

**QUESTION 1**

A sign structure has four forces and a couple-moment applied to it in the location shown in Figure 1 below.

- Determine the equivalent force-couple system at A.
- Replace the system of forces and couples by a single force and determine where the line of action intersects the lines  $x$  axis and the  $y$  axis.

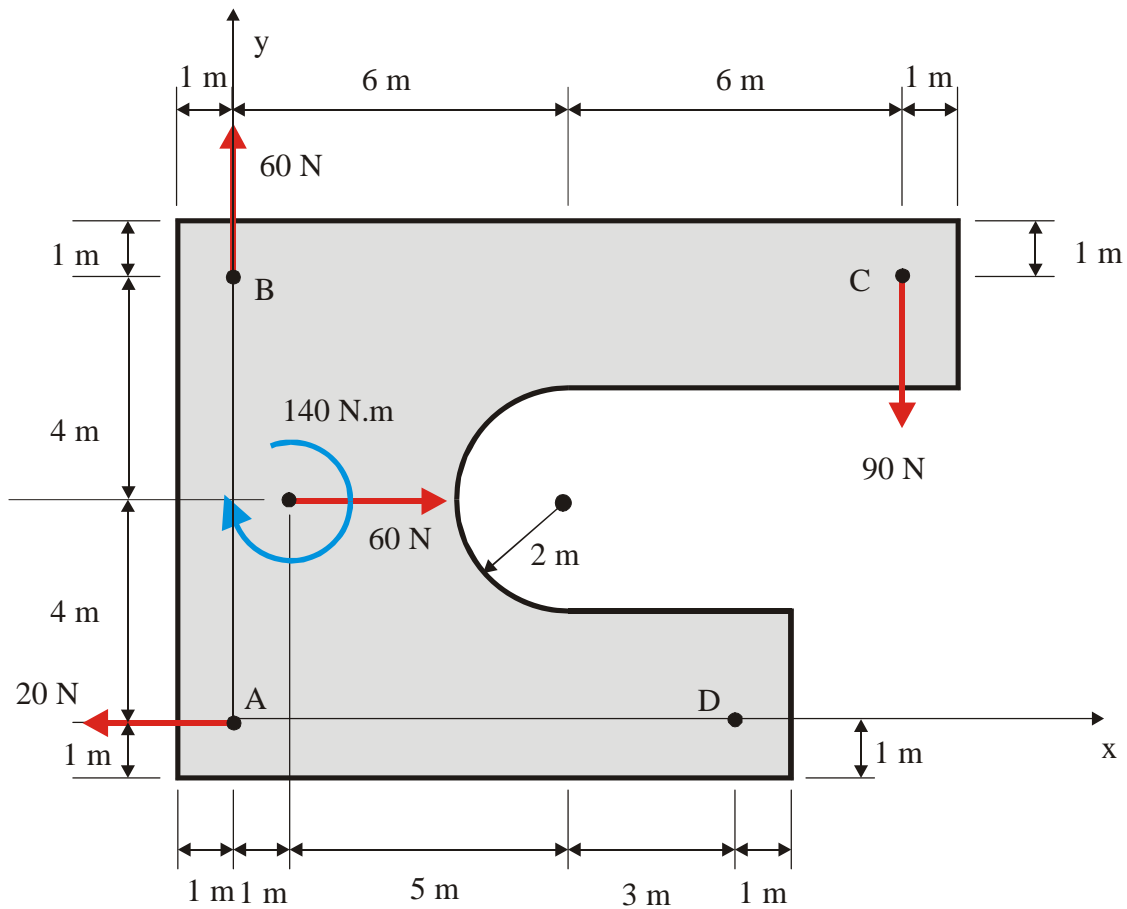


Figure 1

**QUESTION 2**

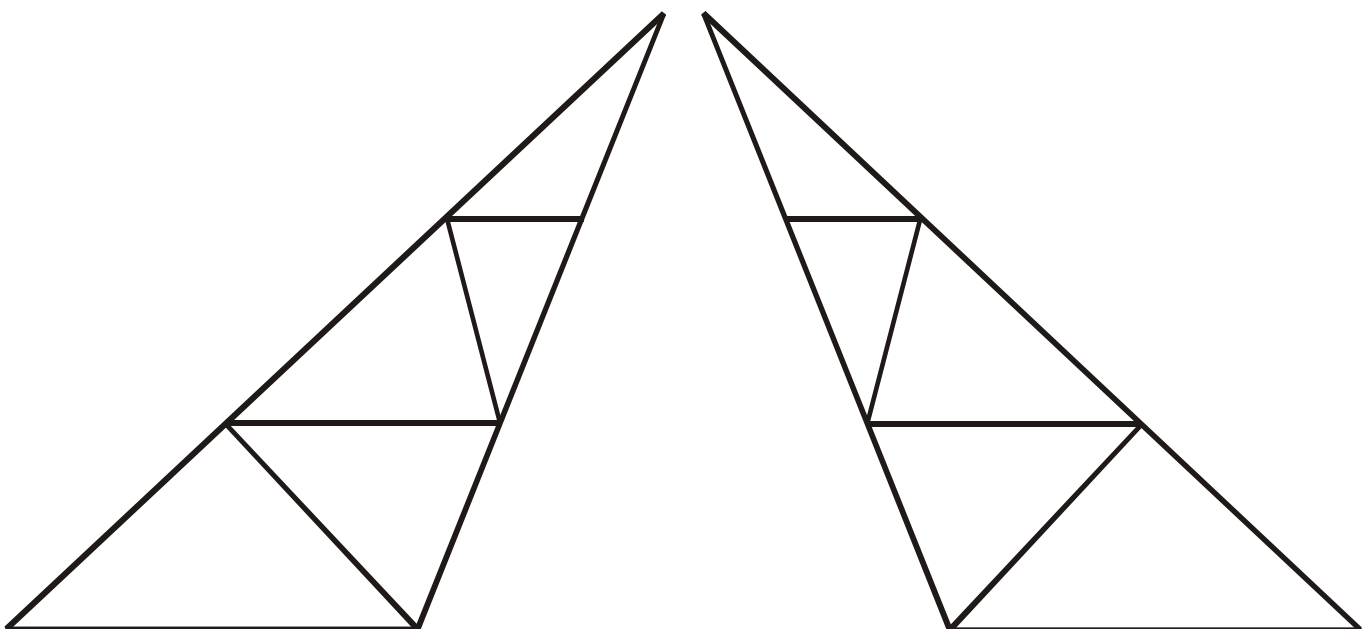
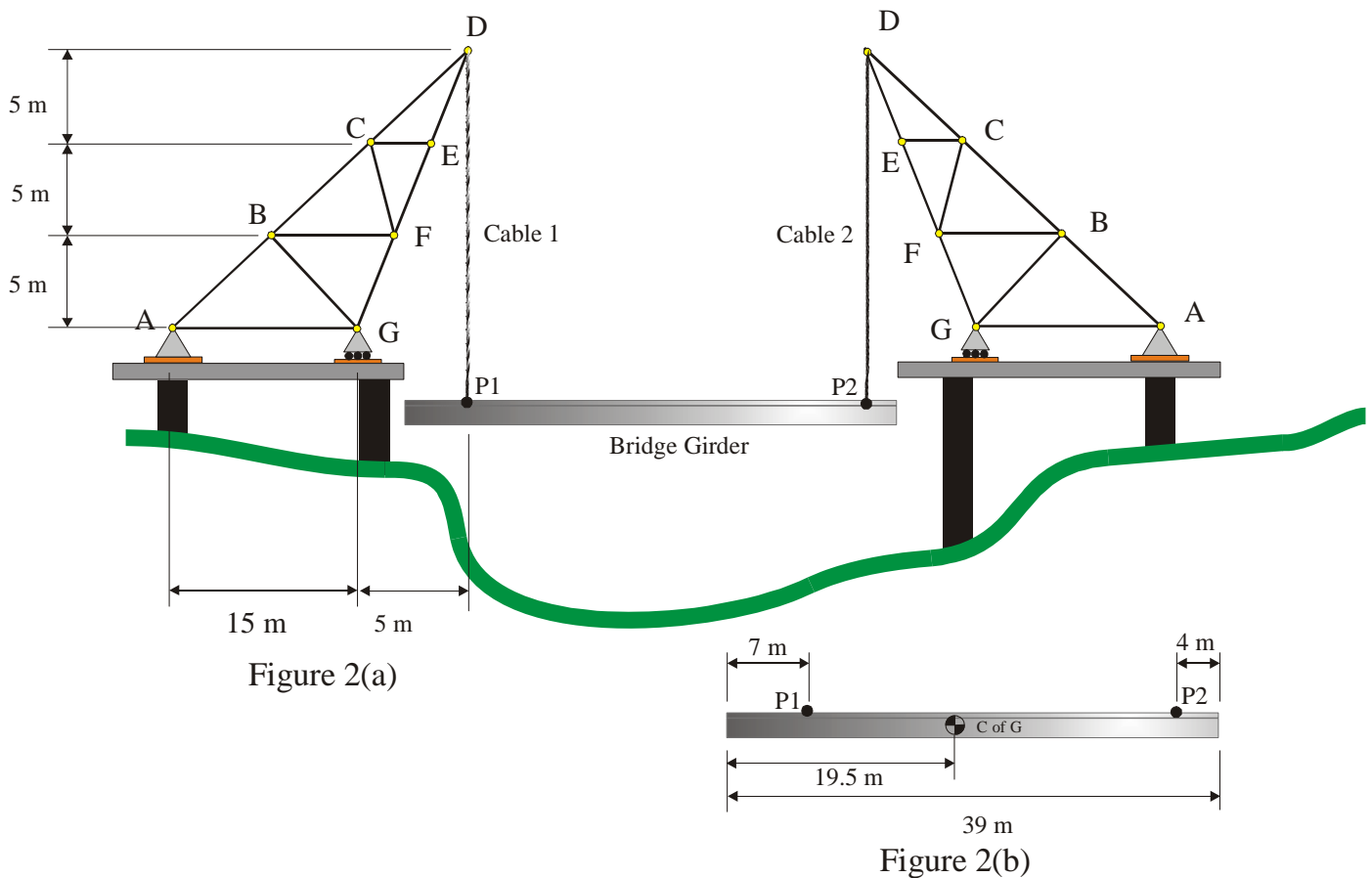
Two identical cranes are positioned on a bridge under construction in order to lift a  $20\,000\text{ kg}$  precast concrete bridge girder into place as shown in Figure 2(a). The lift points (P1 and P2) on the girder are located as shown in Figure 2(b). The  $20\,000\text{ kg}$  may be assumed to act at the centre of gravity of the girder ( $C\text{ of }G$ ).

The maximum capacity of the cable anchors at P1 and P2 is  $115\text{ kN}$ .

The maximum compressive force that any member of the crane can safely carry is  $150\text{ kN}$  and the maximum tension force is  $75\text{ kN}$ .

Before the girder is lifted, you (the professional engineer) are asked by the bridge contractor to approve or not approve the lift and provide supporting calculations.

Provide calculations to support your recommendation: (USE  $g = 9.8\text{ m/sec}^2$ ). Indicate your results on one or both of the figures provided at the bottom of this page.



**QUESTION 3**

The frame shown in Figure 3 supports a  $50\text{ kN}$  weight suspended from a cable that passes over a smooth pulley and is attached to an external support at  $C$ . A  $100\text{ kN}\cdot\text{m}$  clockwise couple moment is applied to bent member  $AD$ . Determine:

- the reactions at pin supports  $A$  and  $B$ ,
- the force exerted at  $D$  on the member  $BD$  and,
- the force exerted at  $D$  on the member  $AD$ .

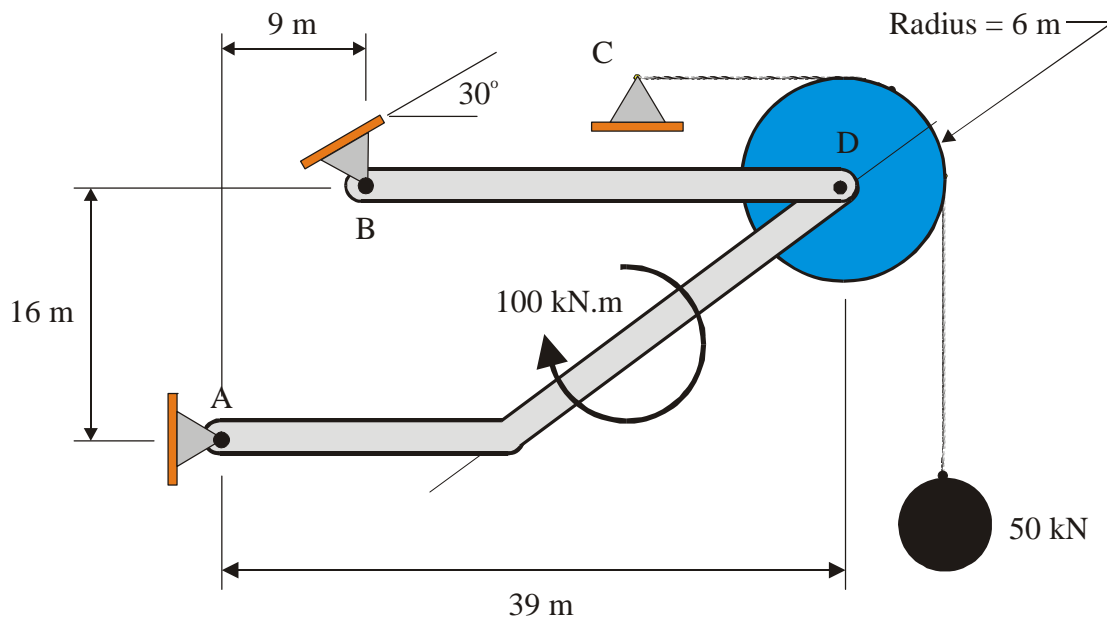


Figure 3