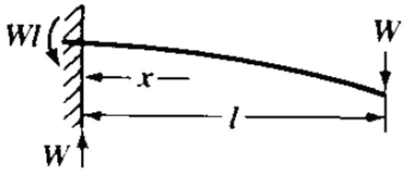
Case 1: constant drill pipe



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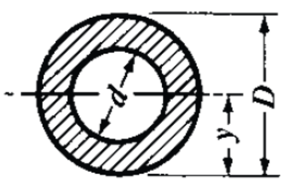
Modulus of Elasticity $E := 30 \cdot 10^{6} psi$

Load $W := -1000 lbf$

Some distance as indicated $x := 120 in$

Some distance as indicated $L := 120 in$

Finding Moment of Inertia:



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Outside Diameter $D := \left(6 + \frac{5}{8}\right) in$

Inside Diameter $d := 5.901 in$

Moment of Inertia $I := \frac{\pi\left(D^4 - d^4\right)}{64} = 35.04 \cdot in^4$

section modulus of the cross-section of the beam $Z := \pi \frac{\left(D^4 - d^4\right)}{32 \cdot D} = 10.578 \cdot in^3$

Stress at x $s := \frac{W}{Z}(L - x) = 0 \cdot ksi$

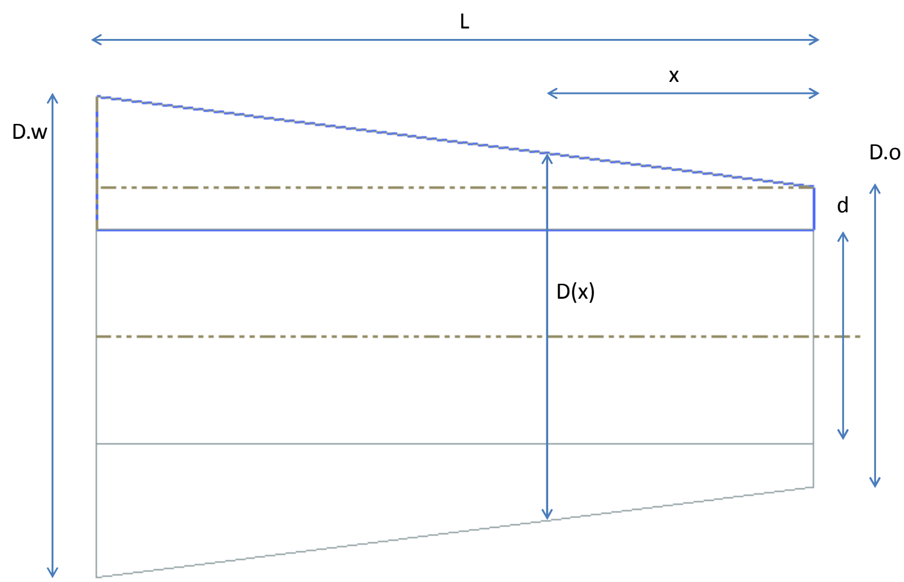
Stress at mount $s := \frac{(W \cdot L)}{Z} = -11.344 \cdot ksi$

Deflection $y_1 := \frac{W \cdot x^2}{6E \cdot I}(3 \cdot L - x) = -0.548 \cdot in$

Case 2: Tapered Deflection

$D_w := 6.625in$ $D_o := 6.625in$ $d := 5.901in$ $L := 120in$ $W := -1000lbf$ $E := 30\cdot 10^6 \cdot psi$

$x := 0, .1 .. 120$



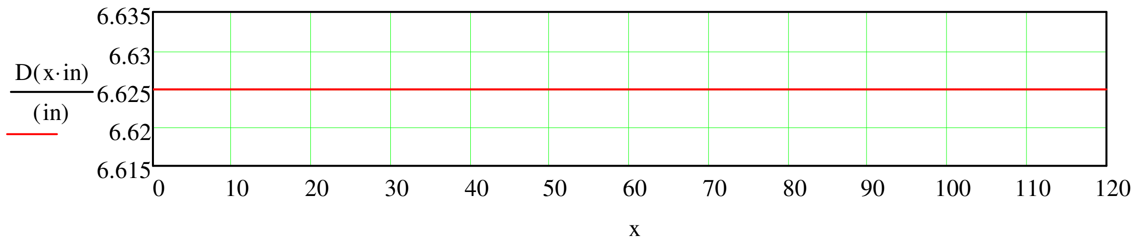
$$D(x) := \left[\left(D_w - D_o\right)\cdot\frac{(x)}{L}\right] + D_o$$ $D(0in) = 6.625\cdot in$ $D(120in) = 6.625\cdot in$

$M(x) := W\cdot(x)$ $M(0\cdot in) = 0\cdot lbf\cdot in$ $M(120in) = -120000\cdot lbf\cdot in$

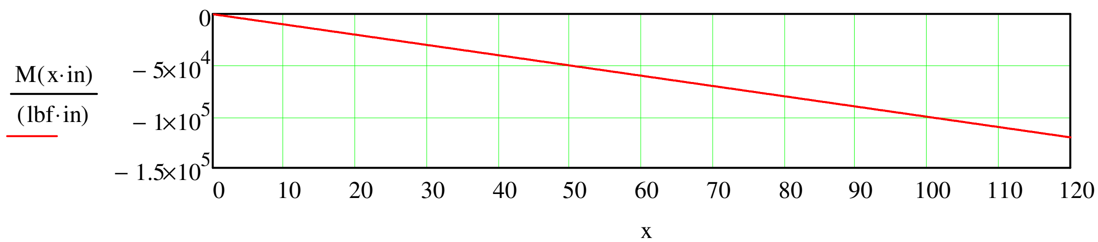
$$I(x) := \frac{\pi}{64}\cdot\left(D(x)^4 - d^4\right)$$ $I(0\cdot in) = 35.04\cdot in^4$ $I(120\cdot in) = 35\cdot in^4$

$$\theta(x) := \left(\int_0^x \frac{M(x)}{E\cdot I(x)}\,dx\right)$$ $\theta(0in) = 0\cdot deg$ $\theta(120in) = -0.392\cdot deg$

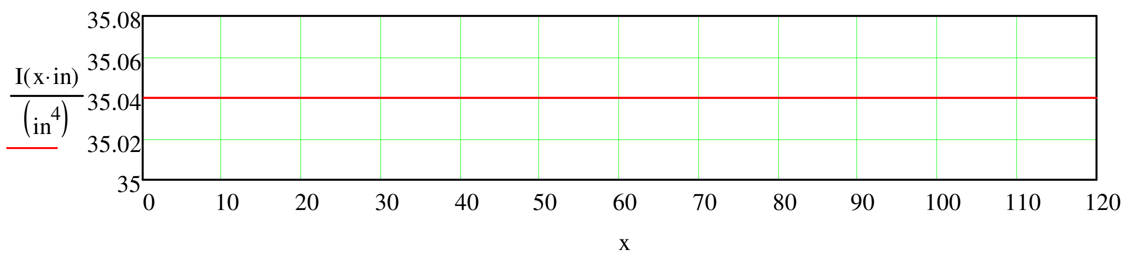
$$y(x) := \int_0^L \int_0^x \frac{M(x)}{E\cdot I(x)}\,dx\,dx - (x)\cdot\left(\int_0^x \frac{M(x)}{E\cdot I(x)}\,dx\right)$$ $y(0\cdot in) = -0.274\cdot in$ $y(120\cdot in) = 0.548\cdot in$



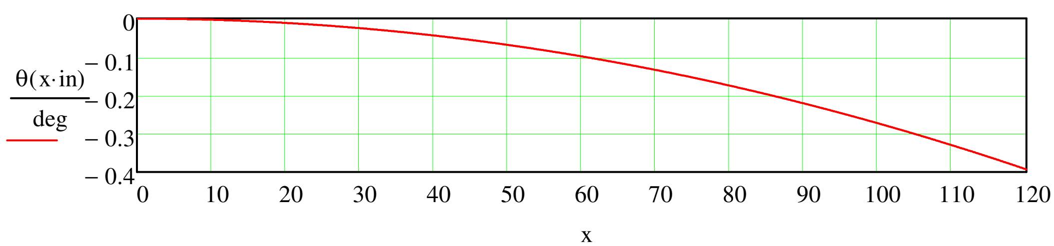
D(x·in) / (in)
6.635
6.63
6.625
6.62
6.615
0 10 20 30 40 50 60 70 80 90 100 110 120
x



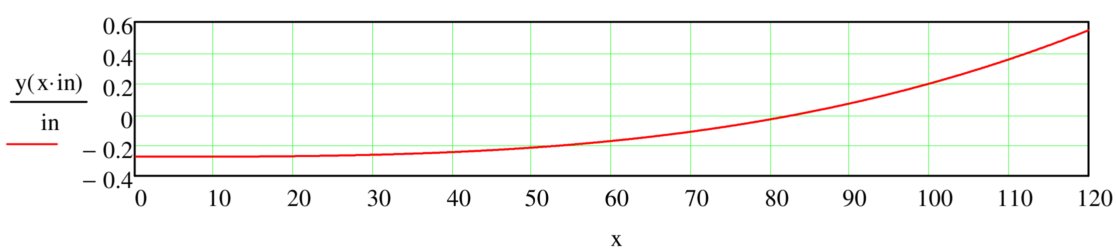
M(x·in) / (lbf·in)
0
− 5×10^4
− 1×10^5
− 1.5×10^5
0 10 20 30 40 50 60 70 80 90 100 110 120
x



I(x·in) / (in^4)
35.08
35.06
35.04
35.02
35
0 10 20 30 40 50 60 70 80 90 100 110 120
x



θ(x·in) / deg
0
− 0.1
− 0.2
− 0.3
− 0.4
0 10 20 30 40 50 60 70 80 90 100 110 120
x



y(x·in) / in
0.6
0.4
0.2
0
− 0.2
− 0.4
0 10 20 30 40 50 60 70 80 90 100 110 120
x