



MECHANICAL PROPERTIES OF CONCRETE CANVAS

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Abstract: This paper provides a thorough analysis of Concrete Canvas (CC), a revolutionary material that is becoming more and more popular in the Indian construction industry. In comparison to conventional concrete, our study explores the applicability of CC for a range of applications by focusing on its mechanical qualities and economically. We carried out thorough tensile and flexure testing, comparing the outcomes to manufacturer specifications, to assess CC's performance. Our goal in examining these crucial mechanical properties was to shed light on CC's dependability as well as possible areas for improvement. In addition, we created a comparative cost model to evaluate if using CC instead of traditional concrete is more financially feasible. This model provides stakeholders with useful information to help them make decisions by quantifying the financial effects of using CC in construction projects. Our results not only highlight the advantages and disadvantages of CC but also offer practical suggestions for its improvement. Our research intends to advance the Indian construction industry by clarifying areas for improvement and empowering stakeholders to fully use this novel material.

IndexTerms - Concrete Canvas, Concrete.

I. INTRODUCTION

In India, the building sector is experiencing a significant change with the introduction of advanced materials such as Concrete Canvas (CC). CC, a cloth saturated with cement, is gaining traction due to its capacity to transform conventional construction methods. This research seeks to investigate the mechanical qualities and cost-effectiveness of CC, which are critical factors that influence its suitability and competitiveness in the construction industry in India.

There has been an increasing interest in studying the mechanical properties of CC, including its tensile and flexural strength, in recent years. This study intends to comprehensively evaluate the mechanical features of CC by exposing it to stringent testing techniques. This study serves to confirm that CC complies with the manufacturer's specifications and also reveals areas that can be improved, providing valuable insights for optimizing tactics.

Moreover, the economic sustainability of CC is a vital concern for players in the building sector. This study gives a comparative cost analysis, explaining the financial ramifications of implementing CC in construction projects. By measuring the cost differentials between CC and traditional concrete, this study offers vital insights into the cost-effectiveness of CC, helping decision-makers to make informed choices regarding material selection.

Through this study project, we want to contribute to the progress of the Indian construction sector by providing relevant insights about the utilization of CC. By analyzing its mechanical qualities and economic efficiency, we seek to support informed decision-making processes, ultimately fostering the wider adoption of CC and pushing innovation in construction techniques.

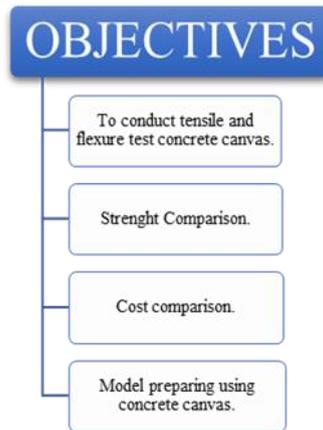


Fig. 1- Objectives

1.2 ABOUT CONCRETE CANVAS

Concrete Canvas (CC) is a pioneering innovation in construction technology, offering a versatile and effective alternative to conventional building materials. Comprising a flexible fabric impregnated with cementitious material (as indicated in fig. 1), CC promotes rapid construction procedures and enhances structural integrity. Its novel composition enables it to be used across varied terrains and applications, making it particularly relevant in the context of the Indian construction industry's increasing needs.

The unique qualities of CC, notably its durability, ease of installation, and adaptability, have gained substantial interest from industry professionals seeking sustainable and cost-effective solutions. As a result, CC has emerged as a promising contender for numerous construction projects, ranging from infrastructure development to emergency shelter providing.

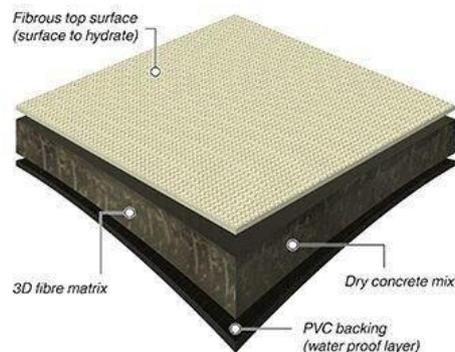


Fig. 2 – Components of Concrete Canvas.



Fig. 3 – Concrete Canvas.

1.3 CHEMICAL COMPOSITION OF CONCRETE CANVAS

A. Concrete Dry Mix: Concrete Canvas employs a specific concrete dry mix, which gives superior mechanical strength and shorter setting time. The concrete mix is created by choosing dry cement powder, Calcium aluminate cement (CAC), Calcium sulfo-aluminate cement (CSA), or a combination of both to accommodate the required strength of concrete Canvas and for its diverse uses.

B. Fibre Matrix: Fiber Matrix is a 3-D fiber reinforcing matrix inside the Concrete Canvas which reinforces the dry concrete mix of Concrete Canvas to offer its strength, flexibility, and durability. Usually, the thickness of the fiber-matrix comes in a range from 5 to 20 mm.

C. Membrane: In Concrete Canvas there are two PVC membranes, one on each side with unique qualities for different purposes. On the bottom side, a waterproof PVC membrane to protect Concrete Canvas from the surrounding water and dampness. On the top side, acceptable fibers (Polyethylene and Polypropylene yarns) membrane helps in the hydration process by letting the water to access the dry concrete mix with fiber matrix.

1.4 METHOD OF APPLICATION

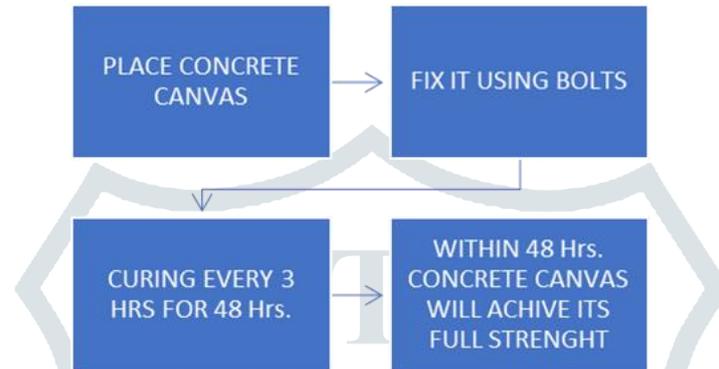


Fig. 4 - Method of application

1.5 APPLICATION OF CONCRETE CANVAS

- A. Channel lining.
- B. Slope Protection.
- C. Bund Lining.
- D. Concrete Repair.
- E. Weed Control.
- F. Culvert Lining.
- G. Lagoon Lining.

2. RESEARCH METHODOLOGY

An assessment of Concrete Canvas (CC) entails examining its mechanical characteristics and cost-effectiveness for various construction uses. This part provides an overview of the methods employed, with a specific emphasis on the interpretation of data obtained from tensile and flexure testing. Additionally, it includes a detailed cost analysis utilizing a tailored model.

CC's structural integrity and performance were evaluated using tensile and flexure tests, which subjected it to various loads. Results were cross-referenced with the manufacturer's specifications to verify adherence to quality standards and pinpoint areas that might be enhanced.

A cost model was created to assess the economic feasibility of CC in comparison to conventional concrete. The analysis took into account the expenses related to materials, personnel, and building schedules in order to offer valuable information regarding cost-efficiency and prospective cost reductions.

2.1 TENSILE TEST

Tensile strength testing was performed on Concrete Canvas (CC) samples after a 48-hour curing time to verify the material's ideal qualities. Specimens with dimensions of 0.6 meter in length and 0.1 meter in breadth were meticulously prepared for testing, following standardized measurements to ensure precise evaluation.

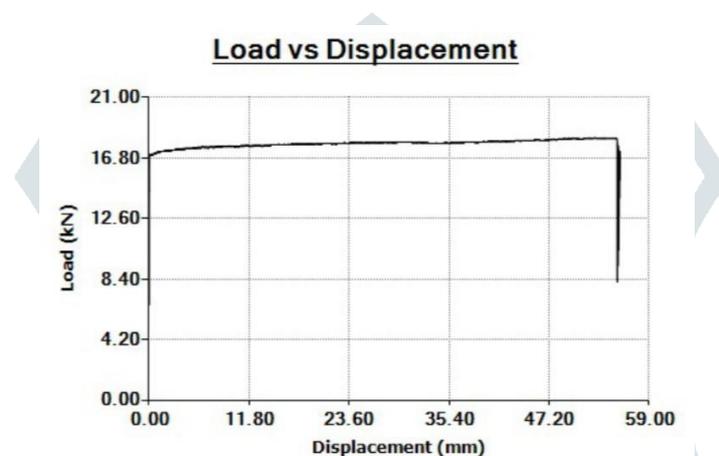
The testing process involves securing the CC sample between specialized clamps mounted onto a Universal Testing Machine (UTM). The sample was subjected to a steady application of tensile force until it reached failure, enabling accurate measurement of the maximum tensile load that the material could withstand.

By exposing CC to tensile strength testing under controlled settings, the study attempted to assess its resistance to longitudinal stress and evaluate its appropriateness for applications requiring high tensile strength. The results obtained from the UTM were compared with industry standards, and the findings were judged to be satisfactory, suggesting that CC fulfills or exceeds recognized criteria for tensile strength within the construction sector.



Fig. 5 – Tensile test using UTM.

After testing following result were obtained:



Graph 1 -Tensile strength (Load vs Displacement)

INPUT DATA		OUTPUT DATA	
Serial No.:	CANVAS	Ultimate Load (kN):	18.20
Material Type:	CANVAS	Ult Tensile Strength (N/mm ²):	56.00
Specimen Type:	Flat	Disp at Ult Load (mm)	0.00
Specimen Width (mm):	65.000	Maximum Disp (mm):	55.51
Specimen Thickness (mm):	5.000	% Elongation (%)	4.167
C/S Area (mm ²):	325.000	% Red in Area (%)	4.000
Original Gaugelength (mm):	600.000	Breaking Load (kN):	17.25
Final Gaugelenght (mm):	625.000	Breaking Stress (N/mm ²):	53.08

Table 1- Tensile strength test result

2.2 FLEXURE STRENGTH

Concrete Canvas (CC) samples were subjected to a standardized testing technique to measure their flexure strength following a curing period of 48 hours. The specified curing period provides the appropriate hardening and stability of the material before testing, in compliance with the highest requirements in the industry. The test was done according to IS 516 (Part 1/Sec 1): 2021.

Specimens, with dimensions of 0.6 meter in length and 0.1 meter in width, were rigorously prepared to ensure uniformity and consistency during testing. Every sample was carefully modified to minimize any potential variables that could effect the test results.

The flexure strength of the samples was evaluated by applying controlled bending stresses to them using a Universal Testing Machine (UTM). The CC sample was firmly fixed in situ using specific clamps to ensure constant loading throughout the testing procedure.

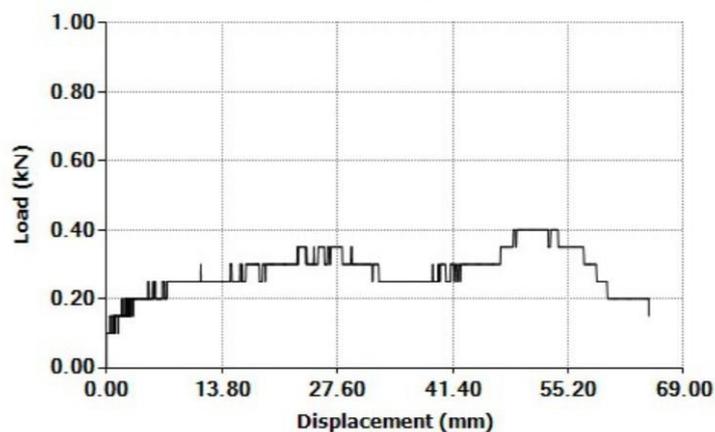
The UTM subjected the CC sample to successive bending forces until it reached the point of failure, providing accurate assessment of flexural stress and strain. Test data were gathered and reviewed to ascertain the flexural strength of Concrete Canvas under the specified testing settings.



Fig. 6 -Flexure strength test using UTM

After testing following result were obtained:

Load vs Displacement



Graph 2 -Flexure strength (Load vs Displacement)

INPUT DATA		OUTPUT DATA	
Serial No.:	Ra1	Ultimate Load (kN):	0.40

Material Type:	CANVAS	Flexural Strenght (N/mm²):	14.4
Specimen Type:	Flat	Disp at Ult Load (mm):	53.97
Specimen Width(mm):	100.00	Maximum Disp (mm):	64.85
Specimen Thickness(mm):	5.000	Breaking load (kN):	5.7
C/S Area (mm²):	500.000	Breaking Stress (N/mm²):	11.40
Span Length (mm):	600.000		

Table 2: Flexure Strength Result.

2.3 MODEL PREPARATION

For the purpose of testing Concrete Canvas (CC) in practical applications, a multipurpose table was created utilizing a fraction of the obtained material. The CC material, totaling 3 square meters, was obtained at a rate of Rs. 3000 per square meter, equating to a total cost of Rs. 9000. Additionally, the cost of the molds required for the table building was Rs. 450, resulting in a total expenditure of Rs. 9450.

The building procedure involves wrapping the concrete fabric around the mould to achieve the appropriate shape of the table. Subsequently, the full construction was submerged in a curing tank and let to cure for a duration of 56 hours. This curing duration allowed the CC material to attain its maximal power. After the curing process was done, the mould was removed, resulting in the final model being formed.

The multifunctional table design was purposefully chosen to demonstrate the adaptability of CC, since it can be utilized for both landscape reasons and inside use. This practical demonstration aims to show the endurance and adaptability of CC in real-world settings, further proving its potential benefits within the construction industry.



Fig. 7- Curing of Model



Fig. 8- Model

Additionally, this model serves as a convincing demonstration of Concrete Canvas's (CC) intrinsic adaptability. Unlike traditional concrete, which would demand additional reinforcement to keep its form, CC's malleable nature enables it to adhere to the curves of the mould without supplementary support. This emphasizes CC's capacity to speed building processes and reduce material requirements, giving a cost-effective and efficient solution for many applications within the construction industry.

2.4 CANVAS CONCRETE MODEL COST

In order to assess the cost-effectiveness of utilizing Concrete Canvas, we developed a cost model for a specific project. The material was acquired at a rate of Rs. 3000 per square meter. For our model, we employed 3 square meters of Concrete Canvas, resulting in a material cost of Rs. 9000. Additionally, producing the requisite mold for the project required Rs. 450. Therefore, the total cost for the project employing Concrete Canvas came to **Rs. 9,450**.

This cost model offers a comprehensive comprehension of the financial consequences and advantages of employing Concrete Canvas in construction applications.

The model we have created is a versatile table that demonstrates the adaptability of Concrete Canvas. This table is versatile and may be used both indoors and for landscaping. The durable structure, along with the visually pleasing appearance of Concrete Canvas, renders it a perfect furniture item for several settings. The versatility and resilience of Concrete Canvas demonstrate its potential for creative uses in contemporary architecture and design.

2.5 ESTIMATE OF MODEL MADE USING M-25 CONCRETE

To offer a comparison analysis, we evaluated the cost of constructing the same table model using M25 concrete, following to the state schedule rates of Maharashtra, India. The dimensions of the model were kept consistent with the one built using Concrete Canvas. The cost calculation included materials such as cement, aggregates, and reinforcing charges. According to the Maharashtra state schedule rates, the total estimated cost for creating the model with M25 concrete was much more than utilizing Concrete Canvas. This comparison underlines the financial advantages of adopting Concrete Canvas for such applications, emphasizing its potential for cost savings in construction projects.

Total area of model	= 3.02 m ²
Volume of concrete	= 3.02*0.3
	= 0.906 m ³
Total cost of concrete	= 0.906*8549
	= Rs. 7,745

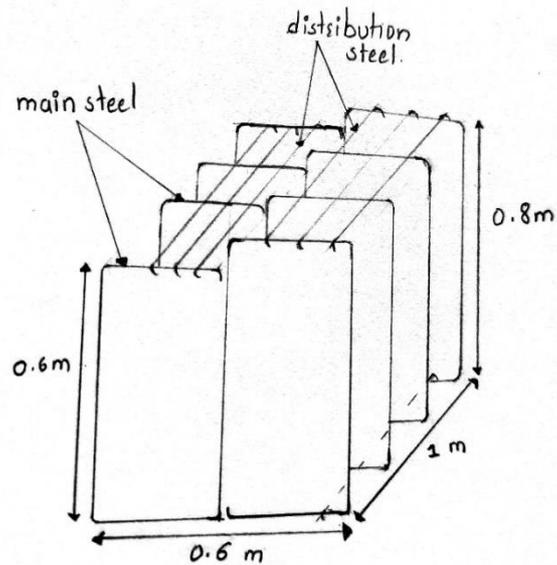


Fig. 9- Reinforcement details

Main bar length	$= 0.25 + 0.8 + 0.25 + 0.8 + 0.25 + 0.6 + 0.25 + 8 * (9 * 0.08)$ $= 3.48 \text{ m.}$
Distribution steel length	$= 1000 + 2 * (9 * 8)$ $= 1.14 \text{ m}$
No. of main bars	$= 9 @ 150 \text{ mm c/c}$
No. of distribution bars	$= 14 @ 100 \text{ mm c/c}$
Total steel required	$= 18.67 \text{ kg}$
Total cost of steel	$= \text{Rs. } 3,380$
Total cost of model	$= \text{Rs. } 11,125$

3. RESULT AND DISSCUSSION

Our study on Concrete Canvas (CC) involved a complete examination of its mechanical capabilities and cost-effectiveness compared to industry standards and conventional materials. The tensile and flexure tests undertaken indicated that CC's performance closely matches to the statistics provided in industry publications and manuals, exhibiting sufficient levels of strength and durability. Our research proved that CC satisfies the requisite parameters for numerous construction uses. In addition, a thorough cost analysis was undertaken by evaluating the expenditures involved with building a model of equal size using reinforced concrete (RCC). The investigation found that although the initial material cost of CC may be more, it offers major advantages over traditional RCC in terms of overall cost effectiveness, reduced labor, and convenience of installation. These findings confirm the assumption that CC has the capacity to be a practical, effective, and inexpensive substitute in the construction sector.

3.1 FLEXURE STRENGTH COMPARISON

We did a study where we compared the flexural strength of Concrete Canvas. This was done by examining data collected from Concrete Canvas Ltd.'s official site and comparing it with the results from our own testing. The results of our investigation showed that the measured flexural strength values were higher than the manufacturer's stated values. The test was conducted as per IS 516 (Part 1/Sec 1): 2021. This favorable outcome demonstrates that Concrete Canvas not only fulfills but exceeds the anticipated performance criteria, confirming its strength and dependability for building purposes. The values are as follows:

Table 3: Flexure strength comparison

3.2 TENSILE STRENGTH

In order to strength of Concrete performed our own we did not have any Concrete Canvas revealed that the strength is 56.00 MPa. The test was conducted as per IS 1786: 2008. This empirical data demonstrates the material's significant ability to withstand tension, further confirming its applicability and effectiveness for a wide range of building applications.

Stated Values		Test Values	
Description	Value	Description	Value
Flexure strength	10 MPa	Flexure strength	14.4 Mpa

analyze the tensile Canvas, we experiments since figures provided by Ltd. Our testing ultimate tensile

3.3 COST COMPARISON

After conducting a detailed cost comparison between the two models, it was revealed that the Concrete Canvas model was much more cost-efficient than the one created using M25 concrete. The overall cost for the Concrete Canvas model was Rs.8450, but the M25 concrete model, computed using the state schedule rates of Maharashtra, India, was Rs. 10968 proven to be more expensive. This cost efficiency, combined with the ease of installation and numerous applications of Concrete Canvas, makes it a highly desirable material for construction projects, particularly where budget constraints are a main factor.

Table 4: comparison

Cost of model			
Description	Rate (Rs)	Description	Rate (Rs)
Concrete canvas model	9,450	Model made using M25 concrete	11,125

Cost

4. CONCLUSION:

This paper has presented a complete examination of Concrete Canvas, concentrating on its tensile and flexural strength, cost efficiency, and practical application in model creation. The objectives outlined at the outset of this study led our investigation and helped us develop some crucial conclusions.

1. Tensile and Flexural Strength Testing:

- The tensile strength tests done using a Universal Testing Machine (UTM) demonstrated an ultimate tensile strength of 56.00 MPa for Concrete Canvas. Despite the lack of comparable data from the manufacturer's site, our results indicated that Concrete Canvas offers substantial tensile strength, reinforcing its appropriateness for diverse construction applications where resistance to pulling forces is crucial. - Similarly, the flexural strength tests verified that Concrete Canvas exceeds the advertised values provided by Concrete Canvas Ltd. Our tests found a flexural strength of 14.4 MPa, compared to the manufacturer's claim of 10 MPa. This finding highlights the material's resilience and reliability in withstanding bending stresses, giving it a viable alternative to standard construction materials in applications needing significant flexural strength.

2. Flexural Strength Comparison:

- The comparison of flexural strength between our test findings and the manufacturer's claims shows that Concrete Canvas surpasses the predicted performance. With a flexural strength value of 14.4 MPa obtained from our testing vs the 10 MPa promised by Concrete Canvas Ltd., the material proved satisfactory and superior performance under flexural stress circumstances.

3. Cost Comparison:

- A detailed cost comparison was undertaken between a model constructed using Concrete Canvas and an equivalent model made with M25 concrete. The overall cost for the Concrete Canvas model was ₹9450, whereas the anticipated cost for the RCC model was ₹11125, based on the State Schedule Rate of Maharashtra, India. This comparison illustrates that Concrete Canvas is a more cost-effective alternative, giving significant savings without compromising on performance.

4. Model Preparation:

- The practical application of Concrete Canvas was illustrated by the fabrication of a multipurpose table model. This model highlighted the material's flexibility and versatility, suited for both indoor use and landscaping applications. The ease of installation and speedy drying process further underscored Concrete Canvas's usefulness and efficiency in real-world circumstances.

In conclusion, the objectives of this study have been successfully realized, providing significant insights into the performance and cost-efficiency of Concrete Canvas. The material's exceptional tensile and flexural strength, coupled with its cost advantages and various uses, highlight its promise as a revolutionary product in the building industry. Future improvements, such as reinforcement using wire mesh, could further boost its strength and widen its variety of applications, establishing its place as a sustainable and innovative construction material.

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