AN EXPERIMENTAL STUDY ON THE BEHAVIOUR OF CONCRETE BY ADDITION OF BAMBOO AND ITS SPLIT TENSILE STRENGTH

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ABSTRACT:

Bamboo is one of the oldest building materials used by mankind. The bamboo culm, or stem, has been made into an extended diversity of products ranging from domestic household products to industrial applications. Examples bamboo products are food containers, skewers, chopsticks, handicrafts, toys, furniture, flooring, pulp and paper, boats, charcoal, musical instruments and weapons. In Asia, bamboo is quite common for bridges, scaffolding and housing, but it is usually a temporary exterior structural material. In many overly populated regions of the tropics, certain bamboos supply the one suitable material that is sufficiently cheap and plentiful to meet the extensive need for economical housing

KEYWORDS: Bamboo fibres, split tensile and compressive strength.

INTRODUCTION

Bamboo is a natural perennial grass-like composite and contains lingo-cellulosic-based natural fibers. Generally it occurs in the natural vegetation of many parts of tropical, subtropical and mild temperature regions, with about 1250 species identified throughout the world. It reaches its full growth in just a few months and reaches its maximum mechanical resistance in just few years.

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But if it is mixed with some durable material like concrete then its durability as well as the strength taking ability will be much higher. This study concentrates on the strength test of composite members made accompanied by bamboo. It determines the compressive strength of cubes made of bamboo concrete. Different mixing ratios are used for conducting the study.

LITERATURE REVIEW

Review on Feasibility of Bamboo in Modern Construction Gulshan Kumar, Deepankar Kr. Ashish.

With the modernization in construction industry and keeping in view the need of sustainable structures, especially in developing countries, requirement of replacement or alternative for traditional construction materials, such as steel, is rising its head. Considering the frequent tectonic activities around the globe, Bamboo seems to be an adequate replacement of steel for reinforcement in concrete. In Indian and Australian tectonic plate alone, 10 percent of world's seismic activities having magnitude M5 – M7 are observed on an average in a year. Also, with the type of explosion we are facing in terms of population increase, it is also required to provide economical and safer habitat to our common man.

"INVESTIGATION ON PROPETIES OF BAMBOO AS REINFORCING MATERIAL CONCRETE"

Harish Sakaray, N.V. Krishna togati (2012)

The various physical and mechanical properties of bamboo for using as reinforcement in concrete were investigated. In this study, authors tested bamboo specimens with a node at middle for the first series and specimens with at ¼ of length from end for the other series. The tensile, compressive, shear and

bond tests were conducted to assess the properties bamboo rods. The bamboo exhibited a uniform identical behavior like steel, both in tension and compression. The average strength of bamboo is about 125N/mm2 is reported from the investigation.

"STUDY ON THE MECHANICAL PROPERTIES OF THE BAMBOO FIBRE REINFORCED CEMENT COMPOSITE MATERIALS"

By Liu Yu Zjou, Aiguo (2011)

The concrete specimens with natural fibers were studied. The bamboo is cut in to 10mm,15mm and 20mm length fibers and mixed with concrete. The cubes were cast and tested for assessing the compressive strength. The study s extended with pre-treated and coated bamboo fibers. The author conclude that the rupture strength of the composite is increased by bamboo fibre and the pre-treatment improved the mechanical properties notably.

"PERFOMANCE EVALUTION OF BAMBOO TWIG AS A POTENTIAL REINFORCEMENT IN CONCRETE CONSIDERING TNSILE PROPERTY"

By Md. Ashan Sabbir (2012)

The study presented the use of bamboo twig as reinforcement in concrete. They investigated into the structure and purposes of strengthening the bamboo nodes. The mechanical properties of bamboo are evaluated in the study. The tensile strength test of bamboo twig specimen having three knots was performed. The stress-strain relation o bamboo twig specimen is observed linear till failure load and the modulus of elasticity of bamboo twig is lower than the steel

reinforcement. The knots is found to be weak point of bamboo which needs an enhancement technique.

"DURABILIY ANALYSIS OF BAMBOO AS CONCRETE REINFORCEMENT"

By Lima .H.C.et al.(2008)

The analysis investigated the durability of bamboo used for concrete reinforcement. The durability was evaluated by changing the tensile strength and young's modulus of bamboo. The bamboo culms let to dry and the divide into 3 sections of which they had used only the basal and intermediate part. The bamboo is splint in a solution of calcium hydroxide and under tap water. The tensile strength and young's modulus are found to be common and does not decrease. The bamboo average tensile strength is found to be 280Mpa with node.

"DURABILITY ANALYSIS OF BAMBOO AS CONCRETE REINFORCEMENT"

By Humberto C. Lima Jr AE Fabio L. Willrich AE Normando P. Barbosa AE Maxer A. Rose AE Burna S. Cunha

The experimental tests on the bamboo species Dendrocalamus giganteus showed that the bamboo tensile strength is comparable with the best woods used in constructions and even with steel. The tensile stress vs. strain curve of the bamboo is linear up to failure. Bamboo average tensile strength is approximately 280Mpa in the specimen without node 100Mpa in the specimen with node. Finally, 60 cycles of wetting and drying in solution of calcium

hydroxide and tap water did not decrease the bamboo tensile strength neither the young's modulus.

METHODOLOGY

1. RESOURCE COLLECTION

- Collection of raw materials
- Bamboo fibres

2. STUDY ON MATERIAS

- Sieve analysis on coarse and fine aggregates
- Specific gravity tests on coarse and fine aggregates

3. CASTING

- Casting of cubes and cylinders with normal mix and design mix

4. COMPRESSION TEST

- Initial test after 7 days of curing
- Test after 14 days of curing
- Test after 28 days of curing

5. SPLIT TENSILE TEST

- Test on cylinders for split tensile strength

6. COMPARISION

- Tabulation of results
- Comparing the results of normal mix with design mix

7. CONCLUSION

- Concluding the above results and verifying the usage of bamboo as FIBER in concrete design

8. REPORT

- Providing the theoretical report of the project with the tabulation of the results

• SIEVE ANALYSIS FOR 20mm AGGREGATE

- **AS PER IS 460:1962**
- WEIGHT OF SAMPLE TAKEN = 4500gms

IS SIEVE SIZE (mm)	WEIGHT RETAINED (gm)	PERSENTAGE OF WEIGHT RETAINED (%)	PERSENTAGE OF CUMMULATIVE WT. RETAINED (%)	PERSENTAGE OF CUMMULATIVE WT. PASSING (%)	SPECIFICATION LIMIT AS PER IS 460:1962
40	0	0	0	0	100
20	240	5.33	5.33	94.67	85-100
10	4220	93.77	99.10	0.9	0-20
4.75	30	0.66	99.76	0.24	0-5
PAN	10	0.22	100	0	0

• SIEVE ANALYSIS FOR FINE AGGREGATE

- **AS PER IS 460 : 1962**
- WEIGHT OF SAMPLE TAKEN 2000gms

IS SIEVE SIZE (mm)	WEIGHT OF RETAINED (gms)	PERSENTAGE OF RETAINED (gms)	PERSENTAGE OF CUMMULATIVE RETAINED (%)	PERSENTAGE OF CUMMULATIVE PASSING (%)	SPECIFICATION LIMIT
10	0	0	0	100	100
4.75	28	1.40	1.40	98.60	92-100
2.36	230	11.50	12.90	87.10	75-100
1.18	320	16.00	28.90	71.10	55-90
0.60	405	20.25	49.15	50.85	35-39
0.30	510	25.50	74.65	25.35	8-30
0.15	476	23.80	98.45	1.55	0-10
PAN	31	0	0	0	0

- **SPECIFIC GRAVITY TEST ON 20mm AGGREGATE**

S.NO	DESCRIPTION	TEST SAMPLE (1)	TEST SAMPLE (2)
1	Weight of empty pycnometer (w1)	652	652
2	Weight of pycnometer and dry aggregate (w2)	1772	1761.5
3	Weight of pycnometer, dry aggregate and water (w3)	2245	2235.5
4	Weight of pycnometer and water (w4)	1533	1533
	Specific gravity	2.74	2.61

AVERAGE SPECIFIC GRAVITY =2.67

- **SPECIFIC GRAVITY TEST ON FINE AGGREGATE**

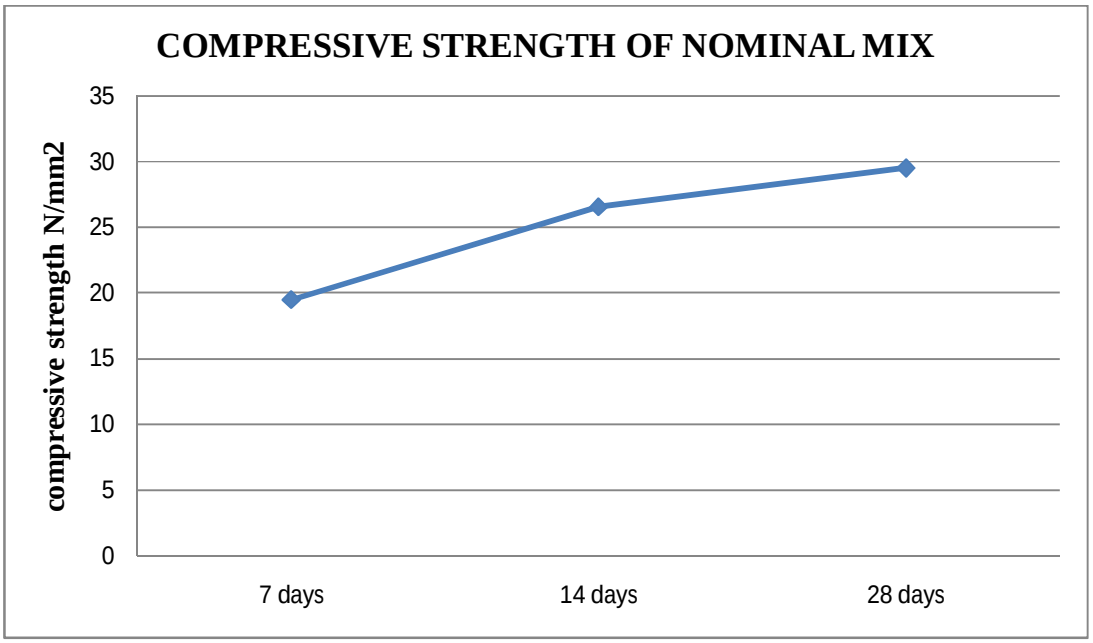
S.NO	DESCRIPTION	TEST SAMPLE (1)	TEST SAMPLE (2)
1	Weight of Empty pycnometer (w1)	**652**	**652**
2	Weight Of Pycnometer and Dry aggregate(w2)	**1336**	**1333**
3	Weight of Pycometer, Dry aggregate and Water(W3)	**1953**	**1957**
4	Weight of Pycnometer and Water (w4)	**1533**	**1533**
	SPESIFIC GRAVITY	**2.59**	**2.65**

AVERAGE SPECIFIC GRAVITY = 2.62

- **FORMULA FOR SPECIFIC GRAVITY**
- **S = (W2-W1)/(W4-W1)-(W3-W2)**
- Where,
- **S –** specific gravity of a material
- **W1** – Weight Of Empty Pycnometer (in gms)
- **W2** – Weight Of Pycnometer And Dry Aggregate (in gms)
- **W3 –** Weight Of Pycnometer, Dry Aggregate And Water (in gms)
- **W4 –** Weight Of Pycnometer And Water (in gms)

COMPRESSION TEST RESULTS ON NOMINAL MIX CUBES

S.NO	MARK	AGE IN DAYS	LOAD AT FAILURE (KN)	COMPRESSIVE STRENGTH (N/MM2)	AVG COMPRESSIVE STRENGTH (N/MM2)
1	0	7	440	19.49	25.203
2	0	14	598	26.58	
3	0	28	664	29.54	

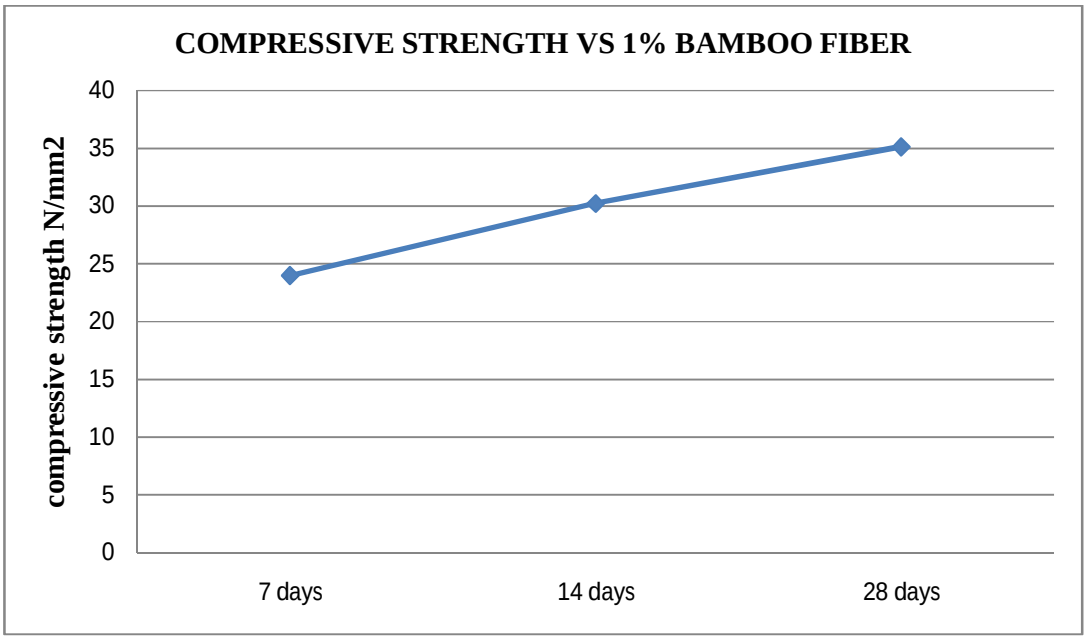


DISCUSSIONS:

- Compressive strength of nominal mix at 28 days is 29.54 N/SQ.MM

COMPRESSION TEST RESULTS OF 1%BAMBOO FIBRE MIXED CONCRETE

S.NO	MARK	AGE IN DAYS	LOAD AT FAILURE (KN)	COMPRESSIVE STRENGTH (N/MM2)	AVG COMPRESSIVE STRENGTH (N/MM2)
1	15F-1B	7	540	24.00	29.78
2	15F-1B	14	680	30.22	
3	15F-1B	28	790	35.12	



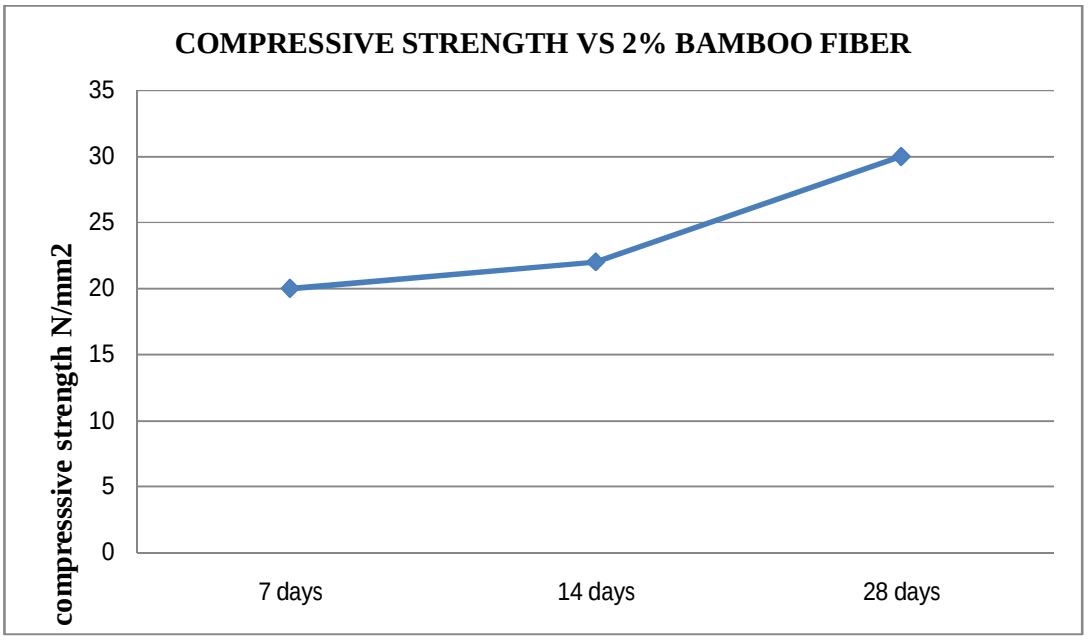
DISCUSSIONS:

Compressive strength of concrete has increased to 35.12 N/sq.mm at 15% flyash and 1% bamboo fibre

It has given better compressive strength at 28 days when compared to nominal mix of concrete

COMPRESSION TEST RESULTS 2%BAMBOO FIBRE MIXED CONCRETE

S.NO	MARK	AGE IN DAYS	LOAD AT FAILURE (KN)	COMPRESSIVE STRENGTH (N/MM2)	AVG COMPRESSIVE STRENGTH (N/MM2)
1	15F-2B	7	450	20.00	24.00
2	15F-2B	14	495	22.00	
3	15F-2B	28	675	30.00	



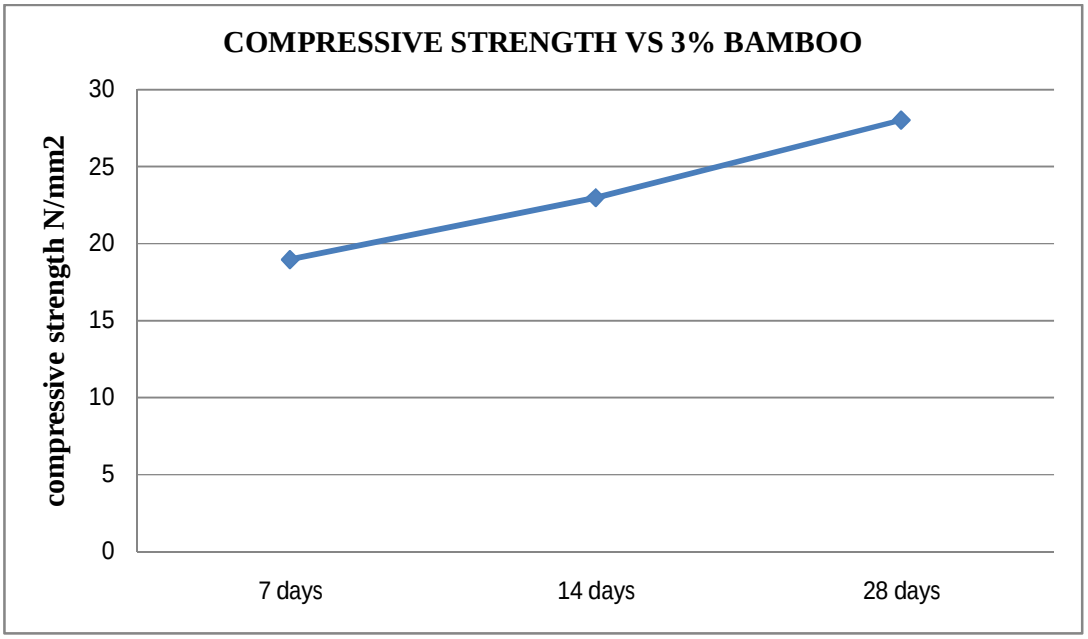
DISCUSSIONS:

The compressive strength of concrete has decreased to 30.00 N/sq.mm at 28 days with 2% bamboo fibre

It is observed that compressive strength has decreased drastically when 2% of bamboo fibre is added in the mix

COMPRESSION TEST RESULTS OF 3%BAMBOO FIBRE MIXED CONCRETE

S.NO	MARK	AGE IN DAYS	LOAD AT FAILURE (KN)	COMPRESSIVE STRENGTH (N/MM2)	AVG COMPRESSIVE STRENGTH (N/MM2)
1	15F-3B	7	427	18.97	23.31
2	15F-3B	14	517	22.97	
3	15F-3B	28	630	28.00	



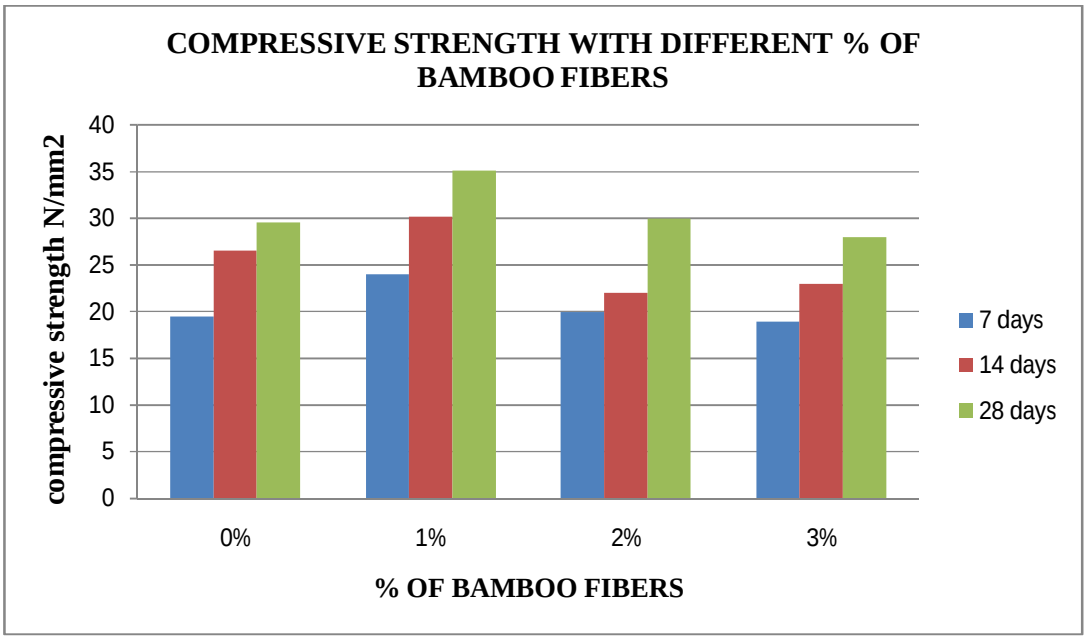
DISCUSSIONS

The compressive strength of concrete has decreased to 28.00 N/sq.mm at 28 days with 3% bamboo fibre

It is observed that compressive strength has decreased drastically when 3% of bamboo fibre is added in the mix

COMPARSION ON CUBE COMPRESSION TEST RESULTS

S.NO	FIBRE CONTENT	7 DAYS COMPRESSIVE STRENGTH	14 DAYS COMPRESSIVE STRENGTH	28 DAYS COMPRESSIVE STRENGTH
1	0	19.49	26.58	29.54
2	1	24.00	30.22	35.15
3	2	20.00	22.00	30.00
4	3	18.97	22.97	28.00

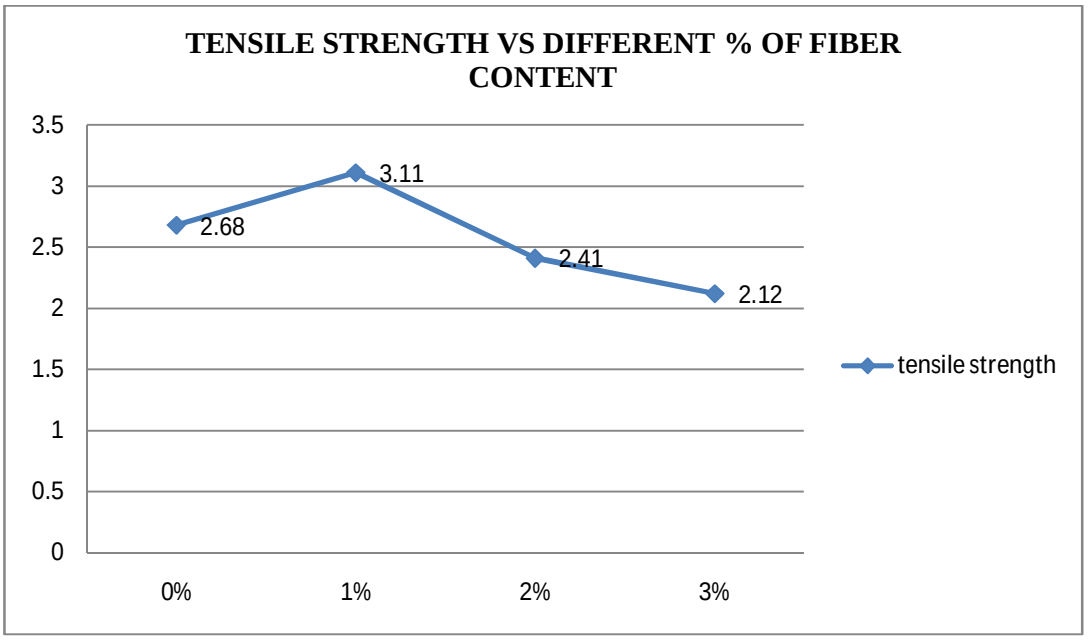


DISCUSSIONS

Finally,by comparing the different percentages of bamboo fibres ,compressive strength of concrete with 1% bamboo fibre has given greater strength at 28 days i.e, 35.12 N/sq.mm

SPLIT TENSILE RESULTS ON CYLINDER

S.NO	MARK	FIBRE CONTENT (%)	LOAD AT FAILURE (KN)	TENSILE STRENGTH (N/MM2)
1	CY0	0	190	2.68
2	CY 1	1	220	3.11
3	CY2	2	170	2.41
4	CY3	3	150	2.12



DISCUSSIONS

- The cylinder split tensile strength increases by 14% for 1% addition of bamboo fibers to concrete when compared.
- The cylinder split tensile strength has decreased when addition of bamboo fibers exceeds

CONCLUSION

Based on the experimental study done on the behavior of concrete by addition of bamboo as FIBRE, the following conclusion was drawn

- The cube compressive strength increase by nearly 18% when 1% of bamboo fiber is added in the mix
- It is found to decrease drastically by 1% to 5% of compressive strength for 2% addition of bamboo fiber when compared to the conventional concrete specimen.

- It is found to decrease drastically by 1% to 4% of compressive strength for 3% addition of bamboo fibers when compared to conventional concrete specimen.

- The cylinder split tensile strength increases by 14% for 1% addition of bamboo fibers to concrete when compared.
- The remaining addition of fibers shows a decreased value when compared to conventional concrete specimen.
- It is also an environmental friendly method since the availability of bamboo is in abundance and can be put to a greater use.
- Hence it has paved a path for an exclusive study of fly ash and bamboo as fiber in the concrete technology.

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