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An Experimental Examination of Concrete for Seven and Twenty-Eight Days of Cement Mortar Recursion

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Abstract

The construction industry's daily increasing demand for fine aggregates to produce concrete cannot be met solely by river sand. As it can meet the growing demand for fine aggregate in mortar and concrete, M-sand is used globally as a substitute for river sand. This is because alternative materials, such as foundry sand, steel slag, copper slag, imperial smelting furnace slag, blast furnace slag, coal bottom ash, ferrochrome slag, and palm oil clinker, are not readily available in sufficient quantities to meet the demand. Due to the size of the building and the high need for fine aggregates, sources other than M sand cannot be made volumetrically available. There is very little research on the properties of mortar and concrete based on Fine Aggregate (FA) grading zones. When moving from river sand to M-sand, zones need to be considered. The primary focus of this study is how the physical properties of M-sand behave zone-wise when compared to river sand. Competent agencies tested M-sand for durability, water permeability, and shrinkage in order to demonstrate its technical qualities. According to all test findings, M-sand was positioned better than river sand. The concrete containing M-sand had RCPT values below 1000 coulombs, indicating very low chloride permeability and high-quality dense concrete, according to the Rapid Chloride Permeability test, which was used to evaluate the durability of M-sand mixes. Likewise, tests for drying shrinkage and water permeability were performed on M-sand grades M25 and M40. The former test showed that the concrete had a very good dense structure, while the latter showed that the shrinkage was within the range predicted by the drying shrinkage estimation curve.

***Major Findings:** Many methods have been employed for examining the features of different river and M-sand zones. In addition to their behaviour in mortar and concrete, the mechanical characteristics of both materials, including workability, compressive strength, and flexural strength, were predetermined. Proportioning, curing, and sample preparation were given the proper consideration. These stages were followed by observation, findings, discussion, and conclusion.*

Keywords: *Cement Mortar, Concrete, Experimental Analysis, Recursion, Seven and Twenty- Eight Days*

1.0 Introduction

It is clear from the review that river sand is a crucial fine aggregate in the building industry[1-2]. However, overuse of rivers leads to several social and environmental problems[3-4]. Sand is a crucial resource for environmental protection in our civilisation. The river bed might be changed by excessive sand mining[5-6]. In addition

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to impacting groundwater recharge, it also ruins the habitat of aquatic creatures and microorganisms[7-8]. Sand mining has been outlawed in a few Indian states[9-10]. This results in indiscriminate and unlawful sand mining, which raises prices and ultimately raises construction costs[11,12]. It became a hazard to the global environment as well[13,14]. The annual demand for sand is around 700 million tons[15,16], and it is growing at a pace of 6-7 %. River sand is insufficient to meet the growing demand of the construction industry for fine aggregates needed to make concrete, which is growing daily[17,18]. M-sand is used worldwide in place of river sand because it can meet the growing demand for fine aggregate in mortar and concrete, while alternative materials such as foundry sand, steel slag, copper slag, imperial smelting furnace slag, blast furnace slag, coal bottom ash, ferrochrome slag, and palm oil clinker are not available in large enough quantities to meet the requirement[19-25]. Sources other than M sand cannot be made volumetrically available due to the volume of building and the enormous need for fine aggregates[26-33].

Research on the characteristics of concrete and mortar according to FA grading zones is extremely limited. Zones must be taken into account when switching from river sand to M- sand[34-41]. The zone-wise behaviour of M-sand's physical characteristics in comparison to river sand is the main topic of this study. For zones I, II, III, and IV, the outcomes of using M-sand mortar and concrete as a 100% substitute for river sand[42-53] were compared. Step-by- step progress was necessary to execute and finish any project with quality and on schedule. Gathering manufactured sand, or M-sand, from various zones as well as natural sand is the initial phase[54-61]. OPC 53 grade cement and high-quality coarse aggregates were utilised. All necessary materials were gathered, and then testing was done on each one. Every test was conducted in compliance with IS code[62-73]. Choosing the optimal approach to be used for the duration of the project is the second phase. The various approaches to investigate characteristics of various river and M-sand zones[74-77]. They behave in mortar and concrete, as well as the mechanical properties of mortar and concrete, such as workability, compressive strength, and flexural strength, were predetermined. Sample preparation, proportioning, and curing received the appropriate attention. Observation, results and debate, and conclusion came after these stages[78-82].

2.0 Methodology and Results Analysis

It is detected that compared with R-sand mortar, M-sand mortar shows higher compressive strength. The 7th day compressive strength for Zone I, Zone II, Zone III and

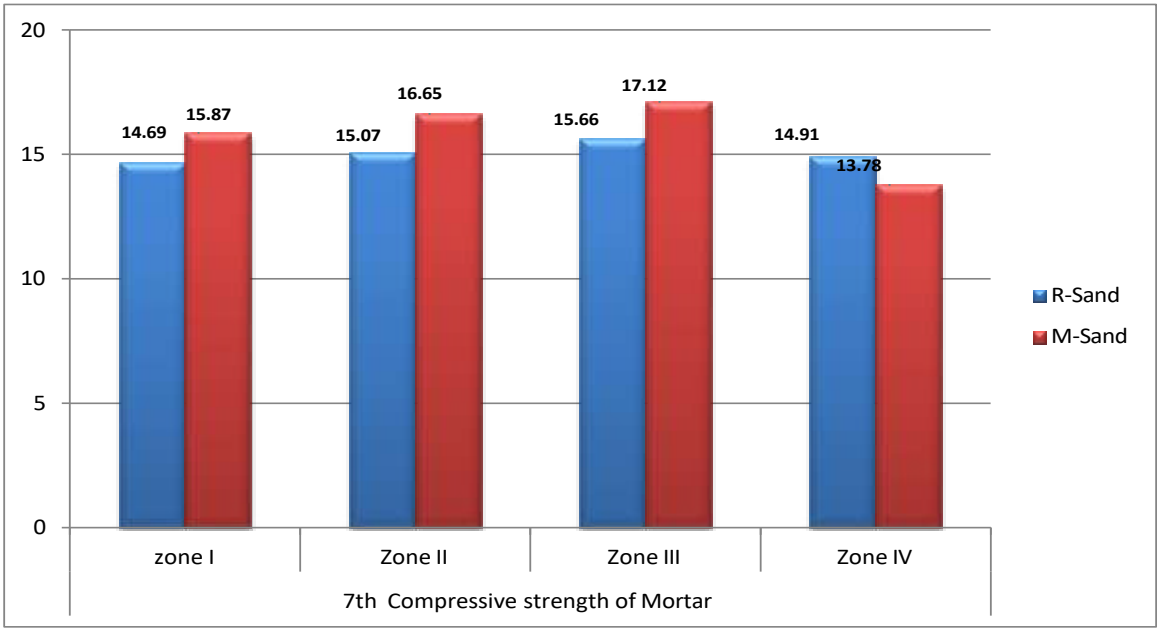


Figure 1. Graph showing the comparison of the 7th compressive strength of motor[3].

Table 1. Mortar mix 1:3:0.50 for compressive strength after 7th days of curing

Serial No.	Zone	Peak Load(KN)		7th day Comp Strength(MPa)		Average Comp Strength (MPa)	
		R-Sand	M-Sand	R-Sand	M-Sand	R-Sand	M-Sand
1	I	71.01	72.8	14.20	14.56	14.69	15.87
2		65.82	83.95	13.16	16.79		
3		83.47	81.35	16.69	16.27		
4	II	68.93	79.45	13.78	15.89	15.07	16.65
5		75.63	81.35	15.12	16.27		
6		81.42	88.9	16.28	17.78		
7	III	74.26	78.25	14.85	15.65	15.66	17.12
8		81.58	92.16	16.32	18.43		
9		79.03	86.44	15.81	17.29		
10	IV	64.07	72.55	12.81	14.51	14.91	13.78
11		88.91	69.45	17.78	13.89		
12		70.65	64.7	14.13	12.94		

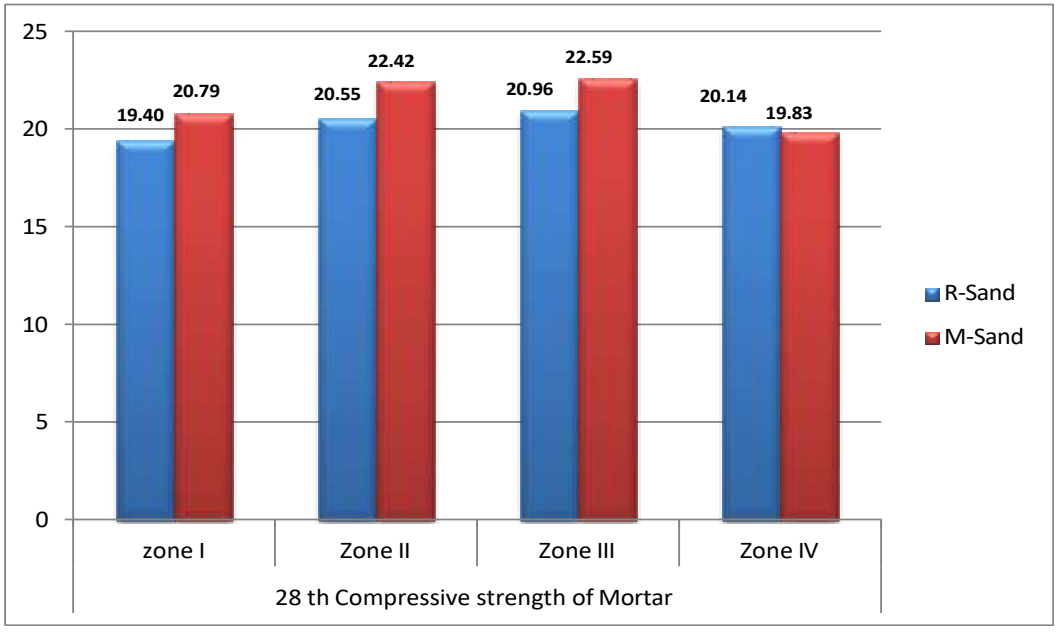


Figure 2. Graph showing the comparison of the 28th compressive strength of mortar[7].

Table 2. Mortar mix 1:3:0.5 for compressive strength after 28th days curing

Serial No.	Zone	Peak Load (KN)		28th day Comp Strength (MPa)		Average Comp Strength (MPa)	
		R-Sand	M-Sand	R-Sand	M-Sand	R-Sand	M-Sand
1	I	83.27	94.25	16.65	18.88	19.40	20.79
2		109.02	98.65	21.80	19.73		
3		98.67	118.90	19.73	23.78		
4	II	117.86	110.41	23.57	19.96	20.55	22.42
5		88.19	107.05	17.64	21.47		
6		102.23	118.84	20.45	24.02		
7	III	95.29	98.55	19.06	19.71	20.96	22.59
8		105.73	123.84	21.15	24.77		
9		113.41	116.39	22.68	23.28		
10	IV	117.35	105.25	23.47	21.05	20.14	19.88
11		95.31	94.46	19.06	18.89		
12		89.55	98.53	17.91	19.71		

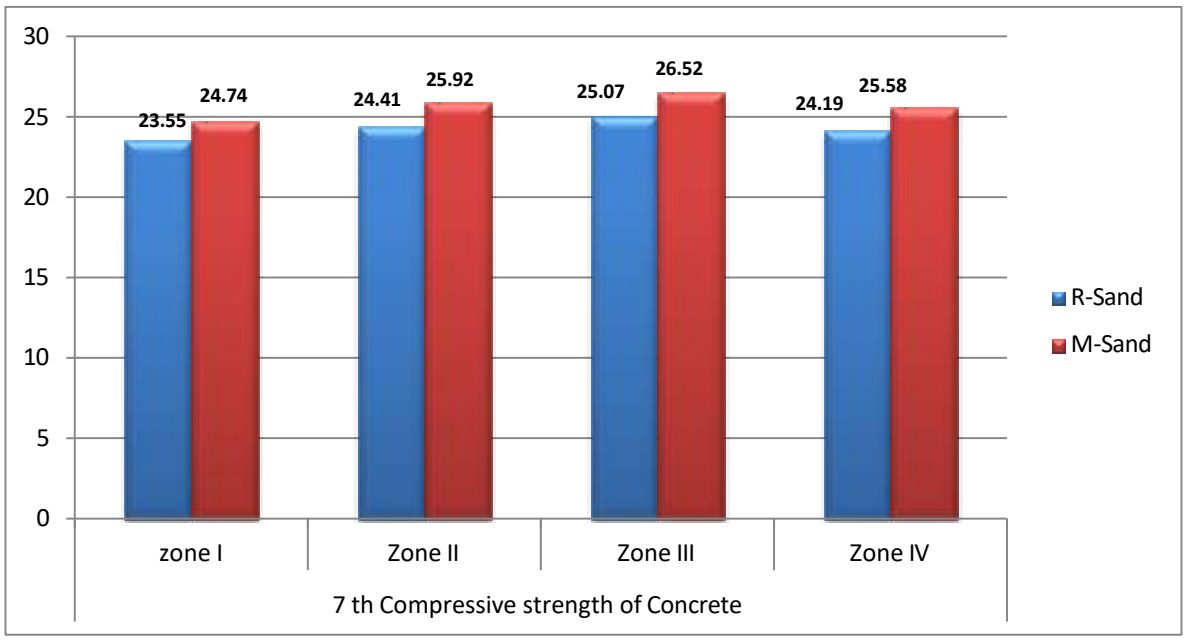


Figure 3. Graph showing the comparison of the 7th compressive strength of concrete[9].

Table 3. Compressive strength of R-sand and M-sand concrete after 7th days of curing

Serial No.	Zone	Peak Load (KN)		7th day Comp Strength (MPa)		Average Comp Strength (MPa)	
		R-Sand	M-Sand	R-Sand	M-Sand	R-Sand	M-Sand
1	I	519.52	573.75	23.09	25.50	23.55	25.75
2		557.12	557.325	25.32	25.77		
3		522.78	538.875	23.23	23.95		
5	II	536.75	585.91	23.86	26.05	25.51	25.92
5		558.59	575.76	25.38	25.59		
6		562.15	587.70	25.98	26.12		
7	III	551.35	592.28	25.50	26.32	25.07	26.52
8		572.69	583.5	25.55	25.93		
9		568.1	615.12	25.25	27.29		
10	IV	528.92	571.05	23.51	25.38	25.19	25.58
11		552.67	561.825	25.12	25.97		
12		561.08	579.375	25.95	25.75		

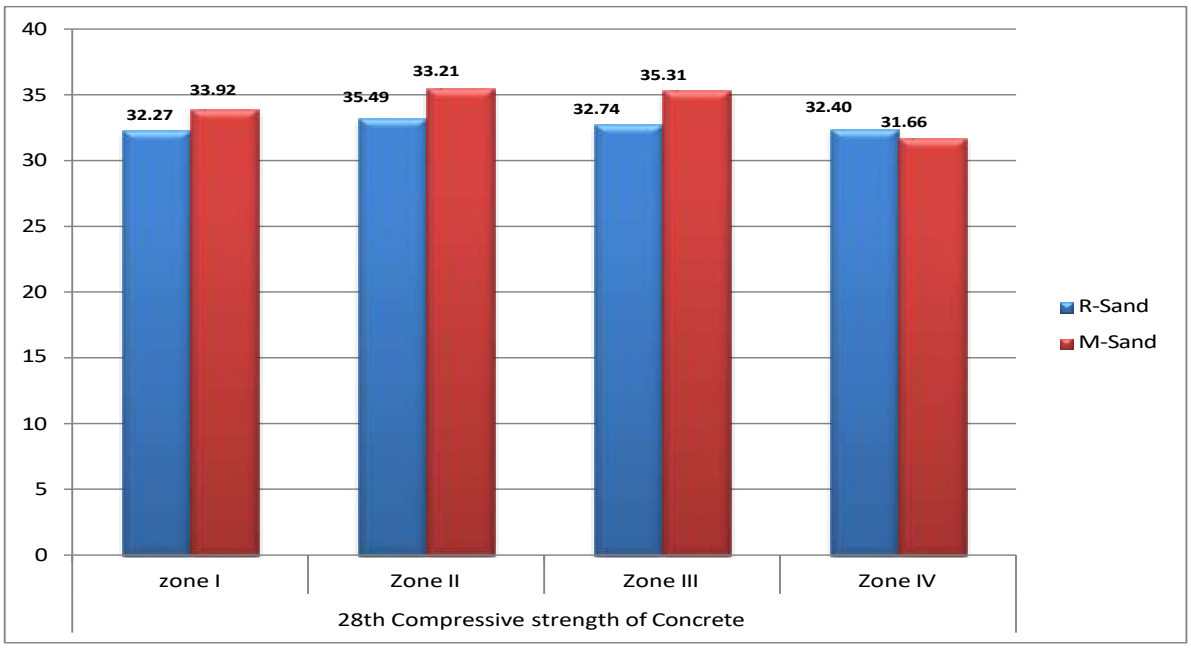


Figure 4. Graph showing the comparison of the 28th compressive strength of concrete[13].

Table 4. Compressive strength of R-sand and M-sand concrete after 28th days of curing

Serial No.	Zone	Peak Load (KN)		28th day Comp Strength (MPa)		Average Comp Strength (MPa)	
		R-Sand	M-Sand	R-Sand	M-Sand	R-Sand	M-Sand
1	I	755.55	792.26	33.58	35.21	32.27	33.92
2		717.08	735.30	31.87	32.68		
3		705.61	762.53	31.36	33.89		
5	II	775.13	773.3	35.55	35.28	33.21	35.59
5		722.70	809.35	32.12	35.97		
6		755.08	812.7	33.07	36.12		
7	III	759.75	805.5	33.32	35.8	32.75	35.31
8		731.83	785.13	32.53	35.85		
9		728.56	793.58	32.38	35.27		
10	IV	730.80	725.92	32.58	32.26	32.50	31.66
11		737.11	691.13	32.76	30.72		
12		719.33	720.13	31.97	32.01		

Zone IV is increased by 8.03%, 10.58%, 9.32% and 8.79% respectively. Zone II mortar shows a higher increase after 100% replacing R-sand in compressive strength then followed by Zone III, Zone IV and Zone I. For 28th days, compressive zone II mortar shows more rise, i.e. 9.09%, followed by 7.78% for zone III and zone I shows 7.16%. But zone IV shows a decrease in strength by 1.37%. Tables 1 and 2 give the test results of 7th and 28th days, respectively, curing cement mortar with a proportion of 1:3, having a water-cement ratio of0.50. Results show that after 7th days, cured concrete replacing M-sand concrete shows an increase in strength. Zone III sand shows higher strength compared to other zones. Whereas the zone II increase in strength is more than the other. It is 6.19%, 5.78%, 5.05% and 5.85% for Zone II, III, I and IV, respectively. For 28th days cured, M-sand concrete of zone II shows 6.87% higher strength than R-sand concrete of the same zone. Followed by zone III and I, i.e. increased by 7.85% and 5.11%. But in the case of zone IV, strength decreased by 2.29% for M-sand[83-87].

The compressive strength test is an extremely vital test which gives an idea of all the qualities of concrete. The cube specimens of size 150mm X 150mm were cast with chemicals and under normal conditions. The specimen loaded for compressive load under CTM for M25 mix. The compressive strength of R-sand and M-sand concrete for 7th days and 28th days cured is shown in Tables 3 and 4.

3.0 Conclusion

The following are the conclusions drawn from the current investigation:

The 7th cured compressive strength shows 8.03%, 10.48%, 9.32% for zones I, II, III, while zone IV shows a 7.58% decrease. For 28th days, compressive zone II mortar shows a further rise, i.e. 9.09%, followed by 7.78% for zone III and zone I shows 7.16%. But zone IV shows a decrease in strength by 1.37%.

The workability of concrete gradually decreases with the addition of M-Sand. So the required workability can be achieved by using a water-reducing admixture.

Compressive strength of 7 days cured concrete is increased by 6.19%, 5.78%, 5.05% and 4.84% for zone I, II, III and IV after the when M-Sand is fully replaced by the river sand. 28 days cured compressive strength increased by 6.87, 7.85%, 5.11% for zone I, II, III whereas zone IV shows decrease of 2.29%.

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