Remarks: See §2.7, pages 45 till 51

Answers 2.49-1:

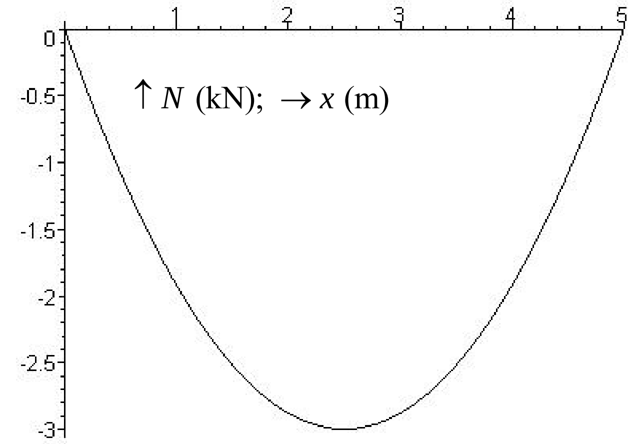
a. $N = +(0,48\ \text{kN/m}^2)x^2 - (2,4\ \text{kN/m})x$

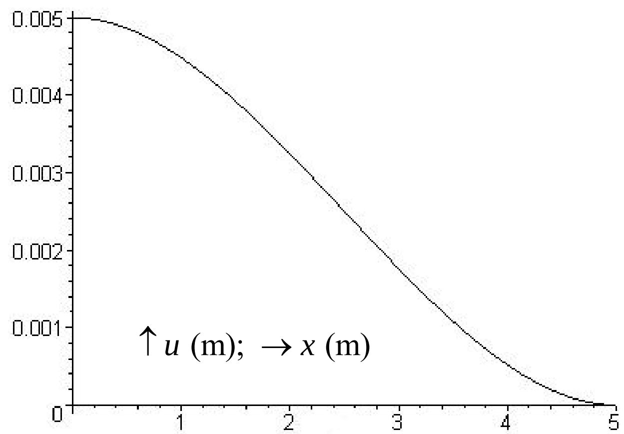
$u = \left\{+(0,08\ \text{m}^{-2})x^3 - (0,6\ \text{m}^{-1})x^2 + (5\ \text{m})\right\} \times 10^{-3}$

b. See the diagrams to the right.

c. $N_\text{B} = 0 \Rightarrow B_\text{h} = 0$ (Equilibrium is satisfied by the load alone)

d. $u_\text{roller} = 5\ \text{mm} \rightarrow$





Explanation:

$$q = -\frac{2\hat{q}}{\ell}x + \hat{q}$$

$$EAu'' = -q = +\frac{2\hat{q}}{\ell}x - \hat{q}$$

$$N = EAu' = +\frac{\hat{q}}{\ell}x^2 - \hat{q}x + C_1$$

$$EAu = +\frac{\hat{q}}{3\ell}x^3 - \frac{\hat{q}}{2}x^2 + C_1 x + C_2$$

$$x = 0;\ N = 0 \Rightarrow C_1 = 0$$

$$x = \ell = 5\ \text{m};\ u = 0 \Rightarrow C_2 = \tfrac{1}{6}\hat{q}\ell^2 = 10\ \text{kNm}$$

Remarks: See §2.7, pages 45 till 51

Answers 2.49-2:

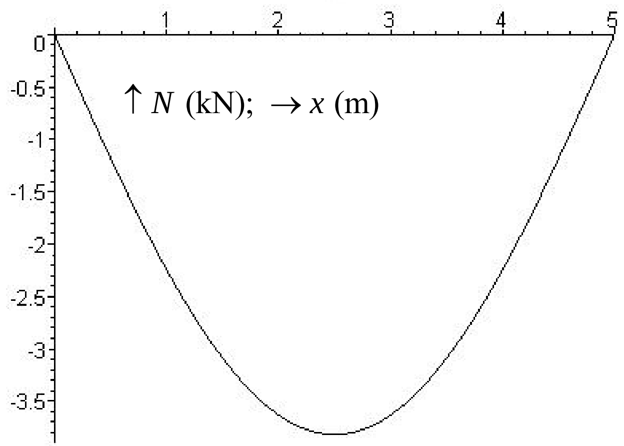
a. $N = -\dfrac{12}{\pi}\sin\dfrac{\pi x}{(5\text{ m})}$ kN

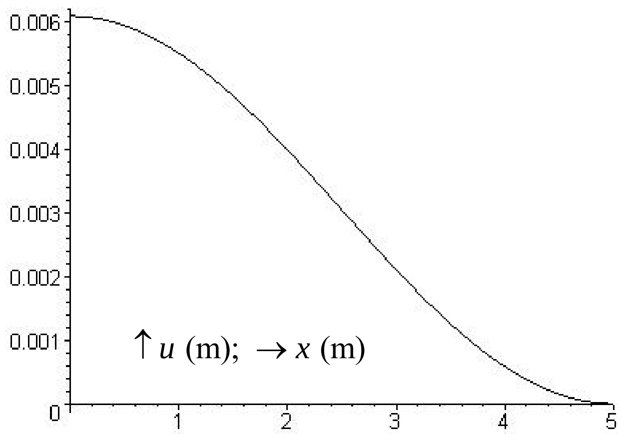
$u = +\dfrac{30\times 10^{-3}}{\pi^2}\left(\cos\dfrac{\pi x}{(5\text{ m})}+1\right)$ m

b. See the diagrams to the right.

c. $N_\text{B} = 0 \Rightarrow B_\text{h} = 0$ (Equilibrium is satisfied by the load alone)

d. $u_\text{roller} = 6{,}1$ mm $\rightarrow$





Explanation:

$$EAu'' = -q = -\hat{q}\cos\frac{\pi x}{\ell}$$

$$N = EAu' = -\frac{\hat{q}\ell}{\pi}\sin\frac{\pi x}{\ell} + C_1$$

$$EAu = +\frac{\hat{q}\ell^2}{\pi^2}\cos\frac{\pi x}{\ell} + C_1 x + C_2$$

$$x = 0;\ N = 0 \Rightarrow C_1 = 0$$

$$x = \ell = 5\text{ m};\ u = 0 \Rightarrow C_2 = \frac{\hat{q}\ell^2}{\pi^2} = \frac{60}{\pi^2}\text{ kNm}$$

Remarks: See §2.7, pages 45 till 51

Answers 2.49-3:

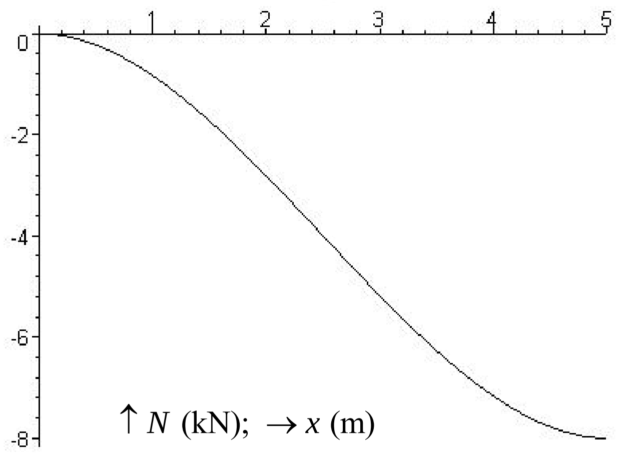
a. $N = +(0{,}128 \text{ kN/m}^3)x^3 - (0{,}960 \text{ kN/m}^2)x^2$

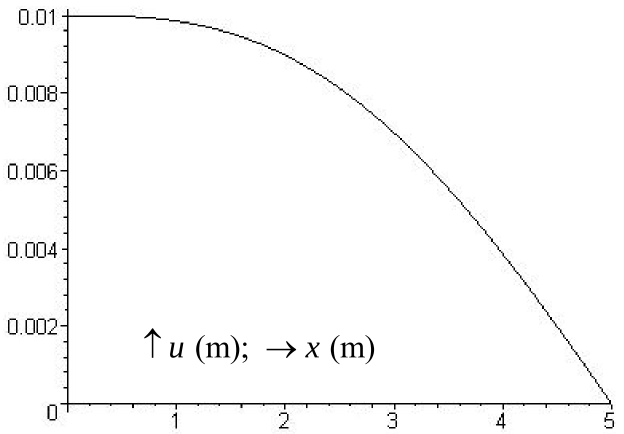
$u = \left\{+(0{,}016 \text{ m}^{-3})x^4 - (0{,}16 \text{ m}^{-2})x^3 + (10 \text{ m})\right\} \times 10^{-3}$

b. See the diagrams to the right.

c. $N_\text{B} = -8 \text{ kN} \Rightarrow B_\text{h} = 8 \text{ kN} \leftarrow$

d. $u_\text{roller} = 10 \text{ mm} \rightarrow$





Explanation:

$$q = -\frac{4\hat{q}}{\ell^2}x^2 + \frac{4\hat{q}}{\ell}x$$

$$EAu'' = -q = +\frac{4\hat{q}}{\ell^2}x^2 - \frac{4\hat{q}}{\ell}x$$

$$N = EAu' = +\frac{4\hat{q}}{3\ell^2}x^3 - \frac{2\hat{q}}{\ell}x^2 + C_1$$

$$EAu = +\frac{\hat{q}}{3\ell^2}x^4 - \frac{2\hat{q}}{3\ell}x^3 + C_1 x + C_2$$

$$x = 0;\ N = 0 \Rightarrow C_1 = 0$$

$$x = \ell = 5 \text{ m};\ u = 0 \Rightarrow C_2 = \tfrac{1}{3}\hat{q}\ell^2 = 20 \text{ kNm}$$

Remarks: See §2.7, pages 45 till 51

Answers 2.49-4:

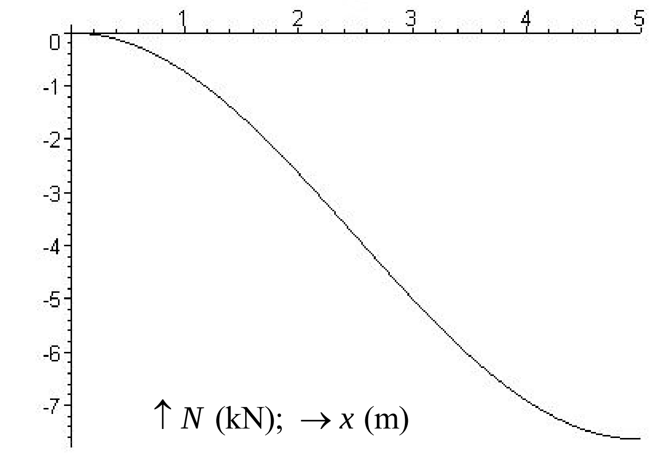
a. $N = \frac{12}{\pi}\left(\cos\frac{\pi x}{(5\text{ m})} - 1\right)$ kN

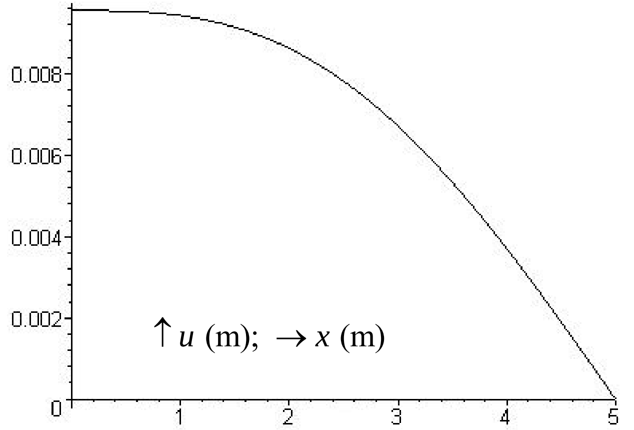
$u = +\frac{30\times10^{-3}}{\pi^2}\left(\sin\frac{\pi x}{(5\text{ m})} - \frac{\pi x}{(5\text{ m})} + \pi\right)$ m

b. See the diagrams to the right.

c. $N_B = -\frac{24}{\pi^2}$ kN $\Rightarrow$ $B_h = 7{,}64$ kN $\leftarrow$

d. $u_{\text{roller}} = 9{,}55$ mm $\rightarrow$





Explanation:

$$EAu'' = -q = -\hat{q}\sin\frac{\pi x}{\ell}$$

$$N = EAu' = +\frac{\hat{q}\ell}{\pi}\cos\frac{\pi x}{\ell} + C_1$$

$$EAu = +\frac{\hat{q}\ell^2}{\pi^2}\sin\frac{\pi x}{\ell} + C_1 x + C_2$$

$$x = 0;\ N = 0 \Rightarrow C_1 = -\frac{\hat{q}\ell}{\pi} = -\frac{12}{\pi}\text{ kN}$$

$$x = \ell = 5\text{ m};\ u = 0 \Rightarrow C_2 = \frac{\hat{q}\ell^2}{\pi} = \frac{60}{\pi}\text{ kNm}$$