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# EXPERIMENTAL INVESTIGATION AND COMPARISON ON MECHANICAL PROPERTIES OF RCC COLUMN WITH KENAF AND BASALT FIBRE WRAPPING

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**Abstract -** *Now- a- days, fibers play a vital role in our developing construction field. The fiber reinforced concrete structures are used to increase the strength of concrete members. The fibers are naturally available material which is used to improve the life period of concrete structure by using the fibre in concrete. Recent technique such as fibre wrapping is introduced to improve the strength of concrete member. This wrapping technique can also used to improve the strength of existing building. This investigation is based on the comparison of the mechanical properties of kenaf fiber and basalt fiber. Kenaf fibre is a natural fibre and basalt fibre is a synthetic fibre. They are economical when compared to other fibers. These fibers have high corrosion resistance and thermal resistances; its tensile strength is 3 times higher than steel. It is good in both compression and tension. This fibres can be used in repair and rehabilitation work. Ultimate aim of this project is to increase the lifespan of RCC column in the building.*

**Keywords**: kenaf, basalt, fabric fibre, natural fibre, synthetic fibre, RCC column, fibre wrapping.

## 1.0 INRODUCTION

Fibres used in construction may be natural as well as synthetic. Both plays an important role. Natural fibres are those obtained from the plants or trees. Some of the natural fibres are kenaf fibre, banana fibre, etc., synthetic fibres are those made by humans by artificial manner. Some synthetic fibres are kevlar, basalt, nylon, etc.,

### 1.1 KENAF FIBRE

Kenaf is one of the natural fibre which is obtained from the plant. Kenaf which Scientific name is Hibiscus cannabinus. It is a plant in the family of malvaceae and it is also called deccan hemp and java jute. The fibres in kenaf are obtained in the bark (long fibre) and core (short fibre) of the plant. The important source of fibre for composites and well known as a cellulosic source with economic and ecological advantages.

### 1.1.1 STRUCTURE OF FIBRE

Kenaf plant consists of two parts. The outer part is called bast and it consists of 40% of stalk dry weight. White inner part is called core and it consists of 60% of dry weights.

**Fig 1 :-** (courtesy Google) KENAF FIBRE

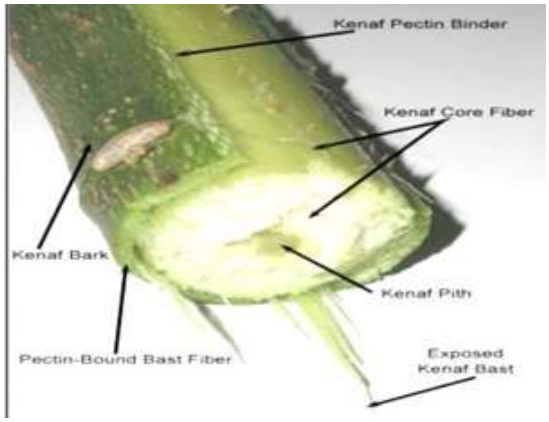


**Fig 2 :-** (courtesy Google) KENAF PLANT STRUCTURE

### 1.1.2 COMPOSITION

The main constituent of plant fibre is cellulose of that plant. It is an important structural component of the primary cell wall of green plants. Cellulose percentage - 44 to 55%, Hemi cellulose - 21%, Pectine- 2%, Lignin percentage- 15 to 19%.

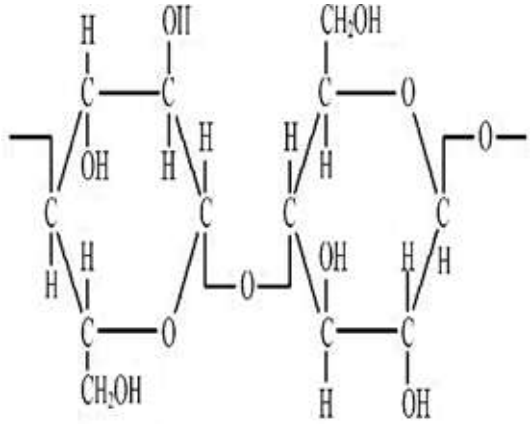

**Fig 3:-** (courtesy Google) CELLULOSE STRUCTURE

### 1.1.3 PROPERTIES OF KENAF FIBRE

The length of the fibre is from 2.6mm to 4mm, its diameter is from 17 to 21.9 micron, the density of the fibre is 1.4 g/cm3 and its elongation percentage is 1.6%. The tensile strength of kenaf fibre is 350-600 MPa and its elastic modulus is 40,000 MPa.

### 1.1.4 KENAF FABRIC FIBRE

Kenaf fibres are woven together to form a fabric material. It is used to wrap around the column of the building. It possess high mechanical properties such as high modulus of elasticity, tensile strength, and flexural strength.

**Fig 4 :-** KENAF FABRIC FIBRE

### 1.2 BASALT FIBRE

Basalt is also a natural fiber available extensively. The molten basalt is extruded through small nozzles to produce continuous filaments of basalt. The fiber is thicker and widely used for textile applications mainly for production of woven fabric. These fibers are used in filament winding, and also used in substitutes for traditional steel rebar in construction.

**Fig 5:-** (courtesy Google) BASALT FIBRE

### 1.2.1 STRUCTURE OF BASALT FIBRE

The basalt fibre is typically have a filament diameter of 10 and 20 µm. They also have a high elastic modulus, resulting in high specific strength.

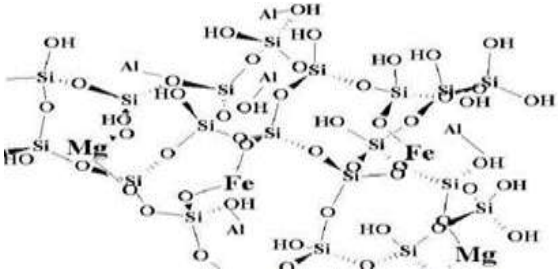

**Fig 6:-** (courtesy Google) BASALT STRUCTURE

### 1.2.2 PROPERTIES OF BASALT FIBRE

The fibre having tensile strength of 2.8-3.1GPa , its elastic modulus is 85-87, its elongation at break is 3.15% and its density is 2.67

### 1.2.3 BASALT FABRIC FIBRE

The basalt fibre is woven together to form a basalt fabric fibre.

**Fig 7:-** (courtesy Google) BASALT FABRIC FIBRE

### 2.0 STUDY ON FIBRES

1.In the review of kenaf reinforced composites(2011), H.M.Akil, et al, said that Natural fibres used as a reinforcement in polymer matrix composites (PMCs). The kenaf fibre exhibits higher strength values in terms of tensile and flexural properties.

2.In the review of kenaf fibre reinforced composites(2015),V.R.Ramanbharath, et al, said that It review the properties and applications of kenaf fibre reinforced composites to provide platform for further research in this area. The kenaf fibre have very high strength and are associated with less waste disposal problems.

3.In the review paper of experimental investigation on basalt fibre reinforced concrete :a review(2018) by s.k.krithika, et la, reviewed that Addition on 0.75 percent of basalt fibers to the concrete the compressive flexural strength, splitting tensile strength were investigated.

4.In the review paper of effect of basalt fibres on the mechanical properties and microstructure of high performance fiber reinforced concrete:a review(2014) by Nasir shafiq, et la, said that Replacing 10 percent of cement with silica fume and addition of basalt fibers. The flexural strength, tensile strength are determined.

## 3.0 MATERIAL COLLECTION

1. Cement -OPC 43 grade

2. Fine aggregate - M sand (size less than 4.75mm)

3. Coarse aggregate - size 20mm

4. steel- Fe 415 of 12mm and stirrups of 8mm

5. Kenaf fibre - mat fabric fibre form of 1sq. m

6. Basalt fibre - mat fabric fibre form of 1sq.m

**Fig 8:-** MATERIAL COLLECTION

## 4.0 TESTING OF MATERIALS

### 4.1 CEMENT TEST

**TABLE 1-** CEMENT LAB TEST

| S. NO. | NAME OF THE TEST | RESULT |
|---|---|---|
| 1 | Specific gravity test | 2.9 |
| 2 | Consistency test | 5mm |
| 3 | Setting time test | |
| | Initial setting time | 30 minutes |
| | Final setting time | 10 hours (600minute) |

### 4.2 FINE AGGREGATE TEST

**TABLE -2** FINE AGGREATE TEST

| S.NO | NAME OF THE TEST | RESULT |
|---|---|---|
| 1 | Specific gravity test | 2.19 |
| 2 | Fineness modulus test | 5.1% |
| 3 | Site-slit test | 13% |

### 4.3 COARSE AGGREGATE TEST

**TABLE -3**COARSE AGGREGATE TEST

| S.NO. | NAME OF THE TEST | RESULT |
|---|---|---|
| 1 | Specific gravity test | 2.8 |
| 2 | Water absorption test | 3% |
| 3 | Impact test | 18.06% |
| 4 | Crushing strength test | 17.15% |

## 5.0 MIX DESIGN:

Mix design can be defined as the process of selecting ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible.

**TABLE -5** MIX DESIGN

| DESCRIPTION | W/C RATIO (Kg/m³) | CEMENT (Kg/m³) | FINE AGGRE -GATE (Kg/m³) | COARSE AGGREGATE (Kg/m³) |
|---|---|---|---|---|
| Quantity (kg) | 186 | 394.32 | 669.527 | 1159.61 |
| Mix ratio | 0.5 | 1 | 1.698 | 2.940 |

## 6.0 TESTING OF COMPANION SPECIMEN

The specimen testing is mainly to identify whether the usage of M-sand provide good compressive strength or not. The cube specimen of size 15x15x15 cm is used.

**Fig 9:-** CUBE SPECIMEN

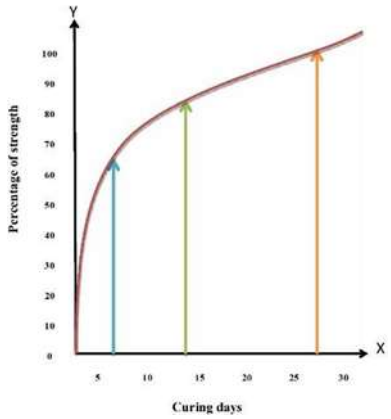


**Fig 10-** COMPRESSIVE STRENGTH OF CUBE SPECIMEN

## 7.0 CASTING OF RCC COLUMN AND WRAPPING BY FIBRE

The column of cross section 230x230 mm and height of 60cm is casted using M-sand. The column is casted by using longitudinal bar of diameter 12mm in 4 nos. and stirrups of diameter 8mm at 150mm c/c as shown in fig-4.The column is allowed for curing of 28 days. After curing, the process of fibre wrapping is started. Before that the resin must be prepared to paste the fibre around the column. The resin is prepared by mixing epoxy resin with thinner and hardner. If epoxy resin is added by 100 litre then thinner and hardner is added by 5 litre respectively. Stir the mix properly. With the help of brush, the resin is applied on the column and the fabric is properly placed over the column. After pasting the fabric on the column, it is allowed to dry for 1 day. When the fabric is dried, the column is ready for testing.

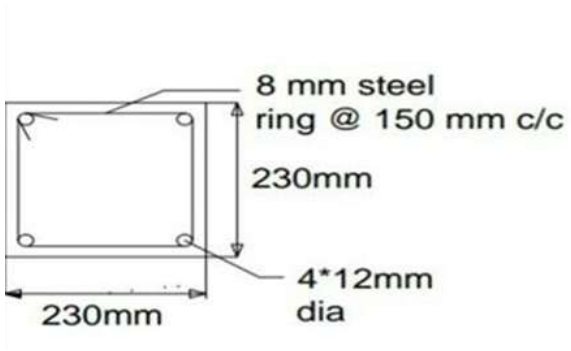


**Fig 11 :-** (courtesy Google) C/S OF RCC COLUMN

## 8.0 TESTING OF COLUMN SPECIMEN

In our project, we cast three columns. Two columns are wrapped by fibers such as kenaf and basalt respectively and one column is conventional. All three Columns are tested in universal testing machine (UTM) to obtain the strength of concret

**Fig - (8) Fig - (9)**

**Fig-12 –** basalt fibre wrapped column in UTM

**Fig-13 –** kenaf fibre wrapped column in UTM

## 9.0 RESULT AND DISCUSSION

Finally testing on the column shows that the wrapping gives the higher strength than the conventional one.

- It shows that the wrapping concept provides the better strength to the existing building. Obtaining result is mainly depend upon the isometric and orthometric properties of concrete as well as the fabric material.
- Aspect ratio concept very helpful for increasing the strength of the column. Here, the epoxy resin plays an important role to create the bond between the column and the fibre.

- The result shown from the respected graph shows that the kenaf wrapped column provides two times of strength than the conventional column.
- And the basalt wrapped column provides three times of strength than the conventional column.
- In comparing the two fibres such as kenaf and basalt, the basalt fibre possess high strength than the kenaf fibre.

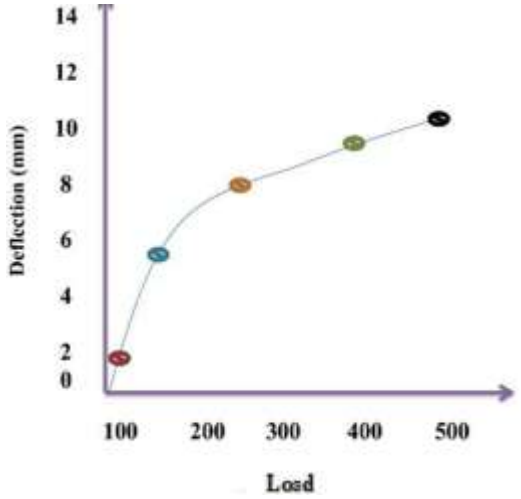


**fig-14** LOAD-DEFLECTION GRAPH OF KENAF FIBRE

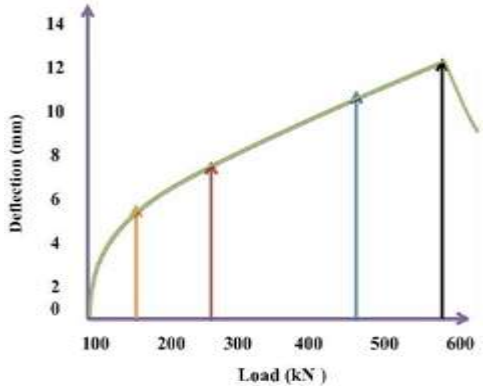


**fig -15** LOAD-DEFLECTION GRAPH OF BASALT FIBRE

## 10.0 CONCLUSIONS

As we conclude that the fabric fibre provide the better strength to the structure.

- In recent years, the fibre have been played an important role. But the fabric is not highly implemented in our constructional field.
- Through this project we exposed that fabric form is really have to work and provide strength to column as well as the existing structure.
- The wrapping concept is effective one and economical and key role of environmental useful for the constructional purposes mainly subjected to column construction.
- Based on the isometric property the material can easily bonded by using epoxy resin.
- It proves that the fabric form is heat resistance, corrosion resistance and provide mechanical strength to the structure.
- This concept mainly involved in repair and rehabilitation of structure and it shows effectiveness and high efficiency than replacement process. This application mainly involved in earthquake resisting building and marine structures and coastal areas mainly implement for steel structures.

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