EXPERMENTAL INVESTIGATION OF M35 GRADE STANDARD CONCRETE BY PARTIALLY REPLACING NATURALFIBERS, FOUNDRY SAND AND SEA SAND

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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-35. After the preparation of M-35 Grade concrete, it should be validated with conventional concrete. The major 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.

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%.

Overview On Raw Materials:

Sand is taken from the foundry when it can no longer be used in the foundry and is referred to as "foundry sand" after it has been removed from the foundry. The yearly output of foundry sand is

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between 6 and 10 million tonnes. Foundry sand, like many other waste materials, has useful uses in a variety of sectors. Silica sands of high quality and size-specificity are purchased by foundries for use in their moulding and casting processes. It is usually of greater quality than the ordinary bank run or natural sands used in fill building projects, which is why it is employed in this application. The sands are responsible for forming the outside contour of the mould cavity. These sands are often bound together with a little quantity of betonies clay, which is a natural binder ingredient. Chemical binders are also used in the production of sand "cores." There are two primary kinds of binder systems used in metal casting, and the foundry sands are categorised into two categories based on the type of binder system employed: I clay bound systems (Green sand) and ii) chemically bonded systems. They are both suited for beneficial use, yet they have distinct physical and environmental properties that distinguish them from one another. Green sand is the recovered foundry sand that is most typically utilised for beneficial reuse in the foundry industry. High-quality silica sand (85-95 percent), bentonite clay (4-10 percent) as a binder, a carbonaceous addition (2-10 percent) to enhance the casting surface polish, and water make up the composition of this material mixture (2-5 percent).

Fig 1: Foundry Sand

In Kolhapur, silica sand is used extensively in casting operations, and the waste created by these foundries amounts to around 700–1000 tonnes per day. This solid garbage is disposed of beside a river at a landfill.

banks. The foundry business has been designated as a "Red Category Industry" for its discharge of hazardous substances into the environment. Yet, owing to the high expense of treatment, foundry companies are not particularly interested in investing in the environmentally friendly disposal of waste sand.

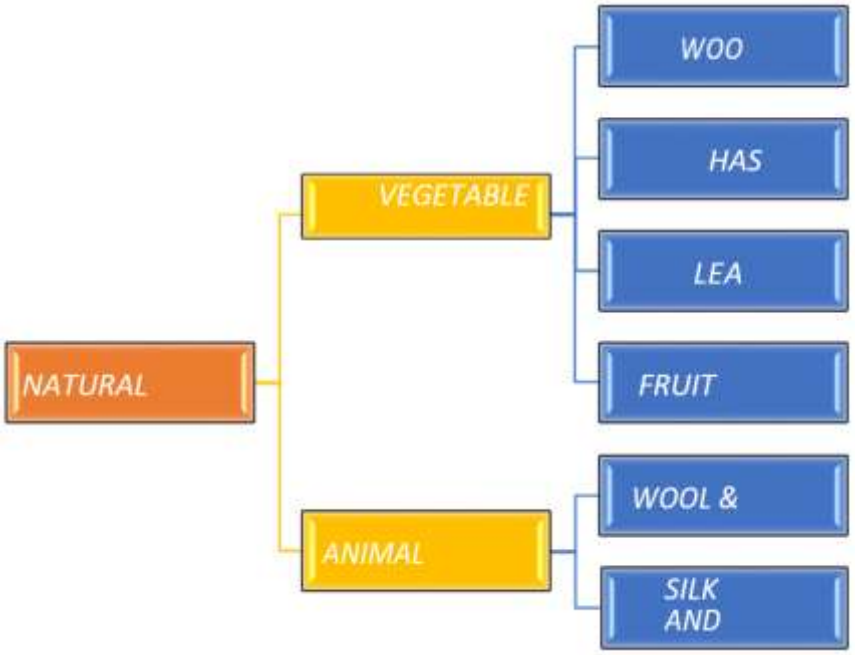

Fig 2: Types of fibers

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Fig: 3 Banana Fibers

Fig : 4 Coir fibers 25 mm

Properties of Matrials

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 ofpermeability	10-3 – 10-6 cm/s
Plastic Limit	Non Plastic
Specific gravity	2.49

2.Chemical Properties Of foundry Sand

Constituents	Value	Constituents	Value
Sio2	67.21	Na_2O	0.48
Al 2O3	4.28	K_2O	0.46
Fe2O3	7.32	P_2O_5	0.00
CaO	0.15	Mn_2O_3	0.12
MgO	0.23	SrO	0.19
S03	0.89	Tio_2	0.48
		Loss of ignition	16.25

Properties OF Sea sand:

In this work, sea sand is used to partially replace fine aggregate as a fine aggregate replacement. It was obtained from Bapatla beach, which is located inside Zone IV. The following are the specific gravity, fineness modulus, and sieve analysis results for sea sand:

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

Chemical PropertieS Of Sea sand

Chlorides are a kind of soluble mineral component that is dissolved by water as it passes through the earth's surface. Chlorides are often found in sea sand, and they are toxic. As recommended by the World Health Organization, the maximum permissible chloride content in drinking water ranges between 250 and 1000 mg/l. Sea water may be tested for chloride concentration by titrating it with a standard silver nitrate solution, which is made using potassium dichromate.

Water samples	River sand in Mg/Lit	Sea Sand without was i mg/lit	Seasandwithwas in mg/l
Amount of chloride content	238	419	269

PH value

The pH of water is a measure of how acidic or basic it is. The numbers range from 0 to 14, with 7 representing neutrality. Having a pH of less than 7 denotes acidity, whereas having a pH of greater than 7 suggests baseness. The pH of water is really a measure of the relative number of free hydrogen and hydroxyl ions present in the solution.

Hardness

Hardness is a feature of water that hinders the creation of lather or foam when the water is combined with soap and other ingredients. It is most often induced by the presence of divalent metallic ions such as calcium and magnesium. Hardness is commonly described as the calcium carbonate equivalent of the presence of calcium and magnesium ions in water, and it is represented in milligrammes per litre of water. Hardness may be classified into two categorie.

Water samples	River sand in Mg/Lit	Sea San without was inmg/li	Seasandwithwa in mg/lit
PH Values	9.55	9.97	9.47

Properties OF NaturalFibers

Water samples	River sand in Mg/Lit	Sea Sand without wa inmg/lit	Seasandwithwas in mg/lit
Hardness values	350	515	947

PhysicaL Properties OF Natural Fibers:

Physical properties	% of composition
Lignin	45.84
Cellulose	43.44
Hemi Cellulose	0.25
Pectin	03.00
Water Soluble	05.25
Ash	02.22

Chemical Properties OF Natural Fibers

Chemical properties	% of composition
Length in inches	6-8
density(g/cc)	1.40

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Tenacity (g/Tex)	10
Breaking elongation	30
Diameter in mm	0.10-1.5
Rigidity modulus	1.8924
Swelling in water	5%

Banana Fiber Physicalproperties

Physical properties	% of composition
Tenacity	29.98
Fineness	17.15
Moisture regain	13.00
Elongation	6.54
Total cellulose	81.80
Lignin	15

Tests on material

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.

Fineness Of Cement

- Taken the 100grams (W1) of ordinary Portland cement in a basin and spread it on the 90µm sieve.
- Shaken it around 10-15minutes.
- The weight residue on the sieve (W2) was measured
- Percentage ratio of W2 to W1 gives the residue of the cement
- Result

Specific Gravity 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 *ii.* Final setting time	 60 Mins 360 min
5	Compressive strength at *i.* 3 days *ii.* 7 days *iii.* 28 days	 34 N/mm^2 44.8 N/mm^2 53 N/mm^2

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Coarse Aggregate properties

S.No.	Property	Value
1	Specific Gravity	2.65
2	Bulk Density *i.* Loose *ii.* Compacted	 13.29 N/mm^2 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 %

Sieve AnalysiS Of Coarse Aggregate

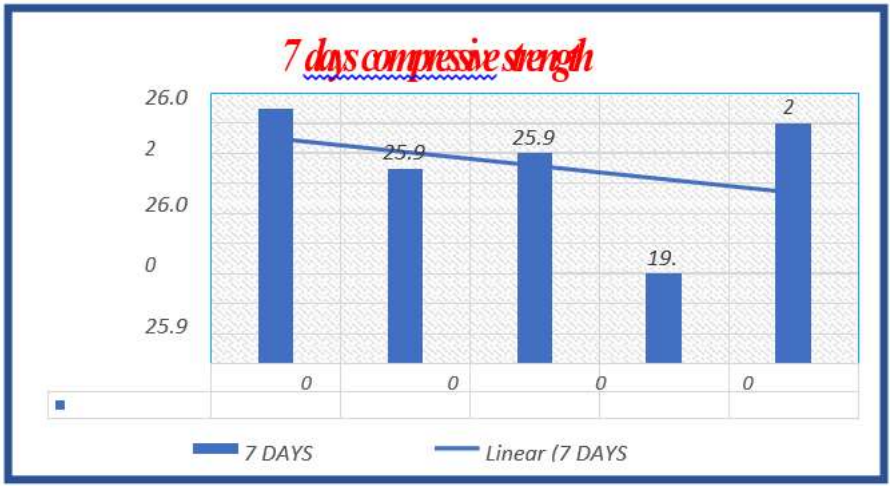
S.No.	Is Sieve	Weight Retained	% Of Weight	Cumulative % Of Weight	%Of Passing
1	20mm	3340	55.34	55.34	44.66
2	12.5mm	1635	27.09	82.43	17.57
3	10mm	875	14.49	96.92	3.08
4	4.75 mm	145	1.73	98.65	1.35
5	2.36 mm	20	0.33	98.98	1.02
6	1.18 mm	0	0	98.98	1.02
7	600 micron	0	0	98.98	1.02
Fineness Modulus 6.328				Total = 630.28	

Test Reports

Compressive **S**trength **O**n **Concrete C**ubes

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

Compressive strength of normal concretemix **M35 grade for 7 day**



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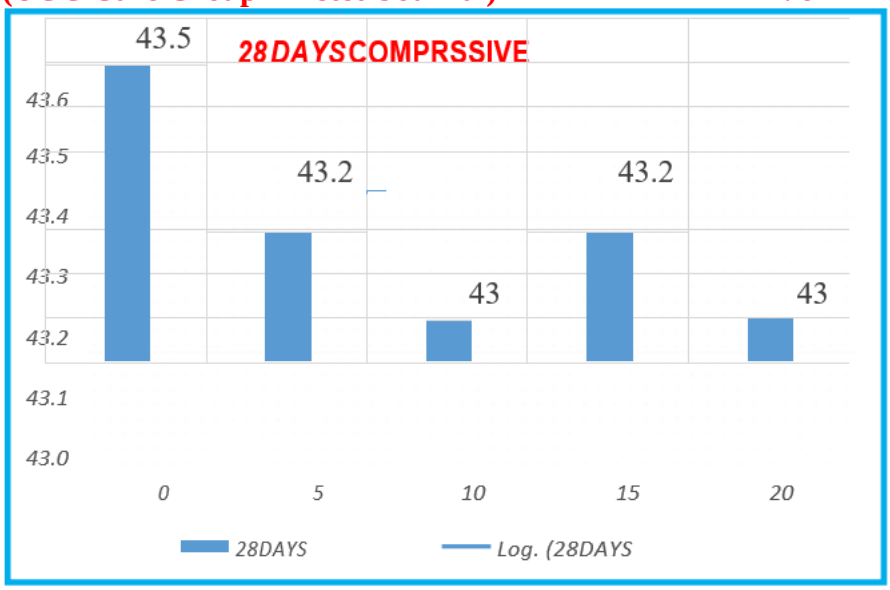

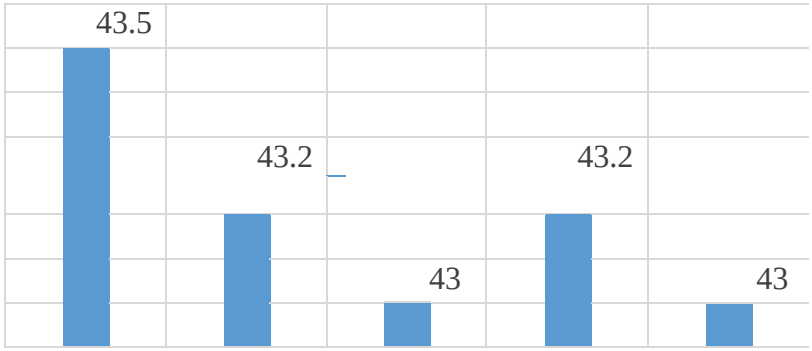

Compressive strength of replacement mix – 7 days (natural fibers only)

S.N O	CUBE ID	% OF REPLACEMNT(NF)	7DAYS 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

Compressive strength of replacement mix foundary sand only 7 days

S.N O	CUBE ID	% OF REPLACEMNT(FS)	7DAYS 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

Compressive strength of Replacement mix sea sand only 7 days

S.N O	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

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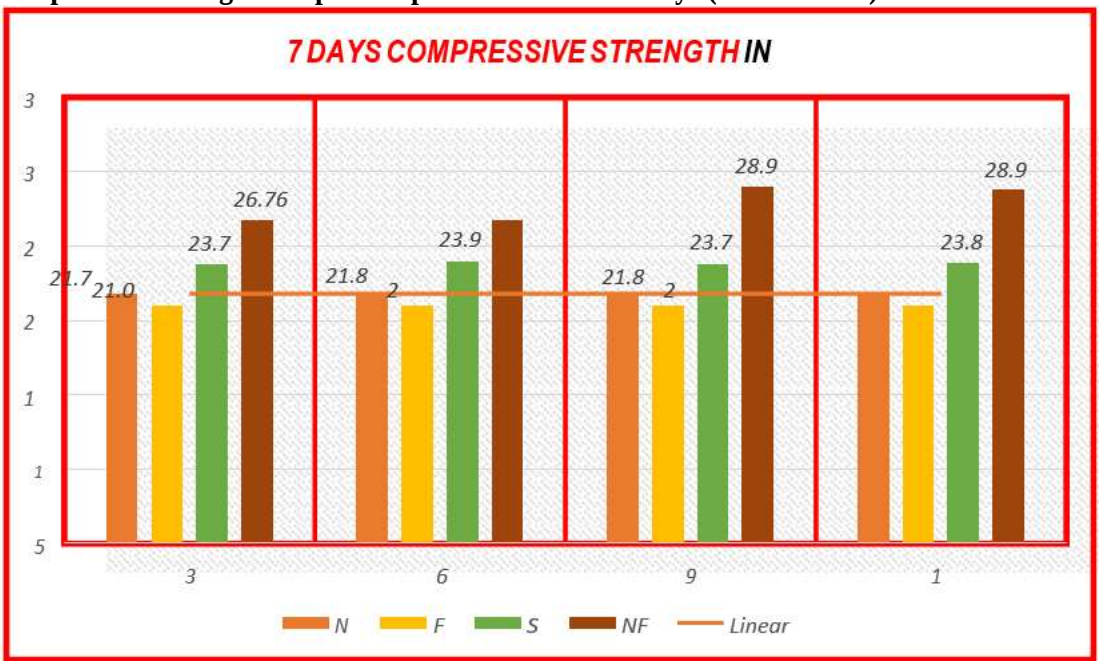
Compressive strength of replacement mix – 7 days (n.f + f.s + s.s)

S.NO	CUBE ID	% OF REPLACEMNT(NFS)	7DAYS 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

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



TEST REPORT FOR 28 DAYS CONCRETE CUBE SPECIMENS

Compressivestrengthofreplacementmix–28days(naturalfibersonly)

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

Compressive strength of replacement mix – 28 mix 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

Compressive strength of replacement mix –28days(n.f+f.s+s.s)

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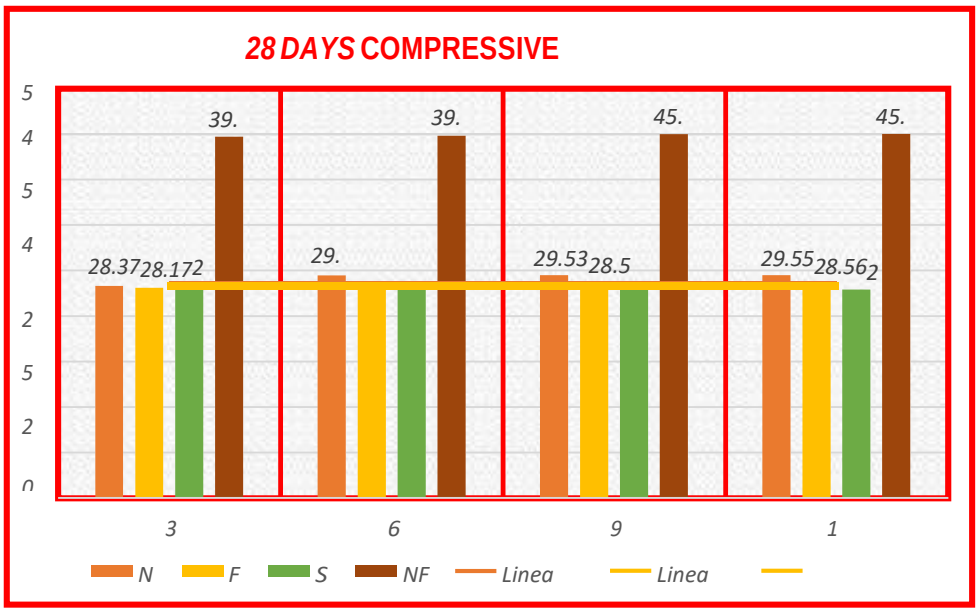
S.NO	CUBE ID	% OF REPLACEMNT(NFS)	28 DAYS N/mm^2
1	RT-Y-1	3%	44.78
2	RT-Y-2	6%	44.86
3	RT-Y-3	9%	45.06
4	RT-Y-4	12%	45.48

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.

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

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

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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 7days& 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 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.

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