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AN IMPROVED METHODOLOGY FOR LANDSLIDE RISK ASSESSMENT

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Landslide Hazard is an important natural hazard and today we are still faced with the problem of subjective nature of the evaluation of this hazard. This is essentially a phenomenon triggered and controlled by natural factors although so-called anthropological causes are increasingly becoming prominent. Risk Management, constitutes an important part of the overall management process, consisting of taking better and sound decisions based on good insight into the processes and factors responsible for exposing the environment to risks. And landslide hazard evaluation forms an important first step in evaluating risk due to landslides.

In recent times, several researchers have worked on landslide hazard zonation. But less work has been done on landslide risk assessment. Although considerable work has been done in the area of vulnerability and risk assessment of engineered and non-engineered structures with respect to earthquakes, not much work has been done in the area of landslide vulnerability, primarily because of the absence of adequate recorded data. Risk Assessment helps in deciding whether the risks are within tolerable limits or not and whether mitigation measures are needed or not.

The present study deals with estimation of landslide hazard on two scales – the regional and the local or site-specific. The approaches required for the two are quite different. The regional problem seeks to evaluate hazard by considering potential landslide-causing factors such as the geological, geomorphological, drainage, landuse and others and subsequently the risk, based on potential losses. The localized evaluation is more rigorous and involves well-founded mathematical models. In this paper, two examples are given: one regional, using a probabilistic model and another, local, using a possibilistic model, from the hilly terrain on the west coast of India.

The regional evaluation attempts to account for the variabilities associated with the subjective assignment of weightages and ratings to the causative factors. The weightages are first evaluated based on known landslide history and then improved upon by accounting for the variabilities and the hazard is computed using a probabilistic technique. The site – specific study, on the otherhand, attempts to evaluate the reliability associated with the evaluation of occurrence of slope failure and landslide by using a possibilistic method. The reason for the use of possibilistic analysis is the fact that the errors and uncertainties in geotechnical evaluation of soil and rock properties are essentially of a fuzzy nature. The presence of fuzziness further reduces the reliability of the computations of stability.

A GIS is well-suited for the regional problem, because it involves the consideration of factors which are easily mapped but not easily quantified. The use of the overlay technique or the superposition technique of the thematic maps of different causative factors is a viable tool for the evaluation of hazard. Combined with this, in the present study, a probabilistic technique is also applied. In the present study, an attempt is also made to bring out the relative importance and influence of the concerned parameters, which further helps to exercise an informed judgment regarding the relative weightages to be given.

Risk is formally defined as Hazard x Vulnerability x Damage. Hazard evaluation and hazard zonation maps are only a first step towards evaluating the landslide proneness of an area. If they are not accompanied by a vulnerability analysis, then they are not useful for taking effective counter measures. For example, a small hazard in a densely populated or strategic location may cause damages many times greater than a large hazard in a sparsely populated area. Therefore, vulnerability analysis and risk assessment become imperative. Landslide vulnerability is a measure of the degree of damage or losses that are likely to occur due to a landslide.

One of the problems often faced in the region under study is the unpredictability of the location and intensity of the landslide. It is true that a natural disaster is difficult to predict. However, there is a real need to gradually move towards predicting them.

Here such an attempt is made to bring out the importance of adequate and appropriate site-investigations, with the help of which a reasonable estimate can be made of the likelihood of occurrence.

Two kinds of slope failures are particularly hazardous:1) debris flows in non-homogenous (layered) soil slopes and 2) debris flows in rock slopes with weathered overburden. The stability of hill slopes, which have been cut to make way for roads and expressways, during monsoon is a matter of great concern. In this paper, reliability analysis of such real slopes is discussed with due consideration for uncertainties in the layers of the type mentioned above.