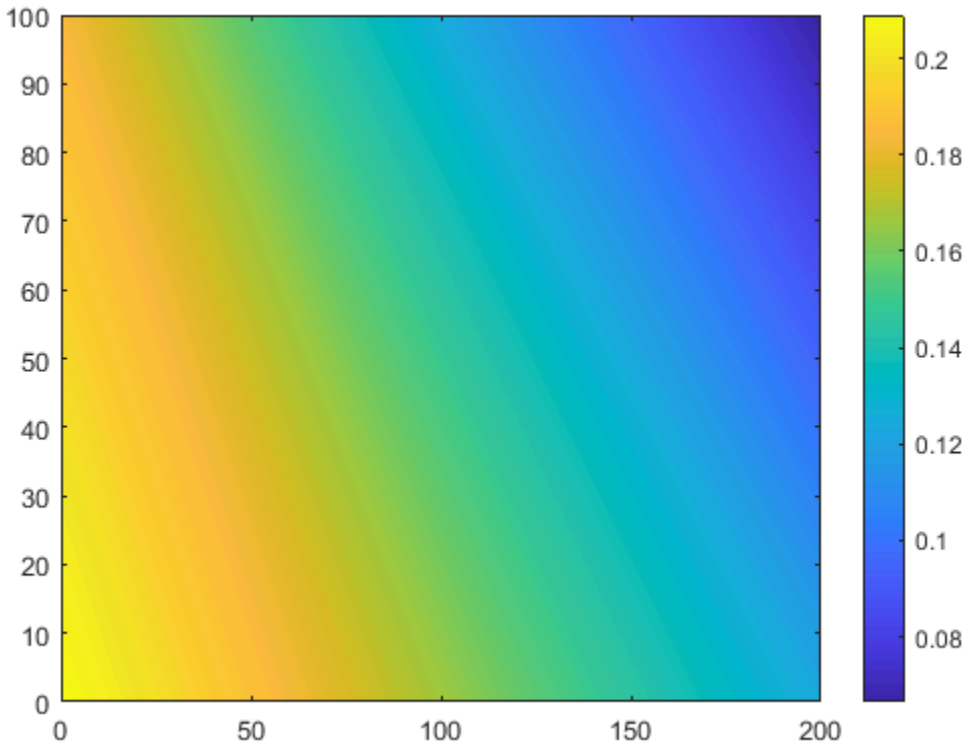
```
% Assignment-4 Q-1
clear

% [ all units in GPa, mm, KN]

ele_X_coord = [0 200 200 0];
ele_Y_coord = [0 0 100 100];

ele_nodes = [1 2 3 4];

KE = stiffness(ele_X_coord,ele_Y_coord);

F = sparse(8,1); U = zeros(8,1);

% DEFINE LOADS AND SUPPORTS (HALF MBB-BEAM)
F(5) = 10/sqrt(2);
F(6) = 10/sqrt(2);
fixeddofs   = [1 2 7 8];
alldofs     = 1:8;
freedofs    = setdiff(alldofs,fixeddofs);
% SOLVING
U(freedofs,:) = KE(freedofs,freedofs) \ F(freedofs,:);
U(fixeddofs,:)= 0;

stress_vm = stress(ele_X_coord,ele_Y_coord,U);

contourf([0,200;0,200], [0 0;100 100],[stress_vm(1) stress_vm(2);stress_vm(3)
 stress_vm(4)],100,'edgecolor', 'none')
colorbar()
function stress_vm = stress(X,Y,Q)
E = 120; % [GPa]
nu = 0.25;
D = (E/((1+nu)*(1-2*nu)))*[1-nu nu 0; nu 1-nu 0;0 0 0.5-nu];
coord = [X',Y'];
stress_temp = [];
for i = 1:2
for j = 1:2
eta = (2*i-3)/sqrt(3);
zeta = (2*j-3)/sqrt(3);
J = (1/4)*[eta-1 1-eta 1+eta -eta-1; zeta-1 -zeta-1 1+zeta 1-zeta]*coord;
H = (1/4)*[eta-1 1-eta 1+eta -eta-1; zeta-1 -zeta-1 1+zeta 1-zeta];
H = J\H;
H = [H(1,1) 0 H(1,2) 0 H(1,3) 0 H(1,4) 0; 0 H(2,1) 0 H(2,2) 0 H(2,3) 0 H(2,4);
 H(2,1) H(1,1) H(2,2) H(1,2) H(2,3) H(1,3) H(2,4) H(1,4)];
stress_temp = [stress_temp D*H*Q]; % Sigma XX, Sigma YY, Sigma XY
end
end
stress_xx = stress_temp(1,:);
stress_yy = stress_temp(2,:);
stress_xy = stress_temp(3,:);
stress_vm = sqrt(stress_xx.^2 + stress_yy.^2 + 3*stress_xy.^2 -
 stress_xx.*stress_yy);
```

```
end

function K = stiffness(X,Y)
E = 120; % [in GPa]
nu = 0.25;
D = (E/((1+nu)*(1-2*nu)))*[1-nu nu 0; nu 1-nu 0;0 0 0.5-nu];
coord = [X',Y'];
K = zeros(8,8);
for i = 1:2
for j = 1:2
eta = (2*i-3)/sqrt(3);
zeta = (2*j-3)/sqrt(3);
J = (1/4)*[eta-1 1-eta 1+eta -eta-1; zeta-1 -zeta-1 1+zeta 1-zeta]*coord;
H = (1/4)*[eta-1 1-eta 1+eta -eta-1; zeta-1 -zeta-1 1+zeta 1-zeta];
H = J\H;
H = [H(1,1) 0 H(1,2) 0 H(1,3) 0 H(1,4) 0; 0 H(2,1) 0 H(2,2) 0 H(2,3) 0 H(2,4);
 H(2,1) H(1,1) H(2,2) H(1,2) H(2,3) H(1,3) H(2,4) H(1,4)];
K = K + det(J)*H'*D*H;
end
end
end
```



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