Open Cell Foams

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1 Young's modulus

$E^* = C_1 \cdot E_s \cdot (\rho^*/\rho_s)^2$

$C_1 \approx 1$

2 Shear Modulus

$G^* = C_2 \cdot E_s \cdot (\rho^*/\rho_s)^2$
$C_2 \approx 3/8 = 0.375$

3 Poisson's Ratio

$\nu^* = \frac{C_1}{2 \cdot C_2} - 1 = C_3 = 1/3$

4 Elastic Collapse

$\sigma^*_{el} = C_4 \cdot E_s \cdot (\rho^*/\rho_s)^2$

$C_4 \approx 0.05$
corresponds to strain when buckling initiates ($\sigma^*_{el}/E^* = C_4 = \epsilon$)

5 Plastic Collapse

$\sigma^*_{pl} = C_5 \cdot \sigma_{ys} \cdot (\rho^*/\rho_s)^{3/2}$

$C_5 \approx 0.3$
elastic collapse precedes plastic collapse if $\sigma^*_{el} < \sigma^*_{pl}$
i.e. $(\rho/\rho_s)_{critical} \leq 36 \cdot (\sigma_{ys}/E_s)^2$

rigid polymers $(\rho/\rho_s)_{critical} < 0.04$
metals $(\rho/\rho_s)_{critical} < 10^{-5}$

6 Brittle Crushing Strength

$\sigma^*_{cr} = C_6 \cdot \sigma_{fs} \cdot (\rho^*/\rho_s)^{3/2}$

$C_6 \approx 0.2$

7 Densification Strain

$\epsilon_D = 1 - 1.4 \cdot (\rho^*/\rho_s)$