

LATERAL COMPRESSION OF SQUARE TUBES AND THEIR CROSS LAYERED SYSTEMS

By

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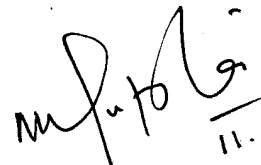


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CERTIFICATE

This is to certify that the thesis entitled "Lateral Compression of Square Tubes and their Cross Layered Systems" by Sri Santosh Kumar Sinha has been prepared under my supervision and has attained a standard required for a Ph.D. degree of the Institute. The thesis is a record of bonafide research work carried out by him and its contents have not been submitted to any other University or Institute for the award of any degree or diploma.



11.6.88

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S.K. SINHA

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ABSTRACT

Mechanical devices or systems for dissipating kinetic energy in a controlled manner or at a predetermined rate are of importance particularly in situations related to the collision of vehicles of various sorts, wherein it is important for the safety of the occupants and the structure that an excessively high rate of retardation is prevented. Devices normally used for this purpose are such items that under the situation of collision, may undergo large plastic deformation in a specified and predictable manner without restitution while absorbing the kinetic energy of the collision. Once subjected to the load and plastically deformed, these items are discarded and replaced. Simple structure elements like wires, bars, frames and tubes form components in such devices because of their capacity to undergo large plastic deformations. It is therefore important to study large deformation plasto-mechanics of these simple elements, the essential requirements being that the devices should be able to dissipate energy irreversibly and possess a more or less rectangular force displacement characteristics.

The present work consists of an experimental study of the quasi-static deformation of single square tubes and

their cross-layered combinations when subjected to lateral compression. The tubes were made of aluminium and mild steel and were tested in as received as well as in annealed conditions. The experiments were generally performed on an Instron machine. The indenters used in the experiments were wedge shaped or flat surfaced. The dimension of the tubes as well as the angle or width of indenters were varied in different experiments. The single tubes were subjected to lateral compression under pairs of identical or non-identical indenters. In cross layered systems both number of tubes in a layer and number of layers were varied. These were sandwiched and compressed between two rigid platens and their deformation behaviour has been studied. The experimental results of the deformation history, the load deformation characteristics and the energy absorbed are presented both for single tubes and their cross layered combinations. Attempt has been made to study the behaviour of single tubes with different combinations of indenters and relate it to the behaviour of cross-layered systems. The analysis presented has been based on plastic hinge formation, with associated assumptions and results thus obtained are compared with the experimental results.

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