

## HAZARDS 1

The Earth's crust is dynamic, in some places, there is strong flow of heat from the interior of the Earth causing major structural movements. Others are cooler and less mobile. Dynamic zones occur where new crust is formed at Mid-Ocean Ridges and in mountain-building zones where crust is destroyed for instance around the margins of the Pacific Ocean. Rocks melt deep beneath areas of high heat flow. Resulting magma, less dense than surrounding cooler rocks, rises towards the surface. If it breaks through, volcanic activity occurs. In dynamic areas, rigid rocks are also subjected to strong pressures as masses of crust move past each other. This causes fracturing of rocks and gives rise to earthquakes. Volcanic activity and earthquakes are not limited to these zones but are generally less frequent and less damaging elsewhere.

Volcanoes variously eject ash, lava and hot gases when they erupt. Hot ash or gas clouds, or lava, may flow down the slopes of the volcano causing local devastation. Ash clouds can be carried by wind for long distances causing collapse of buildings due to the weight of deposits or damage to crops. After ejection of large amounts of material, parts of the mountain may collapse as large landslides. Surface or groundwater or rain may mix with ash leading to hot or cold mudflows which can flow long distances down valleys. Less commonly, clouds of asphyxiating carbon dioxide may flow down the slopes killing livestock and people. The locations of volcanoes are readily identified but, too often, it is assumed that these not active when they are really only dormant.

Earthquakes cause vibrations of the ground surface that can rupture the ground or shake and destroy buildings and other structures. Large earthquakes can cause severe damage as much as several hundred kilometres from the point of origin. Small earthquakes can also cause locally significant damage. These may not be expected if they recur at relatively long intervals. Small events are also known when the Earth's crust is placed under stress by underground mining, loading the crust with large reservoirs, or unloading when, for example, ice sheets melt.

Volcanic activity and earthquakes cannot be stopped but locating development well away from the main hazardous zones reduces risks. In practice, this is difficult because many cities and settlements exist already in such locations. Volcanoes can be monitored to give early warning of impending eruptions, allowing evacuation plans to be implemented. While the main areas for large earthquakes are well known, there is currently no reliable means of predicting these. Poorly constructed buildings, structures located on weak ground or unstable slopes are vulnerable to such events, as well as fires from ruptured fuel supplies. Therefore high quality construction and locating structures away from hazardous ground can greatly reduce risks.

Displacement of the ground by earthquakes, collapse of volcanic mountains, or landslides in marine or lake areas, can give rise to large-scale displacements of water. These run ashore as large waves or tsunamis that can destroy everything in their paths. The effects can be experienced hundreds or even thousands of kilometres from the source. Such waves vary in height from place to place reaching peaks when they enter confined bays or travel across gently sloping shallow water areas. Ideally, development would avoid vulnerable coastlines but many fishing communities and ports exist already in such locations. Tsunami travel quickly so it is difficult to give warnings to nearby settlements in time but evacuation instruction could be effective further away if there are adequate warning systems.

Tsunami give rise to particularly destructive flooding but there are many other types of flooding. Flash floods occur where intensive rainfall fills narrow valleys. Inundation of the low-lying reaches of rivers is a normal natural process but, even so, development is often constructed in areas of potential risk. Coastal storm surges commonly flood low-lying coastal zones. Major problems occur when such surges coincide with peak flow of rivers.



The most vulnerable areas can be identified from records of past events. Settlements protected by embankments have reduced risk of flooding but this does not prevent it completely. It is more effective to avoid or limit built development in flood prone areas and construct any necessary development to resist flooding. Evacuation procedures can be developed for high-risk areas and refuges can be constructed on higher ground, but it is necessary to accompany these by a good warning system. Dangerous floods can also be caused by failures in man-made structures such as dams. It is important to design these with sufficient capacity and strength and to maintain them properly. Urbanisation can cause increased risk. Buildings and roads are impermeable and lead to more run-off rainwater that causes flooding if the capacity of drainage systems is exceeded. Flood potential is affected by climate change, so past experience gives only a limited guide to likely future events.

Large-scale disasters lead to loss of life, massive damage to property, displacement of people, and trauma and shock. In addition to psychological damage, victims are vulnerable to epidemics and adverse weather conditions. They may depend on aid for a long period but it is logistically difficult to get aid into such disaster zones when much of the local infrastructure has been destroyed.

Flooded homes



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