

Firehole Technologies Tech Brief

Using Abaqus Crushable Foam Material to Model Honeycomb Cores

Overview

Our goal is to use an Abaqus crushable material to model a stabilized honeycomb core, which has load-displacement behavior similar to the behavior shown in Figure 1.

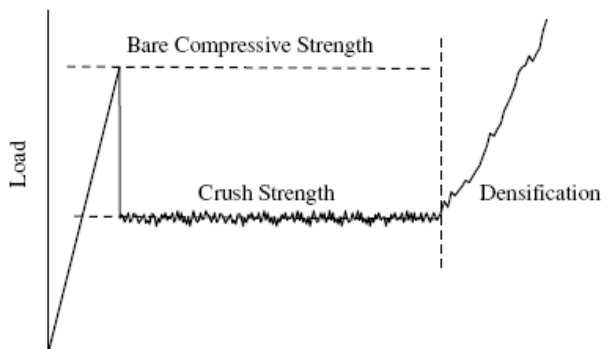


Figure 1. Load-displacement behavior of a honeycomb core. Taken from Othman A.R. and D.C. Barton. (2008) *Comp. Struct.* 85: 126-138.

Input File Commands

To accomplish this, simply use the following commands in the input file to define the core material:

```
*Material, name="Foam core"  
*Elastic  
E, NU  
*Crushable Foam  
1.0, 0.1  
*Crushable Foam Hardening  
Sc, 0.  
Scrush, ep_crush  
0.99*Scrush, ep_max  
Smax, 1.1*ep_crush
```

Required Foam Property Modifications

Abaqus requires that the crushable foam be an isotropic elastic material, so some modifications must be made to the actual foam properties to accommodate this.

- Under the **Elastic** card, **E** is simply the stabilized compressive modulus taken from the datasheet.
- Take the average in-plane shear modulus G from the datasheet and use it to determine the Poisson ratio $\nu = E/(2G) - 1$.
- Under the **Crushable Foam Hardening** card, the uniaxial compressive strength **Sc** (stabilized value) and the compressive crush strength **Scrush** are taken from the datasheet for the honeycomb core. Choose **Smax** to be larger than the largest expected stress.
- The plastic strain after initial crushing **ep_crush** is generally not known from the datasheet. If it is not known, set $ep_crush = 1/E(2Sc - Scrush)$
- The maximum plastic strain due to crushing is also not readily available from the datasheet. As a default value, which may be tuned as needed, choose **ep_max = 0.5**.

About Firehole Technologies

Firehole Technologies supplies innovative computer-aided simulation software and consulting services specializing in analysis of composite materials. Headquartered in Laramie, WY, the company's mission is to enable wide-spread use of composite materials leading to lighter, stronger and more fuel efficient applications. For more information, visit www.fireholetech.com.