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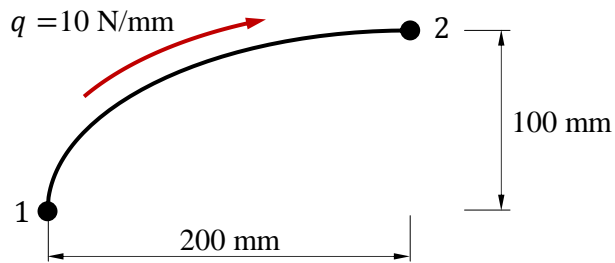
(c) The line of action of the resultant force.

Figure 1: An elliptical curved web.

3.1

a) Magnitude / Direction

$S_{12} = q_{12} \, L_{12}$

$L_{12} = 223.6 \, mm$

$= \left(10 \, \frac{N}{mm} \right) \sqrt{200^2 + 100^2}$

$$\boxed{S_{12} = 2.236 \, kN}$$

$\alpha = \tan^{-1} \left(\dfrac{100}{200} \right) = \boxed{26.6°}$

b) Moment resultant about O

$M = 2A \, q_{12}$ $\longrightarrow$ $\boxed{M = 314 \times 10^3 \, Nmm}$

$A_{ellipse} = \pi ab$ $\therefore A = \dfrac{1}{4} \pi ab$

$= \dfrac{1}{4} \pi \left(200 \times 100 \right)$

$A = 15.7 \times 10^3 \, mm^2$

c) Line of action

$e = \dfrac{2A}{L_{12}}$ but $M = S \cdot e$

$e = \dfrac{M}{S}$

$e = \dfrac{314 \cdot 10^3 \quad Nmm}{2.236 \cdot 10^3 \quad N}$

$$\boxed{e = 140.4 \, mm}$$