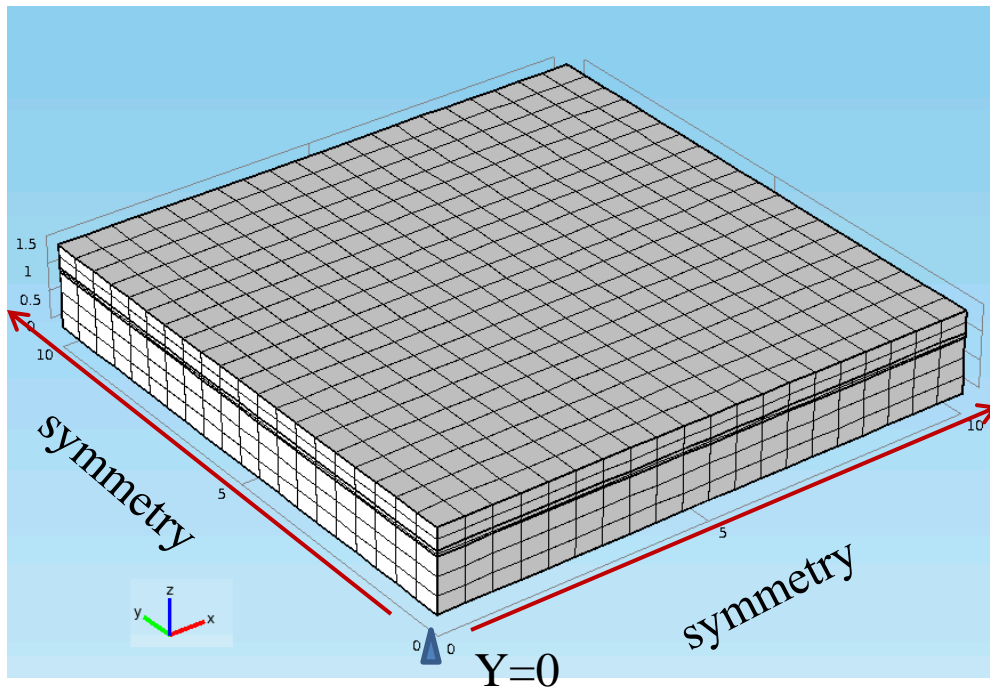


# The Linear Elasticity Material Model



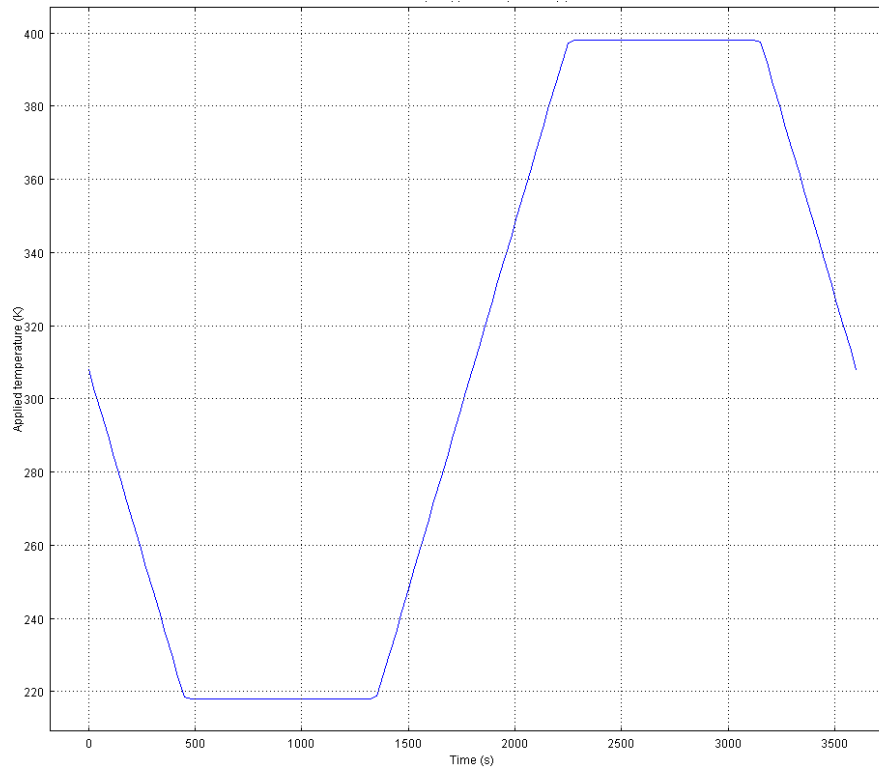
3D Quarter symmetric model

### Geometry dimensions

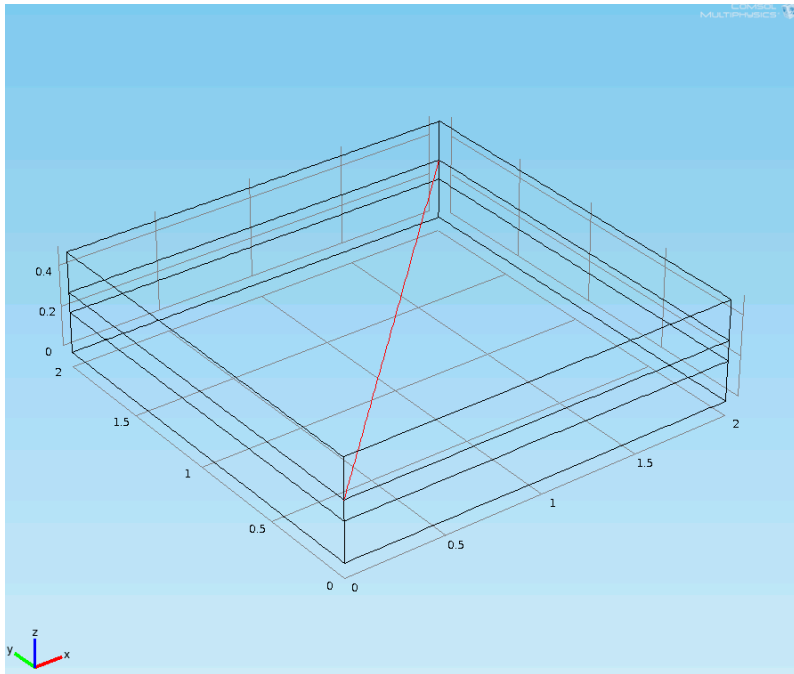
| Components          | Thickness (mm) | Length(mm) | Width(mm) |
|---------------------|----------------|------------|-----------|
| <b>Silicon</b>      | 0.2            | 2          | 2         |
| <b>Solder layer</b> | 0.1            | 2          | 2         |
| <b>Copper plate</b> | 0.2            | 2          | 2         |

# Physical properties

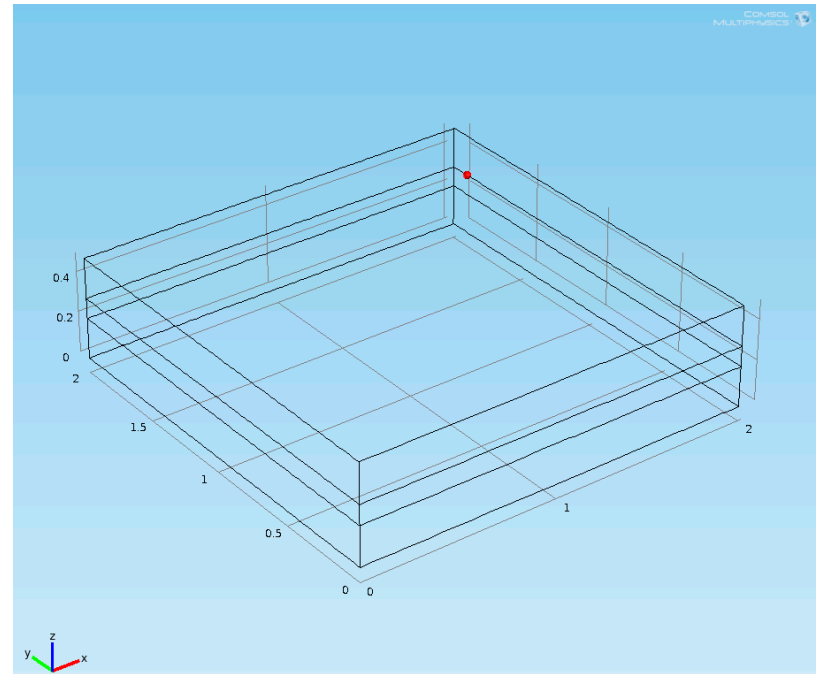
| Components | Young's modulus [GPa] | Poisson's ratio | CTE [1/K] |
|------------|-----------------------|-----------------|-----------|
| Silicon    | 110                   | 0.28            | 2.3e-6    |
| Solder     | 10                    | 0.4             | 25e-6     |
| Copper     | 110                   | 0.35            | 17e-6     |



Applied thermal cycle



the chosen diagonal on the top surface of the solder layer



the chosen point at the edge of the top surface of the solder layer

# Mesh convergence

- Linear element type

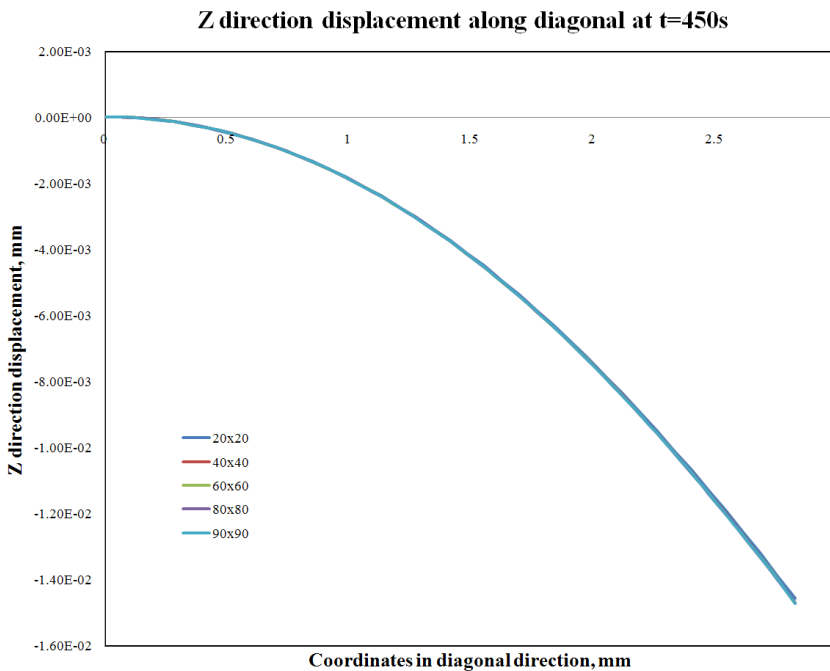


Fig. 1 Z-direction component displacement along diagonal

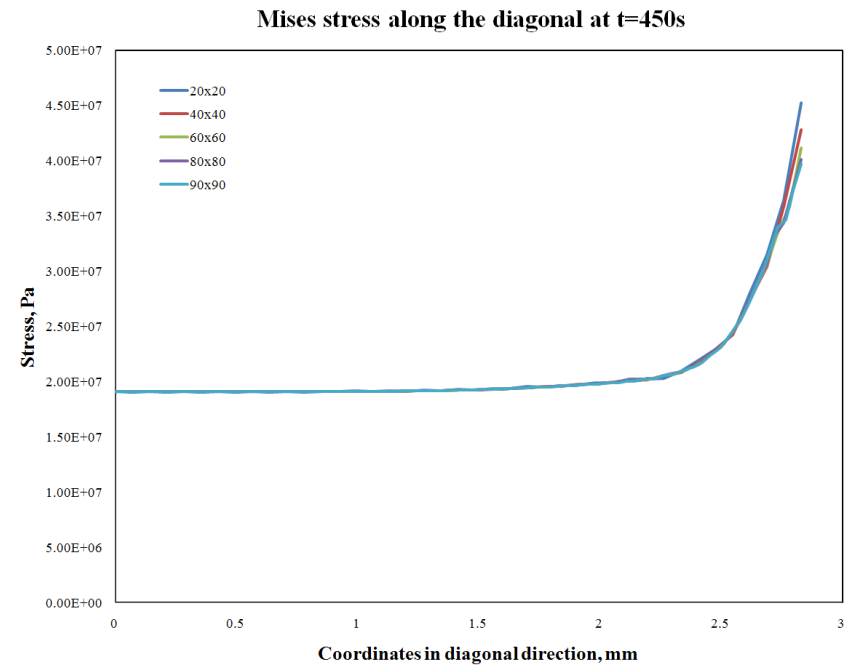


Fig. 2 Von mises stress along diagonal

**Displacement at the chosen point**

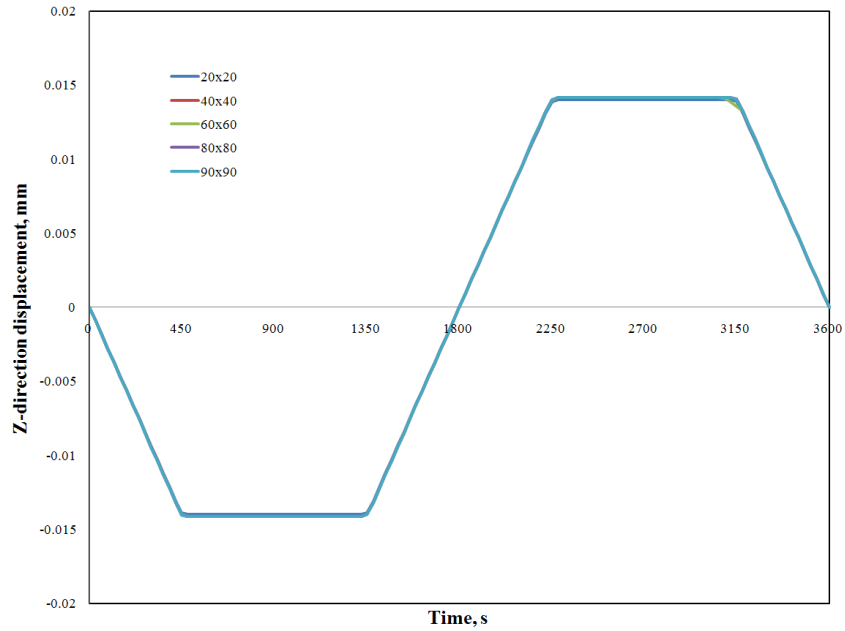


Fig. 3 Z-direction component displacement at the chosen point

**Mises stress at the chosen point**

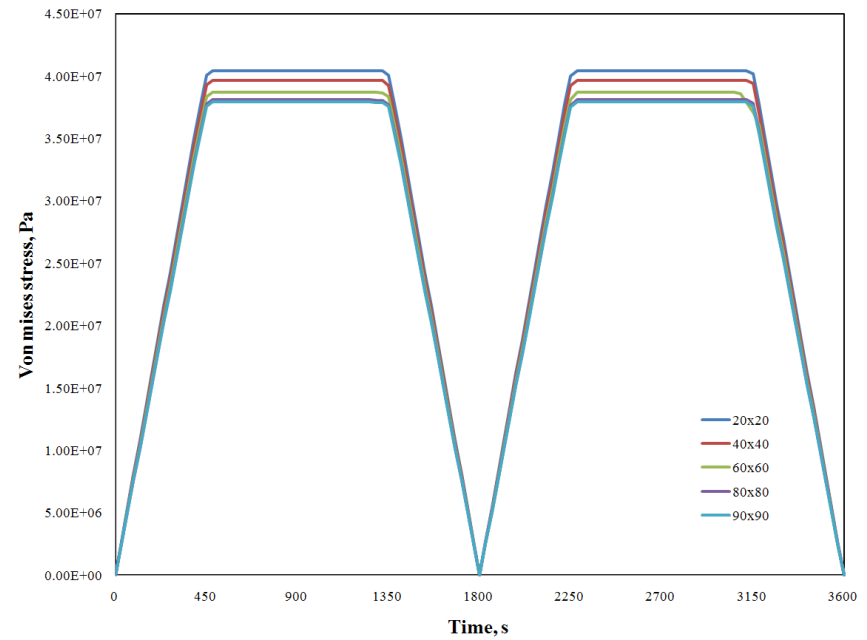


Fig. 4 Von mises stress at the chosen point

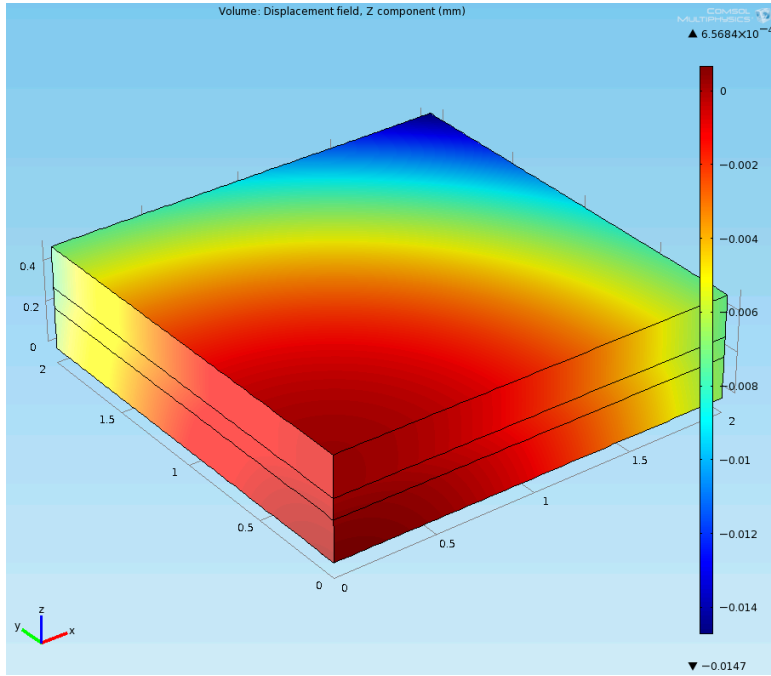


Fig. 5 Z-direction component displacement at t=450s

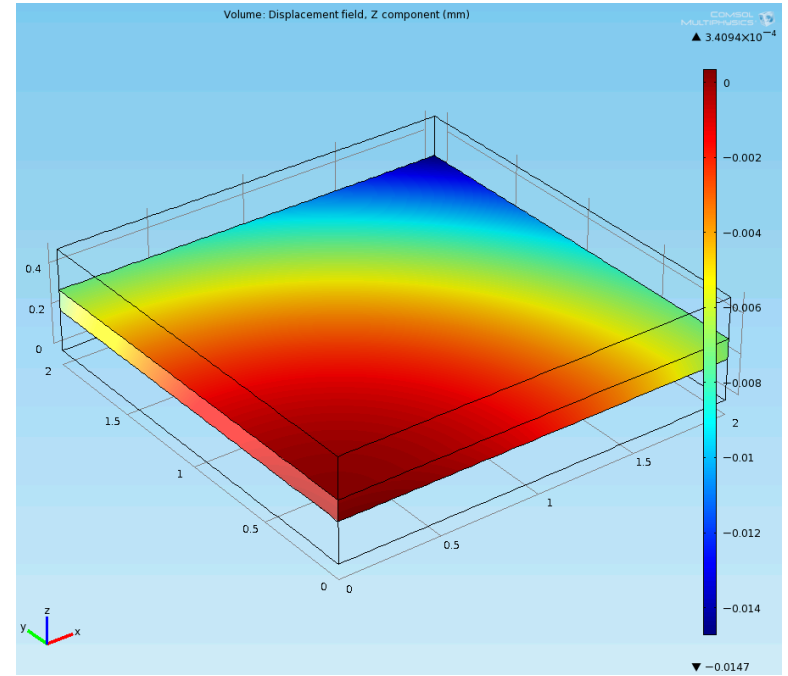


Fig. 6 Z-direction component displacement of solder layer at t=450s

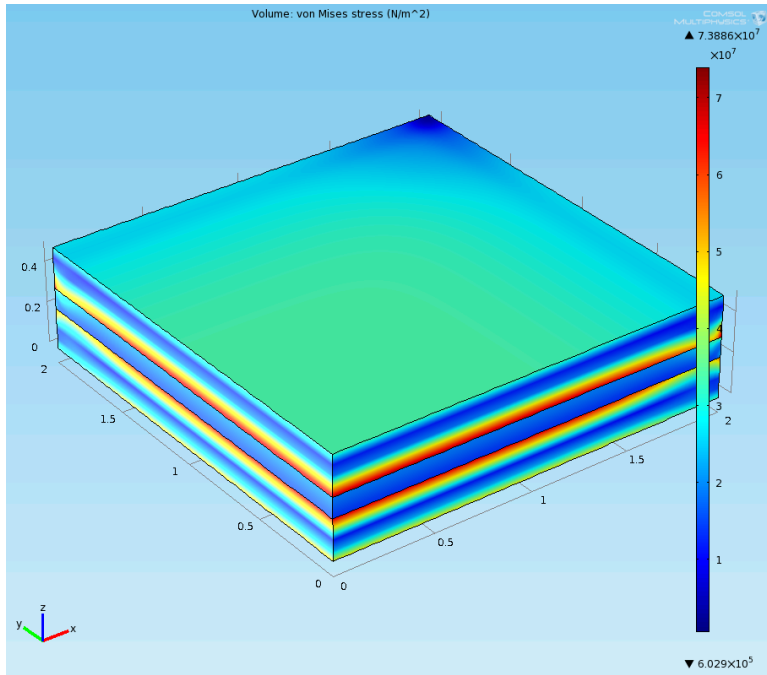


Fig. 7 Von mises stress distribution at t=450s

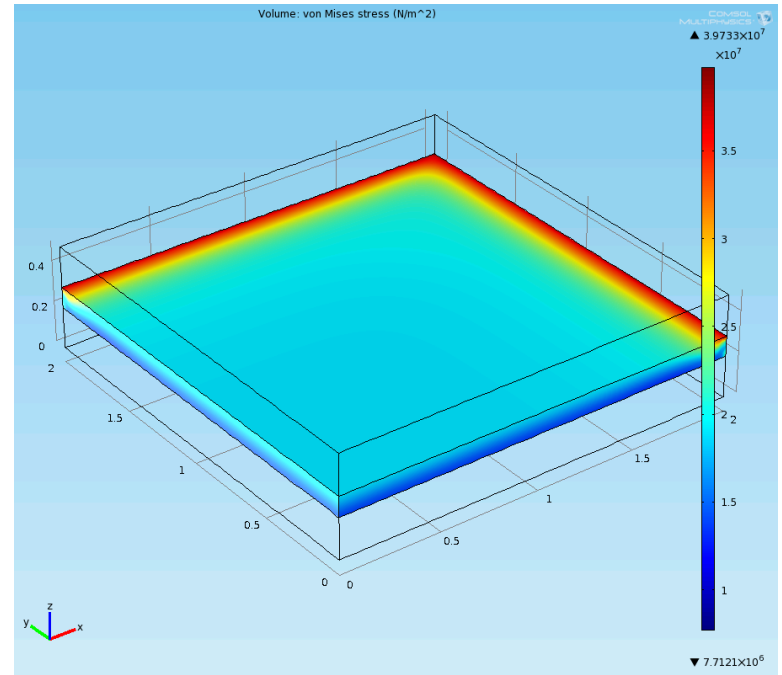


Fig. 8 Von mises stress distribution of solder layer at t=450s



- Quadratic element type

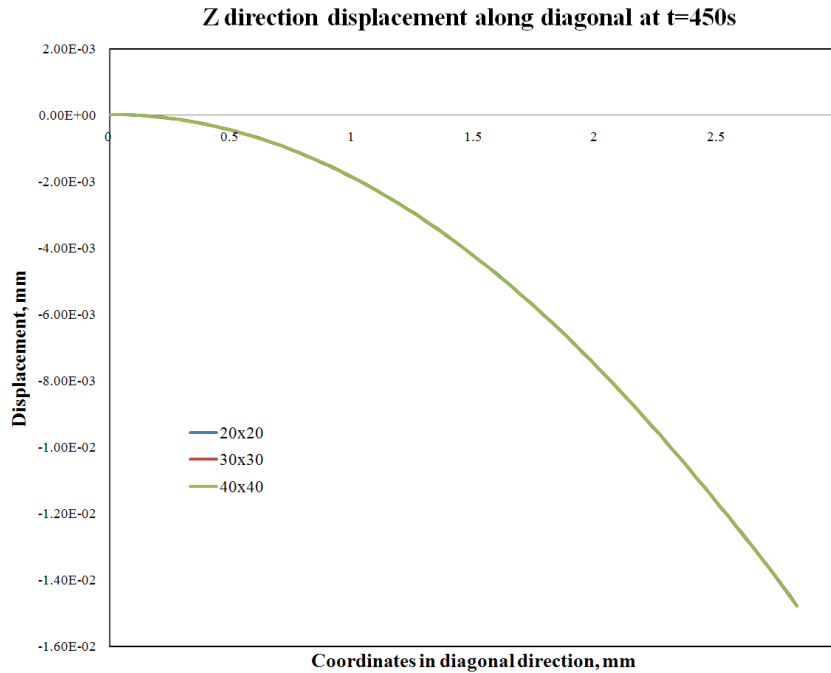


Fig. 9 Z-direction component displacement along diagonal

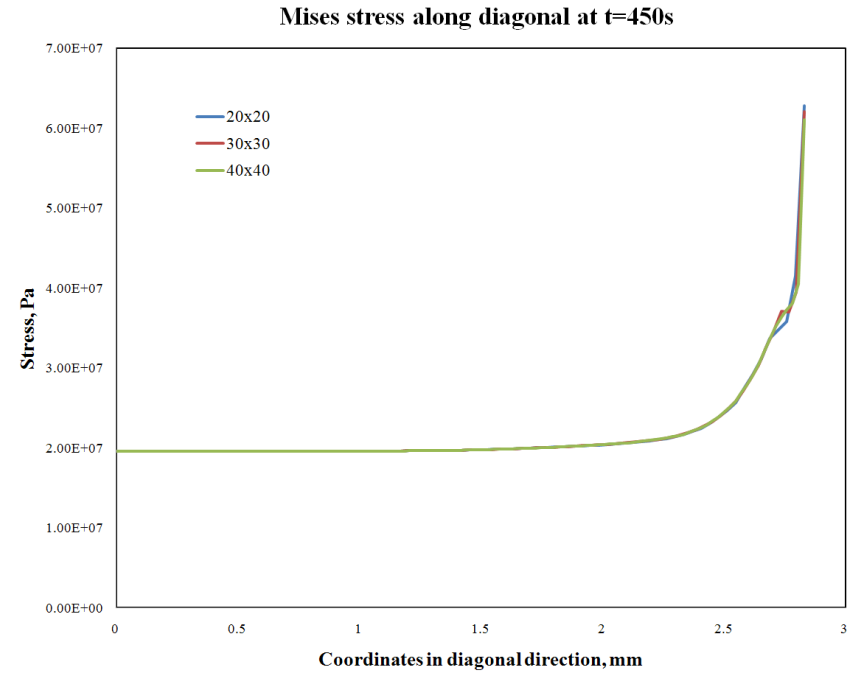


Fig. 10 Von mises stress along diagonal

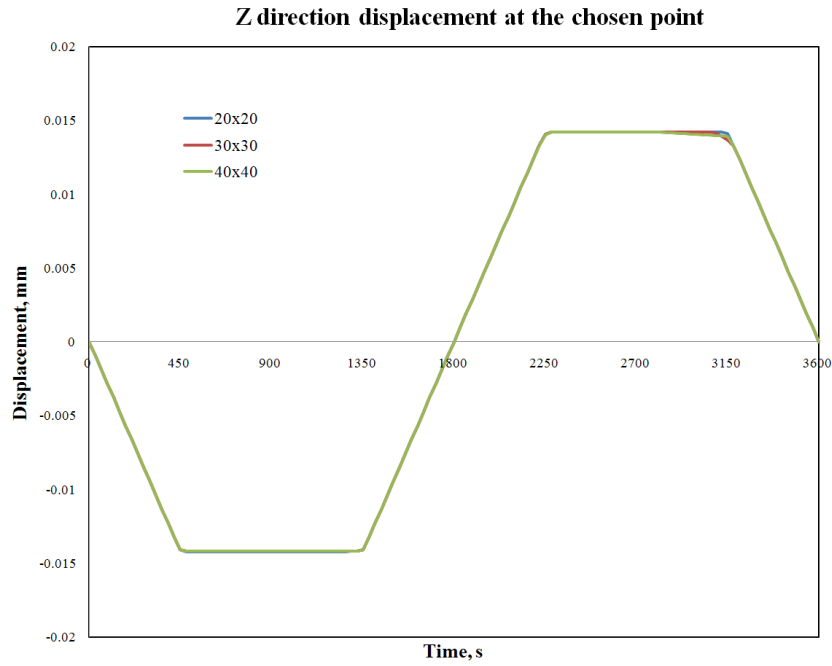


Fig. 11 Z-direction component displacement at the chosen point

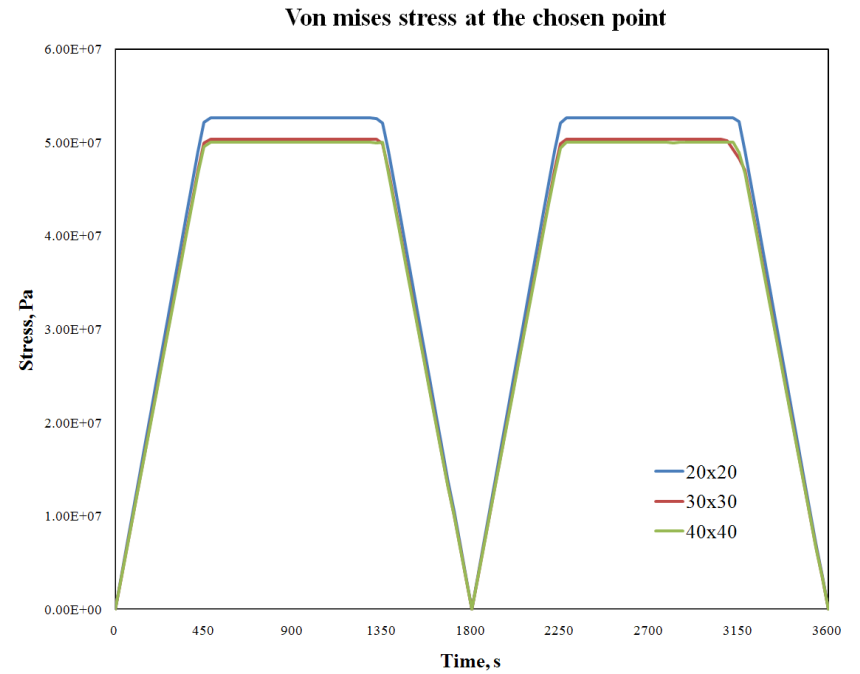


Fig. 12 Von mises stress at the chosen point

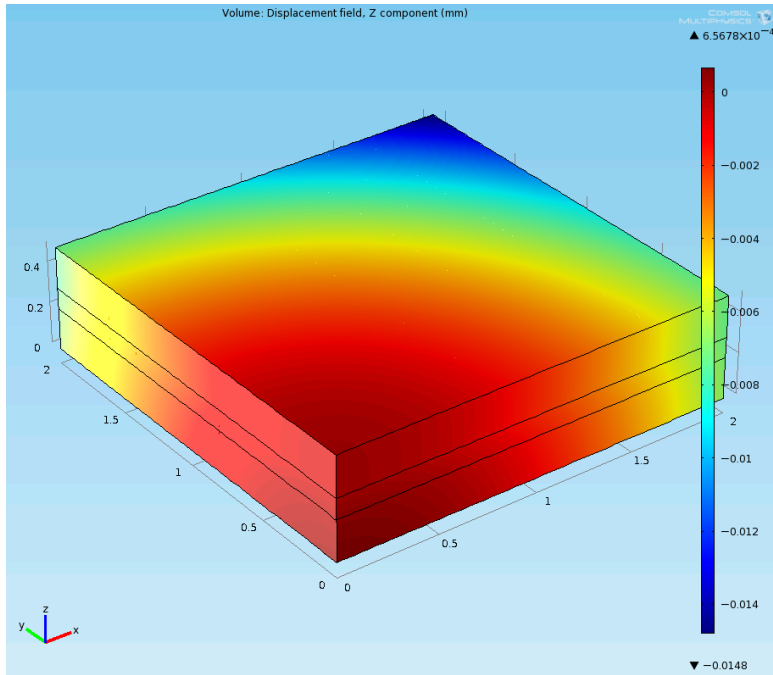


Fig. 13 Z-direction component displacement at t=450s

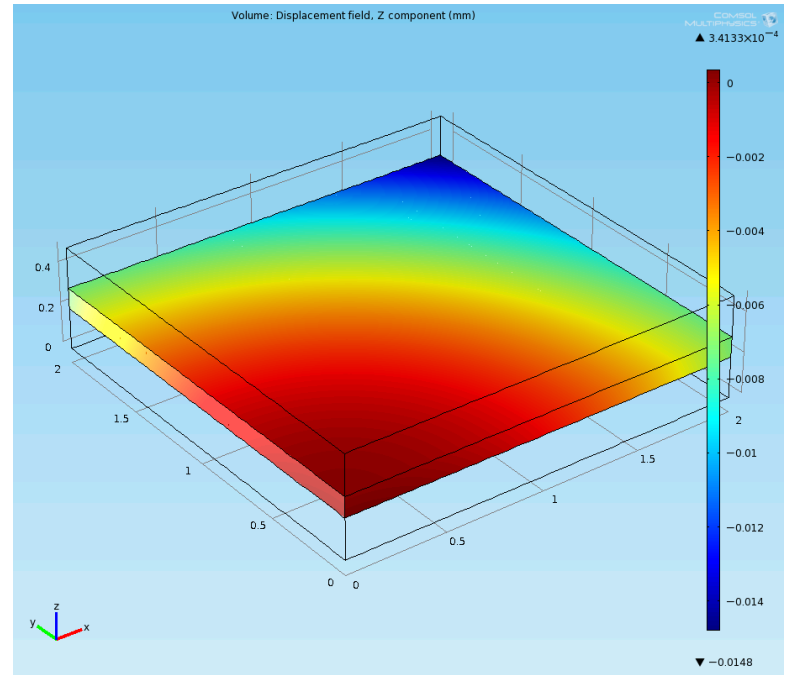


Fig. 14 Z-direction component displacement of solder layer at t=450s

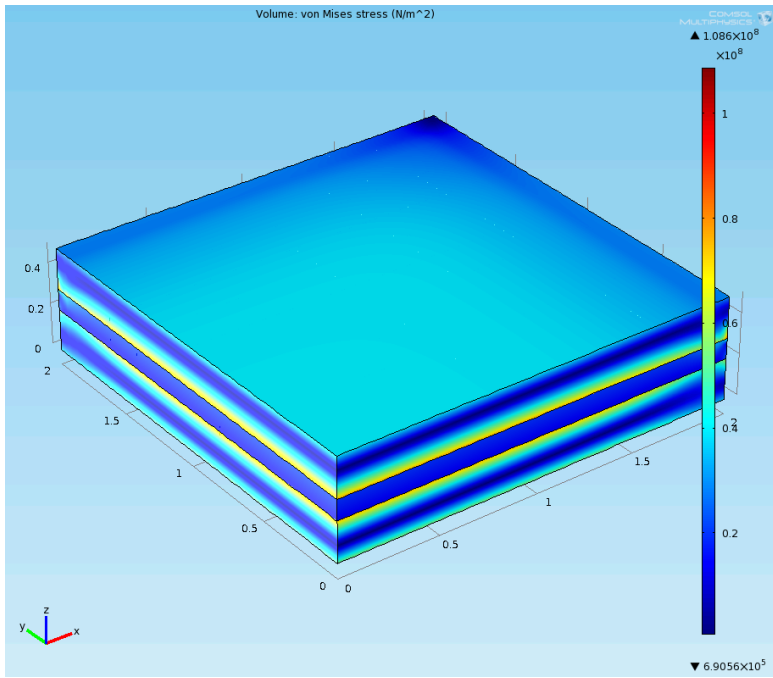


Fig. 15 Von mises stress distribution at t=450s

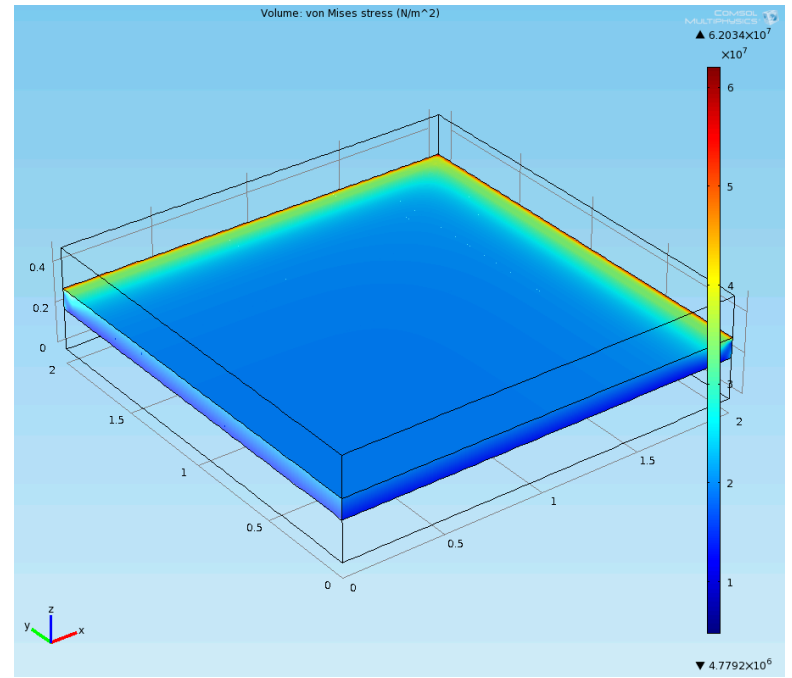


Fig. 16 Von mises stress distribution of solder layer at t=450s

# Comparison between Quadratic and linear element types

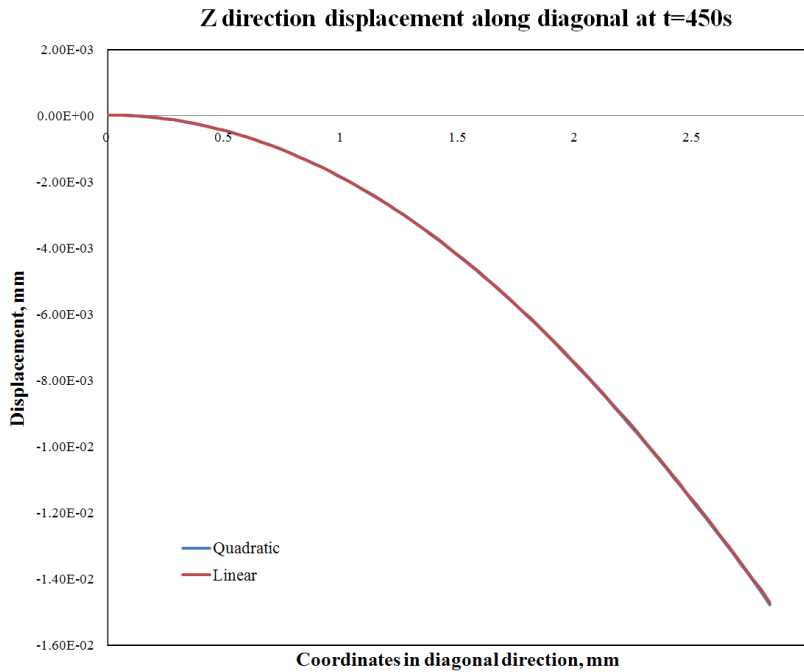


Fig. 17 Z-direction component displacement along diagonal

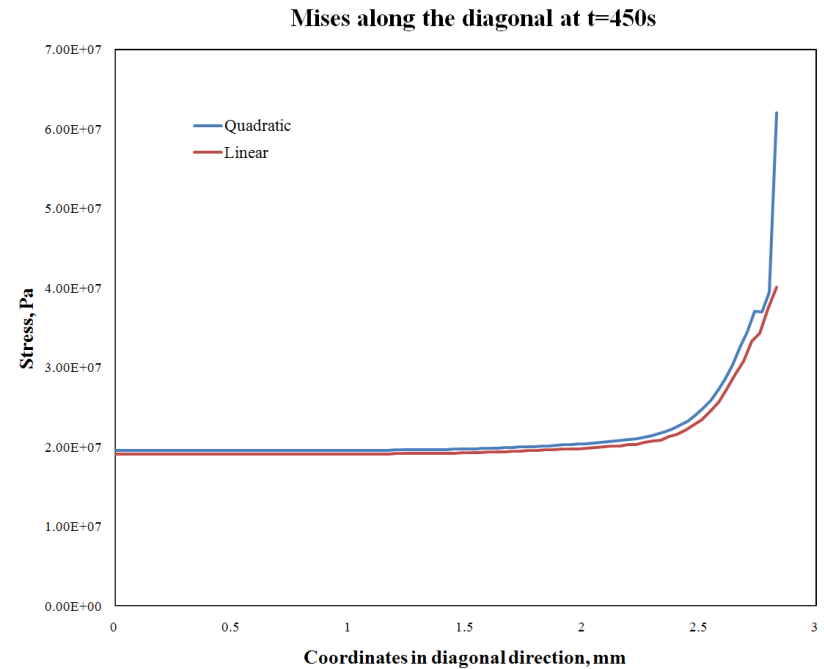


Fig. 18 Von mises stress along diagonal

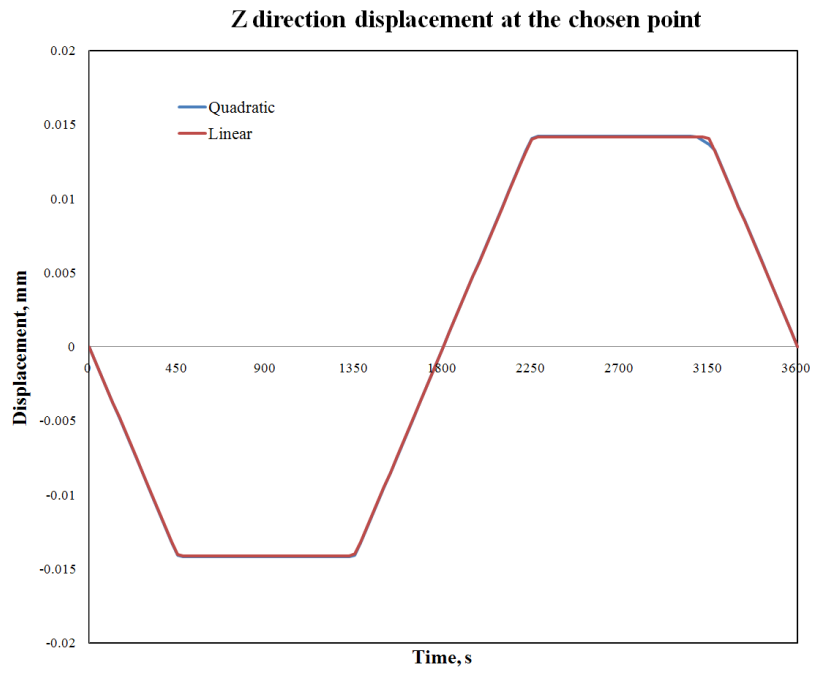


Fig. 19 Z-direction component displacement at the chosen point

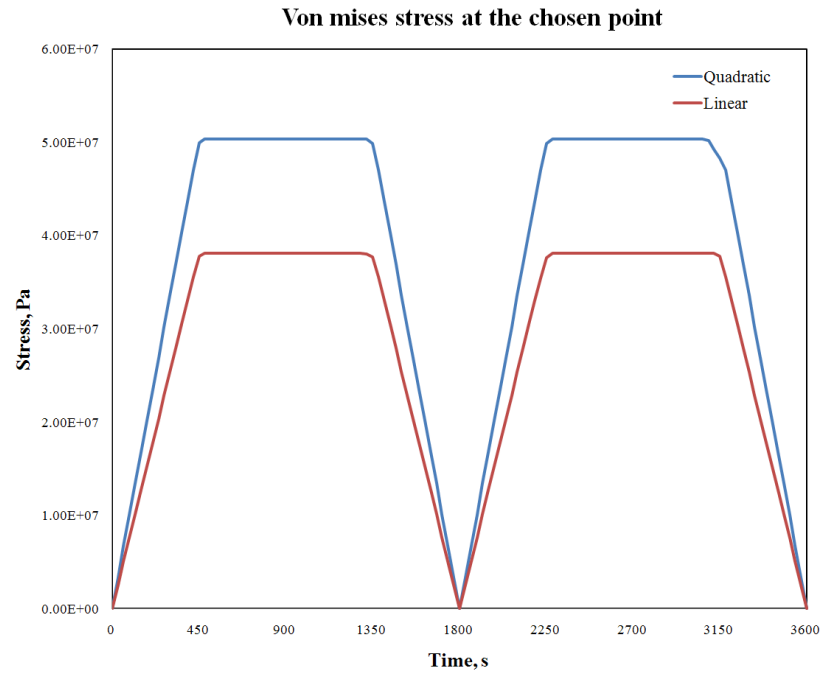


Fig. 20 Von mises stress at the chosen point