

Chapter 70

Landslides: A Guide to Researching Landslide Phenomena and Processes

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ABSTRACT

Landslide research is an interdisciplinary field that primarily encompasses scientists from geomorphology, engineering geology, and geotechnical engineering in collaboration with researchers from such fields as geodesy, hydrogeology, geophysics, and many others. This chapter is intended as a resource for researchers interested in landslide engineering and landslide science to acquire a summarized review of research subjects and the state-of-the-art literature. A wide range of landslide topics are presented in the following sections: landslide mapping, landslide investigation, landslide monitoring, landslide hazard and risk assessment, and landslide stabilization and remediation measures. The results of landslide studies have practical applications to society via the avoidance, prevention, and mitigation of landslide hazards and risks. Landslide avoidance and prevention are the primary interests for land-use policies based on landslide mapping, followed by the prediction of landslide processes and their consequences. Landslide mitigation includes the development of engineering technologies for landslide investigation, monitoring, and remediation.

INTRODUCTION

The surface of the earth, both on land and beneath the oceans, continually undergoes modifications by mass movements that operate in response to gravitational forces. Landslides represent one type of these mass movements and describe ‘the

movement of a mass or rock, debris or earth down a slope’ (Cruden, 1991). In this chapter, the term ‘landslide’ will include all types of gravity-caused mass movements, ranging from rock falls and topples and a variety of slumps and slides to flows of different materials. Varnes (1978) provided an idealized schematic presentation that displays the

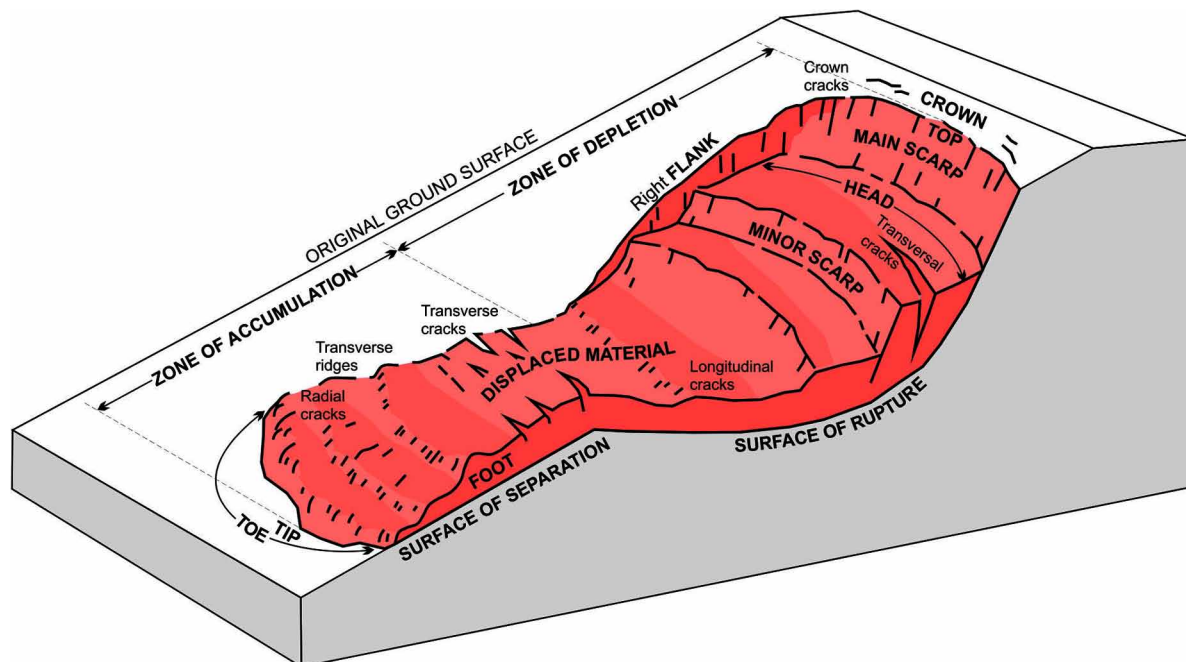
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features of a landslide in soil material (Figure 1). The system of landslide classification devised by Varnes (1978), completed by concepts defined in IAEG Commission on Landslides (1990) and Cruden and Varnes (1996), has become the most widely used system in the English language. Hungr et al. (2014) proposed a new version of the Varnes classification to reflect recent advances in the understanding of landslide phenomena and the materials and mechanisms involved, including 32 landslide types in rock and soil materials supplemented by examples and references.

Landslides are a component of the erosion process, which is described as a continual leveling of the surface features of the earth. Although precipitation, earthquakes, and volcanic eruptions are the principal natural drivers of landslides, in many cases, landslides result directly from disturbance of hillsides during road construction or other human activities. Landslides occur in all geographic regions of the world in response to a

wide variety of natural conditions and triggering processes that include storms, earthquakes, and human activity. These phenomena belong to natural hazards (i.e., geohazards) because this environmental process is responsible for direct damages that can be expressed in thousands of deaths and injuries each year and monetary losses in the billions (Schuster, 1996; Petley, 2012). Indirect damages include long-term economic disruption and population removal. According to the definition adopted by United Nations Disaster Relief Organization (UNDRO) in 1979 for all potentially damaging natural phenomenon or natural hazards (UNDRO, 1980), a landslide hazard is 'the probability of occurrence, within a specified period of time and within a given area'. Landslide risk is the term developed to describe the expected degree of loss due to a landslide according to the following definition: 'risk meaning the expected number of live lost, people injured, damage to property and disruption of economic

Figure 1. Schematic representation of an idealized landslide according to Varnes (1978) that was slightly modified



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