Light Aircraft Structures
Shear Forces and Moments in Skin-Boom Analyses

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Straight Web

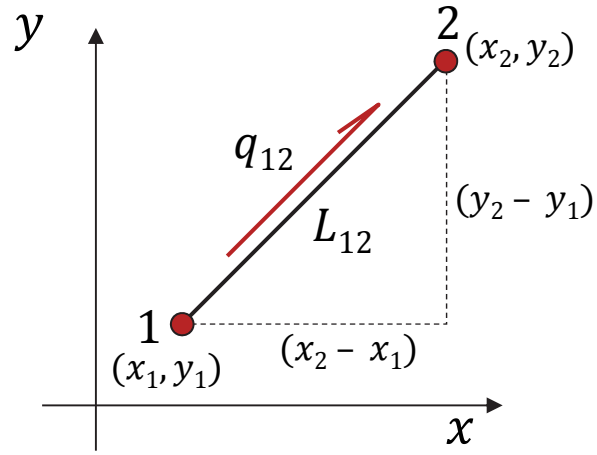
- Resultant shear force:

$$S = q_{12} \cdot L_{12}$$

  - Cartesian components:

$$S_x = q_{12}\,(x_2 - x_1)$$

$$S_y = q_{12}\,(y_2 - y_1)$$

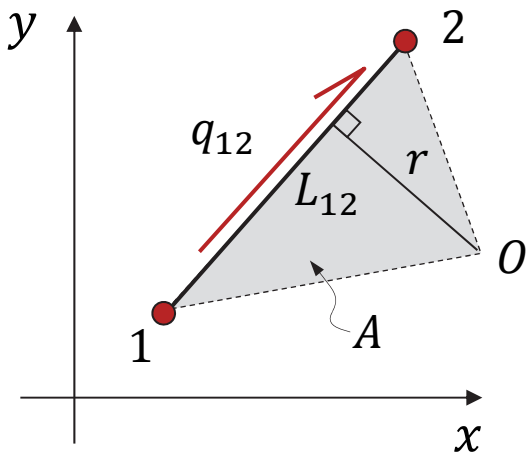


- Total torque:

$$M = q_{12} \cdot L_{12} \cdot r$$

$$M = q_{12} \cdot 2\,A$$

  - where A is the area subtended between the web and the chosen moment centre O



$$L_{12} \cdot r = 2A$$

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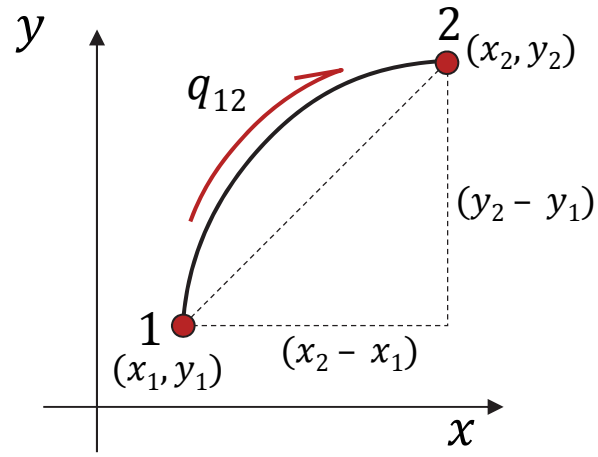
Curved Web – Shear Force

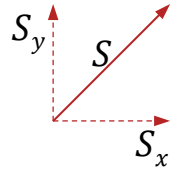
- The total shear force in a given direction is **again** the product of the **shear flow** and the **projected length** of the wall in that direction

$$S_x = q_{12}\,(x_2 - x_1) \qquad S_y = q_{12}\,(y_2 - y_1)$$

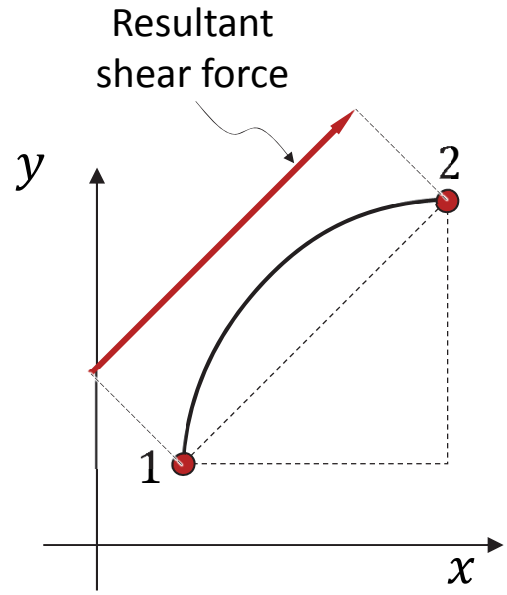


- The total resultant shear force S is

$$S = \sqrt{{S_x}^2 + {S_y}^2}$$



- Thus the resultant shear force acting on a curved web is the product of the shear flow and the length of the straight line joining the ends of the wall
  - The direction of the resultant is parallel to this line but not in general through this line



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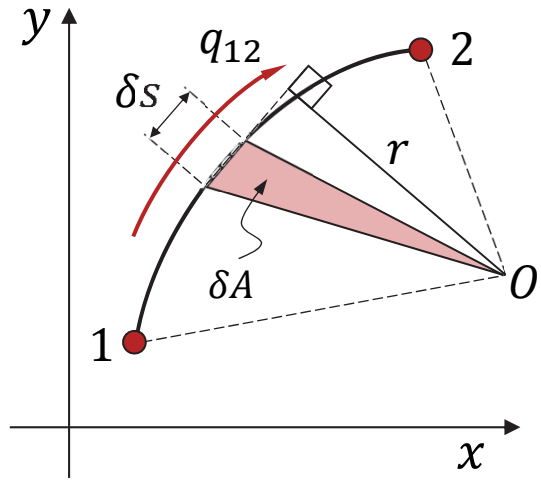
Curved Web – Moment Resultant

- The moment M produced by the shear flow about any point O in the plane of the section can be obtained from:

$$M = \int_1^2 q_{12}\, r\, \mathrm{d}s$$

$$M = q_{12} \int_1^2 2\, \mathrm{d}A$$

$$\boxed{M = 2\, A\, q_{12}}$$



- where A is the total area enclosed by the web and the lines joining the ends of the web to point O

- Thus the moment about any point due to the shear flow in a web is twice the product of the shear flow and the area subtended between the web and the chosen point

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Curved Web – Resultant Line of Action

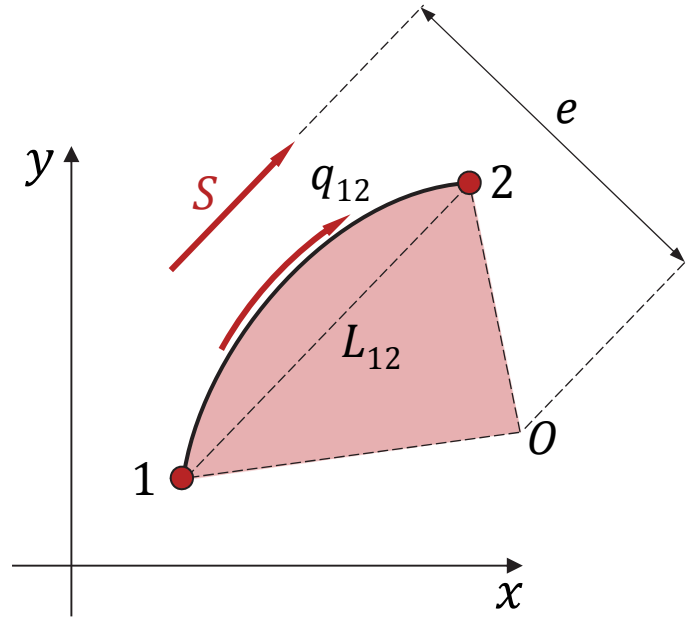
- The line of action of the shear flow force resultant S is parallel to the line joining the booms each side of the web, but is not coincident
- To determine the distance of the line of action from a chosen point consider the force and moment resultant equations:

$$M = S \cdot e$$

$$M = 2\,A\,q_{12} \qquad S = q_{12}\,L_{12}$$

$$2\,A\,q_{12} = q_{12}\,L_{12}\,e$$

$$e = \frac{2\,A}{L_{12}}$$



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