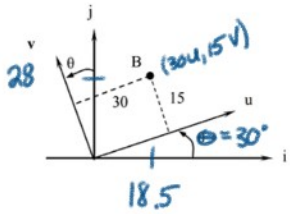
HW2

Sunday, September 17, 2023 2:45 PM

1. Determine the global coordinates of point B if the local coordinate system is rotated 30 degrees relative to the global coordinate system. The local coordinates of point B: (30,15).

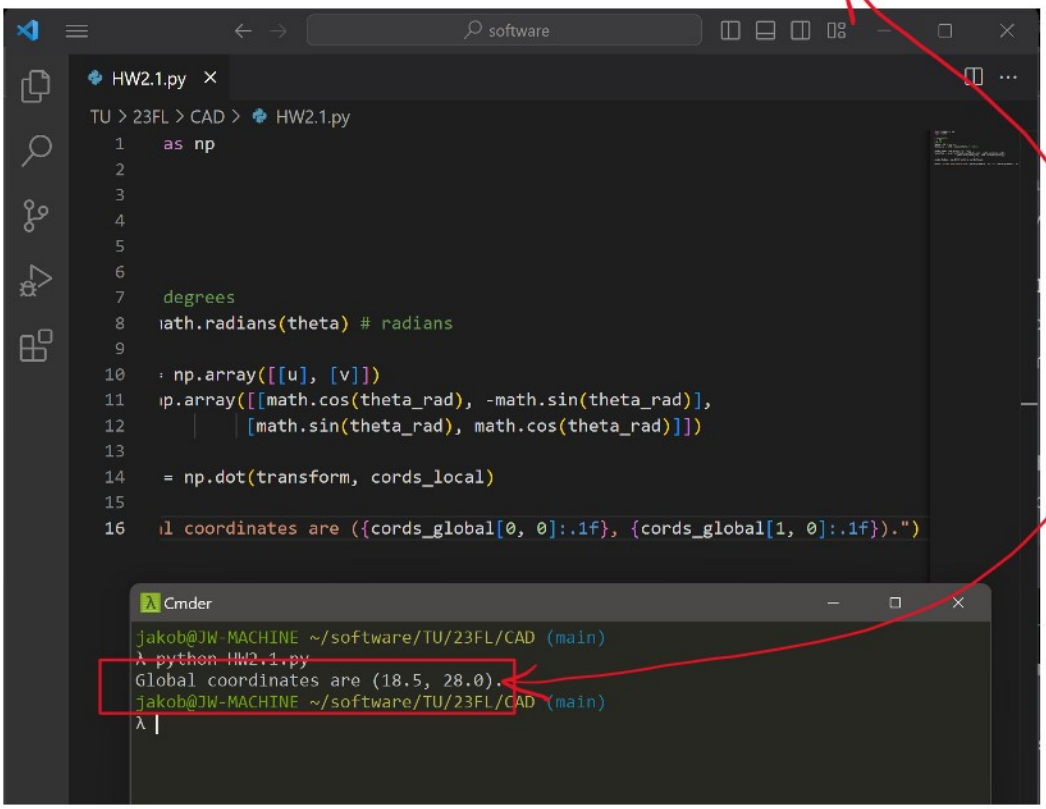


LOCAL → GLOBAL

$$\begin{Bmatrix} i \\ j \end{Bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \begin{Bmatrix} u \\ v \end{Bmatrix}$$

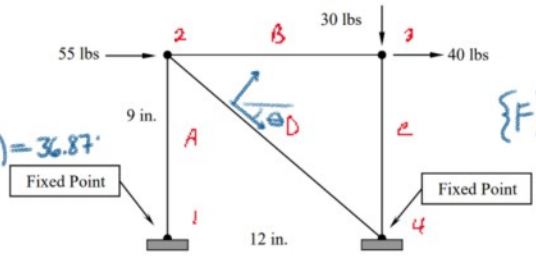
$$\begin{Bmatrix} i \\ j \end{Bmatrix} = \begin{bmatrix} 0.866 & -0.5 \\ 0.5 & 0.866 \end{bmatrix} \begin{Bmatrix} 30 \\ 15 \end{Bmatrix}$$

$(i,j) = (18.5, 20)$ SOLVED W/ PYTHON



2. Given the 2-D truss structure shown below, find the displacements of the nodes, reaction forces, and normal stresses developed in the members. Material steel, diameter ¼ in.

$L_A = 9$ $\theta_A = 90°$
$L_B = 12$ $\theta_B = 0°$
$L_C = 9$ $\theta_C = 90°$
$L_D = 15$ $\theta_D = \tan^{-1}(9/12) = 36.87°$
$F_{2X} = 55$
$F_{3X} = 40$
$F_{3Y} = -30$



$$\{F\} = [K]\{x\} = \frac{EA}{L}\{x\}$$

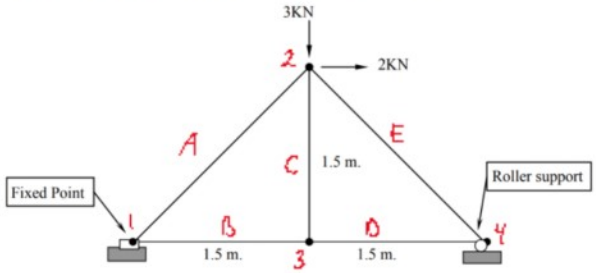
FX1	KA(1,1)	KA(1,2)	KA(1,3)	KA(1,4)	0	0	0	0
FY1	KA(2,1)	KA(2,2)	KA(2,3)	KA(2,4)	0	0	0	0

0
0

FX1		KA(1,1)	KA(1,2)	KA(1,3)	KA(1,4)	0	0	0	0
FY1		KA(2,1)	KA(2,2)	KA(2,3)	KA(2,4)	0	0	0	0
55		KA(3,1)	KA(3,2)	KA(3,3)+KB(1,1)+KD(1,1)	KA(3,4)+KB(1,2)+KD(1,2)	KB(1,3)	KB(1,4)	KD(1,3)	KD(1,4)
0	=	KA(4,1)	KA(4,2)	KA(4,3)+KB(2,1)+KD(2,1)	KA(4,4)+KB(2,2)+KD(2,2)	KB(2,3)	KB(2,4)	KD(2,3)	KD(2,4)
40		0	0	KB(3,1)	KB(3,2)	KB(3,3)+KC(1,1)	KB(3,4)+KC(1,2)	KC(1,3)	KC(1,4)
-30		0	0	KB(4,1)	KB(4,2)	KB(4,3)+KC(2,1)	KB(4,4)+KC(2,2)	KC(2,3)	KC(2,4)
FX4		0	0	KD(3,1)	KD(3,2)	KC(3,1)	KC(3,2)	KC(3,3)+KD(3,3)	KC(3,4)+KD(3,4)
FY4		0	0	KD(4,1)	KD(4,2)	KC(4,1)	KC(4,2)	KC(4,3)+KD(4,3)	KC(4,4)+KD(4,4)

		X1	X2	X3	X4	X5	X6	X7	X8
		x1	y1	x2	y2	x3	y3	x4	y4
1	F1x	AB	AB	A	A	B	B	0	0
2	F1y	AB	AB	A	A	B	B	0	0
3	F2x	A	A	ACE	ACE	C	C	E	E
4	F2y	A	A	ACE	ACE	C	C	E	E
5	F3x	B	B	C	C	BCD	BCD	D	D
6	F3y	B	B	C	C	BCD	BCD	D	D
7	F4x	0	0	E	E	D	D	DE	DE
8	F4y	0	0	E	E	D	D	DE	DE

3. Given the 2-D truss structure shown below, find the displacements of the nodes, reaction forces, and normal stresses developed in the members.



Material: Steel, diameter 50mm.