

# 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

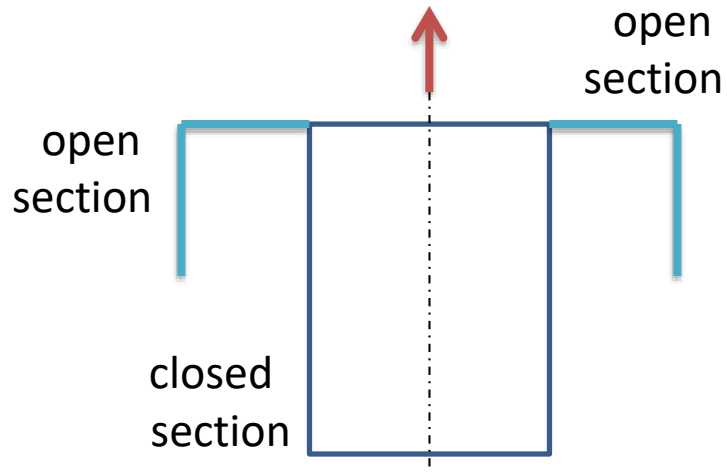
$$\sigma_z = \left( \frac{M_y I_{xx} - M_x I_{xy}}{I_{xx} I_{yy} - I_{xy}^2} \right) x + \left( \frac{M_x I_{yy} - M_y I_{xy}}{I_{xx} I_{yy} - I_{xy}^2} \right) y$$

or

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

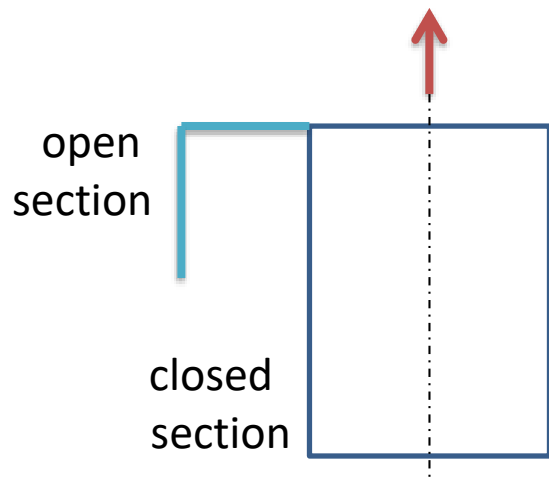
# Shear

## 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.