

با سه تعالی

۱۷، ۲۰

نیروی محوری، نیروی برشی، لنگر خمشی

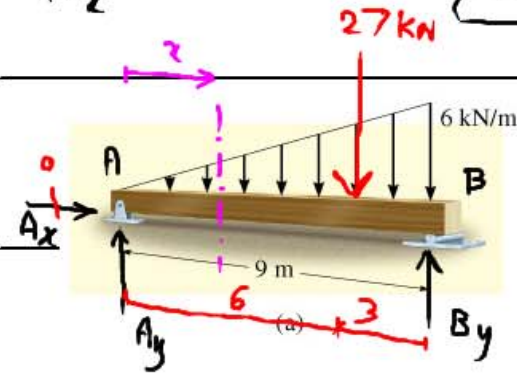
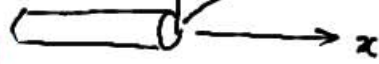
: 2D

: 3D

تکلیف قاب و ماشین

نیروی محوری N_x ، نیروی برشی V_x و V_y ، لنگر M_x و M_y و M_z

بیجینی M_z

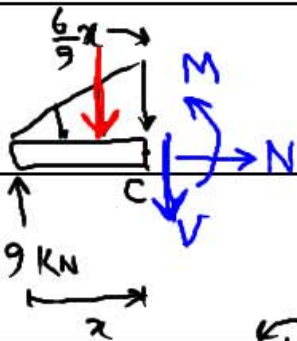


$$\sum M_A = 0$$

مثال

$$9B_y - 27 \times 6 = 0 \rightarrow B_y = 18 \text{ kN}$$

$$\uparrow \sum F_y = 0 \quad A_y + 18 - 27 = 0 \quad A_y = 9 \text{ kN}$$

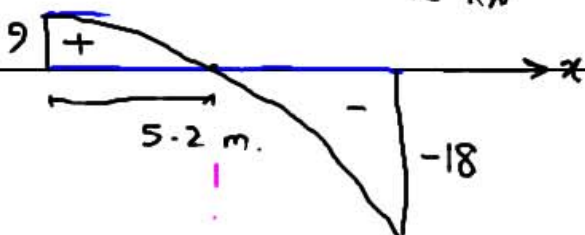
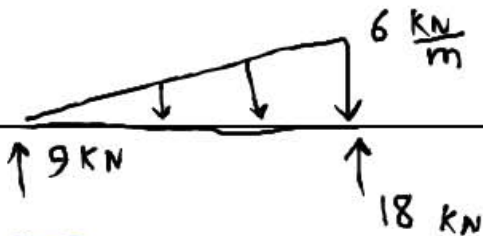


$$\uparrow \sum F_y = 0 \quad 9 - \left(\frac{6}{9}x \times x \times \frac{1}{2}\right) - V = 0$$

$$V = 9 - \frac{x^2}{3}$$

$$\sum M_c = 0 \quad M - 9x + \frac{x^2}{3} \times \frac{x}{3} = 0$$

$$M = 9x - \frac{x^3}{9}$$



$$V(9) = -18 \text{ kN}$$

$$\frac{dV(x)}{dx} = -\frac{2}{3}x = 0 \quad x = 0$$

$$V(x) = 9 - \frac{x^2}{3} = 0 \quad x = 3\sqrt{3} \text{ m}$$

31.2 kN-m

$$M = 9x - \frac{x^3}{9}$$

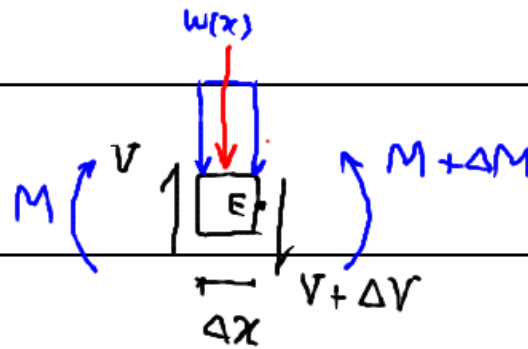
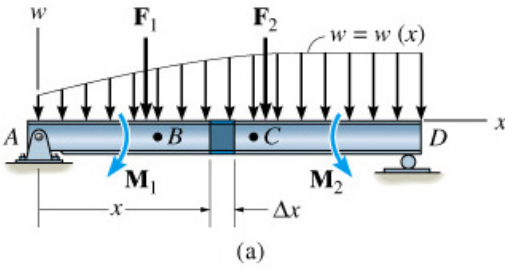


$$M(0) = 0 ; M(9) = 0$$

$$\frac{dM}{dx} = 9 - \frac{x^2}{3} = 0 \quad x = 3\sqrt{3} \text{ m}$$

$$M(3\sqrt{3}) = 31.2 \text{ kN-m}$$

رابطه بین بارکنش و گشتاور



$$+\uparrow \sum F_y = 0 \quad V - w(x)\Delta x - (V + \Delta V) = 0 \quad \frac{\Delta V}{\Delta x} = -w(x)$$

$$\frac{\partial V}{\partial x} = -w(x)$$

$$\curvearrowleft + \sum M_E = 0$$

$$M + \Delta M - M - V \cdot \Delta x + (w(x)\Delta x) \frac{\Delta x}{2} = 0$$

$$\frac{\Delta M}{\Delta x} = V \quad \frac{\partial M}{\partial x} = V$$

تغییرات برش = - (سخت بارکنش)

$$\frac{dV}{dx} = -w(x)$$

$$\Delta V_{BC} = \int_B^C -w(x) dx$$

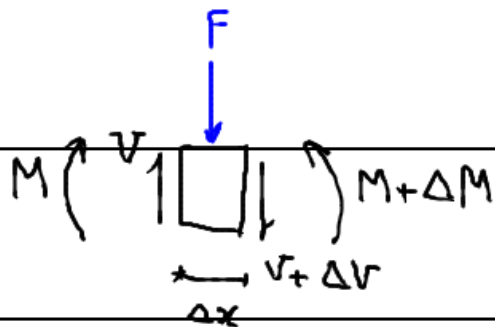
تغییرات گشتاور = (سطح زیر نمودار بارکنش)

تغییرات لنگر خمشی = سطح زیر نمودار برش

$$\frac{dM}{dx} = V$$

$$\Delta M_{bc} = \int_b^c V dx$$

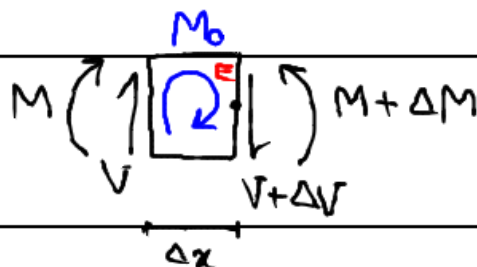
تغییرات لنگر خمشی = سطح زیر نمودار برش



$$+\uparrow \Sigma F_y = 0$$

$$V - F - V + \Delta V = 0$$

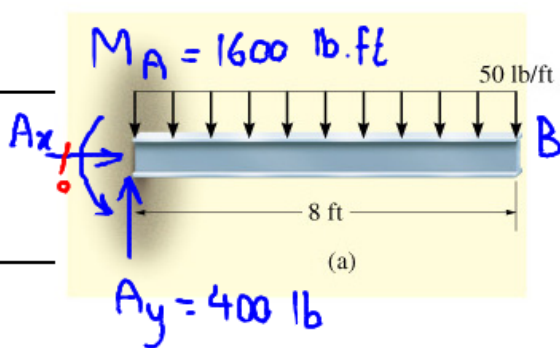
$$\Delta V = -F$$



$$\curvearrowleft \Sigma M_E = 0$$

$$M + \Delta M - M - V(\Delta x) - M_0 = 0$$

$$\left. \begin{aligned} \Delta M &= M_0 + V(\Delta x) \\ \Delta x &\rightarrow 0 \end{aligned} \right\} \Delta M = M_0$$



$$V = \int -w(x) dx = \int -50 dx = -50x + c$$

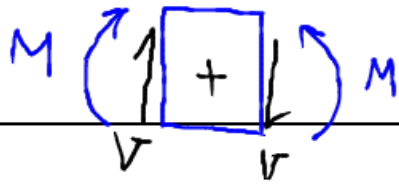
$$V(0) = 400 \text{ lb}$$

$$V(x) = -50x + 400$$

$$M = \int V dx = \int (-50x + 400) dx = -25x^2 + 400x + C_2$$

$$M(0) = -1600 \text{ lb.ft}$$

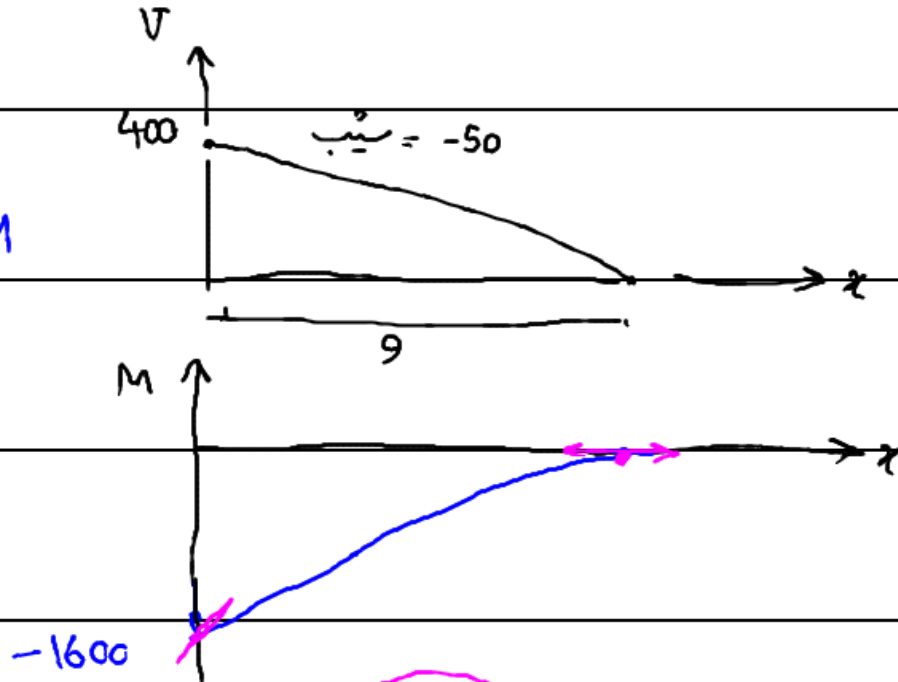
$$M(x) = -25x^2 + 400x - 1600$$



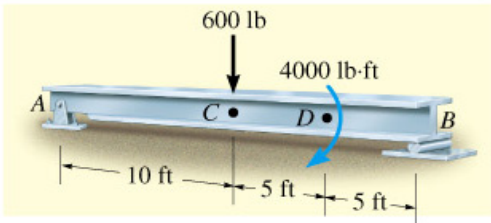
$$M(8) = 0$$

$$\frac{dM}{dx} = -50x + 400 = 0$$

$$x = 8$$



20
30
قاب پیاپی
فصل V
فصل 7
فصل 11



(a)

$$\sum M_B = 0 \quad -20 \times A_y + 600 \times 10 - 4000 = 0$$

$$A_y = 100 \text{ lb}$$

$$\sum M_A = 0$$

