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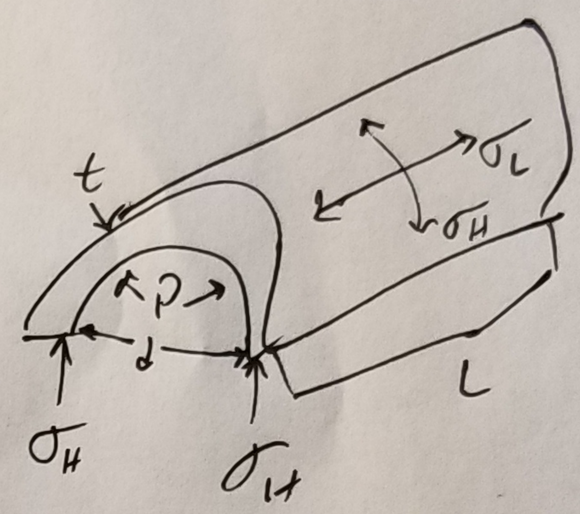
1.) a.) $F = P \times A$

$F = P \times dL$ (UP)

$F = 2\sigma_H \times tL$ (down)

$2\sigma_H \times tL = P \times dL$

$\sigma_H = \frac{Pd}{2t}$



1.) b.) Hoop Stress is thrice the Longitudinal Stress, shown by $\sigma_L = \frac{Pd}{4t}$. By keeping the hoop Stress Below the Yield Stress of the material the cylinder will be Twice as Strong as it needs to be.

c.) 1.0265 kg/m3

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1.) d.) $P = \rho g h$ $P = 0$

ρ = density = 1.0265

$g = 9.81$

$h = ?$

$h = \frac{P}{\rho g} = \frac{190}{(1.0265)(9.81)} = 18.87 m$

1.) e.)

$P = \rho g h$

$380 = (1.0265)(9.81)h$

$h = 37.7 m$

$P_{max} = \frac{2\sigma_{H} t}{d}$

$P_{max} = \frac{2 \times ((90 \times 10^6)(.0017))}{1.7}$

$P_{max} = 380 kPa$

1.) f.) The Real Scenario might have varying densities of water because of her Temperature and depth. The real SUB would also have Seams and Joints to consider.

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2.)a.) A is define the Problem. The Problem that needs to be solved needs to be clearly defined. B is gather information. Create as much information about the Problem as possible. Every detail needs to be known to find the correct solution. ~~Eight~~ C is Generate multiple Solutions, more Solutions is better than one. Take new ideas and existing Ideas and Improve them to create a new novel Solution to the Problem. D is Analyse and Select a Solution. Look at all possible Solutions to Choose the Best one. Look at the functionality of it, its Useability, the Safety factors, →

2.) a.) ...the all important economic factors, and of course the mechanical factors. Once all of those have been considered the best solution needs to be choosen. E is ~~the~~ Test and Implement ~~of~~ the solution. This is the final phase where Prototyping, Engineering and documentation happens. Testing should be ~~a~~ thourough and is helped by modern technology with concurrent Engineering being made possible with Computer Aided Engineering. Finally Implementing the solution and applying for Patents to Protect your Intelectual Property concludes the Process.

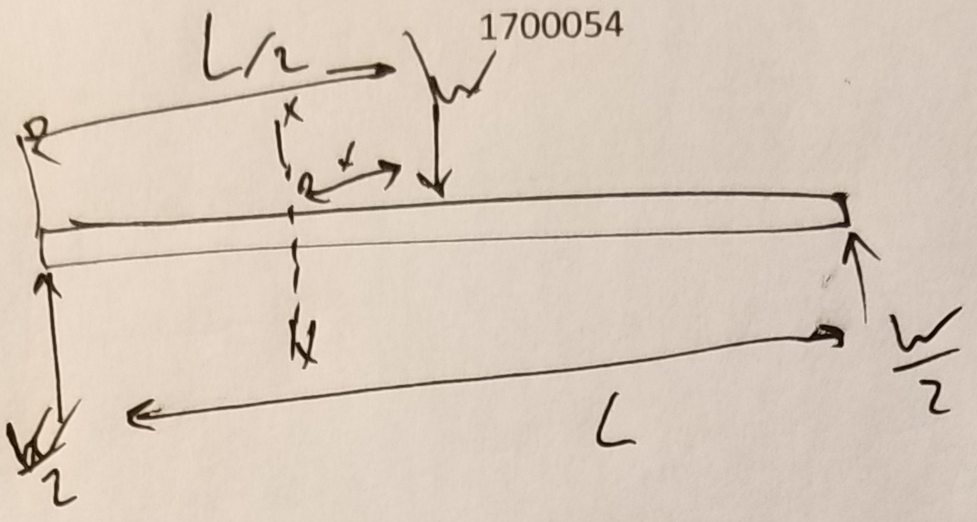
2.) b.) Steps that could benefit from FEA are Generate multiple Solutions, Analysing and Selecting a Solution, and most of all Testing and implemnting Solutions. FEA Speeds up testing and implementing →

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2.) b.) ... Solutions by a huge Amount
Allowing multiple tests to be
run at once.

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3.) a.)



$EI\frac{d^2y}{dx^2} = M$

moment at x $= \frac{w}{2}(L/2 - x)$

$$\frac{wL}{4} - \frac{wx}{2} = EI\frac{d^2y}{dx^2}$$

$$EI\frac{dy}{dx} = \frac{wLx}{4} - \frac{wx^2}{4} + A \text{ and}$$

$$EIy = \frac{wLx^2}{8} - \frac{wx^3}{12} + Ax + B$$

When $x = 0$ Slope $= 0$ So $A = 0$

When $x = L/2$ deflection $= 0$, $B = \frac{wL^3}{48}$

$$\therefore y = \frac{1}{EI}\left[\frac{wLx^2}{8} - \frac{wx^3}{12} - \frac{wL^3}{48}\right]$$

3.) b.) $y_{max} = x = 0$

$$\therefore y = \frac{1}{EI}\left[\frac{wLx^2}{8} - \frac{wx^3}{12} - \frac{wL^3}{48}\right] \rightarrow y = \frac{1}{EI}\left[\frac{wL^3}{48}\right)$$

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3.) c.) $y_{max} = -\frac{WL^3}{48EI}$

$y = 9mm$

$E = 196 GPA$

$I = 41 \times 10^{-6} m^4$

$W = 51 kN$

$.009 = \frac{(51{,}000)L^3}{48(196\times10^9)(41\times10^{-6})}$

$\frac{48(196\times10^9)(41\times10^{-6})(.009)}{51{,}000} = \frac{(51{,}000)L^3}{51{,}000}$

$L^3 = \frac{48(196\times10^9)(41\times10^{-6})(.009)}{51{,}000}$

$\sqrt[3]{L^3} = \sqrt[3]{68.06964706}$

$L = 4.083 m$

3.) d.) The results considered in this scenario may differ from the real one because the train would be moving at speed! The material would eventually fatigue and cause a derailment.

3.) e.) Life span of the material