FIELD OF STUDY

Structural Mechanics

M.S. THESIS TOPIC

HYPERELASTIC MODELING OF ROHACELL FOAMS BY EMPLOYING THE PLANAR TENSION TEST

EXAMINING COMMITTEE

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ABSTRACT

Polymethacrylimide (PMI) foams are increasingly the prime material choice for sandwich structure cores. Rohacell, one of the industry's leading PMI foams, is manufactured in different grades, many of which demonstrate varying degrees of nonlinear elastic behavior. To capture this behavior, a hyperelastic material model was calibrated from test data. The calibration of hyperelastic foam models typically requires test data from difficult and expensive test methods. Motivated by this, a relatively inexpensive test method called the planar tension test was employed to calibrate a compressible hyperelastic foam model known as the Hyperfoam model. The planar tension test was previously used only on hyperelastic elastomers while Rohacell is a more brittle material.

Three different grades of Rohacell were chosen for investigation: 200 WF, 200 HERO, and 71 HERO. A redesign of the classic planar tension test was developed through iterative modeling to be suitable for a brittle material. This test along with the uniaxial tension test was used to calibrate six different variations of the Hyperfoam model for all three Rohacell grades. The performances of the model variations were measured by comparing the model predictions to experimental data. Digital image correlation (DIC), a non-contact strain measurement method, was implemented. Further validation was sought in the design, fabrication, and testing of a novel shear test termed the "Offset-Hole Shear" test, or simply the OHS test.

Multiple variations of the Hyperfoam model were formed by varying the order of the model as well as the data used to calibrate it. The predictions of each variation were compared to the original experimental data as well as the OHS specimen results. The results demonstrated that the planar tension test data did not improve the accuracy of the Hyperfoam model but rather worsened its performance. It was also shown that calibrating the Hyperfoam model with uniaxial data only provides better behavioral prediction than the linear elastic model.

BIOGRAPHICAL SKETCH

Ben Drane began pursuing his bachelor's degree in civil engineering in the fall of 2008 at Tennessee Tech University. He was enrolled into the BS/MS fast-track program during his senior year at TTU and began pursuing his master's degree in civil engineering with a concentration in structural mechanics.

EDUCATION

B.S. Civil Engineering
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College of Engineering

TENNESSEE TECH

The Department of

Civil Engineering

Announces the Thesis Defense

Of

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