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import numpy as np

L=12#length of beam in meters

w=10#intensity of load in KN/m

#Question a

#Bending moment(M) and shear force(V) at the first end ,x=0

x=0

M=(w\*(-6\*x\*\*2+6\*L\*x-L\*\*2))/12

V=w(L/2-x)

m='The bending moment at x=0 is'

n='The shear force at x=0 is'

print()

print('(a.1)'+ m + str(M)+'and',n + str(V))

#Bending moment(M) and shear force(V)at the last end,x=L=10

x=L

M=(w\*(-6\*x\*\*2+6\*L\*x-L\*\*2))/12

V=w\*(L/2-x)

a='The bending moment at x=L is'

b='The shear force at x=L is'

print()

print('(a.2)'+ m + str(M)+'and',n + str(V))

#Question b

#When the bending moment is zero,we get an expression,x\*\*2-L\*x+L\*\*2/6=0

#from the expression

a=1

b=-L

c=L\*\*2/6

#Using the completing the squares method,(x\*\*2-L\*x+(-L/2\*\*2))=((l\*\*2/6)+(-L/2\*\*2))

root\_1b = ("L/2+np.sqrt (5L\*\*3/12)")

root\_2b = ("L/2-np.sqrt (5L\*\*3/12)")

print()

print('(b) The points of contra-flexure are {0} and {1}'.format(root\_1b,root\_2b))

#Question c

#When the shear force is zero,x=L/2

print()

print('(c) The point at which V=0 is {}'.format(x))

#Question d

j=0

l=0.01

k=L+l

x=np.arange(j,k,l)

M=(w\*(-6\*x\*\*2+6\*L\*x-L\*\*2))/12

print()

print('(d)Using the initialized variable, the bending moment at each step in the array is {0}'.format(M))

#Question e

V=w\*(L/2-x)

print()

print('(e) The shear force for each step is {}'.format(V))

#Question f

""

#Let the absolute value of the bending moment array be AM

#Also let the minimum AM be m\_AM

""

#When the bending moment is m\_AM,we get an expression x\*\*2-L\*x+(L\*\*2/6)+(2\*m\_AM)/W=0

""

#from the above expression

a=1

b=-L

c="(L\*\*2/6)+(2\*m\_AM)/w"

#Using the completing the squares formula the two roots are;

root\_1f="(L/2+np.sqrt(5L\*\*3/12))"

root\_2f="(L/2-np.sqrt(5L\*\*3/12))"

print()

print('(f) The points along L at which the absolute values of the bending moment array is minimum are {0} and {1}'.format(root\_1f,root\_2f))

#Question g

""

#Let the relative errors be r\_e

""

r\_e1=((root\_1b-root\_1f)/root\_1b\*100)

r\_e2=((root\_2f-root\_2b)/root\_2f\*100)

print()

print('(g)The relative errors between estimated points of a contra-flexure are {0}% and {1}%'.format(r\_e1,r\_e2))

#Question h

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#Let the maximum bending moment be max\_M and the minimum bending moment be min\_M

""

#for the maximum

max\_M=max(M)

""

#When the bending is max\_M,we get an expression x\*\*2-L\*x+(L\*\*2/6)+(2\*max\_M)/w=0

""

a=1

b=-L

c="(L\*\*2/6)+(2\*min\_M)/w"

#Using the completing the squares method the two roots are;

root\_1="(L/2+np.sqrt(5L\*\*3/12))"

root\_2="(L/2-np.sqrt(5L\*\*3/12))"

print()

print('(h.1)The points at which the maximum bending moment occur are {0} and {1}'.format(root\_1,root\_2))

#for the minimum

min\_M=min(M)

""

#When the bending moment is min\_M,we get an expression x\*\*2-L\*x+(L\*\*2/6)+(2\*min\_M)/w=0

""

a=1

b=-L

c=(L\*\*2/6)+(2\*min\_M)/w

#Using the completing the squares method the two roots are;

"root\_1=(L/2+np.sqrt(5L\*\*3/12))"

"root\_2=(L/2-np.sqrt(5L\*\*3/12))"

print()

print("The points {0} and {1} are where bending moment is minimum".format(root\_1,root\_2))