

UNDERGRADUATE AND POST-GRADUATE TRAINING IN ENGINEERING
GEOLOGY AT BELGRADE UNIVERSITY AND ITS PERSPECTIVE

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A mérnökgeológiai képzés és továbbképzés jelene és jövője
a Belgrádi Egyetemen

1. INTRODUCTION

The Faculty of Mining and Geology of the University of Belgrade is one of the most important academic centers for the training of experts in the field of engineering geology in Yugoslavia. It was here that the majoring in engineering geology and hydrogeology was first introduced. A further development was the introduction of two separate majors: one in geotechnics, the other in hydrogeology. Until quite recently this was only academic center for the training of engineering geological personnel. At present, the University of Zagreb and the University of Tuzla offer major courses with similar curricula leading to a degree in engineering geology.

At the University of Belgrade, like in most other Yugoslav Universities, the courses in engineering geology are designed to train

- (a) Experts majoring in engineering geology or geotechnics, and
- (b) Experts in other fields related to geotechnics for whom a knowledge of the principles of engineering geology is prerequisite for successful work in their particular profession such as civil engineering, architecture, mining, urban planning, and some specific geological disciplines, e.g. geology of mineral deposits, hydrogeology, geophysics, regional geology, etc.

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The engineering geology curricula and syllabi of related Academic institutions or of other major courses at the Faculty of Geology in other University centers are, as a rule well adapted to take care of the needs of the future profession of the trainees.

The present report is devoted exclusively to the engineering geology curricula of those schools and major courses which provide training in engineering geology and/or geotechnics.

2. ON THE DEVELOPMENT OF ENGINEERING GEOLOGY IN SERBIA AND AT THE UNIVERSITY OF BELGRADE

The first application of geological science to the study of the terrain for civil engineering design and construction in Serbia is to be credited to D. Antula and S. Radovanović. The work was done in 1907 in connection with the Zaječar-Paraćin railway line project. Further application and development of engineering-geological investigations was stopped by the Balkan Wars and the World War I. In the period between the two World Wars engineering geology was applied in the study of geological conditions along proposed routes for the railway line connecting Belgrade with the Adriatic Sea. For this purpose as many as ten different variants were analyzed. Engineering geological conditions were also studied in connection with several smaller hydroelectric projects and other civil engineering structures. It is noteworthy that during this period the participation of geologists in the design and construction of various projects was mostly restricted to occasional inspection of the terrain and projects under construction, and writing of short routine reports. The complex of engineering geological problems were only rarely followed systematically throughout the working process - from the project to the finished engineering structure.

This level of engineering geologocial investigations reflects, essentially, the comparatively underdeveloped economy of the time, the absence of social planning and development, lack of professional staff, and the general level of scientific and technical attainments of that time.

Consequently, the engineering geology as a scientific and technical discipline could not but develop within narrow limits, the entire research and practice being associated with a few outstanding scientists in this field. A special credit must be given to the late academician Professor Milan Luković for his pioneer initiative and his later remarkable work in the field of engineering geology. Professor Luković is justly considered to be the founder of engineering geology in Yugoslavia, because under his guidance the Section for Technical Geology was established at the Civil Engineering Department of the Faculty of Technology in Belgrade in 1921, and engineering geology was introduced as a subject. Professor Luković's textbook Inženjerska geologija (Engineering Geology) came out as early as 1931, and is certainly one of the first books of its kind.

In the period directly following the World War II, intensive reconstruction and development of the devastated country, and remarkable technical progress based on long-term planning imposed the need and offered possibilities for further development of engineering geology. It became evident that in addition to basic geological disciplines, the curriculum of an engineer in geology should include mathematics and physics, the elements of the theory of construction, soil mechanics, etc. enabling him to solve complex tasks involved in the study of geological conditions, the knowledge of which is prerequisite in the planning, designing, construction and exploitation of various civil engineering and mining works, hydro-electric and ammelioration projects, and the like.

To take care of all these problems, the Mining Department was established at the High Technical School of the University of Belgrade as early as 1946. This department which later developed into the Faculty of Mining (1949), and the newly

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organized Faculty of Geology (1949) were reorganized into the Faculty of Mining and Geology (1957) whose aim was to educate mining engineers and technically oriented geologists specializing in geological mapping, exploration of mineral deposits, engineering geology with hydrogeology, and applied geophysics. One of the initiators of this educational change was Professor M. Luković whose main subject was engineering geology and hydrogeology.

The first generation of the newly organized Faculty of Geology graduated in 1950. This group of 36 engineers gave an important contribution to the economic development of the country by their remarkably active role in carrying out electrification and industrialization projects. To meet the needs imposed by the economy of the country, almost one quarter of the first generation of graduates were engaged in solving engineering geological problems. Special groups for engineering geological and hydrogeological investigations were soon organized in a number of research institutes and economic enterprises. The problem of engineering geological personnel has long been solved.

In the entire post-war period the engineering geological curricula and syllabi at the University of Belgrade have subjected to comparatively frequent and important changes with the aim to adjust the profile of graduates to the demands of the country's economy and the state as a whole, taking care that the available staff and funds, as well as the past experience, are used to the best advantage. The first curriculum set up in 1946 comprised subjects of a general character (chemistry, physics, etc.), a group of subjects of general professional orientation, and a group of subjects covering applied geology and geophysics. This last group of subjects included engineering geology with hydrogeology and soil mechanics. After registering for the major course in applied geology, the students could specialize in a more specific field according to their own choice. For this purpose the candidate did individual research the results of which were incorporated in his diploma work. With minor changes this curriculum remained in force until 1961.

In 1961 the tuition in applied geology ("Technical Geology") was organized in three major courses: (1) in engineering geology and hydrogeology, (2) in exploration of mineral deposits; (3) in applied geophysics.

In addition to the existing subjects (engineering geology, hydrogeology, soil mechanics) other subjects, like rock mass mechanics, grouting and stabilization of the terrain, hydrology, hydraulics, design of engineering geological and hydrogeological investigations, etc. were introduced into the major course in engineering geology with hydrogeology.

The most essential innovations in the tuition of an engineering geologist have been introduced since 1971. It was in that year that a special Major course and a Chair for geotechnics were organized in which parts of the former Major course and Chair for engineering geology and hydrogeology were included. In the reorganized Major course, training in engineering geology was separated from training in hydrogeology. By reducing to a certain extent the subjects relating the study of groundwater, it was possible to introduce new subjects more relevant for a detailed analysis of the interaction between terrain and manmade structures. Programs of the already existing professional courses were expanded or split into two or more units with simultaneous introduction of new subjects such as Principles of engineering geology, Engineering geology of Yugoslavia, Soil mechanics, Rock mass mechanics, Geostatical calculations, Geotechnical amelioration of the terrain, Design of geotechnical investigations, Foundation engineering, etc.

The post-graduate courses in engineering geology were first introduced in 1967, and since then six generations have completed their post-graduate training, the courses being organized every second year, on an average. The curricula at the post-graduate level are even more frequently changed than those of under-graduate courses in order to adapt them to the particular needs of successive generations.

In conformity with the existing Yugoslav High School legislation, there are post-graduate four-semester courses leading to the Master's degree and two-semester specialization courses; the former are research-oriented, while the latter have the character of in-service permanent professional education.

3. THE PRESENT STATE OF ENGINEERING GEOLOGICAL TRAINING

The present curriculum of the Major course in geotechnics is basically that set up in 1971 with certain innovations introduced in 1977. The complete list of subjects of a full-time four-year university course in Geotechnics is given below.

Table 1.

Subject	Year of study and semester		Year							
			1st		2nd		3rd		4th	
	I	II	III	IV	V	VI	VII	VIII		
1. Mathematics	3+4	2+2	2+2	2+2						
2. Physics		3+3								
3. Chemistry	3+2									
4. General geology	2+2	2+2								
5. Mineralogy	2+2	2+3								
6. Descriptive geometry		2+3								
7. National defence	2+0	2+0	2+0	2+0						
8. Elements of sociology		2+0	2+0							
9. Mechanics, Part 1			3+3							
10. Strength of material				2+2						
11. Petrology			2+2	2+2						
12. Historical geology			2+1	2+1						
13. Geomorphology			2+3							
14. Exploratory boring				2+1						
15. Geodesy				2+2						
16. Physical education			0+2	0+2						
17. Foreign language (English, French, German or Russian)			2+0	2+0						
18. Structural geology					2+3					
19. Geological mapping					2+3	2+3				
20. Hydrogeology					2+1	2+2				
21. Methods of geophysical investigation					2+2	2+2				
22. Principles of engine- ering geology					2+0	2+2				
23. Elements of civil engineering structures					2+2	2+0				
24. Photogeology						1+2				
25. Soil mechanics						2+2	2+2			
26. Rock mass mechanics						2+2	2+2			
27. Geostatical calculations									3+3	
28. Methods of eng.geol. investigation of terrain								2+2	2+4	
29. Engineering geodynamics								2+2		
30. Geotechnical amelioration of terrain								2+2	2+2	
31. Engineering geology of Yugoslavia								2+0		
32. Design of eng.geol. investigations								1+2	1+3	
33. Foundation engineering									2+2	
34. Social, Economic and Political Systems in Yugoslavia								2+0	2+0	
Total number of periods per week*	12+10	15+13	17+17	16+12	12+11	15+15	15+12	12+14		
Field course (May 15 th-31st)										

Note: The first number refers to lectures, the second to practicals.

Although practical training during summer vacation is optional, it is often organized at students' request and is arranged to suit the interests of students and possibilities of the economic enterprises to which they are admitted for practice.

Participation of individual groups of subjects in the total number of periods per academic session is as follows:

I.	General educational subjects	11,1%
II.	Subjects covering basic disciplines in the field of science (mathematics, physics, chemistry)	21,0%
III.	Geotechnical subjects of a general character	
	Total:	38,3%
	Of which,	
	Subjects on civil engineering	4,7%
	Subjects of a general geological character	22,5%
	Subjects covering various methods of geological investigation	11,1%
IV.	Geotechnical subjects, str. Total:	29,6%
	Of which,	
	General theoretical subjects in the field of geotechnics	15,9%
	Subjects dealing with methods of geotechnical investigation	8,1%
	Subjects involved in geotechnical project engineering	5,6%

After passing all these subjects the undergraduate proceeds to individual research executed under supervision of a member of the teaching staff, written up in the form of Diploma Work, and defended before an approved panel of experts. The Diploma Work must reflect student's proficiency in all the principles of investigations relevant for the given professional problem.

In the post-graduate curriculum, the Academic course leading to a Master's degree has four basic groups of subjects:

- Group 1.- Methodology of research (one subject);
- Group 2.- Mathematical subjects (a choice of 5 subjects);
- Group 3.- Theoretical studies (a choice of 20 technical subjects)
- Group 4.- Professional studies (a choice of 12 subjects)

The only non-optional subject is Methodology of research (Group 1). From all other groups (2-4) students are allowed to choose the subjects they are most interested in, their choice being subject to approval by the supervisor and the chair at which they have enrolled. The only limiting condition is that the total number of lectures agrees with the curriculum schedule. In this way the candidate is enabled to choose the program of studies that will best suit his interests and the needs of his particular job (in-service training).

Post-graduate two-semester specialization is advanced (taught) career-oriented course, organized to meet the needs of each particular candidate. This is achieved by devising a special program for the given field of specialization. The program of studies falls within the responsibilities of the Chair for geotechnics.

4. OUTLINE OF NEW DEVELOPMENTS IN THE EDUCATIONAL SYSTEM

The entire system of education and vocational and/or professional training in Yugoslavia is undergoing a thorough change which will, naturally, be reflected in the university curricula and syllabi.

To obtain the best possible insight into the prospective system of teaching and training in engineering geology and geotechnics, the new Yugoslav educational system will be schematically presented in Fig. 1.

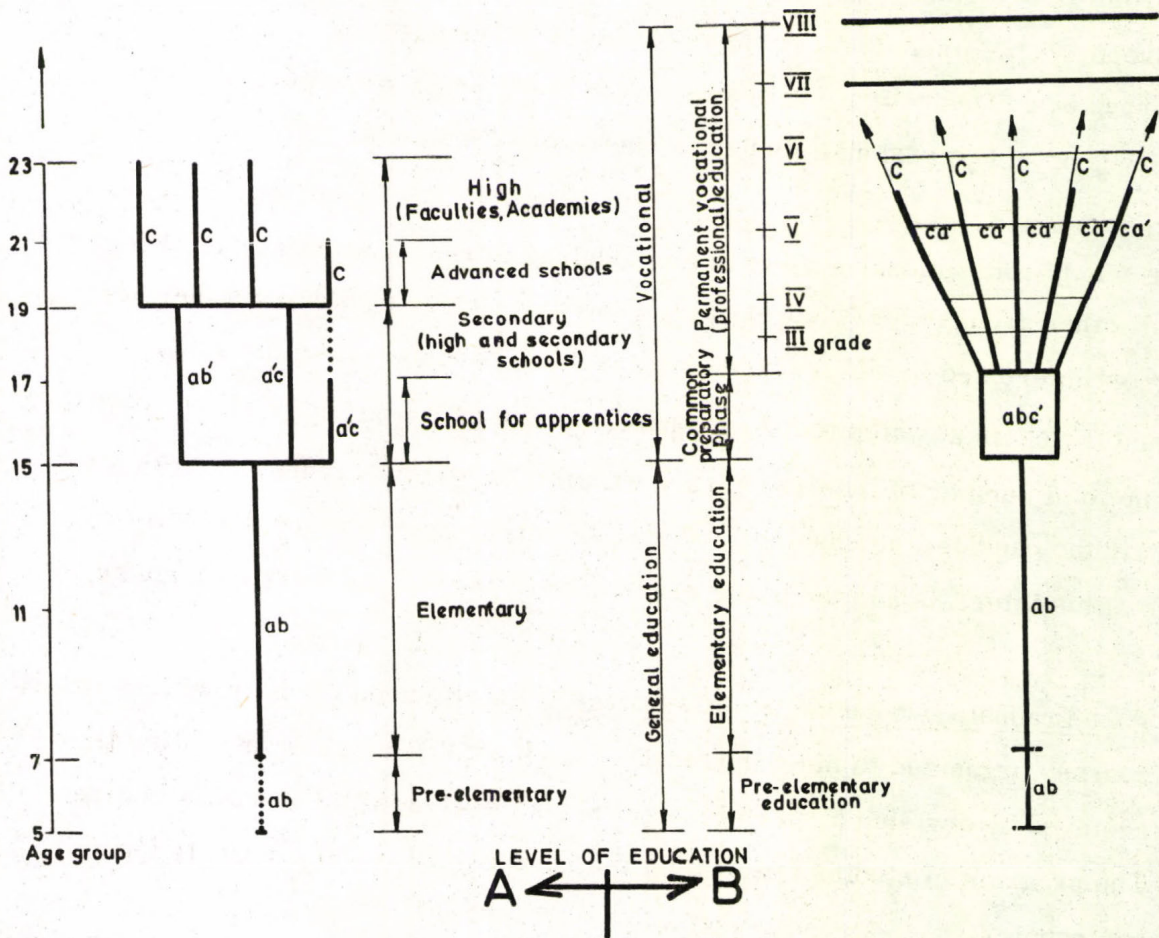


Fig. 1 - Schematics of the former (A) and the new (B) educational systems in Yugoslavia.

Legend: (a) general education; (b) in-service and polytechnical education; (c) vocational education; (a') elements of general education; (b') elements of in-service and polytechnical education; (c') possible vocational education.

It is evident that the new educational system consists of the following two major parts,

The first comprising the pre-elementary and the eight-form compulsory elementary instruction and education; and

The second comprising (a) common preparatory phase, and (b) graded vocational education and training.

The educational system as a whole incorporates eight grades of vocational education. In this multi-grade system the vocational and/or professional education starts with the third grade and ends with the eighth grade, the first and second grades being special forms of in-service education.

In the proposed educational system, the education of prospective engineering-geological and/or geotechnical staff starts in the third form of the secondary school and/or at the third grade level of the vocational in-service education. The third grade is devised to educate analysts for geotechnical investigations, the fourth grade to educate technicians for geotechnical investigations.

At present, the fifth-grade level of vocational education does not provide instruction for engineering geological staff. Plans are, however, being discussed to create conditions for the initiation of this level which is to educate geological engineers with a major in geotechnics. On completing the sixth-grade level the candidate will obtain the title of a graduated geological engineer with a major in geotechnics. The sixth-grade level is an equivalent of the present four-year academic course.

The seventh and eighth levels of education correspond to master and doctoral courses in the field of geotechnics.

After the complete reconstruction of the educational system, there will be a continuity in the training of the staff for engineering geology and/or geotechnics between the earliest phase (third-grade level) and the highest academic degree (eighth-grade level). The curricula and syllabi, admission requirements to successive levels, criteria for registration of master's and/or doctoral dissertations will be devised so as to form a well-articulated integral educational system.

Kivonat a "MÉRNÖKGEOLÓGIAI KÉPZÉS ÉS TOVÁBBKÉPZÉS JELENE ÉS
JÖVŐJE A BELGRÁDI EGYETEMEN" c. előadásból.

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Jugoszláviában a mérnökgeológiai képzés egyik legfontosabb felsőoktatási központja a Belgrádi Egyetem Bányászati és Geológiai Kara,

A Belgrádi Egyetemen – hasonlóan a többi jugoszláviai egyetemhez – mérnökgeológiai ismereteket oktatnak:

- a főfoglalkozású mérnökgeológusok és geotechnikusok részére, valamint
- a mérnökgeológia szakismeretet nem nélkülözhető szakmák részére pl. építőmérnök, építészmérnök, bányamérnök, várostervezőmérnök. Ezek számára speciális geológiai oktatás is folyik pl. teleptan, hidrogeológia, geofizika, általános földtan stb.

1971 óta a Belgrádi Egyetemen a korábbi Mérnökgeológiai Hidrogeológiai Tanszék beolvadt az akkor alakuló Geotechnikai Tanszékbe. Az oktatásban megnőtt a szerepe az emberi létesítmények és az alapkőzet közötti kapcsolatot tárgyaló tantárgyaknak. Olyan új tantárgyak bevezetésére került sor, mint a mérnökgeológiai alapjai, Jugoszlávia mérnökgeológiája, talajmechanika, kőzetmechanika, geostatikai számítások, talajjavítás, alapozás, geotechnikai kutatások tervezése stb.

1967-ben bevezették a mérnökgeológiai mérnöktovábbképzést is. Minden második évben megszervezik a tanfolyamokat.

A tantárgyak az igényeknek megfelelően állandóan változnak. A mérnöktovábbképzésnek két formája alakult ki. Van négy féléves és két féléves tanfolyam. A négy féléves tanfolyamon elsősorban kutatómérnököket, a két féléves tanfolyamon kivitelező mérnököket képeznek.