

Natural FIBRE Reinforced Concrete

**B. Ankaiah**

P.G Student,

Dept of Civil Engineering,

Siddhartha Institute of Engineering & Technology,
Puttur, A.P.India.**Dr. K. Chandrasekhar Reddy**

Professor of Civil Engineering & Principal,

Dept of Civil Engineering,

Siddhartha Institute of Engineering & Technology,
Puttur, A. P, India.

ABSTRACT:

Fiber Reinforced concrete can offer a convenient, practical and economical method for overcoming micro-cracks and similar type of deficiencies. The fiber reinforced concrete means that in the concrete some type of materials (fibers) are used to increase the strength of concrete, because concrete weak in tension and more in compressive strength. So increase the tensile strength for adding the fibers to concrete because the fibers are strong in tensile strength. Generally the fibers are classified in to two types; they are artificial fibers and natural fibers. In the artificial fibers steel, asbestos, glass, carbon, synthetics etc are used and in the natural fibers horse hair, sisal, coir, bamboo, jute, aware, elephant grass, coconut fibers etc are used. And in this human hair was used as a fiber.

Human hair is natural fiber and it is strong in tension, so it can be used as a fiber reinforcement material. Hair Fiber (HF) an alternate non-degradable matter. And also available in very cheap cost. The hair decomposing is difficult; it also creates environmental problems for its decompositions. Present studies has been undertaken to study the effect of human hair on plain cement concert on the basis of its compressive, crushing, flexural strength and cracking control to economize concrete and to reduce environmental problems and reduce the micro-cracks in concrete.

Experiments were conducted on concrete cubes with various percentages of human hair fiber I.e. 0%, 1%, 1.5%, 2%, 2.5%, 3%, and 3.5% etc, by weight of cement for M20, M25 grade concretes. For each combination of proportions of concrete three cubes are tested for their mechanical properties.

KEY WORDS:

Fiber reinforced concrete, hair fiber, compressive strength, split tensile test.

INTRODUCTION:

Concrete is weak in tension and has a brittle character. The concept of using fibers to improve the characteristic of construction materials is very old. The fiber reinforced concrete was invented by French gardener Joseph Monier in 1849 and patented in 1867. Early applications addition of straw to mud bricks horse hair to reinforce plaster and asbestos to reinforce pottery use of continuous reinforcement in concrete (reinforcement concrete) increase strength ductility, but requires careful placement and labor skill. Alternatively, introduction of fibers in discrete from in a plain or reinforced concrete may provide a better solution.

The modern development of fiber enforced concrete (FRC) started in the early sixties. Addition of fibers to concrete makes it a homogeneous and isotropic material. When concrete cracks, the randomly oriented fibers start functioning, arrest crack formation and propagation, and thus improve strength and ductility. The failure modes of FRC are either bond failure between fibers or matrix or material failure. This project, the hair fiber reinforced concrete is tested and compared the results with conventional concrete.

Fiber reinforced concrete:

Almost everybody heard about the concrete, but few members heard about the Fiber reinforced concrete.

The fiber reinforced concrete is defined as the in concrete some type of materials are used to increase the strength of concrete, this concrete is known as fiber reinforced concrete and that material is known as the fiber. ie the concrete is more in the compressive strength and less in the tensile strength. Generally the fibers have the more tensile strength, so by the fibers adding to concrete to increase the strength of concrete. These fibers are two types; those are natural fibers and artificial fibers.

The natural fibers means that this fibers are formed naturally, but artificial fibers are manmade fibers. In the artificial fibers following fibers are came, i.e. steel, asbestos, glass, carbon, synthetics etc and in the natural fibers are horse hair, sisal, coir, bamboo, jute, aware, elephant grass... etc. In the natural fibers except horse hair remaining fibers are come from plants. There is a relation between concrete strength and its ductility. ie higher strength of concrete having the lower ductility. Strength is inversely proportional ductility.

It is the serious drawback for use of high strength concrete. So reduce this property for adding the fibers to concrete. The concept of fibers are using to improve the characteristics of construction material are old. An addition of fibers to concrete makes it more homogeneous and isotropic and it transforms from brittle to a more ductile material. When the micro cracks are formed in the concrete, these are arrested by the fibers. Thus improving strength and ductility, and under loading reinforced fibers will stretch more than concrete.

Hair fiber reinforced concrete:

The main element of hair composition is keratin. Keratins are proteins with long chains of amino acids that form the cytoskeleton of all cells of outer shell. Number of investigations clearly started the sulphur is the main reason of strength hair cords in front of disintegration in the face of environmental stress and these sulphur compounds are linked with amino acids it very high levels in hair cords. Sulphur in amino acids molecules is adjacent to keratin protein till form disulphide chemical chain (chains are very strong and resistant to breakage). These chains are very resistant to acids disulphide performance, but in alkaline solutions they can decomposed.

In fact alkaline environment losses the hair cords. The potential impact of reduced strength in the cement mortar is still a noteworthy but we have to mention that the purpose of this article is to investigate the impact of hair cord in control of shrinkage and cracks which are caused in normal concrete. Before the alkaline environment loose the hair cords, these cords may respond on purpose to their functions to prevent shrinkage.

The detail image of the external surface of human hair that has been studied with electron micro scope the outer layer of hair which is called cuticle is much like tree trunks and has bumps. Hair diameters are 50 to 100 micro meter and bumps on it are is nano size these bumps help to lock cement motor with hair cords. Size and number of these bumps is variable depending on hair type.

Advantages:

- The fiber reinforced concrete was used to many areas of civil infrastructure applications especially where the need for repairing, increased durability areas.
- It is also used in civil structures where corrosion is to be avoided at the maximum
- It is better suited to control cavitation's erosions damage in sluice-ways, navigational Locks and bridge piers where high velocity flows are encountered.
- The fibers are decreases the internal forces by blocking of microscopic cracks from forming with concrete.
- The hair fiber reinforced concrete was used in the laying of runways, aircraft parking pavements and other type of pavements.
- The fiber reinforced concrete was used for lining of tunnel and rock stabilization. It neglects need for mesh reinforcement at scaffolding.
- It is also used in blast resistant structures of plane concrete slabs
- In the preparing of hemi spherical domes, thin shells, walls, pipes and manholes the fiber reinforced concrete was used.

- The fiber reinforced concrete is used for the construction and repairs of dams and other hydraulic structures to provide resistance to cavitations and erosion caused by the impact of large Waterboro debris.

Disadvantages:

The main disadvantage associate with the fiber reinforced concrete is fabrication. The process of incorporating fibers into the cement matrix is labored intensive and costlier than the production of the plain concrete. The real advantages gained by the use of FRC overrides this disadvantage.

The hair used as a fiber due to following reasons:

- The hair has high tensile strength, which it is equal to that of a copper wire with similar diameter.
- Hair creates the environmental problems in decomposition.
- It is non-degradable matter.
- It is also available in very low cost.
- It reinforce the mortar and pavements it from sapling.

TEST RESULT AND DISCUSSIONS:

S.NO	Mix	% hair	Compressive strength(N/mm ²)			Avg. compressive strength (N/mm ²)
			Cube No.1	Cube No.2	Cube No.3	
1	M-20	0%	26.55	26.88	26.55	26.66
2	M-25	0%	31.24	31.17	31.33	31.24
3	M-20	1%	25.81	27.53	27.12	26.82
4	M-25	1%	32.72	32.64	31.81	32.39
5	M-20	1.5%	28.65	27.96	28.75	28.45
6	M-25	1.5%	33.56	33.25	33.78	33.53
7	M-20	2%	28.93	28.36	28.94	28.74
8	M-25	2%	34.74	33.97	34.24	34.31
9	M-20	2.5%	30.86	30.21	31.16	30.74
10	M-25	2.5%	36.01	35.56	36.27	35.94
11	M-20	3%	31.04	31.18	31.54	31.25
12	M-25	3%	36.21	35.64	36.47	36.10
13	M-20	3.5%	31.01	31.12	31.24	31.12
14	M-25	3.5%	36.10	35.25	36.41	35.92

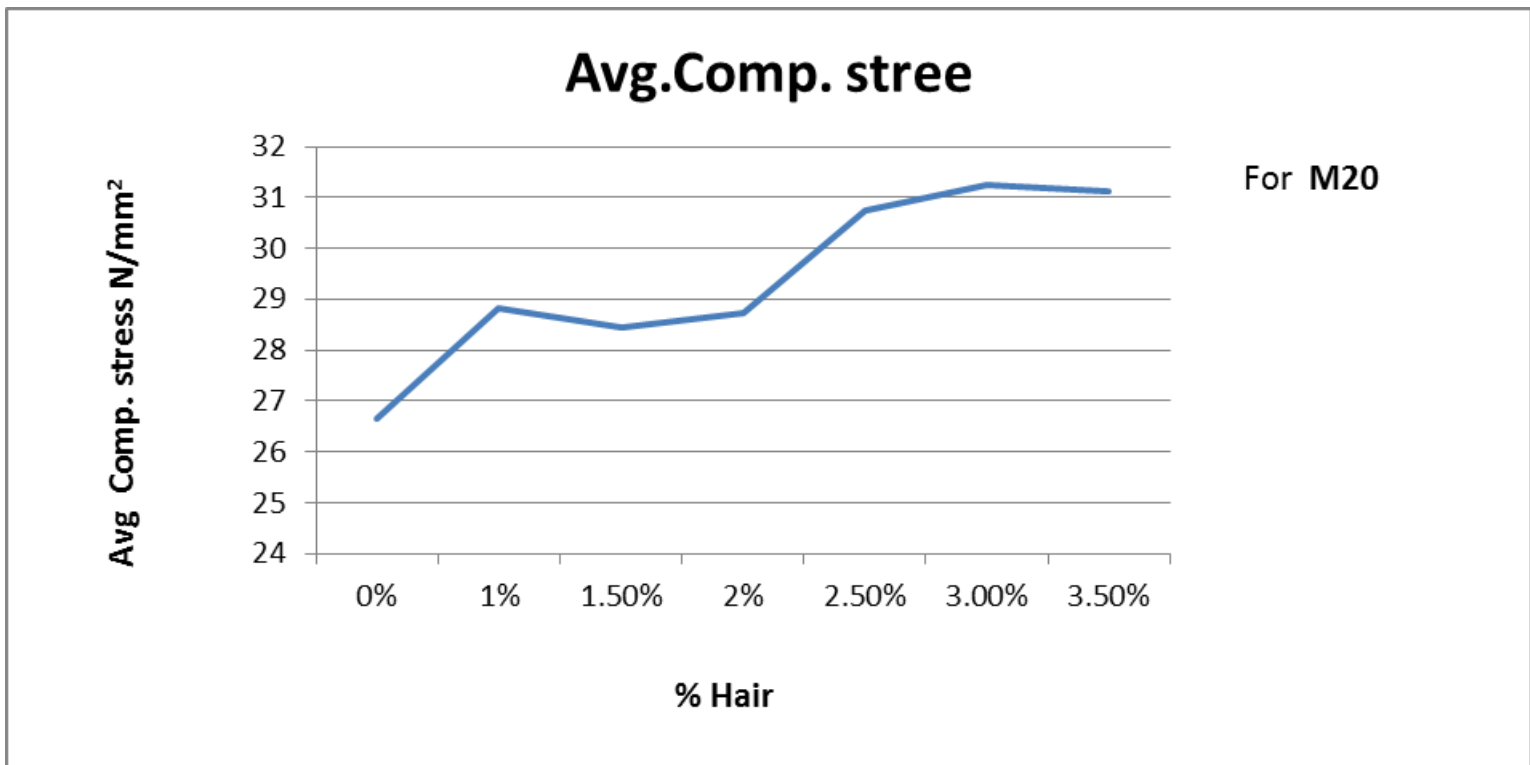
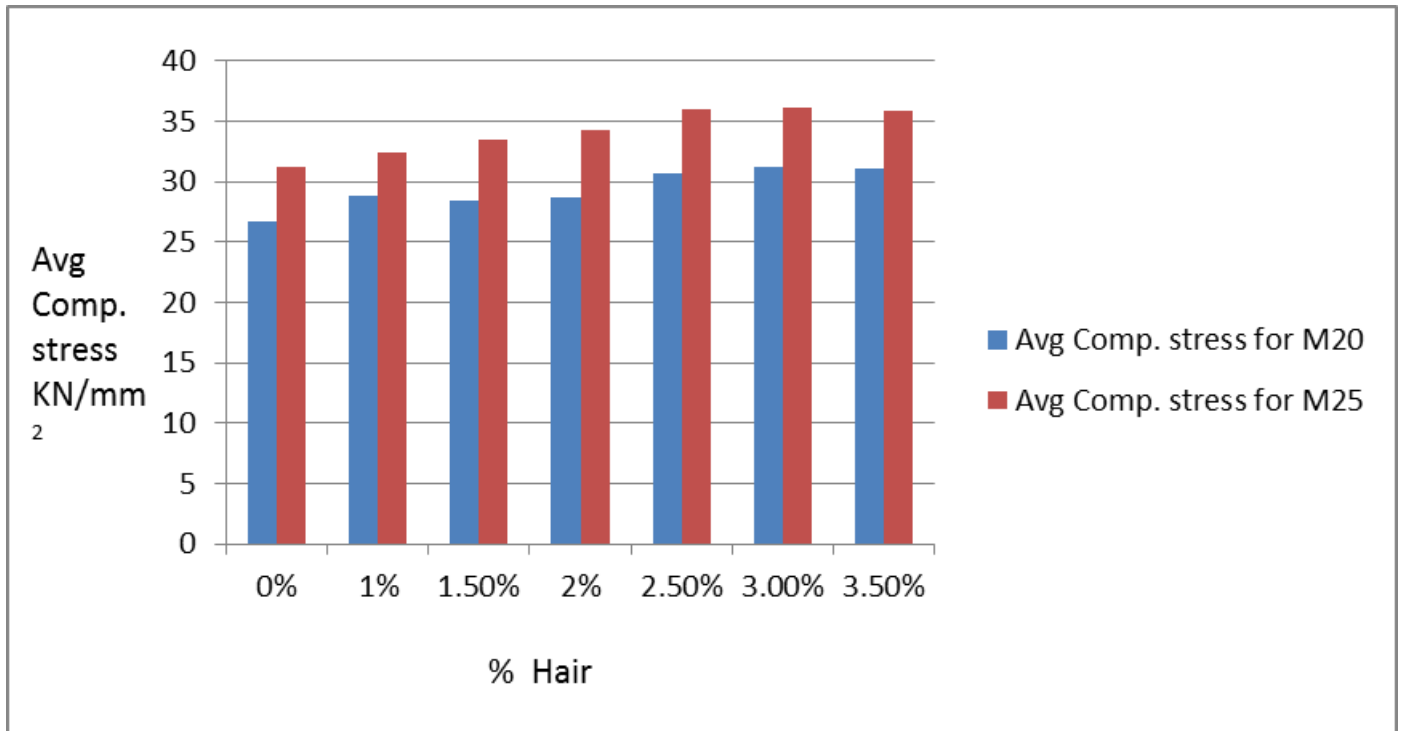
1.Compressive strength test:

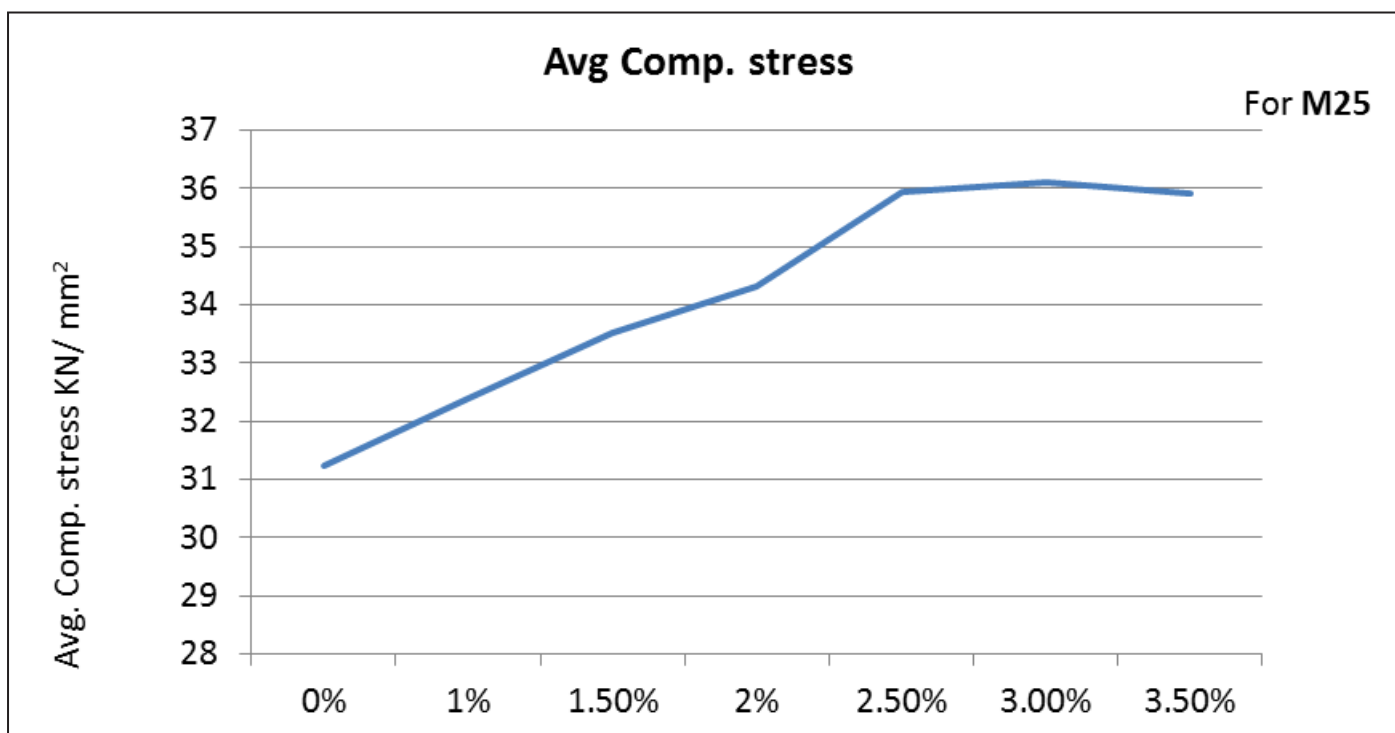
The results from the compression test are in form of the maximum load the cube can carry before it ultimately fails. The compressive stress can be found by dividing the maximum load by the area normal to it. The results of compression test and the corresponding compressive stress is shown in table 1.Let,

P = maximum load carried by the cube before the failure

A = area normal to the load = 150 x 150 mm² = 22500 mm²

σ = maximum compressive stress (N/mm²), Therefore, $\sigma = P / A$ N/mm²





2.Splitting tensile strength test:

Splitting tensile strength (STS) test was conducted on the specimens for all the mixes at different curing periods as per IS 5816(1999). Three cylindrical specimens of size 150mm×300mm were cast and tested for each age and each mix. The load was gradually till the failure of the specimen occurs. The maximum load was then noted. Length and cross-section of the specimen was measured. The splitting tensile strength (fct) was calculated as follows

$$f_{ct} = \frac{2P}{\pi l d}$$

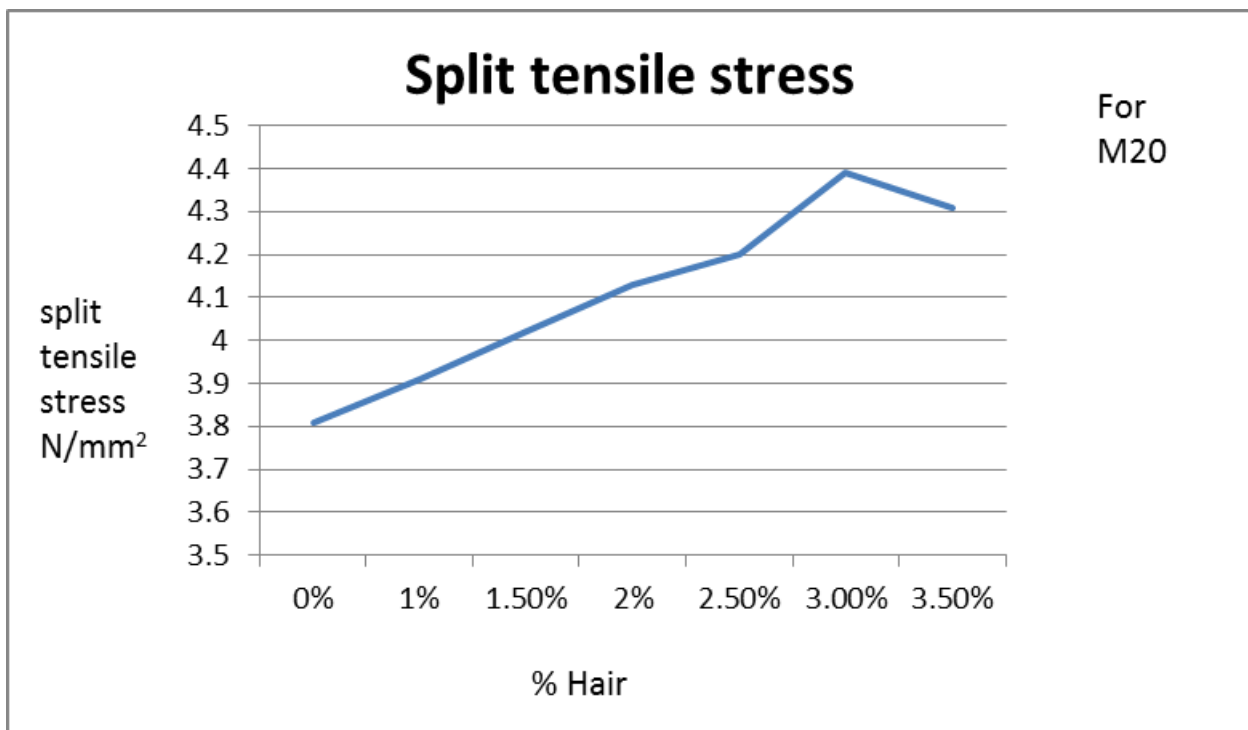
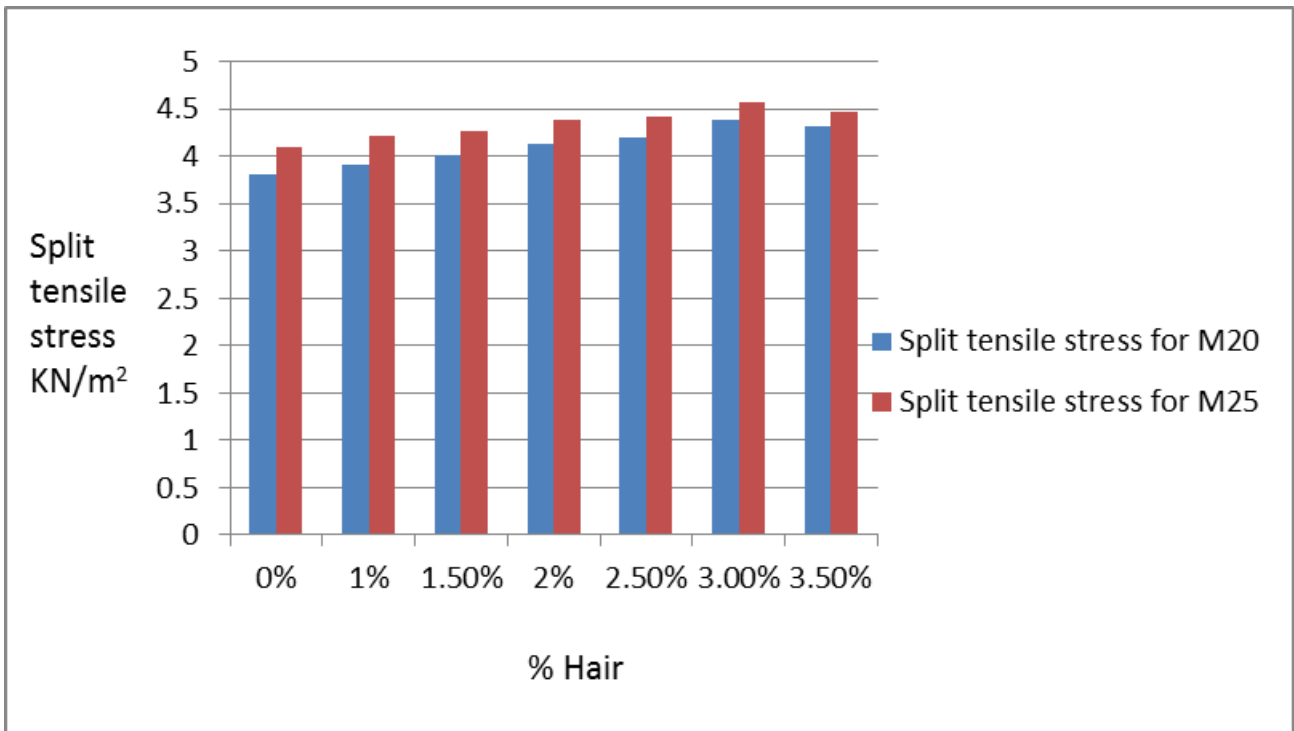
Where, fct=Splitting tensile strength of concrete (N/mm²)

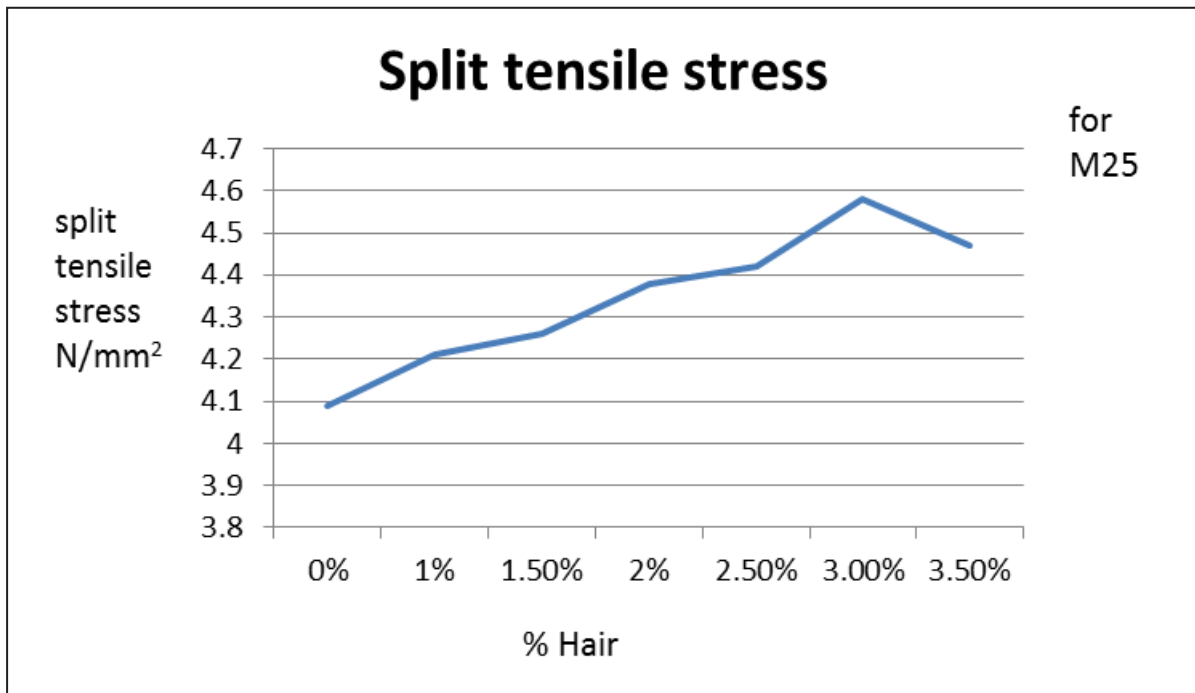
P = Maximum load applied to the specimen (in Newton)

l = Length of specimen (in mm)

d =Cross sectional diameter of the specimen (in mm)

S.NO	Mix	% of hair	Split tensile stress(N/mm ²)
1	M-20	0%	3.81
2	M-25	0%	4.09
3	M-20	1%	3.91
4	M-25	1%	4.21
5	M-20	1.5%	4.02
6	M-25	1.5%	4.26
7	M-20	2%	4.13
8	M-25	2%	4.38
9	M-20	2.5%	4.26
10	M-25	2.5%	4.42
11	M-20	3%	4.39
12	M-25	3%	4.58
13	M-20	3.5%	4.31
14	M25	3.5%	4.47





Conclusion:

According to the test performed it is observed that there is increment in strength in concrete by increased the percentage of hair by weight of cement 0% to 3%. And at 3.5% the concrete strength was started decreasing. So the hair 3% is the mean value for adding of hair percentage by weight of cement, after adding of 3% of hair it was failure. The results are similar in compression test and splitting tensile test, i.e. .in compression test and splitting tensile test 3% of hair by weight of cement is mean point to failure of concrete.

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