Glossary – Natural hazards in Switzerland

Area-wide/spatial protection

Protection measures that reduce risks for entire populated areas, such as avalanche barriers against avalanches, dikes against floods or protective forests against gravitational processes.

Avalanche

Event during which snow or ice comes loose and suddenly shoots downhill in a fall line as a sliding mass or a whirling mix of snow and air, coming to a halt in a sedimentation area. Avalanches are classified into various types according to starting zone, fall line and sedimentation area. In the winter, the avalanche hazard is assessed daily in an avalanche report using one of five hazard levels: low, moderate, considerable, high and very high.

Becquerel

Becquerel, abbreviated Bq, is the International System of Units (SI) unit for the activity of a radioactive material, such as, for example, radon. The activity indicates the average number of atomic nuclei that decay per second. 1 Bq corresponds to one nucleus decaying per second; 300 Bq/m^3 correspond to 300 nuclei decaying per cubic meter per second.

Building protection measures

Structural measures to protect buildings directly at or around the buildings themselves. Buildings can be protected, for instance, by installing sealed doors and windows or backflow valves or by erecting flood protection walls.

Debris flow

Slurry-like, often quickly flowing mix of water and solid materials such as sand, gravel, stones, blocks or wood. Solid materials account for about 30 to 60 percent of the total mass. A debris flow has a higher percentage of water than a landslide and is often triggered by heavy rainfall or rapidly melting snow. This water-logged mix flows downhill, mostly in surges, at a high speed of between 40 and 60 km/h in the channel of a torrent or down old furrows. A debris flow mostly occurs in high-altitude mountainous areas and in the foothills of the Alps where there are sufficiently steep slopes (at least 22,5 degrees).

Dosimeter

Device for measuring the radiation dose from radon over a certain period of time (total dose received). By contrast, a rate meter measures the dose rate (radiation dose per time unit).

Earthquake

Severe tremors of the ground from seismic waves spreading due to a fault in the earth's crust. Earthquakes originate in the interior or at the surface of the earth. Their size can be expressed in two ways: the unlimited magnitude scale (Richter scale) measures the physical size of the earthquake. The intensity scale ranging from I to XII (in Europe the EMS98 scale) indicates the observed effects and damages caused by the earthquake.

Intensity

I: Not felt
II: Felt slightly by very few individuals at rest
III: Noticed by a few people as a slight vibration or tremor
IV: Clearly noticed by some people outdoors and by many people indoors
V: Noticed by a few people outdoors and by most people indoors
VI: Many people are frightened. Many houses, in particular of inferior construction, suffer slight damage.
VII: Most people are frightened, run outdoors. Furniture is shifted, objects fall off shelves. Numerous buildings are damaged.
VIII: Many people find it difficult to stand. Severe damage occurs to many buildings, simple buildings can collapse.
IX: General panic. Solid buildings are also severely damaged.
X: Many well-built houses are destroyed or suffer severe damage.
XI: Devastating earthquake, most buildings are destroyed.
XII: Nearly all structures are destroyed.

Between 500 and 800 earthquakes occur on average every year in Switzerland. About ten of these have a magnitude of 2.5 or more and can be felt by the population. Earthquakes with a magnitude of 5 are likely every five years in Switzerland; those with a magnitude of 6, ever 100 years.

Fall processes

Fall processes are broken down into rock falls and block falls, rock slides and rock avalanches. Rock falls and block falls can involve individual rocks and blocks suddenly breaking loose. Other rock falls/slides and rock avalanches involve a larger volume of rock breaking loose "en bloc" from a rock face. The mass breaks down into blocks and rocks during the fall or on impact. Rock avalanches differ in rock volume from small-scale rock falls and can reach speeds of up to 140 km/h.

Flood or inundation

Unusual flows of water or water levels (river floods, flash floods, water level changes in lakes and in the groundwater) caused by a storm, by melting snow or other events.

Hail

Precipitation in the form of chunks of ice with a diameter of more than 5 millimeters. Hail is formed in connection with thunder clouds and strong turbulence. The hail damage scale of VKF (Swiss Federation of Cantonal Fire Insurance Offices) distinguishes between eleven categories of intensity depending on the size of the hailstones (between 5 and 100 mm in diameter).

In Switzerland, the central and eastern Swiss Plateau and the eastern part of Jura have the highest hail hazard. Statistically, hail of 1 cm in diameter in these regions is to be expected annually; hailstones of 2 cm in diameter, every five years; and hailstones of 4 cm, every 100 hundred years.

Hail impact resistance class

The hail impact resistance classes are based on the diameter of the hailstones and how this variable is used for meteorological and climatological analysis. A building product with a hail impact resistance class of HIR3, for example, can withstand the impact of a hailstone 30 mm in diameter without damage.

Class	ø of hailstone	Hail impact resistance of building product
HIR 1	10 mm	very weak
HIR 2	20 mm	weak
HIR 3	30 mm	medium
HIR 4	40 mm	high
HIR 5	50 mm	very high

Hail register

The hail register provides information about the resistance of products to hailstones hitting them. The tests are conducted in recognized test laboratories. Tested products guarantee hail-resistant construction. Buildings built with products with a hail impact resistance class HIR3 are generally hail-resistant in Switzerland because there is hardly any precipitation in this country involving hailstones larger than 30 mm in diameter.

Hazard

Hazards affect people and animals as well as property. Flood hazards are caused, for instance, by an overflowing body of water or by surface runoff after heavy precipitation or storms. A hazard can be quantified, modeled and displayed on a hazard map taking into account the probability of occurrence or the recurrence interval for a certain location.

Hazard index map

Provides a rough overview of where natural hazards can be expected over a larger area (as opposed to a detailed hazard map). It serves as the basis for the initial assessment of a hazard if a hazard map does not yet exist. Also serves, among other things, as a tool for cantonal spatial planning. It is based on computer-assisted model calculations and past events.

Hazard map

Indicates populated areas exposed to floods, avalanches, landslides and gravitational processes. A flood hazard map shows, for instance, the flood hazard in a certain area, often using differently colored zones that show the various recurrence intervals or probabilities of occurrence. It is generally the authorities (municipality or cantonal) who order a hazard and risk assessment to be conducted.

Meaning of the hazard zones as defined by the Swiss Federal Office for the Environment FOEN:

White
The risk of hazards is nil or negligible according to current available information.

Yellow and white hatched
Areas with a residual risk of hazards. Events are expected to occur only very rarely, but they can range from minor to severe.

Yellow
Minor risk of hazards. People are hardly at risk. Minor damage to buildings or obstructions can be expected.

Blue
Medium risk of hazards. People inside buildings are barely at risk, but people outdoors are. In these areas, one can expect damage to buildings but not rapid destruction of buildings as long as certain construction requirements are observed. Severe damage can generally be prevented in blue areas by taking suitable precautions.

Red
Considerable risk of hazards. People are at risk both inside and outside buildings. Rapid destruction of buildings is to be expected, or the events occur with a high probability but weaker intensity. In this case, either people outdoors are particularly at risk or buildings become uninhabitable. New construction and/or reconstruction are largely banned in red areas.

In the Zurich Natural Hazard Radar, different color schemes are used to depict the hazard levels for presentation reasons.

→ Info at: www.zurich.ch/naturalhazards

Hazard zone

Depending on the hazard, the types of usable space are broken down into various zones for a hazard assessment: into red zones with a high hazard level, where construction is prohibited; into blue zones with a medium hazard level, where construction is permitted subject to certain constraints/obligations; and in yellow zones or yellow and white hatched zones with a minor or very minor hazard level, where construction is generally permitted without any obligations. Only buildings with a high concentration of people, such as schools, hospitals, or retirement homes, should be built outside these zones because events may occur here, albeit with a very small probability.

Landslide, slope instabilities

Downhill flows of sections of the flank of a hill consisting of rock and soil. A landslide is largely triggered by gravity and does not have a transport medium such as water (as opposed to a mudflow). Landslides can occur on slopes with moderate to steep inclinations of between 10 and 40 degrees. They vary greatly in size, depth and shape of the sliding surface and unfold very differently depending on the substrate properties and involvement of water. Instabilities of this kind are very frequent in Switzerland. They affect about six percent of the country's territory.

Log jam

Log jams are the partial or complete congestion of a river or stream as a result of washed-up driftwood, swept stones and solid materials or sedimentation of other materials (e. g. slide or avalanche sedimentation). This results in water being dammed up, which, in turn, causes water levels to rise quickly and strongly above the flow-off obstacle and the level of the river- or streambed to rise. This can lead to overflowing, flooding or erosion and, if the mass is penetrated, to debris flows.

→ Avalanche, landslide

Mudflow

A mudflow is a mix of rock, soil and water that flows down the hill as slurry. Mudflows have a higher proportion of water than landslides, making them more liquid. They are therefore able to speed down to the valley at a much higher velocity. For this reason, mudflows can have a sudden, destructive effect. At the edges of mudflows, the speed is slower, which sometimes results in the formation of small levees. At the foot of the slope, the mudflow slows down, expands in the shape of a tongue and finally comes to a halt. Mudflows occur in the soil material on a slope and flow to the valley at the surface, whereas a debris flow forms within a streambed and flows to the valley within it.

Overload case

Overload with respect to the defined protection goal of a protective measure, for example, when a flood causes a dike to overflow. The overload case needs to be already incorporated into the planning phase so that a protective measure does not fail catastrophically if an overload occurs, resulting in this example in a dike ultimately breaking if an extreme flood occurs.

Precaution

Official measures such as resource planning, training of emergency services or taking out insurance that help to cope with an event.

Prevention

The aim is to avoid damage during an event by using the space appropriately or to prevent losses by taking protective measures. Prevention is part of prophylaxis.

Probability of occurrence

This term is defined as the probability in percent that an event of a certain magnitude will occur at a certain place within a certain period of time. A 100-year flood occurs statistically every one hundred years on average but the probability of it occurring once in 100 years is not 100 percent. For example, the probability of a 100-year flood occurring along a certain section of river over the next ten years is about 9,5 percent. There is a probability of 26 percent that it will occur over the next thirty years and 64 percent, over the next hundred years.

→ Recurrence interval

Prophylaxis

This consists of preventive and precautionary measures to reduce the risks to people and property.

Protection goal

Safety level to be achieved. Protective measures are designed for an event of a particular level of intensity (for instance a dike that withstands a certain level of water in the event of floods) or of a certain recurrence interval.

Protective measures

Mitigate the effects of a hazard for a building or an entire area. They can be natural protective measures (for instance natural flood retention areas in the event of a flood hazard), structural measures (such as bypasses, damming, dikes), mobile measures (such as sandbags, barriers, pumps) or organizational measures (such as evacuation, emergency plans). Although protective measures have no impact on the natural hazard itself, they reduce the risk and have an effect on the area and/or buildings.

Radon

A natural radioactive inert gas that is produced by uranium decaying in the Earth's interior and that is present in small quantities everywhere in Switzerland in subterranean rock. The radon concentration is highest in alpine areas and in the Jura. Ground-floor and basement rooms are impacted in particular, especially where there is a natural basement. Radiation exposure can be determined precisely only in a professional measurement with a dosimeter because radon concentration can vary markedly from one house to the next.

Recurrence interval

The average period of time between two comparable events (same place, same intensity). This is a purely statistical average value. A 100-year flood may occur not only once in 100 years, it may occur several times in one year or not at all in 100 years.

→ Probabilit of occurrence

Residual hazard

Indicates a hazard situation with a very low probability of occurrence (less frequent than once in 300 years). It is provided as information in addition to the given scenarios shown in the hazard map. These originate mostly from large rock fall or rock avalanche events or very rare flood and avalanche events.

Residual risk

The remaining risk for a certain scenario once all necessary protective measures have been implemented. These include consciously accepted, wrongly assessed and unidentified risks.

Risk

Product of severity multiplied by the probability of potential damage. Risk is calculated from the probability of occurrence and the severity of potential (economic, geographic) damage.

Rock avalanche

Fall of a very large rock mass from a rock face (variously defined as more than 100'000 m^3 to over 1 million m^3). The mass breaks down into blocks or stones during the fall or on impact. Interactions can occur between the components, pulverizing the blocks and stones. Differs in size from smaller rock falls/block falls that can involve less than 100 m^3 and rock falls/slides that involve more than 100 m^3.

→ Rock fall, block fall, rock slide, gravitational processes

Rock fall

Can involve a larger mass of rock (more than 100 m^3) falling from a rock face. The mass breaks down into blocks or stones during the fall or on impact. Can also involve a volume less than 100 m^3 and less than in a rock avalanche (more than 1 million m^3).

→ Rock avalanche, rock fall/block fall, fall processes

Rock fall/block fall

Can involve sudden breaking loose of less than 100 m^3 of individual blocks or rocks from a rock face. Differs in volume from rock falls of more than 100 m^3 and rock avalanches that can involve more than 1 million m^3.

SIA

SIA is the German abbreviation for the Swiss Society of Engineers and Architects. This organization draws up, maintains and publishes standards, codes, guidelines, recommendations and sets of documentation that are authoritative for the Swiss construction industry and for the construction of protective measures or earth-quake resistant buildings. About 200 expert commissions further develop the body of standards.

Storm

A heavy precipitation event caused by an atmospheric disturbance. In a hydrological sense, "storm event" is often used to distinguish between dry and strongly humid periods. A storm also refers to an event involving strong winds with speeds in excess of 75 km/h or wind force 9 (Beaufort). Winds at speeds in excess of 117 km/h or wind force 12 are called hurricanes.

Structural class

For existing structural class I buildings such as residential buildings as well as smaller office, commercial and industrial buildings, an earthquake safety inspection is a disproportionate step in most cases unless a renovation project is involved.

For a planned construction project involving a structural class I building, it is recommended to have an expert clarify whether earthquake-resistant renovation or conversion is worthwhile. Relevant factors are the type and scope of the planned construction project, the total investment, the value of the building and the remaining useful life of the piece of real estate.

For existing structural class II buildings with significant infrastructure and larger congregations of people such as hospitals, shopping centers, schools, administrative buildings or churches, an earthquake safety inspection is recommended.

An earthquake safety inspection is advisable for existing structural class III buildings with vital infrastructure such as acute care hospitals or fire stations as well as supply, sewage and telecommunication infrastructures (dams, nuclear power plants).

Surface run-off

Surface run-off refers to the portion of a heavy rainfall that no longer seeps into the ground on impact but runs off on the surface instead. This run-off is shown on the surface run-off hazard map. Flood hazard maps, for their part, show flooding from water that has already arrived in a body of water and can overflow from there.

Usage concept

The use of buildings and interior space should take into account the hazards they face. In regions exposed to flooding, for instance, IT infrastructure or valuable painting collections should not be stored in basements. To address avalanche and rock fall hazards, rooms frequently used by people must be located on the side facing away from the hazard.

Water-borne debris

Objects swept away by floods, such as wood, logs, but also vehicles or garbage containers. As little as 30 cm of water can suffice to sweep away a vehicle. When assessing the water-borne debris risk, the water height and speed are taken into account.

Water level

A measured variable that indicates the level of flowing surface run-off water or of standing surface run-off water in flat areas. Water with a water level of 10 cm, for instance, is flowing on the surface at a maximum level of 10 cm. Refer also to surface run-off.

Wind speed class

Wind speed is measured in beauforts (Bft), a scale that classifies wind speed from 0 (no wind) to 12 (hurricane-force wind). It is named for Sir Francis Beaufort.

MeteoSwiss utilizes a danger level scale that is an extension of the Beaufort Scale: Danger level 2 corresponds to beaufort force 9 (strong gale) on the Beaufort Scale.

Beaufort scale description (No.)	MeteoSwiss danger level	Below 1'800 m asl	Above 1'800 m asl
Fresh gale (8) (62–74 km/h)	1 (no danger or minimal danger)	No warning	No warning
Strong gale (9) (75–88 km/h)	2 (moderate danger)	70–90 km/h	No warning
Whole gale (10) (89–102 km/h)	3 (significant danger)	90–110 km/h	130–160 km/h
Violent storm (11) (103–117 km/h)	4 (severe danger)	110–140 km/h	160–200 km/h
Hurricane-force (12) (> 117 km/h)	5 (very severe danger)	> 140 km/h	> 200 km/h

Fig. Danger levels as classified by MeteoSwiss