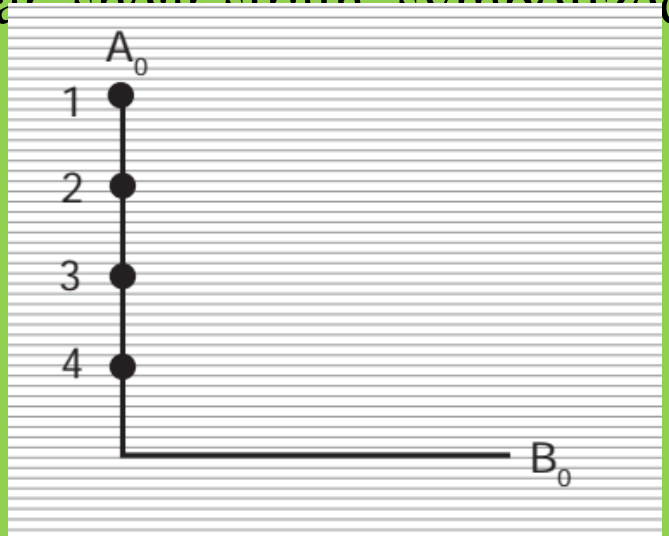
Structural Geology
and
Structural Analysis

The Earth is a Dynamic Planet.

Shear Strain:

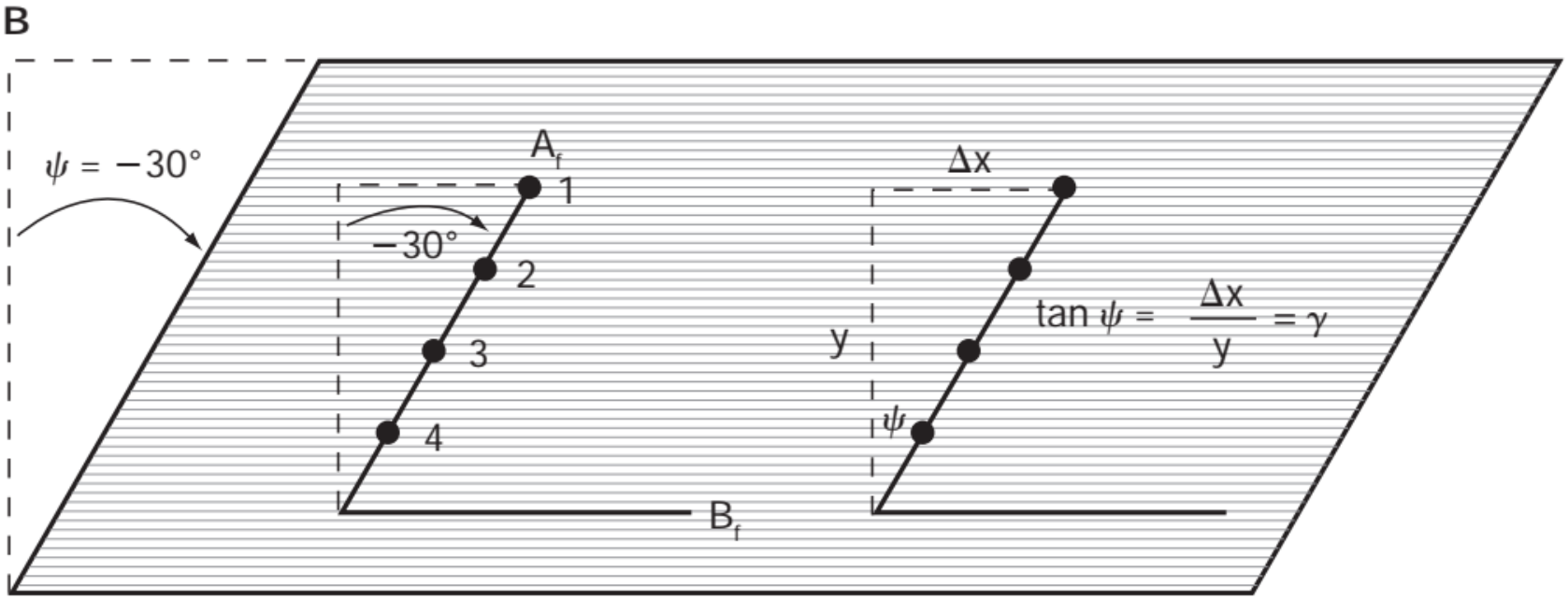
Let us consider how points on a line move as a response to angular shear, shear strain, symbolized by the Greek letter gamma (γ),



$$\tan \psi = \frac{\Delta x}{y}$$

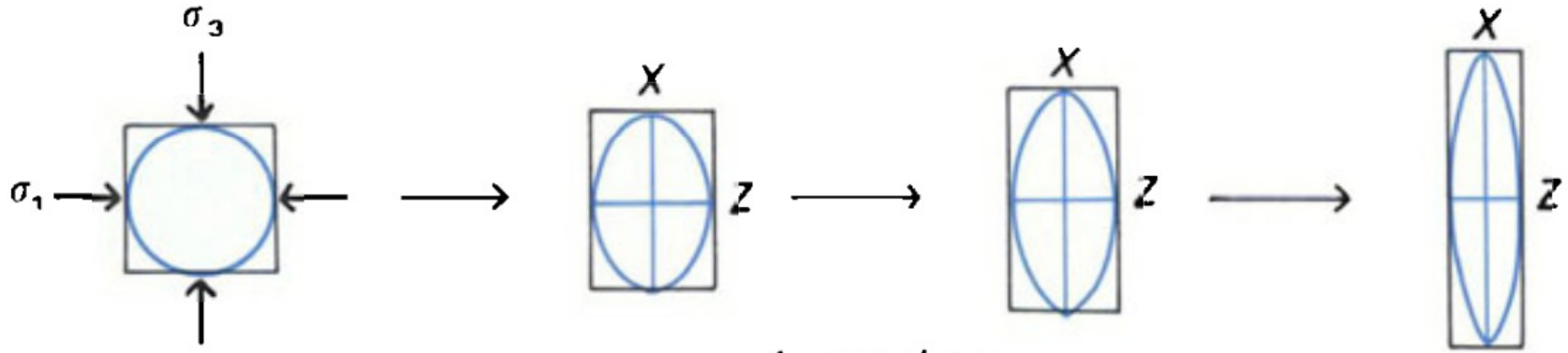
$$\Delta x = y \tan \psi$$

$$\gamma = \tan \psi$$

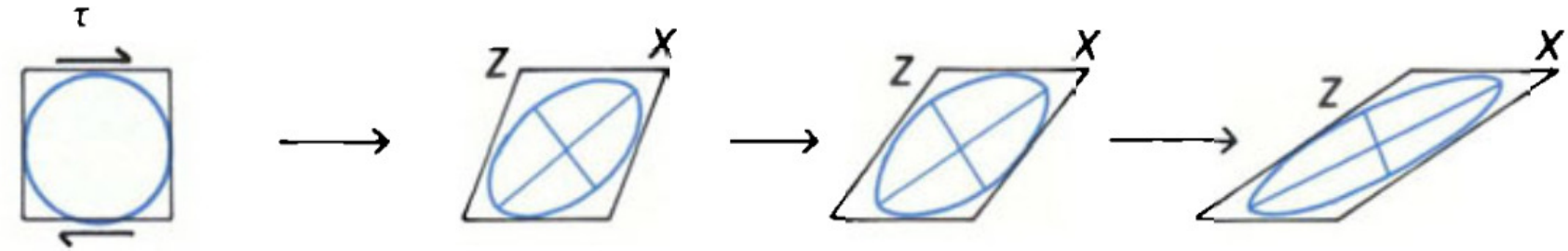


Pure Shear and Simple Shear:

If the orientations of the principal strains X, Y and Z have not changed during the deformation, the strain is non-rotational, and is described as coaxial. Such a strain is generally known as pure shear . Where a change in orientation has occurred, the strain is described as rotational, or non-coaxial, and this process is known as simple shear.



A pure shear



B simple shear

Key Terms to know

Plane: a flat surface; it has the property that a line joining any two points lies wholly on its surface. Two intersecting lines define a plane.

Attitude: the general term for the orientation of a plane or line in space, usually related to geographical coordinates and the horizontal . Both trend and inclination are components of attitude.

Trend: the direction of a horizontal line specified by its bearing or azimuth.

Bearing: the horizontal angle measured east or west from true north or south.
Azimuth: the horizontal angle measured clockwise from true north.

Strike: the trend of a horizontal line on an inclined plane. It is marked by the line of intersection with a horizontal plane.

Structural bearing: the horizontal angle measured from the strike direction to the line of interest.

Inclination: the vertical angle, usually measured downward, from the horizontal to a sloping plane or line.

True dip: the inclination of the steepest line on a plane; it is measured perpendicular to the strike direction.

Apparent dip: the inclination of an oblique line on a plane; it is always less than true dip

Dip and strike
The terms dip and strike apply to any structural plane and together constitute attitude.

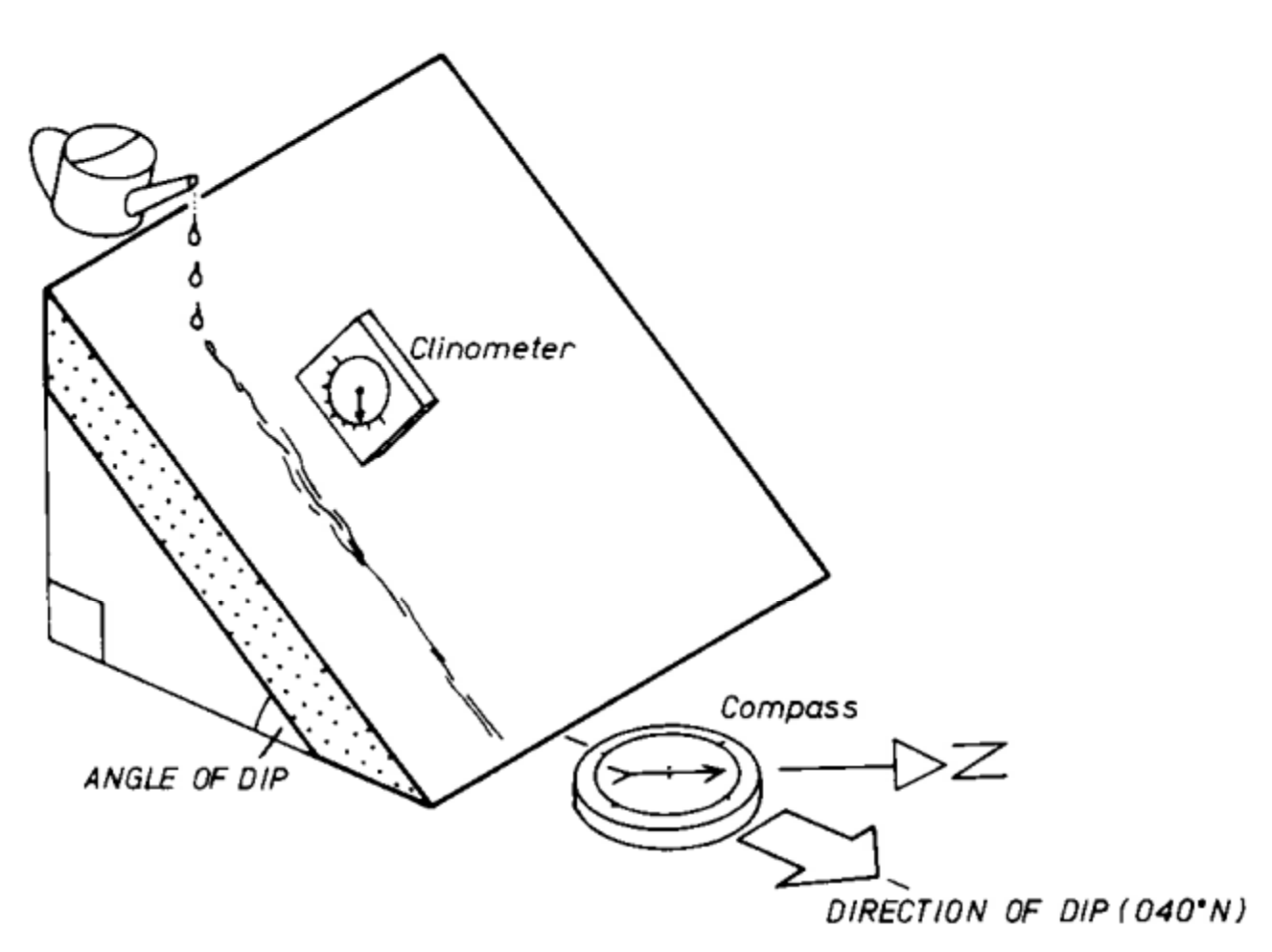
Bedding and other geological layers and planes that are not horizontal are said to dip. The *dip* is the slope of a geological surface.

There are two aspects to the dip of a plane:

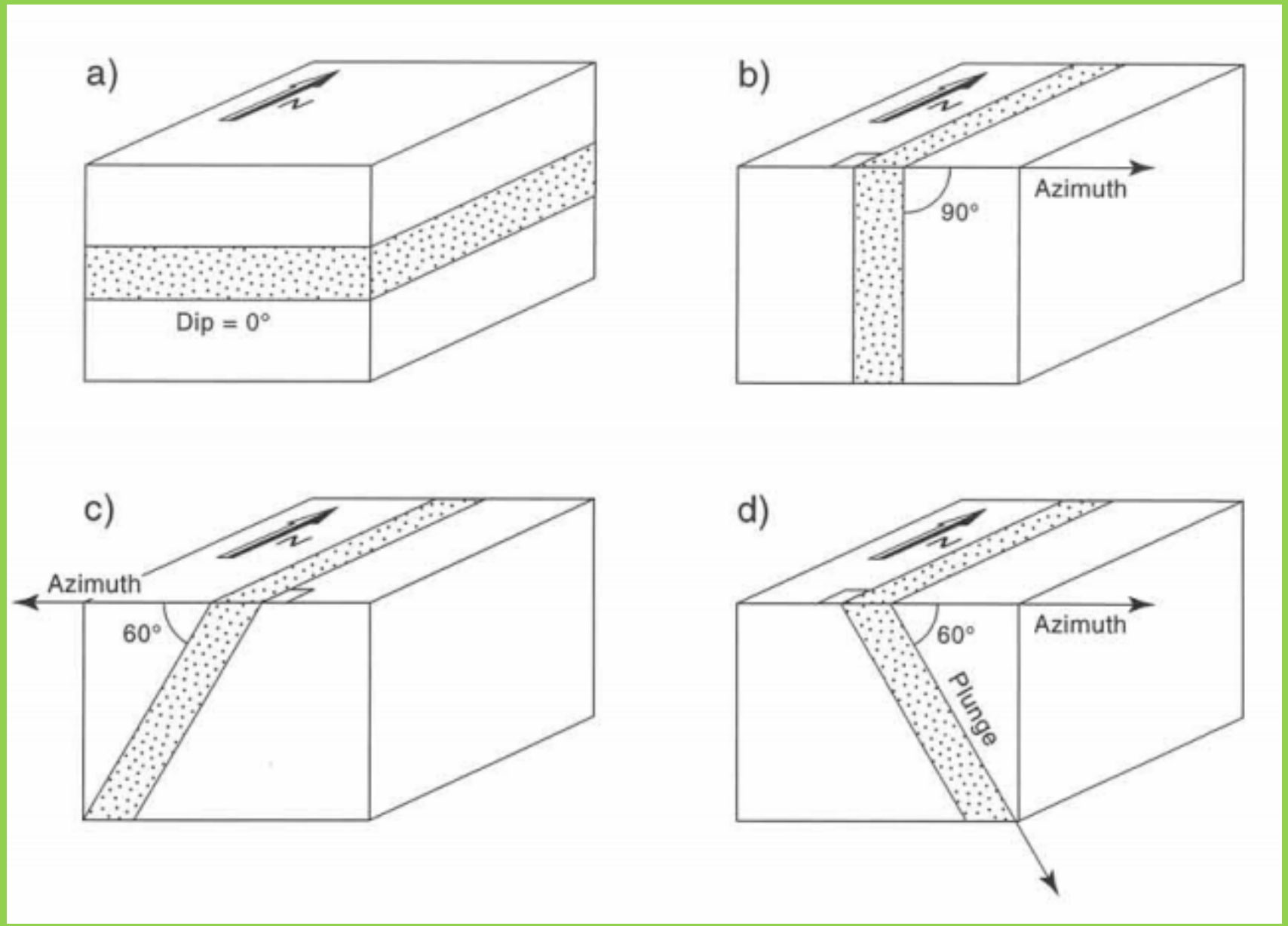
- The direction of dip, which is the compass direction towards which the plane slopes.

- The angle of dip which is the angle that the plane makes with a horizontal plane.

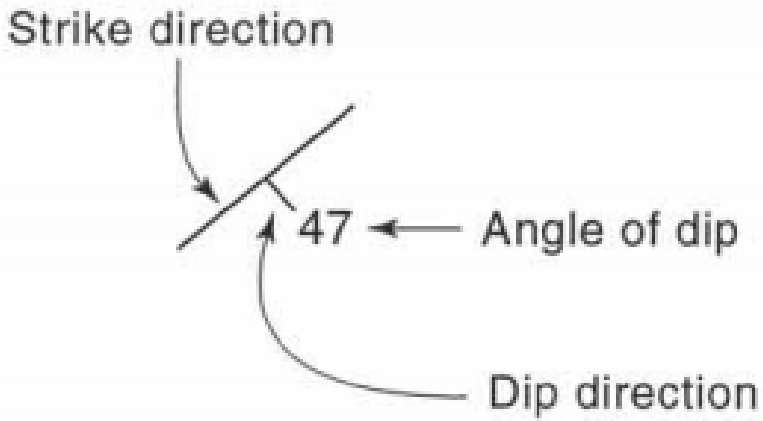
The angle of dip is an angle between 0° (for horizontal planes) and 90° (for vertical planes).



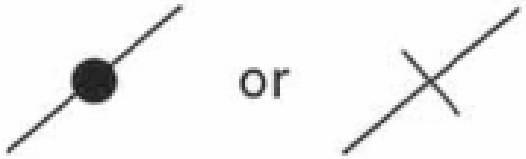
The concepts of direction of dip and angle of dip


a)
Dip = 0°
b)
Azimuth
90°
c)
Azimuth
60°
d)
60°
Azimuth
Plunge

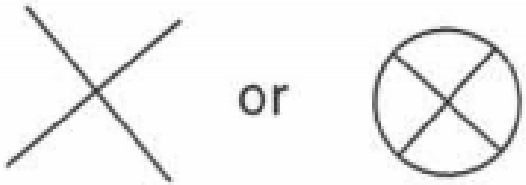
a) Strike and dip of inclined bedding

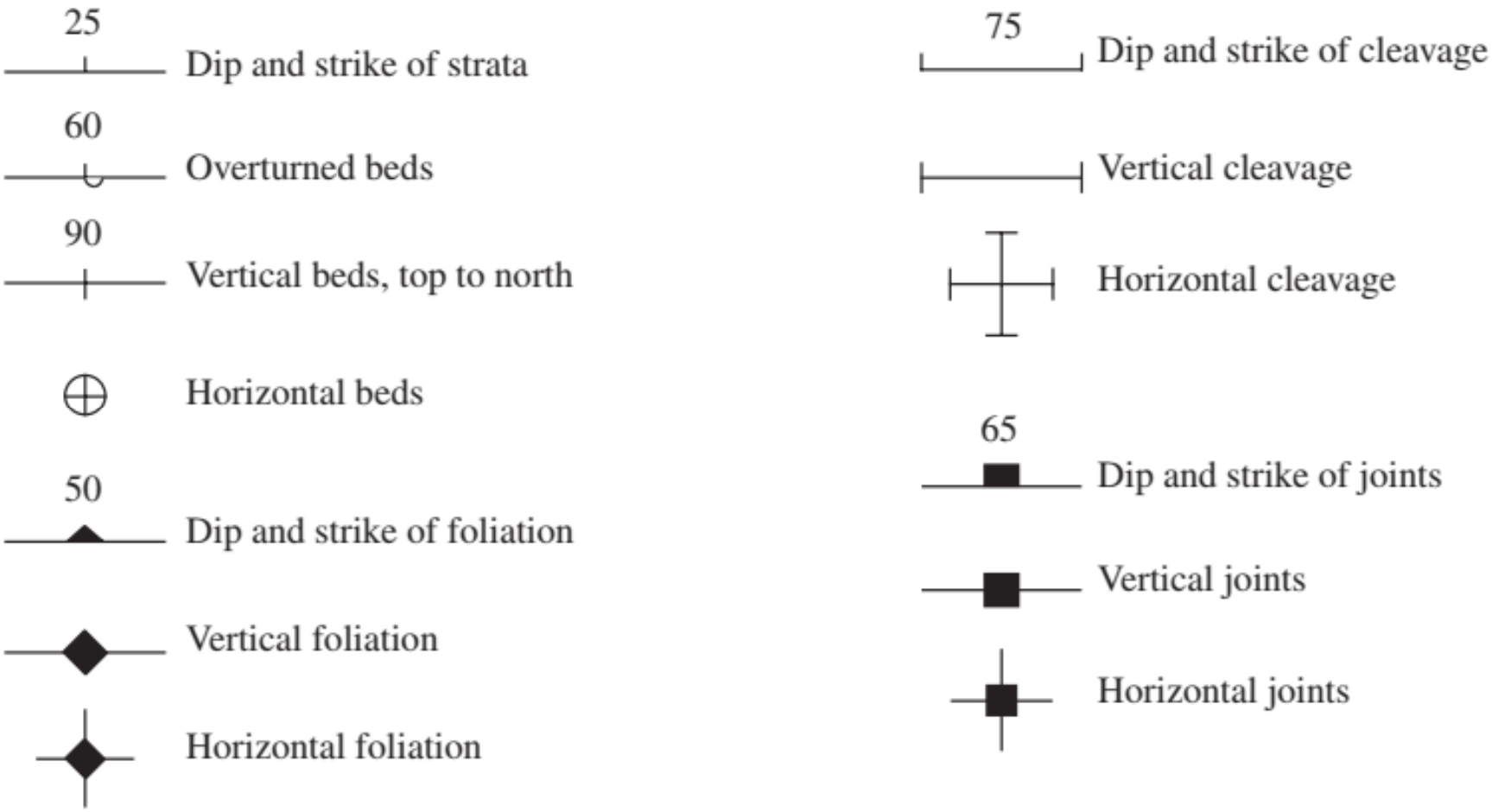


b) Vertical bedding



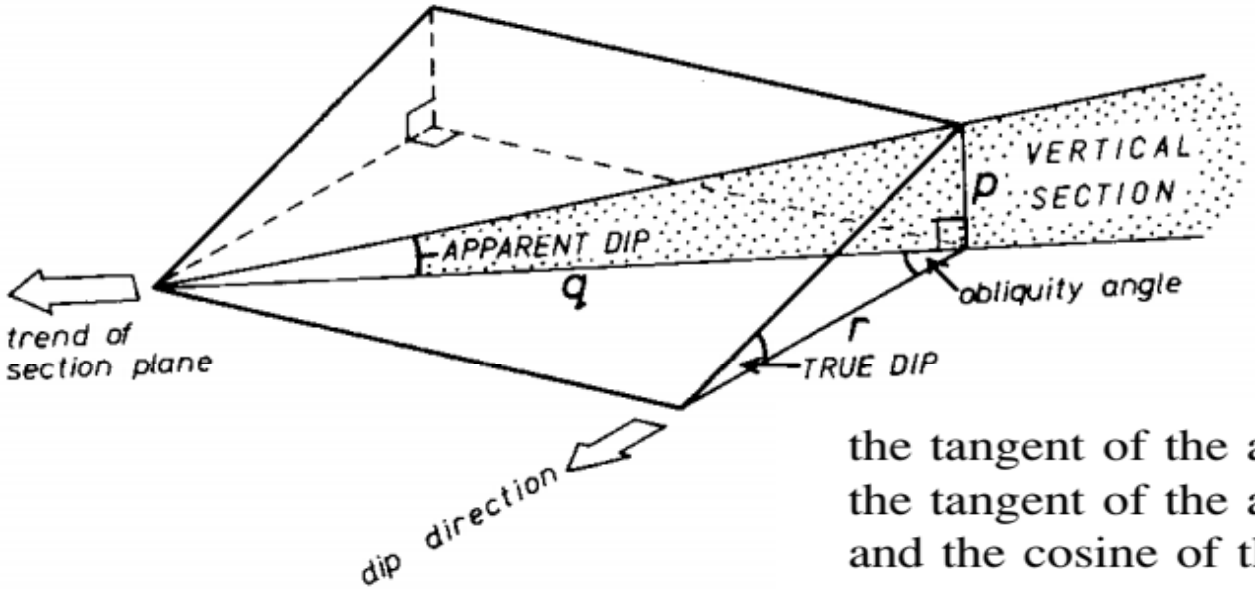
c) Horizontal bedding




25
Dip and strike of strata
60
Overturned beds
90
Vertical beds, top to north
Horizontal beds
50
Dip and strike of foliation
Vertical foliation
Horizontal foliation
75
Dip and strike of cleavage
Vertical cleavage
Horizontal cleavage
65
Dip and strike of joints
Vertical joints
Horizontal joints

Strike lines: The *strike line* is a horizontal line within a dipping plane.

Relation of apparent dip to true dip



the tangent of the angle of apparent dip $= p/q$,
the tangent of the angle of true dip $= p/r$
and the cosine of the obliquity angle $= r/q$.

Since it is true that:

$$p/r \times r/q = p/q$$

it follows that:

$$\tan(\text{apparent dip}) = \tan(\text{true dip}) \times \cos(\text{obliquity angle})$$