Lab Report 2011/12

You may work together in groups of two or max. three students to have more fun.

Steps to do:

A) Perform your own little bending **experiment**. Measure the deflection.

B) Perform a **FEA** corresponding to your experiment. Determine the deflection.

C) Use the Simple Beam Theory to calculate the beam deflection **analytically**.

D) Write a lab report covering A, B & C. Discuss the results and their differences.

E) Send it to me via email (ulrich.simon@uni-ulm.de). Please include the e-mail addresses of all other members of the group in CC. Due date is **Sunday 04th Dec., 2011, 12:00 pm**

Hints regarding A) "Bending Experiment"

1) You have to find a beam-like object that you can load in a three-point bending with a known (measurable) force to such an extent that you are able to measure the deflection easily.

   Examples:

   - Take a thin flexible ruler preloaded by the weight of an empty water glass and then increase loading by filling the glass with water. Measure the additional deflection resulting from the weight of the water. You may determine the weight of the water just by measuring its volume.
   - Another possibility is to go to a hardware/home improvement store (e.g. "Bauhaus", "Praktiker") and find a beam and load it with your own body weight. You may also find tools in the store to measure the deflection of the beam. If you perform the experiment inside the store without breaking anything, you probably won't have to buy anything…
   - Example:

2) Measurements: In addition to the result, which is ...
   - ... the maximum deflection w_{max} of the beam (in the center)

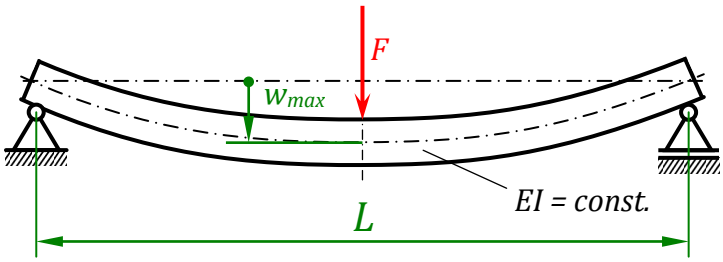
... you have to determine the following parameters :
   - length, height and thickness of the beam
   - material properties of the beam (use the internet!)
   - the force acting on the beam

3) If possible take a little photo of your experiment!

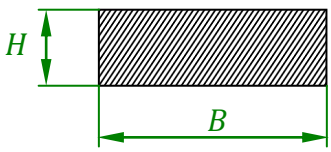
Hints regarding B) "Finite Elements Analysis"

4) Perform the FE analysis similar to exercises 1 and 2 of labs 1 and 2.
5) Create a hardcopy (screen shot) of the deflection contour plot (similar to Figure 23 in the script of Exercise 1) with
   - the option **`/dscale, 1, 1.0`** (= true scale) on and
   - applied boundary conditions visible.

Hints regarding C) "Analytical Solution"



Cross section of the beam



This is the analytical formula for the beam deflection

$$w_{\max} = \frac{L^3}{48\,EI} F$$

where:

L	– Length of the full beam
E	– Young's modulus

$I = BH^3/12$ – Axial second moment of area for a rectangular cross section
F – Force acting on full beam
w – Deflection of the beam

Hints regarding D) "Lab Report"

The lab report should consist of the following parts:

- A **title page** containing names (surname in capitals), matriculation numbers and e-mail addresses of all group members.
- Brief description of the **experiment** together with a photo or drawing.
- **Analytical** calculation and result.
- **FEA** result: A hardcopy (screen shot) of the deflection plot is sufficient.
- Summary in form of a **Table** with parameters and results like shown below.
- Short **discussion**: Compare the different results and give possible reasons for differences.

Parameters		
Variables	*Unit*	*Value*
Length L (half length of the full beam!)	…	…
Height H	…	…
Thickness B	…	…
Moment of area I	…	…
Young's modulus E*	…	…
Poisson's ratio ν*	…	…
Force F	–	…
	…	…
Results of deflection w_{max} from…		
… Experiment	…	…
… FEA	…	…
… Analytical	…	…
* Indicate here in the footer of the table the name of the beam material and where do you get material parameters from.		