

## TRANSPORTATION ENGINEERING EDUCATION IN LATVIA

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### Summary

There is only one university in Latvia offering higher education in the field of Transportation Engineering - Riga Technical University (RTU). We provide programs organised in accordance with Bologna Declaration at two levels, what allow obtaining bachelor and master degrees in transportation engineering. Upon the completion of the first level in RTU, students are conferred the bachelor's degree, which grants them the right either to continue education in master studies or enter labour market, because having completed the bachelor studies, students receive the Engineer's qualification. Upon the completion of the Master's studies, a student may pursue the doctoral program to be awarded the Dr. Sc. Ing. The latest trend shows a tendency of student's number increasing in university as well as change in student's orientation from academically oriented education to professional. Objectives of given paper are: 1) to summarize the Latvian experience in organizing of higher transportation engineering education after winning of independency in 1991; 2) to show latest trends in the field of higher transportation engineering education; 3) to emphasize the higher transportation engineering education structure in RTU.

### Introduction

Road and bridge engineering education was a part of Riga Polytechnic Institute's program already in previous century. At that time it was held within the Faculty of Civil Engineering under the code 1211, but later in Department of Roads, Bridges and Geodesy (program's code 2910). On the basis of Construction Department of Roads, Bridges and Aerodromes (established in 1960<sup>th</sup>), there were developed other three departments as depicted in Fig 1. From 1960<sup>th</sup> up to 2007<sup>th</sup> this resulted in graduation of more than 1000 road and bridge engineers. Dynamics of successfully graduated engineers is depicted in Fig 2 below.

It has to be emphasized, that Transportation engineering higher education system in Latvia after winning of independency was reformed. Instead of continental study scheme was introduced anglo-saxon study system, i.e., were introduced academic bachelor and academic master study programs with nominal study length 3 years and 2 years respectively. Our experience has shown that after 3 year long bachelor studies graduates were not ready to enter labor market. That is one of the reasons why we have introduced bachelor professional studies with nominal study length 4,5 years.

Professional bachelor's program is implemented according to the RTU Senate decision Nr. 476 in March 31, 2003 (see Appendix "RTU Senate decision of implementation of the study program *Transportation Engineering*"). Details of program are agreed within the same decision.

Professional bachelors program Transportation Engineering (code BCT0) is held within department of Roads and Bridges. Director of this department is also responsible person of the mention study program. In May 19, 2004 professional study program Transportation Engineering received official accreditation issued by Ministry of Education for both bachelors and engineers qualification.

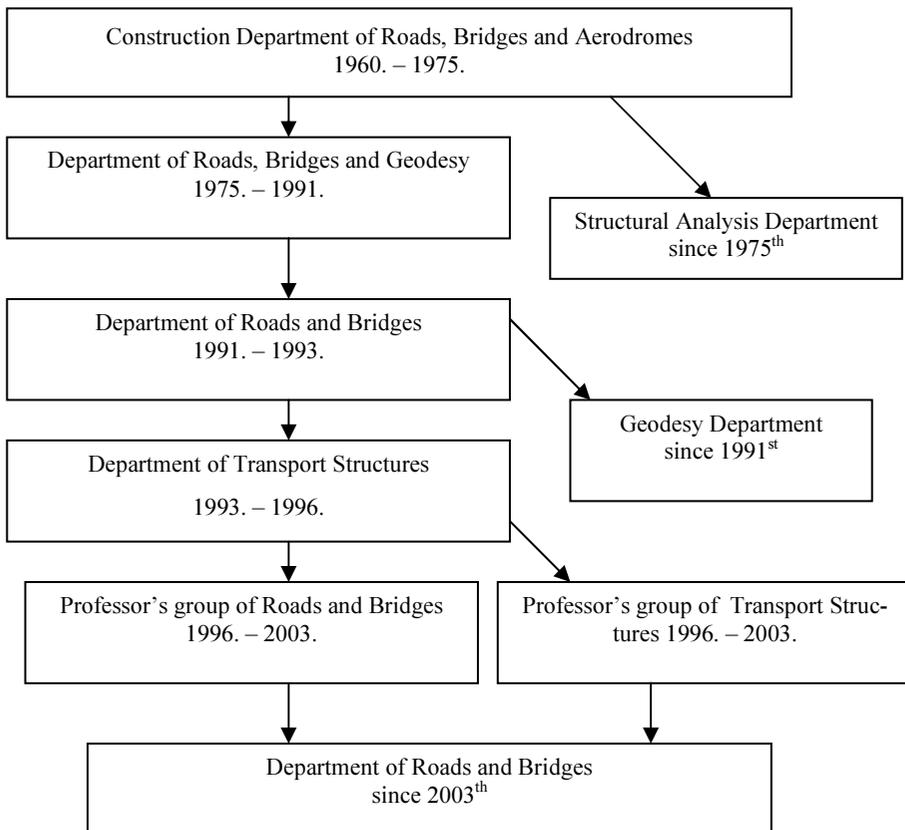


Fig 1. Development history of Department of Roads and Bridges

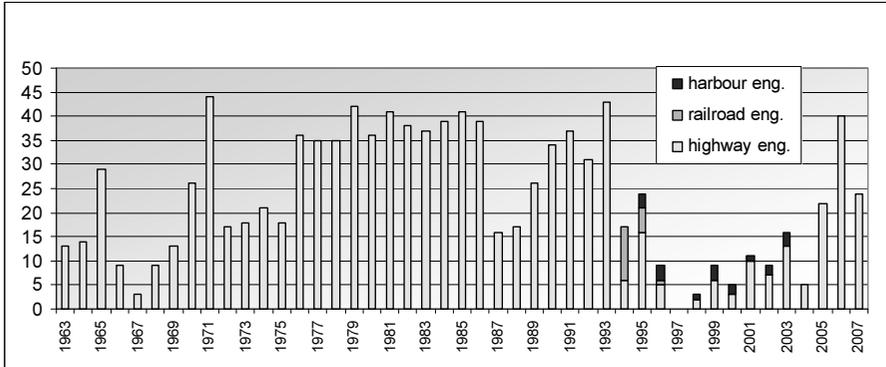


Fig 2. Number of graduates

## 1. Conditions of program implementation

### 1.1. Purpose of program

Purpose of professional bachelor's studies is to provide second level professional education in the branch of transport structures, to prepare student for independent work in practical engineering as well as to give an opportunity for a student to continue studies in professional/academic master's program.

### 1.2. Objectives and main tasks of the program

Program of professional bachelor in the branch of transport structures is delivered in lectures, practical lessons and in guided independent studies with a purpose to acquire knowledge in all related fundamental sciences. Along with the technical subjects there is a space provided for some economical and arts oriented subjects.

During the bachelor's professional studies student obtains necessary proficiency to be able to start work in industry or to continue studies in the PhD level studies. While studying in the professional master's program student acquires:

- skills of orientation in technical literature and independent research;
- ability to use theoretical knowledge in definition of particular problem as well as to distinguish problem-solving options;
- ability to plan, execute and to interpret experimental data and results;
- at least 26 weeks of practical work experience.

Professional masters program builds a highly intelligent ground encouraging students for wide social and professional interaction with both local and international authorities.

### 1.3. Duration of program

The program lasts for 4,5 years and consists of 180 credit points. After a successful fulfillment of study requirements student is granted with the **professional bachelor's degree in Transportation Engineering and professional Engineering qualification.**

### 1.4. Expected academic background

Applicants are admitted to the professional bachelor's program *Transportation Engineering* if they possess secondary school diploma or any other diploma comparable with this kind of education. Program is available also for RTU students who accomplished three-year studies of first level professional studies in Transportation Engineering. This is achieved through system of equation between these two programs.

## 2. Educational content

Professional bachelor's program of Transportation Engineering provides subjects of general education in mathematics, economics, communication and introduction of construction science. Field related subjects or core courses include physics, computer science, descriptive geometry and engineering graphics, computer aided design, structural analysis, construction materials, geology, finite element methods, probabilistic methods in structural analysis and mathematics for construction. In the professional level courses following subjects are included: software for design of transport structures, work safety basics, public safety, geodesy, inspection of transport structures, advanced structural analysis, design of streets and parking places, road design, bridge structures, structures, hydraulics, hydrology and hydrometrics, structural foundation, construction of roads and highways, transport systems, transport and environment, road maintenance, road traffic planning and safety. Courses aimed for a more detailed specialisation covers design of highways, bridges and structures, introduction of traffic flow theory, modern practice of structural design and maintenance, aesthetics of transport structures, improvement of roads as well as number of art and social science related subjects. There is also opportunity for other courses provided within the list of optional subjects. Finally students have to acquire some practical field related experience for a certain time period and also to prove ability of individual work while developing bachelor and engineer's paper. Latter positions are aimed to satisfy requirements for an engineer standard of Transportation Engineering according to PK fifth qualification level: 2142 04 Bridge Engineer, 214105 Traffic Planner, 2142 10 Engineer of Streets and Highways and 2142 15 Road Engineer.

### 3. Program by parts and credit point distribution

For the purpose of comparison program has to informally split into groups. Within this context following grouping is offered: GE – general education subjects, FRT – engineering field related theoretical courses and information technology courses, FRP – field related professional specialisation courses, AEM – art, economics and management related courses, LA – languages other than Latvian. Organisation of professional bachelors program Transportation Engineering is as follows (Table 1).

Table 1. Organisation of professional bachelors program Transportation Engineering

Core courses:	117 credits		
• general education subjects (GE)		14 credits	7,8 %
• engineering field related theoretical courses and information technology courses (FRT)		44 credits	24,4 %
• field related professional specialisation courses (FRP)		59 credits	32,8 %
Optional core courses:	15 credits		
• field related professional specialisation courses (FRP)		9 credits	5,0 %
• art, economics and management related courses (AEM)		2 credits	1,1 %
• languages (LA)		4 credits	2,2 %
Optional courses	6 credits		3,3 %
Praxis	26 credits		14,4 %
Bachelors paper (including engineer's project)	16 credits		9,0 %
<b>Total:</b>	<b>180 credits</b>		<b>100 %</b>

As it can be seen considerable proportion of the program is formed by transportation engineering specific subjects (32,8+5=37,80160 %). This fact allows to account for students professional preparedness and it is also in line with knowledge level defined by Bologna declaration for academic category “undergraduate”.

In accordance with standards passed by Cabinet of Ministers second level professional studies have to consist of at least 20 % of general education subjects. AEM, LA and GE falls within this group, therefore standard requirement is fulfilled.

Field related theoretical and information technology courses should not be less than 36 credit points. Organisation of current program satisfies this requirement as FRT courses account for 44 credits.

Field related professional specialisation courses (FRP) are expected to be of amount not less than 60 credit points. In this case it is  $59+9=68$  credits, requirement is satisfied.

Knowledge level in professional bachelors program is assessed in a system of 10 marks. Methods of knowledge assessment are tests, tutorials, praxis and exams in accordance with the approved study schedules. Final examination deals with bachelor's paper (including project) and its oral presentation.

### **3.1. Bachelor's paper**

Bachelor's paper is aimed to demonstrate student's ability of real problem solving in relation to transport structures based on literature review practical skills. Before the final presentation, paper is specialist reviewed. Reviewing person is nominated on behalf of Transportation Engineering department based on the order of department director. Publicly accessible presentation is assessed by the RTU rector appointed testing commission. Commission consists of delegates from professional associations, business and other institutions.

### **3.2. Implementation of program**

Implementation of program is achieved through lectures, study projects, tutorials and laboratory works.

In total there is 1008 lecture hours provided, 896 hours of practical exercise and 304 hours of laboratory work. Summing up it gives 2208 hours of guided study, which is 76,6 % of the whole time amount allocated for the program. Other 256 study hours are provided for the development of bachelor's paper and engineering project.

The number of exams is 20, tests – 49 and study projects – 15, five of them are separate subjects. The study works are assigned in following subjects: structural analysis (two units for the general part of the subject); computer science; special course for building contractors; special course of structural analysis, urban roads, streets and parking places; road construction (basic course); highway construction (basic course); hydraulics, hydrology and hydrometrics; design of highways (introduction course); structures; bridges and structures (basic course); highway design (two units for the basic course), highway design (special course); bridges and structures (special course)

## **4. System of evaluation**

Student academic abilities are evaluation within the scale of ten marks (according to RTU Senate decision *Transition to unified assessment of studies* of January 29, 2001 and decision *Criteria for assessment of studies* of May 25, 2001. All results are assessed with the help of tests, exams and study works according to the approved study plans.

Content of exam and test material is under responsibility of subject's applicant, who also maintains class material to be in line with the description of the subject and fits the whole program. Main principle of developing exam questions is to test whether or not student has achieved academic goals.

According to regulations of January 26, 1998 and March 30, 1998 *Exam procedures in RTU* exams are of written form.

### **5. Program's comparison in international perspective**

Civil engineering education in Europe has two common systems – Continental and Anglo-Saxon. Continental system is characterised by continuous education where students at the final gain a specific professional qualification. In a forth-coming review continental system is represented by Vienna Technical University, Sofia University of Architecture, Civil Engineering and Geodesy as well as Russia's program 291000 *Roads and Aerodromes*. Anglo-Saxon system firstly covers general engineering subjects with no specialisation in a specific profession. This system will be represented by Leipzig University of Technique, Economics and Culture as well as Carleton University in Canada.

Study programs of professional engineering qualification in relation to transport structures are available in a number of European countries. Recently there is a trend to compare and equate such kind of programs to each other. For instance, Vienna Technical University in cooperation with Sofia University of Architecture, Civil Engineering and Geodesy offers program *Transportation Engineering* in German. These are five-year studies. If comparing the latter university program and program of RTU, one must agree on a similarity with only exception that there is no praxis in Vienna and Sofia Universities as well studies does not grant bachelor' degree.

In Russia engineering qualification of *Roads and Aerodromes* can be obtainable within five-year program under the code 291000. Up till beginning of 1990ies similar program was held in RTU (RPI at that time) faculty of Civil Engineering. Amount of professionally oriented subjects currently and at that time is very similar. Russia's program pays more attention to praxis, for example, in hydrology and pre-degree period. There is also a state exam in speciality, which altogether extent studies for an additional semester.

Three-year program in Civil engineering (Bachelor of Engineering, B.Eng) is available in Leipzig University of Technique, Economics and Culture (Hochschule für Technik, Wirtschaft und Kultur Leipzig). Studies are of amount of 180 credit points according to European Credit Transfer System, which is  $180/1,5=120$  RTU credit points. In sixth semester students are spending 16 weeks in praxis and developing their bachelor papers evaluated for 8 ECTS credits. Studies result in a degree of B.Eng. Comparatively to

RTU capacity of bachelor's paper there is smaller as the main attention is paid towards the general engineering subjects. As a result engineer's diploma work is not carried out and consequently engineer's qualification is not granted.

Four-year professional programs resulting in B.Eng. are common in many universities of UK, USA and Canada These countries grant B.Eng. degree in Civil Engineering.

Main conclusion from this kind of comparative analysis follows that professional bachelor's program of RTU is very similar to those in other European universities considering length and content of the program.

### Results of questionnaire

Aim of the questionnaire was to obtain more information about the study program from different points of view including students, academic personnel and employers. Following questions were included in the questionnaire (Table 2).

Table 2. Questionnaire

Task	Largely	Partly	Insufficiently
To obtain an ability to organise and carry out experiments, analyse and interpret the results			
To obtain an ability to structure an algorithm in order to achieve the established objective			
Obtain an ability to work in multi-branch problems and teams			
Obtain an ability to recognise, formulate and to solve engineering problems			
Obtain an ability to distinguish professional and ethical liability			
Obtain an ability for effective communication			
Develop and maintain a cognition of long-run continuous self education			
Acquire recent developments in design, construction and maintenance of transport structures			
Obtain ability to use skills and methods to operate with modern engineering equipment			

Altogether there were 47 questionnaires spread among 18 employers, 8 persons from academic sector and 21 students. Following system of points were assigned to different questions:

- Response „Largely“ means +2 points;
- Response „Partly“ means +1 point;
- Response „Insufficiently“, -2 points assigned.

Points obtained are expressed in percentage of all possible points for each of the question. Such an approach gives additional information about the weak and strong points of the program, see summary in Fig 3.

As it can be seen all three groups of respondents have positively acknowledged program in a task „to acquire recent developments in design, construction and maintenance of transport structures“ (students 89 %, academic sector persons 100 %, employers 97 %). Positive results are observed also in the task of to obtain an ability to recognise, formulate and to solve engineering problems“ - 77 %, 83 % and 86 % respectively as well as in “to obtain ability to use skills and methods to operate with engineering equipment” – 71 %, 83 %, 88 %.

Employers have pointed out that firstly communication skills should be improved (69 %) and secondly ability to work in multi-branch teams (55 %). At the same time employers have recognised the level of knowledge regarding the recent trends in transport structures’ sector (97 %). Students themselves have noticed that communication skills (53 %) and understanding of long-run self-education are still underdeveloped. As the most sceptic points in opinion of teaching staff are students ability to organise and analyse experiments (50 %) as well as ability to structure necessary algorithms (60 %).

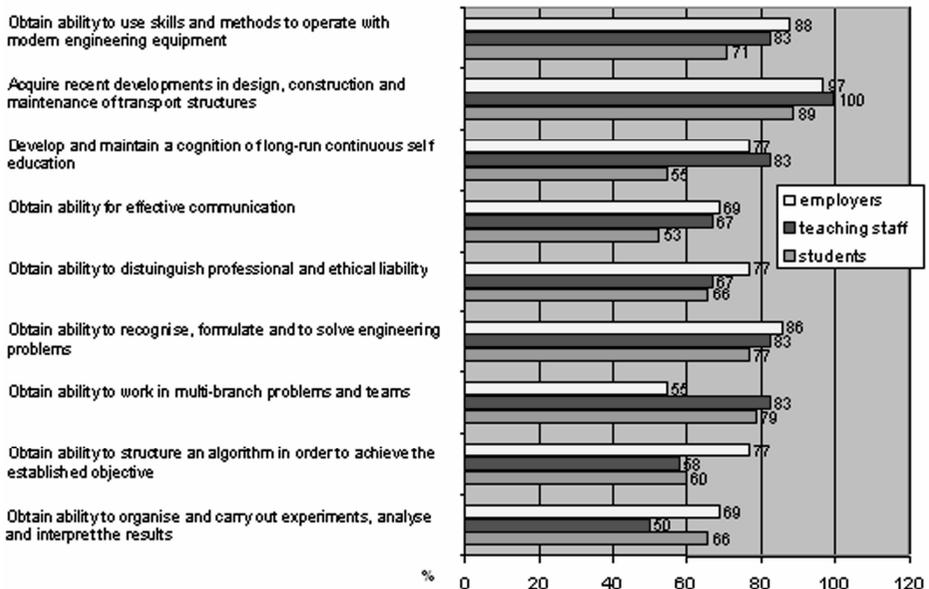


Fig 3. Questionnaire results

## References

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