Assignment B - Light Aircraft Structures

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1 Assignment Details

This is an **individual exercise** which accounts for 10% of the unit *AENG 21200 - Structures and Materials 2* (*i.e.* 2 credit points). You will need to submit your results through Blackboard by **Friday the 3rd of May 2019** (23:59). An online form will be made available on Blackboard where you can upload your solution as a file or ZIP archive containing **either**:

- Scans of hand calculations done with pen and paper;
- Word-processed documents (*e.g.* Word or LaTeX) summarising your hand calculations;
- Source file of **analytical solutions** developed using computer algebra software (*e.g.* Maple or Matlab's Symbolic Toolbox). Note that *numerical solutions* based on space discretisation will **not** be accepted.

2 Question

The thin-walled wing section shown in Figure 1 is 5 m long and made of aluminium alloy with $E = 70$ GPa and $\nu = 0.3$. The leading edge is a perfect half-ellipse and all other walls are perfectly straight. Note that the geometry has been parameterised and each student has a unique cross-section, which is defined by the data files provided on Blackboard.

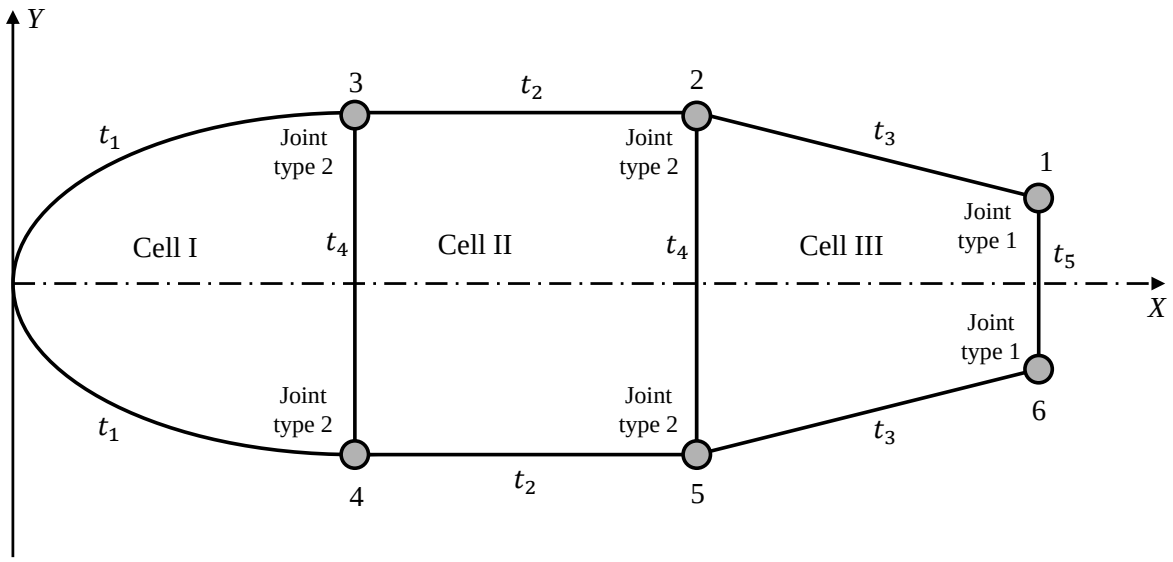

Figure 1: Parameterised cross-section geometry.

Note that the effective areas of each boom, A_k, need to be computed based on skin thickness *plus* the cross-sectional areas associated with each joint type.

Using boom-skin idealisation, determine:

- The effective boom cross sections, A_k.
- The coordinates of the shear centre of the section, e_X and e_Y.
- The torsional stiffness of the wing section about its shear centre, in units of $(\mathrm{N\ mm})/\mathrm{rad}$.

In addition, please discuss the assumptions and limitations of the theory utilised here, indicating how the wing box is likely to behave in real life.

3 Resources

On Blackboard you will find an Excel spreadsheet containing the geometry of your cross-section, with the following file name:

`Assessment_B.xlsx`

When uploading documents on Blackboard, could you please use the file naming scheme defined previously, *i.e.*

`Surname_FirstName_Username.zip`

for a ZIP file, and so on.

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