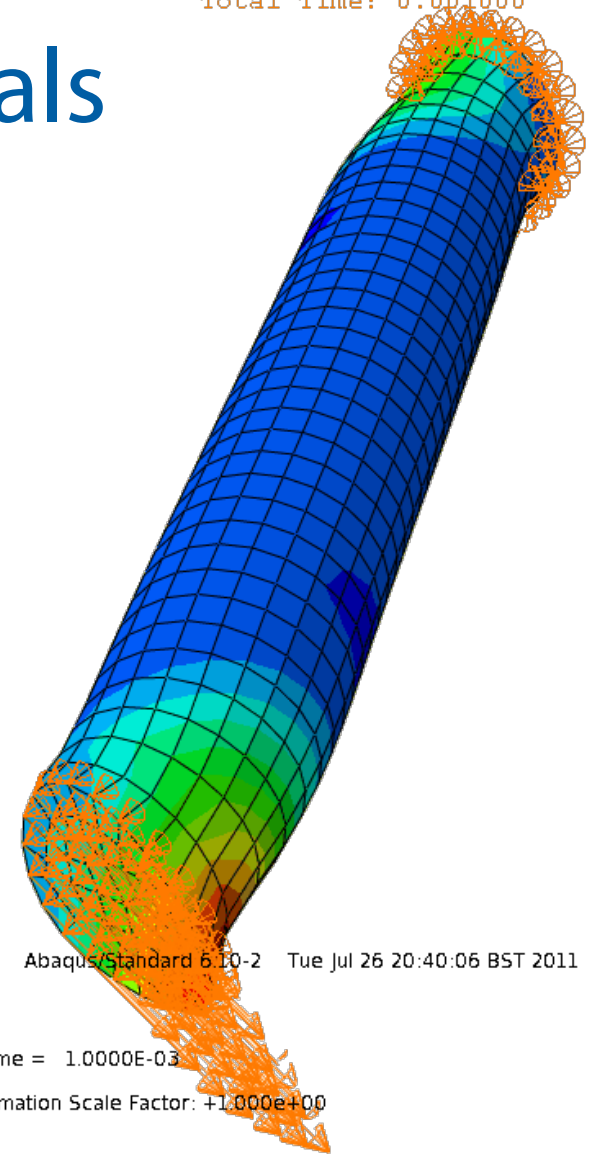# ABAQUS

ME 498CA1 Fall 2016
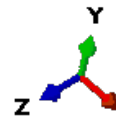
Material, Failure, and Yield Modeling

ABAQUS Materials

Primary References

- *Abaqus/CAE User's Manual, §12.7–11*

- *Getting Started with Abaqus: Keywords Edition, §10*
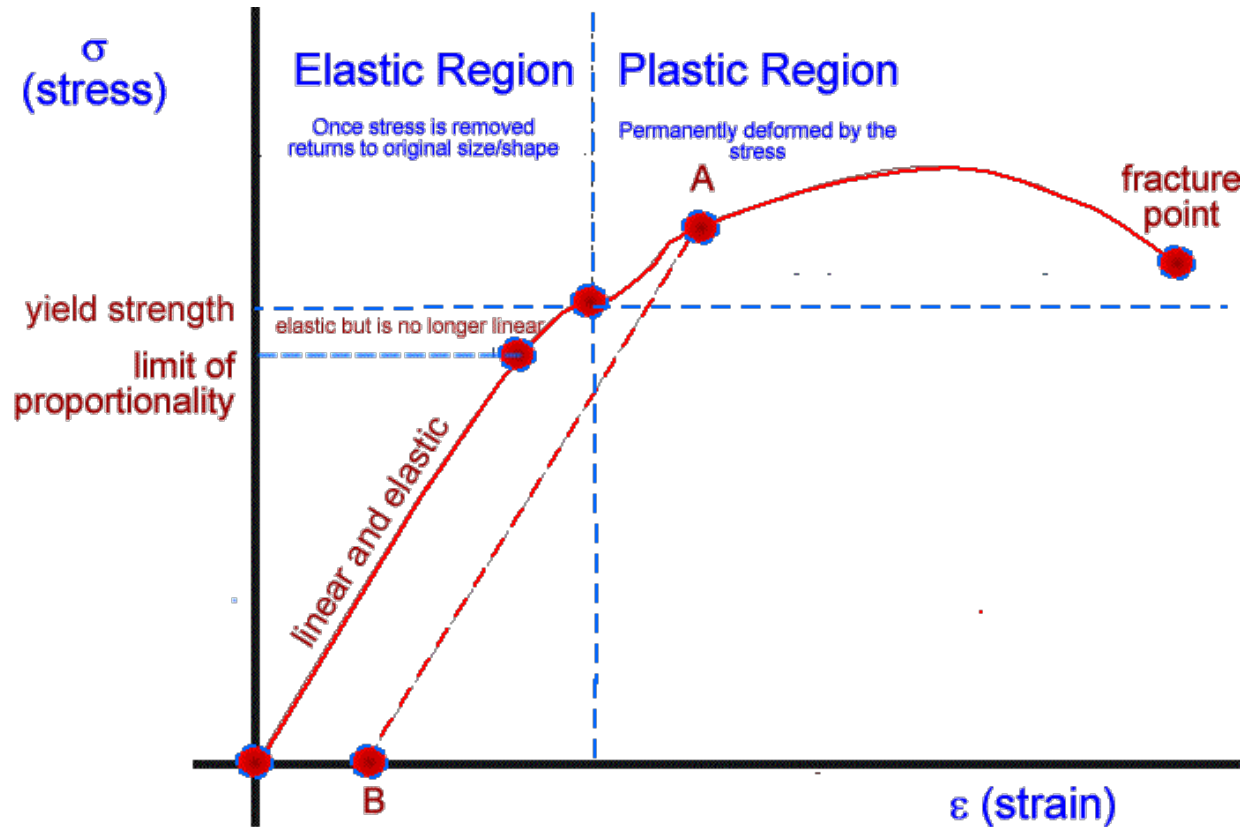
- *Abaqus Theory Manual, §4*

ODB: pl-is-st-bs-usr.odb   Abaqus/Standard 6.10-2   Tue Jul 26 20:40:06 BST 2011

Step: Step-1
Increment   31: Step Time =   1.0000E-03
Primary Var: SDV8
Deformed Var: U   Deformation Scale Factor: +1.000e+00

Computational Science
and **Engineering**

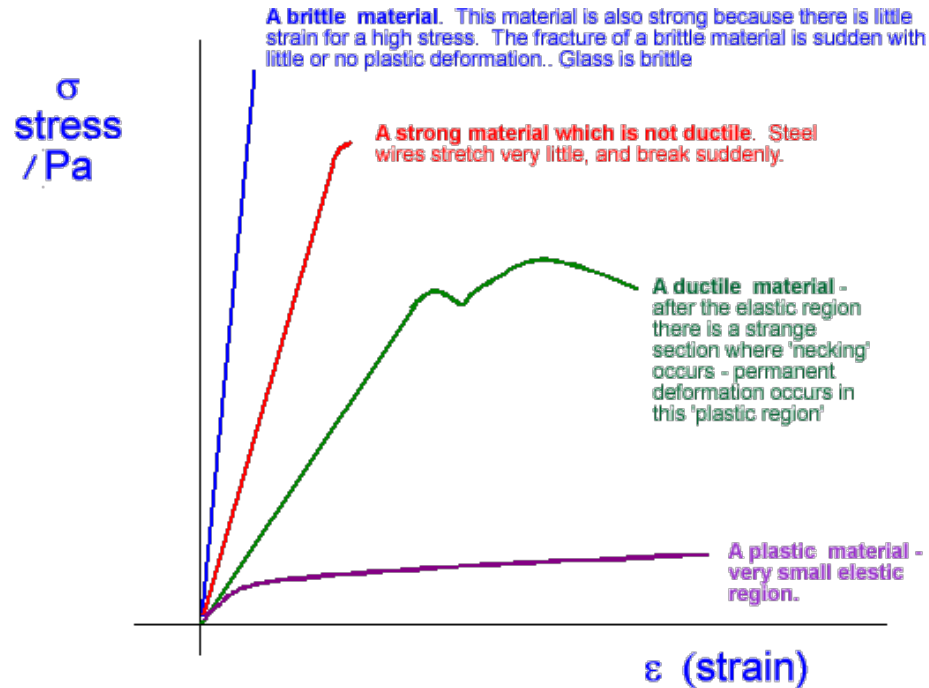# ABAQUS Materials

Stress–Strain Modeling

ABAQUS Materials

Models

- **Elastic**—Purely elastic response (linear or hyper)
  - *simple models, rubber, solid propellant, elastomer*
- **Plastic**—Ductility beyond yield
  - *metal, clay, ice at low strain*
- **Particulate**—Friction-dominated
  - *sand*
- **Brittle**—Little yield before failure
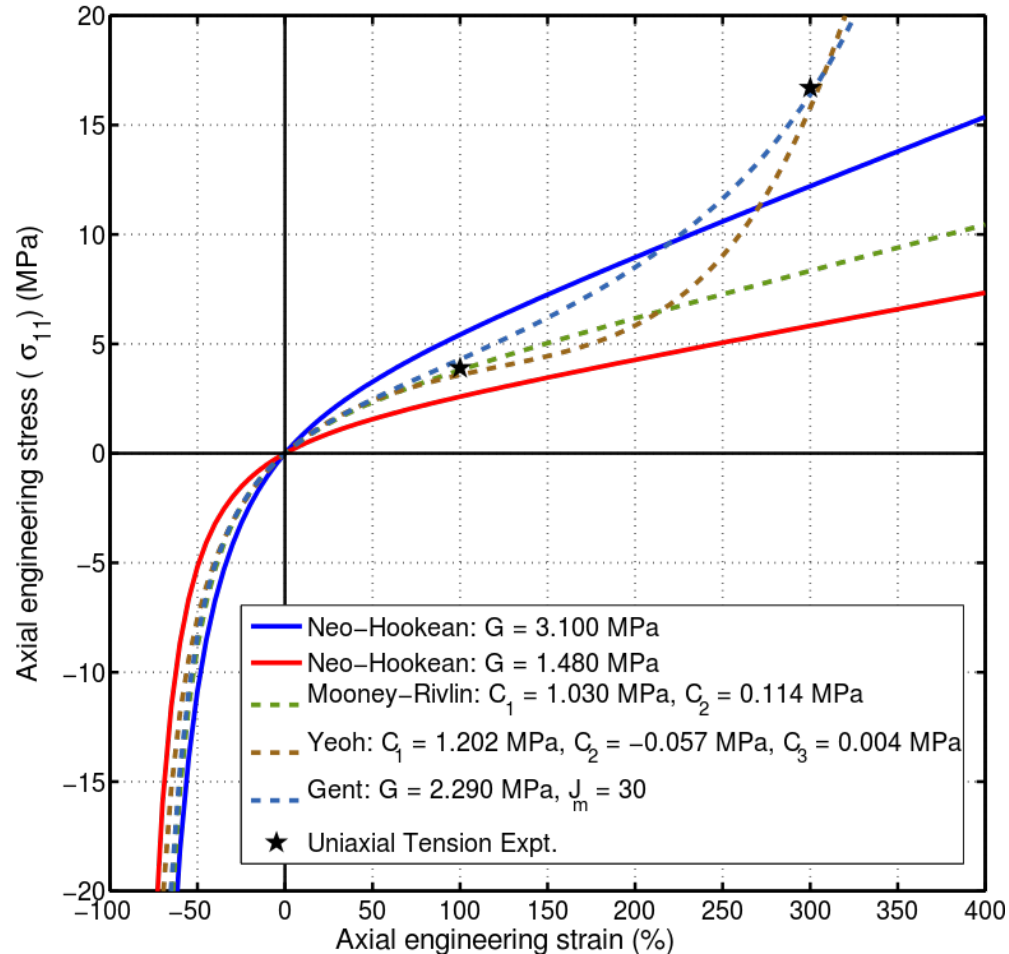 - *rock, concrete, ceramic*

ABAQUS Materials
Models

ABAQUS Materials

Models—Hyperelasticity

Uniaxial stretch with K=2180 GPa

Legend:
- Neo–Hookean: G = 3.100 MPa
- Neo–Hookean: G = 1.480 MPa
- Mooney–Rivlin: C_1 = 1.030 MPa, C_2 = 0.114 MPa
- Yeoh: C_1 = 1.202 MPa, C_2 = −0.057 MPa, C_3 = 0.004 MPa
- Gent: G = 2.290 MPa, J_m = 30
- ★ Uniaxial Tension Expt.

Axial engineering stress (σ_{11}) (MPa)
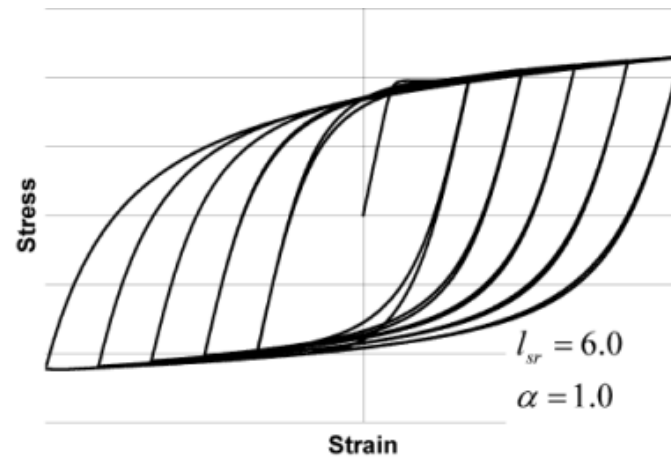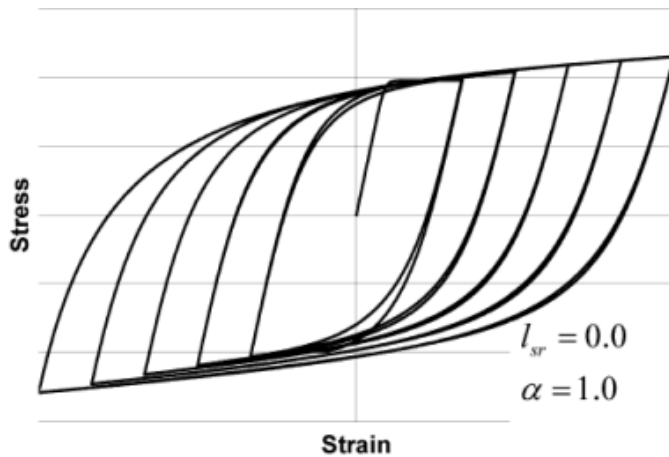Axial engineering strain (%)

ABAQUS Materials
Models

- Inelastic models
  - *classical plasticity (metals)*
  - *cyclic loading/hardening*
  - *rate-dependent yield*
  - *creep/swelling (incl. anisotropicity)*
  - *annealing/melting*
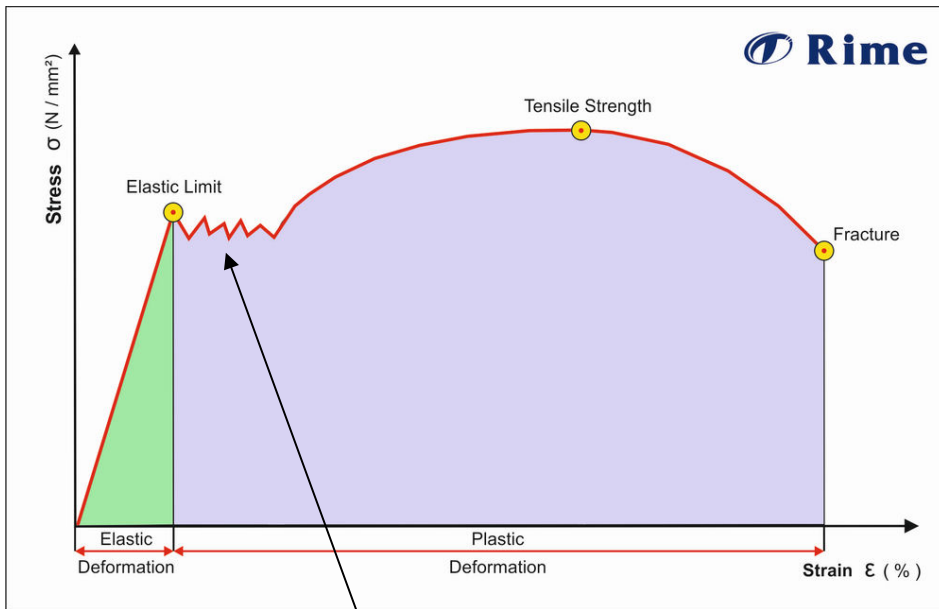 - *dynamic failure (Abaqus/Explicit)*
  - *etc.*
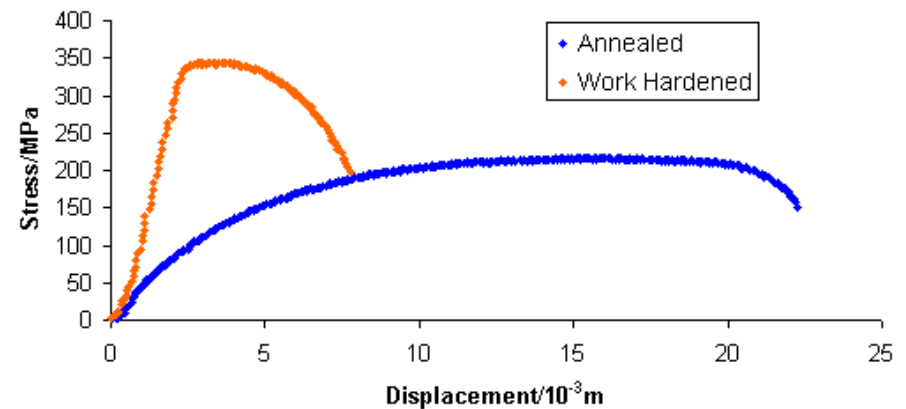
ABAQUS Materials

Models—Cyclic Hardening

$l_{sr} = 0.0$
$\alpha = 1.0$

$l_{sr} = 6.0$
$\alpha = 1.0$

ABAQUS Materials

Models—Work-Hardening/Annealing

strain hardening

ABAQUS Materials

Models—Internal Representation

Plasticity data

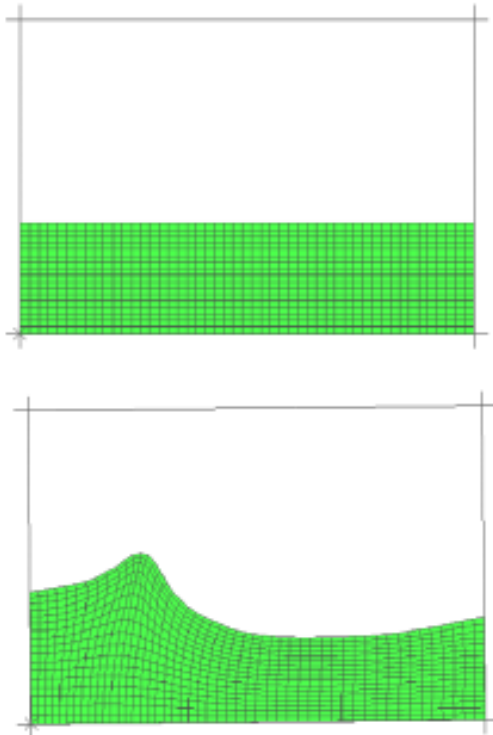Computational Science
and **Engineering**
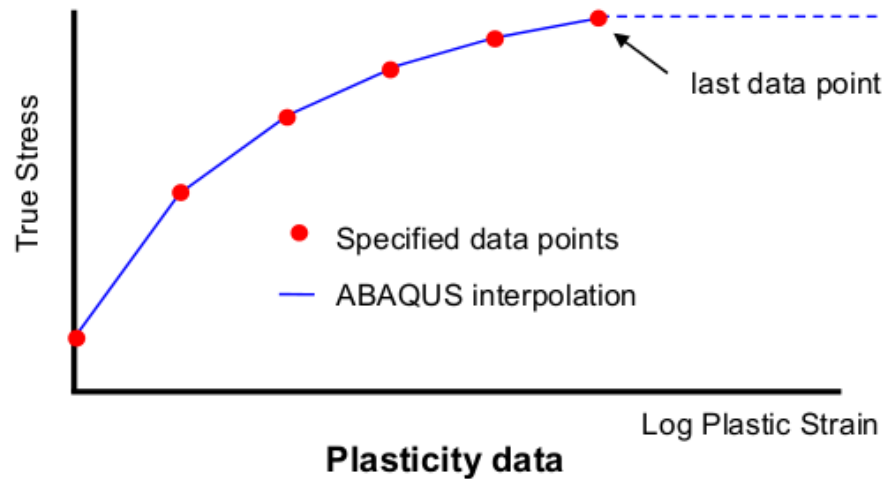
ABAQUS Materials

Models—Brittleness
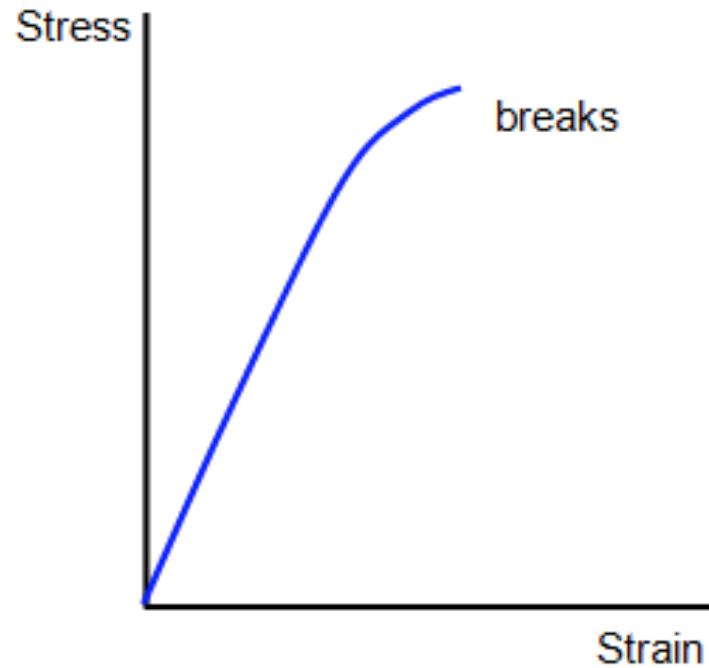
ABAQUS Materials

Models—Hydrodynamic/EOS

Simulation of water sloshing in a tank using hydrodynamic material models.