**Seismic Scale**

A **seismic scale** is used to measure and compare the relative severity of earthquakes.

Two fundamentally different but equally important types of scales are commonly used by seismologists to describe earthquakes. The original force or energy of an earthquake is measured on a *magnitude scale*, while the intensity of shaking occurring at any given point on the Earth's surface is measured on an *intensity scale*.

**Severity**

The severity of an earthquake is described by both magnitude and intensity. These two frequently-confused terms both refer to different, but related, observations. *Magnitude,* usually expressed as an Arabic numeral, characterizes the size of an earthquake by measuring indirectly the energy released. By contrast, *intensity* indicates the local effects and potential for damage produced by an earthquake on the Earth's surface as it affects humans, animals, structures, and natural objects such as bodies of water. Intensities are usually expressed in roman numerals, each representing the severity of the shaking resulting from an earthquake. Any given earthquake can be described by only one *magnitude*, but many *intensities* since the earthquake effects vary with circumstances such as distance from the epicenter and local soil conditions.

Charles Richter, the creator of the Richter magnitude scale, distinguished *intensity* and *magnitude* as follows: "I like to use the analogy with radio transmissions. It applies in seismology because seismographs, or the receivers, record the waves of elastic disturbance, or radio waves, that are radiated from the earthquake source, or the broadcasting station. Magnitude can be compared to the power output in kilowatts of a broadcasting station. Local intensity on the Mercalli scale is then comparable to the signal strength on a receiver at a given locality; in effect, the quality of the signal. Intensity, like signal strength, will generally fall off with distance from the source, although it also depends on the local conditions and the pathway from the source to the point."

**Seismic intensity scales**

The first simple classification of earthquake intensity was devised by Domenico Pignataro in the 1780s. However, the first recognizable intensity scale in the modern sense of the word was drawn up by P.N.G. Egen in 1828; it was ahead of its time. The first widely adopted intensity scale, the Rossi-Forel scale, was introduced in the late 19th century. Since then numerous intensity scales have been developed and are used in different parts of the world: the scale currently used in the United States is the Modified Mercalli scale (MM), while the European Macroseismic Scale is used in Europe, the Shindo scale is used in Japan, and the MSK-64 scale is used in India, Israel, Russia and throughout the CIS. Most of these scales have twelve degrees of intensity, which are roughly equivalent to one another in values but vary in the degree of sophistication employed in their formulation.

**Magnitude scales**

The first attempt to qualitatively define a single, absolute value to describe the size of earthquakes was the magnitude scale (the name being taking from similarly formulated scales used to represent the brightness of stars).

**Local magnitude scale**

*Main article: Richter magnitude scale*

The local magnitude scale (ML), also popularly known as the Richter Scale, is a quantitative logarithmic scale. In the 1930s, California seismologist Charles F. Richter devised a simple numerical scale to describe the relative sizes of earthquakes in Southern California. The name "Richter Scale" was coined by journalists and is not generally used by seismologists in technical literature. ML is obtained by measuring the maximum amplitude of a recording on a Wood-Anderson torsion seismometer (or one calibrated to it) at a distance of 600 km from the earthquake. Other more recent magnitude measurements include: body wave magnitude (mb), surface wave magnitude (Ms), and duration magnitude (MD). Each of these is scaled to give values similar to those given by the local magnitude scale; but because each is based on a measurement of one part of the seismogram, they do not measure the overall power of the source and can be negatively affected by saturation at higher magnitude values—meaning that they fail to report higher magnitude values for larger events. This problem sets in at around magnitude 6 for local magnitude; surface-wave magnitude saturates above 8. Despite the limitations of older magnitude scales, they are still in wide use, as they can be calculated rapidly, catalogues of them dating back many years are available, and the public is familiar with them.

**Moment magnitude scale**

*Main article: Moment magnitude scale*

Because of the limitations of the magnitude scales, a new, more uniformly applicable extension of them, known as moment magnitude (MW), was developed. In particular, for very large earthquakes moment magnitude gives the most reliable estimate of earthquake size. This is because seismic moment is derived from the concept of moment in physics and therefore provides clues to the physical size of an earthquake—the size of fault rupture and accompanying displacement and length of slippage — as well as the amount of energy released. So while seismic moment, too, is calculated from seismograms, it can also be obtained by working backwards from geologic estimates of the size of the fault rupture and displacement. The values of moments for different earthquakes range over several orders of magnitude, and because they are not influenced by variables such as local circumstances, the results obtained make it easy to objectively compare the sizes of different earthquakes. These characteristics, plus the seismic moment's immunity to saturation at higher magnitudes and compatibility with other magnitude scales, led Tom Hanks and Hiroo Kanamori to introduce in 1979 the moment magnitude (MW) scale for representing the absolute size of earthquakes.