Term Project

June 16, 2020

[7]:
```
import pandas as pd
df = pd.read_fwf('TermProject.tex')
df.to_csv('TermProject.csv')
```

[75]:
```
df1 = pd.read_csv('TermProject.csv')
df1
```

[75]:

	0	Goup_No	Ramp_Weight(kN)	Ball_Weight(kN)	Impact_time(sec)	h1(m)	\
0	1	1	70	10	0.1	10	
1	2	2	80	15	0.2	11	
2	3	3	90	20	0.1	12	
3	4	4	100	25	0.3	13	
4	5	5	70	30	0.1	13	
5	6	6	80	35	0.3	12	
6	7	8	90	30	0.1	11	
7	8	9	100	25	0.3	10	
8	9	10	70	20	0.1	9	
9	10	11	60	25	0.2	8	
10	11	12	65	35	0.3	7	
11	12	13	55	45	0.2	8	
12	13	14	75	35	0.3	8	
13	14	15	85	25	0.2	10	

	h2(m)	L1(m)	L2(m)	r(cm)	a(cm)	t(cm)
0	1.0	11	2.75	10	40	1
1	1.5	12	3.00	12	20	2
2	2.0	13	3.25	14	30	1
3	2.5	14	3.50	16	20	2
4	2.0	10	2.50	14	40	1
5	1.5	11	2.75	12	30	2
6	1.0	12	3.00	10	20	1
7	1.5	13	3.25	12	30	2
8	2.0	14	3.50	14	20	1
9	2.5	12	3.10	13	30	2
10	2.3	13	3.20	13	20	1
11	2.4	12	3.30	12	30	2
12	2.2	13	3.40	12	20	1

```
13    2.1     12   3.20     11     30      2
```

[76]:
```
data = df1.loc[7]
data
```

[76]:
```
0                     8.00
Goup_No               9.00
Ramp_Weight(kN)     100.00
Ball_Weight(kN)      25.00
Impact_time(sec)      0.30
h1(m)                10.00
h2(m)                 1.50
L1(m)                13.00
L2(m)                 3.25
r(cm)                12.00
a(cm)                30.00
t(cm)                 2.00
Name: 7, dtype: float64
```

[296]:
```
#if the load is distributed equally
F = data['Ramp_Weight(kN)']/4
F1 = F + data['Ball_Weight(kN)']
print('Equal Force:',F)
print('Force at the first point:',F1)
```

```
Equal Force: 25.0
Force at the first point: 50.0
```

[298]:
```
#suport reaction of roller
from sympy import symbols,solve
By_1 = symbols ('By_1')
Eqn01 =␣
 ↪(F*data['L2(m)'])+(F*data['L2(m)']*3)+(F*data['L1(m)'])-(By_1*data['L1(m)'])
By_1 = solve(Eqn01)
print(By_1)
```

```
[50.0000000000000]
```

[299]:
```
#suport reaction of pinned
from sympy import symbols,solve
Ay_1 = symbols ('Ay_1')
Eqn01 =␣
 ↪(F*data['L2(m)'])+(F*data['L2(m)']*3)+(F1*data['L1(m)'])-(Ay_1*data['L1(m)'])
Ay_1 = solve(Eqn01)
print(Ay_1)
```

```
[75.0000000000000]
```

[300]:
```
#vertical force
Ax = 0
```

[301]:
```
#convert cm to m
r = data['r(cm)']/100
a = data['a(cm)']/100
t = data['t(cm)']/100
b = a/2
```

[302]:
```
#finding the heights in the range
import numpy as np
h2=[]
for i in np.arange(data['h2(m)'],16*data['h2(m)']/5,data['h2(m)']/5):
    h2.append(i)
print(h2)
```

```
[1.5, 1.8, 2.1, 2.4000000000000004, 2.7, 3.0, 3.3000000000000003,
3.6000000000000005, 3.9000000000000004, 4.2, 4.5]
```

[303]:
```
df['h2']= pd.Series(h2)
df['h2'].dropna()
```

[303]:
```
0     1.5
1     1.8
2     2.1
3     2.4
4     2.7
5     3.0
6     3.3
7     3.6
8     3.9
9     4.2
10    4.5
Name: h2, dtype: float64
```

[304]:
```
#moment of I column
MI_x = ((b*(a**3))-((b-t)*(a-2*t)**3))/12
MI_y = ((2*t*(b**3))+(a-2*t)*t**3)/12
M1 = MI_x + MI_y
print(M1)
```

```
0.00015851666666666654
```

[319]:
```
#Moment of column I relative to the ground
MI = M1*(df['h2'].dropna()/a)*(r/t)
print(MI)
```

```
0     0.004755
1     0.005707
```

```
2     0.006658
3     0.007609
4     0.008560
5     0.009511
6     0.010462
7     0.011413
8     0.012364
9     0.013315
10    0.014266
Name: h2, dtype: float64
```

[306]:
```
# Horizontal force of I column
for i in df['h2'].dropna():
    i = Ax
df['Ix'] = i
df['Ix']
```

[306]:
```
0     0
1     0
2     0
3     0
4     0
5     0
6     0
7     0
8     0
9     0
10    0
11    0
12    0
13    0
14    0
Name: Ix, dtype: int64
```

[307]:
```
# vertical force of I column
for j in df['h2'].dropna():
    j = Ay_1
df['Iy'] = pd.Series(j)
df['Iy'].fillna(75.0000000000000)
```

[307]:
```
0     75.0000000000000
1                   75
2                   75
3                   75
4                   75
5                   75
6                   75
7                   75
8                   75
```

```
9                    75
10                   75
11                   75
12                   75
13                   75
14                   75
Name: Iy, dtype: object
```

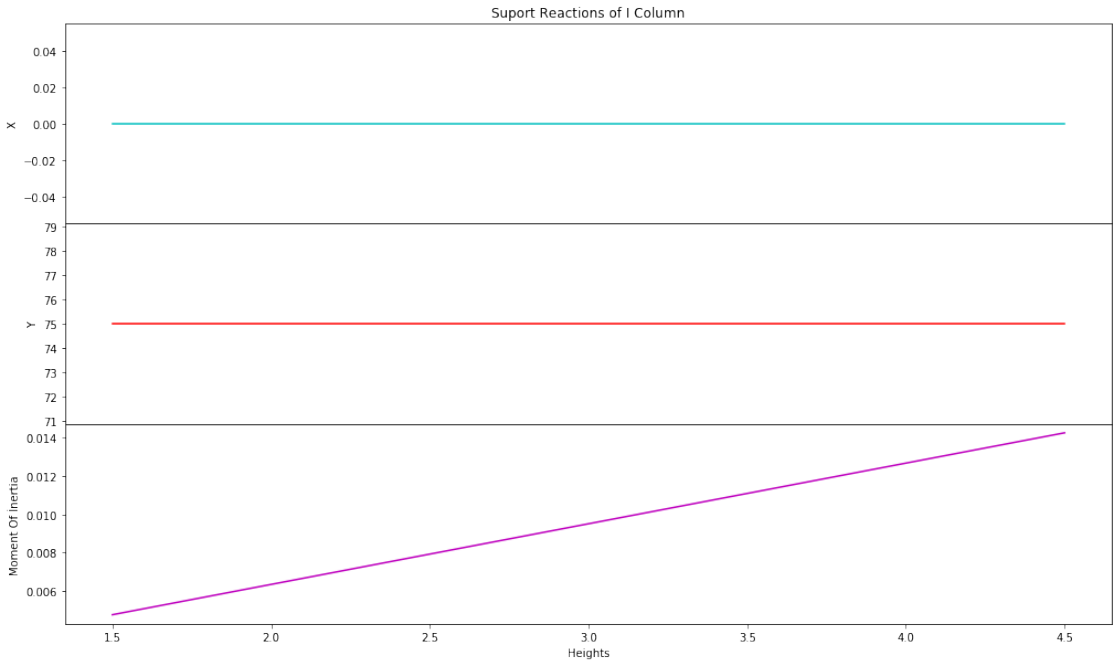
[321]:
```
import matplotlib.pyplot as plt
import matplotlib

fig=plt.figure(figsize=(17,10))
fig.subplots_adjust(hspace=0)

plt.subplot(3, 1, 1)
plt.plot(df['Ix'], '-',color='c')
plt.title('Suport Reactions of I Column')
plt.ylabel('X')

plt.subplot(3, 1, 2)
plt.plot(df['Iy'].fillna(75) , '-',color='r')
plt.ylabel('Y')

plt.subplot(3, 1, 3)
plt.plot(h2, MI, '-',color='m')
plt.ylabel('Moment Of nertia')
plt.xlabel('Heights')
plt.show()
```



[309]:
```
#moment of box section column
MB_x = ((b*a**3)-(b-2*t)*(a-2*t)**3)/12
MB_y = ((a*b**3)-(b-2*t)**3*(a-2*t))/12
M2 = MB_x + MB_y
print(M2)
```

```
0.00023192333333333325
```

[320]:
```
#Moment of column box section column
MB = M2*(df['h2'].dropna()/a)*(r/t)
print(MB)
```

```
0     0.006958
1     0.008349
2     0.009741
3     0.011132
4     0.012524
5     0.013915
6     0.015307
7     0.016698
8     0.018090
9     0.019482
10    0.020873
Name: h2, dtype: float64
```

[317]:
```
# Horizontal force of box section column
for k in df['h2'].dropna():
    k = Ax
df['Bx'] = k
```

[317]:
```
0     0
1     0
2     0
3     0
4     0
5     0
6     0
7     0
8     0
9     0
10    0
11    0
12    0
13    0
14    0
```

```
Name: Bx, dtype: int64
```

[344]:
```
# vertical force of box section column
for l in df['h2'].dropna():
    l = By_1
df['By'] = pd.Series(l)
df['By'].fillna(50.0000000000000)
```

[344]:
```
0     50.0000000000000
1                   50
2                   50
3                   50
4                   50
5                   50
6                   50
7                   50
8                   50
9                   50
10                  50
11                  50
12                  50
13                  50
14                  50
Name: By, dtype: object
```

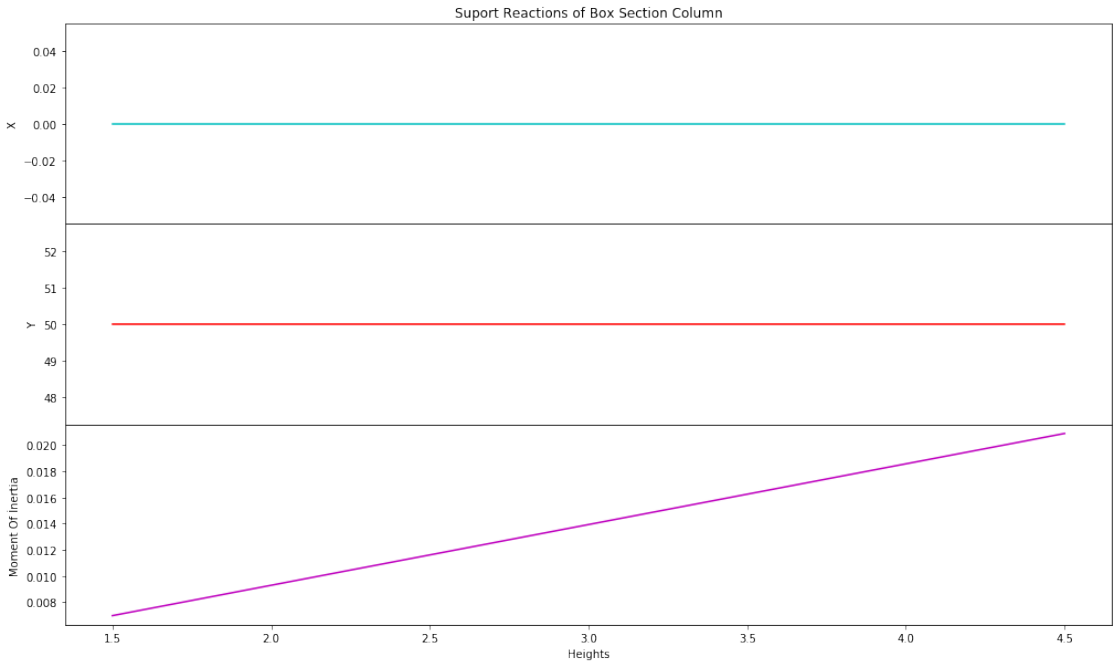
[322]:
```
import matplotlib.pyplot as plt
import matplotlib

fig=plt.figure(figsize=(17,10))
fig.subplots_adjust(hspace=0)

plt.subplot(3, 1, 1)
plt.plot(df['Bx'], '-',color='c')
plt.title('Suport Reactions of Box Section Column')
plt.ylabel('X')

plt.subplot(3, 1, 2)
plt.plot(df['By'].fillna(50.0000000000000), '-',color='r')
plt.ylabel('Y')

plt.subplot(3, 1, 3)
plt.plot(h2, MB, '-',color='m')
plt.ylabel('Moment Of nertia')
plt.xlabel('Heights')
plt.show()
```



[217]:
```
# 1/2*m*v*2+1/2*I*w*2=m*g*h
# I=2/5*m*r**2
#We do the necessary simplifications.

g = 9.81 # m/s**2
import math
v=math.sqrt(10*g*data['h1(m)']/7)
v
```

[217]:
```
11.838194843085544
```

[218]:
```
#moment created by the ball

M = data['Ball_Weight(kN)'] / g * v
M
```

[218]:
```
30.16869226066652
```

[329]:
```
#horizontal force generated by the ball
# F*t = m*v

F2 = M/data['Impact_time(sec)']
F2
```

[329]:
```
100.56230753555508
```

[323]:
```
#new support reaction of roller

M_a = 0
```

```
By_2 = (25 * data['L2(m)'] + 25 *3*data['L2(m)'] + 25 *data['L1(m)'] + M)/
 ↪data['L1(m)']
By_2
```

[323]: 52.32066863543589

[324]:
```
#new support reaction of pinned

Ay_2 = (50* data['L1(m)'] + 25 *3*data['L2(m)']+25*data['L2(m)'] - M)/
 ↪data['L1(m)']
Ay_2
```

[324]: 72.67933136456412

[330]:
```
# New  horizontal force of I column
for m in df['h2'].dropna():
    m = F2/2
df['Ix_2'] = m
df['Ix_2']
```

[330]:
```
0     50.281154
1     50.281154
2     50.281154
3     50.281154
4     50.281154
5     50.281154
6     50.281154
7     50.281154
8     50.281154
9     50.281154
10    50.281154
11    50.281154
12    50.281154
13    50.281154
14    50.281154
Name: Ix_2, dtype: float64
```

[331]:
```
# New vertical force of I column
for n in df['h2'].dropna():
    n = Ay_2
df['Iy_2'] = n
df['Iy_2']
```

[331]:
```
0     72.679331
1     72.679331
2     72.679331
3     72.679331
4     72.679331
5     72.679331
6     72.679331
```

```
7     72.679331
8     72.679331
9     72.679331
10    72.679331
11    72.679331
12    72.679331
13    72.679331
14    72.679331
Name: Iy_2, dtype: float64
```

[338]:
```
#New moment of column I relative to the ground
MI_2 =(F2/2*df['h2'].dropna())+ (M1*(df['h2'].dropna()/a)*(r/t))
print(MI_2)
```

```
0      75.426486
1      90.511783
2     105.597081
3     120.682378
4     135.767675
5     150.852972
6     165.938270
7     181.023567
8     196.108864
9     211.194161
10    226.279458
Name: h2, dtype: float64
```

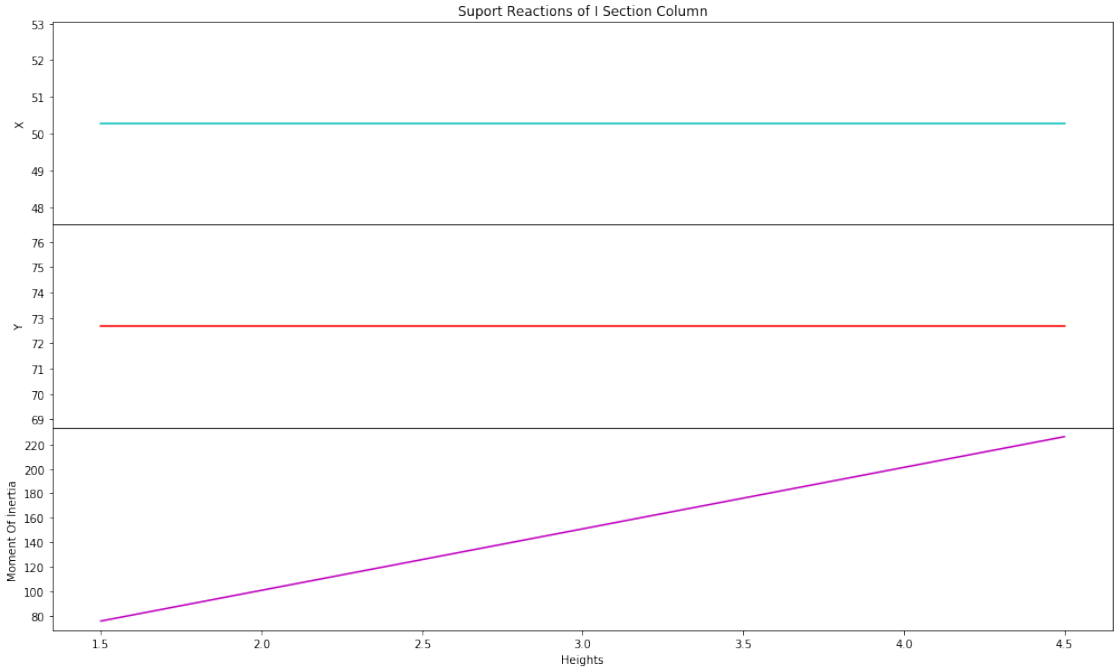
[339]:
```
import matplotlib.pyplot as plt
import matplotlib

fig=plt.figure(figsize=(17,10))
fig.subplots_adjust(hspace=0)

plt.subplot(3, 1, 1)
plt.plot(df['Ix_2'], '-',color='c')
plt.title('Suport Reactions of I Section Column')
plt.ylabel('X')

plt.subplot(3, 1, 2)
plt.plot(df['Iy_2'], '-',color='r')
plt.ylabel('Y')

plt.subplot(3, 1, 3)
plt.plot(h2, MI_2, '-',color='m')
plt.ylabel('Moment Of nertia')
plt.xlabel('Heights')
plt.show()
```



[335]:
```
# New  horizontal force of box section column
for q in df['h2'].dropna():
    q = F2/2
df['Bx_2'] = q
df['Bx_2']
```

[335]:
```
0     50.281154
1     50.281154
2     50.281154
3     50.281154
4     50.281154
5     50.281154
6     50.281154
7     50.281154
8     50.281154
9     50.281154
10    50.281154
11    50.281154
12    50.281154
13    50.281154
14    50.281154
Name: Bx_2, dtype: float64
```

[336]:
```
# New vertical force of box section column
for o in df['h2'].dropna():
    o = By_2
df['By_2'] = o
```

```
df['By_2']
```

[336]:
```
0     52.320669
1     52.320669
2     52.320669
3     52.320669
4     52.320669
5     52.320669
6     52.320669
7     52.320669
8     52.320669
9     52.320669
10    52.320669
11    52.320669
12    52.320669
13    52.320669
14    52.320669
Name: By_2, dtype: float64
```

[341]:
```
#New moment of box section column relative to the ground

MB_2 =(F2/2*df['h2'].dropna())+ (M2*(df['h2'].dropna()/a)*(r/t))
print(MB_2)
```

```
0      75.428688
1      90.514426
2     105.600164
3     120.685901
4     135.771639
5     150.857377
6     165.943114
7     181.028852
8     196.114590
9     211.200327
10    226.286065
Name: h2, dtype: float64
```

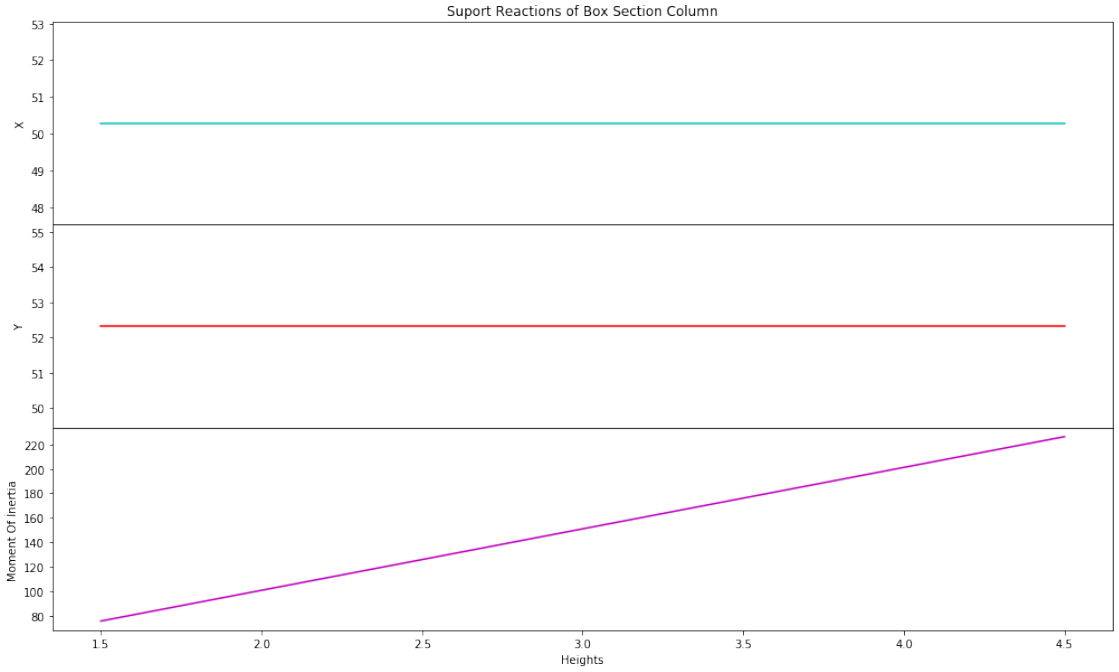
[342]:
```
import matplotlib.pyplot as plt
import matplotlib

fig=plt.figure(figsize=(17,10))
fig.subplots_adjust(hspace=0)

plt.subplot(3, 1, 1)
plt.plot(df['Bx_2'], '-',color='c')
plt.title('Suport Reactions of Box Section Column')
plt.ylabel('X')
```

```
plt.subplot(3, 1, 2)
plt.plot(df['By_2'], '-',color='r')
plt.ylabel('Y')

plt.subplot(3, 1, 3)
plt.plot(h2, MB_2, '-',color='m')
plt.ylabel('Moment Of nertia')
plt.xlabel('Heights')
plt.show()
```



[ ]: