April 26, 2021

[5]:
```
import math as m
###3.1.1
#///    ////
a=2*1e-3
 =1.5*1e-3
D =25*1e-3
h=8*1e-3
B =0.5
Dm=D -a
k=0.3
 0=m.pi*4*1e-7
#///    ////

###3.2.1

Sm=m.pi*Dm**2/4
S =h*m.pi*D
Sm_S =Sm/S
Bm=B *1/Sm_S *(1+k)
print(' Sm= %.3e\n' %Sm,'S = %.3e\n' %S ,'Sm/S = %.3e\n' %Sm_S ,'Bm= %.3e\n' %Bm)

Hm=32*1e3
Bm_Hm=Bm/Hm
print(' Bm_Hm= %.3e\n' %Bm_Hm)
Lm=Bm_Hm*( /( 0*(1+k)))*Sm_S
#Lm=1.866*1e-2

print(' Lm= %.3e\n' %Lm,'Dm= %.3e\n' %Dm)
```

```
Sm= 4.155e-04
S = 6.283e-04
Sm/S = 6.612e-01
Bm= 9.830e-01

Bm_Hm= 3.072e-05

Lm= 1.865e-02
Dm= 2.300e-02
```

[6]:
```
#
Bm=0.99 #
Hm=31e3 #
Dm=m.sqrt((B *4*D *h*(1+k))/(Bm))
Dm=round(Dm,3) #
Sm=m.pi*Dm**2/4
Sm_S =Sm/S
Bm_Hm=Bm/Hm
Lm=round(Bm_Hm*( /( 0*(1+k)))*Sm_S ,3)
print(' Lm= %.3e\n' %Lm,'Dm= %.3e\n' %Dm,'Sm_S = %.3e\n' %Sm_S )
```

```
Lm= 1.900e-02
Dm= 2.300e-02
Sm_S = 6.612e-01
```

[7]:
```
###3.2.2
Bm_Hm= 0*(1+k)*S /Sm*Lm/
Hm2=31*1e3 #                    y
Bm2=Bm_Hm*Hm2
#
Bm_izm=0.99
Hm_izm=31*1e3
Фm=Bm*Sm #
Ф =B *S
B =Ф /S
print(' Фm= %.3e\n' %Фm,'Ф = %.3e\n' %Ф ,'B = %.3e\n' %B )
```

```
Фm= 4.113e-04
Ф = 3.142e-04
B = 5.000e-01
```

[1]:
```
import math as m
###4.1.1
#///    ////
a=8
b=8
c=20
d =0.25
h=30
S0=150
Fizm=12
f=a
#///    ////
d0=0.2
```

```
d1=0.22
lamb=1.5
eps=3
 0=m.pi*4*1e-7
```

[2]:
```
f0_list=[0.6,0.55,0.5]
f0=f0_list[0] #                (          )
w=m.ceil(4*f0*(c-eps-lamb)*(h-2*lamb-f)/(m.pi*d1**2)) #                ,        ␣
 ↪
print('w= ','%.0f'%w)
```

```
w=  4649
```

[3]:
```
 0max1=d /0.15 #                      1
 0min1=d /0.2
print(' 0min1=', 0min1,'\n 0max1=','%.3f'% 0max1)

 0min2=a*0.1 #                      2
 0max2=a*0.2
print('\n 0min2=', 0min2,'\n 0max2=', 0max2)
```

```
0min1= 1.25
0max1= 1.667

0min2= 0.8
0max2= 1.6
```

[9]:
```
#                ,
min = 1e10
if  0min1< 0min2:
     0=round( 0min2,2)
else:
     0=round( 0min1,2)

print(' 0=', 0)
print('                                    0,                    ')
# 0=1.7
print(' 0=', 0)
```

```
0= 1.25
                                    0,


0= 1.25
```

[10]:
```
 0max= 0+d  #
 0min= 0-d
print(' 0max=', 0max,'\n 0min=', 0min)
```

```
0max= 1.5
```

```
0min= 1.0
```

[11]:
```
def x_  ( 0, 0max= 0max,w=w,k1=1):
    global Ze_max,Ze_min
    global I min,Gb4_max,Gb4_min,I max,Gb2_max,Gb2_min
    #4.1.3.2.
    #            -          .                                B=0.2
    B=0.3 #0,3    -
    #
    #
    X_=c/2
    print('X_=',X_)
    #    . 7          X'/ max        Zb/ max
    print(' 0=', 0)
    print('X_/ 0=',X_/ 0)

    #                  (          <35        1.3)
    Zb_ max=X_/ 0 /1.3
    print('Zb_ max=',Zb_ max)
    Zb=Zb_ max* 0
    print('Zb=',Zb)
    Z_a=a
    print('Z_a=',Z_a)
    Z__b=Z_a
    print('Z__b=',Z__b)
    x__ max= Z__b/ 0*1.3
    x__=x__ max* 0
    print('x__=','%.3f'%x__)
    #
    m1=(Z__b+(x__- 0/2))/2
    m2=(Zb+(X_- 0))/2
    print('m1=%f'%m1,'\nm2=%f'%m2)

    G1= 0*((2*b*1e-3)/(m.pi*(( 0/m2)+0.5)))
    print('\n\nG1=','%.3f e-9'%(G1*1e9))

    G2= 0*0.52*b*1e-3
    G3= 0*(a*b*1e-3/ 0)
    G4= 0*0.26*b*1e-3
    print('G2=','%.3f e-9'%(G2*1e9))
    print('G3=','%.3f e-9'%(G3*1e9))
    print('G4=','%.3f e-9'%(G4*1e9))


    G5= 0*((2*b*1e-3)/(m.pi*(( 0/m1)+1)))
    print('m1=',m1,'\n\nG5=','%.3fe-9'%(G5*1e9))
    #       2
```

```
G6= 0*0.077* 0*1e-3
G7= 0*m1*1e-3/4
G8=2*G6+2*G7
print('G6=','%.3f e-9'%(G6*1e9))
print('G7=','%.3f e-9'%(G7*1e9))
print('G8=','%.3f e-9'%(G8*1e9))

Gb4=G1+G2+G3+3*(G4+G5)+2*(G6+G7+G8)
print('\nGb4=','%.3f e-9'%(Gb4*1e9))

Rb4=1/Gb4
print('\nRb4=','%.3f e6'%(Rb4*1e-6))

Gb2=G1+G2+G3+2*(G4+G5+G8)
print('\nGb2=','%.3f e-9'%(Gb2*1e9))
Rb2=1/Gb2
print('\nRb2=','%.3f e6'%(Rb2*1e-6))

R_ms=(Rb2+Rb4)/2

print('\nR_ms','%.3f e6'%(R_ms*1e-6))
#4.1.3.3.
ro=0.0174

lsr=2*(2*(c-eps-lamb)/k1+3*a+2*eps+4*lamb) #    -
#lsr=4*(h+lamb)/k1+2*eps  #     -

q=m.pi*d0**2/4
ow=2*m.pi*50
Ra_r=ro*lsr*1e-3*w/q
Ra_im=ow*w**2/R_ms
Ze=(Ra_r**2+Ra_im**2)**0.5
if  0== 0max:
    Ze_min=(Ra_r**2+Ra_im**2)**0.5
    print('\nZe_min= %.2f e3 '%(Ze_min*1e-3))
else:
    Ze_max=(Ra_r**2+Ra_im**2)**0.5
    print('\nZe_max= %.2f e3 '%(Ze_max*1e-3))
print('lsr=%.2f'%lsr)

print('\nRa_r=%.2f'%Ra_r)
print('Ra_im=%.2f'%Ra_im)


#4.1.3.4.
I=(B*2*a*b*R_ms*10**(-6))/(w*(2**0.5))
```

```
    print('I= %f'%I)
    j=I/q
    print('j<=2..2.5 j= %.2f'%j)
    U=I*Ze
    print('U= %.2f'%U)
    if  0== 0max:
        I max=I
        Gb4_max=Gb4
        Gb2_max=Gb2
    else:
        I min=I
        Gb4_min=Gb4
        Gb2_min=Gb2
```

[12]:
```
x_  ( 0= 0max)
print('\n\n\n\n\n')
x_  ( 0= 0min)
print('dZe=%.2e'%(Ze_max-Ze_min))
```

```
X_= 10.0
 0= 1.5
X_/ 0= 6.666666666666667
Zb_ max= 5.128205128205129
Zb= 7.692307692307693
Z_a= 8
Z__b= 8
x__= 10.400
m1=8.825000
m2=8.096154


G1= 9.339 e-9
G2= 5.228 e-9
G3= 53.617 e-9
G4= 2.614 e-9
m1= 8.825

G5= 5.470e-9
G6= 0.145 e-9
G7= 2.772 e-9
G8= 5.835 e-9

Gb4= 109.941 e-9

Rb4= 9.096 e6

Gb2= 96.022 e-9
```

```
Rb2= 10.414 e6

R_ms 9.755 e6

Ze_min= 0.78 e3
lsr=134.00

Ra_r=345.04
Ra_im=696.05
I= 0.056975
j<=2..2.5 j= 1.81
U= 44.26




X_= 10.0
 0= 1.0
X_/ 0= 10.0
Zb_ max= 7.692307692307692
Zb= 7.692307692307692
Z_a= 8
Z__b= 8
x__= 10.400
m1=8.950000
m2=8.346154


G1= 10.326 e-9
G2= 5.228 e-9
G3= 80.425 e-9
G4= 2.614 e-9
m1= 8.95

G5= 5.757e-9
G6= 0.097 e-9
G7= 2.812 e-9
G8= 5.817 e-9

Gb4= 138.541 e-9

Rb4= 7.218 e6

Gb2= 124.353 e-9

Rb2= 8.042 e6
```

```
R_ms 7.630 e6

Ze_max= 0.95 e3
lsr=134.00

Ra_r=345.04
Ra_im=889.92
I= 0.044563
j<=2..2.5 j= 1.42
U= 42.53
dZe=1.78e+02
```

[13]:
```
dZe=m.fabs(Ze_max-Ze_min)
print('dZe=%e'%dZe)
S=dZe/(2*d )
print('S=%e'%S)
print('S0=%e'%S0)
k1=(S/S0)**0.5
print('k1=%f'%k1)
w_new=w/k1
print('w_new=%f'%w_new)
```

```
dZe=1.775955e+02
S=3.551910e+02
S0=1.500000e+02
k1=1.538811
w_new=3021.163275
```

[14]:
```
w
```

[14]: 4649

[15]:
```
z=0
while m.fabs(S-S0)>1:
    z=z+1
    w_new=round(w_new)
    x_  ( 0= 0min,w=w_new,k1=k1)
    x_  ( 0= 0max,w=w_new,k1=k1)
    print('\n\n\n\n\n')
    dZe=m.fabs(Ze_max-Ze_min)
    print('dZe=%e'%dZe)
    S=dZe/(2*d )
    print('S=%e'%S)
    k1=(S/S0)**0.5
    print('k1=%f'%k1)
    w_new=w_new/k1
    print('w_new=%f'%w_new)
```

```
    print('\n\n\n\n\n')
print('z=%d'%z)
m.fabs(S-S0)
print('w_new=%f'%round(w_new))
```

```
X_= 10.0
 0= 1.0
X_/ 0= 10.0
Zb_ max= 7.692307692307692
Zb= 7.692307692307692
Z_a= 8
Z__b= 8
x__= 10.400
m1=8.950000
m2=8.346154


G1= 10.326 e-9
G2= 5.228 e-9
G3= 80.425 e-9
G4= 2.614 e-9
m1= 8.95

G5= 5.757e-9
G6= 0.097 e-9
G7= 2.812 e-9
G8= 5.817 e-9

Gb4= 138.541 e-9

Rb4= 7.218 e6

Gb2= 124.353 e-9

Rb2= 8.042 e6

R_ms 7.630 e6

Ze_max= 0.42 e3
lsr=112.29

Ra_r=187.89
Ra_im=375.78
I= 0.068578
j<=2..2.5 j= 2.18
U= 28.81
X_= 10.0
 0= 1.5
```

```
X_/ 0= 6.666666666666667
Zb_ max= 5.128205128205129
Zb= 7.692307692307693
Z_a= 8
Z__b= 8
x__= 10.400
m1=8.825000
m2=8.096154


G1= 9.339 e-9
G2= 5.228 e-9
G3= 53.617 e-9
G4= 2.614 e-9
m1= 8.825

G5= 5.470e-9
G6= 0.145 e-9
G7= 2.772 e-9
G8= 5.835 e-9

Gb4= 109.941 e-9

Rb4= 9.096 e6

Gb2= 96.022 e-9

Rb2= 10.414 e6

R_ms 9.755 e6

Ze_min= 0.35 e3
lsr=112.29

Ra_r=187.89
Ra_im=293.92
I= 0.087679
j<=2..2.5 j= 2.79
U= 30.59




dZe=7.129681e+01
S=1.425936e+02
k1=0.975000
```

```
w_new=3098.462984




X_= 10.0
 0= 1.0
X_/ 0= 10.0
Zb_ max= 7.692307692307692
Zb= 7.692307692307692
Z_a= 8
Z__b= 8
x__= 10.400
m1=8.950000
m2=8.346154


G1= 10.326 e-9
G2= 5.228 e-9
G3= 80.425 e-9
G4= 2.614 e-9
m1= 8.95

G5= 5.757e-9
G6= 0.097 e-9
G7= 2.812 e-9
G8= 5.817 e-9

Gb4= 138.541 e-9

Rb4= 7.218 e6

Gb2= 124.353 e-9

Rb2= 8.042 e6

R_ms 7.630 e6

Ze_max= 0.46 e3
lsr=135.59

Ra_r=232.65
Ra_im=395.18
I= 0.066873
j<=2..2.5 j= 2.13
U= 30.67
```

```
X_= 10.0
 0= 1.5
X_/ 0= 6.666666666666667
Zb_ max= 5.128205128205129
Zb= 7.692307692307693
Z_a= 8
Z__b= 8
x__= 10.400
m1=8.825000
m2=8.096154


G1= 9.339 e-9
G2= 5.228 e-9
G3= 53.617 e-9
G4= 2.614 e-9
m1= 8.825

G5= 5.470e-9
G6= 0.145 e-9
G7= 2.772 e-9
G8= 5.835 e-9

Gb4= 109.941 e-9

Rb4= 9.096 e6

Gb2= 96.022 e-9

Rb2= 10.414 e6

R_ms 9.755 e6

Ze_min= 0.39 e3
lsr=135.59

Ra_r=232.65
Ra_im=309.09
I= 0.085500
j<=2..2.5 j= 2.72
U= 33.08




dZe=7.171641e+01
```

```
S=1.434328e+02
k1=0.977864
w_new=3168.128355




X_= 10.0
 0= 1.0
X_/ 0= 10.0
Zb_ max= 7.692307692307692
Zb= 7.692307692307692
Z_a= 8
Z__b= 8
x__= 10.400
m1=8.950000
m2=8.346154


G1= 10.326 e-9
G2= 5.228 e-9
G3= 80.425 e-9
G4= 2.614 e-9
m1= 8.95

G5= 5.757e-9
G6= 0.097 e-9
G7= 2.812 e-9
G8= 5.817 e-9

Gb4= 138.541 e-9

Rb4= 7.218 e6

Gb2= 124.353 e-9

Rb2= 8.042 e6

R_ms 7.630 e6

Ze_max= 0.48 e3
lsr=135.40

Ra_r=237.58
Ra_im=413.24
I= 0.065395
```

```
j<=2..2.5 j= 2.08
U= 31.17
X_= 10.0
 0= 1.5
X_/ 0= 6.666666666666667
Zb_ max= 5.128205128205129
Zb= 7.692307692307693
Z_a= 8
Z__b= 8
x__= 10.400
m1=8.825000
m2=8.096154


G1= 9.339 e-9
G2= 5.228 e-9
G3= 53.617 e-9
G4= 2.614 e-9
m1= 8.825

G5= 5.470e-9
G6= 0.145 e-9
G7= 2.772 e-9
G8= 5.835 e-9

Gb4= 109.941 e-9

Rb4= 9.096 e6

Gb2= 96.022 e-9

Rb2= 10.414 e6

R_ms 9.755 e6

Ze_min= 0.40 e3
lsr=135.40

Ra_r=237.58
Ra_im=323.21
I= 0.083610
j<=2..2.5 j= 2.66
U= 33.54
```

```
dZe=7.552969e+01
S=1.510594e+02
k1=1.003525
w_new=3156.871781




X_= 10.0
 0= 1.0
X_/ 0= 10.0
Zb_ max= 7.692307692307692
Zb= 7.692307692307692
Z_a= 8
Z__b= 8
x__= 10.400
m1=8.950000
m2=8.346154


G1= 10.326 e-9
G2= 5.228 e-9
G3= 80.425 e-9
G4= 2.614 e-9
m1= 8.95

G5= 5.757e-9
G6= 0.097 e-9
G7= 2.812 e-9
G8= 5.817 e-9

Gb4= 138.541 e-9

Rb4= 7.218 e6

Gb2= 124.353 e-9

Rb2= 8.042 e6

R_ms 7.630 e6

Ze_max= 0.47 e3
lsr=133.78

Ra_r=233.92
```

```
Ra_im=410.38
I= 0.065623
j<=2..2.5 j= 2.09
U= 31.00
X_= 10.0
 0= 1.5
X_/ 0= 6.666666666666667
Zb_ max= 5.128205128205129
Zb= 7.692307692307693
Z_a= 8
Z__b= 8
x__= 10.400
m1=8.825000
m2=8.096154


G1= 9.339 e-9
G2= 5.228 e-9
G3= 53.617 e-9
G4= 2.614 e-9
m1= 8.825

G5= 5.470e-9
G6= 0.145 e-9
G7= 2.772 e-9
G8= 5.835 e-9

Gb4= 109.941 e-9

Rb4= 9.096 e6

Gb2= 96.022 e-9

Rb2= 10.414 e6

R_ms 9.755 e6

Ze_min= 0.40 e3
lsr=133.78

Ra_r=233.92
Ra_im=320.97
I= 0.083902
j<=2..2.5 j= 2.67
U= 33.32
```

```
dZe=7.519489e+01
S=1.503898e+02
k1=1.001298
w_new=3152.906101
```

```
z=4
w_new=3153.000000
```

[16]:
```
w_new=round(w_new)
#4.1.3.7.

Fsum=w_new**2*(I min**2*(Gb4_min+Gb2_min)/
 ↪( 0min*1e-3)-I max**2*(Gb4_max+Gb2_max)/( 0max*1e-3))
print('Fsum=%.2f'%Fsum)
print('Fizm=%.2f'%Fizm)
print('Fizm>Fsum*5..10')
print('%.2f>%.2f..%.2f'%(Fizm,Fsum*5,Fsum*10))
```

```
Fsum=1.65
Fizm=12.00
Fizm>Fsum*5..10
12.00>8.23..16.46
```

[ ]:
```

```