“I want to build a home near the intersection of Grand Avenue and Main Street. Is that spot safe in case of earthquake?” Questions in that vein are familiar to every seismologist. The answer is that there is no locality on earth completely safe against earthquakes. Rather than avoiding the neighborhood of active faults, have structures designed to resist earthquakes and build them on solid ground.

Even in the strongest earthquakes well-built houses frequently withstand the shaking. In San Francisco in 1906, houses in the immediate vicinity of the fault, where a slipping of many feet occurred, remained in useful condition for many years. Large globes on street lights have remained intact while poorly constructed buildings across the sidewalk have been demolished. Fences have been displaced near scarcely damaged houses. Contrary to general belief, it is extremely rare that fissures open in the ground wide enough to swallow people and houses, and then close.

Occasionally a large earthquake occurs in a region where none has ever been observed or suspected before, and for that reason it is impossible to say that any given locality is safe from such shocks. However, about 80 percent of all quakes occur in a relatively narrow belt circling the Pacific Basin, as shown in the accompanying illustration giving geographic distribution of earthquakes from 1904 to 1947. Seismic activity in the Aleutian Islands is rather high but decreases somewhat as we approach the Alaska Peninsula and is still smaller in British Columbia. In California such activity increases and reaches a relatively high level in Mexico and Central America, surpassed only by that in Japan and parts of the southwestern Pacific near the Solomon Islands and New Hebrides.

From time to time forecasters arise who “predict” earthquakes. As there are more than 1,000,000 such disturbances every year strong enough to be felt by an observer close to the source, whoever predicts one for any specified date in the western Pacific will be right. This actually is no prediction. Nor is it such if someone foretells an earthquake in the California-Nevada area on a given date, as there are more than 1,000 shocks annually large enough to be felt somewhere in this area. A truly scientific prediction must include date and approximate time, fairly accurate location of the earthquake, and a reasonably accurate description of intensity. Such a prediction is impossible to make at present.

We do not know positively the cause of earthquakes. The bottom of the Pacific Basin, inside the earthquake zone, is formed by different types of rock than the crustal layers in the surrounding continental areas. Because of different physical properties of the two materials, tensions apparently form in the boundary area, and these finally lead to a breaking of the material and shifting of the two sides along the break. The breaking causes heavy shaking, or an earthquake.

Geodetic investigations leave no doubt that the earth’s crust is undergoing distortion continuously. Triangulations of the U.S. Coast and Geodetic Survey in California clearly indicate the angles of the triangles there are changing and that the earth’s crust is undergoing shearing which sooner or later must result in earthquakes. Where these shocks will occur, or when, cannot be predicted, largely because they originate at
such depths that it is impossible to find by direct observation how close the strain is to the breaking strength of the material.

Usually such fracturing occurs at depths of 10 to 20 miles, depending on the region, but occasionally much greater depths, down to about 400 miles, are indicated by instrument records. The shaking near the surface depends appreciably on the depth at which the break occurs. In relatively shallow earthquakes, say about 10 miles deep, usual for California, the surface directly over the break shakes much more than where the break occurs at greater depth, but the surface area of perceptible shaking is relatively smaller. Earthquakes at depths of over 200 miles are rarely felt.

Large earthquakes relieve strain in an extended area, but give rise locally to new strains which are relieved by aftershocks. Normally these are smaller than the main shock. Occasionally a second large shock occurs, and sometimes a quake larger than the first.

Surface effects of earthquakes are usually expressed in a scale of 12 degrees indicating "intensity." This depends on depth of the shock, distance from its source, density of population, and nature of the ground. Water-saturated soil acts like a jelly and results in considerably increased intensity and greater damage.

The energy of an earthquake is expressed in terms of "magnitude," not to be confused with intensity. Magnitude is calculated from seismograms of many observatories and does not depend on local information. Each half degree increase in magnitude means an increase in energy of roughly eightfold. Zero point on the scale represents an earthquake barely recorded on a sensitive instrument near the epicenter.

Before 1904 instruments were unsuitable for determination of seismic magnitude. Greatest magnitude recorded since then has been about 8½ noted for earthquakes in Colombia, 1906; Chile, 1906; Tien-Shan, 1911; Kansu, 1920; and Japan, 1933. The Tokyo earthquake of 1923 had a magnitude of about 8, while San Francisco in 1906 registered a magnitude of about 8½. An earthquake in 1915 in north central Nevada, with a magnitude of approximately 7¾, ranks second among earthquakes along the United States Pacific zone since 1904. It caused relatively little excitement as the stricken region was almost uninhabited. The only really great earthquake in the United States east of Nevada, for which there is historical evidence, was in 1811 in Missouri. In comparison the magnitude of the Charleston, South Carolina, earthquake of 1886 was definitely lower, according to all indications.

What can we do about earthquakes? Seismologists furnish data to architects and engineers to enable them to design and build earthquake-resistant structures. With very few exceptions it is not the earthquake that does the damage, but failure of structures, such as the collapse of roofs, walls, and other unsafe parts. Despite warnings that most persons killed by earthquakes are hit by falling debris in streets near buildings, many still immediately run out of their houses at the first indication of a quake, instead of taking shelter under protecting furniture or under a reinforced part of the structure.

A disaster plan prepared in advance will save lives and property in case of earthquake. Local disaster committees that include all interested agencies should meet at regular intervals to consider improvements and additions to the plan, and to ascertain that it is being followed. Special points to be included in such a plan are: water departments must see that water is available from independent reservoirs for use in case water mains are broken; chemical means of firefighting should be provided; as all utilities may be cut off for several days, emergency facilities should be planned for; arrangements should be made for emergency radio communication systems. Once the plan is agreed upon and drawn up, it must be publicized repeatedly to the entire community. Publicity should include warning the public that immediately following a shock gas should be shut off until the danger of conflagration is past, and should stress any additional hazards of individual cooperation. The fire hazard, especially in schools and institutions, but also in homes and other buildings, can be further greatly reduced by installation of valves which automatically shut off gas supply in case of earthquakes.

To reduce damage and casualties every committee would do well to work for enactment and enforcement of a proper earthquake building code for its community if not already established by the state. Especially schools, fire departments, hospitals, and other public buildings should be earthquake resistant.