



Table 2.2 Cubic Finite Element Matrices for Fourth Order Differential Equation

a) Differential Equation

$$\frac{d^2}{dx^2} \left[EI \frac{d^2 v}{dx^2} \right] - N \frac{d^2 v}{dx^2} - \frac{dN}{dx} \frac{dv}{dx} + kv = q$$

b) Shape Function

$$v = C_1 + C_2 x + C_3 x^2 + C_4 x^3$$

c) Beam Stiffness Matrix (7,8)

$$\left\{ \frac{d^2}{dx^2} \left[EI \frac{d^2 v}{dx^2} \right] \right\} \begin{bmatrix} 12 & 6L & -12 & 6L \\ 4L^2 & -6L & 2L^2 & \\ \text{symm.} & 12 & -6L & 4L^2 \end{bmatrix}$$

d) Axial Stiffness Matrix (7)

$$\left\{ -N \frac{d^2 v}{dx^2} \right\} \begin{bmatrix} 36 & 3L & -36 & 3L \\ 4L^2 & -3L & -L^2 & \\ \text{symm.} & 36 & -3L & 4L^2 \end{bmatrix}$$

