

**Education and research in organization, technology and  
management in construction  
University of Rijeka, Faculty of Civil Engineering, Croatia**

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## **1. Education**

### **1.1. Status of new curricula according to Bologna process**

Study programme on the Faculty of Civil Engineering University of Rijeka has been reformed on the principles of Bologna process and has been applied in the Academic Year 2005/06.

In structuring the new study programmes the main principles were:

- Following experience in educating civil engineering personnel for last 30 years;
- **Considered the needs of the labour market** and the demands that will be set on prospective students;
- Considered the fact that the Faculty of Civil Engineering in Rijeka **is the only higher education institution in the greater area** (the Primorsko-goranska County, the Istrian County, and the Lika-Senj County) that educates civil engineering professionals;
- Due to the present-day intense activity in planning, designing and constructing the infrastructure (transportation systems, housing development, water supply systems, etc.) there is a great need for highly educated professionals in civil engineering. Figures show that **there are no unemployed Diploma Engineers and Engineers in Civil Engineering registered with the employment agencies;**
- It is safe to say that the trend toward an intense infrastructure construction will also continue in the years to come (during the process of approach and admission of Croatia to the European Union). In the longer term, the need to plan and design new civil engineering structures will be transformed into the need **to manage, maintain and reconstruct the infrastructure systems**. Therefore, part of the curriculum has also been adapted to meet this demand;
- In the course of structuring the study programmes, the Faculty cooperated **closely with the related Faculties of Civil Engineering in Croatia** and **analysed study programmes from different respectable european universities**.

## Academic study programme

In regard with the structure of new programmes it must be pointed that the academic study programme is based on the 3+2 model according the scheme shown in Figure 1.

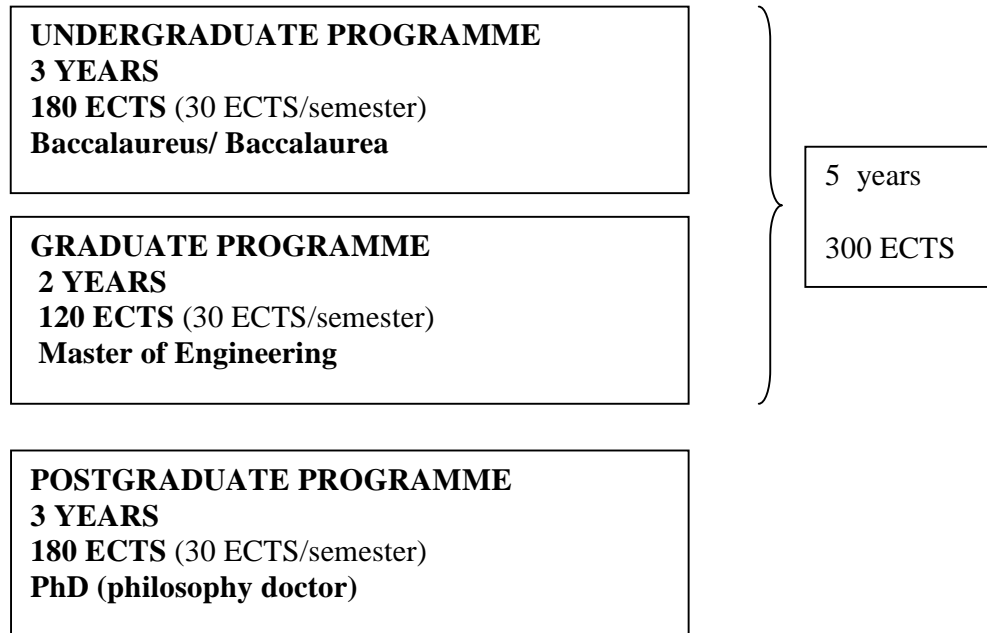


Figure 1. Academic study programme

In regard with curricula basic data are:

### a) Undergraduate Programme (in Civil Engineering)

**Duration:** 3 years (6 semesters), 180 ECTS

**Courses:** 47 courses offered (31 compulsory courses and 16 optional courses)

**Core curriculum:** around 65% of courses/programm

**Competences:**

- student acquires the fundamental competences for the design of structures as well as basic knowledge that enables him to attend Graduate programmes in Civil Engineering;
- student is qualified for structural design in concrete, timber and steelwork;
- student is qualified taking part in planning and designing hydraulic and transportation systems and structures;
- student acquires knowledge that enables him to attend Graduate programmes in other related engineering studies.

## b) Graduate Programme

**Duration:** 2 years (4 semesters), 120 ECTS

**Courses:** 80 courses offered (35 compulsory courses and 45 optional courses)

Programme is organised through **modules of different civil engineering branches** and offers **12 possible combinations of modules** (Figure 2).

### Competences:

- With completion of the *Academic Graduate Programme* the student acquires **the basic competences to understand the general phenomena and problems connected with civil engineering and particularly with a specific branch of civil engineering;**
- The student is able to apply **general knowledge, acquire new knowledge and ideas, and draw conclusions based on science and his profession** as well as to develop his scientific and applied scientific-research competences;
- He is qualified **for the design, construction and maintenance of civil engineering structures and systems in terms of bearing capacity, stability, safety, environmental protection and cost;**
- The student is specially **qualified for understanding and solving problems in a specific branch of Civil Engineering;**
- The student develops **the ability to communicate his own ideas, analyses and conclusions, connected with specific civil engineering problems, to the professional and non-professional public.** He is able to manage a group of people preparing and executing complex civil engineering projects;
- He is able **to attend postgraduate - doctoral study** in civil engineering and related engineering disciplines.

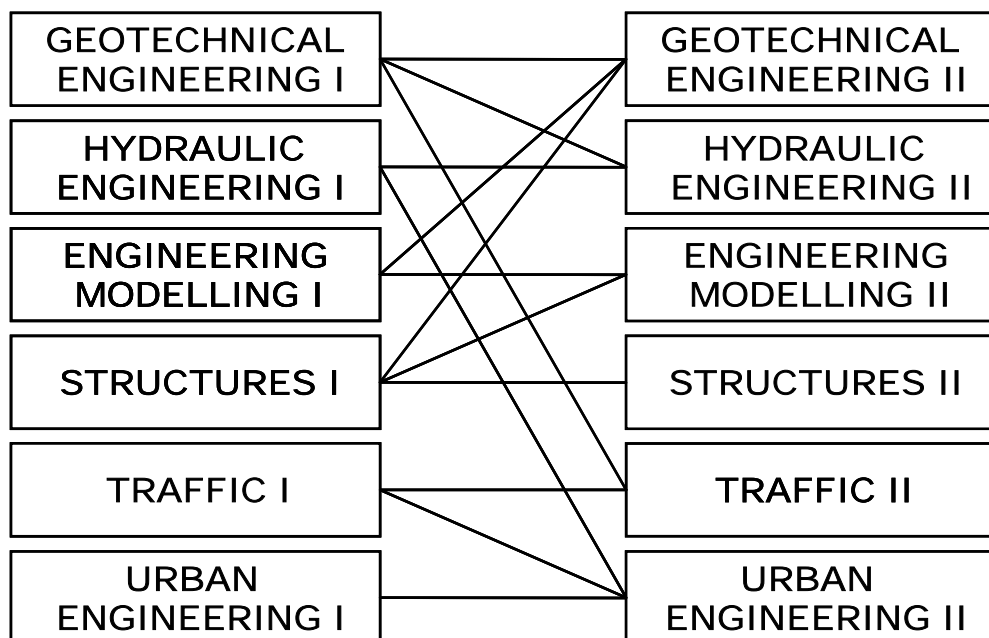


Figure 2. Possible combinations of modules in different Civil Engineering branches

c) **Vocational study programme**

Vocational study programme is based on the 3+1,5 model according the scheme shown in Figure 3.

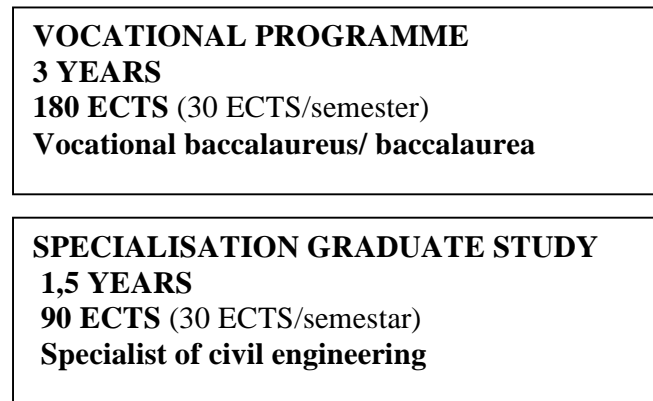


Figure 3. Vocational study programme

In regard with curricula basic data are:

**c-1) vocational study (in Civil Engineering)**

**Duration: 3 years** (6 semesters), 180 ECTS

**Courses:** 43 courses offered (28 compulsory courses and 15 optional courses)

**Core curriculum:** around **35%** of courses/programm

**c-2) specialisation graduate study**

**Branch: communal systems and building at the coastal area**

**Duration: 1,5 years** (3 semesters), 90 ECTS

**Courses:** 22 courses offered (7 compulsory courses and 15 optional courses)

**Core curriculum:** around **35%** of courses/programm

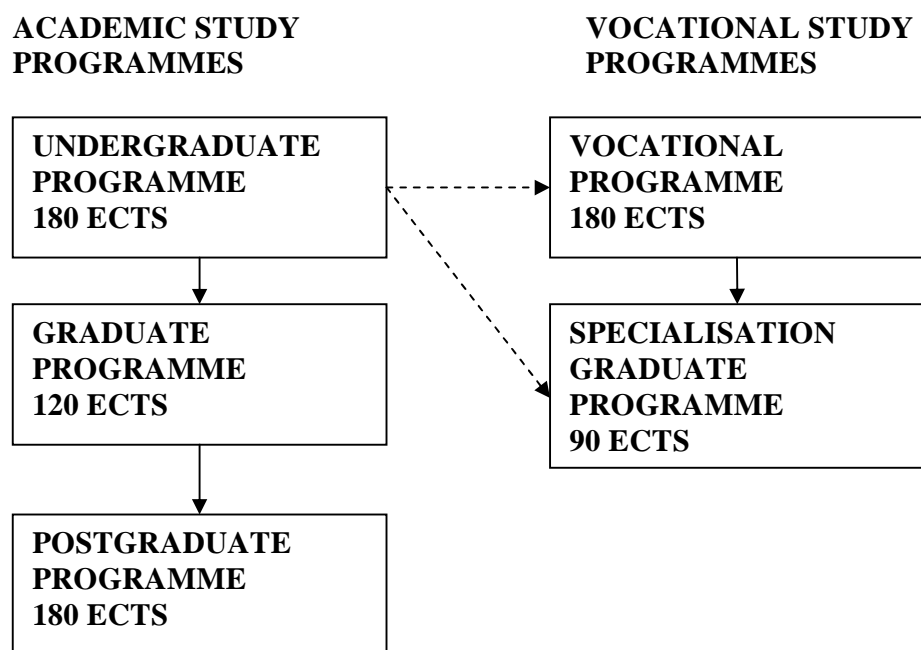


Figure 4. Structure of Study Programmes Delivered by CE Faculty of Rijeka

Experience and successes of the first year students on the study programmes based on programmes reformed on the principles of Bologna Declaration were researched through activities on the Project of monitoring and improvement of Quality of Studying at the Faculty (financed by National foundation for science and higher education) and by the University Centre for Quality Assurance at the University of Rijeka. Researches done at the University level, by the University Centre for QA, on the students experience and perception of the first and second years of CE study programmes pointed out that students are very satisfied with teachers and teaching support and with assessment methods and marking (which are done on the base of their activities during hole year). However, students percept their study as very complex and in great percent they claim that they have problems in following some of the courses. Researches done at the Faculty level showed that for 4 of 12 first year courses (or 33% of courses) students have the impression that their obligation are greater than they should be regarding ECTS connected with that courses.

The workshop for the first year teachers of students loading, obligation and exam successes was done at the end off the second semester. The conclusion of the workshop was that after first experience some improvement in the organization of study and particularly of some courses that students find extreamly complex could improve quality of studying and assure better student's results. As the Bologna process started just this year the conclusion is that all aspects of study programmes must be followed and researches every year in order to improve study programmes and quality of studying constantly.

In all of study programmes allowed by the Ministry of Science during the year of 2005. it is presumed that courses can be held in Croatian and in foreign languages. On the base of students interest parts (modules) of the graduate study programme will be in English (or in Italian) language and it is also planned that postgraduate doctoral study can be in English.

The mobility of students and teachers is allowed and it will be activated when study programmes based on Bologna declaration will be standard in whole Europe. For now it is realistic to assume that mobility will start between four Croatian CE Faculties and with Universities with which University of Rijeka already has some agreements of cooperation like University of Maribor, Ljubljana, Trieste, Rostock, Malta and others.

## **1.2. The status of subjects related to organization, technology and management**

In regard with the area of organization, technology and management two improvements, compared to the previous state, need to be pointed:

- Construction management, technology and architecture department was established about a year ago and earlier it has been "drowned" into the Department of Transportation Engineering.
- Organization and technology becomes compulsory course of undergraduate academic study programme according to Bologna. Earlier it has been the optional course of academic study programme. On vocational study there have always been three compulsory courses, at that: construction organization, construction technology and construction economics. Under the academic programme, field work has been also compulsory course for a period of 22 work days, after the 8th semester and on the vocational study for a period of 44 workdays in the 6th semester. Students have to keep a work diary, complete an individual practical task and after it they have oral exam.

### **Status of the area according to Bologna programme**

#### **a) Undergraduate study programme**

The courses of considered area in programmes based on the principles of Bologna process are:

- 1) organization and technology, 5th semester, 6 ECTS, 45+30+0 hours (lectures + excersises + seminars);
- 2) construction economics, 6th semester, 4 ECTS, 30+15+0 hours;
- 3) field work, 6th semester, 6 ECTS, 0+30+0 hours.

Listed courses are compulsory courses of academic study programme - undergraduate study.

Optional courses of this programme are:

- 1) management in civil engineering with 45 hours totally or
- 2) civil engineering regulations with 30 hours, 6th semester, 3 ECTS.

#### **b) Graduate study programme**

Graduate study programme is not completely established but, in spite of it, project management will definitely be compulsory course, probably in 8th semester, with 6 ECTS. There were more propositions in regard with optional courses: building maintance, planning methods, construction machinery, investment policy but it depends on possibility and on student interest to organize these courses.

### **c) Vocational study programme**

Compulsory courses of this programme are:

- 1) construction technology in the 3rd semester, 30+15+0, 4 ECTS
- 2) construction organization in the 4th semester, 45 + 30+0, 7 ECTS
- 3) construction economics in the 5th semester, 30+30+0, 5 ECTS
- 4) field work in the 6th semester, 0+360+60, 15 ECTS

In the specialisation graduate programme Management in civil engineering is vocational course.

In regard with the educational methods we do the significant effort to implement Bologna principles in educational process, new technologies, adequate software appliance and organize site visits, the more is possible.

### **1.3. Stream oriented to organization, technology and management**

Unfortunately, there is no stream or programme oriented exclusively on considered area. The reason is in lack of adequate teaching stuff. But, this reason points also on another problem. Obviously, this problem is the consequence of, so to say, not adequate relation to this area for years past. Already mentioned facts that organization and technology has been optional course, as well as the fact that there was no organization department, are the arguments that speak in favour of it.

### **1.4. Future development of education on organization technology and management in construction**

Some improvements have been already mentioned. Besides, young assistant was employed two months ago. The main objective of development is to increase the number of teaching stuff in order to, firstly, increase the number of organizational and technological oriented courses, and then establish particular programme oriented to organization, technology and management.

## **2. Research**

Until 2006. the research project titled Standards and prices in civil engineering, supported by Ministry of science, education and sport in Croatia, has been developed. The main objective has been to determine construction standards applicable on Croatian market. The main research results have been published in professor's Gorazd Bučar book titled Standards and prices in civil engineering, from 1999, and the second edition from 2003.

In 2006, the research project, Development of sustainable construction time planning models registration, has been submitted, in order to get a financial support of Ministry of science, education and sport of Croatia. Basic research problem is determining of sustainable construction time planning model in the conditions of usual risk level, always present in the construction process, as well as in conditions of increased risk level. Civil

engineering practice experiences in regard with frequent delays of civil engineering projects which often cause also rising costs, as abroad, so too in Croatia, put this problem in the focus of scientific-research interest in the area of project management. In regard with the repeatedly confirmed optimal applicability of simple linear regression analysis, as well as through the use of, by regression determined "time-cost" model, also in this case, these will be basic research points of reference.

Initial regression model which is the research starting point is "time-cost" model. In this model independent variable is construction cost  $C$ , and dependent variable is time  $T$ , whereas  $K$  and  $B$  are through the use of linear regression determined constants, namely, in civil engineering practice, as abroad, so too in Croatia, problem of civil engineering projects delay, which often cause also rising costs is particularly marked. A series of researches, so far, point to even about 70 % of time extension at approximately 60 % researched projects. At the same time, about 40 % rising costs has been noted. Time planning model development dates from the end of sixties of last century, when in Australia, Bromilow has formulated "time-cost" model. Construction time has been as function of construction cost expressed. This model rests on simple linear regression method application, which has been also during later researches confirmed as the most appropriate mathematical method in regard with time planning model development. In Bromilow's model,  $K$  and  $B$  are constants that need to be calculated for a particular similar facilities sample, using linear regression, at that. Constant  $K$  expresses time needed to construction works of 1.000.000,00 money-units of respective national currency could be realized.

$B$  is the constant which expresses project value impact on construction time. Problem is in the fact that mentioned constants are not universally applicable. In regard with the fact that constants significantly depends on economical characteristics, they need to be calculated separately for every one state. A great number of researchers in the world have occupied themselves with  $K$  and  $B$  constants calculating for different kinds and types of facilities. Until 2004. There were no such researches in Croatia, and even then they have been done for not numerous samples of facilities. In spite of modification trials, "time-cost" model has been verified during numerous researches, as the most acceptable for time planning. Because of it, the idea is to research about 300 hundreds facilities that have been realized in Croatia during transition period from ninetieth years on, then databases, structured according to defined criteria, analyse using Bromilow "time-cost" algorithm. As the result "time-cost" models need to be obtained, that apply, sustainable construction time for consider kinds and types of facilities, can be calculated. These models are suitable for usual risk level. Model, multiplied by significant risk coefficients product is suitable for higher risk level.



### **3. Conclusion**

In regard with education and the status of the area, we think, the following problems need to be particularly pointed:

- To much theory in education and not enough practical work;
- As the consequence of the 1. point, young engineers sometimes have problems by inclusion in professional work. Also, the reactions of employers in regard with the young, engineers and their competences to solve the real, practical problems, are not good;
- Also the students are not satisfied with so much theory in education. They are more interested for practical, engineering problems. Also, they don't feel ready enough when they finish education.

The idea is, that it would be very useful to organize significant part of organizational and technological courses through site visits, adequate explanations on the sites, students' work and solving specific real, practical engineer problems. But, it has to be solved through the educational system, for example through the agreements between construction companies and faculties, and may not be left to participants' good will to organize such type of educational process.

In regard with research, we find that staff mobility, especially involvement on foreign universities, need to be stimulated and support. It is of particular importance for young novices and assistants. Of course, increased level of allocating funds from budget is necessary, but also rationally and economically finances using is of particular importance.