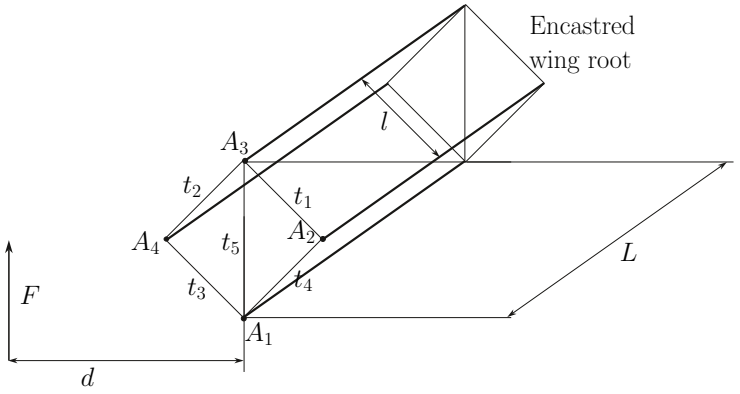
# Course of Aerospace Structures

Written test, Feb $10^{th}$, 2020

Exercise 1

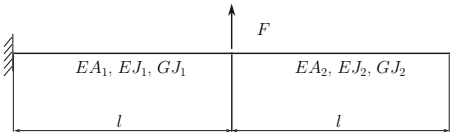
The semi-monocoque two-cell structure in the figure has a rotated square cross section, with sides of lenght $l$. It is loaded by a a force $F$ whose line of action goes through a point that is at a distance $d$ with respect to the vertical panel of the structure. Compute the displacement of the point of application of the force.

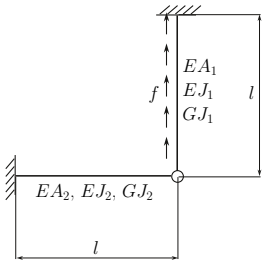



*Data*
$L = 2000$ mm;
$l = 200$ mm;
$E = 70000$ MPa;
$\nu = 0.3$;
$A_2 = A_4 = 400$ mm$^2$;
$A_1 = A_3 = 500$ mm$^2$;
$t_1 = t_2 = 0.8$ mm;
$t_3 = t_4 = 1.0$ mm;
$t_5 = 1.1$ mm;
$d = 500$ mm;
$F = 1{\times}10^3$ N;

Exercise 2

1. Consider the encastred beam in the figure below on the left. A concentrated force $F$ is applied at a distance $l$ from the constraint. The axial, bending and torsional cross-section stiffness properties are equal to $EA_1$, $EJ_1$ and $GJ_1$ in the portion of the beam between the constraint and the point of application of the force, and to $EA_2$, $EJ_2$ and $GJ_2$ from there to the beam tip. Solve the problem using the Ritz method and compute:
   - an approximate solution for the whole structure, by assuming a quadratic transverse displacement for the whole beam;
   - an approximate solution for the whole structure, by assuming a quadratic transverse displacement for the first half of the beam and a different quadratic transverse displacement for the second half.
2. Consider now the L-shaped beam on the right. The two beams are connected by an hinge. The vertical beam is subject the a distributed axial load per unit of lenght $f$. Compute an approximate solution for the whole structure by assuming, for both beams, quadratic transverse displacement and linear axial displacement fields.




Question 1

Illustrate the relation between the Principle of Complementary Virtual Work and the compatibility equations.