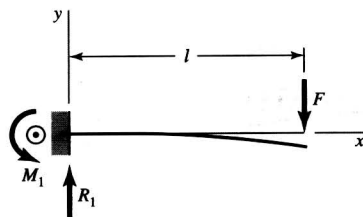


Tabla E-9

Cortante, momento y
deflexión de vigas

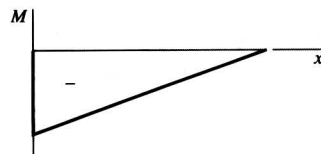
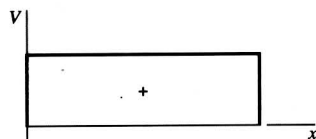
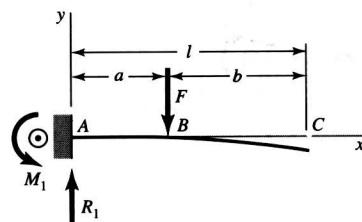
1 En voladizo: carga en extremo

$$R_1 = V = F \quad M_1 = -Fl$$

$$M = F(x - l)$$

$$y = \frac{Fx^2}{6EI}(x - 3l)$$

$$y_{\text{máx}} = -\frac{Fl^3}{3EI}$$

**2 En voladizo: carga intermedia**

$$R_1 = V = F \quad M_1 = -Fa$$

$$M_{AB} = F(x - a) \quad M_{BC} = 0$$

$$y_{AB} = \frac{Fx^2}{6EI}(x - 3a)$$

$$y_{BC} = \frac{Fa^2}{6EI}(a - 3x)$$

$$y_{\text{máx}} = \frac{Fa^2}{6EI}(a - 3l)$$

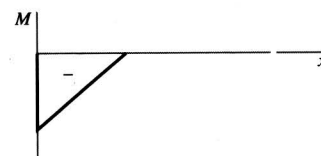
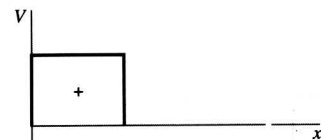
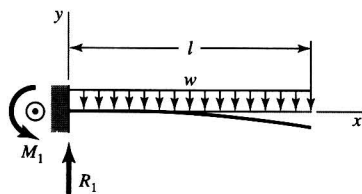


Tabla E-9

Cortante, momento y
deflexión de vigas
(continuación)

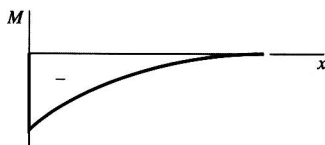
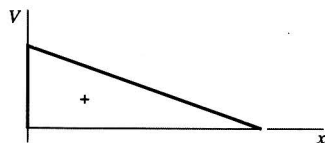
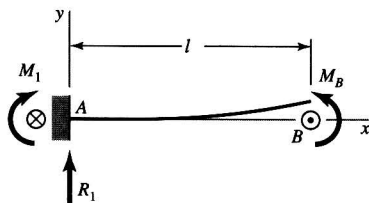
3 En voladizo: carga uniforme

$$R_1 = wl \quad M_1 = -\frac{wl^2}{2}$$

$$V = w(l-x) \quad M = -\frac{w}{2}(l-x)^2$$

$$y = \frac{wx^2}{24EI}(4lx - x^2 - 6l^2)$$

$$y_{\text{máx}} = -\frac{wl^4}{8EI}$$

**4 En voladizo: carga de momento**

$$R_1 = 0 \quad M_1 = M_B \quad M = M_B$$

$$y = \frac{M_B x^2}{2EI} \quad y_{\text{máx}} = \frac{M_B l^2}{2EI}$$

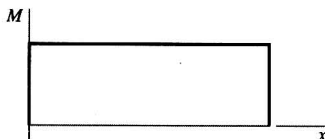
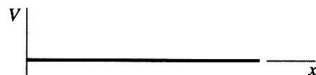
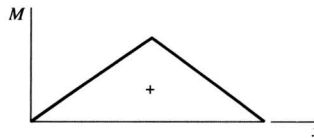
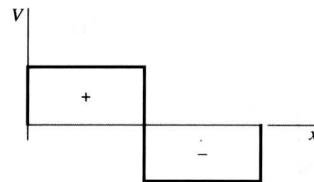
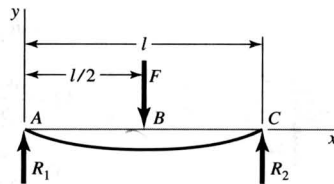


Tabla E-9

Cortante, momento y deflexión de vigas
(continuación)

5 Apoyos simples: carga central



$$R_1 = R_2 = \frac{F}{2} \quad V_{AB} = R_1$$

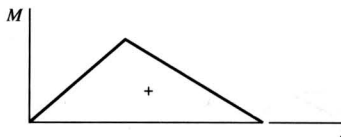
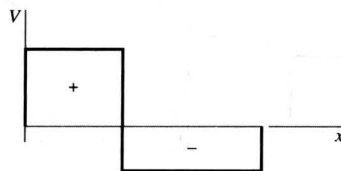
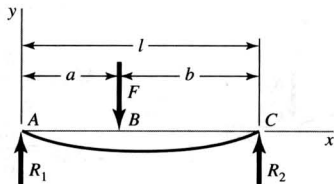
$$V_{AB} = R_1 \quad V_{BC} = -R_2$$

$$M_{AB} = \frac{Fx}{2} \quad M_{BC} = \frac{F}{2}(l-x)$$

$$y_{AB} = \frac{Fx}{48EI}(4x^2 - 3l^2)$$

$$y_{\max} = -\frac{Fl^3}{48EI}$$

6 Apoyos simples: carga intermedia, $a < b$



$$R_1 = \frac{Fb}{l} \quad R_2 = \frac{Fa}{l}$$

$$V_{AB} = R_1 \quad V_{BC} = -R_2$$

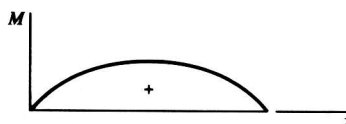
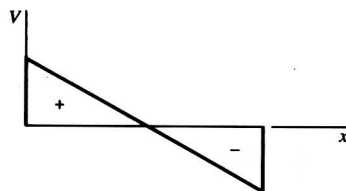
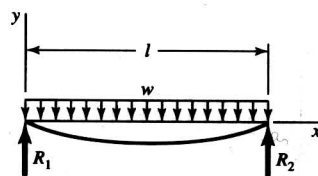
$$M_{AB} = \frac{Fbx}{l} \quad M_{BC} = \frac{Fa}{l}(l-x)$$

$$y_{AB} = \frac{Fbx}{6EI}(x^2 + b^2 - l^2)$$

$$y_{BC} = \frac{Fa(l-x)}{6EI}(x^2 + a^2 - 2lx)$$

Tabla E-9

Carga, momento y deflexión de vigas
(continuación)

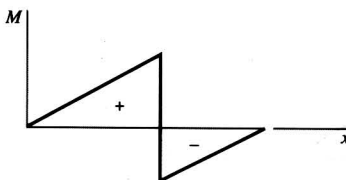
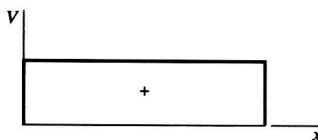
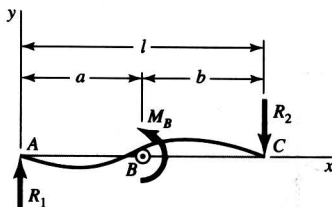
7 Apoyos simples: carga uniforme

$$R_1 = R_2 = \frac{wl}{2} \quad V = \frac{wl}{2} - wx$$

$$M = \frac{wx}{2}(l - x)$$

$$y = \frac{wx}{24EI}(2lx^2 - x^3 - l^3)$$

$$y_{\text{máx}} = -\frac{5wl^4}{384EI}$$

8 Apoyos simples: carga de momento

$$R_1 = -R_2 = \frac{M_B}{l} \quad V = \frac{M_B}{l}$$

$$M_{AB} = \frac{M_B x}{l} \quad M_{BC} = \frac{M_B}{l}(x - l)$$

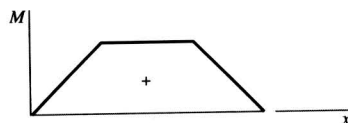
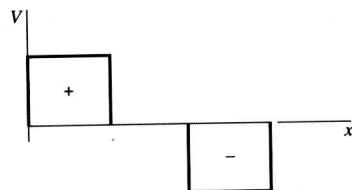
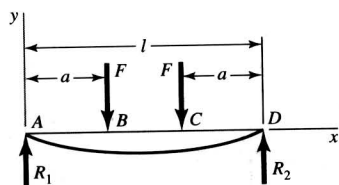
$$y_{AB} = \frac{M_B x}{6EI}(x^2 + 3a^2 - 6al + 2l^2)$$

$$y_{BC} = \frac{M_B}{6EI}[x^3 - 3lx^2 + x(2l^2 + 3a^2) - 3a^2l]$$

Tabla E-9

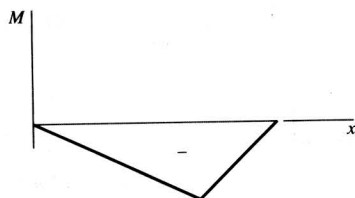
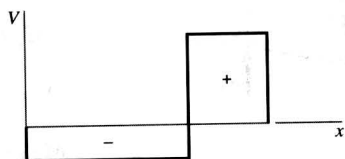
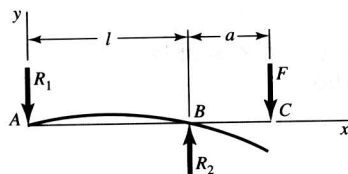
Cortante, momento y deflexión de vigas
(continuación)

9 Apoyos simples: cargas idénticas



$$\begin{aligned} R_1 &= R_2 = F & V_{AB} &= F & V_{BC} &= 0 \\ V_{CD} &= -F \\ M_{AB} &= Fx & M_{BC} &= Fa & M_{CD} &= F(l-x) \\ y_{AB} &= \frac{Fx}{6EI}(x^2 + 3a^2 - 3la) \\ y_{BC} &= \frac{Fa}{6EI}(3x^2 + a^2 - 3lx) \\ y_{\text{máx}} &= \frac{Fa}{24EI}(4a^2 - 3l^2) \end{aligned}$$

10 Apoyos simples: carga en voladizo

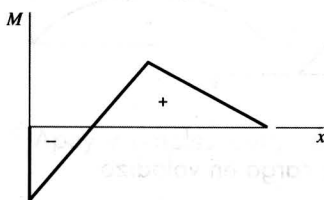
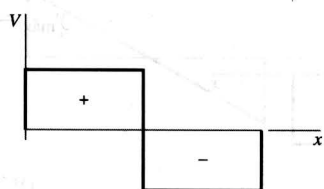
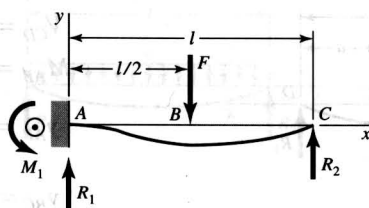


$$\begin{aligned} R_1 &= -\frac{Fa}{l} & R_2 &= \frac{F}{l}(l+a) \\ V_{AB} &= -\frac{Fa}{l} & V_{BC} &= F \\ M_{AB} &= -\frac{Fax}{l} & M_{BC} &= F(x-l-a) \\ y_{AB} &= \frac{Fax}{6El}(l^2 - x^2) \\ y_{BC} &= \frac{F(x-l)}{6El}[(x-l)^2 - a(3x-l)] \\ y_c &= -\frac{Fa^2}{3El}(l+a) \end{aligned}$$

Tabla E-9

Cortante, momento y deflexión de vigas (continuación)

11 Empotramiento y apoyo simple: carga central



$$R_1 = \frac{11F}{16} \quad R_2 = \frac{5F}{16} \quad M_1 = -\frac{3Fl}{16}$$

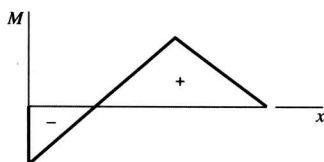
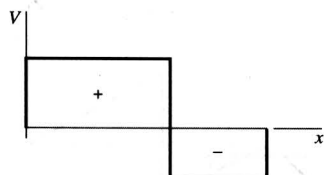
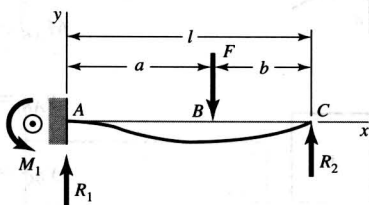
$$V_{AB} = R_1 \quad V_{BC} = -R_2$$

$$M_{AB} = \frac{F}{16}(11x - 3l) \quad M_{BC} = \frac{5F}{16}(l - x)$$

$$y_{AB} = \frac{Fx^2}{96EI}(11x - 9l)$$

$$y_{BC} = \frac{F(l-x)}{96EI}(5x^2 + 2l^2 - 10lx)$$

12 Empotramiento y apoyo simple: carga intermedia



$$R_1 = \frac{Fb}{2l^3}(3l^2 - b^2) \quad R_2 = \frac{Fa^2}{2l^3}(3l - a)$$

$$M_1 = \frac{Fb}{2l^2}(b^2 - l^2) \quad V_{AB} = R_1$$

$$V_{AB} = R_1 \quad V_{BC} = -R_2$$

$$M_{AB} = \frac{Fb}{2l^3}[b^2l - l^3 + x(3l^2 - b^2)]$$

$$M_{BC} = \frac{Fa^2}{2l^3}(3l^2 - 3lx - al + ax)$$

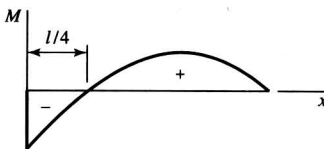
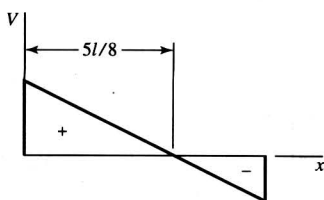
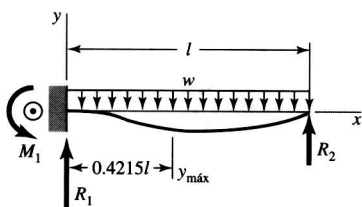
$$y_{AB} = \frac{Fbx^2}{12EI l^3}[3l(b^2 - l^2) + x(3l^2 - b^2)]$$

$$y_{BC} = y_{AB} - \frac{F(x-a)^3}{6EI}$$

Tabla E-9

Cortante, momento y deflexión de vigas
(continuación)

13 Empotramiento y apoyo simple: carga uniforme



$$R_1 = \frac{5wl}{8} \quad R_2 = \frac{3wl}{8} \quad M_1 = -\frac{wl^2}{8}$$

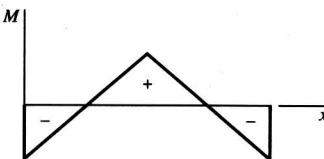
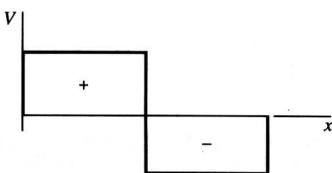
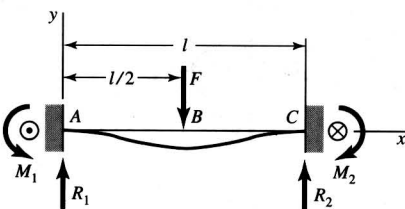
$$V = \frac{5wl}{8} - wx$$

$$M = \frac{w}{8}(4x^2 + 5lx - l^2)$$

$$y = \frac{wx^2}{48EI}(l-x)(2x-3l)$$

$$y_{\max} = -\frac{wl^4}{185EI}$$

14 Doble empotramiento: carga central



$$R_1 = R_2 = \frac{F}{2} \quad M_1 = M_2 = -\frac{Fl}{8}$$

$$V_{AB} = -V_{BC} = \frac{F}{2}$$

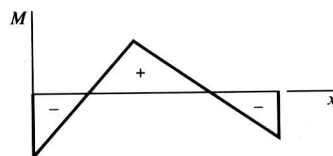
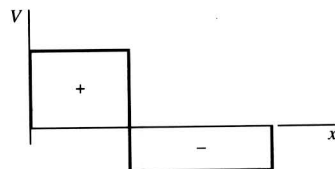
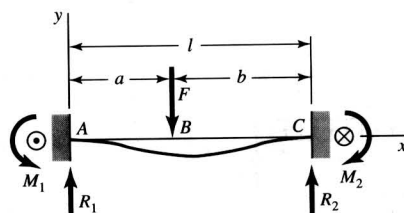
$$M_{AB} = \frac{F}{8}(4x-l) \quad M_{BC} = \frac{F}{8}(3l-4x)$$

$$y_{AB} = \frac{Fx^2}{48EI}(4x-3l)$$

$$y_{\max} = -\frac{Fl^3}{192EI}$$

Tabla E-9

Cortante, momento y
deflexión de vigas
(continuación)

15 Doble empotramiento: carga intermedia


$$R_1 = \frac{Fb^2}{l^3}(3a+b) \quad R_2 = \frac{Fa^2}{l^3}(3b+a)$$

$$M_1 = -\frac{Fab^2}{l^2} \quad M_2 = -\frac{Fa^2b}{l^2}$$

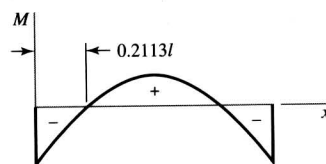
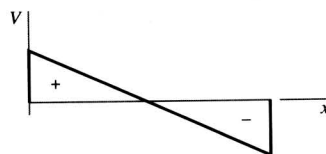
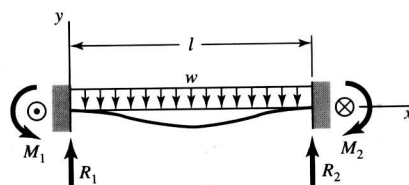
$$V_{AB} = R_1 \quad V_{BC} = -R_2$$

$$M_{AB} = \frac{Fb^2}{l^3}[x(3a+b)-al]$$

$$M_{BC} = M_{AB} - F(x-a)$$

$$y_{AB} = \frac{Fb^2x^2}{6EI l^3}[x(3a+b)-3al]$$

$$y_{BC} = \frac{Fa^2(l-x)^2}{6EI l^3}[(l-x)(3b+a)-3bl]$$

16 Doble empotramiento: carga uniforme


$$R_1 = R_2 = \frac{wl}{2} \quad M_1 = M_2 = -\frac{wl^2}{12}$$

$$V = \frac{w}{2}(l-2x)$$

$$M = \frac{w}{12}(6lx-6x^2-l^2)$$

$$y = -\frac{wx^2}{24EI}(l-x)^2$$

$$y_{\max} = -\frac{wl^4}{384EI}$$