

# STUDY ON WORKABILITY AND COMPRESSIVE STRENGTH PROPERTIES OF JUTE FIBRE COMPOSITE CONCRETE

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**ABSTRACT:** The primary intention of this work is to scrutinize the ability of concrete by utilizing of raw jute fibre and additionally utilizing fly ash as partial substitute of cement and examine the traits or tendencies of concrete. The natural raw jute fibre is an influential material in concrete blend as reinforcement and which is not only ponder a way to edify the properties of concrete, it will also ponder the utilization of jute fibre without any treatment and restrict the use of polymer which is environmentally deleterious. The unique percentages of raw jute fibre used in concrete is 0.1%,0.3% and 0.6% of volume of concrete with different lengths that is 12 mm,16 mm and 22 mm which is cutted manually by scissor or by any other cutting tools. To implement this aim, an experimental study of compressive strength test of raw jute fibre concrete composites has been conducted. 90 cubes of standard dimension has been made with different percentages and different lengths of raw jute fibre and 30% replacement of cement with fly ash were added in M20 concrete for different water binder ratio 0.45,0.53 and 0.58. The workability test has been done for 0.45, 0.53 and 0.58 water binder ratio with different volume and lengths of jute fibre. The strength tests have also been conducted after 28 days by using appropriate testing apparatus in the laboratory.

**INDEX TERMS -** Jute fibre, Fly ash, Reinforcement, Polymer, Compressive strength, M20 concrete.

## 1. INTRODUCTION

Concrete is a union of cement as binding material, fine and coarse aggregate as filler material and water. Concrete is strong as stone, that is because of chemical reaction among cement and water. Concrete is the product which can be moulded to any shapes with help of moulds and can be easily casted. But the concrete is weak in tension and strong in compression hence it is necessary to provide reinforcement bars which are strong in tension. Now a day it is difficult task to dump the waste materials like slag, fly ash etc. which is produced from factories and which cause pollution. Hence by using these materials as partial replacement of conventional material, we can minimize above problem up to certain limit. Not only factory outlet we can use materials which are existed in nature like natural fibres, coconut shells etc. which is easily available, environment friendly and also economical. The natural fibres act as reinforcement in concrete such as coconut coir fibre, sisal fibre, jute fibre, banana fibre, hemp fibre, kenaf fibre etc. In our project among the above fibres, jute fibres are used as reinforcement which is stiff and strong in tensile strength and flyash used as a partial substitute of cement. The object of this project is to know the compressive strength and workability characteristics of concrete by using different percentage of raw jute fibre with different lengths and in combination with flyash as a partial substitute of cement to study the properties and behavior of concrete. Jute fibre is soft and shiny vegetable fibre and it is also called as golden fibre. These fibres are strong threads which is available from 1-4 meters in length and 17-20 micron in diameter. Jute fibres are made mainly of plant material cellulose, lignin and pectin. Both fibre and plant from which produce are commonly called jute. Jute is a type of a crop which grown in stagnant water and it needs alluvial soil, enormous rainfall that is weekly 5 to 8 centimeter of rainfall and also during sowing period more water is required. During monsoon season this crop grown in wet and warm climate. For fruitful or satisfied cultivation it requires temperature from 20 to 40 degree Celsius. The huge or bulk cultivation of raw jute is in the Bangladesh. In India, raw jute cultivate mainly in eastern states such as Meghalaya, Bihar, and West Bengal, Assam etc. Half of the production or 50% production is from West Bengal. 76 Jute mills are there in India and in these mills approximately 137679(October 2001) people are working. Greater than 90% seed productions were from Maharashtra and Andhra Pradesh. Jute fibre having more tensile strength, moderate heat, lower extensibility, fire resistance, eco-friendly and biodegradable.



Fig 1.1 12mm length



Fig 1.2 16mm length



Fig 1.3 22mm length

## 2. OBJECTIVES

### 2.1 The main objectives of this project are as follows:

- To study the workability properties of concrete of different water binder ratio along with different volume and lengths of raw jute fibre.
- To scrutinize and study the compressive strength of concrete.
- Comparing the strength of jute fibre concrete with conventional concrete.
- To examine the behavior or traits of concrete with unique percent and lengths of raw jute fibres.
- To know the properties of concrete with inclusion or addition of flyash, this replaces some part of cement.
- To study the effect of variation of raw jute fibres with flyash in concrete.
- To find out the optimum percentage of raw jute fibre.

## 3. LITERATURE REVIEW

### 3.1 General

This phase represents the view of studies which involves work on the jute fibre reinforced concrete. Hence we need to study in detailed by using with different proportions, different lengths and different material. Following are some reviews which are need to improve our project.

### 3.2 Literature survey:

[1] **T. Sai Vijaya Krishna and B. Manoj Yadav (September 2016):** In this research to know the mechanical properties, flexure, tensile and crushing strength tests were done. The nominal M20 grade concrete of 1:1.5:3 concrete mixes were made with constant w/c ratio (0.50). The varying proportions 0.5, 1 and 2% jute fibre of volume of concrete were added in concrete mix. The locally available jute fibre without any treatment by chopping 25-30 mm was used in this research. The casted cubes, cylinders, and prisms are then cured for different periods of 7, 28, 56 and 90 days. It is ascertain that the workability of concrete drops down by increasing the jute dosage, for this reason admixture is require to enhance the workability of concrete. The crushing strength of concrete decreased with increasing the jute content at 7 and 28 days. The crushing strength increased up to 1% of jute content and decreased with further increase of jute content at 56 and 90 days. Flexure and tensile strength of concrete increased up to 1% of jute content and decreased with further increase of jute fibre dosage.

[2] **Rahul R. Kshatriya, Vikas L. Kumavat, Mansi S. Kothalkar, Chetan C. Chaudhary, Roshan A. Khode, Chetan N. Mahale, and Sanyogita S.Pawar (March 2016):** In this project, the flexure, tensile and compressive strength test of concrete by using jute fibre were compared with and without treatment of jute fibre. The jute fibre were cutted to 6 cm length and kept in alkali solution for 24 hours and then it washed with distilled water to remove excess alkali from fibre surface and then jute fibre dried for 24 hours at room temperature. The M40 grade concrete were made with constant w/c 0.4 and the proportion of concrete mix is 1:1.44:2.35. Here the jute fibre is used to replace by 1% of weight of cement. It is observed that the raw jute fibre added in concrete by 1% of weight of cement, the compressive strength increased by 17.5% and with treatment the compressive strength increased by 26.5%. For split tensile strength increased by 7% and with treatment of jute fibre it is increased by 9%. Similarly for flexure strength it is increased by 1% and by adding jute fibre with treatment the flexure strength increased by 4%.

[3] **Pooja warke and Shrinkhala Dewangan (May- June 2016):** In this study four mixes of concrete were done of M20 grade concrete with constant water cement ratio 0.5. The different proportions of jute fibres were used that is 0%, 0.2 %, 0.3% and 0.4%. In this project test was done on cubes for crushing strength at 3, 7 and 28 days. It can be seen that by adding 0.2% fibre cement ratio, the compressive strength decreases where by adding or inclusion of 0.3% fibre cement ratio, the compressive strength decreased than the 0.2% fibre cement ratio and increases when compared to 0.4% fibre cement ratio. Here the raw jute fibre is used without any treatment.

[4] **Mr.S.Sabarath, D.Devaraj, M.Jeyamani, D.Priyadharshini (March 2017):** This paper describes the strength test like crushing strength and split tensile strength of concrete by using jute fibre, in this research M30 grade concrete were made with constant water cement ratio that is 0.45. The ratio of mix proportion is 1:1.57:2.69. In this work four different percentage of jute fibre were added in concrete that is 0.5%, 1%, 1.5% and 2%. It concluded that the crushing and tensile strength of jute fibre reinforced concrete is increases progressively by increasing the percentage of jute fibre with water cement ratio 0.45.

[5] **Priyanka Goel, Mohd. Usman, Sandeep Panchal (July 2017):** In this research, the affect of jute fibre in concrete, and also the strength and ductility properties of concrete were analyzed. The different dosage of jute fibre added in the concrete they were 0%, 0.25%, 0.5% and 1% of volume of concrete. The compression strength and flexure strength test were done after curing of specimen at 28 days, to recognize the strength of concrete. From this paper the high content of jute fibre in concrete mix reduces unit weight and workability and also there will be decrease in compression strength of concrete. There will be increase in ductility after cracking of concrete and rapid crack arrested by fibre and also increases the strain life.

[6] **Mohamad Zakari, Masud Ahmed, Md Mohamed Hoque and Shafqul Islam (2016):** This research carried out by using locally available raw jute fibre without any treatment. The raw jute fibre cutted manually by scissor in four different lengths that is 10 mm, 15 mm, 20

mm and 25 mm which is used in concrete mix. Here they done experiments on two different grades of concrete and two different water cement ratio they were M15 and M20 and 0.6 and 0.55 respectively. They conducted strength tests on cubes, cylinders and prisms of standard dimensions in universal testing machine after 28 days of curing. In this research the different dosage of raw jute fibre used that 0%, 0.1%, 0.25%, 0.5% and 0.75% volumetric content. After studying, in this paper it is found that the crushing strength of concrete specimens is increased 15% for 15mm fibre length with 0.10% dosing in 1:1.5:3 mix ratio and 10% strength increment observed with same length and dosage for 1:2:4 ratio. For flexure strength of concrete prism were increased 22 to 14% for 15 mm length of 0.10% dosage in 1:1.5:3 and 1:2:4 respectively. In split tensile strength test, it can be observed that 35% strength increment for 15 mm with 0.10% dosage in 1:1.5:3 mix ratio. Finally they concluded that 0.1 and 0.25% content of jute fibre and fibre length of 10 and 15mm raw jute fibre enriches the result for strength properties of concrete composites.

#### 4. WORKABILITY TEST ON FRESH CONCRETE

##### 4.1 General

The following table shows the slump values which are observed or obtained from our project work. The slump test is conducted on a different water binder ratio with different percentage of jute fibre content with different length.



Fig 4.1 For 0.48 w/b ratio



Fig 4.2 For 0.53 w/b ratio



Fig 4.3 For 0.58 w/b ratio

Table 4.1 Slump results for 0.48 W/B ratio

Percentage of jute fibre	Length of the jute fibre in mm	Slump value in mm
0%	0	90
0.1%	12	79
	16	76
	22	75
0.3%	12	73
	16	72
	22	65
0.6%	12	60
	16	62
	22	55

**Table 4.2 Slump results for 0.53 W/B ratio**

Percentage of jute fibre	Length of the jute fibre in mm	Slump value in mm
0%	0	93
0.1%	12	80
	16	77
	22	76
0.3%	12	74
	16	72
	22	71
0.6%	12	68
	16	65
	22	62

**Table 4.3 Slump results for 0.58 W/B ratio**

Percentage of jute fibre	Length of the jute fibre in mm	Slump value in mm
0%	0	105
0.1%	12	90
	16	79
	22	78
0.3%	12	76
	16	75
	22	72
0.6%	12	70
	16	67
	22	64

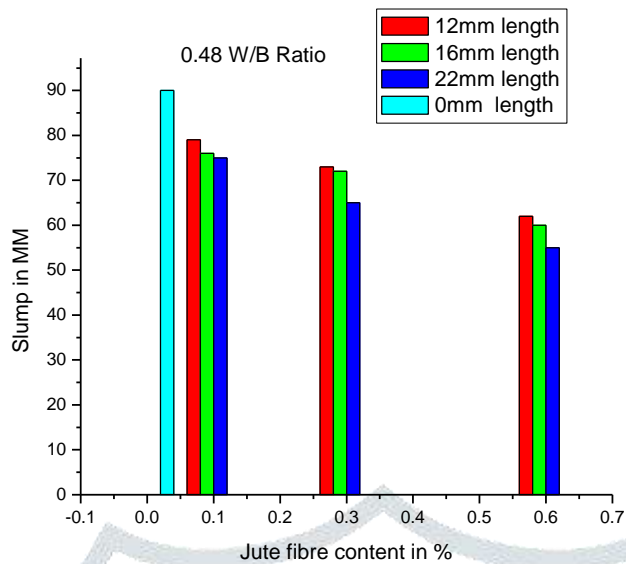


Fig 4.4 Graph shows the slump value against jute fibre content for 0.48 W/B Ratio

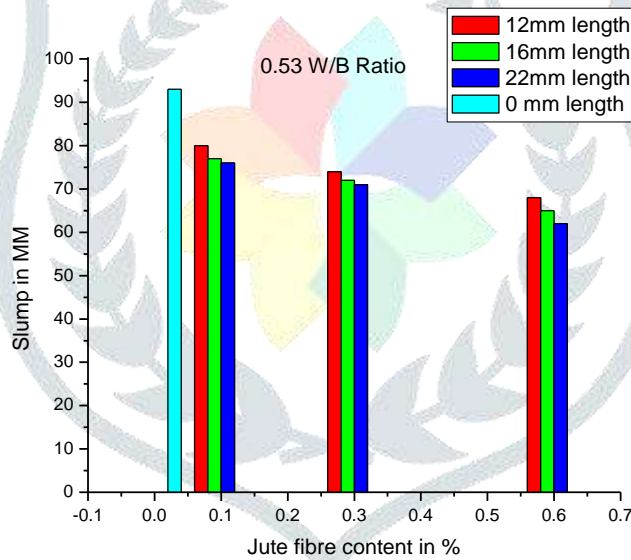
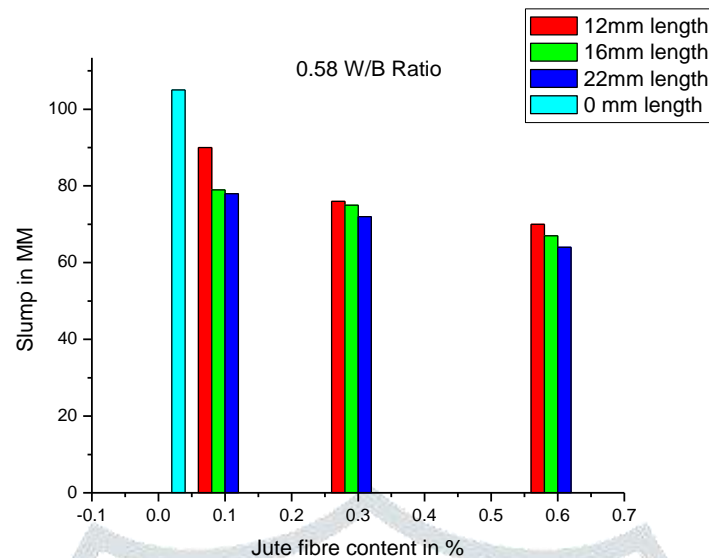


Fig 4.5 Graph shows the slump value against jute fibre content for 0.53 W/B Ratio



**Fig 4.6 Graph shows the slump value against jute fibre content for 0.58 W/B Ratio**

- From the table 4.1, 4.2 and 4.3, it is observed that the workability has been increased along with increasing w/b ratio.
- Above fig 4.4, 4.5 and 4.6 shows the graph of slump value against jute fibre content for different w/b ratio.
- It can be seen that by increasing the volume of jute fibre in concrete reduces the workability. This is due to water absorption nature of jute fibres.
- By increasing the length of jute fibres the workability characteristics of concrete also decreases due to stiff mix.

## 5. RESULTS AND DISCUSSION

### 5.1 Compressive strength:-



**Fig 5.1 Compressive strength test on JFC cube**



**Fig 5.2 Failure of Jute fibre concrete cube**

**Table 5.1 Compressive strength results for 0.48 W/B ratio**

SL NO	Fibre content (%)	Fibre length(mm)	Strength (Mpa)
1)	0%	0	32.62
2)	0.1%	12	33.78
		16	41.78
		22	35.33
3)	0.3%	12	31.42
		16	42.67
		22	31.56
4)	0.6%	12	30.84
		16	33.33
		22	28.89

**Table 5.2 Compressive strength results for 0.53 W/B ratio**

SL NO	Fibre content (%)	Fibre length(mm)	Strength (Mpa)
1)	0%	0	28.178

2)	0.1%	12	23.42
		16	29.33
		22	24.89
3)	0.3%	12	24.44
		16	33.51
		22	27.86
4)	0.6%	12	25.18
		16	26.08
		22	23.11

**Table 5.3 Compressive strength results for 0.58 W/B ratio**

SL NO	Fibre content (%)	Fibre length(mm)	Strength (Mpa)
1)	0%	0	26.67
2)	0.1%	12	22.67
		16	26.22
		22	24.75
3)	0.3%	12	21.78
		16	26.97
		22	24.89
4)	0.6%	12	22.53
		16	22.67
		22	18.22



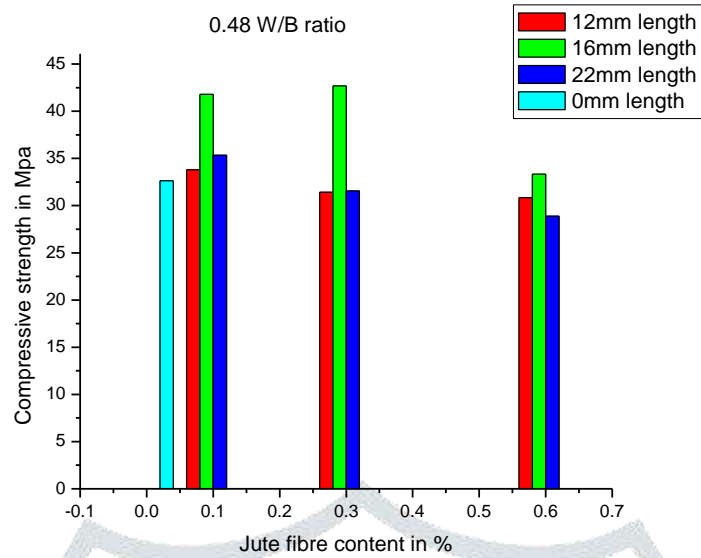


Fig 5.3 Compressive Strength versus Jute fibre content for 0.48 W/B Ratio

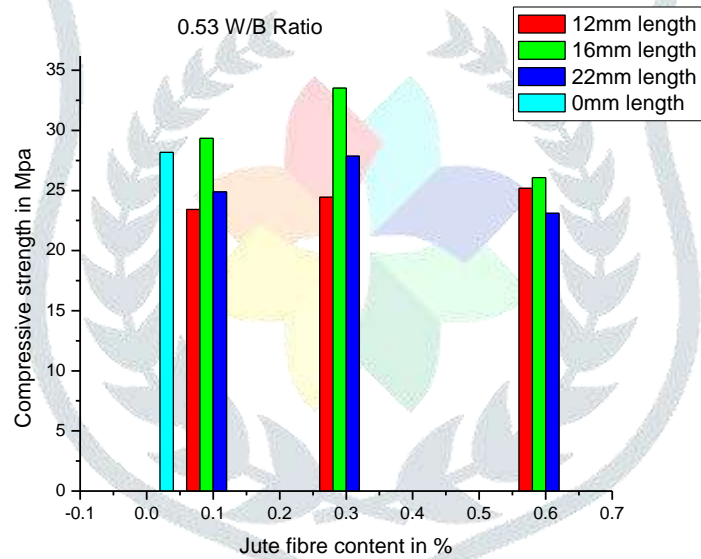
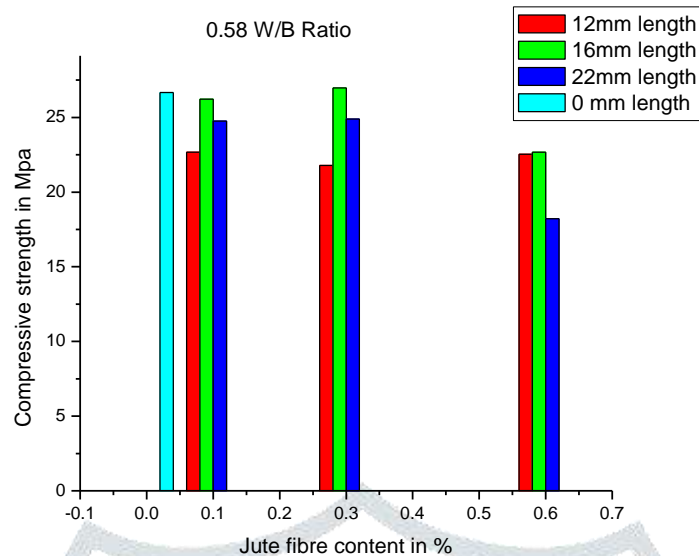


Fig 5.4 Compressive Strength versus Jute fibre content for 0.53 W/B Ratio



**Fig 5.5 Compressive Strength versus Jute fibre content for 0.58 W/B Ratio**

- The comparison of a compressive strength of plain concrete cubes with jute fibre concrete cubes with respect to 3 volumetric dosages with 3 different lengths of jute fibres that is 0.1%, 0.3% and 0.6% and 12, 16 and 22 mm respectively in three different mix proportions 1:0.42:2.32:3.54, 1:0.42:2.68:3.93 and 1:0.42:3.06:4.30 are tabulated above.
- From table 5.1 it can be observed that, Jute fibre of 16 mm length of 0.3% of volume of concrete for 0.48 W/B ratio having a maximum strength that is 42.67 Mpa. The maximum strength is due to low water binder ratio with optimum jute fibre length and optimum volume of jute fibre which enriches the strength of concrete when compared to other mixes.
- And from table 5.1, Jute fibre of 22mm length of 0.6% of volume of concrete for 0.48 W/B ratio having a minimum strength that is 28.89 Mpa, this is because of balling process caused by larger length and higher percentage of jute fibre, during mixing process.
- From table 5.2 it can be observed that, Jute fibre of 16 mm length of 0.3% of volume of concrete for 0.53 W/B ratio having a maximum strength that is 33.51 Mpa. However this strength drops down when compared to 0.48 W/B ratio.
- And from table 5.2, Jute fibre of 22mm length of 0.6% of volume of concrete for 0.53 W/B ratio having a minimum strength that is 23.11 Mpa which is less when compared to 0.48 W/B ratio.
- Similarly from table 5.3 it is found that, Jute fibre of 16 mm length of 0.3% of volume of concrete for 0.58 W/B ratio having a maximum strength that is 26.97 Mpa and Jute fibre of 22mm length of 0.6% of volume of concrete for 0.58 W/B ratio having a minimum strength that is 18.22 Mpa which the strength value decreases when compared to 0.48 and 0.53 W/B ratio.
- By adding jute fibre to concrete there is an enhancement of strength when compared to conventional concrete (0% dosage and 0mm length) this can be observed from the tables 5.1, 5.2 and 5.3 that is 32.62 Mpa, 28.178 Mpa and 26.67 respectively which the strength value decreased with increasing the W/B ratio. Above figures (graphs) 5.3, 5.4 and 5.5 represents the comparison of compressive strength of concrete for 0.48, 0.53 and 0.58 W/B ratio.

## 6. CONCLUSION

1. By adding jute fibres in a concrete mix with optimum percentage and optimum length with lower water binder ratio can achieve maximum strength when compared to conventional concrete.
2. Compressive strength increases up to 0.3% dosage with 16mm length of jute fibre with lower water binder ratio.
3. Compressive strength gradually decreases with increase in dosage and length of jute fibre and also decreased with increase in water binder ratio.
4. It is observed that the workability has been increased along with increasing the w/b ratio.
5. It can be seen that by increasing the jute volume in concrete leads to drops down the workability of concrete.

6. By increasing the length of jute fibre which also decreases the workability characteristics of concrete.

7. Finally it can be concluded that the mechanical properties of concrete can be enhanced with inclusion or addition of jute fibres with dosage of 0.3 percent of volume of concrete and with length of 16 mm and with 0.48 water binder ratio.

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