

# Flexural and Split tensile Strength of Concrete Reinforced with Human Hair

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## ABSTRACT

Use of human hair in mortar and concrete is very recent now a days. Human hair is used as natural fiber to enhance the strength characteristic of concrete and mortar. Use of human hair in concrete not only reduces the waste disposal problem but also, it contributes to the economic system by providing an economic construction material. Human hair has advantage that it is completely biodegradable, renewable and easily available at negligible cost. Many studies have been conducted to know human hair concrete performance. In this paper M40 concrete with 0%, 4%, 8%, 12% and 16% hair content was produced in the laboratory. Human hair concrete was tested for flexural strength and split tensile strength. Investigation shows human hair concrete has more flexural strength and split tensile strength as compared to conventional concrete. Maximum flexural strength and split tensile strength were found at 12% and 8% human hair content respectively.

**Keywords-** Flexural strength, split tensile strength, human hair content, cement, concrete.

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## I. INTRODUCTION

Human hair is considered as a waste material in most parts of the world and is a common constituent found in municipal waste streams which cause enormous environmental problems like burning of human hair or the waste piles congaing them which is respected in many regions of the world produces foul odour and toxic gases such as ammonia carbonyl sulphides hydrogen sulphides, sulphur dioxide, phenols etc. open dumps of hair generate hair dust which causes discomfort to nearby people and if inhaled in large quantities can result in several respiratory problems and death. Oil sweat and other organic matter getting to the hair rot over time and become a source of foul odour and breeding ground for pathogens.

It is widely recognized that use of natural fibers when used correctly in concrete has many advantages. In similar way when human hair used in correct proportion and manner it give ideal choice of fibers in concrete. Many studies have been conducted to understand the performance characteristic of human hair concrete. The brief literature reviews of the latest studies are as follows.

Pawar et.al. [1] investigated the effect of hair fibre and basalt fibre on compressive strength and flexural strength of M40 grade concrete. Initially both fibre were used separately and then combination of hair fibre and basalt fibre were used. Investigation shows increment in flexural and compression

strength when both fibre are used separately. Maximum increment in both strength was observed at 1% fibres. There is no increase in strength when fibres are used in combination

Khansaheb [2] conducted study for M20 grade. Author used 0.5% and 1% human hair content with 5% bargaase ash. It was observed that there is significant improvement in compression strength and flexural strength at 28 days.

Ganiron [3] studied performance of human hair as additive in asphalt cement mixture. Human hair were added to asphalt mixture as additive with variable percentage ( 3% to 12%) by weight of bitumen. Study shows addition of human hair fibres provide good binding and the mixture exhibit superior results to deformation and fatigue.

Jain Alok et.al. [4] reported maximum increases in compressive strength at hair fibre content 2% by weight of cement. Maximum increase in flexural strength was observed at 1.5% to 2% human hair fibre content when compared with conventional concrete and percentage of increase was 5 to 15%.

Agrawal Achal et. al. [5] reported maximum increase in compressive strength (6.29% ) and flexural strength (6.82%) at 5% hair fibre content when compared to conventional concrete at the age of 7 days curing . At 28 days curing maximum increase in compressive strength and flexure strength was found 9.81% and 6.95% respectively.

G. Sreevami et.al. [6] investigated high compressive strength and better split tensile strength when human hair fibres added to concrete. Investigation reported the addition of human hair to the concrete not only modifies various properties of concrete like tensile strength compression strength but also enhance the binding properties micro cracking control.

Kumar shantaverayya et.al. [7] reported many advantages as compared to conventional concrete such as modified tensile strength, compressive strength, binding properties, spalling resistance and micro cracking control.

Chinnadurai et.al. [8] investigated study to find effect on compressive strength and splitting tensile strength due to addition of human hair as fibre in concrete . Author reported addition of human hair fibre results in increase in both strength characteristic. The result was similar for both strength and maximum strength were achieved at 3% human hair fibre content by weight of cement.

## II. OBJECTIVE OF THE STUDY

The research was aimed to investigate effect of flexural and split tensile strength of concrete reinforced with human hair.

## V. RESULTS AND DISCUSSION

### 5.1 Flexural Strength and Split Tensile Strength

**Table 5.1 Flexural and split tensile strength of M40 grade concrete reinforced with 0%, 4%, 8%, 12% and 16 % human hair content.**

S. No.	Mix	Human hair content (%)	Flexural strength (MPa)	Split tensile strength (MPa)
			28 Days	28 Days
1.	M0 (control mix)	0	5.10	3.2
2.	M10	4	5.12	3.4
3.	M20	8	5.16	3.8
4.	M30	12	5.20	3.4
5.	M40	16	5.12	3.3

## III. MATERIALS AND THEIR PROPERTIES

**3.1 Cement** OPC 53 grade cement of Ultra tech was used for this research program.

**3.2 Natural Sand.** Narmada sand (zone-II) was used

**3.3 Aggregate** A combination of 20mm nominal size aggregate and 10mm nominal size aggregate is used as coarse aggregate in this experimental program.

**3.4 Water** The water used was ordinary tap water from the Bhopal city.

**3.5 Human hair.** Human hair in various proportions were used in this study.

## IV. EXPERIMENTAL PROGRAM

To conduct experimental program human hair in 0%, 4%, 8%, 12%, 16% were used in the laboratory for grade M40

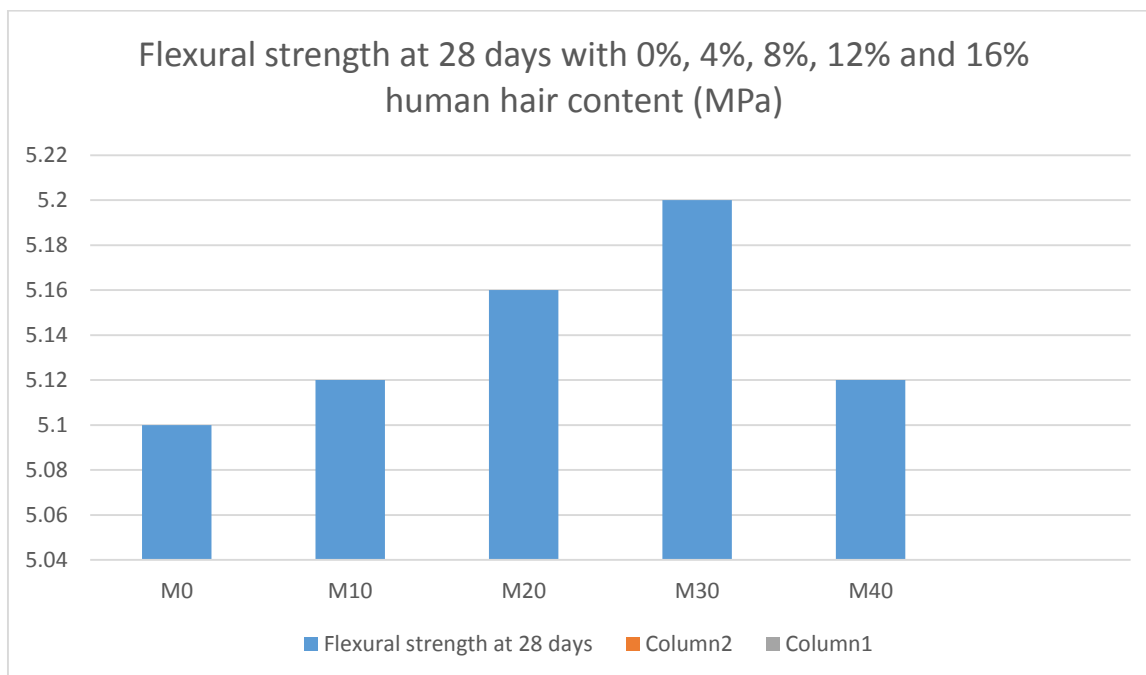


Fig. 5.1 Flexural strength of concrete with 0%, 4%, 8%, 12% and 16% human hair content at 28 days

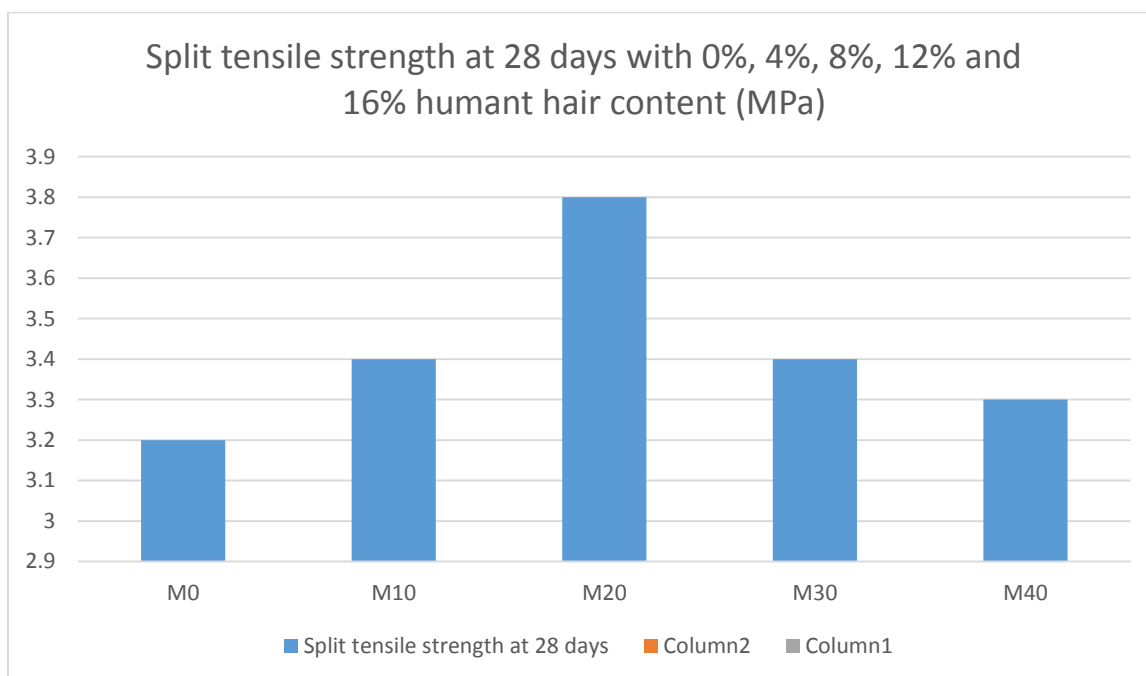


Fig. 5.2 Split tensile strength of concrete with 0%, 4%, 8%, 12% and 16% human hair content at 28 days

It can be seen from fig. 5.1 and fig. 5.2 that use of human hair content for reinforcing concrete results in increased flexural strength and split tensile strength. Both strength for all mixes containing 4%, 8%, 12% and 16% hair content found more than the conventional control concrete. Maximum flexural strength were found at 12% human hair content and maximum split tensile strength were found at 8% human hair content respectively.

## VI. CONCLUSIONS

On the basis study it was observed that addition of human hairs to the concrete modifies both flexural strength and split tensile strength properties at 28 days. Hence it can be concluded that human hair fibres give ideal choice of fibres in concrete if used in correct proportion and manner and human hair fibre has other advantages like it is

completely biodegradable, renewable and easily available at negligible cost.

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