



BOLOGNA PROCESS – FIRST EXPERIENCES

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Abstract

The introduction brings an overview of both former and new concept (the Bologna Process) of university study in civil engineering at the Faculty of civil Engineering of the University of Zagreb.

Based on the experiences from the Bologna Process in civil engineering university study at the Faculty of Civil Engineering of the University of Zagreb which was introduced in 2005, the paper analyses the learning outcomes and competences at undergraduate (Bachelor) and graduate (Master) level of study. Undergraduate study level analyses the competences required for further study in civil engineering, that is, the relevance of the acquired competences for the first workplace. Although the graduate study level is being completed by the first generation of students in 2010, the paper covers present experiences and some specific features of transportation engineering discipline, since student competences are developed in the field of infrastructure and not traffic engineering, owing to the fact that within the University of Zagreb there is a special study of traffic engineering at Bachelor and Master level.

Keywords: Bologna Process, Bachelor, Master, learning outcomes, competences.

1 Introduction

It has been four and half years since the new curriculum and study programme at the Faculty of Civil Engineering of the University of Zagreb was started. That is, the first students studying according to the Bologna Process are in the last (tenth) semester, and are working on their graduation papers. It is therefore appropriate time to analyse the results, overcome disadvantages and improve educational process. This overview aims at the successful analysis by taking into account two relevant factors which will contribute to changes.

The first is the fact that the professional circles and the general public are poorly informed about the changes brought by the Bologna Process. It is not easy to establish whose “blame” it is. On the one hand, part of the blame probably lies with the Faculty, but not in the area of informing the public (rendering information to interested parties, accessible information on the Faculty’s web pages, presentations at annual University Festivals etc.), but in the unsatisfactory promotional activities in the direct contact with professional organisations, large systems (Croatian Highways, Croatian Roads, Croatian Railways) and professional associations. On the other, the complete lack of interest in new programmes by professional circles is highly surprising, particularly at the peak of recession (maybe because of it?). The second motive for writing this paper is to, upon having looked over the curriculum and programme pursuant to the Bologna Process, encourage civil engineering-traffic engineering profession to criticise and praise it, particularly because the study of transportation engineering at the Faculty of Civil Engineering in Zagreb, compared to similar west European studies, is more oriented at design, construction and maintenance of traffic routes, and less at traffic engineering. The reason is the independent faculty of traffic engineering (Bachelor + Master) within the University of Zagreb.

2 Study structure

2.1 The concept of the new study

According to the Bologna Process higher education framework is divided into two cycles [1]: *“The system that is based on two main cycles, undergraduate and graduate. Students are required to complete the first cycle, lasting minimum three years. The requirement for the second cycle is successful completion of the first cycle. The level achieved after three years is considered necessary qualification level for the European labour market. The second cycle leads to master or doctoral degrees, as is the case in many European countries.”*

The expert body in charge of developing the new study scheme at the Faculty of Civil Engineering in Zagreb, considered two proposals for the duration of the first and second cycles, 3+2 and 3.5+1.5. The Faculty Council decided on the 3+2 proposal, just like the majority of technical faculties in Croatia and other European countries. Without presenting arguments for or against any of the above proposals, we have to emphasise that the main “disadvantage” of 3+2 system is the fact that for the civil engineering study (like for many other technical studies) it is difficult to meet the proclaimed condition of the Bologna Declaration that a student after the completion of a three year study is interesting (wanted) in the labour market. More is said on the above topic in Paragraph 3 of this paper. For the purpose of understanding thereof, the outlines of undergraduate study programme (Supplement 1) and graduate study programme (Supplement 2) of university study (transportation engineering discipline) in civil engineering at the Faculty of Civil Engineering of the University of Zagreb.

2.2 Comparison of previous and new study programmes

The comparison of the framework of previous and new study programmes is represented in Figure 1. The key change was the fact that in the former Croatian higher education system, master’s degree continued on BSc C.E. degree and opened the possibility for developing a doctoral dissertation. University study programme leading to BSc C.E. degree was organised in 9 semesters, unlike in most west European countries, where the studies in civil engineering lasted 10 semesters. This discrepancy resulted in the fact that Croatian degrees were not recognised internationally without additional examinations. However, it is important to say that it did not cause problems in obtaining employment (work permits) in construction companies. It particularly refers to the period of extensive employment of Croatian engineers in Germany, Austria and other European countries in 60-s and 70-s in the last century.

The variety of higher education systems in European countries and the difficulties arising from it, like (not) recognised education degrees, and the possibility for unrestricted international mobility of students and professionals, brought the idea of the implementation of, what is now called, the Bologna Process. The Bologna Declaration was signed by 29 European countries. Croatia joined in 2001, and thus accepted the international obligation to harmonise its higher education system with the Bologna Process principles and demands by 2010.

One of the major goals of the Bologna Declaration is the following: *“The acceptance of easily recognisable and comparable levels and introduction of diploma supplements, in order to promote employment of European citizens and international competitiveness of European higher education system.”*

In terms of formal and structural aspects, the adoption of the new university education system pursuant to the Bologna Process opened the question whether the previous degrees are equivalent to the new ones. Formal aspect was addressed by the provision [2] by the Act by which the degree BSc. C.E. granted upon completion of previous university undergraduate study is equivalent to the academic degree of MSc. C. E. of the new university graduate study. It is not easy to compare the essentials of the previous and the current system. Firstly, because it is difficult to select objective criteria for comparison. For this purpose the Bologna

Declaration introduced the ECTS credit system [3], by which every course carries a certain amount of credits according to its level of complexity. The number of credits reflects how hard a student has worked. The manner how the number of credits is determined is neither simple nor unambiguous, since all the activities in a course have to be objectively represented: lectures, exercises, seminar papers, practical work, supervised work, homework, assessment etc. The above shows how dangerous is a subjective evaluation of certain activities, the argument which cannot be refuted even by the most ardent supporters of the “fairness” of the ECTS system. The issue of ECTS credit system is beyond the scope of this paper, so we only point out that 1 ECTS credit demands 25–30 hours of work by an average student. Since the previous system did not have the ECTS credit system, it is impossible to make any comparisons. For this reason, the author of this paper will take the liberty of comparing with his comments, and choose a few criteria for comparison, regardless of justified objections to his selective analysis.

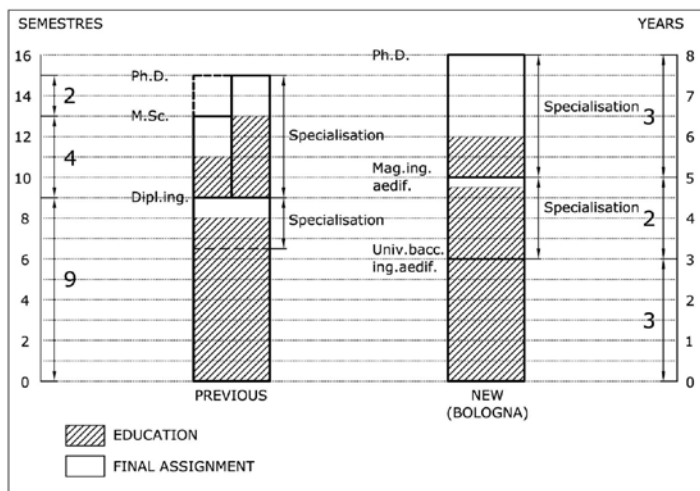


Figure 1 Previous and new (“Bologna”) study duration compared

According to the criteria of regular length of study (Figure 1), the duration of former (9 semesters) and new (10 semesters) study is not equal, particularly if direct instruction is taken into account, since in previous study, the instruction lasted for 8 semesters, and in the new study it lasts 9.5 semesters. However, this difference of 1.5 semesters is not relevant to the evaluation of the identical value of both studies, without analysing weekly (semester) direct instruction load. The average weekly direct instruction load in previous system was 27 hours, and in a 15 week long semester accounted for 405 hours a semester, that is, approx. 3240 hours during studies (8 semesters). The average weekly instruction load in the new undergraduate study (Bachelor) is 25 hours, that is 325 hours a semester or 2250 hours during study (6 semesters), and in graduate study (Master) 20 hours weekly, that is, 300 hours a semester or approx. 1050 hours during study (3.5 semesters). If the work load in graduate study is added to undergraduate study, the entire load is approx. 3300 hours, which is a small difference compared to the previous system workload of 3240 hours!

It has to be emphasised that the instruction load of the previous study (in force from 1996 to 2005) was essentially lower than the instruction load in the official system until 1996, when it was 3850 hours!

Based on the above evidence, we can conclude that, according to the criterion of the instruction load, two studies are equal, which justifies the formal-legal equality of the new and previous degrees. Furthermore, a similar comparison of previous study to the studies

in German speaking countries, which were the basis for Croatian study in civil engineering, would have a similar result, considering that students in those countries regularly have lower instruction loads. Such, to some extent, analysis abuse, which only applied the criterion of student instruction load to prove the equivalent value of both studies, still does not bring objective conclusions, because the analysis has to include a series of factors relevant to the assessment and evaluation of the value of each study. On the other hand, this criterion is not to be underestimated and belongs to the category of objective criteria, that is, to the criteria less subject to individual assessment, which is, as a rule, subjective. It has to be also emphasised that the above analysis of previous and new study can be applied only to the study leading to the degree of BSc. in civil engineering at the Faculty of Civil Engineering of the University of Zagreb, and not to other faculties of civil engineering in Croatia, where student instruction loads have usually been lower.

The comparison of two studies, according to the courses leading to a degree, reflects the aim to reduce the course curriculum, that is, to split it into two courses, of which, as a rule, each lasts one semester. The consequence is the increased total number of courses, from 47 to currently 56 courses in the new study (discipline transportation engineering), which was partly caused by the prolonged study time to 10 semesters. The fact about this (significant) increase in a number of courses does not mean that the new study is more demanding than the previous one, particularly if student activities required to complete each course have been realistically evaluated. Student survey has shown that students more easily complete studies with a larger number of exams of limited extent than studies with a smaller number of exams with a larger extent of subject matter.

It is too early to make comparisons in terms of the most important criterion, the real average duration of study time. Statistical data on the average length of previous study are rather negative, although they are similar to the data by other faculties of the University of Zagreb, and even by a number of faculties in Europe. Thus, instead of 4.5 years planned in the curriculum, the average students studied for 7.5 years, and only 40% of students enrolled in the first semester graduated from the Faculty. In this respect, the new study offers some conditions that should give positive results, some of them belonging to the Bologna Process and some being the result of the measures carried out for the purpose of more effective education. One of the measures, which has had a visible positive effects, is the reduction of students (from 250 to 185) enrolled in the first year of study. The reasons for this measure were twofold. The first was the statistical data that only 5–7% of students ranked below 190th place in the entrance exam successfully complete the first year of study. The other is the more effective instruction with a reduced number of students, particularly in exercises.

3 Learning outcomes and competences

3.1 Undergraduate university study in civil engineering

Undergraduate study in civil engineering lasts (for full time students) three years, that is, six semesters (180 ECTS credits). Upon the completion of studies, students are granted the academic title of *baccalaureus* or *baccalaurea* in civil engineering, widely known by the English term *Bachelor*. The abbreviation is: *univ. bacc. ing. aedif.*

The undergraduate study programme [4] states “learning outcomes”, that is, knowledge and skills acquired during studies and “competences”, that is, jobs a student can perform upon the completion of studies.

Assuming that planned learning outcomes and competences can be really achieved, which widely depends on the quality of instruction, professional, scientific and pedagogical level of the academic staff and the students’ wish to commit themselves to study, by looking into undergraduate programme (Appendix 1), we can conclude that the programme leads more to the continuation of education, and less to professional employment. The curriculum is the proof

to that, since in the first four semesters students acquire knowledge in natural sciences-mathematics and technical-mathematics, technical-theoretical courses, and professional civil engineering courses are taught only in the 5th and 6th semesters. Moreover, the wish to cover the extensive field of civil engineering in two semesters, resulted in the fact that some courses are general in their content, which can only serve as the basis for more in depth study of profession during further study, and not the basis for efficient work in construction business.

Appendix 1 Undergraduate university study programme [4]

1. semester			2. semester		
Course	L+P	ECTS	Course	L+P	ECTS
Elective ¹	2+0	3	Mathematics 2	4+3	8
Mathematics 1	4+4	9	Mechanics 1	2+2	5
Descriptive Geometry	2+3	6	Building Construction	3+3	7
Physics	4+1	6	Probability and Statistics	2+1	4
Bas. of Eng. Informatics 1	1+2	3	Materials Science	2+1	4
Elective ²	2+0	3	Bas. of Eng. Informatics 2	1+1	2
Total	15+10	30	Total	14+11	30

1 Introduction to Civil Engineering, History of Building

2 Sociology of Work and Professional Ethics, Basic Law in Civil Engineering, Business Economy or Foreign Language

3. semester			4. semester		
Course	L+P	ECTS	Course	L+P	ECTS
Strength of Material 1	3+3	7	Elective ⁴	2+0	3
Geodesy	2+2	5	Strength of Material 2	3+2	6
Fluid Mechanics	3+2	6	Structural Analysis 1	4+3	8
Mechanics 2	2+1	4	Soil and Rock Mechanics	3+2	6
Elective ³	2+2	5	Elective ⁵	2+1	4
Hydrology	2+0	3	Engineering Legislation	2+0	3
Total	14+10	30	Total	16+8	30

3 Building Materials or Basics of Concrete Technology

4 Applied Geology or Environment Protection

5 Water Supply and Sewerage 1 or Water Protection

5. semester			6. semester		
Course	L+P	ECTS	Course	L+P	ECTS
Concr./Masonry Struct.	4+3	8	Construction Management	3+3	7
Geotechn. Eng.	3+2	6	Metal Structures	2+1	4
Roads	3+2	6	Bridges	2+1	4
Elective ⁶	2+0	3	Elective ⁸	2+1	4
Elective ⁷	2+2	5	Hydrotech. Buildings.	3+0	4
Railways	2+0	3	Construction Site Practice	0+3	3
			Final Assignment	0+0	3
Total	16+9	31	Total	12+9	29

6 Construction Technology of Buildings or Construction Technology of Civil Engineer.

7 Structural Analysis 2 or Numerical Modeling of Structures

8 Timber Structures or Light Structures

The same is proved by the fact that all graduate students (two generations) continued their studies at graduate study level in civil engineering! It is not reasonable to draw conclusions based on such a small sample, but some facts cannot be ignored, regardless of their “gravity”. Thus, the fact shows that one of the goals of the Bologna Process has not been achieved, that is, in three years to train professionals for work in construction business. On the other hand, construction business shows very little interest in professionals at this level of competence, despite the fact that recession contributes to this situation. The question is, how much are these professionals known to wider professional circles or are they simply not recognised as well-trained for professional work? It has to be emphasised that the situation is very similar at other technical faculties of the University of Zagreb.

Within the context, the dilemma between the study schemes 3+2 or 3.5+1.5 is rightful, since the optimal number of professional courses could be added in the 7th semester of undergraduate study (and professional practice which has been left out from the current programme!), which would contribute to the development of students’ additional (professional) competences required for the first employment.

There are similar attitudes in other countries. For instance, German accreditation agency ASBau (which evaluates higher education) in 2006 proposed [5] in 2006 the adoption of study scheme 3.5+1.5 (“after six-semester a Bachelor is not trained for work”). However, the resistance by major German civil engineering faculties to this does not arise from the fact that they consider a three year study adequate for first employment, but from their (un) hidden interest in the scheme 5+0!

Can we, or must we, learn a lesson from this example?

3.2 Graduate university study in civil engineering

Graduate study in civil engineering lasts (for full time students) two years, that is, four semesters (120 ECTS credits). Upon the completion of the study a master’s degree in civil engineering is earned, widely known by the English term Master. The abbreviation is mag. ing. aedif. The graduate study curriculum [4] states “learning outcomes”, that is, knowledge and skills acquired during study, and “competences”, that is, jobs a student is trained for upon the completion of the study.

Graduate university study in civil engineering offers seven disciplines: geotechnical engineering, water research, structures, materials, construction management, transportation engineering and theory and modelling of structures. This paper will deal with the instruction in transportation engineering (Appendix 2).

Compared to the previous transportation engineering discipline, the duration of the new study programme in transportation engineering has been practically doubled, which made possible to include a new subject matter with the aim of meeting the needs of the profession, partly by creating new courses, and partly by transferring courses from previous postgraduate master’s study, which was abandoned upon the introduction of the Bologna Process. The courses in transportation engineering are divided in core (13 in total) and elective (6 in total) courses. The range of courses has been created according to the currently available academic staff and its structure, with the deficit of young course leaders (assistant professors), although the Department for Transportation Engineering employs an optimal number of assistants and junior researchers, so there is a good prospect of upgrading the academic staff. The Department for Transportation Engineering has two sub-departments, Roads and Railroads (4 full professors, 2 associate professors, 5 junior researchers, 3 assistants, 4 expert associates), Department Laboratory and computer room. Laboratory, computer and teaching equipment in the Department are at a highest level, as are the number of reference books and computer programmes. That means that all the necessary conditions for smooth instruction have been met, that is, for the development of personal and academic competences of students in graduate study in transportation engineering.

Appendix 2 Graduate university study programme (Transportation Engineer.) [4]

1. semester			2. semester		
Course	L+P	ECTS	Course	L+P	ECTS
Elective ¹	3+2	7,5	Construction Mangement	2+0	3,0
Traffic Noise	2+1	4,5	Elective ²	2+0	3,0
Traffic Tehnics	2+2	6,0	Pavements	2+2	6,0
Road Design	2+2	6,0	Permanent Way	3+1	6,0
Railway Design and Construction	2+2	6,0	Earthworks	2+2	6,0
			Road Intersections	2+2	6,0
Total	11+9	30	Total	13+7	30

1 Mathematics 3 or Stochastic Processes

2 Applied Geology or Environment Protection

3. semester			4. semester		
Course	L+P	ECTS	Course	L+P	ECTS
Research Methods	1+0	1,5	Pavement Management	2+0	3,0
Traffic Tunnels	2+2	6,0	Elective ⁴	?	≥4,5
Airports	2+1	4,5	Elective ⁴	?	≥4,5
Transportation Facility Eq.	3+0	4,5			
Traffic Systems	3+0	4,5			
Elective ³	?	≥4,5			
Elective ⁴	?	≥4,5	Final Assignment	0+12	18
Total	?	≥30	Total	?	≥30

3 Traffic Routes Drainage, Traffic Buildings, Soil Improvement Methods, Foreign Language, Basics of Differential Geometry or other courses.

4 Urban Transportation Facilities, Parking Lots, Railways Track Maintenance, Numerical Mathematics, Perspective, Waves and Vibrations or other courses

It is, clearly, too early to make a realistic evaluation of the success rate of the teaching process, because the first reactions and reports of the construction profession may be expected in the next year at the earliest, when the first generation of graduates starts working. Additional responsibility for success (or failure) lies on the academic staff at the Department for Transportation Engineering at the Faculty of Civil Engineering, since it is the only university graduate study in transportation engineering in Croatia with academic staff, premises and equipment required for high quality of instruction.

3.3 Postgraduate study in civil engineering

Postgraduate studies at the Faculty of Civil Engineering of the University of Zagreb are organised, as a rule, every academic year (the third cycle pursuant to the Bologna Process is under way) as doctoral and specialised studies. Doctoral studies, lasting three years, are in the fields of: geotechnical engineering, water research, building structures, building materials, structure mechanics, organisation in construction and transportation engineering. Specialised studies, lasting one year, are organised in the following fields: water research, structures, bridges, fire engineering, numerical and experimental structure analysis and organisation and management in construction business. Since the scope of this paper does not allow for a detailed outline of postgraduate studies in civil engineering, interested parties may get the relevant information on the Faculty's Internet Page [6].

4 Instead of conclusion

The expectations within the academic community and general public about the success of the Bologna Process range from scepticism to enthusiasm. We know from experience that not even the best of concepts cannot bring fast and radical improvement, thereby an abrupt step into the “knowledge society”, whatever it means, is not possible. However, a badly conceived concept will most probably end with the changes for the worse! Within this context, in this case the inertia of the university system is positive, because the traditional, higher education institution, thanks to its quality, can resist danger of hasty ideas. Wishing to warn about the dangers of introducing the Bologna Process and make us think to what extent sceptic have been right, we bring a few thoughts by Konrad Paul Liessmann [7] from the paragraph titled: “Bologna: the emptiness of European higher education system”.

- on mobility:

If we consider that only 10% of students take advantage of the mobility programmes within the European Union, and if we presume that, for economic reasons, this number will not increase, because at undergraduate level there is no time to dedicate one semester to studying abroad, the mobility seems a very weak argument. It seems very questionable to force all the states to submit their higher education to a very expensive restructuring for the sake of student minority. High mobility and study programme recognition might be achieved in other, much simpler manners.

- on dualistic higher education system (universities and colleges):

This (compulsive three year bachelor) seems to have been designed for countries without separate school and vocational-school systems. For other countries, a three year baccalaureus programme is an unnecessary restructuring of university environment. In cold blood, it liquidated the very sense of university as the place for professional education having the advantage of the unity of research and teaching.

- on ECTS-credit system:

Among particularly juicy aspects of the Bologna Process belongs the calculation of study performance according to ECTS credits...By it, supposedly, a “student workload” is measured, that is, work a student needs to put in for achieving teaching goals. ECTS credits, or success credits, granted for student activities (in theory not related to courses) do not determine the content equivalents of studies, but compare spent working time. The irony of the world history is the fact that Marx’s theory on the value of work, which economists discarded with indignation, is merrily resurrected in European planned economy of education. The value of study is estimated according to the average working time put into it.

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