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The effect of the elliptical ratio on the tubular energy absorber subjected to lateral loading under quasistatic conditions

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Abstract:

Tubular systems are proposed to be used as energy absorber because they are cheap and easy to manufacture; recently some researchers use the elliptical tube as energy absorber.

In this work, the influence of elliptical ratio (r =D1/D2) on energy absorption capability and load carrying capacity and stress of mild steel elliptical tubes has been investigated both experimentally and numerically, the experimental analyses conducted by using Zwick Type BT1-FB050TN testing instrument.

This machine is universal instrument for performing tensile test and compression test, Fig (1) and bending test and it is consider as an important machine for measuring the mechanical properties of materials and structures. The loading frame consist of two vertical lead screws, a moving crosshead and an upper and lower bearing plate which bears the load of the lead screws. The maximum capacity of the loading frame attached to the table mounted unit is 50KN In this study a velocity between 3-10mm/min was applied to the moving component to ensure the quasistatic conditions whereas velocities between 0.5mm/min and 15 mm/min have been used by many researchers to simulate the quasi-static lateral compression of tubes between various indenters [1-2]. In addition to the experimental work, computational method using ANSYS is used to predict the loading and response of such tubes where series of models was performed with elliptical ratios ranging from 0.5 to 1.5. Comparison of numerical and experimental forcedeflection response is presented.

Fig (1): elliptical and circular tube before and after the compression test.

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It has been found that with changing the elliptical ratio of the tube the loaddeflection curve change and this leads to change the energy absorbed by tube, the changing of the geometrical shape of the tube leads to change the volume of this tube and hence the mass. By reducing the elliptical ratio to 0.5 the tube will absorb 43.3% more energy and the system will gain 102% more in terms of specific energy, fig (2).

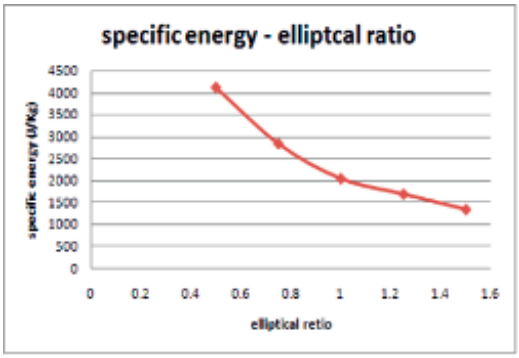

Fig (2): relationship between specific energy and elliptical ratio.

Keywords:

Energy Absorber, ANSYS, Quasi-static analyses, compression test, elliptical tube

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