1. Assuming the Prandtl stress function for the torsion of a bar of equilateral triangular cross-section with sides $x+a/3=0$, $x-2a/3+\sqrt{3}y=0$ and $x-2a/3-\sqrt{3}y=0$, to be of the form

$$\phi = m(x+a/3)(x-2a/3+\sqrt{3}y)(x-2a/3-\sqrt{3}y)$$

obtain
(a) m
(b) the stresses at the corners and the centroid of the triangle.
(c) the maximum magnitude of the shear stress and the position where it occurs
(d) the expression for torsional rigidity C.

2. Find the maximum shearing stress and the rate of twist, α, of the bar having cross section as shown, when it is subjected to a torque of 600 $N.m$ at its ends (G=77.5 MPa)

3. Consider a rectangular cross-section bar with sides a and b. Take the origin at the geometric center and consider the stress function

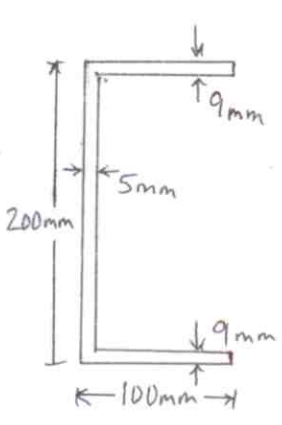
$$\phi = \sum_{m=1}^{\infty}\sum_{n=1}^{\infty} A_{mn} \sin\frac{m\pi(x+a/2)}{a}\sin\frac{n\pi(y+b/2)}{b}$$

(a) Obtain A_{mn} such that ϕ satisfies the Poisson equation for torsion. Verify that the BC's are satisfied.
(b) Obtain the expression for the rate of twist (α) and the shear stresses in terms of the applied moment M.
(c) Obtain the expression for the torsional rigidity.

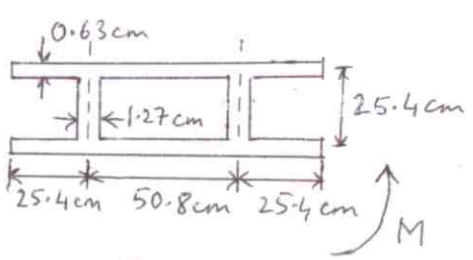
4. Determine the allowable twisting moment for a maximum shear stress of 68950 kPa and calculate the resulting stresses in the various parts of the section.

5. The thin walled member is subjected to a torque M=113000 Nm. Determine the shear stresses in the various parts of the wall.

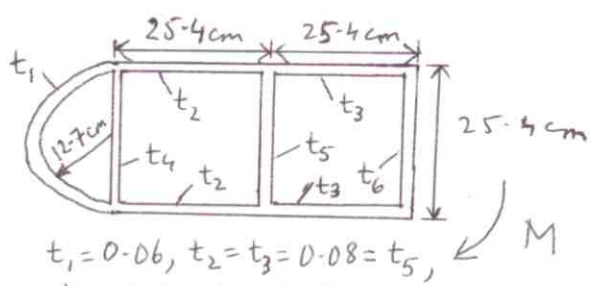
6. Obtain the finite difference solution for the twist rate (α) for the L shaped section shown by taking the mesh size $h = a/2$.



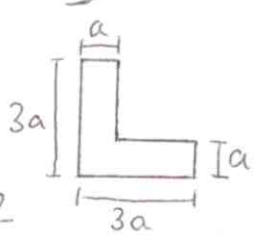
P.2



P.4



$t_1 = 0.06,\ t_2 = t_3 = 0.08 = t_5,$
$t_4 = 0.13,\ t_6 = 0.10$
P.5



P.6