

THE MECHANICAL BEHAVIOUR OF A PROTOTYPE OF A BAR FOR PNEUMATIC STRUCTURES

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The most common materials for structures built in civil engineering and architecture are concrete and steel. In another type of engineering, properties of materials for structures are very different. For example, the space technology and the aeronautics use structures in which the lightness is the main property of the material. Under the perspective of the execution of very light structures it is presented the possibility of the design of frame articulated structures constituted by rigidizable bars inflated with air pressure.

The main goal of this work is to characterize the strength behaviour of a single inflated bar with high pressure air. Mechanical tests in laboratory will show the response of an inflated bar under tension, compression and bending. At a long term, the behaviour of a single bar will assist to desing more complex frame structures made by the assembly of inflated bars.

The first chapter of the present work describes actual applications of inflatable structures classified according to their inner pressure and detailing advantages and disadvantages of each type. From this study we proceed with the construction of a prototype of inflated bar stiffened by pressurised air. The objective is to design a prototype with no air losses and capable of bear a high pressure. Breaking test finds its maximum strength and air losses are controlled during test time.

Once the prototype is constructed, we perform bending and compression tests to determine the structural behaviour of the prototype. The tests are made with different values of inner pressure because the inner pressure is one of the fundamental variables in this kind of structure.

By means of bending tests, the curve load-displacement is drawn to find a model of behaviour of the element under bending and a value of the bar stiffness is found. Moreover, we measure the inner pressure of the prototype and determine the influence over the bending behaviour. Finally the distribution of stress and deformations is found using extensometric gages.

By means of the compression tests, the ultimate load is found taking account the instability effects. A load-displacement curve is drawn and the influence of the inner pressure over the compression behaviour is found.

Finally, we compile a list of conclusions of the performed studies and some recommendations for future developments derived from the difficulties found in the design of the prototype and the accomplishment of the tests.