Teaching Geotechnics at the Faculty of Civil Engineering, VŠB-Technical University Ostrava after Destructuralisation of University Study in the Czech Republic

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ABSTRACT: This paper gives the information about the teaching geotechnics and geotechnical disciplines at the Faculty of Civil Engineering VSB-Technical University Ostrava (Czech Republic). The authors present the historical development of this study from the mining orientation towards the field of underground and geotechnical engineering. In this paper there is presented structural modification of the study program resulted from the necessity to adopt both the study structure and the study program to the requirements of the European Union (Bologna Declaration). There are stated three educational stages (bachelor, master, postgradual), duration of these stages, their basic subjects, profile of the graduates and the basic directions of future development of geotechnical program.

1 INTRODUCTION

Teaching geotechnics and geotechnical disciplines has a long tradition at the VŠB-Technical University (VŠB-TU) as teaching of mining programs, for which the university was established in 1849, contained disciplines which, in the sense of the definition of Terzhagi, are possible to line up in the contentual context of geotechnics.

Since the founding of the Department of Mine Construction in 1955 and later the founding of the Department of Geotechnics and Mine Construction in 1974, the teaching of geotechnics have systematically developed not only in the light of specialisation but also in the contentual context and study structure. Development of mining geotechnical disciplines have been gradually replaced, due to the downturn of mining industry in 1968-1970 and subsequently in 1989, by a broader specialization in the area of underground engineering and environmental geotechnics.

After the creation of the Faculty of Civil Engineering in 1997, the Department of Geotechnics and Underground Engineering, one of the key departments of the faculty, was founded and then the master's and doctoral programs had been accredited in the area of geotechnics (study program Geotechnics and Underground Engineering).

2 DEVELOPMENT OF THE MASTER'S PROGRAM

Since the establishment of the department in 1955, the teaching activity of the department has mainly oriented to the area of construction of mines, particularly the deep ones. This was necessary due to the very extensive investment activities in the mining industry. Disciplines, which had been expertly and pedagogically cultivated by the department, converged into the subjects like: Blasting, Driving of Mine Workings, Construction Materials, Shaft Sinking, Structural Engineering, Mine Facilities Design, Construction of Mines etc. Gradually, in connection with the indications of recession in the mining industry and preparatory work for important subsurface construction projects (for example, Prague underground transport project) in the middle of the sixties of the last century, the departmental work started distinctly to orient towards the areas of geotechnics and underground engineering. Concurrently, the department had extended its work in the field of mining to the area of mine planning since 1974. Orientation towards the field of underground engineering and geotechnics gradually took roots according to the societal demands on the profile of the graduates and in consequence of the expansion of activities of mine construction companies, who were the main employers of the graduates, to the field of underground engineering which became their main sphere of activities (An example is, the transformation of the company "Construction of Mines of Uranium Industry" to the today´s

Subterra.) Greater demands were as well placed on the knowledge of the students in pure structural disciplines (concrete and steel structures etc.). In spite of a temporary strengthening of investment activities in mining industry in the seventies and eighties, this trend further continued and the interest of constructional orientation of initial mining program gained furher strength. After 1989, a great change in orientation took place, when due to the sudden recession in the mining industry the efforts towards constructional orientation of the program further strengthened and extended in the fields of ecological structures, municipal engineering and construction of industrial objects. The division of Czechoslovakia had the impact of extension of orientation towards transport engineering. This wide spectrum was manageable only by the extension of a number of study programs with orientation towards construction. They have developed on the following order:

• since 1955 - specialization in the field of mine construction within the program Mining of Deposits
• since1976- Program no.21-22-08: Construction of Mines and Geotechnics
•since1989- Program no.21-33-08: Mining and Underground Engineering
Specialisation: Underground Engineering and Geotechnics
Specialisation: Ecological Engineering
• since1992-Program no.37-23-08: Geotechnical and Transport Engineering
Specialisation: Underground Engineering and Geotechnics
Specialisation: Transport Engineering
• since1997- Programno.36-19-08:Geotechnical and Underground Engineering

Since the establishment of the department in 1955, more than 570 students have completed the engineering programs with specialisation in the fields of construction and geotechnics at the Mining Engineering Faculty and at the Faculty of Civil Engineering. The 5-year program Geotechnical and Underground Engineering has been accredited (up to 2007) within the study program no. 36-07-T „Civil Engineering“.

The program had been realised through credit system and used to be finished by the defence of undergraduate thesis work and final public examination. The compulsory part of the program included basic subjects from geotechnical and civil engineering fields (Mining Engineering, Rock Disintegration, Driving and Supporting of Underground workings, Engineering Geology and Hydrology, Mechanics of Underground Structures, Underground Constructions, Foundation Engineering, Improvement of Soil and Rock properties), and this was further supported by elective selection of disciplines of more detailed professional specialisation, which was satisfied by the contents of 4 specialisations:

• Underground Engineering
• Geotechnics
• Mining Constructions
• Blasting Technics and Desintegration of Rock

Graduate of the so called lengthy master´s program is able to fulfil enginering tasks (making proposals, realization, design and supervision) in the area of geotechnical and underground engineering, special geotechnics, environmental geotechnics, geotechnical prospecting, disintegration of rocks and mine constructions.

3 STRUCTURAL MODIFICATION OF THE PROGRAM AND THE POSSIBILITIES OF STUDYING GEOTECHNICS

Structural modification of the program has been done in connection with the planned accession of the Czech republic to EU and the necessity of adopting the university education system to the requirements of EU formulated by the so called „Bologna Declaration“ made by EU Ministers of Education. It is based on the introduction of 3-phase university education system in different stages:

- Bachelors Program
- Master´s Program
- Postgradual(Doctoral) Program

After a series of analysis and discussions regarding the contents of particular level of education and training, the Faculty of Civil Engineering has accepted the following duration of study under each phase :

- 4 years in case of the bachelor program (Bc.)
-1 and a half year in case of the master´s program(Ing.)
- 3 years in case of the doctoral program (PhD.)

The name of the program has been unified in all stages of study within the framework of structural modification and subsequent to accreditation teaching activities have started in the academic year 2003/04:

• Bc. Program 3647R017 Geotechnics(4-year program)
• Master´s(Ing.) program 3607T035 Geotechnics (1 and a half year – consequent master´s program)
• Ph.D program 3607V035 Geotechnics (3 year program)

The program duration has great importance for education and training of students in the area of geotechnics. Philosophical basis for the development of bachelor programs have stemmed from the realities and demands on the profile of the graduates. Those are:

- graduate of bachelor program must be useable and prepared mainly for constructional geotechnical tasks to be performed in the field and organisational positions. They must, therefore, have sufficient knowledge on civil engineering basics as well as ba-

sic geotechnical disciplines to the extent of more than the graduates from industrial schools, whose technical and professional tradition and standard is known in the Czech and Slovak Republic. This also relates to the extent of training and education in management and economic disciplines.

- graduate of bachelor program must have such standard and extent of theoretical and natural science basics, which will enable him to continue in the engineering and doctoral education without the necessity of specialised training courses.
- it is necessary to reduce credit load of students with regard to the European and world trends and ensure maximum use of modern teaching tools.
- curriculum of bachelor program must make mobility of students possible within the Czech republic and to other European universities and ensure mutual recognition of the finished examinations
- after certain years of experience, the graduate of bachelor program must have the opportunity to obtain authorised certificate in the field of activities.

Experience from the realization of 4-year engineering programs in the past (1981-1994) certifies that this goal is realistic and achievable and graduates of this type of program can be successful in the constructional geotechical area.

Curriculum of bachelor program„Geotechnics“ is included in the study program „Civil Engineering“ and the first two years are based on a common curriculum which contains basic natural science, socio-economic and engineering disciplines (mathematics, physics, chemistry., geology, underground engineering, geodesy, static, theory of architecture and others). The other part of the program based on constructional,technical and technological disciplines offers the possibilities of specialized study of geotechnical subjects as per the following structure and extent:

•Geology 3rd semester– 3+2 hours*
•Mechanics of Soil and Rock – 4th semester– 3+2 hours *
•Foundation Engineering–5th semester–2+2 hours *
•Engineering Geology and Hydrogeology – 5th semester – 2+2 hours *
•Blasting and Rock Disintegration – 5th semester – 2+2 hours *
• Driving and Supporting of Underground Workings – 6 th semester – 2+2 hours *
• Improvement of Soil and Rock properties – 6th semester – 2+2 hours *
• Environmental Geotechnics – 7th semester – 2+2 hours *
•Underground Engineering – 7th semester – 2+2 hours *
•Foundations in Complicated conditions – 7 semester – 2+2 hours *
•Geotechnical Monitoring – 8th semester – 2+2 hours *

* - weekly teaching load

This structure of disciplines ensures that graduate of this program obtains basic geotechnical knowledge in a broad theoretical and practical extent (including technical training), and, a series of special geotechnical disciplines related to that body of knowledge is offered in the master´s program . In particular, those are:

• Mechanics of Underground Structures – 9th semester – 2+2 hours *
• Geohydrodynamics– 9th semester – 2+2 hours *
• Excavation of Mine workings and Shafts – 9th semester – 2+2 hours *
• Ventilation of Underground Workings –9th semester – 2+2 hours *
• Technical Blasts and Their Effects – 9th semester – 2+2 hours *
• Modelling in Geotechnics – 9th semester – 0+3 hours
• Underground Structures – 10th semester – 2+2 hours
• Geotechnical Structures – 10th semester – 2+2 hours
• Road and Geotechnical laboratory – 10th semester – 0+3 hours
• Statics and Dynamics of geotechnical constructions – 10th semester – 3+2 hours
• Undergraduate Thesis work -11th semester – 0+10 hours

It is necessary to emphasize, that this geotechnical education is realised in the mutual relationship with professionally pure civil engineering disciplines (construction; concrete, steel and wooden structures, building materials, , structural mechanics, reliability of structures, economics in construction industry etc.), therefore, the profile of civil engineer is simultaneously fulfilled and the possibility of placement of graduate is further expanded.

4 POSTGRADUATE STUDY OF GEOTECHNICS

The unseperable part of scientific and pedagogical works always was the training for scientific works (research and study towards the title CSc.).Within the framework of this program, the interested persons had been educated and trained in the scientific activities in the area of construction of mines since the initiation of this form of study in the then Czechoslovakia (around the year 1960) under the jurisdiction of the committee “Mining of Deposits”(sub-committee for construction of mines). The total number of persons who have been awarded the degree of Candidate of Science during the life of this sub-committee is 55. As a result of transformation into the postgradual doctoral program (University Act 1990), this program has been included within the study field „Mining and Underground Engineering“. In connection with the necessity of deepening the knowledge of geotechnics and sciences related

with the rock environment, the doctoral program „Rock Enginnering“ was accredited in 1994 and the responsibility of maintaining the quality of the program had been jointly taken up by the Department of Geotechnics and Underground Engineering along with the Institute of Geonika of the Czech Academy of Science located in Ostrava and some research guides and persons had been recruited from the ranks of this institute as research guide and persons guaranteeing certain disciplines. Doctoral program 21-142-09 „Rock Engineering“ was the direct continuation of the engineering program „Geotechnical and Underground Engineering“, and deepened knowledge base with emphasis on independent scientific work of the Ph.D student. Basic object of interest was rock mass in itś whole entity and complexity. The aim of the doctoral study was to manage the issues of „working with rocks and in the rock environment“. The study program was systematic, based on multidisciplinary concept, which can be best documented by the fact that there was unnegligible participation of specialists in the teaching activities from top geotechnical working places in the Czech republic. Content of the program respected the direction of study developed in advanced countries (Felsbau, Rock Engineering), as is evident from the list of study disciplines:

A. Subject of theoretical basis:
- Rock Physics
- Engineering Geology
- Constitutive Modelling of Geomaterials
- Mathematical and Physical modelling in Mining engineering
- Theoretical Geomechanics

B. Technical subjects:
- Applied Geomechanics
- Geophysical Survey Methods
- Hydrogeology and Dewatering
- Engineering Classification of Rock Mass
- Rock Bolting
- Monitoring and Back Analysis in Mining Engineering
- Stability of Slopes and Slope redevelopment
- Stability of Foundations and Foundation Shafts
- Improvement of Soil and Rock properties

C. Applied subjects:
- Geotechnic and Geotechnical Structures
- Mechanics of Underground Structures
- Geotechnics of Waste Disposal
- Underground Engineering
- Case studies in Mining Engineering
- Rock Disintegration
- Mining of Raw Materials
- Excavation of Underground Objects
- Influence of Anthropological Activities in Rock mass on Environment
- Foundation Engineering

This concept along with some minor modifications has been taken up also for the model of the structured study program. The program has been accredited in 2005 with the change of program title to „Geotechnics“ having following duration:
- 3 years for internal study
-5 years for external study

The study is a selective one, and meant for the best graduates of the related master´s program and specialists with work experience in geotechnical areas. From the academic year 2007/2008 the study is being realised through credit system.

5 DEVELOPMENT OF GEOTECHNICAL STUDY PROGRAM

Further development of Geotechnic program is first of all connected with the continued intensive utilisation of underground for civilization, ecological and urbanisation needs of the society, with the development of needs of introducing more effective, economic and safe methods of realisation of underground constructions.

Particularly, we see the basic directions of further development in:
- orientation towards more complex understanding of physicall laws of effects and interactions playing within the rock mass in the process of construction of underground workings
-orientation towards innovation and technological development of the process of construction of underground workings
- orientation towards the economisation of construction and higher work safety in rock environment
-development of disciplines in the area of underground urbanism and their inclusion in the study program of geotechnics in all forms
-creation and utilization of information and knowledge database and systems
-utilization of systems of e-learning and bibliographic databases in the teaching process and more effective use of laboratory, computational and simulation methods in the training and education of students
-higher utilisation of professional training and excursions in the process of bachelor and master´s program
-enhancing quality of training and education in the area of management and team management, economics, preparation and realization of construction by utilising the specialistss from the field
-enhancing quality of training and education of teachers and the methods of teaching and their involvement in scientific research and professional work in collaboration with the industry, higher utilization of team work and their multidisciplinary character