

靜力學四題, 佔 50%

1. A rectangular concrete foundation mat supports four column loads as shown. Determine the magnitude and point of application of the resultant of the four loads.

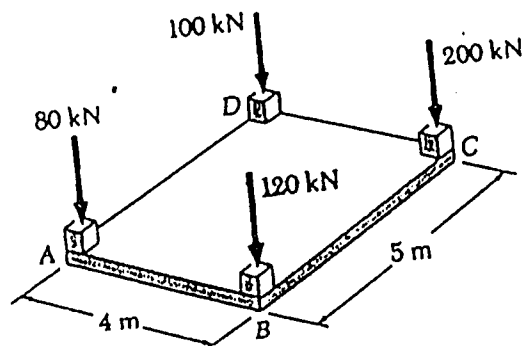


Fig. 1.

2. The bent rod DEF fits into the bent pipe ABC as shown. Neglecting the effect of friction, determine the reactions at A and F due to the 360-N force applied at B .

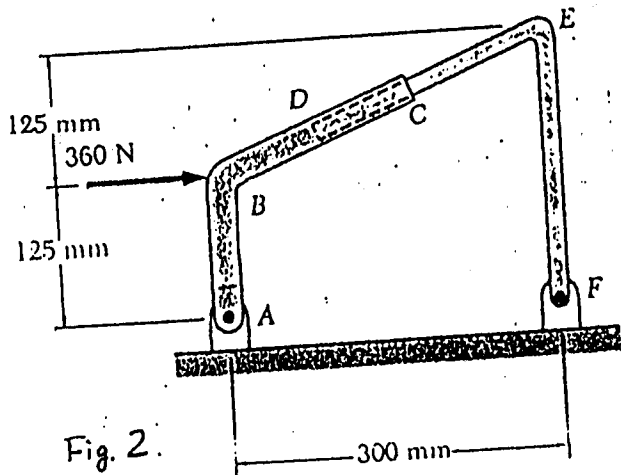


Fig. 2.

3. Locate the centroid of the plane area shown.

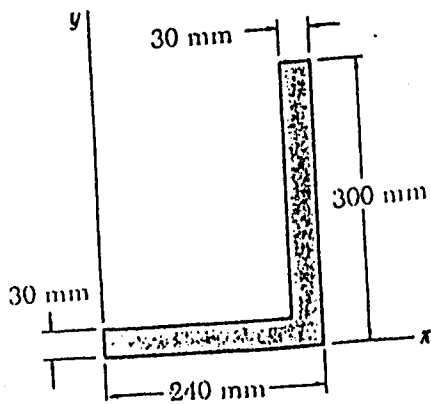


Fig. 3.

4. The axis of the three-hinged arch ABC is a parabola with vertex at B . Knowing that $P = 72.8$ kips and $Q = 109.2$ kips, determine (a) the components of the reaction at C , (b) the components of the force exerted at B on segment AB .

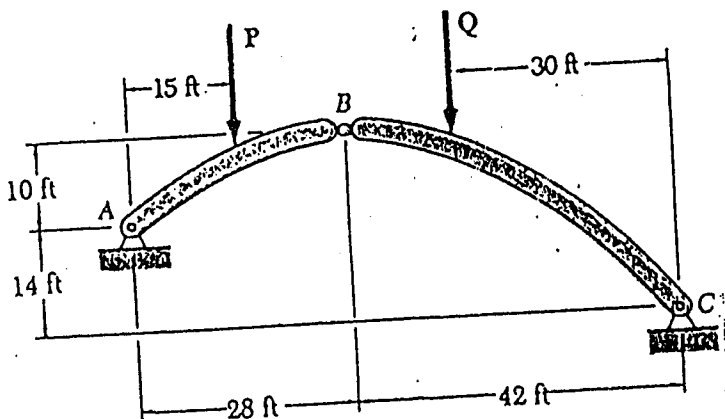


Fig. 4.

動力學三題:

- A disk of mass m and radius r rotates at a constant rate ω_2 with respect to the arm OA, which itself rotates at a constant rate ω_1 about the y axis. Determine the force couple system representing the dynamic reaction at O. (figure 5, 15%)
- A uniform disk of radius r and mass m is supported by a frictionless horizontal table. Initially the disk is spinning freely about its mass center G with a constant angular velocity ω_1 . Suddenly a latch B is moved to the right and is struck by a small stop A welded to the edge of the disk. Assuming that the impact of A and B is perfectly plastic, determine the angular velocity of the disk and the velocity of its mass center immediately after impact. (figure 6, 15%)
- At the swing phase of a gait (步態) analysis the dimension configuration is shown as in figure 7 and the numerical values are given in table 1. Determine the reaction system at knee center O. (20%)

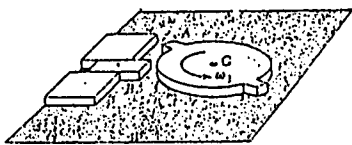


Figure 6.

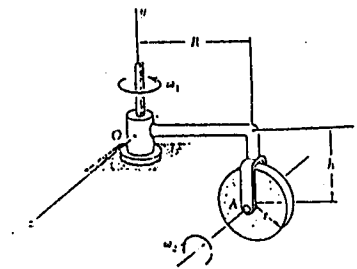


Figure 5.

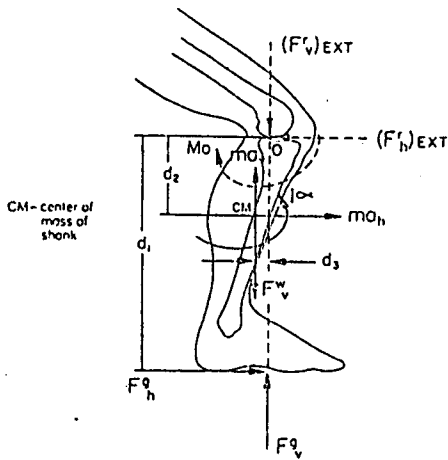


Figure 7.

Description	Symbol	Value
Knowns		
Ground reaction		
Vertical	F'_v	700 N
Horizontal	F'_h	150 N
Shank weight		
Vertical	F^w_v	28 N
Inertial forces		
Shank mass (m) \times vertical acceleration (a_v)	ma_v	1.3 N
Shank mass (m) \times horizontal acceleration (a_h)	ma_h	0.7 N
Inertia (I) \times angular acceleration (α)	$I\alpha$	0.06 Nm
Lever arms		
Floor to knee center	d_1	0.4 m
Shank mass center to knee center	d_2	0.1 m
Horizontal distance, shank mass center to point O	d_3	0.03 m
Unknowns		
External reaction		
Vertical (Eq. 2)	$(F'_v)_{ext}$	
Horizontal (Eq. 3)	$(F'_h)_{ext}$	
Moment (Eq. 4)	$(M_O)_{ext}$	

Table 1.