Mech 425/6521 (Fall 2018)

Solution to Homework 5

Q1:

Using the Equation (3.21) in the textbook

$$\sigma_b = \frac{3\pi E}{\beta^4} \frac{1-\sqrt{\frac{V_f}{V_0}}}{\left(\sqrt{\frac{V_f}{V_0}}-1\right)^4}$$

the compressive load can be calculated through $P_y = \sigma_b \cdot A$, in which $A = 0.5\text{m} \times 0.4\text{m} = 0.2\text{m}^2$.

Then the following results can be obtained:

| $V_f$ | $P_y$ (kN) |
|---|---|
| 0.6 | 3.8 |
| 0.65 | 22.2 |
| 0.7 | 183 |
| 0.75 | 4417 |

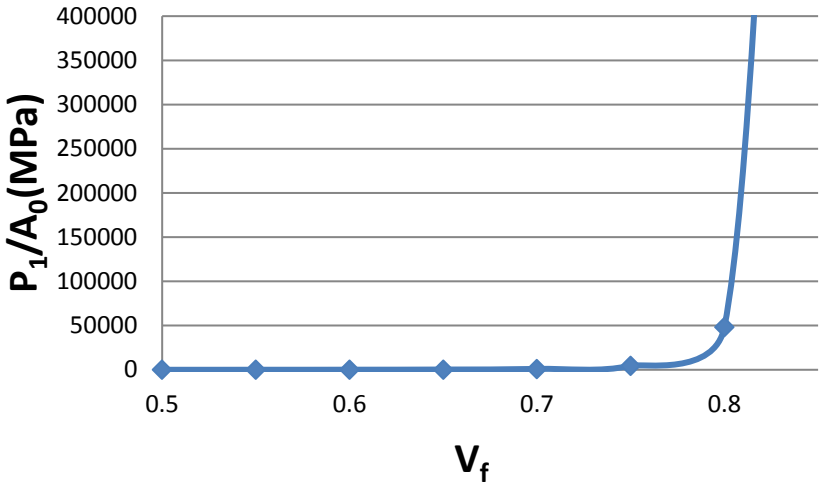
Q2: Using the Equation (3.20) in the textbook

$$P_1 = -\frac{A_0 V_0}{V_f} \frac{1-\sqrt{\frac{V_f}{V_0}}}{\frac{16}{\pi^3}\frac{\beta^2}{e}\sqrt{\frac{V_a}{V_f}}\left(\sqrt{\frac{V_a}{V_f}}-1\right)^3}$$

the values can be obtained and are shown in the following table.

| $V_f$ | $\frac{P_1}{A_0}$ (MPa) |
|---|---|
| 0.50 | 0 |
| 0.55 | 5.29 |
| 0.60 | 16.2 |
| 0.65 | 40.1 |
| 0.70 | 100.2 |
| 0.75 | 295.9 |
| 0.80 | 1487.1 |
| 0.85 | $+\infty$ |

The graph can be plotted:




Since the variation between in $\frac{P_1}{A_0}$ values is huge, the relationship between $V_f$ and $\log\frac{P_1}{A_0}$ can be introduced here.