Experiences from Advanced Teaching in Geotechnics under Erasmus Programme

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ABSTRACT: The GEOTACO (Advanced Courses in Geotechnics) Intensive Programme is a three-year project under the EU’s Erasmus programme. It focuses on advanced education in Geotechnics. Project is dedicated to Master or PhD. students of civil engineering. Two-week courses are the main project outputs. These courses will consist of a balanced mixture of lectures, computer exercises, individual work and team work. Laboratory tests, field investigations and excursions will also be substantial part of the course. First course will be held in March 2008. Conclusions of the course will be introduced during the conference.

1 HIGHER EDUCATION IN EU

1.1 Geotechnical engineering

Human civilisation relies more than ever on teams of inventive people to design, build and maintain the sophisticated environment that surrounds us. The EU provides an exciting challenge to civil engineers. An important step in a career in civil engineering is the achievement of a professional qualification. This is recognised as a benchmark of quality and defines person as a professional capable of practising throughout Europe. Geotechnical engineering is an essential element required in the design and construction of buildings, roads and railways, retaining walls, basements and tunnels, slopes, embankments and cuttings. Today also presents a lot of challenges and opportunities for the geo-engineers considering imminent natural hazards and needs of remediation of the sins of the past. Solving geotechnical engineering problems requires significant amounts of knowledge, a multidisciplinary approach and flexibility, in addition to a strong understanding of basic principles and foundation design. Civil engineers with special competence in geotechnical problems – geotechnical engineers are able to provide integrated and appropriate solutions to meet clients’ needs. Despite of this situation, there are only few special study programs (BSc, MSc, PhD) for professional geotechnical engineers in the civil engineering higher education area within the EU. Therefore there is still a lack of graduated geotechnical engineers in the EU. At the same time there are disproportions in educational systems and geotechnical engineering curriculas across Europe.

Successful geotechnical engineering education therefore depends on a fruitful cooperation of research, education and practice in international context. All three components are important and this necessitates positive action from European universities. Most of European higher education institutions share the common understanding of the principles, objectives and commitments of the process as expressed in the Bologna Declaration to establish the European Higher Education Area (EHEA). The two-cycle degree system is being implemented on a large scale. However, there are still some obstacles to access between cycles.

1.2 Experiences at the University of Žilina

The two-cycle study system respecting the Bologna process has been implemented in the educational system of the Civil Engineering Faculty at University of Žilina in 2003. In accordance with the Slovak law 131/2002, which introduced the two-tier study system in Slovakia in 2002, the length of the first cycle, i.e. bachelor study was predetermined on 3 or 4 years and the length of the master study was fixed on 2 years. The creation of knowledge cores valid for individual study specialisation was the first step of the implementation of the two-tier study programmes in Slovak educational system. It was the general basis for preparation of two-tier study programmes, so that every new study program had to respect the knowledge core of individual study specialisation at least of 60%. This decision of the Accreditation Committee of the Slovak Republic allowed developing the more variable study programmes at three Civil Engineering Faculties in Slovakia. At the Faculty of Civil Engineering, University of Žilina, the special attention was paid to the preparation of the bachelor study programmes. The effort was to create balanced study programmes of
the first study degree, either to prepare bachelors to be employable in building industry or to continue the second study degree of engineering study. Beside the bachelor study program for Civil Engineering, also the curricula for Buildings, Technology and Management of Buildings and Transport Planning were developed. All these study programmes respect the minimal knowledge set (cores) of individual specialisations and the aforementioned basic principle of the study program development. From the viewpoint of the study length, it is necessary to underline, that all study programmes are three-year programmes. Only exception is study program for Buildings, whose length is 4 years.

Application of the abovementioned principle caused decreasing extent of theoretical courses compared to the previous classic system of engineering education at our Faculty. To preserve theoretical knowledge of future engineers finishing two-cycle study system, some parts of theoretical subjects had to be removed to the second-degree study programmes – to the engineering study. There was also the rule of the Accreditation Committee in Slovakia, to respect maximum 25 study hours per week. From the viewpoint of these principles, the development of bachelor study programmes was very complicated and time demanding process.

After finishing the first cycle of the bachelor study, the following principal problems of study could be identified:

- Minimum amount of students finishing the bachelor study are ready to leave University and to be employed on labour market;
- The length of the bachelor study according to study programmes seems to be rather short and generally students have problem to finish it in the determined time;
- The only six semesters long study is especially very time demanding for preparation of the bachelor thesis during the last semester, thus many students finish the final exam in alternate term in September;

The first mentioned problem indicates that the bachelor degree is rather new at Slovak labour market. There is also deficiency of the basic philosophy of the bachelor study programmes structure, because it was based on the principle of equilibrium between courses with the theoretical background and the professional as well as technical subjects. If the situation on the Slovak labour market would not change in the short time period, it would be necessary to correct actual approach to the curricula structure from the viewpoint of the study rearrangement in order to strengthen theoretical courses in the bachelor study.

As it was mentioned in the second and third point, the bachelor study in the proposed length of three years seems to be very short and students studying the Civil Engineering study programme have problems to finish study programme at planned time. The given problems could be eliminated through the reorganization of the study programme in two last semesters by removing some time consuming courses to the previous semesters. In addition, a possibility exists to begin with the elaborating bachelor thesis earlier, e.g. at the beginning of the fifth semester. In this way students could have much more time to prepare their bachelor thesis. However, the essential problem remains. This is the low knowledge level of bachelor students. The deficiency is not only problem of previous education at the secondary schools, but also problem of the low interest of the contemporary young population on technical education. This is incomprehensible and rather surprising reality from the viewpoint of the actual building activities offering excellent job opportunities.

The solution of the problem is very complicated due to global social situation and the policy of the transformation countries. Therefore, we must find another possibility to help bachelor students to finish successfully their study.

Implementation of two-cycle system has affected also arrangement of geotechnical subjects in study programmes. As indicates table 1, now there are courses as follows.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Lectures</th>
<th>Exercises</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Geomechanics and Hydrology</td>
<td>2</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Geomechanics Foundations of Structures</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Foundations of Structures</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Engineering Geology</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Excursion</td>
<td>4</td>
<td>1 week</td>
<td>1</td>
</tr>
</tbody>
</table>

European universities recognise that now there is a need to optimise the impact of structural change on curricula and thus to ensure the introduction of the innovative teaching and learning processes that European needs. They also emphasise the importance of research and research training in maintaining and improving the quality and enhancing the competitiveness and attractiveness of the EHEA. Therefore there is a need to improve the synergy between the higher education sector, research sectors and practice. To achieve these objectives, doctoral level qualification is the key element. Considering the need for
structured doctoral programmes universities have to ensure that their doctoral programmes promote interdisciplinary training and the development of transferable skills, thus meeting the needs of the wider European employment market also in the field of geotechnics.

2 GEOTACO PROJECT

2.1 Project synopsis

Project GEOTACO addresses above mentioned problems. The GEOTACO (Advanced Courses in Geotechnics) Intensive Programme is a three-year project under the EU' Erasmus programme. It focuses on advanced education in Geotechnics. GEOTACO is a short programme of study, which brings together students, lecturers and practitioners from universities and firms from five European countries. The combination of partners covers the required spectrum and balance of expertise and practical applications. Each partner brings their special expertise, and has a unique contribution that matches the components of the project plan. Knowledge of the essential attributes of the geotechnical conditions should include multi-disciplinary analysis by application of the state-of-the-art tools as well as the required expertise, which the participants accumulated through years of work in the related fields. The members of the partnership can provide experts with long term experience in various disciplines related to the project scopes: geotechnics, hydrology, hydrodynamics, chemistry, geology, soil sciences, ecology, water management, numerical modelling, GIS, environmental and societal sciences, economy and so on. The project partnership consists of 8 core partners as follows:

1 Faculty of Civil Engineering – University of Žilina, Slovakia
2 Faculty of Technical Sciences – University of Warmia and Mazury in Olsztyn, Poland
3 Faculty of Civil Engineering – Silesian University of Technology, Poland
4 Faculty of Civil and Environmental Engineering – University of Technology and Life Sciences Bydgoszcz, Poland
5 Geotechnics and Underground Buildings Dep. – Technical University of Mining and Metallurgy of Ostrava, Czech Republic
6 Faculty of Civil Engineering – Brno University of Technology, Czech Republic
7 Department of Civil Engineering and Architecture – University of Beira Interior, Portugal
8 Dep. of Civil, Environmental and Territory Engineering and Architecture – University of Parma, Italy

Project is dedicated to self-motivated Master or PhD. students of civil engineering with a basic knowledge of geotechnics and skilled in English.

Two-week courses are the main project outputs. Each project year, two-weeks courses attended by participants from universities (teachers and lecturers) and consulting companies will be organized. These courses will consist of a balanced mixture of lectures, computer exercises, individual work and team work. Laboratory tests, field investigations and excursions will also be substantial part of the course. Teaching and tutoring will primarily focus on special geotechnical topics. A group of approximately 90 students (30 per year) from the partners' universities will meet in a series of lectures, laboratory practice sessions, interactive seminars and virtual on-line sessions. The course builds on the wide range of complementary research interests and expertise in geotechnical engineering of the staff of the partners involved. It also takes into consideration developments in the industry, as well as requirements identified by students at each institution. The course will provide a challenging and stimulating learning experience.

It will aim to meet the objectives below:

☐ Apply the principles of geotechnical engineering effectively in a “real-world setting”;
☐ Plan, manage, and successfully execute geotechnical projects;
☐ Train students to work effectively;
☐ Learn to work in an international team environment, but also learn to be independent;
☐ Bring together students, teaching staff and practitioners.

A wide range of teaching methods will be used with particular emphasis placed on the value of exploring live projects. Laboratory work and a range of computational exercise will be used to support study. Students will become familiar with up-to-date software applications. A typical geotechnical engineering project begins with a site investigation of soil and bedrock on and below an area of interest to determine their engineering properties. Therefore students will take part in field investigations and excursions. The annual rotation of the GEOTACO host country will offer the valuable opportunity to learn more about the country, its specific geotechnical conditions and problems. In the first period (academic year 2007/2008) GEOTACO will take place in Žilina, Slovakia. The project will be coordinated by the University of Žilina and, although renewed annually, is expected to run for three years, with Italy and the Czech Republic as the venue in subsequent years.

Students will have great opportunity to obtain new knowledge about specific geotechnical problems. E.g. gravitational slope deformations belong among most dangerous geodynamic phenomenons in Slovakia, so as there occur coastal processes in Portugal, undermining in Poland or Czech Republic or rock mass movement in Italy. Existing study pro-
Programmes of the participating institutions will derive profit from a European project dimension.

The following teaching formats will be used:
- Traditional formal lectures (given by lecturers and practitioners);
- On-line tutoring;
- Individual student work in classroom (including software applications);
- Work in international team (development of geotechnical project);
- Laboratory tests and field investigation;
- Excursion (countryside, construction sites).

2.2 Project activities and outputs

GEOTACO starts annually on 1 October and finishes on 31 August. Project is divided into several periods as shown in the Figure 1.

<table>
<thead>
<tr>
<th>Year</th>
<th>Project management</th>
<th>Preparatory period</th>
<th>Course assessment</th>
<th>Final evaluation</th>
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<tbody>
<tr>
<td>1st year</td>
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<tr>
<td>2nd year</td>
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Successful course requires careful planning. To design the most effective learning experience for students, lecturers should examine sample syllabus, talk to partners who will teach in the course, understand how the course fits into the partners’ curricula, etc. Therefore preparatory on-line session was held in autumn in the first year. During the session partners approved final course syllabus. It contains general course information; narrative description of the course content; clearly articulated course objectives; list of teaching staff; list of the required course materials to be used in the course by lecturers and students; final definition of teaching methods; list of requirements and expectations for completion of the course, etc. Partners designed and developed project web site www.geotaco.org. Project web site is dedicated to support project management, to provide space for discussion and exchange of knowledge among students and teaching staff (forum), to provide inventory for all project materials, to provide environment for on-line exercises, etc. Course teaching methods range from formal lectures, exercises and practicals, to guided study, individual work and team work. In conjunction with formal lectures and class work, students will be encouraged for independent study of complementary literature before and after the course. In the first project year course will deal with two main topics, landslides and underground constructions.

Slope movements are the widely distributed geodynamic processes in hilly part of Slovakia. Many of previously dormant or stabilized landslides reactivated by human activity are now hazardous. The slope stability is limiting factor in an optimum land-use. Therefore systematic investigation of unstable slopes together with new technologies of their stabilization is frequent challenge for Slovak geotechnical engineers. During the course students will get information on landslide investigation and stabilization projects, which have been realized by Slovak teachers or practitioners. They will also visit some of landslides during excursion. Due to the mountainous character of Slovakia (mainly in the northern part), 17 tunnels, with a total length of 38 km, need to be built on the three main Slovak highways. Since several tunnels are under construction near Žilina, students will have opportunity to visit construction sites and already realized tunnels. They will also given by lectures on the theory of underground constructions and up-to date software applications.

After the course, students will develop reports – projects concerning real geotechnical problems. They will work individually or in a team. This form of course assessment demands teamwork, cooperation and organisation skills, which students could improve during the course. Reports will be evaluated by teachers. Successful students will be awarded ECTS credits (3 points). Each project year participants from all project target groups will evaluate a course. Evaluation report will consist of several parts corresponding to the course objectives. Inevitable part of the report will be comments and recommendations for the next years. They could lead to redesign or an extension of the project in future. Evaluation report will also assess progress on each course objective and assess the value of each element of the project, sum up each day of course, its balance, etc. In 2008 the course is held in March therefore we can not include course analysis or conclusions. We would like to present them during the June conference in Constanza.

3 ACKNOWLEDGEMENT

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