POLITECNICO MILANO 1863

DIPARTIMENTO DI SCIENZE E TECNOLOGIE AEROSPAZIALI

____
Name

____
Surname

____
Id

AEROSPACE STRUCTURES

Written test February 11 2019

1. The semi-momocoque wing of Figure 1 is loaded by a concentrated force F. Refer to Table 1 for the problem data, and assume reasonable values for any missing constant. Compute
   (a) the stress of the stringers at a distance $l/2$ from the loaded end;
   (b) the average shear stress of the two rivets with diameter d_1 and d_2 connecting the panels to the stringer. The rivets are spaced with pitch p_1 and p_2, respectively. Assume the area A_1 to belong to the L-shaped stringer only.

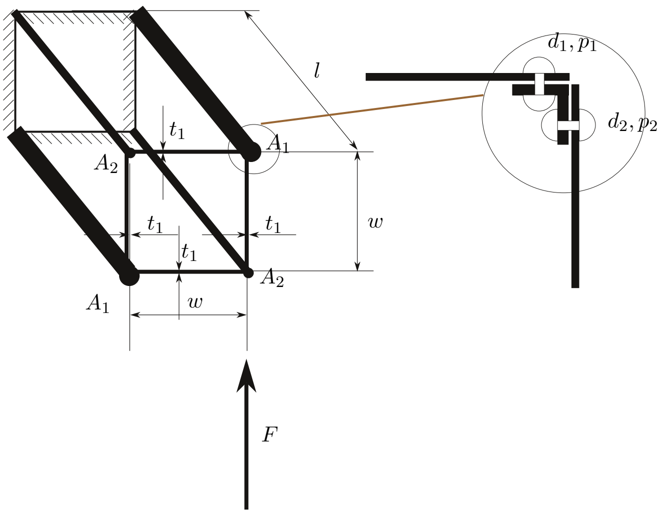

Figure 1: Loaded wing

A_1	300 mm^2	l	1500 mm
A_2	150 mm^2	d_1	2 mm
t_1	1.5 mm	d_2	3 mm
w	100 mm	p_1	10 mm
E	72000 MPa	p_2	12 mm
ν	0.3	F	15 kN

Table 1: Semi-momocoque wing data

2. The slender beam of Figure 2 is supported by two springs of stiffness k_x and k_y at one of its extremity, and clamped at the other. A force $\boldsymbol{F}$ with components F_x, F_y and F_z is applied at $l/3$. The beam axial stiffness is EA, while the bending stiffnesses are EJ_{xx} and EJ_{yy} (note: $EJ_{xy} = 0$). Compute the unknown reaction forces and the strain energy of the system (including the strain energy of the springs).

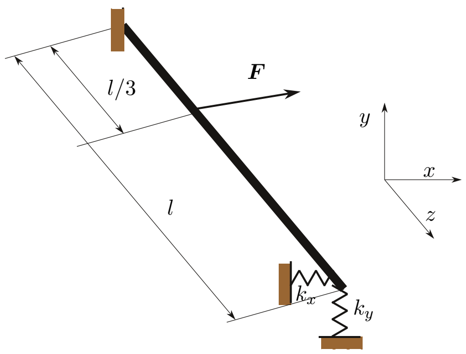

Figure 2: Cantilever bending

l	2000 mm	F_x	100N
EJ_{xx}	8×10^9 Nmm^2	F_y	150 N
EJ_{yy}	5×10^9 Nmm^2	F_z	10000 N
EJ_{xy}	0 Nmm^2	k_x	2 N/mm
EA	7×10^7 N	k_y	5 N/mm

Table 2: Cantilever bending data

3. Derive the principle of virtual work starting from the indefinite equilibrium equation of a three dimensional solid.