratio on fresh and hardened properties of concrete with partial replacement of natural sand by manufactured sand was investigated. Concrete mix M20 grade was done according to Indian Standard code (IS: 10262). Concluded the compressive, tensile and flexural strength of concrete with 60% replacement of natural sand by manufactured sand reveals higher strength as compared to reference mix. Priyanka et al,(2013) studied on effect of replacement of natural sand by manufactured sand on the properties of cement mortar. The effect of water cement ratio on hardened properties of cement mortar with partial replacement of natural sand by manufactured sand is investigated. Designed mortar mix having proportion as 1:2, 1:3 and 1:6 with water cement ratio of 0.5 and 0.55 are considered. Concluded the compressive strength of cement mortar with 50 % replacement naturals and by manufactureds and reveals higher strength as compared to reference mix. The overall strength of mortar linearly increases from 0%, to 50% for replacement of natural sand by manufactured sand as compared with reference mix. Shanmugapriya et al,(2012) have studied on optimization of partial replacement of M-sand by natural sand in high performance concrete is combination with silica fume. Concrete mixes were evaluated for compressive strength and flexural strength. The ordinary Portland cement was partially replaced with silica fume by 1.5%, 2.5 %, and 5% and natural sand was replaced with manufactured sand by 10%, 30%, 50%, and 70%. The results indicated that there is an increase in the compressive and flexural strength of HPC nearly 20% and 15% respectively with the increase of manufactured sand percentage. The optimum percentage of replacement of natural sand by M-sand is 50%. The results also revealed that increase in percentage of partial replacement of silica fume, increased the compressive and flexure strength of High Performance Concrete. Syam Prakash,(2007) investigated ready mixed concrete using manufactured sand as fine aggregate. The physical and mechanical properties of M-Sand and ready mixed concrete using M-Sand are considered. Three type of admixtures FOSROC, CERAPLAST, and SIKAMENT are used, founded that the compressive strength on 7 days and 28 days are 18.86 MPa and 29.05MPa respectively. Xinxin Ding et al,(2016) studied long-term compressive strength of concrete with manufactured sand. Influences of stone powder content on long-term compressive strength of concrete with different water-to-cement ratios were investigated. Concluded that the cohesiveness of fresh concrete was improved with the increase of stone powder content, 9% stone powder content was the best for workability. A 13% of stone powder content in manufactured sand has positive effect on the long-term growth of compressive strength of concrete. Zhou Mingkai et al, (2008) investigated the effects of manufactured-sand on dry shrinkage and creep of high- strength concrete. The influences of natural sand, manufactured-sand (MS) and stone-dust (SD) in the manufactured-sand on workability, compressive strength, elastic modulus, drying shrinkage and creep properties of high-strength concrete were tested, compared and concluded that the reasonable content 7%-10.5% of SD in MS will not deteriorate the workability of MS-HSC. It could even improve the workability. Moreover, the compressive strength increases gradually with the increasing SD content, and the MS-HSC with low SD content of 7%. The elastic modulus of the natural sand HSC reduces when the SD content is high.

### III. MATERIAL PROPERTIES

The important properties of manufactured sand that influence concrete performance include particle shape, particle size distribution, and surface texture. Proper gradation ranging from 150  $\mu\text{m}$  to 4.75 mm helps in reducing voids in concrete and improving workability. General requirements of M-sand include:

- All sand particles should possess high crushing strength.
- The particle surface should be relatively smooth.
- The edges of particles should be properly graded.
- The percentage of fines below 600  $\mu\text{m}$  should be less than 30%.
- Silt content should not exceed 2 %.
- Fineness below 75  $\mu\text{m}$  should not exceed 15%.

### IV. EXPERIMENTAL PROGRAM

#### A. Compressive Strength Test

In the case of cubes, the specimen is placed in the machine in such a manner that the load is applied to opposite sides of the cubes as cast.



Figure 4.1 Cube Compression Test

The axis of the specimen is carefully aligned with the Centre of thrust of the spherically seated plate. No packaging is used between the faces of the test specimen and the steel plate of the testing machine. A spherically seated block is brought to bear on the specimen; the movable portion is rotated gently by hand so that uniform seating may be obtained. The load is applied without shock and increased continuously until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The maximum load to the specimen is then recorded. The compression strength values of all the cubes are found as shown in Figure 4.1.

### B. Modulus of elasticity

For each mix three cylinder of size 150mm diameter and 300mm long were cast to determine the modulus of elasticity of concrete. The cylinder were placed inside the young's modulus testing apparatus called compressometer, providing equal clearance to top and bottom of specimen. Each cylinder was tested in 300T capacity compression testing machine. Loads were applied by means of 0.5T and reading is noted in the deflectometer. The results were tabulated. Tests were conducted as per IS 516-1959. The cylinder kept in the compression testing machine as shown in figure 4.2.



Figure 4.2 Test Setup of E for Concrete

### C. Flexural Strength Test

For each mix three prism of size 500mm long, 100mm breadth, and 100mm depth were cast to determine the flexural strength of concrete. The prism were placed on the two supports. The applied load is distributed by two points (two point load). The load is applied gradually, the breaking points of the results are tabulated. Tests were conducted as per IS 516-1959. The sample prism kept in the table shown in figure 4.3.

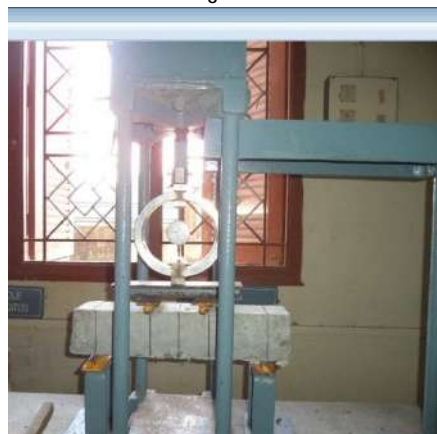


Figure 4.3 Test Setup of Flexural Strength

## V. CONCLUSION

The experimental investigation demonstrates that the use of manufactured sand in high-strength concrete improves mechanical properties such as compressive strength, modulus of elasticity, and flexural strength. M-sand provides a sustainable and economical alternative to natural river sand while maintaining or enhancing structural performance.

## REFERENCES

1. Adams Joe.M, Maria Rajesh.A, Brightson.P, (2013),Experimental Investigation On The Effect Of M-Sand In High Performance Concrete, American journal of research,Vol.02(12), pp. 46-51.
2. Elavenil. S,Vijaya.B (2013), Manufactured Sand, A Solution and An Alternative To River Sand and In Concrete Manufacturing, Journal of Engineering Computers and Applied Science,Vol.02(02), pp. 20-24.
3. Gobinath R,VijayanV, Sivakumar N,Prakash P, Suganya S, Dhinesh. A (2013), Strength of Concrete by Partially Replacing The Fine Aggregate Using M-Sand, Scholors Journal of Engineering Technology,Vol.1(4), pp. 238- 246.
4. Jaishankar.P and Vayugundlachenchu Eswara Rao (2016), Experimental Study on Strengthof Concrete Using Metakaolin and M-Sand, International Journal of Chem Tec Research, Vol.02 (05), pp. 446-452.

5. Jayaraman A, Senthil kumar V (2013), Optimization of Fully Replacement of Natural Sand by M-Sand In High Performance Concrete With Nano Silica, International Journal of Emerging Technology and Advanced Engineering, Vol.3(11), pp. 497-502.
6. Jose Ravindra Raj (2014), High Strength Concrete Made Using Manufactured Sand, Coconut Shell and Steel Fibre, International Journal of Innovations in Engineering and Technology (IJET) ,Vol.3, pp. 54-57.
7. Kah Yen Foong, U. Johnson Alengaram, MohdZaminjumaat, Kim Hung Mo (2015), Enhancement of The Mechanical Properties of Lightweight Oil Palm Shell Concrete Using Rice Husk Ash And Manufactured Sand, Journal of Zhejiang University Science A (Applied Physics & Engineering), Vol.16(1), pp. 59-69.
8. Krishna Rao, P. Sravana, T. Chandrasekhar Rao (2016), Investigating the Effect of M-Sand On Abrasion Resistance of Roller Compacted Concrete Containing GGBS, Construction and Building Materials Vol.122, pp. 191-201.
9. Li Beixing, Wang Jiliang, Zhou Mingkai (2009), Effect of Limestone Fines Content In Manufactured Sand On Durability Of Low-and High-Strength Concretes, Construction and Building Materials, Vol.23, pp. 2846-2850.
10. Magudeaswaran.P, Dr.Eswaramoorthi (2016), High Performance Concrete Composite Using M-Sand, International Journal of Advanced Engineering Technology, Vol.07 (02), pp. 736-742.
11. Nimitha Vijayaraghavan and A.S.Wayal (2013), Effect Of Manufactured Sand On Compressive Strength and Workability Of Concrete, International Journal of Structural and Civil Engg. Research, Vol.02 (04), pp. 228-232.
12. Nithyambigai.G (2015), Partial Replacement Of Manufactured Sand And Fly Ash In Concrete, International Journal of Emerging Technology and Advanced Engg, Vol.05 (06), pp. 166-170.
13. Mani Kandhan K.U, Sathya Kumar N, Uthaya K (2015), Mechanical Properties of High Strength Concrete by Using M-Sand as A Fine Aggregate, International Journal of Advanced Technology in Engineering and Science, Vol.03(01), pp. 66-79.
14. Prakash Nanthagopalan Manu Santhanam (2011), Fresh And Hardened Properties of Self - Compacting Concrete Produced With Manufactured Sand, Cement & Concrete Composites, Vol.33, pp. 353-358.
15. Priyanka.A, Jadhav and Dilip, Kulkarni.K (2012), An Experimental Investigation On The Properties of Concrete Containing Manufactured Sand, International Journal of Advanced Engineering Technology, Vol.02(02), pp. 101-104.