

Combined open and closed section beams

2013

Bending

It is immaterial what form the cross-section of a beam takes.
The direct stresses due to bending are given by either of

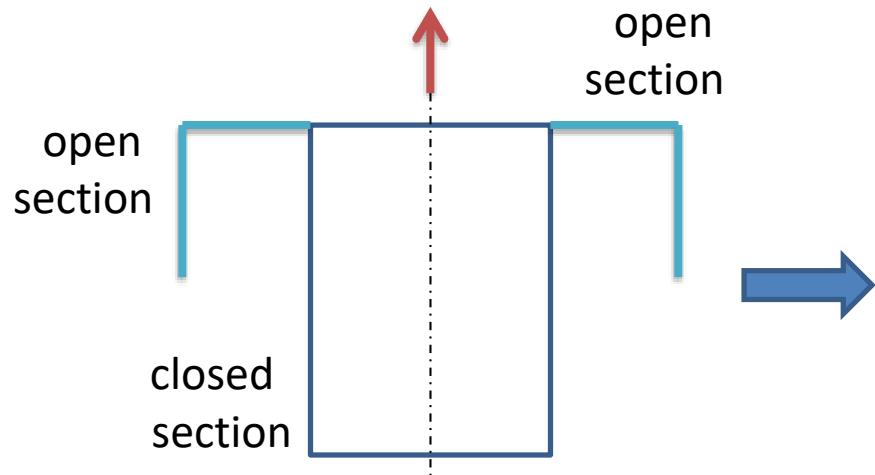
$$\sigma_z = \left(\frac{M_y I_{xx} - M_x I_{xy}}{I_{xx} I_{yy} - I_{xy}^2} \right) x + \left(\frac{M_x I_{yy} - M_y I_{xy}}{I_{xx} I_{yy} - I_{xy}^2} \right) y$$

or

$$\sigma_z = \frac{M_x (I_{yy}y - I_{xy}x)}{I_{xx} I_{yy} - I_{xy}^2} + \frac{M_y (I_{xx}x - I_{xy}y)}{I_{xx} I_{yy} - I_{xy}^2}$$

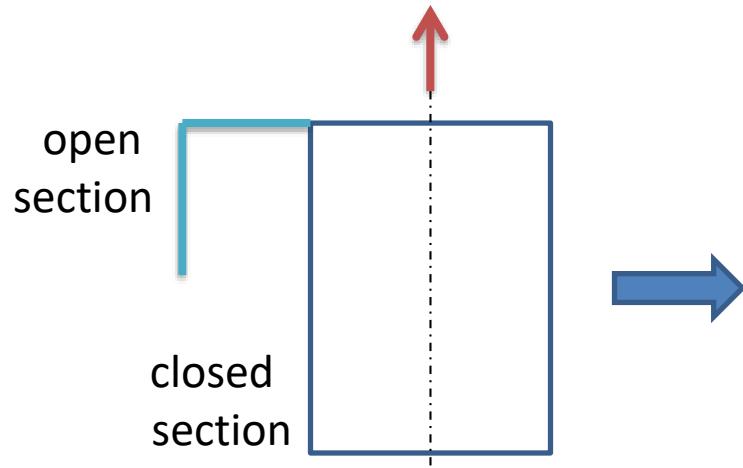
Shear

Case 1: shear loads applied through the SC



1. No twist
2. At free edge of open section
 $q_{s,0} = 0$
3. Cut the closed section where SC will not move (i.e. $q_{s,0} = 0$)

Case 2: shear loads are not applied through the SC



1. Find SC
2. Apply shear loads through SC and find torque
3. Solve two problems (shear and torsion)

Torsion

Since the torsional stiffness of the open section is small in comparison with closed section, it can be ignored during calculation.

Shear stresses in open section should be checked.