Lab for Lecture 4

Modeling of Artificial Trabecular Bone Structure – PART 2: STRENGTH

Use your artificial trabecular bone structure (= scaffold) model from the last time and add an ideal elastic-plastic material law. You may find the necessary parameters (yielding stresses) in our lecture slides or in the internet.

Tasks

1. Calculate the global stress-strain curve including loading and unloading regimes.

2. Calculate the ultimate loading of the structure. This however will be difficult because ultimate loading means that the stress can not be increased any more and at the same time the displacements are increasing more and more leading potentially to convergence problems. You may try a displacement-loaded analysis.

3. Try axial and shear loading or even other, maybe combined loading cases.

4. How is the ultimate loading depending from the bone volumetric content. Evaluate the strength-density relation from Carter & Hayes, 1977.
Figure: Examples of post-yielding load-displacement curves for real trabecular structure specimens [Tsouknidas et al.: "Anisotropic post-yield response of cancellous bone simulated by stress-strain curves of bulk equivalent structures". CMBBE, 2013].