Assignment 8
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Question 3

```
K =

   1.0e+08 *

    4.4457    1.9819   -3.2644   -0.5408   -1.8409   -1.7344    0.6596    0.2933
    1.9819    5.3402   -1.2139   -0.0694   -1.7344   -3.0337    0.9664   -2.2372
   -3.2644   -1.2139    4.5821   -1.1373    1.2607    1.0235   -2.5784    1.3276
   -0.5408   -0.0694   -1.1373    2.6422    0.3504   -1.7049    1.3276   -0.8679
   -1.8409   -1.7344    1.2607    0.3504    3.6442    1.9058   -3.0641   -0.5218
   -1.7344   -3.0337    1.0235   -1.7049    1.9058    4.6305   -1.1948    0.1080
    0.6596    0.9664   -2.5784    1.3276   -3.0641   -1.1948    4.9828   -1.0992
    0.2933   -2.2372    1.3276   -0.8679   -0.5218    0.1080   -1.0992    2.9970

displacement =

    0.0026
   -0.0007
    0.0017
    0.0011
```

m

```
ReactionForce =

   1.0e+05 *

   -2.2160
   -3.3333
   -0.2840
    3.3333
    2.5000
    0.0000
   -0.0000
         0
```

N

The fixed boundary nodes have less displacement compared to further away, with the applied loads creating larger displacements in the regions away from the fixed nodes, which is seen in the reaction forces. Therefore, this is expected to be an actual structure.

Code:

```
CordMat=[0.2 0.8 0.6 0; 0 0 0.8 0.6];
E=7*10^10;
v=0.3;

syms zeta eta

%Plain Strain
m=E/((1+v)*(1-(2*v)));


%Shape Functions
N1= (0.25)*(1-zeta)*(1-eta);
N2=(0.25)*(1+zeta)*(1-eta);
N3= (0.25)*(1+zeta)*(1+eta);
N4= (0.25)*(1-zeta)*(1+eta);

J = 0.25*[eta-1 1-eta 1+eta -1-eta; zeta-1 -1-zeta 1+zeta 1-zeta]*[transpose(CordMat)];

D= m.*[1-v v 0 ; v 1-v 0; 0 0 (1-(2*v))/2];
te=0.01;

Hstar= inv(J)*[diff(N1,zeta) diff(N2,zeta) diff(N3,zeta) diff(N4,zeta); diff(N1,eta) diff(N2,eta) diff(N3,eta) diff(N4,eta)];

H= [Hstar(1,1) 0 Hstar(1,2) 0 Hstar(1,3) 0 Hstar(1,4) 0; 0 Hstar(2,1) 0 Hstar(2,2) 0 Hstar(2,3) 0 Hstar(2,4); Hstar(2,1) Hstar(1,1) Hstar(2,2) Hstar(1,2) Hstar(2,3) Hstar(1,3) Hstar(2,4) Hstar(1,4)];

Kstar= transpose(H)*D*H;

gp = [-0.577 0.577];
weight = [1 1];
%n_gp = [-0.7745966692 0 0.7745966692];
%wts = [0.5555555556 0.8888888889 0.5555555556];

fin_K = zeros(size(Kstar));
for i =1:length(gp)
    for j = 1:length(gp)
        zeta = gp(i);
        wt_z = weight(i);

        eta = gp(j);
        wt_e = weight(j);

        fin_K = fin_K + wt_z*wt_e*subs(Kstar*det(J));
    end
end

K = te*double(fin_K)

F= transpose([0 0 0 0 250*10^3 0 0 0]);

kboundcond=K(5:8,5:8);
F=F(5:8);

displacement=kboundcond\F

ReactionForce=K*[0 0 0 0 displacement']'
```