The Influence of Mean Curvature on the Collapse of Sharp-Notched Circular Tubes under Cyclic Bending

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ABSTRACT

This study discusses an experimental investigation of the effect of the mean curvature on the response and collapse of sharp-notched circular tubes subjected to cyclic bending. To highlight the influence of the mean curvature effect, six different curvature ratios $r$ (minimum curvature / maximum curvature) were experimentally investigated. We found that the moment-curvature loop cyclically hardens, and stabilizes after a few cycles for $r = -1$. However, the moment-curvature loop cyclically relaxes and also stabilizes after a few cycles for $r \neq -1$. In addition, the ovalization-curvature curve shows un symmetrical, fluctuating and increasing manner with the number of cycles for any $r$. Finally, the empirical formulation proposed by Pan and Lee (2002) was modified to simulate the relationship between the controlled curvature range and the number of cycles necessary to produce buckling. The results of the experimental investigation and the simulation were in good agreement with each other.

The increasing ovalization causes a progressive reduction in the bending rigidity of the tube. A tube will buckle when a critical magnitude of ovalization is reached. It is therefore of great importance to understand the response and buckling of circular tubes under cyclic bending in many industrial applications.

![Fig. 1. Definition of the ovalization.](image)

Kyriakides and his co-workers designed and constructed a tube cyclic bending machine as shown in Fig. 2, and conducted a series of experimental and theoretical investigations. Shaw and Kyriakides (1985) investigated the inelastic behavior of 6061-T6 aluminum and 1018 steel tubes subjected to cyclic bending. Kyriakides and Shaw (1987) extended the