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# Modification of pelvic chair with brake support device for descent in personnel of the Colombian national army

## Modificación de silla pelvica con dispositivo de apoyo al freno para descenso en personal del ejército nacional de Colombia

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## ABSTRACT

This research article arises from the project modified pelvic chair with brake support device for descent, this project is based on the experiences of contingencies presented in the first man when descending in the Air Assault tower of the National Army of Colombia, seeking to reduce the risk of accident of the user, implementing a braking device that consists in the adaptation of a carabiner located in a specific point (lateral part of the left or right leg) of the pelvic chair, being a fixed point with greater adaptability and anchorage security, allowing to continue with the tasks that are being performed, giving orientation and control to the rope, avoiding knots due to oscillation when releasing the brake rope.

**Keywords:** Descent, support device, national army, pelvic chair.

**RESUMEN**

El presente artículo de investigación surge del proyecto silla pélvica modificada con dispositivo de apoyo al freno para descenso, este proyecto se realiza con base en las experiencias de contingencias presentadas en el primer hombre al momento de descender en la torre de Asalto Aéreo del Ejército Nacional de Colombia, buscando reducir el riesgo de accidentalidad del usuario, implementando un dispositivo de freno que consiste en la adaptación de un mosquetón ubicado en un punto específico (parte lateral pierna izquierda o derecha) de la silla pélvica, siendo un punto fijo con mayor adaptabilidad y seguridad de anclaje, permitiendo continuar con las tareas que estén realizando, dando una orientación y control a la cuerda, evitando nudos por oscilación al soltar la cuerda de freno.

**Palabras clave:** Descenso, dispositivo de apoyo, ejército nacional, silla pélvica.

## Introduction

The Air Assault School trains officers, non-commissioned officers and professional soldiers of the Colombian Armed Forces in the planning, development and execution of air assault operations with emphasis on jungle, combining strategic speed with the tactical mobility of air elements. As a specialty, they have the maneuvers of insertion and extraction of personnel in the most remote and jungle areas of Colombia. This implies the descent from helicopters by means of ropes, which generates a risk for the personnel who descend, especially for the first man, for not having the support of the rope master who is on the ground.

The Air Assault School of the Colombian Armed Forces seeks to specialize military personnel in the highest tower in South America, so that the user socializes with the tower and loses fear, with the above, at the time of certification in aircraft through a

simulation of a normal operation, the military can perform their exercise without any contingency.

In order to continue training military personnel by seeking continuous improvement of both units and equipment in the training and training of special forces, descent training is carried out in a tower of approximately 14 meters. In this structure, which has a cabin similar to that of real helicopters (blajot, MI17, UH) and simulates the distance of an aircraft over the ground, fast rope maneuvers are performed, used when there is a high value target on a flat terrain, with the structure of the tower seeks to optimize the effectiveness of the troops destined in the fight against illegal armed groups or to capture and hold key positions. It is not trained with aircraft, to avoid accidents and reduce costs. In a real assault operation, they descend to more than 60 meters (200 feet). (Colombian National Army Aviation, 2012).

The practice of aerial assault has had a great acceptance within the Colombian armed forces due to the fact that its results in the field have proven to be quite effective. In the training of personnel assigned to military aerial assault operations, the need to create an element that avoids accidents due to slipping or falling into the void or contingencies presented to the first man descending from a helicopter, who faces risks such as loosening the descent rope or brake, knots, and tangles in the material, is recognized. The first man is the one who is most exposed to the dangers of the descent because he does not have someone to provide him with the safety protocol at the end of the rope.

The project focuses on designing a braking device adapted to the certified pelvic chair, which can provide greater safety to users of assault teams, an equipment with a combination of strength and lightness and thus contribute to improve the development of operations, as is the project called "Modified pelvic chair with brake support device for descent".

The braking device proposed for the pelvic chair is a second additional friction point that goes at the height of the leg (right or left depending on the laterality of the descender), which allows to give an orientation and notion of position of the rope. Likewise, friction device number two prevents knots from being tied because it is a control point through which the rope passes. In addition, the vital function in case of rope release is to have a fixed point to place the hand and recover or pick up the rope again, avoiding a free fall over the area of operations. Article 348 of the Substantive Labor and Social Security Code, which was modified by Article 10 of Decree 13 of 1967, stipulates and regulates the hygiene and safety measures to be adopted by companies in different areas of the work environment. (Ministry of Labor).

This design seeks to reduce the risk of accidents and provide the user with greater flexibility, adapting the pelvic harness to create a safer and more effective system even in more demanding situations. This braking device is based on the adaptation of a carabiner to the pelvic harness at a strategic point, allowing control of the rope. It should be emphasized that the main function is to allow a higher survival rate of the first man to descend from a helicopter to a military operations area.

The Universal Declaration of Human Rights in its article 22 (United Nations, 1948) refers to "everyone, as a member of society, has the right to social security and is entitled to realization, through national effort and international cooperation and in accordance with the organization and resources of each State, of the economic, social and cultural rights indispensable for his dignity and the free development of his personality".

## Materials and methods

According to Cruz, et. al, (2020). The use of artificial intelligence tools minimizes research data errors.

The methodological development of the project "Modified pelvic chair with brake support device for descent" will take into account the scope of both the project and the product. (Project Management Institute , 2012) It states:

- Scope of the project: All the processes and the necessary work that the research team must do to provide the product (modified pelvic chair) with the required features and functions.
- Product scope: This refers to the characteristics and functionality that the product generated by the project should have. This scope will have to include all the requirements that were gathered through the stakeholders, as long as they are directly related to the need for which the project was undertaken and to the strategic objectives of the project.

For a clearer perception, the Work Breakdown Structure (WBS) tool will be used, which allows a hierarchical decomposition of the total scope of work, in addition to creating a frame of reference with respect to the sub-deliverables to be delivered.

The scope of the project includes the scope of the product (pelvic chair with modified brake support device). The scope of the product based on the WBS presented had 4 phases:

- **Phase 1:** Prototype design
- **Phase 2:** Prototype Construction
- **Phase 3:** Laboratory Tests
- **Phase 4:** Redesign and final construction

## Results

The "Prototype Design" phase consists of 3 work packages. The first, "CAD Design", is the realization of a virtual prototype of the pelvic chair, in a design program such as AutoCAD, SolidWorks or 3D Max. This will detail the shape, location, characteristics, size, etc., of the brake support device.

***Figure 1.*** Example of a CAD simulated pelvic saddle.

**Source:** Own

Once the CAD (Computer Aided Design) design was completed, the second work package, "Dynamic and Static Analysis", was started. This work package is very important for the development of the pelvic chair, since it allows estimating the behavior under specific operating conditions.

During the CAD design phase of the prototype, the work packages "analysis and selection of textile material" and "analysis and selection of carabiners" were carried out in order to manufacture the first prototype for testing.

For the analysis and selection of textile material, we searched for standards related to the physical properties of the material, based on this we will analyze which of these is the most appropriate for the pelvic chair brake support device, which will be selected for use in the product of the project.

For the analysis and selection of carabiners, different types of carabiners are analyzed, thanks to the CAD design and the dynamic and static analysis, the different loads to which the carabiners may be exposed can be calculated, thus calculating the resistance that the carabiners should have, material and thickness.

Through Resolution 3673 of 2008, the Ministry of Social Protection established the technical regulations for work at heights, a document that at the time became a fundamental pillar for the regulation of work at heights. (SURA, 2008)

It was planned to perform different types of tests on the prototype. Mechanical tests, physical tests and functional tests, each of these tests will be carried out in a laboratory with the necessary equipment and the corresponding report will be obtained.

**Mechanical tests:**

- **Tensile strength:** This test is performed to measure the resistance of a textile material to the applied tensile force, it can be performed directly on the fabric, to measure its maximum tensile strength or to measure the strength of the fastening between fabrics (seams), thus validating if the strength meets the required needs or if it is necessary to change the type of fabric to be used or type of seam made.

***Figure 2.*** Tensile strength

**Source:** Web

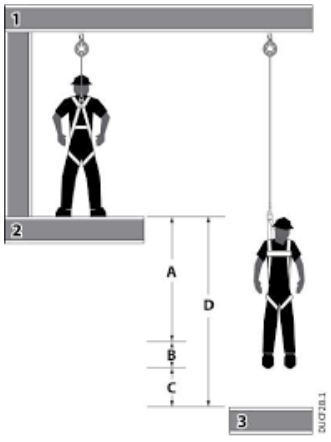
- **Textile fatigue resistance:** It is a test to determine the resistance of seam constructions. For this, a cyclic tension process is performed by means of a machine (the material is tensioned and then untensioned), in order to analyze after how many cycles the seam or fabric can fail, break or unravel. This number of cycles may vary depending on the tension force applied in the cycles.

***Figure 3.*** Fatigue resistance

**Source:** Web

- **Static pull test:** This test is very similar to the tensile strength test, where an increasing force is applied until the seam or fabric fails. The difference is that in this test, a static pull is performed (a specified amount of force in an instant of time). With this it will be possible to know which is the maximum resistance of the material before a moment much force applied in a very short instant of time. (For example, it is calculated if the force with which the product was designed is necessary to support a person in the descent, if it is entangled any and stops abruptly).

***Figure 4.*** Example of Static Pull Test

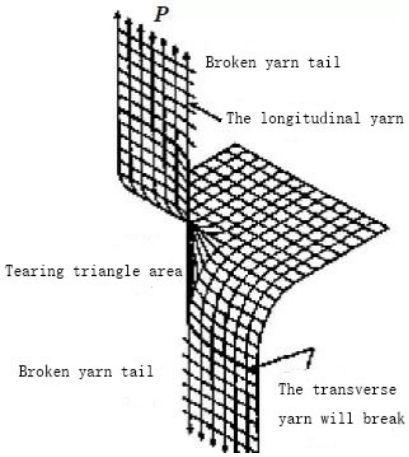



**Source:** Web

**Physical Tests:**

- **Tear Strength:** This is a test to analyze the force needed to perform the tearing, either edge tearing (force needed to initiate the tearing of the material) or internal tearing (force needed to continue with the tearing). This test is used for material characterization and subsequent selection. With it we can obtain criteria to know what would be the durability of the textile.

***Figure 5.*** Textile Tearing Process




**Source:** Web

- **Accelerated aging test:** The accelerated aging test is an artificial procedure that allows to establish what will be the useful life of the product. The procedure consists in using some conditions, but increased, such as heat, humidity, sunlight, etc. This makes it possible to increase the aging of the product. This is done by means of an airtight cabin, where the product is placed for a certain number of hours, each hour of permanence, according to conditions, will be equivalent to a certain number of hours under normal conditions.

***Figure 6.*** Accelerated aging chamber

**Source:** Web

- **Safety Expert Pilot Test:** An expert company in height safety will be in charge of evaluating the performance of the modified pelvic chair in controlled conditions (first prototype), which, after having used and analyzed the product, will issue a concept with comments and recommendations to improve the product. Based on this and on the results delivered in each of the tests performed (both physical and mechanical), the next stage of the project, redesign of the product and construction of a new modified prototype, will begin.

The redesign and construction of the final prototype will consist of three work packages, the first "redesign of the product", followed by the "construction of the final prototype". For the first package, an engineer will redesign the prototype with each of the recommendations gathered in each of the tests and with the concept of the certified height safety expert, this work will be done in a CAD design program, and if possible a 3D sample will be reprinted in ABS plastic.

With this redesign, measurements and new features, we proceed with the second work package, the construction of the final prototype. It will include the observations gathered in each of the tests performed, such as material, type of carabiner, type of stitching, stitching material, etc.

## Conclusions

The project intends, on the one hand, to raise awareness of the military that performs this type of training, the risks that may occur with the current pelvic chair taking into account that the brake is given with the maneuverability of the hand whether left-handed or right-handed, with the design of the prototype we want to reduce this risk by means of a braking device,

On the other hand, to try to detect the real needs that arise in the practice of air assault and to be able to evolve through this design for future air assault training.

The modified pelvic chair with brake device adaptation will serve as equipment to minimize the indicators of fatalities due to malfunction of the chair in the field of operation.

The prototype developed vs. the conventional pelvic chair will generate more sources of strength when used and produced for the different safe works at heights, which originates a better competitiveness with the occupational health sector.

The impact generated by the modified Pelvic Chair with braking device is obtained when the prototype is discarded.

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