

```
# -*- coding: utf-8 -*-  
"""
```

```
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```

```
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"""
```

```
import numpy as np  
import pylab as pl
```

```
# Maten grijper en constanten/variabelen [mm]
```

```
a = 180  
b = 90  
c = 140  
d = 123  
e = 190  
f = 420  
g = 188  
k = 200  
l = 420
```

```
Auit=68/6E5  
Ain=51/6E5  
p=6E5
```

```
G = 9.81  
mappel = 0.3
```

```
Vgrijper=(0.005*((4*0.006)+(4*0.0033)+(4*0.0027)+(8*0.0017)+(4*0.0004)))*1000 #[dm3]  
Varm=((f*4*20*2)+(f*4*15*2))/(10**6) #[dm3]
```

```
rohout=0.58 #[kg/dm3]  
roppma=1.18 #[kg/dm3]  
roal=2.7 #[kg/dm3]
```

```
mgrijper=(Vgrijper*roppma)+0.050  
mhouthouder=0.600  
marm=Varm*roal  
mcontra=1.25
```

```
dx = np.linspace(0,100,100)
```

```
gamma=np.arccos(((dx+e)**2+c**2-g**2-d**2)/(2*(dx+e)*c))  
beta=np.arcsin((np.sin(gamma)*c)/(np.sqrt(g**2+d**2)))+np.arctan(g/d)  
alfa=np.pi-beta-gamma  
theta=np.arctan((k-(np.sin(alfa)*l))/(np.cos(alfa)*l))
```

```
# Krachten
```

```
Ftouw=mcontra*G
```

```
Fzappelengrijper = (mappel+mgrijper)*G
```

```
Fzhouthouder=mhouthouder*G
```

```
Fzarm=marm*G
```

```
Factuator = p*Auit
```

```
Factuatory = Factuator*np.sin(beta)
```

```
Factuatorx = Factuator*np.cos(beta)
```

```
Ftouwz=Ftouw*np.cos(theta)
```

```
Ftouwxy=Ftouw*np.sin(theta)
```

```
# Momentarmen
```

```
rmuurappel = (a+b+np.cos(alfa)*f)
```

```
rmuurhouthouder=(b+np.cos(alfa)*f)
```

```
ractuatorax = c*np.cos(alfa)
```

```
ractuatoray = c*np.sin(alfa)
```

```
rarm=f*0.5*np.cos(alfa)
```

```
rtouwz = np.cos(alfa)*l
```

```
rtouwxy=np.sin(alfa)*l
```

```
# Momenten
```

```
Mappelengrijper = (-1*Fzappelengrijper*rmuurappel)/1000
```

```
Mhouthouder = (-1*Fzhouthouder*rmuurhouthouder)/1000
```

```
Mactuator = ((Factuatory*ractuatorax)+(Factuatorx*ractuatoray))/1000
```

```
Marm = (-1*Fzarm*rarm)/1000
```

```
Mtouw = ((Ftouwz*rtouwxy)+(Ftouwxy*rtouwz))/1000
```

```
Mr = Mappelengrijper + Mactuator + Marm + Mhouthouder + Mtouw
```

```
# Plot
```

```
p1=pl.plot(dx,Mr,'r',label='Arm omhoog')
```

```
# Krachten/momentarmen/momenten 2
```

```
Fzappelengrijper = (mappel+mgrijper)*G
```

```
Fzhouthouder=mhouthouder*G
```

```
Fzarm=marm*G
```

```
Factuator = -1*p*Ain
```

```
Factuatory = Factuator*np.sin(beta)
```

```
Factuatorx = Factuator*np.cos(beta)
```

```
Ftouwz=Ftouw*np.cos(theta)
```

```
Ftouwxy=Ftouw*np.sin(theta)
```

```
rmuurappel = (a+b+np.cos(alfa)*f)
```

```
rmuurhouthouder=(b+np.cos(alfa)*f)
```

```
ractuatorax = c*np.cos(alfa)
```

```
ractoray = c*np.sin(alfa)
rarm=f*0.5*np.cos(alfa)
rtouw = np.cos(alfa)*l
rtouwy =np.sin(alfa)*l
Mappelengrijper = (-1*Fzappelengrijper*rmuurappel)/1000
Mhouthouder = (-1*Fzhouthouder*rmuurhouthouder)/1000
Mactuator = ((Factuatory*ractorax)+(Factuatorx*ractoray))/1000
Marm = (-1*Fzarm*rarm)/1000
Mtouw = ((Ftouwx*rtouwy)+(Ftouwy*rtouwxx))/1000
Mr = Mappelengrijper + Mactuator + Marm + Mhouthouder + Mtouw
```

```
# Plot 2
p2=pl.plot(dx,Mr,'r--',label='Arm omlaag')
pl.legend()
pl.xlabel('dx (mm)')
pl.ylabel('Mr (Nm)')
pl.show()
```