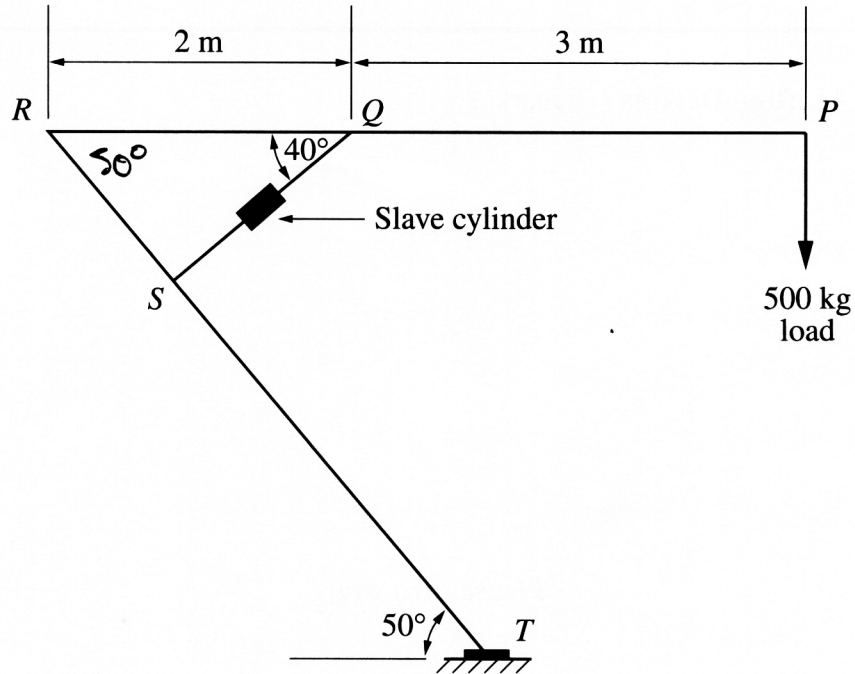


Question 14 — Lifting Devices (10 marks)

The diagram shows a lifting device. Arm *RP* is raised or lowered by a hydraulic system comprising a master cylinder and a slave cylinder.



- (a) The lifting device is required to hold a load of 500 kg. Determine the minimum force required in member *QS* to keep arm *RP* horizontal. 2

$$2 \times 500 + 3 \times 500 = 2500 \text{ kg}$$

$$25000 \text{ N}$$

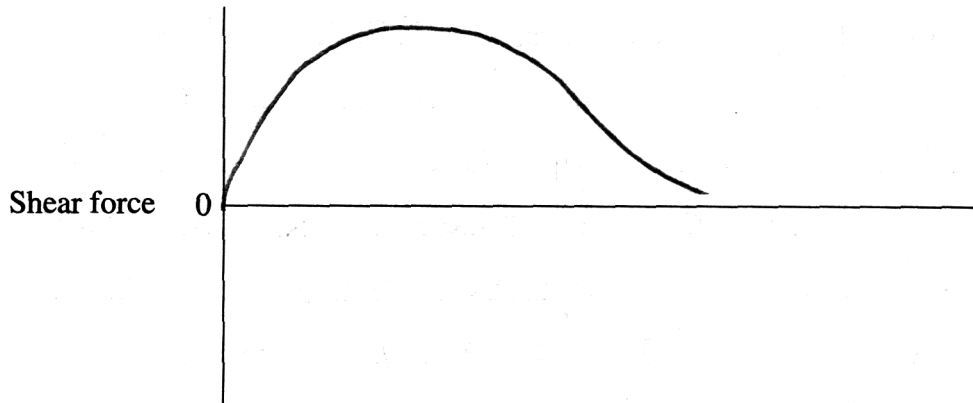
Minimum force = 25000 N

Question 14 continues on page 19

Question 14 (continued)

(b) For another set of conditions, the force in member *QS* was found to be 21.35 kN.

- (i) Draw the shear-force diagram for the arm *RP*. Label the values on the diagram. The mass of the arm should not be considered. 2



- (ii) Determine the diameter of the master cylinder if the mechanical advantage of the hydraulic system is 3. The slave cylinder has a cross-sectional area of 2800 mm². 3

$$2800\text{mm}^2 \times 3 = 8400\text{mm}^2$$

$$\begin{aligned} \text{area } \emptyset &= 4\pi r^2 \\ r &= \frac{\sqrt{8400}}{4\pi} \\ &= 81\text{mm} \end{aligned}$$

$$\begin{aligned} &\cancel{4\pi 25.25^2} \\ &= \\ &4\pi 25.8555^2 \\ &= 8400\text{mm}^2 \end{aligned}$$

$$25.8555\text{mm}$$

Diameter = ~~81mm~~

Question 14 continues on page 20

Question 14 (continued)

- (c) Gears used in lifting devices can be manufactured by powder-forming or by a variety of other processes.

3

Identify an alternative manufacturing process, and contrast the properties of gears formed by this process with the properties of the powder-formed gears.

gears formed by cold forging maintain a high strength due to the work hardening but powder formed gears are set in a precise shape some thing cold forging has more difficult doing, powder formed maintains high strength as well but only as much as it has been relaxed.

End of Question 14