

A Twin Helical Spring Numerical Modeling under Tension Loading

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The Twin Helical Spring (THS) is characterized by its specific and complex geometrical shape. Its form can be defined as being generated by a double rolling of a cylindrical stem. Its frame, of millimetric size, can be employed in industrial applications as for the filament of light-bulb.

To our knowledge, it should be noted that there are no available contributions in the literature dealing with numerical modelling of Twin Helical Springs. Indeed, all the paper consulted focus on analytical or numerical Simply Helical Springs (SHS).

This paper presents the design of 3D geometric model of a twin helical spring and its finite element discretisation in order to study the mechanical behaviour under tension axial loading. This work consists firstly to use tools of the Computer Aided Design (CAD) for the graphic design of the spiralled structure. Composed of linear segments, the three-dimensional spiralled structure in "wire model" is then numerically transcribed as an assignment support of finite elements, from which the mechanical model is generated. The finite element used is the 18 dof Pentaedric element, which allows analysing completely the mechanical response of the double spiralled helical spring under an axial load.

The results show that the normal stress evolution along the references fibers (internal radial fibers and external) describes a sinusoidal form consistent with the theoretical approach. The power of the numerical approach has allowed us to visualize the stress fields (normal, principal and Von Mises) at all structure points, thing that we can not have it with the theoretical approach. The isovalues of Von Mises equivalent stresses clearly indicate a stresses preponderance along the internal and radial fibers so pronounced at the filament straight sections correspondents to $\varphi = 180^\circ$.