Remarks: See §6.4, example 2, pages 448 till 453

Answers 6.30-1:

a. $M_t^{(AB)} = +120 \text{ Nm}$, $M_t^{(BC)} = +80 \text{ Nm}$, $M_t^{(CD)} = +100 \text{ Nm}$

b. $\chi^{(AB)} = +30\times10^{-3} \text{ rad/m}$
$\chi^{(BC)} = +50\times10^{-3} \text{ rad/m}$
$\chi^{(CD)} = +40\times10^{-3} \text{ rad/m}$

c. $\Delta\varphi_x^{(AB)} = +22,5\times10^{-3} \text{ rad}$
$\Delta\varphi_x^{(BC)} = +50\times10^{-3} \text{ rad}$
$\Delta\varphi_x^{(CD)} = +50\times10^{-3} \text{ rad}$

d. $\varphi_{x;B} - \varphi_{x;A} = \Delta\varphi_x^{(AB)} = +22,5\times10^{-3} \text{ rad}$

e. $\varphi_{x;C} - \varphi_{x;A} = \Delta\varphi_x^{(AB)} + \Delta\varphi_x^{(BC)} = +72,5\times10^{-3} \text{ rad}$

f. $\varphi_{x;D} - \varphi_{x;A} = \Delta\varphi_x^{(AB)} + \Delta\varphi_x^{(BC)} + \Delta\varphi_x^{CD} = +122,5\times10^{-3} \text{ rad}$

Explanation:

$$\chi^{(AB)} = \frac{M_t^{(AB)}}{GI_t^{(AB)}} = \frac{120 \text{ Nm}}{4\times10^3 \text{ Nm}^2} = 30\times10^{-3} \text{ m}^{-1} \text{ (of rad/m)}$$

$$\Delta\varphi_x^{(AB)} = \chi^{(AB)}\ell^{(AB)} = (+30\times10^{-3} \text{ rad/m})(0,75 \text{ m}) = +22,5\times10^{-3} \text{ rad}$$

Answers 6.30-2:

a. $M_t^{(AB)} = +80 \text{ Nm}$, $M_t^{(BC)} = -40 \text{ Nm}$, $M_t^{(CD)} = +50 \text{ Nm}$

b. $\chi^{(AB)} = +20\times10^{-3} \text{ rad/m}$
$\chi^{(BC)} = -25\times10^{-3} \text{ rad/m}$
$\chi^{(CD)} = +20\times10^{-3} \text{ rad/m}$

c. $\Delta\varphi_x^{(AB)} = +15\times10^{-3} \text{ rad}$
$\Delta\varphi_x^{(BC)} = -25\times10^{-3} \text{ rad}$
$\Delta\varphi_x^{(CD)} = +10\times10^{-3} \text{ rad}$

d. $\varphi_{x;B} - \varphi_{x;A} = \Delta\varphi_x^{(AB)} = +15\times10^{-3} \text{ rad}$

e. $\varphi_{x;C} - \varphi_{x;A} = \Delta\varphi_x^{(AB)} + \Delta\varphi_x^{(BC)} = -10\times10^{-3} \text{ rad}$

f. $\varphi_{x;D} - \varphi_{x;A} = \Delta\varphi_x^{(AB)} + \Delta\varphi_x^{(BC)} + \Delta\varphi_x^{CD} = 0$

Explanation:

$$\chi^{(AB)} = \frac{M_t^{(AB)}}{GI_t^{(AB)}} = \frac{80 \text{ Nm}}{4\times10^3 \text{ Nm}^2} = 20\times10^{-3} \text{ m}^{-1} \text{ (of rad/m)}$$

$$\Delta\varphi_x^{(AB)} = \chi^{(AB)}\ell^{(AB)} = (+20\times10^{-3} \text{ rad/m})(0,75 \text{ m}) = +15\times10^{-3} \text{ rad}$$