Lecture 8: Measuring Strain

The last lecture explained the basic ideas about strain and introduced the strain tensor. This lecture explores a few different ways to measure strain and explains how strain, like stress, can be represented graphically using Mohr's circle.

1. Measuring Techniques

a. Leveling

Leveling uses a level telescope and two measuring sticks to measure the vertical distance between two points.

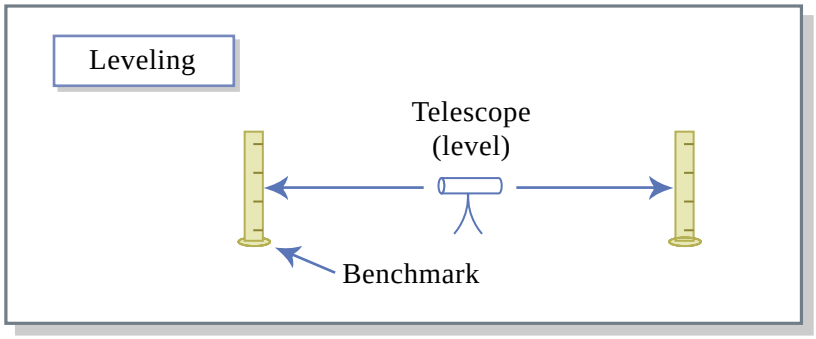

Figure 8.1

Figure by MIT OCW.

b. Triangulation

Triangulation uses a telescope mounted on a protractor to measure the angle between two points.

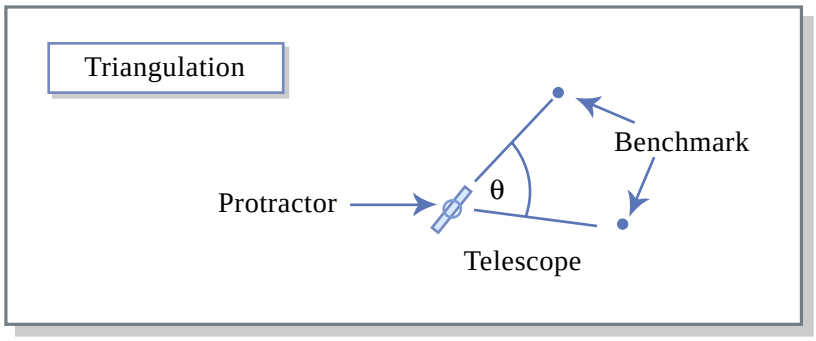

Figure 8.2

Figure by MIT OCW.

c. Trilateration

Trilateration uses a laser mounted on a protractor to measure the distance to two objects and the angle between them.

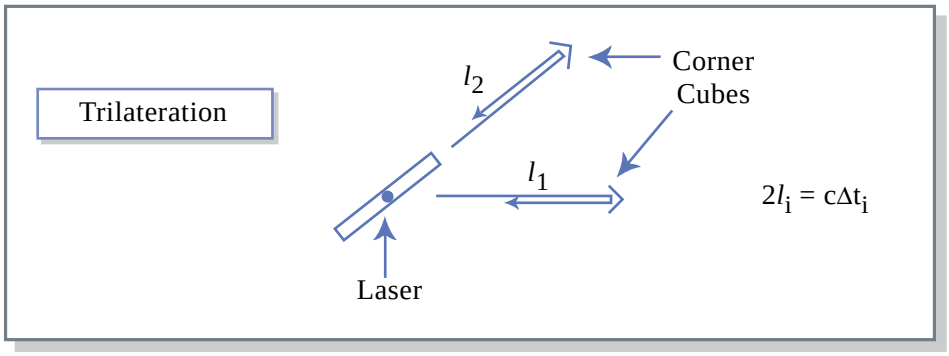

Figure 8.3

Figure by MIT OCW.

d. Very Long Baseline Interferometry (VLBI) and the Global Positioning System (GPS)

VBLI and GPS measure the location of objects on the Earth's surface by using antennae to read signals from space. In VBLI, this signal comes from quasars. In GPS, the signal comes from a satellite.

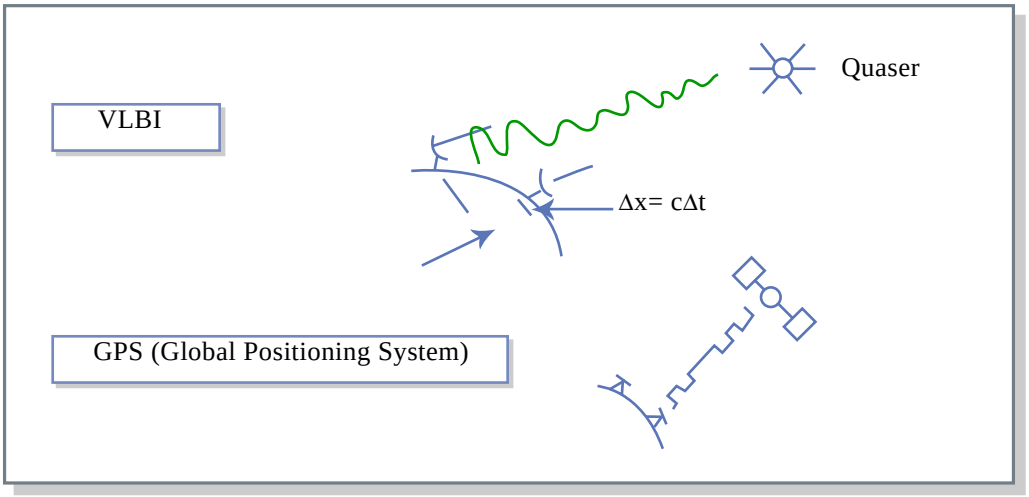

Figure 8.4

Figure by MIT OCW.

	Angle	Distance	Height	Orientation
Leveling			Yes	
Triangulation	Yes			
Trilateration	Yes	Yes		
VLBI	Yes	Yes	Yes	Yes
GPS	Yes	Yes	Yes	Yes

For a more complete treatment of these techniques with examples, see pages 94-107 in Geodynamics by Turcotte and Schubert.

2. Indirect Measurement of Strain

In addition to using the techniques listed above, strain can sometimes be measured indirectly by observing the change in shape of objects that naturally have a certain geometry. For example, a geologist may compare the deformed shape of fossils, pebbles, or veins in an outcrop to their undeformed shape to determine the presence of tension, shear, or compression.

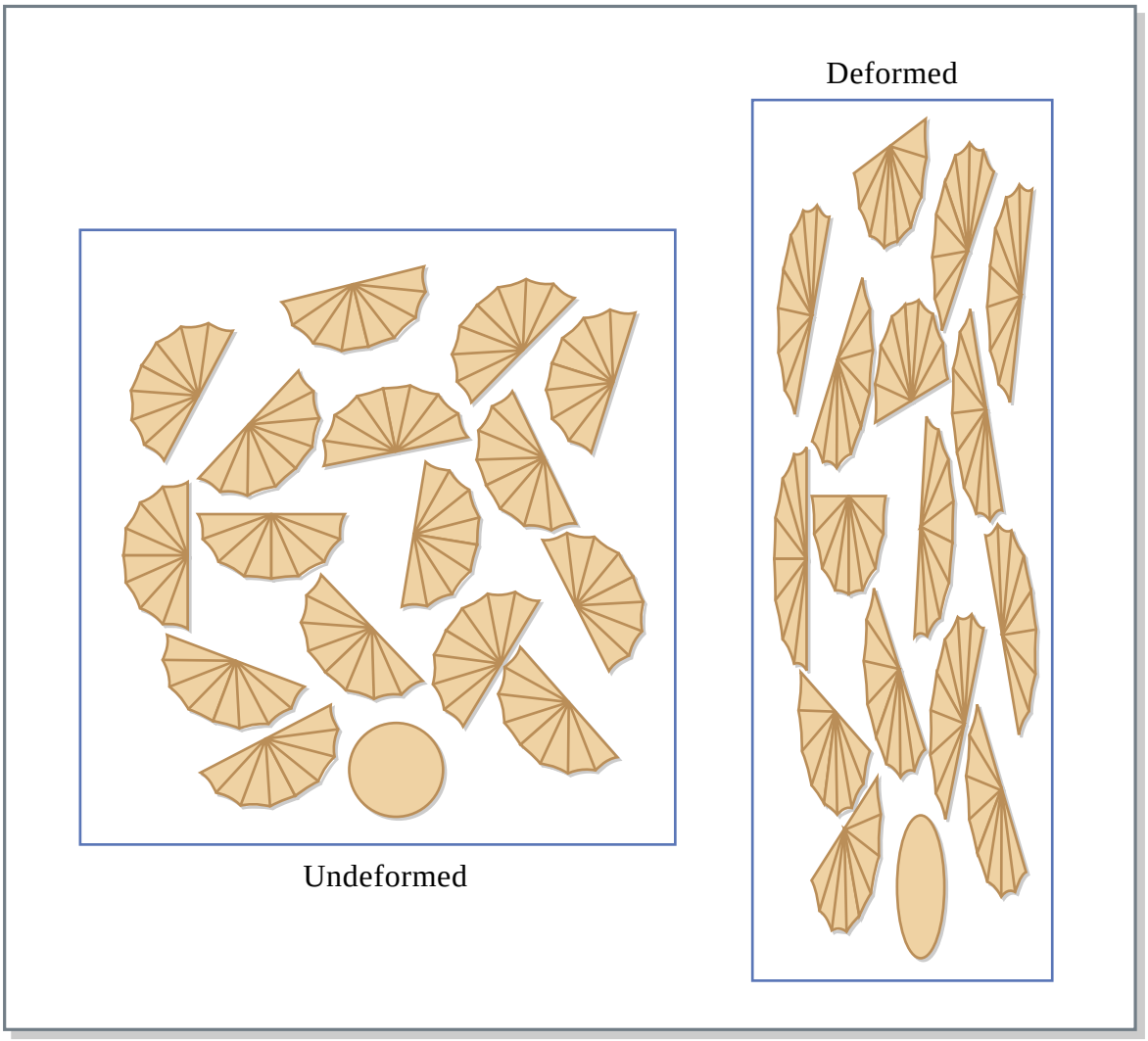

Figure 8.5

Figure by MIT OCW.

This picture shows how deformed fossils and pebbles can be used to infer the strain in the host rock.

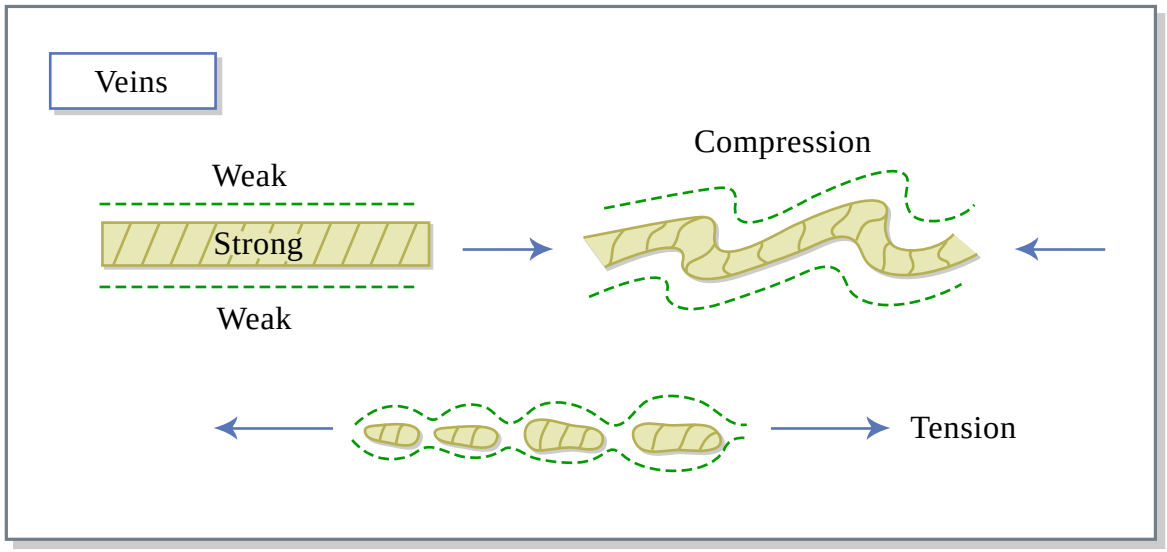

Figure 8.6

Figure by MIT OCW.

This picture shows how veins form waves under compression and boudins under tension.