We compute now the bending moment in the beam using formula (6.18):

$$M = [D][B]\{u\} = EI\,[B]\{u\}$$

where (6.16) $[B] = \left[\left(-\frac{6}{\ell^2} + \frac{12x}{\ell^3}\right)\left(-\frac{4}{\ell} + \frac{6x}{\ell^2}\right)\left(\frac{6}{\ell^2} - \frac{12x}{\ell^3}\right)\left(-\frac{2}{\ell} + \frac{6x}{\ell^2}\right)\right]$

element 1:

$$M(x) = EI[B]\cdot\begin{bmatrix} v_1 \\ \varphi_1 \\ v_2 \\ \varphi_2 \end{bmatrix} = [B]\begin{bmatrix} -\frac{q\ell^4}{10EI} - \frac{M\ell^2}{10EI} \\ 0 \\ 0 \\ \frac{q\ell^3}{5EI} + \frac{M\ell}{5EI} \end{bmatrix}\cdot EI$$

$$= \left(-\frac{6}{\ell^2} + \frac{12x}{\ell^3}\right)\left(-\frac{q\ell^4}{10EI} - \frac{M\ell^2}{10EI}\right) + \left(-\frac{2}{\ell} + \frac{6x}{\ell^2}\right)\left(\frac{q\ell^3}{5EI} + \frac{M\ell}{5EI}\right)EI$$

$$= -\frac{6}{\ell^2}\cdots = 0.2q\ell^2 + 0.2M \quad \text{constant}$$

element 2:

$$M(x) = EI[B]\begin{bmatrix} v_2 \\ \varphi_2 \\ v_3 \\ \varphi_3 \end{bmatrix} = [B]\begin{bmatrix} 0 \\ \frac{q\ell^3}{5EI} + \frac{M\ell}{5EI} \\ \frac{19q\ell^4}{120EI} + \frac{M\ell^2}{5EI} \\ \frac{q\ell^3}{60EI} + \frac{M\ell}{10EI} \end{bmatrix}\cdot EI$$

$$= \left[\left(-\frac{4}{\ell} + \frac{6x}{\ell^2}\right)\left(\frac{q\ell^3}{5EI} + \frac{M\ell}{5EI}\right) + \left(\frac{6}{\ell^2} - \frac{12x}{\ell^3}\right)\left(\frac{19q\ell^4}{120EI} + \frac{M\ell^2}{5EI}\right) + \left(-\frac{2}{\ell} + \frac{6x}{\ell^2}\right)\left(\frac{q\ell^3}{60EI} + \frac{M\ell}{10EI}\right)\right]EI$$

$$= \left(-\frac{4}{\ell}\cdot\frac{\ell}{5} + \frac{6}{\ell^2}\cdot\frac{19\ell^2}{120} - \frac{2}{\ell}\,\frac{\ell}{60}\right)q\ell^2 + \left(\frac{6x}{\ell^2}\cdot\frac{\ell}{5} - \frac{12x}{\ell^3}\cdot\frac{19\ell^2}{120} + \frac{6x}{\ell^2}\cdot\frac{\ell}{60}\right)q\ell^2 +$$

$$\cdots = \left(\frac{7}{60} - \frac{3}{5}\frac{x}{\ell}\right)q\ell^2 + \left(\frac{1}{5} - \frac{3}{5}\frac{x}{\ell}\right)M$$