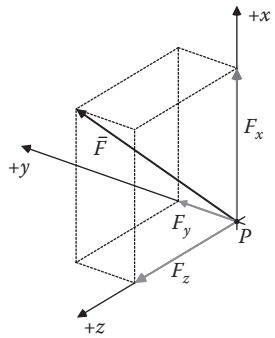


Figure 2.1
A force vector $\bar{F}$ acting at point *P*. Force components F_x, F_y, and F_z acting parallel to the x–y–z coordinate axes, respectively, are also shown.

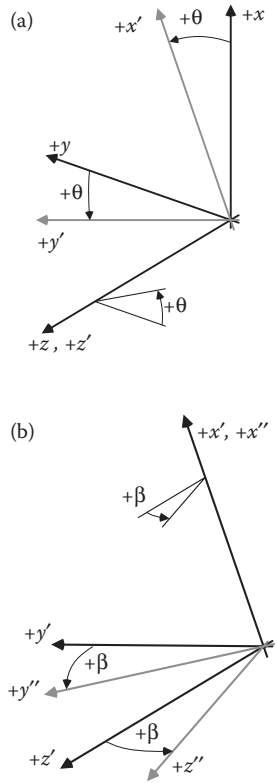


Figure 2.2
Generation of the x''–y''–z'' coordinate system from the x–y–z coordinate system. (a) Rotation of θ-degrees about the original z-axis (which defines an intermediate x'–y'–z' coordinate system); (b) rotation of β-degrees about the x'-axis (which defines the final x''–y''–z'' coordinate system).

002x002.eps

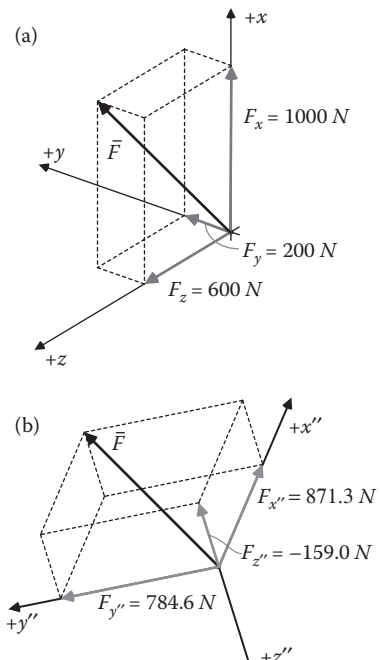


Figure 2.3
Force vector $\bar{F}$ drawn in two different coordinate systems. (a) Force vector $\bar{F}$ in the original x–y–z coordinate system; (b) force vector $\bar{F}$ in a new x''–y''–z'' coordinate system.

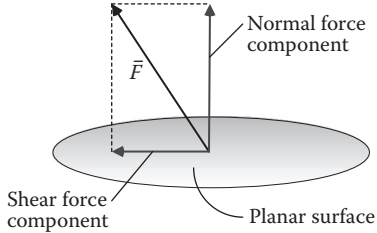


Figure 2.4
A force $\bar{F}$ acting at an angle to a planar surface.

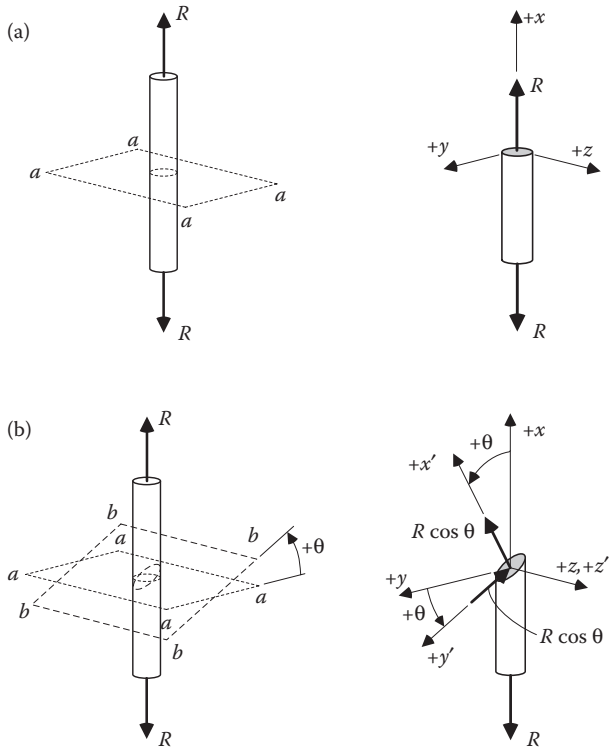


Figure 2.5
The use of free-body diagrams to determine internal forces acting on planes *a–a–a–a* and *b–b–b–b*. (a) Free-body diagram based on plane *a–a–a–a*, perpendicular to rod axis; (b) free-body diagram based on plane *b–b–b–b*, inclined at angle +θ to the rod axis.

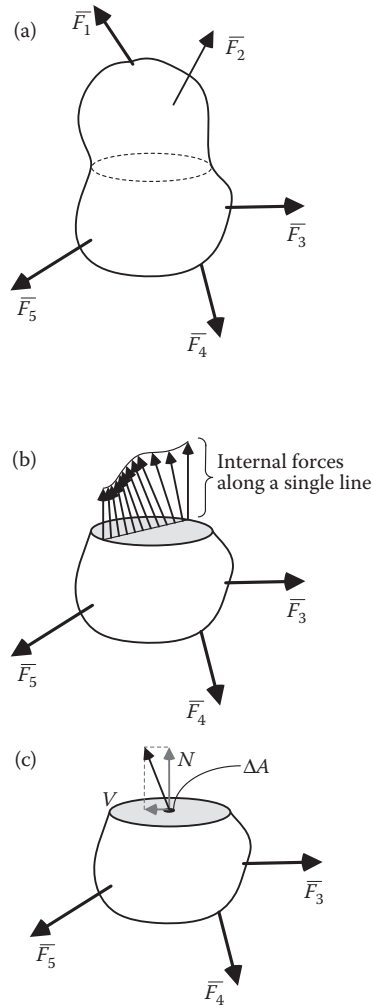


Figure 2.6
A solid 3-D body in equilibrium. (a) A solid 3-D body subject to external forces $\overline{F}_1 \rightarrow \overline{F}_5$; (b) variation of internal forces along an internal line; (c) internal force acting over infinitesimal area ΔA.

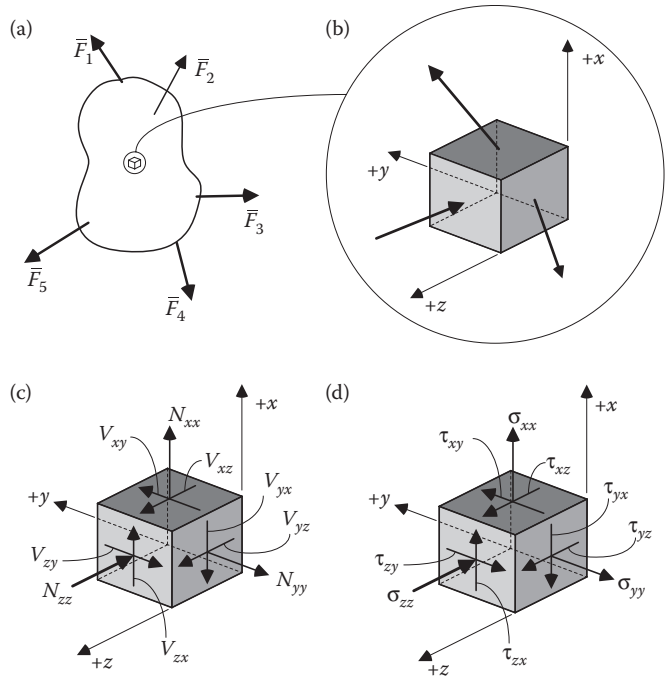


Figure 2.7
Free-body diagrams used to define stress induced in a solid body. (a) 3-D solid body in equilibrium; (b) infinitesimal cube removed from the solid body (internal forces acting on three faces shown); (c) normal force and two shear forces act over each face of the cube; (d) normal stress and two shear stresses act over each face of the cube.

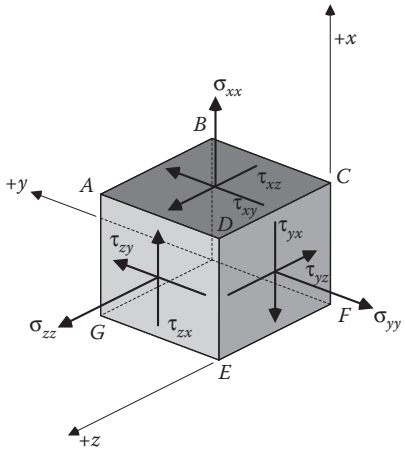


Figure 2.8
An infinitesimal stress element (all stress components shown in a positive sense).

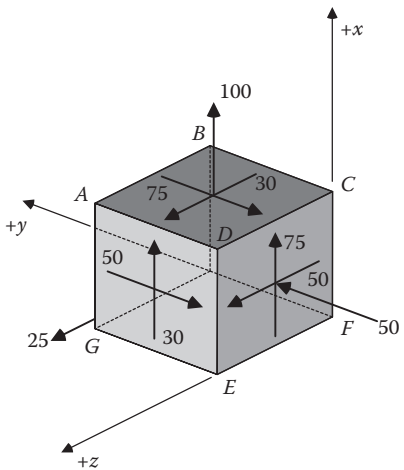


Figure 2.9
Stress components acting on an infinitesimal element (all stresses in MPa).

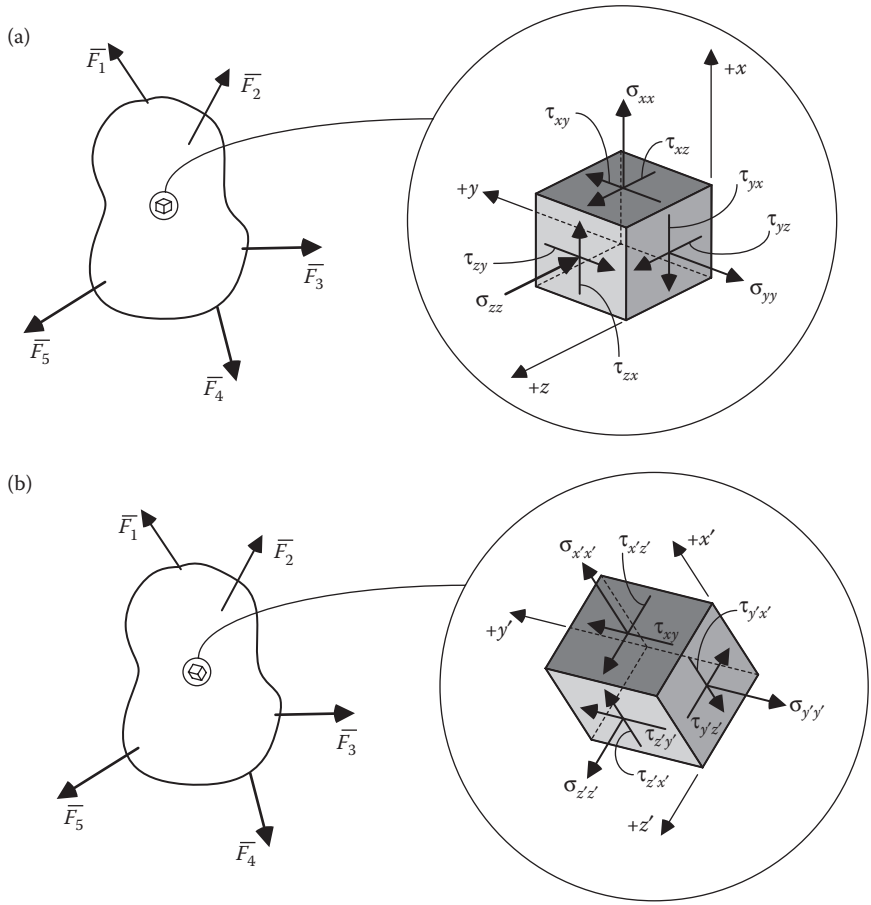


Figure 2.10
Infinitesimal elements removed from the same point within a 3D solid but in two different orientations. (a) Infinitesimal element referenced to the *x*–*y*–*z* coordinate system; (b) infinitesimal element referenced to the *x*′–*y*′–*z*′ coordinate system.

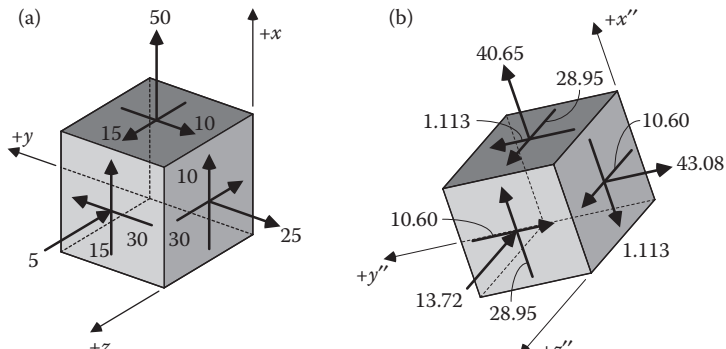


Figure 2.11
Stress tensor of Example Problem 2.3, referenced to two different coordinate systems (magnitude of all stress components in ksi). (a) Referenced to *x*–*y*–*z* coordinate system; (b) referenced to *x*″–*y*″–*z*″ coordinate system.

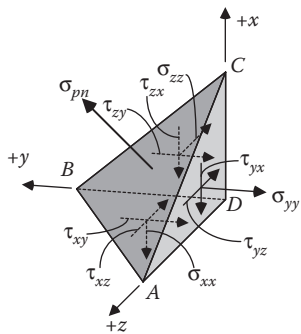


Figure 2.12
Free-body diagram used to relate strress components in the *x–y–z* coordinate system to a principal stress.

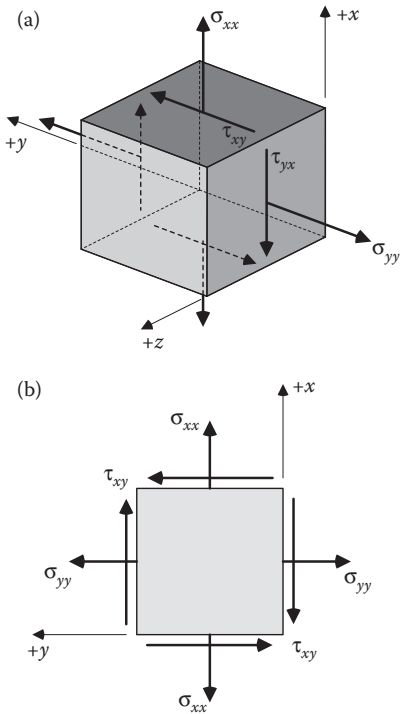


Figure 2.13
Stress elements subjected to a state of plane stress. (a) 3-D stress element subjected to a plane stress state (all stress components shown in a positive sense); (b) plane stress element drawn as a square rather than a cube (positive *z*-axis out of the plane of the figure; all stress components shown in a positive sense).

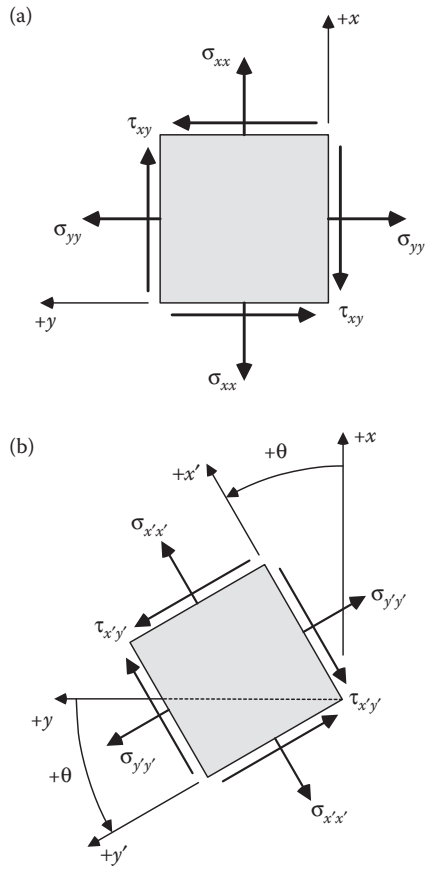


Figure 2.14
Transformation of a plane stress element from one coordinate system to another. (a) Plane stress element referenced to the *x*–*y*–*z* coordinate system; (b) plane stress element referenced to the *x*′–*y*′–*z*′ coordinate system, oriented θ-degrees counter-clockwise from the *x*–*y*–*z* coordinate system.

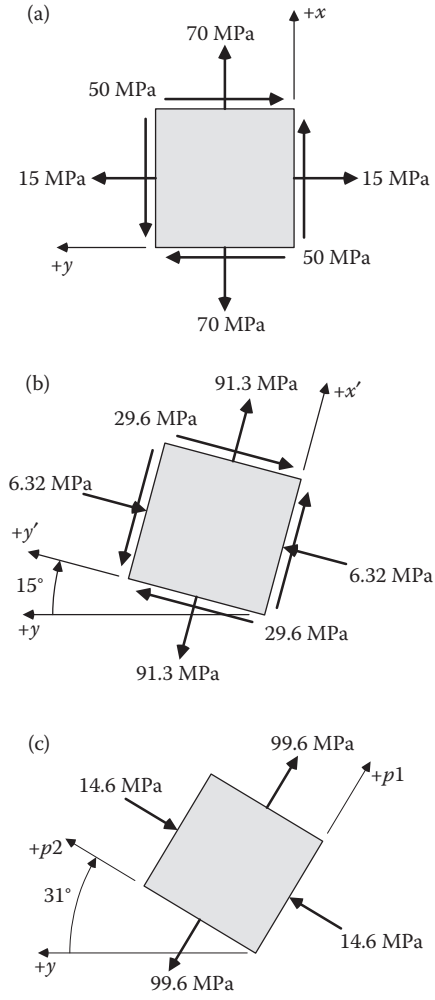


Figure 2.15
Plane stress elements associated with Example Problem 2.5. (a) Plane stress element in the x–y coordinate system; (b) plane stress element in the x'–y' coordinate system; (c) plane stress element in the principal stress coordinate system.

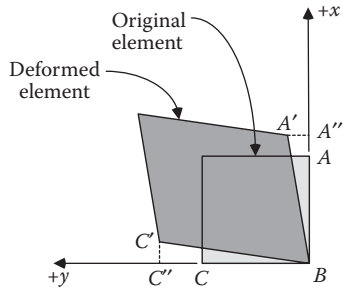
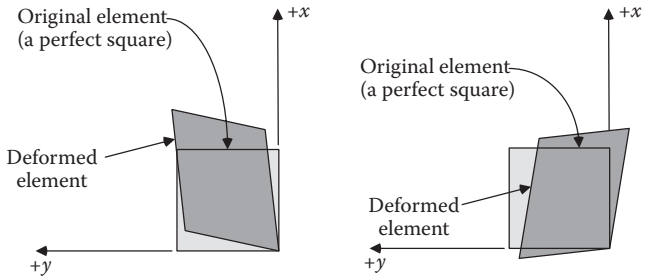


Figure 2.16
2-D element used to illustrate normal and shear strains (deformations are shown greatly exaggerated for clarity).



(a) Deformed strain element implied by:

$\varepsilon_{xx} = 1000\ \mu m/m$

$\varepsilon_{yy} = -500\ \mu m/m$

$\gamma_{xy} = 1500\ \mu rad$

(b) Deformed strain element implied by:

$\varepsilon_{xx} = 1000\ \mu m/m$

$\varepsilon_{yy} = -500\ \mu m/m$

$\gamma_{xy} = -1500\ \mu rad$

Figure 2.17
Strain elements associated with Example Problem 2.6 (not to scale).

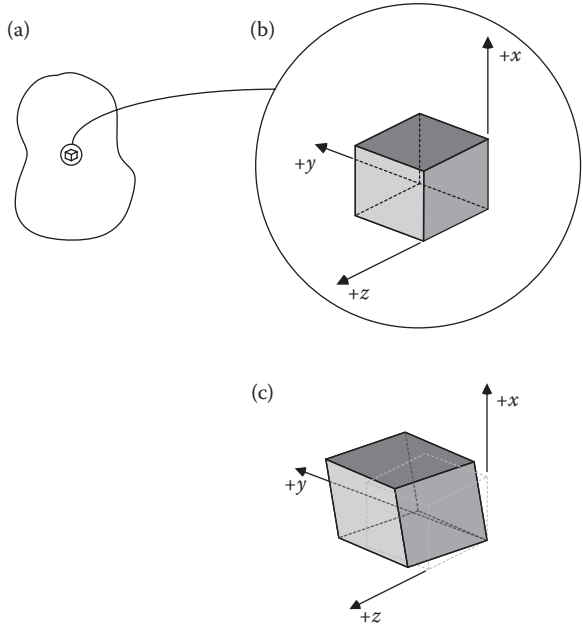
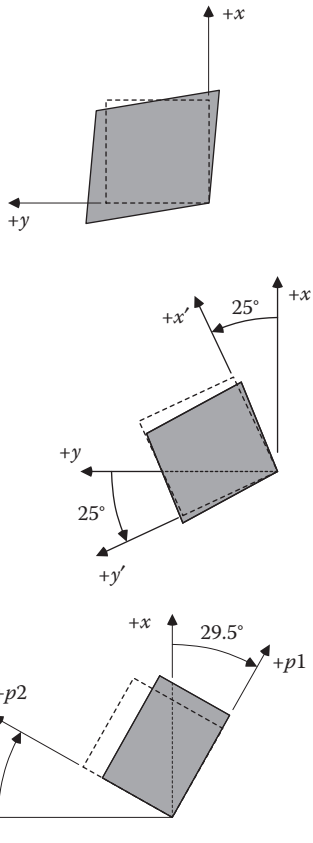


Figure 2.18
Infinitesimal element used to illustrate the strain tensor. (a) General 3-D solid body; (b) infinitesimal cube removed from the body, prior to deformation; (c) infinitesimal cube removed from the body, after deformation.



(a) Strain element in the x–y coordinate system:

$\varepsilon_{xx} = 500\ \mu m/m$
$\varepsilon_{yy} = -1000\ \mu m/m$
$\gamma_{xy} = -2500\ \mu rad$

(b) Strain element in the x'–y' coordinate system:

$\varepsilon_{xx} = -725\ \mu m/m$
$\varepsilon_{yy} = 225\ \mu m/m$
$\gamma_{xy} = -1378\ \mu rad$

(c) Strain element in the principal strain coordinate system:

$\varepsilon_{p1} = 1208\ \mu m/m$
$\varepsilon_{p2} = -1708\ \mu m/m$

Figure 2.19
Strain elements associated with Example Problem 2.9 (all deformations shown greatly exaggerated for clarity).