1.6-6 CONT.

$A_b = 259.8\ \text{mm}^2 - 113.1\ \text{mm}^2$
$= 146.7\ \text{mm}^2$

$\sigma_b = \frac{P}{A_b} = \frac{9.0\ \text{kN}}{146.7\ \text{mm}^2} = 61.3\ \text{MPa}$ ←

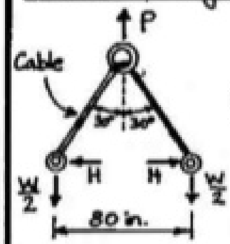
(b) Shear stress in head of bolt

A_s = shear area
$= \pi d t$

$\tau_{AVE} = \frac{P}{A_s} = \frac{P}{\pi d t} = \frac{9.0\ \text{kN}}{\pi(12\ \text{mm})(6\ \text{mm})}$
$= 39.8\ \text{MPa}$ ←

1.6-7 Steel plate hoisted by a sling

Free-body diagram of sling



d = diameter of clevis pins
= 0.70 in.

W = weight of steel plate

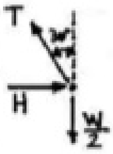
Weight of steel plate

W = (weight density)(volume)
$= \gamma V$; $\gamma = 490\ \text{lb/ft}^3$

$V = (100\ \text{in.})(50\ \text{in.})(4\ \text{in.})$
$= 20{,}000\ \text{in.}^3$

$W = (490\ \text{lb/ft}^3)\left(\frac{1}{1728}\ \frac{\text{ft}^3}{\text{in.}^3}\right)(20{,}000\ \text{in.}^3)$
$= 5671\ \text{lb}$

Tensile force T in cable



$\Sigma F_{VERT} = 0$ ↑+ ↓−

$T\cos 30° - \frac{W}{2} = 0$

$T = \frac{W}{2\cos 30°} = \frac{5671\ \text{lb}}{2\cos 30°}$
$= 3274\ \text{lb}$

Shear stress in the pins (double shear)

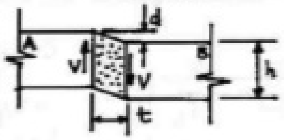
$\tau_{AVE} = \frac{T}{2A_{PIN}} = \frac{3274\ \text{lb}}{(2)(\frac{\pi}{4})(0.70\ \text{in.})^2}$
$= 4250\ \text{psi}$ ←

Bearing stress between steel plate & pins

A_b = (thickness of plate)(diameter of pin)
$= (4.0\ \text{in.})(0.70\ \text{in.}) = 2.80\ \text{in.}^2$

$\sigma_b = \frac{T}{A_b} = \frac{3274\ \text{lb}}{2.80\ \text{in.}^2} = 1170\ \text{psi}$ ←

1.6-8 Epoxy Joint between concrete slabs



h = 100 mm
t = 12 mm
L = 1.0 m
d = 0.048 mm
G = 960 MPa

(a) Average shear strain

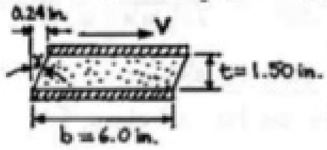
$\gamma_{AVE} = \frac{d}{t} = 0.004$ ←

(b) Shear forces V

Average shear stress : $\tau_{AVE} = G\gamma_{AVE} = 3.84\ \text{MPa}$

$V = \tau_{AVE}(hL) = 384\ \text{kN}$ ←

1.6-9 Bearing pad subjected to shear



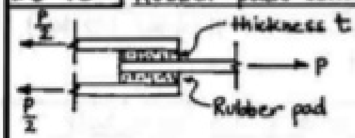
V = 1200 lb
Width of pad:
a = 5.0 in.
Length of pad:
b = 6.0 in.

$\tau_{AVE} = \frac{V}{ab} = \frac{1200\ \text{lb}}{(5.0\ \text{in.})(6.0\ \text{in.})} = 40\ \text{psi}$

$\gamma_{AVE} = \frac{0.24\ \text{in.}}{1.50\ \text{in.}} = 0.160$

$G = \frac{\tau}{\gamma} = \frac{40\ \text{psi}}{0.16} = 250\ \text{psi}$ ←

1.6-10 Rubber pads bonded to steel plates



Rubber pads: t = 12 mm
Length L = 200 mm
Width b = 150 mm
G = 830 kPa
P = 15 kN

(a) Shear stress and strain in the rubber pads

$\tau_{AVE} = \frac{P/2}{bL} = \frac{7.5\ \text{kN}}{(150\ \text{mm})(200\ \text{mm})} = 250\ \text{kPa}$

$\gamma_{AVE} = \frac{\tau_{AVE}}{G} = \frac{250\ \text{kPa}}{830\ \text{kPa}} = 0.301$ ←

(b) Horizontal displacement

$\delta = \gamma_{AVE}\, t = (0.301)(12\ \text{mm}) = 3.61\ \text{mm}$ ←

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