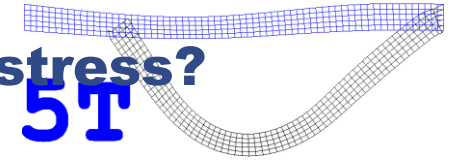


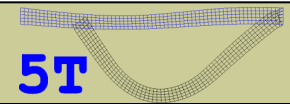
Comparison of stress directions in the insert when subjected to perpendicular and angular shearing

Jan Hernelind, 5T Engineering AB

What is the direction for maximum principal stress?



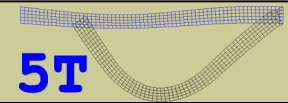
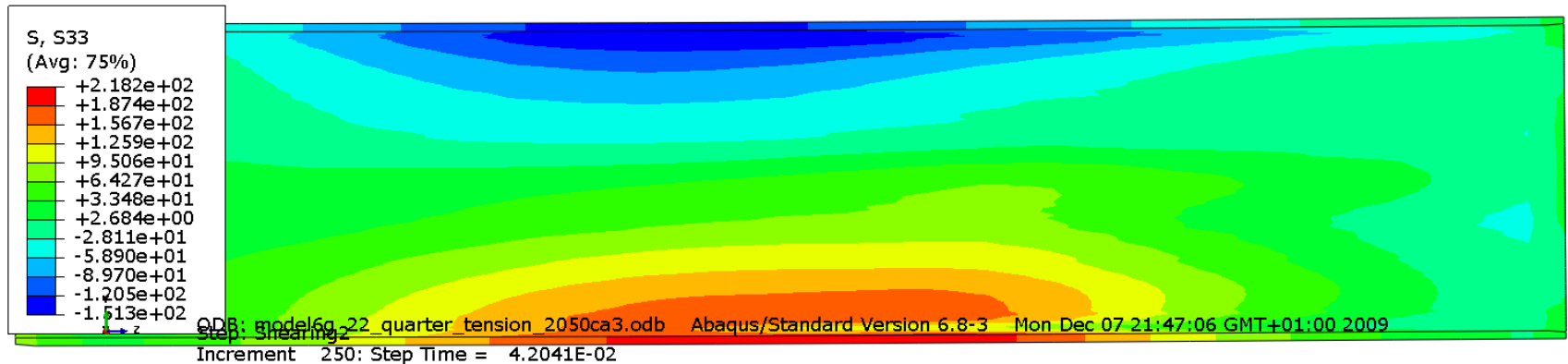
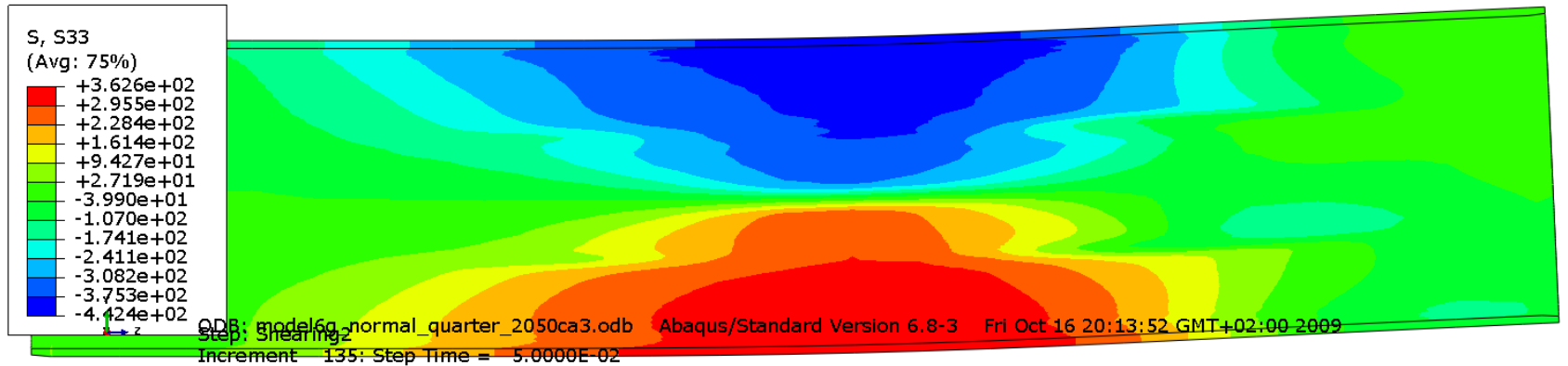
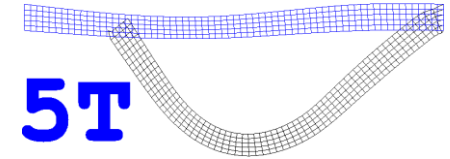
- Comparison of stress directions for two cases:
 - 1 – horizontal shearing, quarter-point
 - 2 – shearing (tension) at 22.5 degrees, quarter-point
- Bentonite density 2050 kg/m³
- Shearing amplitude 5 cm
- Surface stresses and internal stresses are analysed



Plots of S 33 (axial stress in the surface)

Top: Horizontal shearing

Bot: Tension shearing at 22.5 degrees

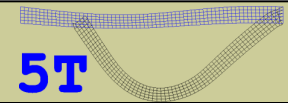
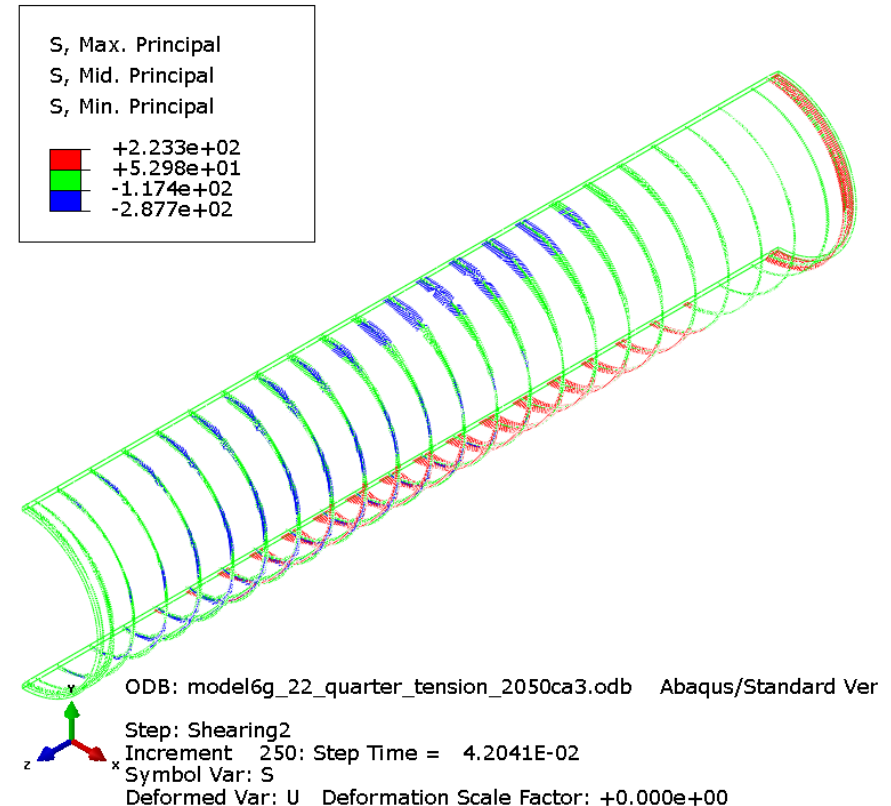
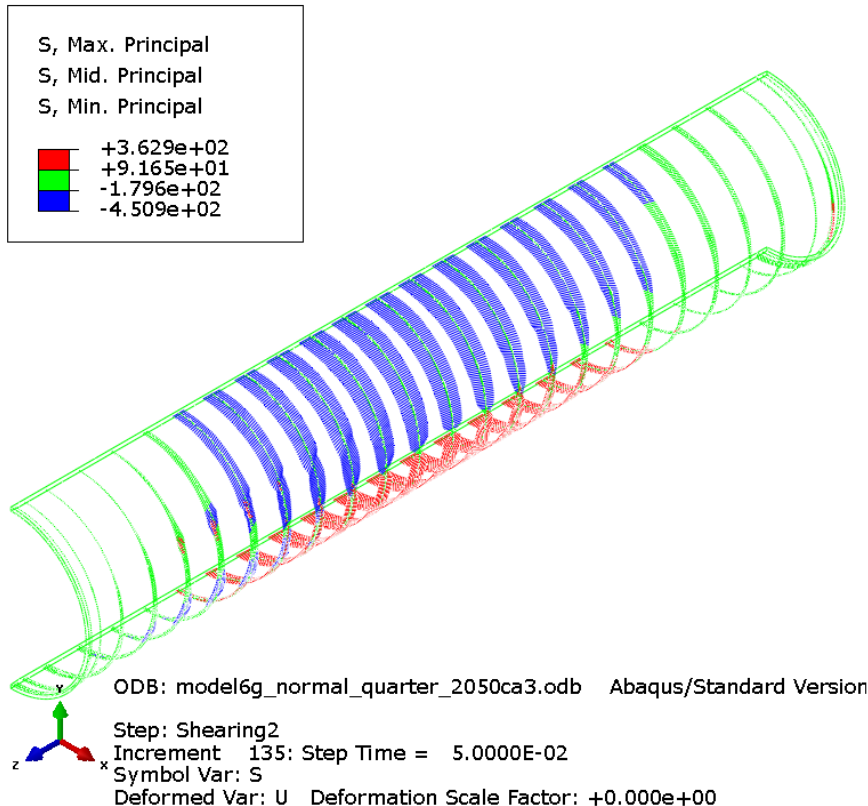
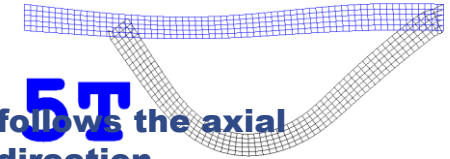


Overview of principal stresses in the surface

Left: Horizontal shearing

Right: Tension shearing at 22.5 degrees

At the tensile surface, S_{\max} the principal stress component (red arrows) follows the axial direction and the principal stress component S_{\min} follows the tangential direction.

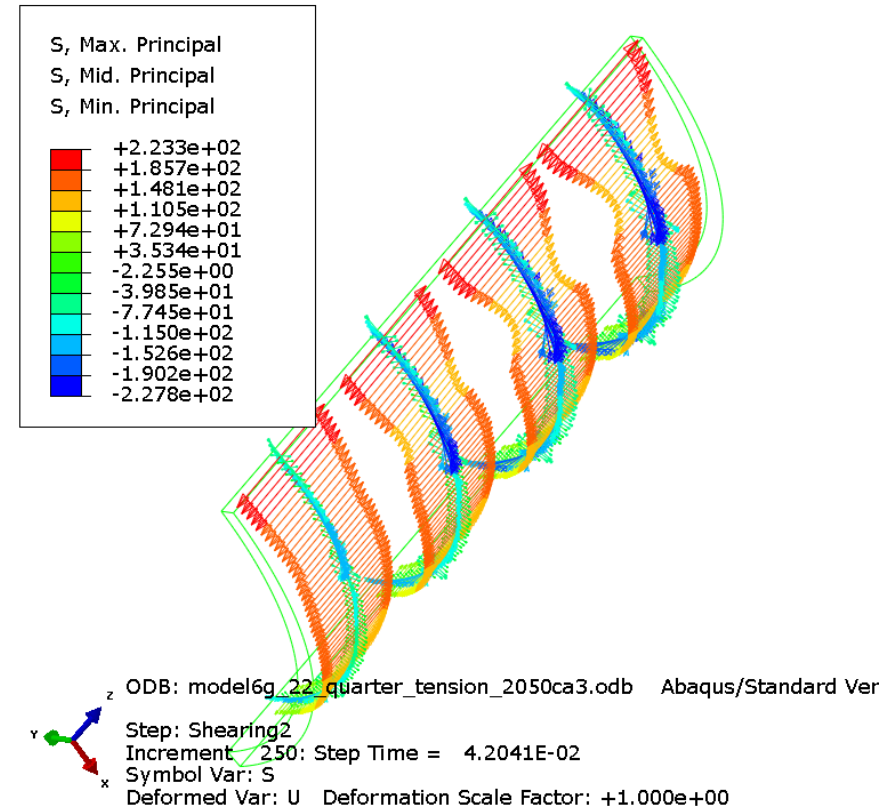
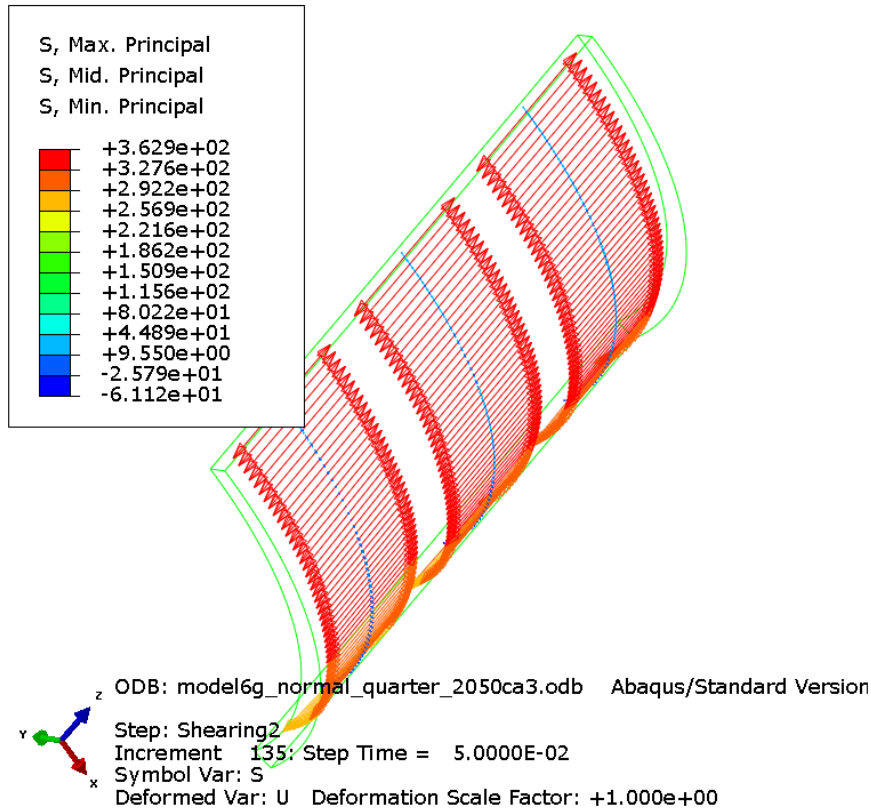


Principal stresses Smax directed along the axis of the insert

Left: Horizontal shearing

Right: Tension shearing at 22.5 degrees

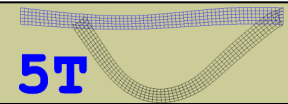
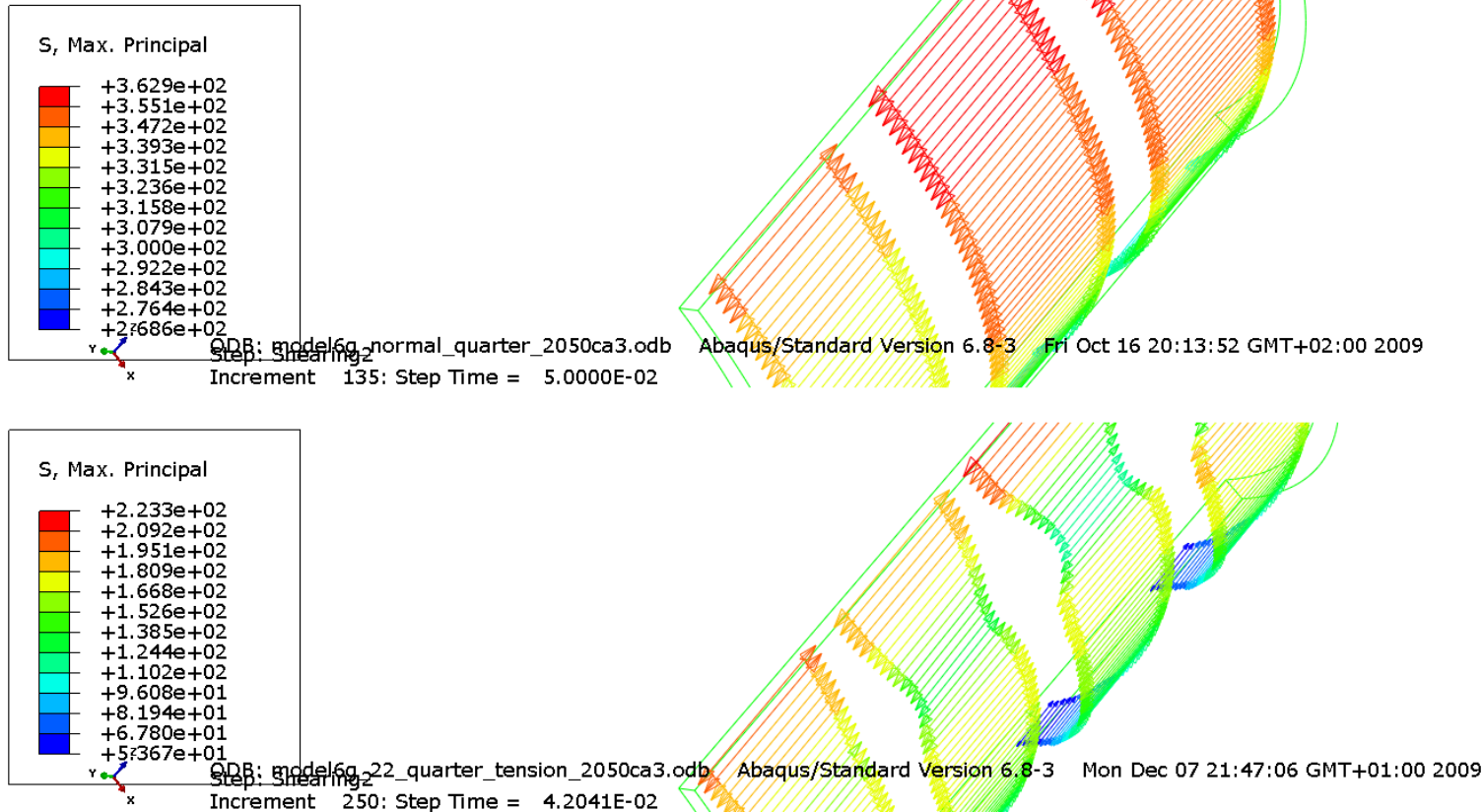
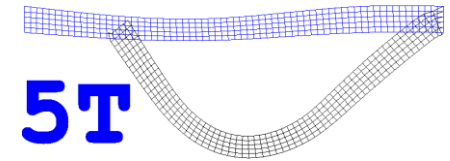
5T



Detail at the zone of maximum stresses

Top: Horizontal shearing

Bot: Tension shearing at 22.5 degrees

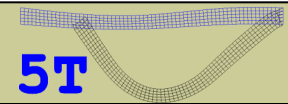
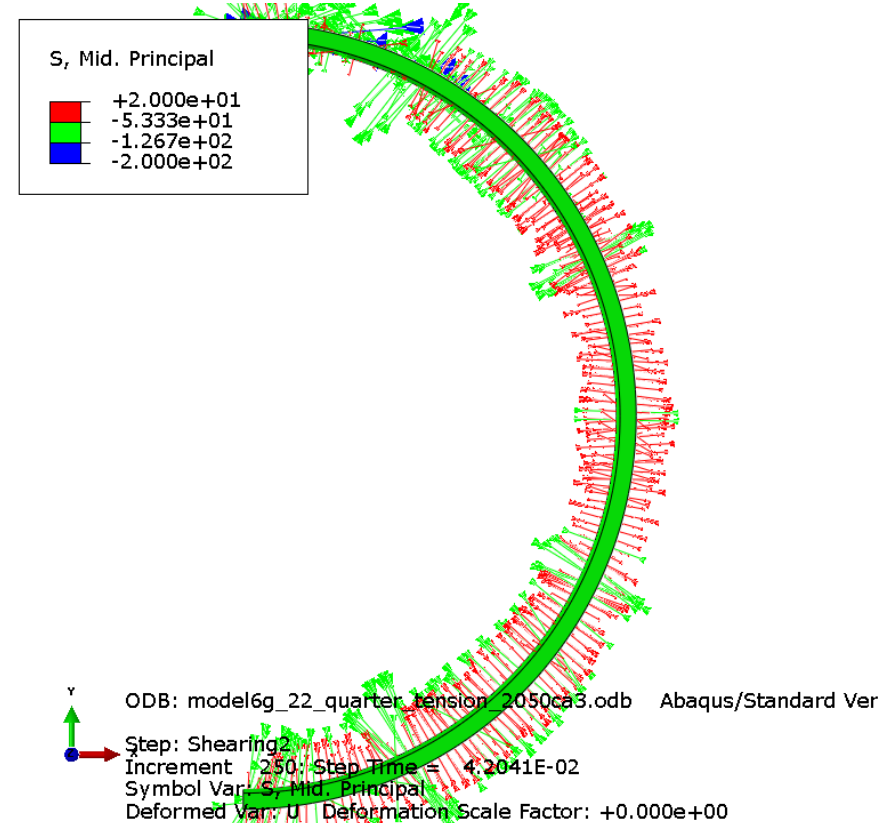
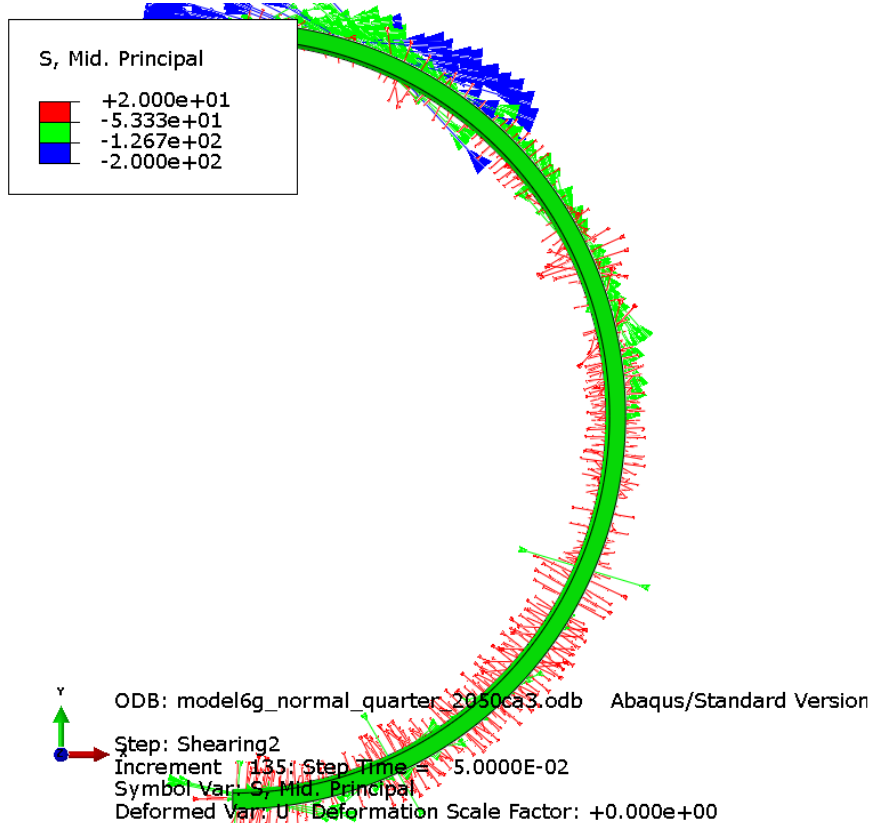
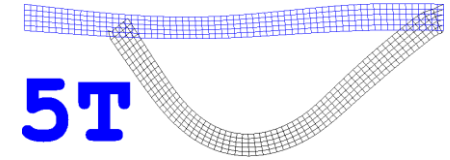


Mid principal stresses

Left: Horizontal shearing

Right: Shearing (tension) at 22.5 degrees

S mid in radial direction and mainly compressive

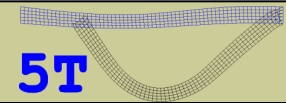
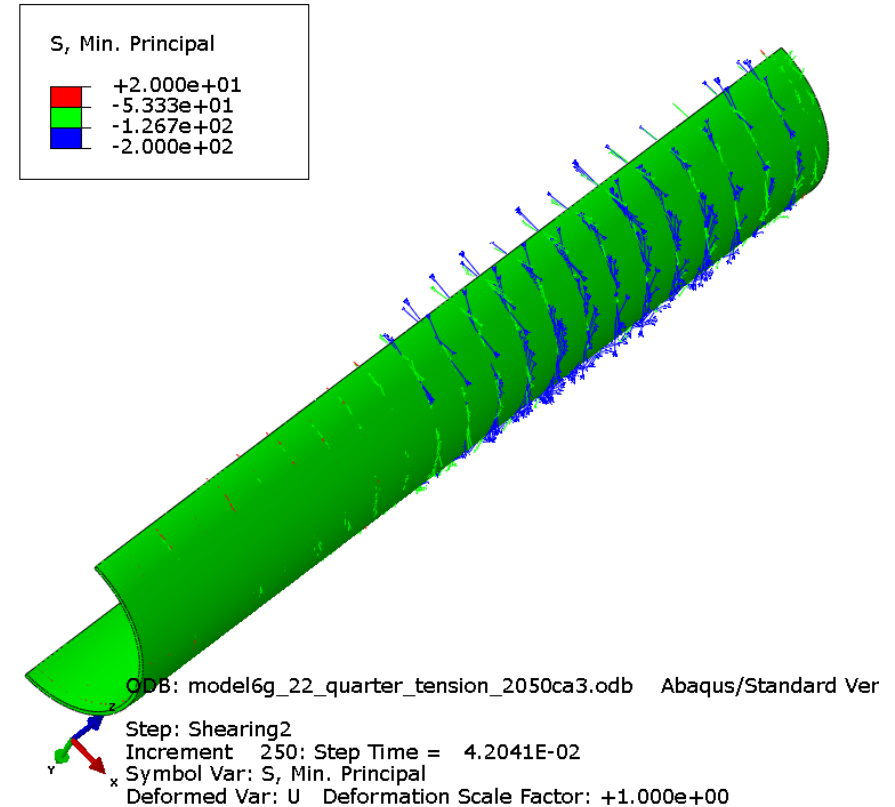
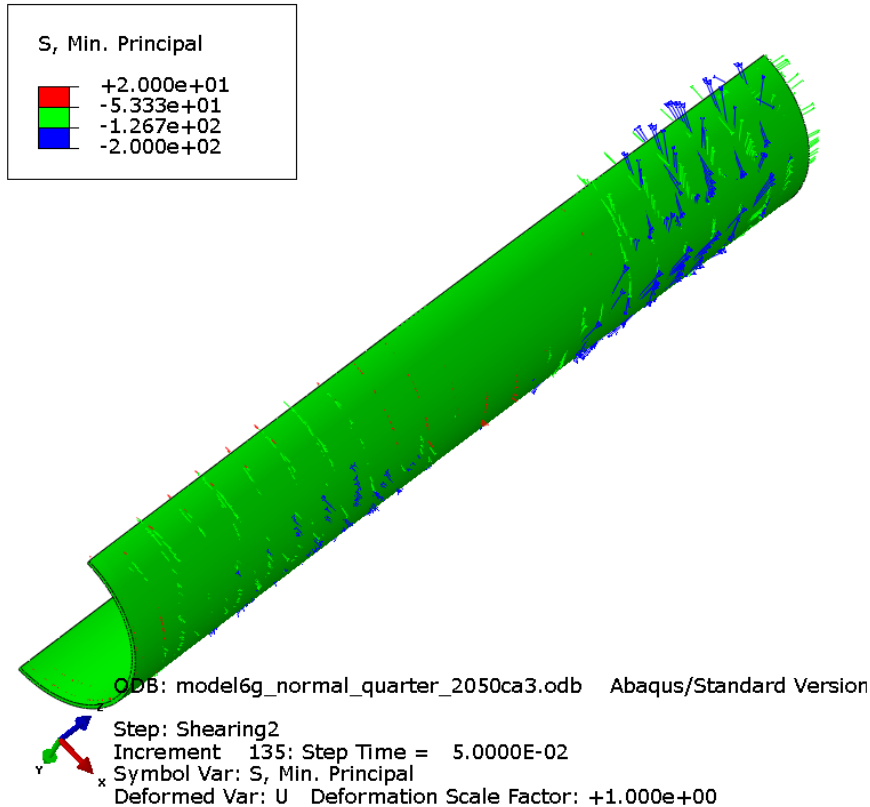
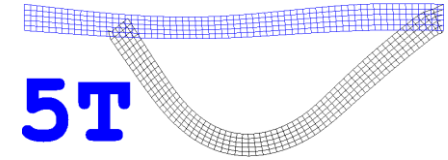


Min principal stresses

Left: Horizontal shearing

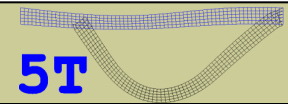
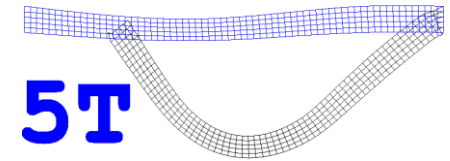
Right: Shearing (tension) at 22.5 degrees

Smin in radial direction, mainly compressive



Internal principal stress

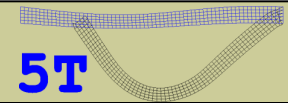
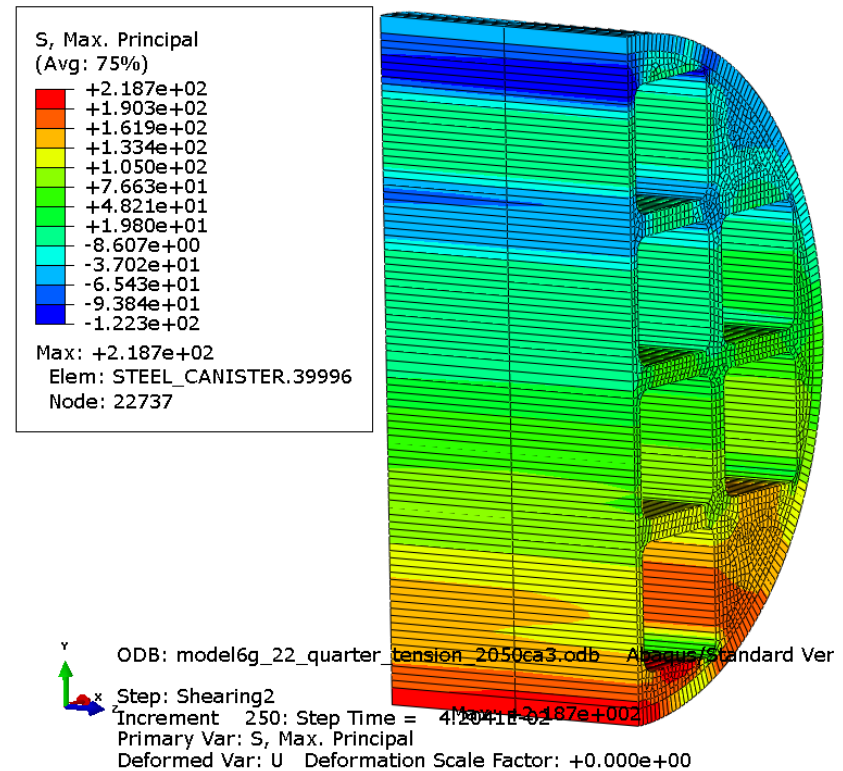
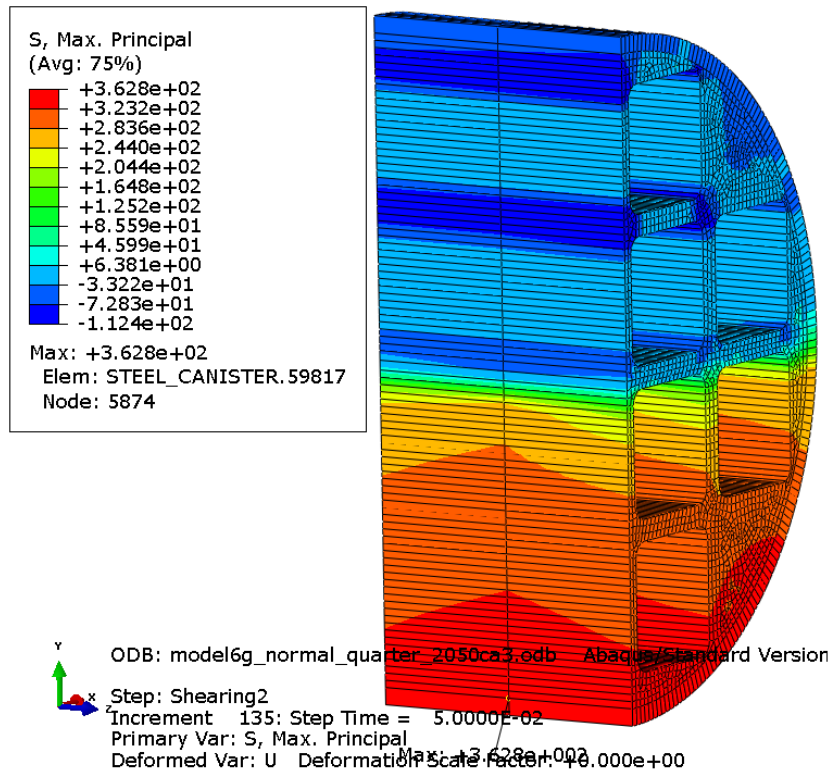
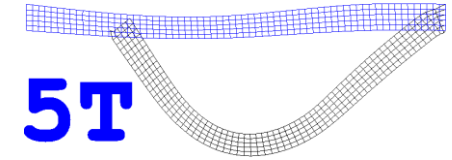
- Analyzed in the cross section with the highest stress levels, same loadcase as for surface stresses.



Principal stress S, max

Left: Horizontal shearing

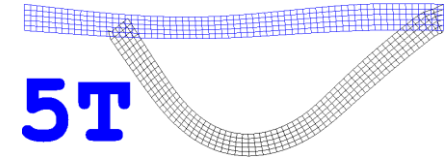
Right: Shearing (tension) at 22.5 degrees



Axial stress S33

Left: Horizontal shearing

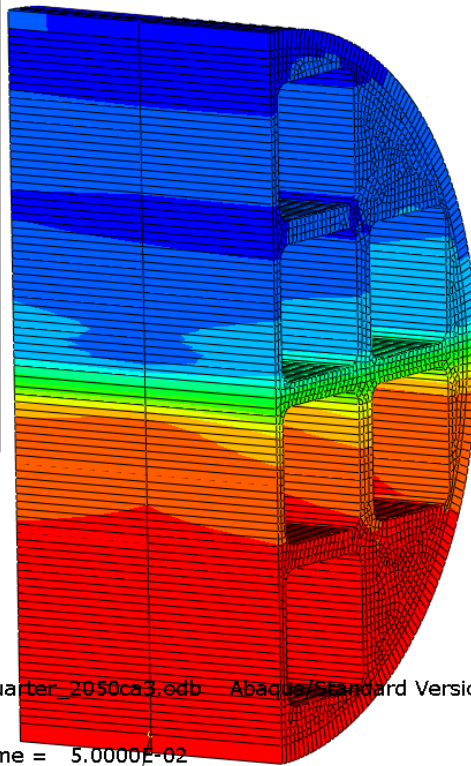
Right: Shearing (tension) at 22.5 degrees



S, S33
(Avg: 75%)

+3.626e+02
+2.927e+02
+2.228e+02
+1.529e+02
+8.301e+01
+1.311e+01
-5.679e+01
-1.267e+02
-1.966e+02
-2.665e+02
-3.364e+02
-4.063e+02
-4.762e+02

Max: +3.626e+02
Elem: STEEL_CANISTER.59817
Node: 5874

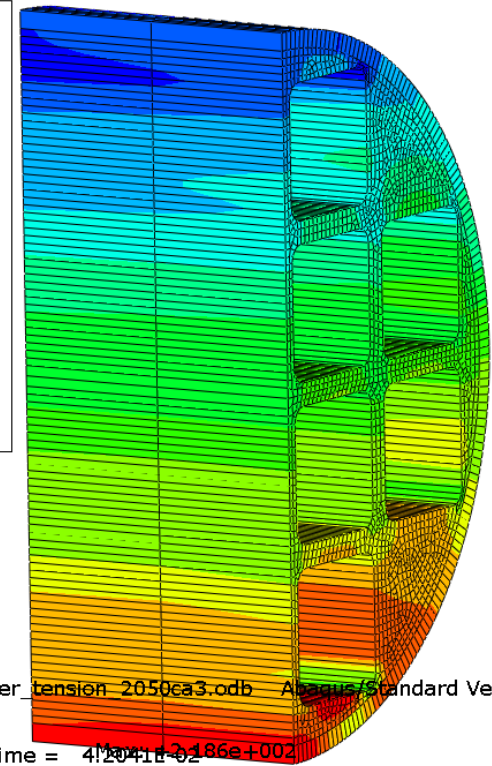


ODB: model6g_normal_quarter_2050ca3.odb Abaqus/Standard Version
Step: Shearing2
Increment 135: Step Time = 5.0000e-02
Primary Var: S, S33
Deformed Var: U Deformation Scale Factor: +0.000e+00

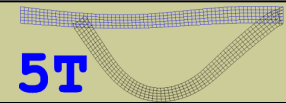
S, S33
(Avg: 75%)

+2.186e+02
+1.871e+02
+1.556e+02
+1.241e+02
+9.253e+01
+6.100e+01
+2.947e+01
-2.052e+00
-3.358e+01
-6.510e+01
-9.663e+01
-1.282e+02
-1.597e+02

Max: +2.186e+02
Elem: STEEL_CANISTER.39996
Node: 22737



ODB: model6g_22_quarter_tension_2050ca3.odb Abaqus/Standard Ver
Step: Shearing2
Increment 250: Step Time = 4.2041e-02
Primary Var: S, S33
Deformed Var: U Deformation Scale Factor: +0.000e+00

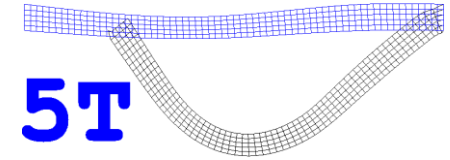


Vector plot, sectionen at highest Smax

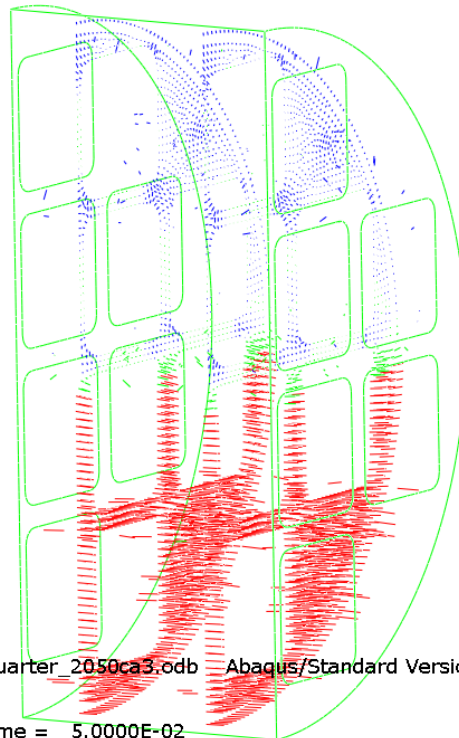
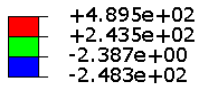
Left: Horizontal shearing

Right: Shearing (tension) at 22.5 degrees

Smax in axial direction in both cases



S, Max. Principal



ODB: model6g_normal_quarter_2050ca3.odb Abaqus/Standard Version

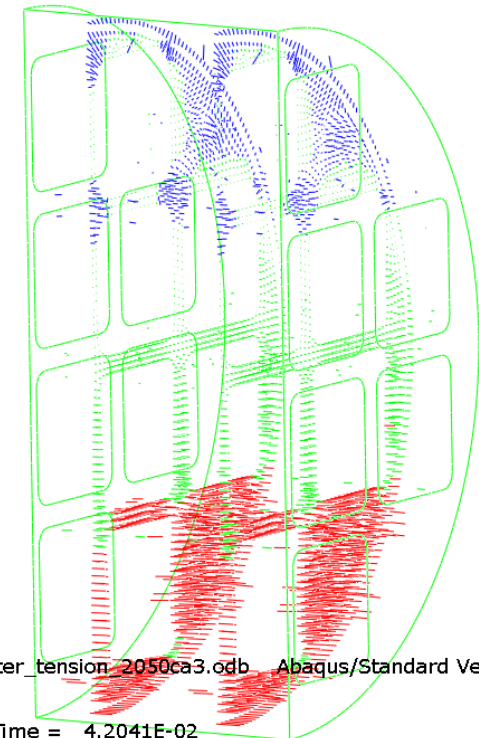
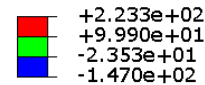
Step: Shearing2

Increment 135: Step Time = 5.0000E-02

Symbol Var: S, Max. Principal

Deformed Var: U Deformation Scale Factor: +0.000e+00

S, Max. Principal



ODB: model6g_22_quarter_tension_2050ca3.odb Abaqus/Standard Ver

Step: Shearing2

Increment 250: Step Time = 4.2041E-02

Symbol Var: S, Max. Principal

Deformed Var: U Deformation Scale Factor: +0.000e+00

