Study on Properties of Sisal Fiber Reinforced Concrete by Adding of Different Percentages and Different Sizes of Sisal Fiber.

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Abstract-the present research was designed to check the workability and strength properties of sisal fiber reinforced concrete with different percentage of fibre addition. The materials were chosen to improve the various strength properties of the structure to obtain sustainability and better quality structure. Normally concrete is strong in compression and weak in tension. So we will provide the reinforcement to the concrete. Majorly steel is used as the reinforcement. Many of the researches are in progress to find a substitute to this material. Many investigations proposed artificial fibres. In this study we would like to take the naturally available fiber named sisal fiber is taken as a substitute material to the reinforcement and studied the properties. The results show that the composites reinforced with sisal fibers are reliable materials to be used in practice for the production of structural elements to be used in rural and civil construction. This material could be a substitute to the steel reinforcement which production is a serious hazard to human and animal health and is prohibited in industrialized countries. The production of sisal fibers as compared with synthetic fibers or even with mineral asbestos fibers needs much less energy in addition to the ecological, social. Short discrete vegetable fiber (sisal) was examined for its suitability for incorporation in cement concrete. The physical property of this fiber has shown no deterioration in a concrete medium. Fibers were brushed lined up and cut to obtain 4cm length. Degree of workability of concrete mix with 0.2% super plasticizer and water cement ratio 0.50 had good workability with slump value 58mm and compaction factor 0.97, which is effective, was obtained. Materials were hand mixed with 0%, 0.5%, 1%, 1.5%,2.0 %,2.5%,3.0%addition of fiber in m25 mix design and casted in cubes and cylinders. The obtained specimens were subjected to tests aimed to check the compressive, water absorption and tensile strength. An increased in compressive strength by 41.11%, tensile strength by 5.9 n/mm^2 for 28days and water absorption by 0.02% and 0.1% was observed for 10grams fiber in 7 & 28 days respectively.

INTRODUCTION

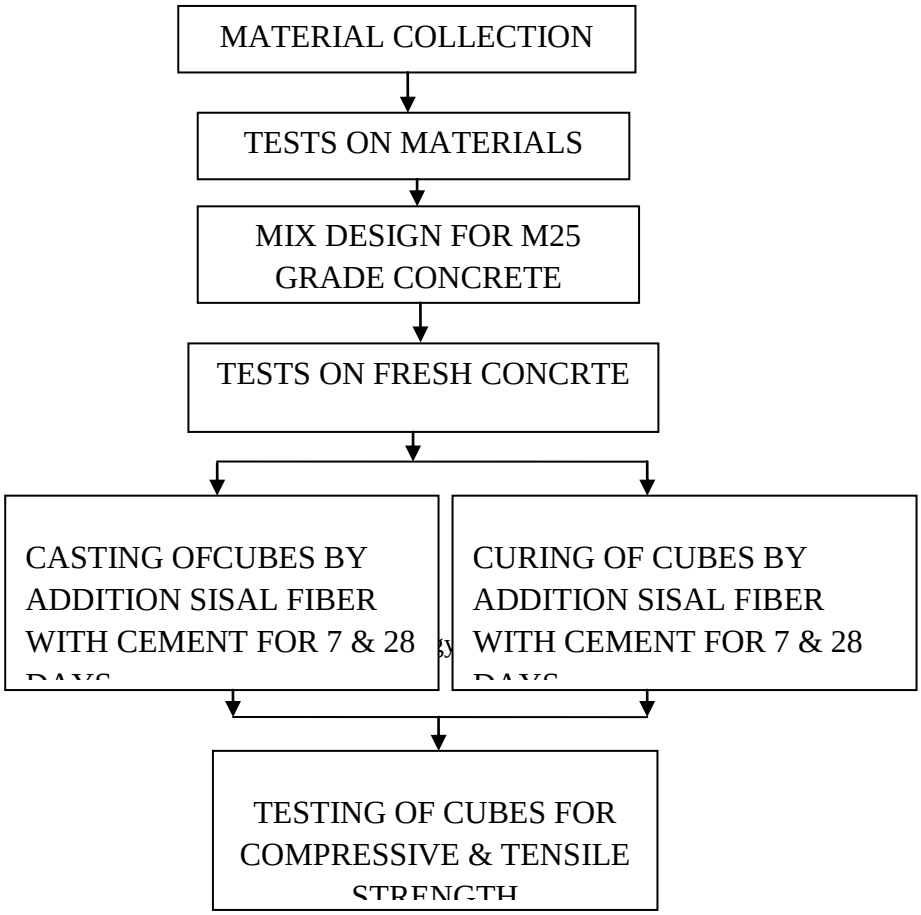
Concrete is a combination of cement, fine and coarse aggregates and water, which are mixed in a particular proportion to get a particular strength. The cement and water react together chemically to form a paste, which binds the aggregate particles together. The mixture sets into a rock-like solid mass, which has considerable compressive strength but little resistance in tension. The concrete likewise bear three basic properties namely workability, strength and durability. Amount of useful internal work necessary to overcome the internal friction to produce compaction is termed as workability. Size, shape, surface texture and grading of aggregates, water-cement ratio, use of admixtures and mix proportion are important factors affecting workability. Strength is to bear the desired stresses within the permissible factor of safety in expected exposure condition. The factors influencing the strength are: quality of cement, water-cement ratio, grading of aggregates, degree of compaction, efficiency of curing, curing temperature, age at the time of testing, impact and fatigue. Durability is sustenance of shape, size and strength, resistance to exposure conditions, disintegration and wearing under adverse condition. Properly compacted and cured concrete used in RCC continues to be substantially water tight and durable till capillary pores and micro cracks in the interior are interconnected to form a pathway up to the surface.

The compressive strength of concrete is likewise one of the most important properties of concrete. In most structural applications, concrete is employed primarily to resist compressive stresses. Therefore, the concrete

making properties of various ingredients of mix are usually measured in terms of the compressive strength. Compressive strength is also used as a qualitative measure for other properties if a hardened concrete. No exact relationship between compressive strength, modulus of elasticity, wear resistance, fire resistance and permeability has been established nor are they likely to be. It should be emphasized that compressive strength gives only an approximate value of these properties and that other tests specifically designed to determine these properties should be more useful and precise.

Metakoalin, produced by controlled thermal treatment of kaolin, can also be used as a concrete constituents, since it has pozzolanic properties. Metakaolin is a manufactured pozzolanic mineral admixtures which significantly enhance many performance characteristics of cement based mortars, concrete and related products. The use of pozzolanic materials in the manufacturing of the concrete has a long, successful history. Most pozzolans used in the world today are by products from other industries, such as coal fly ash, blast Furnas slag, rice husk and silica fume .As such there has been relatively little work done with regard to manufactured, optimized and engineered pozzolanic materials which are specially intended for use in Portland cement based formations. The use of Metakaolin and various chemical admixtures have staple in gradients in the production of concrete with designed strength in exess of 7500psi (>50Mpa) or where service environments, exposure or cycle cost considerations dictate the use of High performance of concrete (HPC).

METHODOLGY



EXPERIMENTAL ANALYS:

PHYSICAL AND CHEMICAL PROPERTIES OF SISAL FIBER:

Table 1: Physical and Chemical Properties of Sisal Fiber

S.No	PROPERTIES		PERCENTAGE
1	Physical	Density	1.41 (g/cm^3)
		Elongation at break	6–7 (%)
		Cellulose content	60–65 (%)
		Young's modulus	12.8 (GPa)
		Diameter	205–230 (µm)
2	Chemical	Cellulose	71.5%
		Hemi cellulose	18.1%
		Lignin	5.1%
		Pectin	2.3%
		Lignin	0.5%
		TOTAL	**100%**

PHYSICAL PROPERTIES OF CEMENT:

Table 2: Physical Properties of Cement

S.No.	Property	Experimental Values
1.	Fineness of cement (percentage of residue)	5.1%
2.	Specific gravity	2.80
3.	Normal Consistency	30%

PHYSICAL PROPERTIES OF FINE AGGREGATE:

Table 3: Sieve Analysis of Fine Aggregates

S.No	Property	Value
1.	Specific gravity	2.56
2.	Fineness of Modulus	2.22
3.	Bulk Density	6%

PHYSICAL PROPERTIES OF COARSE AGGREGATE:

Table 4: Sieve Analysis of Coarse Aggregate (20mm)

S.No	Property	Value
1.	Specific gravity	2.78
2.	Fineness of Modulus	4.88
3.	Impact value	16.6%
4.	Crushing value	24.9%
5	Crushing strength	16%

RESULTS AND DISCUSSIONS:

The test results of all the 36 cubes that were tested in compressive testing machine and tension testing machine in universal testing machine. Each set of cubes and cylinder prisms have different curing periods being 7 days and 28 days. Also difference in the percentage composition of the Sisal fiber in the cubes and cylinder is also there which are 0%, 0.50%, 1.00%, 1.50%, . All the test values are shown and their comparative study is done with the help of graphs.

SLUMP CONE TEST:

Slump cone test was conducted for each concrete batches before they were casted in order to check the workability of the concrete. Concrete having the least value of 50 mm was deemed to be workable. The results of the test are below.

Table 5: Slump Cone Test Values

S.No	Percentage of Fiber Addition in Concrete	Slump Value (mm)
1	0	51
2	0.5	57
3	1.0	58
4	1.5	59
5	2.0	60
6.	2.5	60
7	3.0	58

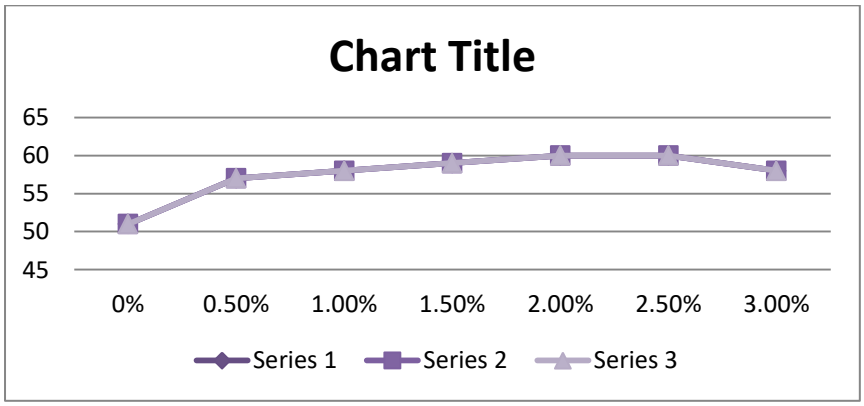


Figure 2: Slump Cone Test

COMPACTION FACTOR TEST:

Compaction factor test was also carried out for workability. The following are the results of the test:

Table 6; Compaction Factor test values

S.No	Percentage Of Fiber Addition In Concrete	Compaction Factor
1	0	0.89
2	0.5	0.91
3	1.0	0.94
4	1.5	0.96

COMPRESSIVE STRENGTH TEST:

Compressive Strength of M-25 Grade Concrete with different percentage of Sisal fiber for 7 & 28 days curing.

i). sisal fiber 2cm:

Table 7: Compressive Strength Test Values for 7 & 28 days

S.No.	Percentage of Sisal fiber	Average Compressive Strength Values (N/mm^2)	
		7 days	28 days
1	0	17.78	32.48
2	0.5	18.11	33.96
3	1.0	19.99	35.91
4	1.5	21.47	37.07
5	2.0	24.44	40.40
6	2.5	26.11	41.60
7	3.0	25.80	41.11

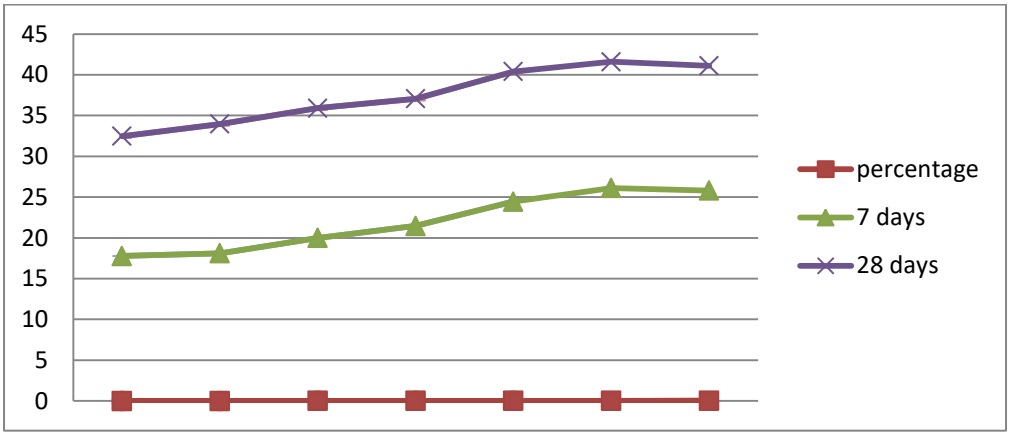


Figure 3; Graphical representation of add 2cm Sisal fiber

ii). Sisal fiber 3cm:

Table 8: Compressive Strength Test Values for 7 & 28 days

S.No.	Percentage of Sisal fiber	Average Compressive Strength Values (N/mm^2)	
		7 days	28 days
1	0	17.1	32.1
2	0.5	17.79	33.42
3	1.0	18.75	35.63
4	1.5	22.05	36.99
5	2.0	26.67	39.7
6	2.5	26.90	40.70
7	3.0	26.7	40.57

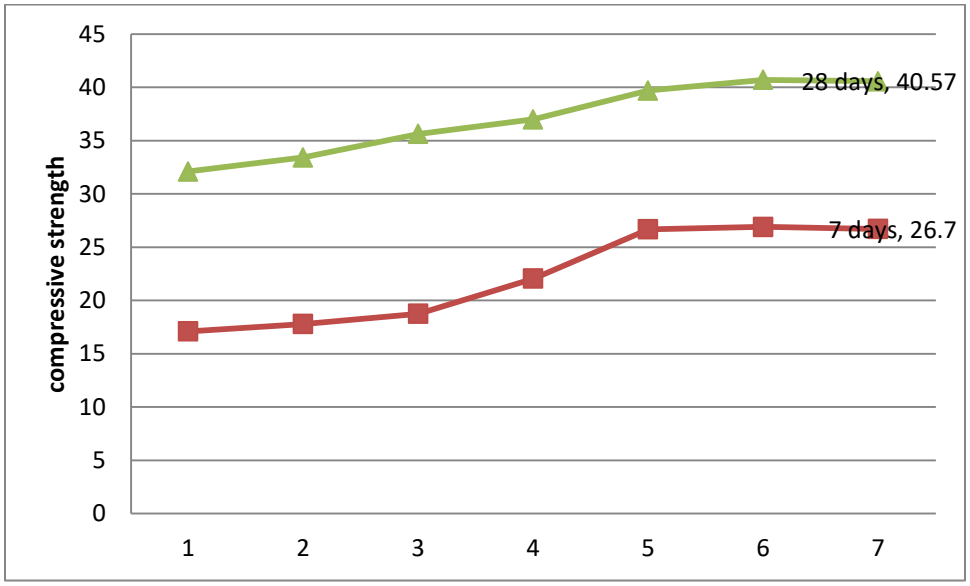


Figure 4: Compressive strength of concrete for various percentages

TENSILE STRENGTH TEST:

i). Sisel fiber 2cm:

Table 9: Tensile strength as per curing 7days and 28days

S.No.	Percentage of Sisal fiber	Average Tensile strength (N/mm^2)	
		7 days	28 day
1.	0	2.8	4.34
2.	0.5	3.02	4.6
3.	1.0	4.24	5.26
4.	1.5	4.35	5.65
5	2.0	4.66	5.9
6	2.5	4.79	6.1
7	3.0	4.65	5.75

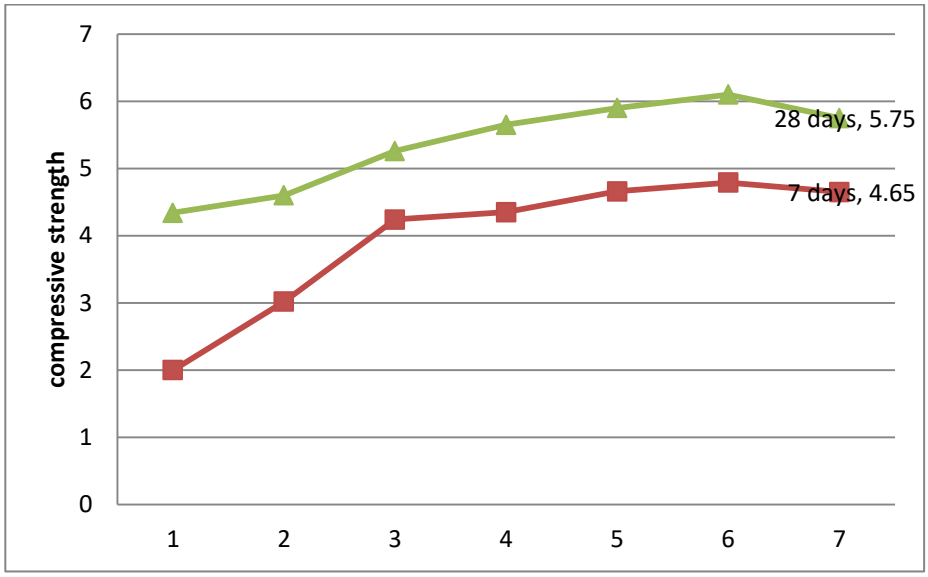


Figure 5: Tensile strength of concrete for various percentages

II). SISEL FIBER 3CM:

Table 10; Tensile strength as per curing 7days and 28days

S.No.	Percentage of Sisal fiber	Average Tensile strength (N/mm^2)	
		7 days	28 day
1.	0	2.72	4.23
2.	0.5	3.09	4.58
3.	1.0	4.15	5.2
4.	1.5	4.3	5.53
5	2.0	4.59	5.85
6	2.5	4.7	6.2
7	3.0	4.3	5.9

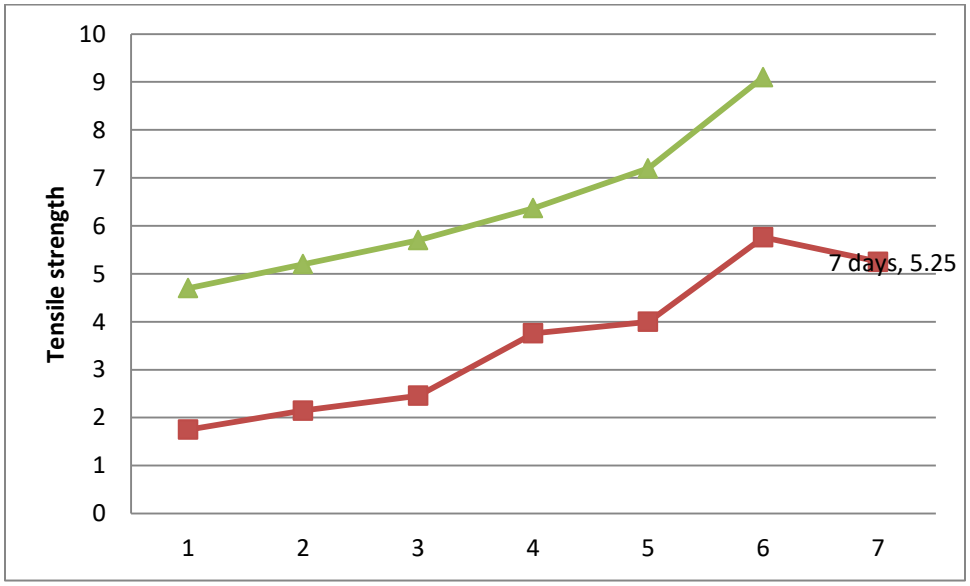


Figure 6: Tensile strength of concrete for various percentages

FLEXURAL STRENGTH TEST;

i). sisel fiber 2cm:

Table 11: Flexural strength of concrete for 7days and 28days

S.No.	Percentage of Sisal fiber	Average Tensile strength (N/mm^2)	
		7 days	28 day
1.	0	.96	4.34
2.	0.5	1.56	4.6
3.	1.0	2.24	5.26
4.	1.5	3.35	6.65
5	2.0	3.66	7.6
6	2.5	4.2	8.9
7	3	4.75	8.1

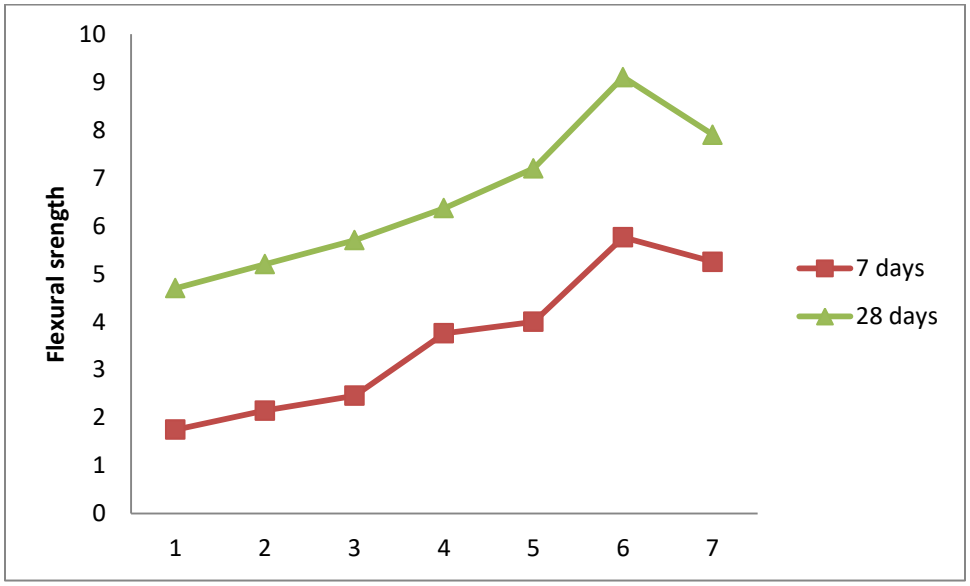


Figure 7: Flexural strength of concrete for various percentages

II). SISEL FIBER 3CM:

Table 12: Flexural strength of concrete as per curing 7days and 28days

S.No.	Percentage of Sisal fiber	Average Tensile strength (N/mm^2)	
		7 days	28 day
1.	0	1.75	4.7
2.	0.5	2.15	5.2
3.	1.0	2.46	5.7
4.	1.5	3.76	6.37
5	2.0	4.0	7.2
6	2.5	5.76	9.1
7	3.0	5.25	7.9.

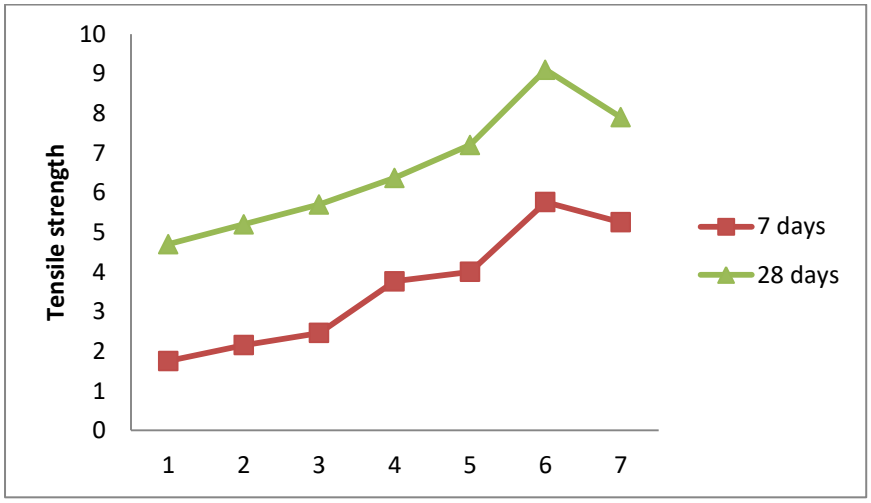


Figure 8: Flexural strength of concrete for various percentages

Conclusion:

The strength and durability characteristics of concrete mixtures have been computed in the present work by addition of 0.5%, 1.0% ,1.50% , 2.0% ,2.5 %,3.0% sisal fiber with the Cement. On the basis of present study, following conclusions are drawn. The study has concluded that there was an increase in slump value from 51mm to 60mm after addition of super plasticizer. Early gain for compressive strength for sisal fiber reinforced concrete with proves to be better option for repair work. One day results are not to be estimate for the fiber content as the increase in the fiber percentage the setting time of concrete is delayed. The addition of fiber in small amounts will increase the both tensile & compressive and flexural strength. Degree of workability for concrete mixture with 0.2% super plasticizer and water cement ratio 0.50 provided good workability. Compaction factor increases by 0.02 to 0.03 after addition of super plasticizer. Compression strength increased by 41.6 N/mm^2 and Tensile strength increased by 6.1N/mm^2 after addition of 2.50% fibers for M25 mix design. Water Absorption is absorbed in 0.1% for 28days. It is concluded that 2.5% addition of fiber will give better strength.

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