International Conference on Case Histories in Geotechnical Engineering
(1998) - Fourth International Conference on Case Histories in Geotechnical Engineering

12 Mar 1998, 10:30 am - 12:00 pm

Geotechnical Risk and Reliability from Theory to Practice

Lenka S. Timiovska
IZIIS, Skopje, Macedonia

Proceedings: Fourth International Conference on Case Histories in Geotechnical Engineering, St. Louis, Missouri, March 9–12, 1998.

GEOTECHNICAL RISK AND RELIABILITY FROM THEORY TO PRACTICE

Lenka S. Timiovska
IZIIS, Salvador Aljende 73
P.B. 101, Skopje, Macedonia

Paper No. 9.15

ABSTRACT

Indeterminate combined with evaluating the safety of existing lifeline systems are, large and here one would expect format risk and reliability techniques to have found their most urgent need. Besides, risk analysis has languished in safety practice, is only now beginning to appear in established safety programs in my country. It is of interest to explore the reasons why this has been so, and to point the way to the adaptations that are necessary if risk analysis is to assume its deserved role in life-line systems and related areas of geotechnical practice.This paper has proposed that geotechnical conditions are needed to enable more reliable predictions of performance in practical. The main problem can be establish finally to the fundamental differences in approach between engineering science and engineering practice. In discussing these differences Peck(1979) described how science reasons from first principles based on laboratory behavior and analysis, while field performance data and empirical methods provide the basis for practice.

KEYWORDS

Risk analysis, geotechnical, reliability, transportation network.

Introduction

For the most part, engineering science has managed the development of probabilistic techniques in geotecnichal engineering, gathering upon a rich inheritance in fields like life-line reliability where material properties and component failure frequencies are characterized with a degree of statistical stictness. In geotechnical terms, these approaches have often translated into probabilistic characterization of soil strength properties as input to deterministic analysis procedures, most commonly to infer probability of slope failure . Of such applications only some of the more recent, for example that by Christian et. al. (1992), have explicitly acknowledged the importance of failure mechanisms that go beyond statistical characterization of input parameters, but these factors have been more often removed to the status of invaluables.

Analysis

Geotecnichal risk and reliability of principal transportation routes in Macedonia has been done as one of the basic elements at risk for consideration of possible damages and losses under natural and man-made disasters. This analysis has a great importance for every country, since especially the risk under earthquakes accessibility affects to the speed of the emergency response in the relief period.
The territory of Macedonia offers a variety of lithological media of metamorphic, magmatic and sedimentary origin. From geotechnical aspects, the rock masses are classified into three groups: a) non-consolidated rocks, b)loosely aggregated rocks and c)consolidated rocks.

Table 1 Criteria for Zoning Depends on Geotechnical Conditions

ncr	The geotechnical medium of the zone is represented by highly sedimentary rock metamorphic and plutonic rock as bedrock complexes
lar	The geotechnical media of this zone are represented by older layered sedimentary rock and bedrock, with frequent presence of surface weathered.

cr The geotechnical media of this zone are represented by unconsolidated Pliocene of dynamic instability under the effects and quaternary sediments.

Taking into account the spatial distribution of the rock masses and their specific characteristics, could be distinguished three main regions in Macedonia.The regions of West, East and Central part of the country. The West part is mainly represented by slightly to moderately crystallized shales, marbleized limestone's, dispersed granites and highly crystallized shales as well as neogene-quaternary mainly non-consolidated and loosely aggregated sediments within recent valleys (Polog, Ohrid, Prespa, Pelagonija, Kicevo and Debar). The region of Central Macedonia is characterized by non-consolidated, loosely aggregated, flysch-like sediments , rare shale-carbonate rocks and diabetes. East part of Macedonia is characterized by prevalence of highly crystallized shales, granites, massive metabasites, volcanic rock and pyroclasts, sparse marbles and slightly crystallized shales.

Criteria for Estimated Seismic Hazard Conditions

Criteria currently been developed to establish tolerable risk levels are similar in form to those originally presented by Whitman (1984). These criteria are intended to supplement but not replace conventional deterministic practices for transportation routes safety decision making.

A principal element in this project has been to develop procedures for estimating the occurrence of the dynamic soil instability depends on seismic influence expressed by peak ground acceleration. Several precepts have emerged:

- the overall intent of risk analysis is to aid in better understanding transportation system by distinguishing those seismic failure modes having greatest risk contributions from those with less; investigations can be better targeted to those area posing larger risks.
- the purpose of the risk analysis is to communicate and support the rationale for transportation system safety judgments and safety modification decisions to both engineering and financial managers; this requires conceptually simple, transparent, and well documented procedures.
- the level

Having in mind the importance of transportation system for communication and normal functioning of all activities in the country, or some of its regions, the existing network of highways, principals and regional roads of Republic of Macedonia has been analyzed as one of the basic elements at risk and reliability from geotechnical point of view.

Criteria for Estimated Soil Dynamic Instability

On the basis of analysis and synthesis of earthquake field survey data in terms of intensity and corresponding accelerations we defined the potential for occurrence of dynamic soil instability in this form:

Table 2 Criteria for Estimated Dynamic Soil Instability

Dynamic instability	Approach	Geotechn. media	Max acc (g)
LP-Low potential for dynamic instability	is	The geothecnical media is composed of highly consolidated sediments as well as magmatic and metamorphic rock	< 0.10
	ws	This zone is composed uncosolidated recent sediments.	
MP-Moderate potential	is	This zone is composed of consolidated sediments metamorphic schists and volcanoes, with presenc of degradation	0.10-0.35
	ws	This geotechnical media is composed of unconsolidated young quaternary sediments	
HP-High potential	is	This zone is composed of older metamorphic and volcanous with presence of weathered and degraded rock masses.	>0.35
	ws	The geotechnical media of this zone is composed of unconsolidated neogen-quaternary.	

The critical sections of transportation network estimated for the 'is'-individual seismicity and 'ws'-whole seismicity , which are depicted in Fig.1 and Fig 2.

Conclusion

Sections at the beginning of this paper set onward some view about why risk analysis has not been widely applicable in transportation routes safety practice and what can be done about it. The defectives in many probabilistic techniques can be assigned to what practicing engineers have known all along. In the large number of cases not statistical or spatial soil property controls an uncertain quantity, but rather limitations in up-to-date capability to understand, explain and quantify the field behavior of soils over the full extent of the processes that produce failure.

Perhaps the greatest toughness of the geotechnical profession is in the capability to appraise and gain knowledge from field acquirement experience both successful and unsuccessful, and engineering decision is the means by which this toughness is restrained at the level of the individual engineer. It has been shown here that subjective degree-of-belief probability interpretations can permit the engineer to translate field acquirement experience in the form of decision into risk analysis applications. This supplies the means to overcoming, even if never eliminating, the blockade to probabilistic methods that modeling indeterminates otherwise unavoidable present.

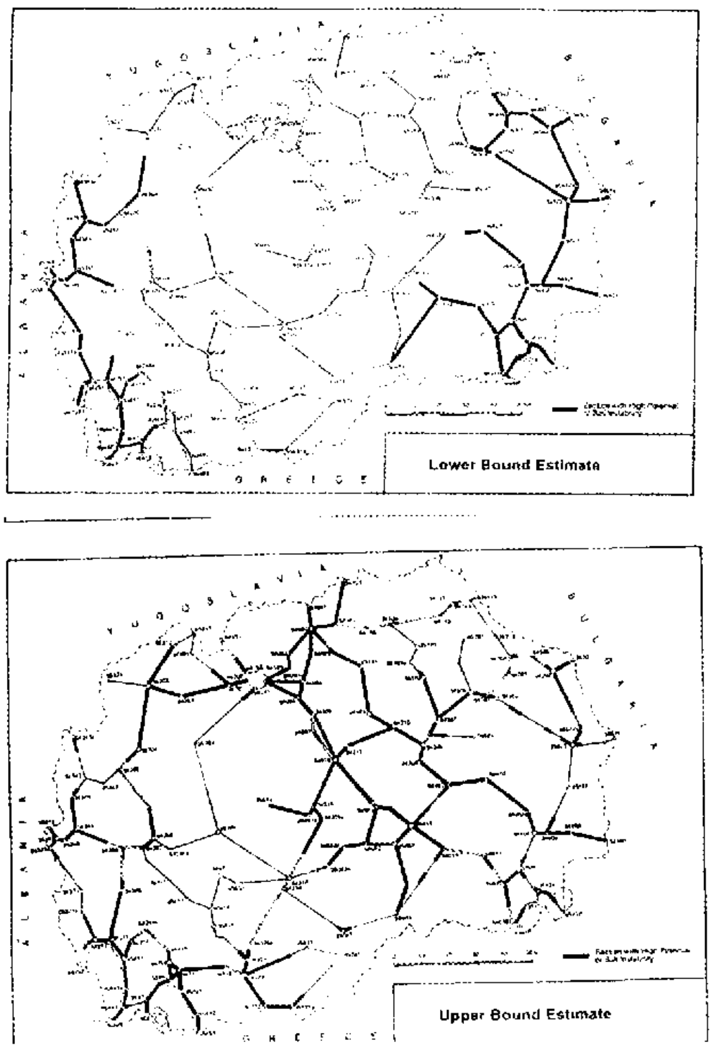


Fig. 1 Dynamic soil instability of Macedonia transportation network for 'is' approach.

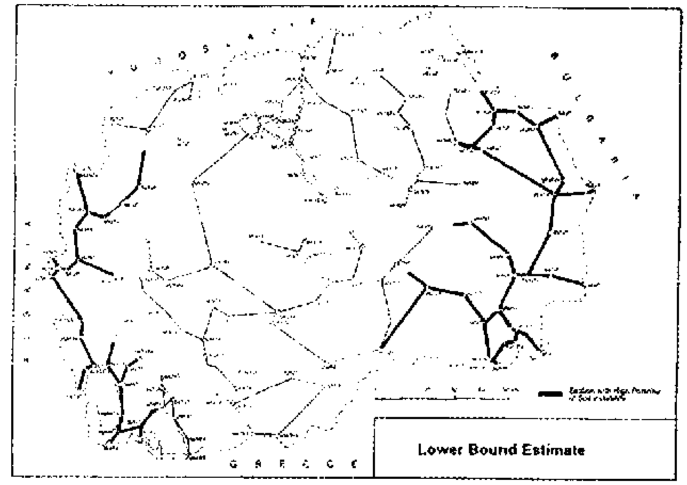
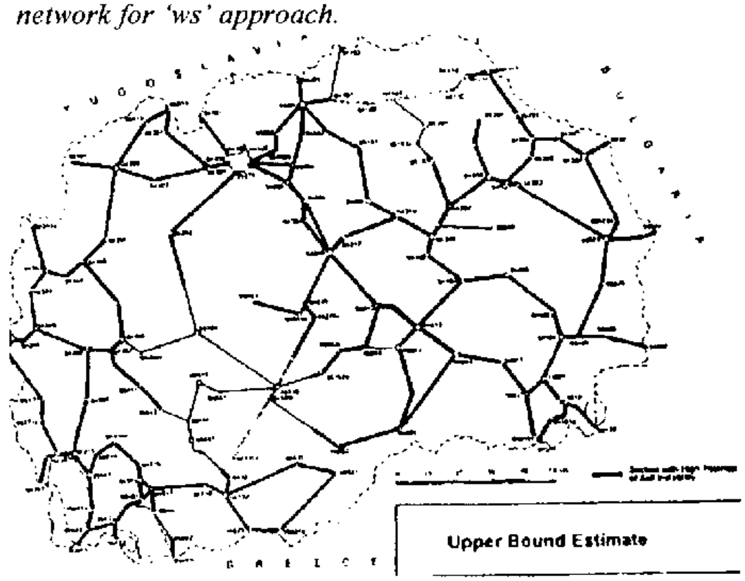


Fig. 2 Dynamic soil instability of Macedonia transportation network for 'ws' approach.



REFERENCES

Baecher, G. [1972]. "*Site Exploration: A Probabilistic Approach.*", Ph.D. thesis, Massachusetts Institute of Technology, Cambrige, MA.

Christian, J., Laad, C. and Baecher, G. [1992]. "Reliability and Probability in Stability Analysis.", in *Stability and Performance of Slopes and Embankments* - II, R. Seed and R. Boulanger, editors, Geotech. Spec. Pub. No. 31, ASCE, 1071-1111.

Cornell, C. [1968]. "Engineering Seismic Risk Analysis.", *Bull. Seis. Soc. of Am.*, vol. 58,

Roberds, W. [1990]. "Methods for Developing Defensible Subjective Probability Assessments.", *Trans. Res. Record No. 1288*, Transportation Research Board, National Research Council, Washington, D.C.

Whitman R. [1984]. "Evaluating Calculated Risk in Geotechnical Engineering.", *Journal. Geotech. Eng.*, ASCE, 110(2), 143-188.