If $T = 6000 \text{ N-mm}$, $G = 80 \text{ GPa}$, compute the angle of twist/unit length and the maximum shearing stresses (neglecting stress concentrations) in the closed section and the fin.
Center line distances

\[\Omega = (18.5)(19.5) = 360.75 \text{ mm}^2\]

\[
\int ds = \frac{18.5}{1} + \frac{18.5}{2} + \frac{19.5}{1} + \frac{19.5}{2} = 57
\]

\[
T = G \phi' \left[ \frac{4\Omega^2}{\int ds / t} + \frac{1}{3} \int t^3 ds + \frac{1}{3} \int_{\text{fin}} t^3 ds \right]
\]

N-mm \quad rad/mm \quad mm^4

6000 = 80,000 \phi' \left[ \frac{(4)(360.75)^2}{57} + \frac{(18.5)(2)^3}{3} + \frac{(19.5)(2)^3}{3} + \frac{(18.5)(1)^3}{3} + \frac{(19.5)(1)^3}{3} + \frac{(15.5)(2)^3}{3} \right]

N/mm^2
\[6000 = 80,000 \phi'[9132.67 + 49.33 + 26 + 6.17 + 6.5 + 41.33]\]

\[\phi' = + + + + + + + \text{ rad / mm}\]

\[\phi' = 8.10 \times 10^{-6} \text{ rad / mm}\]

Torque carried by closed section is
\[T_c = (80,000)(8.1 \times 10^{-6})(9220.67) = 5975 \text{ N-mm}\]

so the fin contributes very little

In the closed section
\[\tau_{\max} = \frac{T_c}{2\Omega t_{\min}} = \frac{5975}{2(360.75)(1)} = 8.28 \text{ MPa}\]

In the fin
\[\tau_{\max} = \frac{T_f t_{\max}}{J_f} = \frac{(6000 - 5975)(2)}{(15.5)(2)^3 / 3} = 1.2 \text{ MPa}\]
Now, consider the same geometry where we slit the section as shown. Again determine the twist/unit length and maximum shearing stress.
\[ J_{\text{eff}} = \sum \frac{1}{3} b_i t_i^3 \]

\[ J_{\text{eff}} = \frac{1}{3} \left[ (18.5)(1)^3 + (18.5)(1)^3 + (19.5)(2)^3 + (34)(2)^3 \right] \]

\[ = 155 \text{ mm}^4 \]

\[ \phi' = \frac{T}{GJ_{\text{eff}}} = \frac{6000}{(80,000)(155)} = 484 \times 10^{-6} \text{ rad / mm} \]

\[ \tau_{\text{max}} = \frac{T t_{\text{max}}}{J_{\text{eff}}} = \frac{(6000)(2)}{155} = 77.4 \text{ MPa} \]

so slitting causes:

\[ \phi' \] to increase by a factor of 59.8

\[ \tau_{\text{max}} \] to increase by a factor of 9.3