Exercise 9: 3D-2D solid mechanics model coupling

- Blank Model
- Add Component/3D
- Geometry/Length units: cm
- Geometry/Cylinder/ Radius: 1.4 cm, Height: 48 cm
- Geometry/Cylinder/ Radius: 0.7 cm, Height: 48 cm
- Geometry/Difference: cyl1 – cyl2
- Geometry/Cylinder/ Radius: 0.7 cm, Height: 10 cm, Position z: 38 cm
- Add Physics/Structural Mechanics/Solid Mechanics/
- Material/Blank Material/ E: 18 [GPa], nu: 0.3, rho: 1800 kg/m^3
- Materia/Add Material/ (search for titanium) select Titanium beta-21S, Selection: cyl3
- Solid Mechanics/Boundary Load/ Selection: implant upper face, Load type: Total force, Fx=200, Fy=0, Fz=2000
- Add Study/Stationary/
- Compute
- Check bending deformation in default stress plot
- Geometry/Work Plane/ Plane: xy-plane, z-coordinate: 43
- Work Plane/Plane Geometry/Circle Radius: 1.4 cm
- Check material properties of the bone and stem
- Add Component/2D
- Geometry 2/ Length unit: cm
- Geometry 2/Circle Radius: 1.4 cm
- Geometry 2/Circle Radius: 0.7 cm
- Geometry 2/Difference: c1 – c2
- Component 2/Add Physics/Structural Mechanics/Solid Mechanics/ 2D Approximation: Plane strain (default), Thickness: 1 m (default value, not relevant here)
- Material/Blank Material/ E: 18 [GPa], nu: 0.3, rho: 1800 kg/m^3
- Component 1/Definitions/Component Couplings/General Extrusion/ Source selection: Geometric entity level: Boundary, Selection: "the 2D ring of the workplane", Set (x,y,z)=(x,y,0) for both Destination and Source map.
- Component 2/Solid Mechanics/Prescribed Displacement/ Selection: all inner & outer boundaries, u0x: comp1.genext1(u), u0y: comp1.genext1(v)
- Study/(right click)/Study Steps/Stationary/Stationary/ Uncheck 1st model: Solid Mechanics (solid)
- Study/Step 1/ Uncheck 2nd model: Solid Mechanics 2 (solid2)
- Compute
- Results/Data Sets/(right click)/Surface/ Data Set: Study 1, Parametrization: XY-plane, Selection: "the 2D ring"
- Results/2D Plot Group/ Data set: Surface 1
- Results/2D Plot Group/Surface/ Expression: u
- Results/2D Plot Group/ Data set: Study 1/Solution 1 (2)
- Results/2D Plot Group/Surface/ Expression: u2
- Geometry 2/Circle Radius: 0.8 cm (move it above difference node)
- Geometry 2/Difference: (c1+c3) – c2

- Material/Blank Material/ E: 1 [MPa], nu: 0.17, rho: 1000 kg/m^3, Selection: inner ring
- Component 2/Solid Mechanics/Prescribed Displacement/ Selection: remove boundary between bone and granulation tissue.
- Compute
- Compare results (2D vs 3D)
- Results/Data Sets/Study 1/Solution 1 (2)/(right click)/Duplicate/
- Rename duplicated data set as "copy of 2D data set"
- Right click on this duplicated data set/Selection/ Selection: "the granulation ring"
- Results/2D Plot Group/ Data set: copy of 2D data set
- Results/2D Plot Group/Surface/ Expression: solid2.J (Component 2/Solid Mechanics 2/Strain/Strain invariants/Volume ratio)