Experimental Evaluation Of M35 Grade Conventional Concrete By Supplementing Natural Fibers, Foundry Sand And Sea Sand As Partial Replacements

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Abstract: **Present urbanization required a huge variety of concretes and minimized effects of newly developed composite materials. This development leads to adverse effects on the surrounding environment. As a part of environmental concern, we have to minimize the negative effects. The use of fine aggregate in the construction industry is more. Therefore, the use of river sandcan be replaced with other materials to protect the environment of the river as well as prevent erosion and flood, in My present research paper is similar to this, based on the recycling technique I used to do materials replacements of natural fibers and waste foundry sand & sea sand are the major partial replacements of fine aggregate and grade of concrete are M-35. After the preparation of M-35 Grade concrete, it should be validated with conventional concrete. Themajor tests are conducted on M-35 grade hardened concrete, which are Concrete cube tests, Cylinder Test & flexural tests. After the test results are verified with referenced documents and satisfactory results are obtained, the complete discussions and results are listed separately in further chapters.**

Key words: Recycled Materials, Natural fibers, M-35 grade, Foundry waste, Foundry sand

I. INTRODUCTION

By volume, aggregate accounts for about 80% of the total weight of concrete. In the manufacturing of concrete, both fine and coarse aggregates are used. With startling rapidity, the use of sand as a fine aggregate in the building sector has risen to unprecedented heights. Natural river sand is in short supply in the sector, which is making it difficult to meet the growing demand for the material. In order to address this dilemma, the building industry has developed alternatives such as synthetic sand, robo sand, rock dust, and other materials such as gravel. Another option to this is the utilisation of waste material in the construction of concrete structures. Sedimentary sand and waste foundry sand are two types of waste materials produced by the ferrous and non-ferrous metal casting industries, respectively. It is possible that the use of such a material in concrete will help to reduce the environmental problems associated with waste foundry sand and other resources, as well as make concrete manufacturing more cost-effective. Sand is essential in the building sector on a large scale. It is a significant ingredient in the manufacture of mortar and concrete, and it plays an important role in the design of concrete mixes. River sand is in low supply these days as a result of erosion and other environmental concerns. The building sector would be adversely affected by the lack of river sand, and as a result, it is necessary to develop innovative alternative materials to replace river sand. Many researchers are working to develop alternative materials to sand, with sea sand being one of the most commonly used substitutes for sand. The M35 grade of concrete was used in the current investigation. Natural sand was largely replaced by sea sand in quantities ranging from 0 to 40%.

II LITERATURE REVIEW

Naik et al. (1987) He performed research on using waste foundry sands in concrete, that is, concrete that makes use of discarded foundry sands in lieu of a fine mixture. The proportions of a manipulated concrete blend have been adjusted to attain a compressive energy of 38 MPa after 28 days. Other concrete mixes have been balanced such that clean/new foundry sand and used foundry sand have been substituted for 25 percent and 35 percent, respectively, of the same old concrete sand weight. The compressive strength, tensile power, and modulus of elasticity of the concrete have been measured and analysed to determine its overall performance. At 28 days, used foundry sand-containing concrete had values that were 20-30% lower than non-used foundry sand-containing concrete.Clean/new foundry sand became utilised in 25 percent and 35 percent of the concrete mixes, respectively, and the compressive electricity became almost equal to that of the control blend.

Sravastano *et al.* (2009) It has been suggested that proof of crack bridging and fibre pull-out has been seen on the fractured surface of the R curve (Resistance to fracture curve) specimen, which has been damaged. A further finding was made, which was that the deterioration of bridging zones can be responsible for the constant fatigue crack propagation of the herbal fibre cementious composite. In addition, it's been mentioned that toughening occurs by and large as a result of fracture bridging in herbal fibre reinforced composites. The inherent sturdiness of natural fibre cement composites reinforced with sisal, banana, and eucalyptus fi

Boghossion and Wegner (2008) In keeping with the research, a tiny quantity fraction of quick flax fibres introduced to Portland cement mortar has been proven to be green in minimising the fractures as a result of restrained plastic shrinkage under conditions of excessive evaporation. It has additionally been located that the improvement progressed to an increasing extent, but that the change in fibre lengths (10 mm and 38 mm) had no widespread impact on the cracking behaviour of the composite.

III PROPERTIES AND METHODOLOGY

Cement: Generally speaking, cement is a binder, which means it is a substance that sets and hardens on its own and may be used to bind other materials together as a binding agent. Cement is generally composed of components in the form of limestone, chalk, and marl, as well as argillaceous minerals, as well as other additives. It is necessary to use standard Portland cement grade 53

Table 1 physical properties of cement

S.No.	Property	Value
1	Fineness of cement	4.12 %
2	Specific gravity	3.15
3	Normal consistency	28 %
4	Setting time	
	i. Initial setting time	60 Mins
	ii. Final setting time	360 min
5	Compressive strength at	
	i. 3 days	34 N/mm^2
	ii. 7 days	44.8 N/mm^2
	iii. 28 days	53 N/mm^2

Coarse Aggregate: Fine aggregate is defined as material that retains its 4.74 mm size after being crushed. For the majority of projects, 20 mm of aggregate is sufficient. The aggregate, with a nominal size of 20 mm, that was readily accessible in the area was employed.

Table 2 physical properties of Coarse aggregate

S.No.	Property	Value
1	Specific Gravity	2.65
2	Bulk Density	
	i. Loose	13.29 N/mm^2
	ii. Compacted	15.00 N/mm^2
3	Water Absorption	0.7%
4	Flakiness Index	10.22 %
5	Elongation Index	11.54 %
6	Crushing Value	21.43 %
7	Impact Value	15.50 %

Fine Aggregates: Fine aggregate is a material such as sand, crushed stones, or crushed gravel that has been crushed to a size less than 4.75 mm. Fine aggregate in the concrete mix is made from readily accessible sand from the local area.

Sea Sand: In this research, sea sand is used to partially replace fine aggregate as a fine aggregate replacement. A portion of it was obtained from Baptla Beach, which is located in Zone IV.

Table 3 physical properties of fine aggregate

S.No.	Property	Value
1	Specific Gravity	2.60
2	Fineness Modulus	3.77
3	Bulk Density i. Loose ii. Compacted	 14.67 KN/m³ 16.04 KN/m³
4	Grading	Zone II

Water: Potable water has been used in this experimental program for mixing and curing.

Super Plasticizer: When super plasticizers are mixed with concrete, they increase the workability of the concrete. They are mostly composed of naphthalene or melamine sulphonates, which are generally condensed in the presence of formaldehyde to produce a solid.

Fibers: Fibers are thread-like materials that may be used for a variety of diverse applications. Natural fibres are fibres created by plants (vegetables, leaves, and wood), animals, and geological processes. They are classified as either synthetic or natural fibres. In order to increase the strength qualities of composites (such as cement paste mortar and/or concrete), researchers have employed plant fibres as an alternative source of steel and/or artificial fibres to be included in the composites. Coir, sisal, jute, Hibiscus cannabinus, eucalyptus grandis pulp, malva, ramie bast, pineapple leaf, kenaf bast, sansevieria leaf, abaca leaf, vakka, bamboo, palm, banana, hemp, flax, cotton, and sugarcane are examples of plant fibres that are referred to as natural fibres in this context.

Figure 1 Fibers

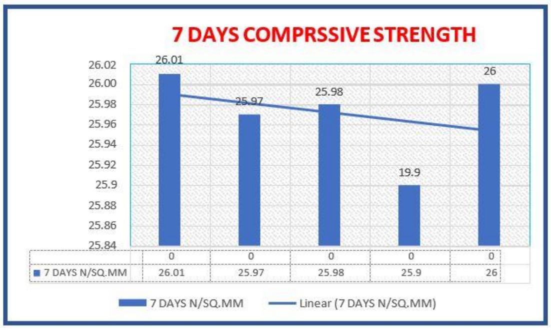
IV RESULTS

Compressive Strength On Concrete Cubes: The uniaxial compressive strength of a material is defined as the value of uniaxial compressive stress attained by the material when it totally fails. As part of this research, cube specimens with dimensions of 150 millimetres by 150 millimetres by 150 millimetres are examined in line with IS: 516 – 1969 [Method of test for concrete strength]. The compression testing was carried out using compression testing equipment with a capacity of 300 KN. The machine is equipped with a control valve that allows the operator to regulate the pace of loading. The equipment has been calibrated in accordance with the established norms. The plates have been cleaned, the oil level has been checked, and the machine has been prepared in every way for testing.

After 28 days of curing, the cube specimens were taken from the curing tank and thoroughly cleaned to eliminate any remaining surface water. The specimens were placed on the swivelling head of the machine in such a way that the weight was applied at the centre of the specimens. The bearing surfaces are put on the specimen's flat surfaces, which act as bearing surfaces. By spinning the handle, the top plate was brought into contact with the specimen on the bottom plate. The oil pressure valve was closed, and the machine was turned on for the first time. It was possible to maintain a constant loading rate of 140 kg/cm2/min. It was determined what the maximum load to failure was at which the specimen broke and the pointer began to move back. The test was repeated for each of the three specimens, and the mean of the three values was selected to represent the average strength. The compressive strength test on concrete containing various sizes of coarse aggregate has been carried out in the current inquiry. The M35 grade was examined on the 7th and 28th days.

Table 4 Compressive strength of normal concrete mix [M-35 grade] for 7 days

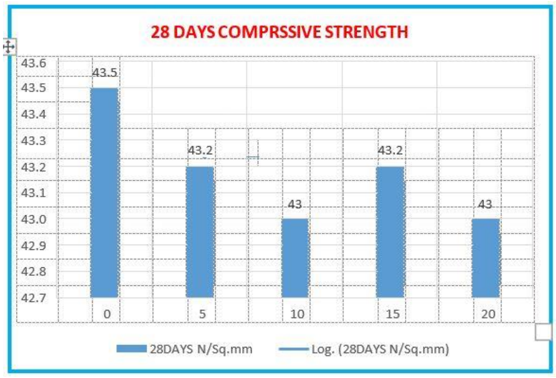
S.NO	CUBE ID	% OF REPLACEMNT (%)	7 DAYS N/mm²
1	N-MIX	0 %	26.01
2	N-MIX	0 %	25.97
3	N-MIX	0 %	25.98
4	N-MIX	0 %	25.90
5	N-MIX	0 %	26.00



Graph 1 Compressive strength Graph of normal concrete mix [M-35 grade] for 7 days

Table 5 Compressive strength of normal concrete mix [M-35 grade] for 28 days

S.NO	CUBE ID	% OF REPLACEMNT(%)	28 DAYS N/mm^2
1	N-MIX	0%	43.5
2	N-MIX	0%	43.20
3	N-MIX	0%	43.00
4	N-MIX	0%	43.20
5	N-MIX	0%	43.00



Graph 2 Compressive strength Graph of normal concrete mix [M-35 grade] for 28 days

Table 6 compressive strength of replacement mix – 7 days (natural fibers only)

S.NO	CUBE ID	% OF REPLACEMNT(NF)	7 DAYS N/mm^2
1	RT-X1	3%	21.78
2	RT-X1	6%	21.89
3	RT-X1	9%	21.87
4	RT-X1	12%	21.89

Table 7 compressive strength of replacement mix – 7 days (foundry sand only)

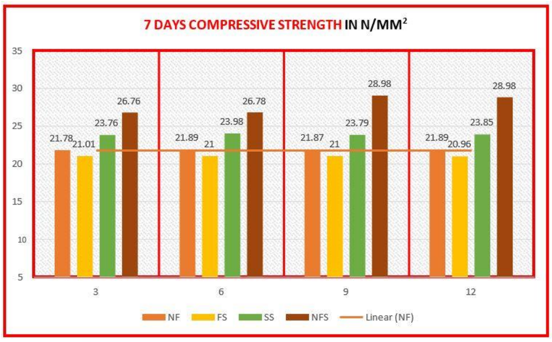
S.NO	CUBE ID	% OF REPLACEMNT(FS)	7 DAYS N/mm^2
1	RT-X2	3%	21.01
2	RT-X2	6%	21.00
3	RT-X2	9%	21.00
4	RT-X2	12%	20.96

Table 8 Compressive strength of replacement mix – 7 days (sea sand only)

S.NO	CUBE ID	% OF REPLACEMNT(SS)	7 DAYS N/mm^2
1	RT-X3	3%	23.76
2	RT-X3	6%	23.98
3	RT-X3	9%	23.79
4	RT-X3	12%	23.85

Table 9 compressive strength of replacement mix – 7 days (n.f + f.s + s.s)

S.NO	CUBE ID	% OF REPLACEMNT(NFS)	7 DAYS N/mm^2
1	RT-1	3%	26.76
2	RT-2	6%	26.78
3	RT-3	9%	28.98
4	RT-4	12%	28.76



NOTE: Brown Color Bar Showing the Combined Replacement

Graph 3 compressive strength Graph of replacement mix – 7 days (n.f + f.s + s.s)

Table 10 compressive strength of replacement mix – 28 days (natural fibers only)

S.NO	CUBE ID	% OF REPLACEMNT(NF)	28 DAYS N/mm^2
1	RT-Y1	3%	28.37
2	RT-Y1	6%	29.50
3	RT-Y1	9%	29.53
4	RT-Y1	12%	29.55

Table 11 compressive strength of replacement mix – 28 days (foundry sand only)

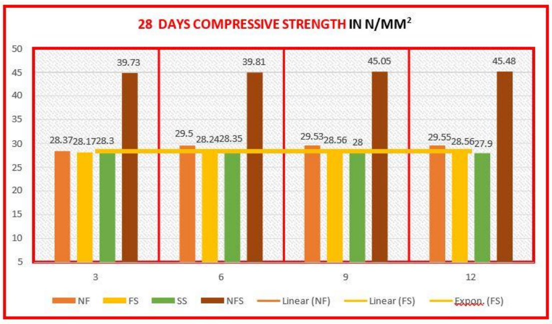
S.NO	CUBE ID	% OF REPLACEMNT(FS)	28 DAYS N/mm^2
1	RT-Y2	3%	28.17
2	RT-Y2	6%	28.24
3	RT-Y2	9%	28.56
4	RT-Y2	12%	28.56

Table 12 compressive strength of replacement mix – 28 days (sea sand only)

S.NO	CUBE ID	% OF REPLACEMNT(SS)	28 DAYS N/mm^2
1	RT-Y3	3%	28.35
2	RT-Y3	6%	28.36
3	RT-Y3	9%	28.05
4	RT-Y3	12%	27.96

Table 13 compressive strength of replacement mix – 28 days (n.f + f.s + s.s)

S.NO	CUBE ID	% OF REPLACEMNT(NFS)	28 DAYS N/mm^2
1	RT-Y-1	3%	44.78
2	RT-Y-2	6%	44.86
3	RT-Y-3	9%	45.06
4	RT-Y-4	12%	45.48



GRAPH : 4 COMPRESSIVE STRENGTH GRAPH OF COMBINED MIX 28 DAYS

NOTE: Brown Color Bar Showing the Combined Replacement

Graph 4 compressive strength Graph of replacement mix – 28 days (n.f + f.s + s.s)

Ultrasonic Pulse Velocity Test: When checking the quality of concrete and natural rocks, an ultrasonic pulse velocity test is used in-situ and is non-destructive. The strength and quality of concrete or rock are determined in this test by measuring the velocity of an ultrasonic pulse that passes through a concrete construction or natural rock formation and back out again. It is performed by delivering an ultrasonic wave pulse into the concrete to be tested and recording the time it takes for the pulse to travel through the construction. When the material moves at a faster rate, it indicates better quality and consistency, while slower movement may suggest concrete with many fractures or cavities.

Table 14 Ultrasonic pulse velocity test reports for 7 days cubes:

S NO	CUBE ID	% REPLACEMENT	Obtained average velocity(m/s)	Quality of Concrete
1	RT-1	3	3540	Good
2	RT-2	6	3600	Good
3	RT-3	9	3611	Good
4	RT-4	12	4032	Good

Table 15 Ultrasonic pulse velocity test reports for 28 days cubes:

S NO	CUBE ID	% REPLACEMENT OF	Obtained average velocity(m/s)	Quality of Concrete
1	RT-Y-1	3	3620	Good
2	RT-Y-2	6	4234	Good
3	RT-Y-3	9	4320	Good
4	RT-Y-4	12	4367	Good

V CONCLUSION

To obtain the mechanical properties we run two tests on concrete cubes. A total of 106 Concrete cubes were casted and obtained reports for 7 &28 days conducted tests are compressive strength and UPV tests.

For normal concrete mix seven days‟ strength achieved is cumulative of **61 %** which is accurate based on Indian standards

For twenty-eight days‟ concrete mix strength achieved is cumulative of **99 %** which is also accurate based on Indian standards For single replacements like natural fibers, foundry sand& sea sand the obtained results are very low which is very less < **40-45 %** of **7 days & 28 days**

For combined replacement they obtained results are reached target mean strength of **43.25 N/mm^2** the average cube results are **45.04 N/mm^2** Finally conducted UPV test on Concrete Test cubes 8 cubes are Obtained result of „GOOD‟ Quality of concrete

further replacements up to 15%-25% was not defined by past reviewers andresearchers,

Most of the vegetable fibers, when dried, lose their moisture. To achieve better results, the presence of certain amounts of moisture is necessary, and this aspect needs further study. The effects of creep and cyclic reversal of stresses on NFRC should be investigated.

My present research work is limited up to 12 % of replacements of Foundry sand /Sea sand/Natural fibers.

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