Extended definitions of the five landslide risk zones

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Abstract

Five zones have been used to define landslide risk. These zones are re-defined and further descriptions given.

Five landslide zones have been used in Tasmania (Stevenson, 1975) to indicate the risk of landslide damage in areas subject to this hazard. The zones have been advisory and descriptive and they apply to domestic buildings only.

The five zones are:

I Stable ground on hard rocks - no abnormal problems or risks.

II Stable ground but on soft rocks - strict adherence to existing building codes.

III Potential landslide areas - building in accordance with a special code.

IV Old landslides and adjacent areas - no building without specialised investigation and design.

V Active landslides and adjacent area. No building.

After seven years application of these zones, and after associated detailed investigations it has become possible and necessary to re-define them. Additional knowledge has also allowed a slight retreat from the simple rigidity of the zoning scheme to allow more freedom to building development.

The zones were first designed to deal with an area of Tertiary lacustrine sediments under erosion on slopes in a restricted graben environment, but it has become necessary to apply the scheme to areas where other slip-prone materials are present, for example deeply weathered basalt, Triassic mudstone, Permian mudstone and Quaternary colluvium derived from all of these.

At the same time a conscious effort has been made to retain the essential features of the five class scheme, because the users - planners, developers, the legal profession, house buyers and local authorities - have become accustomed to the meaning of the zones and any radical change would undo this gain.

The special building code is contained in an amendment to the Building Regulations (1965) of the State of Tasmania. Briefly, these closely control siting, drainage, size, use of domestic building, the storage of dangerous materials and of water, and the excavation of deep permanent cuts and placing of deep fills, the use of vibrating machinery and the felling of trees. The special code is intended to reduce as far as possible the impact of building on fragile slopes, and appears to have done so.

In the definitions which follow a standard pattern has been followed:-

(1) Brief description.

(2) Essential elements.

(3) Comments.

(4) Examples of geology.

(5) Perceived influence on development.

Zone I

(1) Stable areas of no significant risk.

(2) Areas not zoned otherwise.

(3) These areas are those of low slope on indurated rocks (seismic velocity >1500 m/s), often with less than 2 m of soil development, or are steeper areas on indurated rocks with less than one metre of soil.

(4) Basalt plateaux, dolerite slopes, sandstone slopes.

(5) Of no effect.

This zone is defined exclusively, that is it contains all areas not in the other four zones. This action carries with it the implications of acceptable risk. No area can be totally safe, but in the real world we accept the very small risk without much thought. The aim of zoning is to reveal the greater-than-thoughtlessly-accepted risk that exists in the other four zones.

Zone II

(1) Stable areas on soft rocks.

(2) Soft rock areas of slope less than the critical slope. The critical slope in any geological formation is the lowest angle at which mass movement has been seen. The critical slope concept has evolved during the zoning experience. A close investigation of an area will reveal the lower bound of slope angle classes below which failures do not occur even under the most adverse conditions. This simple concept has to be treated with care, and is not one which can be used alone or without further questioning, because slope failure can be initiated by highly variable water conditions, and because of variations in earth materials. Nevertheless the lower limiting angle has repeatedly been shown to be reliable and to be constant in consistent geological conditions.

(3) Swelling soils are often present. These are a different though related problem but are not distinguished on landslide zone maps. Simple slope profiles are normal. Seismic velocity is less than 1500 m/s. Drainage may be poor and water tables high. This land is usually cleared and is often built over.

(4) 'Red soil' areas, deep weathered Tertiary basalt plateaux. Tertiary clays of the Launceston area. Quaternary alluvium.

(5) Minor restrictions on development, mainly due to poor drainage, low bearing strengths and swelling soils.

Zone III

(1) Potential landslide areas.

(2) Soft rock areas of slope greater than the critical angle but not known to have failed.

(3) Generally similar to Zone II, but greater than the critical angle. Swelling soils may occur. Simple slope profiles are usual. Seismic velocity less than 1500 m/s. These areas are usually cleared and built over. The term 'potential' has caused immense problems but is used in the Shorter Oxford Dictionary sense of 'possible but not probable'. Other meanings are current, not least that understood by real estate agents in Australia, of 'having great promise'.

(4) Tertiary clay sediments. Weathered Tertiary basalt and derived soils. Deeply weathered Jurassic dolerite and derived soils. Solifluxion deposits derived from Permian mudstone.

(5) This zone is intended to warn developers and property owners of the risk that they run if poor drainage is allowed to persist or if large earthworks are constructed without seeking adequate advice.

If warning is not sufficient then Zone III can be enforced as Landslip Zone B under the Local Government Act (No. 2) 1973, and the Building Amendment Regulations (No. 5) 1974 apply.

These regulations are a useful guide even if enforcement is not contemplated.

Zone IV

(1) Old landslips and adjacent areas.

(2) Apparent failure now inactive.

(3) Complex slopes, diverted drainage, displaced geology, disturbed subsoil, no measureable strains. This zone can be divided into subzones:

IVa Fresh, small, complex, translational-like modern movements, factor of safety close to 1.

IVb Truly relict features, large, old, simple, blurred, broadly rotational, different from modern mass movements and now having a factor of safety well above 1.

This subdivision is made necessary because of the past history of the landslide phenomenon in Tasmania, the details of which, particularly the ages, have not been elucidated.

The addition of adjacent areas recognised that landslips are progressive and that movements can spread to hitherto undisturbed land often uphill. The size of the adjacent area is dependant on the judgement of the zoner but may normally include the whole affected topographic element unless subsurface investigation can decide otherwise.

(4) Soft oversteepened Tertiary clay slopes below basalt spring lines (reservoir principle (Denness, 1972)).

Basalt soil slopes in similar situations. Slope deposits derived from Permian and Triassic mudstones.

(5) There is a very great limitation on development in these areas. Some IVb is acceptably safe after detailed investigation, but IVa may only be a few years away from activity or may only be in a temporarily inactive phase. IVb may be proclaimed as 'B' and IVa as 'A' landslip area.

Zone V

(1) Active landslip and adjacent areas.

(2) Areas of measureable landslide strains. Factor of safety less than 1.

(3) These areas are usually small compared with other zones, illustrative of the episodic nature of mass movement.

(4) As in Zone IV.

(5) Building in active areas has not been wittingly attempted here. When attempted unwittingly the results have been disastrous Specialised building methods could undoubtedly be successful, but would be very costly.

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