Faculty of Maritime Engineering and Marine Sciences

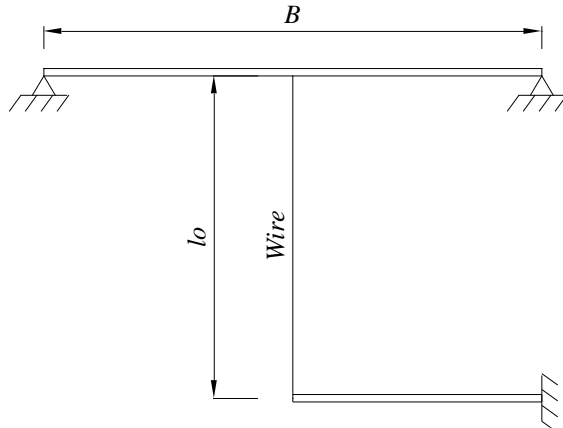## Ship's Structure

Quiz 5 – Comprehensive evaluation   **September 25th, 2020**

Group 1 (Review on beam bending).
Two horizontal beams are connected by a vertical wire, from the mid span of the simply supported upper to the end of the clamped lower, as shown in the figure. The wire suffers a temperature drop of 31.25°C, and it is desired to calculate the force which is exerted on the upper beam. The wire has the following characteristics: lo: 5.08 m, E_{wire}: 2.11E10 kg/m², A_{wire}: 0.0003 m², and, thermal expansion coefficient: 1.04E-5 1/°C. Dimension B: 1.52 m, and both beams have the following characteristics: E: 1.06E9 kg/m² and Ic: 5.00E-6 m⁴. Express your answer in kilograms.

Group 2 (Shear in bending).
Calculate the maximum shear force that may be applied on the following beam section considering the stress at level AA. The section corresponds to a cast steel beam with two circular holes to save weight. Dimensions are: B: 5 cm, $h1$: 3 cm, $h2$: 6 cm, and, diameters of the holes D: 4 cm. The allowable stresses that may be developed on the material are: normal: 120 N/mm² and shear: 55 N/mm². Express your answer in Newton.
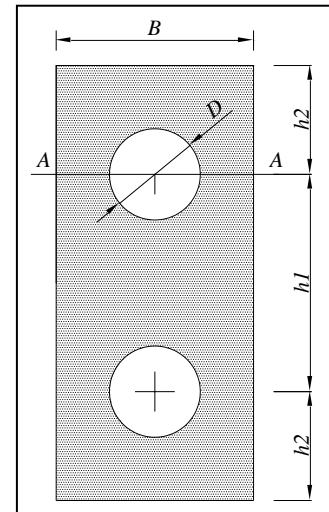
Group 4 (Hull beam bending)
Consider the bending of a simplified ship hull, with quadratically distributed beam and vertical sides: $B(x) = B\left[1-(2x/L)^2\right]$, where B is the beam at amidships and L is the length of the ship. The lightship weight distribution is represented with the following function $w_{light} = 100\left[1-(x/L)^2\right] kN/m$. For both functions the origin is located at amidships, with positive x pointing towards the forward perpendicular. The cargo is represented by a concentrated force of 1800 tons at amidships, while the aft superstructure and machinery is represented by another concentrated force of 300 tons applied at 20 m from amidships. The ship is navigating in sea water with no presence of waves, and you are required to calculate the shear force at a point $x=+L/4$; express your answer in tons using sign convention from DNV. Consider L: 80 m, B: 13 m, and, D: 6.5 m.