Example 3.1

For the curved web in Figure 1 calculate:

(a) The magnitude and direction of the resultant shear force;

(b) The moment of the shear flow about the chosen moment centre O;

(c) The line of action of the resultant force.

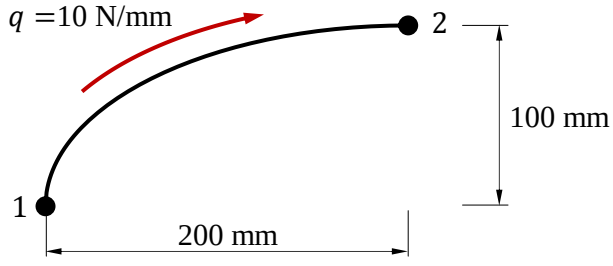

Figure 1: An elliptical curved web.

Example 3.2

Calculate the shear flow distribution for the idealised C-section in Figure 2, assuming that skins carry only shear stresses and booms carry only direct stresses.

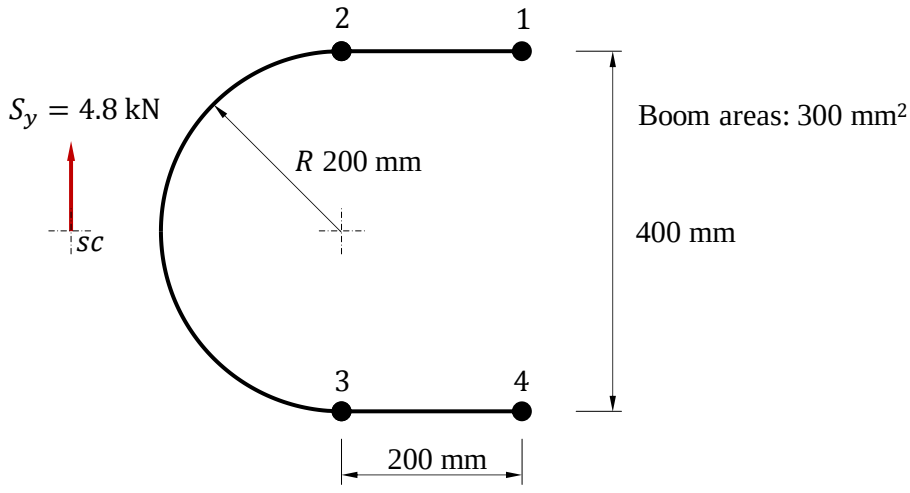

Figure 2: Open C-section with semi-circular member loaded through its shear centre.

Example 3.3

Calculate the position of the shear centre for the singly-symmetric closed-cell section in Figure 3, assuming that skins carry only shear stresses and booms carry only direct stresses.

Section area: 135 000 mm^2

Boom areas:
$A_1 = A_4 = 450$ mm^2
$A_2 = A_3 = 550$ mm^2

Length of wall 2-3: 580 mm

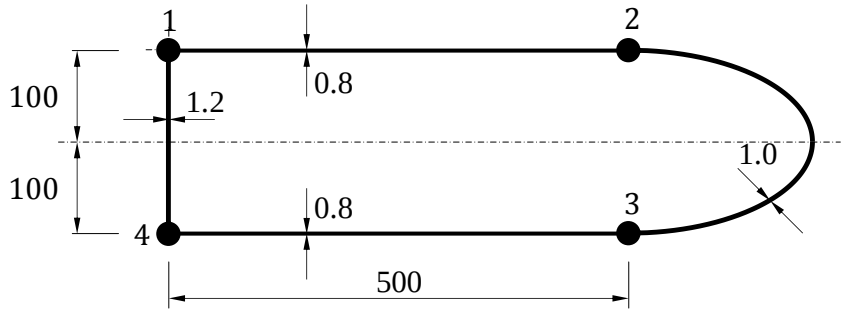

Figure 3: Singly-symmetric closed-cell section. Assume skins to resist only shear and booms to carry all direct stresses.

Example 3.4

Calculate the shear stress distribution in the walls of the three-cell wing section shown in Figure 4, when it is subjected to an anticlockwise torque of 11.3 kN m.

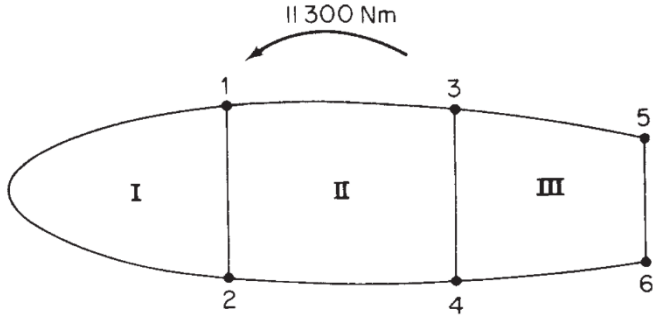

Figure 4: A multi-cell wing section.

Table 4: Properties of the wing section.

Wall	Length (mm)	Thickness (mm)	G (N/mm^2)	Cell area (mm^2)
12^o	1650	1.22	24 200	$A_I = 258\,000$
12^i	508	2.03	27 600	$A_{II} = 355\,000$
13, 24	775	1.22	24 200	$A_{III} = 161\,000$
34	380	1.63	27 600	
35, 46	508	0.92	20 700	
56	254	0.92	20 700	

Example 3.5

The wing section in Figure 5 carries a vertically upward shear load of 86.8 kN in the plane of web 572. The section has been idealised such that the booms resist all the direct stresses while the walls are effective only in shear. If the shear modulus of all walls is 27 600 N/mm^2 except for wall 78 for which it is three times this value, calculate the shear flow distribution in the section and the rate of twist.

Boom areas: $B_1 = B_6 = 2\,580$ mm^2, $B_2 = B_5 = 3\,880$ mm^2, $B_3 = B_4 = 3\,230$ mm^2.

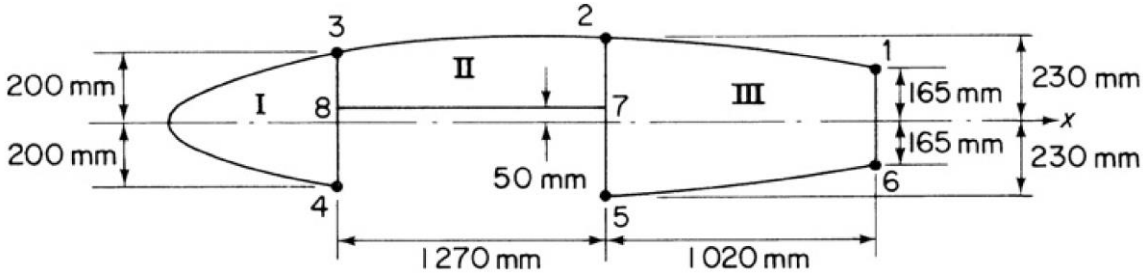

Figure 5: A multi-cell wing section.

Table 5: Properties of the wing section.

Wall	Length (mm)	Thickness (mm)	Cell area (mm^2)
12, 56	1023	1.22	$A_{\mathrm{I}} = 265\,000$
23	1274	1.63	$A_{\mathrm{II}} = 213\,000$
34	2200	2.03	$A_{\mathrm{III}} = 413\,000$
483	400	2.64	
572	460	2.64	
61	330	1.63	
78	1270	1.22	