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New Trends in Civil Engineering Curricula at the Slovak University of Technology

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Abstract

System of higher education, especially technical, has been permanently influenced by many factors as: using new materials and technologies, developing new methods and information technologies etc. This paper is dealing with an influence of some aspects on changes of civil engineering programmes at the Slovak University of Technology (SUT) in Bratislava. Author describes briefly the structure of civil engineering programmes and curriculum, the particular stages of gradual changes from the one-stage to two-stage programmes as well as knowledge and experiences from this process. The changes (regarding the time and content) among the old and new programmes as well as their expected contribution are compared.

Key words: European higher education, two-stage educational system, technical sciences

Introduction

During the recent years the system of civil engineering education in Slovak Republic has been influenced by several important aspects of its developing, the most important are as follows:

- the political and economical changes in society and intensifying of the academic freedom of universities,
- rising of the independent Slovak Republic grounded on the Czechoslovak tradition,
- effort of the incorporating to the European and Trans-Atlantic structures,
- an intensive developing and using of new materials and technologies in civil engineering branch,
- fast changes in using the software products during the design of buildings and structures and management the building processes.

These and other aspects also play an important role in changes of existing and developing new programmes as well as an adaptation of their curricula to the new, permanently changing conditions. Author presents some experiences reached by his long teaching praxis with the changes of the teaching methods used in structural mechanics and the design of structures under the recent trends. The area of statics and dynamics of structures has always been one of the crucial points of the design of structures. In past the education of civil engineers was grounded on the time-consuming practical calculations done by hand or by support of simple computing technique. The huge developing of the computers and new numerical methods and software in recent years changed very rapidly the process of design structures using the CAD. More and more engineers and students are able to use their computers during their study and

work, what brings the new problems in changes of the teaching methods in structural mechanics.

Another important component of civil engineering education in conditions of the unifying of European countries is the process of the gradual harmonization of the civil engineering programmes at particular universities in Europe. In last part of paper author expresses his opinion in this process and deals with the positive results reached in the international project EUCEET as well as the possible ways in some future common European Civil Engineering Education Projects.

Civil engineering education at undergraduate and postgraduate level

Engineering education is one of the most extended part of tertiary stage of education in Slovak Republic. The institutions dealing with the engineering sciences are called "Technical University "or "University of Technology". Our Faculty of Civil Engineering was founded in 1938 as the first faculty of Slovak University of Technology (STU) in Bratislava. More than 25 000 MSc. Students and 900 PhD. students has graduated from the Faculty during its history. A new system of study introduced after 1989 at the Faculty has recently been further updated to a credit-based modular-unit-system.

The first stage is the undergraduate course providing the education in four basic civil engineering branches with the three years duration (180 credits) completed by a final thesis awarded with BSc. degree. The minimum requirements for admission are based on the pre-university certificate level. All applicants pass the university entrance exam mainly on mathematics and physics. This stage gives the student the theoretical background necessary for further branch together with the basics of civil engineering. To broaden the students´ educational perspectives, courses in the arts and social sciences, including laws, philosophy, sociology, psychology and aesthetics, have been added to the curricula. There are two semesters in each year of study - winter semester (13 weeks lectures from October to January) ensued by 6 weeks session, and summer semester (13 weeks lectures from March to June) ensued by 8 weeks session. The programmes consist of 30-35subjects (10-12 each year). The lectures, exercises and laboratory are taught in 28 contact hours per week, 50% lectures, 50% exercises and laboratory. The final exam comprises the presentation of the short final project and the exam from one of the core subjects. The final assessment consist of average mark of all subjects assessed during study, the mark of final project and the mark of final exam.

The second stage - the post-graduate course providing the continual education in eight specialised engineering branches with two years duration (120 credits) aimed at developing special skills in the chosen specialisation, is completed by a diploma thesis and awarded with MSc. degree. It permits students to implement their individual goals for their vocational education and specialisation. Students are enrolled either after completing their BSc. studies in Civil Engineering branch or BSc graduates from earlier period on the base of their final studies mark and the interview. There are two semesters in first and second year of study - winter semester (13 weeks lectures from October to January) ensued by 6 weeks session, and summer semester (13 weeks lectures from March to June in first year and 8 weeks lectures from March to May in second year) ensued by 8 weeks session. The programmes consist of 20-24 subjects (10-12 each year). The lectures, exercises and laboratory are taught in 26 contact hours per week, 40% lectures, 60% exercises and laboratory. The final exam comprises the presentation of the diploma project and the exam from two core subjects. The final assessment consists of average mark of all subjects assessed during study, the mark of diploma project and the marks of final exams. Thereafter,three-year PhD. study programmes

in ten major civil engineering sciences are offered to students with the MSc. degree.

Civil and transportation engineering programme

Civil and Transportation Engineering Programme is one of the most important programmes at our faculty. Graduates of this programme are qualified not only to perform structural design but also organise and manage civil engineering works such as the construction of bridges, high-rise buildings, industrial structures, foundations and underground structures, as well as special building constructions made of concrete, masonry, steel, timber, soil, rock and newly-developed composites.

Programme	1950	1960	1966	1980	1990	2000
	Contact hours during the study					
Mathematics	273	299	494	390	338	273
Physics	91	130	130	130	117	104
Drawing Geometry	130	117	130	52	52	104
Structural Mechanics	403	455	481	468	416	286
Mechanics of Materials	65	52	143	182	169	156
Concrete Structures and Bridges	364	390	338	325	247	299
Steel and Timber Structures and Bridges	377	364	273	299	299	260
Foundations and Underground Structures	182	273	273	273	312	299
Roads, Motorways, Railways, Airports	312	312	221	429	377	273
All core subjects	2197	2392	2483	2548	2327	2054
Programme contact hours	3700	3660	4075	3750	3750	3120

Tab.2 Contact hours of the core subjects of CTEP during 1950-2000

They are further qualified for the planning, management, implementation, maintenance and reconstruction of transportation-related structures (roads, motorways, railways, airports) and work in the related fields of urban network planning, transportation infrastructures and traffic engineering. To be able to work successful in areas mentioned above student must pass more than 50 different subjects, some theoretical and some practical. Author selected some subjects, which in his opinion play the most important role in this programme and compared the amount of the contact hours in some programmes from 1950 to 2000 years. The comparison is presented in Tab.1. In the last column of the table there is the two-stage programme, all other are previous one-stage programmes. The total number of contact hours were during 50-90 years practically constant and they felt rapidly (about 20%) in last years.

In Fig.1 the sharing of some theoretical subjects as Mathematics, Physics, Drawing Geometry, Structural Mechanics and Mechanics of Materials is presented. As it is clear from the diagrams, some small differences occur in percentage of the chosen subjects during the years, when Mathematics varies from 7,4% to 12,1%, Physics from 2,5% to 3,6%, Drawing Geometry from 1,4% to 3,5%, Structural Mechanics from 9,2% to 12,5% and Mechanics of Materials from 1,4% to 5,0%.

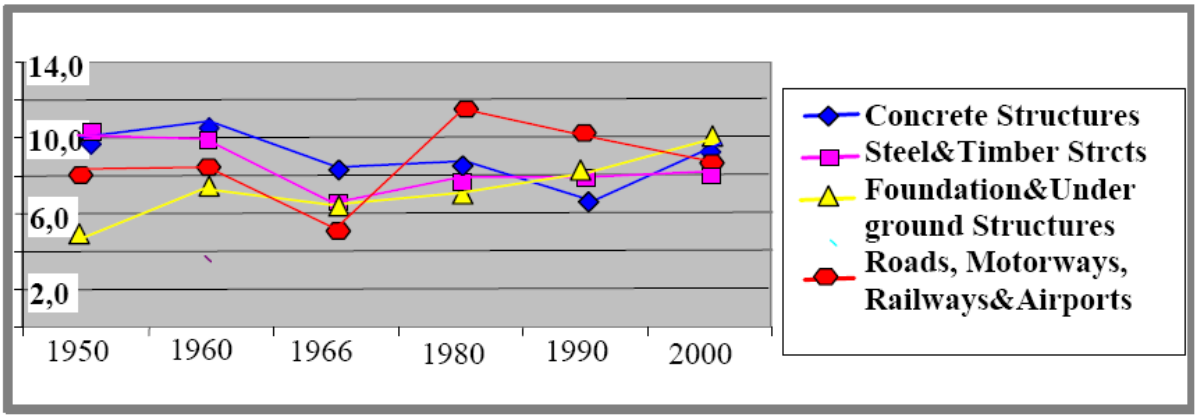

Fig.1 Share of some theoretical subjects on Civil Engineering Programmes (in percentage of the total number of contact hours)

Likewise in Fig.2 the sharing of some core civil engineering subjects as Concrete Structures & Bridges, Steel and Timber Structures & Bridges, Foundation & Underground Structures, and Roads, Motorways, Railways & Airports is presented. As it is clear from the diagrams some small differences occur in percentage of the chosen subjects during the years, when Concrete Structures & Bridges varies from 6,6% to 10,7%, Steel and Timber Structures & Bridges from 6,7% to 10,2%, Foundation & Underground Structures from 4,9% to 9,6%, and Roads, Motorways, Railways & Airports from 5,4% to 11,4%.

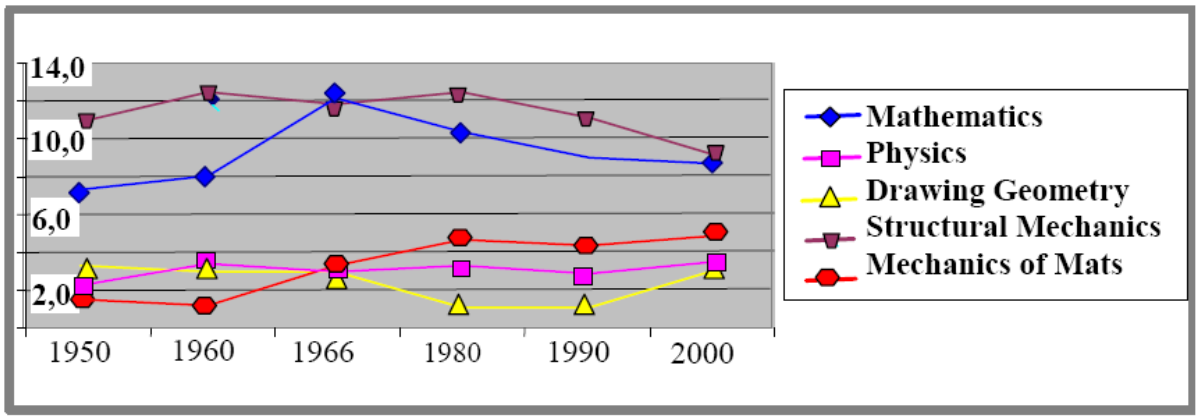

Fig.2 Share of some core Civil Engineering Subjects (in percentage of the total number of contact hours)

Trends in teaching methods of structural engineering subjects

The number of contact hours of different subjects and their mutual balance is one of the factors influencing the educational process. As we could see from the previous paragraph, the numbers of chosen core subjects at our faculty during the last 50 years have not changed very rapidly.

Another, in the author´s opinion more important factor is the balance of the syllabi of different subjects. Present time is known of the huge developing of all areas of the human activities, mainly in natural and technical sciences. In the last decades there were developed new materials and technologies also in civil engineering branch. They play together with the huge developing of the computers and new numerical methods and technique and computer programmes an important role in automation in design of buildings and structures as well as during the building process, what lays some increased claims to the changes of the syllabi.

In process of finding the new directions of the next development of syllabi and teaching methods especially in nature and technical sciences two following aspects play an important role:

- a decision, which parts from the big amount of the theoretical knowledge may be used and which can be neglected when changing the content of the lectures, because of the constant or decreased number of contact hours,
- methods and ways of teaching the topic theoretical knowledge and practical procedures connected with using the new materials and technologies.

If the balance between above mentioned aspects is taken into account by the innovation of the content of subjects, the education of civil engineers will be permanently on a high level. Let us present the authors´ experience with the content of subject Structural Mechanics. During the centuries, but mainly in last decades, the theoretical knowledge and practical procedures used in the static and dynamic analysis of structures rose very rapidly. It influenced the increase of the content of mentioned subject. Student in past had to learn practically by hard the methods of calculation of inner forces acting in many different types of structural elements, statically determined or undetermined, loaded by the constant or moving, static or dynamic, load. The crucial point of the subject was beside the theoretical explanation of the problems focused mainly in teaching the procedures of the “manual” calculations because of missing the computer technique. Student was loaded by a big amount of the manual calculation and it was practically impossible to ask him doing more than one alternative during the process of the design of structures. The design processes were based mainly on the engineering intuition and previous experiences.

Nowadays this process has rapidly changed. The huge developing and using of computers as well as the modern effective numerical methods caused the existence of many packets of computer programmes, which are able to calculate and draw the distribution of inner forces in structures and finally design the necessary dimensions of their elements without the help of the users. It may inspire an impression (and there are many students having it) that it is not necessary to explain the students, future users of these computer programmes, the theoretical background and confine only to the teaching the manuals and practical using of the programmes, but the true is opposite. Because of many existing computer programmes, which take into account the different assumptions of the model of structure, just the engineer must be this creative subject, who will decide the different aspects and components of the analysed model. Thanks to the computers programmes and technique the structural analysis takes only

a little time and the saved time may be used for the creative education, e.g. teaching students to create and to compare different models, the perfect controlling of the results and so on. These changes bring a huge amount of the work for teachers because sometimes it is necessary to change teaching methods from the ground.

Conclusion

An important component, which was not mentioned in this paper is the process of the gradual harmonisation of the civil engineering programmes at particular universities in Europe. Author takes part in an international project EUCEET (European Civil Engineering Education and Training), which deals with these problems. The most positive result of this project is that the teachers from many Civil Engineering Faculties from almost all European countries found the common platform for the mapping of civil engineering programmes. Big amount of the facts as well as the group of people working in this project should create a good base for some next projects in this area. One of the possible way could by an attempt to create some common Civil Engineering Programme in European area and define the general conditions for “Euro” Civil Engineering Programme.

References

[1] Civil Engineering Programmes 1950/51. SVŠT Bratislava, 1950.
[2] Civil Engineering Programmes 1960/61. SVŠT Bratislava, 1960.
[3] Civil Engineering Programmes 1965/66. SVŠT Bratislava, 1965.
[4] Civil Engineering Programmes 1980/81. SVŠT Bratislava, 1980.
[5] Civil Engineering Programmes 1990/91. SVŠT Bratislava, 1990.
[6] Civil Engineering Programmes 2000/01. SVŠT Bratislava, 2000.
[7] Fifty Years of the Slovak University of Technology. ALFA, Bratislava, 1987.
[8] Sixty Years of the Slovak University of Technology. SUT, Bratislava, 1997.
[9] Sixty Years of the Faculty of Civil Engineering of the Slovak University of Technology. SUT, Bratislava, 1998.
[10] Seventy Years of the Faculty of