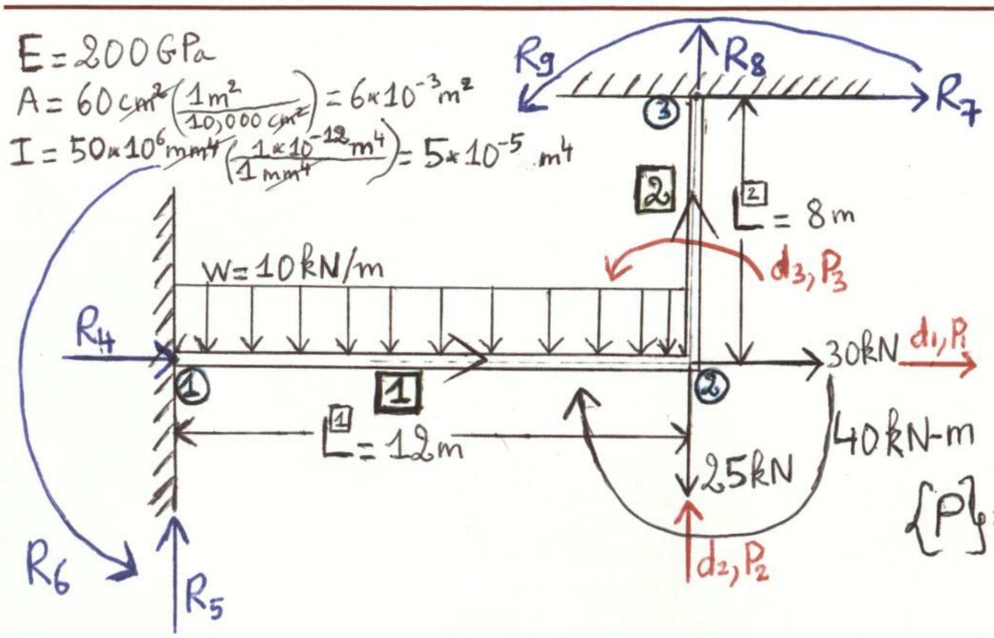
DTY Tutoring, inc.
Email: dtytutoring@gmail.com
Website: www.dtytutoring.com

$E = 200\,GPa$

$A = 60\,cm^2\left(\frac{1\,m^2}{10{,}000\,cm^2}\right) = 6\times10^{-3}\,m^2$

$I = 50\times10^6\,mm^4\left(\frac{1\times10^{-12}\,m^4}{1\,mm^4}\right) = 5\times10^{-5}\,m^4$



Date: 12th December 2019

Member	Code Number
1	4 5 6 1 2 3
2	1 2 3 7 8 9

Assemble {P}

$$\{P\} = \begin{Bmatrix} P_1 \\ P_2 \\ P_3 \end{Bmatrix} = \begin{Bmatrix} 30\,kN \\ -25\,kN \\ -40\,kN\text{-}m \end{Bmatrix}$$

$$[K] = \frac{EI}{L^3}\begin{bmatrix}
\frac{AL^2}{I}\cos^2(\theta)+12\sin^2(\theta) & \left(\frac{AL^2}{I}-12\right)\cos(\theta)\sin(\theta) & -6L\sin(\theta) & -\left(\frac{AL^2}{I}\cos^2(\theta)+12\sin^2(\theta)\right) & \left(\frac{AL^2}{I}-12\right)\cos(\theta)\sin(\theta) & -6L\sin(\theta) \\
\left(\frac{AL^2}{I}-12\right)\cos(\theta)\sin(\theta) & \frac{AL^2}{I}\sin^2(\theta)+12\cos^2(\theta) & 6L\cos(\theta) & -\left(\frac{AL^2}{I}-12\right)\cos(\theta)\sin(\theta) & -\left(\frac{AL^2}{I}\sin^2(\theta)+12\cos^2(\theta)\right) & 6L\cos(\theta) \\
-6L\sin(\theta) & 6L\cos(\theta) & 4L^2 & 6L\sin(\theta) & -6L\cos(\theta) & 2L^2 \\
-\left(\frac{AL^2}{I}\cos^2(\theta)+12\sin^2(\theta)\right) & -\left(\frac{AL^2}{I}-12\right)\cos(\theta)\sin(\theta) & 6L\sin(\theta) & \frac{AL^2}{I}\cos^2(\theta)+12\sin^2(\theta) & \left(AL^2/I-12\right)\cos(\theta)\sin(\theta) & 6L\sin(\theta) \\
-\left(\frac{AL^2}{I}-12\right)\cos(\theta)\sin(\theta) & -\left(\frac{AL^2}{I}\sin^2(\theta)+12\cos^2(\theta)\right) & -6L\cos(\theta) & \left(\frac{AL^2}{I}-12\right)\cos(\theta)\sin(\theta) & \left(AL^2/I\,\sin^2(\theta)+12\cos^2(\theta)\right) & -6L\cos(\theta) \\
-6L\sin(\theta) & 6L\cos(\theta) & 2L^2 & 6L\sin(\theta) & -6L\cos(\theta) & 4L^2
\end{bmatrix}$$

DTY Tutoring, inc.
Email: dtytutoring@gmail.com
Website:www.dtytutoring.com

Date: 12th December 2019

$$[K]^{\boxed{1}} = \begin{bmatrix} 1\times10^5 & 0 & 0 & -1\times10^5 & 0 & 0 \\ 0 & 69.44 & 416.67 & 0 & -69.44 & 416.67 \\ 0 & 416.67 & 3.33\times10^3 & 0 & -416.67 & 1.666\times10^3 \\ -1\times10^5 & 0 & 0 & 1\times10^5 & 0 & 0 \\ 0 & -69.44 & -416.67 & 0 & 69.44 & -416.67 \\ 0 & 416.67 & 1.666\times10^3 & 0 & -416.67 & 3.33\times10^3 \end{bmatrix} \frac{kN}{m}$$

$\theta^{\boxed{1}} = 0°$

$$[K]^{\boxed{2}} = \begin{bmatrix} 234.375 & 0 & -937.5 & -234.375 & 0 & -937.5 \\ 0 & 1.5\times10^5 & 0 & 0 & -1.5\times10^5 & 0 \\ -937.5 & 0 & 5\times10^3 & 937.5 & 0 & 2.5\times10^3 \\ -234.375 & 0 & 937.5 & 234.375 & 0 & 937.5 \\ 0 & -1.5\times10^5 & 0 & 0 & 1.5\times10^5 & 0 \\ -937.5 & 0 & 2.5\times10^3 & 937.5 & 0 & 5\times10^3 \end{bmatrix} \frac{kN}{m}$$

$\theta^{\boxed{2}} = 90°$

$$[k]^{\boxed{1}} = [K]^{\boxed{1}}$$

DTY Tutoring, inc.
Email: dtytutoring@gmail.com
Website:www.dtytutoring.com

Date: 12th December 2019

$$[k]=\frac{EI}{L^3}\begin{bmatrix}\frac{AL^2}{I} & 0 & 0 & -\frac{AL^2}{I} & 0 & 0\\ 0 & 12 & 6L & 0 & -12 & 6L\\ 0 & 6L & 4L^2 & 0 & -6L & 2L^2\\ \frac{AL^2}{I} & 0 & 0 & \frac{AL^2}{I} & 0 & 0\\ 0 & -12 & 6L & 0 & 12 & -6L\\ 0 & 6L & 2L^2 & 0 & -6L & 4L^2\end{bmatrix}$$

$$[k]^{\boxed{2}}=\begin{bmatrix}1.5\times10^5 & 0 & 0 & -1.5\times10^5 & 0 & 0\\ 0 & 234.375 & 937.5 & 0 & -234.375 & 937.5\\ 0 & 937.5 & 5\times10^3 & 0 & -937.5 & 2.5\times10^3\\ 1.5\times10^5 & 0 & 0 & 1.5\times10^5 & 0 & 0\\ 0 & -234.375 & 937.5 & 0 & 234.375 & -937.5\\ 0 & 937.5 & 2.5\times10^3 & 0 & -937.5 & 5\times10^3\end{bmatrix}\frac{kN}{m}$$

$$[T]^{\boxed{1}}=\begin{bmatrix}\cos(\theta) & \sin(\theta) & 0 & 0 & 0 & 0\\ -\sin(\theta) & \cos(\theta) & 0 & 0 & 0 & 0\\ 0 & 0 & 1 & 0 & 0 & 0\\ 0 & 0 & 0 & \cos(\theta) & \sin(\theta) & 0\\ 0 & 0 & 0 & -\sin(\theta) & \cos(\theta) & 0\\ 0 & 0 & 0 & 0 & 0 & 1\end{bmatrix}=\begin{bmatrix}1&0&0&0&0&0\\0&1&0&0&0&0\\0&0&1&0&0&0\\0&0&0&1&0&0\\0&0&0&0&1&0\\0&0&0&0&0&1\end{bmatrix}$$

$\theta^{\boxed{1}}=0°$

$$[T]^{\boxed{2}}=\begin{bmatrix}\cos(\theta) & \sin(\theta) & 0 & 0 & 0 & 0\\ -\sin(\theta) & \cos(\theta) & 0 & 0 & 0 & 0\\ 0 & 0 & 1 & 0 & 0 & 0\\ 0 & 0 & 0 & \cos(\theta) & \sin(\theta) & 0\\ 0 & 0 & 0 & -\sin(\theta) & \cos(\theta) & 0\\ 0 & 0 & 0 & 0 & 0 & 1\end{bmatrix}=\begin{bmatrix}0&1&0&0&0&0\\-1&0&0&0&0&0\\0&0&1&0&0&0\\0&0&0&0&1&0\\0&0&0&-1&0&0\\0&0&0&0&0&1\end{bmatrix}$$

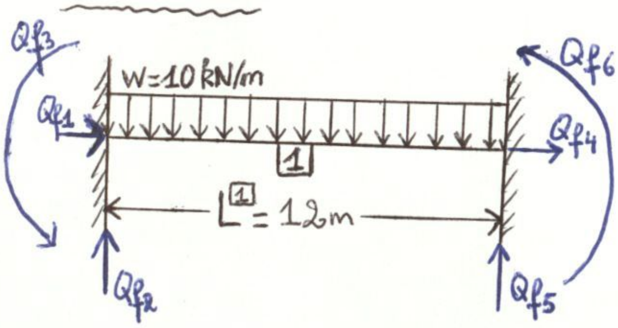
$\theta^{\boxed{2}}=90°$

DTY Tutoring, inc.
Email: dtytutoring@gmail.com
Website:www.dtytutoring.com

Date: 12th December 2019

Fixed-End Forces

Member $\boxed{1}$



Member $\boxed{2}$

$\{Q_f\}^{\boxed{2}} = \{F_f\}^{\boxed{2}} = 0 \rightarrow$ No member forces

$Q_{f1} = 0$

$$Q_{f2} = \frac{wL}{2}\left[1 - \cancelto{0}{\frac{l_1}{L^4}}(2L^3 - 2l_1^2 L - l_1^3) - \cancelto{0}{\frac{l_2^3}{L^4}}(2L - l_2)\right] = \frac{\left(10\frac{kN}{m}\right)(12\,m)}{2} = 60\,kN$$

$$Q_{f3} = \frac{wL^2}{12}\left[1 - \cancelto{0}{\frac{l_1^2}{L^4}}(6L^2 - 8l_1L + 3l_1^2) - \cancelto{0}{\frac{l_2^3}{L^4}}(4L - 3l_2)\right] = \frac{\left(10\frac{kN}{m}\right)(12\,m)^2}{12} = 120\,kN\text{-}m$$

$Q_{f4} = 0$

$Q_{f5} = Q_{f2} = 60\,kN$

$Q_{f6} = -Q_{f3} = -120\,kN\text{-}m$

$$\{F_f\}^{\boxed{1}} = \{Q_f^{\boxed{1}}\} = \begin{array}{c} \left\{\begin{array}{c} 0 \\ 60\,kN \\ 120\,kN\text{-}m \\ 0 \\ 60\,kN \\ -120\,kN\text{-}m \end{array}\right\} \end{array}\begin{array}{c} 4 \\ 5 \\ 6 \\ 1 \\ 2 \\ 3 \end{array}$$

$\{F_f\}^{\boxed{2}} = \{0\}$

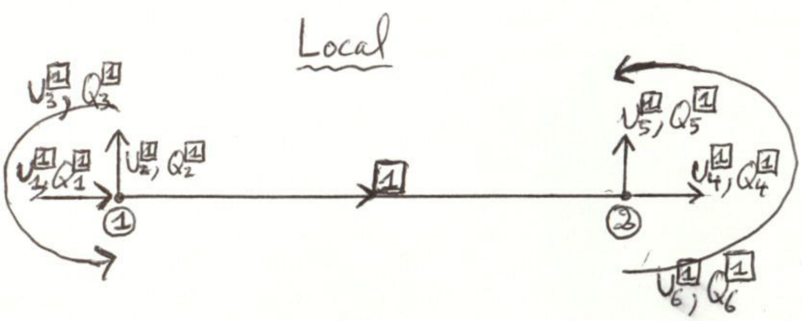
Assemble $\{P_f\}$ using Code number method

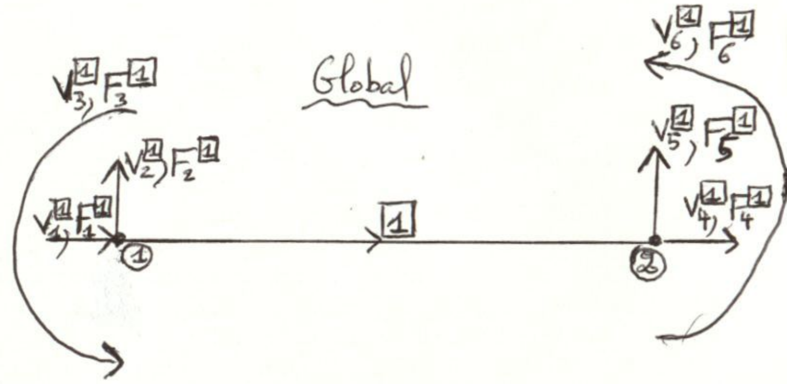
$$\{P_f\} = \left\{\begin{array}{c} 0 \\ 60\,kN \\ -120\,kN\text{-}m \end{array}\right\}\begin{array}{c} 1 \\ 2 \\ 3 \end{array}$$

DTY Tutoring, inc.
Email: dtytutoring@gmail.com
Website:www.dtytutoring.com

Date: 12th December 2019

FBD Member $\boxed{1}$





Compatibility

$V_1^{\boxed{1}} = U_1^{\boxed{1}} = 0$

$V_2^{\boxed{1}} = U_2^{\boxed{1}} = 0$

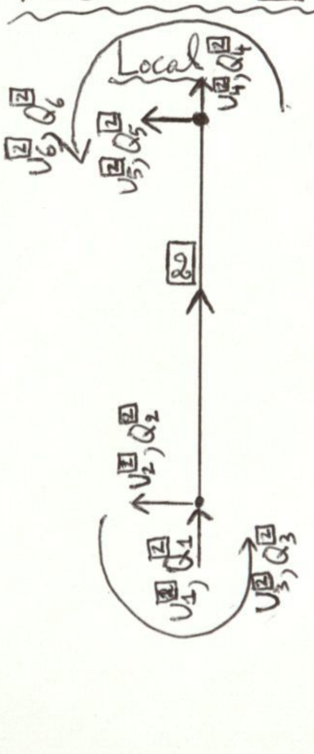
$V_3^{\boxed{1}} = U_3^{\boxed{1}} = 0$

$V_4^{\boxed{1}} = U_4^{\boxed{1}} = d_1$

$V_5^{\boxed{1}} = U_5^{\boxed{1}} = d_2$

$V_6^{\boxed{1}} = U_6^{\boxed{1}} = d_3$

FBD Member $\boxed{2}$



$\Rightarrow$ Compatibility

$U_1^{\boxed{2}} = d_2$

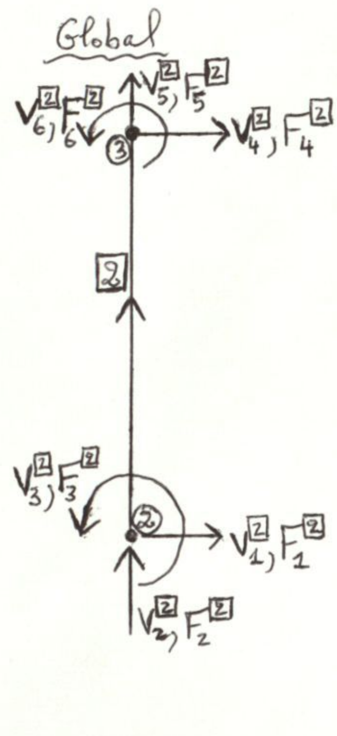
$U_2^{\boxed{2}} = d_1$

$U_3^{\boxed{2}} = d_3$

$U_4^{\boxed{2}} = 0$

$U_5^{\boxed{2}} = 0$

$U_6^{\boxed{2}} = 0$



$\Rightarrow$ Compatibility

$V_1^{\boxed{2}} = d_1$

$V_2^{\boxed{2}} = d_2$

$V_3^{\boxed{2}} = d_3$

$V_4^{\boxed{2}} = 0$

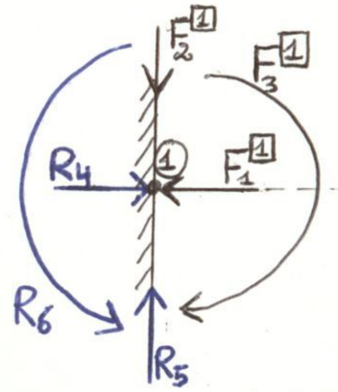
$V_5^{\boxed{2}} = 0$

$V_6^{\boxed{2}} = 0$

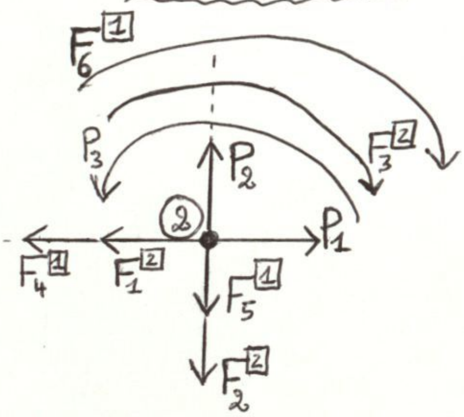
DTY Tutoring, inc.
Email: dtytutoring@gmail.com
Website: www.dtytutoring.com

Date: 12th December 2019

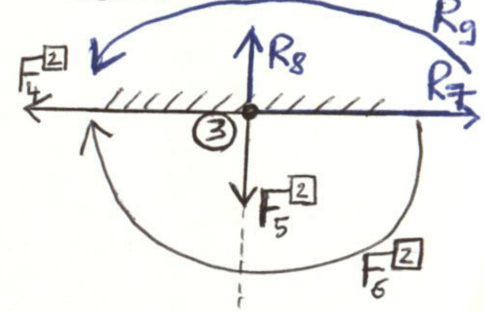
Joint ① FBD



Joint ② FBD



Joint ③ FBD



Joint ①:

$\overset{+}{\rightarrow}\Sigma F_x = 0;\ \boxed{R_4 = F_1^{\boxed{1}}}$

$+\uparrow \Sigma F_y = 0;\ \boxed{R_5 = F_2^{\boxed{1}}}$

$+\circlearrowleft \Sigma M_{①} = 0;\ \boxed{R_6 = F_3^{\boxed{1}}}$

Joint ②:

$\overset{+}{\rightarrow}\Sigma F_x = 0;\ \boxed{P_1 = F_4^{\boxed{1}} + F_1^{\boxed{2}}}$

$+\uparrow \Sigma F_y = 0;\ \boxed{P_2 = F_5^{\boxed{1}} + F_2^{\boxed{2}}}$

$+\circlearrowleft \Sigma M_{②} = 0;\ \boxed{P_3 = F_6^{\boxed{1}} + F_3^{\boxed{2}}}$

Joint ③:

$\overset{+}{\rightarrow}\Sigma F_x = 0;\ \boxed{R_7 = F_4^{\boxed{2}}}$

$+\uparrow \Sigma F_y = 0;\ \boxed{R_8 = F_5^{\boxed{2}}}$

$+\circlearrowleft \Sigma M_{③} = 0;\ \boxed{R_9 = F_6^{\boxed{2}}}$

$$P_1 = \left[F_4^{\boxed{1}}\right] + \left[F_1^{\boxed{2}}\right]$$

$$= \left[\left(F_{f_4}^{\boxed{1}}\right) + \left(K_{41}^{\boxed{1}}\cancelto{0}{V_1^{\boxed{1}}} + K_{42}^{\boxed{1}}\cancelto{0}{V_2^{\boxed{1}}} + K_{43}^{\boxed{1}}\cancelto{0}{V_3^{\boxed{1}}} + K_{44}^{\boxed{1}}\cancelto{d_1}{V_4^{\boxed{1}}} + K_{45}^{\boxed{1}}\cancelto{d_2}{V_5^{\boxed{1}}} + K_{46}^{\boxed{1}}\cancelto{d_3}{V_6^{\boxed{1}}}\right)\right] +$$

$$= \left[\left(F_{f_1}^{\boxed{2}}\right) + \left(K_{11}^{\boxed{2}}\cancelto{d_1}{V_1^{\boxed{2}}} + K_{12}^{\boxed{2}}\cancelto{d_2}{V_2^{\boxed{2}}} + K_{13}^{\boxed{2}}\cancelto{d_3}{V_3^{\boxed{2}}} + K_{14}^{\boxed{2}}\cancelto{0}{V_4^{\boxed{2}}} + K_{15}^{\boxed{2}}\cancelto{0}{V_5^{\boxed{2}}} + K_{16}^{\boxed{2}}\cancelto{0}{V_6^{\boxed{2}}}\right)\right]$$

$$\{P_1\} = \underbrace{\left(F_{f_4}^{\boxed{1}} + F_{f_1}^{\boxed{2}}\right)}_{P_{f_1}} + \underbrace{\left(K_{44}^{\boxed{1}} + K_{11}^{\boxed{2}}\right)}_{S_{11}} d_1 + \underbrace{\left(K_{45}^{\boxed{1}} + K_{12}^{\boxed{2}}\right)}_{S_{12}} d_2 + \underbrace{\left(K_{46}^{\boxed{1}} + K_{13}^{\boxed{2}}\right)}_{S_{13}} d_3$$

$$P_2 = \left[F_5^{\boxed{1}}\right] + \left[F_2^{\boxed{2}}\right]$$

$$= \left[\left(F_{f_5}^{\boxed{1}}\right) + \left(K_{51}^{\boxed{1}}\cancelto{0}{V_1^{\boxed{1}}} + K_{52}^{\boxed{1}}\cancelto{0}{V_2^{\boxed{1}}} + K_{53}^{\boxed{1}}\cancelto{0}{V_3^{\boxed{1}}} + K_{54}^{\boxed{1}}\cancelto{d_1}{V_4^{\boxed{1}}} + K_{55}^{\boxed{1}}\cancelto{d_2}{V_5^{\boxed{1}}} + K_{56}^{\boxed{1}}\cancelto{d_3}{V_6^{\boxed{1}}}\right)\right] +$$

$$\left[\left(F_{f_2}^{\boxed{2}}\right) + \left(K_{21}^{\boxed{2}}\cancelto{d_1}{V_1^{\boxed{2}}} + K_{22}^{\boxed{2}}\cancelto{d_2}{V_2^{\boxed{2}}} + K_{23}^{\boxed{2}}\cancelto{d_3}{V_3^{\boxed{2}}} + K_{24}^{\boxed{2}}\cancelto{0}{V_4^{\boxed{2}}} + K_{25}^{\boxed{2}}\cancelto{0}{V_5^{\boxed{2}}} + K_{26}^{\boxed{2}}\cancelto{0}{V_6^{\boxed{2}}}\right)\right]$$

DTY Tutoring, inc.
Email: dtytutoring@gmail.com
Website:www.dtytutoring.com

Date: 12th December 2019

$$\{P_2\} = \overbrace{\left(F_{f5}^{\boxed{1}} + F_{f2}^{\boxed{2}}\right)}^{P_{f2}} + \overbrace{\left(K_{54}^{\boxed{1}} + K_{21}^{\boxed{2}}\right)}^{S_{21}} d_1 + \overbrace{\left(K_{55}^{\boxed{1}} + K_{22}^{\boxed{2}}\right)}^{S_{22}} d_2 + \overbrace{\left(K_{56}^{\boxed{1}} + K_{23}^{\boxed{2}}\right)}^{S_{23}} d_3$$

$$P_3 = \left[F_6^{\boxed{1}}\right] + \left[F_3^{\boxed{2}}\right]$$

$$= \left[\left(F_{f6}^{\boxed{1}}\right) + \left(K_{61}^{\boxed{1}} \cancelto{0}{V_1^{\boxed{1}}} + K_{62}^{\boxed{1}} \cancelto{0}{V_2^{\boxed{1}}} + K_{63}^{\boxed{1}} \cancelto{0}{V_3^{\boxed{1}}} + K_{64}^{\boxed{1}} \cancelto{d_1}{V_4^{\boxed{1}}} + K_{65}^{\boxed{1}} \cancelto{d_2}{V_5^{\boxed{1}}} + K_{66}^{\boxed{1}} \cancelto{d_3}{V_6^{\boxed{1}}}\right)\right] +$$

$$\left[\left(F_{f3}^{\boxed{2}}\right) + \left(K_{31}^{\boxed{2}} \cancelto{d_1}{V_1^{\boxed{2}}} + K_{32}^{\boxed{2}} \cancelto{d_2}{V_2^{\boxed{2}}} + K_{33}^{\boxed{2}} \cancelto{d_3}{V_3^{\boxed{2}}} + K_{34}^{\boxed{2}} \cancelto{0}{V_4^{\boxed{2}}} + K_{35}^{\boxed{2}} \cancelto{0}{V_5^{\boxed{2}}} + K_{36}^{\boxed{2}} \cancelto{0}{V_6^{\boxed{2}}}\right)\right]$$

$$\{P_3\} = \underbrace{\left(F_{f6}^{\boxed{1}} + F_{f3}^{\boxed{2}}\right)}_{P_{f3}} + \underbrace{\left(K_{64}^{\boxed{1}} + K_{31}^{\boxed{2}}\right)}_{S_{31}} d_1 + \underbrace{\left(K_{65}^{\boxed{1}} + K_{32}^{\boxed{2}}\right)}_{S_{32}} d_2 + \underbrace{\left(K_{66}^{\boxed{1}} + K_{33}^{\boxed{2}}\right)}_{S_{33}} d_3$$

DTY TUTORING, inc.

DTY Tutoring, inc.
Email: dtytutoring@gmail.com
Website: www.dtytutoring.com

Assembling [S] using Code Number method

Date: 12th December 2019

$$[K]^{\boxed{1}} = \begin{array}{c} \\ \\ \\ \\ \\ \\ \end{array}\begin{array}{cccccc} 4 & 5 & 6 & 1 & 2 & 3 \\ \end{array}$$

$$[K]^{\boxed{1}} = \begin{array}{cc} \begin{bmatrix} 1\times10^5 & 0 & 0 & -1\times10^5 & 0 & 0 \\ 0 & 69.44 & 416.67 & 0 & -69.44 & 416.67 \\ 0 & 416.67 & 3.33\times10^3 & 0 & -416.67 & 1.666\times10^3 \\ -1\times10^5 & 0 & 0 & 1\times10^5 & 0 & 0 \\ 0 & -69.44 & -416.67 & 0 & 69.44 & -416.67 \\ 0 & 416.67 & 1.666\times10^3 & 0 & -416.67 & 3.33\times10^3 \end{bmatrix} & \begin{matrix} 4 \\ 5 \\ 6 \\ 1 \\ 2 \\ 3 \end{matrix} \end{array} \ \frac{kN}{m}$$

$$\begin{matrix} 1 & 2 & 3 & 7 & 8 & 9 \end{matrix}$$

$$[K]^{\boxed{2}} = \begin{array}{cc} \begin{bmatrix} 234.375 & 0 & -937.5 & -234.375 & 0 & -937.5 \\ 0 & 1.5\times10^5 & 0 & 0 & -1.5\times10^5 & 0 \\ -937.5 & 0 & 5\times10^3 & 937.5 & 0 & 2.5\times10^3 \\ -234.375 & 0 & 937.5 & 234.375 & 0 & 937.5 \\ 0 & -1.5\times10^5 & 0 & 0 & 1.5\times10^5 & 0 \\ -937.5 & 0 & 2.5\times10^3 & 937.5 & 0 & 5\times10^3 \end{bmatrix} & \begin{matrix} 1 \\ 2 \\ 3 \\ 7 \\ 8 \\ 9 \end{matrix} \end{array} \ \frac{kN}{m}$$

$$\begin{matrix} 1 & 2 & 3 \end{matrix}$$

$$[S] = \begin{array}{cc} \begin{bmatrix} (1\times10^5)+(234.375) = 1.002343750\times10^5 & (0)+(0) = 0 & (0)+(-937.5) = -937.5 \\ (0)+(0) = 0 & (69.44)+(1.5\times10^5) = 1.5006944\times10^5 & (-416.67)+(0) = -416.67 \\ (0)+(-937.5) = -937.5 & (-416.67)+(0) = -416.67 & (3.33\times10^3)+(5\times10^3) = 8.33\times10^3 \end{bmatrix} & \begin{matrix} 1 \\ 2 \\ 3 \end{matrix} \end{array} \ \frac{kN}{m}$$

DTY Tutoring, inc.
Email: dtytutoring@gmail.com
Website:www.dtytutoring.com

Date: 12th December 2019

$$\{P\} = \{P_f\} + [S]\{d\}$$

Solve for displacements

$$\{d\} = \left[\{P\} - \{P_f\}\right] * [S]^{-1}$$

$$= \left[\begin{Bmatrix} 30 \\ -25 \\ -40 \end{Bmatrix} - \begin{Bmatrix} 0 \\ 60 \\ -120 \end{Bmatrix}\right] * \begin{bmatrix} 1.002343750\times10^5 & 0 & -937.5 \\ 0 & 1.5006944\times10^5 & -416.67 \\ -937.5 & -416.67 & 8.33\times10^3 \end{bmatrix}^{-1}$$

$$\boxed{\begin{Bmatrix} d_1 \\ d_2 \\ d_3 \end{Bmatrix} = \begin{Bmatrix} 0.000389281\,\cancel{m}\left(\frac{1{,}000\text{ mm}}{1\,\cancel{m}}\right) = 0.389281\text{ mm} \\ -0.000539693\,\cancel{m}\left(\frac{1{,}000\text{ mm}}{1\,\cancel{m}}\right) = -0.539693\text{ mm} \\ 0.00962066\text{ rad} \end{Bmatrix}}$$

Member Forces and Reactions

$$\{F\}^{\boxed{1}} = \{F_f\}^{\boxed{1}} + [K]^{\boxed{1}}\{V\}^{\boxed{1}}$$

$$= \begin{Bmatrix} 0 \\ 60\text{ kN} \\ 120\text{ kN-m} \\ 0 \\ 60\text{ kN} \\ -120\text{ kN-m} \end{Bmatrix} + \begin{bmatrix} 1\times10^5 & 0 & 0 & -1\times10^5 & 0 & 0 \\ 0 & 69.44 & 416.67 & 0 & -69.44 & 416.67 \\ 0 & 416.67 & 3.33*10^3 & 0 & -416.67 & 1.666\times10^3 \\ -1\times10^5 & 0 & 0 & 1\times10^5 & 0 & 0 \\ 0 & -69.44 & -416.67 & 0 & 69.44 & -416.67 \\ 0 & 416.67 & 1.666\times10^3 & 0 & -416.67 & 3.33*10^3 \end{bmatrix} \begin{Bmatrix} 0 \\ 0 \\ 0 \\ 0.00038\text{ m} \\ -0.000539\text{ m} \\ 0.00962\text{ rad} \end{Bmatrix}$$

$$\boxed{\{F\}^{\boxed{1}} = \{Q\}^{\boxed{1}} = \begin{array}{c} 4 \\ 5 \\ 6 \\ 1 \\ 2 \\ 3 \end{array} \begin{Bmatrix} -38.9281\text{ kN} \\ 64.046116684\text{ kN} \\ 136.25289344\text{ kN-m} \\ 58.39215\text{ kN} \\ 55.95388332\text{ kN} \\ -87.73832832\text{ kN-m} \end{Bmatrix} \begin{array}{l} \to R_4 \\ \to R_5 \\ \to R_6 \\ \\ \\ \\ \end{array}}$$

DTY Tutoring, inc.
Email: dtytutoring@gmail.com
Website: www.dtytutoring.com

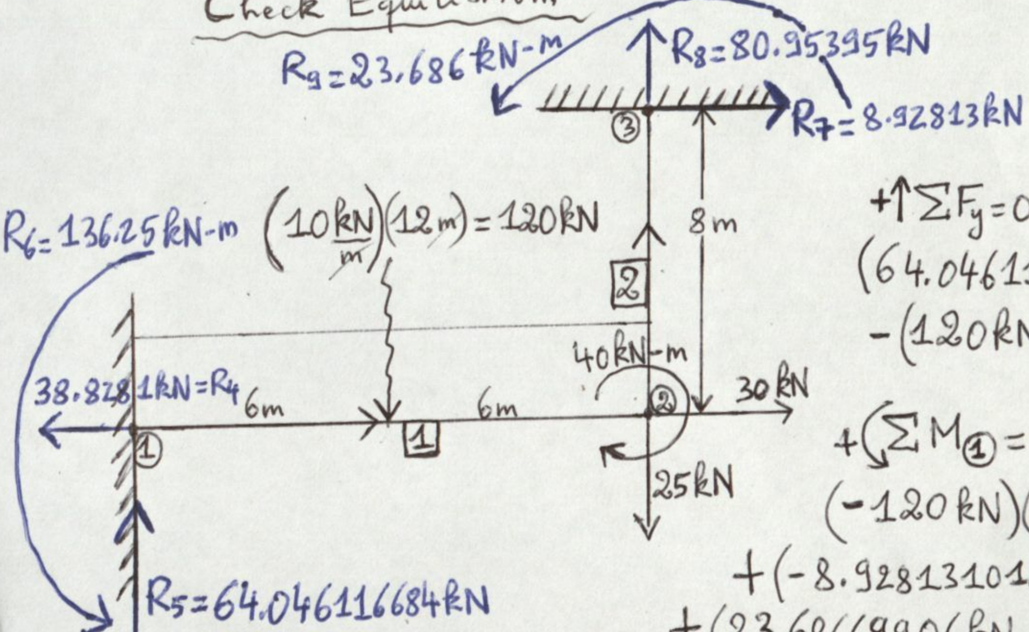
Date: 12th December 2019

$$\{F\}^{\boxed{2}} = \cancel{\{F_f\}^{\boxed{2}}}^{\,0} + [K]^{\boxed{2}}\{V\}^{\boxed{2}}$$

$$= \begin{bmatrix} 234.375 & 0 & -937.5 & -234.375 & 0 & -937.5 \\ 0 & 1.5*10^5 & 0 & 0 & -1.5\times10^5 & 0 \\ -937.5 & 0 & 5\times10^3 & 937.5 & 0 & 2.5\times10^3 \\ -234.375 & 0 & 937.5 & 234.375 & 0 & 937.5 \\ 0 & -1.5\times10^5 & 0 & 0 & 1.5\times10^5 & 0 \\ -937.5 & 0 & 2.5\times10^3 & 937.5 & 0 & 5\times10^3 \end{bmatrix} \begin{Bmatrix} 0.000389281\,m \\ -0.000539693\,m \\ 0.00962066\,rad \\ 0 \\ 0 \\ 0 \end{Bmatrix}$$

$$\{F\}^{\boxed{2}} = \begin{array}{c} 1 \\ 2 \\ 3 \\ 7 \\ 8 \\ 9 \end{array} \begin{Bmatrix} -8.928131016\ kN \\ -80.95395\ kN \\ 47.73834906\ kN\text{-}m \\ 8.928131016\ kN \rightarrow R_7 \\ 80.95395\ kN \rightarrow R_8 \\ 23.68669906\ kN\text{-}m \rightarrow R_9 \end{Bmatrix}$$

Check Equilibrium



$\overset{+}{\rightarrow}\Sigma F_x = 0\,?$

$(-38.9281\,kN) + (30\,kN) + (8.9281\,kN) = 0$ ✓

$+\uparrow \Sigma F_y = 0\,?$

$(64.046116684\,kN) - (25\,kN) + (80.95395\,kN) - (120\,kN) = 6.6684*10^{-5} \approx 0$ ✓

$+\circlearrowleft \Sigma M_{①} = 0\,?$

$(-120\,kN)(6m) + (-25\,kN)(12m) - (40\,kN\text{-}m) + (-8.928131016\,kN)(8m) + (80.95395\,kN)(12m) + (23.68669906\,kN\text{-}m) + (136.25289344\,kN\text{-}m) = -0.038064088 \approx 0$ ✓