To Determine the Strength of Concrete using Human Hair & Corn Starch

Lalit Kumar, Samad Mobin, Akshit Pathania

Abstract: Admixtures are used to alter the properties of concrete. They are introduced to a batch of concrete during or immediately before its mixing . The specific effects of admixtures generally vary with a type of cement & mixed proportion. The benefits of using admixtures are improve quality, improve, workability, improve fibre resistance, increase in setting time&increase in tensile strength. Fibre reinforced concrete provide good flexular strength with less crack development. Since concrete is weak in tension. Human hair are strong in tension, non degradable and is available in abundance, present studies have shown the effect of human hair on cement concrete increase the tensile strength of concrete. Human hair doesn't harm the environment. Also in addition of human hair enhances the binding properties, micro cracking control, impart ductility and also increases swelling resistance. In this study an attempt has been made to identify the various properties necessary for design of concrete mix by adding human hair.

I. INTRODUCTION

Concrete usually portland cement concrete is a composite material compared of fine and coarse aggregate bounded together with cement, sand & aggregate. It is distinguished from other, Non cementations type of concrete all binding some form of aggregate together, including bitumen binder with a asphalt concrete, which is used for road surfaces. Cement most commonly Portland cement, associated with the term "concrete". One of the most familiar of this alternative cement is asphalt concrete. To produce concrete from most cement, water is mixed with the dry powder and aggregate, which produces semi-liquid slurry. Concrete is graded according to its compressive strength. The various grades of concrete as stipulated in IS: 456-2000 and IS: 13431980. In this classification of a concrete mix, Letter M refers to the mix and the number to the specified characteristic compressive strength of 15 cm cubes at 28 days expressed in N/mm2 or MPa.

Revised Manuscript Received on June 7, 2019

Lalit Kumar, Assistant Professor Civil Engineering . Department JIMS Engineering Management Technical Campus Affiliated To GGSIPU University Delhi

Samad Mobin, (Student) B-TECH Fourth Year JIMS Engineering Management Technical Campus Affiliated To GGSIPU University Delhi.

Akshit pathania, (Student) B-TECH Fourth Year JIMS Engineering Management Technical Campus Affiliated To GGSIPU University Delhi.

The characteristic strength is defined as the strength of material below which not more than 5% of the rest results are expected to fail. Concretes of compressive strength lower than 20 MPa may be used for lean concrete bases and simple foundations for masonry walls.

II. MOTIVATION

Bearbeitrt Von and Clarence R .Robbin in their book summarized that-Hair fibres (about 50-100 μm in diameter) consist of the cuticle and cortex and medulla in the central region. All are composed of dead cells which are mainly filled with keratin protein. depending upon moisture content human hair consists of 65-95% keratin proteins the remaining constituents are water, lipids , pigment and trace elements. Proteins are made up of long chains of various mixture 2of some 20 or 50 amino acids. Jain D and Kothari A, observed that there is remarkable increament in properties of concrete according to the percentages of hairs by weight of in concrete. When M20 concrete with 1% hair is compared with the plain cement concrete, it is found that ther is an increase of 10% in compressive strength and 3.2% in flexural strength

A. CORN STARCH Corn Refineries Association 1701 Pennsylvania Avenue, noted that- The use of starch was found in early records of the Egyptians. Corn plant has high capacity factor for efficiently converting large amounts of radiant energy from the sun into stable chemical energy. This energy is stored as cellulose, oil and starch in the corn plant and in the corn kernel. A Akindahunsi (2015) analysed concrete cubes, containing different proportions of maize by weight of cement(0,0.5,1.0,1.5 and 2.0%). Crushed granite was used as coarse and fine aggregates. The maximum coarse aggregate size used was 22mm Xing et al.(2006) and Crepy et al.(2011) noted that starch is one of the most abuntant resource in the world . Starch and its derivatives are said to exhibit viscosity modifying characterstics. Major advantage of starch is that it is abundantly available and is cheap. It is renewable material, biodegradable and doesn't harm the surrounding environment.

III. SPECIMEN PREPARATION

Making of the samples(Different proportions):-A normal mix of cement (OPC), fine aggregate and coarse aggregate was mixed together in the proportions 1 : 1.5 : 3 i.e. 1 part of cement, 1.5 part of sand-3 parts of coarse aggregate(crushed stones) to make M-20 grade concrete.

This M-20 grade concrete was used to make 3 cubes, so that the initial results could be obtained by these 3 cubes of M-20 and further results could be compared by the results of these 3 cubes.

Further, same proportions of cement (OPC), fine aggregate and coarse aggregate were taken and M-20 grade concrete was prepared. Now we added corn starch in this mix by altering the proportions of corn starch; As (3% and 5%) in the mix. 3 Cubes each for different proportions i.e. 3 cubes for 3% and 3 cubes for 5%, were prepared. These all cubes were marked under the A group and were named as (a1,a2…..an).

Now, same procedure was repeated and a concrete mix of M-20 grade was prepared with the same proportions as prepared before. Now we added human hair as a fibre in the proportions of 1%, 1.5% and 2% by weight in accordance to the weight of the cement added in the mix. By adding fibre by weight we tried to convert the mix into fibre reinforced concrete. Again 3 cubes each for different proportions i.e. 3 cubes for 1%, (vi) cubes for 1.5%, and 3 cubes for 2% were prepared. These all cubes were marked under the B group and will be named as (b1, b2….. bn).

Again, same procedure was repeated and a concrete mix of M-20 grade was prepared with the same proportions of cement (OPC), fine aggregate and coarse aggregate as prepared before. This time we added both corn starch as a admixture and human hair as a fibre and will be trying to make a mix which have it's properties more better than using only corn starch as a admixtute or only human hair as a fibre. Different proportions of human hair and corn starch were added in the mix. For the first set of cubes we added 3% of corn starch and 1.5% of human hair by weight in accordance to weight of the cement in the mix. This set was under c group and the first set of cubes was named as c1.1 each set of cubes will contain 3 cubes. Further for the second set of cubes we added 5% corn starch and 1.5% human hair by weight in accordance to weight of cement in the mix. This set of cubes will be named as c2. Now for the third set of cubes we added 5% corn starch 1.5% human hair by weight in accordance to weight of cement in mix.

Testing of Samples:-All the prepared samples will be now tested to known about the compressive strength and workability of the samples.

For Compression Test:-A compression test is a test in which the specimen experiences opposing inward forces and the strength of the material is obtained. Generally compression test is done on the compression testing machine (CTM).

IV. RESULTS AND CONCLUSION

Concrete Grade M20 was used during the casting of this hair reinforced fibrous concrete so the general proportions for M20 were used i.e. (1: 1.5: 3) for cement, sand and aggregate respectively.

Average weight of a standard cube of M20 concrete = 8.43 Kg

weight of cement = 1.53 Kg

weight of sand = 2.3 kg

weight of aggregate = 4.6 Kg

2 CONVENTIONAL CUBE

Cement = 1.53 Kg
Sand = 2.3 kg
Aggregate = 4.6 Kg

5.21Compression Test

Three specimens (cube of 150 x 150 x150 mm) were casted for 0% of hair content and tested on their 7th Day of Curing to be taken as areference. Readings on the UTM (Universal Testing Machine) were as follows:-

Specimen A = 220 KN
Specimen B = 210 KN
Specimen C = 240 KN

Average compressive strength = 11.55 + 10.22 + 11.11 / 3
= 10.96 N / mm^2

Table1: Readings of Compressive Testing for Conventional M20 Concrete

SPECIMEN	LOAD APPLIED BY UTM (KN)	COMPRESSIVE STRENGTH (N/mm^2)	AVERAGE COMPRESSIVE STRENGTH (N/mm^2)
A	230	10.22	10.96 N/mm^2
B	260	11.55	
C	250	11.11	

5.22 Split Tensile Test

Three specimens (cylinder of 150mm diameter and 300mm length) were casted for 0% of hair content and tested on their 7th Day of Curing to be taken as areference. Readings on the UTM (Universal Testing Machine) were as follows

Specimen A = 120 KN
Specimen B = 150 KN
Specimen C = 130 KN

Average Split Tensile Strength = 1.69 + 1.98 + 1.83 / 3
= 1.83 N/mm^2

Table2: Readings of Split Tensile Testing for Conventional M20 Concrete

SPECIMEN	LOAD APPLIED BY UTM (KN)	SPLIT TENSILE STRENGTH (N/mm^2)	AVERAGEE SPLIT TENSILE STRENGTH (N/mm^2)		
A	120	1.69			

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

B	150	1.98	1.83 N/mm^2		
C	130	1.83			

3 FOR 1% Hair

Table3: Readings of Compressive Testing for 1% hair

SPECIMEN	LOAD APPLIED BY UTM (KN)	COMPRESSIVE STRENGTH (N/mm^2)	AVERAGE COMPRESSIVE STRENGTH (N/mm^2)
A	260	11.55	12.14 N/mm^2
B	270	12.00	
C	290	12.88	

Table4: Readings of Split Tensile Testing for 1% hair

SPECIMEN	LOAD APPLIED BY UTM (KN)	SPLIT TENSILE STRENGTH (N/mm^2)	AVERAGE SPLIT TENSILE STRENGTH (N/mm^2)
A	140	1.98	2.16 N/mm^2
B	170	2.40	
C	150	2.12	

FOR 1.5% Hair

Table5: Readings of Compressive Testing for 1.5% hair

SPECIMEN	LOAD APPLIED BY UTM (KN)	COMPRESSIVE STRENGTH (N/mm^2)	AVERAGE COMPRESSIVE STRENGTH (N/mm^2)
A	270	12.00	13.33 N/mm^2
B	320	14.22	
C	310	13.77	

Table6 : Readings of Split Tensile Testing for 1.5% hair

SPECIMEN	LOAD APPLIED BY UTM (KN)	SPLIT TENSILE STRENGTH (N/mm^2)	AVERAGE SPLIT TENSILE STRENGTH (N/mm^2)
A	170	2.40	2.35 N/mm^2
B	170	2.40	
C	160	2.26	

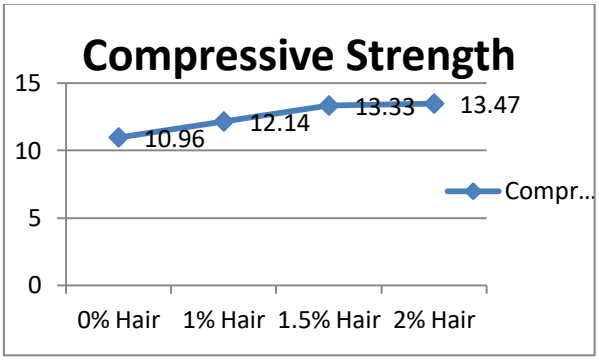
FOR 2% Hair:

Table7: Readings of Compressive Testing for 2% hair

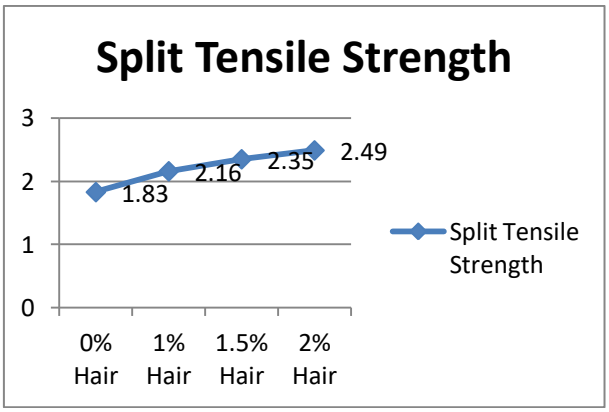
SPECIMEN	LOAD APPLIED BY UTM (KN)	COMPRESSIVE STRENGTH (N/mm^2)	AVERAGE COMPRESSIVE STRENGTH (N/mm^2)
A	310	13.77	13.47 N/mm^2
B	270	12.00	
C	330	14.66	

Table8 : Readings of Split Tensile Testing for 2% hair

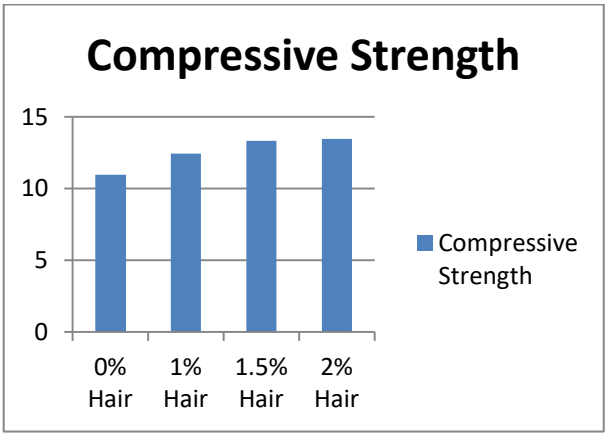
SPECIMEN	LOAD APPLIED BY UTM (KN)	SPLIT TENSILE STRENGTH (N/mm^2)	AVERAGE SPLIT TENSILE STRENGTH (N/mm^2)
A	160	2.26	2.49 N/mm^2
B	180	2.54	
C	190	2.68	



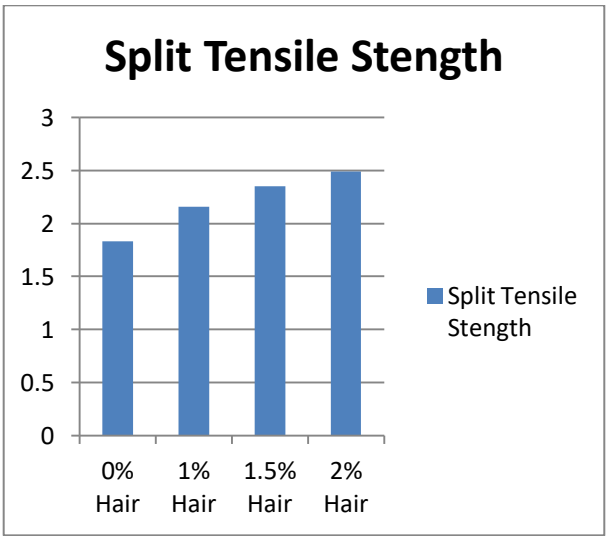
Graph5.1: Line Representation Of Compressive Strength



Graph5.2: Line Representation of Split Tensile Strength



Graph 5.3: Bar Representation of Compressive Strength



Graph 5.4: Bar Representation Of Split Tensile Strength

The graphs above show an increase in compressive strength by 10% in case of 1% hair, 21% in case of 1.5% hair and about 23% increase in case of 2% hair content.

Also an increase in Tensile Strength by 18% in case of 1% hair, 28% in case of 1.5% hair

And about 36% increase in case of 2% hair.

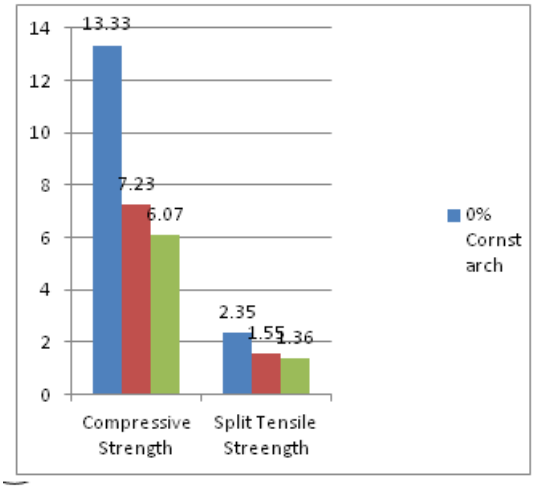
USING CORNSTARTCH WITH 1.5% OF HAIR

We will be using 1.5% of hair content because it will already be a lot of replacement of major component so as to balance the contents we'll be using 1.5%. As 1.5% of the total weight of the dry components constitutes of Hair and on addition to it we'll be adding two different percentages of corn starch as a replacement of cement in it and checking for both compressive and tensile strengths.

SPECIMEN WITH 3% OF CORNSTRACH

Table 5.9: Readings of Compressive Testing for 1.5% hair and 3% cornstarch

SPECIMEN	LOAD APPLIED BY UTM (KN)	COMPRESSIVE STRENGTH (N/mm^2)	AVERAGE COMPRESSIVE STRENGTH (N/mm^2)
A	150	6.66	7.23 N/mm^2
B	170	7.50	
C	170	7.50	



Split Tensile Test

Readings of Split Tensile Testing for 1.5% Hair and 3% Cornstarch

SPECIMEN	LOAD APPLIED BY UTM (KN)	SPLIT TENSILE STRENGTH (N/mm^2)	AVERAGE SPLIT TENSILE STRENGTH (N/mm^2)
A	100	1.41	1.55 N/mm^2
B	130	1.83	
C	110	1.55	

SPECIMEN WITH 5% OF CORNSTRACH

Table5.11: Readings of Compressive Testing for 1.5% hair and 3% cornstarch

SPECIMEN	LOAD APPLIED BY UTM (KN)	COMPRESSIVE STRENGTH (N/mm^2)	AVERAGE COMPRESSIVE STRENGTH (N/mm^2)
A	160	7.11	6.07 N/mm^2
B	120	5.33	
C	130	5.77	

Readings of Compressive Testing for 1.5% hair and 3% cornstarch

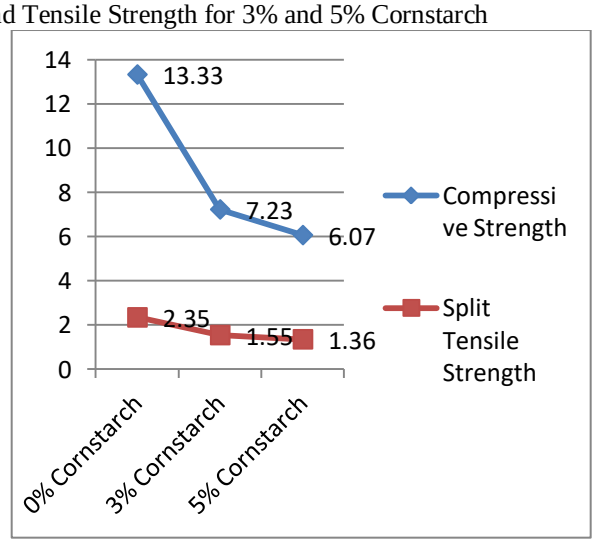
SPECIMEN	LOAD APPLIED BY UTM (KN)	COMPRESSIVE STRENGTH (N/mm^2)	AVERAGE COMPRESSIVE STRENGTH (N/mm^2)
A	160	7.11	6.07 N/mm^2
B	120	5.33	
C	130	5.77	

Split Tensile Test

Table 5.12: Readings of Split Tensile Testing for 1.5% Hair and 3% Cornstarch

SPECIMEN	LOAD APPLIED BY UTM (KN)	SPLIT TENSILE STRENGTH (N/mm^2)	AVERAGE SPLIT TENSILE STRENGTH (N/mm^2)
A	100	1.41	1.36 N/mm^2
B	90	1.27	
C	100	1.41	

Graph 1: Bar Graph representation of compressive and Tensile Strength for 3% and 5% Cornstarch



Graph 2: Line Graph representation of compressive and Tensile Strength for 3% and 5% Cornstarch

The graphs above depict that the compressive and tensile strength of the specimen has fallen

To almost half of the expected value which may be happened because of the major replacement of things from the fundamental Components of the concrete

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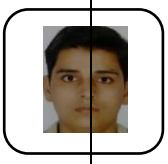
AUTHORS PROFILE

Lalit Kumar Assistant Professor Civil Engineering . Department JIMS Engineering Management Technical Campus Affiliated To GGSIPU University Delhi



Samad Mobin (Student) B-TECH Fourth Year JIMS Engineering Management Technical Campus Affiliated To GGSIPU University Delhi.

Akshit pathania (Student) B-TECH Fourth Year JIMS Engineering Management Technical Campus Affiliated To GGSIPU University Delhi.