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Designing and preparing materials for engineering geology courses with respect to local geology and domestic needs: A case study from Iran

La préparation du matériel pour les cours de géologie de l'ingénieur et son rapport avec la géologie locale et les nécessités domestiques: Une expérience en Iran

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ABSTRACT: Lack of suitable textbooks usually interfere with the successful training of engineering geology in a developing country such as Iran. A package has been developed which consists of objectively designed course materials in the field of engineering geology. The package is designed so that various combinations of the 24 units can be chosen to suit different applications.

RESUMÉ: Manque des livres de guide convenables pour l'éducation avec succès des étudiants en géologie de l'ingénieur est un obstacle tangible dans des pays en voie de développement comme l'Iran. Un ensemble de documents contenant des cours en géologie de l'ingénieur a été dévelopé d'une manière objective. Cet ensemble a été préparé d'une façon qu'il puisse offrir differents combinaisons de 24 unités de cours, qu'on puisse choisir, pour differents usages.

1 PRELIMINARY STUDIES

Teaching engineering geology is a relatively new issue in Iran. The absence of textbooks written in Farsi, the native language and the formal medium of communication in Iranian universities, is one of the main obstacles against presenting any successful engineering geology course.

The main aim of the project discussed in this paper is to prepare a package of objectively designed course materials in the field of engineering geology. It is intended that the package meets international standards, as well as local geology and domestic needs, and also satisfies a wide range of readers from civil and mining engineers to geologists, both at undergraduate and postgraduate levels. The aim has also been to put significant information in the package to serve as a handbook of facts and methods for qualified practitioners.

Problems arise when a scientific text is prepared for a wide range of readers. As Roberts (1977) has stated, it is important to bring such a diversified audience or group of readers to a common level of participation whilst maintaining their interests.

Civil and mining students in engineering faculties of Iranian universities are normally high school graduates that have majored in physics and mathematics. No geology courses are offered to these students in the last three years of their secondary studies. In contrast, geology students have normally completed a few geology courses during their secondary studies.

At the tertiary level, a first or second year course, which is invariably called 'Geology for Engineers' or 'Engineering Geology', is offered in engineering disciplines. In science faculties, however, geology students are offered a course called 'Engineering Geology' at a third or fourth year level.

Geological information required by civil and mining engineers, however, is not the same all over the world (Pitt, 1984). One deficiency in internationally published literature, is that it is in the context of local geology. For a textbook to be used in Iran, the geological issues encountered locally in civil and mining practices need to be emphasised.

The Iranian Plateau is one of the major earthquake prone areas of the world. Many Iranian cities have been repeatedly destroyed by devastating earthquakes throughout their history. Migrating sand dunes and flash floods are among the other dominant geological hazards. Conversely, natural hazards, such as those caused by volcanic eruptions or problematic glacial soils, are not significant in Iran. The high rate of population growth and

migration of people to larger urban centres such as Tehran, has introduced new issues particularly in relation to environmental management that engineers must address.

A review of the past and present engineering geology curricula in Iranian universities showed that, in many cases, the course contents were almost identical to traditional physical geology courses. To eliminate this deficiency, the syllabi of engineering geology courses offered in some foreign universities, mostly from the United States of America, Canada, Australia and United Kingdom, were carefully examined. At the same time, the contents of twelve internationally recognised engineering geology textbooks from United States of America, Canada, United Kingdom, Czechoslovakia, India and former Union of Soviet Socialist Republics were compared, and a synthesis compiled.

The results from the preliminary study refined the initial objectives and established the final framework of the package.

2 STRUCTURE OF THE PACKAGE

One step taken to reduce some of the existing problems discussed earlier, was the presentation of the course material in twenty-two, mostly self instructive units. Each of these units, while following the general format of the package, is independent and can be studied individually without geological knowledge or experience. To satisfy the objectives of different courses any combination of units may be used.

The texts is organised into five sections:

1. geological environment;
2. geotechnical investigation;
3. geotechnical properties of rocks;
4. geotechnical properties of soils; and
5. ground geotechnical behaviour.

Each section comprises three to six units. Table 1 shows the relative significance of each section and the length of each unit, with respect to the total length of the text.

The first section of this package deals with those parts of the science of geology which are most frequently used by engineers. This section, which is mostly an introduction to geology for civil engineers, discusses the Planet Earth as man's habitat, geological materials and structures, climatic processes and surface and underground waters (Table 1). This section is mostly designed for readers that have no previous background in geology.

Different aspects of the rapidly growing field of geotechnical investigation are presented in the second section. It covers topics such as surface and subsurface exploration, geotechnical sampling and data processing (Table 1). Techniques for converting raw geological data to maps, sections, charts, and block diagrams are reviewed in the last unit of this section.

The next two sections are devoted to the geotechnical properties of geological materials. Measurement techniques of engineering and hydraulic properties of rocks and soils, as well as the behaviour of these materials in different engineering applications are reviewed. One unit on sand and gravel describes the formation, exploration, extraction and processing of these deposits. Specifications of suitable sand and gravel for different engineering applications are also discussed in this unit.

Table 1. Contents of the package

Section	Unit	Allocated Pages	%
I. Geological Environment			**21.8**
	Planet Earth, Man's Habitat	28	
	Geological Materials	78	
	Geological Structures	64	
	Climatic Processes	54	
	Surface Waters	72	
	Groundwater Resources	56	
II. Geotechnical Investigation			**16.4**
	Surface Reconnaissance	74	
	Field Geology	38	
	Subsurface Exploration	60	
	Geotechnical Sampling	34	
	Presentation of Geotechnical Data	58	
III. Geotechnical Properties of Rocks			**12.4**
	Mechanical Properties of Rocks	42	
	Measurement of Rock Properties	50	
	Engineering Classification of Rocks	50	
	Rocks in Engineering Practices	58	
IV. Geotechnical Properties of Soils			**16.4**
	Measurement of Soil Properties	93	
	Soils in Engineering Practices	84	
	Constructional Sand and Gravel	88	
V. Ground Geotechnical Behaviour			**19**
	Seismicity	62	
	Slope Stability	98	
	Tunnels and Underground Spaces	70	
	Dams and Reservoirs	77	
Appendices		226	**14**
		Total 1614	**100**

The interactions between geological materials, structures and processes with stress fields through time, create numerous geotechnical problems. Earthquakes and slope instability are two major examples of this kind. The final section of the package deals with the geotechnical behaviour of the ground, with units on seismicity, slope stability, tunnels and underground spaces, and dams and reservoirs (Table 1).

3 PRESENTATION OF THE PACKAGE

One of the original objectives of this project was to formulate a common ground for a better and more meaningful communication between geologists and civil and mining engineers. More than 15 years of teaching experience, both in science and engineering faculties, and feedback from both disciplines were used in formulating this package.

The authors or translators of the first few books of a new discipline, published in another language, normally face the challenging problem of selecting proper equivalents for newly created terms. A poorly selected equivalent, might stay in the host language for ever. Equivalents for geological and geotechnical terms were determined during the period 1976-1983 by a committee comprising geologists, mining engineers and an expert in Farsi. A dictionary is appended to each volume and contains a total of 2112 equivalents for the most frequently used geological and engineering geological terms used in the text.

A large amount of data was excluded from the main body of the package and summarised in 262 tables (Fig. 1). Experience shows that engineers have more faith in numerical data and also in data presented in tabulated form.

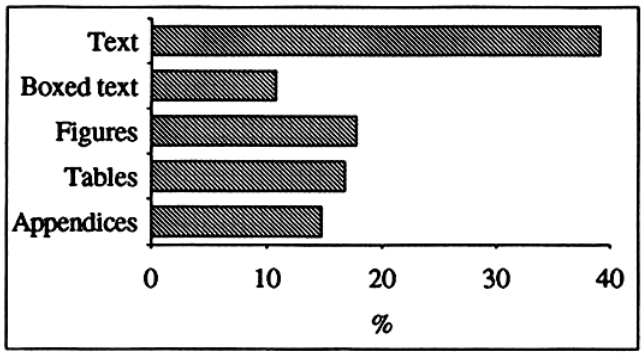

Figure 1.

Case histories, the procedures of laboratory and field tests, as well as the description of various techniques, such as preparing geological cross sections or working with air photographs, are separated from the main text and located in 76 framed boxes. These boxes comprise approximately 10% of the total volume of the package. The main body of the text occupies less than 40% of the package (Fig. 1).

In view of the possible lack of qualified staff in some universities, the text is designed to be mostly self instructive. No assumption is made to the background experience or knowledge of the reader. The text is descriptive and mostly non-mathematical.

The package is published by Tehran University Press in two volumes. These volumes are titled 'Geology for Engineers', and 'Engineering Geology and Geotechnics' (Memarian, 1992 , 1994).

4 COURSES OFFERED BASED ON THIS PACKAGE

'Geology for Engineers', 'Engineering Geology' and 'Advanced Engineering Geology' are among those courses which can use the present package as their course materials. Every teacher has a preferred approach and may select a different set of units from this package and present them in their desired sequence.

In the Engineering Faculty of Tehran University 'Geology for Engineers' is a one term, 18 weeks subject offered in second year. It consists of two hours of theory and two hours of laboratory work. This course is mainly concerned with the geological environment. It is also an introduction to the procedures of gathering geological data from the field. All parts of section 1 and two units from section 2 are the selected text materials for this course (Table 1).

Two hours of laboratory work per week are devoted to identification of rocks and minerals in hand specimens, working with topographic and geological maps and drawing cross sections, preliminary aerial photograph interpretation, and techniques of using a geological compass in the field. Physical geology textbooks (Memarian and Sedaghat, 1990; and Sedaghat and Memarian, 1990) are partly used for laboratory work. These books are also proposed as a supplement to the package.

The author is in full agreement with Glossop (1968) that the education of engineers in geotechnology is incomplete until they have had relevant experience of geology in the field. Due to some logistic problems, field excursions for this undergraduate course have been limited to 1-3 days. This deficiency is partly compensated for by the addition of more figures and photographs to the course material. More than 600 figures are used, which is approximately 18% of the total volume of the textbooks (Fig. 1). The course is also supported by four hours of video programs,

especially prepared to describe internal and external processes.

Selected units from sections 2 to 4, and all the units from section 5 are suggested for 'Engineering Geology' courses offered in science faculties (Table 1).

The content of postgraduate Engineering Geology courses, offered to civil engineers at Tehran University, changes according to the major interests of the students and their fields of specialisation. Once again emphasis is put on the recognition of geological materials, structures and processes, and also the techniques of gathering relevant geological data from the field, aerial photographs or geological maps. Section 2 and selected units from other sections of the package are contained within the contents of this course.

REFERENCES

Glossop, R. 1968. The rise of geotechnology and its influence on engineering practice, *Geotechnique*, 18, pp 105-150.

Memarian, H. 1992. *Geology for engineers*, Tehran University Press, Tehran, 736 pp (in Farsi).

Memarian, H. 1994. *Engineering geology and geotechnics*, Tehran University Press, Tehran, 887 pp (in Farsi).

Memarian, H. & M. Sedaghat 1990. *Physical geology: internal processes*, Payame Noor University Press, Tehran, 718 pp. (in Farsi).

Pitt, J. 1984. *A manual of geology for civil engineers*. World Scientific Publishing Company, Singapore.

Roberts, A. 1977. *Geotechnology: an introductory text for students and engineers*, Pergamon Press, Oxford, UK, 347 pp.

Sedaghat, M. & H. Memarian 1990. *Physical geology: external processes*, Payame Noor University Press, Tehran, 706 pp (in Farsi).

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