SAND2016-XXXX

SAND2016-7970C

Exceptional service in the national interest

Sandia National Laboratories

Yield Surface Effects on Stability and Failure

William M. Scherzinger
Sandia National Laboratories

August 25, 2016

U.S. DEPARTMENT OF ENERGY

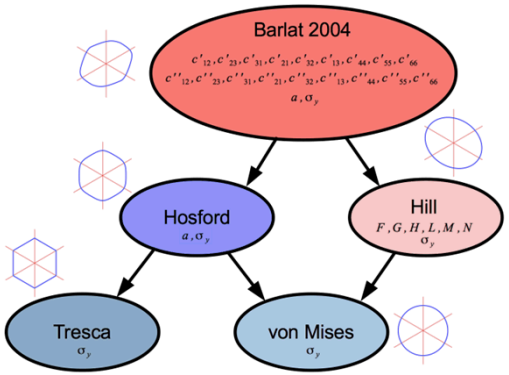
National Nuclear Security Administration

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.
SAND No. 2011–XXXXP.

Plasticity Model Hierarchy

Sandia National Laboratories

Plasticity Model Hierarchy



Model represents material behavior

- How well?
- Compared to other models?

What do we expect?

von Mises :

$$\phi(\boldsymbol{\sigma}) = \sqrt{\frac{1}{2}\left[(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2+(\sigma_1-\sigma_2)^2\right]}$$

Hosford :

$$\phi(\boldsymbol{\sigma}) = \left\{\frac{1}{2}\left[|\sigma_2-\sigma_3|^a+|\sigma_3-\sigma_1|^a+|\sigma_1-\sigma_2|^a\right]\right\}^{1/a}$$

Hill :

$$\phi(\boldsymbol{\sigma}) = \sqrt{F(\hat{\sigma}_{22}-\hat{\sigma}_{33})^2+G(\hat{\sigma}_{33}-\hat{\sigma}_{11})^2+H(\hat{\sigma}_{11}-\hat{\sigma}_{22})^2+2L\hat{\sigma}_{23}^2+2M\hat{\sigma}_{31}^2+2N\hat{\sigma}_{12}^2}$$

Barlat :

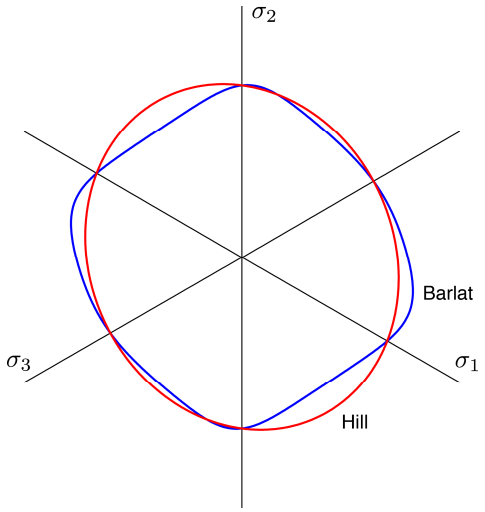
$$\begin{aligned}\phi(\boldsymbol{\sigma}) = \Bigg\{\frac{1}{4}\Big[&|s_1'-s_1''|^a+|s_1'-s_2''|^a+|s_1'-s_3''|^a \\ &+|s_2'-s_1''|^a+|s_2'-s_2''|^a+|s_2'-s_3''|^a \\ &+|s_3'-s_1''|^a+|s_3'-s_2''|^a+|s_3'-s_3''|^a\Big]\Bigg\}^{1/a}\end{aligned}$$

$$\mathbf{s}' = \mathbf{L}' : \boldsymbol{\sigma}$$

$$\mathbf{s}'' = \mathbf{L}'' : \boldsymbol{\sigma}$$

Internal Pressurization of a Cylinder

Sandia National Laboratories



Example of two anisotropic models that give the same yield stresses

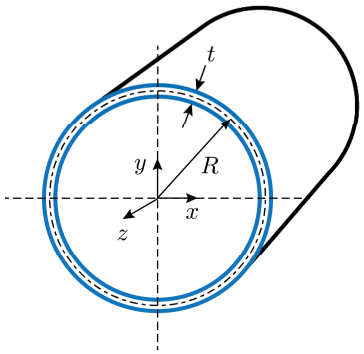
What results do they give?

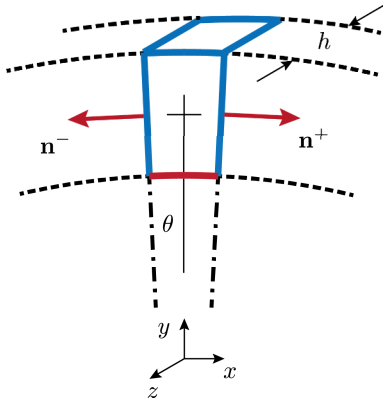
We expect a maximum pressure

How different are our models?

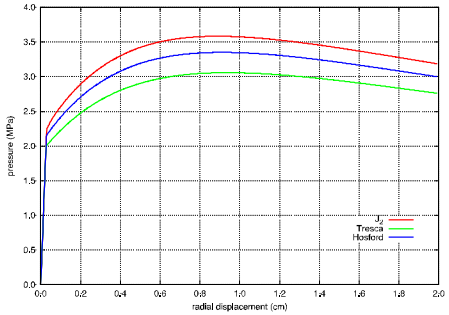
We will consider parameterizations based on uniaxial stress

Internal pressurization of a cylinder





Isotropic



Anisotropic