Exam 2-2

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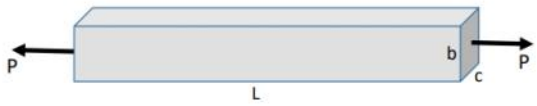
2. Typical Poisson's ratio for conventional structural materials, such as steel, aluminum, etc, is in the range of 0.3 to 0.4. For example for aluminum ν = 0.35. New artificial materials (called metamaterials) may have very unusual properties. Imagine new material with Poisson's ratio ν = - 0.35. A bar made from this new material is subjected to a uniform tensile stress by Load P = 200 kN.

a. Find cross-section area after application of the stress.
(E = 70 GPa, L = 1 m, b = 60mm, c = 40 mm)



b. What is unusual in the response to the stress of this new material?

Solution:

Rather than decreasing, height extends.

A.) $\delta = \frac{FL}{AE}$

$A = bc$

$A = (.06)(.04)$

$A = .024\ m.^2$

$\delta = \frac{(200 \times 10^3)(1)}{(.024)(70 \times 10^9)}$

$\delta = .0012\ m.$

$\nu = -\frac{\varepsilon_t}{\varepsilon_a}$ $\quad .35 = \frac{\varepsilon_t}{.0012}$

$\varepsilon_t = .00042\ m. = .42\ mm.$

$A' = (60 + .42)(40)$

$A' = 2416.8\ mm.^2$