

Gravity is a force that all objects on Earth experience. Gravity originates from and pulls everything toward Earth's center. Gravity is the force that holds the molecules of Earth's atmosphere in place. Without the atmosphere, plants and animals could not live on the planet because there would be no air to breathe. Gravity also holds lakes, rivers, and oceans on Earth's surface. This gives us liquid water, which is so vital to life on Earth.

The Role of Gravity in Disasters

Unfortunately, gravity sometimes causes disasters. The continuous downward force of gravity creates strain on mountain slopes and hillsides. The strain can cause slopes to collapse—sometimes with hardly any warning. These collapses can cause massive damage to any structures that happen to be in the path of the falling debris.

The collapse of strained slopes is generally referred to as “mass wasting.” Mass wasting describes events such as landslides, mudslides, rockslides, avalanches, and debris flows. The causes and results of these events are generally the same: A large amount of sediment or rock on the slope of a hill has a high potential energy because gravity is acting on it. This potential energy makes the slope unstable. Unstable sediments will generally stay in place as long as the sediments are undisturbed, but movement is still possible. Certain conditions can make the slope even more unstable, however, and it is when these conditions are met that landslides occur.

Excess water is one factor that can make slopes dangerously unstable. Sediments contain many small holes, or pores. Rainwater enters these pores and remains there, where it is available for plants to use. However, this absorbed water also increases the mass of the soil, which increases the soil's potential energy. (Increasing the mass of the soil increases the force of gravity on the soil and makes the slope less stable.) Water stored in the pores also makes soil more likely to flow.



Landslides can be extremely destructive to populated areas, especially those beneath steep hills.

Adding more soil on top of a hillside also increases its mass, which again increases the soil's potential energy. Sometimes the hill becomes unstable enough for a landslide to occur spontaneously. Sometimes a disturbance such as an earthquake is necessary. Either way, once sediments begin moving, the sediments will not stop until they reach a flat area.

How can landslides be prevented? Often, it is difficult or impossible to stop an unstable slope from sliding away. However, certain strategies can reduce the likelihood of a landslide or mass wasting event. Reducing potential hazards is known as mitigation. In the case of landslides, hazard mitigation is often performed by engineers.

Steps for Landslide Mitigation

In areas where landslides are likely, engineers must work to decrease the risk.

The first step is to recognize unstable areas. Unstable areas are often found on the slopes of hills. Tension cracks on the top of a slope can be signs that a landslide is likely. Another indication is the presence of bent tree trunks. Trees always grow straight up. If the trunk is bent, the ground beneath the trunk has likely been moving downhill slowly. This soil movement is known as "creep." Creep is often an indication of an approaching landslide.

Sometimes, these dangerous slopes are located above towns or roads. Landslides in these areas can severely damage property and put lives at risk. The most effective way to protect the people living beneath the slope is to increase slope stability.

One way improve the stability of slopes is to add walls to support the slope. Walls or wire mesh restraints are sometimes installed next to



This damage resulted from a landslide near Laguna Beach, California, in 2005.



Putting a mesh net over loose rocks can help prevent the rocks from falling to lower ground and injuring people or damaging property.

roads. These restraints help to maintain the slope's shape and make the soil less likely to travel downhill rapidly. These structures also help to keep rocks from falling into the road.

A natural way to keep slopes stable is to add plants to the slopes. The root systems in plants help to hold soil in place beneath the roots. The roots also take up water from the pores of the soil, which makes the soil less heavy and less likely to flow. Also, plants on the surface decrease infiltration. Infiltration is a measure of how much water from rain is able to enter the pores of the soil.

Another way that engineers may increase stability is to change the slope entirely. One such method is called terracing. Terracing is often practiced by farmers. The farmers dig broad steps, or terraces, into the side of a steep slope. Crops are then planted in the terraces. To further increase stability, walls are often built next to the steep cliffs that separate each terrace. Where cliffs are less steep, the farmers may add plants to the slopes because the plant roots make the slopes more stable. Terracing can make good farmland available in areas that would otherwise not support crops.

Gravity is a force that has the potential to cause destruction on the slopes of hills. Landslides are a powerful destructive force resulting from slope instabilities. Engineers must work against the force of gravity to help make slopes stable.



Terrace farming increases the stability of a slope. Terraces help to mitigate hazards on steep slopes and prevent the loss of crops to erosion.