International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 02 | Feb 2021 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL EVALUATION OF M30 GRADE CONVENTIONAL CONCRETE BY SUPPLEMENTING NATURAL FIBRES, FOUNDRY SAND & 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 sand can 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-30. After the preparation of M-30 Grade concrete, it should be validated with conventional concrete. The major tests are conducted on M-30 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 fibres, M-30 grade, Foundry waste, Foundry sand.

1.Introduction:

About 80% of concrete is composed of aggregate by volume. Both fine and coarse aggregate is used in concrete production. The utilization of sand as fine aggregate in the construction industry has increased by an alarming rate. To cater to this increasing demand the industry is facing difficulty in the supply of natural river sand. To overcome this situation, construction industries have identified alternatives like manufactured sand, robo sand, rock dust etc. Another alternative to this can be use of waste material in concrete. Waste foundry sand and sea sand & foundry sand are a waste material obtained from ferrous and non-ferrous metal casting industries. The incorporation of such material in concrete can help to reduce the disposal concerns of waste foundry sand, and other materials and also makes concrete production economical. Sand plays a major role in any construction industry. It is a major material used for preparation of mortar and concrete and which plays a vital role in mix design. In present days due to erosion and relevant environmental issues, there is a shortage of river sand is formed. The shortage of river sand will affect the construction industry; hence there is a need to find the new alternative material to replace the river sand. Many researchers are finding different materials to replace sand and one of the major materials used to replace the sand is sea sand. M30 grade concrete was taken for the present study. Natural sand was replaced partially by sea sand with the percentages 0-40%.

Natural fibres: Fibres are thread like materials which can be used for different purposes. Fibres produced by plants (vegetable, leaves and wood), animals and geological processes are known as natural fibres. Researchers have used plant fibres as an alternative source of steel and/or artificial fibres to be used in composites (such as cement paste mortar and/or concrete) for increasing its strength properties. These plant fibres, herein referred as natural fibres, include coir, sisal, jute, Hibiscus cannabinus, eucalyptus grandis pulp, malva, ramie bast, pineapple leaf, kenaf bast, sansevieria leaf, abaca leaf, vakka, date, bamboo, palm, banana, hemp, flax, cotton and sugarcane. Natural fibres are cheap and locally available in many countries. So their use as a construction material for increasing properties of composites costs a very little (almost nothing when compared to the total cost of the composites). Their use can lead to have sustainable development. Another benefit may also include the easy usage/handling of fibres due to their flexibility, because the problem arises when a high percentage of fibres is to be used as in case of steel fibres. But for use of very high percentage of fibres, there is a need to invent a methodology for casting. Volume fraction and fibre content are two terminologies used for expressing the quantities of fibres in a given composites reinforced composites can be used for many civil engineering applications including roofing tiles, corrugated slabs, simple slab panels, boards and mortar etc. floors where the loads will be greater, shear walls and foundations. High strengths are also occasionally used in bridge applications as well. In high rise structures, high strength concrete has been successfully used in many countries across the globe. High Strength Concrete is occasionally used in the construction of highwaybridges.HSC also permits reinforced or restressed concrete girders to span greater lengths than normal strength concrete girders. High Strength Concrete enables to build the super structures of long span bridges and to enhance the durability of bridge decks. Other structural members in which High Strength Concrete is used are dams, grand stand roofs, marine foundations, heavy duty industrial floors and parking garages.

3. Catageories of fibres :

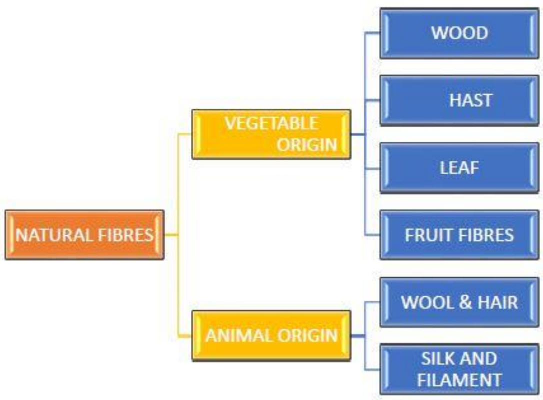


FIG : 2 CATAGEORES OF FIBRES

Naik et al. (1987) He carried out a research on Utilization of Used Foundry Sand in Concrete. This research was conducted to investigate the performance of fresh and hardened concrete containing discarded foundry sands in place of fine aggregate. A control concrete mix was proportioned to achieve a 28-day compressive strength of 38 MPa. Other concrete mixes were proportioned to replace 25% and 35% by weight of regular concrete sand with clean/new foundry sand and used foundry sand. Concrete performance was evaluated with respect to compressive strength, tensile strength, and modulus of elasticity. At 28-day age, concrete containing used foundry sand showed about 20-30% lower values than concrete without used foundry sand. But concrete containing25% and 35% clean/new foundry sand gave almost the same compressive strength as that of the control mix.

Reddi et al. (1995) : He reported that compressive strength of stabilized foundry sands decreases as the replacement proportion of foundry sand increases in the mixes and the strength is achieved relatively faster with fly ash than with cement. Cement and fly ash mixtures were prepared using 0%, 25%, 50%, 75%, & 100% levels of replacement of silica sand by foundry sand. Initial experiments with class F fly ash were unsuccessful because it lacked cementitious properties to form a stable mix therefore subsequent experiments were restricted to class C fly ash only. The ratio of water to the cementitious binder was chosen to be 1.0 in the case of Portland cement and 0.35 in the case of fly ash. The samples were founded in PVC pipes, 2.85 cm in dia. and 5.72 cm long. The mixtures of sands and the binders were poured into these pipes and then vibrated on a vibrating table to minimize air pockets. For each of the replacement levels, compressive strengths were obtained after 3, 7, 14, 28, & 56 days in order to evaluate the difference due to curing time. The clay bonded foundry sand reduced the strength of the **H V Pal, Sujith Kumar C.P** conducted an experimental investigation on high performance steel fibres reinforced self-compacting concrete (SFRSCC) with silica fume as the filler material. Fibre content was varied from 0 to 5% at intervals of 1 % by weight of cements. Effect of the addition of these fibers on the various strength of concrete was studied. From the experimental study it was found that the compressive strength of concrete at 28 days shows a peak value of 80.44 MPa at w/c ratio of 0.34, with 7.5% silica fume dosage, 0.6% super plasticizer and 4% steel fibers, all by weight of cement.

Conducted experiments using different natural fibers to concrete in order to study the strength properties and also to observe if there is reduction in propagation of shrinkage crack problems. Basically natural fibres are of two types. Natural inorganic fibres such as Basalt, Asbestos…etc and the other are the natural organic fibres such as coconut, palm, kenaf, jute, sisal, banana, pine, sugarcane, bamboo…etc.he concluded that Slump is decreasing with the addition of fibres. More the fibres-cement ratio, more is the decrease in slump due to absorbency of water by fibres. The addition of fibres increased compressive strength with 0.5% fibres-cement ratio and little increase for 1% of fibres-cement ratio compared to plain concrete. But at 1.5% of fibres-cement ratio, though plasticizer is added, the compressive strength is decreasing compared to plain concrete.

4. Properties of materials:

1. PHYSICAL PROPERTIES OF FOUNDRY SAND

Characteristics	Values
Bulk Relative Density	2592 kg/m3
Absorption	0.43 %
Moisture Content	0.1 – 9.8
Clay Lumps and Friable Particles	1 – 42
Coefficient of permeability	10-3 – 10-6 cm/s
Plastic Limit	Non Plastic
Specific gravity	2.49

2. CHEMICAL PROPERTIES OF FOUNDRY SAND

Constituents	Value	Constituents	Value
SiO_2	67.21	Na_2O	0.48
Al_2O_3	4.28	K_2O	0.46
Fe_2O_3	7.32	P_2O_5	0.00
CaO	0.15	Mn_2O_3	0.12
MgO	0.23	SrO	0.19
SO_3	0.89	TiO_2	0.48
		Loss of ignition	16.25

3. physical properties of Sea sand d

Physical properties	% of composition
Lignin	45.84
Cellulose	43.44
Hemi Cellulose	0.25
Pectin	03.00
Water Soluble	05.25

4.chemical properties of sea sand

S.no	Property	Test results
1	Specific Gravity	2.16
2	Fineness modulus	0.90
3	Zone	4
4	pH value	8.2

5.properties of banana fibres

Chemical properties	% of composition
Length in inches	6-8
density(g/cc)	1.40
Tenacity (g/Tex)	10
Breaking elongation	30
Diameter in mm	0.10-1.5
Rigidity modulus	1.8924
Swelling in water	5%

super plasticizer

Super Plasticizers are new class of generic materials which when added to the concrete causes increase in the workability. They consist mainly of naphthalene or melamine sulphonates, usually condensed in the presence of formal dehyde.

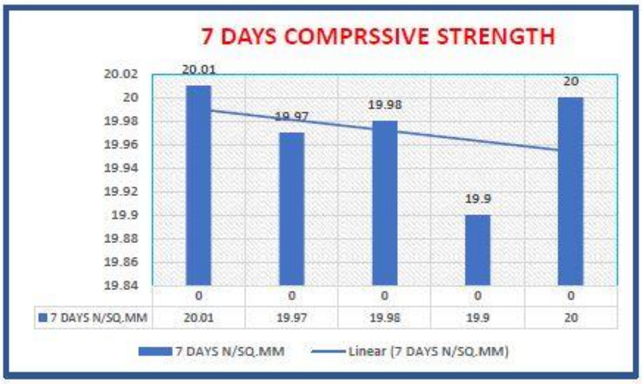
5. Mix design :

Design steps are followed according is10262-2009

6.Results:

S.NO	CUBE ID	% OF REPLACEMNT(%)	7 DAYS N/mm²
1	N-MIX	0 %	20.01
2	N-MIX	0 %	19.97
3	N-MIX	0 %	19.98
4	N-MIX	0 %	19.90
5	N-MIX	0 %	20.00

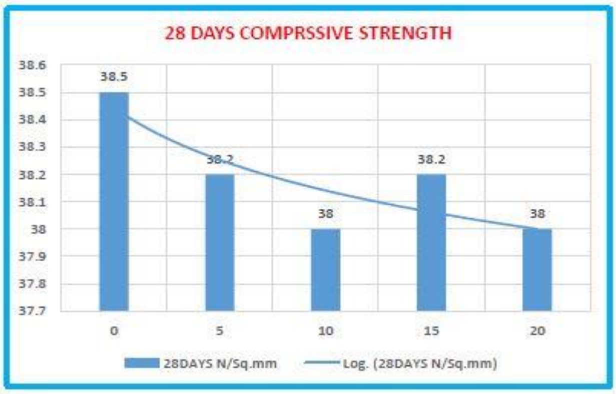
a) **Compressive strength of normal mix 7 days**



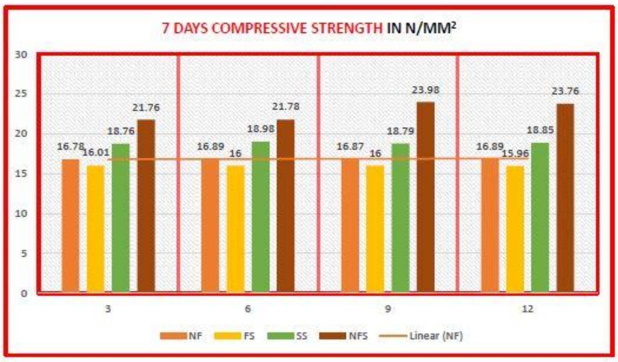
b) **Compressive strength graph normal mix 7 days**

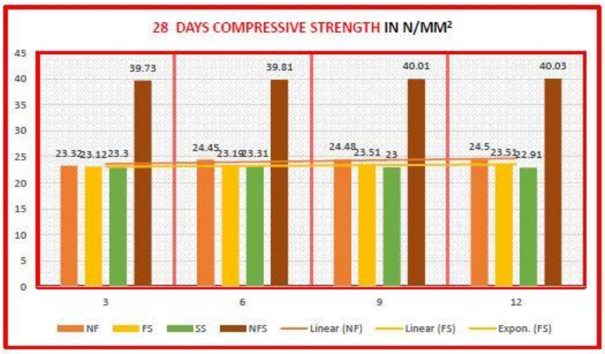
S.NO	CUBE ID	% OF REPLACEMNT(%)	28 DAYS N/mm²
1	N-MIX	0%	38.5
2	N-MIX	0%	38.2
3	N-MIX	0%	38.00
4	N-MIX	0%	38.20
5	N-MIX	0%	38.00

c) Compressive strength of normal mix 28 days

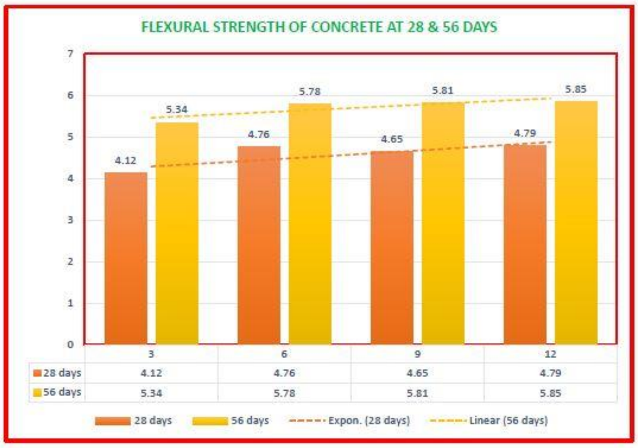


D)Compressive strength of normal mix 28 days





GRAPH : 4 COMPRESSIVE STRENGTH GRAPH OF COMBINED MIX 28 DAYS



S NO	CUBE ID	% REPLACEMENT	Obtained average velocity(m/s)	Quality of Concrete
1	RT-1	3	3518	Good
2	RT-2	6	3578	Good
3	RT-3	9	3589	Good
4	RT-4	12	4010	Good

S NO	CUBE ID	% REPLACEMENT OF	Obtained average velocity(m/s)	Quality of Concrete
1	RT-Y-1	3	3598	Good
2	RT-Y-2	6	4212	Good
3	RT-Y-3	9	4298	Good
4	RT-Y-4	12	4345	Good

To obtain the mechanical properties we run Three important tests on concrete cubes and beams, For concrete moulds we casted 56 moulds generated repots for 7 days and 28 days conducted tests are compressive strength and UPV tests. For concrete beams of 6x6 We casted 10 beams generated reports for 28 days and 56 days conducted tests flexural strength only [two-point loading]

- For normal concrete mix seven days' strength achieved is cumulative of **62 %** which is accurate based on Indian concrete code

- For twenty-eight days' concrete mix strength achieved is cumulative of **98 %** which is also accurate based on Indian standards

- For single replacements like natural fibres, foundry sand& sea sand the obtained results are very low which is very less **< 50 %** of **7 days & 28 days**

- For combined replacement they obtained results are reached target mean strength of **38.25 N/mm2** the average cube results are **39.12 N/mm2**
- From the flexural strength also we got **satisfactory results** as we got M-30 in Steel Reinforcements
- Finally conducted UPV test on Concrete Test cubes out 12 cubes 8 cubes are Obtained result of 'GOOD' Quality of concrete
- Further replacements upto 20%-30% was not defined by past reviewers and researchers,

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 /seasand/Natural fibres.

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