# 02-23_Slope_Code_Fixed

February 23, 2023

[1]:
```
import sympy as sp
```

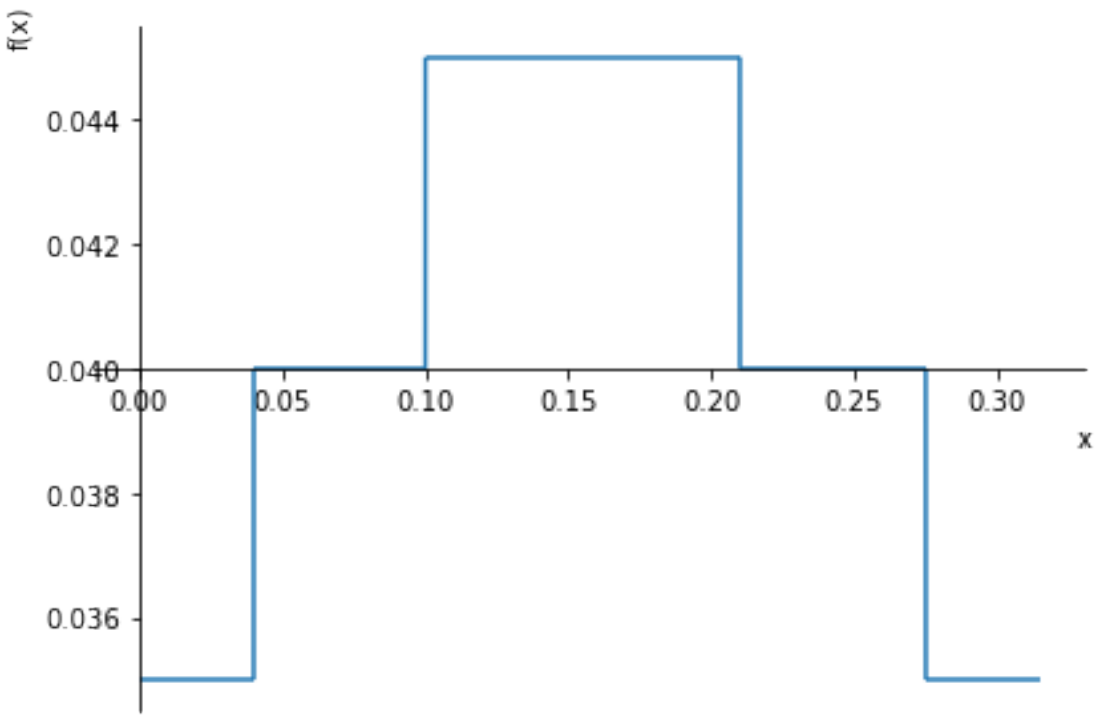
[2]:
```
sp.var('x');
```

[3]:
```
E = 207e9
domain = (x, 0, 0.315)
```

[4]:
```
d = sp.Piecewise(
  (0.035, x < 0.04),
  (0.04, x < 0.1),
  (0.045, x < 0.21),
  (0.04, x < 0.275),
  (0.035, True),
)
d
```

[4]:
$$\begin{cases} 0.035 & \text{for } x < 0.04 \\ 0.04 & \text{for } x < 0.1 \\ 0.045 & \text{for } x < 0.21 \\ 0.04 & \text{for } x < 0.275 \\ 0.035 & \text{otherwise} \end{cases}$$

[5]:
```
sp.plot(d, (x, 0, 0.315));
```



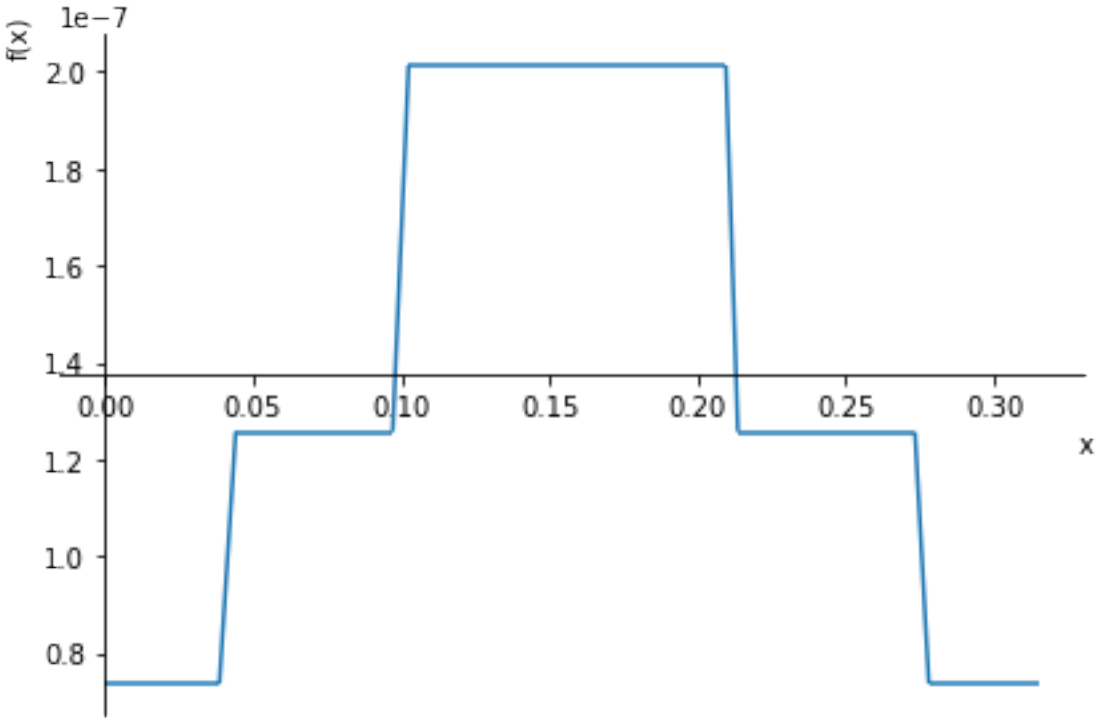

[6]:
```
I = sp.pi * d**4 / 64
I
```

[6]:
$$\frac{\pi \begin{cases} 1.500625 \cdot 10^{-6} & \text{for } x < 0.04 \\ 2.56 \cdot 10^{-6} & \text{for } x < 0.1 \\ 4.100625 \cdot 10^{-6} & \text{for } x < 0.21 \\ 2.56 \cdot 10^{-6} & \text{for } x < 0.275 \\ 1.500625 \cdot 10^{-6} & \text{otherwise} \end{cases}}{64}$$

[7]:
```
I.n().simplify()
```

[7]:
$$\begin{cases} 7.36617574342685 \cdot 10^{-8} & \text{for } x < 0.04 \\ 1.25663706143592 \cdot 10^{-7} & \text{for } x < 0.1 \\ 2.01288958986354 \cdot 10^{-7} & \text{for } x < 0.21 \\ 1.25663706143592 \cdot 10^{-7} & \text{for } x < 0.275 \\ 7.36617574342685 \cdot 10^{-8} & \text{otherwise} \end{cases}$$

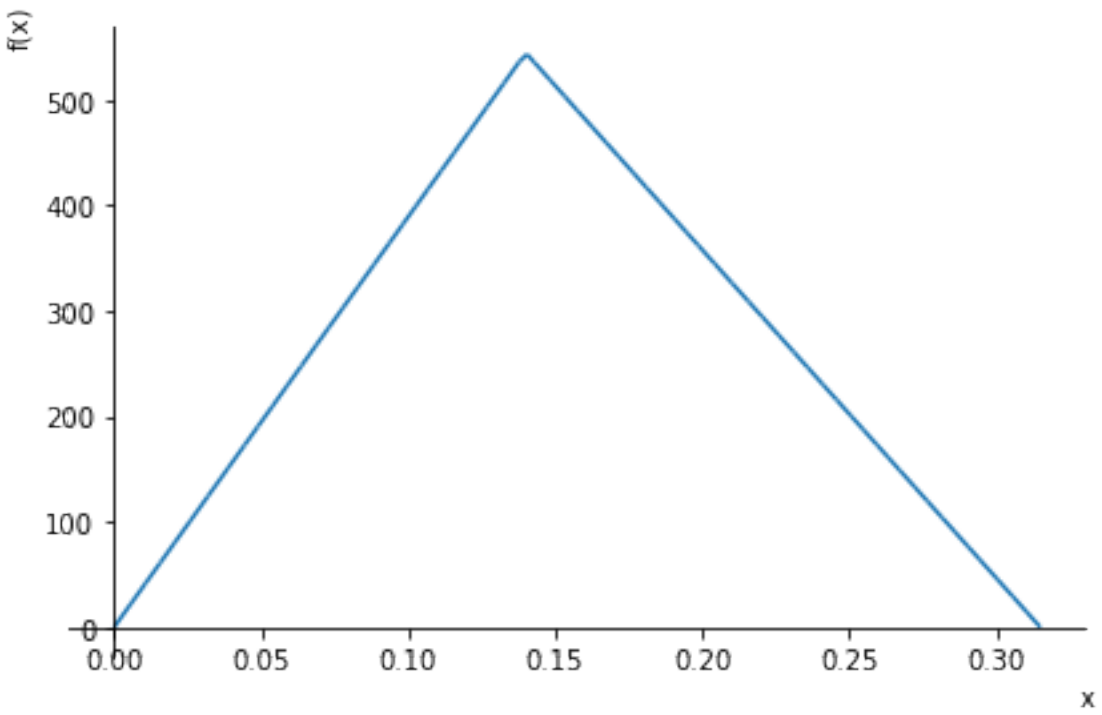
[8]:
```
sp.plot(I, (x, 0, 0.315));
```




[9]:
```
M = sp.Piecewise(
  (3889 * x, x < 0.14),
  (980 - 3111 * x, True),
)
M
```

[9]:
$$\begin{cases} 3889x & \text{for } x < 0.14 \\ 980 - 3111x & \text{otherwise} \end{cases}$$

[10]:
```
sp.plot(M, (x, 0, 0.315));
```




[11]:
```
sp.var("C1 C2")
intrim = sp.integrate(sp.integrate(M / (E * I), x) + C1, x) + C2
intrim
```

[11]:
$$C_2+\begin{cases} 1.0C_1x + \frac{0.133543927282044x^3}{\pi} \\ 0.04C_1 + \frac{0.078280998389694x^3}{\pi} + \frac{1.0x(1.0\pi C_1+0.000265262058683278)}{\pi} - \frac{0.04(1.0\pi C_1+0.000265262058683278)}{\pi} + \frac{3.5368274491103}{\pi} \\ 0.04C_1 + \frac{0.0488704419149805x^3}{\pi} + \frac{1.0x(1.0\pi C_1+0.00114757875292469)}{\pi} + \frac{0.06(1.0\pi C_1+0.000265262058683278)}{\pi} - \frac{0.1(1.0\pi C_1+0.00}{\pi} \\ 0.04C_1 - \frac{0.0390938402667792x^3}{\pi} + \frac{0.0369449985163391x^2}{\pi} + \frac{1.0x(1.0\pi C_1-0.00402472103936278)}{\pi} - \frac{0.14(1.0\pi C_1-0.00402472103936}{\pi} \\ 0.04C_1 - \frac{0.0626207729468599x^3}{\pi} + \frac{0.0591787439613527x^2}{\pi} + \frac{1.0x(1.0\pi C_1-0.0102502809326938)}{\pi} - \frac{0.21(1.0\pi C_1-0.010250280932693}{\pi} \\ 0.04C_1 - \frac{0.106828274048454x^3}{\pi} + \frac{0.100956324558809x^2}{\pi} + \frac{1.0x(1.0\pi C_1-0.0231983734488706)}{\pi} - \frac{0.275(1.0\pi C_1-0.0231983734488706}{\pi} \end{cases}$$

[12]:
```
sols = sp.solve((
  intrim.subs(x, 0),
  intrim.subs(x, 0.315),
))
sols
```

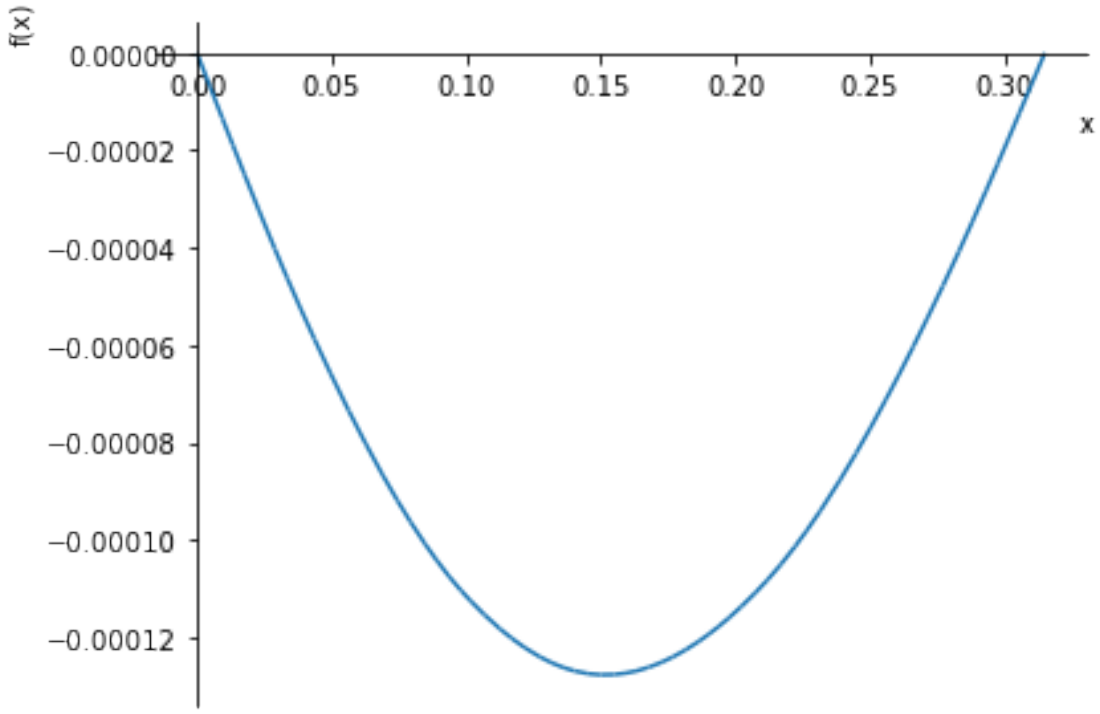
[12]:
```
{C1: -0.00142662228772857, C2: 0.0}
```

[13]:
```
y = intrim.subs(sols).simplify()
y
```

[13]:

$$\begin{cases} \frac{0.133543927282044x^3}{\pi} - 0.00142662228772857x \\ \frac{0.078280998389694x^3+1.0x(0.00026526205868683278-0.00142662228772857\pi)-7.07365489822074\cdot10^{-6}}{\pi} \\ \frac{0.0488704419149805x^3+1.0x(0.00114757875292469-0.00142662228772857\pi)-6.58947678476479\cdot10^{-5}+6.7762635780344\cdot10^{-21}\pi}{\pi} \\ \frac{-0.0390938402667792x^3+0.0369449985163391x^2-1.0x(0.00402472103936278+0.00142662228772857\pi)+1.35525271560688\cdot10^{-20}\pi+0.000175479}{\pi} \\ \frac{-0.0626207729468599x^3+0.0591787439613527x^2-1.0x(0.00142662228772857\pi+0.0102502809326938)-6.7762635780344\cdot10^{-21}\pi+0.00072022154}{\pi} \\ \frac{-0.106828274048454x^3+0.100956324558809x^2-1.0x(0.00142662228772857\pi+0.0231983734488706)-6.7762635780344\cdot10^{-21}\pi+0.0020408953332}{\pi} \end{cases}$$

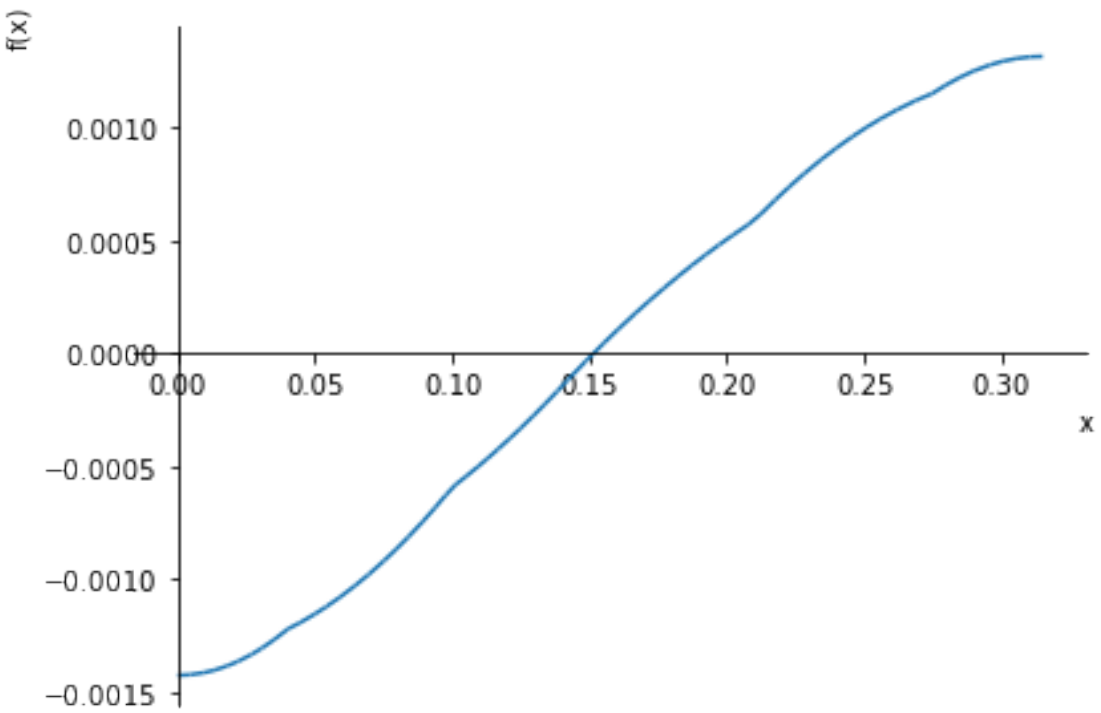
[14]:
```
sp.plot(y, (x, 0, 0.315));
```




[15]:
```
yp = sp.diff(y, x)
yp
```

[15]:
$$\begin{cases} \frac{0.400631781846131x^2}{\pi} - 0.00142662228772857 & \text{for } x < 0.04 \\ \frac{0.234842995169082x^2-0.00142662228772857\pi+0.000265262058683278}{\pi} & \text{for } x < 0.1 \\ \frac{0.146611325744941x^2-0.00142662228772857\pi+0.00114757875292469}{\pi} & \text{for } x < 0.14 \\ \frac{-0.117281520800338x^2+0.0738899970326781x-0.00142662228772857\pi-0.00402472103936278}{\pi} & \text{for } x < 0.21 \\ \frac{-0.18786231884058x^2+0.118357487922705x-0.0102502809326938-0.00142662228772857\pi}{\pi} & \text{for } x < 0.275 \\ \frac{-0.320484822145362x^2+0.201912649117618x-0.0231983734488706-0.00142662228772857\pi}{\pi} & \text{otherwise} \end{cases}$$

[16]:
```
sp.plot(yp, (x, 0, 0.315));
```




[17]:
```
yp.subs(x, 0).n()
```

[17]: $-0.00142662228772857$

[18]:
```
yp.subs(x, 0.14).n()
```

[18]: $-0.000146647071040092$

[19]:
```
yp.subs(x, 0.315).n()
```

[19]: $0.00131211741997159$