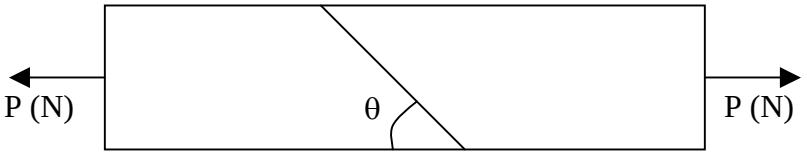
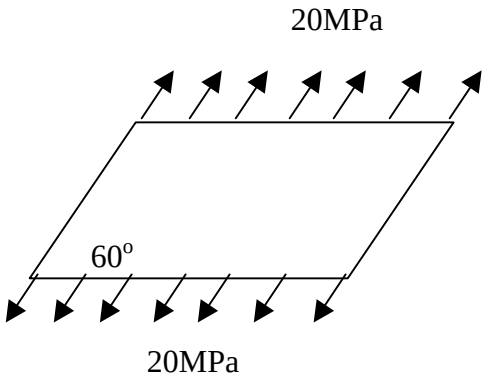
ME 362 Stress Analysis:
Review Problem Set 1

(1) A cylinder of radius 50mm breaks at an angle $\theta=40^o$ as shown in the figure. The two parts are glued back together. The maximum allowable normal and shearing stress across the glued joint is 700 and 560 kPa respectively. What is the maximum axial load P that the cylinder can withstand so that the glued joint does not fail?

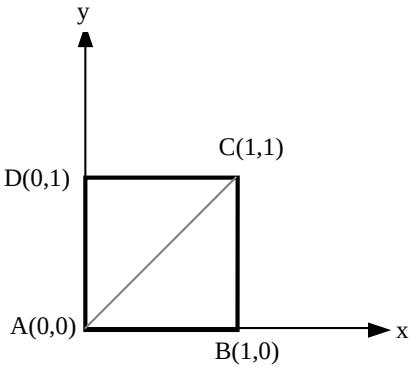


(2) A thin skewed plate is subjected to a uniform stress of 20MPa along the top and bottom as shown in the figure. Determine the maximum normal stress and the plane on which it acts. Determine also the maximum shear stress and the plane on which it acts.



(3) A body is subjected to the following two-dimensional plane deformation:
$u_x = (\gamma - \omega)y$; $u_y = (\gamma + \omega)x$ where γ and ω are small positive constants such that γ > ω.

(3.i) If a unit square ABCD (see figure) is drawn on the body before deformation, draw its new shape A'B'C'D' upon deformation, and specify the coordinates of A', B', C' and D'.



(3.ii) What are the strains ε_{xx}, ε_{yy} and ε_{xy}?

(3.iii) For an isotropic, linear elastic material, what are the stresses in the plate?

(3.iv) Analogous to strains, we can define a quantity called ``rotation'' as follows:

$$\Omega_{xy} = \frac{1}{2}\left\{\frac{\partial u_y}{\partial x} - \frac{\partial u_x}{\partial y}\right\}$$

What is the rotation Ω_{xy} for the given deformation?

(3.v) Show, with the help of sketches, that if ω=0, the diagonal of the square AC deforms to A'C' without changing orientation, i.e., A'C' is in the same direction as AC.

(4) A thin long rectangular beam (L=1m, b=0.01m, h=0.1m) is hinged at two locations and carries a distributed line load p_o (N/m) on the entire top surface as shown in the figure. Determine the largest value that p_o can be if the maximum bending stress should not exceed 50MPa anywhere in the beam.