Finite Element Modeling of Inflated Fabric Air Beams

Dr. Arthur R. Johnson
Mechanical Engineer
ARL/VTD/NASA Langley

Cadet Daniel F. Lotspeich
United States Military Academy
West Point, New York

ABSTRACT:

Pressurized fabric air beams are used in several Army applications, including temporary medical shelters and aircraft maintenance hangars. Modeling pressurized fabric air beams requires accounting for many elements of beam behavior, including traditional Timoshenko beam theory as well as fabric pre-stress caused by pressure, localized compressive buckling, and volume changes that occur during loading. Three existing models analyze the behavior of these beams. One model accounts for fabric pre-stress, one for the work caused by shear deformations, and another accounts for both behaviors. In this project we evaluated each model using finite element modeling software in Matlab, Fortran, and an Abaqus plug-in to compare the linear (pre-buckling) behavior of each of the approaches to existing pressurized fabric air beam test data.

KEYWORDS: pressurized fabric air beams, finite element modeling, Timoshenko theory

CONTACT: Dr. Arthur R. Johnson, U.S. Army Research Laboratory, Vehicle Technology Directorate, NASA Langley Research Facility

CDT Daniel Lotspeich, United States Military Academy, West Point, NY, Tel: (845) 515-2502, E-mail: Daniel.lotspeich@usma.edu