```
%Brian Trybus 11/2/2021 HM8 Problem 8.1
%
%Demonstrate FEM of a 3 member truss in 6 parts.
%
L = 30;
Le = [1,sqrt(4/3),(sqrt(3)/3)/cosd(30)]*L;
P = 200;
E = 3000;
A = [2, 4, 3];

%Step 1

K1 = rotateElement2d(0)*((E*A(1))/Le(1)) %1 to 4
K2 = rotateElement2d(pi/6)*((E*A(2))/Le(2)) %2 to 4
K3 = rotateElement2d((4*pi/6))*((E*A(3))/Le(3)) %3 to 4

%Step 2
%Find k total

K1e = zeros(8,8);%1 to 4
K1e(1:2,1:2) = K1(1:2,1:2);
K1e(1:2,7:8) = K1(1:2,3:4);
K1e(7:8,1:2) = K1(3:4,1:2);
K1e(7:8,7:8) = K1(3:4,3:4);

K2e = zeros(8,8);%2 to 4
K2e(3:4,3:4) = K2(1:2,1:2);
K2e(3:4,7:8) = K2(1:2,3:4);
K2e(7:8,3:4) = K2(3:4,1:2);
K2e(7:8,7:8) = K2(3:4,3:4);

K3e = zeros(8,8);%3 to 4
K3e(5:6,5:6) = K3(1:2,1:2);
K3e(5:6,7:8) = K3(1:2,3:4);
K3e(7:8,5:6) = K3(3:4,1:2);
K3e(7:8,7:8) = K3(3:4,3:4);

K = K1e+K2e+K3e

%Step 3 Apply Bondry Conditions u = [0,0,0,0,0,0,x,y]'
%F = [?,?,?,?,?,?,0,-P]'

Kr = K(7:8,7:8)

%Step 4 Find Displacement

Fr = [0;-P];

Ur = inv(Kr)*Fr

%Step 5 Find Reactions
```

```
U = [0;0;0;0;0;0;Ur(1);Ur(2)];
F = K*U

%Step 6 Find Internal Forces

F1 = -F(1)

F2 = -sqrt((F(3)^2)+(F(4)^2))

F3 = -sqrt((F(5)^2)+(F(6)^2))


function matrix = rotateElement2d(t)

    matrix = [cos(t)^2,sin(t)*cos(t),-cos(t)^2,-
sin(t)*cos(t);sin(t)*cos(t), sin(t)^2,-sin(t)*cos(t),-sin(t)^2;-
cos(t)^2,-sin(t)*cos(t),cos(t)^2,sin(t)*cos(t);-sin(t)*cos(t), -
sin(t)^2,sin(t)*cos(t),sin(t)^2];

end
```

*K1 =*

```
   200     0  -200     0
     0     0     0     0
  -200     0   200     0
     0     0     0     0
```

*K2 =*

```
  259.8076  150.0000 -259.8076 -150.0000
  150.0000   86.6025 -150.0000  -86.6025
 -259.8076 -150.0000  259.8076  150.0000
 -150.0000  -86.6025  150.0000   86.6025
```

*K3 =*

```
  112.5000 -194.8557 -112.5000  194.8557
 -194.8557  337.5000  194.8557 -337.5000
 -112.5000  194.8557  112.5000 -194.8557
  194.8557 -337.5000 -194.8557  337.5000
```

*K =*

*Columns 1 through 7*

```
  200.0000         0         0         0         0         0 -200.0000
         0         0         0         0         0         0         0
         0         0  259.8076  150.0000         0         0 -259.8076
         0         0  150.0000   86.6025         0         0 -150.0000
```

```
         0         0         0         0  112.5000 -194.8557 -112.5000
         0         0         0         0 -194.8557  337.5000  194.8557
 -200.0000         0 -259.8076 -150.0000 -112.5000  194.8557  572.3076
         0         0 -150.0000  -86.6025  194.8557 -337.5000  -44.8557

  Column 8

         0
         0
 -150.0000
  -86.6025
  194.8557
 -337.5000
  -44.8557
  424.1025


Kr =

  572.3076  -44.8557
  -44.8557  424.1025


Ur =

   -0.0373
   -0.4755


F =

    7.4541
         0
   81.0120
   46.7723
  -88.4661
  153.2277
    0.0000
 -200.0000


F1 =

   -7.4541


F2 =

  -93.5446


F3 =

 -176.9321
```

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