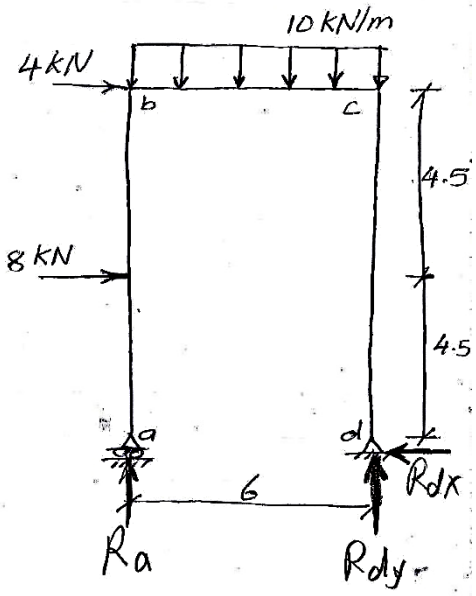
Ex.: N V M

Draw axial, shear & moment diagrams.



Sol.:

$\Sigma M_d = 0$

$R_a * 6 + 8*4.5 + 4*9 - 6*10*3 = 0$

$R_a = 18\ KN \uparrow$

$\Sigma F_y = 0$

$-10*6 + 18 + R_d = 0$

$R_{dy} = 42\ kN \uparrow$

$\Sigma F_x = 0$

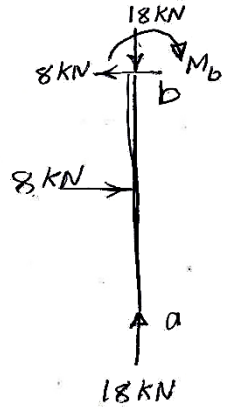
$4 + 8 - R_{dx} = 0$

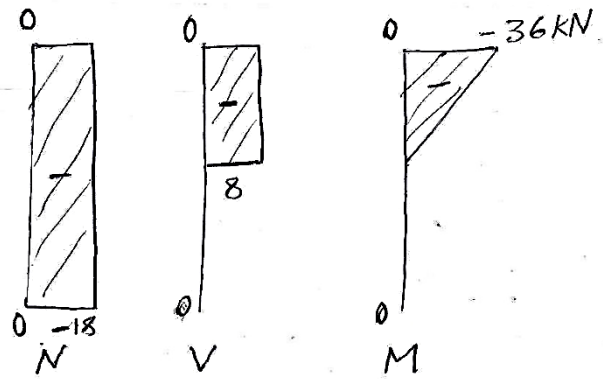
$R_{dx} = 12\ kN \leftarrow$

$\Sigma M_b = 0$

$M_b - 8*4.5 = 0 \Rightarrow M_b = 36\ kN.m$)

member ab:



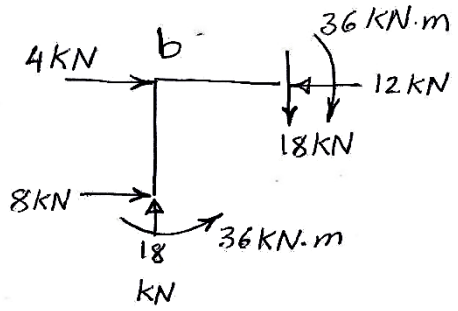


member bc :

$\Sigma F_x = 0$

$4 + 8 - N_b = 0$

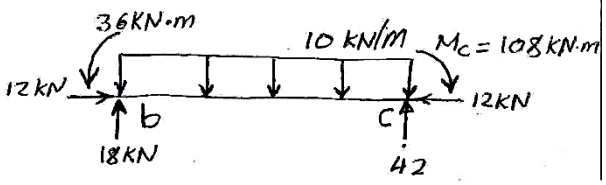
$N_b = 12\ kN \leftarrow$



$\Sigma M_c = 0$

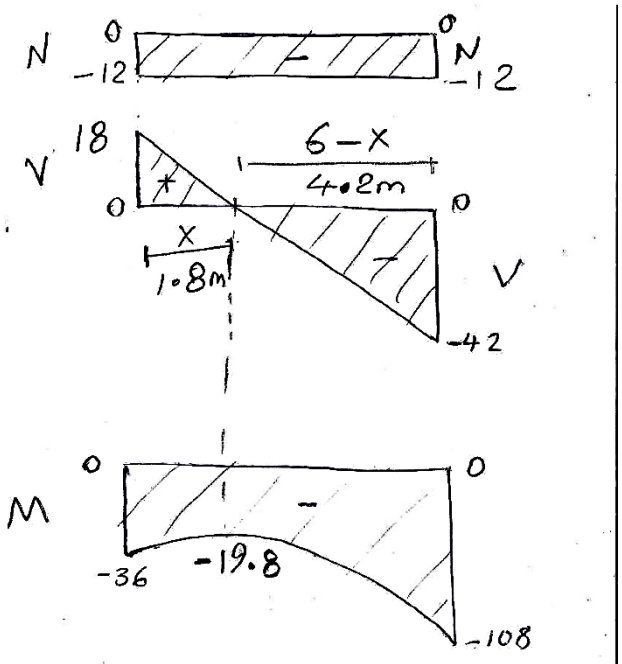
$18 * 6 - 36 - 10 * 6 * 3 + M_c = 0$

$M_c = 108\ kN.m$ ↻

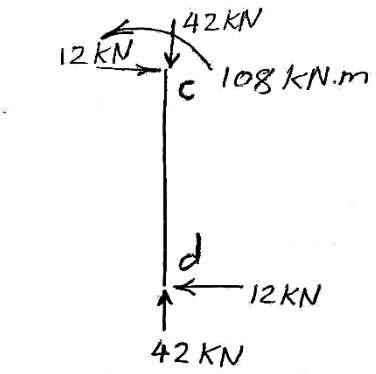


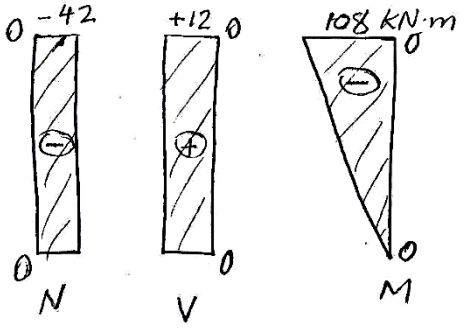
$\frac{x}{18} = \frac{6}{60}$

$x = 1.8\ m$



member cd :



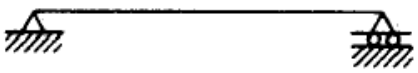


General Stability and Determinacy of Structures

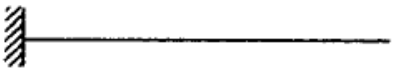
Beams

Let r denote the number of reaction
c the number of equations of condition ($c = 1$ for a hinge; $c = 2$ for a roller; $c = 0$ for a beam without internal connection).

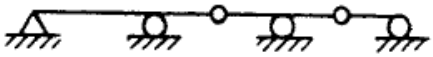
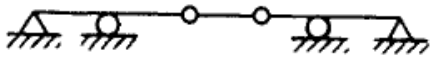
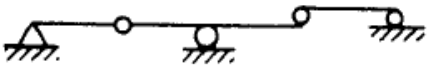
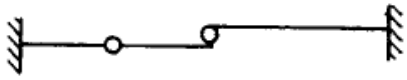
1. If $r < c + 3$, the beam is statically unstable.
2. If $r = c + 3$, the beam is statically determinate
3. If $r > c + 3$, the beam is statically indeterminate.



r = 3
c + 3 = 0 + 3 = 3
r = c + 3
determinte and stable



r = 3
c + 3 = 0 + 3 = 3
r = c + 3
determinte and stable

Beam	r	c	$r : c + 3$	Classification
	5	2	$5 = 5$	Stable and determinate
	6	2	$6 > 5$	Stable and indeterminate to the first degree
	4	3	$4 < 6$	Unstable
	6	3	$6 = 6$	Stable and determinate

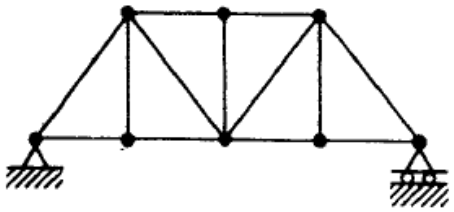
Trusses

1. If $b + r < 2j$, the system is statically unstable.
2. If $b + r = 2j$, the system is statically determinate provided that it is also stable.
3. If $b + r > 2j$, the system is statically indeterminate.

b = No. of bars

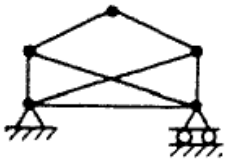
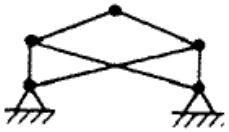
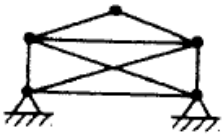
R = No. of reactions

j = No. of joints



b = 13
r = 3
j = 8

b + r = 16
2j = 16
b + r = 2j
Determinate and stable

Truss	b	r	j	$b + r : 2j$	Classification
	7	3	5	10 = 10	Stable and determinate
	6	4	5	10 = 10	Stable and determinate
	8	4	5	12 > 10	Stable and indeterminate to the second degree

Rigid Frames

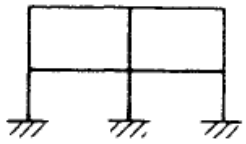
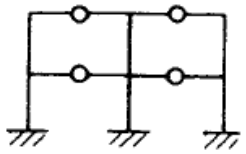
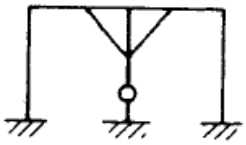
1. If $3b + r < 3j + c$, the frame is statically unstable.
2. If $3b + r = 3j + c$, the frame is statically determinate
3. If $3b + r > 3j + c$, the frame is statically indeterminate.

b = No. of members

R = No. of reactions

j = No. of joints

c = No. of equations of constructions.

Frame	b	r	j	c	$3b + r : 3j + c$	Classification
	10	9	9	0	$39 > 27$	Indeterminate to the 12th degree
	10	9	9	4	$39 > 31$	Indeterminate to the eighth degree
	10	9	9	1	$39 > 28$	Indeterminate to the 11th degree