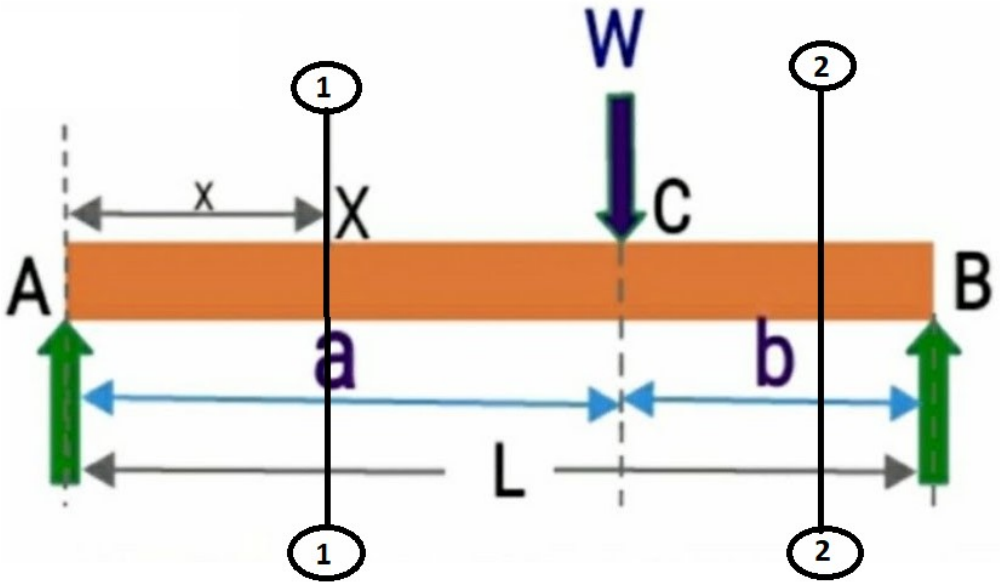


$$Recation\ force\ at\ A = R_A = \frac{Wb}{L}; \quad Recation\ force\ at\ B = R_A = \frac{Wa}{L}$$

Consider only left side part of section $1-1$ *and take moment with respect to section* $1-1$

$$\boldsymbol{M_1(x) = R_A x} \qquad \boldsymbol{for\ \ 0 \le x \le a}$$

Consider only left side part of section $2-2$ *and take moment with respect to section* $2-2$

$$\boldsymbol{M_2(x) = R_A x - W(x-a)} \qquad \boldsymbol{for\ \ a \le x \le L}$$

$$EI\frac{d^2y}{dx^2} = M(x)$$

$$slope(x) = \frac{dy}{dx} = \frac{1}{EI}\int M(x)$$

$$deflection(x) = y(x) = \frac{1}{EI}\iint M(x)$$

Conditions to evaluate contants during integration

$at\ x = 0\ , y = 0\ ;\quad at\ x = L, y = 0;$

slope at $x = a$ *obtained from* $\boldsymbol{M_1(x)}$ *and* $\boldsymbol{M_2(x)}$ *is* $\boldsymbol{slope\_a}$

MATLAB code for simply supported beam with point load 'W' at a distance 'a' from extreme left side of beam

(a) To draw Shear Force, Bending Moment, slope and deflection diagrams
(b) To find out location of maximum deflection and its value

Input parameters:

E=Youngs Modulus or Modulus of elasticity in Pascals or N/m^2
I=Area moment of inertia in m^4
L=Length of beam in meters
W=Intensity of point load W in Newton
a= Location of Point load from Extreme Left side of Beam in meter

MATLAB code:

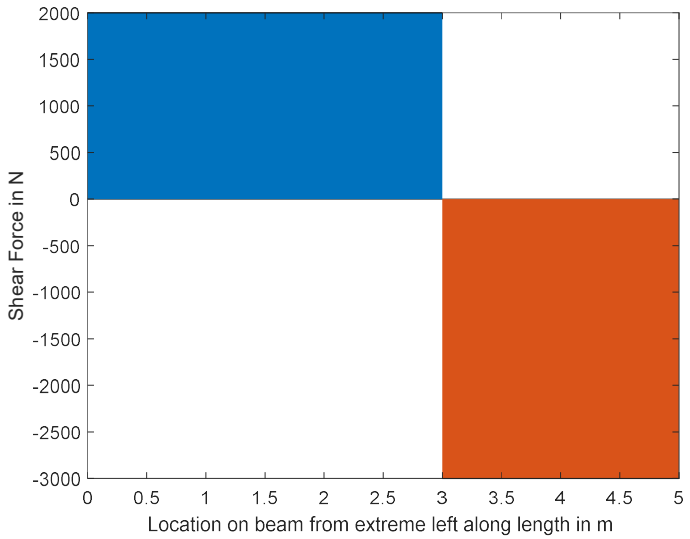
```
clear all;
clc;
E=input('Youngs Modulus or Modulus of elasticity in Pascals \n E=')
I=input('Area moment of inertia in m^4\n I=')
L=input('Length of beam in meters \n L=')
W=input('Intensity of point load W in Newton \n W=')
a=input('Location of Point load from Extreme Left side of Beam in meters \n a=')
b=L-a;
Ra=(W*(L-a))/L;
Rb=(W*(a))/L;
syms x Dy(x) M1(x) M2(x)  deflection1(x) deflection2(x);
```

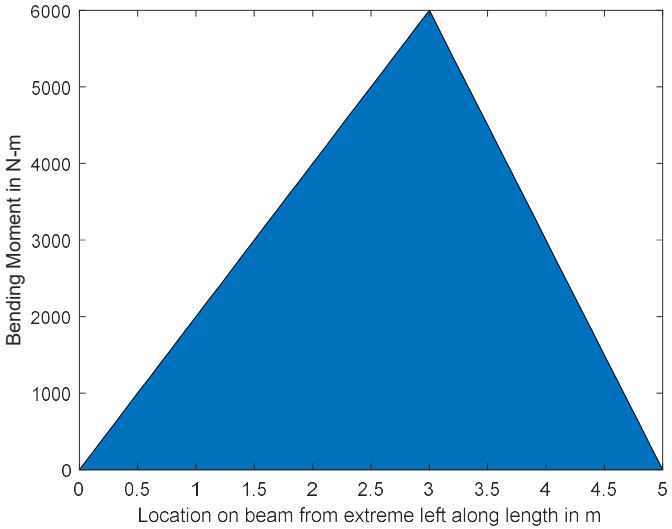
```
syms C2 C3 C4 C5 slope_a;
syms slope(x) slope1(x) slope2(x);
M2(x)=(Ra*x)-(W*(x-a));
M1(x)=Ra*x;
SF1(x)=diff(M1(x),x);
SF2(x)=diff(M2(x),x);
format long;
%first section
deflection1(x,C2,C3)=((int(int(M1(x),x),x))+(C2*x)+C3)/(E*I);
D1y(x,C2,C3)=diff(deflection1,x);
eq2 =deflection1(0,C2,C3) == 0;
eq3 =D1y(a,C2,C3) == slope_a;
C3=eval(vpasolve(eq2,C3));
C2=eval(vpasolve(eq3,C2));
deflection1(x,slope_a)=deflection1(x,C2,C3);
%second section
deflection2(x,C4,C5)=((int(int(M2,x),x))+(C4*x)+C5)/(E*I);
D2y(x,C4,C5)=diff(deflection2,x);
eq2=D2y(a,C4,C5)==slope_a;
eq3=deflection2(L,C4,C5)==0;
C4=eval(vpasolve(eq2,C4));
C5=eval(vpasolve(eq3,C5));
deflection2(x,slope_a)=deflection2(x,C4,C5);
% Evaluating slope at load point slope_a
eq=deflection1(a,slope_a)==deflection2(a,slope_a);
slope_a=eval(vpasolve(eq,slope_a));
% deflection and slope equations for section-1 and section-2
deflection1(x)=deflection1(x,slope_a);
deflection2(x)=deflection2(x,slope_a);
slope1(x)=diff(deflection1(x),x);
slope2(x)=diff(deflection2(x),x);
%Defining BM,deflection and slope equations of beam using piecewise functions
BM(x)=piecewise(x<=a,M1(x),(x>a & x<=L),M2(x));
```

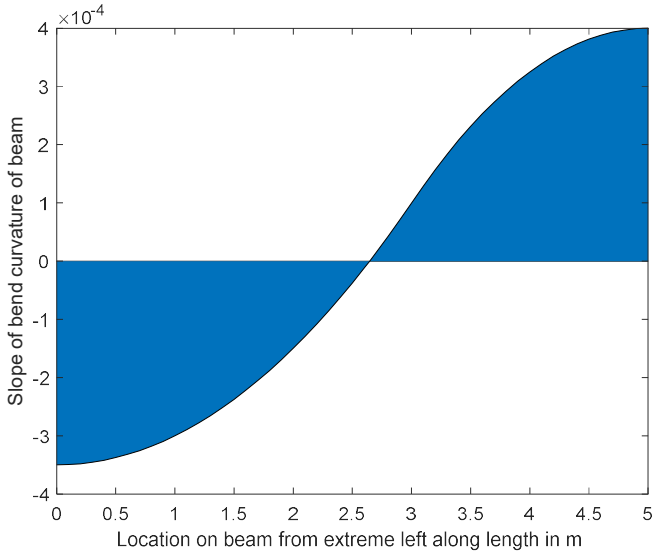
```
deflection(x)=piecewise(x<=a,deflection1(x),(x>=a & x<=L),deflection2(x));
slope(x)=piecewise(x<=a,slope1(x),(x>=a & x<=L),slope2(x));

X=0:0.1:L;
% Plotting Shearforce Diagram
X1=0:0.1:a;
X2=a:0.1:L;
figure
area(X1,double(SF1(X1)))
hold on
area(X2,double(SF2(X2)))
ylabel('Shear Force in N');
xlabel('Location on beam from extreme left along length in m');
figure
area(X,double(BM(X)))
ylabel('Bending Moment in N-m');
xlabel('Location on beam from extreme left along length in m');
figure
area(X,double(slope(X)))
ylabel('Slope of bend curvature of beam');
xlabel('Location on beam from extreme left along length in m');
figure
plot(X,double(deflection(X)))
ylabel('Deflection in m');
xlabel('Location on beam from extreme left along length in m');

if a>b
    Def_max_loc=vpasolve(diff(deflection1(x),x)==0,x,[0,a]);
    Def_max_loc=eval(Def_max_loc);
    max_def=double(deflection1(Def_max_loc))*1000;
elseif a<b
    Def_max_loc=vpasolve(diff(deflection2(x),x)==0,x,[0,a]);
    Def_max_loc=eval(Def_max_loc);
```

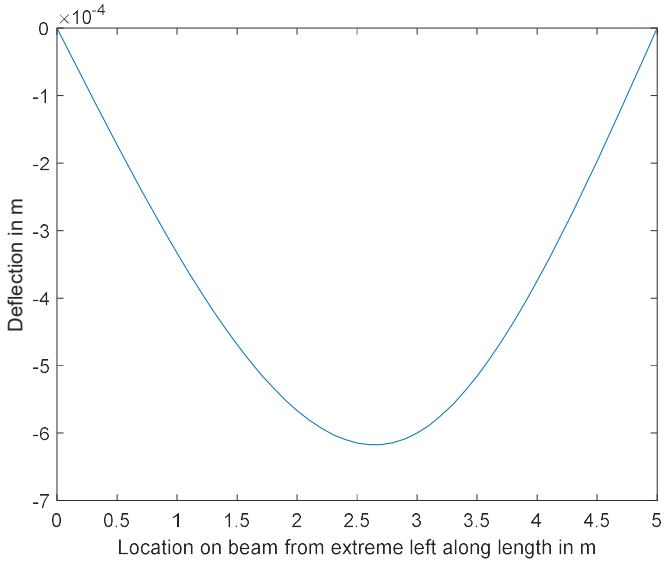
```
    max_def=double(deflection2(Def_max_loc))*1000;
elseif a==b
    Def_max_loc=L/2;
    max_def=double(deflection1(Def_max_loc))*1000;
end
fprintf('Maximum deflection is at %f from extreme left side of beam
\n',Def_max_loc)
fprintf('Maximum deflection is %f mm \n',max_def)
```

OUTPUT :









Maximum deflection is at 2.645751 from extreme left side of beam

Maximum deflection is -0.617342 mm