Lab for Lecture 2

1 Static equilbrium

Calculate the muscle force in the biceps rope for the changed load case. Performe the working steps of the receipt analog to those of the lecture. Assuming h3 = h2, how much larger is the muscle force compared to the result of the lecture case?



2 Physiological Stresses and Strains in Long Bones

Define a simplified bone geometry for a long bone (e.g. human tibia) with same length L and same amount of cross sectional area A but two different cross sectional shapes: (i) hollow and (ii) solid. X-Rays (see below) ore measures of available materials (nails and bones) might help you.



The bones are loaded by three different load cases:

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

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Tasks

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

- 1. Calculate global deformations, stresses and strains of both geometries loaded by the three different load cases. Use the information given in the lecture.
- 2. Compare the stresses and strains with ultimate stresses and strains.
- 3. Those who are not familiar with Ansys should do the Intro-Exercises (www.uniulm.de/einrichtungen/uzwr/lehre/praktikum-siso-cse-3-sem/downloads)
 - Praktikum 01: Strukturmechanik 1: Einführung in Ansys
 - Praktikum 02: Strukturmechanik 2: Verifikation & Validierung
- 4. Build a FE model of both geometries (in one model) using Ansys Workbench. Simulate the load cases as different "load steps" of that model. Analyze
 - displacements
 - stresses and strains
- 5. Compare the FE results between the geometries, between the load cases and with the analytical results.
- 6. Perform mesh convergence analyses.
- 7. Repeat the FEAs for models with reduced geometry dimensions (compare to step 3, Praktikum 01: 2D, 1D models).

Pictures and Links that might help



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

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