$z=0 \quad v_A=0, \quad z=\ell \quad v_B=0$

$z=0 \quad M_A=0, \quad z=\ell \quad \varphi_B=-\varphi_B$

$$M_A=0 \rightarrow \frac{d^2v(z)}{dz^2}=C_2=-\frac{M_A}{EI}=0 \Rightarrow \boxed{C_2=0}$$

$$v_A=0 \Rightarrow \boxed{C_4=0}$$

$$\varphi_B=\frac{-q\ell^3}{6EI}-C_1\frac{\ell^2}{2}-C_3=-\varphi_B$$

$$v_B=-\frac{q\ell^4}{24EI}+C_1\frac{\ell^3}{6}+C_3\ell=0$$

$$C_3=-\frac{q\ell^3}{24EI}-C_1\frac{\ell^2}{6}$$

$$-\frac{q\ell^3}{6EI}-C_1\frac{\ell^2}{2}+\frac{q\ell^3}{24EI}+C_1\frac{\ell^2}{6}=-\frac{q\ell^3}{8EI}-C_1\frac{\ell^2}{3}=-\varphi_B$$

$$\boxed{C_1=\frac{3}{\ell^2}\left(\frac{q\ell^3}{8EI}+\varphi_B\right)=\frac{3q\ell}{8EI}+\frac{3}{\ell^2}\varphi_B}$$

$$\boxed{C_3=-\frac{q\ell^3}{24EI}+\frac{q\ell^3}{16EI}-\frac{\varphi_B}{2}=\frac{q\ell^3}{48EI}-\frac{\varphi_B}{2}}$$

$$z=\ell/2 \rightarrow \boxed{\varphi_C=-\frac{q}{EI}\frac{\ell^3}{48}-\left(\frac{3q\ell}{8EI}+\frac{3\varphi_B}{\ell^2}\right)\frac{\ell^2}{8}-\frac{q\ell^3}{48EI}+\frac{\varphi_B}{2}}$$

$$=-\frac{q\ell^3}{48EI}+\frac{3q\ell^3}{64EI}-\frac{3}{8}\varphi_B-\frac{q\ell^3}{48EI}+\frac{\varphi_B}{2}=$$

$$=\boxed{\frac{q\ell^3}{192EI}+\frac{\varphi_B}{8}}$$