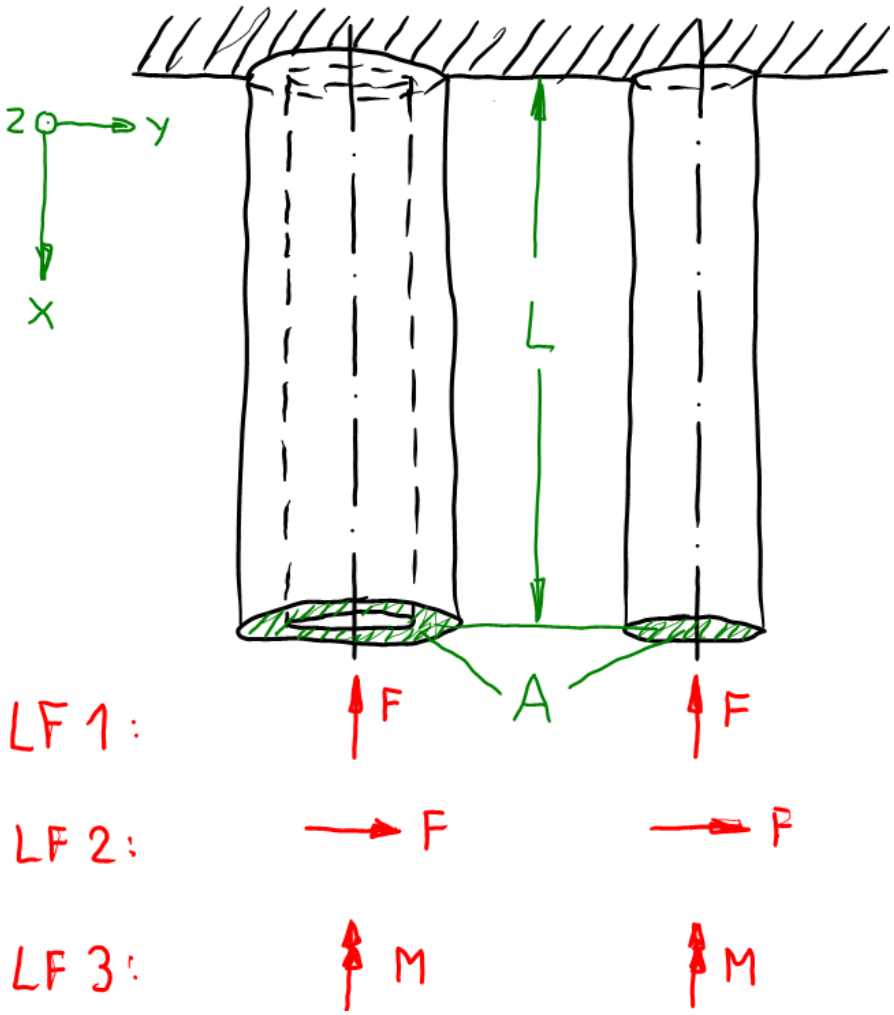
Lab: "Simple Bone FE Model"

Simulation of Physiological Stresses and Strains in Long Bones

Define two simplified bone geometries for a long bone (e.g. human tibia) with same length L and same amount of cross sectional area A. One with a hollow and the other with a solid cross sectional shape. X-Rays (see below) ore measures of available materials (nails and bones, your own leg) might help you to find appropriate data.



Both bone models should be loaded by three different load cases:

- LF1: Axial compression F = 3 BW (BW = body weight)
- LF2: Cantilever bending
- LF 3: Torsion: M = F*L

Hints

It is not necessary to finish with all tasks within the official lab time. The ECTS points for the course are taking 2 hours "homework" each week into account.

1. Those who are not familiar with Ansys Workbench should do the Intro-Exercises (www.uni-ulm.de/einrichtungen/uzwr/lehre/praktikum-siso-cse-3-sem/downloads)
   - Praktikum 01: Strukturmechanik 1: Einführung in Ansys
   - Praktikum 02: Strukturmechanik 2: Verifikation & Validierung
2. You may build both geometries in one Workbench model in order to better compare the results. Define the load cases as different "load steps" within one Workbench model. So you can easily combine the load cases
3. Calculate global directional deformations, stresses and strains of both geometries loaded by the three different load cases. Use the information given in the lecture.
4. Compare the stresses and strains with ultimate stresses and strains of human cortical bone.
5. Compare the FE results between the geometries, between the load cases and with the analytical results.
6. Combine the load cases to find the worst case scenario.
7. Perform mesh convergence analyses.
8. Repeat the FEAs for models with reduced geometry dimensions (compare to SiSo-Exercise, Praktikum 01, step 3: 2D, 1D models).

Pictures that might help

Figure: Fractured human tibia with intramedulary nail.
(http://medapparatus.com/Introduction/Images/RushPin_TibialNail.jpg).