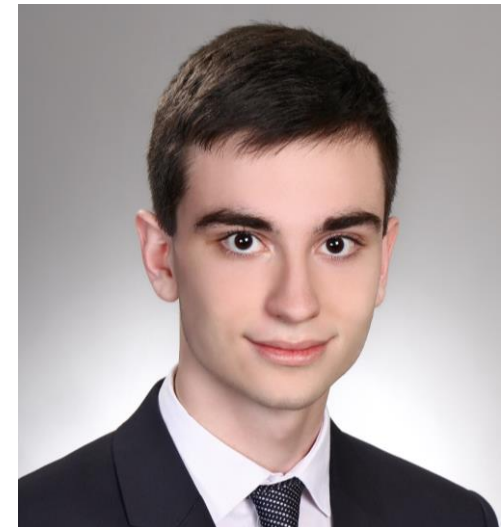# FEM ANALYSIS OF OVERCORING MEASUREMENTS IN ROCKS

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FACULTY: FACULTY OF MECHANICAL ENGINEERING

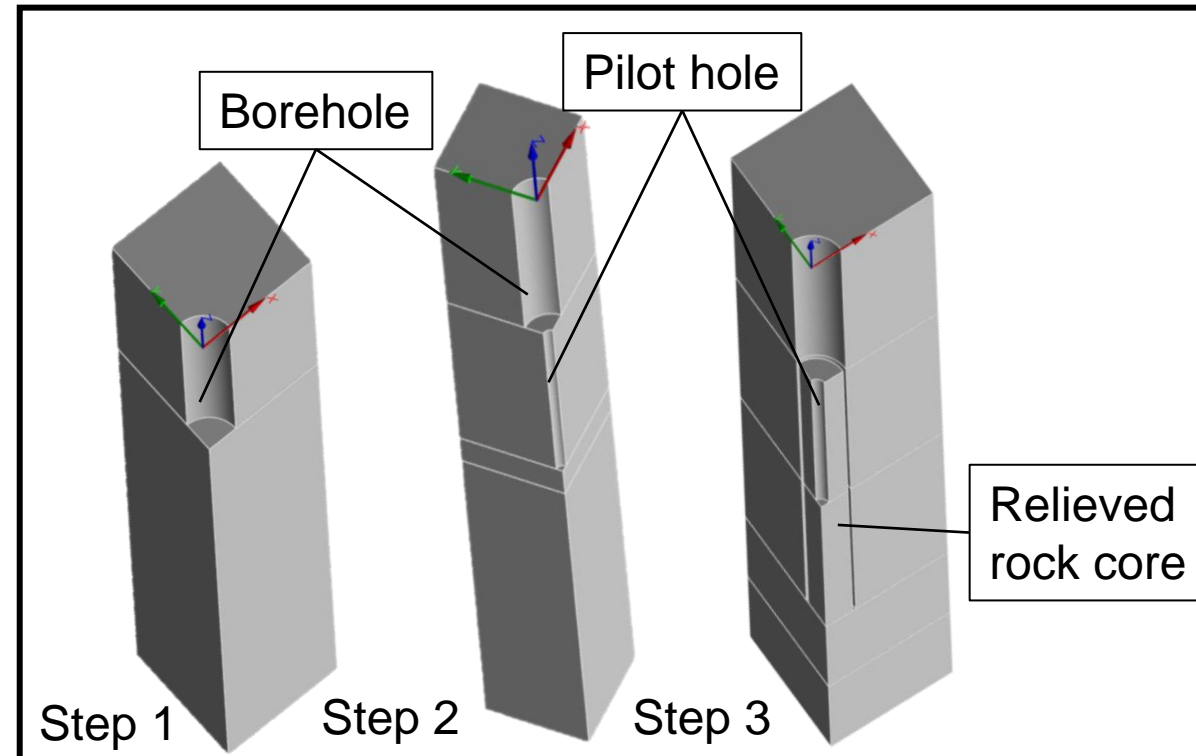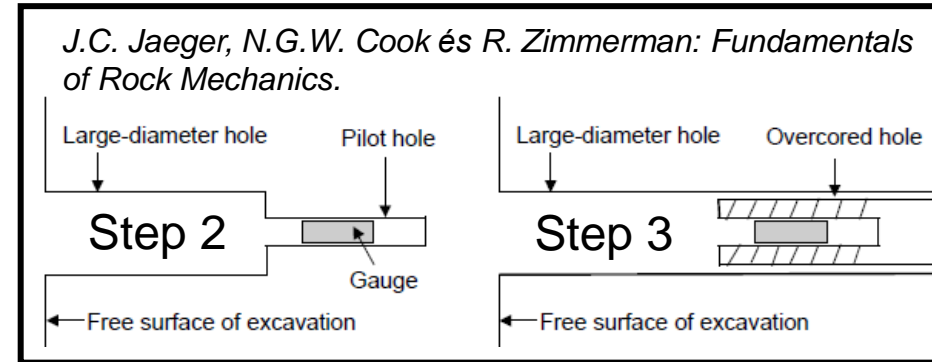E-MAIL: BORZAD0212@GMAIL.COM

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PROJECT OBJECTIVE AND APPLIED GEOMETRY

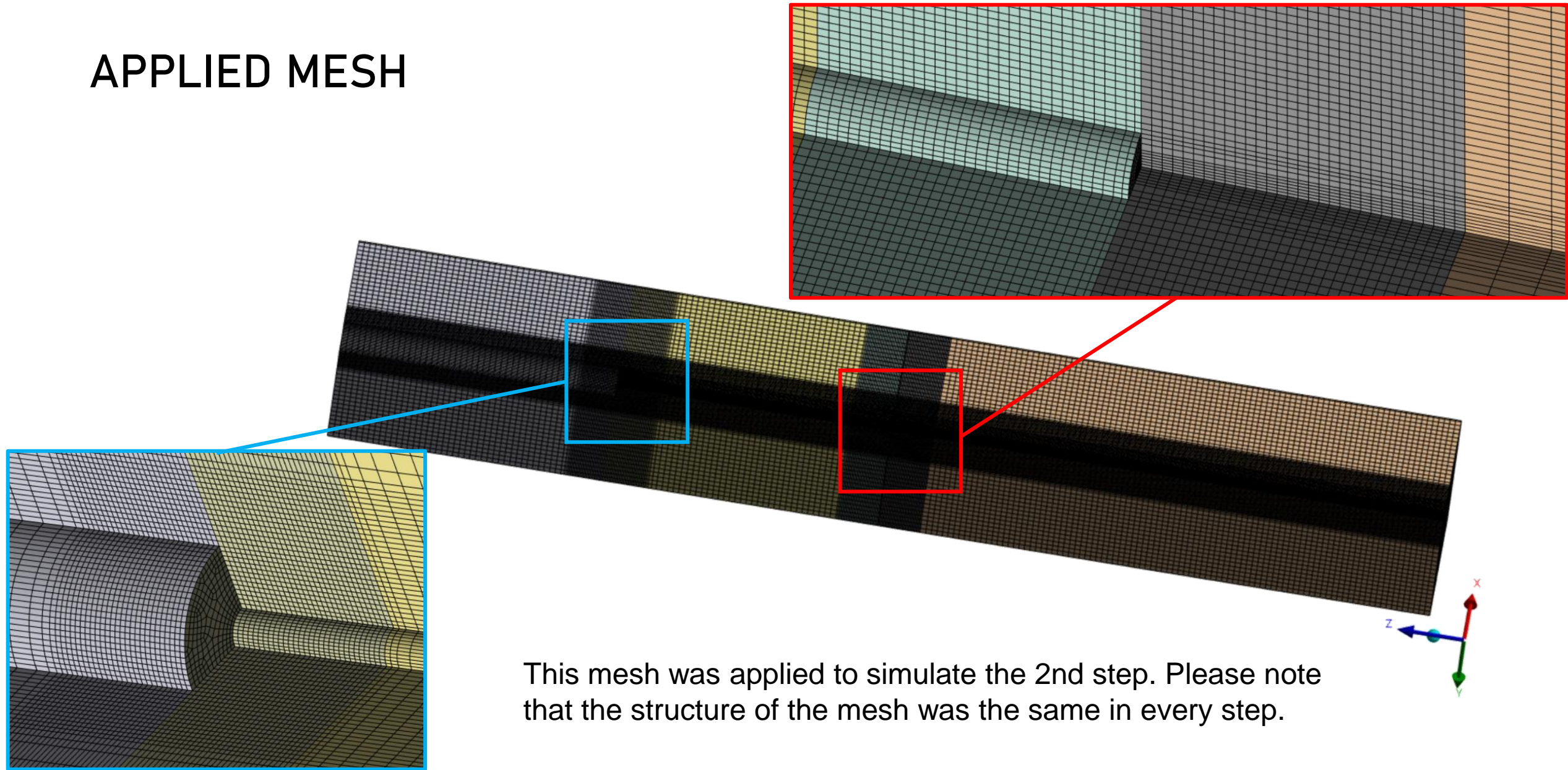Overcoring is an in situ stress measurement technique with the following 3 steps:

- Step 1: Borehole is drilled (ØD).

- Step 2: Pilot hole is drilled (Ød, d<D), and a gauge is inserted.

- Step 3: The gauge is overcored by a ØD diameter drill.

The in situ stress components can be calculated from the deformations (SIGRA IST gauge) or from the strains (CSIRO HI cell) measured during the relief of the rock core.

- The aim of the analysis is to determine the accuracy of the overcoring technique by simulating the 3 steps of the measurement.

- Additionally, based on the simulation results, I examined how the accuracy of the estimations depends on the location of the gauge in the pilot hole.
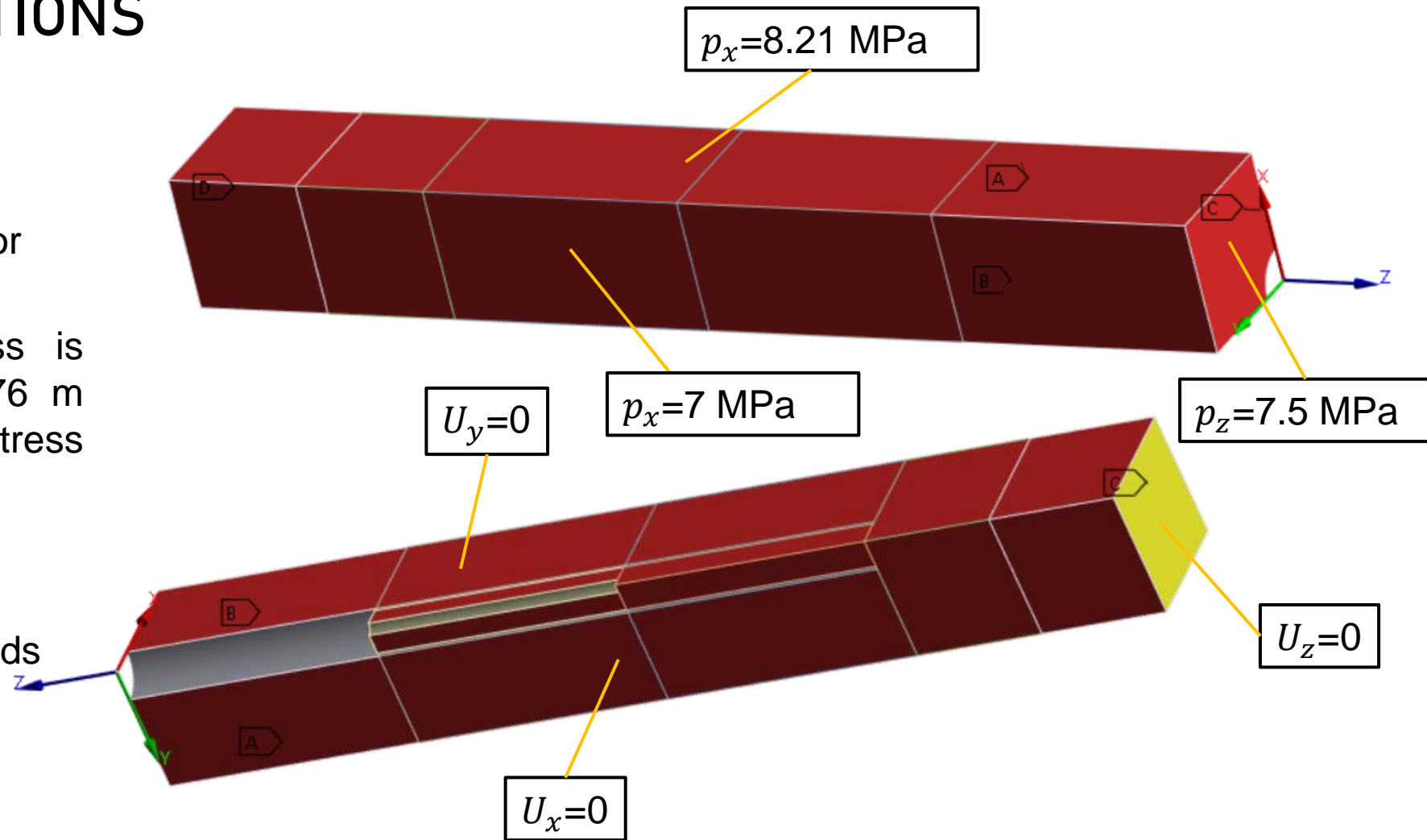

J.C. Jaeger, N.G.W. Cook és R. Zimmerman: Fundamentals of Rock Mechanics.

Step 2 — Large-diameter hole, Pilot hole, Gauge, Free surface of excavation

Step 3 — Large-diameter hole, Overcored hole, Free surface of excavation

Borehole

Pilot hole

Relieved rock core

Step 1   Step 2   Step 3

APPLIED MESH

This mesh was applied to simulate the 2nd step. Please note that the structure of the mesh was the same in every step.
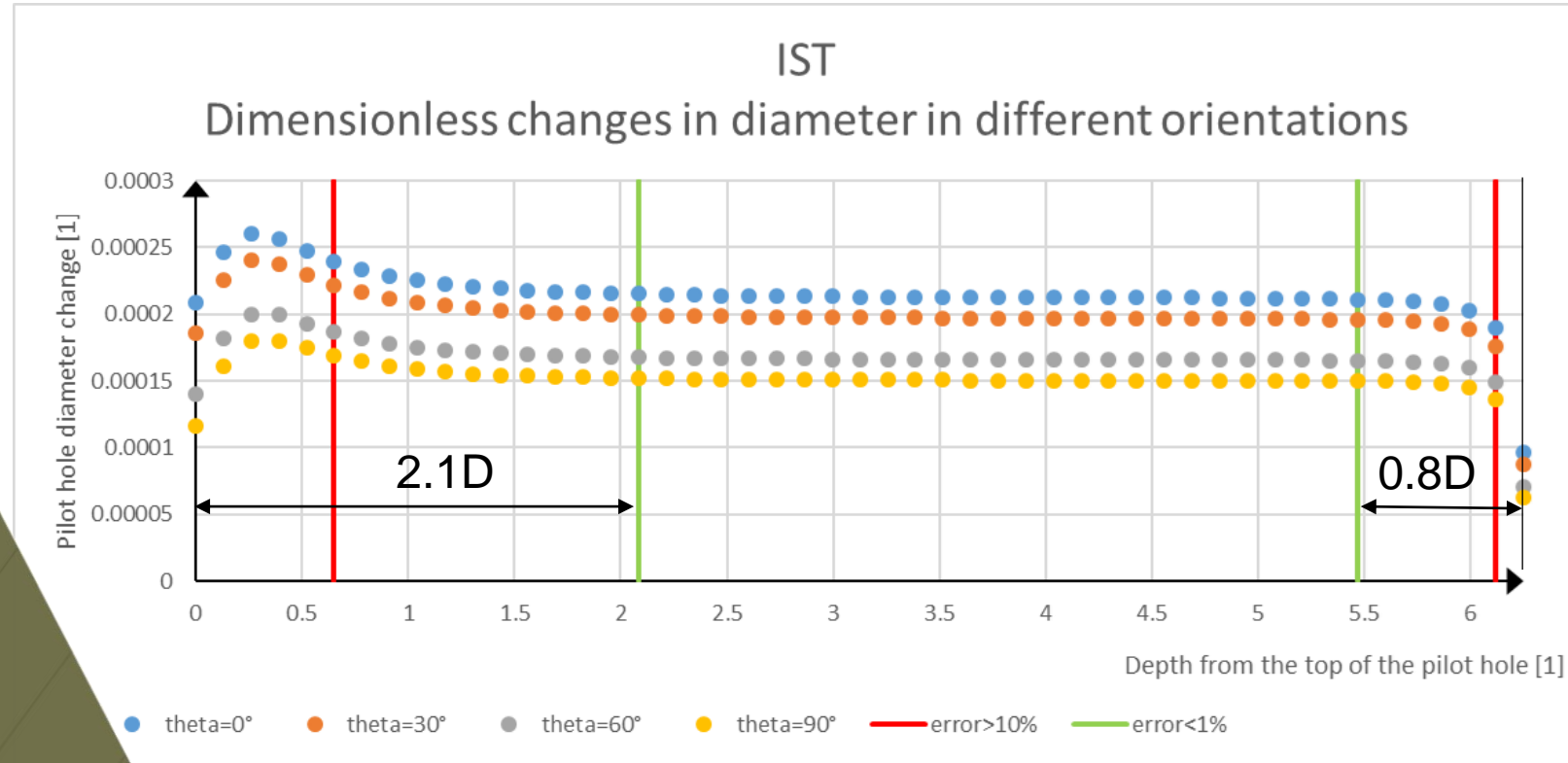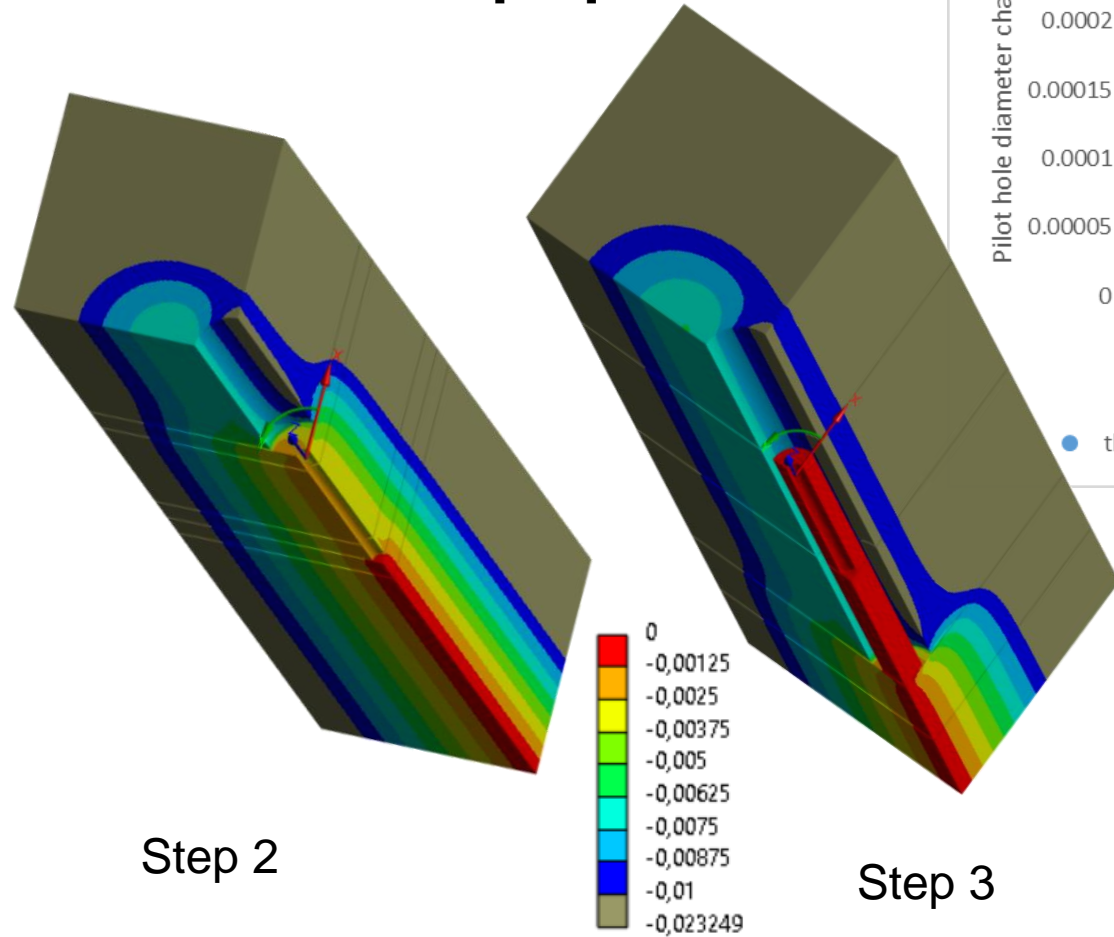
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BOUNDARY CONDITIONS

- Static Structural analysis for every step.
- The modelled rock mass is located at a depth of 276 m and loaded by the in situ stress state.
- Linearly elastic, isotropic material behavior.
- Material properties and loads are set based on a real overcoring test.

p_x=8.21 MPa

p_x=7 MPa

p_z=7.5 MPa

U_y=0

U_z=0

U_x=0

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RESULTS – IST

Radial deformation [mm]

Step 2

Step 3

IST
Dimensionless changes in diameter in different orientations

- theta=0°
- theta=30°
- theta=60°
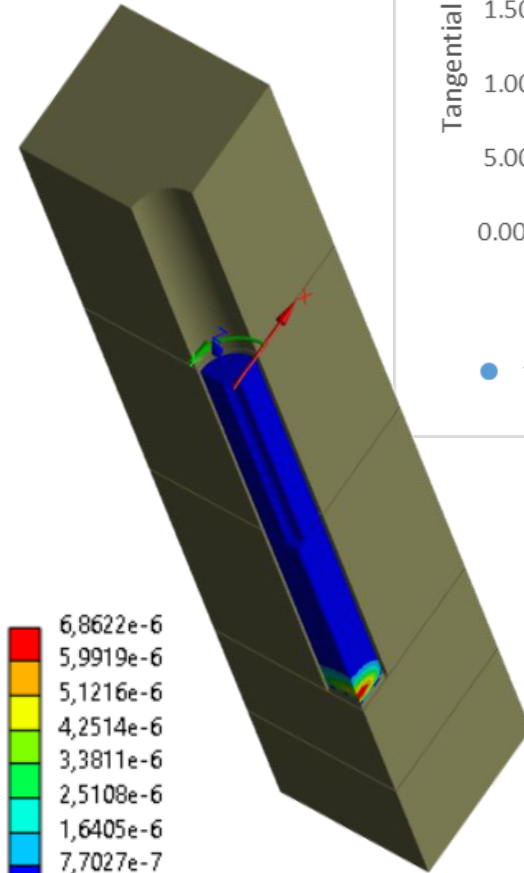- theta=90°
- error>10%
- error<1%
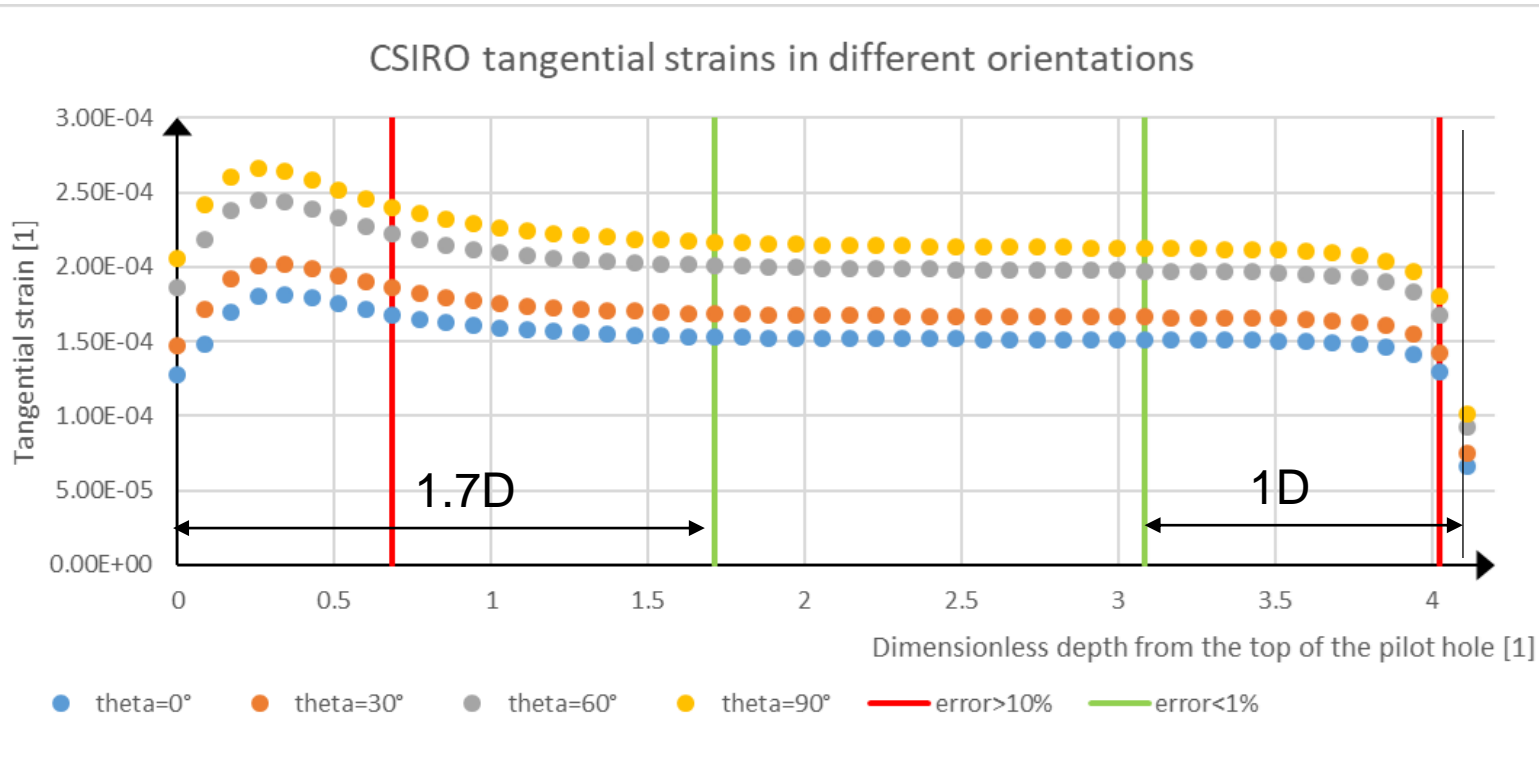
Conclusions:

- In situ stress components in the plane parallel to the borehole axis can be estimated with an error less, than 1%.
- The IST gauge should be set at least 2.1D beneath the bottom of the borehole, and 0.8D above the pilot hole bottom.
- D = 96 mm (borehole diameter).

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RESULTS – CSIRO

Tangential strain [1]
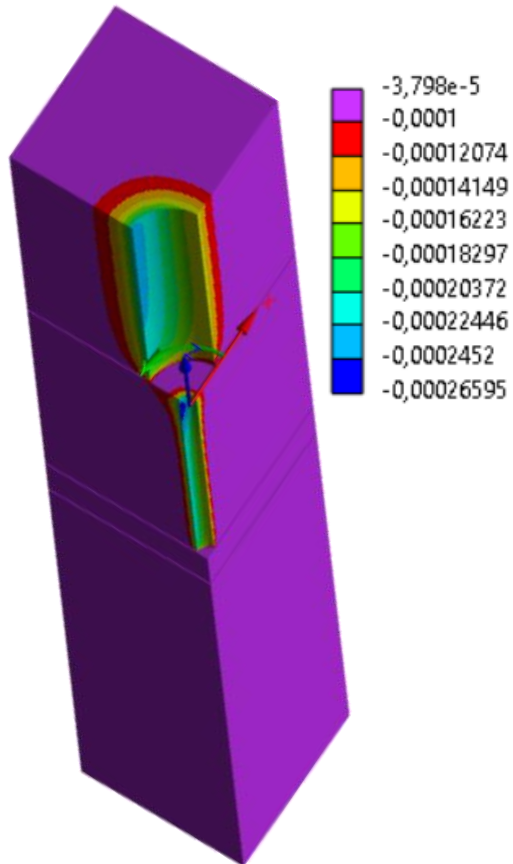
Step 2

Step 3



CSIRO tangential strains in different orientations

Conclusions:

- In situ stress components in the plane parallel to the borehole axis can be estimated with an error less, than 1%.

- In situ stress components parallel to the borehole axis can be estimated with an error less, than 5%.

- The CSIRO HI cell should be set at least 1.7D beneath the bottom of the borehole, and 1D above the pilot hole bottom.
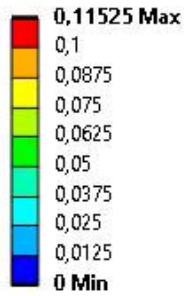
- D = 146 mm (borehole diameter).

ANIMATIONS – CSIRO HI
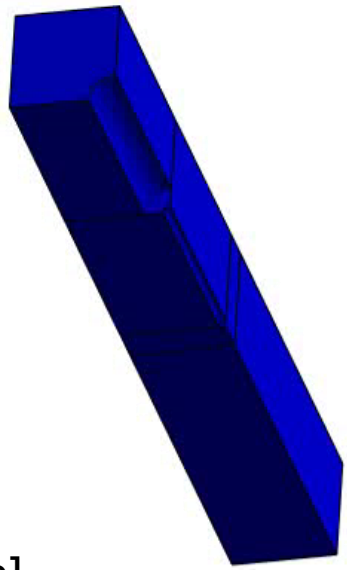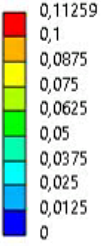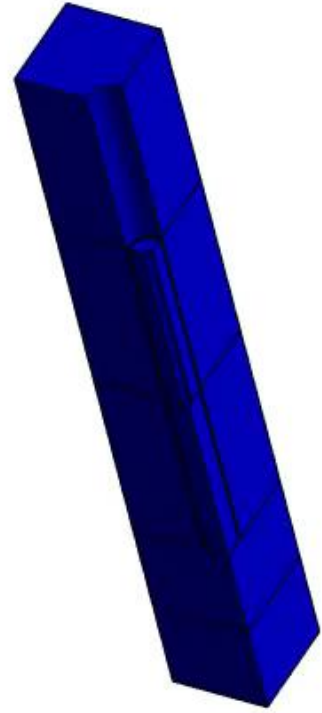
Total deformation [mm]
Step 3
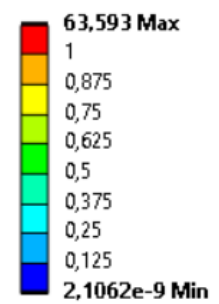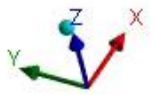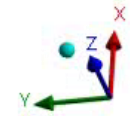
Relieved rock core
Step 3, Von Mises plot

Total deformation [mm]
Step 2