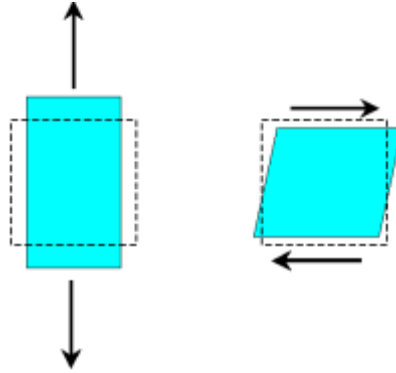


## Mechanical Strain



*Mechanical strain* is the mathematical expression of the shape changes resulting from mechanical stresses. Strains are defined as the ratios of displacements divided by reference lengths. For the normal strain on the left, the reference length is the initial vertical *length*. For the shear strain on the right, the reference length is the initial vertical *height*. This definition for shear strain is also equivalent to the tangent of the angle that the slanted sides make.

The above figure for normal strain shows the usual observation that extension in one direction is accompanied by a contraction in a transverse direction. Not apparent is that this usually involves a volume change. In contrast, shear deformation is a change of shape with constant volume.

As with stresses, there are six independent strains that are expressed in a 3X3 symmetrical strain tensor. All strains are dimensionless, most often expressed as percentages. Normal strains are most commonly designated with the Greek letter epsilon ( $\epsilon$ ) and shear strains with the Greek letter gamma ( $\gamma$ ).