METHOD OF MEASURING MECHANICAL PROPERTIES OF COATED FABRIC USING PHOTOGRAMMETRY TECHNIQUES

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ABSTRAC

A rapid growth is reported in the demand of the materials that are very flexible and easy to handle. Other than that people like to buy such kind of materials that do not require a lot of space and perform rapid deployment. This is because these type of materials are quite durable and have low maintenance cost. The fiber waste materials like the coated fibers are quite important in today's world. These things are being used in different type of industries and applications such as technical textiles, geotextiles, beauty care products and many health care products. There are many short and intelligent electronic applications that also use these fibers. Coated fabric is very useful in the places where you need a product which behaves like a stretched membrane. It is also suggested by different type of studies that there is no bending in the coated fabric. That is the main reason they provide great strength and metallic properties at various places. If anyone want to examine the mechanical properties of the coated fabric then there is a special paper which is very helpful in this procedure. It is very required to find out the mechanical properties of fabric for getting the information about the software. People will be able to get the different type of information related to the photogrammetry techniques and material testing equipment in this paper. These photogrammetry techniques are very helpful for recording different type of linear and angular displacement data which is caused due to the uniaxial and biaxial tension. There are different type of tests that are used in this procedure such as a Young's modulus and Poisson's ratio. The results that are provided by the photogrammetry method are completely equal to the results obtained from the tensile testing machine. It is very helpful in getting the information about the stress shear strain behavior. These values are obtained with the help of bias tension test. The paper will provide different type of information related to the testing that is very helpful in getting the mechanical properties of a coated fabric.

Keywords: Photogrammetry, Finite element analysis, Solid Works, Coated fabric, Inflatable structur

INTRODUCTION

The information will describe the applications of a coated fiber that is very helpful in the industrial areas due to its advantages such as lightweight and it's unique performance. It will also help in getting the limitations of the mechanical behavior of the flexible fabric [1].

It is hard to deny to the fact that a fabric are the mixture of fiber and air, they are also known as porous media. It is very easy to describe their properties with the help of loading direction. The fabric cannot be included in homogeneous and isotropic. It is completely difficult to analyze the fabric behavior theoretically and it is also be more difficult to give the experimental verification of the theoretical prediction that is used for the fabric.

There are many limitations that people will be able to get in the conventional method. The fabric tensile and shear properties go from separate tests [4]. But if anyone want to measure the properties of tensile and shear the same time then it is very necessary to focus on the more integrated approaches.

Issues in Fabric Measurement

Number of Independent Properties:

Tensile stress in wrap, filler direction and in plane shear stress, these are the three independent properties that are available in the experimental method. The experiment technique that is an ideal one will have a independent variable in the series of tests. Three parameters are completely connected with each other in this fabric structure. These parameters are interconnected with each other due to the nature of its fabric [2]. Here is the basic information about the three effects that are completely interconnected in this procedure.

Bucking Effects:

it has been reported that there is a slight bulking in the fabric due to the bending and deformation. There is a very less effect in the bending properties and the fabric properties are of very small magnitude that is the reason they do not show huge difference in their properties. Study does not include any effects of bulking.

Time and Frictional Effects:

When the mechanical energy is removed in the deformation process then the strain energy imported to the fabric is also recoverable. This procedure only occurs in the ideal elastic material. There is no significant behavior is reported between the relationships of stress strain to linear [5].

Stress and Strain Distribution:

If anyone want to calculate the mechanical properties of the fabric then it is very vital to have the distribution of stress and strain completely homogeneous. It is very difficult to get the information about stress and strain distribution accurately, that's why, it is very difficult to calculate the mechanical property [6].

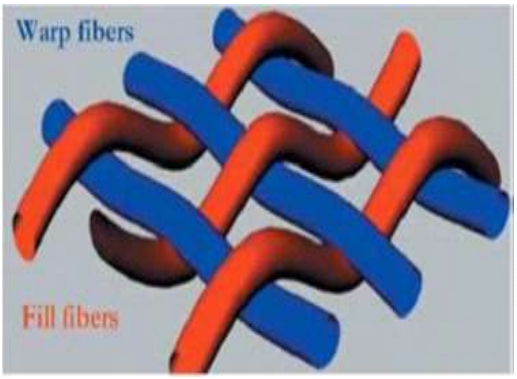

Figure 1: Coated Fabric

The input of the proper values of material property plays a very vital role in the finite element simulation in the inflatable structures that are Aerostat, Airship and Inflatable structures. If the authorities prefer special designing of material testing then it is very easy to obtain these properties. There are several changes obtained in the testing of materials that are griping method and strain measurement. The basic information about numerical method is that it is very required to have fabric strength and constituent material coefficient, damping and density. It is also very required to focus on the changes that occur due to dynamic and thermal environment. Warp and Weft are two different directions of fabrics. There is a stiffness reported due to the unique behavior of a coated woven fabric. Two primary Axes are used for the woven procedure of the fabric. These two axes have separate Mechanical properties. The basic difference between these fibers is that Wrap fibers are straight and fill fibers are curved [7].

It is very required to focus on the microscopic studies for understanding the coated fabric. When someone perform the straightening procedure of the curved fill fabric then crimp removal happen [8].

Morton and Hearle give the basic information about the parameters that are quite essential in the foundation of fiber of textile application. They described that the fibers cause the loss of strength in the yarn but it is easy to mitigate the loss with the help of parallel arrangement. If people provide the freedom of molecular movement then it is very easy to get sufficient openings for moisture [3].

Material properties of coated fabrics:

Materials that are used in the composite site have orthotropic behavior that is the mechanical properties are quite different from each other in the directions of orthogonal. The end grip effect can lead to misleading results in the properties of the measurement. What is the main reason it is very required to focus on the non contact type of method that is known as photogrammetry. It can easily help in calculating the material properties accurately [9].

Previous experiments work on fabric properties:

It has been observed that the tensile properties are completely measured without the help of shear properties and most of the tensile test include the use of uniaxial textile stress.

The most helpful method that can be very helpful in getting the complete result of shear properties is gripping an initially rectangular specimen. People have performed different type of attempts for understanding the shear properties with the help of uniaxially extended specimen.

Evolving material properties through photogrammetry:

Photogrammetry is the best method of getting the measurements with the help of a photographs. People can completely get the full characterization of things like length width and thickness. 13.0 megapixel camera is very helpful in getting the photographs for photogrammetry. Labview software can easily digitalize all the taken photograph.

The authorities perform 50 + test for getting the methodology. A sample length is used for getting all the information which is a 200mm to 300mm. The sample width that is used for the photogrammetry is 30mm to 200mm. The strain is 50 mm per minute to 200 mm per minute.

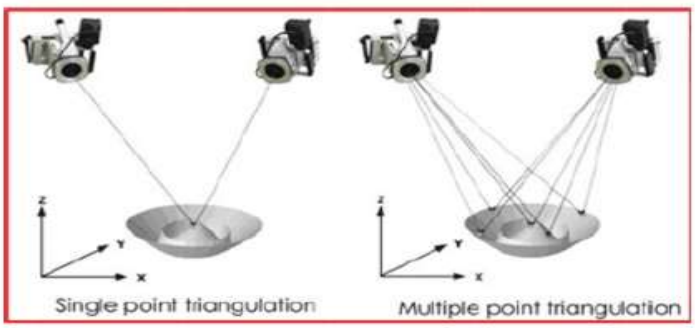

Figure 2: Photogrammetry Technique

Material Testing Methodology

To evaluate the material property of coated fabric, sample of different sizes have been cut having different orientation. Samples were cut in Wrap, Weft and 450 orientation W weft direction as shown in figure 3, 4 and 5.

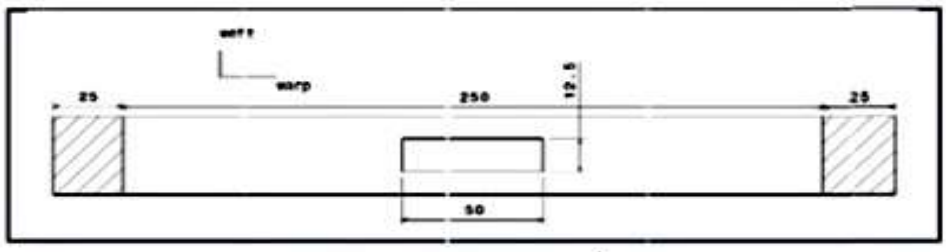

Figure 3: Sample A

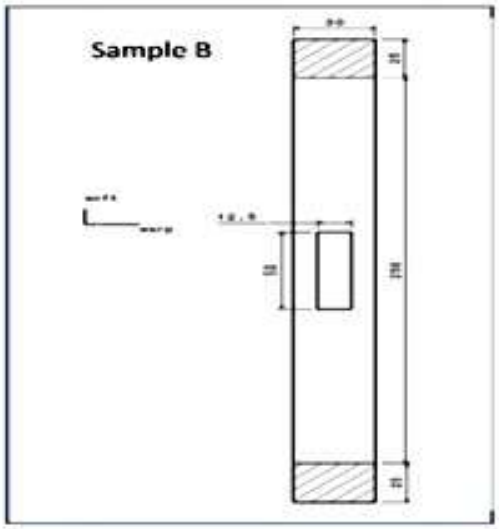

Figure 4: Sample B

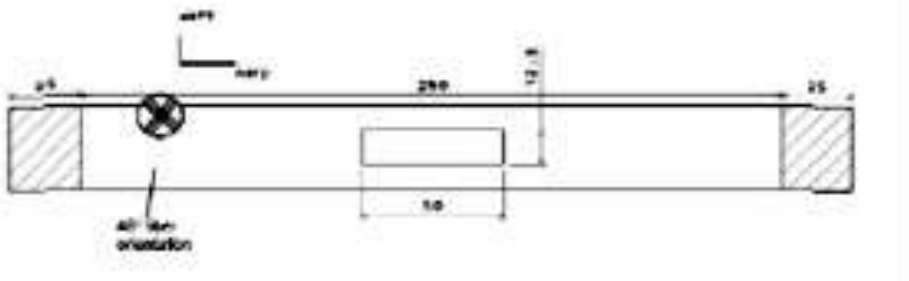

Figure 5: Sample C

Testing methodology adopted for testing is summarized in the table below:

Table 1: Testing Methodology

S. No.	Type of test
1	Tensile to failure - ty
2	Tensile to failure - ty
3	Tensile to failure - ty

Zwick 150 Textile testing machine (Figure 6 and 7) is used for testing of various specimen samples.

Figure 6: Textile Testing Machine

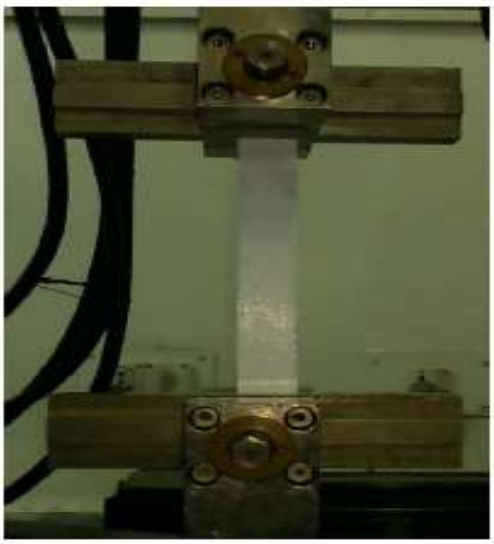

Figure 7: Sample of Machine

ESTIMATION OF MATERIAL PROPERTY

Material properties estimated are summarized in the table below.

Table 2: Testing Methodology

S. No.	% Elongation	Force (N)	Width of specimen (mm)	Material property evaluated	
1	21.50	399.00	30.00	E11 (N/mm2)	171.83
2	20.10	175.00	30.00	E22 (N/mm2)	80.62
3	195.02	39.37	30.00	E45 (N/mm2)	1.87

% shrinkage & % Elongation obtained for a sample fabric after image processing in LabVIEW software are shown in the Figure 8 & 9 respectively.

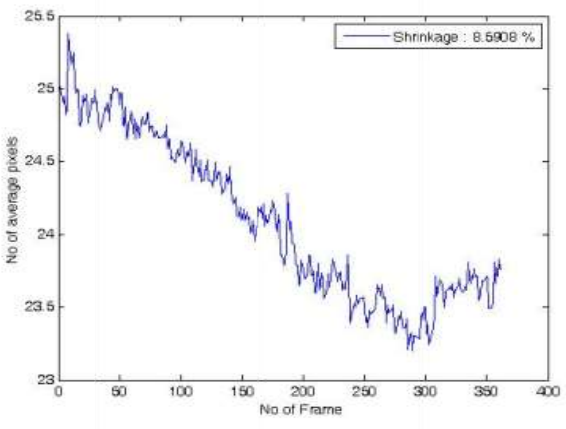

Figure 8: %Shrinkage

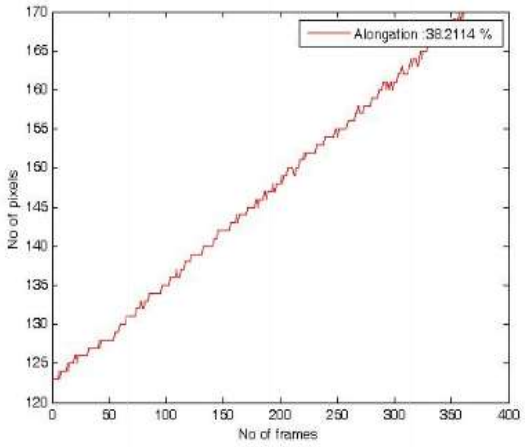

Figure 9: %elongation

Shrinkage along thickness = 6.06%

Shrinkage along length = 38.21%

Shrinkage along width = 8.59%

Poisson's Ratio obtained in respective directions is as follows:

$\vee 12 = 0.22$

$\vee 31 = 0.16$

Stress-strain diagram obtained for different samples having orientation A, B & C are summarized Figure 10.

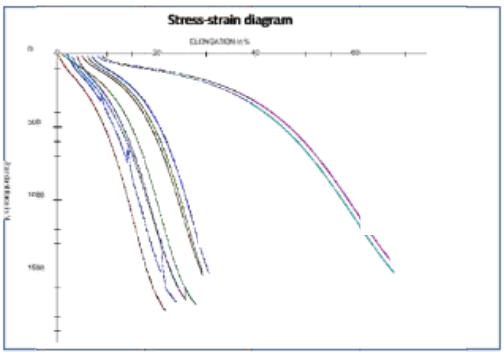

Figure 10: Stress–Strain Diagram

CONCLUSION

Photogrammetry technique is very helpful in getting the full estimation of young modulus and Poisson's ratio. The coated fabric shows nonlinear behavior under the conditions. It is very necessary to focus on the gripping method and strain method for this technique. If authorities want to examine the material behavior of a coated fabric then it is very necessary to check out the uniaxial testing. Stress and strain curve is shown it is quite helpful in getting the information about the behavior of the material. There is a lost if n is also reported in the coated fabric.

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