1. The observation cage of the Brighton Tower has a weight of 1000 kg and moves up and down the 9 m diameter column, made out of steel plates with thickness of 6 mm.
a) Neglecting column's own weight, find the stress at the base of the column; does it depend of the position of the observation cage?
b) Determine the displacement of the top end of the column relative to the base, as a function of the position *y* of the observation cage.
c) How does the stress at position y changes if the own weight of the column is taken into account? The elastic modulus of steel is E=200GPa and density is 7800kg/m^3.

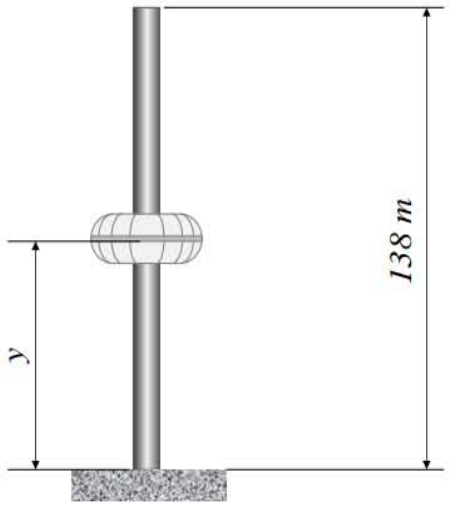

Figure 1

2. Determine the strain ε_x knowing that the following strains have been determined by use of the rosette gage shown in figure below: $\varepsilon_a = +460\times10^{-6}$, $\varepsilon_b = -100\times10^{-6}$, $\varepsilon_c = +75\times10^{-6}$. Also calculate the maximum direct and shear strains at point O in the part.

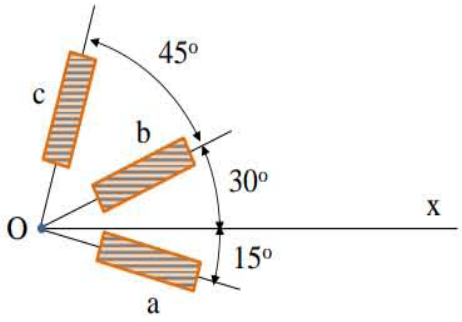

Figure 2

3. A rectangular element of a mechanical part is subjected to direct stresses only, σ_x, σ_y in directions parallel to its sides. Strain gauges parallel to the sides of the element read strains $\varepsilon_x = 530\times10^{-6}$ and $\varepsilon_y = -210\times10^{-6}$.
If the modulus of elasticity of the material is 200 GPa and Poisson's ratio is 0.3 find:
a) the direct stresses σ_x and σ_y;
b) maximum shear stress;
c) the change of the thickness of the plate, the element is part of, if the initial thickness is 12 mm.

4. A composite metallic bar is made of two different metals with moduli of elasticity E_1 and E_2. The two constituent parts of the bar have rectangular cross section of dimensions a and $a/2$, such that the cross section of the composite bar is square. A force P is applied axially through rigid plates as shown in figure 4. The line of action of force P is displaced from the axis of the bar by a distance b such that each part of the composite bar is stressed uniformly.
a) What are the axial forces P_1 and P_2 carried by each bar?
b) Calculate distance b.
c) What is the ratio of axial direct stresses in the two bars?

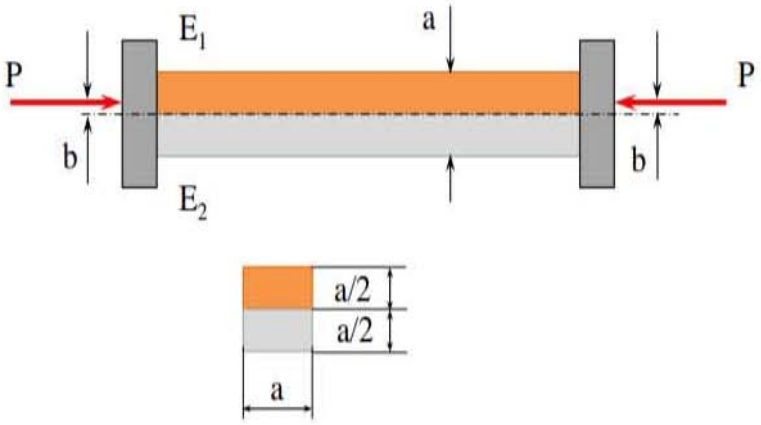

Figure 4

5. A rigid block with mass of 363 kg hangs from three wires, two made of steel and one of aluminium as shown in figure 5. The wires are equally spaced and have the diameter of 3 mm. The initial length of the wires is the same.
What is the temperature increase ΔT in all three wires, which makes the entire load carried by the steel wires only? Elastic modulus of steel and aluminium are 207 GPa and 75 GPa respectively, while the thermal expansion coefficients are $12\times10\text{-}6\ /^{o}C$ for steel and $23\times10^{-6}\ /^{o}C$ for aluminium.

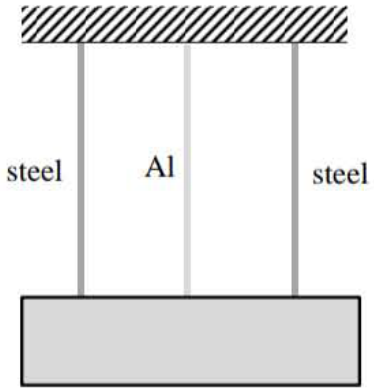

Figure 5