



Study of Concrete Beams Reinforced With Jute Fibres And Twines

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Abstract

Jute fibre is a natural bast fibre which is available in many parts of the Indian subcontinent and widely used for making twines. It has tensile strength and its properties are found to be suitable for use in concrete. The paper presents the effect of jute twines on the flexural behaviour of concrete beam reinforced with jute fibres. Concrete mixes were prepared with jute fibre (0.75% by volume of concrete and fibre length 25mm). Concrete beams of size 100mm X 150mm X 1000mm were cast with four different percentages of jute twines (0.56%, 0.94%, 1.12% and 1.88%) with and without jute fibres.

Keywords: *Natural Fibre, Flexural Strength, Deflection*

INTRODUCTION

Jute fibres are comparatively cheaper than any other fibers like steel, plastic carbon, glass etc. and are easily available in almost all the developing countries. Their processing requires low degree of industrialization, low input in their production resulting in low unit cost. The relative cheapness and easy availability points to the direction of their use and application in large scale as a building material in conjunction with concrete for cost effective construction.

Research on the use of jute fibers as reinforcement in concrete has been carried out by many authors (1-6). Literature survey reveals studies on the use of fibers from Jute (1), Lechuguilla and Maguey (2), Water reed, Elephant grass, Plantain and Musamaba (3), Bamboo and Coir (4), Kenaf (5) and San (6).

In the present investigation jute fibre and twines are used as reinforcement in concrete beams. Jute fibre is available in many parts of Indian sub-continent and used for marking twines, ropes etc.

This paper presents the effect of jute twines on the flexural behavior of concrete beams reinforced with or without fibres.

PHYSICAL PROPERTIES OF THE FIBRE

General Description of the Fiber

Jute fibre plant is about 1.0 m to 2.0 m in height and is green in color. The diameter of the stem is between 10.0 mm to 30.0 mm. It has a single straight stem with leaves at the top. The stem of the plant is fully covered with a thin layer of fibrous skin which can be removed from the stem in long longitudinal pieces, even at green stage but with difficulty. To make extraction of the fibres easy, the uprooted plants are dipped in water for a period of 3 to 4 weeks after which they can be taken out of the water, the fibrous skin is separated easily.

Diameter of the Fibre

Microscopic observations of the fibres were made for several representative samples. The diameter of the fibre varies from 3×10^{-2} to 10×10^{-2} mm.

Specific Gravity of the Fibre

Specific gravity of the jute fibre is 1.01 to 1.04.

Water Absorption capacity of the Fibre

Rate of water absorption by the fibres is rapid during first 5 minutes and it is of the order of 77% to the dry weight of the fibres. Fibres almost get saturated in one day with about 98% absorption.

Tensile Strength of the Fibre

The average tensile strength of the jute fibre is 222.0 N/mm^2 . Percentage elongation is of the order of 1.25% to 1.34%, Initial tangent modulus of the fibre is $2.2 \times 10^4 \text{ N/mm}^2$.

Resistance to Alkaline Attack

Jute fibres were also tested in alkaline environment of sodium hydroxide solution of pH 11. Fibres were kept in an alkaline environment for 7, 14 and 28 days and reduction in tensile strength of the fibres is by 14%, 20% and 30% respectively.

EXPERIMENTAL DETAILS

Concrete mix were prepared with coarse aggregate (passing through 12.5mm sieve), fine aggregate (passing through 4.75mm sieve), cement (confirming to IS specifications) and fibres which were cut manually by scissor with an accuracy of 2mm. water-cement ratio of 0.50 and mix proportion 1: 1.45: 3.10 were adopted for the investigation, an extra amount of water equal to the dry weight of the fibres was added to the mix to account for the mix to account for the water absorption capacity of the fibres. Concrete beams of size 100mm X 150mm X 1000mm were cast with four different percentages of jute twines (0.56%, 0.94%, 1.12% and 1.88%) of the cross-sectional area of the beam with fibres (25mm fiber length and 0.75% by volume of concrete) or without fibers. After setting, the specimens were immersed for curing for 28 days. After 28 days the specimens were removed from water surface, dried before testing. Arrangement of placement of twines of one case (0.94% of twines) has been shown in figure 1 & 2.

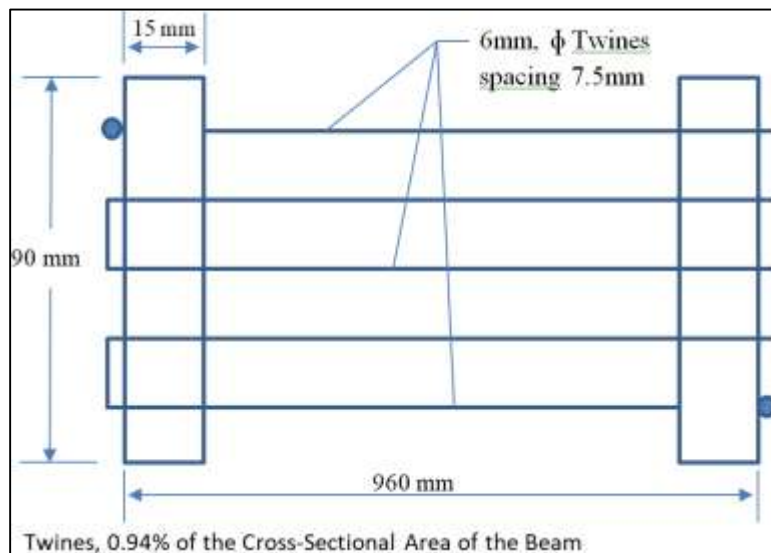


Fig. 1 Plan Showing Arrangement for placement of Twines.

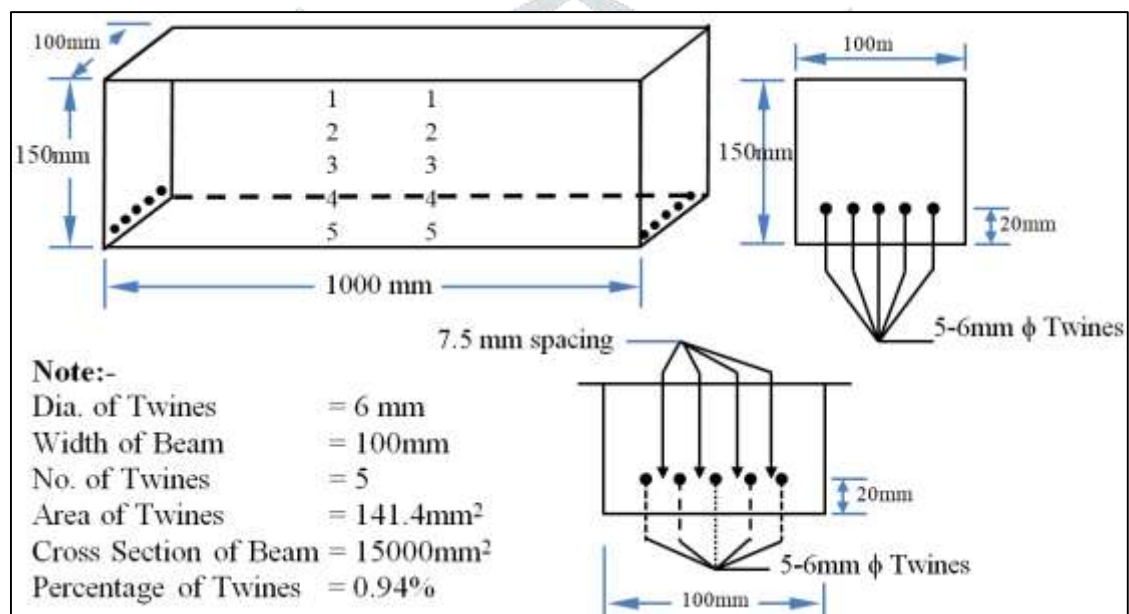


Fig. 2 Beam with Jute Twines

TESTING PROGRAMME

Beams were placed in Universal testing machine under two point load. On an average three specimens were tested for each series. Flexural strength and central deflection was measured at an interval of 2000 N and the curves were plotted.

Discussion of the Test Results

Flexural strength and load-deflection results of jute twines concrete beams reinforced with fibres at first crack load and at ultimate load have been plotted in figures 3, 4, 5 and 6. It is clear from the figures that the flexural strength and the deflection of concrete increases with increases in percentage of jute twines. It is also observed that the flexural strength and the deflection of fibrous concrete beams reinforced with jute twines increases more than the concrete beams reinforced with jute twines.

The flexural strength of concrete beams reinforced with jute twines is increased by 116% at first crack load and 112% at ultimate load. Also the flexural strength of fibrous concrete beams reinforced with jute twines is increased by 134% at first crack load and 121% at ultimate load.

There is increase in load carrying capacity of concrete beams reinforced with twins at first crack load (23.5% to 28.2%) and at ultimate load (12.2% to 30%) where as for fibrous concrete beams reinforced with twines at first crack load (25.8% to 33.2%) and at ultimate load (19.3% to 37.3%).

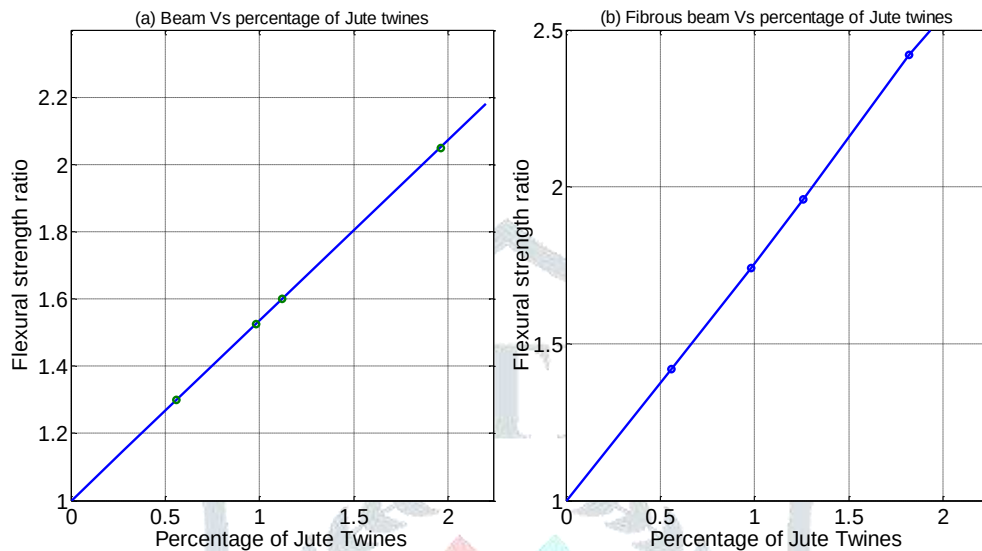


Fig. 3 Flexural Strength ratio at first crack of (a) beam Vs percentage of jute twines and (b) Fibrous beam Vs percentage of jute twines.

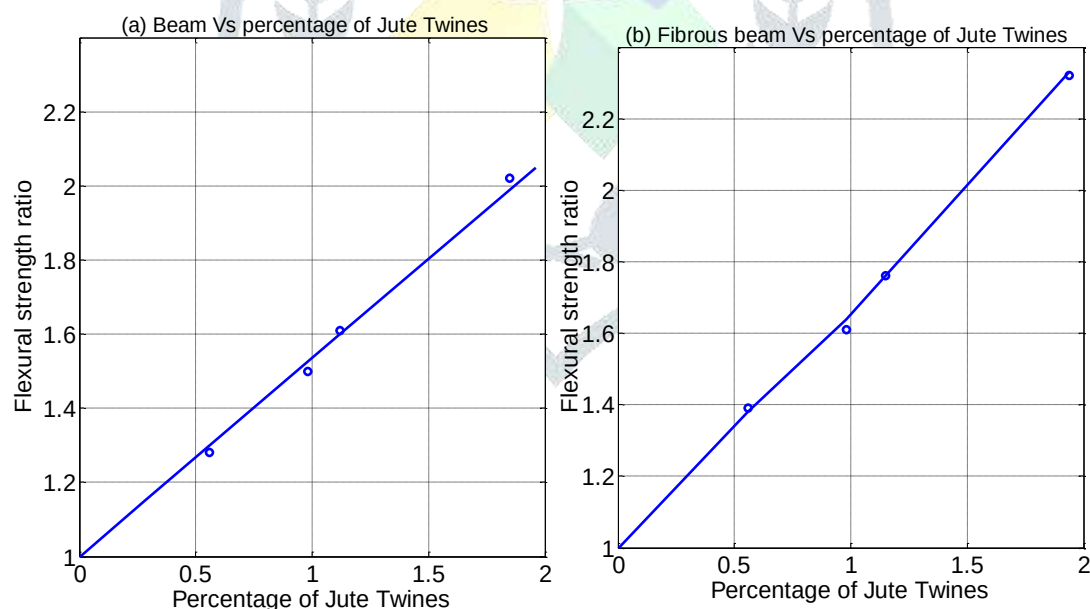


Fig. 4 Flexural Strength ratio at ultimate load of (a) beam Vs percentage of jute twines and (b) Fibrous beam Vs percentage of jute twines.

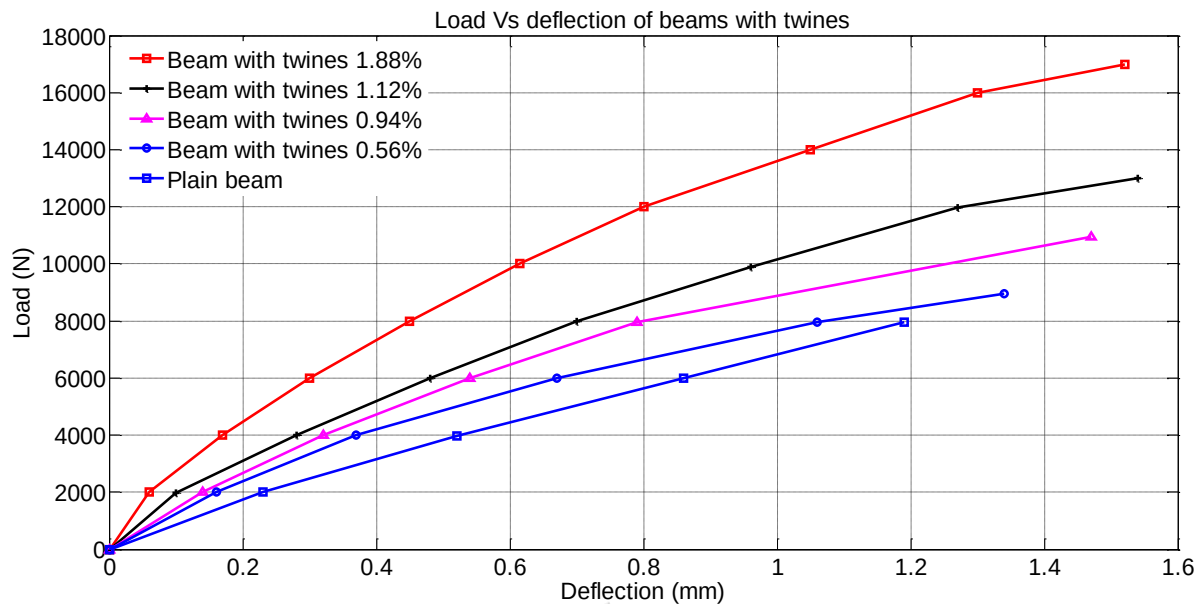


Fig. 5 Load Vs deflection of beam with twines.

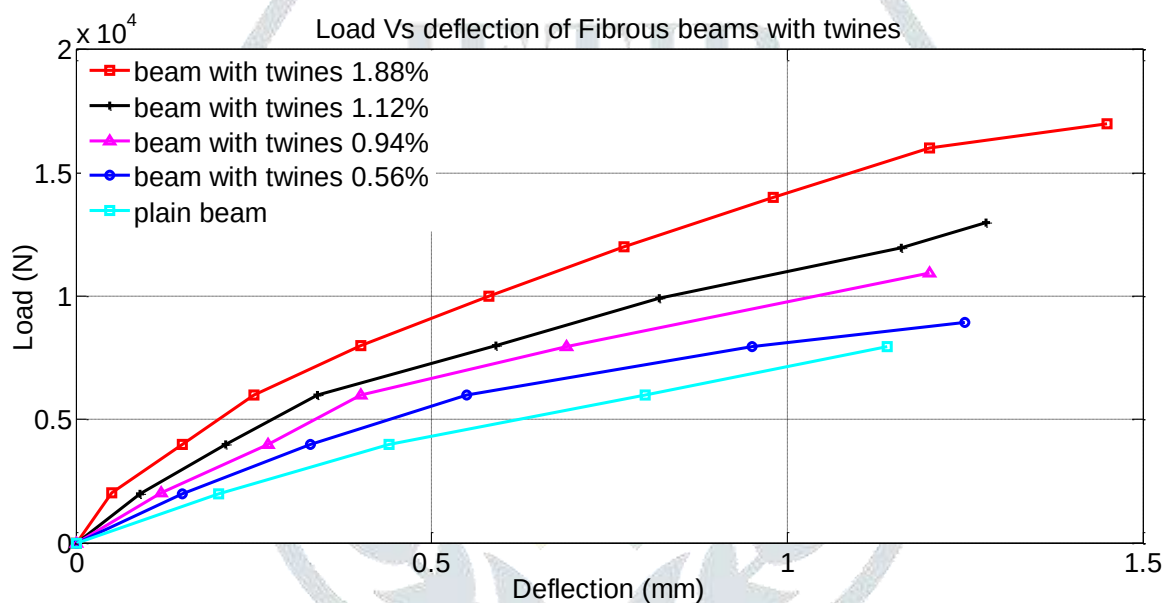


Fig. 6 Load Vs deflection of Fibrous beam with twines (fibre length = 25mm, percentage of fibre = 0.75%)

CONCLUSION

The following conclusions can be made from the study:-

1. Jute can be effectively used as a reinforcing material in concrete.
2. Jute also improves the ductility of plain concrete.
3. Jute enhances the flexural strength of concrete. The flexural strength of concrete beams reinforced with jute twines is increased by 100% at ultimate load while for fibrous concrete beams reinforced with jute twines is 121%.
4. The first crack strength and ultimate load strength were both found to be increased with addition of fibres and twines.
5. Jute also improves the load carrying capacity of concrete. For concrete beams reinforced with jute twines, the load carrying capacity increases (12.2% to 30%) at ultimate load while for fibrous concrete beams reinforced with jute twines is (19.3% to 37.3%).

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