
```

%truss analysis
clearvars;clc;
%input
COORD =[0 0; 10 0; 20 0; 0 12; 10 12; 20 12]; %node coordinate. node 1
        is in center point
CON = [1 2; 2 3; 4 5; 5 6; 1 4; 2 4; 1 5; 2 5; 3 5; 2 6; 3
        6]; %element connecting node
EQ = [10 11; 1 2; 3 12; 4 5; 6 7; 8 9];%each node reaction force.
        Degree of freedom variable p1,p2---p12
NR = 3;%no of support reaction force
NE = size(CON,1);%no of elements
NN = size(COORD,1); %no of nodes
EA = [2 3 3 3 2 2 3 2 3 4 2] '*10^3; %E * A value are different for
        each elements
Pf = [0 0 0 0 0 0 -10 0 0]'; %external load from DOF p1 to p9.
        p10,p11,p12 are fixed point
Ur = [0 0 0]';% P10,P11, P12 are the support reaction

%calculation
%Structural information
NOS = NE+NR-2*NN;%no of static indeterminacy
NOK = 2*NN-NR;%no of kinematic indeterminacy

%length of the elements
L = zeros(NE,1);
for k =1:NE
    i= CON(k,1);%first starting point of local node
    j=CON(k,2);%ending point of local node
    dx=COORD(j,1)-COORD(i,1);
    dy=COORD(j,2)-COORD(i,2);
    L(k) =sqrt(dx^2+dy^2);
end

%degree of freedom variable(p1,p2,----p12)-ID array
ID= zeros(NE,4);
for k = 1:NE
    i= CON(k,1);%first starting point of local node
    j=CON(k,2);%ending point of local node
    ID(k,1:2)=EQ(i,1:2);
    ID(k,3:4)=EQ(j,1:2);
end

%stiffness matrix
NDOF= 2*NN;
K=zeros (NDOF, NDOF);
for k =1:NE
    i=CON(k,1);%first starting point of local node
    j=CON(k,2);%ending point of local node
    dx=COORD(j,1) - COORD(i,1);
    dy=COORD(j,2) - COORD(i,2);

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        a= [-dx/L(k) -dy/L(k) dx/L(k) dy/L(k)];%cos(theta)=dx/
L(k)),sin(theta)=dy/L(k)
        ES = a' .*EA(k)/L(k)*a;
        %assembly of global stiffness matrix
        for m = 1:4
            for n =1:4
                mi =ID(k,m);
                ni = ID(k,n);
                K(mi,ni)= K(mi,ni) + ES(m,n);
            end
        end

    end

    fprintf('Global stiffness matrix K')
    K
    Kff(1:NOK,1:NOK) = K(1:NOK,1:NOK);
    Kfr(1:NOK,1:NDOF-NOK) = K(1:NOK, NOK+1:NDOF);
    Krf=Kfr';
    Krr(1:NDOF-NOK,1:NDOF-NOK) =K(NOK+1:NDOF,NOK+1:NDOF);

    %deformation
    Uf = Kff\Pf;%guess elemination
    fprintf('Deflection in each element')
    U =[Uf;Ur]%deflection
    scale = 10;

    %internal force
    N = zeros(NE,1);
    for k =1:NE
        i=CON(k,1);%first starting point of local node
        j=CON(k,2);%ending point of local node
        dx=COORD(j,1) - COORD(i,1);
        dy=COORD(j,2) - COORD(i,2);
        a= [-dx/L(k) -dy/L(k) dx/L(k) dy/L(k)];%cos(theta)=dx/
L(k)),sin(theta)=dy/L(k)
        u =zeros(4,1);
        for m=1:4
            u(m) = U(ID(k,m));
        end
        N(k) = EA(k)/L(k).*a*u;
    end
    %support reaction
    R=Krf*Uf + Krr*Ur
    %-----
    %Plot structure
    fl=figure();
    NCOORD = zeros(size(COORD));%deformed co-ordinate generation through
    zero matrix
    scale = 10;
    for n =1:NN
        NCOORD(n,1) = COORD(n,1) +scale*U(EQ(n,1));
        NCOORD(n,2) = COORD(n,2) +scale*U(EQ(n,2));
    end

```

```

for k =1:NE
    i=CON(k,1);%first starting point of local node
    j=CON(k,2);%ending point of local node
    x=[COORD(i,1) COORD(j,1)];
    y=[COORD(i,2) COORD(j,2)];
    xlim([-1 21]);
    ylim([-1 13]);
    plot(x,y,'k-');
    hold on
    ux=[NCOORD(i,1) NCOORD(j,1)];
    uy=[NCOORD(i,2) NCOORD(j,2)];
    xlim([-1 21]);
    ylim([-1 13]);
    plot(ux,uy,'r--');
    hold on
end

Global stiffness matrix K
K =

Columns 1 through 7

    657.4224    62.9690 -300.0000   -52.4741    62.9690         0         0
    62.9690   393.3549         0    62.9690   -75.5627         0 -166.6667
 -300.0000         0   378.7112         0         0   -78.7112    94.4534
   -52.4741    62.9690         0   352.4741   -62.9690 -300.0000         0
    62.9690   -75.5627         0   -62.9690   242.2294         0         0
         0         0   -78.7112 -300.0000         0   757.4224         0
         0 -166.6667    94.4534         0         0         0   393.3549
 -104.9483 -125.9379         0         0         0 -300.0000         0
 -125.9379 -151.1255         0         0         0         0         0
 -200.0000         0         0         0         0   -78.7112   -94.4534
         0         0         0         0 -166.6667   -94.4534 -113.3441
         0         0   -94.4534         0         0    94.4534 -113.3441

Columns 8 through 12

 -104.9483 -125.9379 -200.0000         0         0
 -125.9379 -151.1255         0         0         0
         0         0         0         0   -94.4534
         0         0         0         0         0
         0         0         0 -166.6667         0
 -300.0000         0   -78.7112   -94.4534    94.4534
         0         0   -94.4534 -113.3441 -113.3441
    404.9483   125.9379         0         0         0
    125.9379   317.7922         0         0 -166.6667
         0         0   278.7112    94.4534         0
         0         0    94.4534   280.0108         0
         0 -166.6667         0         0   280.0108

Deflection in each element
U =

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```

0.0153
-0.0253
0.0251
0.0153
-0.0079
0.0116
-0.0422
0.0075
-0.0089
0
0
0

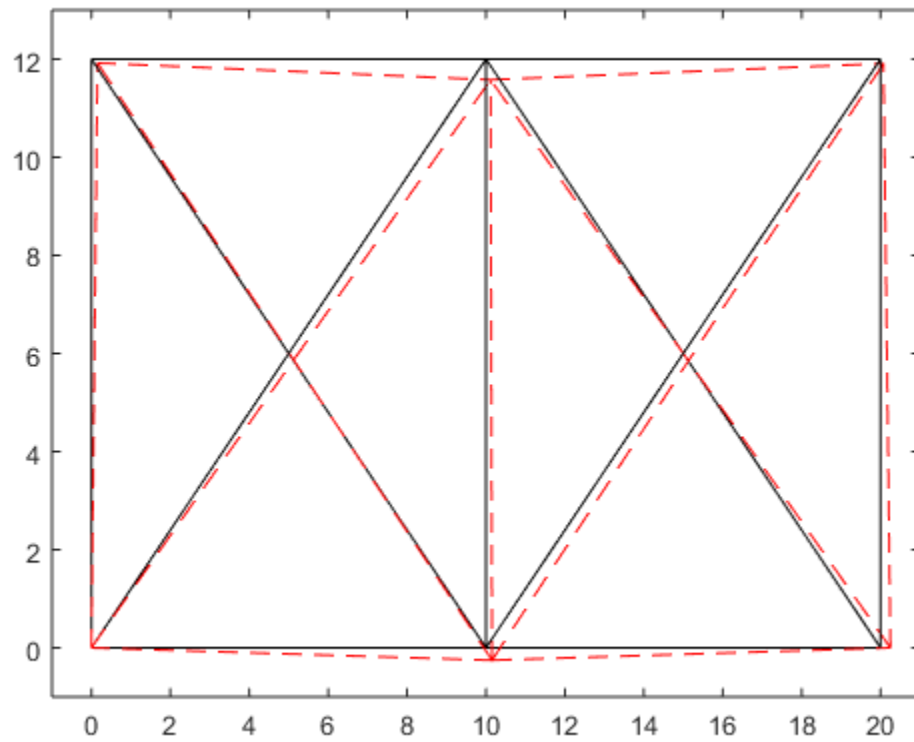
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$R =$

```

0.0000
5.0000
5.0000

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