Design Study of a Ring Stiffened Cylinder for use as a Manned Submersible

Elastic Shell Buckling using Non-Dimensional Analysis - Comstock, John Paul, "Principles of Naval Architecture", 1967, Page 208

SafetyFactor := 2.0

DesignGoal := 1320·ft·SafetyFactor DesignGoal = 2640 ft

Design Variables:

Outside Diameter	OD := 42·in
Shell Thickness	t := .375·in, .4375·in .. .625·in
Shell Length	Len := 104.25·in
Number of Rings	num := 2

Constants:

SeaWaterDensity := $64 \cdot \frac{lbf}{ft^3}$

Material Properties:

Yield Strength	$\sigma := 38000 \cdot \frac{lbf}{in^2}$
Youngs Modulus	$E := 30 \cdot 10^6 \cdot \frac{lbf}{in^2}$

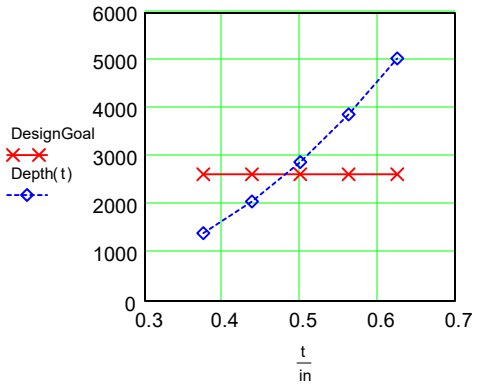
Equations:

$$L(t) := \frac{\frac{1}{3}\cdot\frac{OD}{2} + Len + \frac{1}{3}\cdot\frac{OD}{2}}{num + 1}$$

$$\lambda(t) := \left[\frac{\frac{L(t)}{OD}}{\left[\left(\frac{t}{OD}\right)^{\frac{3}{2}}\right]}\cdot\frac{\sigma}{E}\right]^{\frac{1}{2}}$$

$$Pc(t) := \frac{2\cdot t\cdot\sigma}{OD\cdot SeaWaterDensity}$$

$$Depth(t) := Pc(t)\cdot\frac{1.3}{\left(\lambda(t)^2\right)}$$



$\frac{t}{in}$ =

0.375
0.438
0.5
0.563
0.625

$\frac{Depth(t)}{ft} = \begin{pmatrix} 1409 \\ 2071 \\ 2892 \\ 3882 \\ 5052 \end{pmatrix}$

$OD := 39 \cdot in, 40 \cdot in .. 45 \cdot in$

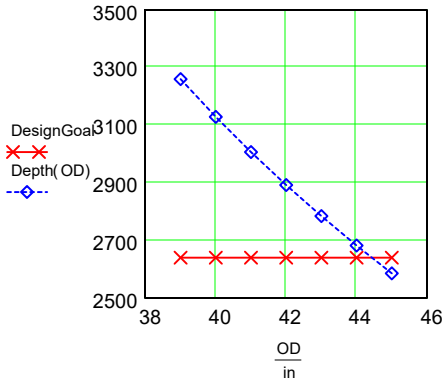
$t := .5 \cdot in$

$$L(OD) := \frac{\frac{1}{3} \cdot \frac{OD}{2} + Len + \frac{1}{3} \cdot \frac{OD}{2}}{num + 1}$$

$$\lambda(OD) := \left[\frac{\frac{L(OD)}{OD}}{\left[\left(\frac{t}{OD} \right)^{\frac{3}{2}} \right]} \cdot \frac{\sigma}{E} \right]^{\frac{1}{2}}$$

$$Pc(OD) := \frac{2 \cdot t \cdot \sigma}{OD \cdot SeaWaterDensity}$$

$$Depth(OD) := Pc(OD) \cdot \frac{1.3}{\left(\lambda(OD)^2\right)}$$



$$\frac{OD}{in} = \begin{pmatrix} 39 \\ 40 \\ 41 \\ 42 \\ 43 \\ 44 \\ 45 \end{pmatrix}$$

$$\frac{Depth(OD)}{ft} = \begin{pmatrix} 3259 \\ 3129 \\ 3007 \\ 2892 \\ 2784 \\ 2682 \\ 2586 \end{pmatrix}$$