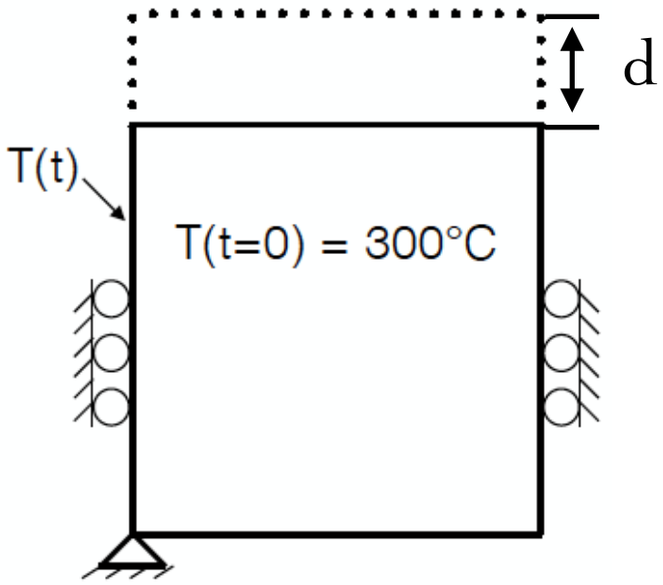
Verification Tests on Multiphysics Problem

Thermal expansion (one way coupling)

Initial and boundary conditions



$$\boldsymbol{F} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1+d & 0 \\ 0 & 0 & 1+d \end{bmatrix}$$

$$^{h}\boldsymbol{F} = \begin{bmatrix} 1+\alpha\triangle T & 0 & 0 \\ 0 & 1+\alpha\triangle T & 0 \\ 0 & 0 & 1+\alpha\triangle T \end{bmatrix}$$

$$^{e}\boldsymbol{F} = \boldsymbol{F}\,{}^{h}\boldsymbol{F}^{-1}$$

Analytical solution

$$\nabla \cdot \boldsymbol{\sigma} = \mathbf{0}$$

where

$$\boldsymbol{\sigma} = \mathrm{f}(\mu, k, {}^{\mathrm{e}}\mathbf{F})$$

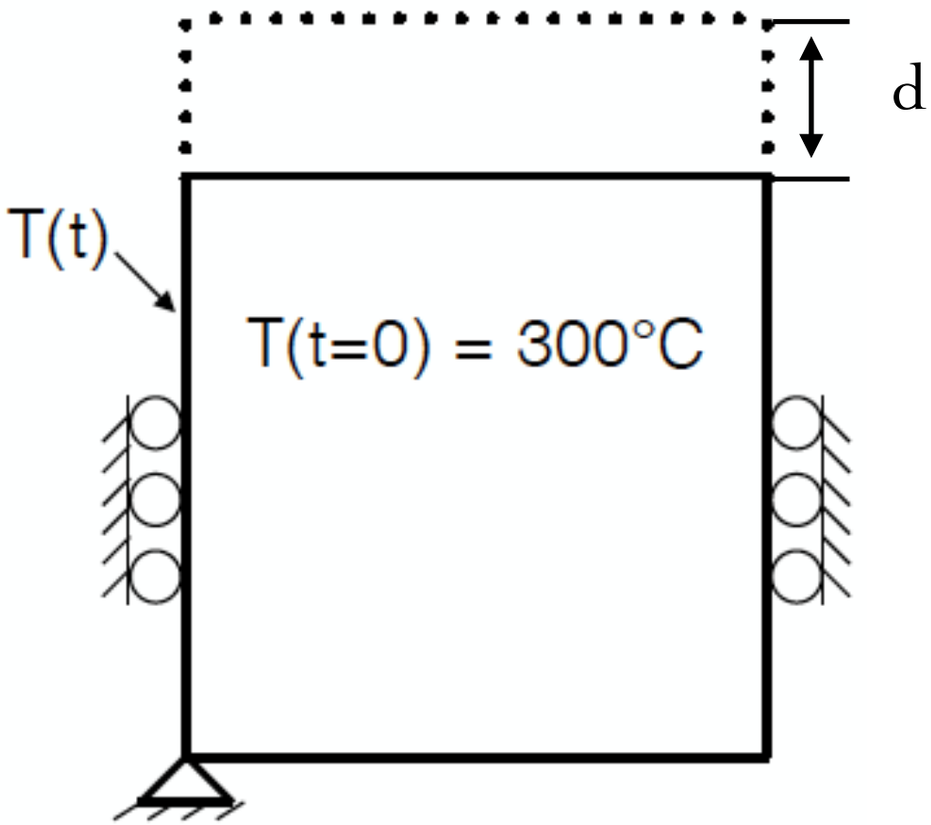
$u_1 = 0$

$T = T_0 + \Delta T \times t \quad \text{on} \quad X_1 = 0$

$$\sigma_{22} = \sigma_{33} = 0 \quad \Rightarrow \quad 2\mu \left\{ \frac{(d+1)^2}{2(\alpha\triangle T+1)^2} - \frac{1}{2} \right\} + \frac{\kappa \left\{ \frac{(d+1)^2}{(\alpha\triangle T+1)^3} - 1 \right\}}{\alpha\triangle T+1} = 0$$

Verification Tests on Multiphysics Problem

- Thermal expansion (one way coupling)
  - Parameters



$$
\begin{aligned}
\Delta T &= 118.7 \\
T_0 &= 300 \\
\alpha &= 0.01 \\
\mu &= 1.2 \\
\kappa &= 2 \\
t &= 1
\end{aligned}
$$

$u_1 = 0$

$T = T_0 + \Delta T \times t$ on $X_1 = 0$

  - Analytical solution
    - d = 1.5
    - Residual force = -7.106996