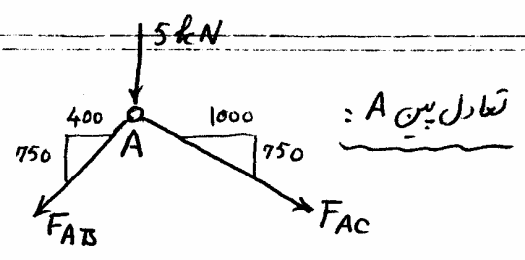
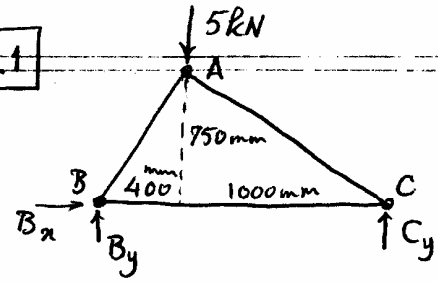


حل مسائل فصل (7)

6.1



تبادل بین A :

$$\sum F_x = 0 \Rightarrow F_{AC} \left(\frac{1000}{\sqrt{1000^2 + 750^2}} \right) = F_{AB} \left(\frac{400}{\sqrt{400^2 + 750^2}} \right) \Rightarrow F_{AC} = 0.5882 F_{AB}$$

$$\sum F_y = 0 \Rightarrow -F_{AC} \left(\frac{750}{\sqrt{1000^2 + 750^2}} \right) - F_{AB} \left(\frac{750}{\sqrt{400^2 + 750^2}} \right) - 5 \text{ kN} = 0$$

$$\Rightarrow -0.5882 F_{AB} \left(\frac{750}{\sqrt{1000^2 + 750^2}} \right) - F_{AB} \left(\frac{750}{\sqrt{400^2 + 750^2}} \right) - 5 = 0$$

$$\Rightarrow -1.2353 F_{AB} = 5 \Rightarrow F_{AB} = -4.048 \text{ kN} \rightarrow \text{فشار}$$

$$\Rightarrow F_{AC} = -2.381 \text{ kN} \rightarrow \text{فشار}$$

تبادل در خرابی :

$$\sum M_B = 0 \Rightarrow C_y (1400) = 5 \text{ kN} (400) \Rightarrow C_y = 1.429 \text{ kN}$$

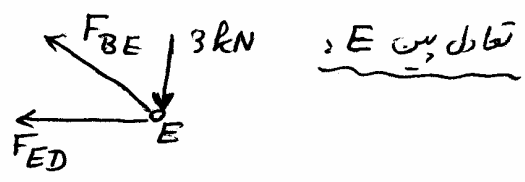
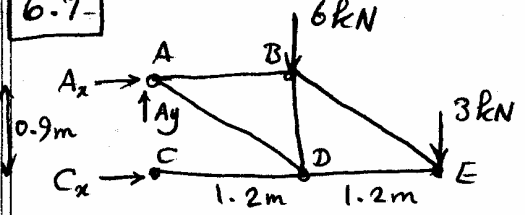
تبادل بین C :

$$\sum F_x = 0 \Rightarrow -F_{BC} - F_{AC} \left(\frac{1000}{\sqrt{1000^2 + 750^2}} \right) = 0$$

$$\Rightarrow F_{BC} = -F_{AC} (0.8) = -(-2.381)(0.8)$$

$$\Rightarrow F_{BC} = 1.904 \text{ kN} \rightarrow \text{کشش}$$

6.7-



تبادل بین E :

$$\sum F_y = 0 \Rightarrow F_{BE} \left(\frac{0.9}{\sqrt{1.2^2 + 0.9^2}} \right) = 3 \text{ kN} \Rightarrow F_{BE} = 5 \text{ kN} \rightarrow \text{کشش}$$

$$\sum F_x = 0 \Rightarrow -F_{ED} - F_{BE} \left(\frac{1.2}{\sqrt{1.2^2 + 0.9^2}} \right) \Rightarrow F_{ED} = -7.5 \text{ kN} \rightarrow \text{فشار}$$

تبادل بین B :

$$\sum F_x = 0 \Rightarrow -F_{AB} + F_{BE} \left(\frac{1.2}{\sqrt{1.2^2 + 0.9^2}} \right) = 0 \Rightarrow F_{AB} = 4 \text{ kN} \rightarrow \text{کشش}$$

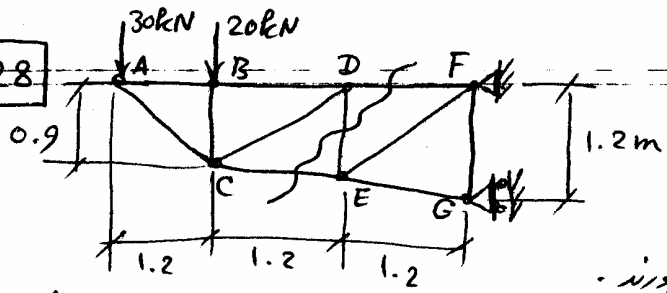
$$\sum F_y = 0 \Rightarrow -F_{BD} - 6 \text{ kN} - F_{BE} \left(\frac{0.9}{\sqrt{1.2^2 + 0.9^2}} \right) \Rightarrow F_{BD} = -9 \text{ kN} \rightarrow \text{فشار}$$

تبادل بین D :

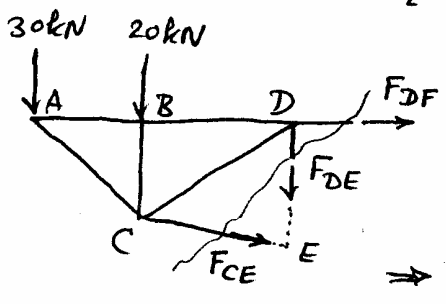
$$\sum F_y = 0 \Rightarrow F_{AD} \left(\frac{0.9}{\sqrt{1.2^2 + 0.9^2}} \right) + F_{BD} = 0 \Rightarrow F_{AD} = 15 \text{ kN} \rightarrow \text{کشش}$$

$$\sum F_x = 0 \Rightarrow -F_{CD} - F_{AD} \left(\frac{1.2}{\sqrt{0.9^2 + 1.2^2}} \right) + F_{ED} = 0 \Rightarrow F_{CD} = -19.5 \text{ kN} \rightarrow \text{فشار}$$

6.28



خوبه را به صورتی مقطع میزنیم. عضوهای
خراسته شده DF و DE برش نخورند.
تقابل قسمت چپ خوب خرابه را در نظر میگیریم:



$$\sum M_E = 0 \Rightarrow 30(2.4) + 20(1.2) = F_{DF} \overline{DE}$$

$$\overline{DE} = \frac{1.2 + 0.9}{2} = 1.05 \text{ m}$$

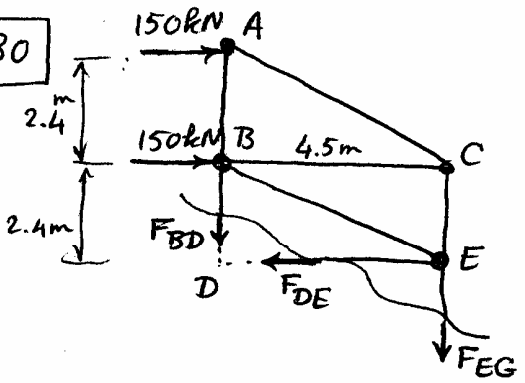
$$\Rightarrow F_{DF} = 91.43 \text{ kN} \quad \text{کشش}$$

$$\sum F_x = 0 \Rightarrow F_{DF} + F_{CE} \frac{2.4}{\sqrt{2.4^2 + 0.3^2}} = 0 \Rightarrow F_{CE} = -92.14 \text{ kN} \quad \text{فشار}$$

$$\sum F_y = 0 \Rightarrow -F_{DE} - 20 - 30 - F_{CE} \frac{0.3}{\sqrt{2.4^2 + 0.3^2}} = 0$$

$$\Rightarrow F_{DE} = -38.57 \text{ kN} \quad \text{فشار}$$

6.30



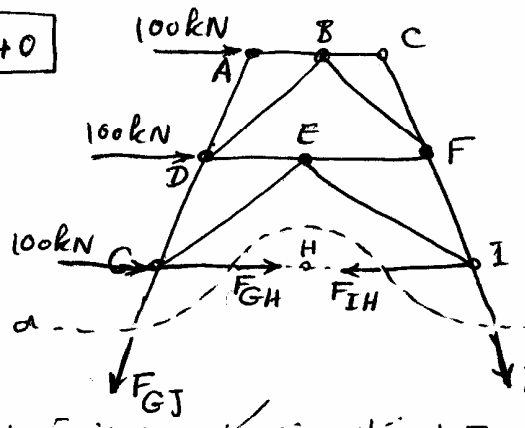
$$\sum M_E = 0$$

$$\Rightarrow F_{BD}(4.5) = 150(2.4) + 150(4.8)$$

$$\Rightarrow F_{BD} = 240 \text{ kN} \quad \text{کشش}$$

$$\sum F_x = 0 \Rightarrow F_{DE} = 150 + 150 = 300 \text{ kN} \quad \text{کشش}$$

6.40

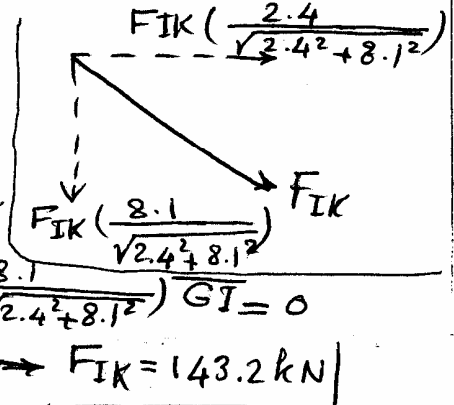


نیروی F_{IK} را در امتدادهای افقی و عمودی
تجزیه و سپس عمل نقطه G کنیم و برتری
کنیم. (نیروهای F_{GH} , F_{IH})
حذف می‌کنیم.

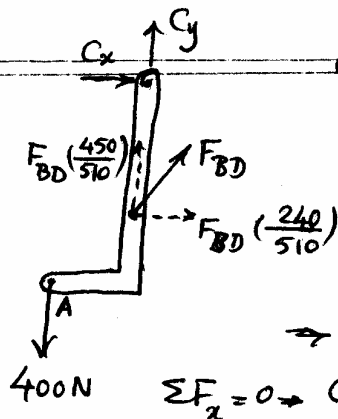
از نیروی F_{IK} را به نقطه I منتقل کنیم، مؤلفه افقی آن نیرو عمل
کنند و ندارد.

$$\sum M_G = 0 \Rightarrow -100(2.7) - 100(2.7 + 2.7) - F_{IK} \left(\frac{8.1}{\sqrt{2.4^2 + 8.1^2}} \right) \overline{GI} = 0$$

$$\frac{\overline{GI} - 2.7}{2.7 + 2.7} = \frac{7.5 - 2.7}{2.7 + 2.7 + 2.7} \Rightarrow \overline{GI} = 5.9 \text{ m} \Rightarrow F_{IK} = 143.2 \text{ kN}$$



6.50



عضو BD دو نیروی است بنابراین نیروی آن در راستای خود عضو باشد.

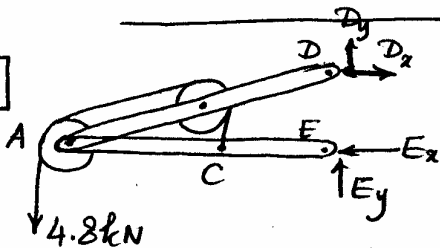
$$\sum M_C = 0 \Rightarrow 400(135) + F_{BD} \left(\frac{240}{510}\right) \times 450 = 0$$

$$\Rightarrow F_{BD} = -255 \text{ N} \quad \text{فشاری}$$

$$\sum F_x = 0 \Rightarrow C_x = -F_{BD} \left(\frac{240}{510}\right) = 120 \text{ N}$$

$$\sum F_y = 0 \Rightarrow C_y = 400 - F_{BD} \left(\frac{450}{510}\right) = 625 \text{ N}$$

6.69



تقابل کل قلاب :

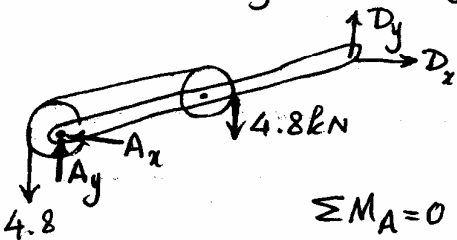
$$\sum M_E = 0 \Rightarrow 4.8(2+2+0.25) = D_x(1.5)$$

$$\Rightarrow D_x = 13.6 \text{ kN}$$

$$\sum M_D = 0 \Rightarrow 4.8(2+2+0.25) = E_x(1.5) \Rightarrow E_x = 13.6 \text{ kN}$$

$$\sum F_y = 0 \Rightarrow D_y + E_y = 4.8 \text{ kN} \quad *$$

تقابل عضو ABD و در قلاب :



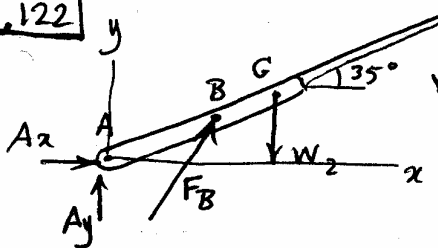
عضو ACE در بین A دو نقطه نیروی A_x و A_y به مجموعه وارد می کند.

$$\sum M_A = 0 \Rightarrow 4.8(0.25) - 4.8(2+0.25) - D_x(1.5) + D_y(2+2) = 0$$

$$\Rightarrow D_y = \frac{-4.8(0.25) + 4.8(2.25) + 1.5D_x}{4} = 7.5 \text{ kN}$$

$$* \Rightarrow E_y = -2.7 \text{ kN}$$

6.122



حول نقطه A گشتاورگیری می کنیم.

$$\sum M_A = 0$$

$$\vec{M}_A = \vec{r} \times \vec{F}_B$$

$$= (0.5\vec{i} - 1\vec{j}) \times (F_B \frac{(2\cos\theta - 0.5)\vec{i} + (2\sin\theta + 1)\vec{j}}{\sqrt{(2\cos\theta - 0.5)^2 + (2\sin\theta + 1)^2}})$$

$$= (0.5\vec{i} - 1\vec{j}) \times \left(\frac{1.138}{2.43} F_B \vec{i} + \frac{2.147}{2.43} F_B \vec{j} \right)$$

$$= (0.442 + 0.468) F_B \vec{k} = 0.91 F_B \vec{k}$$

گشتاور F_B حول A

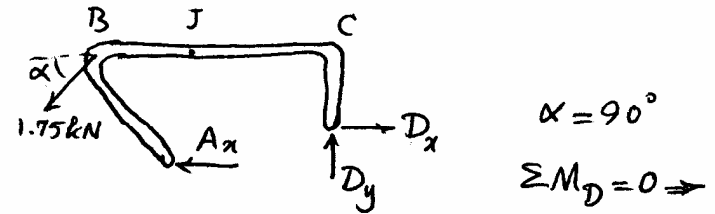
$$\Sigma M_A = 0 \rightarrow 0.91 F_B = W_1(7 \cos \theta) + W_2(3 \cos \theta)$$

$$\Rightarrow F_B = \frac{200 \times 9.81 \times 7 \cos 35 + 625 \times 3 \times 9.81 \times \cos 35}{0.91}$$

$$= 28.9 \text{ kN}$$

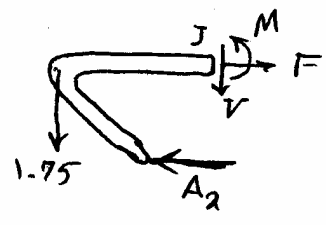
حل مسائل - فصل (۷)
تبادل کل جسم

7.8



$$1.75(200+400) = A_x(175) \Rightarrow A_x = 6 \text{ kN}$$

برای پیدا کردن نیروهای داخلی در نقطه J از آن نقطه برش فرضی میزنیم و سمت چپ را در نظر میگیریم



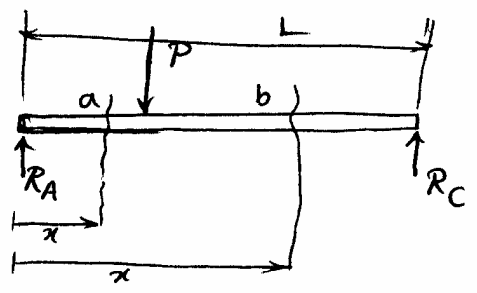
$$\Sigma F_x = 0 \Rightarrow F = A_x = 6 \text{ kN}$$

$$\Sigma F_y = 0 \Rightarrow V = -1.75 \text{ kN}$$

$$\Sigma M_J = 0 \Rightarrow M + 1.75(300) - A_x(375) = 0$$

$$\Rightarrow M = 1725 \text{ kN.m}$$

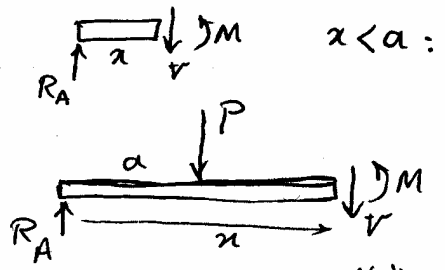
7.20



$$\Sigma M_A = 0 \Rightarrow R_C b = Pa$$

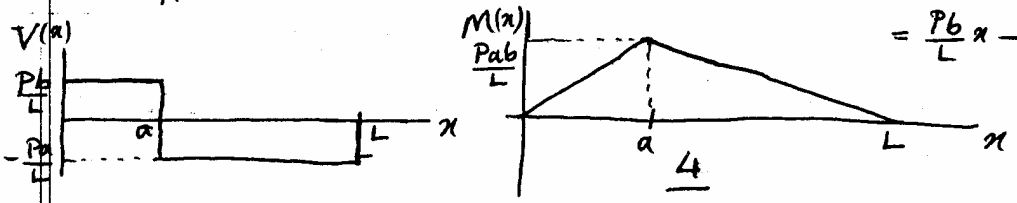
$$\rightarrow R_C = \frac{Pa}{b}$$

$$\Sigma M_C = 0 \Rightarrow R_A = \frac{Pb}{L}$$

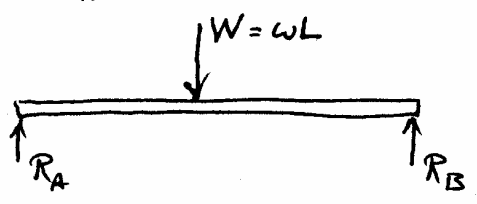
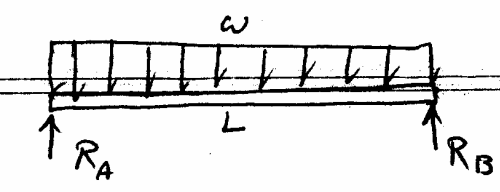


$$x < a: \begin{cases} \Sigma F_y = 0 \Rightarrow V = \frac{Pb}{L} = R_A \\ \Sigma M = 0 \Rightarrow M = R_A x = \frac{Pb x}{L} \end{cases}$$

$$x > a: \begin{cases} \Sigma F_y = 0 \Rightarrow V = R_A - P = P(\frac{b}{L} - 1) = -\frac{Pa}{L} \\ \Sigma M = 0 \Rightarrow M = R_A x - P(x-a) \\ = \frac{Pb x}{L} - P(x-a) \end{cases}$$

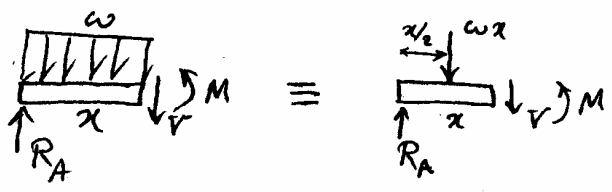


7.21



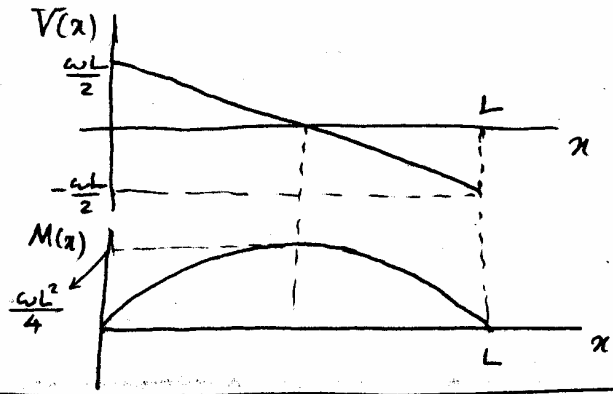
$$\sum M = 0, \sum F_y = 0$$

$$\Rightarrow R_A = R_B = \frac{W}{2} = \frac{wL}{2}$$



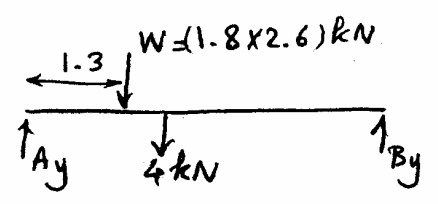
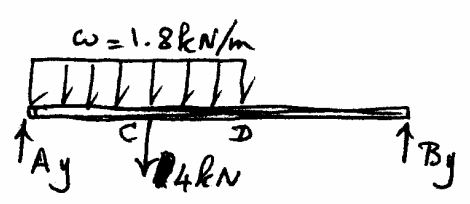
$$\sum F_y = 0 \Rightarrow V = R_A - wx = \frac{wL}{2} - wx$$

$$\sum M = 0 \Rightarrow M = R_A x - wx \left(\frac{x}{2}\right) = \frac{wL}{2} x - \frac{wx^2}{2}$$



7.26

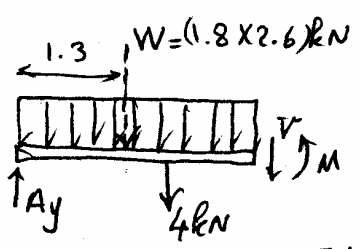
صورت زوال تعویض شود: « مقدارهای نیروی برشی و گشتا در محلی را در نقطه D محاسبه کنید. »



تعادل کل تیر:

$$\sum M_B = 0 \Rightarrow W(2.7) + 4(2.4) - A_y(4) = 0$$

$$\Rightarrow A_y = 5.559 \text{ kN}$$



تعادل قسمت AD:

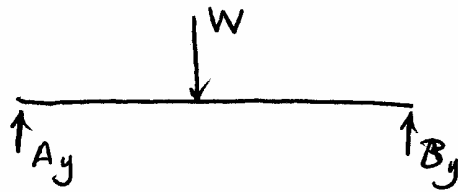
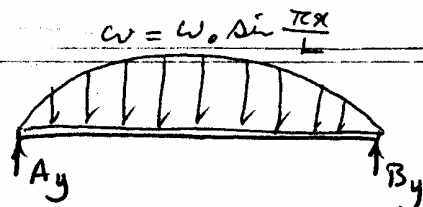
$$\sum F_y = 0 \Rightarrow A_y - W - 4 - V = 0$$

$$\Rightarrow V = 5.559 - 1.8 \times 2.6 - 4 = -3.121 \text{ kN}$$

$$\sum M = 0 \Rightarrow M + W(1.3) + 4(1) - A_y(2.6) = 0$$

$$\Rightarrow M = 5.559(2.6) - 1.8 \times 2.6 \times 1.3 - 4 = 4.37 \text{ kN.m}$$

7.67



$$W = \int_0^L w dx = \int_0^L w_0 \sin \frac{\pi x}{L} dx$$

$$= -\frac{w_0 L}{\pi} \cos \frac{\pi x}{L} \Big|_0^L = \frac{2w_0 L}{\pi}$$

$$A_y = B_y = \frac{W}{2} \quad \text{symmetrisch}$$

$$= \frac{w_0 L}{\pi}$$

$$V(x) = \int -w(x) dx$$

$$\Rightarrow V(x) - V(x_0) = \int_{x_0}^x -w(x) dx$$

$$V(x_0) = A_y = \frac{w_0 L}{\pi}$$

$$\Rightarrow V(x) - \frac{w_0 L}{\pi} = \int_0^x -w_0 \sin \frac{\pi x}{L} dx$$

$$\Rightarrow V(x) = \frac{w_0 L}{\pi} \cos \frac{\pi x}{L} \Big|_0^x + \frac{w_0 L}{\pi} = \frac{w_0 L}{\pi} \cos \frac{\pi x}{L} - \frac{w_0 L}{\pi} + \frac{w_0 L}{\pi}$$

$$\Rightarrow \boxed{V(x) = \frac{w_0 L}{\pi} \cos \frac{\pi x}{L}}$$

$$M(x) = \int V(x) dx$$

$$\Rightarrow M(x) - M(x_0) = \int_{x_0}^x V(x) dx$$

$$M(x_0) = 0$$

$$\Rightarrow M(x) = \int_0^x \frac{w_0 L}{\pi} \cos \frac{\pi x}{L} dx = \frac{w_0 L^2}{\pi^2} \sin \frac{\pi x}{L} \Big|_0^x$$

$$\Rightarrow \boxed{M(x) = \frac{w_0 L^2}{\pi^2} \sin \frac{\pi x}{L}}$$

