TRANSVERSE COLLAPSE OF SQUARE AND RECTANGULAR TUBES AND THEIR CROSS LAYERS

By

ATUL KHULLAR

APPLIED MECHANICS DEPARTMENT

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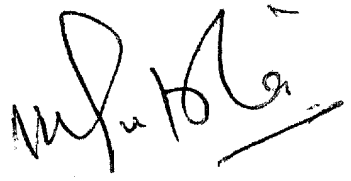
CERTIFICATE

This is to certify that the thesis entitled ' **Transverse Collapse of Square and Rectangular Tubes and their Cross Layers** ' by Atul Khullar 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.



(N.K.GUPTA)
Professor,
Applied Mechanics Department,
Indian Institute of Technology, Delhi.

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ATUL KHULLAR

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ABSTRACT

Study of the collapse behavior of square and rectangular tubes under lateral loading is very necessary and important as it finds application in the design of energy absorbing devices employed to dissipate kinetic energy of impact in a collision. These devices absorb energy by undergoing large plastic deformation in a controlled manner and the devices or their components are normally discarded and replaced after a single use.

Understanding the mechanics of transverse collapse of square and rectangular tubes is also important, as the tubes represent in shape important vehicular and other structures which need to be designed for their crash-worthiness under impact.

The modes of collapse of these tubes undergoing large plastic deformation are quite complex primarily because of the inherent instability of the slender tube walls. Further, as the compression of tubes proceeds, the manner in which energy is dissipated in the stationary and rolling plastic hinges changes. These changes reflect in the nature of the load-compression and energy-compression curves and, therefore, are important to be understood.

In the present work a systematic study of the lateral compression of single tubes of square and rectangular cross-sections, and their orthogonal and non-orthogonal cross layers was undertaken. Single tubes were laterally compressed between (i) two rigid flat overhanging platens; (ii) between a short width indenter and a platen; and (iii) symmetrically between two short width indenters. Short width indenters were placed both orthogonally and non-orthogonally.

Analyses were carried out for all these cases by considering the appropriate hinge patterns formed and the energy absorbed in the stationary and rolling plastic hinges during the collapse of the tubes.

Experiments were conducted wherein orthogonal and non-orthogonal cross layers of single tube on tube were compressed and their results were compared with those of single tubes compressed between short width indenters and platens. Both orthogonal and non-orthogonal cross layers of these tubes were also laterally compressed between flat platens; number of layers as well as number of tubes in each layer were varied in different experiments. The collapse behavior of these combinations were analyzed and related to the behavior of single tube multi-layered cross systems, and results are presented.

The computed results of the analyses in all the cases have been compared with the respective experiments. Predicted location of hinges, the modes of deformation at different compressions, collapse loads, and the load–compression and energy–compression curves show very good agreement with the experiments in each case.

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BIO DATA OF THE AUTHOR