EFFECT OF YIELD ANISOTROPY ON BUCKLING OF TUBES UNDER BENDING

E. Corona[1], L.-H. Lee[2] and S. Kyriakides[2]

1 Dept. of Aerospace & Mech. Eng.
365 Fitzpatrick Hall
University of Notre Dame
Notre Dame, IN 46556, USA
E-mail: **ecorona@nd.edu**

2 Center Mech. of Solids, Structures & Materials
WRW 110, C0600
The University of Texas at Austin
Austin, TX 78712, USA
E-mail: skk@mail.utexas.edu

Relatively thin-walled tubes bent into the plastic range buckle by axial wrinkling. The wrinkles initially grow stably but eventually localize and cause catastrophic failure in the form of sharp local kinking. The onset of axial wrinkling was previously established by bifurcation analyses that use instantaneous deformation theory moduli. The curvatures at bifurcation were predicted accurately, but the wrinkle wavelengths were consistently longer than measured values. The subject was revisited with the aim of resolving this discrepancy. A set of new bending experiments was conducted on aluminum alloy tubes. The results were in line with previous ones. However, the tubes used were found to exhibit plastic anisotropy. The anisotropy was measured and characterized through Hill's quadratic anisotropic yield function. It was then incorporated in the flow theory used for prebuckling and postbuckling calculations as well as in the deformation theory used for bifurcation checks. With the anisotropy accounted for, calculated tube responses were found to be in excellent agreement with the measured ones while the predicted bifurcation curvatures and wrinkle wavelengths fell in line with the measurements also. The postbuckling response was established using a finite element model of a tube assigned an initial axisymmetric imperfection with the calculated wavelength. The response developed a limit moment that was followed by a sharp kink that grew while the overall moment dropped. The curvature at the limit moment agreed well with the experimental onset of failure. From parametric studies of the various instabilities it was concluded that, for optimum predictions, anisotropy must be incorporated in both bifurcation buckling as well as in postbuckling calculations.

References:

1. E. Corona, L.-H. Lee and S. Kyriakides, "Yield Anisotropy Effects on Buckling of Circular Tubes Under Bending." *Inter'l J. Solids & Structures* (to appear).