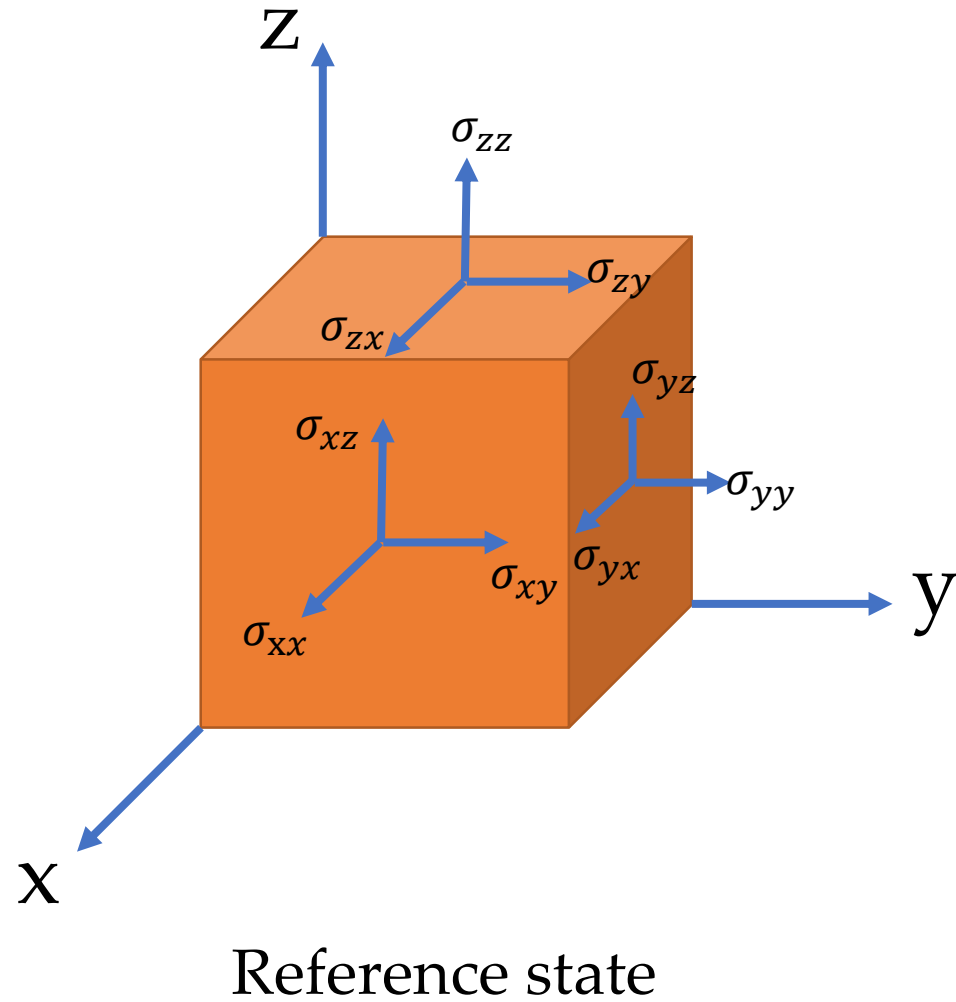


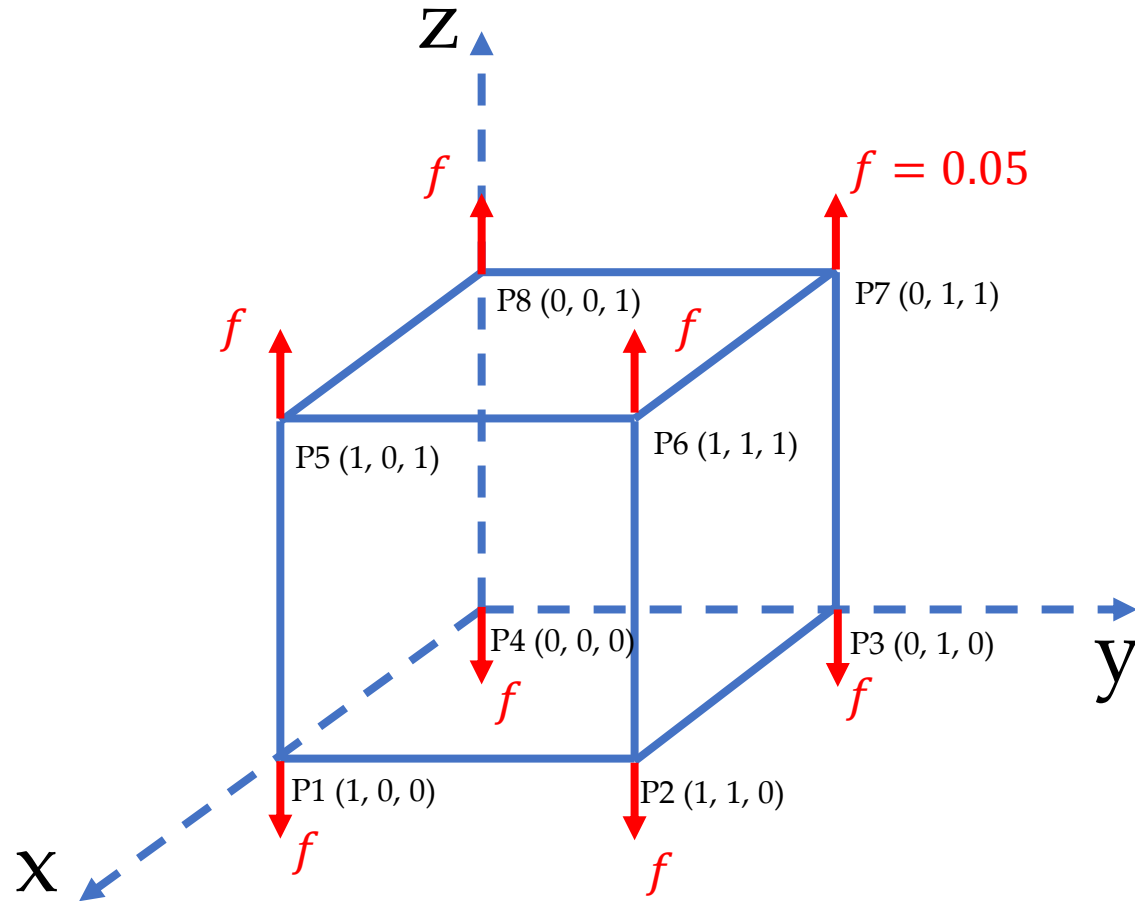
Uniaxial tension of an elastic cube



Stress and strain tensors? Geometric nonlinearities?

NLGEOM = OFF

A single element test (ABAQUS C3D8)



Stress-strain law $S_{33} = E e_{33}$

Definition of Poisson's ratio $\nu = -\frac{e_{trans}}{e_{longitudinal}}$

Nominal Stress $S_{33} = \frac{F}{A_0} = 0.2$

Nominal Strain

$$e_{33} = \frac{S_{33}}{E} = 0.2$$

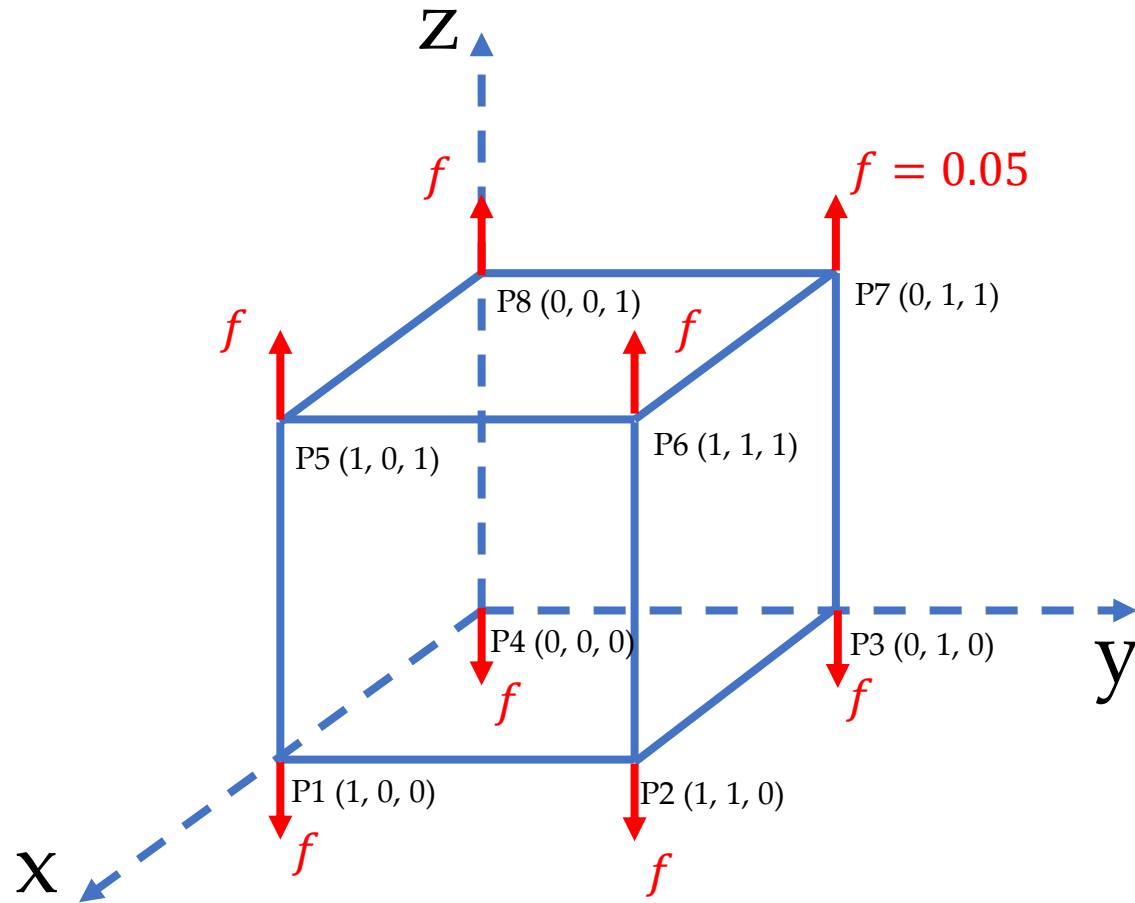
$$e_{11} = -\nu e_{33} = -0.06$$

$$e_{22} = -\nu e_{33} = -0.06$$

Linear elastic material $E = 1, \nu = 0.3$

NLGEOM = ON

A single element test (ABAQUS C3D8)



Linear elastic material $E = 1, \nu = 0.3$

Stress-strain law $\sigma_{33} = E \varepsilon_{33}$

Definition of Poisson's ratio $\nu = -\frac{\varepsilon_{trans}}{\varepsilon_{longitudinal}}$

Logarithmic Strain $\varepsilon = \ln(1 + e)$

Cauchy Stress $\sigma_{33} = \frac{F}{A}$ $A = (1 + e_{11})(1 + e_{22})$

Logarithmic Strain

Now we have a system of seven equations and seven unknowns!

$$\varepsilon_{33} = \frac{\sigma_{33}}{E}$$

$$\varepsilon_{11} = -\nu \varepsilon_{33}$$

$$\varepsilon_{22} = -\nu \varepsilon_{33}$$

$$\varepsilon_{11} = \ln(1 + e_{11})$$

$$\varepsilon_{22} = \ln(1 + e_{22})$$

ABAQUS Results

$$\sigma_{33} = 0.2295$$

$$\varepsilon_{33} = 0.2295$$

$$\varepsilon_{11} = -0.06886$$

$$\varepsilon_{22} = -0.06886$$

Stress measures

The stress measure used in ABAQUS is Cauchy or 'true' stress, which corresponds to the force per current area. Note that for geometrically linear analysis (NLGEOM=OFF), Cauchy stress and nominal stress are equal, since the infinitesimal strain theory is applied and the geometry can be assumed to be unchanged.

Strain measures

Unlike "true" stress, there is no clearly preferred "true" strain. For geometrically nonlinear analysis (NLGEOM=ON), a large number of different strain measures exist (integrated strain measure E, nominal strain measure NE, and logarithmic strain measure LE). LE is the default strain measure for output to the output database (.odb) file and E is the default strain measure for output to the data (.dat) and results (.fil) file. Note that for geometrically linear analysis (NLGEOM=OFF), all strain measures are equal.