Faculty of Maritime Engineering and Marine Sciences

Ship's Structure

Quiz 4 – Ship hull stress analysis **September 11th, 2020**

Group 1 (Primary hull bending)

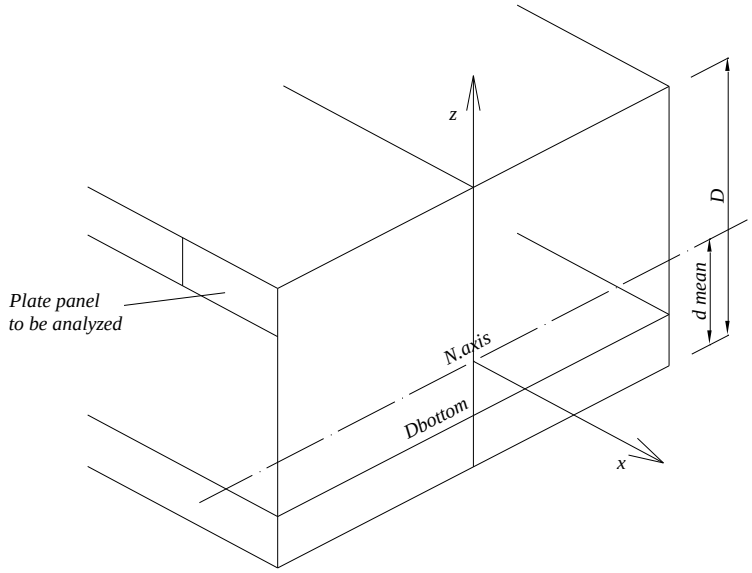
Consider a box barge with main dimensions: *L*: 80, *B*: 16, *D*: 8.2 m, and with the following simplified weight distribution in light condition: $w_{light} = 55\left[1-(x/L)^2\right]$ in ton/m, floating in static equilibrium in sea water. The origin of the reference system is located at midship section. To represent the weight of cargo, two concentrated forces are applied at +/- 15m, each one with a value of 900 tons. Calculate the shear force at *x=-L/4* in calm water, and specify your answer using the sign convention of ship classification societies.

Group 2 (Grillage analysis).

The secondary deck structure of a transversely framed steel ship (L: 55m, B: 11 m, D: 5.75 m, C_B: 0.63) is to be analyzed to determine the maximum pressure that may be applied on it. Characteristics from the distribution plan are: spacing between longitudinal bulkheads: 4.5 m, and between transverse bulkheads: 6 m. This secondary structure can be considered as a grillage, with 1 girder and 9 stiffeners, which in a simplified way are represented as flat bars, with dimensions: 20x1 cm. and, 8x0.8 cm, respectively: deck plate thickness is 7 mm, after subtracting the corrosion allowance. Girder has much larger inertia than stiffeners. According to DNV, plate effectiveness is 70% for girder and 100% for stiffeners, and, maximum allowable normal stress is 90 MPa.

Group 3 (Combination of stresses)

Calculate the equivalent von Misses stress at the center of a plate panel located at the upper region of the side of a ship (L: 75, B: 12, D: 6, $h_{doublebottom}$: 1.2 m, C_B: 0.72). Bending moment and shear force on the hull section are: 71887 kNm and 3478 kN, respectively. In the following figure, it is shown the structural distribution of the ship which has double bottom and one longitudinal bulkhead, and, hull beam sectional properties are also shown. The structure has longitudinally framing system with girders separated 2 m and side longitudinals spaced 0.75 m; pressure on the side can be considered as uniform with a value of 10 kN/m^2.



B: 12 m
D: 6 m
tdeck: 8 mm
tsides: 9 mm
tlongbk: 9 mm
tdbott: 10 mm
tbott: 10 mm
Ic:26522 m^2cm^2
dmean: 2.42 m

For the calculations, you may estimate the primary shear stress with its mean value, and the bending moment in the center of the plate can be estimated using Timoshenko's results as: $M_x = 0.013qa^2$ and $M_z = 0.0415qa^2$. Since the region of interest is away from the stiffeners, secondary stresses may be neglected.

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