

Stress Analysis on All-Ceramic Specimens of Different Geometries During Thermalcycling Tests

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Introduction: Constant changes in temperature in the oral cavity can create residual thermal stresses, specially in dental restorations. Dental restorations are usually made by two materials bonded together: one provides aesthetic and the other provides mechanical resistance, creating stresses mainly at their interface. On this work, a thermalcycling test was simulated to evaluate the stresses in two different sample geometries.

Computational methods: One full cycle of the thermalcycling test was simulated. The samples start at 310K, then they are exposed to 328K for 15 seconds. Then they are transferred to a 278K environment for another 15 seconds. The transfer time took 5 seconds at 298.

The Thermal Stress physics interface was used to simulate these conditions. An inward heat flux was considered on all external walls of the samples. Two different geometries made of porcelain and alumina were used in this work, as shown on Figure 1. The maximum principal stresses have been evaluated.

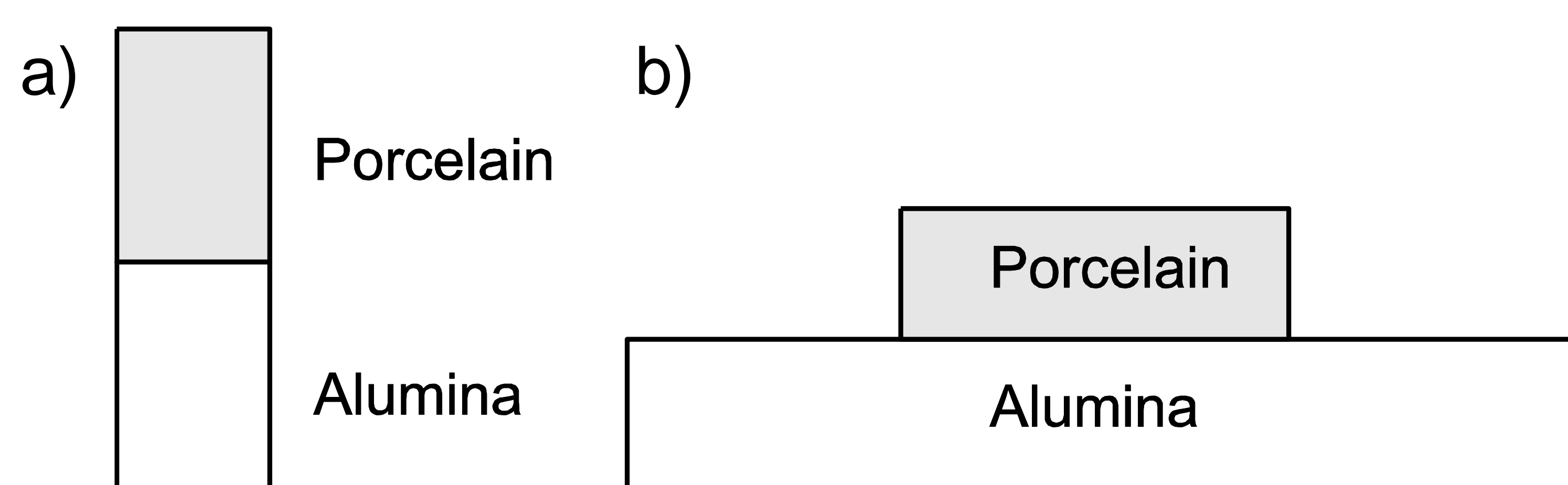


Figure 1. 2D schematic of the two geometries used in this work: a cylinder rod (a) and a three-point bending test sample (b).

Results: The simulation shows different stress distribution profiles over time for the cylinder (Fig. 2(a) and (b)) and for the bending test sample (Fig. 1 (c) and (d)). Fig. 3(a) and (b) show maximum stress at the samples over time.

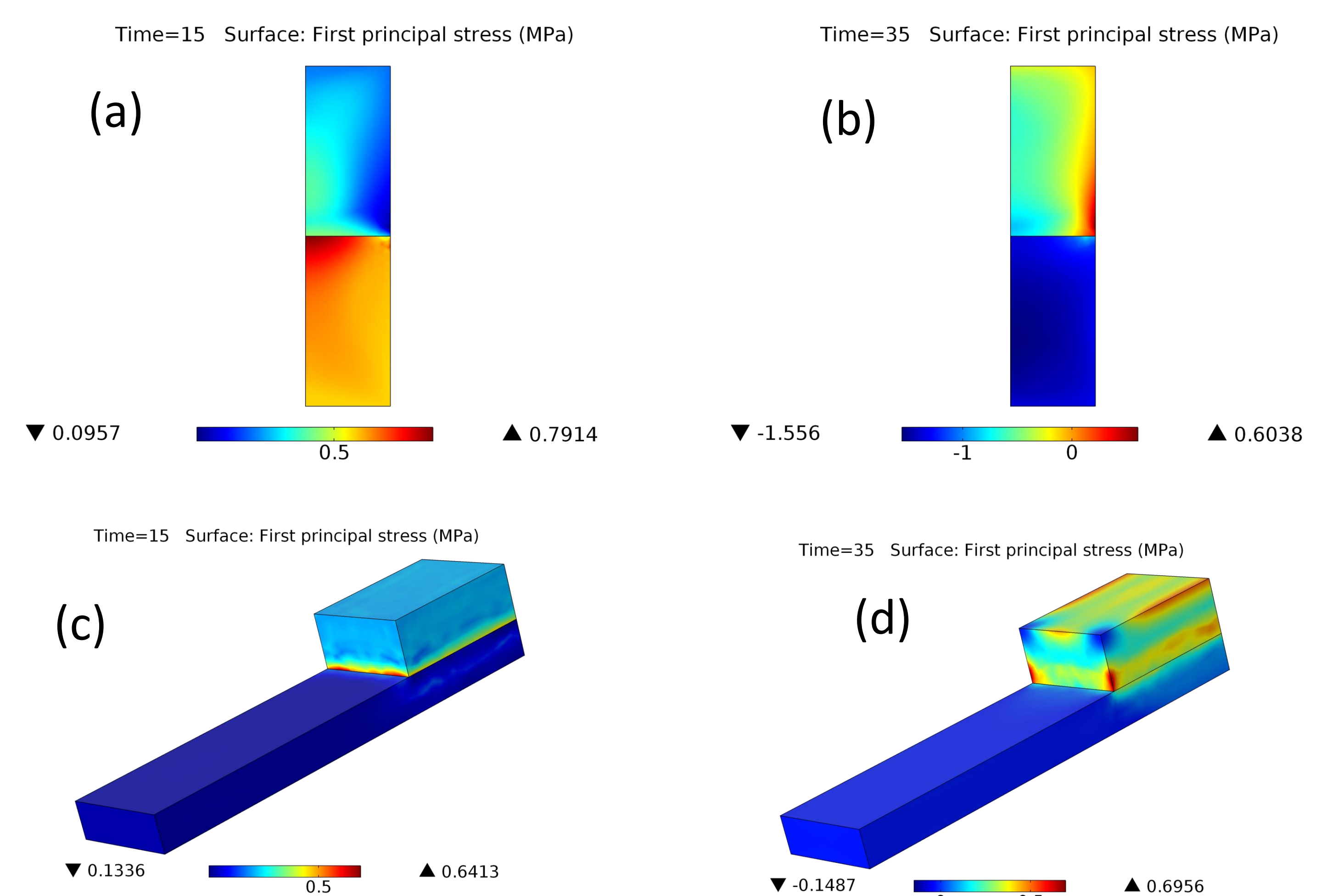


Figure 2. Stress profile for t=15s and 35s respectively for the cylinder sample (a) and (b) and the bending test sample (c) and (d).

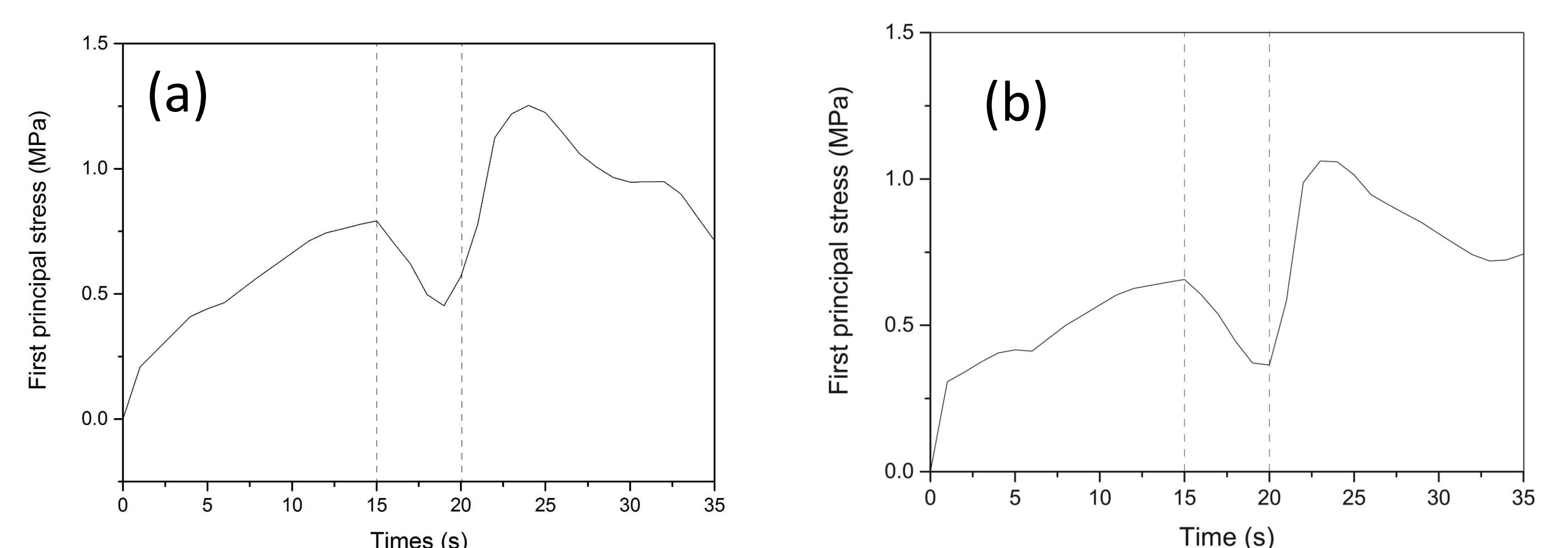


Figure 3. Maximum first principal stress over time for the cylinder sample (a) and bending test sample (b).

Conclusions: The stress over the samples were evaluated. Different stress fields and stress magnitudes were observed for the two types of geometries.

References:

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