EXAMPLE-3

$E = 2 * 10^7 \, Kn/m^2$

$A = 0.06 \, m^2$

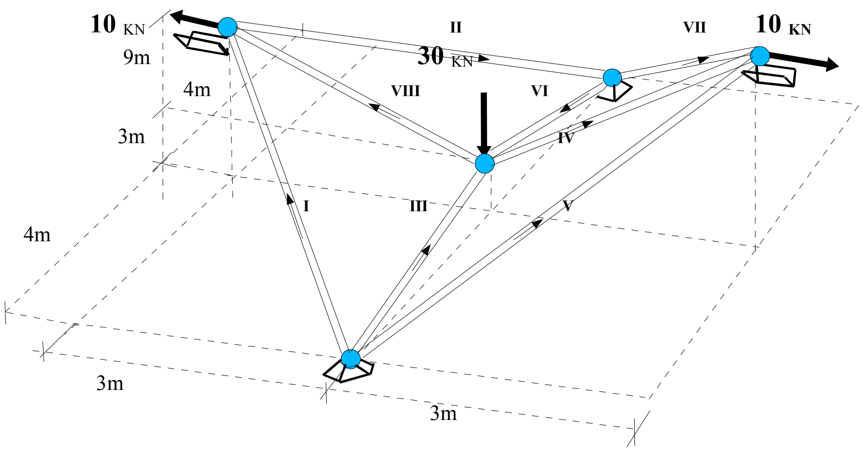
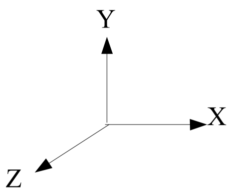


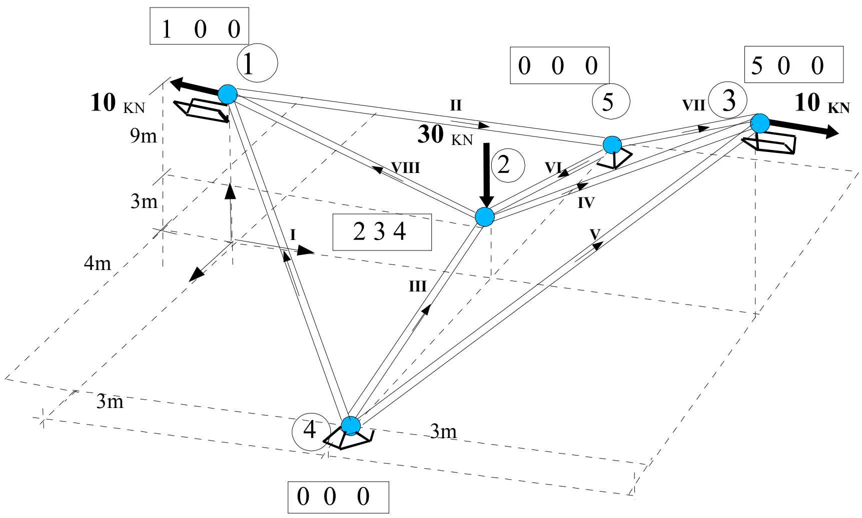
Figure-1: A simple space truss system model

This shape show a simple one space truss system under the singular force effects. All element has material properties are equal as Elasticity modules E and cross-sectional areas are A . This system is analyse with accumulate method.

SOLUTION-3:

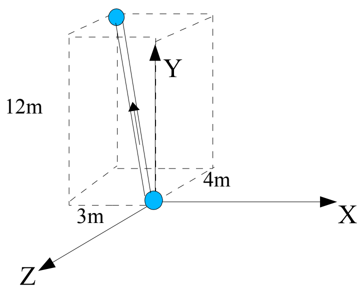
global axis system





Element No	*X(i) m.*	*Y(i)m.*	*Z(i)m.*	*X(j)m.*	*Y(j)m.*	*Z(j)m.*	*Modal displacement coefficients*	
I	3,0	0,0	4,0	0,0	12,0	0,0	0- 0- 0	1- 0- 0
II	0,0	12,0	0,0	3,0	0,0	-4,0	1- 0- 0	0 -0- 0
III	3,0	0,0	4,0	3,0	3,0	0,0	0- 0- 0	2 -3- 4
IV	3,0	3,0	0,0	6,0	12,0	0,0	2- 3- 4	5 -0- 0
V	3,0	0,0	4,0	6,0	12,0	0,0	0 -0- 0	5 -0- 0
VI	3,0	0,0	-4,0	3,0	3,0	0,0	0 -0- 0	2 -3- 4
VII	3,0	0,0	-4,0	6,0	12,0	0,0	0 -0- 0	5 -0- 0
VIII	3,0	3,0	0,0	0,0	12,0	0,0	2 -3- 4	1 -0- 0

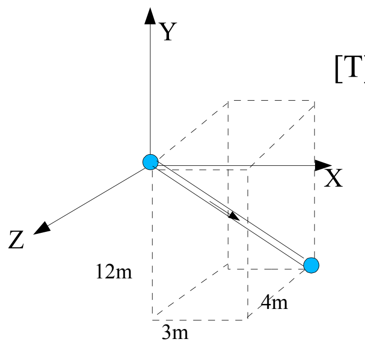
I. element's transformation matrix



$$[T]_{I} = \begin{array}{cc} \begin{array}{cccccc} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{0} \end{array} & \\ \left[\begin{array}{cccccc} -3/13 & 12/13 & -4/13 & 0.00 & 0.00 & 0.00 \\ -12/13 & -3/13 & 0.00 & 0.00 & 0.00 & 0.00 \\ 4/13 & 0.00 & -3/13 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & -3/13 & 12/13 & -4/13 \\ 0.00 & 0.00 & 0.00 & -12/13 & -3/13 & 0.00 \\ 0.00 & 0.00 & 0.00 & 4/13 & 0.00 & -3/13 \end{array}\right]_{6*6} & \begin{array}{c} \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{1} \\ \mathbf{0} \\ \mathbf{0} \end{array} \end{array}$$

l = Cos(α) = -3/13
m = Cos(β) = +12/13
n = Cos(γ) = -4/13

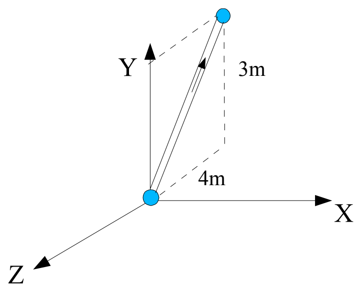
II. element's transformation matrix



$$[T]_{II} = \begin{array}{cc} \begin{array}{cccccc} \mathbf{1} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \end{array} & \\ \left[\begin{array}{cccccc} 3/13 & -12/13 & -4/13 & 0.00 & 0.00 & 0.00 \\ 12/13 & 3/13 & 0.00 & 0.00 & 0.00 & 0.00 \\ 4/13 & 0.00 & 3/13 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 3/13 & -12/13 & -4/13 \\ 0.00 & 0.00 & 0.00 & 12/13 & 3/13 & 0.00 \\ 0.00 & 0.00 & 0.00 & 4/13 & 0.00 & 3/13 \end{array}\right]_{6*6} & \begin{array}{c} \mathbf{1} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \end{array} \end{array}$$

l = Cos(α) = 3/13
m = Cos(β) = -12/13
n = Cos(γ) = -4/13

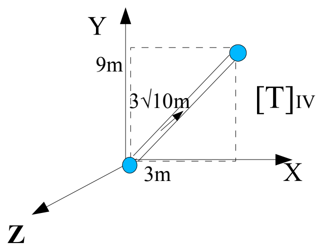
III. element's transformation matrix



$$[T]_{III} = \begin{array}{cc} \begin{array}{cccccc} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{2} & \mathbf{3} & \mathbf{4} \end{array} & \\ \left[\begin{array}{cccccc} 0.00 & 3/5 & -4/5 & 0.00 & 0.00 & 0.00 \\ -3/5 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 4/5 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 3/5 & -4/5 \\ 0.00 & 0.00 & 0.00 & -3/5 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 4/5 & 0.00 & 0.00 \end{array}\right]_{6*6} & \begin{array}{c} \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{2} \\ \mathbf{3} \\ \mathbf{4} \end{array} \end{array}$$

l = Cos(α) = 0.00
m = Cos(β) = 3/5
n = Cos(γ) = -4/5

IV. element's transformation matrix



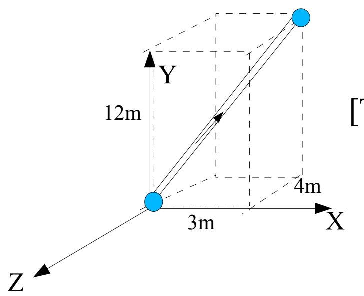
$$[T]_{IV} = \begin{array}{c} \begin{array}{cccccc} \mathbf{2} & \mathbf{3} & \mathbf{4} & \mathbf{5} & \mathbf{0} & \mathbf{0} \end{array} \\ \left[\begin{array}{cccccc} 1/\sqrt{10} & 3/\sqrt{10} & 0.00 & 0.00 & 0.00 & 0.00 \\ -3/\sqrt{10} & 1/\sqrt{10} & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 1/\sqrt{10} & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 1/\sqrt{10} & 3/\sqrt{10} & 0.00 \\ 0.00 & 0.00 & 0.00 & -3/\sqrt{10} & 1/\sqrt{10} & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 1/\sqrt{10} \end{array}\right]_{6*6} \end{array} \begin{array}{c} \mathbf{2} \\ \mathbf{3} \\ \mathbf{4} \\ \mathbf{5} \\ \mathbf{0} \\ \mathbf{0} \end{array}$$

l = Cos(α) = +1/√10

m = Cos(β) = +3/√10

n = Cos(γ) = 0.00

V. element's transformation matrix



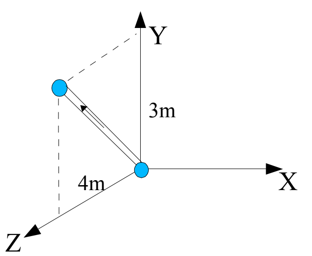
$$[T]_{V} = \begin{array}{c} \begin{array}{cccccc} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{5} & \mathbf{0} & \mathbf{0} \end{array} \\ \left[\begin{array}{cccccc} 3/13 & 12/13 & -4/13 & 0.00 & 0.00 & 0.00 \\ -12/13 & 3/13 & 0.00 & 0.00 & 0.00 & 0.00 \\ 4/13 & 0.00 & 3/13 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 3/13 & 12/13 & -4/13 \\ 0.00 & 0.00 & 0.00 & -12/13 & 3/13 & 0.00 \\ 0.00 & 0.00 & 0.00 & 4/13 & 0.00 & 3/13 \end{array}\right]_{6*6} \end{array} \begin{array}{c} \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{5} \\ \mathbf{0} \\ \mathbf{0} \end{array}$$

l = Cos(α) = 3/13

m = Cos(β) = 12/13

n = Cos(γ) = - 4/13

VI. element's transformation matrix



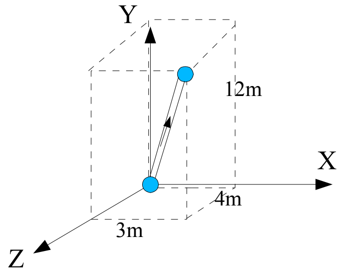
$$[T]_{VI} = \begin{array}{c} \begin{array}{cccccc} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{2} & \mathbf{3} & \mathbf{4} \end{array} \\ \left[\begin{array}{cccccc} 0.00 & 3/5 & 4/5 & 0.00 & 0.00 & 0.00 \\ -3/5 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ -4/5 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 3/5 & 4/5 \\ 0.00 & 0.00 & 0.00 & -3/5 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & -4/5 & 0.00 & 0.00 \end{array}\right]_{6*6} \end{array} \begin{array}{c} \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{2} \\ \mathbf{3} \\ \mathbf{4} \end{array}$$

l = Cos(α) = 0.00

m = Cos(β) = 3/5

n = Cos(γ) = 4/5

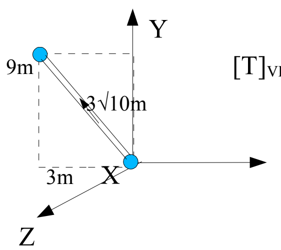
VII. element's transformation matrix



$$[T]_{VII} = \begin{array}{c} \begin{array}{cccccc} 0 & 0 & 0 & 5 & 0 & 0 \end{array} \\ \begin{bmatrix} 3/13 & 12/13 & 4/13 & 0.00 & 0.00 & 0.00 \\ -12/13 & 3/13 & 0.00 & 0.00 & 0.00 & 0.00 \\ -4/13 & 0.00 & 3/13 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 3/13 & 12/13 & 4/13 \\ 0.00 & 0.00 & 0.00 & -12/13 & 3/13 & 0.00 \\ 0.00 & 0.00 & 0.00 & -4/13 & 0.00 & 3/13 \end{bmatrix}_{6*6} \end{array} \begin{array}{c} 0 \\ 0 \\ 0 \\ 5 \\ 0 \\ 0 \end{array}$$

l = Cos(α) = 3/13
m = Cos(β) = 12/13
n = Cos(γ) = 4/13

VIII. element's transformation matrix



$$[T]_{VIII} = \begin{array}{c} \begin{array}{cccccc} 2 & 3 & 4 & 1 & 0 & 0 \end{array} \\ \begin{bmatrix} -1/\sqrt{10} & 3/\sqrt{10} & 0.00 & 0.00 & 0.00 & 0.00 \\ -3/\sqrt{10} & -1/\sqrt{10} & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & -1/\sqrt{10} & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & -1/\sqrt{10} & 3/\sqrt{10} & 0.00 \\ 0.00 & 0.00 & 0.00 & -3/\sqrt{10} & -1/\sqrt{10} & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & -1/\sqrt{10} \end{bmatrix}_{6*6} \end{array} \begin{array}{c} 2 \\ 3 \\ 4 \\ 1 \\ 0 \\ 0 \end{array}$$

l = Cos(α) = -1/√10
m = Cos(β) = 3/√10
n = Cos(γ) = 0.00

All element's global axis stiffness matrix

I. element stiffness matrix

$$[K]_{I} = \begin{array}{c} \begin{array}{cccccc} 0 & 0 & 0 & 1 & 0 & 0 \end{array} \\ \begin{bmatrix} 9/169 & -36/169 & 12/169 & -9/169 & 36/169 & -12/169 \\ -36/169 & 144/169 & -48/169 & 36/169 & -144/169 & 48/169 \\ 12/169 & -48/169 & 16/169 & -12/169 & 48/169 & -16/169 \\ -9/169 & 36/169 & -12/169 & 9/169 & -36/169 & 12/169 \\ 36/169 & -144/169 & 48/169 & -36/169 & 144/169 & -48/169 \\ -12/169 & 48/169 & -16/169 & 12/169 & -48/169 & 16/169 \end{bmatrix}_{6*6} \end{array} AE/13 \begin{array}{c} 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{array}$$

II. element stiffness matrix

$$
[K]_{II} = \begin{array}{c} \begin{array}{cccccc} \mathbf{1} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \end{array} \\ \begin{bmatrix} 9/169 & -36/169 & -12/169 & -9/169 & 36/169 & 12/169 \\ -36/169 & 144/169 & 48/169 & 36/169 & -144/169 & -48/169 \\ -12/169 & 48/169 & 16/169 & 12/169 & -48/169 & -16/169 \\ -9/169 & 36/169 & 12/169 & 9/169 & -36/169 & -12/169 \\ 36/169 & -144/169 & -48/169 & -36/169 & 144/169 & 48/169 \\ 12/169 & -48/169 & -16/169 & -12/169 & 48/169 & 16/169 \end{bmatrix}_{6*6} \end{array} \frac{AE}{13} \begin{array}{c} \mathbf{1} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \end{array}
$$

III. element stiffness matrix

$$
[K]_{III} = \begin{array}{c} \begin{array}{cccccc} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{2} & \mathbf{3} & \mathbf{4} \end{array} \\ \begin{bmatrix} 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 9/25 & -12/25 & 0.00 & -9/25 & 12/25 \\ 0.00 & -12/25 & 16/25 & 0.00 & 12/25 & -16/25 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & -9/25 & 12/25 & 0.00 & 9/25 & -12/25 \\ 0.00 & 12/25 & -16/25 & 0.00 & -12/25 & 16/25 \end{bmatrix}_{6*6} \end{array} \frac{AE}{5} \begin{array}{c} \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{2} \\ \mathbf{3} \\ \mathbf{4} \end{array}
$$

IV. element stiffness matrix

$$
[K]_{IV} = \begin{array}{c} \begin{array}{cccccc} \mathbf{2} & \mathbf{3} & \mathbf{4} & \mathbf{5} & \mathbf{0} & \mathbf{0} \end{array} \\ \begin{bmatrix} 1/10 & 3/10 & 0.00 & -1/10 & -3/10 & 0.00 \\ 3/10 & 9/10 & 0.00 & -3/10 & -9/10 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ -1/10 & -3/10 & 0.00 & 1/10 & 3/10 & 0.00 \\ -3/10 & -9/10 & 0.00 & 3/10 & 9/10 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \end{bmatrix}_{6*6} \end{array} \frac{AE}{3\sqrt{10}} \begin{array}{c} \mathbf{2} \\ \mathbf{3} \\ \mathbf{4} \\ \mathbf{5} \\ \mathbf{0} \\ \mathbf{0} \end{array}
$$

V. element stiffness matrix

$$
[K]_{V} = \begin{array}{c} \begin{array}{cccccc} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{5} & \mathbf{0} & \mathbf{0} \end{array} \\ \begin{bmatrix} 9/169 & 36/169 & -12/169 & -9/169 & -36/169 & 12/169 \\ 36/169 & 44/169 & -48/169 & -36/169 & -144/169 & 48/169 \\ -12/169 & -48/169 & 16/169 & 12/169 & 48/169 & -16/169 \\ -9/169 & -36/169 & 12/169 & 9/169 & 36/169 & -12/169 \\ -36/169 & -144/169 & 48/169 & 36/169 & 44/169 & -48/169 \\ 12/169 & 48/169 & -16/169 & -12/169 & -48/169 & 16/169 \end{bmatrix}_{6*6} \end{array} \frac{AE}{13} \begin{array}{c} \mathbf{0} \\ \mathbf{0} \\ \mathbf{5} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \end{array}
$$

V. element stiffness matrix

$$[K]_{VI} = \begin{array}{c} \begin{array}{cccccc} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{2} & \mathbf{3} & \mathbf{4} \end{array} \\ \begin{bmatrix} 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 9/25 & 12/25 & 0.00 & -9/25 & -12/25 \\ 0.00 & 12/25 & 16/25 & 0.00 & -12/25 & -16/25 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & -9/25 & -12/25 & 0.00 & 9/25 & 12/25 \\ 0.00 & -12/25 & -16/25 & 0.00 & 12/25 & 16/25 \end{bmatrix}_{6*6} \end{array} \frac{AE}{5} \begin{array}{c} \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{2} \\ \mathbf{3} \\ \mathbf{4} \end{array}$$

VI. element stiffness matrix

$$[K]_{VII} = \begin{array}{c} \begin{array}{cccccc} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{5} & \mathbf{0} & \mathbf{0} \end{array} \\ \begin{bmatrix} 9/169 & 36/169 & 12/169 & -9/169 & -36/169 & -12/169 \\ 36/169 & 144/169 & 48/169 & -36/169 & -144/169 & -48/169 \\ 12/169 & 48/169 & 16/169 & -12/169 & -48/169 & -16/169 \\ -9/169 & -36/169 & -12/169 & 9/169 & 36/169 & 12/169 \\ -36/169 & -144/169 & -48/169 & 36/169 & 144/169 & 48/169 \\ -12/169 & -48/169 & -16/169 & 12/169 & 48/169 & 16/169 \end{bmatrix}_{6*6} \end{array} \frac{AE}{13} \begin{array}{c} \mathbf{0} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{5} \\ \mathbf{0} \\ \mathbf{0} \end{array}$$

V. element stiffness matrix

$$[K]_{VIII} = \begin{array}{c} \begin{array}{cccccc} \mathbf{2} & \mathbf{3} & \mathbf{4} & \mathbf{1} & \mathbf{0} & \mathbf{0} \end{array} \\ \begin{bmatrix} 1/10 & -3/10 & 0.00 & -1/10 & 3/10 & 0.00 \\ -3/10 & 9/10 & 0.00 & 3/10 & -9/10 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ -1/10 & 3/10 & 0.00 & 1/10 & -3/10 & 0.00 \\ 3/10 & -9/10 & 0.00 & -3/10 & 9/10 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \end{bmatrix}_{6*6} \end{array} \frac{AE}{3\sqrt{10}} \begin{array}{c} \mathbf{2} \\ \mathbf{3} \\ \mathbf{4} \\ \mathbf{1} \\ \mathbf{0} \\ \mathbf{0} \end{array}$$

All system stiffness matrix

K_{11} = AE*[9/169*1/1 +9/169*1/13 + 1/10*1/3√10 = 0.018734*AE
K_{12} = AE*[-1/10*1/3√10]=-0.010540*AE
K_{13} = AE*[3/10*1/3√10] =+0.031622*AE
K_{14} = 0.00
K_{15} = 0.00

K_{22} = AE*[1/10*1/3√10 +1/10*1/3√10]=0.02108*AE
K_{23} = AE*[3/10*1/3√10 -3/10*1/3√10]=0.00
K_{24} = 0.00
K_{25} = AE*[-1/10*1/3√10]=-0.01054*AE

K_{33} = AE*[9/25*1/5 +9/10*1/3√10 + 9/25*1/5 +9/10*1/3√10]=0.333736*AE
K_{34} = AE*[-12/25*1/5 +0.00 + 12/25*1/5 +0.00]=0.00
K_{35} = AE*[-3/10*1/3√10]=-0.031627*AE

K_{44} = AE*[16/25*1/5 +16/25*1/5] = 0.256*AE
K_{45} = 0.00
K_{55} = AE[1/10*1/3√10 +9/169*1/13 +9/169*1/13] =0.018733*AE

All system displacements

$$[K]\{D\}=\{P\}$$

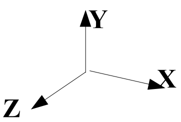
$$\begin{bmatrix} 0.018734 & -0.010540 & 0.031622 & 0.000 & 0.000 \\ -0.010540 & 0.02108 & 0.000 & 0.000 & -0.01054 \\ 0.031622 & 0.000 & 0.333736 & 0.000 & -0.03162 \\ 0.000 & 0.000 & 0.000 & 0.256 & 0.000 \\ 0.000 & -0.01054 & -0.031627 & 0.000 & 0.018733 \end{bmatrix}_{6*6} AE * \begin{Bmatrix} D_1 \\ D_2 \\ D_3 \\ D_4 \\ D_5 \end{Bmatrix}_{6*1} = \begin{Bmatrix} -10.000 \\ 0.000 \\ -30.000 \\ 0.000 \\ 10.000 \end{Bmatrix}_{6*1}$$

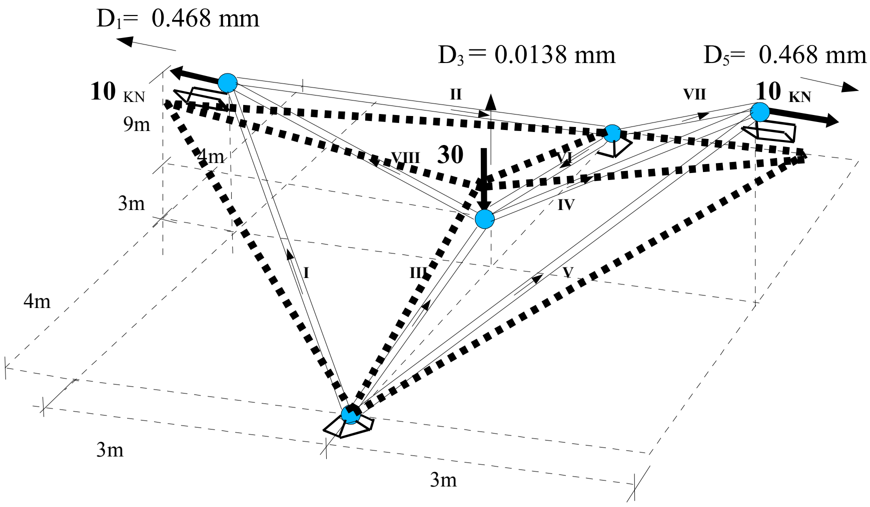
D_1 = -561.7531 /AE = -561.7531/(2*10+7 *0.06) = -4.6812 E-4 metre = -0.468 mm
D_2 = 0.000
D_3 = 16.5651/AE = 16.5651/(2*10+7 *0.06) = 1.3804 E- 5 metre = 0.0138 mm
D_4 = 0.000
D_5 = 561.7531/AE=561.7531/(2*10+7 *0.06) =-4.6812 E-4 metre = -0.468 mm

All system deformation shape

$$E=2*10^7\,Kn/m^2$$

$$A=0.06\,m^2$$





I. element's global edge node reactions

$$[Pg]_I = \begin{array}{c} \begin{array}{cccccc} 0 & 0 & 0 & 1 & 0 & 0 \end{array} \\ \begin{bmatrix} 9/169 & -36/169 & 12/169 & -9/169 & 36/169 & -12/169 \\ -36/169 & 144/169 & -48/169 & 36/169 & -144/169 & 48/169 \\ 12/169 & -48/169 & 16/169 & -12/169 & 48/169 & -16/169 \\ -9/169 & 36/169 & -12/169 & 9/169 & -36/169 & 12/169 \\ 36/169 & -144/169 & 48/169 & -36/169 & 144/169 & -48/169 \\ -12/169 & 48/169 & -16/169 & 12/169 & -48/169 & 16/169 \end{bmatrix}_{6*6} \end{array} AE/13 * \begin{Bmatrix} 0.000 \\ 0.000 \\ 0.000 \\ -561.75 \\ 0.000 \\ 0.0000 \end{Bmatrix}_{6*1} /AE = \begin{Bmatrix} 2.3012 \\ -9.2049 \\ 3.0683 \\ -2.3012 \\ 9.2049 \\ -3.0683 \end{Bmatrix}_{6*1}$$

II. element's global edge node reactions

$$[Pg]_{II} = \begin{array}{c} \boxed{\begin{array}{cccccc} \mathbf{1} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \end{array}} \\ \begin{bmatrix} 9/169 & -36/169 & -12/169 & -9/169 & 36/169 & 12/169 \\ -36/169 & 144/169 & 48/169 & 36/169 & -144/169 & -48/169 \\ -12/169 & 48/169 & 16/169 & 12/169 & -48/169 & -16/169 \\ -9/169 & 36/169 & 12/169 & 9/169 & -36/169 & -12/169 \\ 36/169 & -144/169 & -48/169 & -36/169 & 144/169 & 48/169 \\ 12/169 & -48/169 & -16/169 & -12/169 & 48/169 & 16/169 \end{bmatrix}_{6*6} \end{array} \frac{AE}{13} * \begin{Bmatrix} -561.75 \\ 0.000 \\ 0.000 \\ 0.000 \\ 0.000 \\ 0.000 \end{Bmatrix}_{6*1} / AE = \begin{Bmatrix} -2.3012 \\ 9.2049 \\ 3.0683 \\ 2.3012 \\ -9.2049 \\ -3.0683 \end{Bmatrix}_{6*1}$$

III. element's global edge node reactions

$$[Pg]_{III} = \begin{array}{c} \boxed{\begin{array}{cccccc} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{2} & \mathbf{3} & \mathbf{4} \end{array}} \\ \begin{bmatrix} 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 9/25 & -12/25 & 0.00 & -9/25 & 12/25 \\ 0.00 & -12/25 & 16/25 & 0.00 & 12/25 & -16/25 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & -9/25 & 12/25 & 0.00 & 9/25 & -12/25 \\ 0.00 & 12/25 & -16/25 & 0.00 & -12/25 & 16/25 \end{bmatrix}_{6*6} \end{array} \frac{AE}{5} * \begin{Bmatrix} 0.000 \\ 0.000 \\ 0.000 \\ 0.000 \\ 16.565 \\ 0.000 \end{Bmatrix}_{6*1} / AE = \begin{Bmatrix} -2.3012 \\ 9.2049 \\ 3.0683 \\ 2.3012 \\ -9.2049 \\ -3.0683 \end{Bmatrix}_{6*1}$$

IV. element's global edge node reactions

$$[Pg]_{IV} = \begin{array}{c} \boxed{\begin{array}{cccccc} \mathbf{2} & \mathbf{3} & \mathbf{4} & \mathbf{5} & \mathbf{0} & \mathbf{0} \end{array}} \\ \begin{bmatrix} 1/10 & 3/10 & 0.00 & -1/10 & -3/10 & 0.00 \\ 3/10 & 9/10 & 0.00 & -3/10 & -9/10 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ -1/10 & -3/10 & 0.00 & 1/10 & 3/10 & 0.00 \\ -3/10 & -9/10 & 0.00 & 3/10 & 9/10 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \end{bmatrix}_{6*6} \end{array} \frac{AE}{3\sqrt{10}} * \begin{Bmatrix} 0.000 \\ 16.565 \\ 0.000 \\ 561.75 \\ 0.000 \\ 0.000 \end{Bmatrix}_{6*1} / AE = \begin{Bmatrix} -5.3976 \\ -16.1927 \\ 0.000 \\ 5.3976 \\ 16.1927 \\ 0.000 \end{Bmatrix}_{6*1}$$

V. element's global edge node reactions

$$[Pg]_{V} = \begin{array}{c} \boxed{\begin{array}{cccccc} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{5} & \mathbf{0} & \mathbf{0} \end{array}} \\ \begin{bmatrix} 9/169 & 36/169 & -12/169 & -9/169 & -36/169 & 12/169 \\ 36/169 & 44/169 & -48/169 & -36/169 & -144/169 & 48/169 \\ -12/169 & -48/169 & 16/169 & 12/169 & 48/169 & -16/169 \\ -9/169 & -36/169 & 12/169 & 9/169 & 36/169 & -12/169 \\ -36/169 & -144/169 & 48/169 & 36/169 & 44/169 & -48/169 \\ 12/169 & 48/169 & -16/169 & -12/169 & -48/169 & 16/169 \end{bmatrix}_{6*6} \end{array} \frac{AE}{13} * \begin{Bmatrix} 0.000 \\ 0.000 \\ 0.000 \\ 561.75 \\ 0.000 \\ 0.000 \end{Bmatrix}_{6*1} = \begin{Bmatrix} -2.3012 \\ -9.2049 \\ 3.0683 \\ 2.3012 \\ 9.2049 \\ -3.0683 \end{Bmatrix}_{6*1}$$

VI. element's global edge node reactions

$$[Pg]_{VI} = \begin{array}{c} \boxed{\begin{array}{cccccc} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{2} & \mathbf{3} & \mathbf{4} \end{array}} \\ \begin{bmatrix} 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 9/25 & 12/25 & 0.00 & -9/25 & -12/25 \\ 0.00 & 12/25 & 16/25 & 0.00 & -12/25 & -16/25 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & -9/25 & -12/25 & 0.00 & 9/25 & 12/25 \\ 0.00 & -12/25 & -16/25 & 0.00 & 12/25 & 16/25 \end{bmatrix}_{6*6} \end{array} \frac{AE}{5} * \begin{Bmatrix} 0.000 \\ 0.000 \\ 0.000 \\ 0.000 \\ 16.561 \\ 0.000 \end{Bmatrix}_{6*1} / AE = \begin{Bmatrix} 0.000 \\ -1.1927 \\ -1.5903 \\ 0.000 \\ 1.1927 \\ 1.5903 \end{Bmatrix}_{6*1}$$

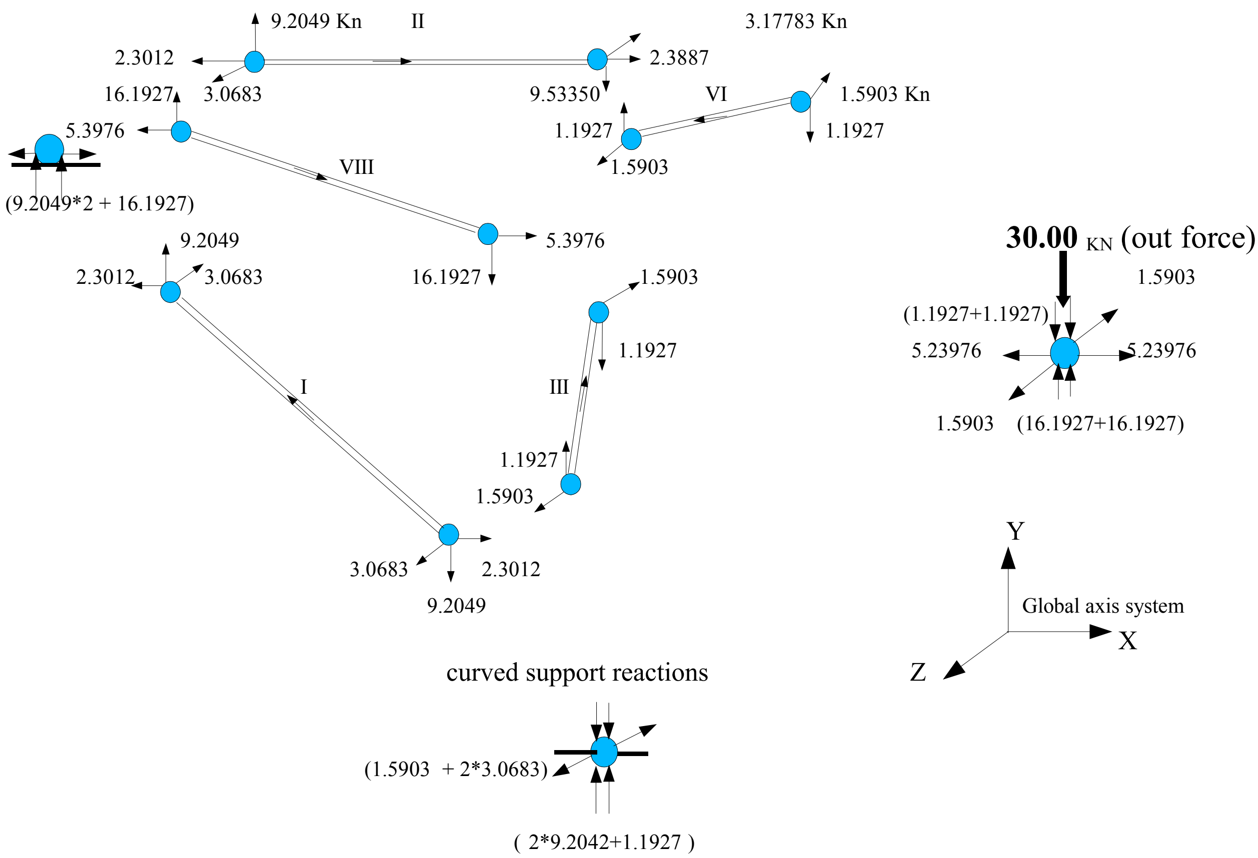
VII. element's global edge node reactions

$$
[Pg]_{VI} = \begin{array}{c} \begin{array}{cccccc} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{5} & \mathbf{0} & \mathbf{0} \end{array} \\ \begin{bmatrix} 9/169 & 36/169 & 12/169 & -9/169 & -36/169 & -12/169 \\ 36/169 & 144/169 & 48/169 & -36/169 & -144/169 & -48/169 \\ 12/169 & 48/169 & 16/169 & -12/169 & -48/169 & -16/169 \\ -9/169 & -36/169 & -12/169 & 9/169 & 36/169 & 12/169 \\ -36/169 & -144/169 & -48/169 & 36/169 & 144/169 & 48/169 \\ -12/169 & -48/169 & -16/169 & 12/169 & 48/169 & 16/169 \end{bmatrix}_{6*6} \end{array} \frac{AE}{13} * \begin{Bmatrix} 0.000 \\ 0.000 \\ 0.000 \\ 562.57 \\ 0.000 \\ 0.000 \end{Bmatrix}_{6*1} / AE = \begin{Bmatrix} -2.3012 \\ -9.2049 \\ -3.0683 \\ 2.3012 \\ 9.2049 \\ 3.0683 \end{Bmatrix}_{6*1}
$$

VIII. element's global edge node reactions

$$
[Pg]_{VIII} = \begin{array}{c} \begin{array}{cccccc} \mathbf{2} & \mathbf{3} & \mathbf{4} & \mathbf{1} & \mathbf{0} & \mathbf{0} \end{array} \\ \begin{bmatrix} 1/10 & -3/10 & 0.00 & -1/10 & 3/10 & 0.00 \\ -3/10 & 9/10 & 0.00 & 3/10 & -9/10 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ -1/10 & 3/10 & 0.00 & 1/10 & -3/10 & 0.00 \\ 3/10 & -9/10 & 0.00 & -3/10 & 9/10 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \end{bmatrix}_{6*6} \end{array} \frac{AE}{3\sqrt{10}} * \begin{Bmatrix} 0.000 \\ 16.561 \\ 0.000 \\ -561.753 \\ 0.000 \\ 0.000 \end{Bmatrix}_{6*1} = \begin{Bmatrix} 5.3976 \\ -16.1927 \\ 0.000 \\ -5.3976 \\ 16.1927 \\ 0.000 \end{Bmatrix}_{6*1}
$$

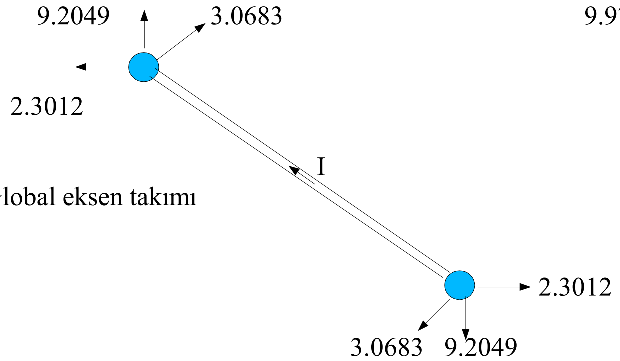
Node equilibrium method



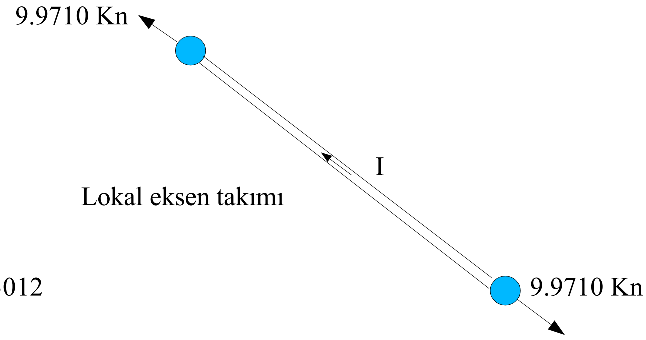
Notice: This system is symmetric

I. element's global edge node reactions

$$[PL]_I = \begin{bmatrix} -3/13 & 12/13 & -4/13 & 0.00 & 0.00 & 0.00 \\ -12/13 & -3/13 & 0.00 & 0.00 & 0.00 & 0.00 \\ 4/13 & 0.00 & -3/13 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & -3/13 & 12/13 & -4/13 \\ 0.00 & 0.00 & 0.00 & -12/13 & -3/13 & 0.00 \\ 0.00 & 0.00 & 0.00 & 4/13 & 0.00 & -3/13 \end{bmatrix}_{6*6} * \begin{Bmatrix} 2.3012 \\ -9.2049 \\ 3.0683 \\ -2.3012 \\ 9.2049 \\ -3.0683 \end{Bmatrix}_{6*1} = \begin{Bmatrix} -9.9719 \\ 0.000 \\ 0.000 \\ 9.9710 \\ 0.000 \\ 0.000 \end{Bmatrix}_{6*1}$$



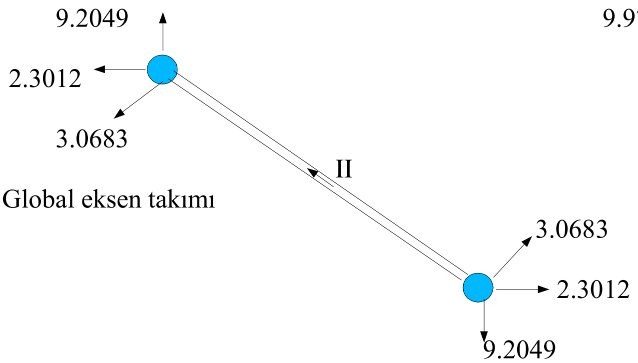
Global eksen takımı



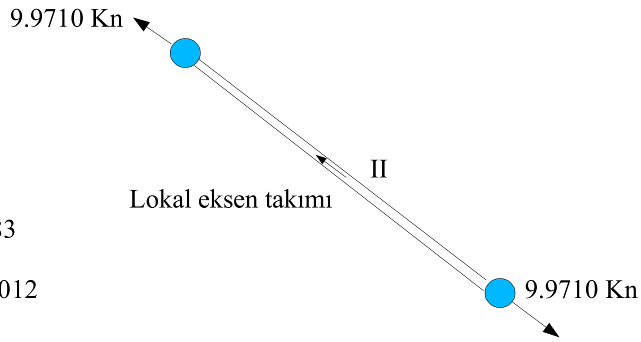
Lokal eksen takımı

II. element's global edge node reactions

$$[P_L]_{II} = \begin{bmatrix} 3/13 & -12/13 & -4/13 & 0.00 & 0.00 & 0.00 \\ 12/13 & 3/13 & 0.00 & 0.00 & 0.00 & 0.00 \\ 4/13 & 0.00 & 3/13 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 3/13 & -12/13 & -4/13 \\ 0.00 & 0.00 & 0.00 & 12/13 & 3/13 & 0.00 \\ 0.00 & 0.00 & 0.00 & 4/13 & 0.00 & 3/13 \end{bmatrix}_{6*6} * \begin{Bmatrix} -2.3012 \\ 9.2049 \\ 3.0683 \\ 2.3012 \\ -9.2049 \\ -3.0683 \end{Bmatrix}_{6*1} = \begin{Bmatrix} 9.9719 \\ 0.000 \\ 0.000 \\ -9.9719 \\ 0.000 \\ 0.000 \end{Bmatrix}_{6*1}$$



Global eksen takımı

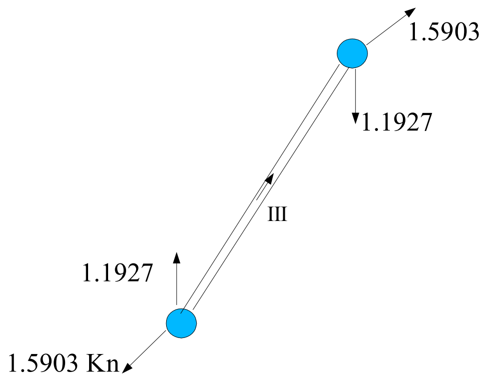


Lokal eksen takımı

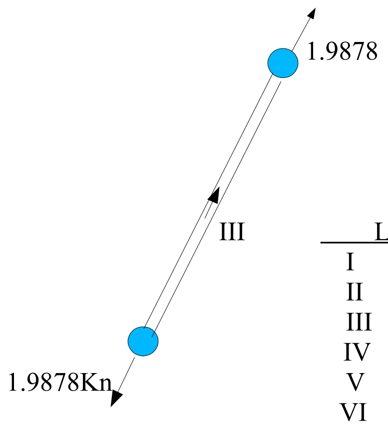
III. element's global edge node reactions

$$[P_L]_{III} = \begin{bmatrix} 0.00 & 3/5 & -4/5 & 0.00 & 0.00 & 0.00 \\ -3/5 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 4/5 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 3/5 & -4/5 \\ 0.00 & 0.00 & 0.00 & -3/5 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 4/5 & 0.00 & 0.00 \end{bmatrix}_{6*6} * \begin{Bmatrix} 0.000 \\ -1.1927 \\ 1.5903 \\ 0.000 \\ 1.1927 \\ -1.5903 \end{Bmatrix}_{6*1} = \begin{Bmatrix} -1.9878 \\ 0.000 \\ 0.000 \\ 1.9878 \\ 0.000 \\ 0.000 \end{Bmatrix}_{6*1}$$

Global eksen takımı



Lokal eksen takımı

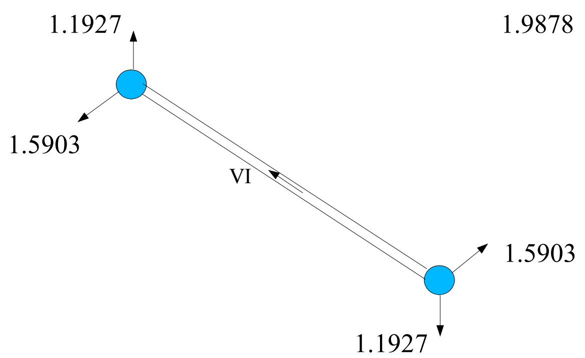


Local element's Reactions	
I	9.9719 KN (+)
II	9.9719 KN (+)
III	1.9878 KN (+)
IV	17.9686 KN (+)
V	9.9719 KN (+)
VI	1.9878 KN (+)
VII	9.9719 KN (+)
VIII	17.9689 KN (+)

VI. element's global edge node reactions

$$[P_L]_{VI} = \begin{bmatrix} 0.00 & 3/5 & 4/5 & 0.00 & 0.00 & 0.00 \\ -3/5 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ -4/5 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 & 3/5 & 4/5 \\ 0.00 & 0.00 & 0.00 & -3/5 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & -4/5 & 0.00 & 0.00 \end{bmatrix}_{6*6} * \begin{Bmatrix} 0.000 \\ -1.1927 \\ -1.5903 \\ 0.000 \\ 1.1927 \\ 1.5903 \end{Bmatrix}_{6*1} = \begin{Bmatrix} -1.9878 \\ 0.000 \\ 0.000 \\ 1.9878 \\ 0.000 \\ 0.000 \end{Bmatrix}_{6*1}$$

Global axis system



Local axis system