Buckling resistance of cylinders made of textile composite material

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Abstract. Composite materials were made by integration of two or more substances, one of them is a supported material like fabric, the other is a matrix material like resin. The outcome of the integration of the two substances produce new material has the attributes differ from the specifications of its constituent materials. This paper presents a comparative study of buckling resistance for cylinders made of a composite material once using a woven cloth as supporting material and the other using knitted cloth. Cylinders have been manufactured, one by woven fabric as supporting material and other by knitting fabric as supporting material, by test the cylinders under the buckling test, we found that the buckle for cylinder producing by knitting fabric is 20% higher than that produced of woven fabric. Comparing the scheme (force-displacement) of the test of two cylinder, it was found that the cylinder producing by knitting fabric has a rapid failure, while the other one has a more displacement.

1. Introduction
Composite materials are produced by combining different materials with each other, which work together to provide a new material with different properties than the materials involved in its installation [1,2]. There are many options available for bonding materials and supporting main materials, and are selected based on the mechanical requirements required for the application [3].

Composite materials produced with the support of Textile Reinforced Composites (TRCs) help to satisfy the desire to produce improved materials and properties designed for composite materials to be produced. Where tissue materials give strength, while the ricin ensures good adhesion and distributes emotion over the entire product [4,5]. According to Safri et al [6] textile materials can be divided into 4 groups, depending on the method of their production. All methods of fabric production can be used to produce supporting materials in composite materials, but the peculiarities of each method lead to differences in potential, behavior and characteristics [7,8]. The main processes used in the production of supporting fabrics are: weaving, braiding, knitting, and non-woven. There are also other processes, and the most common supporting fabric is woven cloth and non-woven cloth because of the possibility of overlap of bonding material [9].

When compared with other types of textile materials, the simulated cloth was not developed, mainly due to their low mechanical properties (as a tensile resistor) Leong and his research team [8]. The woven fabrics have a lower tensile strength compared to the woven and non-woven fabric. However, it is widely used as a supporting cloth in composite materials, because its structure does not depend on friction as in the case of woven fabric. As for the complexity of the structure of the fabric, this can be achieved...
through woven fabric and not woven or non-woven. This can be done in the form of a rectangle, a square, a specific one, etc. as required, while the woven and uncoated fabric is flat. If necessary, the limbs must be connected by well-known sewing machines [10].

Cardarelli Compared the strength of the collapse (Euler) under the test of the sequestration of three cylinders produced from composite materials supported by woven fabric with three 1/1 pad chains, 1/3 twill, 1/4 satin. It was found that the best cylinder is the knitting of 1/4 satin due to the ability of the bonding material to penetrate the fabric [11]. Isa tested two resin-producing cubes as a bonding material with polyproline fibers as a two-threaded, woven fabric under pressure test, and found that the strength of the cube collapse supported by the woven cloth was 22% greater than the strength of the cube collapse supported by the fabric [12].

The research aims to manufacture a cylinder of composite materials supported by woven and woven fabric, and then conduct a quiz test which shows which methods are best suited for the production of this type of cylinder, by calculating the torque. The importance of the research is that previous studies did not compare the test of the hydrocarbons to two cylinders of composite materials supported by woven or woven fabric, but tested a cylinder backed by woven fabric only.

2. Materials and methods of research
Composite material consists of the following basic materials:
1. Matrix material (Resin)
2. Reinforcement material (Fabric made of BCF yarn)
3. Accelerated material (cobalt)
4. A substance that increases hardness
   
   Tested cloth are two kinds:
   - Woven fabric made of plain weave 1/1 (Tafta) because it is the strongest weave.
   - Knitted fabric made also of plain weave (single joursh)
     
     The two samples were made of 2400 den polypropylene yarn, and the weight per square meter was 700 g / m². The thickness is 1.45 mm.
     
     As for the sample of the woven cloth, it remained in the shape of a cylinder, because it is produced on a circular knitting machine in the form of a bag with a diameter of 10 cm, while the sample of woven cloth was reached at the end of the limbs in the form of a bag of diameter also 10 cm.

   Preparation of the bonding material:
   
   The bonding material is prepared by placing the accelerated materials for drying (cobalt + catalase) and mixing it well until it is ready.

   ![Figure 1. Preparation of the bonding material.](image)

   Coating the cylindrical mold with wax material:
   
   In order to facilitate the removal of the processed samples and prevent them from sticking to the wood mold, wait approximately half an hour until the insulation is dried, and in the process it is forbidden to touch it or else the first layer is deformed. About the template.
Add cloth:

After making sure that the entire frame is fully painted, we put the fabric layer on the mold and then fill it with adhesive material by brushing it. It must be pressed well to discharge it from the air and fill the material with it. It must be worked quickly so that the bonding material does not dry in the area without the other, the bonding and deformation of the piece and the loss in cost especially when the accelerator exists.

Retention Period:

After finishing the cloth and the bonding material, leave the piece for 24 hours to dry and stick together. After this period with a screwdriver or other tool, separate the piece from the mold by its side and then easily by hand.

Tested roller produced from composite material with cloth:

The cylinder was tested with a test on the tensile device, produced by Testometric, but with the replacement of the cracks as stipulated by the ASTM for the test of the discarding of the cylinders.

ASTM: D 6641 / D has been adopted to conduct the quiz test.

1. The purpose of the experiment:
2. Determination of the properties of al-Mahnib, by drawing the relationship between stress and
emotion or between force and bending arrow.

3. Testing apparatus: Figure (4) consists of:
   - Lower hard jaw: A central stabilizer with two centers. Load the dimensions of each center as follows: 5 cm, width 5 cm, height 2 cm.
   - Upper movable jaw: A movable element with a fixed handle with a load center whose dimensions resemble the dimensions of their predecessors.
   - Handles: In order to hold the sample, place the sample between the fixed handle and the moving handle.

![Figure 4](image)

**Figure 4.** The test apparatus with the cavities of the quenching test.

3. **Results and discussion**

Two types of samples were tested: (a cylinder produced from the composite material with the woven cloth, a cylinder produced from the composite material produced with the woven cloth).

![Woven textile composite](image) ![Knitted textile composite](image)

**Figure 5.** The two cylinders produced by composite materials.

3-1- Test of the cylinder produced of knitted fabric:
   The sample collapsed under a strength of 289 N, as shown in figure (6).
Figure 6. Buckling test result of the knitted composite cylinder.

3-2- Test of the cylinder produced of woven fabric:

The sample collapsed under a force of 241 N, as shown in figure (7).

Figure 7. Buckling test result of the woven composite cylinder.

The determination of the arithmetic is calculated using the following equation [13]:

$$M_{\text{buckle}} = \frac{P_f}{w \times h} \text{ [N} \times \text{mm}^2\text{]}$$

whereas: $M_{\text{buckle}}$: torque determination $\text{[N} \times \text{mm}^2\text{]}$, $P_f$: the power of collapse $\text{[N]}$, $w$: Sample length $\text{[mm]}$, $h$: sample thickness $\text{[mm]}$. 
Figure 8. Distribution of the forces on the tested cylinder during load application.

Figure 9. Comparison of the torque determination between the two cylinders.

We note that the cylinder made of composite materials supported by the woven cloth collapsed under a stronger force than the roller made of composite material supported by woven fabric and because it is produced directly in the form of a bag, which gives it greater balance during its formation with a roller to manufacture the cylinder. While the woven fabric used to manufacture the cylinder needs to be connected by the two sides (because it is produced in an open manner), so the two sides are sewn in a way that the tip of the sewing top to form a bag, as this method gives stronger resistance at the place of connection, Weaknesses in the sample, resulting in an imbalance, which caused the sample to collapse under less force than its counterparts using the fabric [14].

A comparison of the shape of planners 6 and 7 shows that the cylinder produced from composite materials is supported by a uniformed cloth, as the shape of its collapse indicates this, which is consistent with [15]. It collapses under a larger force than the composite material produced by woven fabric. While the latter shows from the test scheme that it has a greater transmission than its counterpart since the form of collapse indicates that. This result is explained by reference to the structure of both woven and woven
fabrics, since the rest of the materials used to produce the two cylinders are stable. The woven fabric depends on the friction between the threading and braiding, as shown in Figure 10. This friction prevents the penetration of the bonding material Thereby reducing the consolidation between the parties [16].

![Figure 10. Woven cloth structure.](image)

While the fabric has two types of bonding between the rows and between the columns as shown in Figure 11, this bonding allows the bonding material to penetrate and the support between the cloth and the bonding material is greater. Thus, the cylinder produced from the composite material is supported by the stronger and more precise fabric [17].

The solvent of the cylinder produced from the composite materials supported by the woven cloth is greater than the torque of the cylinder produced from the composite materials supported by the woven fabric [18]. To explain this, we have made a microscopic picture of the structure of both samples and found that there are pneumatic spaces in the structure of the produced cylinder. The cloth is not flat, but is a rise and fall due to overlapping threads together [19].

These spaces, as a result of the pressure of the vents of the test apparatus on both ends of the cylinder, will result in the concentration of the stresses, and increasing the volume of these spaces will accelerate the collapse of the cylinder [20]. The size of these blanks was measured in both cylinders. The average size of the air spaces in the composite material structure supported by the woven cloth was 85.05 μm, which is greater than the average size of the air spaces in the composite material structure supported by the woven cloth of 61.34 μm. The reason for the difference in the size of the air spaces is due to the structure of the two cloths, where we notice that the spaces are placed in the woven fabric in the low places between the threads of clothing and clothing, where it is difficult to reach the Rizin to these places. The threads in the woven fabric are intertwined with two types of bonding (between the rows and between the columns) so that the threading is larger and the size of the formed spaces is narrowed [21].

This difference in the size of the blanks explains our conclusion that the masking moment of the composite material supported by the woven cloth is greater than that of the composite material supported by woven fabric [22].
Vacancy sizes in woven composite

Figure 12. Comparison of the size of the spaces between the two samples.

4. Conclusion
Cylinders can be produced using composite materials made of resin as matrix material and woven or knitted fabric as a supporting material.

The Cylinder supported by the woven fabric has a 20% greater torque than the knitted.

The Cylinder supported by the knitted fabric is larger in gap size than the woven fabric, thus it has a greater transition than another one.

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