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# Complex Education in Underground Structures at CTU in Prague

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**ABSTRACT:** Problems of traditional lecture classes after study curriculum changes and reduction of seminar lessons three years ago were the impulse to developing of the complex education system in underground structures at the Department of Geotechnics of the Czech Technical University in Prague (CTU). During the academic year 2006/2007 the staff developed courses in geology with a significant on-line support based on new website project, finished building up the classroom for high performance numerical modelling and started to use a new Underground Educational Facility Josef - "Josef UEF" (operated by Centre of Experimental Geotechnics). Now we can provide classical learning of geology with e-support, offer verification of acquired knowledge in the practical courses at the Josef UEF and we are able to use back analyses in lectures on numerical modelling, based on in-situ measurements. In the first part of the paper the on-line support system will be described with focus on the usage. In the next part the used software and our experience with 3D FEM modelling is mentioned. The main part will be devoted to Underground Educational Facility Josef (UEF) which was opened in June 2007 near the village of Čelina (Příbram district, 50 km south of Prague). Trial courses had started in June 2007. The education of students, according to the latest study plans commenced in September 2007.

## 1 EDUCATION SYSTEM AT CTU

Studies of Civil Engineering at CTU Prague currently consist of bachelor (4 years), master (1,5 year) and doctoral (3 years) degrees in several study programmes. Fundamental branches of study are Architecture, Building Structures, Structural and Transportation Engineering, Water and Environmental engineering, Material Engineering, Geodesy, Management and Economics in Building Industry. Students enroll in about ten subjects in every semester, usually five of them are finished by exam. Each subject is valued by credits (1 credit is about 1 hour per week, crucial subjects are valued little more) and in a 14-week semester the standard study load is 30 credits. The CTU credit system is compatible with ECTS (the European Credit Transfer System). A wide offer of optional courses allows students to concentrate on a selected specialization, the mastering of which they eventually demonstrate in their bachelor final projects and diploma works.

## 2 PRINCIPLE OF THE UNITING EDUCATION OF UNDERGROUND STRUCTURES

Fundamental lectures on Geotechnics – geology, soil mechanics and foundations are parts of all branches of study, but detailed lectures on rock mechanics and underground structures are compulsory in branch of study Structural and Transportation Engineering and optional in Material and Environmental Engineering, where the specialization Geotechnics is offered. Geotechnical education is developed in several steps with common scheme – lectures and seminars added with on-line courses, concentrated on self-activity of students. It starts in first year with geology, soil mechanics in second, rock mechanics in third year of study and consequently foundation structures and underground structures. Theory and technology in Geotechnics is replenished with computations, based both on classical methods in basic lectures and on computer analysis in fourth year of study. Lectures in Engineering Geology as the basis for collection the input data of all analyses are popular for their in



a cross-section of 40 m<sup>2</sup> is connected to various exploration workings by numerous insets, which follow ore formations and provide access to two further levels. The total length of the galleries is approx. 9 km; 90% of the breakings are not fitted with linings. The end of the main gallery is connected to the ground surface by means of an unsupported 90 m vent. The Josef gallery is located in an area of Psí hory auriferous deposits. The geological structure is heterogeneous, consist of volcanic rock (basalts, andesites, rhyolites), sedimentary rock (hornfels) and their combinations (tuffs, tuffites), characterised by younger intrusive rock types (granodiorites, albitic granites). The Psí hory gold-bearing district which is located mainly in the proterozoic belt, in rock of more than 600 million years old. These rocks were subsequently penetrated by Central Bohemian Pluton granitoid rocks during the Variscan orogenesis.. The deposits in the eastern Mokrsko ore-zone are situated in the tuffs and volcanites of the Jílovské belt and most of the western Mokrsko ore zone lies in the granodiorite of the Central Bohemian Pluton. The overburden consists of a volcanic-sedimentary formation - mostly tuffs and tuffitic shales.

## 5.2 History of the Gallery

The Josef Gallery underground complex was constructed during the large-scale geological exploration of the Čelina and Mokrsko gold bearing deposits in the nineteen eighties. The excavation of the gallery commenced in 1981 and in the mid 1990s exploration of the area ceased and the gallery was closed, the low gold concentration makes mining unprofitable and environmentally unfriendly. In 2005 the agreement on the use of the gallery for educational and research purposes was signed between the faculty and the Ministry of the Environment which owned the complex. Renovation work, carried out by Metrostav Ltd at its own expense, commenced almost immediately. In February 2007 Metrostav handed the complex over to the faculty. Currently 600 meters of underground galleries are accessible. Work aimed at improving access to the rest of the underground complex continues and a project for the construction of a surface support facility is currently in the preparation stage.

## 5.3 Use of the facility

The Josef Underground Educational Facility is being built as a multidisciplinary workplace. Its main uses will consist of the following:

- teaching in 1-3 day blocks focusing on underground structures, rock mechanics, material testing, engineering geology, geodetic work and mapping

- specialised tuition and courses in machine operation, bolt lining and anchorage, blasting work, ventilation and safety training.
- experimental scientific research in material engineering, geotechnics, geology and hydrology.

The education of students, according to the latest study plans, commenced in September 2007 in the renovated section of the underground area – Fig. 3. The trial education courses started in June 2007 – Fig. 4, 5. Modern support facilities (the reconstruction of the existing surface building for administration purposes, accommodation, workshops and surface laboratories) will be added to the site in the near future projects.

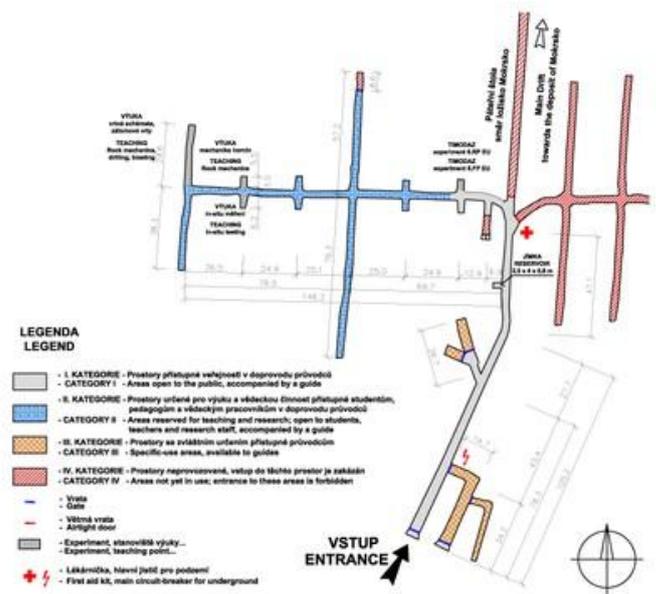


Fig. 3 Plan of the renovated section



Fig. 4 Practical education of the rock mechanics



Fig. 5 Practical education of the geodesy

## 6 ACKNOWLEDGEMENT

The reported work was supported by Ministry of Education of the Czech Republic for research project MSM 6840770003 “Development of the Algorithms of Computational Mechanics and their Application in Engineering”.