Mechanics of Materials: A Lecturebook

A set of conceptual questions

Conceptual question 2.1

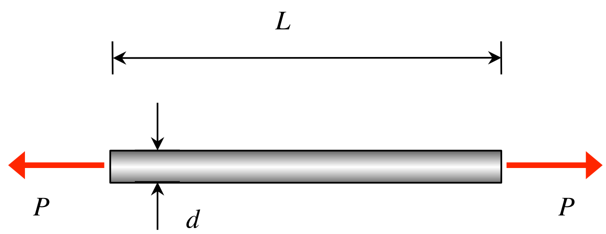
A rectangular cross-section rod (made up of a material with an elastic modulus of E and Poisson's ratio ν) has undeformed dimensions of L, h and b, with L > h > b. As a result of the tensile axial load P being applied to the ends of the rod, the dimensions of the rod change by amounts of ΔL, Δh and Δb, respectively. Circle the correct answer below:

a) $|\Delta h| > |\Delta b|$

b) $|\Delta h| = |\Delta b|$

c) $|\Delta h| < |\Delta b|$

Conceptual question 2.2



A homogeneous rod having a length of $L = 30\ in$ and circular cross section with an outer diameter of d is acted upon by an axial load $P = 4000\ lb$. The material of the rod has a Poisson's ratio, a Young's modulus, a yield strength and an ultimate strength of: $\nu = 0.3$, $E = 30 \times 10^6\ psi$, $\sigma_Y = 36 \times 10^6\ psi$ and $\sigma_U = 58 \times 10^6\ psi$, respectively.

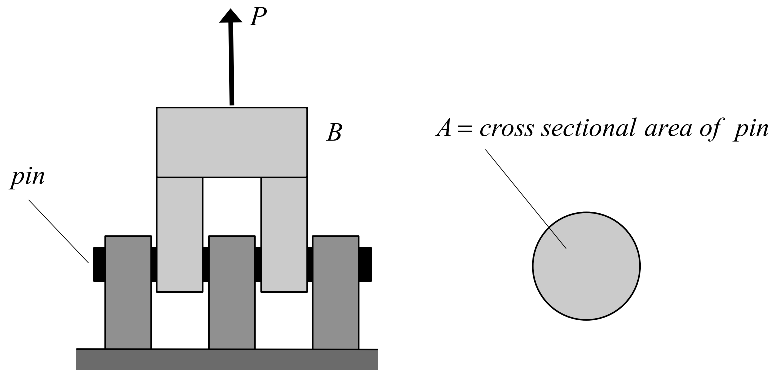
a) Determine the minimum value of d for which the elastic strains in the rod do not exceed $10 \times 10^{-3}\ in / in$.

b) Determine the minimum value of d for which the material does exhibit an offset in length once the load is removed.

c) Determine the minimum value of d for which the material does not exhibit necking.

Conceptual question 3.1

Consider the hinge shown below that is supported by a single pin whose cross-sectional area is A. A load P is applied to end B of the hinge. What is the maximum shear stress in the pin?

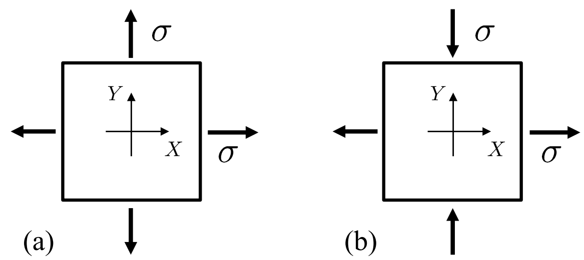


Conceptual question 5.1

For each state of plane stress shown below, i.e., for configurations (a) and (b), indicate whether each component of the state of strain is:

- = 0 (equal to zero)
- > 0 (greater than zero)
- < 0 (less than zero)

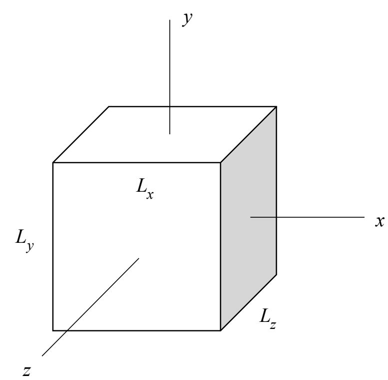
The material is linear elastic with Poisson's ratio ν ($0 < \nu < 0.5$), and the deformations are small.



	(a)	(b)
ϵ_x		
ϵ_y		
ϵ_z		
γ_{xy}		
γ_{xz}		
γ_{yz}		

Fill in with '= 0', '> 0', or '< 0'.

Conceptual question 5.2



A cube of dimensions $\left(L_x, L_y, L_z\right)$ experiences a state of stress with uniform components of stress though out the cube. The material of the cube has a Young's modulus of E and a Poisson's ratio of $\nu = 0.4$. As a result of the loading on the cube, it is known that $\sigma_y = \sigma_z = \sigma_x / 2 > 0$. As a result of this loading (circle the correct answer):

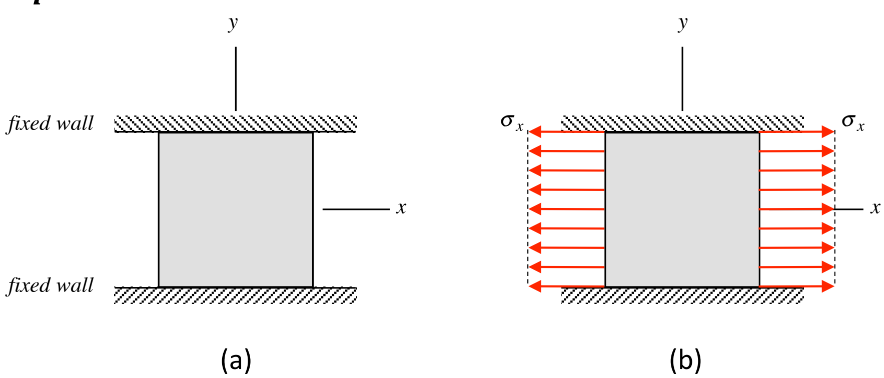
a) The dimension L_z is *increased*.

b) The dimension L_z remains the *same*.

c) The dimension L_z is *decreased*.

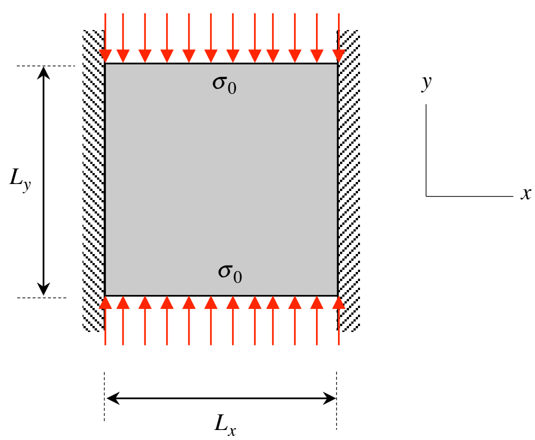
d) More information is needed to answer this question.

Conceptual question 5.3



A square homogeneous block made up of a material with a Poisson's ratio of $\nu = 0.3$ is placed between two smooth, rigid walls. Initially, the temperature of the block in Figure (a) above is increased by an amount that produces a compressive normal stress of $\sigma_y = -20\ ksi$. After that, the block is given an additional tensile stress component σ_x, as shown in Figure (b) above, with this stress, in turn, reducing the y-component of stress to $\sigma_y = -5\ ksi$. Determine the value of σ_x.

Conceptual question 5.4



A block of dimensions $\left(L_x, L_y, L_z\right)$ is placed between two smooth walls, as shown above. The block experiences a state of plane stress ($\sigma_z = 0$) as a result of a uniform compressive stress of σ_0 acting on the y-faces of the block. The material making up the block has a Young's modulus of E and a Poisson's ratio of ν. Determine the three components of normal strain in the block.