Combined Loads

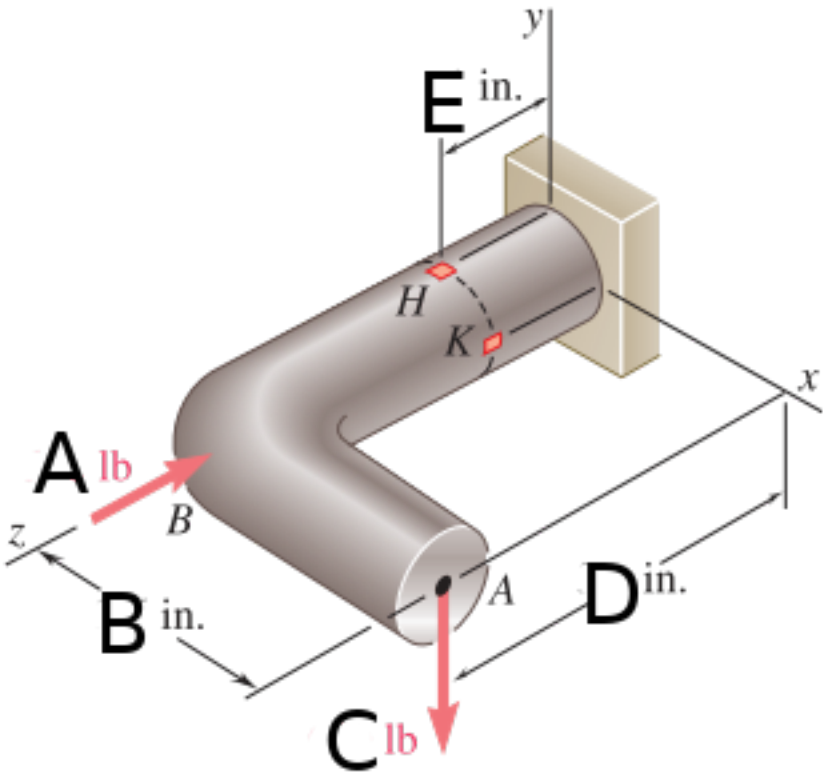
November 19, 2021

1 Workshop Design of Beams and Elements under combined loads

As we are not going to do a final exam, this workshop will reinforce your knowledge on design of beams and elements under combined loads

1.1 Exercise 1

Forces are applied at points A and B of the solid cast-iron bracket shown. Knowing that the bracket has a diameter of 0.8 in., determine the principal stresses and the maximum shearing stress at (a) point H, (b) point K.



Please consider the following values for each:

[1]:
```
import numpy as np
import pandas as pd
```

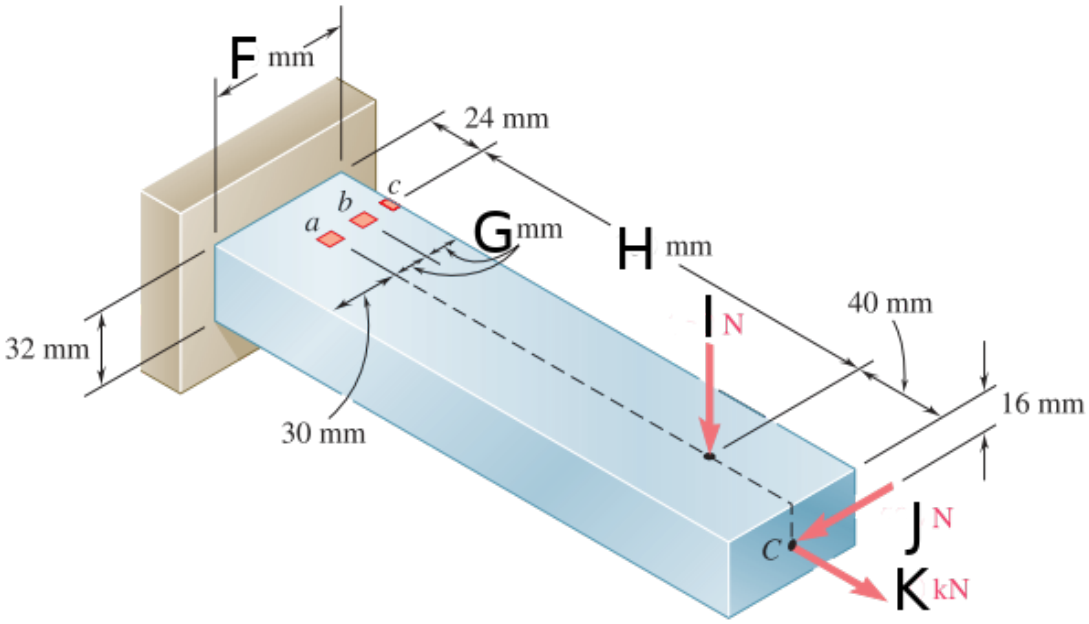
```
lock = False
solve = False
if lock:
    classlist = pd.read_excel('classlist2021II.xlsx')

    A = np.random.choice(np.arange(1500, 3500, 6),20) # lb
    B = np.random.choice(np.linspace(1.5, 3.5, 6),20) # in
    C = np.random.choice(np.arange(500, 1000, 6),20) # lb
    D = np.random.choice(np.linspace(2.0, 4.0, 6),20) # in
    E = np.random.choice(np.linspace(0.5, 1.5, 6),20) # in
    var_d = {'A':A,'B':B,'C':C,'D':D, 'E':E}

    for key, item in var_d.items():
        classlist[key] = np.random.choice(item,16)

    classlist = classlist.round(3)
    classlist.to_csv('problem1.csv')
else:
    classlist = pd.read_csv('problem1.csv', index_col=[0])
    classlist = classlist.drop(['ID'], axis=1)
classlist
```

[1]:

	Nombre	A	B	C	D	E
0	DÍAZ PÉREZ,DAVID STEVEN	2910	1.5	830	4.0	0.9
1	Florez Huerfano,Brandon	1740	1.9	902	3.2	0.5
2	GARCIA RODRIGUEZ,ANDRES FELIPE	1716	2.3	926	2.8	1.3
3	GRACIA GUERRA,DANIEL FELIPE	1716	3.1	878	2.0	0.7
4	IGLESIAS GARCIA,ANDRES FELIPE	3414	1.9	878	2.8	1.3
5	JARAMILLO GUTIERREZ,FABIAN ALEJANDRO	2658	1.5	830	2.0	1.3
6	PARRA MADRIGAL,JUAN GILBERTO	2820	3.5	566	3.2	1.3
7	PORTILLA HURTADO,JUAN PABLO	1740	1.9	926	4.0	0.5
8	PÉREZ CASTRILLÓN,NICOLÁS	2850	3.1	656	3.2	1.5
9	ROMERO REY,CRISTIAN ALEXANDER	1536	2.3	896	3.2	0.7
10	SALGADO DÍAZ,ALLEN SANTIAGO	1740	1.9	674	3.2	1.3
11	SANCHEZ GALVIS,JUAN DAVID	3114	3.5	950	3.2	1.3
12	SUAREZ FORERO,ANDERSON GIOVANY	2892	3.1	500	3.2	1.5
13	VAQUEN MARQUEZ,DANIEL CAMILO	2910	2.3	674	2.0	0.5
14	VILLAMIL TORRES,JORGE ELIECER ALFREDO	2820	3.5	902	3.2	1.3
15	Vargas Rodriguez,Cristian Camilo	1716	2.7	590	2.0	1.3

1.2 Exercise 2

Three forces are applied to the bar shown. Determine the normal and shearing stresses at (a) point a, (b) point b, (c) point c.



[3]:
```
lock = False
if lock:
    classlist2 = pd.read_excel('classlist2021II.xlsx')

    F = np.random.choice(np.arange(50, 100, 6),20) # mm
    G = np.random.choice(np.arange(15,30, 6),20) # mm
    H = np.random.choice(np.arange(150, 300, 6),20) # mm
    I = np.random.choice(np.arange(600, 1000, 6),20) # I
    J = np.random.choice(np.arange(300,1000, 6),20) # N
    K = np.random.choice(np.arange(5, 30, 6),20) # KN
    var_d = {'F':F,'G':G,'H':H,'I':I, 'J':J, 'K':K}

    for key, item in var_d.items():
        classlist2[key] = np.random.choice(item,16)

    classlist2 = classlist2.round(3)
    classlist2.to_csv('problem2.csv')
else:
    classlist2 = pd.read_csv('problem2.csv', index_col=[0])
    classlist2 = classlist2.drop(['ID'], axis=1)
classlist2
```

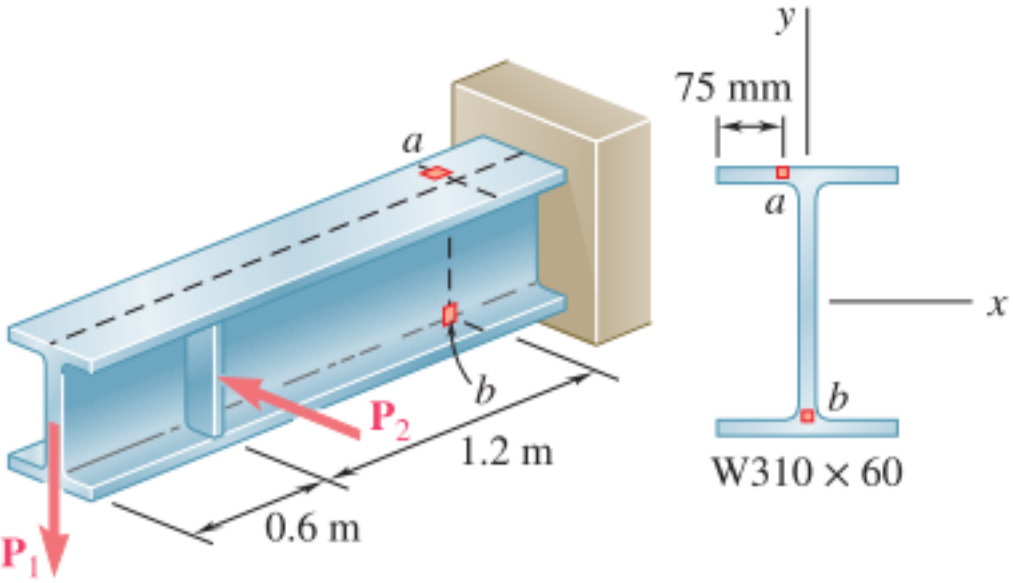
[3]:

	Nombre	F	G	H	I	J	K
0	DÍAZ PÉREZ,DAVID STEVEN	56	15	210	642	444	17
1	Florez Huerfano,Brandon	68	27	258	738	324	17
2	GARCIA RODRIGUEZ,ANDRES FELIPE	62	27	210	726	390	17
3	GRACIA GUERRA,DANIEL FELIPE	68	27	222	726	534	17
4	IGLESIAS GARCIA,ANDRES FELIPE	80	21	288	648	534	29

5	JARAMILLO GUTIERREZ,FABIAN ALEJANDRO	56	15	198	984	324	5
6	PARRA MADRIGAL,JUAN GILBERTO	50	27	252	648	324	29
7	PORTILLA HURTADO,JUAN PABLO	68	21	222	744	456	5
8	PÉREZ CASTRILLÓN,NICOLÁS	56	27	246	984	804	23
9	ROMERO REY,CRISTIAN ALEXANDER	68	27	204	726	534	29
10	SALGADO DÍAZ,ALLEN SANTIAGO	80	15	258	744	390	5
11	SANCHEZ GALVIS,JUAN DAVID	56	27	156	996	948	23
12	SUAREZ FORERO,ANDERSON GIOVANY	74	21	204	894	624	23
13	VAQUEN MARQUEZ,DANIEL CAMILO	56	27	198	948	588	11
14	VILLAMIL TORRES,JORGE ELIECER ALFREDO	80	21	192	762	654	5
15	Vargas Rodriguez,Cristian Camilo	86	27	252	882	402	17

1.3 Exercise 3

Take the following figure as reference:



Two forces P1 and P2 are applied as shown in directions perpendicular to the longitudinal axis of a W310 × 60 beam. Knowing that P1 = X kN and P2 = Y kN, determine the principal stresses and the maximum shearing stress at point a and b. X and Y are your last and last-last code number multiplied by 5. Consider 25 kN if any of those are 0.

Regards.

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