MECH5700 Assignment

Due Thursday 3rd December at 12:00 Noon[1]

1. The cantilever beam of Figure 1 is loaded with a vertical shear force Sy = 1000 N and a horizontal shear force Sx = 250 N through the shear centre at its free end, Figure 1. Determine the bending stress distribution and sketch it at a section 125 mm from the free end.

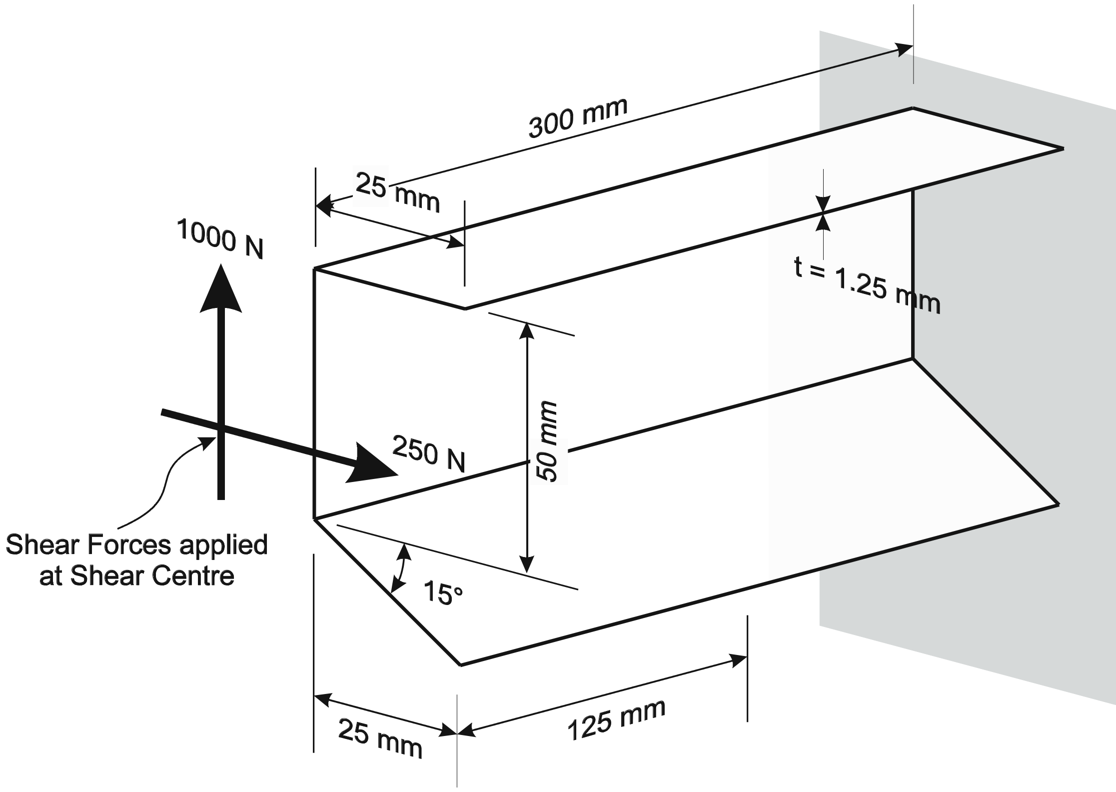

Figure 1: I-Beam beam with applied loading

2. The thin walled closed beam section of Figure 2 is subjected to only a vertical shear force Sy = 10 kN applied at the shear centre. Calculate the shear flow distribution and plot it. Then go on to determine the position of the shear centre.

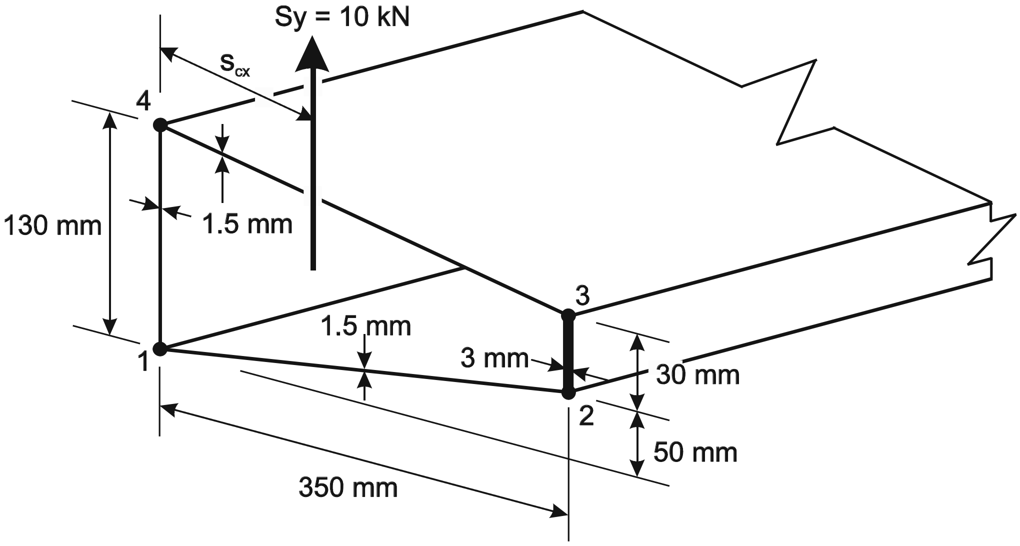

Figure 2: Thin walled beam with applied shear force

[1]Please note that this is a tentative deadline schedule. For the definitive deadline information for this and all other modules, please visit the VLE and look for the Deadlines and Feedback page.

3. Using the bending stress equation which you calculated for question 1, idealise the cross section of the cantilever beam of Figure 1 at a distance of 125 mm from the free end. You will need to use booms which are equally spaced over the perimeter of the cross section, and their number should range between 7 and 42 For the idealised section, calculate the shear flow distribution and calculate the position of the shear centre (s_{cx}, s_{cy})

4. The multi-cell aircraft wing of Figure 4 is applied a torque due to the lift and drag distribution. The beam has been idealised and the coordinates and area of the booms are given in Table Question 4a. The material properties for all skin segments are given in Table Question 4b. Determine the shear flow distribution and rate of twist for this wing.

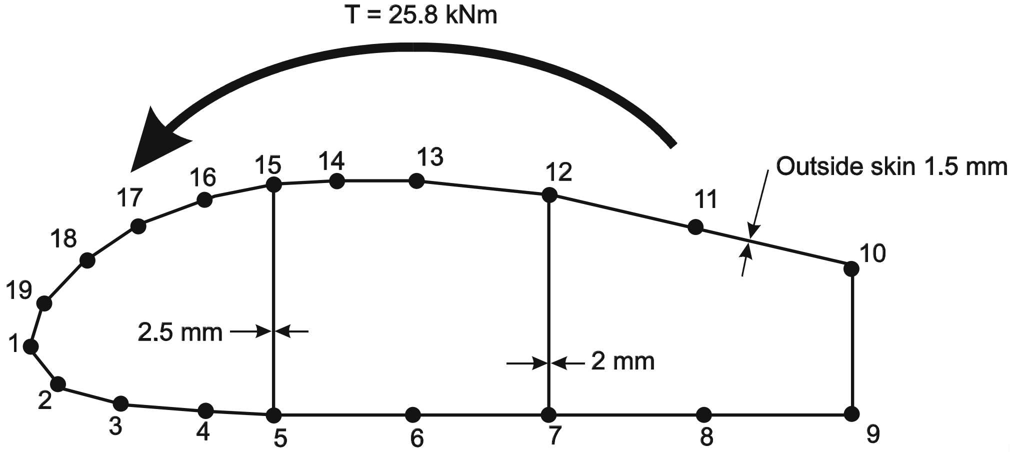

Figure 4: Three cell wing section with applied torque

Table Question 4a: Boom areas and their locations

Boom	x (mm)	y (mm)	B_i	Boom	x (mm)	y (mm)	B_i
1	0	125	107.0	11	1225	337.5	303.7
2	55	50	132.6	12	950	400	496.7
3	170	20	165.9	13	700	430	296.1
4	320	5	147.5	14	560	430	209.3
5	450	0	396.2	15	450	425	411.7
6	700	0	302.1	16	340	400	106.3
7	950	0	472.9	17	200	350	185.4
8	1225	0	327.0	18	100	280	148.8
9	1500	0	388.9	19	25	200	107.3
10	1500	275	212.5				

Table Question 4b: Shear modulus for the skin segments

Skin segment	G (GPa)
5-15	80.77
7-12	44.44
All others	26.32

5. The closed single cell beam of Figure 5 has been idealised to have 12 booms. If the beam is loaded with a vertical shear force of magnitude 1250 N through the shear centre, determine the shear flow distribution and the location of the shear centre. The coordinates of the 12 booms and their areas are given in Table Question 5.

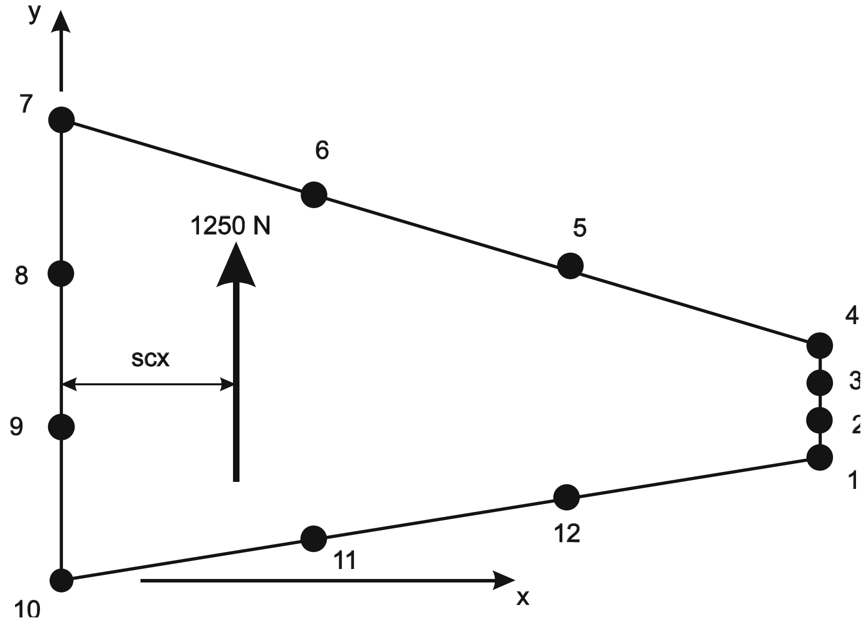

Figure 5: Closed single cell beam

Table Question 5: Boom areas and their locations

Boom	x (mm)	y(mm)	Area (mm^2)
1	350	35	130.41
2	350	45	10.20
3	350	55	9.79
4	350	65	131.82
5	233.33	85	177.55
6	116.67	105	177.55
7	0	125	105.56
8	0	83.33	62.50
9	0	41.67	21.02
10	0	0	104.85
11	116.67	11.67	175.87
12	233.33	23.33	175.87

Note: *In order to do this assignment you will have to generate some spread sheets to be able to carry out some of the calculations. Copies of these need to be included in your submitted coursework together with explanations of the equations used and any equations derived. A copy of the spreadsheets should also be included so that the calculated values can be checked.*