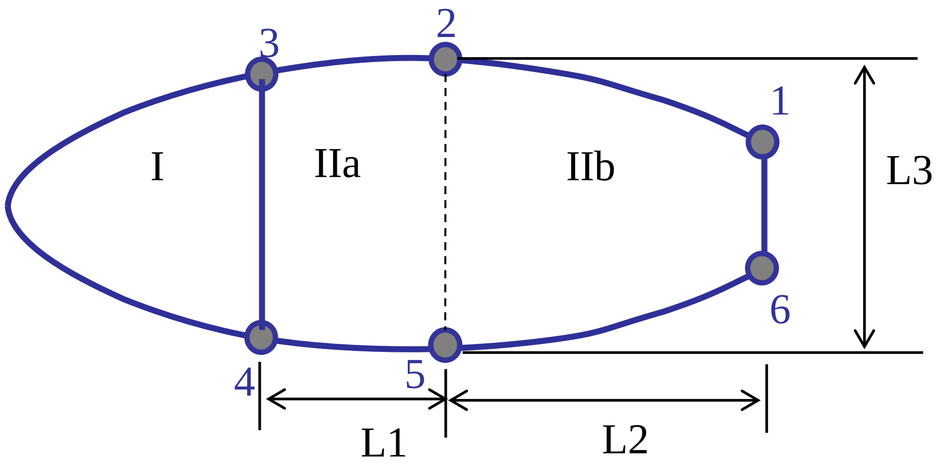
LIÈGE université

Aeronautical Structures (MECA0028-1)

June 2020

Question n° 1



The two-cell wing depicted here above has the idealized cross-section properties reported in the four Tables here below. The area of the cell II is given in two parts: the part left to the virtual line 25 and the part right to the virtual line 25. There is no wall between booms 2 and 5.

Wall	Length (mm)	Thickness (mm)	Shear modulus (GPa)
12, 56	950	0.5	22
23, 45	265	0.5	22
34(	950	0.5	22
34|	380	1.5	71
16	250	0.5	22

Boom	Section (mm^2)
1, 6	1 000
2, 5	1 300
3, 4	1 200

Cell	Area (mm^2)
I	115 000
IIa	105 000
IIb	315 000

Distance	Length (mm)
L1	250
L2	900
L3	400

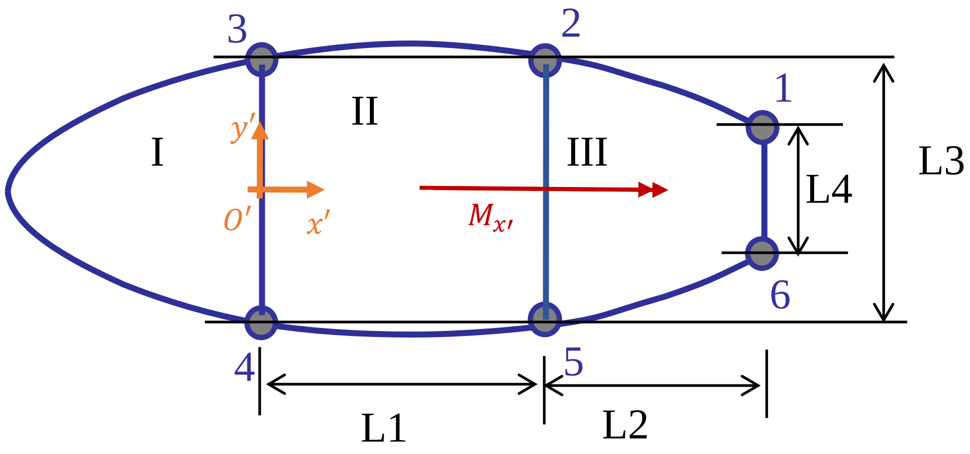
We consider the following assumptions

- The booms carry the direct stress (due to bending) only;
- The skin panels sustain the shear stress only;
- The taper effect can be neglected;
- The cross-section has a single symmetry;
- Twist and shear centres are assumed to coincide.

You are requested to compute

A) The location of the shear centre of the wing.
B) The twist rate for a load T_y= 1 kN, T_z = 2kN passing through this shear centre.

Question n° 2



The three-cell wing depicted here above has the booms distribution reported in the two Tables here below. **The booms do not all have the same Young's modulus and are not symmetrically distributed in terms of their cross-section**.

Distance	Length (mm)
L1	500
L2	400
L3	150
L4	50

Boom	Section (mm^2)	Young's modulus (GPa)
1	1 000	71
2	1 300	22
3	1 200	22
4	1 000	22
5	900	22
6	800	22

We consider the following assumptions

- The booms carry the direct stress (due to bending) only;
- The skin panels sustain the shear stress only;
- The taper effect can be neglected.

You are requested to compute

A) In the referential *O'x'y'* linked to the mid-length of wall 3-4, the location of the inertia centre *C* governing the bending behaviour;
B) The adequate second-moment of area terms that govern the bending behaviour with respect to this inertia centre *C;*
C) The direct stress in the different booms considering an applied bending moment $M_{x'}$= -10 kN.m.