CIVIL ENGINEERING EDUCATION IN EUROPE - 2004

SOCRATES - ERASMUS
THEMATIC NETWORK PROJECT

EUROPEAN CIVIL ENGINEERING EDUCATION AND TRAINING

FOURTH EUCEET VOLUME

Edited by
Iacint Manoliu

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FOREWORD

This is the fourth of a serie of volumes to be published within the frame of the Thematic Network Project EUCEET (European Civil Engineering Education and Training) run on the basis of a grant of the European Commission under the auspices of the Erasmus component of the SOCRATES programme.

The decision to prepare the volume was taken by the Working Group A of EUCEET I "*Curricula in European Civil Engineering Education at undergraduate level*", chaired by the editor. The volume was meant to complement the two studies elaborated by the Working Group A (*Study on the organisation of civil engineering education at undergraduate level in Europe* and *Study on the curricula structure for the first civil engineering education degree in Europe*) included in the first EUCEET volume. While the two mentioned studies were based on the answers to a questionnaire, the approach adopted for this volume was different. A general frame being agreed upon, contributors were asked to prepare papers on the civil engineering education in their country. Until the middle of 2002, more than 20 such papers were received. By that time it became, however, obvious that important changes were under way, as a result of the *Bologna process* and, hence, a real risk subsisted, of having a large amount of obsolete information when the volume was to be printed. The editor had then no other choice but to postpone for some time the publication of the volume.

In May 2004, the authors were invited to revise and update the papers at the level of the academic year 2003 - 2004, with due consideration to changes already brought or about to be brought by the Bologna process. Shifting the volume publication from 2002 to 2004 proved to be a sound idea. Decisions on the implementation of the Bologna Declaration were meanwhile adopted in most European countries and could be reflected in the papers. The postponment allowed also to enlarge the circle of contributors, to include papers from Russia and Turkey.

The bulk of the volume is represented by the 26 papers referring to the civil engineering education in 26 European countries. Most of the papers give a complete picture of the civil engineering in Europe in the respective country while few of them are based on the relevant example of only one institution. The responsibility for the content and for the presentation of the papers belongs entirely to the authors.

Following the 26 papers, the volume includes a sampling from the answers received from some EUCEET partners to a Questionnaire on the impact of the Bologna Declaration. By the information and the point of views provided, the sampling contributes to the state-of-the art of the civil engineering education in Europe in 2004, as revealed by the papers.

The volume is completed with an overview in 2004 of the civil engineering education in Europe in the context of the Bologna process.

The editor expresses the most sincere thanks to the authors of the 26 papers for their valuable contribution and for the support to the Thematic Network EUCEET.

The editor

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CIVIL ENGINEERING EDUCATION IN AUSTRIA

Josef Eberhardsteiner[1]

1. GENERAL VIEW ON THE PRE-UNIVERSITY EDUCATION

In Austria compulsory schooling lasts nine years. The four-year elementary school (ages 6 to 10) is followed by secondary education (in either a *Lower Secondary School* or the lower classes of an *Secondary Academic School*). Pupils who leave school at fourteen and do not intend to pursue further school education can enrol at a *Polytechnical Course* that prepares them for working life. The upper segment of secondary education is covered by a range of school types:

Secondary Academic School: Schools for general higher education providing a general education with the emphasis either on the arts or on sciences.
Technical and Vocational School: Higher vocational schools for providing specific and theoretical education on different kind of professions.

A school-leaving certificate acquired at one of the above school types entitles the holder to enrol at university.

2. GENERAL VIEW ON THE ENGINEERING EDUCATION

2.1 Engineering education at undergraduate level

In Austria different programmes in various types of vocational schools realize the engineering education at undergraduate level. It is based on the duration of the programmes (short/long duration) and on the degree awarded.

2.1.1 Programmes at secondary academic level

In particular, there are
- five year vocational courses following the secondary education and closing with a school-leaving certificate, and
- two year vocational courses following the secondary academic school.

After a certain time of job-experience the title “Ing” (engineer) is bestowed.

2.1.2 Programmes at tertiary academic level

[1] Professor, Vienna University of Technology

At the present time the academic engineering education in Austria is done at the so-called "Fachhochschulen" and at universities. The courses at the Fachhochschulen comprise four years and the one at the universities five years. Both programmes lead to graduated engineers with a Master-type degree called "Diplom-Ingenieur (Dipl.-Ing)", equivalent to MSc.

Separated Bachelor and Master programmes with a duration of three and two years, respectively, are planned to be introduced in Austria until 2006.

2.2 Engineering education at postgraduate level

In Austria the postgraduate engineering education consists of doctoral programmes which normally take three to four years. The degree awarded is a "Dr. techn.", it is equivalent to a PhD.

3. CIVIL ENGINEERING EDUCATION

3.1 Engineering education at undergraduate (tertiary academic) level

The Fachhochschulen represent a tertiary educational opportunity established only recently in Austria. While the universities (five year courses) are assigned the task of providing scientific pre-professional education, the Fachhochschulen offer a scientifically sound professional education (four year courses).

In Austria at the following locations a civil engineering education at a tertiary academic level is established:

a) Fachhochschulen

Vienna: fh-campus Vienna (Civil Engineering – Contruction Management)
Spittal a.d. Drau: FH Technikum Kärnten (Civil Engineering – Structural Engineering)
Spittal a.d. Drau: FH Technikum Kärnten (Civil Engineering – Projekt Management
Pinkafeld: Fachhochschulstudiengäne Burgenland Building Technology and Management)
Graz: FH Joanneum (Construction Engineering and Management)

b) Universities

- Vienna: Vienna University of Technology (Civil Engineering)
- Vienna: University of Agricultural Sciences (Environmental Engineering)
- Graz: Graz University of Technology (Civil Engineering)
- Innsbruck: University of Innsbruck (Civil Engineering)

The particular universities specify on different branches of engineering education, but some curricula have similar contents at different locations.

3.1.3 Admission of students at the undergraduate level

Prerequisite for admission to all degree courses in Austria is a school-leaving certificate of a school for general higher education or a higher vocational school. For admission to a Fachhochschule a qualifying examination has to be passed. In contrast, no further examination is necessary for admission to universities.

All students in the tertiary academic level have to pay tuition fees.

3.2 Civil engineering education at postgraduate level

Doctoral programmes are offered at following universities:

- Vienna: Vienna University of Technology
- Vienna: University of Agricultural Sciences
- Graz: Graz University of Technology
- Innsbruck: University of Innsbruck

In general, the duration of the postgraduate engineering education in Austria is between three and four years. The degree awarded is a "Dr. techn.", equivalent to a PhD.

The doctoral students are required to take a limited number of relevant courses from taught masters programmes. The doctoral theses – which are normally in reconciliation with specific research activities of institutes – are examined by internal and external assessors.

4. RECENT TRENDS IN CIVIL ENGINEERING EDUCATION IN AUSTRIA

The reorganization of the civil engineering eductation according to the Bologna Declaration is just in preparation now at the Austrian Fachhochschulen and universities. Generally, it ends up in separated Bachelor and Master programmes, with a duration of three and two years, respectively. The reorganization should be finished by 2006.

CIVIL ENGINEERING EDUCATION IN BELGIUM

Ghislain Fonder[1] , Jean Berlamont[2]

PRELIMINARY REMARK

Governance in Belgium is divided into three levels: the Federal Government, the Regions (Flanders, Wallonia, Brussels) and the so-called Communities (Flemish-, French- and German-speaking). Since higher education is a matter of Communities competence, a unified view is difficult to provide, especially now that the Bologna Declaration is implemented at a different pace and along different modes in the northern and southern parts of the country.

In the Flemish region the "BaMa" decree has been published on 04/04/2003. Universities and University colleges ("Hogescholen") are in the process of implementing it. The BaMa reform will start in the academic year 2004-2005. In the French-speaking part, the situation is in turmoil because the decree re-organising higher education has been formally voted only on 23/03/2004, that is less than two months before updating the present report. The authors therefore apologise for inaccuracies or information, which could soon become obsolete. What follows is a mix between the former situation, which is progressively being replaced and should become extinct after 2008-2009, the present situation, which is evolving every day, and the future situation, which is still undefined in some respects.

1. GENERAL VIEW ON THE PRE-UNIVERSITY EDUCATION

Education in Belgium is compulsory from the age of 6 until the age of 18. This period is divided into primary and secondary education, each one extending over a normal duration of 6 years

The primary education is the same for all pupils. At secondary level however, a choice can be made between vocational schools and a more comprehensive education. A certificate awarded upon completion of secondary education is the basic entry requirement for higher education.

Three years after secondary school, vocational schools (in Flanders: integrated into the University colleges, "Hogescholen") can award a "graduate" in Health sciences, Education, some engineering fields like Mechanics, Informatics or Construction, etc.; these "graduates" will become in Flanders a (professional) bachelor starting in the academic year 2004-2005.
They are not considered in the present report.

[1] Professor, University of Liège

[2] Professor, University of Leuven

2. GENERAL VIEW ON THE ENGINEERING EDUCATION

At the higher level, education is organised along two main streams:

- Institutes of Higher Education have recently merged, from an administrative point of view, into a few “Hautes Ecoles”, “Hogescholen” or “University colleges”. They are usually composed of several institutes or departments specialising in Architecture, Commerce, Management, etc; some specialise in Engineering. Most of the latter have retained the former denomination of “Instituts Supérieurs Industriels“ or “Industriële Hogescholen“; they usually offer a limited choice of formations: Mechanics, Electronics… Constructions; they award a degree after a 4 years curriculum (“Ingénieur Industriel“ or “Industrieel Ingenieur“).

- Universities are composed of faculties: Law, Medicine, Sciences, Psychology… Engineering (“Faculté des Sciences Appliquées“ or “Faculteit Toegepaste Wetenschappen"). Some universities are limited to one faculty. Six universities, three in the Flemish-speaking part of the country and three in the French-speaking part, the UG (Gent), VUB and ULB (Brussels), KUL and UCL (Louvain) and ULg (Liège) are called the major or full universities. In engineering, they offer a wide choice of formations: Mining, Geology, Constructions, Mechanics, Electricity, Electronics, Electromechanics, Aeronautics, Chemistry, Metallurgy, Informatics, Computer sciences…. They award a degree after a 5 years curriculum, for instance “Civil Engineering Degree in Constructions”[3] (“Ingénieur civil des constructions” or “Burgelijke ingenieur in bouwkunde”).

As a consequence of the Bologna declaration, in the Flemish-speaking part a closer co-operation has now been enforced between university colleges and universities: they are grouped into so called “University Associations”, which will allow the university colleges to award some Master degrees in co-operation with a university. In the French-speaking part, “Académies” are being created, merging major universities with smaller ones and with “Hautes Ecoles”; merging is more or less based on geographical and/or philosophical proximity but discussions are still in progress.

[3] The term “civil“ intends to differentiate between a military degree awarded after a 5 years curriculum by the Polytechnic Department of the Royal Military School. One can get a “Civil Engineering Degree in Electronics“ for instance. The Belgian equivalent of a “Civil Engineer“ in the English language would therefore be a “Civil Engineer in Civil Engineering“; he is better called a “Civil Engineer in Constructions“.

The engineering offer is now limited to 11 domains in the French-speaking part, to avoid proliferation of specialisations and to encourage concertation within or between "Académies". Not all 11 domains are necessarily offered in all 6 major universities but the "Constructions" domain still is.

2.1 ENGINEERING EDUCATION AT UNDERGRADUATE LEVEL

The universities used to differentiate from the institutes of higher education (Hautes Écoles, Hogescholen or University colleges) by several aspects:

- In universities, access to engineering studies was subject to successfully passing an entrance examination.
- The degree awarded by the universities after 5 years was considered equivalent to a MEng, while the degree awarded by the "Instituts Supérieurs Industriels" or "Industriële Hogescholen" after 4 years could somewhat be considered equivalent to a BEng.
- The education provided by the university engineering faculties was of a more basic and theoretical or conceptual nature, whereas the institutes of higher education took the more practical viewpoint of direct application of the technical knowledge. The two systems were considered complementary.

These distinctions are now somewhat blurred.

- The entrance examination will be abolished in the Flemish-speaking part as from the academic year 2004-2005, which possibly will result in shifting a significant number of enrolments from institutes of higher education (or from "bio-engineering" or "agronomy engineering" faculties) to universities (faculty of engineering). This reform is too recent to allow an assessment of the effect on the number of graduates and the impact on professional life. In the French-speaking part the entrance examination is conserved.
- The first academic degree will be "Bachelor in Engineering Science"; it will be awarded after completion of 180 ECTS, obtained over 3 years *at least.* The second degree will be "Master in Engineering Science", awarded after completion of *60 or* 120 ECTS, obtained over 1 or 2 years *at least*. The professional denomination "Civil Engineer" in a given domain is still maintained, for instance "Civil Engineer in Constructions" (for a 3 + 2 curriculum).
- The 4 years curriculum of the institutes of higher education does not fit easily into the 3-5-8 frame. That is why the subtleties of 3 years *at least* and *60 or* 120 ECTS have been introduced into the Bachelor and Master requirements respectively. To clarify the ambiguity, the institutes of higher education ask for an extension of their 4 years curriculum to 5 years. In the

French-speaking Region, the universities rather advocate its reduction from 4 to 3 years (to preserve their own monopoly over the 5 years curriculum). So far, no governmental decision has been taken.

- The Bologna declaration assumes relevance of the first degree, that is after 3 years, to the labour market. This has induced at least one Flemish-speaking University (see later) to shift some emphasis from basic knowledge and theory to professionally relevant subjects during these first three years. In general, however, the universities basically maintain an (integrated) 5 years curriculum and claim that the BSc degree does not necessarily has a professional outcome but forms a "pivot" for allowing student mobility.

Bridges have long been established between the two types of engineering education. They usually enabled good students transferring from institutes of higher education to universities to obtain a civil engineering degree at the cost of an additional year (total of 4+2 instead of 5 years). The program of the 2 additional year was most often fixed on an ad hoc basis, depending on the institution of origin and the timing of the transfer. The problem was that it usually forced the transfer student to juggle with courses taught in different years of the curriculum. Transfers from the universities to institutes of higher education concerned less good students and were less frequent.

The decree, with its reference to ECTS (European Credit Transfer System), intends to ease transfers in both directions. The Flemish-speaking part is ahead in this respect. In the French-speaking part many practicalities are still under discussion.

2.2 ENGINEERING EDUCATION AT POSTGRADUATE LEVEL

After their 5 years curriculum, the French-speaking universities used to offer postgraduate studies:

- The D.E.S. ("Diplôme d'Etudes Spécialisées" in French), open to holders of a Civil Engineering degree, to deepen their knowledge without aiming at research purposes.
- The D.E.A. ("Diplôme d'Etudes Approfondies"), intermediate and compulsory step towards the Ph.D. for university graduates who obtained their first degree outside of the Faculty of Engineering or in foreign country.
- The Doctoral degree ("Doctorat en Sciences appliquées" or Ph.D.), open to graduates who obtained a Civil engineering degree or successfully passed the D.E.A. in the institution.
- The so-called "Agrégation de l'enseignement supérieur" ("Habilitation"), considered as the highest university degree, sometimes awarded to Doctors

with an experience of approximately 10 years or more who presented a comprehensive additional thesis.

In the Flemish Region:

- Postgraduate studies led to so-called "diploma of complementary studies" or "diploma in advanced studies".
- The Doctoral degree was also open to "industrieel ingenieurs" (alumni from the university colleges) after an additional (predoctoral) study of 60 or 90 ECTS.
- The "Agregation" had been abolished many years ago.

According to the new governmental decree, the D.E.S., D.E.A., diploma of complementary studies, diploma in advanced studies and "Agrégation" will disappear, after a transition period extending to 2006-2007.

Instead a "Master after Master" will be obtained after (at least) 60 additional credits; but only a few selected fields will be opened in each University.

For what regards the doctoral studies, nothing changes so far in the Flemish Region: they remain the prerogative of the universities. In the French-speaking part, they will be the responsibility of doctoral schools accredited within the "Académies"; it is not guaranteed that all "Académies" will be competent to deliver a Ph.D. in all 11 domains of engineering. The doctoral work should be at least equivalent to 180 ECTS, which means at least 3 years work: 60 ECTS corresponding to an advanced formation delivered by a doctoral school, the remaining 120 ECTS corresponding to the thesis preparation.

3. CIVIL ENGINEERING EDUCATION

The program offered by the "Instituts Supérieurs Industriels" or "Industriële Hogescholen" may vary depending on the institutions. Usually, the first two years are common to all students. During the last two years, Civil Engineering is a full-fledged specialisation in some cases while in some others it consists of a package of optional courses.

The organisation of the year (semester, trimester, modules), of the examinations (number, duration, written, oral), the number of contact hours, the work placement (duration, objectives), the importance of a graduation work, etc … depend on the institutions. A comparative study would go far beyond the scope of the present report.

For what regards Civil Engineering in the 6 major universities, implementing the March 2004 "Bologna decree" has led to much soul searching; some have introduced long planned modifications, others have hastily modified the programs, others are still working on the changes or have decided to maintain the existing situation. What is described below is the

organisation of Civil Engineering studies such as it was until 2003-2004 and the planned modifications from 2004-2005 onwards.

3.1 Undergraduate education

3.1.1 Past situation.

- The first two years of the Civil Engineering curriculum used to be common to all disciplines of engineering; they were devoted to basic sciences: Mathematics, Physics, Chemistry, Theoretical Mechanics, Computer Programming. Since they were very similar in the different institutions, the degree awarded after these two years ("Candidat ingénieur civil" or "Kandidaat burgelijk ingenieur") enabled transfer of students from one university to another one before the start of the last three years.

- Since the reform will start with the students first enrolled in 2004-2005, the third, fourth and fifth years are not yet affected. They are devoted to the chosen discipline, Civil Engineering ("Constructions" or "Bouwkunde") in the present instance. Core civil engineering subjects will be mostly covered during the first 3 semesters; specialisation takes place during the next 2 semesters (hydraulic engineering, foundations engineering, structural engineering, transportation engineering, environmental engineering…); the so-called "Final project" or "Graduation work" occupies most of the last semester.

Economics, Management, Social sciences are interspersed over the 5 years and represent 5 to 10% of the curriculum, depending on the institution and the year. The knowledge of foreign languages is actively encouraged and very often a compulsory requirement.

The number of contact hours can be estimated between 600 and 850 per year. The Final project involves personal work and can be estimated equivalent to 300 contact hours. Training periods in industry are seldom compulsory; they are encouraged, sometimes credited as an optional course, and must be performed during the vacations, which puts severe limitations on its duration.

3.1.2. Present situation at the bachelor's level.

To the author's knowledge, two radically different paths have been chosen by the *UG* (*University of Gent)* (Flemish-speaking) and the *ULB (Université Libre de Bruxelles)* (French-speaking) for what regards the basis formation.

- At the University of Gent, a strong component of applied engineering has been introduced into the 3 bachelor years, to the detriment of the basic

sciences. After the 3rd semester, the students must make a choice between 6 specialisations, constructions being one of them. The 4th semester already contains 2 courses (out of a total of 5) devoted to civil engineering; in the 5th semester, one course only is shared with other specialisations; the 6th semester is totally devoted to civil engineering.

The advantages are that the bachelor diploma is indeed marketable and the reduction in basic sciences facilitates transfers from institutes of higher education to the university; bridges are already clearly organised. The inconveniences are that the differences with respect to these institutions of higher education tend to disappear: what remains of the specificity of the University? Besides, complements of the basic courses will have to be re-introduced in the master's years: how well will they be received?

- The ULB seems intent on introducing no modification at all in the immediate future. The first 2 years will remain common to all engineers. The 3rd year will remain devoted to the basic aspects of civil engineering. At the end of this 3rd year, the students will be awarded a bachelor's degree, which will have little professional value but will be a stepstone towards the master's degree.

The *VUB (Vrije Universiteit Brussels)* (Flemish-speaking) has chosen the supplest approach. The first 3 semesters are common to all engineers and devoted to basic sciences; a few more courses with a theoretical content or of general engineering interest are still offered later during the bachelor's curriculum. During the 4th semester, by means of PBL (Project and/or Problem Based Learning), an introduction is given to the 4 offered specialisations, constructions being one of them. During semesters 5 and 6, courses related to the chosen specialisation are mainly offered. Apparently, the choice of a given bachelor's programme does not exclude the possibility of making a different choice for the master's degree, although it is not explained how the student can catch on the missing subjects when entering the 4th year.

The *KUL (Katholieke Universiteit Leuven)* (Flemish-speaking) has clearly divided the bachelor's formation into two parts. The first 3 semesters (90 ECTS) are devoted to basic sciences (82 ECTS) and general formation (Management, Economy). During the last 3 semesters a major-minor system is introduced: the students must make preliminary choices among 7 domains, Civil Engineering being one of them: the so-called "bachelor's domain", which amounts to 36 ECTS, and an "additional domain", for 45 ECTS; the remaining 9 ECTS concern again the general formation. The "additional domain" retains a strong formation in the different fields of applied engineering. This enables the student to pursue the master's studies either in the "bachelor's domain" or in the "additional domain". Some pairings of subjects are obvious, like Chemistry with Materials Science or Electrical Engineering; but Civil Engineering can

only be paired with Geotechnical and Mining Engineering. Much emphasis is put on PBL ("Project Based Learning"), which is a facilitator of cross-border disciplines.

The *ULg (University of Liège)* (French-speaking) has chosen a similar approach: basic courses plus two domains, to be chosen among 8, civil engineering being again one of them. Two differences must be noticed with respect to the KUL. First, the common formation is slightly broader (108 ECTS) and extends over the 3 years. Second, the two chosen domains are also called "major" (42 ECTS) and "minor" (30 ECTS) but their organisation is peculiar: domain courses taught at the bachelor's level comprise a main part, for "minor" students, and a supplement, for "major" students; in this way, a student who would like to take a master's degree in the minor field must only catch on with the supplements, totalling 12 ECTS. To claim that the bachelor's degree gives the access to the profession is rather optimistic. At the ULg, there is relatively little emphasis on PBL.

On the contrary the *UCL (Université Catholique de Louvain)* (French-speaking) has put much weight on PBL when the engineering programmes were overhauled 5 years ago. The implementation of the "Bologna decree" in the PBL based engineering and constructions programmes is not yet available.

3.1.3. Future situation at the master's level.

The Universities have devoted much energy to be ready and offer 3 years bachelor's programmes to students enrolling in 2004-2005. The 4th and 5th year programmes leading to the master's degree should be organised in 2007-2008 and 2008-2009 respectively. They are now in preparation.

3.2 Civil Engineering education at postgraduate level

This has already been described in §2.2. for Engineering. Nothing special must be added about Civil Engineering.

4. TRENDS IN ENGINEERING AND CIVIL ENGINEERING EDUCATION

4.1 Recruitment of students.

Admission to engineering studies in the French-speaking universities or polytechnic faculties still requires passing an entrance examination. It is organised in a similar way by all concerned institutions and success gives access to any of them. Holders of a final secondary education diploma need to take

only the mathematical part; some students prepare for this examination with an extra year mostly devoted to Mathematics. There is no limitation on the number of students admitted in engineering; cumulative success rate over July and September is approximately 70%.

As already explained, this entrance examination has been suppressed in the Flemish-speaking part of the country, with as a possible consequence a shift of enrolment from institutes of higher education towards universities. This change is however too recent to measure the final impact on the profession.

Recruitment of engineering students peaked towards the end of the 80's; it decreased during the 90's; although it picked up in the recent years, the trend remains uncertain. The perception is that Mathematics and Sciences are neglected in secondary school and are not fashionable subjects when compared with Medicine, Law or Management. The entrance examination, where it still exists, scares away some potential candidates; the studies are reputed to be tough; the workload is demanding; the media do not valorise the profession. And yet there is a strong demand for engineering graduates, especially in Electronics and Informatics but also in Civil Engineering.

The enrolment in Civil Engineering remains relatively stable or is slightly decreasing. It seems however that, for Civil Engineering, and for other traditional orientations as well (Geology, Mechanics, Chemistry…), a charismatic professor or the renown of the Engineering faculty in a particular field can significantly influence the recruitment in the first years.

4.2. Programmes

The "Bologna decree" is supposed to harmonise programs and to facilitate the exchange of students. This is probably true at the European level, thanks to the common notions of ECTS and bachelor's degrees. But, between the Belgian institutions, the situation was probably clearer and there was more compatibility after the first two years in the former system. As shown above, the universities at the bachelor's level have chosen different paths. Probably, without returning to the previous uniformity, some harmonisation will be discussed between the concerned engineering faculties.

4.3. Trends

In all six universities, the general trend is to reduce the number of contact hours, and the overall workload, at least during the first years. It is the author's opinion that this is an unfortunate consequence from the fact that students are no longer trained for intensive work during the course of their secondary studies: the transition to the university must be smoothed!

In the curricula being prepared for the master's degree, work in the industry is much recommended. This will further erode the time devoted to the theoretical formation and bring the education offered by the universities one more step closer to the institutes of higher education. This rapprochement will also be a consequence of the bridge programs for graduates of the institutes of higher education who would like to upgrade their bachelor's degree to a university master's degree: some prospective university students could choose this path to circumvent the theoretical formation and the eventual entrance examination for engineering at the university.

Changes are also appearing in teaching methods. The trend is towards group work, interdisciplinary exercises and emphasis on learning. It has been pioneered by the UCL and KUL and is more or less followed in the other universities. But this requires an important staff, at a time when available resources are decreasing or stagnant at best.

This brings to light an indirect but not innocent consequence of the "Bologna decree": it is perceived as a money-saving device set up by the government to limit the budget devoted to higher education.

To make more with less, there is an obvious solution. Instead of offering most engineering disciplines in all six major universities, grouping of students could be introduced in the less attended fields like Geology, Mining, Metallurgy… Belgium being a small country, either students or professors could easily commute between institutions. But determining which institutions should retain which field is a highly sensitive subject! For instance, should Civil Engineering remain offered by 6 Universities distant of 200 km at most?

Will the universities harmonise their bachelor's programme and how much? What will be the respective situation of universities and institutes of higher education in the future engineering landscape? Who will be entitled to research money? Will mobility be the norm for students and professors? Will the dispersion of engineering formation be maintained? Where will be the doctoral schools? All these questions and many others concerning Engineering and Civil Engineering will be debated in the coming years!

CIVIL ENGINEERING EDUCATION IN BULGARIA

Ivan Totev[1]

1. GENERAL VIEW ON THE PRE-UNIVERSITY EDUCATION

The structure of the education system in Bulgaria consists of these levels:

- pre-school education;
- school education (primary and secondary);
- high school education (university education)

The primary school (education) 1 – 8 grade ISCED "97 level 2A. The secondary school education ISCED "97 level 3A is divided to secondary general education and specializes schools.

There are professional secondary schools after 8th grade 4 school years.

The compulsory education is to 16 - year - old children in Bulgaria.

2. GENERAL VIEW ON THE ENGINEERING EDUCATION

Until 1995 engineering education was of continental type, with 5-year long duration and 3-year short duration programmes. At the end of 1995 was adopted a new Law of Higher Education. The new model comprises 4 types of education after the secondary school.

2.1 Engineering education at undergraduate level

There are two types of education:

- specialist – college non university type of education, with a duration of 2 years;
- bachelor – university type of education, with a duration of 4 years;

2.2 Engineering education at postgraduate level

2.2.1 Master - engineer

The Master programme follows the bachelor programme and has a duration of minimum 1 year.

2.2.2 Doctoral programmes

The doctoral programmes have a duration of 4 years after the bachelor programme and 3 years after the master's programme.

[1] Professor, Universty of Architecture, Civil Engineering and Geodesy Sofia

3. CIVIL ENGINEERING EDUCATION

3.1 Undergraduate education

In Bulgaria there are 3 Faculties of Civil engineering – in the University of Architecture, Civil Engineering and Geodesy - Sofia, the Open University "Chernorisetz Hrabar" - Varna and the Civil Engineering Higher School – VSU "L. Karavelov" (former Military school) – Sofia.

Their respective shares from the total number of students in Structural Engineering are approximately 45%, 25% and 30%. There is a 5 years program in the University of Architecture, Civil Engineering and Geodesy - Sofia, leading directly to the degree Master engineer. The two other faculties are preparing bachelors in 4 year programme. The Bachelors from these faculties have the possibility to continue their education in Masters Programme, either in The University of Architecture, Civil Engineering and Geodesy or in faculties where they have graduated. Our Faculty proposes five different Master's programmes for these bachelor graduates.

The programmes are organised in semesters. The first semester begins on 1st October and ends in the middle of January. The second semester begins on 1st March and ends in the middle of June.

The duration of each semester is 15 weeks.

The number of contact hours in the Faculty of Structural Engineering in our University is different in each year of study. The histogram of contact hours per week is represented in figure 1.

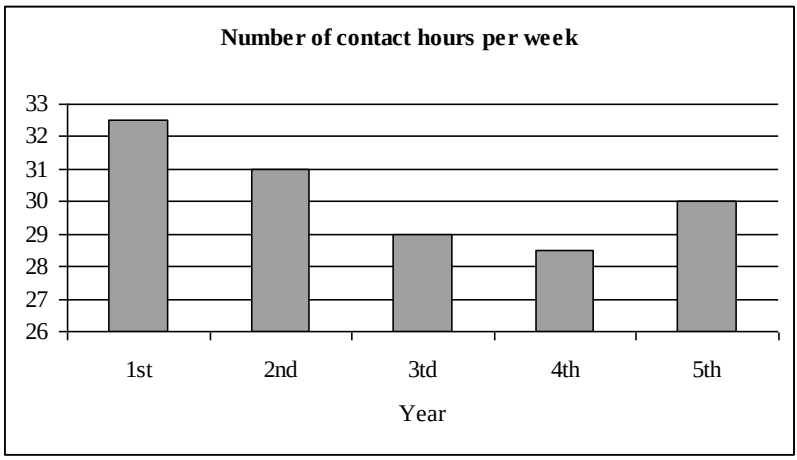

Figure 1. Number of contact hours per week

The average ratio of lecture/others contact hours (laboratory, tutorial, projects, etc) is represented in histogram – figure 2.

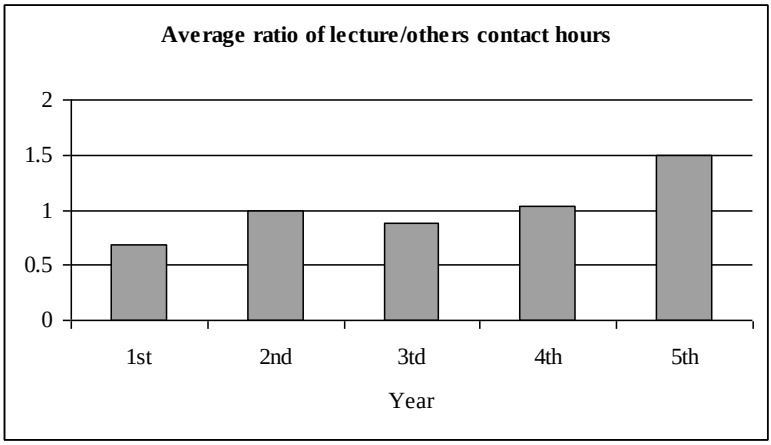

Figure 2 Average ratio of lecture / others contact hours.

There are two regular examination sessions and three additional. Regular examination sessions (each 4 weeks long) are in January-February and June-July. The additional sessions are after regular ones (10 days long) and in September (three weeks long).

Two years ago, the number of the contact hours in the two other universities (with bachelor's programme) was reduced to 25 hours per week.

The programme is finalized by diploma project.

Admission of students includes local examination. Each University conducts its admission procedure, usually consisting of a written exam. For our Faculty this exam is Mathematics.

The number of admitted students is determined by the State (Ministry of Education) each year. In the last three years the number of admitted students slightly decreased.

3.2 Civil engineering education at postgraduate level

3.2.1 Master programmes

As it was mentioned above, the main programme offered at the University of Architecture, Civil Engineering and Geodesy Sofia, is a 5-year programme leading directly to the degree of Master Engineer in Structural Engineering. For the bachelors of the other Civil Engineering faculties in the country, this University is proposing five Master's programmes, in parallel to the main one specified above:

- Structural Engineering;

- Seismic Engineering;
- Refurbishing and strengthening of the buildings;
- CAD based design of the structures.
- Construction technology.

All programmes are planned with a duration of one year and a half including preparation of the Master Thesis. The number of contact hours varies between 250 and 400.

3.2.2 Doctoral programmes

Full time and part time doctoral studies are offered each year in our Faculty in different fields of the Structural Engineering. They are taught and research type of programmes. In some cases, research takes an essential part in doctoral studies. The minimum legal duration is 3 years for full time and 4 years for part times doctoral studies.

Admission procedure comprises two exams:

- a basic subject from the undergraduate curriculum, depending on the field of study of proposed doctoral studies;
- a foreign language (English, French or German) .

The Thesis supervisors are elected by Departments Board for each doctoral student. Usually these supervisors are professors or lecturers in the department. In some cases, a second supervisor can by appointed, usually from another department.

The thesis subject is assigned by agreement between the student and the supervisor. The thesis supervisor works out individual programme for doctoral study of his student. All Individual programmes must be discussed and approved by Faculty's Scientific Board. Annually the thesis supervisor renders an account for progress of his doctoral student before Faculty's Scientific Board – attestation procedure. If individual programme is systematically not fulfilled Faculty's Scientific Board can recommends appropriate disciplinary measures going up to the exclusion of the doctoral student**.**

The first year of the doctoral study is used for deepening of the student's knowledge in the appropriate field. This preparatory work is controlled by 2 or 3 exams.

The second and third years are devoted to research work and writing of doctoral thesis. It must be a previously unpublished, substantial written report.

The final phase is the procedure for awarding of doctoral degree. It begins with an oral presentation of the thesis work in the department.The next step is an oral presentation of the thesis work for an open audience in the Specialised Scientific Board of the Higher Commission for Attestation. Before the open oral presentation, Specialised Scientific Board assigns two reviewers for the Doctoral thesis. Their reviews are the basis for discussion on the oral

presentation. The Higher Commission for Attestation makes the final approval of the Doctoral Thesis and awards the Doctoral degree.

4. RECENT TRENDS IN ENGINEERING EDUCATION IN BULGARIA

In Bulgaria the reform in higher education started at the end of 1995 with the adoption of a new Law for Higher Education. According to this law, the Bachelor/Master system is mandatory for higher education institutions in Bulgaria.

The duration of education for the bachelor's degree is 4 years with 2500 – 3000 contact hours. The second degree education (masters programs) is with a duration of one or one and a half years, including the diploma project.

The state budget gives a full financial support for 20% of the bachelors to continue their education in master programmes. There is a possibility for those of them who have an average success rate over "very good 4.5", according to the Bulgarian grading scale, to continue their study, if they pay a tutorial fee covering about 70% of the expenses made for their education.

In Bulgaria are introduced for the engineering graduate "bachelor engineer" and "magister engineer" as a title.

The new system started 9 year ago and coexisted with the older one in a transition period of 5 years.

In the previous Bulgarian system, did not exist a short term of post secondary school education, except for a very small number of courses of so cold "semihigher" education. The bulk of the non high school graduate professionals in the industry were prepared in technical secondary schooI. A specific Bulgarian form of engineering education is a short term post secondary school education with a two years duration awarding the qualification of "specialist". These types of programmes do not give possibility to continue directly in bachelor's degree programme. It is necessary to start studying from the beginning.

It seems that new bachelor's degree is relevant to the job market in Civil Engineering. There is not very high demand from the graduates with this degree to continue their education in a master's level. It is early to be made very precise conclusions, since period of approbation is very short.

ECTS system is introduced by law since this school year. Our University introduced some elements of this system two years ago. We prepared information packages in Bulgarian and in English languages. Sets of ESTS credits were established for all degree courses. An advisory team of ECTS visited our University recently. There are some difficulties related with the recognition of specific courses, but as a whole the student's mobility has not serious obstacles related to the contents of the curriculum.

The decision to introduce a new system is taken by the Parliament, adopting the Law of Higher Education proposed by the government.

Universities have the possibility to decide how to introduce the new system but in the case of non-compliance with the law they can lose some of the state subsidies for education.

One of the fundamental requirements of the National Accreditation Society is the compliance with the Law of Higher Education. The first reaction of the National Council of Rectors was mixed. Some of the rectors agreed with the Bologna Declaration others expressed some reservation. Since the new system was introduced by Law, it was accepted as a fact. Only way to preserve the previous duration of courses was to apply for an approval for a specific course to be recognized as very important for the society. In such cases master's degree is recognized as the minimal professional qualification. Such status was accorded to Medicine, Law, Architecture and few other professions. Our efforts to see Civil Engineering included in this list were not succesful, despite of the fact that they were supported by the Ministry of Regional Development and Public Works and by some professional organizations.

It seems that the industry needs professionals with bachelor's degree, but it is too early to assess the right proportion between master's and bachelor's graduate.

The newly created *Chamber of engineers in investment design process* is introducing restrictions for its bachelor's members.

My personal opinion is that for a small country like Bulgaria, with a high seismic risk and difficult geological conditions, it is appropriate to have about 50% of the professionals in Structural Engineering with Master's degree. A direct acess to master degree could save the time, efforts and financial resources of both students and society.

CIVIL ENGINEERING EDUCATION IN THE CZECH REPUBLIC

Vaclav Kuraz*

1. OVERVIEW OF PRE-UNIVERSITY EDUCATION

Elementary education is compulsory between the ages of 6-15 years. Since the 1995/96 school year elementary schooling has lasted nine years. Secondary schools offer 4-year programmes, at the end of which students take the maturity examination in selected subjects. There are various types of secondary schools preparing students for engineering education:

- Gymnasia offering general education and basic specialised preparation for university study.
- Secondary professional schools for various specializations. Students leaving a technical secondary school at the age of 19 years may find work as technicians or may continue studying at technical universities.

2. OVERVIEW OF ENGINEERING EDUCATION

2.1 Engineering education at undergraduate level

University level institutes of higher education (technical universities) in their engineering faculties offer bachelor degree programmes. The length of these programmes is nominally 3-4 years. After completion of all requirements, which may include a bachelor project, graduates are awarded a Bachelor degree ("Bc", in Czech "bakalář"). A limited number of bachelor programmes were first introduced in 1992, before which there was no tradition of bachelor-level studies in the Czech Republic.

2.2 Engineering education at postgraduate level

2.2.1 Engineering programmes providing "full master type" engineering education in a single step

The full master type engineering programme lasts nominally 5-5,5 years. The graduates of this type of programme are awarded an "Engineer" degree ("Ing.", in Czech "inženýr"). This degree is equivalent to the German "Dipl. Ing." and corresponds to an MSc or MEng level. The engineering study programme is concluded by the state examination in front of an examination

* Professor, Czech Technical University, Prague

commission approved by the Ministry of Education, and by the presentation and defence of a diploma project. It is traditional in the Czech Republic that the graduates of economic, agricultural and chemical universities are awarded the same "Engineer" degree, while the graduates of faculties of architecture are awarded the title "Ing. Arch." (after a 6-year study programme). Due to changes in the educational system, from the 2003/04 academic year the "full master type" engineering education is no longer offered.

2.2.2 Doctoral programmes

The graduates of engineering faculties may continue as postgraduate students to be educated as independent researchers. These doctoral programmes last 3 years (of full-time study) and lead up to a "doctoral" examination and the presentation and defence of a dissertation. The graduates of these postgraduate programmes are awarded a "Doctor" degree ("PhD", in Czech "doktor"). This new system of degrees was introduced by Higher Education Act No. 172/1990, and is similar to the systems used for example in the USA or UK. The PhD degree has replaced the former Candidate of Technical Sciences (CSc) degree. Another degree, Doctor of Technical Sciences (DrSc), was awarded for a long time research work, based on a further dissertation. Since the end of 2001 this degree has no longer been awarded.

3. CIVIL ENGINEERING EDUCATION

The information in Table 1 refers only to engineering (master type) one-step study programmes. The two-tier "serial" study system, recommended by the Bologna declaration has been accredited and offered beginning the 2003/04 academic year. Basic information on bachelor programmes is given in table 2 and in the enclosure.

4. TRENDS IN ENGINEERING EDUCATION IN THE CZECH REPUBLIC

Stagnating interest of students in studying engineering in the Czech Republic in recent years was a major factor leading to changes in the educational system. As mentioned above, implementation of the recommendations of the Bologna Declaration, i.e., a three-tier system (BSc, MSc, PhD) was introduced. New BSc study programmes have been developed at CTU in Prague, Faculty of Civil Engineering; with study programmes in Civil Engineering (study branches: Building Construction, Structural and Transportation Engineering, Water Engineering and Water Structures, Environmental Engineering, Management and Information Systems in Civil Engineering), in Building and Architecture Engineering (one study branch) and Geodesy and Cartography (one study

branch). BSc programs last 4 years, and may be followed by an MSc program lasting 1, 5 years. For the first two years there is a joint programme for all students, after which there will be two-year programmes differing according to study branch. The study plans were acredited in 2002 and the new bachelor study programmes were introduced the 2003/04 academic year.

The re-structuring of the system of Civil Engineering studies has been prepared in a similar way at the universities of Brno, Ostrava and Pardubice. The new programmes were accredited and introduced in Ostrava and Pardubice in the 2003/04 academic year and in the 2004/05 academic year in Brno.

Table 1

<table>
<tr><td colspan="2">Engineering, one-step study, MSc level</td><td colspan="8">Title awarded: Engineer (Master of Civil Engineering) - Ing.</td></tr>
<tr><td>Admission</td><td colspan="9">The admission rules vary from university to university. There is usually a written entrance exam in mathematics and physics. The study results from secondary schools are also taken into consideration.</td></tr>
<tr><td>Duration</td><td colspan="9">5-5,5 years (6 years for architecture programmes). Only full-time programmes are available.</td></tr>
<tr><td>Course organisation</td><td colspan="9">14-week semesters:
• “winter” semester from the end of September to the middle of January
• “summer” semester from the end of February to the beginning of June</td></tr>
<tr><td>Examinations</td><td colspan="9">Two sessions: in January/February and in June (at the end of each semester). Examinations may be written and/or oral. Each examination may be re-taken twice.</td></tr>
<tr><td rowspan="3">Teaching organisation</td><td colspan="9">The teaching programme is divided into approximately 50 courses.
Full-time programmes involve 25 - 30 contact hours per week.
Subject category weighting: *</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td></tr>
<tr><td>12-17%</td><td>6-17%</td><td>30-31%</td><td>19-34%</td><td>4-9%</td><td>2%</td><td>1,2-5%</td><td>10%</td></tr>
<tr><td>Final exam</td><td colspan="9">The final examination comprises;
• presentation of a final project (thesis) presentation, and defence before the state commission
• A final state examination in three relevant subjects – one connected with the student’s special field. The final assessment consists of the mark awarded for the diploma project and the average mark covering the final exam.</td></tr>
</table>

Note: The last study group of students entering one – step Engineer programmes began their studies in 2002/03

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* The subject categories were established and used by the EUCEET Working Group 17 (Curricula in Civil Engineering Education Undergraduate Level), as follows:

Category	Name of category	Examples of subjects
A	**Basic Sciences**	Mathematics, Physics, Chemistry
B	**Engineering Sciences**	Mechanics, Strength of materials, F.E.M., Computer science, Drawing-graphics
C	**Core Civil Engineering Subjects**	Statics, Dynamics, Hydraulics, Soil Mechanics, Fluid mechanics, Elasticity & Plasticity, Building materials, Surveying, Reinforced concrete, Hydrology
D	**Engineering Specialisation**	Steel structures, Reinforced concrete structures, Foundation Engineering, Earthquake engineering, Non-linear design of structures, Hydraulic systems in transitory regime, Hydraulic structures
E	**Economics and Management subjects**	
F	**Humanities, Social sciences, Languages and Physical Education**	
G	**Field Work**	
H	**Final Project**	

Table 2

<table>
<tr><td colspan="2">Engineering, two-step study, BSc level</td><td colspan="8">Title awarded: Bc</td></tr>
<tr><td>Admission</td><td colspan="9">The admission rules vary from university to university. There is usually a written entrance exam in mathematics and physics. The study results from secondary schools are also taken into consideration.</td></tr>
<tr><td>Duration</td><td colspan="9">4 years. Only full-time courses are available.</td></tr>
<tr><td>Course organisation</td><td colspan="9">14-week semesters:
• “winter” semester from the end of September to the middle of January
• “summer” semester from the end of February to the beginning of June</td></tr>
<tr><td>Examinations</td><td colspan="9">Two sessions: in January/February and in June (at the end of each semester). Examinations may be written and/or oral. Each examination may be re-taken twice.</td></tr>
<tr><td rowspan="3">Teaching organisation</td><td colspan="9">The teaching programme is divided into approximately 40 courses.
Full-time programmes involve 21 - 27 contact hours per week.
Subject category weighting:</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td></tr>
<tr><td>12-17%</td><td>6-17%</td><td>30-31%</td><td>19-34%</td><td>4-9%</td><td>2%</td><td>1,2-5%</td><td>10%</td></tr>
<tr><td>Final exam</td><td colspan="9">The final examination comprises;
• presentation of a bachelor project (thesis), and defence before the state commission
• A final state examination in relevant subjects. The final assessment consists of the mark awarded for the bacalar project and the average mark covering the final exam.</td></tr>
</table>

Note: Since the 2003/04 academic year only the two tier system of study has been offered

Table 3 Doctoral programmes

PhD level	Title awarded: Doctor ("PhD")
Admission	The admission rules vary from university to university.
Duration	3 years of full-time study, both full time and part-time (distance) programmes are available
Course organisation	14-week semesters: • "winter" semester from the end of September to the middle of January • "summer" semester from the end of February to the beginning of June
Examinations	Two sessions: in January/February and in June, at the end of each semester.
Teaching organisation	The teaching organisation varies a little from university to university. PhD students pursuing a full-time study programme design their own individual study plan, which must include 6 - 8 courses suggested by the supervisor. These courses are compulsory. In addition, optional courses may be added to the plan on the supervisor's recommendation. Students must pass an examination at the end of each course. Students must also pass a mandatory examination in two foreign languages. At the end of the first part of their studies, PhD students have to pass a "doctoral examination" showing their readiness for scientific research work. Finally, students must present and defend their PhD Thesis.

Annex

List of higher education institutions offering Civil Engineering Education in the Czech Republic

1. CTU Prague, Faculty of Civil Engineering

Postal address: Thakurova 7, 166 29 Prague 6 http://www.fsv.cvut.cz

The Faculty offers the following Master degree programmes (5.5 years duration):

- Building construction and architecture (6 years);
- Building construction and structures;
- Structures and transportation engineering;
- Structures and material engineering;
- Water management and hydraulic structures;
- Enterprise in civil engineering;
- Economics and construction management;
- System engineering in civil engineering;
- Geodesy and cartography;
- Environmental engineering;

The master study programme in Building construction and structures is also completely available in English. A limited number of individual courses are offered in English, French, German and Spanish.

Beginning the academic year 2003/04, BSc study programmes of 4 years duration followed by 1,5 years MSc study programmes are offered:

- Study Programmes: Civil Engineering Study branches: Building and Structural Engineering, Structural and Materials Engineering, Structural and Transportation Engineering, Water Management and Water Structures, Environmental Engineering, Business and Management in the Civil Engineering, Management and Economics, System Engineering in the Building Industry and Capital Construction

2. Brno University of Technology, Faculty of Civil Engineering
Postal address: Veveri 95, 662 37 Brno. http://www.fce.vutbr.cz

6 master study programmes were offered until the 2003/04 academic year (5 years duration):

- Building constructions;
- Building materials engineering;
- Structural engineering and transportation structures;
- Water management and water structures;
- Economics and management in building industry;
- Geodesy and cartography.

Two- tier study programmes will be offered from the 2004/05 academic year.

3. TU Ostrava, Faculty of Civil Engineering
Postal address: 17. listopadu 15, 708 33
Ostrava – Poruba. http://www.fast.vsb.cz

The Faculty of Civil Engineering (established in 1997), offered 5 MSc study programmes of 5 years duration until the 2002/03 academic year. Regional aspects such as revitalization of regions affected by mining activity, urbanization of industrial areas, engineering and geotechnical activities in the course of exploitation of raw materials, industrial and transport engineering in undermined areas are included in the study programmes:

- Building construction and architecture;
- Urban engineering;
- Building materials and building diagnostics;
- Geotechnical and underground engineering;
- Transport construction.

From the 2003/04 academic year a two tier study system similar to that of Prague was introduced at TU Ostrava and TU Pardubice.

4. TU Pardubice, University of Pardubice, Jan Perner Faculty of Transportation
Postal address: Studentska 95, 532 10 Pardubice. http://www.upce.cz

A 5-year MSc study program in Civil Engineering, specializing in transport technology and communications is offered. Four study branches are available:

- Transport management, marketing and logistics;
- Transport technology and management;
- Transport means;
- Transport infrastructure.

Appendix

Examples of the study program for 5,5 year full Engineering and new Bsc 4 year studies.

CTU in Prague, Faculty of Civil Engineering
4 years bacalar study branch: Building and Structural Engineering.

Course:	**Credit Points**	**Subject Category**
Mathematics 1	5	A
Physics	4	A
Language 1	2	F
Economic theory	2	E
Law	2	E
Development of architecture	2	D
Structural mechanics 1	3	B
Building chemistry	2	A
Constructive geometry	4	A
Mathematics 2	5	A
Building materials 1	3	C
Urban design and planning	2	C
Structural mechanics 2	3	B
Geology	3	C
Environmental engineering	2	C
Mathematics 3	4	A
Language 2	2	F
Building structures 1	4	C
Loading and reliability	2	C
Theory of elasticity	5	B
Soil mechanics	3	C
Hydraulics	4	C
Language 3	2	F
Economics and management	4	E
Structural mechanics 3	4	C
Concrete and masonry structures 1	4	C
Steel structures	4	C
Engineering surveying	3	C

Fieldwork surveying	2	G
Building structures 2	4	D
Energ. and ecolog. systems 1	4	D
Structural analysis	4	C
Concrete and masonry structures 2	4	D
Steel structures 2	4	D
Foundations 1	4	C
Construction processes	4	D
Building materials 2	2	C
Building structures 3	4	D
Failures, deteriorations, renovations	3	D
Structural design 1	3	D
Energ. and ecolog. systems 2	3	D
Concrete and masonry structures 3	2	D
Timber structures 1	2	D
Structural design 2	3	D
Construction planning and operation	4	E
Building structures 4	3	D
Economics	3	E
Transport engineering	4	C
Bachelor Project	8	H
Bachelor Project Seminar	2	H
Building structures 5	4	D
Legislation	2	F
Water engineering	4	C
Informatics	2	B
Social sciences	2	F
Optional Courses	12	D

THE CIVIL ENGINEERING EDUCATION IN GERMANY[1]

Peter Ruge[2], Stavros Savidis[3], Ralf Reinecke[4]

1. GENERAL VIEW OF PRE-UNIVERSITY EDUCATION

At any level the German educational system is a public one, some minor exceptions are existing. Education is administered by the state governments; the federal government has guideline responsibilities, only. The formal educational system is divided into 3 levels: primary, secondary and higher education. The general principles of the system of higher education are set out in the federal Hochschulrahmengesetz (Higher Education Framework Law). Based on this act each state legislature passes laws on higher education.

Entry qualifications to higher education are the secondary school leaving certificates, i.e. the Allgemeine Hochschulreife and the Fachhochschulreife, respectively. A certificate of Allgemeine Hochschulreife is the general or subject-specific proof of aptitude for higher education. It is awarded after passing the Abitur examination after 13 consecutive years of primary and secondary education (12 years in some states). A certificate of Fachhochschulreife states the aptitude for programmes at some institutions of higher education only.

During the final years at school the curricula provide a large amount of options for the students. Because courses in basic sciences may be studied in more detail as well as cancelled, an extreme diversity in the knowledge of the students can be seen at the beginning of higher education.

2. GENERAL VIEW ON THE ENGINEERING EDUCATION

2.1 Engineering education at undergraduate level; various types

In Germany mainly two types of institutions offer studies in the field of engineering, the (Technical) Universities and the Fachhochschulen (Universities of applied sciences). Both types of institutions award upon graduation as the first degree the “Diplom-Ingenieur”.

The Fachhochschulen offer 4 year courses which are geared to applied engineering. Universities offer 5 year courses of study which are more research oriented. The Gesamthochschule (comprehensive university) combines both sys-

[1] State as of 2002

[2] Professor, Technische Universität Dresden
[3] Professor, Technische Universität Berlin
[4] Dr. Ing., IB Reinecke, GmbH München

tems in a so called Y-model with a common basic study of 2 years and a specialization in either the research oriented university tier or the practice oriented Fachhochschule tier.

Since the late 70'ies a new type of professional schools called "Berufsakademie" has been developed, derived from the dual system on the vocational level as a kind of sandwich model. 6 or more week periods are allocated alternating to theoretical studies and practical work in an industrial company. The duration of undergraduate studies is 3 years, the students are employed by their respective company.

In Germany no formal procedure of accreditation in the field of engineering exists; the title "Engineer" is protected by law. Universities, Gesamthochschulen and Fachhochschulen are entitled to award the degree "Diplom-Ingenieur" (abbr. "Dipl.-Ing."). In case of the Fachhochschulen the same state law requires an appendix "FH" in parentheses, i.e. "Diplom-Ingenieur (FH)", the final degree of the Berufsakademie is "Diplom-Ingenieur (BA)"

Two Universities (Gesamthochschule Kassel, TU Hamburg-Harburg) provide a consecutive type with a first degree of "Diplom", a kind of Bachelor's degree' after 3-4 years and a university "Diplom-Ingenieur" after additional 2 years of study.

A combination of engineering subjects and economics can be studied at some universities and Fachhochschulen. Students from these courses graduate with the profession of Wirtschaftsingenieur.

2.2 Engineering education at postgraduate level

Doctorates in engineering (Dr.-Ing.) are awarded by the Universities only. Studying for a doctorate degree does not involve formal coursework but always takes the form of a research project under the scientific supervision of a professor, usually performed at an institute of a the university. The most common way is writing a doctoral dissertation during a period of being employed as a member of the scientific staff (about 3 years without and about 5 years with teaching obligations).

A Dipl.-Ing. (FH) or Dipl.-Ing. (BA) degree obtained at Fachhochschule and Berufsakademie does not entitle to a doctoral study. Additional courses and examinations towards university level have to be taken in order to prove appropriate scientific abilities.

3. CIVIL ENGINEERING EDUCATION

3.1 Undergraduate education

3.1.1 Short description of each type of programme

The academic year is divided into two semesters. The lecture period of a winter semester is 15 weeks for both types of institutions, the lecture period of the summer semester is around 14 weeks at Universities and about 16 weeks at Fachhochschulen.

Degree courses at Universities and Fachhochschulen are designed for a total period of 160-170 semester-week-hours (Semesterwochenstunden, abbr. SWS). This is a kind of German equivalent for the total credits in the US educational system required for graduation. One SWS is the unit for the student semester load per week of coursework (contact hours per week). For one semester of studies the semester load in the curricula varies between 25-35 SWS (lectures, seminars, tutorials, laboratories, projects but adding home-works and preparation for examinations it reaches 50 up to 60 SWS). Teaching units usually have a duration of 90 minutes that means two SWS.

3.1.2 Short description of the course curricula for each type of programme

The undergraduate programme at universities is divided into three more or less independent parts. The Grundstudium (basic stage) is designed for mainly 4 semesters of coursework. Mainly basic sciences and basic engineering sciences (categories A and B) are taught in these courses, as well as some core civil engineering subjects. The successful accomplishment of the Grundstudium is certified by the Vordiplom, a pre-diploma certificate. This intermediate examination does not provide a professional qualification.

The following period of about 3 semesters is called Grundfachstudium; it mainly contains core civil engineering subjects and economics & management (categories C and E). Most of these courses are obligatory for all students. For the Vertiefungsstudium - the final part of the studies - the students will choose one or two fields of in-depth specialisation. Usually the Diplomarbeit (thesis) will be written in one of the fields of specialisation. The combination of the last two parts is also called Hauptstudium (main stage).

At Fachhochschule the programmes are divided in a similar way. But, more emphasis is laid on core civil engineering subjects in the first part already, basic sciences are reduced to a minimum. The Grundfachstudium contains more optional subjects and the in-depth specialisation is replaced by a semester of practical industrial placement.

Depending on the institution undergraduate students have to work out at least two major design projects. Lectures in laboratories are mainly restricted by

the limited capacity of the institutions. Trainee jobs in industry have to be done before the beginning of the studies.

Courses in non-technical subjects, languages and sports are offered by all institutions. The number of contact hours being obligatory for these courses is varying from institution to institution.

3.1.3 Admission of students at the undergraduate level

In order to get admitted to civil engineering courses at Universities and Fachhochschulen students have to prove a leaving examination from secondary school. Additionally, some institutions require a certain duration of trainee jobs being done in the building industry. Entrance examinations are not carried out at state owned institutions of higher education in the field of engineering. If the number of applicants exceeds the capacity of the institution by a certain ratio, applicants will be chosen according to the overall result of the school leaving examination.

The number of applications roughly coincides with the economic situation of the building industry. Hence, the number of new enrollments in civil engineering courses decreased during the recent years after having a maximum in about 1995.

3.1.4 Accreditation of degrees

The first two thirds of the undergraduate courses (Grundstudium + Grundfachstudium) at universities can be considered to be equivalent to a bachelor programmes, since both are designed for a broad field of subjects without going too deep into details and are of about the same duration. The in-depth specialisation (Vertiefungsstudium) during the last third of a diploma study course at a German university still contains a certain width of subjects. Master programmes, on the contrary, are designed to deliver even deeper scientific depth in a very specific field of specialisation. Hence, the Diplom-Ingenieur degree awarded by German universities can be considered to be at least equivalent to the master degree.

3.2 Doctoral programmes in Civil engineering

The procedure to approach a Dr.-Ing. degree is similar to that described in 2.2. Additionally, some PhD-programmes mainly funded by the German Research Council are existing; these programmes deal with a special problem during a restricted period.

4. RECENT TRENDS IN ENGINEERING EDUCATION IN THE COUNTRY

A complex discussion on structural changes in the German system of university education is currently being held under the subject "Internationalization of Study Courses". The question of introducing the two-stage Anglo-American system with bachelor and master degrees is hereby of special interest.

The legal basis for introducing new study courses following the Anglo-American system was given with a new paragraph of the German Higher Education Framework Law, introduced in 1998. This paragraph implies that bachelor and master study courses can be implemented for a evaluation period of 5 years. The regulations are valid for both, universities and Fachhochschulen.

This new situation is controversially discussed at the universities. Many Federal Assemblies of Faculties (Faktultätentage) disregard the new regulations and hesitate to introduce bachelor and master study courses. In October 1999 the Federal Assembly of Civil and Surveying Engineering Faculties decided for the following recommendations to their member faculties:

– The existing diploma study courses are well approved and widely accepted. These programmes should not be replaced. The Diplomingenieur degree being awarded by universities is considered to be equivalent to the master degree.
– The organisation of the existing programmes should be modified in order to achieve more transparency. This implies a modular structure of the courses and the introduction of a credit system based on ECTS.
– The international compatibility of existing diploma study courses can be achieved in the way of Fig. 2. If – during an evaluation period – the bachelor/master study system is introduced, a model 3+2 years will be preferred to a 4+1 year model. As well as the American Society of Civil Engineers (ASCE), the German building industry and the Federal Assembly of Civil and Surveying Engineering Faculties do not consider the bachelor degree being a professional qualification for civil engineers.

5. CPD-PROGRAMMES

Postgraduate courses in the framework of Continuing Professional Development are provided by several engineering associations, such as Baukammer, Verband Deutscher Ingenieure, etc. Sometimes courses are delivered in co-operation with the institutions providing the undergraduate education. Employees of major companies also receive CPD in internal programmes.

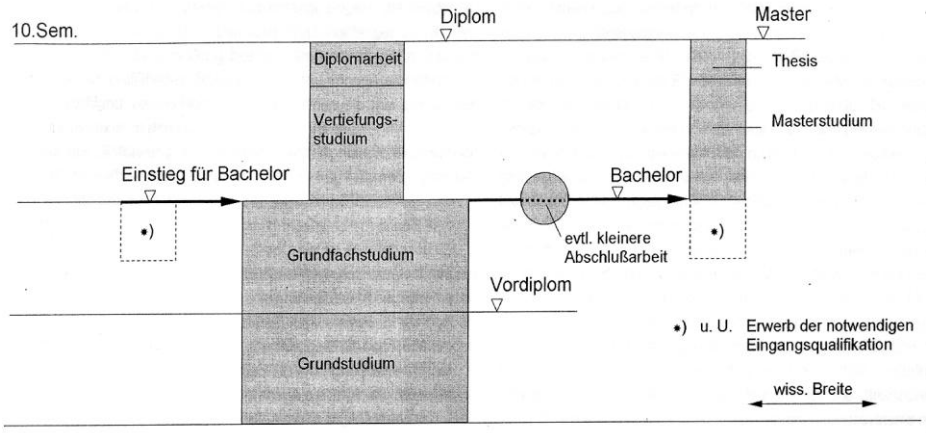

Figure 2 Scheme to bring about compatibility between diploma and bachelor/ master study courses in civil engineering at universities

REFERENCES

[1] Heitmann G. and Kurz G. Engineering education in Germany, SEFI Guide.

[2] Ramm W., (2000). Zur Internationalisierung des Studiums – Über die Bedeutung von Bachelor- und Masterabschlüssen im Bauingenieurwesen. Bauingenieur (75), Springer-Verlag.

ANNEX

Universitäten and Technische Hochschulen in Germany offering civil engineering education

Nr.	Name	Address	City
1	Rheinisch-Westfählische Technische Hochschule Aachen	Mies-van-der-Rohe-Str. 1 Pf. 1646	52074 Aachen
2	Technische Universität Berlin	Str. des 17. Juni 135	10623 Berlin
3	Technische Universität Braunschweig	Pf. 3329	38023 Braunschweig
4	Ruhr-Universität Bochum	Gebäude IA 4/126 Universitätsstraße 150	44780 Bochum
5	Brandenburgische Technische Universität Cottbus	Karl-Marx-Str. 17	03046 Cottbus
6	Technische Universität Darmstadt		
7	Universität Dortmund	August-Schmidt-Straße 8 GB2/Kampus Süd	44227 Dortmund
8	Technische Universität Dresden	Postfach	01062 Dresden
9	Universität – Gesamthochschule Essen	Universitätsstraße 15	45117 Essen
10	Technische Universität Bergakademie Freiberg	Akademiestr. 6	09596 Freiberg/Sachsen
11	Technische Universität Hamburg – Harburg	Denickestraße 22	21073 Hamburg
12	Universität der Bundeswehr Hamburg		
13	Universität Hannover	Appelstr. 9a	30167 Hannover
14	Universität Kaiserslautern	Erwin-Schrödinger-Straße	67663 Kaiserslautern
15	Universität – Gesamthochschule Kassel	Mönchebergstraße 7	34125 Kassel
16	Universität Karlsruhe	Richard-Willstädter Allee	76131 Karlsruhe
17	Universität Leipzig	Augustusplatz 9 – 11	04109 Leipzig
18	Technische Universität München	Arcisstr. 21	80333 München
19	Universität der Bundeswehr München		
20	Universität Rostock	Justus v. Liebig-Weg	18059 Rostock
21	Universität Stuttgart	Pfaffenwaldring 35	70569 Stuttgart
22	Bauhaus-Universität Weimar	Marienstraße 7a, Zi. 112	99421 Weimar
23	Bergische Universität - Gesamthochschule Wuppertal	Pauluskirchstraße 7	42285 Wuppertal

Fachhochschulen in Germany offering civil engineering education

Nr.	Name	Address	City
1	Fachhochschule Aachen	Kalverbenden 6	52066 Aachen
2	Fachhochschule Augsburg	Baumgartnerstr. 16	86161 Augsburg
3	Fachhochschule für Technik und Wirtschaft Berlin	Treskowallee 8	10313 Berlin
4	Technische Fachhochschule Berlin	Luxemburger Str. 10	13353 Berlin
5	Fachhochschule Biberach – Hochschule für Bauwesen und Wirtschaft	Karlstraße 11	88400 Biberach
6	Fachhochschule Bochum	Universitätsstr. 50	44801 Bochum
7	Hochschule Bremen	Neustadtswall 30	28199 Bremen
8	Fachhochschule Coburg	Friedrich-Streib-Str. 2	96450 Coburg
9	Fachhochschule Darmstadt	Haardtring 100	64295 Darmstadt
10	Fachhochschule Deggendorf	Franz-Josef-Strauss-Str. 7	94469 Deggendorf
11	Hochschule für Technik und Wirtschaft Dresden (FH)	Friedrich-List-Platz 1	01069 Dresden
12	Fachhochschule Erfurt	Altonaer Str. 25a	99085 Erfurt
13	Fachhochschule Frankfurt am Main	Nibelungenplatz 1	60318 Frankfurt am Main
14	Fachhochschule Gießen-Friedberg	Wiesenstraße 14	35390 Gießen
15	Fachhochschule Hamburg	Winterhuder Weg 29	22085 Hamburg
16	Fachhochschule Hannover	Ricklinger Stadtweg 118	30459 Hannover
17	Fachhochschule Hildesheim-Holzminden	Hohnsen 3	31134 Hildesheim
18	Fachhochschule Kaiserslautern	Morlauterer Str. 31	67657 Kaiserslautern
19	Fachhochschule Karlsruhe – Hochschule für Technik	Moltkestr. 30	76133 Karlsruhe
20	Fachhochschule Kiel	Sokratesplatz 1	24149 Kiel
21	Fachhochschule Koblenz	Finkenherd 4	56075 Koblenz
22	Fachhochschule Köln	Claudiusstraße 1	50678 Köln
23	Fachhochschule Konstanz – Hochschule für Technik, Wirtschaft und Gestaltung	Brauneggerstraße 55	78462 Konstanz
24	Fachhochschule Anhalt	Bernburger Straße 52-57	06366 Köthen
25	Hochschule für Technik, Wirtschaft und Kultur Leipzig (FH)	Karl-Liebknecht-Straße 132	04277 Leipzig
26	Fachhochschule Lippe	Liebigstraße 87	32657 Lemgo
27	Fachhochschule Lübeck	Stephensonstraße 3	23562 Lübeck
28	Fachhochschule Magdeburg	Am Krötentor 8	39104 Magdeburg
29	Fachhochschule Mainz	Seppel-Glückert-Passage 10	55116 Mainz
30	Fachhochschule München	Lothstraße 34	80335 München
31	Fachhochschule Münster	Hüfferstraße 27	48149 Münster
32	Fachhochschule Neubrandenburg	Brodaer Straße 2	17033 Neubrandenburg
33	Georg-Simon-Ohm-Fachhochschule Nürnberg	Keßlerplatz 2	90489 Nürnberg
34	Fachhochschule Oldenburg	Ofener Straße 16-19	26121 Oldenburg

35	Fachhochschule Potsdam	Pappelallee 8-9	14469 Potsdam
36	Fachhochschule Regensburg	Prüfeninger Straße 58	93049 Regensburg
37	Hochschule für Technik und Wirtschaft des Saarlandes	Goebenstraße 40	66117 Saarbrücken
38	Fachhochschule Lausitz	Großenhainer Straße 57	01968 Senftenberg
39	Universität – Gesamthochschule Siegen	Herrengarten 3	57072 Siegen
40	Fachhochschule Stuttgart – Hochschule für Technik	Schellingstraße 24	70174 Stuttgart
41	Fachhochschule Trier	Schneidershof	54293 Trier
42	Fachhochschule Wiesbaden	Kurt-Schumacher-Ring 18	65197 Wiesbaden
43	Hochschule Wismar – Fachhochschule für Technik, Wirtschaft und Gestaltung	Philipp-Müller-Straße	23966 Wismar
44	Fachhochschule Würzburg – Schweinfurt – Aschaffenburg	Münzstraße 12	97070 Würzburg
45	Hochschule für Technik, Wirtschaft und Sozialwesen Zittau/Görlitz (FH)	Theodor-Körner-Allee 16	02763 Zittau

Berufsakademien in Germany offering civil engineering education

Nr.	Name	Address	City
1	Berufsakademie Berlin, Staatliche Studienakademie	Neue Bahnhofstraße 11-17	10245 Berlin
	diverse other		

CIVIL ENGINEERING EDUCATION IN DENMARK

C. S. Soerensen[1]

1. GENERAL VIEW ON PRE-UNIVERSITY EDUCATION

An overview of the length and the type of educations in Denmark appears from Table 1. In the column named age, it is assumed that the student proceeds directly from one educational institution to another. However, in recent years it has become the general situation that the student after the upper secondary school spends a year or two doing other things, for example, travelling abroad or working, before starting at the university. The student may also discontinue the studies after the master degree and wait a couple of years before a decision on a Ph.D. education.

Table 1. Overview of the Danish educational system.

Age [years]	Length of education [years]	Type of education
6 - 7	1	Preschool class
7 - 16	9-10	Compulsory education Primary and lower secondary school Public or private schools
16 - 19	3	Gymnasium (Upper secondary school)
19 - 22	3 (3½)	University, Bachelor degree
22 - 24	2	University, Master degree
24 - 27	2½	University, Ph.D. degree

2. GENERAL VIEW ON ENGINEERING EDUCATION

2.1 Engineering education at undergraduate level

Engineering education in Denmark comprises a 3½-year undergraduate course leading to a Bachelor of Engineering degree. Engineering degree courses are not directly accredited by the Society of Danish Engineers but are indirectly

[1] Director of the Civil Engineering School, Aalborg University, Denmark

accredited by the Danish Evaluation Institute, EVA, which is an independent institution formed under the auspices of the Danish Ministry of Education. This institute:

- develops methods for evaluating the quality of teaching and learning
- develops and highlights quality of education and teaching through systematic evaluation
- advises and collaborates with public authorities and educational institutions on quality issues
- is the national centre of knowledge of national and international experience in educational evaluation.

Graduates can achieve professional recognition through the IDA - The Society of Danish Engineers.

2.2 Engineering education at postgraduate level

Master programmes normally have duration of 5 years, but can also have duration of 2 years after a bachelor degree. The degree awarded is a MSc.

Doctoral programmes are nominally of 2½ years duration, but often take three years or longer to complete. The degree awarded is a Ph.D.

3. CIVIL ENGINEERING EDUCATION

3.1 Undergraduate education

3.1.1 Short description for each type of programme

In Denmark, undergraduate degree courses in civil engineering are offered by the following university colleges and technical universities:

- Copenhagen University College of Engineering www.ihk.dk
- Aarhus University College www.iha.dk
- Odense University College of Engineering www.iot.dk
- Vitus Bering Denmark www.vitusbering.dk
- Technical University of Denmark www.dtu.dk
- Aalborg University www.auc.dk

All of these degree courses are of 3½ years duration and are direct-entry to civil engineering degree courses.

The total teaching period, including examination, is usually about 35 weeks, commencing in September and finishing in June.

Examinations are usually at the end of each semester, i.e. twice a year.

3.1.2 Short description of the main features of the curriculum for each type of programme

As an example of one of the civil engineering courses in Denmark a short description of the civil engineering programme at Aalborg University is given. The programme contains educational programmes for both bachelor and master levels. Each year approximately 100 students start on this programme and, with a dropout rate of only 10%, 90 of these students finalize an education within this programme. The economic consequence of this low dropout rate is a possibility to finance five different educations. These are:

- Structural Engineering
- Management in the Building Industry
- Indoor Environmental Engineering
- Transportation Engineering
- Water and Environment

These educations are tailored to the needs in the relevant branches of the Danish industry. This industry is working all over the world, which makes large demands both on the educational programme and on the students. One of the vision elements is to offer an attractive programme for the best part of the students from the upper secondary school. This vision has been fulfilled for a long period. The consequence is that both the candidates and the industry are very pleased with this study programme.

The structure of these educations is shown in Figure 1:

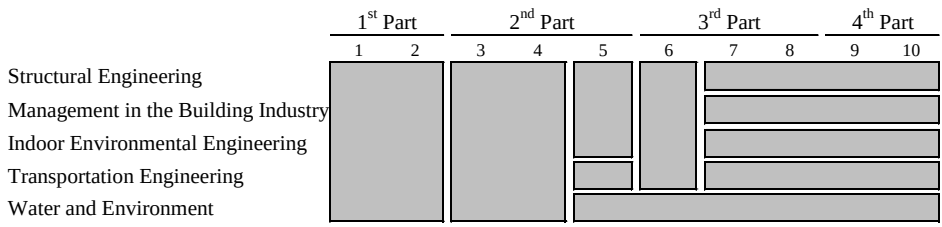

Figure 1. The general structure of the Civil Engineering Programme at Aalborg University

A civil engineer needs to be interdisciplinary and fortunately. This is a wish from the students in Denmark. As the students work with the same problems and have the same courses in the first two parts of the study, it is relatively easy to make an economic educational programme. As shown in Figure 1, all the students in the first 4 semesters work together, i.e. "structural students" may e.g.

be working together with "environmental students". After these 4 semesters the final specialization starts. In the final part of their study, the students are only working together with students from their own specialization. It is obvious that the last part of the study programme is more expensive to run than the first.

Each semester the student works on real projects from the industry or the society. As well as giving students the opportunity of gaining some experience in the practice of engineering, they are also considered valuable in providing links between academia and industry.

3.1.3 Admission of students at the undergraduate level

General access requirements to higher education in Denmark are 12 years of education including secondary school or comparable qualifications. Access requirements to the engineering area from the upper secondary school are:

- a 3-year course in mathematics (A-level)
- a 2-year course in physics (B-level)
- a 1-year course in chemistry (C-level)

3.2 Civil engineering education at postgraduate level

The two-year masters courses usually run from September to July. They typically comprise project research work where the last project has status of a dissertation as a result of 1 or 2 semesters work.

4. RECENT TRENDS IN ENGINEERING EDUCATION IN THE COUNTRY

All the universities and the technical colleges in Denmark are working with the Bologna process and it is expected that all our civil engineering educations will be in accordance with the Bologna Declaration before 2005.

THE CIVIL ENGINEERING EDUCATION IN ESTONIA

Tiit Koppel[1], Toomas Laur[2]

1. OVERVIEW OF THE PRE-UNIVERSITY EDUCATION

The current Estonian educational system consists of pre-school education, basic education, general secondary education and higher education. For handicapped children there are special basic and upper-secondary schools.

Basic education is the compulsory educational minimum which is provided by basic schools (grades 1-9). Children reaching the age of seven have to attend school.

On completion of basic education, studies may be continued in an upper-secondary general schools (grades 10-12) or in a vocational institution.

Vocational education is offered by upper-secondary vocational school and post-secondary professional school. Post-secondary professional school gives a vocational higher education.

Higher education is divided into two parallel sectors, applied higher education (diploma studies) and the academic higher education (bachelor's, master's and doctorate studies).

Estonia has the following types of higher educational institutions:

- public universities;
- private universities;
- public institutions of applied higher education;
- private institutions of applied higher education.

There are six public universities in Estonia and TUT is one of them.

The universities are autonomous to the extent determined by the law of universities. This autonomy means that universities have the right to independently determine their academic and organisational structure, the content of teaching and research work, the course curricula, the requirements for admission and graduation, etc.

2. OVERVIEW OF THE ENGINEERING EDUCATION

Tallinn University of Technology (TUT), the only university of technology in Estonia, is committed to high level research and development in

[1] Professor, Tallin University of Technology, Head of Department of Mechanics

[2] Professor, Tallin University of Technology, Head of Department of Building Production

the field of engineering, technology, science and management. TUT plays an important role on both the undergraduate and graduate level of education. Research and technological development is conducted by the academic structure which is organized into 9 faculties, 30 departments, 6 affiliated research institutes. The faculties are the following: civil engineering, power engineering, humanities, information technology, chemistry, economics and business administration, mathematics and physics, mechanical engineering and systems engineering. In the university there are over 1700 staff members and over 9000 students, including some 1300 postgraduate students.

TUT has three colleges: School of Higher Economics in Tallinn, Kuressaare College and Virumaa College, where it is possible to get applied higher education (diploma studies) after 3-4 nominal years of studies.

In August 1991 Estonia regained its independence, and in 1992 profound reforms of the structure of education at TUT began. The year system was replaced by the subject system. The curricula have constantly been changed. Up to 1994 the education of diploma engineers was based on a 5-year course of studies, in 1995 the transition to 4-year bachelor studies started, which was supplemented by 4-year diploma studies beginning from 1998.

Starting from autumn 2002 TUT changed curricula again and 3+2 years system was introduced in academic studies. Bachelor studies will last three nominal study years and master studies 2 years respectively. Subsequently it is possible to proceed with doctoral studies for 4 years.

The Faculty of Civil Engineering transferred the 4-year bachelor study curricula, 4-year diploma studies curricula (there were 3 specialities) followed 2-year master study curricula to the new integrated continuous 5-year bachelor and master curricula of engineering. Graduating from the engineering studies will give the qualification equivalent to the master degree. After graduating from the engineering studies it is possible to proceed with doctoral studies for 4-years. The former educational system was not capable of educating engineers with appropriate knowledge and expertise in the field of civil engineering.

The other University in Estonia giving higher academic education in some engineering fields is Estonian Agricultural University in Tartu. Starting from academic year 2002/2003 Estonian Agricultural University changed the curricula to the system 3+2 years as well. It is possible to study Rural Engineering in Tartu.

3. CIVIL ENGINEERING EDUCATION IN TUT

At present there are five departments in the Faculty of Civil Engineering in TUT: the department of structural design (5 chairs), environmental engineering (3 chairs), transportation (3 chairs), building production (3 chairs), and mechanics (4 chairs). There are three study fields in the domain of civil engineering at present: construction engineering,

environmental engineering and transport engineering. In the following sections a new integrated bachelor and master 5-year civil engineer's curricula will be presented which started to be applied in the academic year 2002/2003. In these curricula after 3 nominal years of study and after collecting 180 ECTS Credits, including compulsory subjects, the student has fulfilled the requirements of the bachelor degree.

A separate study field in the Faculty is logistics, where the students will acquire wide technical, economic, juridical and information technology knowledge.

3.1 Admission

In order to apply for engineer and bachelor studies it is necessary to present to the Admission Commission of the TUT the document certifying secondary education and national final examinations certificate. Admission is done by a competition based on the three national final exam grades – mathematics, native language (Estonian or Russian) and a foreign language (English, German or French). The score for mathematics may amount to 50% of the possible total.

3.2 Civil engineering education

3.2.1 Integrated programmes

i) Study field: Civil and Building Engineering
Level of curriculum: Engineering degree
Nominal study period: 5 years
Capacity of curriculum: 300 ECTS Credits
Degrees granted: Bachelor of Engineering/B.Eng/, Master of Engineering/M.Eng/
Specialization: 1. Construction Engineering
2. Construction Management and Economics
Completion of the main courses of basic studies during 4 semesters
Beginning of specialization: 150 ECTS Credits
Transfer to the completion stage: 240 ECTS Credits

Structure of the curriculum (including Bachelor of Engineering)

Code	Type	ECTS Credits
1	General studies	31.0
2	Basic studies	54.5
	Total	**85.5**
3	Core studies	79.5
4	Special studies	87.0
5	Free choice courses	12.0
	Total classroom studies	**264.0**
	Including optional studies	56.0
	common domain studies	139.0
6	Practice	6.0
7	Graduation thesis	30.0
	Total	**300.0**

ii) Study field: Environmental Engineering
Level of curriculum: Engineering degree
Nominal study period: 5 years
Capacity of curriculum: 300 ECTS Credits
Degrees granted: Bachelor of Engineering/B.Eng/,
Master of Engineering/M.Eng/
Specialization: 1. Water engineering
2. Heating and ventilation
3. Environmental management
Completion of the main courses of basic studies during 4 semesters
Beginning of specialization: 150 ECTS Credits
Transfer to the completion stage: 240 ECTS Credits

Structure of the curriculum (including Bachelor of Engineering)

Code	Type	ECTS Credits
1	General studies	31.0
2	Basic studies	54.5
	Total	**85.5**
3	Core studies	77.0
4	Special studies	88.5
5	Free choice courses	12.0
	Total classroom studies	**263.0**
	Including optional studies	39.0
	common domain studies	139.0
6	Practice	7.0
7	Graduation thesis	30.0
	Total	**300.0**

iii) Study field: Transport Engineering and Engineering survey
Level of curriculum: Engineering degree
Nominal study period: 5 years
Capacity of curriculum: 300 ECTS Credits
Degrees granted: Bachelor of Engineering/B.Eng/,
Master of Engineering/M.Eng/
Specialization: 1. Road engineering
2. Engineering survey
Completion of the main courses of basic studies during 4 semesters
Beginning of specialization: 150 ECTS Credits
Transfer to the completion stage: 240 ECTS Credits

Structure of the curriculum (including Bachelor of Engineering)

Code	**Type**	**ECTS Credits**
1	General studies	31.0
2	Basic studies	54.5
	Total	**85.5**
3	Core studies	79.5
4	Special studies	84.0
5	Free choice courses	12.0
	Total classroom studies	**261.0**
	Including optional studies	41.0
	common domain studies	130.0
6	Practice	9.0
7	Graduation thesis	30.0
	Total	**300.0**

3.2.2 Doctoral programme

Study field: Civil and Environmental Engineering
Level of curriculum: Doctor degree
Nominal study period: 4 years
Capacity of curriculum: 240 ECTS Credits
Degrees granted: Doctor of Engineering/D.Eng/

Structure of the curriculum

Code	Type	ECTS Credits
1	General studies	15.0
2	Basic studies	0.0
	Total	**15.0**
3	Core studies	0.0
4	Special studies	37.5
5	Free choice courses	0.0
	Total classroom studies	**52.5**
	Including optional studies	7.5
	common domain studies	15.0
6	Practice	0.0
7	Graduation thesis	187.5
	Total	**240.0**

4. RECENT TRENDS IN ENGINEERING EDUCATION IN THE COUNTRY

The Faculty of Civil Engineering is transferring from 4-year bachelor study curricula, 4-year diploma studies curricula (there were 3 specialities) and from 2-year master study curricula to the new integrated continuous 5-year bachelor and master curricula of engineering in 2002. Graduating from the engineering studies will give the qualification equivalent to the master degree. In these curricula after 3 nominal year studies and after collecting 180 ECTS Credits including certain compulsory subjects, the student has fulfilled requirements of the bachelor degree.

ANNEX

List of higher education institutions offering civil engineering education in Estonia

Tallinn University of Technology	Master Degree in Civil Engineering	(300 ECTS Credits)
Estonian Agricultural University	Master Degree in Rural Engineering	(300 ECTS Credits)
Tallinn College of Engineering	Diploma studies in Civil Engineering	(240 ECTS Credits)

THE CIVIL ENGINEERING EDUCATION IN SPAIN

Jose-Luis Juan Aracil[1] , Xavier Sanchez Villa[2]

1. GENERAL VIEW ON THE PRE-UNIVERSITY EDUCATION

The system is a 12 year one divided into three parts:

- Primary education (6-12 years).
- Secondary education (13-16 years)
- High school: (17-18 years): with four options: Arts, Social/Human Sciences, Natural Sciences and Health, Technology.

2. CIVIL ENGINEERING EDUCATION

2.1 Introduction

Civil Engineering Education in Spain is structured in two levels. Both are organised inside the University studies. Both levels are granted with a university diploma. The short duration one with a duration of three academic years leads to the "Ingeniero Tecnico de Obras Publicas" Diploma (Public Works Technical Engineer). The long duration Diploma leads to the title of "Ingeniero de Caminos, Canales y Puertos" (Roads, Channel and Harbour Engineer). At present, the duration of the studies at University is five academic years at all the Universities where the title is awarded. The exception is Madrid Polytechnical University where the duration is six academic years.

2.2 Schools

There are 12 Spanish Escuelas (Department or Faculty) where you can follow the Ingeniero Tecnico de Obras Publicas courses: Algeciras (Cadiz), Alicante, Avila, Barcelona, Burgos, Caceres, Santander, Belmez (Cordoba), Las Palmas, Madrid, Valencia and Zamora. Three of them - Barcelona, Santander and Valencia are courses given in the same Institution and with the same staff as the Ingeniero de Caminos courses.

The long duration course: Ingeniero de Caminos, Canales y Puertos is given at present in nine Institutions belonging to nine different Universities. These Escuelas are located in: Madrid (1802), Santander (1966), Valencia (1968), Barcelona (1973), Granada (1988), Coruña (1991) Ciudad Real (1998), Burgos (1998). In brackets are given the foundation year of each Institution. The only

[1] Professor, Universidad Politecnica de Madrid
[2] Professor, Universidad Politecnica de Catalunya, Barcelona

private University giving civil engineering studies in Spain was created eight years ago (1996): the Alfonso X el Sabio University, located in the surroundings of Madrid.

2.3 Admission of students at the undergraduate level

After high school there is a National examination. Each student passing is assigned a final grade (between 5 and 10) which comes as an average between the scores in the final exam and the high school curriculum. Students express their preference for studies and universities. Students are assigned their preferences depending on this global score. Some schools have "numerus clauses", so no more students are admitted after the school offer of places is covered and a "threshold score" is defined.

The trend in admission is a decreasing number of people. Still the demand is higher than the offer. This implies a good quality of students (the threshold score is quite high for some schools).

2.4 The undergraduate education programs

Today the education law states that a Civil Engineering course (higher level) to get the "Ingeniero de Caminos, Canales y Puertos" Diploma may have a maximum of 375 credits distributed in four or five academic years (one credit = 10 contact hours). Out of these, the so-called core subjects must have 180 credits. Core subjects are the matters, which are considered essential in the technical formation of a Civil Engineer and therefore are compulsory to be lectured in each Institution entitled to award the official title of Ingeniero de Caminos, Canales y Puertos.

The present situation is that each institution defines the total number of credits. Barcelona has a curriculum of 395 credits, Coruña 420 credits, Alfonso X el Sabio 375 credits, and so on. All these institutions offer a 5-year program. Madrid still holds the old six-year program of 450 credits because its proposal for a new plan of 428 credits divided in five academic years was not approved by the Spanish Universities Council. Therefore the Polytechnical University of Madrid was provisionally authorised to maintain the old course programme.

In all programs the difference between the total numbers of credits and the core ones must be fulfilled with mandatory courses (decided individually by the school) and elective credits. That means that the same Diploma or Title may differ from one University to another in more than 50% of its content.

For the short duration courses (Ingeniero Técnico de Obras Públicas) the maximum numbers of credits to be lectured are 270 credits divided into three academic courses. Again, there are some core subjects. In all programmes (short and long duration) free election subjects should be 10 % of the total amount of credits.

The Civil Engineering Courses in Spain allow each student to follow different specialities or branches inside the same curricula. Normally the first

academic years are dedicated to basic Maths, Physics, Materials and Representation Systems Sciences and from third year on begin the technical and technological education. On the last two years, in the case of long duration courses and on the last year in the case of three year studies, each student choose one of the different specialities offered by the educational institution.

At both levels, short and long duration courses, you need to complete a Final Course Project, which is a compulsory need to award the Diploma. The type of this Final Course Project differs from one University to another, but in all cases must be completed to get the Title. In the curriculum of the School in Barcelona students must also complete a Tesina ("little Thesis") which introduces them to research. After the graduation, each Civil Engineer may enter in his correspondent professional Association and most of the graduates do so.

The studies can be structured into semesters or into academic years. At the end of the academic year (around June) there is a period for final exams. Students failing the courses can attend a second comprehensive exam which takes place either in July or in September, depending on the School.

2.5 Post-graduate studies

Phd Studies are provided at the high level Institutions -Escuelas Tecnicas Superiores- but not at the three-year duration Institutions. To obtain a Phd degree in Civil Engineering in Spain it is necessary to collect a certain number of credits in the first one-two years of studies. No later than four years after starting Phd Studies, you have to read your thesis in front of a Committee formed by Professors nominated on national basis by the Spanish Ministry of Education.

2.6 The professional engineers

It is important to remark the fact that in Spain a Civil Engineering Diploma gives the bearer exclusive technical competencies in his/her field of activity. The Diploma is valid nation-wide and entitles the bearer to exercise certain exclusive official competencies recognised by the State. Therefore only Government is competent to give authorisation to an Institution to award official Diplomas.

Most graduates in Caminos, Canales y Puertos (ICCP) work for construction companies and usually they lead important construction projects. They are in charge of both technical and financial aspects. Other graduates work for consulting companies developing projects or as public servants in the government ministry. In general, the first 2-3 years after graduation, the Engineer assists an experienced engineer but soon is left alone to manage big projects.

Graduates in Ingeniero Técnico de Obras Públicas (ITOP) normally should work together with an ICCP. The original concept of the ITOP was to assist. At

present the professional activity of the ITOP is related to more technical issues than the ICCP, while ICCP tend to the construction management sector.

3. RECENT TRENDS IN ENGINEERING EDUCATION IN THE COUNTRY

Several proposals for curriculum adapted to the Bologna declaration have been proposed in Spain. A brief description of them is presented in this section.

Model 1

Benjamin Suarez[1], a professor of the Civil Engineering School of Barcelona (UPC: Universitat Politécnica de Catalunya) proposes 4 types of graduation. These are summarised in Figure 1 and are the following:

Ingeniero Civil Académico ***Academic Civil Engineer***	This is the basic graduation and it takes 3 courses to graduate. It contains basic formation and graduation is not intended for professional activity. After these 3 courses the student may go to the Professional Civil Engineer or to the Master in Civil Engineering.
Ingeniero Civil Profesional ***Professional Civil Engineer***	The duration of this graduation is 3+1=4 courses. This means that the 3 courses of Academic Civil Engineer are complemented by 1 course of Professional Specialisation defined with the advice of the Professional Institutions but the course is taken at the University. Professional Activity can start after this graduation.
Master Académico en Ingeniería Civil ***Master in Civil Engineering***	The total duration of studies to reach the Master is 3+1+1=5 courses, i.e. this is composed by the Academic Civil Engineer plus one Specialisation course and one course of Scientific Formation. All contents are defined in the Academic environment. An alternative graduation with a Master is that the 1+1 courses are added to the Professional Civil Engineer which is composed by 3 courses. In this alternative the total duration is ((3+1)+1+1) = 6. This graduation gives access to the Ph. D. in Civil Engineering and to the Advanced Professional Civil Engineer.
Ingeniero Civil Avanzado Profesional ***Advanced Professional Civil Engineer***	The total duration of these studies is (3+1+1+1) = 6. This graduation is composed by the Master in Civil Engineering and one course of Professionalization of knowledge defined jointly by the University and the Professional Institution. Professionalization in this case would imply to make practical application of knowledge, real simulations of professional activity, case analysis, group work and business administration.

The model proposed by Benjamin Suarez is rather comprehensive and introduces different levels, it condenses the existing types of graduation (2 types rather parallel and independent) and it is modular (3, 4, 5, 6 courses lead to different levels of knowledge)

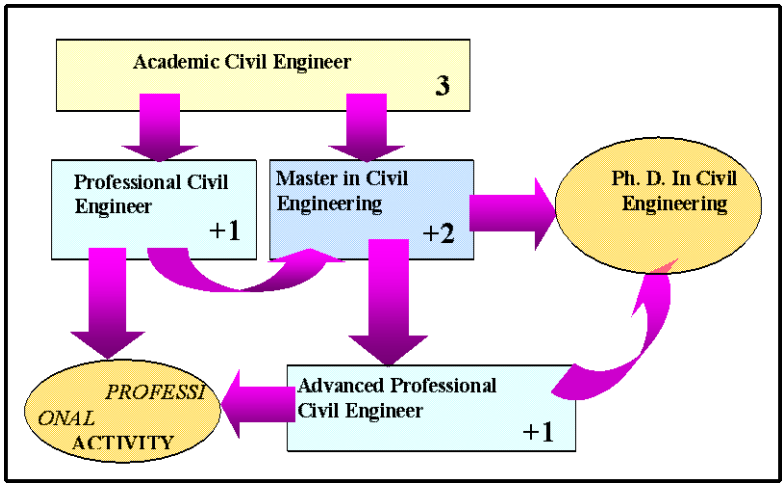

Figure 1 Model proposed by Benjamin Suarez (Professor at the Civil Engineering School of Barcelona, UPC)

Model 2

Federico Bonet[2], a professor of the Civil Engineering School of Valencia (UPV: Universitat Politécnica de Valencia) proposes the following:

A first cycle of three or four years in order to obtain any of the three qualifications as Public Works Thenical Engineer (ITOP, defined above) and which subsequently allows the "bachelor" to practice their speciality. It should be indicated that while the three qualifications are different, the labour market does not differentiate among the three and, therefore, it would be better if there were a certain standardization of these qualifications.

A second cycle of two years which covers complementary basic science subjects, company administration and technical subjects which were not studied in the first cycle. At present our second cycle lasts three years, but in reality those students proceeding from the Public Works courses are awarded a number of credits equal to one year in accordance with their speciality**.**

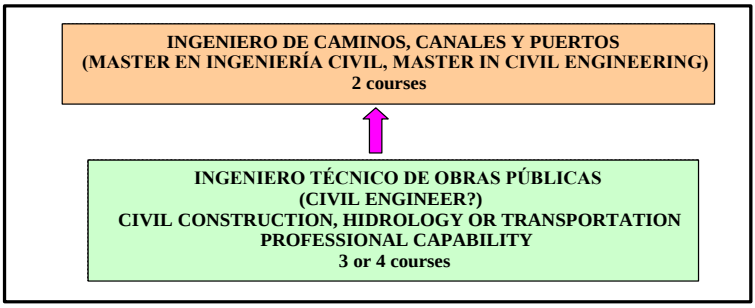

Figure 2 Model proposed by Federico Bonet (Professor at the Civil Engineering School of Valencia, UPV)

Model 3

Edelmiro Rua[3], the director of the Civil Engineering School of Madrid (UPM: Universitat Politécnica de Madrid) has proposed the model that is described in Figure 3. It has the following types of graduation:

Ingeniero Civil Diplomado **Diplome of Civil Engineer**	This is the basic graduation and it takes 3 courses to graduate. After these 3 courses the student may go to the in Civil Engineering graduation.
Ingeniero Civil **Civil Engineer**	The duration of this graduation is 3+1 = 4 courses. This means that the 3 courses of Diplome of Civil Engineer are complemented by 1 course of Specialisation Professional Activity can start after this graduation.
Master en Ingeniería Civil **Master in Civil Engineering**	The total duration of studies to reach the Master is 3+1+2=6 courses, i.e. this is composed by the Diplome of Civil Engineer plus one Specialisation course and two courses of Scientific Formation. This graduation gives access to the Ph. D. in Civil Engineering and to the Professional activity.

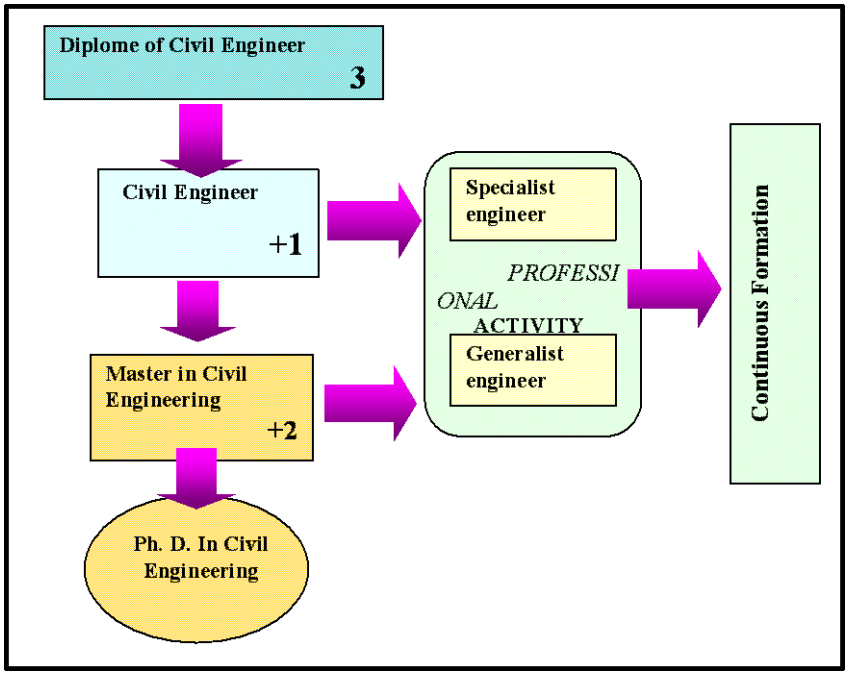

Figure 3 Model proposed by Edelmiro Rua (Director of the Civil Engineering School of Madrid, UPM)

REFERENCES

[1] Benjamin Suarez Arroyo, Hacia un Ingeniero Civil Europeo. Reflexiones sobre las declaraciones de la Sorbona y de Bolonia, Towards a European Civil Enginer. Discussion on the Sorbone and Bologna declarations. Revista de Obras Públicas, 3402, october 200, pp 7-18.

[2] Federico Bonet Zapater, La formación del Ingeniero Civil en España. Ideas para el Futuro. Civil Engineering Education in Spain. Ideas for the Future. Revista de Obras Públicas, 3408, march 2001, pp 7-18.

[3] Fernando Cañizal Berini: "El presente y futuro de la formación académica del Ingeniero de Caminos, Canales y Puertos". II Seminario sobre el perfil del Ingeniero de Caminos del siglo XXI. Zaragoza, Abril de 2001.

CIVIL ENGINEERING EDUCATION IN FINLAND

Aarne Jutila[1]

1. GENERAL VIEW ON THE PRE-UNIVERSITY EDUCATION

The basic education, compulsory and free for every Finnish child, lasts 9 years (from 7 to 16). After that you either enter a practical professional school or another school leading directly to practical profession or a lower level degree, respectively, or you enter a high-school for three more years (from 16 to 19). The high-school ends with a matriculation examination common to all high-school students in the country. Basically this examination is required for university education. Before starting university studies, the military service, compulsory for every male and voluntary for females, usually is taken requiring from half a year to one year. So the female and male students use to be 19 or 20 years old, respectively, when starting the university education.

2. GENERAL VIEW ON THE ENGINEERING EDUCATION

2.1 Engineering education at undergraduate level

At university level there is only one degree in engineering education, i.e. Diploma Engineer's degree. It is equivalent to Master's degree in other countries. The nominal duration of the studies required to obtain this degree is five years. There are 2 universities in Finland offering civil engineering courses, namely Helsinki University of Technology (HUT) and Tampere University of Technology (TUT).

The title of an engineer can also be obtained on polytechnics level (in German: Fachhochschule), where the education lasts four years. There are 17 polytechnics in Finland offering civil engineering courses.

2.2 Engineering education at postgraduate level

2.2.1 Master or Master-type programmes

In universities no Master-type programmes exist, because the lowest degree obtained is already at this level (see Chapter 2.1 above). In polytechnics the level is more equivalent to Bachelor's degree.

2.2.2 Doctoral programmes

There are two postgraduate degrees and study programmes, that any student having reached the Diploma Engineer level with sufficiently high notes (good at

[1] Professor, Helsinki University of Technology

least) can enter. The lower one is called "Licentiate Degree", which is a Nordic speciality (exists only in Denmark, Finland and Sweden), and the higher one "Doctor of Technology Degree", equivalent to Doctor of Science Degree, respectively. The former one requires 80 credits, i.e. two years full-time studies, and the latter one 160 credits, i.e. four years. To get the Doctor's Degree you do not need to be a Licentiate, but many students take both degrees. Sometimes, there are post-graduate students who got their basic degree in a non-engineering university, but who want to pursue the postgraduate studies in an engineering university. In the end they are awarded the Doctor of Philosophy Degree instead of the Doctor of Technology Degree.

The requirements for the postgraduate degrees usually consist of individual courses or seminars or examinations based on literature studies or special assignments. This part is the same for the licentiate students and the doctoral students, and its share usually is 45 credits. The rest of the requirements is fulfilled by writing the thesis, which is equivalent to 35 and 115 credits, respectively.

3. CIVIL ENGINEERING EDUCATION

3.1 Undergraduate education

3.1.1 Short description for each type of programme

Concerning duration of the undergraduate programmes, please see Chapter 2.1.

There are two semesters a year (September...December and January...May). Each semester consists of 13 weeks of lectures and from one to two weeks examination period.

The scheduled nominal number of working hours per week of a student is 40 hours. The number of contact hours (lectures, exercises, laboratory assignments etc.) is approximately 60 % of that, i.e. around 24 hours.

3.1.2 Short description of the main features of the curriculum for each type of programme

The relative weight of various categories of subjects is approximately the following:

Mathematics	13 %
Physics	8 %
Chemistry	3 %
Computer Science	4 %
Civil and Environmental Engineering	49 %
Economy and Law	3 %
Languages	2 %
Optional courses	7 %
Diploma Work (Master's thesis)	11 %

The average ratio between lectures, contact hours (exercises and other tutorial hours) and home work (incl. examination) is approximately 30 %: 30 %: 40 %, when the estimation is based on the time used by a student.

The programme is finalized by a Diploma Work (Master's thesis) equivalent to 20 credits out of the total 180 credits (11 %).

3.1.3 Admission of students at the undergraduate level

There is a national examination common to both universities teaching Civil Engineering in the country.

The number of applicants willing to study Civil Engineering at HUT or TUT has been rather constant during the last years. Complete statistics, however, is not available, but when only students, whose primary interest is Civil Engineering are considered, the list is as follows:

Year	Primary applicants		Accepted	
	HUT	TUT	HUT	TUT
1999	178	80	101	49
2000	117	83	105	56
2001	129	82	136	51
2002	226	122	130	63

When considering these figures one should be aware of the system, by which the students choose the study direction between many different options. In their application to university they are allowed to name five different faculties or study directions in one or several universities in the order of their primary interest. If they do not succeed to get into their first choice, the next option on the list becomes valid and so on. This explains why the number of primary applicants can be smaller than the number of enrolled students.

3.2 Civil engineering education at postgraduate level

See Chapter 2.2

4. RECENT TRENDS IN ENGINEERING EDUCATION IN THE COUNTRY

The Bologna Declaration is noticed and the universities are preparing its application to the university education. In Finland the Bologna Declaration will be fully obeyed and in operation from year 2006 onwards.

ANNEX

Updated list of higher education institutions offering civil engineering education of various kinds

There are a total of 20 Universities in Finland. Only two of these offer university level education in Civil Engineering, namely:

Helsinki University of Technology (HUT), http://www.hut.fi
Founded 1849, located in Espoo at Helsinki,

Tampere University of Technology (TUT) http://www.tut.fi
Founded 1965, located in Tampere (160 km northwest from Helsinki).

Additionally, there are 29 Polytechnics in the country. 17 of these offer courses in Civil Engineering.

THE FRENCH HIGHER EDUCATION SYSTEM FOR CIVIL ENGINEERING

Richard Kastner[1]

A - Preliminary remarks

In the classical French universities, there are now some major changes in the higher Civil Engineering education system in relation with the introduction of the « LMD » (Licence-Master-Doctorat) type system, but some of the previous curricula are still existing. In the same time, most of the "Ecoles d'Ingénieur" are still keeping their curriculum leading directly to a five years degree named "Diplôme d'Ingénieur".

The situation being not yet stabilised, this paper describes in a first part the French higher education system for civil engineering existing until 2002-2003.

The new curricula resulting from the changes in relation with the introduction of the "LMD" sytem are briefly presented in the second part.

B -Situation before 2004

1. GENERAL PRESENTATION

In the French higher education system for Civil Engineering, there are 3 main levels of training, with reference to the number of years (X) required to complete the course after the « baccalauréat » (A-level), called « BAC+X » level.

1.1 Education at « BAC+2» level (DUT)

The "Instituts Universitaires de Technologie" called IUT propose courses which lead to a « technicien superieur » qualification called DUT. There are 19 IUT of civil engineering in France. This type of curriculum will not be presented here, but it can be noted that after a DUT type degree, the students can apply to the 3rd year of the new "License professionnelle".

1.2 Education at « BAC+4» level (« Maitrises des Sciences et Techniques, IUP : Institut Universitaires Professionnalisés)

These institutions are established in the general scientific universities.

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1.3 Education at « BAC+5» level

About 40 institutions are leading to a « Diplôme d'Ingénieur » with partial or complete education in civil engineering.

It should be noted that:

- all these formations lead to a Degree recognised by the French government.
- in France, there is no specific professional accreditation in civil engineering.

2. BAC + 4 DEGREES

BAC + 4 engineering courses have been set up in the general scientific universities, named "Maitrises des Sciences et Techniques" and "IUP" (Instituts Universitaires Professionnalisés). The recruitment is carried out there essentially at bac+1 or bac+2 level, the specialisation in civil engineering taking place during the two last years.

The academic degrees awarded in these courses are either a "Maîtrise en Génie Civil"or a degree of "Ingénieur-Maitre".

The « Instituts Universitaires Professionnalisés » (IUP) specialized in civil engineering and infrastructures prepare students to a professional career, on the basis of three academic years associated with several months of industrial training. We can find this speciality in 14 universities : Angers, Béthune, Bordeaux, Cergy, Égletons, Grenoble, La Rochelle, Lorient, Lyon, Marne la Vallée, Metz, Nantes, Toulouse and Valenciennes.

Civil engineers have traditionally applied scientific and engineering knowledge to the task of providing the built environment, starting from its design and planning, to its design and construction, its maintenance and its rehabilitation. Consequently, the program in civil engineering at IUP emphasizes the fundamentals in mechanics and engineering associated with the various fields of the profession, including economic legal and management aspects, and fully reflects the advances in science, mathematics, engineering and computing.

The resulting knowledge and a minimum of five months (usually more) of industrial training enable graduates not only to enter the profession thoroughly well prepared but also to adapt to further changes or eventually to pursue advanced studies elsewhere.

Each IUP in civil engineering and infrastructures offers specializations (options) during their third year and graduates about 20 to 50 students each year.

Entrance requirements are one fully completed year, after the "baccalauréat", of scientific education (1st year of DEUG or CPGE) to apply for admission in the first year at IUP, or a diploma such as DUT, BTS, DEUG or CPGE (2nd year) to enter the second year at IUP.

3. COURSES LEADING TO A « DIPLÔME D'INGENIEUR » (BAC+5 LEVEL)

The French education system leading to a « Diplôme d'Ingénieur » is rather complex and diversified. The various institutions, named « Ecoles d'Ingénieur » offering such a «BAC + 5» degree vary by their course, their mode of recruitment, and even by the ministry in charge of their supervision.

3.1 The administrative status

The majority of the « Ecoles d'Ingénieur » are public institutions which depend on the Department of National Education. But these institutions are generally separated from the general Scientific Universities.

Some other « Ecoles d'Ingénieur » are under the supervision of other ministries such as the Ministry of Defence (Ecole Polytechnique), the Department of Public Works (Ecole Nationale des Ponts et Chaussées, Ecole Nationale des Travaux Publics de l'Etat), the Department of Industry (Ecole des Mines de Paris …) or the Department of Agriculture (Ecole nationale du Genie Rural et des Eaux et Forets). These institutions are primarily intended for the education of civil servants who are the technical experts attached to the ministry concerned.

More recently, some institutions offering a «Diplôme d'Ingénieur» were created in the general Scientific Universities.

Finally there is also a private institution delivering a complete training in civil engineering.

3.2 Admission

3.2.1. The" traditional" way of admission

The traditional way of admission is based on the system of the "Preparatory Classes" : the students enter these classes after their baccalaureat, for a 2 to 3 years course in order to train for the entrance examination for the « Ecoles d'Ingénieur ". The course includes primarily basic sciences (math, physics, chemistry, introduction to engineering sciences, languages...). At the end of these "preparatory classes", students apply for different "Ecoles d'Ingénieur"and are selected through an entrance examination (written and oral exams). The level of this examination depends on the level of prestige of the different "Ecoles d'Ingénieur ".

3.2.2. Other types of admission at BAC+2

Others "Ecoles d'Ingénieur" have a broader recruitment, at BAC +2 level (preparatory classes, scientific first cycle of the general universities, high-level

technicians).The selection is generally done on the basis of previous academic results and sometimes an interview.

3.2.3. Admission after the Baccalauréat

Finally there are "Ecoles d'Ingénieur" where the recruitment is done immediately after the baccalaureat. The selection of the students applying is performed based on previous academic results supplemented sometimes by an interview and/or written exams. These "Ecoles d'Ingénieur" have a 5 years course, the first two years being generally devoted to the general scientific education, the specialisation in civil engineering taking place during the 3 last years.

3.2.4. Other types of admission

In most of the "Ecoles d'Ingénieur", there are some possibilities to apply at the "BAC+4" level, for students having a scientific BAC+4 degree, the students being generally selected on the basis of previous academic results and an interview.

3.3 The organisation of the curriculum

In a general way, specialisation in civil engineering does not start before the BAC +3 level. One finds however here a great diversity, with institutions having first an education in general engineering sciences and proposing only some classes specialised in the field of civil engineering during the last year. On the other hand, other institutions propose a complete training in civil engineering over the three last years.

4. POST-GRADUATED COURSES

The post-graduated studies system is organised in two stages:

- the DEA (Diplôme d'Etudes Approfondies) whose recruitment is made at BAC+4 level. This one year course is research oriented and comprises some high level lectures and a dissertation. The students being in their fifth year of engineering studies may prepare a DEA simultaneously with the preparation of their « Diplôme d'Ingénieur ».

After the DEA, students can begin a PhD named « these de doctorat » which normally takes from 3 to 4 years.

C – Changes in 2004

1. The LMD type organisation in general scientific universities

In the new LMD type organisation, the 3 years curriculum named « Licence » (equivalent to a bachelor degree) is the first level of higher

education studies. In this system the two first years are mainly devoted to basic sciences, the third year being more professional oriented.

After these three years, the students can apply for the 2 years Master curriculum, the second year being professional or research oriented.

2. MASTER COURSES

The post-graduated study system is now organised in three stages:

- the M1 Master (first year of a 2 year master course), the recruitment being made after a BAC+3 curriculum.

- the M2 Master (second and final year) whose recruitment is made after the M1 curriculum or some BAC+4 scientific and technical curriculum. This one year course can be "professional" or research oriented. In the second case (research Master which replaces the DEA), it comprises some high level lectures and a dissertation. The students being in their fifth year of engineering studies and preparing their «Diplôme d'Ingénieur» can apply to prepare simultaneously the research oriented Master at the M2 level.

- after the research oriented Master, students can begin a PhD named «These de Doctorat » which normally takes from 3 to 4 years.

CIVIL ENGINEERING EDUCATION IN GREECE

by Pericles Latinopoulos[1]

1. GENERAL VIEW ON THE PRE-UNIVERSITY EDUCATION

Pre-university education in Greece is a typical two-stage process, constituting of: (a) elementary education and (b) secondary education. Each stage has a duration of 6 years. Consequently, and given that the age of entrance to the elementary education is 6, students enter tertiary (higher) education at the age of 18, at the earliest.

As admission to higher education institutions is permitted only to persons who have successfully finished their secondary education studies, a short description of the Greek system of secondary education is given. Secondary education in Greece comprises the *Gymnasia* and *Lykeia*. The *Gymnasio* (i.e. the first cycle of secondary education) lasts three years and is compulsory for all Greeks. *Lykeio* constitutes the second cycle of secondary education, also of a three-year duration. This second cycle is non-compulsory. Upon successful completion of the second cycle and – mainly – based upon the results of the final *Panhellenic* examinations, *Lykeia* graduates may gain entrance into a faculty or department at an institution of higher education.

A well-balanced curriculum, offering both general and specialised knowledge, characterizes the last years of the secondary education. It should be noted, though, that the preparation for the national (*Panhellenic)* examinations, which are required for admission to tertiary education, is very hard and time consuming, due to high competition. This fact leads to very intensive study, mostly of specialised subjects, during the last two years of the secondary education.

One of the main problems of higher education in Greece is the number of secondary school leavers who choose for the same fields of study. So, it is a common fact that every year there are too many of *Lykeia* graduates competing for new places in higher education studies in medicine, computer sciences, modern economics, engineering and law. A typical consequence of this fact relates directly to another major problem: the high number of Greeks who study abroad. Recent statistics show a steadily increasing rate of Greek students who enrol in foreign institutions because of the above mentioned lack of available places in the national institutions.

[1] Professor, Aristotle University of Thessaloniki

2. GENERAL VIEW ON THE ENGINEERING EDUCATION

2.1 Engineering education at undergraduate level

Higher education in Greece follows a binary one-tier education system for studies up to doctoral level and one-tier doctoral structure. At the undergraduate level the University Sector awards the *Diploma* (engineering and architecture) or the *Ptychio* (rest of disciplines) after studies of normally four to five years' duration (medicine faculties are the exception, with six-year programmes of studies). The *Diploma Metaptychiakion Spoudon Exidikefsis* (Diploma of Postgraduate Specialisation) is a postgraduate intermediate specialisation of minimum one to two years' duration, and is obtained by following specific Master-type programmes. Finally, the *Didactorico* is the doctoral degree, obtained after a minimum of three years of study, research and public defense of a thesis.

The *Anotata Technologica Ekpaideftika Idrymata* (ATEI – Higher Technological Education Institutions) are non-university higher education institutions that award qualifications, called the *Ptychio*, after studies of three and a half years in specific, professionally oriented fields. It should be noted that the possibilities of transfer from a non-university to a university course are fairly limited and, above all, it requires graduation from a ATEI.

Within the above framework, it is clear that engineering education at the undergraduate level in Greece is offered by Universities and Technological Education Institutes. As far as the duration of undergraduate studies is concerned, the distinction between the two types of education is based on the duration of the their programmes: as previously mentioned, it is set by law that University engineering programmes are of 5 years of duration (long duration) while ATEI programmes are of only $3^{1/2}$ years (short duration). Two other points, that emphasize the difference between the two types of Institutions, are: (a) Professional qualification awarded by ATEIs is limited, as compared to the one awarded by the Universities. (b) Postgraduate studies are not allowed at the Technological Education Institutes in an autonomous way, but only through collaboration with Universities.

2.2 Engineering education at postgraduate level

2.2.1 Master or Master-type programmes

As mentioned above, engineering education at the postgraduate level is offered autonomously only by Universities. Each university faculty or department may offer postgraduate programmes in several specialisations. In addition, interdepartmental or interuniversity postgraduate studies may also be organised and operated. In order to be admitted to a postgraduate study

programme, students must provide – among other prerequisites – evidence that they have a good command of a foreign language, whereas foreign students have to prove that they have a competent knowledge of the Greek language.

The first class of postgraduate programmes includes 1- or 2-year specialisation studies which lead to the Diploma of Postgraduate Specialisation. These programmes are Master-type ones. Still, due to the high degree of specialisation that engineering students get during the five years of their undergraduate studies, a new law has been recently proposed by which the *Diploma* obtained from Engineering and Architecture faculties/departments would be renamed to *Diploma Prohorimenon Spoudon* (Diploma of Advanced Studies).

2.2.2 Doctoral programmes

The second class of postgraduate programmes, that is the doctoral programmes, are offered in all engineering disciplines and last from 3 to 6 years. Today these programmes are of three types: (a) "Old" type programmes (by thesis only). These are being rapidly replaced by new ones, belonging to one of the following two types. (b) "Pure" Doctoral programmes. (c) Combined Postgraduate Diploma and Doctoral programmes. In the last two types the doctoral candidates have to complete 1 or 2 years of taught studies.

3. CIVIL ENGINEERING EDUCATION

3.1 Undergraduate education

3.1.1 Short description for each type of programme

Civil Engineering education at the undergraduate level is offered in Greece by 12 Institutions, 5 at the highest level (long duration studies at Universities) and 7 at the higher level (short duration studies at ATEIs). The names of Institutions, Schools/Departments and their locations are given in Tables 1 and 2 of the Annex.

Each School/Department of Civil Engineering of the five Universities runs a single degree course at the undergraduate level leading to the *Diploma Politikou Mihanikou* (Diploma of Civil Engineering). Following the current national legislation for higher education, the duration of studies in all Engineering Universities is five academic years (long duration). The seven Departments of ATEIs run single degree courses of short duration ($3^{1/2}$ years).

All undergraduate programmes are divided into semesters, each one with an average duration of 13 weeks of teaching plus 3 weeks for examinations. The

average number of contact hours per week varies among institutions from 50 to 75. The winter semester commences in late September and the spring semester continues until the second half of June. There is also a third examination period for all courses taught in both semesters which, takes place in early September, before the beginning of the courses for the winter semester.

3.1.2 Short description of the main features of the curriculum for each type of programme

With slight deviations, all University Schools/Departments are made up of four Divisions which refer to the following major fields: (a) Structural Engineering, (b) Hydraulic Engineering, (c) Geotechnical Engineering, and (d) Transport Engineering. Under this general classification all other fields relevant to Civil Engineering education are fully covered (e.g. Material Technology, Earthquake Engineering, Environmental Engineering, Water Resources, Coastal Engineering).

As a general rule, the 5-year (10-semester) course requirements consist of: (a) a number of compulsory course units, which is about two-thirds of the total number of units, (b) a number of optional course units, which covers the remaining one-third, and (c) a diploma thesis. Normally it is the 10th semester that is devoted to the preparation of the thesis. Most of the optional course units should be selected from within one of four lists provided by each Division. So, at the end, each qualified graduate has achieved a particular specialisation. Still the title of the degree (i.e. Diploma in Civil Engineering) is offered to everybody and consequently the professional qualification awarded covers all possible fields in the profession of Civil Engineer.

From the seven Departments of Higher Technological Education Institutes, three offer education related mainly to Building Construction (Structural Engineering) whereas the other four concentrate on Civil Works (Civil Engineering Infrastructure). In general, most subjects taught in ATEIs are much less theoretical, as compared to those taught in the Universities. Thus, the average ratio of lectures over other types (i.e. more practical) of contact hours is lower in ATEIs.

3.1.3 Admission of students at the undergraduate level

The admission of students at the undergraduate level results from a national examination procedure (*Panhellenic* examinations), which takes place once per year (usually at the end of May). It is a general competition with common examination subjects for all engineering courses.

Recent trends regarding the admission, not only for civil but for all engineering studies, are characterized by a slight decrease in the quality of students. This is because, despite the high demand for undergraduate studies in Greece, engineering programmes are not as attractive as they used to be up to a decade ago. Today the most favoured disciplines in the country are medicine, computer sciences and economics.

3.2 Civil engineering education at postgraduate level

Postgraduate civil engineering education does not differ from any other engineering discipline. So the types and main features of postgraduate programmes are exactly as they have been presented in section 2.2 above.

4. RECENT TRENDS IN ENGINEERING EDUCATION IN THE COUNTRY

The engineering education in Greece is harmonised with the international standards regarding both the curriculum structure and content and the teaching approaches and methodologies. The most distinct trend, common in all engineering disciplines, concerns the high degree of specialisation obtained by students during the five-year programmes of the undergraduate studies at Universities.

As far as the impact of the Bologna declaration on engineering education is concerned, the process is still slow, as there is a high opposition in conforming to a pure two-tier system. So, the situation stands as described in section 2.1 above.

ANNEX

Lists of Greek institutions offering civil engineering education

Table 1 Civil Engineering Schools/Departments in Universities (long duration studies)

Name of Institution	Name of Faculty/Department	City
National Technical University of Athens	School of Civil Engineering	Athens
Aristotle University of Thessaloniki	Department of Civil Engineering	Thessaloniki
University of Patras	Department of Civil Engineering	Patras
Democritus University of Thrace	Department of Civil Engineering	Xanthi
University of Thessaly	Department of Civil Engineering	Volos

Table 2 Departments in Technological Education Institutes (short duration studies)

Name of Institution	Name of Faculty/Department	City
Technological Education Institute of Piraeus	Department of Building Construction Engineering	Piraeus
Technological Education Institute of Iraklion	Department of Building Construction Engineering	Iraklion
Technological Education Institute of Serres	Department of Civil (Structural) Engineering	Serres
Technological Education Institute of Athens	Department of Civil Works Technology	Athens
Technological Education Institute of Thessaloniki	Department of Civil Engineering	Thessaloniki
Technological Education Institute of Thessaly	Department of Civil Works Technology	Larisa
Technological Education Institute of Patras	Department of Civil Works Technology	Patras

CIVIL ENGINEERING EDUCATION IN HUNGARY

Antal Lovas[1]

1. GENERAL VIEW OF PRE-UNIVERSITY EDUCATION

Hungary has pre-university education in structure of a 8+4 years; 8 years of preliminary school, followed by 4 years of secondary school. The secondary schools have two types:

- high-school (gymnasium on the Continent);
- specialized secondary school.

They are ended with a maturity exam, which is the requirement for admission to universities and colleges. The level of the Hungarian pre-university education is high and competitive.

2. GENERAL VIEW OF ENGINEERING EDUCATION

2.1 Engineering education at undergraduate level

In Hungary there are two programmes for engineering education. The first one's duration is 3 years and gives BSc in Engineering. This type of programme is offered by technical colleges, its aim is educating skilled practical engineers in lower position for the industry.

The universities offer a 5 year programme and an MSc grade for the students. The two types of programmes have no connection, and an institution offers only one of the programmes. The new BSc & MSc courses will start in 2005.

2.2 Engineering education at postgraduate level

2.2.1 Master or Master-type programs

At post-graduate level engineering education can be followed by additional education. The correspondence program gives the opportunity to have an MSc degree for those who are awarded by corresponding BSc degree.

Specialized programs offer deep and professional education in one particular field of interest within the prrofession. The specialized programs are organized by the faculties of the universities. These programs are open to anybody with a corresponding BSc or MSc.

2.2.2 Doctoral programmes

The Budapest University of Technology and Economics (BUTE) is a strongly research oriented university that has conferred doctoral degrees since

[1] Professor, Budapest University of Technology and Economics

1901 in various filed of engineering. The academic staff of our University is doing research in almost all engineering disciplines, related applied sciences, and in a few areas of the social sciences as well.

A PhD at the BUTE is a degree that can be earned by sufficiently proving the candidate´s ability for selfstanding scientific work that must be demonstrated by writing a thesis summarising the candidate´s research results. Furthermore, it is necessary to pass a set of qualifying examinations in some basic and applied sciences related to the field of the submitted thesis. Finally, the candidates must prove their proficiency in two foreign languages besides the language of the thesis or their native language, respectively. Candidates are to publish their results prior to the submission of their theses.

Applicants for the PhD program must have an M.Sc. or equivalent degree issued by an academic institution recognized by the Hungarian Ministry of Education and must possess an overall understanding of, and a high competence in their field of knowledge, and be familiar with cognitive disciplines. PhD candidates carry out their studies and research on an individual basis under the guidance of a professor or a senior member of the specific faculty´s academic staff. This research work must contribute to scientific knowledge in general and it must be accepted by the international scientific community. In order to prove this, doctoral candidates must present their research results at national and international conferences and symposia, and they are expected to publish their work´s significant and major achievements in internationally referred professional periodicals.

Work toward a PhD degree requires at least 3 years (6 semesters) of study. This time might be considerably longer, depending on the topic and the candidate´s personal diligence. It is possible to set individual PhD study plans for candidates who spend a part of their preparation period at another institution, e.g. their original research oriented affiliation, or another university. Upon completing all necessary work for the PhD thesis, this dissertation must be prepared according to the formal requirements in the Doctoral Code of the BUTE.

3. CIVIL ENGINEERING EDUCATION

3.1 Undergraduate education

Civil engineers are faced to new tasks as a result of modern social and economics demands such as the construction of up-to-date infrastructure, the rational and optimal exploitation of natural resources, the protection and conscious formation of the environment.

Unified civil engineering training is going on the **major in Civil Engineering**, which was established by merging the former specialities of Structural Engineering, Hydraulic Engineering and Transport Construction Engineering. There are two branches, such as Structural Engineering (Buildings,

Bridges, Geotechnics, and Management Engineering) and Infrastructural-Environmental Engineering (Highway and Railway, Hydraulic, Water Management, Environmental and Sanitary Engineering). This period of study is mostly devoted to common obligatory, the so-called core training, which is followed by much deeper special training via the wide-range offer of optional subject groups. The **major in Surveying and Geoinformatics** is continued on the basis of the traditions of the former speciality of Surveying and Geodesy, with a new curriculum modified according to the requirements of our age.

3.1.1 Short description of each type of programme

Graduates from the Civil Engineering major, Branch of Infrastructure-Environmental Engineering, gain detailed knowledge of road, motorway, and airfield construction; railway and metropolitan railroad construction; urban transport, and road traffic. Because the construction and foundations of buildings, bridges, hydraulic engineering and other structures require knowledge of geotechnics (soil mechanics, earthwork, foundations, and underground structures), they also study these areas. The principal subjects of this branch essentially focus on design, but the students also learn about related technological, constructional, and operational problems. In addition, they become proficient in using methods of laboratory testing and of research and development, which are incorporated in the main specialized subjects. Students possess knowledge in hydrology, hydraulics, hydraulic engineering, and water management and hence are qualified in engineering design, investments, construction, operation and maintenance of hydraulic engineering structures, water supply and canalization, agricultural hydraulic engineering, and water management. They also possess a working knowledge of such subjects as flood protection, river regulation, foundations, reinforced concrete and steel structures for hydraulic structures, water supplies for residential areas and industrial establishments, the technical-economic aspects of hygienic and public services (drainage, irrigation, sewage treatment and utilization), the design, construction and operation of hydraulic engineering structures, and also environmental engineering.

Graduates from the Civil Engineering major, Branch of Structural Engineering create engineering structures by utilizing and designing structural materials. They are expected to design, construct, and organize the investments of mechanically, structurally, and technologically complex structures in cooperation with architects and transport and hydraulics specialists. Future structural engineers who graduate from this branch will be able to design and construct, among others, flyovers and underpasses for traffic networks; power stations, cooling towers, crane ways, transmission line structures and TV towers; halls, storehouses, industrial plants, and multistory buildings; and hydraulic engineering and water supply structures.

Graduates from the Land Surveying and Geoinformatics major can spatially locate and map natural and artificial objects, set out designed engineering structures, determine deformations of constructions, develop control point networks, perform astronomical and gravitational measurements, and determine the Earth`s geodynamical processes. Graduates in surveying engineering can design and manage economic solutions for geodesic problems at a high engineering level. They can also develop relevant technologies and perform significant scientific research.

3.1.2 Short description of main features

The technical colleges offer in the education program some minors. The duration of their program is 3 years, and they earn BSc degree. Their main task is training of practical engineers who are able to fulfil the requirements of the everyday engineering practice.

The Universities offer all of the majors and minors in the field of Civil Engineering, the education linked closely to research and engineering work. The main task is training of well-skilled experts who are able to make research work, take high responsible leadership positions as well as have suitable practical engineering education. The duration of the program is 5 years.

The education is made in ECTS credit-system which makes the program more flexible. In the program, the subjects could only be booked if the pre-requirement subjects are fulfilled.

3.1.3 Admissions of students at undergraduate level

The students have admission points which could be calculated in two ways:

- Points could be calculated based on the student's results in the main subjects at secondary school, or
- An admission exam could be taken which exam is centralized by state.

The student can choose between the two possibilities.

After the admission exams each institute declares a point threshold; in the Faculty of Civil Engineering the threshold is about the 90% of the maximum. Every applying student who has points more than or equal to the treshold is accepted, and under the treshold everybody is rejected. There is a possibility for a limited number of students, who have better than 60% result in the admission exam, but do not have enough points to exceed the treshold to be accepted by the institute on payment of education fee.

3.2. Civil engineering education at post-graduate level

3.2.1 Master or Master-type programmes

Correspondence program

Graduated student with BSc degree in any branch of civil engineering can apply for this course. The type of the BSc diplome determines which major and which branch could be chosen. The duration of this program is three years.

Specialized programs are opened for people with BSc or MSc degree in Civil Engineering. These courses offer very deep and specialized knowledge in a special area. The course takes two years.

These programs are on education fee.

3.2.2 Doctoral programmes

The Faculty of Civil Engineering launches two separate but related PhD programs:

- Civil Engineering Sciences,
- Earth Sciences.

There are three sub-programs within Civil Engineering Sciences Program, namely:

- Highway and Railway Engineering,
- Structural Engineering and
- Sanitary and Environmental Engineering.

The Earth Sciences Program covers mainly geodesy, geoinformatics and land surveying.

The PhD is a full time three year long course. The program is based on training researchers to an advanced level. The candidates work under the supervision of the advisor. They have access to the library, computers, and laboratories. The PhD course contains two main elements: *a)* attending at the course lectures, and *b)* individual research work.

The curriculum of both Faculty´s PhD programs consists of basic methodological and special subjects. Subjects can be selected from the facultative list of programs and from other faculty or university postgraduate programs, approved by the advisor.

4. RECENT TREND IN ENGINEERING EDUCATION

Hungary joined the Bologna declaration which says that in the EU the education should be arranged as BSc and MSc education. Now the changing of the system is under examination by the government.

Originally, the Budapest University of Technology and Economics was the only one offering MSc degree. Nowadays, some technical colleges joined the universities, and hence are offering MSc degree in Civil Engineering.

ANNEX

List of higher education institutions offering civil engineering education

- Budapest University of Technology and Economics,
  Faculty of Civil Engineering,
- Szent Istvan University, Godollo,
  Faculty of Ybl Miklos College, Budapest,
- University of Debrecen
  College of Engineering,
- University of Pecs,
  Faculty of Engineering Pollack Mihaly,
- Széchenyi Istvan University of Applied Sciences, Gyor.

CIVIL ENGINEERING EDUCATION IN THE REPUBLIC OF IRELAND

Bruce Misstear[1]

1. GENERAL VIEW ON PRE-UNIVERSITY EDUCATION

Pre-university education in the Republic of Ireland comprises primary education (usually from ages 6 to 12) and secondary education (usually from ages 13 to 18). Secondary education is normally for 6 years, with state examinations at the end of year 3 (Junior Certificate) and year 6 (Leaving Certificate). The examinations in each subject can be taken at 'Ordinary' or 'Higher' level. Secondary education follows a broad curriculum, with most pupils taking between six and eight subjects at Leaving Certificate. The majority of students take Mathematics, English and Irish and they select their remaining subjects from the sciences, languages, business, art, music and vocational courses. From the perspective of engineering, one of the worrying trends in the last decade has been the reduction in the numbers of students taking physics and chemistry.

Two other features of the Irish pre-university education system are worth mentioning here. Firstly, in year 4 of the secondary system many schools offer a so-called transition year. This is based more on project-related activities than formal classes/examinations, and students are also given the opportunity of gaining some limited work experience. Secondly, there is a significant number of post-Leaving Certificate courses available in vocational subjects.

2. GENERAL VIEW ON ENGINEERING EDUCATION

2.1 Engineering education at undergraduate level

Engineering education in the Republic of Ireland normally comprises a four year undergraduate course (but in some cases five years – see 3.1.1 below) leading to a Bachelor of Engineering degree (BAI, BEng, BE, BScEng, depending on the institution).

Engineering degree courses are accredited by the Institution of Engineers of Ireland (IEI). Graduates from accredited degree courses can achieve professional recognition through the IEI by seeking election as a Chartered Engineer, usually after having acquired at least four years relevant experience and postgraduate training.

[1] Senior Lecturer, Trinity College, Dublin,

2.2 Engineering education at postgraduate level

Masters programmes are of two types: taught courses (usually one year full time, two years part time) or research (usually two years). The degree awarded is an MSc.

Doctoral programmes are nominally of three years duration, but often take four years or longer to complete. The degree awarded is a PhD.

3. CIVIL ENGINEERING EDUCATION

3.1 Undergraduate education

3.1.1 Short description for each type of programme

In the Republic of Ireland undergraduate degree courses in civil engineering and related disciplines are offered both by university colleges and by institutes of technology (ITs). Summaries of the relevant university and IT degree courses are given in subsections a) and b) below, while comments on such details as contact hours and term lengths are included in c).

a) Degree courses in civil engineering (university colleges)

There are four university colleges in the Republic of Ireland that offer undergraduate degrees in civil engineering:

- National University of Ireland, Cork (also known as University College Cork);
- National University of Ireland, Dublin (also known as University College Dublin);
- National University of Ireland, Galway (also known as University College Galway);
- University of Dublin (also known as Trinity College Dublin).

All of these degree courses are of four years duration, and are accredited by the IEI. The National University of Ireland (NUI) courses at Cork and Galway are direct-entry civil engineering degree courses. NUI Dublin previously had a common entry for all engineering courses, with specialisation into the civil and other streams at the beginning of second year. This college has now changed to a direct entry system, although there is a common entry option for civil or mechanical engineering. The Trinity College Dublin (TCD) course has two common years, followed by two years in the civil (or other) stream. The NUI colleges award a BE (Civil), whereas TCD awards a BAI. As well as civil engineering, NUI Galway has introduced a four year direct-entry degree course in environmental engineering.

b) Degree courses in civil engineering or related disciplines (institutes of technology)

There are four undergraduate degree courses in civil engineering or related disciplines offered by the institutes of technology in Ireland:

- Cork Institute of Technology: BEng in Structural Engineering;
- Dublin Institute of Technology: BScEng in Structural Engineering;
- Sligo Institute of Technology: BEng in Civil Engineering;
- Waterford Institute of Technology: BSc in Construction Management.

The Cork and Sligo courses are of five years duration, comprising a two year national certificate course, a one year diploma, followed by a two year degree course. Both the Dublin and Waterford degree courses are of four years duration. The degrees in Cork, Dublin and Sligo are accredited by the IEI as satisfying the educational requirements for graduates seeking election to Chartered Engineer.

c) Terms, semesters, contact hours

There are considerable differences in the term and semester structures of the different university colleges and ITs, so attempts to generalise must be treated with caution. Some university colleges follow a three term system, while others have two semesters. The total teaching period in the university colleges is usually about 24 weeks, commencing in September/October and finishing in April/May. The ITs follow a two semester system, usually with a longer teaching period than the universities (30 weeks).

The total contact hours for the four year degree programmes are generally between 2000 and 2500.

Examinations are usually at the end of the academic year in the three term system, or at the end of each semester with the other system.

3.1.2 Short description of the main features of the curriculum for each type of programme

The university civil engineering courses tend to focus on mathematics and the engineering sciences in the early years, and these subjects account for between 40% and 50% of the total contact hours over the four year degree programme. There is greater emphasis on the civil engineering subjects in the later years, although the opportunities for specialisation vary from institution to institution. A final year project is part of the degree assessment. As well as engineering topics the degree programmes also cover management, communication skills and other topics relevant to the engineer in society. There is perhaps less emphasis on foreign language and humanities courses than is the case with engineering degrees in some other European countries.

Less information is available for the ITs from the EUCEET questionnaire survey, but it is probably fair to say that the IT degree programmes - two of

which comprise a two year degree that follows on from a three year national diploma - place a greater emphasis on applied subjects.

Industrial placements are a feature of many (but not all) civil engineering degree courses in Ireland. As well as giving undergraduates the opportunity of gaining some experience in the practice of engineering, they are seen as valuable in providing links between academia and industry.

3.1.3 Admission of students at the undergraduate level

Entrance to all degree courses in the Irish Republic is based on points achieved in state examinations (Leaving Certificate). Points are awarded according to the grade achieved in each subject (there are different points scales for subjects taken at 'Ordinary' or 'Higher' level). The points required for each college course vary depending on the popularity of the course and the number of places available. A particular grade in mathematics (at 'Higher' level) is also specified for many engineering courses.

With unprecedented economic growth in the 1990s, the number of students taking civil engineering has increased (although there are, of course, fluctuations from year to year). Points levels for many civil engineering courses have also increased.

3.2 Civil engineering education at postgraduate level

The one year taught masters courses usually run from September to September. They typically comprise lecture terms (or semesters), written examinations, and a major dissertation (the latter to be completed over a three to five month period).

Masters by research and doctoral theses are examined by internal and external examiners appointed by the university; the assessment process includes a viva voce. In some institutions, research students are required to take a limited number of relevant courses from taught masters programmes.

4. RECENT TRENDS IN ENGINEERING EDUCATION IN THE COUNTRY

In February 2004 the IEI published its position on the Bologna Declaration in a document entitled "A New Structure for Engineering Education in Ireland - Implementation of the Bologna Declaration". This advocates a five year integrated Master Degree programme as the new educational standard for the title of Chartered Engineer, with a Bachelor degree awarded after third year.

CIVIL ENGINEERING EDUCATION IN ITALY: THE TRANSITION PHASE FROM OLD TO NEW SYSTEM*

Diego C.F. Lo Presti,[1] Riccardo Nelva[2] & M. Lodovica Tordella[3]

1. INTRODUCTION

Historically, higher education system in Italy was quite inflexible and aimed at graduating a relatively small number of highly qualified people. Course duration ranged from a minimum of 4 years to a maximum of 6 years depending on the type of studies. Fundamental subjects, for a given graduation course, were fixed by the Ministry of University and Research (MIUR) and represented on average about 90% of the total subjects, which should have guaranteed, at least in principle, a uniform preparation of graduates. A final thesis dissertation was required in order to graduate. The time necessary for thesis preparation ranged (in the case of Civil Engineering) from 4 months to about 1 year (in the case of experimental works). Generally, no admission test was necessary and fees were relatively low. In any case fees did not cover the real cost.

According to the cultural heritage of Latin countries, the teaching of a given subject consists firstly in stating the basic principles and secondly in applying those principles to solve practical and simplified problems (see as an example the tradition of ENPC or École Politecnique in France). In other words, the education is based on a deductive method, while in anglo-saxon countries the inductive approach is usually preferred. It is possible to recognize the same structure in the graduation-course organization.

As an example, the Civil Engineering was a five-year course consisting of 30 subjects more or less equivalent to 300 credits. The first and second years were devoted to providing the students a strong mathematical-physical basis and in general the necessary tools (chemistry, drawing, etc.). Third year and part of the fourth year were devoted to giving the specific education (strength of materials and solid mechanics, construction of buildings, hydraulics, geotechnics, construction of road, railway and airport, etc.). Fourth year and part of the fifth year were mainly devoted at obtaining a specialization. In particular five specializations were available: building, structural, hydraulic, geotechnical, transportation. Appendix A1 shows a typical curriculum for Civil Engineering (Geotechnical specialization).

* This is an updated version of the paper the authors presented at the EUCEET-ECCE Conference in Sinaia, July 2001

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The University degree is a necessary requirement in order to practice. Another requirement is to become chartered practicing and, consequently, member of a given Professional Association. The rules to become chartered practicing are different depending on the type of profession. Graduates in Civil Engineering become chartered engineers by taking an examination just after the degree. Such an examination consists of the design of a simple structure (residential building, retaining wall, swimming pool, shelter, etc.), that has to be completed in 8 hours, and a colloquium. Members of the Engineer Society and of Academia are charged with such an examination. In the light of what explained above, the expression "chartered engineer" that means expert or senior engineer, should be replaced with "certified or authorized engineer".

In conclusion, the idea behind the previously outlined system is that the State guarantees a given uniform preparation and capacity of practicing, at least in principle.

The National Society of Engineers (Ordine Nazionale degli Ingegneri) takes a register of certified or authorized engineers. There is a register for each Province and until June 2001 it was unique for Civil, Mechanical and Electronic engineers. The main practical consequence was that any registered engineer could sign designs in the field of Civil Engineering, irrespective of his specialization. Such a situation was a direct consequence of quite uniform curricula in Engineering, as far as the past system is concerned.

The main limitations of the previously described system can be summarized as follows:

a) The number of graduates is low and generally is not sufficient for the needs of a modern society.
b) Highly qualified graduates after many efforts and years of studies often find an occupation that is below their capacities which causes many frustrations.
c) The absence of admission tests and the general low level of fees cause a tremendous waste of resources. In-fact there is a very large number of young people that attempt to graduate and soon give up.
d) The rules to become chartered engineer are very soft and do not involve a training period.

In order to overcome the previously indicated limitations, the Italian government, in the last decade, has started to change the higher education system in the framework of a project aimed at modernizing the country and, in particular, at pursuing harmonization of the higher education system within the European Community. This paper tries to show the innovations introduced by the new system, in comparison to the old one, and to point out the problems arisen during the transition phase. To avoid confusion, the old system degree will be called LAUREA.

2. SOME STATISTICAL DATA CONCERNING THE OLD SYSTEM

In order to better understand the old system, some statistical data are reported in this chapter. Data have been taken from MIUR 2003. Table 1 summarises the information concerning the number of students enrolled and that of graduates.

In order to appreciate the data reported in Table 1, it is worthwhile to mention that the number of graduates in Italy in 1998 is of about 14% (i.e. 14 graduates over 100 people of the same age). In other countries higher percentages have been observed in the same year (France 24, Belgium 16, Portugal 7, Germany 16, UK 45, USA 45, Austria 14, Spain 28). It is important to remark that, as far as other countries have been considered, the number of graduates include different kinds of degrees. The above-mentioned statistics refer to all University studies. As far as Engineering is concerned, a different distribution between short and long term courses is possible. In any case, the percentage of graduates in Italy remains low in comparison to other developed countries.

Table 1 Students enrolled and graduates in Italy and Politecnico di Torino

University	Total Students	Students (1st year)	Graduates
All in Italy (*)	1.612.734	247.796	133.199
Civil Engineering in Italy (+)	28.991	3566	2352
Politecnico di Torino (*)	20.260	2388	1989
Civil Engineering (Politecnico di Torino) (+)	1310	161	123

(*) No. of students for the academic year 1998/99 & graduates in the academic year 1997/98

(+) No. of students for the academic year 1998/99 & graduates during 1998.

Figure 1 shows the data above mentioned.

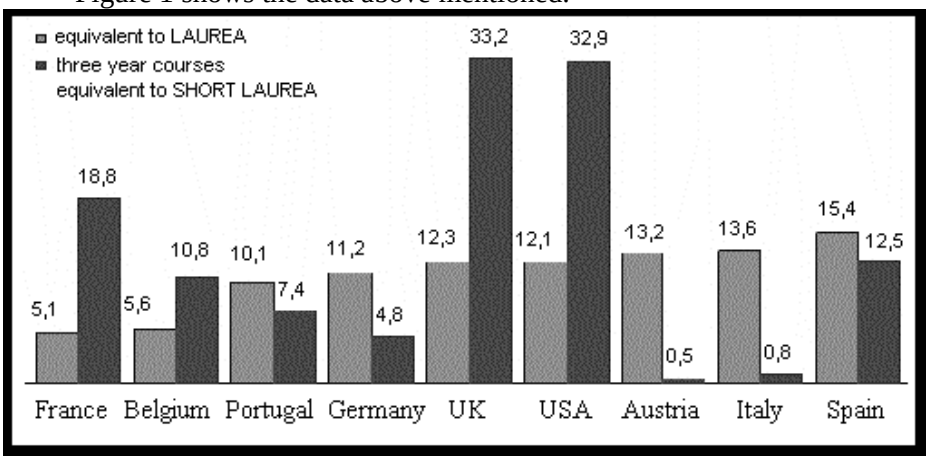

Figure 1 Graduates in different countries

Figure 2 shows the % of undergraduates at the first year in different countries. As far as Italy is concerned, there are a quite large number of young people that initiate the university studies. Unfortunately, only 40% of the undergraduates are able to complete the studies (ISTAT 2001). Young people give up studying within the first two years. As far as the Politecnico di Torino is concerned, about 27% give up studying within the first year (25% in the case of Civil Engineering). The above percentage represents the average for the period from 1998 to 2000. For the year 1997, the giving up, for Engineering, is on average 25.1% in Italy (SIA, 2001).

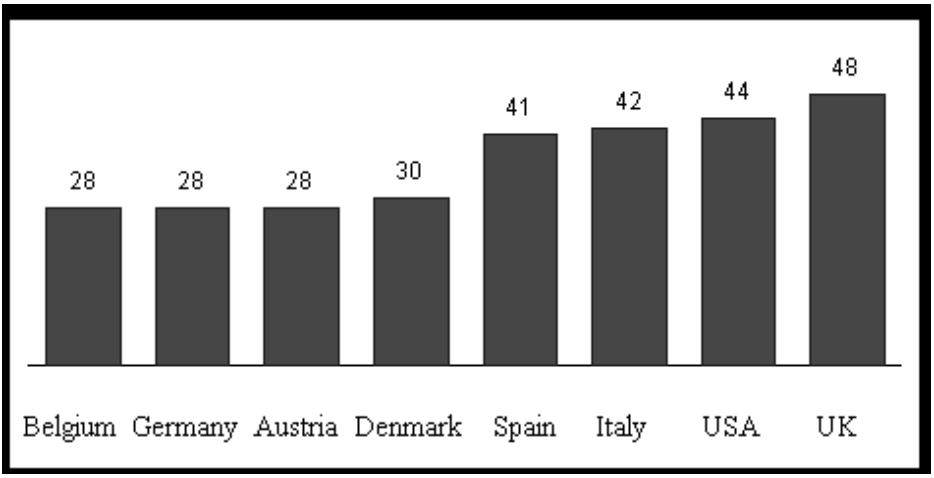

Figure 2 Undergraduates at the first year

Another important aspect is the real duration of studies. Table 2 shows the number of regular undergraduates and graduates over the total number of students.

Table 2 Study-regularity

University	**Total No. of students/ No. of regular students**	**Total No. of graduates/ No. of regular graduates**
Civil Engineering (+)	28.991 17.256	2352 242
Civil Engineering (Politecnico di Torino) (+)	1310 519	123 17

(+) No. of students for the academic year 1998/99 & graduates during 1998.

The regular graduates are those that have concluded their studies within the established period (5 years for Civil Engineering). The regular undergraduates are those that have passed a certain number of examinations per year. The percentage of regular undergraduates ranges in between 40 and 60% of the total number of undergraduates, while that of regular graduates is of only

10 to 15%. Higher number of regular undergraduate (60%) is observed in small Universities.

Many students do not succeed in passing examinations, which is the main reason for having non-regular undergraduate and increasing the real duration of studies. Table 3 shows, in the case of some fundamental subjects, the number of passed examinations in comparison to the total number of students for that subject in a given year (1999).

Table 3 Passed examination (Civil Engineering at the Politecnico di Torino) (yr. 1999)

Subject	**Total No. of students**	**Total No. of Success**
Mathematics I	325	275
Mathematics II	308	235
Physics I	324	283
Physics II	302	220
Solid Mechanics	364	211
Hydraulics	361	330
Construction of building	362	203
Construction of road	217	176
Geotechnics	250	194
Rock Mechanics	180	174

Table 4 Success in University-studies (yr. 1999)

	Politecnico di Torino (%)	**Other (%)**
Regular	7.8	9.0
Non-regular 1st year	20.9	16.5
Non regular 2nd year	23.2	20.5
Non-regular 3rd year	17.0	17.2
Non-regular 4th year	12.3	12.7
Non-regular 5th year and next	17.3	23.8

The percentage of successes ranges in between 60 and 90%. Accumulation of several failures at examinations is the main reason for having non-regular undergraduates.

In order to better understand the importance of this aspect it is worthwhile to provide more statistical data. Table 4 shows for the year 1999 the number of regular and non-regular students per year.

It is obvious that what is depicted in Table 4 leads to an increase of the effective period of study. For example the same database used for Table 4 (AlmaLaurea 2000) indicates an average period of 7.3 years to graduate at the Politecnico di Torino and of 7.1 year to graduate in other Universities and Faculties.

More specifically, considering the Civil Engineering course in 10 different Universities the age of graduate students is that reported in Table 5.

Table 5 Age of graduates (Civil Engineering 10 Universities – Politecnico di Torino) (year 1999)

Age of graduates (years)	**Other**	**Politecnico**
Less than 25 (%)	8.9	22.4
From 25 to 26 (%)	40.5	52.7
More than 27 (%)	50.6	24.8
Average age (year)	27.8	26.5

3. THE NEW SYSTEM

The main aspects of the new system can be summarized as follows:

a) Students graduate a first degree in three years (180 credits), and a second degree (specialization) in another two years (120 credits). These two degrees are in series, i.e. after the first level graduation it is possible to continue the career without paying any cultural "debt". Anyway, those students who don't want to continue have slightly different curricula, more oriented to the practice. If they change opinion and decide to obtain the second level degree, they have to pay a cultural "debt" (mainly consisting of advanced mathematics courses). To avoid confusion the first degree will be called SHORT LAUREA while the second degree will be called SPECIALISED LAUREA.

b) Master courses are available at the end of the first three years and of the next two years as well. In this contest, the Master Course has a different meaning than usually. Master Courses deal with very peculiar topics and consist of about 500 to 600 hour lectures taught by people coming from both the professional and academic world. As an example, the II Faculty of Engineering in Vercelli (Politecnico di Torino) has established a Master Course on Public Work Management. Such a course is

c) offered to those who graduate SHORT LAUREA and SPECIALISED LAUREA.

d) Ph. D. courses are available at the end of the specialization degree. A limited number of positions is available and only about 50 % of these positions is financially supported by scholarships. Students who want to enter Ph. D. studies need to pass an admission test.

e) The Universities are relatively free in establishing curricula, admission criteria, fees, pre-requisites etc. Anyway, the curricula should have a minimum number of credits for different cultural areas as specified later on.

As an example, the II Faculty of Engineering in Vercelli has established an admission test. The test is divided into four sections: text understanding, mathematics, logic & physics – chemistry. It is sufficient to obtain a grade of 401 over 1000 to pass the test. Anyway, 50 % of the grade is

due to the higher-school mark that ranges from 300 to 500. From this point of view the test has only a psychological effect and only serves to select motivated students. Most importantly, those students who pass the test without obtaining a 200 grade in the mathematics section are obliged to attend a pre-University class consisting of 40-hour lecture in mathematics. A final test to assess the improvements is done at the end of this three-week course. Those students that do not pass such a test have to follow curricular studies different than the other students.

The admission test adopted by the I Faculty of Engineering is quite different than that above described.

The new system is much more flexible than the old one. The MIUR has fixed the minimum number of credits that should belong to a given cultural area. As for the first degree, which consists of 180 credits, a minimum of 27 credits should belong to the area of Mathematics, Physics and Chemistry, 36 credits should characterise the graduation course (for example Civil Engineering), 18 should belong to cultural areas close to that of the graduation course (for example other Engineering course) or different cultural areas (Human Science, Economics & Law, Social & Political) 9 credits are for the Thesis preparation and for the foreign language (English). An example of curriculum in Civil Engineering is shown in appendixes A2 and A3 (II Faculty of Engineering in Vercelli). The I Faculty has adopted different curricula, introducing specialization even during the first three-year course. The writers do not evaluate positively such a decision. Therefore the Universities are quite free in preparing curricula and also have the possibility of establishing admission criteria, fees, pre-requisites etc.

More interestingly, it is to notice that the teaching of Mathematics is not restricted to the first year but, for those who want to graduate the specialization “Laurea”, advanced subjects of Mathematics are taught during the third year (see A2).

The fact that basic subjects are taught even in the higher degree courses (SPECIALISED LAUREA & Ph. D.) is a basic requirement for the system functionality. The adoption of an inductive teaching approach should be another fundamental aspect.

The new system has been experienced since four and five years at the main Campus of the Politecnico di Torino and at that in Vercelli (II Faculty of Engineering of the Politecnico di Torino) respectively. Therefore it is now possible to draw some conclusions.

As a first indication, the number of enrolled students increased after the adoption of the new system as shown in Table 6.

Table 6 No. of students enrolled

Year	Civil Engineering at the Politecnico	Engineering at the Politecnico
1998	155	1707
1999	194	1836
2000	204	2604
2001	194	2945
2002	189	2880
2003	180	2662

It is quite obvious that, after a previous constant decrease of the number of students, there is a sudden and permanent increase starting with the new system in 1999/2000. The decrease in the number of students was probably due to the awareness of the fact that studies in Engineering last even more than 7 years, are quite hard and occupation conditions do not compensate the efforts supported to graduate.

The main problem faced during the transition phase was the overlapping of classes and examination period. To solve this problem the academic year was divided in three periods consisting of 10 weeks for lecturing and at least three weeks for examinations. Such a calendar was adopted for both old and new systems.

It is too early to draw conclusions concerning the student career with the new system and the study regularity. Anyway, at this stage, some critical aspects of the new system are quite evident. In particular, it should be remarked that students should graduate SHORT LAUREA before entering the SPECIALISED LAUREA studies. More importantly, the admission to the SPECIALISED LAUREA is not authomatic, at least in principle. For these reasons, students who have accumulated some delay in the first degree studies, can loose one year if they intend to continue.

Some additional considerations can be done concerning the occupation of the graduates with the new system:

a) The first consideration is based on a previous experience in Italy concerning three-year courses called DIPLOMA. The DIPLOMA degree was introduced about 13 years ago and was in parallel with LAUREA degree that is students graduating DIPLOMA should pay a cultural "debt" to graduate LAUREA. The payment of a cultural debt means integrative studies and examinations. A limited number of students graduated DIPLOMA. In 1998 about 14 % graduated LAUREA, as already stated, while only 0.9 % graduated DIPLOMA. Anyway, 75.2% of those that graduated DIPLOMA found an employment or occupation related with the studies undertaken, while only 67 % of those that graduated LAUREA were in the same condition. The percentage of employed graduates approached 80 % in the case of DIPLOMA degree

in Engineering. This means that there are very good opportunities of occupation for three-years course graduates.

b) Engineer Society has not accepted positively the new system, which represents a big problem especially in the case of Civil Engineering. The crucial points are i) the role of Engineer Society and ii) the rules to become chartered (certified or authorized) engineer. The writers believe that the role of Engineer Society should be more cultural and less bureaucratic. This means in turn that the admission to the Society should be based on effective work-experience instead of a formal and "academic" examination of graduates without any experience.

Very recently, Italian Government has defined new rules to become chartered (certified or authorised) engineer (June 2001).

The graduates are admitted to the Society by taking an examination as in the past. Anyway, graduates are divided in two "sections": section A for graduates with SPECIALISED LAUREA degree (engineer, able to apply advanced and innovative methodologies) and section B for graduates with SHORT LAUREA degree (junior engineer, able to apply standard methodologies).

The examinations are obviously different for the two sections.

Another important innovation is represented by the fact that the engineer register is divided into three sections for a) civil and environmental engineers, b) mechanical engineers and c) electronic engineers.

It is worthwhile to notice that the previously mentioned DIPLOMA course was in parallel with LAUREA thus requiring parallel classes in various subjects. DIPLOMA courses have now disappeared. The new system does not involve parallel classes; therefore the new system will reduce the costs of higher education in Italy or, at least, will not increase them.

4. CONCLUSIONS

In the last decade a big effort has been done by the Italian Government to modernize the higher education system in Italy. The main objectives of the Government project were: a) to reduce the number of students that give up studies, b) to reduce the number of years that are necessary to graduate LAUREA (actually on average more than 7 years for the LAUREA degree in civil engineering), c) to increase the number of graduates.

It is too early to give a complete evaluation of the results of the new system. Anyway it is very clear that:

1) the number of students has increased with the adoption of the new system;
2) the occupation opportunity for three-year course could be very good, but unfortunately, at this stage, the demand for such a graduate is very poor especially inside the public administration;

3) actually most of the students want to continue the studies obtaining the second level degree;
4) the effectiveness of the new system in order to reduce the real study duration is questionable;
5) the new system will require some adjustments in the next future

As far as the last point is concerned, the actual (2004) Ministry of Education is going to propose some modifications of the recently adopted system. More specifically, the main changes can be summarized as follows:

a) there will be a single degree of five years for the Faculty of Law (actually this is the case of the Faculties of Medicine and Veterinary Science);
b) for the other Faculties there will be a three year degree followed by a two year specialization, like in the actual system. Anyway, the three year degree will be structured in the following way:
   I. curricula of the first year will be the same
   II. curricula of the second and third year will differentiate into two different courses: a) practice oriented and b) more based on methodological approaches.

ACKNOWLEDGEMENTS

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REFERENCES

ALMA LAUREA 2000 PROFILO DEI LAUREATI 1999 *A cura dell'Osservatorio Statistico dell'Università degli Studi di Bologna. Giugno 2000 Consorzio Interuniversitario, via Belle Arti 41, Bologna*

ALMA LAUREA 2001 CONDIZIONE OCCUPAZIONALE DEI LAUREATI – INDAGINE 2000 *A cura dell'Osservatorio Statistico dell'Università degli Studi di Bologna. Marzo 2001 Consorzio Interuniversitario, via Belle Arti 41, Bologna*

MIUR 2003 ONLINE DATABASE http://www.murst.it

ISTAT 2001 ONLINE DATABASE http://www.istat.it

SIA 2001 Politecnico di Torino Statistiche su superi e abbandoni

DPR 5/6/2001 Attuativo dell'art. 1 c.18 della Legge 4/99

Annexes

A1 OLD SYSTEM

Year	1st Period	2nd Period
1st	Mathematics I Chemistry Drawing I	Analytic geometry Physics I Drawing II
2nd	Mathematics II Physics II Computer programming	Theoretical mechanics Economics Topography
3rd	Structural Mechanics and Mechanics of Materials Hydraulics Materials Science & applied chemistry	Constructions Building analysis (use & maintenance) Geology
4th	Rock Mechanics I Hydraulic constructions Y(1)	Geotechnics Heat transmission, acoustic & illumination design Reinforced concrete & pre-stressed concrete constructions
5th	Foundations Roads, railways & airports Y(3) Y(4)	Municipal engineering Rock Mechanics II Y(4)

Y(1), Y(3) & Y(4) = selected by students among various subjects contained in a list.

Annex

A2 SHORT LAUREA

Year	1st Period	2nd Period	3rd Period
1st	Mathematics I (5) Economics (4) Computer Science (4) Drawing (4)	Mathematics II (4) Linear algebra (5) Chemistry (6) Computer Aided Drawing (5)	Statistics & probability (5) Theoretical Mechanics (5) Electromagnetisms & Optics (4) Multidisciplinary project (3)
2nd	Hydraulics I (5) Materials Science & applied chemistry I (5) Topography (5) **Advanced Mathematics I (7)**	Building industry (5) Hydraulic Infrastructure I (5) Thermodynamics (5) Idrology (5)	Structural Mechanics & Mechanics of Materials (10) Electric circuits (4) Heat transmission, acoustic & illumination design (5)
3rd	Constructions (10) Building analysis (use & maintenance) I (5) **Hydraulics II (5)**	Geotechnics I (5) Building design I (5) Roads, railways & airports I (5) **Advanced Mathematics II (6)**	Theory of traffic I (4) Methods of cost evaluation (3) European Culture (2) **Multidisciplinary project (5)** Final project (5) English (5)

Credits are in brackets. Those students that do not want to undertake the second level degree are allowed to replace some of the subjects (mainly

mathematics) of second and third year with more practical subjects. In total 18 credits (those in bold character) can be replaced by anticipation of some subjects of the specialized laurea, like, for example, Urban Planning, Concrete and pre-stressed concrete, Geotechincs II, Hydraulic Infrastructures II. The multidisciplinary project, for the students who do not continue, is replaced by the Technical Placement (10 credits), to be held in a firm or in a consulting office. The "multidisciplinary projects" (design-oriented learning) are hold by a group of teachers. The multidisciplinary project of the 1st year consists of the application of Mathematical tools to the solution of physical and chemical problems. The multidisciplinary project of the 3rd year consists of the complete design of a an industrial building and/or a river embankment.

Students that graduate the above-described three-year course will have a robust mathematical-scientific culture and some professional capacity. It is supposed that they will find a job in: a) consultant companies, b) building industry firms, c) technical staff of Municipalities or other local administration, d) civil-engineering yard. As far as design activities are concerned, it is supposed that they will be able to apply standard methodologies.

Annex A3 SPECIALISED LAUREA

Year	1st Period	2nd Period	3rd Period
1st	Experimental Physics (4) Technics for the building construction (6) Y1(10)	Materials Science & applied chemistry II (5) Building analysis (use & maintenance) II (5) Y2(10)	Geotechnics II (5) Concrete and pre-stressed concrete (5) Hydraulic Infrastructures II (5) Y3(5)
2nd	Y4(20)	Y5(20)	Multidisciplinary project or Technical Placement(10) Final project (15)

Y1 to Y5 = selected by students among various subjects contained in a list.

For example:

Y1	Rock Mechanics I (5) Earthquake Geotechnical Engineering (5)
Y2	Hydraulic of underground water (5) Design of structures (5)
Y3	FEM for structures I (5)
Y4	Concrete and pre-stressed concrete II (5) Foundations I (5) Structural retrofitting I (5) Rock Mechanics II (5) or FEM for structures II
Y5	Foundations II (5) Slope Stability (5) Dynamics of structures (5) Structure retrofitting II (5)

CIVIL ENGINEERING EDUCATION IN LITHUANIA

Vincentas Stragys [1], Povilas Vainiunas [2]

Introduction

The origination of Lithuanian higher education dates back to the 16th century, to the oldest East European university in Vilnius (Universitas Vilnensis). The attention to technical knowledge greatly increased at the 18th century when such disciplines as statics, dynamics, architecture, building structures etc. were being taught at the university. But in 1832 the university was closed under the Russian tsar's order and Lithuania for almost 90 years was deprived of the possibility to have its own institution of higher education.

After World War I engineering was taught at University in Kaunas, which in 1930 was named as Vytautas Magnus University.

In 1940 Lithuania was incorporated in the Soviet Union and for some years Lithuanian engineers were trained only at Kaunas Vytautas Magnus University and later at Kaunas Politechnical Institute because Vytautas Magnus University was closed. Today the main technical Universities in Lithuania where Civil Engineering is taught are:

Vilnius Gediminas Technical University and

Kaunas University of Technology.

Some Civil engineering programs are also offered at Klaipeda University, Lithuanian University of Agriculture and Siauliai University.

1. PRE-UNIVERSITY EDUCATION

It is common that pre-university education lasts 12 years and schoolchild finishes secondary education being 18 years.

2. GENERAL VIEW OF ENGINEERING EDUCATION

In Technical universities there are basic (academic and professional) studies, specialised professional studies, Master's degree and Doctorate studies.

Up to 1991 there was very strict Engineering education system and unique programs in all Soviet Union including Lithuania. In 1991 Lithuania restored it's independence and experienced principal reform.

[1] Professor, Vilnius Gediminas Technical University

[2] Professor, Vilnius Gediminas Technical University

Lithuania was one of the first from post- Soviet Union countries, which introduced two- tier system even before Bologna Declaration has been signed. Engineering education system in years 1990-2000 is given in figure 2.

Since 2000 non-university sector in higher education system, i.e. colleges have been established.

Therefore structural schema changed. Latest schema is given in figure 3.

Colleges are starting to implement non-university higher education study programs.

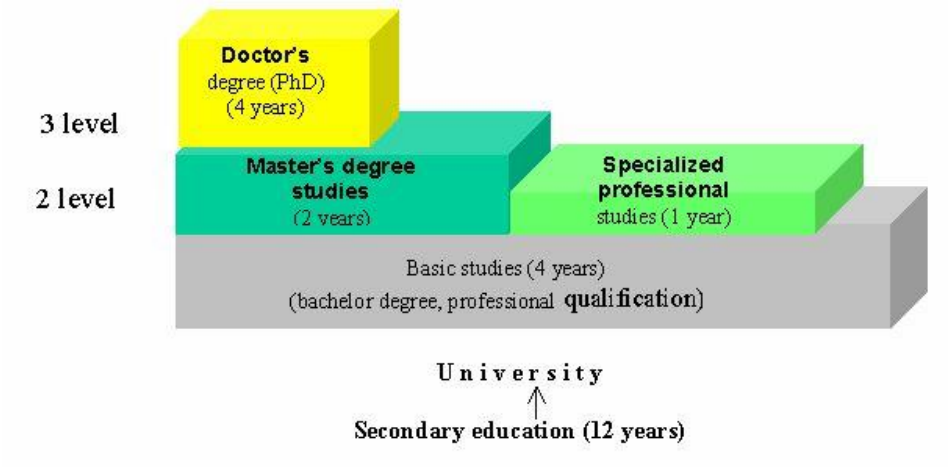

Figure 2 Engineering higher education system in 1990-2000

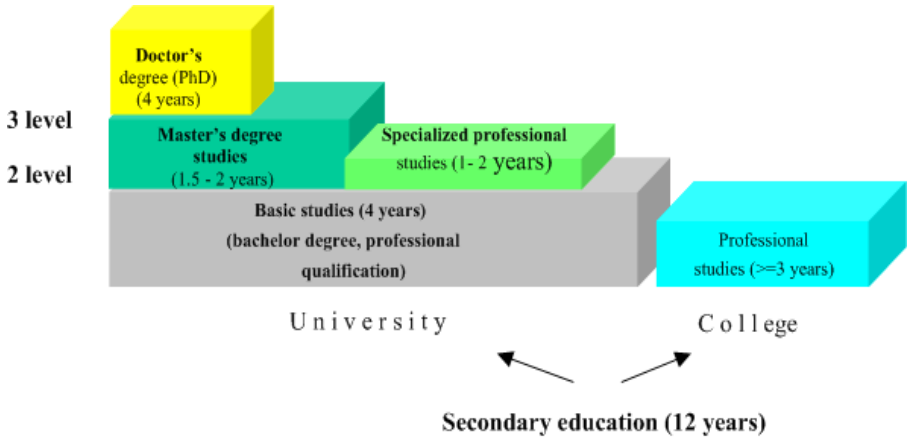

Figure 3 Engineering higher education system since 2000

2.1 Engineering education at undergraduate level

The duration of the undergraduate studies is 4 years, comprising 160 local credits, or 240 ECTS. One credit in Lithuania is equal to 1.5 ECTS. Having finished the basic academic studies, students are awarded Bachelor's degree and the right to study for Master's degree or to continue their studies in a specialized professional field.

After graduation of basic professional studies a student gets a higher education engineering qualification and also the right to continue his studies at postgraduate level.

2.2 Engineering education at postgraduate level

2.2.1 Master or Master-type programs

The duration of the Master's degree studies is 2 years, comprising 80 local credits. On completing the studies and defending the thesis students get a Master's degree and the right to continue their studies for Doctor's degree.

2.2.2 Doctoral programs

Doctor's degree studies and preparation of a dissertation take 4 years, comprising 160 local credits. Doctor's degree studies, preparation and presentation of Doctoral thesis are approved by regulations of the Doctorate Committees.

3. CIVIL ENGINEERING EDUCATION

Civil Engineering higher education studies are an integral part of Engineering studies. System of University studies in Civil Engineering is given in figure 4.

3.1 Undergraduate education

3.1.1 Bachelor's degree programs

Bachelor's degree programs are offered in five Universities of Lithuania.
In Vilnius Gediminas Technical University:

- Structural design;
- Construction technology and management;
- Building materials;

- Urban and road engineering;
- Environmental engineering;
- Surveying

In Kaunas University of Technology:

- Civil engineering

In Siauliai University

- Civil engineering

In Lithuanian University of Agriculture

- Hydrotechnics

In Klaipeda University

- Civil engineering

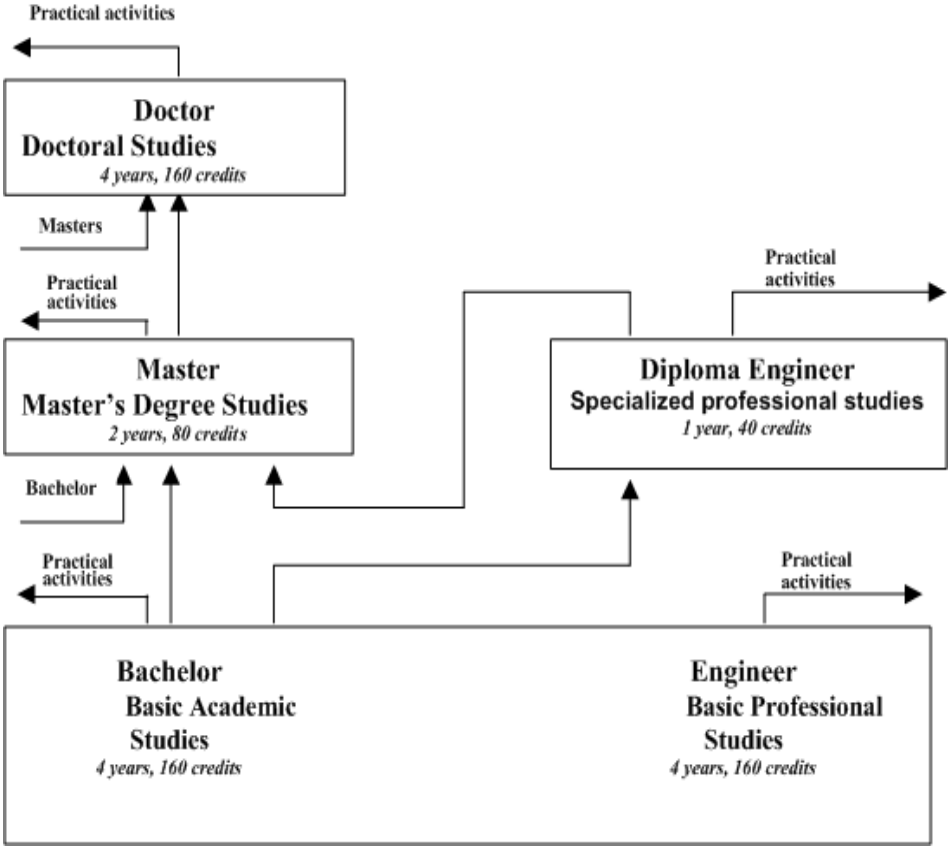

Figure 4 University studies in civil engineering

3.1.2 Bachelor's degree programs structure

Ratio of different categories of disciplines is common for all undergraduate programs and is given in figure 5.

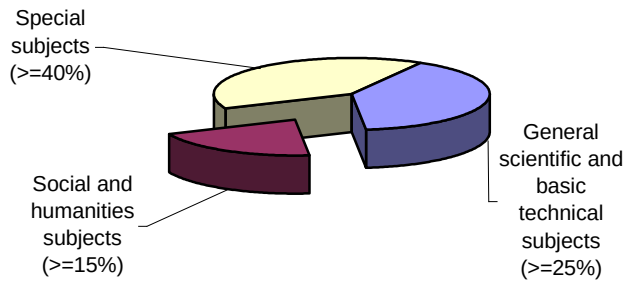

Figure 5 Bachelor's degree programs structure

3.1.3 Admission of students at the undergraduate level

Permanent residents and the citizens of Lithuania for the studies at the undergraduate and postgraduate levels are admitted according to the competition rules.

Persons from foreign countries are admitted to the universities by making a contract. It is signed under the agreed admission and academic conditions.

Persons having secondary education are admitted for the first year of the basic studies, and foreigners additionally must present the document ensuring the English language proficiency. Those who are entering the basic studies may apply for several study programs. Persons are selected in order of competition, according to the general sum of points accumulated by certain secondary school estimation points and the points of entrance test performed at the university. Most of study programs do not require entrance tests, except the architecture study program that requires to perform a drawing and composition test.

No entrance exams are necessary for starting Master's degree studies. Persons having obtained Bachelor's or equivalent degree may participate in the competition. The average grade of basic studies exams must be at least 7 out of 10. Priority is given for the following persons: the ones having the higher grades of basic studies evaluation; the ones who have carried out research works or creative activities. Lithuanian citizens and permanent residents are admitted to Master's degree studies in English in order of the general competition. The admission of foreigners to the Master's degree studies is organized by International Study Center.

Specialized professional studies may start without any entrance exams. Persons having Bachelor's degree of the corresponding type of basic studies (or equivalent ones) and the average grade of the exams at least 6 grades out of 10 may participate in the competition.

3.2 Civil engineering education at postgraduate level

3.2.1 Master or Master-type programs

Master's degree programs are offered in four Universities of Lithuania.
In Vilnius Gediminas Technical University:

- Structural design
- Construction technology and management;
- Environmental engineering;
- Bridges and Viaducts;
- Renovation of Buildings;
- Geotechnics;
- Building materials and products;
- Water supply and treatment;
- Road and traffic engineering;
- Geodesy and Cartography;

In Kaunas University of Technology:

- Civil engineering

In Lithuanian University of Agriculture

- Hydrotechnics

In Klaipeda University

- Port Construction engineering

Ratio of different categories of subjects for Master's degree programs is given in figure 6.

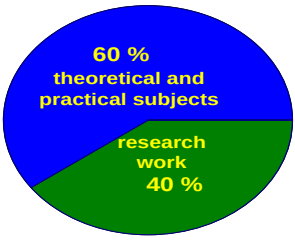

Figure 6 Master's degree programme structure

3.2.2 Doctoral programs

Doctoral programs in Civil Engineering are very specialized, they last 4 years and are offered only in Vilnius Gediminas Technical University and Kaunas University of Technology

4. RECENT TRENDS IN ENGINEERING EDUCATION IN THE COUNTRY

- Higher education study system Bachelor/ Master/ Doctor was implemented in 1991 – 1994 (in Engineering – 1990/1991);
- Transfer from narrow specialized studies to more general was done;
- ECTS systems was introduced;
- ERASMUS/SOCRATES student exchange and staff mobility was legalized and started;
- Possibility to get different level of education was introduced;
- During the last decade most of the employers understood this study system essence and accept it;
- Since 2000 non – university sector of higher education studies was established and binary system was created. In engineering sector non-university sector is still weak.

ANNEX

List of universities in Lithuania, where civil engineering studies are offered

Study programs at the Lithuanian universities are of several types:

a. Bachelor study programs (duration – 4 years), after completion of which the bachelor's or other equivalent qualification degree (until recently no such equivalent degrees were created) may be awarded;
b. Master study programs (duration 1.5-2 years), after completion of which master's or other equivalent degree (also not known until now) may be awarded;
c. Postgraduate study programs for professional engineer' qualification (duration 1-2 years), that still exists in the sphere of engineering/civil engineering studies;
d. Study programs for doctor's degree.

There are 15 universities in Lithuania, five from which have Civil Engineering study programs. Those are:

- Vilnius Gediminas Technical University - http://www.vgtu.lt
- Kaunas University of Technology - http://www.ktu.lt
- Klaipeda University - http://www.ku.lt
- Lithuanian University of Agriculture - http://www.lzuu.lt
- Siauliai University - http://www.su.lt

Vilnius Gediminas Technical University (former Vilnius Civil Engineering Institute) was founded in 1969 and proposes very wide range of programs for studies Civil Engineering in two faculties, i.e. Civil Engineering faculty and Environmental Engineering faculty.

Kaunas University of Technology (former Kaunas Politechnical Institute) was founded after the Second Word War on the basis of the before closed Vytautas Magnus University. The main areas of studies at the university are – engineering and management. Civil Engineering is taught in the faculty of Civil Engineering and Architecture and in the faculty of Technology.

Klaipeda University was founded on a basis of faculties of different higher education institutions. It offers wide range of study programs including different type of engineering programs: shipping, environmental protection, chemical engineering, management, civil engineering. Civil Engineering is taught in the faculty of Marine Technology. Bachelour studies program in Civil Engineering

is titled – Civil Engineering and program for master studies is specialized to Port Construction Engineering.

Lithuanian University of Agriculture (former Lithuanian Academy of Agriculture) was founded in 1934. Study programs of this University are focused to agriculture: agricultural engineering, agronomy, management in agriculture, home economics, forestry, etc. Civil Engineering is taught in the Water and Land Management faculty.

Basic, professional postgraduate and Master Programs are titled "Hydrotechnics".

Siauliai University is the newest University in Lithuania. It was founded just recently (in 1997) on the basis of Siauliai Pedagogical Institute and faculties of Kaunas University of Technology. The main specialization of University is to prepare teachers for primary school as well as teachers for primary education. A number of students of management and engineering are also attending courses at this university. Civil Engineering is taught in the Faculty of Technology.

CIVIL ENGINEERING EDUCATION IN LATVIA

Juris Rihards Naudzuns[1], Juris Smirnovs[2]

Summary

There are two universities in Latvia offering higher education in the field of Civil Engineering - Riga Technical University (RTU) and Latvia University of Agriculture (LUA). Both institutions provide academic programmes organised in accordance with Bologna Declaration at two levels, which allow obtaining bachelor, master and doctoral degrees in civil engineering, as well as professional higher education programmes.

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 the post-graduate studies or enter the professional studies cycle. Upon the completion of the Master's studies, a student may pursue the doctoral program to be awarded the Dr.Sc.Ing.

Having completed the professional studies program, students receive the Engineer's qualification. Upon the receipt of this qualification, students may continue their education in pursuit of an academic or scientific degree, provided they have fulfilled the requirements posed.

The latest trend shows a tendency of student's number increasing in both universities as well as change in students orientation from academically oriented education to professional. The worst times for higher education in civil engineering were during the mid-nineties, when total number of students decreased drastically. The numerical dynamic of accepted first-year students in the Faculty of Civil Engineering in RTU is provided below.

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Number of students	89	135	151	203	168	185	197	238	240	240	243

Objectives of the paper are:

- To summarize the Latvian experience in reorganizing of higher civil engineering education after winning of independency in 1991;
- To show latest trends in the field of higher civil engineering education;
- To emphasize the binary higher civil engineering education structure in both universities.

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1. HIGHER EDUCATION SYSTEM

The system of higher education in Latvia is binary since the Law on Education Establishments (1995) sets a difference between academic and professional higher education. The popularity of professional programmes is growing rapidly - in the academic year 1998/99 professional programmes attracted more than double number of new enrolees compared to the Bachelor programmes. The binary structure of higher education system in Latvia however is not strictly institutionalised, therefore one can see universities running professional programmes and institutions not bearing the name of university running academic programmes. In principle, three groups of programmes can be distinguished: - academic programmes leading to academic degrees, - professional programmes based upon a standard of the first academic degree thus making graduates eligible for further academic studies, and, finally - the applied professional programmes oriented towards higher professional qualifications but not providing background for direct admission to further academic studies" (1 - http://www.aic.lv/En/default.htm)

1.1 Engineering education at undergraduate level; various types

Professional higher education

"The Law on professional education" (1999) provides for higher professional programmes of two levels: college programmes, leading to Level IV professional qualifications, and professional higher education programmes leading to Level V professional qualifications. In a number of professional fields it is possible to establish college programmes as the first cycle of professional higher education" (1- http://www.aic.lv/En/default.htm).

College programme in Civil Engineering is opened in RTU with three-year duration and is considered as the first cycle of higher professional education. Civil Engineering on college level is taught also in Riga Construction College (Rigas Celtniecibas koledza). This programme leads to Level IV professional qualifications (theoretical and practical preparedness for performing sophisticated executive tasks and for organisation and management of other specialists' work) and give credit to one's further studies in the second cycle of professional higher education" (1- http://www.aic.lv/En/default.htm)

1.2 Engineering education at postgraduate level

1.2.1 Master or Master-type programmes

Master degree in Civil Engineering is awarded after the second stage of academic education and requires total duration of university studies at least 5 years. In accordance with document set up by Cabinet of Ministers starting with year 2002 Master studies have to be no longer than 2 years after Bachelor studies.

1.2.2 Doctoral programmes

Doctoral studies. The degree of Magistrs (or the equivalent) is required for admission to doctoral studies. The degree Doktors, which usually is internationally recognised as a Ph.D., can be achieved at public defence of a doctoral thesis. Doctoral studies last four or (more seldom) three full-time years. They include advanced studies of the subject as well as a research towards doctoral thesis. Publications in internationally quoted scientific journals are required before defence of the doctoral thesis. In the past, especially while most research institutes in Latvia were outside the universities, an equivalent amount of independent research and passing of the appropriate doctoral examinations while working at a research institution very often replaced doctoral studies. At present, regular studies in doctoral study programmes at the universities and having thesis research as an integral part of study programme is becoming the main way ”(1- http://www.aic.lv/En/default.htm).

2. CIVIL ENGINEERING EDUCATION

2.1 Undergraduate education

2.1.1 Short description for each type of programme

General Information

Academic year consists of two semesters. In both universities offering the higher education in Civil Engineering field - in Riga Technical University and Latvia University of Agriculture – length of semesters is the same – 16 weeks. Number of contact hours per week in RTU is 20, in LUA – 16 to 24. After each semester there is four weeks long examination session.

2.1.2 Short description of the main features of the curriculum for each type of programme

Credit point system used in Latvia is rather close to that of ECTS. It has to be emphasized, that “weight” of Latvian credit point is 1,5 times bigger than that of ECTS, i.e. 1,5 ECTS credit points = 1 credit point in Latvia.

BACHELOR STUDY PROGRAMS

In Riga Technical University

Previous education*:* *general secondary.*
Study duration*:* *3 years*
Study volume*:* *122credit points (CP),*
Educational document issued*:* *Bachelor diploma*

General information on contents of the programmes

The subject structure and average ratio of lectures/other contact hours of **the study program of Bachelor's degree** in Civil Engineering sciences (B.sc) is given in the 1.and 2. tables.

Table 1

	Credit points	Weight in %
Obligatory disciplines at RTU	29	23,8
Humanitarian-social subject block	4	3,3
Economy subject block	2	1,6
Obligatory disciplines of civil engineering	56	45,9
Optional subjects of program	14	11,5
Foreign languages	3	2,4
Free choice subjects	4	3,3
Bachelor's thesis	10	8,2
TOTAL	**122**	**100**

Table 2

No.	Type of activity	Classroom hours	Weight in %
1	Lectures	80	65
2	Practical work	25	21
3	Laboratory work	17	14
	Total	122	100

ENGINEER TYPE STUDIES – Bachelor of Engineering (B.Ing.)

There is also possibility for students to start study in professional branch after completing the comprehensive secondary school. For example is given description of such type programs carried out by RTU.

Level of Study	*Bachelor of Engineering*
Nominal Study Length	*4,5 years*
Credit Points	*180*
Prerequisites	*Comprehensive Secondary*
Qualification	*Civil Engineer*

The Bachelor of Engineering programmes in Riga Technical University are offered in such fields:

- Civil Engineering;
- Transportation Engineering.

After a successful fulfilment of study requirements student is granted with the **professional bachelor's degree either in Transportation Engineering or Civil Engineering and professional Engineering qualification**.

For the purpose of comparison, programme has been split into groups. Within this context, following grouping is used: 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 programme is presented in table 3.

Table 3

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

As it can be seen, considerable proportion of the programme is formed by professional engineering specific subjects (32,8+5=37,8%). This fact allows to account for students professional preparedness and it is also in line with

knowledge level defined by Bolognese 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.

Knowledge level in professional bachelors programme 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

In Latvia University of Agriculture

The undergraduate programmes at LUA require a minimum of 162-168 course points (credits) - CP. One CP is equivalent to 24 academic classroom hours or to one week of studies or to one week of field training or to two weeks of practical training. "The structure of the professional education programmes is the following:

- **part A** - studies of general courses common for LLU (24,5 CP): courses in the Humanities (Ethics, Aesthetics, Psychology, Pedagogy, Sociology), Philosophy, Economics and Principles of Market Economy, Foreign Languages for special purposes, Law and Legislation, Environmental Protection and Ecology, Ergonomics, Physical Training;
- **part B** - compulsory courses - mathematics, physics, computer science, graphic arts for engineers, mechanics, resistance of materials, mathematical modelling etc..;
- **part C** - compulsory courses - mechanics of building structures, soil mechanics, foundations, geology for engineers, geodesy, roads, bridges, metal structures, wood and plastic structures, hydrotechnical structures, water supply and sewage systems, building materials, architecture of building, building technology, economics of building etc. Elective courses in efficient delimitation structures, design of public houses, design of farm buildings, foundations at special conditions, etc (Rauhvargers, Brensone, 1998/99, 118)

The compulsory courses cover 70-80% of the volume of the professional programme, the electives - 20-30%" (Rauhvargers, Brensone. 1998/99, 107)

In both universities, Bachelor programs are finalized by bachelor's work presentation and successful defending of it. Part of Bachelor's studies program in Civil Engineering in both universities is standardised.

2.1.3 Admission of students at the undergraduate level

Access to higher education.

In Riga Technical University admission is organized on a competition. Starting from 2004. the results of centralised exams are taken as a competition basis.

In LUA admission is organized on a competition based on secondary school transcripts.

The latest trend shows a tendency of student's number increasing in both universities. Also the admission requirements are higher in comparison with previous years and it allows saying that quality level of student knowledge has to be better. The numerical dynamic of accepted first-year students in the Faculty of Civil Engineering in RTU is provided in Table 4.

Table 4

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Number	89	135	151	203	168	185	197	238	240	240	243

2.2 Civil engineering education at postgraduate level

2.2.1 Master or Master-type programmes

In RTU and LUA Master studies are organised as **taught and research master** studies. Short overview of program structure is given below:

In Riga Technical University

Previous education:	*bachelor (B.sc.) degree in Civil engineering or (B.Ing.) degree in Civil/Transportation engineering*
Duration of studies -	*2 years*
Credit points -	*80 credit points (CP),*
Educational document issued:	*Master diploma (M.sc.Ing.)*

The Master's programme in Riga Technical University in Civil Engineering is offered in such fields

- in structural engineering and reconstruction;

- in descriptive geometry and engineering computer graphics
- in transportation engineering
- in building technology;
- in building material production;
- in computer aided design in civil engineering;

The subject structure and lectures/other contact hours ratio of **the study program of Master's degree** in Civil Engineering sciences is given in tables 5 and 6.

Table 5.

	Credit points	**Weight, in %**
Humanitarian-social subject block	4	5
Obligatory disciplines of building profile	36	44,3
Obligatory disciplines of the respective area of building program	17	21,0
Optional subjects	4	5,0
Master's thesis	20	24,7
TOTAL	**81**	**100**

Table 6

No.	Type of activity	Classroom hours	Weight, in %
1	Lectures	48-58	60-72
2	Practical work	12-18	15-22
3	Laboratory work	5-10	7-13
	Total	81	100

ENGINEER TYPE STUDIES – Master of engineering (M.Ing.)

After Bachelor studies, students can choose also the professional engineer education, what is based on bachelor's degree. For example is given such type of program carried out by RTU.

Program in RTU	*Civil Engineering*
Level of Study	*Master of Engineering*
Nominal Study Length	*1 year*
Credit Points	40
Prerequisites	*bachelor (B.sc.) degree in Civil engineering or (B.Ing.) degree in Civil/Transportation engineering*
Qualification	*Civil Engineer*

The programme lasts for one year and consists of 40 credit points. After a successful fulfilment of academic requirements student is granted with the

professional master's degree either in Transportation Engineering or in Civil engineering.

The Master of Engineering programmes in Riga Technical University are offered in such fields:

- Civil Engineering;
- Transportation Engineering.

Organisation of professional masters programme is presented in table 7.

Table 7.

	Credit Points	**Weight, in %**
• Core courses	8 credits	20%
• Optional core courses: o specialisation courses o courses of pedagogy and psychology	6 credits 4 credits 2 credits	15% 10% 5%
• Praxis	6 credits	15%
• Master's thesis	20 credits	50%
Total:	**40 credits**	100%

Section of compulsory core courses provides two significant theoretical and practical subjects. Section of optional core courses is divided in specialisation subjects of 4 credits and pedagogy/psychology subjects of amount of 2 credit points. Only 6 credit points are allocated for praxis. That is due to the main attention to be directed to elaboration of thesis. Such organisation of the programme allows to account for students professional preparedness and it is also in line with knowledge level defined by Bologna Declaration for academic category "graduate".

In accordance with standards passed by Cabinet of Ministers, second level highest professional studies have to consist of subjects of at least 7 credit points, which ensures student ability to operate with the state-of-the-art knowledge. As all core courses fall in this category (8 credits in total) standard requirement is fulfilled.

Research, design related and management courses should not be less than 5 credit points. Section of optional core course include number of subjects of this criteria totally in 6 credit points, thus requirement is satisfied.

Subject of pedagogy and psychology form 2 credit points that means standard requirement is fulfilled.

Total time to be spent on professional master's programme depends on time amount of previous studies in bachelor's level.

If a student has professional bachelor's degree either in Transportation Engineering or in Civil Engineering (study period 4,5 years), then total time necessary to obtain professional master in a similar branch is 4,5 + 1 = 5,5 years, i.e. more than 5 years required as a minimum by the standards. On the other hand, if the student obtained bachelor's degree (B.Sc.) in Civil Engineering (length of studies 3 years) then for the master 3 + 2,5 = 5,5 years are required. This fits with the standards because for the latter category of students additional subjects are scheduled.

Provision of praxis and master's thesis, respectively 6 and 20 credits points, comply with the regulations Nr. 481 of Cabinet of Ministers.

The following course structure (table 8) presents the study program in building and civil engineering after the first bachelor's (B.sc.) degree:

Table 8.

	Credit Points	**Weight, in %**
Cluster of humanities and social sciences courses	2	2
Mandatory courses for the particular direction of the study programme	21	21
Limited selection courses for the particular direction of study	19	19
Master thesis with Engineering Project	26	26
Praxis	32	32
Total	**100**	**100**

Program is finalised by presentation and successful defending of master thesis with engineering project.

In Latvia University of Agriculture

Graduate Programme in Civil And Hydraulic Engineering

Faculty	*Rural Engineering*
Degree	*Master of Science in Engineering (Mgr.sc.ing.)*
Diploma	*Mgr.sc.ing.*
Admission Requirements	*Baccalaureate degree (B.sc.ing.) – four-year studies or Diploma of professional qualification (five-year studies) in civil engineering or water management and land reclamation*
Duration of Studies	*two years.*
Degree Requirements	*Completition of the whole graduate study program, passing of the Master's examinations in civil or hydraulic engineering and presentation of the Master's thesis*

The graduate programme in Civil and Hydraulic Engineering are offered in such fields:

- projection and architectural design of buildings;
- landscape architecture;

- mechanics of materials, structural analysis and optimisation;
- reconstruction of buildings;
- technology of construction and structural repairs;
- building of hydraulic engineering;
- water supply, canalisation and waste water treatment;

The content of the special parts of the Graduate Program:

- general basic subject such as ecology, soil mechanics and foundations, computer added design of building construction, quality control and certification of building, material modelling and system analysis, methods of scientifical research and experimental planning, ethics for engineers etc.;
- special subject selected according to the individual research and study field of M. sc. student (2 – http://www.llu.lv)

2.2.2 Doctoral programmes

In Riga Technical University

Previous education: *M.sc.Ing. or M.Ing. degree in Civil Engineering*
Duration of studies: *3 years*
Credit points: *144 CP*
Educational document: *Doctor diploma (Dr.sc.Ing.)*

The Doctor's programme in Riga Technical University in Civil Engineering is offered in such fields:

- structural engineering and reconstruction
- transportation engineering
- computer aided design in civil engineering.

The subject structure of the study program of Doctorate in Civil Engineering sciences is given in table 9:

Table 9.

	Credit Points	**Weight, in %**
Building branch sciences disciplines	30	20,8
Foreign languages	6	4,2
Optional subjects	6	4,2
Development of scientific project	102	70,8
TOTAL	**144**	**100**

In Latvia University of Agriculture

Previous education: *Master academic degree in Civil Engineering*

Duration of studies: *3 years*
Credit points: *144 CP*
Educational document: *Doctor diploma*

The Doctor's programme in Latvia University of Agriculture is offered in Civil engineering.

Persons having passed the necessary entrance examinations are enrolled in the Doctoral studies in the sequence of competition. The sequence of enrolment is determined by the regulation of the Doctorate studies.

The duration of the Doctoral studies is 3 years for full-time studies. The duration of the Doctoral studies of full-time and part-time financed by physical and juridical persons is not limited.

The study programs envisage the investigation in the basic subject (lectures and individual work), development of practical skills (laboratory works, seminars and practical training), pedagogical activities (lectures, tutorials etc.), as well as carrying out scientific research. In order to increase drastically the personal contribution in scientific research, the amount of the scientific work was increased up to 94...114 CP in the training process, while the required extent of theory studies was reduced up to 30...50 CP.

Degree of Doctor of engineering sciences (Dr.Sc.Ing) is awarded after successful presentation and defence of dissertation.

3. RECENT TRENDS IN ENGINEERING EDUCATION IN THE COUNTRY

Starting from 2004, *Academic and professional* studies in civil engineering at RTU are organised in accordance with Bologna Declaration at two levels. Upon the completion of the first level, students are conferred the bachelor's (B.sc. or B.eng.) degree, which grants them the right either to continue education in the post-graduate studies or enter the professional studies cycle.

Upon the completion of the Master's studies, a student may pursue the doctoral program to be awarded the Dr.Sc.Ing.

Professional studies at RTU may be undertaken:

- Upon the completion of the Bachelor's degree;
- Upon the completion of a comprehensive secondary education.

Having completed the professional studies program, students receive the Engineer's qualification and degree Bachelor of Engineering. Upon the receipt of this qualification, students may continue their education in pursuit of

an academic or scientific degree, provided they have fulfilled the requirements posed.

Literature&sources

1. http://www.aic.lv/En/default.htm
2. http://www.llu.lv
3. A.Rauhvargers, I.Brensone. Higher Education in Latvia. – Riga, 1998/99- 292p.
4. Riga Technical University 2001/2002. – Riga – 2001.- 23 pages.

ANNEX 1 Higher Educational Institutions Offering Civil Engineering Education Of Various Kinds

RIGA TECHNICAL UNIVERSITY

Founded 1862 as Riga Polytechnic Institute, 1919 -1958 existed as several faculties of Latvia University, 1958 re-established as Riga Polytechnic Institute, present name since 1990

Status: State university
Financing: state-financed
Address: Kaļķu iela 1, LV-1658, Rīga, Latvia.
Telephone : +371 - 7225885
www: http://www.rtu.lv
E - mail: rtu@adm.rtu.lv
Fax: +371 - 782 00 94

LATVIA UNIVERSITY OF AGRICULTURE

Founded 1863 as Agriculture Department of Riga Polytechnic Institute;
1919 - 1939 - existed as Faculty of Agriculture at University of Latvia.
1939 - 1990 existed as Academy of Agriculture, present name since 1990

Status: State institution
Financing: State-financed
ADDRESS: Lielā iela 2, Jelgava LV-3001, LATVIA
Phone: + 371 - 30 - 22584
Fax: + 371 - 30 - 27238
www: http://www.cs.llu.lv

E-mail: rector@inka.cs.llu.lv

THE CIVIL ENGINEERING EDUCATION IN NETHERLANDS

Helen Wasmus[1]

1. GENERAL VIEW OF PRE-UNIVERSITY EDUCATION

University Preparatory Education (VWO)

§ Pre-university education (VWO), is lasting six years and intended for pupils aged 12 to 18 years.It prepares pupils mainly for admission to university.

VWO begins after seven to eight years of primary education and its purpose is to prepare students for university. As such VWO offers the highest level of general secondary education available in the Netherlands.

The first stage (first three years) provides a broad-based general education for pupils between 12 and 15 with no strict dividing line between general and technical subjects.

The second stage encompasses the 4th to 6th years of VWO. Pupils choose one of 4 sets of subject groups combinations ("profiles"):

- Culture and society;
- Economics and society;
- Science and health care;
- Science and technology.

The final examination has two parts: a school examination, consisting of a series of tests in all subjects through-out the 4th to 6th year; and a national examination, taken in May and June of the 6th year. The school examination is set and marked by the school; the national examination is the same for all VWO schools to guarantee a uniform standard for the diploma. A VWO diploma gives direct access to university education. The two profiles science & health care and science & technology give access to all programs of Delft University of Technology and the other two universities of technology in the Netherlands.

The VWO program covers in all cases the liberal arts and basic sciences that are taught in the U.S., for example, in the first two years of college or university. Dutch students therefore concentrate on their major field of study from the moment they enter university.

2. GENERAL VIEW ON THE ENGINEERING EDUCATION

2.1 Engineering education at undergraduate level; various types

In the Netherlands two types of engineering education are offered:

a. engineering programs at university level
b. engineering programs at vocational level.

[1] Director of Studies, Department of Civil Engineering, Delft University of Technology

The programs at vocational level, the so called HBO programs concentrate on applied science and train students for professions that require both scientific knowledge and the skills that put that knowledge to work in specific situations. A HBO program is therefore almost always closely associated with a particular occupation. Emphasis is placed on practicality and longer periods of internship are an integral part of the program. HBO programs take four years to complete.

University education prepares students for the independent pursuit of knowledge in an academic or professional setting. Engineering programs at university level take nominally five years.

2.2 Engineering education at postgraduate level

2.2.1 Master or Master-type programmes

Civil Engineering education at postgraduate level is only offered at university level.

2.2.2 Doctoral programmes

Doctoral or PhD programs as such are not offered. Gaining a doctorate in the Netherlands is done by doing a highly individual piece of research. In case a candidate feels that he or she wants to take a set of courses this is an individual program.

3. CIVIL ENGINEERING EDUCATION

3.1 Undergraduate education

3.1.1 Short description of each type of programme

From September 2002 the Faculty of Civil Engineering and Geosciences, Delft University of Technology has a three-year BSc-programme in Civil Engineering In the BSc-programme the whole range of civil engineering subjects are covered. This program is 126 credits, which equals 180 ECTS. Most courses are compulsory, especially in the first two years. In the first semester of the third year students choose a field of interest. The courses offered in these fields are a first step towards one of the six MSc-variants. Each variant offers a so called package of two courses, together approx. 18 ECTS credits. Up to that students can take another approx. 18 ECTS credits electives from the BSc-electives shortlist.[2]

[2] In the annex 1 is given the Bachelor programme in Civil Engineering for the academic year 2003 – 2004.

The BSc-program Civil Engineering contains a solid core of mathematics and computer science (35 ECTS credits), mechanics, (including fluid mechanics and dynamics) (40 ECTS credits), structural engineering, materials science and constructive design. Furthermore the program covers the entire field of civil engineering subjects, management, law and planning. 17 ECTS credits are spent on project work. The BSc-program is completed with a BSc-thesis of 8,5 ECTS credits.

The University Twente offers a BSc in Civil Engineering & Management. For a program description we refer to their web site.

The schools for vocational education (HBO) offer a four year program: the first two years in school, one year of internship (most of the time in more than one position) and a final year in which the student does a graduation project (see annex 3).

3.1.2 Short description of the course curricula for each type of programme

For a description of the HBO-programs we refer to their web sites.

3.1.3 Admission of students at the undergraduate level

Admission to Civil Engineering at university level is granted to all students with the appropriate VWO-diploma i.e. all students with the profile Science and health care and the profile Science and technology or students who have completed the first year of a HBO-program in Civil Engineering. There is no entrance examination and no numerus fixus. Admission to Civil Engineering at HBO-level is granted to all students with the appropriate Senior General Secondary Education (HAVO)-diploma with the right profiles. There is no entrance examination and no numerus fixus.

3.1.4 Accreditation of degrees

Quality control and program evaluation are the responsibilities of the universities themselves. University departments are visited according the following procedures:

- periodic visits by an external committee are organised every five years for each discipline;
- the committee consists of experts in the field to be assessed; members come from universities, professional organisations and industry and from abroad.
- departments perform a self analysis , which is the basis for the review by the external committe;
- the task of the visiting committee consists of assessing the quality of education during a two day visit to the department concerned;

- a final public report on the discipline visited includes conclusions and recommendations.

The National Accreditation Board supervises this process of quality control and evalation. The Board grants accreditation.

3.2 Civil engineering education at postgraduate level

3.2.1 Master or Master-type programmes

Master programs in civil engineering only exist at university level. Some HBO's offer master programs in civil engineering related specialisations. For more information we refer to the web sites.

Within the master program the following variants are possible:

- Building Engineering
- Structural Engineering
- Transportation and Planning
- Hydraulic and Geotechnical Engineering
- Water management
- Offshore Engineering

Within these variants a great diversity of specialisations and topics are offered.

Each variant has a core of compulsory courses of app. 47 ECTS credits, a choice of 2 of the following 4 modules of 11 ECTS credits each: Traineeship, multidisciplinary Masterproject, extra package of elective courses or extra thesis work. Furthermore 17 ECTS credits are free electives. The MSc-program is completed with a 37 ECTS credits MSc-thesis.[3]

The University Twente has a MSc in Civil Engineering & Management under construction (message on their web site 16 April 2003). For a program description we refer to their web site.

3.2.2 Doctoral programmes

As explained in par. 2.2.2. the Dutch university system does not know doctorate programs as such. To obtain a "doctoraat", roughly equivalent to the Ph.D., there is a procedure known in Dutch as the "promotie". There are two ways to obtain this degree.

Most candidates are appointed as assistant researcher. For a period of four years, during which the thesis has to be completed, these assistants do the research necessary for the dissertation, take some courses and do some teaching.

[3] In the annex 2 are given curricula valid in 2003-2004 for the 6 variants of the master programs offered by the Department of Civil Engineering at Delft University of Technology.

There are a limited number of assistant researcher posts available at each university and in most cases competition is tough.

Furthermore it is possible to complete the "doctoraat" all by one self. The only requirement apart from the MSc-diploma is that a full professor be willing to supervise the candidate's research and give her/his approval before the dissertation is published.

4. RECENT TRENDS IN ENGINEERING EDUCATION IN THE COUNTRY (particularly in relation to the Bologna Process)

Dutch universities work on full speed to adapt their programs to the BSc-MSc-structure as was decided on in the Bologna declaration. Delft University of Technology offers its programs according the Bsc-MSc structure from September 2002 on for all fields of study and is ready to receive students from the participating countries. All courses in the Master programs are taught in English or, if not, special classes are organised for the foreign students.

Annex 1

Bachelor programme Civil Engineering schedule 1st year 2003 - 2004

Quarter 1		Quarter 2		Quarter 3		Quarter 4	
WI1316CT Calculus	2	WI1316CT Calculus	2	WI1317CT Lineair algebra	2	WI1317CT Lineair algebra	2
CT1121 Sustainable development	2						
CT1031 Structural mechanics 1	3	CT1021 Dynamics 1	3	CT1041 Structural mecanics 2	3	CT1102 Intr. Urban & regional planning, law & policy science	3
CT1051 Basics on structural engineering 1	1	CT1051 Basics on structural engineering 1B	1,5	CT1210 Management of building processes	2	CT1051 Basics on structural engineering 1C	0,5
CT1101 Introduction to civil engineering	2	CT1130 Geo-information	2	CT1111 Engineering drawing	1	CT1090 Modelling in civil engineering	2
CT1111 Engineering drawing	1	CT1060 Civil engineering project work 1	2	CT1060 Civil engineering project work 1	2	CT1310 Hydrology	3
Total	11	Total	10,5	Total	10	Total	10,5

Bachelor programme Civil Engineering schedule 2nd year

WI2253CT Differential equations	3	WI3097CT Numerical mathematics	3				
CT2121 Lab experiment	0,5	CT2121 Lab xperiment	0,5			CT2022 Dynamics of systems	2
		CT2122 Material Science	2	CT2051 Advanced basics on structural engineering 2A	3	CT2051 Advanced basics on structural engineering 2B	2
CT2100 Hydraulics	2	CT2100 Hydraulics	2	CT2031 Structural mechanics 3	3		
CT2090 Soil mechanics	2	CT2090 Soil mechanics	2	CT2330 Foundation engineering	2	CT2320 Introduction to coastal engineering	3
CT2071 Introduction to planning	3					CT2060 Civil engineering project work 2	4
		CT2081 Computer applications in civil engineering	1	CT2081 Computer science in civil engineering	2		
Total	10,5	Total	10,5	Total	10	Total	11

Σ = 42

Bachelor programme Civil Engineering schedule 3rd year

Quarter 1		Quarter 2		Quarter 3		Quarter 4	
WI3102CT statistics	2	WI3103CT Risc analysis	2				
CT3051 Structural engineering 3A	2	CT3051 Structural engineering 3B	2				
CT3041 Traffic engineering	4	CT3053 The building cycle	1				
CT3011 Introduction to water management	3	CT3071 Design of buildings	4	CT3060 Civil engineering project work	4	CT3000 BSc thesis	6
		Electives	3	*Electives*	3	*Electives*	3
		A-electives: CT3711 Traffic, roads and railways	3	A-electives: CT3211 Building structures 1	3		
		A-electives: CT3109 Structural mechanics 4	3	A-electives: CT3221 Building physics and building engineering	3		
		A-electives: CT3410 Water management	3	A-electives: CT3121 Steel constructions 2	3		
		A-electives: CT3320 Groundwatermechanics and -flow	3	A-electives: CT3150 Concrete constructions 2	3		
				A-electives: CT3310 Open channel hydraulics	4		
				A-electives: CT3420 Sanitary engineering	3		
				A-electives: CT3721 Planning, design and construction of infrastructure	3		
Total	11	Total	9 or 12	Total	10 or 13	Total	9

Σ = 42

Five of the six Master variants prescribes a set of two A-electives as compulsory courses. Beyond that students may chose another two courses in the so called B-space out of a short list that contains all A-electives, some mathematics and a number of courses offered by the faculty of Technology, Policy and Management. The latter are mainly courses in the field of law, management and languages.

Annex 2

Master programs offered by the Department of Civil Engineering at Delft University of Technology in 2003 - 2004

BUILDING ENGINEERING

This variant is primarily concerned with technological and physical aspects of buildings.

The appreciation of buildings does not only depend on their architecture, but is also determined by quality demands related to functionality, building physics and building technology.

During the variant emphasis is put on solving building engineering problems, which demands a basis of precise scientific knowledge. To obtain the required insight and skills in tackling these problems, students must have acquired substantial knowledge of utility aspects of building, building physics, materials science, structural design, building services and finishing works. Besides these subjects the programme of study also enables the students to acquire knowledge of foundations and structural subjects such as concrete steel, timber, as well as statics in specific relation to buildings.

Compulsory for all Civil Engineering students

Philosophy, technology assessment and ethics in civil engineering 4,3 ECTS
A choice of 2 of the following modules: 22,8 ECTS
traineeship (11,4 ECTS)
multi disciplinary project (11,4 ECTS)
package of (elective) courses (11,4 ECTS)
extra thesis work(11,4 ECTS)

Thesis 37,2 ECTS

Compulsory for all Building Engineering students

A choice of 3 of the following courses:

architecture and building engineering	4,3
facades 2	4,3
building physics	4,3
building structures 2	4,3

A choice of 2 of the following courses:

real estate development management	4,3
building informatics	4,3
knowledge management in building processes	4,3

design and construct in ce	4,3
A choice of 2 (or more) of the following courses:	
structural mechanics 4: elasticity, plasticity and failure	4,3
structural mechanics 5:elastostatics of slender structures	4,3
steel structures 2	4,3
concrete structures 2	4,3
timber structures 1	4,3
Free elective courses	
management in building industry	4,3
building component and material specification	4,3
high-rise buildings	1,4
conservation of the structural heritage	2,9
technical building services	2,9
applied building physics	2,9
constructief ontwerpen b.o.	4,3
problem definition and problem solving for civil engineers	4,3
system dynamics	4,3
civil engineering informatics exercise	5,7
special subjects: civil engineering information systems	2,9
special subjects: model integration and simulation in ce2	2,9
special subjects: graphic data analysis 2	2,9

STRUCTURAL ENGINEERING

Six specializations:

- Structural mechanics
- Concrete structures
- Steel structures
- Timber structures
- Materials sciences
- Road and railway engineering

The basis of Structural Engineering consists of the exact sciences: mathematics, physics, chemistry and mechanics.

In educating civil engineers, structural mechanics plays an important role. In combination with materials science and material engineering it teaches the foundation for the design, construction and maintenance of structures, ranging from typical hydraulic engineering works and bridges to the structural skeletons of tall buildings.

Thesis work can be devoted to different fields, depending on the student's interest. One can focus on: functional design, construction or maintenance. Another possibility is theoretical or experimental research. This research can be of a general nature, stressing a particular phenomenon, or deal

with a particular structure needed for the functional design. In a number of cases co-operation with other groups is essential, i.e. for subjects in offshore, architectural engineering and foundation engineering. New thesis subjects are found in CAD, structural Informatics and computational mechanics.

Compulsory for all Civil Engineering students

Philosophy, technology assessment and ethics in civil engineering	4,3 ECTS

A choice of 2 of the following modules 22,8 ECTS

- traineeship (11,4 ECTS)
- multi disciplinary project (11,4 ECTS)
- package of (elective) courses (11,4 ECTS)
- extra thesis work(11,4 ECTS)

Thesis	37,2 ECTS

Compulsory for all Structural Engineering students

elastostatics of slender structures	4,3
plates and slabs	4,3
materials and ecological engineering	4,3
timber structures 1 *	4,3
steel structures 3	4,3
structural dynamics	4,3
prestressed concrete	4,3

Compulsory for all Structural Mechanics students

A choice of 3 of the following courses:

concrete structures 2	4,3
structural reliability	4,3
structural dynamics	4,3
theory of plasticity	4,3
repair and maintenance of materials in constructions	4,3
finite element method for structures	4,3
theory of elasticity	4,3

Compulsory for all Concrete Structures students

A choice of 3 of the following courses:

concrete structures 2	4,3
construction technology of concrete structures	4,3
building structures 2	4,3
repair and maintenance of materials in constructions	4,3
concrete science and technology	2,9
finite element method for structures	4,3
concrete bridges	4,3

Compulsory for all Steel Structures and Timber Structures students

A choice of 3 of the following courses:

Steel	2,9
theory of plasticity	4,3
building structures 2	4,3
repair and maintenance of materials in constructions	4,3
finite element method for structures	4,3
timber structures 2	4,3
steel bridges	4,3
Fatigue	2,9

Compulsory for all Materials Sciences students

A choice of 3 of the following courses:

methodology for scientific research	2,9
road paving materials	4,3
repair and maintenance of materials in constructions	4,3
concrete science and technology	2,9
capita selecta material sciences	2,9
finite element method for structures	4,3
timber structures 2	4,3

Compulsory for all Road and Railway engineering students

A choice of 5 of the following courses:

laboratory experiments on road building materials	2,9
road paving materials	4,3
structural pavement design	5,7
structural design of railway structures	4,3
construction of roads	2,9
railway engineering, special subjects	2,9

Free elective courses

elastostatics of slender structures	4,3
concrete structures: capita selecta	2,9
concrete structures for sanitary applications	2,9
capita selecta steel and aluminium structures	4,3
fibre reinforced plastic structures	2,9
hydraulic structures in steel and concrete	5,7
fire safety design	2,9
computational methods in non-linear solid mechanics	2,9
structural analysis of shells	2,9
stability and plasticity	2,9
random vibrations	4,3

micro mechanics and computational modelling of concrete	2,9
wind energy conversion systems	2,9

TRANSPORTATION AND PLANNING

The variant Transportation and Planning tries to contribute to an efficient design and reliable operation of transportation systems that meet mobility demands and respect scarce resources of land, environment and people.

The programme concentrates on four main topics: infrastructure planning,
transportation modelling,
public transport design and operation, dynamic traffic management.

Within these topics education is focused on the following subjects:

- formulating a theoretical framework for the analysis and modelling of transportation systems;
- understanding the interaction between migration, activities and travel behaviour and traffic processes in multimodal personal transportation systems directed at optimising their services, system design, and control;
- understanding the interaction between migration, activities and travel behaviour and traffic processes in multimodal personal transportation systems directed at optimising their services, system design, and control;
- developing the notion of reliability for transportation systems in all components and identifying the factors that determine the reliability of transport facilities and services;
- detecting the flow dynamics of heterogeneous traffic in road and rail networks and facilities, enabling the establishment of optimal control strategies;
- explaining the phenomenon of congestion dynamics (road and rail).

Compulsory for all Civil Engineering students

Philosophy, technology assessment and ethics in civil engineering	4,3 ECTS

A choice of 2 of the following modules 22,8 ECTS

- traineeship (11,4 ECTS)
- multi disciplinary project (11,4 ECTS)
- package of (elective) courses (11,4 ECTS)

- extra thesis work(11,4 ECTS)

Thesis	37,2 ECTS

Compulsory for all Transportation and Planning students

impact assessment methods	4,3
infrastructure planning	4,3
transportation and spatial modeling	5,7
design and control of public transport systems	4,3
traffic flow theory and simulation	4,3
dynamic traffic management I: traffic control	4,3
data collection and analysis	4,3
spatial and transport economics	4,3
transport technology A	2,9

Free elective courses

Economics	4,3
meeting and managing demand	4,3
urban planning and management	4,3
subsurface space technology	4,3
environmental impact assessment	4,3
trenchless technologies	2,9
spatial policy and metropolitan development	4,3
multimodal and urban transport modeling	2,9
rail traffic management and delay propagation	2,9
dynamic traffic manag. II: intelligent transport services	2,9
transport and traffic safety	2,9
sociology and psychology in transport	2,9

HYDRAULIC AND GEOTECHNICAL ENGINEERING

3 variants:
- Hydraulic Engineering and Environmental Fluid Mechanics
- Geotechnical Engineering
- Hydraulic Structures

The MSc-programme in Hydraulic and Geotechnical Engineering covers a wide range of topics as illustrated below.

- *Coastal engineering*

This includes coastal morphology, dune erosion, methods of coastal protection and the design of breakwaters

- *River engineering*

This includes river morphology, including reservoirs and estuaries

- *Ports and waterways*

Ports and waterways concentrate on the application of simulation techniques to logistic aspects of ports, terminals and locks.

- *Hydraulic structures*

This comprises all more or less rigid structures in water locks, weirs, piers, storm surge barriers andquay walls. The design of sub-soil infrastructure like immersed or bored tunnels and underground spaces is also a major area of interest. Probabilistic design methods play an important role in e.g. thedesign of sea defences, but are implied nowadays in all fields of hydraulic engineering.

- *Environmental fluid mechanics*

This includes free surface flows and related transport processes, turbulence, density currents, surface waves and fluid-structures interactions.

- *Geotechnical engineering*

The geotechnical engineering section provides soil mechanics, groundwater flow, and foundation design expertise for the entire faculty.

Compulsory for all Civil Engineering students

Philosophy, technology assessment and ethics in civil engineering	4,3 ECTS
A choice of 2 of the following modules • traineeship (11,4 ECTS) • multi disciplinary project (11,4 ECTS) • package of (elective) courses (11,4 ECTS) • extra thesis work(11,4 ECTS)	22,8 ECTS
Thesis	37,2 ECTS

Compulsory for all Hydraulic and Geotechnical engineering students

structural reliability	4,3
introduction to bed, bank and shore protection	4,3

Compulsory for all Hydraulic Engineering and Environmental Fluid Mechanics students

introduction to coastal engineering	4,3
short waves	4,3
ports, waterways and inland navigation 1	4,3
computational modelling of flow and transport	4,3

Compulsory for all Geotechnical Engineering students

numerical soil mechanics	4,3
continuum mechanics	4,3
material models for soil and rock	4,3

experimental research in geotechnics	4,3
Compulsory for all Hydraulic Structures students	
structural dynamics	4,3
prestressed concrete	4,3
introduction to coastal engineering	4,3
short waves	4,3
Free elective courses	
structural mechanics 5:	
elastostatics of slender structures	4,3
steel structures 2	4,3
plates and slabs	4,3
concrete structures 2	4,3
hydraulic structures	4,3
river engineering	4,3
plan and project evaluation	4,3
construction technology of concrete structures	4,3
short waves	4,3
ports, waterways and inland navigation 1	4,3
computational modelling of flow and transport	4,3
numerical soil mechanics	4,3
material models for soil and rock	4,3
experimental research in geotechnics	4,3
hydraulic structures in steel and concrete	5,7
dredging technology	4,3
theory of consolidation	2,9
stratified flows	2,9
dynamics of estuaries and tidal inlets	2,9
hydraulic structures in energy production	2,9
bored and immersed tunneling	4,3
ports, waterways and inland navigation 2	4,3
coastal zone management	2,9
breakwater and closure dams	2,9
morphology and protection of coasts	4,3
probabilistic design in hydraulic engineering	2,9
river dynamics	4,3
turbulence in hydraulics	2,9
hydraulic structures	2,9
flood defences	2,9
computational hydraulics	2,9
wind waves	2,9
physical oceanography	2,9
foundations and superstructures	4,3

soil structures and retaining walls	4,3
soil dynamics	2,9
oceanography and waves	5,7
offshore soil mechanics	2,9
engineering geology for civil engineering	2,9

WATER MANAGEMENT

This variant includes the
following specializations:
Hydrology and Ecology;
Land and Water Management;
Sanitary Engineering.

- Subjects of these fields are:
- Hydrology: Water balances; river forecasting; rainfall-runoff relationships; geohydrology; models of groundwater and surface water
- Ecology/environmental engineering: Pollution/self purification of surface water; water quality models; integrated environmental management of soil, water and air.
- Subsurface Management ; Soil pollution; soil decontamination; soil protection
- Polders: Polder development, water management in rural and urban areas, drainage of land preparation of building sites.
- Irrigation: Design of irrigation canals, discharge regulation, dams, reservoirs and erosion around structures.
- Integrated Water Management: Water systems; development of policies and scenarios; socioeconomic and environmental impacts
- Water supply: Capture systems; groundwater recovery; intake, storage and distribution systems; water demand and water treatment.
- Sewerage: Collection and transport; sewerage systems
- Waste water treatment: Waste water and sludge treatment
- Public hygiene and epidemiology: General hygiene; epidemiology and medical aspects of sanitary engineering.

Compulsory for all Civil Engineering students
Philosophy, technology assessment and ethics in civil engineering 4,3 ECTS

A choice of 2 of the following modules 22,8 ECTS

- traineeship (11,4 ECTS)
- multi disciplinary project (11,4 ECTS)
- package of (elective) courses (11,4 ECTS)
- extra. thesis work(11,4 ECTS)

Thesis	37,2 ECTS
Compulsory for all Water Management students	
geohydrology 1	4,3
integrated water management	4,3
pumping stations and transport pipe lines /water transport	4,3
systems engineering and policy analysis	4,3
Compulsory for all Hydrology and Ecology students	
computational modelling of flow and transport	4,3
water quality management	4,3
hydrological models	4,3
hydrological measurements	4,3
hydrology of catchments, rivers and deltas	4,3
Compulsory for all Sanitary Engineering students	
drinking water treatment 1 – technology	4,3
wastewater treatment 1	4,3
sewerage 1	4,3
hygiene and epidemiology	2,9
laboratory course water and wastewater treatment processes	5,7
Compulsory for all Land and Water Management students	
computational modelling of flow and transport	4,3
water quality management	4,3
irrigation and drainage	4,3
Electives	8,6
Free elective courses	
hydraulic structures	4,3
river engineering	4,3
plan and project evaluation	4,3
production management in construction and civil eng.	4,3
structural reliability	4,3
introduction to coastal engineering	4,3
introduction to bed, bank and shore protection	4,3
short waves	4,3
ports, waterways and inland navigation 1	4,3
computational modelling of flow and transport	4,3
numerical soil mechanics	4,3
material models for soil and rock	4,3
experimental research in geotechnics	4,3
water management workout	5,7
hydrological models	4,3

hydrologic measurements	4,3
integrated water management	4,3
polders and flood control	4,3
drinking water treatment 1 – technology	4,3
wastewater treatment 1	4,3
sewerage 1	4,3
concrete structures for sanitary applications	2,9
dynamics of estuaries and tidal inlets	2,9
stochastic hydrology	4,3
subsurface management	4,3
public hygiene and epidemiology	2,9
laboratory course water and waste water treatment	5,7
geohydrology 2	4,3
hydrology of catchments, rivers and deltas	4,3
ecology and environmental management 1	2,9
ecology and environmental management 2	2,9
soil science	2,9
operational water management	4,3
water law and organization	2,9
water management in urban areas	4,3
water treatment 2	2,9
wastewater treatment 2	2,9
sewerage 2	2,9
water transport	4,3
civil engineering in developing countries	4,3
soil erosion and sedimentation in civil engineering	2,9
problem definition and problem solving for civil engineers	4,3
system dynamics	4,3
civil engineering informatics exercise	5,7
special subjects: civil engineering information systems	2,9
special subjects: model integration and simulation in c.e.	2,9
special subjects: graphic data analysis	2,9

OFFSHORE TECHNOLOGY

Offshore Engineering primarily involves the design and construction of more or less fixed facilities away from the coast. Within the University Civil Engineering as well as Mechanical Engineering, Maritime Technology and Applied Earth Sciences educationally and organisationally support the curriculum. The interfaculty structure of the curriculum gives each participant a background in at least three of the following areas:

- fixed, bottom-founded structures
- floating structures
- sub sea structures

- marine pipelines

Many offshore thesis problems involve using expertise from outside the department. Several problems include industrial support for questions which require the further development of fundamental knowledge. Studies on pile/soil interaction and on the dynamics of jacket type and jackup platform behaviours are examples of fundamental thesis subjects. Other subjects are in the domain of engineering application, such as deepwater pipeline installations and the development of a cost-effective platform concept.

Compulsory for all Civil Engineering students

Philosophy, technology assessment and ethics in civil engineering 4,3 ECTS

A choice of 2 of the following modules 22,8 ECTS

- traineeship (11,4 ECTS)
- multi disciplinary project (11,4 ECTS)
- package of (elective) courses (11,4 ECTS)
- extra thesis work(11,4 ECTS)

Thesis 37,2 ECTS

Compulsory for all OFFSHORE TECHNOLOGY students

structural reliability	4,3
basic soil mechanics for non-civil engineers	2,9
survey of offshore technology	10,0
oceanography and waves	5,7
offshore hydromechanics	7,2
offshore soil mechanics	2,9
bottom founded structures	5,7
floating offshore constructions	4,3
marine pipelines	4,3
Sub sea engineering	4,3
offshore moorings	4,3
offshore wind farm design	4,3
integrating exercise	11,4
ndustrial practice	8,6
marine engineering geology	2,9
finite element method	1,4

ANNEX 3

Updated list of higher education institutions offering civil engineering education in Netherlands

Universities

Engineering programs at university level

Name	Location
Delft University of Technology	Delft
University of Twente	Enschede

Engineering programs at vocational level

Hogeschool Alkmar	Alkmar
Hogeschool Delft	Delft
Hogeschool Diemen	Diemen
Hogeschool Haarlem	Haarlem
Hogeschool Rotterdam	Rotterdam
Hogeschool van Amsterdam	Amsterdam
Hogeschool van Arnhem en Nijmegen	Arnhem, Nijmegen
Hogeschool Brabant	Tilburg
Hogeschool 's-Hertogenbosch	Hertogenbosch
Saxion Hogeschool Enschede	Deventer, Enschede, IJsselland
Hogeschool Utrecht	Utrecht
Hogeschool Zeeland	Vlissingen, Terneuzen
Chr. Hogeschool Windesheim	Zwolle
Haagse Hogeschool	Den Haag
Noordelijke Hogeschool	Leeuwarden
Hanzehogeschool Groningen	Groningen
Hogeschool Zuyd	Sittard
Hogeschool INHOLLAND Alkmaar, Delft, Haarlem, Holland en Rotterdam	Alkmaar, Delft, Diemen, Haarlem, Rotterdam

CIVIL ENGINEERING EDUCATION IN NORWAY

Eivind Bratteland[1]

1. GENERAL VIEW ON THE PRE-UNIVERSITY EDUCATION.

The Norwegian pre-university education system consists of a 10 year compulsory basic education. (primary and lower secondary school). All young people have a right to take a three year upper secondary education.

1.1 Compulsory education.

The compulsory primary and lower secondary education in Norway is based on the principle of a unified school system, providing equal and adapted education for all, related to a single national curriculum. Schooling for children was introduced 250 years ago. From 1889 a 7 year compulsory education were provided, increased to 9 years in 1969, and to 10 years, starting from year 6, in 1997.

The three stages in the compulsory education are:

- Lower primary (grades 1 - 4)
- Upper primary (grades 5 - 7)
- Lower secondary (grades 8 - 10)

The subjects at the primary and lower secondary levels are:

- Christian knowledge and religious and ethical education
- Norwegian
- Mathematics
- Social studies
- Art and crafts
- Science and the environment
- English (compulsory from the primary level)
- Music
- Home economics
- Physical education
- Compulsory additional subjects

In addition the students must choose one of the following subjects: Second foreign language, supplementary language study or practical project work.

[1] Professor, Norwegian University of Science and Technolgy Trondheim

Based on OECD-data, the number of teaching hours per year in Norway is low (713 hours for primary education, and 633 hours for lower secondary education). This is some 10 - 12 % below the OECD country mean, and significantly below (20 - 40 %) in countries as Belgium, Netherlands, New Zealand and USA.

Ratio of student to teaching staff is very favorable in Norway with 12.6 students per teaching staff in primary education and 10.1 in lower secondary education. This is on the level with countries as Austria, Denmark, Hungary and Italy, and some 30 % lower than the OECD country average.

Data for intended instruction time for mathematics and science in hours per year for students of 12 to 14 years age show that Norway comes out about 23 % lower than the OECD average. A further breakdown of the data shows that the main difference is caused by the science subject. Countries like Austria and New Zealand spend 50 - 60 % more time on mathematics and science than Norway. The Norwegian education spends significantly more time on foreign languages and religion than the OECD mean.

1.2 Upper secondary education.

Since 1976, Norway has had a uniform upper secondary school, combining general theoretical education and vocational training and giving equal status to practical and theoretical education. Apprenticeship schemes are part of the upper secondary school system. The educational level of the population has risen considerably in recent years. 83 % of people aged 25 - 64 have education in addition to the compulsory schools. 54 % of people over 16 years of age have upper secondary education.

In 1994, everyone between the ages of 16 and 19 were given a statutory right to three years of upper secondary education leading either to higher education or to vocational qualifications or partial qualifications. The reform of 1994 aimed at three main objectives including:

- *A Rights reform*, right to a three year upper secondary education.
- *A Structure reform*, reducing significantly the basic course units, and improving the follow-up service.
- *A Content reform*, with a broad approach to learning, aiming at a comprehensive competence, and with education and training adjusted to the individual. Focus on objectives, increased use of project approach, and "ICT in all subjects".

The number of teaching hours per year in the upper secondary education is clearly below the OECD mean by some 24 %. (Somewhat less for the vocational programs). Countries like Netherlands, New Zealand and USA have 70 - 80 % higher number of teaching hours than Norway. The student to teaching staff ratio for this level is still very favorable in Norway (9.9), being 30

% below the OECD mean, and on the level with countries as Austria, Greece, Hungary and Italy.

Age distribution of teachers in upper secondary education is a question of concern in Norway. In 1999, around 40 % of the teachers were 50 years and above. Only Sweden had a higher percentage of the OECD-countries, and the average in OECD was 31 %. In Korea, only 15 % of the teachers were 50 years or above.

The total yearly classes of 19 years old in Norway has been reduced since 1994, and will in 2004 reach a low, being 15 % below the 1994 number. After 2004, the "class" size will increase again, reaching the level of 1994 in 2010. Of the students in upper secondary education, about 30 % takes subjects in mathematics and physics that are required for admission to studies in engineering. The number of students in these subjects was at a minimum in 1996, and has shown a slightly increasing trend since then.

In 1998/99 around 98 % of the students in upper secondary education had access to the Internet. This was comparable to countries as Canada and Iceland. For the lower secondary education the percentage was down to 81 %, and for primary education 56 %. These figures were well below Canada, Finland, Iceland and New Zealand.

2. GENERAL VIEW ON THE ENGINEERING EDUCATION

2.1 Higher education in general.

Norway has 4 full Universities, 6 University Colleges, and 26 regionally based State University Colleges, 2 Colleges in Art Education, and 18 private Colleges with State support, covering various fields. In addition there are 6 private Colleges without State support, but with recognized study programs.

Of the students admitted to higher education in 2000, around 30 % entered the universities, 2.5 % the University Colleges, 50 % the State University Colleges, and 17 % the Private Colleges. In 2000, the number of registered students was at the same level at the Universities and the State University Colleges. Around 8 % of the Norwegian youth studying in higher education studied abroad. Of these, 28 % studied in United Kingdom, 13 % in Australia, and 12 % each in USA and in Denmark. 10 % of the students abroad studied technological subjects.

Norway has a high level of education at university and college level. In the age group of 24 to 64 years, the percentage of population with up to 4 years of education at university and college level was 26 % in 1998. This is higher than the national average in OECD which is 21 %. Countries with a higher percentage are Canada, Japan, New Zealand, Sweden and USA. Corresponding figures for more than 4 years education for the same age group give 24 %,

significantly higher than the OECD average of 14 %, with only Netherlands and USA at the same level or above.

The doctoral degrees awarded in Norway per year represent around 6 - 10 % of the higher degree graduates. Up to 2003, around 30 % were awarded in Dr.scient., some 20 % in Dr.ing., and the third largest being Dr.med. with around 15 %.

2.2 Engineering education in general.

Norwegian University of Science and Technology (NTNU) is the main university for engineering education at Master level. In addition, the other three full universities, the Agricultural University of Norway and five of the State University Colleges are entitled to give engineering degrees on Master level. Sixteen of the State University Colleges are giving engineering degrees on Bachelor level.

Of the applicants to a 3 year engineering education in 2000, 49 % had this as their first priority. For the 5 year study the corresponding first priority percentage was 55 %. Compared to other study programs this demonstrates a high percentage of first priority applicants. Only Economics and Medicine show a higher number.

Some general trends for application to studies at NTNU from 1996 - 99 were:

The traditional engineering studies as civil, electrical, chemistry and mechanical all showed a decrease in applicants based on first priority. Studies in economics and data/ICT on the other hand, showed a significant increase by some 60 % over this time period. The last three years has reversed this trend, with reduced number of applicants to data/ICT and a corresponding increase in applicants to the traditional engineering studies, as exemplified by civil engineering.

Cost per student per year, as defined by the Ministry, is 15 % higher for NTNU than for the average of the other three universities, and 30 % above the cost level for the average of the State University Colleges. Total expenditure on educational institutions as percentage of GDP was 6.9 % (1998, OECD), while the average for OECD was 5.75. The ratio between students and academic teaching staff gave in 2000 an average for the universities of 12.3, while the corresponding number for the State University Colleges was 17.1. The OECD data for all tertiary education showed Norway had a ratio of 13.4, being around 15 % lower than the OECD country mean.

The university and college sector are all dependent on a certain amount of external financing for their activities. In the year 2000, NTNU had 19 % external financing, while the State University Colleges on an average had 5.5 % external funding. Agricultural University of Norway had the highest percentage with 29 %.

2.3 Engineering education at undergraduate level.

Engineering education at undergraduate level is mainly given by the State University Colleges, offering professional study programs. Still there is a limited offer at some of the State University Colleges for a one or two year engineering education for technicians, leading to a non-academic, non-protected title.

Up to 2003, the three year engineering undergraduate studies, awarded a degree of "hogskoleingenior", corresponding to a Bachelor degree. From 2002/2003, the Bachelor degree was introduced at these Colleges. The number of graduates from the 3 year (Bachelor) education in engineering is about 25 % higher than graduates from 5 year (Master-level) education in engineering.

A report comparing the estimated supply and demand for engineers at Bachelor level (NIFU, 10/2000), indicated an increasing gap from 2008 to a maximum in 2012, where only some 78 % of the "demand" could be "supplied".

2.4 Engineering education at post-graduate level.

2.4.1 Master or Master-type programmes.

Norwegian University of Science and Technology is the only institution with a broad offer in engineering. Up to 2003, this university granted a degree of "sivilingenior" after a five year study. This degree was equivalent to a Master Degree. From 2003, the Master of Science degree was introduced and replaced the old degree structure. The majority of students are admitted to the university based on the results from the upper secondary education, and enter a five year study program without any intermittent degree. Some students are also enrolled in year four, based on the Bachelor degree from the State University Colleges. In that respect Norway already has implemented a 3 + 2 concept.

Before 2003, some fields of engineering were giving a degree in cand.scient after a five year study program. The number of graduates as "sivilingenior" was steadily increasing until 1995/96. Over a three year period to 1998/99 a dramatic reduction of close to 30 % was observed.

In looking at natural science studies, apprenticeship, and studies in technical subjects, these have combined shown a significant reduction from 1986/87. Graduation in these areas has been reduced from 30 % of the total number of graduates in 1986/87 to 19 % in 1998/99.

2.4.2 Doctoral programs

Situation before 2003:

In Engineering three types of doctoral degrees were awarded: Dr.ing., Dr. scient., and Dr.techn. The Dr.ing. degree was dominating in engineering, while the Dr.scient. was mainly related to natural sciences.

The Dr.ing. study program was a three year full time study. One year was generally used for course units, and two years for research/thesis work. The Dr.ing. program should according to the Strategic Plan for NTNU:

- Give training and experience in scientific methods and work
- Have an international dimension and level
- Be an integrated part of the research activities in the respective fields
- Give background for leading work within industry, administration, education and research

Dr.techn. was a degree awarded for outstanding quality in a specified scientific work providing genuine new advancement in technology.

Over the last 10 years up to 2000, the following degrees were awarded:

- Dr.scient. 1847
- Dr.ing. 1239
- Dr.techn. 14

These degrees represent 54 % of the total number of doctoral degrees awarded in Norway over the same time period.

Situation after 2003:

In engineering subjects all the previous doctoral degrees are replaced by a PhD degree. In some other areas the previous system will be used until 2008.

3. CIVIL ENGINEERING EDUCATION.

3.1 Undergraduate education.

The formal undergraduate education in civil engineering is basically given at the State University Colleges. Shorter courses without degrees awarded are also given by the Universities and the University Colleges. These types of courses could for some subject areas be combined to a sequence giving a Diploma. The Norwegian Society of Chartered Engineers are offering short courses within civil engineering, partly in co-operation with the universities and colleges.

3.1.1 Short description for each type of program.

Ten of the 26 State University Colleges give today a Bachelor degree based on a three year study. (See ANNEX). Two of the State University Colleges are still giving a two year education offer, leading to a non-academic degree. Number of students at these shorter studies is small.

The studies are generally divided into two semesters (autumn and spring), often divided into two terms each. The autumn semester starts in August (around August 20.) There is a two week holiday at Christmas, and the

spring semester ends around June 1. Each semester has a 15 week study period. At the end of each semester there are normally a 2 - 3 weeks examination period. Some Colleges have an examination period of approximately 10 days in March, between term 3 and 4. This is particularly used for the third year study.

The course units can have a large variety in credit levels, in the range of 5 - 20 ECTS credits. The number of contact hours is normally ranging from 22 - 25 hours per week. Today, the lecture hours are a completely dominating part of the total contact hours per week, normally representing some 80 - 90 %. This has been a development over years where the contact time related to exercises and tutoring has been reduced.

3.1.2 Main features of curriculum for programs.

With some variations, a typical split between the various categories of subjects in the undergraduate studies could be (Based on data from one of the main State University Colleges in civil engineering):

1.year:	A. Basic Sciences	27 ECTS
	B. Engineering Sciences	21 ECTS
	C. Core Engineering Subjects	12 ECTS
2. year:	A. Basic Sciences	12 ECTS
	B. Engineering Sciences	6 ECTS
	C. Core Engineering Subjects	6 ECTS
	D. Engineering Specialization	21 ECTS
	E. Economics and Management Subjects	15 ECTS
3. year:	(Example from Structural Engineering)	
	C. Core Engineering Subjects	12 ECTS
	D. Engineering Specialization	18 ECTS
	Various Optional Subjects	12 ECTS
	H. Final Project	18 ECTS

The categories used here are corresponding to the ones used in Working Group A, in the First EUCEET Volume (see reference list). Other study areas could give slightly different results.

Summing up these figures over the three years give the following split of categories:

A. Basic Sciences	22 %
B. Engineering Sciences	15 %
C. Core Engineering Subjects	17 %
D. Engineering Specialization	22 %
E. Economics and Management Subjects	8 %
H. Final Project	10 %
Various Optional Subjects	6 %

The final project represents 18 ECTS. This is taken in the last term of the study, and is normally involving group work of 2 - 4 students. If possible, (and this is usually the case) the final project is in co-operation with the industry, where industrial contact persons act as supervisors on the project as well. The project has a focus on professional deepening of the relevant problem issues, as well as relating to and coordinating knowledge from other subjects and fields. Included are also skills in planning and implementing a project work in a group.

3.1.3 Admission to undergraduate level.

The majority of the students were traditionally admitted directly from the general upper secondary education, provided they had the required subjects in mathematics and physics. An increasing number of students are now admitted without having passed the normal upper secondary final examination. Students with vocational training/studies in the upper secondary education could attend a technical college for two years and then be admitted to the three year educational offer at the State University Colleges. Another entry possibility is through a craft certificate, followed by at least 5 years relevant experience and a successful completion of a preparatory course. This development is related to the introduction of assessment of real-competence as further discussed in section 4.

Admission is competitive. Traditionally, demand has exceeded the number of places available. For civil engineering the trend up to approximately 2000, was a reduction in number of applicants, leading to an "open" admission for all students having the required entry qualifications. Latest years have indicated a reversal of this trend in increased number and qualification of applicants for civil engineering studies.

The admission of students with vocational/apprenticeship background is challenging, particularly related to the level of theoretical knowledge in basic science subjects. These students are, however, providing great opportunities in linking the civil engineering educational aspects closer with the practical working environment. This has a potential for improved developments in skills and in engineering application and implementation.

3.2 Civil engineering education at postgraduate level.

Postgraduate studies in civil engineering are given at Norwegian University of Science and Technology, Agricultural University of Norway, Narvik University College and Stavanger University College. The Master studies at the two State University Colleges are based on a two year study, following the Bachelor degree in civil engineering. The Agricultural University of Norway has since 2003 a 3 year Bachelor degree, followed by a 2 year postgraduate study leading to a Master degree. Norwegian University of

Science and Technology will continue to admit students to the 5 year study program, but also continue to admit students with a Bachelor degree (the 3 + 2 year concept).

3.2.1 Master or Master-type programmes.

A two year study program at the two State University Colleges is following the 3 + 2 concept. This study consists of 120 ECTS, with a distribution in the range of:

Basic methodological subjects - 18 ECTS, engineering subjects including possible optional subjects - 72 ECTS, and a thesis work - 30 ECTS. These study programs are basically following the same general arrangements as the undergraduate studies. The programs are of a taught and research type, having organized course units covering 90 ECTS, and a research-based thesis work of 30 ECTS.

The study program for civil engineering at NTNU is based on a 5 year study leading to a Master of Science degree. The study year starts around August 10, and ends beginning of June. The year is divided into two semesters. There is a 3 weeks examination period before Christmas and in May.

From third year, the students in civil engineering can choose between five different study programs:

- Structures
- Building and Construction
- Water and Environment
- Road, Transport and Areas
- Geomatics

In addition, civil engineering students can participate in two interdisciplinary study programs on Industrial Ecology and Project Management. From autumn 2002, a new interdisciplinary program in Engineering Sciences and ICT was started. An international Master degree program in Hydropower Development has been run over a number of years, with students from developing countries. From autumn 2003, a two year Master degree program in Coastal and Marine Civil Engineering was started. This is an integrated study program for Norwegian and foreign students.

The contact hours will show some variation with the study programs. For the last three years there are some variations, with a trend towards a gradual reduction of contact hours as the study is progressing.

Indications on expected number of hours are:

1 - 4. semester	25 hours	8. semester	15 - 23 hours
5. semester	20 - 25 hours	9. semester	12 - 20 hours
6. semester	18 - 23 hours	10. semester	variable
7. semester	17 - 25 hours		

All course units at NTNU have a credit level corresponding to 7.5 ECTS. Same size of courses facilitates exchange and selection of courses from other areas of study, and/or from other faculties. Each semester consist of 4 course units (30 ECTS).

The final thesis has a time frame of 20 weeks, and is an individual or group-based research work, demonstrating ability to work independent in a specified field.

Typical relative weights of the various categories of subjects as exemplified by the studies in Structural Engineering:

1. year:	A. Basic Sciences	22.5	ECTS
	B. Engineering Sciences	15	ECTS
	C. Core Engineering Subjects	15	ECTS
	F. Humanities, Social Sciences etc	7.5	ETCS
2. year:	A. Basic Sciences	22.5	ECTS
	B. Engineering Sciences	15	ECTS
	C. Core Engineering Subjects	22.5	ECTS
3. year:	A. Basic Sciences	7.5	ECTS
	B. Engineering Sciences	15	ECTS
	C. Core Engineering Subjects	15	ECTS
	D. Engineering Specialization	22.5	ECTS
4. year:	C. Core Engineering Subjects	15	ECTS
	D. Engineering Specialization	30	ECTS
	E. Economics and Management	7.5	ECTS
	Interdisciplinary Project	7.5	ECTS
5. year:	D. Engineering Specialization	22.5	ECTS
	F. Humanities, Social Sciences etc	7.5	ECTS
	Research/Thesis	30	ECTS

Other study areas within civil engineering might have somewhat different relative distribution between the various categories.
Summing up these figures over the five year study will for Structural Engineering yield:

A. Basic Sciences	17.5 %	E. Economics and Management Subjects	2.5 %
B. Engineering Sciences	15 %	F. Humanities and Social Sciences etc.	5 %
C. Core Engineering Subjects	22.5 %	H. Final Project	10 %
D. Engineering Specialization	25 %	Interdisciplinary Project	2.5 %

3.2.2 Doctoral programs

The program for Dr.ing. up to 2003, and now PhD, in Civil Engineering follows the general objectives as given in 2.4.2. Applications are approved by a Doctoral Degree Committee.

In the first semester of the doctoral study for PhD, the student is normally taking approved course units, representing 30 ECTS. There are regulations on the credit levels required for the PhD course units. Doctoral students can choose between some 45 course units from the doctoral study program in Civil Engineering. PhD subjects from other faculties could also be included in the study, as could a limited number of ordinary courses in the post-graduate study program.

The thesis is normally written in English. The thesis must be approved by an appointed evaluation committee of three persons - minimum one of the committee members should be from outside Norway. Following approval, the candidate must give a trial lecture, and defend the thesis in public.

Over the lasts 10 years up to 2002, 136 Dr.ing. degrees were awarded in Civil Engineering. This represent about 7.5 % of the number of Master level graduates in the same time period. Most (98 %) of the applicants for a doctoral study were admitted to the studies. This is caused by a well-defined application procedure, defining clearly the requirements for study, including the financing part.

4. RECENT TRENDS IN ENGINEERING EDUCATION IN NORWAY.

4.1 General trends in education.

The Competence Reform in Norway, states the statutory right for adults to upper secondary education (since August 2000). The reform also introduced (January 1. 2001), the right for employees to study leave. This right is laid down in the Working Environmental Act.

In the reform of quality of higher education: "Do your duty - Demand your rights" of March 2001, students are given increased rights both in relation to the quality of courses and the financing of studies. This will entail clearer obligations on the part of the students as regards progress and completion of studies.

Some of the main points of the report:

- Priority is to be given to a combination of teaching methods involving a high level of student activity, new forms of assessment and regular feedback that promotes learning.
- Clear outline of the rights and responsibilities of the institution and the student in relation to each other.
- Organization of the academic year in three terms (semesters) will be enabled.
- A new common degree structure is proposed for most courses, involving a lower degree on completion of three years of study (Bachelors) and a higher degree building upon this to be awarded on completion of a further two years of study (Masters).

- The financing of the studies will be improved, and the grant element of the financing will be increased to 39 %.
- Participation in international programs and exchange agreements will be given increased priority. It is seen as a goal that all higher education institutions shall offer students a period of study abroad as a component of the Norwegian degree course.

A principal objective of the Competence Reform is to help meet the need for competence in society, in the workplace and for the individual. In this context, the concept of lifelong learning and the related strategy to be adopted, is given high priority.

The workplace is an important source of knowledge. The primary responsibility for competence building in the workplace lies jointly with employers, employees and their organizations. Labor unions and employers federations are important actors in the development of on-the-job skills.

In the continuing education and training for the age group between 25 and 64 years, the participation rate in Norway is 48 %. This is around 15 % below the rate for the other Scandinavian countries, but clearly above (35 %) the average of 18 OECD countries. Also for the mean number of hours per adult spent on continuing education per year, Norway is below the other Scandinavian countries, but well above
(approximately 45 %) the average of 16 OECD countries.

Four major relevant questions have been formulated for policy in the field of lifelong learning:

- Strengthen the foundations for learning throughout life by improving access to education, and supporting the growth of other formal and non-formal learning organizations and situations.
- Promote coherent links between both the different educational levels and between learning and work, facilitating more flexible movement between education and training and work.
- Re-thinking on the roles and responsibilities of all partners.
- Create incentives for individuals, employers and those providing education and training to invest more in lifelong learning.

In June 2000, the Norwegian Council of Universities and University Colleges, the Network for private Colleges, the Employers Confederation and the main employee organizations launched a nation-wide course database containing information about further education open for enterprises and suppliers. The database contains at present about 1700 courses, varying form short courses to complete master's programs.

The "real" competence concept is gaining momentum as a basis for assessing the qualifications also related to education. This calls for development

of "other tools" as the "overall competence" concept of today to a large extent is based on informal and not documented qualifications. It therefore needs to be defined more precisely. On the documentation of non-formal and informal learning one objective is to set up a national system for the documentation and recognition that has legitimacy in both the workplace and the educational system. The challenge will be to develop acknowledged forms of documentation that are of the same standing as diplomas and degree certificates.

4.2 Engineering education.

Institutions, also in engineering education, will need to develop greater flexibility in responding to new demands, and the framework within which they operate should reflect this need.

Engineering and other higher education and research are influenced by:

- Globalization and internationalization.
- Fundamental technological changes (ICT).
- Increased national and international competition between the educational offers.
- Increased demand on education.
- Increased demand for knowledge in the working life.
- Strong demographic changes and a work force with increasing age.
- Significant changes in content in primary and secondary schools.
- New and more diversified student groups.

The degree structure in Norway was in 2003 changed to the Bachelor - Master system (3 + 2). Norwegian University of Science and Technology will continue to have a dual system, partly admitting students from the State University Colleges with a Bachelor degree and offering students with this background admission in year 4, following the studies at NTNU the last two years. The majority of the students will still be admitted to a five year study program leading directly to a Master of Science degree.

From 2003, the ECTS credit system was introduced, providing 60 ECTS credits for a one year full time study. Also markings/grades were changed from a numbering system to the international system of A to F.

Some references:

1. Inquiries into European Higher Education in Civil Engineering. EUCEET, First EUCEET Volume, 2001.

2. UNESCO The United Nations Educational, Scientific, and Cultural Organization. http://www.unesco.org/

3. OECD Organization for Economic Co-operation and Development.

http://www.oecd.org/oecd/pages/home/displaygeneral/

4. FEANI European Federation of National Engineering Associations.
http://www.feani.org/

5. SEFI European Society for Engineering Education.
http://www.sefi.be

6. ODIN Public Documentation and Information in Norway.
Electronic information service from Government and Ministries.
http://odin.dep.no/odin/global/language-en/ and
http://odin.dep.no/ufd/eng/

7. SSB Statistics Norway.
http://www.ssb.no/english/

8. NIFU Norwegian Institute for Studies in Research and Higher Education.
http://www.nifu.no/infoeng.html

9. NFR The Research Council of Norway.
http://www.forskningsradet.no/english/

10. NIF The Norwegian Society of Chartered Engineers.
http://www.nif.no/

ANNEX

Higher education institutions offering Civil Engineering education in Norway

A. Education at Bachelor level

Basically given at the State University Colleges.

1. Agder University College
   http://www.hia.no
   Serviceboks 422
   N-4604 Kristiansand
   Norway
2. Bergen University College
   http://www.hib.no
   Postboks 7030
   N-5020 Bergen
   Norway
3. Gjovik University College
   http://www.hig.no
   Postboks 191
   N-2801 Gjovik
   Norway
4. Narvik University College
   http://www.hin.no
   Postboks 385
   N-8514 Narvik
   Norway
5. Oslo University College
   http://www.hioslo.no
   Wergelandsveien 27
   N-0167 Oslo
   Norway
6. Stavanger University College
   http://www.his.no
   Postboks 2557 Ullandhaug
   N-4091 Stavanger
   Norway
7. Sor-Trondelag University College
   http://www.hist.no
   N-7004 Trondheim
   Norway
8. Telemark University College
   http://www.hit.no
   Postboks 203
   N-3901 Porsgrunn
   Norway
9. Ostfold University College
   http://www.hiof.no
   Remmen
   N-1783 Halden
   Norway
10. Aalesund University College
    http://www.hials.no
    N-6025 Aalesund
    Norway

B. Education at Master level.

1. Norwegian University of Science and Technology
   http://www.ntnu.no
   N-7491 Trondheim
   Norway

2. Agricultural University of Norway
   http://www.nlh.no
   Postboks 5003
   N-1432 Aas
   Norway

3. Narvik University College
http://www.hin.no
Postboks 385
N-8514 Narvik
Norway

4. Stavanger University College
http://www.his.no
Postboks 2557 Ullandhaug
N-4091 Stavanger
Norway

C. Education at Doctoral level.

Before 2003:

Dr.ing degree:
1. Norwegian University of Science and Technology
http://www.ntnu.no
N-7491 Trondheim
Norway

NTNU can also grant a Dr. scient degree, but this has not been used in Civil Engineering. (NTNU has a cooperation with Narvik University College, where the doctoral student there will be given her/his degree at NTNU)

2. Stavanger University College
http://www.his.no
Postboks 2557 Ullandhaug
N-4091 Stavanger
Norway

Dr.scient degree:

3. Agricultural University of Norway
http://www.nlh.no
Postboks 5003
N-1432 Aas
Norway

Dr. techn degree:

Norwegian University of Science and Technology has the right to grant a Dr.techn degree based on a scientific work of outstanding quality.

After 2003:

All these degrees are replaced by a PhD degree based on a three year of study.

CIVIL ENGINEERING EDUCATION IN POLAND

Stanislaw Majewski[1]

1. GENERAL VIEW ON THE PRE-UNIVERSITY EDUCATION

Since 2 years the new educational system has been implemented in Poland. At the pre-university level this system comprises 12 years education organised in 3 stages:

- 6 years of elementary education (primary school),
- 3 years of secondary general education (gymnasium),
- 3 years of secondary specialised education (lyceum) aimed on preparation to the university education

Instead of lyceum one can choose:

- 2 years of vocational school
- 2 years of complementary secondary education (complementary lyceum).

The total duration of primary and secondary education is 12 or 13 years. At the end of the secondary education students can take the standardised national secondary school achievement examination (called *matura*) and receive the secondary school certificate.

The first stage starts in age of 7/6 years. First two stages are obligatory.

2. GENERAL VIEW ON THE ENGINEERING HIGHER EDUCATION

2.1 Introduction

In contradiction to UK and many other countries, Polish Universities have usually narrow specialisation. At the higher education level the term "University" is preserved mainly to the institutions, which deal with Basic Sciences (Mathematics, Physics etc.) and with Humanities. Medicine, Economy, Agriculture and Arts are taught in Academies and Technical Sciences in Polytechnics. Yet all these institutions have the status and independence adequate to the University. Therefore the English name of technical higher schools is usually interpreted as "Technical University" or "University of Technology", which is not only equivalent to similar names in other countries, but essentially means what they really are.

The second problem refers to terms "undergraduate" and "postgraduate" studies. In popular meaning the undergraduate studies provide the lower level of education (BSc or BEng). The higher level (MSc or MEng) can be achieved later on, at the postgraduate course, which succeeds the previous one, but is

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another, self-contained course. This is not consistent with the parallel studies model, in which independent courses provide either BSc (BEng) or MSc (MEng.) title. These courses differ in teaching approach (know how versus know why), subject contents and duration. The one-tiers parallel BSc (or BEng) and MSc (or MEng) courses (tunnel-type) still are the dominating in Polish educational system. Thus talking further on about undergraduate and postgraduate courses we will mean only the graduating sequence and not the education level.

2.2 Engineering education at undergraduate level

There are two main types of undergraduate courses in the Polish engineering education system:

- courses providing the basic engineering education as well as the basis for further studies with 4 year duration awarded with BSc/BEng degree (*inżynier*) ,
- courses providing full engineering education as well as the preparation for creative research work and further doctoral studies with 5 year duration awarded with MSc/MEng degree (*magister*).

2.3 Engineering education at postgraduate level

2.3.1 Master type programmes

Since the Master degree can be achieved in Poland mainly at the one-tier studies, the possibilities of postgraduate studies are limited to:

- supplementary MSc courses with 1,5 to 2 years duration for those who had completed earlier the BSc studies,
- second, MSc level of two-tiers studies with same duration in those universities, which had already modernised their educational system towards the "ladder" model according to current European trends (Bologna declaration).

The number of last type courses will probably rapidly increase in the future.

2.3.2 Doctoral programmes

All Polish universities, which have so called "full academic authorisation", provide the doctoral studies. The duration of these courses is usually 4 years. The majority of PhD students are employed after graduating in the university system, however the doctoral studies are available for external students as well. The doctoral studies are definitely research-oriented with the emphasis on the theoretical basis.

2.1 Academic degrees and titles

- the degree of ***doktor*** (doctor, PhD) is awarded to a person who has passed his/her doctoral examinations and submitted and defended a doctoral dissertation *(rozprawadoktorsk*a). Holding the professional title of *magister* or its equivalent is a necessary condition for the *doktor's* degree;
- the degree of doktor habilitowany (no English equivalent, proposed abbreviation DSc preceded by PhD) is awarded to a person who already has the doktor's degree, has significant scholarly, professional or artistic achievements, has submitted a dissertation (rozprawa habilitacyjna) and has undergone the successive stages of review, debate and defense;
  Scientific degrees *doktor* and *doktor habilitowany* are awarded by organisational units of higher education institutions and by other scientific and research institutes. The *doktor habilitowany* degree must be confirmed by the State Commission for Academic Degrees and Title;
- the title of ***profesor*** (full professor) is conferred by the President of the Republic of Poland after special procedure at the higher education institutions or other scientific/research institutes and confirmation by the State Commission for Academic Degrees and Title.

3. CIVIL ENGINEERING EDUCATION

3.1. Undergraduate education

The following information refers both to one-stage and two-stage studies. The majority of courses are still run in one-stage parallel studies system, comprising independent BSc and MSc courses. According to point 2.1 in this system, there are both BSc and MSc undergraduate courses. The data for these courses are included in tables 1 and 2.

Table 1

One stage studies, BSc level	Title awarded: Bachelor of Civil Engineering (*inzynier*)
Admission	The admission rules differ in particular universities. The minimum requirements are based on the pre-university certificate level and refers mainly to the admission at part-time courses. At full-time courses usually it is the university entrance exam on mathematics, sometimes physics and foreign language as well.
Duration	3,5 to 4 years at part-time courses 4 - 4,5 years at full-time courses
Course organisation	15 weeks semesters: • "winter" semester from the beginning of October to the end of January • "summer" semester from the end of February to the beginning of June
Examinations	Two sessions: in the beginning of February and in June. Repetitions possible in March and In September.

Table 1 (continued)

One stage studies, BSc level	Title awarded: Bachelor of Civil Engineering (*inzynier*)							
Teaching organisation	Teaching material divided for 35-40 subjects. 25-28 contact hours per week at full-time courses. 16-20 contact hours at part-time courses (so called "evening courses", lessons from 3pm to 8:30pm) 45% lectures, 55% others. Subject categories* weight:							
	A	B	C	D	E	F	G	H
	9-11%	9-14%	16-22%	24-37%	5-12%	9-11%	0%**	9-11%
Final exam	The final exam comprises; • final project presentation, • exam - questions connected with speciality. The final assessment consists of average mark of all subjects assessed during the study period (weight 50%), the mark of final project (weight 25%) and the mark of final exam (weight 25%). The weights given in parentheses differ in particular universities.							

* see annex, table 1.3.
** 4-8 weeks during holidays

Table 2

One stage studies, MSc level	Title awarded: Master of Civil Engineering (*magister*)							
Admission	The admission rules differ in particular universities. Usually it is the university entrance exam on mathematics, sometimes physics and foreign language as well.							
Duration	5-5,5 years only at full-time courses							
Course organisation	15 weeks semesters: • "winter' semester from the beginning of October to the end of January • "summer" semester from the end of February to the beginning of June							
Examinations	Two sessions: in the beginning of February and in June. Repetitions possible in March and In September.							
Teaching organisation	Teaching material divided for 35-50 subjects. 25-32 contact hours per week at full-time courses. Subject categories* weight:							
	A	B	C	D	E	F	G	H
	10-13%	11-15%	18-25%	22-35%	5-12%	9-11%	0%**	10-12%
Final exam	The final exam comprises; • final project (thesis) presentation, • exam- 3 questions connected with speciality. The final assessment consists of average mark of all subjects assessed during the study period (weight 50%), the mark of final project/thesis (weight 25%) and the mark of final exam (weight 25%). The weights given in parentheses differ in particular universities.							

* see annex, table 1.3.
** 4-8 weeks during holidays

In some Polish two-stage studies in mode recommended by Bologna Declaration have been organised last time. The data for undergraduate BSc course in this system are given in table 3.

Table 3

<table>
<tr><td colspan="2">Two-stage studies, BSc level</td><td colspan="8">Title awarded: Bachelor of Civil Engineering (inzynier)</td></tr>
<tr><td>Admission</td><td colspan="9">The admission rules differ in particular universities. The minimum requirements are based on the pre-university certificate level and refers mainly to the admission at part-time courses. At full-time courses usually it is the university entrance exam on mathematics, sometimes physics and foreign language as well.</td></tr>
<tr><td>Duration</td><td colspan="9">3,5 to 4 years at part-time courses
4 years at full-time courses</td></tr>
<tr><td>Course organisation</td><td colspan="9">15 weeks semesters:
• “winter” semester from the beginning of October to the end of January
• “summer” semester from the end of February to the beginning of June</td></tr>
<tr><td>Examinations</td><td colspan="9">Two sessions: in the beginning of February and in June. Repetitions possible in March and In September.</td></tr>
<tr><td>Teaching organisation</td><td colspan="9">Teaching material divided for 30-35 subjects. Modular schemes are being introduced.
22-25 contact hours per week at full-time courses. 16-20 contact hours at part-time courses (so called “evening courses, lessons from 3pm to 8:30pm)
45% lectures, 55% others.
Subject categories* weight:</td></tr>
<tr><td></td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td></tr>
<tr><td></td><td>9-11%</td><td>8-10%</td><td>18-22%</td><td>24-36%</td><td>5-12%</td><td>9-11%</td><td>11-13 %</td><td>9-11%</td></tr>
<tr><td>Final exam</td><td colspan="9">The final exam comprises;
• final project presentation,
• exam - 3 questions connected with speciality.
The final assessment consists of average mark of all subjects assessed during the study period regarding weights proportional to credit points, the mark of final project and the mark of final exam.</td></tr>
</table>

* see annex, table 1.3.

3.2 Postgraduate education

3.2.1 Master degree courses

The information refers only to the second level of two-stage studies.

Table 4

Two-stage studies, MSc level	Title awarded: Master of Civil Engineering (*magister-inzynier*)
Admission	Students are enrolled in two ways: • directly after completing the undergraduate studies at BSc level on the base of final studies mark, • BSc graduates from earlier period on the base of final studies mark and the interview
Duration	1,5-2 years at full-time courses
Course organisation	15 weeks semesters: • “winter” semester from the beginning of October to the end of January • “summer” semester from the end of February to the beginning of June

Table 4 (continued)

<table>
<tr><td colspan="2">Two-stage studies, MSc level</td><td colspan="7">Title awarded: Master of Civil Engineering (magister-inzynier)</td></tr>
<tr><td>Examinations</td><td colspan="8">Two sessions: in the beginning of February and in June. Repetitions possible in March and In September.</td></tr>
<tr><td rowspan="3">Teaching organisation</td><td colspan="8">Teaching material divided for 20-25 subjects. Modular schemes are being introduced.
22-24 contact hours per week at full-time courses.
45% lectures, 55% others.
Subject categories* weight:</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td></tr>
<tr><td>11-13%</td><td>10-14%</td><td>18-22%</td><td>24-36%</td><td>5-12%</td><td>9-11%</td><td>0 %</td><td>10-12%</td></tr>
<tr><td>Final exam</td><td colspan="8">The final exam comprises;
• final thesis presentation,
• exam - 3 questions connected with speciality.
The final assessment consists of average mark of all subjects assessed during the study period regarding weights proportional to credit points, the mark of final thesis and the mark of final exam.</td></tr>
</table>

* see annex, table 1.3.

3.2.2. Doctoral courses

Table 5

PhD level	Title awarded: Doctor of Technical Science (*doktor*)
Admission	The admission rules differ in particular universities.
Duration	4 years only at full-time courses
Course organisation	15 weeks semesters: • "winter' semester from the beginning of October to the end of January • "summer" semester from the end of February to the beginning of June
Examinations	Two sessions: in the beginning of February and in June. Repetitions possible in March and In September.
Teaching organisation	The courses are based mainly on seminars and few hour of lectures per week.

4. CURENT TRENDS IN CIVIL ENGINEERING EDUCATION

Trends in civil engineering seem to be positive last years. The number of candidates as well as the their level increases. For example for the academic year 2003 - 2004 the average number of candidates for one place surpassed 2 and in some cases reached 3.

The studies organisation will probably evolve towards two-stage studies system, however the change seems to be difficult.

ANNEX

1. GENERAL REMARKS

Civil & Building Engineering is currently taught at 20 Technical Universities, among them 16 Polytechnics and 4 Agricultural Academies. However the one-tier parallel BSc and MSc courses stil are the dominating educational system in Polish higher education institutions, majority of Civil Engineering Faculties have introduced two-tier (ladder) system, branched (tree) system, or combined two-tier-branched system. Two-tier studies system recommended by the Bologna declaration has been introduced in the framework of Tempus scheme at 3 Polish Universities in Gdansk, Gliwice and Kielce and in some other Universities without Tempus programme aid.

2. SPECIFICATION OF SPECIALITIES

The particular names of specialities being currently taught at Polish Civil Engineering Faculties is greater than 60. In the table below, all specialties were divided into eight groups.

Table 1.1 Groups of specialties and their names

No	General name of speciality	Numb.	Sample particular names of specialities
1.	Structural Engineering	49	Building & Civil Engineering Structures, Bridges, Bridges & Underground Structures,
2.	Geotechnics	7	Geotechnics, Geotechnics & Hydrotechnics, Geotechnics & Special Structures
3.	Construction Technology and Management	34	Construction Technology and Management, Technology & Organisation, Construction Economics
4.	Transportation Engineering	24	Roads and Motorways Construction, Roads and Airports, Railways
5.	Structural Mechanics	6	Computational Mechanics, Computational Methods in Structural Analysis, Theory & Computational Structural Design
6.	Building Construction	16	Building Construction, Ecological and Energy Saving Buildings, Modernisation, Reconstruction and Protection of Buildings, Urban Engineering, Constructing-Architect, Protection of Architectural Monuments
7.	Hydrotechnical Structures	3	Hydrotechnical Structures,
8.	Others	9	Civil Engineering, Environmental Engineering, Sanitary Systems, Agricultural Construction

The most popular specialties are Structural Engineering, Construction Technology and Management and Transportation Engineering.

The list of Polish Universities comprising Civil Engineering Faculties with their addresses, types of courses and specialties taught is given in the table 1.2.

No	Name	City	Address	Specialities (numbers according to the specification in table 1.1)					
				Undergraduate (BSc/BEng. & MSc/MEng.)					Supplementary graduate
				Full time	Part time	Full time	Part time	Full time	Part time
1	Politechnika Białostocka	Białystok	Wiejska 45A, 15-351 Białystok		3,	1, 3, 4, 6,			3,
2	Akademia Techniczno-Rolnicza	Bydgoszcz	Kordeckiego 20, 85-225, Bydgoszcz		3,	1, 3, 4, 7,			3,
3	Politechnika Częstochowska	Częstochowa	Dąbrowskiego 69, 42-200 Częstochowa		1, 3,	1, 3,			
4	Politechnika Gdańska	Gdańsk	Narutowicza 11/12, 80-952, Gdańsk	3, 4, 6,	1, 3, 4, 6,	1, 2, 3, 4, 7,		1, 4,	
5	Politechnika Śląska	Gliwice	Akademicka 5, 44-100 Gliwice	1, 4, 6,	1, 3, 4, 6,	1, 3, 4, 5,			1, 3,
6	Politechnika Świętokrzyska	Kielce	1000-lecia Państwa Polskiego 7 25-314 Kielce	1, 3, 4, 6,	4, 6,	1, 3, 4, 6,			
7	Politechnika Koszalińska	Koszalin	Racławicka 15/17, 75-620 Koszalin	1,	1,	1, 5,			1,
8	Politechnika Krakowska	Kraków	Warszawska 24, 31-155 Kraków	6,	1, 3, 4,	1, 3, 4, 5,			1, 3, 4,
9	Politechnika Lubelska	Lublin	Bernardyńska 13, 20-950 Lublin	1,	6,	1, 3, 4, 6, 8			
10	Politechnika Łódzka	Łódź	Ks. Skorupki 6/8, 90-024 Łódź	1, 3, 6,	1, 3, 4,	1, 3, 6,			
11	Akademia Rolniczo-Techniczna	Olsztyn	Oczapowskiego 2, 20-957 Olsztyn	1,	1,				
12	Politechnika Opolska	Opole	S. Mikołajczyka 5, 45-233 Opole	1,	1,	1, 5,			1,
13	Politechnika Poznańska	Poznań	Pl. Marii Skłodowskiej Curie 5, 60-965 Poznań	3,	1, 2,	1, 3, 4,			1,
14	Politechnika Rzeszowska	Rzeszów	W. Pola 2, 35-050 Rzeszów		1,	1, 5			1,
15	Politechnika Szczecińska	Szczecin	Al. Piastów 17, 70-310, Szczecin	3,	1,	1, 3, 4, 7, 8,			1, 2, 3, 8,
16	Politechnika Warszawska	Warszawa	Pl. Politechniki 1, 00-661, Warszawa	1, 3, 4, 8,	1, 3, 4,	1, 3, 4, 5,			
17	Politechnika Wrocławska	Wrocław	Wybrzeże Wyspiańskiego 27, 50-370 Wrocław	2, 4,	1, 2, 3, 4,	1, 2, 3, 4, 5, 6,			1, 2, 3,
18	Politechnika Zielonogórska	Zielona Góra	Podgórna 50 75-246 Zielona Góra	1, 6,	1,			1, 3, 6, 8,	
19	Akademia Rolnicza	Wrocław	Norwida 25 50-375 Wrocław	8				8	
20	Szkoła Główna Gospodarstwa Wiejskiego	Warszawa	Nowoursynowska 166 02-766 Waeszawa	8		8			

Table 1.3 Subject categories

Category	Subjects
A	**Basic Sciences** (Mathematics, Physics, Chemistry)
B	**Engineering Sciences** (Mechanics, Strength of materials, F.E.M., Computer Science, Drawing-graphics, etc.)
C	**Core Civil Engineering Subjects** (Statics, Dynamics, Hydraulics, Soil mechanics, Fluid mechanics, Elasticity & Plasticity, Building materials, Surveying, Reinforced concrete I, Hydrology, etc)
D	**Engineering Specialisation** (Steel structures, Reinforced concrete II,III, Structures, Soil and foundation dynamics, Earthquake engineering, Non-linear design of structures, Hydraulic systems in transitory regime, Hydraulic structures, etc)
E	**Economics and Management** studies
F	**Non-technical Subjects** (Humanities, Social Sciences, Languages, Sport)
G	**Practical Industrial Placement**
H	**Final Project/Thesis**

CIVIL ENGINEERING EDUCATION IN PORTUGAL

Jose F.G. Mendes[1], Luis S. Silva[2], Ryszard Kowalczyk[3]

1. GENERAL VIEW ON THE PRE-UNIVERSITY EDUCATION

The education system in Portugal is organised in three levels: basic, secondary and higher (Figure 1).

Before entering the university level the students must undergo 12 years of school divided into two levels, which include four main stages corresponding to the first, second and third cycles followed by the secondary course.

Basic school is obviously compulsory and includes three cycles along a 9-year period: first cycle (4 years), second cycle (2 years), and third cycle (3 years). Students enter basic level with an age of 6 year-old and are supposed to finish at 14 year-old.

Secondary level includes general and technological courses, lasting for three years. Students normally enter secondary school at an age of 15 year-old and finish at 17, after completing a national exam.

	17	Diploma	XII
Normal age	16		XI
	15		X
		Secondary School General and technological	
	14	Third cycle	IX
Normal age	13		VIII
	12		VII
Normal age	11	Second cycle	VI
	10		V
	9	First cycle	IV
Normal age	8		III
	7		II
	6		I
		Basic School	

Figure 1 The pre-university education system

[1] Professor, University of Minho,
[2] Professor, University of Coimbra,
[3] Professor, University of Beira Interior

General courses are organised in different domains of knowledge and entitle the students to proceed to a higher school. Courses offered are: Natural Sciences, Sciences and Technology, Visual Arts, Performance (Spectacle) Arts, Human and Social Sciences, Social-Economical Sciences, Literature and Languages.

Technological courses are organised in different technological domains and aim to give the students a professional qualification. Courses offered are: Construction, Electrotechnics/Electronics, Informatics, Mechanics, Chemistry and Environmental Control, Equipment, Multimedia, Audivisual Production, Administration, Commercial Technics, Social Action, Documentation, Turism, Juridical Services, Sports, Territorial Planning and Management, Environment and Nature Conservation.

2. GENERAL VIEW ON THE ENGINEERING EDUCATION

2.1 Engineering education at undergraduate level

The engineering education system at undergraduate level is divided in two different types of programmes: a 5-year (long duration) programme leading to a *Licenciatura* degree, offered by Universities; and a 3-year (short duration) programme leading to a *Bacharelato* degree, offered by Polytechnic Institutes (Figure 2). Recently, the Polytechnic Institutes were authorised to offer the so-called *Licenciatura bi-etápica* degree, which is a two-stage degree including the first 3-year programme (*Bacharelato*) followed by a 2-year programme, resulting alltogether in a *Licenciatura* degree.

University courses are expected to contribute to the education of high level engineers, able to develop their professional activities in both design and production, thus including stronger component in basic sciences (mathematics, physics, chemistry, materials) emphasizing *know-why* capabilities. Polytechnic courses, on the other hand, aim the development of technical vocational skills in order to prepare graduates for the immediate labor market in production activities.

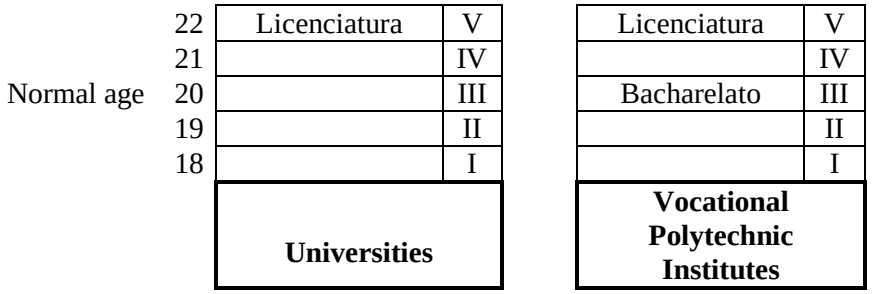

Figure 2 The engineering education system at undergraduate level

2.2 Engineering education at postgraduate level

2.2.1 Master or Master-type programmes

The *Licenciatura* degree has two types of legal recognition: the academic one, which allows the graduate to pursue postgraduate and doctoral programs; and the professional one, for the courses accreditated by the Portuguese Engineering Institution (*Ordem dos Engenheiros*), which entitles the graduate to act as an *Engineer*.

Master programmes provide the students with a deep level of knowledge in a specific scientific area and contribute to the development of research competences. Master courses are organised in a 2-year programme: the first year includes a set of subjects, with courses and exams; the second year is dedicated to research and results in a Master thesis to be submitted by the student. After completion of the first year, the student can ask for a Postgraduation Diploma, which is not considered an academic degree. For the students that go into the second year and complete sucessfully the thesis, i.e. pass the final public exam – evaluation of the thesis by a board of three examiners, one of them coming from a different university -, a Master diploma is awarded (Figure 3).

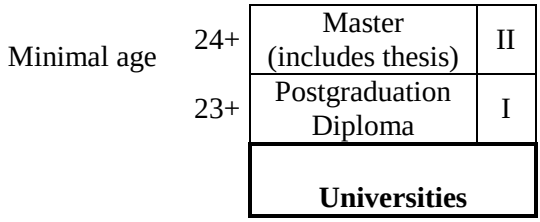

Figure 3 The engineering education system at postgraduation level: Master

2.2.2 Doctoral programmes

A candidate holding a Master degree can apply to a Doctoral programme, which like in the case of Master programmes is offered exclusively by universities.

Although some universities offer Doctoral courses, which include a mix of subject courses and research, the most common formula is a research-oriented programme that lasts for three to four years (Figure 4). Candidates are normally accepted in a specific doctorate field, offered by an university, and develop their work based on a research plan under the direction of a supervisor. The degree is awarded after submission of a thesis and approval in a public exam, before an

examination board that includes at least five professors, two of them being external.

In exceptional cases, candidates without a Master degree can be accepted as Doctoral students, as long as they have a graduation mark equal or greater than 16 (out of 20, according to the Portuguese marking system) or an outstanding CV.

Minimal age	28+	Ph.D	IV
	27+	Ph.D	III
	26+		II
	25+		I
		Universities	

Figure 4 The engineering education system at postgraduation level: Ph.D

3. CIVIL ENGINEERING EDUCATION

3.1 Undergraduate education

3.1.1 Short description for each type of programme

Conceptual differences between short (3-year) and long (5-year) programmes were presented before. In terms of the structure of the programmes, both follow the Portuguese Credit Units System. For the award of a degree, the student is required to complete a certain number of Credit Units, which for a civil engineering 5-year course is normally between 180 and 210. One Credit Unit is equivalent to: 15 hours of theorical lessons; or 40 hours of practice (exercises) lessons; or 22 hours of theorical-practice lessons; or 30 hours of seminar.

Programmes recently approved or reformulated include as well the workload expressed according to the European Credit Transfer System (ECTS).

Long programmes have a nominal length of five years and are organised in semesters. Each semester typically includes 12 to 14 weeks of lecturing, followed by a 1-week break and a 5-week period for student assessment. Programmes include five or six courses per semester with a contact time of 23-30 hours per week, including lectures, problem solving classes (tutorial), and laboratory or computer sessions.

Normal exam periods provide two opportunities for each course, which means that the students can take the first exam and, if failing or wishing to improve their previous marks, repeat the exam in the final weeks of the period. There is an additional period for exams, normally in September, when the students can take a limited number of extra exams.

3.1.2 Short description of the main features of the curriculum

Civil Engineering programmes are designed to provide the students with the skills and knowledge needed to act as a Civil Engineer. But what is a Civil Engineer? In Portugal is someone that holds a Civil Engineering degree (*Licenciatura*) and uses scientific methodologies to apply models, technics and procedures concerning different fields (mathematics, physics, mechanics, hydraulics, operations research, geology, etc.) in order to design, manage and produce construction works, territorial plans and environmental studies.

These requirements imply a balanced programme in terms of the subjects covered and the type of teaching approach.

Subjects are divided in:

- Basic sciences (includes mathematics, physics, chemistry, statistics, etc);
- Engineering sciences (includes subjects on informatics, technical drawing, numerical methods, systems, topography, etc);
- Specialized subjects (includes subjects on structural engineering, hydraulics, water resources and environment; urban and regional planning, roads, transportation and traffic; geotechnics; construction processes and management).

The relative weight of these subjects in a typical civil engineering programme is:

- Basic sciences: 15 to 20%;
- Engineering sciences: 15 to 20%;
- Specialized subjects: 60 to 70%.

The ratio of lecture/other contact hours ranges from 40 to 50%.

The requirement to finalize the programme is the completion of a certain number of credit units. Civil engineering programs normally include a project in the last year.

3.1.3 Admission of students at the undergraduate level

Admission of students for civil engineering studies is made according to a competitive entry system based on a national contest which takes into account the candidate´s marks at the secondary school (11th and 12th years) and the results of specific examinations on mathematics and physics. The number of available places for each course is limited and established every year by the Ministry, according to the proposals of the Universities.

Candidates are ranked based on the resulting weighted average of their marks. The Universities can only establish the specific examinations required (in Portugal, most of them require mathematics and physics), and play no role in the selection.

Recently, some Universities decided to establish a minimum threshold for the student's marks in mathematics and physics, which resulted in an improvement of the average quality of the admitted students.

Currently there is full employment in civil engineering-related activities and all the available places for studies in public Universities are taken every year. Candidates that do not manage to enter in a public university – considered as offering better quality programmes – may apply for a place in a private University, as long as they can afford much higher fees.

3.2 Civil engineering education at postgraduate level

3.2.1 Master or Master-type programmes

Master programmes in civil engineering in Portugal are organised similarly to the graduation courses, i.e. following the credit unit system. Subject courses can be offered on a semester or trimester basis or, in some cases, organised in shorter modules. As said before, the first year is dedicated to lectures on the different subjects, and the second year dedicated to develop research and write a thesis.

There is no tradition of Master courses based exclusively on research.

Some Universities offer Master Courses in Civil Engineering, but the most usual formulation is a Master Course on a specific subject or field. Examples are: Master in Structural Engineering, Master in Hydraulics, Master in Water Resources, Master in Geotechnics, Master in Constructions, Master in Roads, Master in Urban Engineering, Master in Municipal Engineering, etc.

3.2.2 Doctoral programmes

There is no tradition of Doctoral Courses in Civil Engineering in Portugal. The most common formulation is a Research Doctoral Program in Civil Engineering and/or on a specialization: Structural Engineering, Hydraulics, Geothecnics, Roads, Constructions, Urban and Regional Planning, etc.

Doctoral programmes take three to four years and stand on research work, resulting in the submission of a Doctoral thesis.

4. RECENT TRENDS IN ENGINEERING EDUCATION IN THE COUNTRY

The Bologna Declaration motivated a broad discussion within the Universities and the Portuguese Institution of Engineers. Unfortunately in most of the engineering fields there is almost no dialog between stackholders. Particularly the Schools of Engineering and the Institution of Engineers didn't develop so far a common effort in order to define the basis for a national

reformulation of the engineering programmes. These situation, if not changed in the next times, will result in multiple-timing changes, which will not contribute to sort out the engineering courses neither to bring the required uniformity implicit in the Bologna Declaration.

Concerning this issue, one of the most comprehensive efforts, as far as we know, is the unified conceptual model proposed by the School of Engineering of the University of Minho, which aims to unify the engineering degrees according to the Bologna spirit (Figure 5).

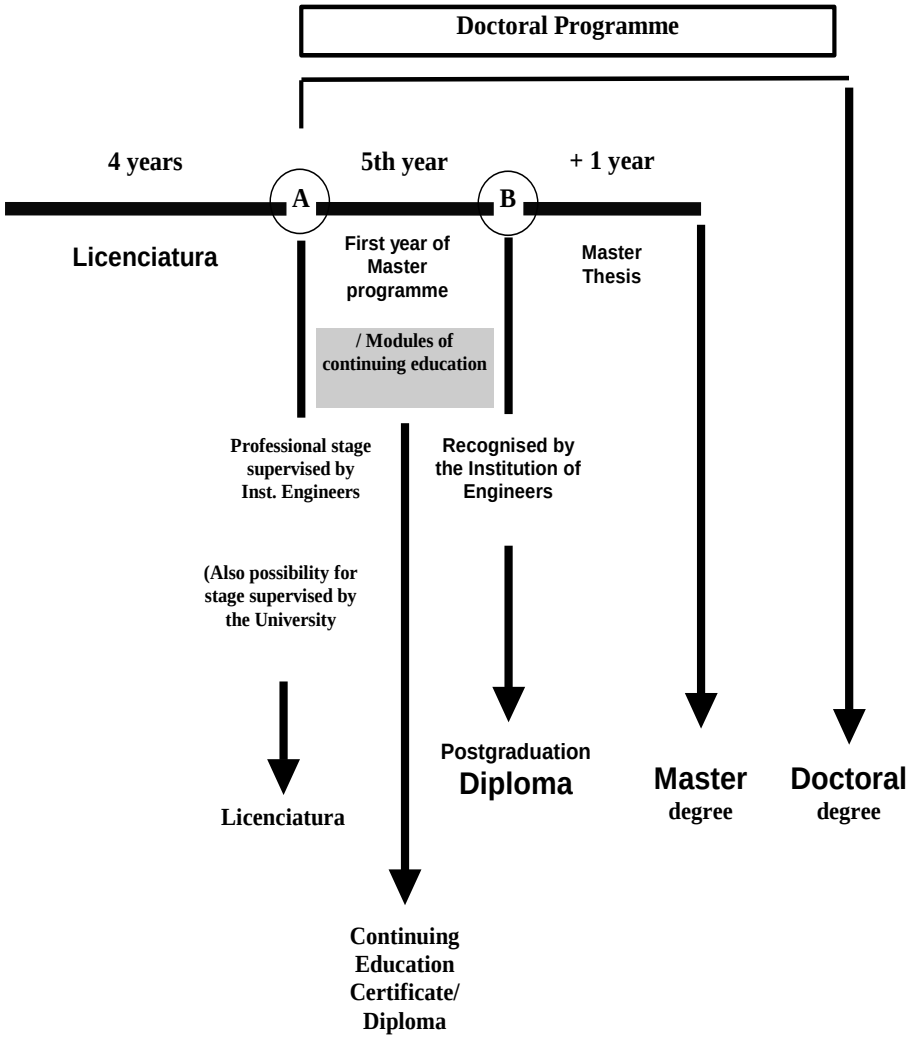

Figure 5 The University of Minho unified model for the engineering degrees

ANNEX

Higher education institutions and Civil Engineering Courses offered in Portugal

Source: Ministry of Education,
http://www.desup.min-edu.pt/escolas.htm, Feb 2002

Institution	Course	Duration (years)	Numerus clausus
Public Universities			
Universidade de Aveiro	Licenciatura	5	50
Universidade da Beira Interior	Licenciatura	5	100
Universidade de Coimbra	Licenciatura	5	125
Universidade Técnica de Lisboa	Licenciatura	5	175
Univeridade Nova de Lisboa	Licenciatura	5	130
Universidade do Minho	Licenciatura	5	135
Universidade do Porto	Licenciatura	5	170
Universidade de Trás-os-Montes e Alto Douro	Licenciatura	5	65
Sum			**950**
Public Polytechnic Institutes			
Univ Algarve – Escola Superior de Tecnologia de Faro	Bacharelato-Licenciatura	3-5	50
Instituto Politécnico de Beja	Bacharelato-Licenciatura	3-5	30
Instituto Politécnico de Bragança	Bacharelato-Licenciatura	3-5	120
Instituto Politécnico de Castelo Branco	Bacharelato-Licenciatura	3-5	65
Instituto Politécnico de Coimbra	Bacharelato-Licenciatura	3-5	75
Instituto Politécnico da Guarda	Bacharelato-Licenciatura	3-5	75
Instituto Politécnico de Leiria	Bacharelato-Licenciatura	3-5	70
Instituto Politécnico de Lisboa	Bacharelato-Licenciatura	3-5	150

(continued)

Institution	Course	Duration (years)	Numerus clausus
Instituto Politécnico de Portalegre	Bacharelato-Licenciatura	3-5	60
Instituto Politécnico do Porto	Bacharelato-Licenciatura	3-5	95
Instituto Politécnico de Viana do Castelo*	Bacharelato-Licenciatura	3-5	60
Instituto Politécnico de Viseu	Bacharelato-Licenciatura	3-5	55
Instituto Politécnico de Tomar	Bacharelato-Licenciatura	3-5	60
Sum			**965**
Private Universities			
Universidade Independente	Licenciatura	5	90
Universidade Fernando Pessoa	Licenciatura	5	60
Universidade Lusófona	Licenciatura	5	110
Sum			**260**
Private Polytechnic Institutes			
Instituto Politécnico Autónomo	Bacharelato-Licenciatura	3-5	50
Sum			**50**
Total number of places offered			
Public			**1915**
Private			**310**
Total			**2225**

* Programme in Civil Engineering and Environment

CIVIL ENGINEERING EDUCATION IN ROMANIA

Iacint Manoliu*

1. GENERAL VIEW OF PRE-UNIVERSITY EDUCATION

The pre-university education can be divided in three parts:

- Pre-primary education (kindergarten) covering the 3-to-6-year old age group;
- Compulsory full – time education, divided in three phases:
  - Primary school (4 years), age group 6-10 years
  - Gymnasium (4 years, first phase of general lower secondary), age group 10-14 years
  - Lyceum – low cycle (2 years, second phase of general or specialized secondary) age group 14-16 years
  - Arts and Trades School (2 years, vocational lower secondary) age group 14-16 years
- Upper secondary education, which can be of two kinds:
  - Completing year (vocational upper secondary) 16-17 years of age
  - Lyceum – superior cycle (2years, general and specializedd upper secondary 16-18-19 years of age).

At the end of primary school, pupils move automatically on to the next level, with no final examination. At the end of Gymnasium, pupils will face final national tests devised by the Ministry of Education and Research. Results obtained in these tests, together with the results obtained during the four years of the first phase of general lower secondary education will enable pupils to choose one of the two institutions for the continuation of lower secondary education: Lyceum or Arts and Trades School, respectively. There is no final examination at the end of lower secondary education, which coincides with the end of compulsory education stage.

Graduates of the lower cycle of Lyceum are awarded a graduation certificate, a portfolio for further education and a copy of the record containing the marks received during compulsory education. The same documents are received by the graduate of the Arts and Trades School which, in addition, may obtain, after successfully passing an exam for certification of vocational skills, a level-one vocational qualification certificate. In order to enter the upper secondary education, they have to attend and graduate the completion year.

At the end of the upper cycle of Lyceum there is a final examination, called Baccalaureate examination. The "Baccalaureat diploma" accompanying this examination allows graduates to apply to take entrance examination for higher education.

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Curriculum for the completion year covers 7 curricular areas: language and communication, mathematics and natural sciences, people and society, arts, physical education, technologies, counseling and guidance. Graduates of completion year are awarded a graduation certificate, a portfolio for further education and a copy of the record containing the marks received. After facing a vocational examination, they may obtain a level-two vocational qualification certificate. Graduates of completion year who possess a graduation certificate and a level-two vocational qualification certificate may attend upper secondary education.

2. GENERAL VIEW ON THE ENGINEERING EDUCATION

The Romanian system of engineering education belongs to what is currently called in Europe the "*continental*" system of higher education.

There are two, parallel, programmes of undergraduate engineering education in Romania: of long duration (5 years) and of short duration (3 years). The engineering education of long duration is organized in technical universities or universities, while the engineering education of short duration is offered by university colleges, which either belong to universities or function under their direct supervision.

From the 56 public institutions of higher education in Romania, 22 are offering engineering education.

As in most countries, in Romania, too, engineering education started with civil engineering. Thus, in 1818 Gheorghe Lazăr founded in Bucharest a School for Land Surveyors which was followed by the creation in 1864 of a School of Bridges and Roads, Mines and Architecture. In 1888 that School transformed into "The National School of Bridges and Roads". In 1921 it became the Polytechnic School of Bucharest. As a result of the Education Reform in 1948, the Faculty of Civil Engineering separated from the Polytechnic School and became an independent higher education establishment called the Civil Engineering Institute of Bucharest, while other faculties of the former Polytechnic School (in the field of mechanical engineering, electrical engineering, chemical engineering) formed the Polytechnic Institute of Bucharest. In 1994 the Civil Engineering institute adopted its present name: The Technical University of Civil Engineering of Bucharest, while the Polytechnic Institute was renamed University "Politehnica" of Bucharest.

Besides the two Technical Universities in Bucharest, other major institutions offering engineering education in Romania are the University "Politehnica" of Timişoara, founded in 1921, the Technical University "Gheorghe Asachi" Iaşi, founded in 1946, the Technical University of Cluj-Napoca, founded in 1953, and Universities of Braşov, Craiova, Galatzi, Oradea, , all founded after 1948. In figure 1 is shown the map of Romania with the location of university centres for higher engineering education.

The letter "C" stands for those centres in which civil engineering education is provided.

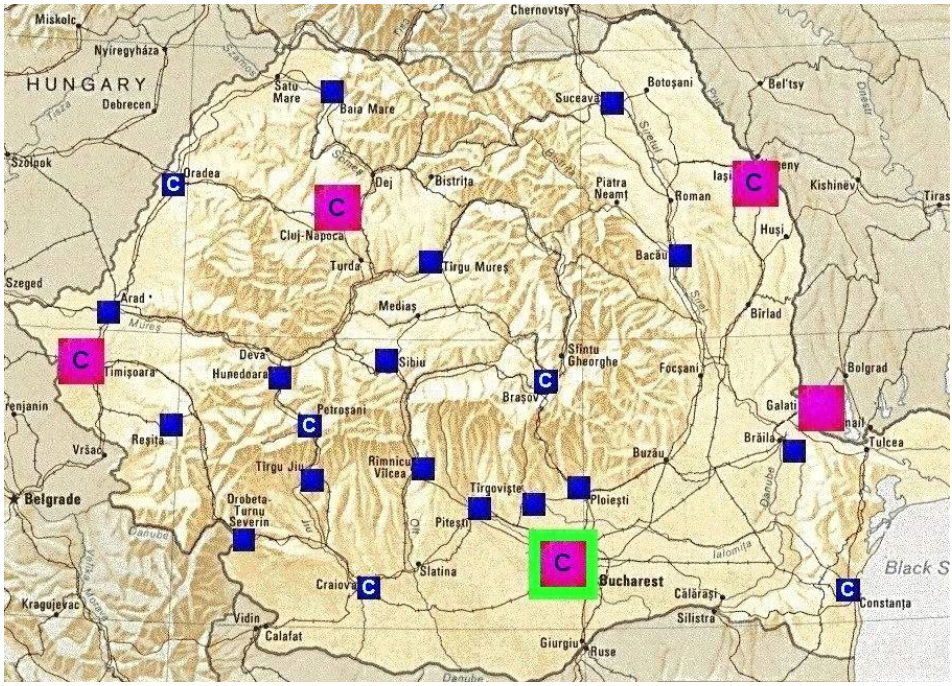

Fig. 1 Map of Romania with the location of university centres for higher engineering education

2.1 Engineering education at undergraduate level

As already shown, there are two types of undergraduate programmes.

The long duration - 5 years - programme, which leads to the degree named in Romanian "Inginer Diplomat", considered to be equivalent to a M.Sc. degree in the anglo-saxon or two-tier system. However, this is an integrated programme, with no intermediary step.

The short duration - 3 years - programme, which leads to the degree named in Romanian "Inginer Colegiu", considered to be equivalent to a B.Sc. degree in the anglo-saxon or two-tier system.

Under conditions defined by the Senate of each university, a graduate of the 3-year programme can continue his/her education to become "*Inginer Diplomat*". This implies at least the equivalent of one-year courses for the "bridge", after which admission is granted in the 3rd year of study of the long programme.

2.2 Engineering education at postgraduate level

There are two types of postgraduate programme, open only for the holders of "*Inginer Diplomat*" degree.

"*Advanced studies in engineering*" were introduced in 1994. This is a one-year postgraduate programme leading to the "*Diploma of advanced studies*". About 1/2 of the time is allocated to lectures and tutorials and 1/2 to research work and to the preparation of a Dissertation. The admission to the "*Advanced studies*" is made by examination. Candidates must be holders of the degree of "*Inginer Diplomat*", with a good academic record. Up to 20% of the graduates of the 5-year programme can be admitted to the "*Advanced studies*" programme.

The Doctorate programme in engineering is open to holders of the "*Inginer Diplomat*" degree. The "*Diploma of advanced studies*" is not a prerequisite for admission, but definitely is an asset at the entrance colloquium and also is taken into consideration when the programme of the doctoral candidate is established.

The normal duration of doctoral studies is of 4 years for intra-mural work (full time) and 6 years for extra-mural (part time) work. There is no requirement for the attendance of courses for credits. Instead, 3-4 comprehensive examinations have to be passed and 3-4 reports have to be elaborated and presented in front of a committee. At least half of the time devoted to doctoral studies is spent for research and for the preparation of a Thesis which should be publicly defended. Pending the approval by vote of a Scientific Committee of 5 members (including the supervisor of the doctoral programme) the candidate is conferred a Doctor of Engineering degree, equivalent to a Ph.D degree in the anglo-saxon system.

3. Civil engineering education

3.1 Undergraduate education

3.1.1 Presentation of various programmes

In the academic year 2003-2004, ten Romanian universities offered degree courses in civil engineering which are listed in the annex I.

Civil engineering programmes in Romania, as well as other tertiary education programmes, are differentiated by fields (profiles) and degree courses (specializations).

In the table 1 are given the names and codes of the degree courses at undergraduate level in civil engineering and other related fields offered by the ten Romanian universities.

The degree courses shown in the table 1 for fields (profiles) other than the civil engineering one (Engineering Economics, Environmental Engineering, Mechanical Engineering, Applied Sciences) have a strong component of civil engineering education which justifies their inclusion in the table.

Table 1. Names and codes of the degree courses at undergraduate level for various fields (profiles)

Field	Name of the degree course	Duration	Code
Civil Engineering	Civil, Industrial and Agricultural Buildings	5 yrs.	CIAB
Civil Engineering	Hydraulic Structures	5 yrs.	HS
Civil Engineering	Sanitary Engineering and Environmental Protection *	5 yrs.	SANEP
Civil Engineering	Railways, Roads and Bridges	5 yrs.	RRB
Civil Engineering	Urban Engineering *	5 yrs.	Urb
Civil Engineering	Land Reclamation and Rural Development *	5 yrs.	LRRD
Civil Engineering	Mining Construction *	5 yrs.	Min
Civil Engineering	Civil Engineering (in English) *	5 yrs.	CEEn
Civil Engineering	Civil Engineering (in French) *	5 yrs.	CEFr
Civil Engineering	Civil Engineering (in German) *	5 yrs.	CEGe
Engineering Economics	Construction Engineering and Management *	5 yrs.	CEMan
Environmental Engineering	Water and Soil Protection Engineering *	5 yrs.	WSP
Mechanical Engineering	Construction Engineering and Mechanization *	5 yrs.	CEMec
Applied Science	Engineering Mathematics *	5 yrs.	EMat
Civil Engineering	Construction Engineering *	5 yrs.	CEng
Civil Engineering	Construction Economics and Management *	3 yrs.	CEcMan
Civil Engineering	Municipal Engineering *	3 yrs.	MunE
Civil Engineering	Construction and exploitation of hydraulic works *	3 yrs.	CEHW
Civil Engineering	Roads and Bridges *	3 yrs.	RB
Civil Engineering	Railways and tunnels *	3 yrs.	RWT

The distribution of the degree courses among the 10 universities is given in the table 2. As one could expect, the largest offer - 16 degree courses - belongs to the Technical University of Civil Engineering of Bucharest which is the only Romanian university devoted entirely to higher education in civil engineering and related fields. T.U.C.E.B. is followed by the Techical University "Gheorghe Asachi" Iaşi with 11 degree courses and University "Politehnica" Timişoara with 10 degree courses. Four univeristies (Braşov, Oradea, Petroşani and Craiova) are offering only one degree course each.

An interesting feature of the civil engineering programmes offered by Romanian universities is the presence of a number of *degree programmes in foreign languages*. The first programme of this kind, a 5-year programme in English, was introduced in the academic year 1990/1991 at the Technical University of Civil Engineering Bucharest. In the following year, the same programme was also offered in French. In the same year 1991/1992, University "Politehnica" Timişoara and Technical University "Gheorghe Asachi" Iaşi introduced also civil engineering programmes in foreign languages, followed by the Technical University Cluj-Napoca in 1994/1995.

Table 2. Degree courses in civil engineering and engineering related fields offered by the Romanian universities

Degree course	University									
	TUCEB	TUI	UPT	TUCN	UOC	UTB	UO	UP	UAVMB	UC
Degree courses of long duration – 5 yrs. – in civil engineering field										
CIAB	x	x	x	x		x				
HS	x	x	x		x					
SANEP	x	x	x				x			
RRB	x	x	x	x						
Urb	x	x								
LRRD		x			x				x	
Min								x		
CEEn	x	x	x							
CEFr	x	x								
CEGe			x							
Degree courses of long duration – 5 yrs. – in other related engineering field										
CE Man	x									
WSP			x						x	
CEMec	x									
EMat	x									
Degree courses of long duration – 3 yrs. – in civil engineering field										
CEng	x	x	x	x						x
CEcM	x	x	x	x						
MunE	x	x			x					
CEHW	x		x							
RB	x			x						
RWT	x			x						

Legend: TUCEB - Technical University of Civil Engineering Bucharest; TUI - Technical University "Gheorghe Asachi" Iaşi; UPT - University Politehnica Timişoara; TUCN - Technical University Cluj-Napoca; UOC - University "Ovidius" Constantza; UTB - University "Transilvania" Braşov; UO - University Oradea; UP - University Petroşani; UAVMB - University for Agricultural and Veterinary Medicine Bucharest; UC - University Craiova

The programmes in foreign languages, particularly those in English, are quite popular among high school graduates seeking education in civil engineering. The foreign language use represents a good motivation for Romanian students who realize that they can earn an engineering degree and at the same time enhance their language skills and knowledge. Experience so far proves that there are better chances for mobilities abroad for students enrolled in such programmes. But the major motivation is represented by the better opportunities after graduation. Most of the graduates face no difficulties in finding good jobs, particularly at the foreign construction or consulting companies operating in Romania.

3.1.2 Short description of the course curricula for each type of programme

The long duration - 5 years - programmes are intended to educate graduates with strong knowledge and understanding in mathematics, science and engineering, able to solve complex civil engineering problems and to use the

techniques, skills and modern engineering tools necessary for civil engineering practice.

The curricula of the engineering programmes of long duration for a given field (profile) comprise a "common trunk" or "common track" of five to six semesters (with scientific, basic engineering and "core" engineering subjects) followed by specialized engineering subjects which make the difference between various degree courses (specializations). Non-engineering subjects (economics, humanities, foreign languages, physical education etc) are also present in the curriculum, as well as two or three periods of practical training. The long duration programmes end with a final examination, which includes the presentation and defense of the diploma project. Graduates who successfully pass the final examination receive the degree of "*Inginer Diplomat*", entitling them to go into practice without need for another professional recognition.

The short duration - 3 year - programmes are intended to educate graduates with know-how in civil engineering and construction engineering technology, able to show an independent judgement within the field of activity and to implement today's knowledge in the construction and exploitation of civil engineering works. The curricula of the engineering programmes of short duration is oriented toward practice. These programmes end also with a final examination.

3.1.3 Admission of students at undergraduate level

As a consequence of university autonomy, conditions for the admission of students at undergraduate level are established by each university. A common and compulsory condition for the candidate is to have finished the secondary education with a Baccalaureat diploma. At some universities, such as the University of Agriculture and Veterinary Medicine Bucharest, confronted with a chronic lack of candidates, the admission, including for the Faculty of Land Reclamation, is based solely on the Baccalaureat Diploma. But this seems to be an exception. In general, admission comprises an examination, with two written tests, in Mathematics and Physics. What might differ from university to university is the relative weight given in the final admission score to the grade obtained at the Baccalaureat. The number of places in public universities is proposed by the university but must be approved by the Ministry of Education. Most of the places are for no fees kind of education. However, in recent years, public universities, faced to increasing financial difficulties, have been allowed to offer also a limited number of places with fees.

The admission at the academic units providing education in foreign languages is a two step process. The first step is a language proficiency test. Those who pass the test can then compete for the number of places allocated for Romanian students in the respective programme.

Foreign students are admitted for undergraduate studies by dossier, having to prove they concluded secondary education with a diploma equivalent to the

Baccalaureat Diploma in Romania. If they want to enroll in a programme with education in Romanian, they must first spend one year for a special course of Romanian language. Those who want to enroll a programme with education in English, French or German, must first pass the language proficiency test.

3.1.4 Accreditation of degrees

Before the December 1989 Revolution, all higher education institutions in Romania were public institutions, under the authority of the Ministry of Education and, as a consequence, there was no need for accreditation. The situation changed drastically since 1990, when private universities started to function. In the academic year 1993/1994 there were 74 private universities, with 396 faculties. At the same time, after 1990 took place a significant increase of degree programmes at the public universities. The establishment of a legal basis for a system of accreditation and quality assurance of higher education institutions became a stringent necessity. This basis has been provided by the "*Law on accreditation of higher education institutions and recognition of diploma*" promulgated in 1993 (Law 88/1993). Eventually, some amendments to the law were brought in1999.

The main provision of the Law 88/1993 was the foundation of a "*National Council for Academic Assessment and Accreditation*" (*NCAAA*), placed under the control of the Parliament.

The process of academic assessment and accreditation, as defined in the Law 88, has two phases:

I. *the provisional operation license*, which gives the right to organize admission of students and to conduct the educational process;

II. *the proper accreditation*, which gives, in addition, the right to organize the graduation examination and to confer diplomas recognized by the Ministry of Education.

The assurance of the quality of the educational process is made by *periodic evaluation*.

For the higher education institutions set up before December 1989, the process of academic assessment and accreditation is based solely on the periodic evaluation.

Universities, faculties or specializations (degree courses) set up after 22 December 1989, both in the public and private sector, were required by the Law 88 to demonstrate that they meet the specified requirements. As a consequence, for them the two phases mentioned before and the periodic evaluation were applicable.

The law stipulates a set of general criteria and compulsory standards.

The criteria refer to the fundamental areas of organization and functioning specific to any higher education institution: teaching staff, curricula, infrastructure for the education process and for the research, research activity, financial activity etc. The standards correspond to each criterion and are

indicative of the minimal levels which are compulsory in the evaluation and accreditation process. These levels are differentiated for the period of provisional functioning or for the period following the establishment by law of an institution.

For an institution which meets the conditions for accreditation, the Government, through the Ministry of Education and Research, drafts the bill on establishing the institution and sends it to the Parliament, which considers and enacts a Law on establishing the higher education institution.

NCAAA has two Evaluation Committees for engineering sciences, one of them covering civil and mechanical engineering. General criteria and standards apply also to engineering schools, but in addition were defined specific rules as, for instance, for the item "curricula".

For engineering fields, the following distribution of courses is compulsory:

- fundamental subject, minimum 18% (from the total number of contact hours);
- general technical subjects, minimum 30%;
- specialty subjects, minimum 30%;
- complementary subjects, maximum 8%.

For each engineering field, a list of subjects is recommended. A ratio of 1:1 is prescribed between the number of contact-hours devoted to lectures and those devoted to practical activities (tutorials, laboratories, projects a.s.o.)

There was only one attempt of a private university to set up a degree course in civil engineering, but it did not succeed to get the provisional operation license from NCAAA. Hence, presently, civil engineering education in Romania is provided exclusively by public institutions.

All degree courses (specializations) set up after 1990 in public universities in civil engineering and related fields, marked with * in the table 1, were granted accreditation.

3.2 Postgraduate programmes in civil engineering

"*Advanced studies*" pertaining to the domain of civil engineering are offered at the Technical University of Civil Engineering Bucharest and the Technical Universities of Iaşi, Timişoara and Cluj-Napoca.

As an illustration is given in what follows the list of specializations of advanced studies at the Technical University of Civil Engineering Bucharest:

1. Advanced Structural Analysis
2. Structures
3. Geotechnical Engineering
4. Construction Engineering
5. Construction Management
6. Environmental Engineering
7. Highway and Airfield Engineering

8. Railway Engineering for High Speed Trains
9. Bridges and Underground Works

The Doctorate in civil engineering is organized at the same four universities which offer "*Advanced studies*" programmes.

Here are the areas in which the Doctorate in civil engineering is organized at the Technical University of Civil Engineering Bucharest:

1. Statics, Dynamics and Stability of Structures
2. Strength of Materials, Elasticity and Plasticity
3. Earthquake Engineering and Safety of Structures
4. Buildings
5. Geotechnical and Foundation Engineering
6. Reinforced Concrete Structures
7. Steel Structures
8. Hydraulic Structures
9. Hydraulics and Fluid Mechanics
10. Water Supply, Sewerage and Waste Water Treatment
11. Land Reclamation
12. Roads and Airfields
13. Railways
14. Construction Management
15. Building Materials

3.3 Continuous Professional Development programmes

So far, continuing education activities in the domain of civil engineering were organized by the four Technical Universities from Bucharest, Iaşi, Timişoara and Cluj-Napoca. Before 1990, they consisted of 2-3 periods of one week duration each, spread over one year. Courses were attended by engineers from the construction companies, design and research institutes, public authorities a.s.o., fees being covered by the sending institutions. Major changes in the economy which occurred after 1990 determined changes in the content, structure and forms of continuing education, too. Quite often courses are organized for homogeneous groups of attendees, brought by various national or local agencies, with curriculum agreed upon "à la carte" together with the respective agency. Emphasis is put on short courses of 2-3-4 days and on distance learning methods. International links developed by the Romanian universities after 1990 gave the opportunity for a great number of short intensive courses, having among lecturers outstanding specialists from EU countries.

4. Engineering education in Romania and the Bologna process

4.1 The Bologna process

By "Bologna process" the author understands the whole chain of changes within the European higher education system triggered by the following documents:

- **Sorbonne** - *"Joint declaration on harmonization of the architecture of the European higher education system*", signed on 25th May 1998 by Ministers of Education from France, U.K., Germany and Italy.
- **Bologna** - *"Joint Declaration: The European Higher Education Area*" signed on 19th June 1999 by Ministers of Education from 29 countries.
- **Prague** - *Communiqué – "Towards the European Higher Education Area"*, signed on May 19th 2001 by Ministers of Education from 31 countries.
- **Berlin** - *Communiqué - "Realising the European Higher Education Area"*, signed on September 19th 2003 by Ministers of education from 40 countries.

The Bologna Declaration defined six action lines.

In what follows, the ***6 action lines*** of the Bologna Declaration will be considered and theirs impact and relevance for the Romanian system of engineering education will be outlined.

1. Adoption of a system of easily readable and comparable degrees

In the opinion of the author, the present system of degrees in Romanian engineering education enjoys a high readability. Indeed, the lower engineering degree (Inginer-Colegiu) awarded at the end of a 3-year programme, which is more practically oriented, is quite similar with degrees conferred by many higher education institutions in Europe offering engineering programmes of short duration. The comparability between the degree of "Inginer-Colegiu" and other degrees of the kind offered in Europe is very good.

The upper engineering degree (Inginer Diplomat), awarded at the end of a 5-year (integrated) programme, with a design-conception oriented curriculum, is in good consonance with degrees of longer engineering education conferred in other European countries.

A convincing proof of the comparability and compatibility between programmes is offered by the conclusion in March 2001 of a Double - Diploma Agreement between the Technical University of Civil Engineering Bucharest and Ecole Nationale des Ponts et Chaussées Paris. According to the provisions of the Agreement, a student from TUCEB can be enrolled directly in the 2nd year of study at ENPC. Since ENPC is a "Grande Ecole", recruiting students at the level BAC+2, after they completed two "preparatory years" in another institution, the 2nd year of study at ENPC corresponds to the 4th year of study at TUCEB. The TUCEB student follows the programme of ENPC in the 2nd year and first semester of the 3rd (last) year. The second semester of the last

year, devoted to the preparation of the Diploma project is spent both at ENPC and at TUCEB. The final examination, including the presentation and defence of the Diploma project, takes place at TUCEB, with a representative of ENPC in the examination committee. The two diplomas are issued simultaneously by the two institutions, after the completion by the student of all obligations towards both institutions (exams, credits etc).

2. Adoption of a system essentially based on two cycles

This is the most controversial action line resulting from the Bologna Declaration. It generated most discussion also in respect to the engineering education system of Romania and it will be considered later in more detail.

3. Establishment of a system of credits

All Romanian universities offering civil engineering education already adopted a credit system based on ECTS (European Credit Transfer System), with 60 credits per academic year.

4. Promotion of mobility

After more than 40 years of almost total isolation from the outside world, in particular from the Western democratic countries, isolation imposed by the totalitarian regime, Romanian universities were keen to develop after December 1989 cooperation with European universities. A substantial support was received in this respect from TEMPUS, the programme of the European Commission devised to help the restructuring process of the higher education in Central and Eastern European countries. Romania took part in the TEMPUS programme between 1991/1992 and 2000/2001. One of the major outcome of the involvement of Romanian universities in various TEMPUS actions was the development of students and teachers mobility. This created a base for mobilities to be organized under the auspices of the SOCRATES-Erasmus programme, for which Romanian universities became eligible in 1998/1999, but under completely different conditions. While TEMPUS was a programme of assistance, covering all expenses required for the participation of institutions from Central-Eastern Europe, SOCRATES is a programme of partnership, meaning that the CEE countries have to take their share in the costs involved. As a result, grants for both students and teachers mobilities are sensible lower in SOCRATES-Erasmus than in the TEMPUS programme. Solutions must, therefore, to be found, at national and/or institutional level. Nevertheless, SOCRATES-Erasmus programme represents for Romanian universities, including those offering civil engineering education, the most efficient way to promote mobility of students. The fact that Bologna Declaration stated the promotion of mobility as a priority, raises hopes that the present difficulties and obstacles will be overcome in the future.

5. Promotion of European cooperation in quality assurance

Presently, the problem of quality assurance in higher education in Romania is covered by provisions of the Law 88/1993 which, as shown in the p. 3.1.4., lead to the creation of the National Council for Academic Assessment and accreditation (NCAAA).

Higher engineering education institutions in Romania are very much concerned on matters of quality assurance and follow with interest activities and developments taking place in Europe in this domain, such as the foundation in September 2000 of ESOEPE (European Standing Observatory for the Engineering Profession and Education), in which Romania is represented.

6. Promotion of the European dimension in higher education

All four Technical Universities offering civil engineering education in Romania have 5-year programmes in English, French or German (see table 2). This represents a very concrete contribution to the promotion of the European dimension in higher education.

4.2 Civil engineering education in Romania and the action line 2 in the Bologna Declaration

Let's return to the action line 2 in the Bologna Declaration summarized in the following terms: "*Adoption of a system essentially based on two cycles*".

It is worth to quote the Action line 2 in the Bologna Declaration in extenso:

"Adoption of a system essentially based on two main cycles, undergraduate and graduate. Access to the second cycle shall require successful completion of first cycle studies, lasting a minimum of three years. The degree awarded after the first cycle shall also be relevant to the European labour market on an appropriate level of qualification. The second cycle should lead to the master and/or doctorate degree as in many European countries."

As already stated, one can admit that the present system of engineering education in Romania, as briefly described in p.3, is compatible with the Bologna spirit. There is, nevertheless, room for improvement, if one considers the positive and negative facets of existing programmes. Thus, there is a reality that the 3-year programmes offered by the university colleges are very unpopular, many colleges do not succeed to fill the places offered at the entrance examinations, and even if they do, the level of the recruited students is poor. At the same time, industry does not show too much interest in the graduates of the colleges. On the other hand, the year of "*Advanced studies*", a kind of *Advanced Master programme* (if the 5 year degree is assimilated to a Master) created mainly as a gate or step toward Doctoral studies, proved not to be so in most cases, since very few of the graduates of the programme eventually enroll for the doctorate. But, with the 3 year programmes out of the scene, a legitimate question arises: could be, indeed, reasonable and necessary to educate all students through 5-year integrated programmes with a marked design / research character, when it is well known that only a minority will be actually employed after graduation in design / research / consultancy activities, while the others will work as contractors or in areas such as public administration, banking, insurance, IT etc? The need of a *"generalist"* type of civil engineer, educated in a shorter period of time, was quite obvious.

In a material prepared in October 2002 for the Senate of the Technical University of Civil Engineering Bucharest, [1], the author proposed a structure of the civil engineering education comprising three programmes:

- a 4-year programme, corresponding to the first cycle, leading to the degree of "inginer" (equivalent to a Bachelor degree);
- a 1.5-year programme, corresponding to the second cycle, leading to a Master degree;
- an integrated 5-year programme, leading to the degree of "inginer diplomat"(equivalent to a Master degree);

The advantages seen for the proposed structure were:

- creating a 4-year programme, stronger than the existing 3-year one and open to the large majority of students; the existence of such a programme also in foreign languages (English, French) would be an important asset in recruiting foreign students from countries where the two-tier system is in operation with 4-year Bachelor programmes;
- creating a proper Master programme, following the 4-year programme, which could be academic / research oriented Master or professionally oriented Master, for various specializations.
- maintaining the integrated 5-year programme, which would allow the compatibility with European universities offering such programmes, and the continuation of the implementation of the Double-Diploma Agreement with ENPC; this is also in line with the strong recommendations made by the most representative associations of European engineering schools, CESAER and SEFI [2].

Disscussions concerning the introduction of the two-tier system in engineering education in Romania started after Sorbonne Declaration, at university level or at national level, taking place mainly under the auspices of the National Council of Rectors and became particularly vivid in the autumn of 2003, when a draft of a "Law on the organisation of university studies" became public.

After being adopted by both Chambers of the Parliament of Romania, the Law was promulgated on 24th June 2004 and became valid on 7th July 2004.

Here are the main provisions of the Law:

- University studies in Romanian are organized in three cycles
- The first cycle, whith a duration of 3-4 years (180-240) ECTS Credits is called *"Licența"* (synonime to *"Licence"* in French). *The Law stipulates that for the engineering education the first cycle is of 4 – year duration.* The qualification level acquired by the graduates of the first cycle should be adequate for providing employability.
- The second cycle with a duration of 1-2 years (60-120 ECTS Credits) is called *"Master"*. The cumulated duration of the cicle I, Licence studies, and of the cycle II, Master studies, should correspond to **at least** 300 ECTS or 5 years. (The Consortium of Technical University in Romania agreed for a duration of 1.5 years - 90 credits for the second cycle).

- A very important provision of the Law is found in the article stating that *for professions regulated by European norms, recommendations or good practice, universities can offer integrated programmes with a duration between 5 and 6 years, leading to diplomas equivalent to a Master degree diplomas.*
- The third cycle corresponds to doctorate studies, having normally a duration of 3 years, which in justified cases (for instance experimental studies) can be extended with 1-2 additional years, pending the approval of the Senate of the university.
- The existing, short duration 3 - year programmes, are going to be dismantled, unless they can be transformed in programmes corresponding to the licence level, (an option which is not going to be made in the engineering field, where only one kind of first cycle programmes, of 4-year duration, will be offered).

The provisions of the law will pe applied starting with the academic year 2005-2006.

As one can recognize, the main proposals formulated in the work [ ] are reflected in the new law.

Having in view the imminent change during the academic year 2002 / 2003 a framework for the two-tier system (4 + 1.5) to be applied at T.U.C.E.B. was established. The main provisions concerning the first cycle will be presented in what follows:

Duration: 4 years x 2 semesters = 8 semesters

Contact hours: 8 x 28 hours / week = 224 hours

Diploma project: to be completed in the summer following the 4^{th} year of study

Final examination: September – October, after the eight semesters of study

The study plan comprises two parts:

a) a *"backbone"* spread on the entire period of study (not just a *"common trunk"* for a number of semesters)
b) a part for the specialization

There are 3 specializations in the offer of TUCEB belonging to the civil engineering domain proper:

- civil, industrial and agricultural buildings (structures)
- hydraulic structures
- railroads, roads and bridges

The structure of the proposed study plan was agreed upon for the above mentioned specializations by the deans of the three faculties.

a) *the backbone* (74%)

No.	Group of subjects	Contact hours / % from total
1	Basic subjects	50h/23%
2	General technical education	55 h / 25%
3	General engineering education	32 h / 14%
4	General economic education	11 h / 5%
5	Foreign languages, social sciences, humanities	16 h / 7%
	Total	**164 h / 74%**

b) *specialization* 60 hours (26%)

The group of subjects in the "backbone" is:

1. Basic subjects: *Mathematics* (including *Descriptive Geometry) Physics, Chemistry, Informatics, Drawing*
2. General technical education: Structural Mechanics (Mechanics, Statics, Strength of Materials), Soil Mechanics, Fluid Mechanics
3. General engineering education: Materials Science, Surveying, Reinforced concrete I, Steel structures I, Construction Machines and two complementary subjects (for instance Roads and Water resources planning for the specialisations Structures)
4. General economic education: Construction Economy, Construction Management
5. Foreign languages, environment, social sciences and humanities: *Foreign language; Ecology; Environmental impact; Elements of architecture;* other social and humanities subjects.

As one can understand, the option made at TUCEB for the 4-year programme leading to the degree of *"Inginer licentiat"* is, definitely, for "**generalist**" graduates, meeting the requirements of employability.

The problems related to the organization of Master studies of 1.5 year duration (90 credits), following the 4-year first cycle (type of and number of programmes, conditions of acces etc) were not yet discussed. At the same time, no decision was yet adopted concerning the possible use of the opportunity created by the law for offering also an integrated programme.

***References*:**

[1] Manoliu, I *"Note asupra situației actuale în învățământul tehnic din Europa, cu referire specială la învățământul în trepte"* (in Romanian), UTCB, October 2002

[2] *"Communication of CESAER and SEFI on the Bologna Declaration"* based on the joint seminar organized at Helsinki University of Technology, February 2003

CIVIL ENGINEERING EDUCATION IN RUSSIA

Valeri Telichenko[1], Vladimir Andreev[2], Vladimir Gagin[3]

1. GENERAL VIEW OF THE PRE-UNIVERSITY EDUCATION

The pre-university education in Russia is a three-stage process, including:

a) elementary education (4 years),
b) common secondary education (5 years),
c) completed secondary education (2 years).

The age of entrance in the elementary education is 6. Students enter higher education at the age of 18, at the earliest.

A person can be admitted into University only by receiving of Completed Secondary Education. It can be achieved in several ways:

1.1. Normal secondary school / gymnasium - 11 years of study;

1.2. Special secondary school / gymnasium with advanced study of Natural Sciences (Physics, Mathematics, Chemistry, etc.) or Humanitarian ones (Foreign Languages, History, etc.) - 11 years of study, or

1.3. Professional Colleges in Civil Engineering, Architecture, Medicine, etc. - 4 years study after Common Secondary Education or 2 years study after Completed Secondary Education.

To be admitted into University, applicants have to pass so-called "Entrance Examinations". In Civil Engineering Universities subjects are: Physics, Mathematics and Russian. For some specialities, for example Engineer - Architect, there are additional examinations in Drawing and Graphics.

All the examinations are written. The admission into University is on competition basis. For the applicants who have passed the competition (Budget Students), University education is free of charge. In the last years Universities are allowed to take so-called "Contract Students", which have to pay for their education. This are the students, who did not get enough points in the competition. This type of education is very popular, because in most Universities "contract students" have a chance to become "budget students" if they are clever enough during the education and gain high points in the examinations.

2. CIVIL ENGINEERING EDUCATION.

Civil Engineering Education in Russia includes three levels:

– Training of skilled workers in various construction specialities in Vocational Schools;

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[2] Vice–Rector of the Moscow State University of Civil Engineering, Professor
[3] Deputy Dean of the Industrial and Civul Engineering Faculty of the Moscow State University of Civil Engineering, Professor, FICE

– Training of the technicians in Secondary Special Educational Institutions (Technical Schools and Colleges);

– Education of Civil Engineers in Higher Educational Institutions (Universities, Academies, Institutes).

It is not necessary to pass the two first steps in order to enter in a Higher Education Institution.

Continuous Professional Development of Civil Engineers is delivered in Higher Education Institutions and in special Training Centers, under special programs.

Today, Civil Engineers in Russia on various specialities are educated in more than 125 Higher Education Institutions, 17 of them being Universities of Architecture and Civil Engineering. In many Technical Universities there are Civil Engineering Faculties or Institutes.

All educational institutions independently of their profile are educating following a uniform methodical basis called *Standard of Higher Education*, which is approved by the Ministry of Education and Science of Russia. For this purpose, *Educational-Methodical Associations* on various educational specialities are created, which are acting in the system of the Ministry. *Educational-Methodical Association* elaborates the standards, develops curricula, solves the questions connected to opening of new specialities in various universities, coordinates publishing of textbooks and manuals. In the field of Higher Civil Engineering Education, such Association is headed by the Moscow State University of Civil Engineering (MSUCE).

The Universities are allowed to make some changes in the curricula, but not more than 10 - 15 %, in so-called Regional and University components. This provides the common level of Civil Engineering education in all the Universities and, as a result, mutual Diploma recognition. Of course, the level of education differs in various Universities and depends on the staff qualification, labs equipment, etc. To have the right of issuing State Diplomas in Civil Engineering, each University has to pass the procedures of State accreditation, certification and licensing at every 5 years. There is a special State Commission for accredition, with participation of academics and professionals from industry.

There are two types of higher Civil Engineering education: Diploma Engineer and Bachelor - Master (Academic) Degree. The system, very similar to the German Y - system, is shown in the figures 1. The most popular is the traditional "Diploma - Engineer" way, because not all of the employers know exactly who the "Bachelor in Construction" is. Usually, students who are interested in scientific and research work are taking the "Bachelor - Master" way, requiring one more year of study and a Thesis for Master Degree, which is a background for doctoral work.

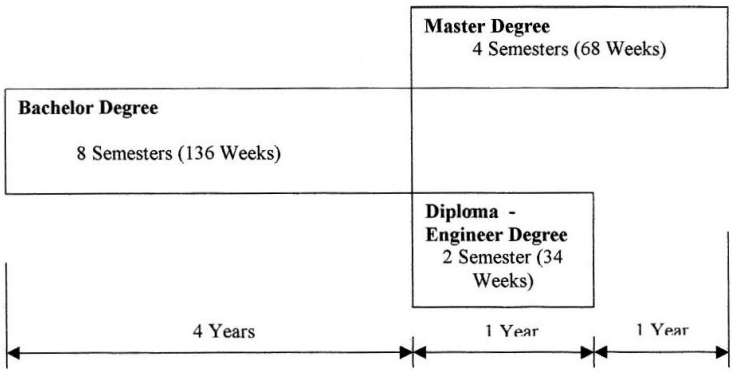


Figure 1.

The multilevel educational structure existing before 1996 provided three possible options of student's education (figure 2):

– Incomplete Higher Education (IHE) – the first step – with training within two years without certification, under the programs of higher education;

– Basic Higher Education (BHE) – the second step – which is carried out on Basic Educational Programs (BEP) (IHE is compulsory) within two years, with final certification (Bachelor Degree);

– Complete Higher Education (CHE) – the third step – which is carried out on Special Educational Programs (SEP) due to elected Speciality, within one year for Diploma Engineer Degree or within two years for Master Degree. In both cases BHE is compulsory.

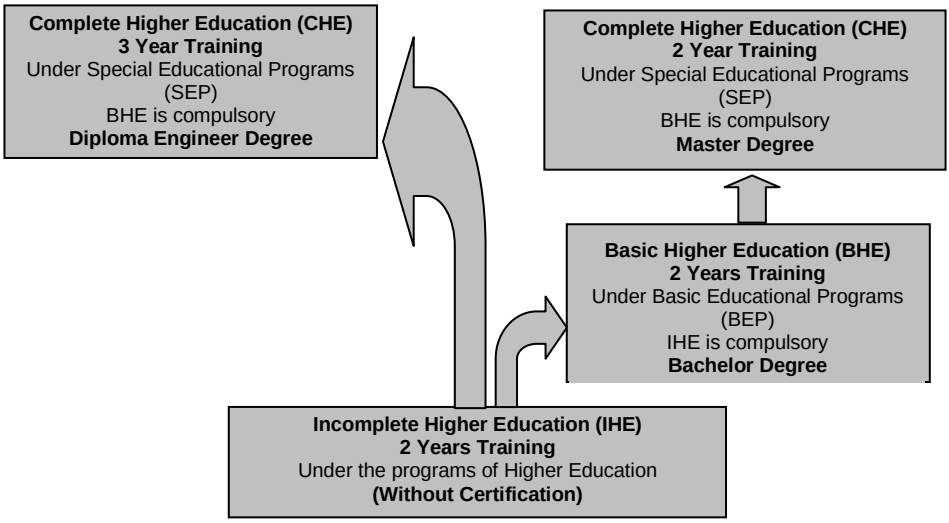


Figura 2

Description of the "Diploma - Engineer" programme.

According to the Educational Standard, there are 10 types of programmes:

1. Industrial and Civil Construction - (290300)
2. Hydraulic Power Construction - (290400)
3. City Planning and Construction - (290500)
4. Production of Building Materials, Goods and Constructions - (290600)
5. Heat- Gas Supply and Ventillation - (290700)
6. Water Supply and Waste Water Treatment - (290800)
7. Mechanization and Automatization in Construction - (291300)
8. Design of Buildings (Engineer - Architect) - (291400)
9. Expertize and Real Estate Management - (291500)
10. Mechanical Equipement and Technological Complexes of the Plants producting Building Materials, Goods and Constructions - (171600).

The duration of all the programmes is 5 Years, except the 291400 - Engineer – Architect programme which is 5,5 Years.

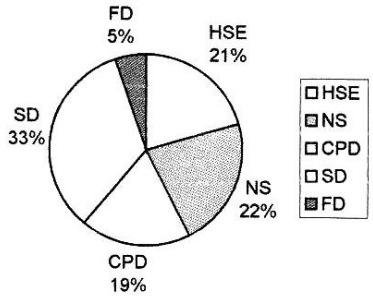
The curriculum consists of four components:

- Federal (F)
- Regional/University (R/U)
- Elective (E)
- Additional

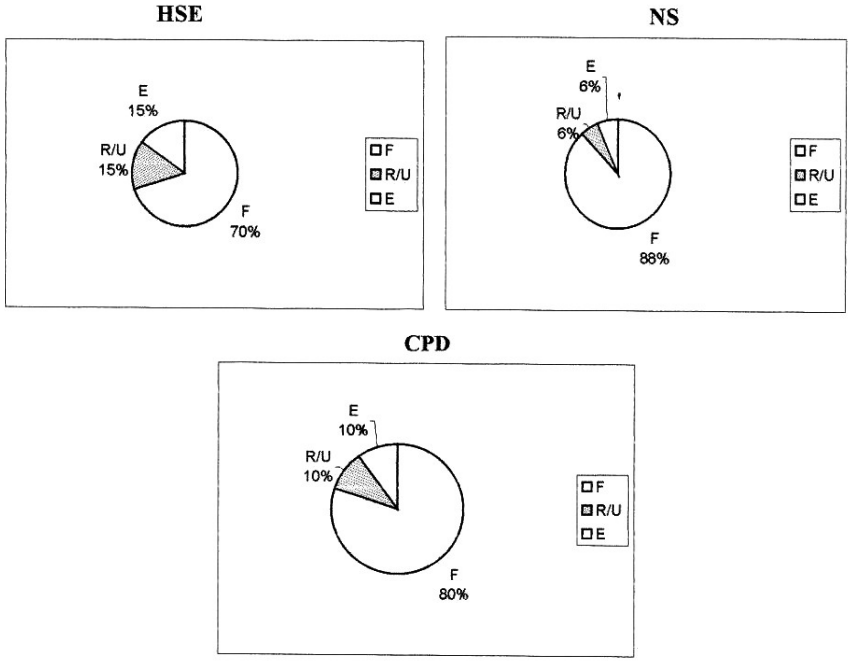
and includes the following blocks:

- Common Humanitarian and Socal-Economical Dispciplines (HSE)
- Common Mathematical and Natural Sciences Disciplines (NS)
- Common Professional Disciplines (CPD)
- Special Disciplines, including Disciplines of Specialization (SD)
- Facultative Disciplines (FD).

The distribution between blocks of total 8.755 hours time in the curriculum, can be seen on the following diagram:

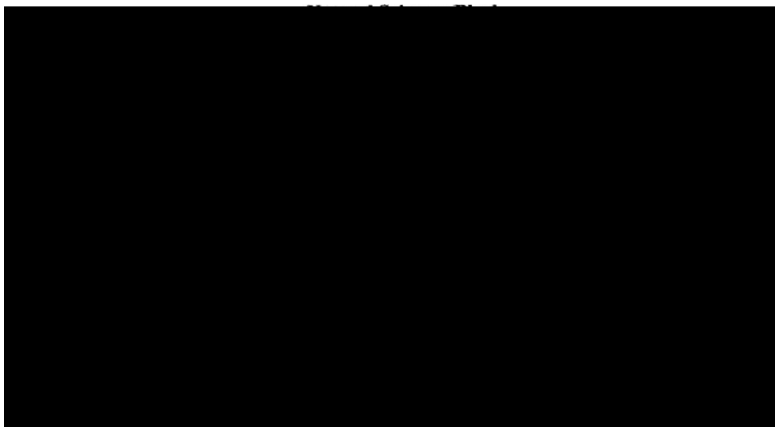


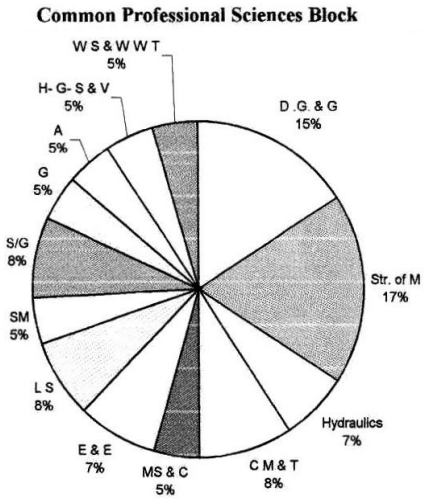
The hours distribution inside various blocks, except SD and FD, which have only R/U components, can be seen in the following diagrams:



The Federal component is obligatory for all Universities offering Civil Engineering. In the HSE block, 4 disciplines are obligatory: Foreign Language, Sports, History of Motherland and Philosophy. Others, to be selected from Culture, Politics, Law, Psyhology and Pedagogics, Russian Language, Sociology and Economics can be set by each University himself in the frame of obligatory hours for this block or used in inter-disciplinary education.

The NS and CPD blocks are common for each programme and they are shown in the following diagrams.

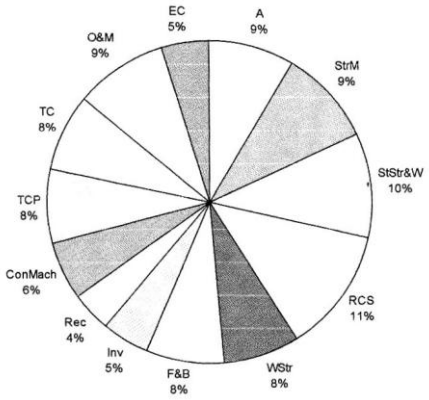




Legend:

D.G & G. - Descriptive Geometry and Graphics
Str. Of M. - Strength of Materials
S M & T - Structural Materials and Technology
MS & C - Metrology, Standartization & Certification
E & E - Electricity & Electronics
L S - Labour Safety
SM - Soil Mechanics
S/G - Surveying/Engineering Geodesy
G - Engineering Geology
A - Architecture
H- G- S & V - Heat- Gas- Supply & Ventillation
WS & WWT - Water Supply & Waste Water Treatment

The CPD block for Industrial & Civil Construction programme looks like in the following diagram:



Legend:
A - Architecture of Civil & Industrial Buildings & Structures
StrM - Structural Mechanics
StStr&W - Steel Structures & Welding
RCB - Reinforced Concrete & Masonry Structures
WStr - Wooden and Plastic Structures
F&B - Foundation Engineerin
Inv - Investigations and Testing of Buildings & Structures
Rec - Reconstruction of Buildings & Structures
ConMach - Construction Machines & Equipement
TCP - Technology of Construction Processes
TC - Technology of Construction
O&M - Organisation & Management in Construction
EC - Economics in Construction.

The reform of the Higher School in the direction of multilevel education started to be carried out in modern Russia more than 10 years ago.

The primary goals of the reform of Higher Education were:

– increasing the ability of higher education system to be flexible to requirements of the market economy;
– maintenance of comparability with foreign educational systems;
– expansion of opportunities for an individual choice of students regarding the content and level of education.

The first step, IHE, was not popular and, consequently, in our country was implemented in 1966 a two-level system, by the Federal Law «On Higher (Graduate) and Post-graduate Professional Education».

In September 2003, Russia has signed the Bologna Declaration. This document is aimed to the rapprochement of the European countries in creating an uniform European Higher Education space, based on three main principles:

– implementation of two-level Higher Education;

– introduction of the ECTS – European Credit Transfer System for the unification of the received education quantitative account;

– maintenance of comparable quality of education.

To realize the objectives of Bologna Declaration, the drafts of two-level models of Higher Professional Education (HPE) (Bachelor and Master as Speciality Degrees) are developed in Russia, as well as corresponding drafts of the State Educational Standards (SES), for a number of technical specialities.

Instead of a model of professional based on knowledge and skills, the model of the **Competent Specialist** is put at the base of the drafts. Such a model should provide higher mobility of graduates of Higher Schools for changing conditions of the labour market.

The model of *Competent Specialist* in the field of technics and technology includes the following groups of competences:

1) social - personal;
2) economical and organizational - administrative;
3) general scientific;
4) general professional;
5) specific.

The first four groups of competences should serve as a basis, allowing graduate to be flexible in the labour market and to be prepared to continue his/her education through the second step of HPE (Master Degree), and through additional post-graduate education.

Kinds and the general tasks of professional work of the Bachelor and the Master on Speciality are determined from the corresponding competence models.

Bachelor on Speciality is oriented on Industrial - Technological, Organizational - Administrative, Service - Operational, Assembling - Debugging, Computing and Design and Experimental - Research activity.

As the Master education is based on the Bachelor one, Master on Speciality should be prepared for all kinds and general tasks of professional activity appropriate to Bachelor. The Master education step is necessary to provide the graduate skills in Construction and Technological Design, Research and Organizational - Administrative activity. Master should receive more qualified education that should provide him/her, in comparison with Bachelor, additional opportunities in the field of professional work, including the right for independent Project Management and Design, for acting as a decision maker etc. In this connection, a Master on Speciality should occupy the positions of a higher level, than a Bachelor.

A major condition of Russian economic development is **strengthening of the innovational activity.** The Master on Speciality should become a key

element in the formation of the staff for national innovational system of the Russian Federation should become.

The new structure of educational program on the in a basis of the competence model of education.

Instead of the curricula stated in the second generation SHE of HPE, the BEP draft for Bachelor on Speciality education for the full-time training includes six cycles of the basic disciplines (instead of four in SHE-2000):

1.	Humanitarian and social *(forming social - personal competence)*	950 hours
2.	Economical and organizational - administrative disciplines (new)	250 hours
3.	Natural-science and mathematical disciplines *(forming general scientific competence - fundamentals of education)*	1500 hours
4.	Common Professional disciplines *(forming common professional competence – readiness for solving common technical problems)*	1500 hours
5.	Disciplines of a direction (new) *(forming competence, necessary for all specialities of the direction)*	1550 hours
6.	Special disciplines *(special competences, providing readiness of the specialist to objects and subjects of labour for the speciality)*	1036 hours
7.	Elective courses	450 hours
	Total:	7236 hours
	In SHE-2000:	7344 hours

Final state certification of the Bachelor on Speciality can include presentation of Final Qualifying Work (FQW) and graduation examination.

FQW of the Bachelor on Speciality should differ from FQW of the Academic Bachelor. As the Bachelor on Speciality education is focused on real industrial activity, his FQW should correspond to the finished work containing novelty aspects and having a scientific or practical importance. Time assigned for FQW should be not less than 8 weeks.

In the structure of the BEP for Master on Speciality full-time education (MEng Degree, based on Bachelor Degree) humanitarian and social disciplines (350 hours) and economic and organizational–administrative (management) disciplines (250 hours) are stipulated.

As the education at Master level should be more specialized than the education at Bachelor level, it is proposed not to allocate General Scientific and Common Professional Disciplines in BEP's for Masters education, but to concede a right to EMA to estabish lists of special sections of those Natural-Sciences and Common Professional Disciplines which are necessary for Masters education in a given speciality. Therefore, it is proposed to include in the curricula for Masters education the Incorporated Cycle of Natural-Sciences, Mathematical and Professional Disciplines in amount of 900 hours, corresponding to a given speciality (direction). By cycle are understored all the disciplines of the direction.

EMA recommended to allocate half of this amount on Natural-Science

and Mathematical disciplines or on corresponding sections in the integrated courses, uniting both fundamental and applied subjects. In Master education the cycle of Special Disciplines in amount of 1254 hours is kept. It is supposed that not less than 300 hours from this amount will be allocated for research work of students. In total, 2862 hours of theoretical training are allocated for Master on Speciality Degree education (3880 hours in SHE-2000).

In the case specializations in Master education are needed, the amount of necessary hours for disciplines of specializations can be taken from special disciplines cycle. It is considered inexpedient to put in force specializations within the frames of Bachelors education.

Final State Certification of the Master on Speciality is supposed to be carried out as the presentation of Final Qualifying Work (the Degree Project/Diploma Design or Degree Work/Research Work).

FQW of the Master on Speciality (MEng) will differ from Master Thesis's of the Academic Master. It can be a Design Project with elements of scientific research and will take into account interests and inquiries of appropriate industrial organization. Time assigned for FQW should be not less than 18 weeks, including 4 weeks of pre-Diploma practice.

The suggested draft has passed preliminary discussion among the experts and at present we are working on the content of this model. According to the general opinion, this model of educational process is more flexible than the existing one.

At the same time, for estimating its efficiency many questions should be solved, first of all of normative and legislative character, connected with financing of educational programs, the definition of the ratio between the steps of education, the acceptance of the nomenclature of the positions for Bachelors and Masters on Speciality (equivalent to BEng and MEng).

Apparently, the real term of the beginning of the two-level system of Higher Professional Education HPE should be 2007-2008.

Until then, not only educational standards of new generation should be prepared but also organizational - informative materials for starting of the educational process.

3. CIVIL ENGINEERING INSTITUTIONS IN THE RUSSIAN FEDERATION

Civil Engineering Education is available in more than 125 special Civil Engineering Universities and Civil Engineering Faculties in Polytechnical Universities.

Since 1999, several of Civil Engineering Universities in Russia have been accredited by the Joint Board of Moderators of the Institution of Civil Engineers and the Institution of Structural Engineers (UK). These Universities are:

1. Moscow State University of Civil Engineering
2. Belgorod State University of Technology of Construction Materials

3. Voronezh State University of Architecture & Civil Engineering
4. St.-Petersburg State University of Architecture & Civil Engineering
5. Novosibirsk State University of Architecture & Civil Engineering
6. Tomsk State University of Architecture & Civil Engineering.

To the list of main Civil Engineering Universities, making policy in Civil Engineering education, can be added:

1. Nizhny Novgorod State University of Architecture & Civil Engineering
2. Rostov- on- Don State University of Civil Engineering
3. Penza State University of Architecture & Civil Engineering
4. Volgograd State University of Architecture & Civil Engineering.

THE CIVIL ENGINEERING EDUCATION IN SLOVENIA

Miroslav Premrov[1]

1. GENERAL VIEW ON THE PRE-UNIVERSITY EDUCATION

Pre-university education in Slovenia consists of:
- 8 year primary school
- 4 year secondary school

In the year 2000 we started the 9 years primary school programme.

2. GENERAL VIEW ON THE ENGINEERING EDUCATION

2.1 Engineering education at undergraduate level; various types

Short duration: ***Professionally oriented*** study programmes ***last 6 terms and an additional year*** in which a student fulfils his/her study requirements and writes a degree dissertation. The courses are devised so as to provide the student with practical knowledge. The student gains theoretical knowledge to be able to solve actual problems in the field of engineering. Technical subjects are taught which provide the student with the skills to be able to work in engineering practice. The student receives the title of a ***Graduated Engineer***.

Long duration: ***Academic*** study programmes ***last 8 terms plus an additional year*** in which a student fulfils his/her study requirements and writes a degree dissertation. The courses are devised so as to provide the student with academic knowledge as well as the knowledge of the methodology of scientific and research work. Students obtain theoretical knowledge in mathematics, physics and theoretical mechanics and professional knowledge in engineering. They receive the title of a ***University Graduated Engineer*****.**

2.2 Engineering education at postgraduate level

2.2.1 Master or Master-type programmes

The study consists of six subjects. Three of them are prescribed and another three are options according to the Master dissertation. The study is finished with the Master dissertation work (approximately 6-9 months), which represents a deeper view in some special kinds of science. The duration of the whole study is 30 months (5 semesters).

[1] Professor, University of Maribor

2.2.2 Doctoral programmes

There are two possibilities of the doctoral study:

- a directly study (without a Master study) – duration 8 semesters,
- or a study consisting of two parts:
  - Master study (duration 5 semesters), to be continued with a Doctoral programme (4 semesters). In this case, there are usually no additional prescribed subjects, but students must finish their PhD Thesis.

3. CIVIL ENGINEERING EDUCATION

Civil engineering education is offered in Slovenia by two universities:
University of Maribor
University of Ljubljana
Information provided is the paper refers to the University of Maribor.

3.1 Undergraduate education

3.1.1 Short description for each type of programme (short/long duration)

Two *completely separated* study programmes are provided at the Faculty of Civil Engineering:

- **the short programme** (6 semesters + additional year) – Graduated Engineer of Civil Eng.
- **the long programme** (8 semesters + additional year) - University Graduated Engineer of Civil Eng.

At the beginning students choose the programme. So, the programmes are completely separated from the first semester.

A) Short programme: The professionally oriented study programme is open to students who have passed the matura examination or a secondary school-leaving examination after a four-year secondary school programme. In case that there are more applicants than places, applicants are chosen with respect to the success obtained in the matura examination or secondary school-leaving examination (60%) and overall success in the 3rd and 4th secondary school year (40%).

The programmes *last 6 semesters and an additional year* in which a student fulfils his/her study requirements and writes a degree dissertation. The courses are devised so as to provide the student with practical knowledge. The student gains theoretical knowledge to be able to solve actual problems in the field of engineering. Technical subjects are taught which provide the student with the skills to be able to work in engineering practice. *The programmes are finalized*

*with **diploma project***. The student receives the title of a *Graduated Engineer of Civil Engineering.*

Two separated study programmes are provided from the first semester:

- **Civil Engineering**
- **Traffic Engineering**.

After the fourth semester there is a possibility in the both programmes to choose the optional course.

A1) Two optional courses are provided in the **Civil Engineering Programme**:

• **Course in Building Technology, Management and Structural Engineering**
• **Course in Hydraulic Engineering**

The student gains theoretical knowledge to be able to solve actual problems in the field of civil engineering. Technical subjects are taught which provide the student with the skills to be able to work in civil engineering practice. The student is qualified to perform tasks in design, erection, maintainace and use of civil structures and buildings. Other fields of application are industry of building materials and industry of semi-finished products and pre-fabricated parts.

A2) Three optional courses are provided in the **Traffic Engineering Programme**:

• **Course in Road Traffic**
• **Course in Railway Traffic**
• **Course in Air, Cable and Pipeline Traffic**

The student gains theoretical knowledge to be able to solve actual problems in the field of traffic and transportation. Technical subjects are taught which provide the student with the skills to be able to work in civil engineering practice.The graduate is qualified to perform tasks in the transportation of people and goods and in planning, erection, maintenance and use of transportation facilities and systems, flows of goods, logistic canals and daily migrations. After successful completion of the professionally oriented study programme, a specialization will be possible to upgrade and deepen professional knowledge.

An average duration of semesters in the both programmes is **15 weeks**. During the semesters the study programme consists of (Table 1).

Table 1 Number of hours per semester – Short programme

	Number of hours	Lectures	Exercises
1. semester	405	270	135
2. semester	400	250	150
3. semester	435	240	195
4. semester	390	225	165
5. semester	375	245	130
6. semester	370	220	150
Total	**2375**	**1450**	**925**
Percent	**100**	**61,05**	**38,95**

From Table 1 it is evident that an average number of **all contact hours per week is 26,39 (Lectures 16,11 hours, Exercises 10,28 hours)**. The total number of a project is 60 hours (in the 6.semester).

B) Long programme: Study programmes last *8 semesters plus an additional year* in which a student fulfils his/her study requirements and writes a degree dissertation. The courses are devised so as to provide the student with academic knowledge as well as the knowledge of the methodology of scientific and research work.

Who can enroll? The academic study programme is open to students who have passed the matura examination or successfully completed a four-year secondary school programme before 1 June 1995. In case that there are more applicants than places, applicants are chosen with respect to the success obtained in the matura examination (60%) and overall success in the 3rd and 4th secondary school year (40%).

There are three study programmes to obtain a **university (or academic) degree**. They are *separated from the first semester:*

- **Civil Engineering**,
- **Traffic Engineering**
- **Industrial Engineering within Civil Engineering**.

B1) The Academic Study Programme in **Civil Engineering** offers *after the sixth semester* two courses:

- **Course in Structural Engineering**
- **Course in Infrastructure Engineering**

Students obtain theoretical knowledge in mathematics, physics and theoretical mechanics and professional knowledge in civil engineering. They can perform tasks in design, erection, maintenance and use of buildings and civil engineering structures and facilities. Other fields of application are building physics, industry of building materials, industry of semi-finished products and pre-fabricated parts etc.

B2) The Academic Study Programme in **Traffic Engineering** offers *after the sixth semester* two courses:

- **Course in Road Traffic**
- **Course in Railway Traffic.**

Students obtain theoretical knowledge and upgrade it with professional knowledge in traffic and transportation engineering. They receive the title of a ***University graduated engineer in traffic engineering****. They can perform tasks in the transport of people and goods, and in the planning, maintainance and use of transport facilities and systems, flows of goods, logistic canals, and daily migrations.*

B3) The Academic Study Programme in **Industrial Engineering within Civil Engineering** is conducted in cooperation with the Faculty of Business and Economics.

A graduated industrial engineer has gained knowledge in natural sciences, general knowledge in economics, business organization and law, general knowledge in information and computer science, general knowledge in civil engineering, and basic technical knowledge in planning, organization, marketing and management of building works from technological and economic point of view. The student receives the title of a ***University graduated industrial engineer*** *and is qualified to perform professional, development and managing tasks which require the combination of technical, technological and economic knowledge, and the knowledge in business organization and information science. Most of the courses are given in the scope of the academic programme of civil engineering and are completed with suitable courses at the Faculty of Business and Economics. After the completion of academic studies, post-graduate studies are possible either as specialization, master's studies or doctoral studies.*

An average duration of semesters in the all programmes is **15 weeks**. During the semesters the study programme consists of (Table 2).

From Table 2 it is evident that an average number of **all contact hours per week is 30,83 (Lectures 18,71 hours, Exercises 12,12 hours)**. The total number of a project is 280 hours (in the 8. semester). By comparing Tables 1 and 2 it is evident that the relationship between the lectures and exercises is practically the same at the long and the short programme.

Table 2 Number of hours per semester – Long programme

	Number of hours	Lectures	Exercises
1. semester	465	300	165
2. semester	435	270	165
3. semester	480	270	210
4. semester	435	210	225
5. semester	420	240	180
6. semester	510	300	210
7. semester	450	255	195
8. semester	505	400	105
Total	**3700**	**2245**	**1455**
Percent	**100**	**60,68**	**39,32**

3.1.2 Short description of the main features of the curriculum for each type of programme

Relative weights of various categories of subjects for the Long programme – study programme Civil Engineering - are presented in Table 3.

3.1.3 Admission of students at the undergraduate level

A) Short programme: The professionally oriented study programme is open to students who have passed the matura examination or a secondary school-leaving examination after a four-year secondary school programme. In case that there are more applicants than places, applicants are chosen with respect to the success obtained in the matura examination or secondary school-leaving examination (60%) and overall success in the 3rd and 4th secondary school year (40%).

B) Long programme: The academic study programme is open to students who have passed the matura examination or successfully completed a four-year secondary school programme before 1 June 1995. In case that there are more applicants than places, applicants are chosen with respect to the success obtained in the matura examination (60%) and overall success in the 3rd and 4th secondary school year (40%).

Table 3 Relative weights of categories of subjects – Long programme

Category of Subjects	**CE** Structural Eng. **%**	**CE** Infrastr. Eng. **%**
Ecology	1.33	1.33
Physics	7.12	7.12
Geology	1.79	1.79
Geodesy	1.75	1.75
Geotechnick	5.50	5.50
Economics of Building Industry	3.33	3.33
Organization and Management	3.50	3.50
Building Technology	2.54	2.54
Hydraulics	2.21	6.42
Construction Information Technology	3.04	1.79
Computer and Information Science	2.66	2.66
Language	1.79	1.79
Steel Structures	4.20	2.13
Timber Structures	1.71	1.71
Concrete Structures	7.58	3.83
Structural Analysis	**9.66**	6.75
Materials	3.58	3.58
Mathematics	**11.53**	**11.53**
Mechanics	**7.95**	**7.95**
Dynamics	3.79	
Roads	2.54	7.79
Traffic Technick		1.46
Environmental Design and Regional Planning	3.08	3.08
Project	7.83	**7.83**

The whole Curriculum is available on our internet side: http://fg.uni-mb.si

Trends in the last years: Interest for a civil engineering study at our faculty in the last years constantly increased (Table 4).

Table 4 Number of students in the first semester

	Short Programme			Long Programme				Total
	Civil Eng.	*Traffic Eng.*	*Total*	*Civil Eng.*	*Traffic Eng*	*Industrial Eng.*	*Total*	
1993	87	/	*87*	92	69	44	*205*	**292**
1994	105	/	*105*	122	92	65	*279*	**384**
1995	160	/	*160*	57	65	48	*170*	**330**
1996	194	/	*194*	39	49	50	*138*	**332**
1997	207	114	*321*	39	33	34	*106*	**427**
1998	134	138	*272*	53	40	42	*135*	**407**
1999	222	169	*391*	61	43	42	*146*	**537**
2000	248	221	*469*	90	71	50	*211*	**680**
2001	223	205	*448*	88	64	61	*213*	**661**

3.2 Civil engineering education at postgraduate level

Graduates can continue their studies in post-graduate programmes of various duration that lead to the degree of *Specialist*, *Master of Science (MSc)* or *Ph.D. – Doctor of Science*. Research focuses on a range of topics in the fields of civil, traffic and industrial engineering. Research programmes comprise basic and applied science projects and development projects. Furthermore, studies are conducted and expert opinions prepared for institutions, industry and other clients.

3.2.1 Master or Master-type programmes

The Master of Science programme last 5 semesters. The study consist of six subjects. Three are basic and prescribed and another three are options according to the chosen study programme:

- **Civil Engineering**
  - Mechanics and Structures,
  - Management
- **Traffic**
- **Energetics.**

All programmes are finalized with Master disertation. There is no general final exam.

3.2.2 Doctoral programmes

Two types of doctoral programmes exist at our faculty:

- the *"indirect programme"* which starts after the master programme. Students, graduated as MS, continue their study on a doctoral programme. There are usually no additional exams. The programme lasts another 4

semesters and it is finalized with a Ph.D Thesis, which must be an original contribution to the science.

- the "*direct programme"* which lasts 8 semesters. The study consists of six exams (three are basic-prescribed and three are options) and is finalized with a Ph.D Thesis, which must be an original contribution to the science.

For both types of study programmes, the options are the same as for the master study:

- **Civil Engineering**
  - Mechanics and Structures,
  - Management
- **Traffic**
- **Energetics.**

4. RECENT TRENDS IN ENGINEERING EDUCATION IN THE COUNTRY

In general, the interest for the engineering education in Slovenia decreases. This is especially evident in Mechanical Engineering and Electrical Engineering. The situation is different in Computer Engineering and especially in Civil Engineering. As we described in Section 3.1.3, the number of students at our faculty in the last years increased. The main reason is in rapid construction of highways and other buildings in Slovenia. On the other hand, interest for the economic study and the law rapidly increases.

Bologna Declaration on engineering education: At the Faculty of Civil Engineering in Maribor we try to compare our curriculum with European faculties. In this way, for the beginning, in year 1999 we introduced the ECTS system. In the last year we started with the Distance Learning by some subjects. In this way we organize *1th International Workshop on Construction Information Technology in Education* in Portorož, Slovenija, September 12-13, 2002.

Another big task will be to change our existing systems to follow the Bologna two-tier requirement. The choice is between 3+2 or 4+1. We work especially on modification of existing short programme (6 semesters + additional year of praxis) to be convenient for the "short Bologna programme" (3 years). In this way we wish to combine the basic subjects of our short programme with the basic subjects of our long programme.

CIVIL ENGINEERING EDUCATION IN SLOVAK REPUBLIC

Jozef Dicky[1]

1. GENERAL VIEW ON THE PRE-UNIVERSITY EDUCATION

Pre-university education in Slovak Republic consists of three relatively independent levels:

- pre-primary education,
- primary education,
- secondary education.

Pre-primary education is organised by both non-obligatory Nurseries offered for children till three years age and Kindergartens offered for children from three till six years age.

Children usually enter their obligatory primary education in the age of six in primary schools, which are divided to two stages:

- first stage (grades 1 - 5),
- second stage (grades 6-9).

Primary schools in Slovak Republic are mostly state run establishments, but in the last decade schools in church or private ownership also appeared.

Finishing the primary school children may continue their education in some secondary school depending on their interests and previous results. Secondary school system consists of following types of schools:

- grammar schools,
- specialised secondary schools,
- vocational secondary schools.

2. GENERAL VIEW ON THE ENGINEERING EDUCATION

Students enter the tertiary level (Higher Education Institutions - HEI) after at least twelve years of their previous study and the successful completion of secondary school obtaining the school leaving certificate, usually at the age 18 or 19 years. The HEI applicants usually recruit from grammar schools, less frequently from some types of specialised or vocational schools.

Engineering education is one of the most extended part of tertiary education in Slovak Republic. An institution dealing with the engineering education is called “Technical University” or “University of Technology”.

[1] Professor, Slovak University of Technology in Bratislava

2.1 Engineering education at undergraduate level

There are three types of undergraduate courses in the Slovak engineering educational system:

- one-step courses providing only the basic engineering education (which can be also the basis for the further engineering studies) with 3-4 years duration, awarded with BSc degree,
- one-step courses providing the advanced engineering education with 5-6 years duration, awarded with MSc. degree,
- two-step courses providing the advanced engineering education with two stages:
  - first stage is the undergraduate course providing the education in one or more basic engineering branches, with the 3-4 years duration, awarded with BSc. degree,
  - second stage is the post-graduate course providing education in some specialised engineering branches, with 2-2,5 years duration, awarded with MSc. degree.

2.2 Engineering education at postgraduate level

2.2.1. Master or Master-type programmes

According to the previous paragraph the Master degree programmes at Slovak Technical Universities may be divided into two groups:

- MSc courses with 2-2,5 years duration, awarded with MSc. degree for those who have earlier completed the BSc. studies,
- second stages of university study as the post-graduate courses providing the continuing education in some specialised engineering branches, with 2-2,5 years duration, awarded with MSc. degree.

2.2.2. Doctoral programmes

Every five years each University in Slovak Republic applies to the State Accreditation Commission for an accreditation of the post-graduate doctoral programmes. After successful accreditation, the University receives full academic authorisation to provide the doctoral studies in these programmes. The official duration of study is 3 years for the full-time students and 5 years for part-time students.

3. CIVIL ENGINEERING EDUCATION

3.1 Undergraduate education

3.1.1. BSc. level one stage study, BSc. level - first part of two stage study

Title awarded: Bachelor of Civil Engineering

Admission	The University is responsible for the rules of admission. The minimum requirements are based on the pre-university certificate level. Most applicants pass the university entrance exam mainly on mathematics and physics.
Duration of study	3 years
Course organisation	Two semesters in each year of study: • So called "winter" semester (lectures from October to January)- duration from 13 to 15 weeks, • so called "summer" semester (lectures from March to June)- duration from 13 to 15 weeks.
Examination	Two sessions: • after "winter" semester duration 4-6 weeks, • after "summer" semester duration 6-8 weeks.
Teaching organisation	The programmes consist of 30-35 subjects (10-12 each year). The lectures, exercises and laboratory are taught in 25-30 contact hours per week, 40-45% lectures, 60-55% exercises and laboratory.
Final exam	The final exam comprises: • presentation of the short final project, • the exam from one core subject. The final assessment consists of an average mark of all subjects assessed during study, the mark of final project and the mark of final exam.

The weight of subject categories	A	B	C	D	E	F	G	H
	10-12%	9-13%	17-23%	23-35%	5-8%	8-12%	0-5%	5%

Subject categories:

A	Basic Sciences	E	Economics and Management
B	Engineering Sciences	F	Non-technical Subjects
C	Core Civil Engineering Subjects	G	Practical Industrial Placement
D	Specialised Civil Engineering Subjects	F	Final Project/Thesis

3.1.2. MSc. level one stage study

Title awarded: Master of Civil Engineering

Admission	The University is responsible for the rules of admission. The minimum requirements are based on the pre-university certificate level. Most applicants pass the university entrance exam mainly on mathematics and physics.
Duration of study	5 years
Course organisation	Two semesters in each year of study: • so called "winter" semester (lectures from October to January)- duration from 13 to 15 weeks, • so called "summer" semester (lectures from March to June)- duration from 13 to 15 weeks. (In fifth year only 8 weeks)

Examination	Two sessions: • after "winter" semester duration 4-6 weeks, • after "summer" semester duration 6-8 weeks.							
Teaching organisation	The programmes consist of 50-60 subjects (10-12 each year). The lectures, exercises and laboratory are taught in 25-30 contact hours per week, 40-45% lectures, 60-55% exercises and laboratory.							
Final exam	The final exam comprises: • presentation of the diploma project, • the exam from two core subjects. The final assessment consist of average mark of all subjects assessed during study, the mark of diploma project and the marks of final exams.							
The weight of subject categories	A	B	C	D	E	F	G	H
	10-12%	9-13%	20-26%	23-35%	6-10%	8-12%	0 -5%	10%

3.2 Civil engineering education at postgraduate level

3.2.1. MSc. level - second part of two stage study

Title awarded: Master of Civil Engineering

Admission	Students are enrolled in two ways: • after completing their BSc. studies in Civil Engineering branch, • BSc graduates from earlier period on the base of final studies mark and the interview.							
Duration of study	2 years							
Course organisation	Two semesters in each year of study: • So called "winter" semester (lectures from October to January)- duration from 13 to 15 weeks, • so called "summer" semester (lectures from March to June)- duration from 13 to 15 weeks. (In second year only 8 weeks)							
Examination	Two sessions: • after "winter" semester duration 4-6 weeks, • after "summer" semester duration 6-8 weeks.							
Teaching organisation	The programmes consist of 20-25 subjects (10-12 each year). The lectures, exercises and laboratory are taught in 25-28 contact hours per week, 40-45% lectures, 60-55% exercises and laboratory.							
Final exam	The final exam comprises: • presentation of the diploma project, • the exam from two core subjects. The final assessment consist of average mark of all subjects assessed during study, the mark of diploma project and the marks of final exams.							
The weight of subject categories	A	B	C	D	E	F	G	H
	10-12%	9-13%	20-26%	23-35%	6-10%	8-12%	0-5%	10%

3.2.2. Doctoral programmes

Title awarded: Philosophiae Doctor (PhD)

Admission	• The University is responsible for the rules of admission. The minimum requirements are based on the MSc degree in civil engineering or similar branch. Most applicants pass the doctoral study entrance exam mainly on basic subjects connected with the study programme.
Duration of study	• 3 years for full-time students, • 5 years for part-time students.
Course organisation	Two semesters in first year of study: • so called "winter" semester (lectures from October to January)- duration from 13 to 15 weeks, • so called "summer" semester (lectures from March to June)- duration from 13 to 15 weeks. Research work on the doctoral thesis during both two years of study.
Examination	Two sessions: • after "winter" semester duration 4-6 weeks, • after "summer" semester duration 6-8 weeks.
Teaching organisation	The teaching programmes consist of 5-6 subjects, from which the foreign language, mathematics and physics are obligatory a two may be chosen from the list of optional subjects. The lectures, exercises and laboratory are taught in 8-10 contact hours per week, 70-80% lectures, 30-20% exercises and laboratory.
Final exam	The first stage of final exam comprises: • presentation of the main problems and methods, used in doctoral thesis, • the exam from all subjects. The second part is the oral presentation of the doctoral thesis. The final assessment is done by the thesis examination board..

4. RECENT TRENDS IN ENGINEERING EDUCATION IN SLOVAKIA

As it is seen from the previous paragraphs, the trends in civil engineering education in Slovakia lead to the three-step system consisting of these stages:

- first stage are the undergraduate courses providing the education in one or more basic civil engineering branches, with 3-4 years duration, awarded with BSc. degree,
- second stage are the post-graduate courses providing the continuing education in some specialised civil engineering branches, with 2-2,5 years duration, awarded with MSc. degree,
- third stage are the doctoral programmes providing the individual continuing education in some special civil engineering science, with 3 years duration, awarded with PhD. degree.

The new programmes at all three Civil Engineering Faculties in Slovakia, all of them adopting the three-step system, are expected to start in the academic year 2004-2005, after the accreditation of all universities in Slovakia.

5. HIGHER EDUCATION INSTITUTIONS OFFERING CIVIL ENGINEERING EDUCATION

There are three universities in Slovakia offering the civil engineering education:

- Slovak University of Technology in Bratislava – Faculty of Civil Engineering,
- Technical University in Košice - Faculty of Civil Engineering,
- University of Žilina - Faculty of Civil Engineering.

SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA FACULTY OF CIVIL ENGINEERING

A new system of study introduced at the faculty after 1989 has recently been further updated to a credit-based modular-unit system. Besides a traditional integrated 5-year master program, which will finish completely in 2004, a new system, consisting on bachelor and master degree programs, was partially implemented in 1998. The first part of this system, a three year course (180 credits), leads to a bachelor′s degree. It gives the student the theoretical background necessary for further specialization together with the basics of civil engineering. To broaden the students′ perspectives, courses in the arts and social sciences, including philosophy, sociology, law, psychology and aesthetic, were added to the curricula.

The second part of the system, which is aimed at developing special skills in the chosen pathway, is completed by a thesis. Its successful completion results in the award of the Diploma in Civil Engineering - an M. Sc. equivalent degree. This part lasts two years (120 credits) and permits students to implement their individual goals for their vocational education and specialization.

Offered programmes:

BACHELORS STUDY

Five branches:

- **Building Structures**
- **Civil and Transport Engineering**
- **Water Management and Water Structures**
- **Geodesy and Cartography**
- **Environmental Engineering**

MASTERS STUDY

Nine branches:

- **Architecture and Building Structures** with specializations as follows:
  Architecture, Architectural Structures, Statics, Urban Engineering
- **Building Technology**
- **Materials Engineering**
- **Building Services** with specializations as follows:
  Sanitary Equipment, Heating, Ventilation and Climatization Systems
- **Economics and Building Industry Management**
- **Civil and Transport Engineering** with specializations as follows:
  Concrete Structures, Steel and Timber Structures, Geotechnics, Roads and Airports, Urban Traffic Engineering, Railways
- **Water Management and Water Structures** with specializations as follows:
  - Hydrotechnics, Water Resources Management, Sanitary Engineering, Geotechnics
- **Geodesy and Cartography** with specializations as follows:
  - Global Positioning and Global Information Systems, Engineering Surveying,
  - Geodesy and Cartography (combined study), Geodesy and Geodynamics,
  - Land Consolidation and Cadastre, Geoinformatics, Geodesy
- **Environmental Engineering**

DOCTORAL STUDY

Ten branches:

- **Theory and Construction of Building Structures**
- **Theory and Construction of Civil Engineering Structures**
- **Building Technology**
- **Sanitary Engineering**
- **Hydraulic Engineering**
- **Applied Mechanics** - specialization Mechanics of Solid and Deformable Bodies
- **Science of Non-metallic and Building Materials**
- **Geodesy and Geodetic Cartography**
- **Hydrology and Water Resources Management**
- **Industrial and Sectorial Economics,** specialization Economy of Trade and Industry

TECHNICAL UNIVERSITY IN KOŠICE
FACULTY OF CIVIL ENGINEERING

Faculty offers the study in four main fields: Building Structures, Civil and Transport Engineering, Environmental Engineering and Building Technology. The study lasts five years. The first part of the study, a two year course is common for all main fields d of study. It gives the student the theoretical background necessary for further specialization together with the basics of civil engineering. In the third year of study students continue upon the different curriculum for each field of study and finally in last two years they study upon the different curriculum for each specialization. Study is completed by a thesis. Its successful completion results in the award of the Diploma in Civil Engineering - an M. Sc. equivalent degree. Faculty is also preparing a new system, consisting on bachelor and master degree programmes, which will start in the academic year 2004/2005.

Offered programmes:

MASTERS STUDY

Four branches:

- **Building Structures** with specializations as follows:
  Architectural Structures, Architecture, Building Reconstructions, Building Services, Static Analysis of Buildings .
- **Civil and Transport Engineering** with specializations as follows:
  Concrete Structures and Bridges, Steel Structures and Bridges, Transport Engineering
- **Environmental Engineering**
  Indoor Enviroment
  Outdoor Enviroment
- **Building Technology**

DOCTORAL STUDY

Four branches.

- **Theory and Construction of Building Structures**
- **Theory and Construction of Civil Engineering Structures**
- **Environmental Engineering**
- **Building Technology**

UNIVERSITY OF ŽILINA
FACULTY OF CIVIL ENGINEERING

Faculty offers the study in two bachelor degree fields: Building Structures and Geodesy as well as in four master degree fields: Railway Engineering, Road Engineering, Buildings in Transport Engineering, Geoinformatics. The bachelors degree study lasts three years, which consist of four semesters of theoretical background and two semesters of special subjects. It leads to a bachelor′s degree. The masters degree study lasts five years, which consist of five semesters of theoretical background in common programme and five semesters of study upon the different curriculum in each field and specialization. Study is completed by a thesis. Its successful completion results in the award of the Diploma in Civil Engineering - an M. Sc. equivalent degree. Faculty partially prepares a new system, consisting on bachelor and master degree programs, which will start completely in the academic year 2004/2005.

Offered programmes:

BACHELORS STUDY

Two branches:
- **Building Structures** with specializations as follows:
  Roads and Bridges, Railways, Building Structures
- **Geodesy**

MASTERS STUDY

Four branches:
- **Railway Engineering** with specializations as follows:
  Railway Buildings, Railways Management
- **Road Engineering** with specializations as follows:
  Roads, Highways and Urban Engineering, Traffic Planning,
  Roads and Highways Management.
- **Buildings in Transport Engineering**
  Bridges and Underground Buildings, Building Structures
- **Geoinformatics**

DOCTORAL STUDY
Four branches
- **Theory and construction of civil engineering structures**
- **Building Technology**
- **Applied Mechanics**
- **Legal Expertise Engineering**

ANNEX

The Curricula 3 + 2 Years Study Programme at Slovak University of Technology in Bratislava

CIVIL AND TRANSPORT ENGINEERING – Bachelor Study Programme

Semester→	1		2		3		4		5		6	
Subject	**L/S**	**Cr**	**L/S**	**Cr**	**L/S**	**Cr**	**L/S**	**Cr**	**L/S**	**Cr**	**L/S**	**Cr**
History of Civil Engineering	1/1 c	2										
Buildings Materials	2/2 e	5										
Geology	2/2 e	5										
Basics of Environmental	2/2 e	5										
Deskriptive Geometry	2/3 e	5										
Mathematics	4/4 e	8	4/5 e	9								
Politology			1/1 c	2								
Statics			3/3 e	7								
Building Constructions			3/2 e	6								
Physics			3/2 e	6	2/2 e	5						
Macroeconomics					2/1 c	3						
Technical Equipment of Buildings					1/1 c	2						
Building Constructions Project					0/3 c	3						
Hydromechanics					2/2 e	4						
Water Supply Buildings					2/2 e	4						
Theory of Elasticity					3/3 e	7			3/2 e	5		
Surveying in Civil Engineering							2/3 e	5				
Building Management							2/2 c	4				
Structural Mechanics							3/3 e	6				
Soil Mechanics							3/2 e	5				
Concrete and Masonry Structures							2/2 e	4				
Hydrotechnical Buildings							2/2 e	4				
Roads and Highways									4/2 e	6		
Steel and Wood Structures									4/2 e	6		
Foundation of Buildings									3/2 e	5		
Reinforced and Prestressed Concrete									3/2 e	5		
Basics of Law											2/1 c	3
Sociology											1/1 c	2
Construction of Roads											4/2 e	6
Steel Structures											3/2 e	5
Engineering Geology and Rock											3/2 e	5
Concrete Structures											2/2 e	5
Field works											2 w	
Surveying Camp									1 w	1		
Foreign Language					0/2 c	2	0/2 c	2	0/2 c	2	0/2 e	2
Bachelor Thesis											0/2 c	2
Total Contact Hours per Week	**27**		**27**		**27**		**27**		**27**		**27**	
Credit Points		**30**		**30**		**30**		**30**		**30**		**30**

CIVIL AND TRANSPORT ENGINEERING – Master Study Programme

Semester→	7		8	
Subject	**Le/Ex e**	**Cr**	**Le/Exe**	**Cr**
Concrete Structures	2/1 e	3		
Timber Structures	2/1 e	3		
Structural Mechanics	2/2 e	5		
Mathematics	2/2 e	5		
Roads in Urban Areas	3/1 e	4		
Underground Buildings	2/1 e	3		
CAD Project	0/4 c	4	0/3 c	4
Concrete Bridges			4/1 e	5
Steel Bridges			3/1 e	4
Structural Dynamics			3/2 e	5
Railroads			3/1 e	4
Foreign Language	0/2 c	3	0/2 c	3
Field Works			1 week	
Optional Subject (one from the following list)			2/2 c	5
Total Contact Hours per Week	**25**		**25**	
Credit Points		**30**		**30**
List of the Optional Subjects				
Airports			2/2 c	5
Composite Steel-Concrete Structures			2/2 c	5
Massive Soil Structures			2/2 c	5

CIVIL AND TRANSPORT ENGINEERING – Master Study Programme
Specialization Module - Concrete Structures

Semester→	9		10	
Subject	**Le/Ex e**	**Cr**	**Le/Exe**	**Cr**
Construction & Commercial Law	2/1 e	4		
Economics of Building Industry	2/1 e	4		
Concrete Bridges	2/2 e	5		
Rheological Effects in Concrete Structures	2/2 e	5		
Special Concrete Structures	2/2 e	5		
Optional Subject	2/2 c	4		
Construction Design	0/3 c	3	0/5 c	4
Lifespan and Repair of Concrete Structures			3/2 c	4
High-Rise Concrete Structures			3/2 c	4
Realisation of Concr. Structures			3/2 c	4
Selected Topics in Concrete Structures and Bridges			3/2 c	4
Master Thesis			5 weeks	10
Total Contact Hours per Week	**25**		**25**	
Credit Points		**30**		**30**
List of the optional subjects				
Selected Topics in Steel Structures			2/2 c	5
Selected Topics in Soil Mechanics			2/2 c	5
Selected Topics in Statics and Dynamics of Structures			2/2 c	5

CIVIL AND TRANSPORT ENGINEERING – Master Study Programme
Specialization Module - Steel and Timber Structures

Semester→	9		10	
Subject	**Le/Ex e**	**Cr**	**Le/Exe**	**Cr**
Construction & Commercial Law	2/1 e	4		
Economics of Building Industry	2/1 e	4		
Steel Bridges	2/2 e	5		
High-Rise and Long-Span Steel Structures	2/2 e	5		
Stability and Plasticity of Steel Structures	2/2 e	5		
Optional Subject	2/2 c	4		
Specialised Seminar	0/3 c	3	0/5 c	2
Timber Structures			3/2 c	5
Diagnosis and Reconstruction of Steel and Timber Structures			3/2 c	5
Thin-Walled Steel Structures			3/2 c	5
Selected Topics in Steel and Timber Structures			3/2 c	3
Master Thesis			5 weeks	10
Total Contact Hours per Week	**25**		**25**	
Credit Points		**30**		**30**
List of the optional subjects				
Selected Topics in Concrete Structures and Bridges			2/2	5
Selected Topics in Soil Mechanics			2/2	5
Selected Topics in Statics and Dynamics of Structures			2/2	5

CIVIL AND TRANSPORT ENGINEERING – Master Study Programme
Specialization Module - Geotechnics

Semester→	9		10	
Subject	**Le/Ex e**	**Cr**	**Le/Exe**	**Cr**
Construction and Commercial Law	2/1 e	4		
Economics of Building Industry	2/1 e	4		
Advanced Engineering and Hydrogeology	2/2 e	5		
Soil Properties	2/2 e	5		
Geomechanics	2/2 e	5		
Optional Subject	2/2 c	4		
Special Seminar	0/3 c	3	0/5 c	2
Underground Structures			3/2 c	5
Building Foundations under Difficult Conditions			3/2 c	5
Dumps and Sludge Beds			3/2 c	5
Management and Reconstruction of Geotechnical Structures			3/2 c	3
Master Thesis			5 weeks	10
Total Contact Hours per Week	**25**		**25**	
Credit Points		**30**		**30**

List of the optional subjects				
Selected Topics in Concrete Structures and Bridges			2/2	5
Selected Topics in Steel Structures			2/2	5
Selected Topics in Statics and Dynamics of Structures			2/2	5

CIVIL AND TRANSPORT ENGINEERING – Master Study Programme
Specialization Module - Roads and Airports

Semester→	9		10	
Subject	**Le/Ex e**	**Cr**	**Le/Exe**	**Cr**
Construction and Commercial Law	2/1 e	4		
Economics of Building Industry	2/1 e	4		
Pavement Diagnoses	2/2 e	5		
Road Intersections	2/2 e	5		
Pavement Mechanics	2/2 e	5		
Selected Topics on Airports	2/2 c	4		
Special Seminar	0/3 c	3	0/5 c	3
Selected Topics on Roads and Highways			3/2 c	5
Reconstruction and Innovations of Roads			3/2 c	4
Quality Control and Experiments			3/2 c	5
Selected Topics in Transport Construction			3/2 c	3
Master Thesis			5 weeks	10
Total Contact Hours per Week	**25**		**25**	
Credit Points		**30**		**30**

CIVIL AND TRANSPORT ENGINEERING – Master Study Programme
Specialization Module - Urban Traffic Engineering

Semester→	9		10	
Subject	**Le/Ex e**	**Cr**	**Le/Exe**	**Cr**
Construction and Commercial Law	2/1 e	4		
Economics of Building Industry	2/1 e	4		
Traffic Flow Theory	2/2 e	5		
Traffic Planning and Prediction	2/2 e	5		
Traffic Management	2/2 e	5		
Urban Planning	2/2 c	4		
Special Seminar	0/3 c	3	0/5 c	3
Selected Topics in CAMDI			3/2 c	5
Traffic Management and Organisation			3/2 c	4
Public Transport Structures			3/2 c	5
Selected Topics in Transport Construction			3/2 c	3
Master Thesis			5weeks	10
Total Contact Hours per Week	**25**		**25**	
Credit Points		**30**		**30**

CIVIL AND TRANSPORT ENGINEERING – Master Study Programme
Specialization Module - Railways

Semester→	9		10	
Subject	**Le/Ex e**	**Cr**	**Le/Exe**	**Cr**
Construction and Commercial Law	2/1 e	4		
Economics of Building Industry	2/1 e	4		
Railways Stations and Junctions	2/2 e	5		
Train-Running Dynamics	2/2 e	5		
Computer Design	2/2 c	4		
Elements of Structures	2/2 e	5		
Special Seminar	0/3 c	3	0/5 c	3
Special Railway Topics			3/2 c	5
Railway Laboratory			3/2 c	4
Track Modernisation and HST			3/2 c	5
Selected Topics in Transport Construction			3/2 c	3
Master Thesis			5 weeks	10
Total Contact Hours per Week **Credit Points**	**25**	**30**	**25**	**30**

CIVIL ENGINEERING EDUCATION IN TURKEY

Gulay Ozdemir(Karakucuk), Elif Bugdaycıoglu1

1. GENERAL VIEW ON THE PRE-UNIVERSITY EDUCATION

In Turkey, pre-university education can be described as having two cycles, first as elementary education of eight years, second as high school education of three years. Entrance age for the elementary education is generally 6-7, and graduation age from high school is generally 17-18.

Elementary education is compulsory. Every Turkish citizen is obliged to have eight years elementary education. High school education of three years is optional in Turkey presently. New laws and regulations are being prepared for a compulsory four year high school education. All schools in Turkey are under the government of Ministry of Education.

Elementary education in Turkey has a standard curriculum. Elementary schools can differ in education language, where most of the schools are educating in Turkish. There are also schools which provide elementary education in English, German and French.

Various high school types exist in Turkey, with curriculum differences between them. Apart from general high schools, there are science schools, occupation schools, public schools of intense and qualified education (known generally as Anatolian high schools), religious schools. The type of the high school, is considered in the university entrance system, where some high school types are graded lower or higher, accordingly.

2. GENERAL VIEW ON THE ENGINEERING EDUCATION

2.1 Engineering education at undergraduate level

Turkish education system is a two-tier system: 4 years for the bachelor degree followed by 1-2 years for the master degree.

There are 53 public and 24 private universities in Turkey. 46 universities out of this total of 77 universities have civil engineering education. Two universities (Istanbul Technical University, Yildiz Technical University) have civil engineering faculties, whereas 44 universities have civil engineering departments within engineering faculties.

In some universities, engineering faculties are together with the architecture. There are also pre-undergraduate programs of two year, offered by

[1] Turkish Chamber of Civil Engineers

pre-undergraduate departments of civil engineering for two years. However, students have to complete their studies up to regular undergraduate program of four years, in order to obtain engineering degree.

To provide a general view on students and teaching staff in Turkish universities, the results of a relevant research in the academic year 2000-2001 term are being used. In that year, there were 1.306.000 undergraduate students, 84.334 graduate students and 86.854 teaching staff in public universities.

2.2 Engineering education at postgraduate level

2.2.1 Master or Master-type programmes

Engineering higher education for master degree involves a thesis work within the 2 years term, which can be extended, if necessary. 5 years programmes, as 4+1, involving a master degree without thesis, started to be applied in parallel to the current engineering education in Turkey, which is a fee-paying system.

Referring the given statistics in previous section, the distribution of higher education students is uneven within the universities. Higher education programmes in universities differ from each other, while some universities do not have a postgraduate offer. Most of the leading universities provide a wide range of engineering postgraduate education, of taught-research type.

Graduating from first stage engineering postgraduate programs of two years, which can be extended, students get the Master of Science engineering degree. It is possible to have the postgraduate education in other engineering departments and/or universities, providing the acceptance criteria are met. All Turkish universities require a minimum grade of LES (Higher Education Exam), differing among universities, for the postgraduate application.

Master degree in engineering provides the graduates both an initiation in research and a specialisation in a related area.

There are also postgraduate programmes which do not qualify the students for a master of science degree, but provide just a higher education diploma.

2.2.2 Doctorate programmes

Second stage of postgraduate degree in engineering in Turkey is the doctorate program, where students get Doctor of Philosophy degree after graduation. Doctorate curricula and programmes differ from university to university, where researches on specialized areas are undertaken.

LES grades are required for the application on doctorate education, similar to master degree. Duration of doctorate programs is generally 2 years, which can be extended, in relation to the research progress.

3. CIVIL ENGINEERING EDUCATION

3.1 Undergraduate Education

3.1.1 Short description for each type of programme

Civil Engineering education in Turkey covers all areas of the field. The architecture of civil engineering education in Turkey shows differences between all universities. A general outline of Turkish civil engineering education system will be presented in what follows.

All civil engineering departments have a four year undergraduate program, which if successfully completed entitles the graduates to a "Bachelor of Science in Civil Engineering" degree. Practical experience is generally required for the degree and accordingly, students being required to go into summer practice at the end of their second and third years and to have a satisfactory record of their summer employment approved by the Department.

3.1.2 Main features of the curriculum for the bachelor's degree course

Usually, in the first three years the programmes is common for all students.

During the fourth year, technical elective courses are offered by most of the universities, to enable the students to advance their knowledge in specific fields, such as: Structural Mechanics, Hydraulics, Geotechnics, Structural Materials, Transportation, Engineering Management. Some universities offer Geodesy, Earthquake Engineering, Environmental Engineering, etc., as separate divisions within the department. These divisions determine also the post graduate specialisations in the department, which can be predetermined by students in the last undergraduate year.

Here is an example of undergraduate curriculum in Turkey:

First Year:	Basic Calculus, Physics, Chemistry, Computer Programming, Geology, Technical Drawing, English Reading and Writing Skills, Introduction to Civil Engineering
Second Year:	Differential Equations, Engineering Mathematics, Surveying, Engineering Mechanics, Materials Science, Engineering Economy, Mechanics of Materials, Non-technical electives and non-credit History/Literature courses

Third Year:	Statistical Methods for Engineering, Structural Mechanics, Soil Mechanics, Foundation Engineering, Transportation and Traffic Engineering, Fluid Mechanics, Hydromechanics, Engineering Hydrology, Reinforced Concrete Fundamentals, Structural Analysis, Summer Practice
Fourth Year:	Water Resources Engineering, Fundamentals of Steel Design, Summer Practice, Technical Electives according to the field of specialization and the content of design courses. Some of the technical electives are:; Structural Design, Applied Surface Hydrology, Planning and Design in Water Resources, Advanced Mechanics of Materials, Finite Elements, Construction Management in Practice, Railway and Metro Tunnels, Advanced Materials of Construction, Highway Design, Computer Applications, Ground Improvement, Open Channel Hydraulics, Design and Construction of Special Structures, Advanced Structural Analysis, Prestressed Concrete, Coastal Engineering, Port Planning and Design, etc.

Credits assigned to courses are based on the weight of the course in the overall curriculum. Basic sciences in first year are of 4 credits, main courses in second and third years are of 3 credits, main division courses in third and fourth years are of 4 credits, technical courses are of 3 or 4 credits. This distribution sums up to an average of 140 credits, which differs within universities. Curriculum above described was evaluated by the Accreditation Board of Engineering and Technology (ABET) from U.S.A. and was taken from Middle East Technical University (METU), which has one of three leading civil engineering departments in Turkey. Similar relations with ABET have been developed by other Turkish universities, such as Istanbul Technical University (ITU).

Credit system in Turkey has been studied recently by research groups in several universities, which started to apply the European Credit Transfer System (ECTS) and the Diploma Supplement.

3.1.3 Admission of students at the undergraduate level

Admission of students for undergraduate level is within the national exam procedure, as mentioned before when describing the general education system. Graduating from high school, students obtain the right to enter university exam (ÖSS-Student Selection and Placement Exam) which covers all fields of higher education in Turkey. University entrance exam is held annually,

with an average number of 1,500,000 students to take it. From this number, an average of 200,000 students is placed in universities and departments for four year undergraduate education, on the basis of the university entrance exam grade. An average of 300.000 students is also placed in short term pre-undergraduate programs, occupation programs, and open education faculty of distance education. Department minimum grade requirements are defined by the department, announced and implemented by YÖK (Council of Higher Education). YÖK is a governmental institution, which was founded by law, managing and regulating higher education system in Turkey. This authority is given only to YÖK, and higher education system in Turkey is independent from the Ministry of Education.

3.2 CIVIL ENGINEERING EDUCATION AT POSTGRADUATE LEVEL

Graduate courses are offered in fields of specialization leading to the degrees of "Master of Science" and "Doctor of Philosophy".

Graduate programs differ from university to university. Some departments offer all divisions, whereas some provide only a limited range.

The course program for a M.Sc. degree is decided by the advisor of the student according to his intended field of specialization and to his future career plans. Students are required to take a minimum-credit hours from the courses, generally 60 credits, which are approved by the Department. Thesis is obligatory and each student is assigned a thesis supervisor. For studies leading to Ph.D. degree, there are also credit and course criteria for each University. Masters degree programme generally lasts for 2 years, but students can take extension in necessary circumstances. Ph.D. degree is framed to a 2 year program, for which an extension can be applied also. Civil engineering graduate programs in Turkey are based on the state-of-the art knowledge in applied science and technology and aimed at the development of new and original information in all civil engineering disciplines. Specific attention is paid to national and regional research needs.

A number of civil engineering departments in Turkey provide major graduate level research activities. Using research facilities and laboratories, graduate students undertake specific studies, also in accordance to international research studies of other universities.

4. RECENT TRENDS IN ENGINEERING EDUCATION IN THE COUNTRY

Council of Higher Education (YÖK) is the institution, founded in 1982, which determines the basic aspects and regulations of higher education in Turkey. YÖK is a governmental institution, which is governed by a committee,

appointed by government. Therefore, accreditation and education structure studies have been progressing rather slowly, by individual efforts of universities.

There are no legal accreditation bodies in Turkey related to university education, but several universities have been collaborating with international researchers on the subject, as is the case of Middle East Technical University and of Istanbul Technical University with ABET. Starting with 2002, Engineering Evaluation Committee (MÜDEK) undertook studies on accreditation of universities and accrediting universities. This independent committee is supported by universities for continuing to its work which could lead to the overall accreditation system in Turkey. The committee board consists of academics, professional engineers and NGO representatives.

Rectors and deans of universities have been approaching the Bologna Declaration affirmatively, although there is not yet a well defined plan for the implementation of the Declaration in Turkey. Deans of engineering faculties are gathering through a body named Engineering Faculty Deans Council, which is a dynamic and efficient forum for higher education system in Turkey. The Council is studying international research projects on education, related declarations and agreements, as well as national constraints and defines action plans. Reaction of this council to the Bologna Declaration has been positive and received a strong support. Member of Deans Council and Dean of the Engineering Faculty in Middle East Technical University, Prof. Mustafa Tokyay, has mentioned Council's intention on studying thoroughly the Bologna Declaration and projecting Turkish implementations, based on the decisions made at the 8th Council Meeting in May 2004, in Izmir. The aim of the study is to provide a common perspective on Declaration application and its impact on the education system by all engineering faculties.

Related to recent professional recognition studies, accreditation system drafts and proposals have also been prepared by Turkish Chamber of Civil Engineers (TCEE) as a projection on Turkish civil engineering education. TCCE has been studying international agreements, studies and projects, such as those promoted by EUCEET, SEFI, ECCE Education Task Force etc. Bologna Declaration has been a recent issue to be considered related to professional recognition and accreditation studies. TCCE reaction to the Declaration is positive, however further studies must be carried on the content and quality of education.

CIVIL ENGINEERING EDUCATION IN THE UNITED KINGDOM

David Lloyd Smith[1]

1. GENERAL VIEW OF PRE-UNIVERSITY EDUCATION

In the UK, all children follow eleven years of compulsory full-time education, beginning with primary school at the age of five years, and transferring to secondary school at age eleven, or twelve in Scotland. They may freely choose to leave school at age sixteen, although many continue in secondary education, and most of these do so with the aim of entering university. Schools are of two basic types: maintained schools, which are funded mostly by the state and at which education is provided without fees, and independent schools where students pay fees and entry is usually selective. School education is unified by a National Curriculum in England and Wales, and by a broad consensus in Scotland and Northern Ireland. Independent schools also tend to adopt this practice, but are not required to do so. The national curriculum comprises ten foundation subjects – English, Mathematics, Science, Technology, History, Geography, Music, Art, Physical Education and Modern Foreign Language – although other subjects may also be studied. Attainment targets are monitored by tests at each of four key stages, completed at ages 7, 11, 14, 16. All schools are subject to independent inspection to ensure the maintenance of standards in teaching quality.

During the final year of compulsory education, Year 11, pupils take the national examinations of the *General Certificate of Secondary Education (GCSE)* in England, Wales and Northern Ireland. These examinations assess the broad range of basic knowledge, and of related practical skills, appropriate for living in a modern, civilised community. After this, many students will choose to remain in secondary education for Years 12 and 13, and some will prepare for university entry. Places are often available in the same secondary school, but a continuation of secondary education can also be had by transferring to a specialist sixth form college or to a College of Further Education. Students normally prepare for entry to university by taking the national examinations of the *General Certificate of Education* (*GCE*) at Advanced Level.

In Scotland, the education system is different from that of the rest of the UK. Firstly, degree courses in the Scottish universities are one year longer in duration than comparable degree courses in other UK universities. At the end of compulsory secondary education, in Year 11, pupils take the examinations of the *National Course* at Intermediate Grade, equivalent to *GCSE*. For those who

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continue, the *National Course* examinations may be taken at Higher Grade in Year 12, at the age of 17+, and success in the *'Highers'* may confer entry to the first year of a degree course in a Scottish university. Some may extend their education into Year 13, where the *National Course* examinations at Advanced Higher Grade are taken. These are broadly similar to the *GCE Advanced Level*, and success in the *'Advanced Highers'* may offer entry directly to the second year of a degree course in a Scottish university or to the first year in other UK universities.

Many pupils leave school at age 16, hoping to enter paid employment. Some of these will engage in training and, either through their employer or independently, will take up vocational courses in Colleges of Further Education. A recently constructed framework of *National Vocational Qualifications (NVQ)* or *Scottish Vocational Qualifications (SVQ)* is now available at five levels, levels 3 and 4 being relevant for entry to university courses. Of older provenance, in the fields of business and engineering, is a system of *National Certificates/Diplomas* and *Higher National Certificates/Diplomas*, the certificates being awarded for part-time and the diplomas for full-time courses. Again, with an appropriate combination of subjects and grades, these may be considered suitable for entry to university courses.

2. GENERAL VIEW OF ENGINEERING EDUCATION

2.1 Engineering Education at Undergraduate Level

In the UK, the Engineering Council has the statutory duty to determine the qualification of engineering professionals, to maintain a register of those who are so qualified, and to regulate the engineering profession for the benefit of the community. The register has three divisions: Chartered Engineer (*CEng*), Incorporated Engineer (*IEng*), and Engineering Technician (*EngTech*), and the most able university graduates in engineering will seek to enter the register of Chartered Engineers. Qualification for any of the three divisions is normally achieved through an appropriate education (the Educational Base), followed by a structured and supervised programme of industry-based engineering practice or training (the Initial Professional Development). Typically, the *CEng* title is now awarded after the successful completion of four years of university-level education (five years in Scotland) and a further period of some four years of industrial training that culminates in a successful examination of professional competence.

With the publication in 1997 of the third edition of *Standards and Routes to Registration*, known widely by the acronym SARTOR, the Engineering Council signalled a sea-change in the qualification of engineering professionals. The principal aim of the new standards is to enhance the quality of future engineering practice by tightening the conditions on those preparing to enter

any of the divisions of the Engineering Council Register. One of the significant changes is the raising of the minimum period of education. For *CEng* registration, the minimum educational requirement used to be a three-year university degree; now the Educational Base must be at least four years in duration. There are two routes: (a) a *Master of Engineering* (*MEng*) degree, or (b) a *Bachelor of Engineering* (*BEng*) degree with honours followed by a supplementary year of accredited study. Similarly, for *IEng* registration, the minimum was a two-year non-degree course; now the Educational Base must be at least three years in duration. There are also two routes: (a) a *Bachelor of Science* (*BSc*) degree in engineering, or (b) a two-year non-degree course followed by a further year of accredited supplementary study. A second major change imposed by the Engineering Council involves the raising of the entry standards for students enrolling in engineering degree courses accredited for *CEng* and *IEng* registration.

2.2 Engineering Education at Postgraduate Level

2.2.1 Master Programmes

Across UK universities, the Master's degree is normally achieved by the successful performance of a taught course programme over twelve months of full-time education. Its basic structure involves seven to eight months of courses, assessed by coursework and written examinations, followed by four or five months on a research project or individual investigation, leading to a dissertation and a *viva voce* examination. The same programme may also be available for part-time study over two or three years and, in a small number of cases, by distance learning. Several different titles are employed for the Master's degree. For academic disciplines associated with the Faculties of Arts and Humanities, the title of the award is that of *Master of Arts (MA)*, and, for the Faculties of Science and Engineering, it is that of *Master of Science (MSc)*. Entry to Master's courses is normally conditional upon the applicant having successfully completed a first degree at an appropriate standard in a subject area considered relevant to the subject of the Master's course.

Such courses have traditionally been seen as providing an in-depth or specialised education, complementing the broader or more general form of undergraduate education. For those entering Master's courses linked to specific vocations, some benefit would usually accrue from having acquired two or three years of commercial or industrial experience. In recent years, however, perhaps half of those admitted to vocationally related Masters courses do so direct from the successful completion of undergraduate courses.

Other types of Master's courses, of relevance to engineering, are now also offered in UK universities. The *Master of Business Administration (MBA)* may be found in most business or management schools. Besides possession of an appropriate first degree, entrants are normally expected to have acquired

relevant professional experience, and the final investigative project is often linked to this experience. In addition to being offered as a full-time programme over a period of twelve months, it may also be run in a part-time mode of study, and occasionally also by distance learning. This may better suit the needs of students who have the option of remaining in part-time employment.

A different type of Master's degree, one that does not require the taking of courses for credit, is that of *Master of Philosophy (MPhil).* It is a research degree, normally involving the undertaking of a research project or individual investigation and leading to the submission of a thesis and to a *viva voce* examination. The duration of the programme is at least one calendar year, although in some universities it may be longer. The substance of the programme would be the type of investigation that produces useful results and educational outcomes, but without the level of originality appropriate for a doctorate.

2.2.2 Doctoral Programmes

The degree of *Doctor of Philosophy (PhD, or occasionally DPhil)* is usually available in all faculties in UK universities. It involves a research programme of at least two calendar years of full-time study. However, it would normally require three to four years to complete, and some universities now impose a maximum of five years from initial registration to submission of the thesis. Occasionally, part-time study is permitted, as is the carrying out of the project in a public research laboratory under a regime of supervision agreed by the university. The programme for the *PhD* degree is that of a coherent research study: it should lead to an advancement of knowledge through the discovery of new facts and provide training in research methodology. Although taught courses may be taken, they do not contribute credit to the award of the *PhD* degree.

In most UK universities, and in most faculties, higher doctorates are available. For engineering, and depending upon the university, the title of this degree may be *Doctor of Science (DSc), Doctor of Engineering Science (DSc(Eng)), Doctor of Engineering (DEng) or Doctor of Technology (DTech).* It is awarded by the university to a holder of one of its degrees (Bachelor, Master or Doctor) whose international reputation for research or other creative scholarship is substantiated by a significant body of publications, patents and other relevant output.

2.3 Independent Scrutiny of Engineering Degree Programmes

Engineering degree programmes in UK universities are subjected to three different types of independent scrutiny. The first is based on the *Visiting Examiner System*. The Vice-Chancellor, or academic head, of a university appoints at least one Visiting Examiner, usually a professor from another

university, to each degree course, whether undergraduate or postgraduate. The Visiting Examiner is empowered to inspect all materials relating to assessment of students, to take part in all decisions affecting the passing or failing of students and to report his or her findings and recommendations for change direct to the Vice-Chancellor.

Secondly, the Engineering Council has responsibility for the *Accreditation of Undergraduate Engineering Degree Courses*. For *MEng* and *BEng* programmes in the areas of civil, structural and building services engineering, the Council delegates its authority to the Institution of Civil Engineers, the Institution of Structural Engineers, and the Chartered Institution of Building Services Engineers. Representatives of those institutions form a jointly appointed body, called the Joint Board of Moderators, to undertake the accreditation. For *BSc* programmes in the same three areas, there is a different appointed body, called the Joint Accreditation Panel. The aim of accreditation is for the appointed body, by a process of inspection and discussion with teachers and students, to ensure that a programme passes the threshold standards of the Educational Base for the registration of engineers, as set out in SARTOR. Currently there are 50 educational institutions of university level providing accredited *MEng* and *BEng* programmes in civil and structural engineering.

Thirdly, there is a process of *Educational Quality Assessment.* The UK Government, which provides a substantial proportion of the funding of the state university system, requires each university to demonstrate that it delivers a quality education service in return for public funds received. Authority for the periodic quality audit of a university's systems and assessment of its educational provision for both undergraduate and postgraduate students is vested in the *Quality Assurance Agency (QAA) for Higher Education*.

3. CIVIL ENGINEERING EDUCATION

3.1 Undergraduate Education

3.1.1 Short Description of Each Type of Programme

The *BSc* degree, leading to *IEng* registration, is of three years' duration. For *CEng* registration, the *BEng* degree and the *MEng* degree are normally three-year and four-year programmes respectively. The way in which these programmes are delivered depends upon the university.

Some UK universities operate a two semester academic year, while others retain the traditional year of three terms, separated by the Christmas and Easter vacations. The academic year is usually of thirty or thirty-one working weeks, from September to May or October to June, although a particularly long-standing tradition supports three eight-week terms. The working weeks encompass all formal teaching and written examinations.

Assessment is by means of written examinations and practical coursework, the latter including projects, laboratories, technical reports etc. Written examinations are usually of two to three hours' duration. With a decrease of emphasis on students being required to memorise facts, additional sheets or booklets of information are introduced into examinations, but textbooks and course notes are not normally allowed. Traditionally, written examinations are located in a single block in May/June at the end of the academic year, with an opportunity in September for the re-examination of students who fail. The employment of the semester system, with modules being completed within a single semester, has allowed examinations to follow each semester.

In recent years, professors of engineering have been influential in bringing about a reduction in contact time within undergraduate courses. This is intended to foster a more reflective approach to learning, and to self-directed learning in particular. Currently, the weekly average contact time is between twenty and twenty-five hours. However, the reduction in contact time has gone hand-in-hand with an increase in project-based learning through which key skills are developed. In addition to contact time, students are expected to spend perhaps a further twenty hours a week in private study on practising problem solving, preparing projects and other practical coursework.

3.1.2 Short Description of the Main Features of the Curriculum

The *BSc* degree is a programme soundly based on engineering science, mathematics and information technology and having the aim of developing a balance of technical, managerial and personal skills. The *BEng* degree is also of three years' duration, but its technological content involves a greater focus on analysis and in-depth learning. The four-year *MEng* degree is intended for the most able students. Compared with the *BEng* course, it may involve more advanced technical modules; but it also aims to develop a broader education for professional leadership through humanities, foreign (mostly European) languages, management and business awareness; and it would also involve a greater level of industrial relevance. All *BEng* courses must have a final project, usually of a research nature, whereas *MEng* courses must have two major projects, one an individual investigative project and the other a group-working design project, preferably multidisciplinary and with appropriate industrial involvement.

The *MEng* course is therefore most suitable for student exchanges within the EU ERASMUS/SOCRATES programme. Some universities favour sending students abroad in the third year. This has the advantage that such students can return to their home university to complete the most important final year of their studies, and they can more easily inform other students of their experiences in the year abroad. Other universities send students abroad in the fourth year. The advantages are that such students will be a little more mature and independent,

and they will normally have completed all compulsory subjects in their third year.

The *BEng* degree is normally awarded with honours, for which purpose performance in the later years is weighted more heavily than in the first year. The *BEng (Hons)* degree is classified into first, second and third class honours. The first class is associated with the most academically able students, and the second class, involving perhaps 60 to 70% of the graduates, is divided into classes 2a and 2b. Traditionally, the UK bachelor's degree may also be awarded, less prestigiously, without honours, as signalled by the descriptions *BEng Pass Degree* or *BEng Ordinary Degree*. The *MEng* degree must always be of honours standard, although it may be awarded with an honours classification or without (unclassified), and the pass or ordinary degree is therefore not available for the least able students. For *CEng* registration, the Engineering Council accredits only the *BEng* degree with honours and the *MEng* degree.

Most UK universities have separate departments of Civil Engineering, Mechanical Engineering, Electrical Engineering etc., and each department offers degrees in its own specialist engineering discipline. A few of these admit their undergraduate students to a common first year course in engineering, after which the students choose the specialist engineering discipline they wish to study. A small number of universities have integrated engineering departments that offer *MEng* or *BEng* courses in General Engineering with an opportunity to take a range of specialist options in Civil Engineering or another engineering discipline during the last two years of the course.

Some university departments offer the *BEng*, or even the *MEng*, degree as a *Sandwich Course*. This is usually structured to contain a year of training in industry immediately after the second year of university study. The performance of a student during industrial placement is assessed, but the time spent in such an activity is not allowed to replace the usual academic study. Therefore the *BEng* Sandwich Course lasts for four years, the *MEng* Sandwich Course has a five-year duration, and Scottish versions of such degrees are invariably one year longer. Some of the learning achieved within properly constructed and assessed sandwich placements may be approved as counting towards the Initial Professional Development phase of preparation for *CEng* registration.

University departments may choose to offer only the *MEng* or only the *BEng* degree course, provided that the entrants meet the Engineering Council admission requirement. Some departments may choose to offer both programmes, but, for greater efficiency, require the first two years to be in common. After these two years, there is a bifurcation: the most able students are offered the *MEng* route to complete their studies, whereas the remaining students take the *BEng* route. However, the proportion of the intake thus transferred to the *MEng* course must be similar to the proportion of the intake satisfying the Engineering Council *MEng* admission requirement. Another

possibility is that some departments may choose to offer both the *BEng* and the *BSc* degree courses. Normally, students admitted to the *BSc* course would not be allowed to transfer to the *BEng* course. However, in exceptional circumstances, a department may be allowed a programme consisting of a common first year, after which the *BEng* and *BSc* streams bifurcate. For such a course, the decision that any particular student should transfer to the *BEng* stream must be based upon the independent Special Examinations of the Engineering Council rather than solely upon the first year examinations of the university.

3.1.2 Admission of Students at the Undergraduate Level

In England, Wales and Northern Ireland, students normally prepare for entry to university by taking the national examinations of the *General Certificate of Education* (*GCE*) at Advanced Level. Most students entering engineering degrees, at the age of 18 or 19 years, take three A-level subjects, usually mathematics, physics and one other subject, passes being achieved in one of the grades A to E in order of decreasing merit. For a cumulative and comparative measure of performance, each passing grade is assigned an equivalent number of points — A=10points, B=8points, C=6points, D=4points, E=2points — and the points are accumulated for the best three subject passes, with a maximum of 30points.

In Scotland, students may prepare to enter a Scottish university at age 17+ by taking the *National Course* examination at Higher Grade (*Scottish Highers*), normally in five subjects. Passing grades for each subject are A to C. Some students remain at school for a further year to take the *National Course* examinations at Advanced Higher Grade in three or sometimes four subjects. Passing grades for each subject are also A to C. This national examination is of similar standard to the *GCE* A-level examination, giving entry to the first year of university degree courses in England, Wales and Northern Ireland or direct to the second year of degree courses in the Scottish Universities.

Through the publication of its policy document *Standards and Routes to Registration* in 1997, the Engineering Council has imposed the requirement that, from the academic year 2001-2002, 80% of the students admitted to each accredited engineering degree course must have a minimum number of points. The requirement is at least 24 points (BBB or equivalent) for an *MEng* course, 18 points (CCC or equivalent) for a *BEng* course and 10 points (CD or equivalent) for a *BSc* course. There is a table of equivalence covering other UK and Irish national school-leaving examinations.

Although only a small proportion of total admissions, an increasing number is of students presenting International, European and French Baccalaureates, and school-leaving examinations from other EU countries. A small proportion of admissions also arises through the acceptance of UK vocational

qualifications, such as *National/Higher National Certificates* or *National Vocational Qualifications*.

Admissions to the first year of undergraduate programmes in UK universities are processed centrally, and in a controlled manner, by a national agency — the *Universities and Colleges Admission Service (UCAS)*. Universities are not allowed to receive applications directly from prospective students. An applicant submits a standard form to UCAS in which he or she asks to be considered for admission to up to six different undergraduate programmes, usually in different universities. The applicant will provide a written statement about personal interests, social contributions and motivation to embark on a career in civil engineering, and he or she will also provide a confidential reference from the head teacher at school, or from somebody of similar standing having knowledge of the applicant's academic ability. UCAS then copies the completed application to the universities on the applicant's list, and each university may choose whether to interview the applicant. International students provide a significant proportion of applications received.

Depending on the quality of application, and on the outcome of any interview, each university notifies UCAS of wishing either to make the applicant an offer or to reject the application. Most offers are made prior to the applicant's completing the national school examinations and are therefore conditional upon the achievement of certain grades. UCAS will allow the applicant to hold only two offers, usually the preferred choice and an 'insurance' offer; other offers must be rejected. In August, when the results of the national school examinations become available, conditional offers automatically become either unconditional offers or rejections, and all applicants holding two unconditional offers must finally decide which one to accept. On the other hand, applicants left without any offer after the national examination results become known may take advantage of the UCAS 'clearing system'. For this purpose, UCAS publishes information in the national press about which universities and programmes have vacancies or unfilled places. Applicants may then contact the university directly and the university can request UCAS to send a copy of the original application form for consideration.

For some universities, direct entry to the second or third year of a civil engineering programme is permitted, but not normally to the final year. This is known as granting the applicant advanced standing. Applicants claiming advanced standing may apply directly to the university, supplying evidence of having successfully covered the appropriate elements of curriculum elsewhere. The quality of students admitted under this concession and their subsequent academic progress is carefully scrutinised when the programme receives its periodic review for Engineering Council accreditation.

3.2 Civil Engineering Education at Postgraduate Level

3.2.1 Master Programmes

The main type of programme in civil engineering is that leading to the *Master of Science (MSc)* degree, and the subject of study would normally be a specialisation from one of the disciplines of civil engineering. Typical subjects for Master's programmes are bridge engineering, concrete structures, marine and offshore engineering, environmental engineering, geotechnical engineering, and Transport Systems and Planning.

Applicants seek admission to MSc courses directly from the university. The academic requirement for entry is the holding of at least a second class honours degree or its equivalent, usually in civil engineering or occasionally in some subject cognate to that of the MSc course.

The programme typically involves seven or eight months of taught courses, delivered either in semesters or terms, and four or five months of research or other individual investigation leading to the presentation of a dissertation. The taught course elements may contribute some four hundred hours to five hundred hours of contact time, at a rate of about twenty-five hours a week, supplemented by practical work requiring some fifteen to twenty hours a week of private study. Assessment of this work is carried out by means of written examinations and practical coursework. The dissertation is often linked directly with ongoing research projects in which the university staff are involved. It may also be founded on industrially relevant problems suggested by part-time teachers normally engaged in industry or by the university staff in connection with industrial consulting work. It must be passed separately from the written examinations and coursework, and one component of the assessment would be a *viva voce* examination normally performed by the university staff.

3.2.2 Doctoral Programmes

The main doctoral programme in civil engineering is that for the *Doctor of Philosophy (PhD or DPhil)* degree, with a normal duration of three to four years. Little more need be written here than is already contained in Section 2.2.2 above. Traditionally, the programme is based on a single coherent research project: it does not involve the taking of courses for credit. Courses are taken when they provide essential support for the research, but any assessment does not contribute to the award of the PhD degree.

4. RECENT TRENDS IN ENGINEERING EDUCATION IN THE U.K.

A proposal that the traditional three-year Bachelor's degree should be extended to four years for the most able 25% of UK engineering students was

made in 1980. There were a few early exemplars of *MEng* degrees, but it is only more recently, during the last ten years, that such programmes have become widely accepted by both students and employers. *BEng* and *BSc* degrees are offered throughout the UK university network and clearly satisfy the structure envisaged in the Bologna Declaration for first-cycle programmes of three or more years. However, it is also envisaged that an award at Master's level would follow a second-cycle programme, normally of two years' further study. The position is therefore not so clear for the four-year *MEng* degree and the one-year *MSc* degree. At present, there is a developing dialogue in the UK about how these programmes measure up to the spirit of the Bologna Declaration.

The *Master of Research (MRes)* is a recently established programme of at least one year in duration, containing both taught courses and a significant research component. It aims to provide a structured research training through the acquisition of research techniques and a broad range of transferable skills, together with the opportunity to demonstrate initiative and creativity in a research project. It is intended to form a foundation for doctoral study or for a research career in industry or the public sector. From this description, its relation to the French *Diplôme d'Etudes Approfondies (DEA)* will be apparent.

The *Engineering Doctorate (EngD)* was established in 1992 by the Engineering and Physical Sciences Research Council, which provides funds to support candidates for four years. It is intended for leading research engineers who aspire to key managerial positions in industry. The programme is currently operated from ten academic centres, which arrange training courses in appropriate specialist technical and business management competencies, the taught courses providing credit towards the award of the degree. However, the research engineer is expected to spend three-quarters of his/her time working directly with the collaborating company and its research teams on one or more live projects. Through these, he/she must thereby demonstrate innovation in the application of knowledge to the engineering business and make a significant contribution to the performance of the company. This programme, which draws some inspiration from aspects of the German *Doktor Ingenieur (Dr Ing)* degree, aims to provide a more vocationally relevant degree than the *PhD*, better suited to the needs of the engineering industry.

Finally, mention should be made of the *New Route PhD*. It was initiated in 2001 and is now on trial in ten UK universities. Approximately 40% of the programme consists of taught modules, offering a blend of subject-related specialist knowledge and professional skills. The remaining 60% is based on both general and specific research training leading to the production of a thesis. Its assessment continues to form the main component in the award of the *PhD* and exacts the same standards as for the traditional *PhD* thesis. Completion of the full *PhD* programme would be expected to take three to four years, and candidates may be eligible for an intermediate award after completion of the first phase of taught course elements. The new route to the *PhD* is intended by

its supporters to provide a more flexible programme of learning, more integrated than the *MSc* plus traditional *PhD*, and more attractive and professionally relevant to potential students.

ANNEX

JOINT BOARD OF MODERATORS ACCREDITED COURSE LIST 2000-2001

The *MEng* and *BEng* programmes listed in this annex have been accredited by the Joint Board of Moderators, and endorsed by the Engineering Council, as providing an appropriate educational base for those proceeding to Chartered Engineer status through corporate membership of the Institution of Civil Engineers or of the Institution of Structural Engineers.

The Joint Board of Moderators consists of representatives of the Institution of Civil Engineers, the Institution of Structural Engineers and the Chartered Institution of Building Services Engineers.

University of Aberdeen, Department of Engineering

MEng Civil Engineering	5 years
MEng Civil & Environmental Engineering	5 years
MEng Civil & Environmental Engineering with European Studies	5 years
MEng Engineering and Diploma in Management	5 years
MEng Civil & Structural Engineering	5 years
MEng Civil & Structural Engineering with European Studies	5 years
MEng Engineering with Safety & Reliability Engineering	5 years
MEng Offshore Engineering	5 years
BEng (Hons) Engineering (Civil Pathway)	4 years
BEng (Hons) Engineering (Civil & Environmental)	4 years
BEng (Hons) Engineering (Civil with European Studies)	4 years
BEng (Hons) Engineering (Civil with Management)	4 years
BEng (Hons) Engineering (Civil & Structural)	4 years

University of Abertay, Dundee, Division of Construction & Environment

MEng Civil Engineering	5 years
BEng (Hons) Civil Engineering	4 years

Aston University, Birmingham, Division of Civil Engineering

MEng Civil Engineering	4 years
MEng Civil Engineering (Sandwich Course)	5 years
MEng Civil & Environmental Engineering	4 years
MEng Civil & Environmental Engineering (Sandwich Course)	5 years
MEng Civil Engineering & European Studies	4 years
MEng Civil Engineering & European Studies (Sandwich Course)	5 years

BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Civil Engineering (STEPS)	4 years
University of Bath, School of Architecture & Civil Engineering	
MEng Civil & Architectural Engineering	4 years
MEng Civil & Architectural Engineering (Sandwich Course)	5 years
BEng (Hons) Civil Engineering with Architecture (Sandwich Course)	4 years
Queen's University of Belfast, Department of Civil Engineering	
MEng Civil Engineering	4 years
MEng Civil Engineering (Sandwich Course)	5 years
MEng Environmental and Civil Engineering	4 years
MEng Environmental and Civil Engineering (Sandwich Course)	5 years
MEng Structural Engineering with Architecture	4 years
MEng Structural Engineering with Architecture (Sandwich Course)	5 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Architectural Engineering	3 years
BEng (Hons) Architectural Engineering (Sandwich Course)	4 years
University of Birmingham, School of Civil Engineering	
MEng Civil Engineering	4 years
MEng Civil Engineering with Management (International Study)	4 years
MEng Civil Engineering (International Studies)	4 years
MEng Civil Engineering with Management	4 years
MEng Civil Engineering with Management with Language	4 years
MEng Civil Engineering with Language	4 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering with Computational Mechanics	3 years
BEng (Hons) Civil Engineering with Environmental Management	3 years
BEng (Hons) Civil Engineering with Language	3 years
University of Bradford, Department of Civil & Environmental Engineering	
MEng Civil Engineering	4 years
MEng Civil Engineering (Sandwich Course)	5 years
MEng Computer-aided Structural Engineering	4 years
MEng Computer-aided Structural Engineering (Sandwich Course)	5 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Computer-aided Structural Engineering	3 years
BEng (Hons) Computer-aided Structural Engineering (Sandwich Course)	4 years

University of Brighton, School of Environment

MEng Civil Engineering	4 years
MEng Civil Engineering (Part-time study)	5 years
MEng Civil Engineering (Sandwich Course)	5 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Part-time study)	4 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years

Bolton Institute of Higher Education

BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Part-time study)	4 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years

University of Bristol, Department of Civil Engineering

MEng Civil Engineering	4 years
MEng Civil Engineering with European Studies	4 years
BEng (Hons) Civil Engineering	3 years

University of Cambridge, Department of Engineering

BA, MEng Engineering Tripos	4 years

College of Cardiff, University of Wales, Division of Civil Engineering

MEng Civil Engineering	4 years
MEng Civil Engineering (sandwich Course)	5 years
MEng Civil Engineering with a year in Europe	5 years
MEng Architectural Engineering	4 years
MEng Architectural Engineering (Sandwich Course)	5 years
MEng Architectural Engineering with a year in Europe	4 years
MEng Civil & Environmental Engineering	4 years
MEng Civil & Environmental Engineering (Sandwich Course)	5 years
MEng Civil & Environmental Engineering with a year in Europe	5 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Civil Engineering with a year in Europe	4 years
BEng (Hons) Architectural Engineering	3 years
BEng (Hons) Architectural Engineering (Sandwich Course)	4 years
BEng (Hons) Architectural Engineering with a year in Europe	4 years
BEng (Hons) Civil & Environmental Engineering	3 years
BEng (Hons) Civil & Environmental Engineering (Sandwich Course)	4 years
BEng (Hons) Civil & Environmental Engineering with a year in Europe	4 years

City University, London, School of Engineering

MEng Civil Engineering	4 years
MEng Civil Engineering (Sandwich Course)	5 years
MEng Civil Engineering with Surveying	4 years
MEng Civil Engineering with Surveying (Sandwich Course)	5 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Civil Engineering with Surveying	3 years
BEng (Hons) Civil Engineering with Surveying (Sandwich Course)	4 years
BEng (Hons) Civil Engineering with Architecture	3 years
BEng (Hons) Civil Engineering with Architecture (Sandwich Course)	4 years

Coventry University, School of Science and the Environment

BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Part-time study)	4-6 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Civil Engineering with European Studies	4 years
BEng (Hons) Civil & Structural Engineering	3 years
BEng (Hons) Civil & Structural Engineering (Part-time study)	4-6 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Civil & Environmental Engineering	3 years
BEng (Hons) Civil & Environmental Engineering (Part-time study)	4-6 years
BEng (Hons) Civil & Environmental Engineering (Sandwich Course)	4 years
BEng (Hons) Civil Engineering & Management	3 years
BEng (Hons) Civil Engineering & Management (Part-time study)	4-6 years
BEng (Hons) Civil Engineering & Management (Sandwich Course)	4 years

Cranfield University, Royal Military College of Science, Shrivenham, Swindon

BEng (Hons) Civil Engineering	3 years

University of Dundee, Department of Civil Engineering

MEng Civil Engineering	5 years
BEng (Hons) Civil Engineering	4 years
BEng (Hons) Civil Engineering & Management	4 years

University of Durham, School of Engineering

MEng Engineering (Civil Pathway)	4 years
MEng Engineering (Overseas Study Option, Civil Pathway)	4 years

University of East London, Dagenham, Department of Civil Engineering

BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Part-time study)	4 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years

University of Edinburgh, Department of Civil Engineering & Building Science

MEng Civil Engineering	5 years
MEng Civil Engineering & Construction Management	5 years
MEng Civil & Environmental Engineering	5 years
MEng Structural Engineering with Architecture	5 years
BEng (Hons) Civil Engineering	4 years
BEng (Hons) Civil Engineering & Construction Management	4 years
BEng (Hons) Civil & Environmental Engineering	4 years
BEng (Hons) Structural Engineering with Architecture	4 years

University of Exeter, School of Engineering and Computer Science

MEng Civil Engineering	4 years
BEng (Hons) Civil Engineering	3 years

University of Glasgow, Department of Civil Engineering

MEng Civil Engineering	5 years
MEng Civil Engineering (fast track entry)	4 years
MEng Civil Engineering with Architecture	5 years
MEng Civil Engineering with Architecture (fast track entry)	4 years
BEng (Hons) Civil Engineering	4 years
BEng (Hons) Civil Engineering with Architecture	4 years

University of Greenwich, Dartford, School of Architecture and Construction

BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Part-time study)	4 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Civil Engineering with Project Management	3 years
BEng (Hons) Civil Engineering with Project Management (Part-time study)	4 years
BEng (Hons) Civil Engineering with Project Management (Sandwich Course)	4 years
BEng (Hons) Civil Engineering with Water & Environmental Management	3 years
BEng (Hons) Civil Engineering with Water & Environmental Management (PTS)	4 years
BEng (Hons) Civil Engineering with Water & Environmental Management (SC)	4 years

Heriot-Watt University, Edinburgh, Department of Civil Engineering

MEng Civil Engineering	5 years
MEng Civil & Environmental Engineering	5 years
MEng Offshore Engineering	5 years
MEng Structural Engineering	5 years
BEng (Hons) Civil Engineering	4 years
BEng (Hons) Structural Engineering	4 years
BEng (Hons) Offshore Engineering	4 years
BEng (Hons) Civil & Environmental Engineering	4 years

University of Kingston, School of Engineering

BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Part-time study)	4 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years

Imperial College of Science, Technology & Medicine, University of London

Department of Civil & Environmental Engineering

MEng Civil Engineering	4 years
MEng Civil & Environmental Engineering	4 years
MEng Civil Engineering with a year in Europe	4 years
MEng Civil & Environmental Engineering with a year in Europe	4 years

University of Leeds, School of Civil Engineering

MEng Civil Engineering	4 years
MEng Civil Engineering (Europe)	4 years
MEng Architectural Engineering	4 years
MEng Civil Engineering with Architecture	4 years
MEng Civil Engineering with Construction Management	4 years
MEng Civil & Structural Engineering	4 years
MEng Civil & Structural Engineering (Europe)	4 years
MEng Civil & Environmental Engineering	4 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Architectural Engineering	3 years
BEng (Hons) Civil Engineering with Construction Management	3 years
BEng (Hons) Civil & Environmental Engineering	3 years
BEng (Hons) Civil Engineering with transport Engineering	3 years
BEng (Hons) Civil & Structural Engineering	3 years

University of Liverpool, Department of Civil Engineering

MEng Civil & Environmental Engineering	4 years
MEng Civil & Maritime Engineering	4 years
MEng Civil & Structural Engineering	4 years
BEng (Hons) Civil Engineering	3 years

BEng (Hons) Civil Engineering (including first year foundation course)	4 years

Liverpool John Moores University, School of the Built Environment

MEng Civil Engineering	4.5 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Pat-time study)	4 years
BEng (Hons) Civil Engineering (Sandwich course)	4 years
BEng (Hons) Civil Engineering with integrated foundation year	4 years
BEng (Hons) Civil Engineering with integrated foundation year Sandwich Course	4 years

University College London, University of London, Department of Civil & Environmental Engineering

MEng Civil Engineering	4 years
MEng Civil & Environmental Engineering	4 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Structural Engineering	3 years
BEng (Hons) Civil Engineering with STEPS	4 years
BEng (Hons) Civil & Environmental Engineering	3 years
BEng (Hons) Civil Engineering Technology and Law	4 years

Loughborough University, Department of Civil & Building Engineering

MEng Civil Engineering	4 years
MEng Civil Engineering (Sandwich Course)	5 years
MEng Civil & Building Engineering	4 years
MEng Civil & Building Engineering with Diploma in Industrial Studies, Sandwich	5 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering with Diploma in Industrial Studies (Sandwich)	4 years

University of Manchester, Division of Civil Engineering

MEng Civil Engineering	4 years
MEng Civil Engineering with a year in Europe	4 years
MEng Civil Engineering (Integrated Japanese Programme)	4 years
MEng Structural Engineering with Architecture	4 years
MEng Structural Engineering with Architecture with a year in Europe	4 years
MEng Structural Engineering with Architecture (Integrate Japanese Programme)	4 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Structural Engineering with Architecture	3 years

University of Manchester Institute of Science & Technology (UMIST)
Department of Civil & Structural Engineering

MEng Civil Engineering	4 years
MEng Civil Engineering with North American Studies	4 years
MEng Civil Engineering with French	4 years
MEng Civil Engineering with German	4 years
MEng Civil & Structural Engineering	4 years
BEng (Hons) Civil Engineering	3 years

Napier University, Edinburgh, School of the Built Environment

BEng (Hons) Civil & Transportation Engineering	4 years

University of Newcastle Upon Tyne, Department of Civil Engineering

MEng Civil Engineering	4 years
MEng Civil & Environmental Engineering	4 years
MEng Civil & Structural Engineering	4 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil & Environmental Engineering	3 years
BEng (Hons) Civil & Structural Engineering	3 years

University of Nottingham, Department of Civil Engineering

MEng Civil Engineering	4 years
MEng Civil Engineering with French	4 years
MEng Civil Engineering with German	4 years
MEng Civil Engineering with Spanish	4 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering with French	3 years
BEng (Hons) Civil Engineering with German	3 years
BEng (Hons) Civil Engineering with Spanish	3 years

Nottingham Trent University, Department of Civil & Structural Engineering

BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Part-time study)	4 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Civil & Structural Engineering	3 years
BEng (Hons) Civil & Structural Engineering (Part-time Study)	4 years
BEng (Hons) Civil Engineering with Management	3 years
BEng (Hons) Civil Engineering with Management (Part-time study)	4 years
BEng (Hons) Civil Engineering with Management (sandwich Course)	4 years
BEng (Hons) Civil & Environmental Engineering	3 years
BEng (Hons) Civil & Environmental Engineering	

(Part-time study)	4 years
BEng (Hons) Civil & Environmental Engineering (Sandwich Course)	4 years

University of Oxford, Department of Engineering Science

MEng Engineering Science (Civil Options)	4 years
MEng Engineering, Economics & Management (Civil Options)	4 years

Oxford Brookes University, Headington, School of Construction & Earth Sciences

BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Part-time study)	4 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years

University of Plymouth

MEng Civil Engineering	4 years
MEng Civil Engineering (Sandwich Course)	5 years
MEng Civil & Coastal Engineering	4 years
MEng Civil & Coastal Engineering (Sandwich Course)	5 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Civil & Coastal Engineering	3 years
BEng (Hons) Civil & Coastal Engineering (Sandwich Course)	4 years

University of Portsmouth, Department of Civil Engineering

MEng Civil Engineering	4 years
MEng Civil Engineering (Sandwich Course)	5 years
MEng Civil Engineering with European Studies	4 years
MEng Civil Engineering with European Studies (Sandwich Course)	5 years
MEng Civil Engineering with Engineering Geology	4 years
MEng Civil Engineering with Engineering Geology (Sandwich Course)	5 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Civil Engineering with European Studies	3 years
BEng (Hons) Civil Engineering with European Studies (Sandwich Course)	4 years
BEng (Hons) Civil Engineering with Engineering Geology	3 years
BEng (Hons) Civil Engineering with Engineering Geology (Sandwich Course)	4 years

University of Salford, School of Aeronautical, Civil & Mechanical Engineering

MEng Civil Engineering	4 years
MEng Civil Engineering (Part-time study)	5 years
MEng Civil Engineering (Sandwich Course)	5 years
MEng Civil Engineering with European Studies	4 years
MEng Civil Engineering with European Studies (Part-time study)	5 years
MEng Civil Engineering with European Studies (Sandwich Course)	5 years
MEng Civil Engineering with Transport	4 years
MEng Civil Engineering with Transport (Part-time study)	5 years
MEng Civil Engineering with Transport (Sandwich Course)	5 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Part-time study)	4 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Civil Engineering with European Studies	3 years
BEng (Hons) Civil Engineering with European Studies (Part-time study)	4 years
BEng (Hons) Civil Engineering with European Studies (Sandwich Course)	4 years
BEng (Hons) Environmental Engineering	3 years
BEng (Hons) Environmental Engineering (Part-time study)	4 years
BEng (Hons) Environmental Engineering (Sandwich Course)	4 years
BEng (Hons) Environmental Engineering with European Studies (Part-time study)	4 years
BEng (Hons) Environmental Engineering with European Studies (Sandwich Crse)	4 years
BEng (Hons) Civil Engineering with Transport	3 years
BEng (Hons) Civil Engineering with Transport (Part-time study)	4 years
BEng (Hons) Civil Engineering with Transport (Sandwich Course)	4 years

Sheffield Hallam University, School of Environment & Development

BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Part-time study)	6 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Civil & Environmental Engineering	3 years
BEng (Hons) Civil & Environmental Engineering (Sandwich Course)	4 years

University of Sheffield, Department of Civil & Structural Engineering

MEng Civil Engineering	4 years
MEng Civil & Structural Engineering	4 years
MEng Civil & Environmental Engineering	4 years
MEng Civil Engineering with a Modern Language	4 years

MEng Civil Engineering with Architecture	4 years
MEng Structural Engineering and Architecture	4 years
BEng (Hons) Civil Engineering	3 years

University of Southampton, Department of Civil & Environmental Engineering

MEng Civil Engineering	4 years
MEng European Studies in Civil Engineering	4 years
MEng Environmental Engineering	4 years
MEng European Studies in Environmental Engineering	4 years
MEng Civil Engineering with Architecture	4 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Environmental Engineering	3 years

South Bank University, London,
Division of Civil Engineering & Construction Management

BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Part-time study)	4 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years

University of Strathclyde, Glasgow, Department of Civil Engineering

MEng Civil Engineering	5 years
MEng Building Design Engineering	5 years
MEng Civil Engineering with European Studies	5 years
MEng Civil Engineering with Environmental Management	5 years
BEng (Hons) Civil Engineering	4 years
BEng (Hons) Building Design Engineering	4 years

University of Surrey, Guildford, Department of Civil Engineering

MEng Civil Engineering	4 years
MEng Civil Engineering (Sandwich Course)	5 years
MEng Civil Engineering with Computing	4 years
MEng Civil Engineering with Computing (Sandwich Course)	5 years
MEng Civil Engineering with a European Language (Sandwich Course)	5 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Civil Engineering with Computing	3 years
BEng (Hons) Civil Engineering (Sandwich Course)	4 years
BEng (Hons) Civil Engineering with a European Language (Sandwich Course)	4 years
BEng (Hons) Civil Engineering with Integrated Foundation Year	4 years
BEng (Hons) Civil Engineering with Integrated Foundation Year (Sandwich)	5 years

University of Ulster, Newtownabbey, Co Antrim, N Ireland
School of the Built Environment

BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering (Part-time study)	5 years
BEng (Hons) Civil Engineering with Diploma in Industrial Studies (Sandwich)	4 years

University of Wales Swansea, Department of Civil Engineering

MEng Civil Engineering	5 years
BEng (Hons) Civil Engineering	3 years
BEng (Hons) Civil Engineering with a European Language	4 years

University of Warwick, Coventry, School of Engineering

MEng Civil Engineering	4 years
BEng (Hons) Civil Engineering	3 years

POSTSCRIPT

At the time the notes above were being written, a reconstruction of the Engineering Council was in progress. In late 2001, the Engineering and Technology Board was created to work together with the Engineering Council, among other organizations, and to nominate one-third of the Council's board membership. It was decided that the Engineering Council should retain responsibility for determining the qualification of engineers, maintaining the Register of qualified engineers and regulating the engineering profession. However, the Engineering and Technology Board was set up to engage closely in a partnership with business and industry, as well as with the science and engineering institutions and their respective regulatory bodies, so as to ensure that the supply of skills for science, engineering and technology better matches present and future needs.

In March 2004, the Engineering Council's *Standards and Routes to Registration* (SARTOR), in its third edition of 1997, was replaced by a new document, *UK Standard for Professional Engineering Competence* (UK-SPEC). It is to be found on the Internet site:

<http://www.uk-spec.org.uk/prof_engineering_standard/index.asp>.

The requirements for all routes to professional status are now specified in terms of a set of threshold standards of competence and commitment, somewhat broadened in comparison with SARTOR and achieved through appropriate education, training and continuing professional development.

Accreditation of UK Undergraduate Degree Courses by the Engineering Institutions, acting as the nominated bodies of the Engineering Council, will now be focused on output standards, viewed in relation to the standards of professional competence and commitment set out in UK-SPEC and expressed in terms of two different categories of learning outcomes. These relate to (a) General Learning Outcomes – knowledge and understanding; intellectual abilities; practical skills; and general transferable skills – and (b) Specific Learning Outcomes in Engineering – underpinning science and mathematics; engineering analysis; design; the economic, social and environmental context; and engineering practice. As for input standards, the requirements for admission to accredited degree programmes, set out in 3.1.3 above, have been withdrawn. Selected admission will continue to be a matter for the universities to decide, but not for the accrediting body, which must decide whether graduates are meeting the required output standards. These are detailed on

<http://www.uk-spec.org.uk/Output_Standards/Output_Standards2.pdf>.

Since the list in the following Annex was compiled in 2000-2001 of *CEng* accredited programmes, leading to the *MEng* and *BEng* degrees in civil engineering, several universities have ceased to offer such *CEng* accredited programmes in civil engineering, some have reduced the number of such programmes they offer and some have amended the programme titles to reflect curriculum change. The Engineering Council UK publishes a full list of educational programmes currently accredited for the *CEng*, *IEng* and *EngTech* registers on its Internet site:

<http://www.engc.org.uk/accredsql/public/simplesearch.asp>.

A SAMPLING
FROM THE ANSWERS TO A QUESTIONNAIRE
ON THE IMPACT OF THE BOLOGNA DECLARATION

In 2001, Prof. Torbjorn Hedberg from Lulea University (Sweden), former President of SEFI, undertook survey among SEFI National representatives and other members on the impact of the Bologna Declaration on engineering education in Europe, based on a comprehensive Questionnaire.

The editor got from Prof. Hedberg the permission to distribute the Questionnaire among the partners of the EUCEET Thematic Network. This was done in April 2004.

21 answers to the Questionnaire were received. As a whole, information provided by the answers does not differ from the one provided by the papers received for the fourth EUCEET volume and, as a consequence, it would have been redundant to publish exhaustively the answers. However, some of the 14 questions were tackling more sensitive issues or asked explicitly personal comments from the respondents. Answers to such questions are of particular interest and could be considered as useful complement of the papers included in this volume.

Samples from these answers were taken and offered in what follows.

Question: **How does the new first cycle degree compare with a possibly already existing shorter and more application-oriented degree?**

Country	Answer
Belgium, Flemish - speaking Community	The universities used to differentiate from the institutes of higher education by several aspects, among which: • In universities, access to engineering studies was conditioned by success at an entrance examination. • The education provided by the universities engineering faculties was of a more basic and theoretical nature whereas the institutes of higher education took the more practical viewpoint of direct application of the technical knowledge. The two systems were considered complementary of each other. These distinctions are now somewhat blurred. • The first academic degree, "Bachelor in Engineering Science", will be awarded after completion of 180 ECTS, obtained over 3 years *at least.* The second degree, "Master in Engineering Science", will be awarded after completion of *60 or* 120 ECTS obtained over 1 or 2 years *at least*. The 4 years curriculum of the institutes of higher education

	does not fit easily into the 3-5-8 frame. That is why the subtleties of 3 years *at least* and *60 or* 120 ECTS have been introduced into the Bachelor and Master requirements respectively. To clarify the ambiguity, the institutes of higher education ask for an extension of their 4 years curriculum to 5 years, while the universities rather advocate its reduction from 4 to 3 years (to preserve their own monopoly over the 5 years curriculum). So far, no governmental decision has been taken.
Finland	The new system will be more theoretical, because it will be a science university degree.
Germany	Our new first cycle degree is more scientific than "Fachhochschulen".
Netherlands	Our first cycle is more theoretical, more fundamental and less application oriented than the HBO/HTS. Our first cycle has the explicit objective too prepare for the MSc-programme.
Slovenia	It is important to note that, according to the law, 2 parallel programs exist in the first cycle (loosely said "professional" and "university"). It still not clear what the formal distinction between the 2 degrees will be. The degree for the professional program should be comparable with the already existing shorter and more application-oriented program. The bachelor's degree for the "university" is very much undefined. In general having two parallel programs in the first cycle is confusing and not well defined, but the main reason for this are funding and the fact that the professional program can be entered without matura exam after the high school. Otherwise, the complete (recently reformed) high school system should be revised again.

Question: **Is there a difference in attitude and interpretation of the process between research oriented Universities and faculties of technology on one hand and Fachhochschulen/ Politechnics on the other?**

Country	**Answer**
Finland	The decision concerns only universities so far. The Polytechnics will be tackled later.
Germany	Yes, a lot of differences.
Greece 1	Higher Technological and Educational Institutions are the Greek equivalents of Polytechnics or Fachhochschulen, offering short-duration study programs which are not related at all to the study programs offered by the Universities. So far their reaction to the Bologna process has been rather

	neutral. This might be explained by the fact that at the time being they do not wish to oppose the Universities position. Yet, they are actively looking at ensuring the recognition of professional rights of their graduates within the country.
Greece 2	As far as we know here at NTUA, so far the representatives from the TEI (i.e., the Technical Educational Institutes who award degrees after 3.5 years of study) have not been vocal about the Bologna issue.
Netherlands	Universities claim the title of Master of Science for their graduates and state that Fachhochschulen only can give degrees in Engineering whereas the Fachhochschulen claim that they give Bachelor or even master of Science diploma's within the new system. This dilemma is not yet entirely solved.

Question: **Do you have any other comments you wish to make relating to Engineering Education and the Bologna Declaration?**

Country	**Answer**
Belgium, Flemish - speaking Community	These are personal comments! • In Belgium, the system in place 15 years ago was clearly defined and functioned quite well: "ingénieurs civils" were educated in 5 years, "ingénieurs techniciens" in 3 years. They were complementary. As soon as "ingénieurs techniciens" were upgraded to "ingénieurs industriels" after a 4 years curriculum, the institutes of higher education attempted to simulate the universities. An intermediate level of education was lost. Under the pretext of the Bologna declaration, this trend is now being reinforced. This has somehow been helped by the universities themselves where the curriculum and the requirements have been progressively lowered to compensate weaknesses of students now graduating from secondary schools. • I feel sorry that the terminology of "engineer" has disappeared from the awarded degree. Ironically, it is still in use in the business schools language where the denomination "ingénieur commercial" is much valued! • In Europe, two systems coexisted: the Anglo-Saxon 3-years system and the continental 5-years system. It is my feeling that, to harmonize, the continental system has been weakened.
Belgium, French-speaking	It is very important to maintain the difference between a professional engineering education (schort cycle: 3+ 1) and the science based engineering education (3 + 2

Community	
Netherlands	Yes, I would like to propose to all departments of Civil Engineering to show a liberal policy towards students who want to join a MSc-programme at an other university, and not to worry too much about the precise content of the BSc-programme that the student has taken.
Norway	From the Norwegian viewpoint, the 3 + 2 system falls into what we already have used for quite a long time in our country. This also means that there are considerable concern about the signals of going for a 4-year first cycle in civil engineering. For our situation this will create potential problems in providing competitive graduates in the international market.
Poland	My personal reaction to the Bologna Declaration was positive from the very beginning. This resulted in the implementing of two-tier system at my faculty. The experience from 5 years of realization is positive as well. Some traditionally oriented staff members, mainly those without links with engineering practice didn't agree with me and probably still they don't agree, however their disagreement seems to fail. In my opinion the success of the education depends mainly on the human engagement not on the system. Good academic teacher with his knowledge and appropriate approach to students together with capable and well-motivated students guarantee high quality and results of education in every system. System just can facilitate, handicap or preclude the cooperation between universities particularly students and staff exchange.
Slovenia	Although the above answers were prepared by myself (Matej Fischinger) alone and not discussed by the Senate or working group for educational system, I believe that they objectively reflect the general situation and different opinions existing within the Faculty and ULJ. In addition I take the liberty to express my personal opinion in the following paragraphs. It is something wrong with the educational system at the Faculty. The length of the study, which is supposed to be 4 + 1 years at the most (4 years of courses, 0.5 year to finish all exams and 0.5 years for the diploma thesis), is approaching 8 years on the average. Less than one quarter of students enrolled, actually finish the study (any time since the beginning of the study). The image and attractiveness of the profession is quite low. The level of students enrolled is very low. Therefore, it has been long recognized that something

	should be done. But in such small, closed and inbreed institution very little can be done from inside. Therefore Bologna Declaration, although enforced from outside or just because of this, should be regarded as something positive. It is an opportunity to make positive changes (if not too much personal interest is again involved). One eventual positive change is to include more topics closely related to the profession. It should be realized that nowadays a percentage of the generation, who is studying, is much higher than some decades ago. The engineering profession is therefore not only an elite job, reserved for those with very high intellectual abilities for abstract reasoning and complex mathematical tools. There is of course still such need for highly skilled designers. But regarding the complexity of modern structures such profile should be educated on the PhD. level (or at least on the specialized Masters programs). Adequately, the professional organizations should award license for design of complex structures to such profiles only. However, many engineering jobs can be made with good knowledge of mathematics, physics and mechanics on the high school level with some additional practical engineering knowledge. This is the knowledge which can be without doubt mastered in 3 years. This is also the knowledge that most of the students enrolling today are capable to absorb. These are students, who are intimidated by the present program and simply intellectual incapable to follow it (some people may not like such direct expression, but this is simply the truth). Such students can not have any motivation, but maybe to get a "paper" recognizing them a degree. Because of the above consideration I am in favour of the 3+2 system. Additionally I am convinced that any serious masters program (including a thesis) can not be squeezed into one year only. This is in particular true for the program, which should first provide advanced basic knowledge, not offered (according to previous discussion) at the bachelor's level. I see that second cycle is the place to provide such advanced knowledge. The students are selected (or at least they should be selected) and they have chosen the courses according to their interests and abilities. Only such students can be successful in absorbing advanced basic (many people do not like expression "theoretical") knowledge needed for advanced engineering courses. However, I fully recognize that there are so many partial,

	personal and pragmatic interests that any solution should be a compromise.

LIST OF RESPONDENTS:

Country	Name	Institution
Belgium Flemish - speaking Community	Jean Berlamont	University Catholic of Leuven
Belgium French - speaking Community	Ghislain Fonder	University of Liège
Finland	Aarne Jutila	Helsinki University of Technology
Germany	Ulvi Arslan	Technical University Darmstadt
Greece 1	Pericles Latinopolous	Aristotle University of Thessaloniki
Greece 2	Marina Pantazidou	National Technical University of Athènes
Netherlands	Helena Wasmus	Technical University Delft
Norway	Eivind Bratteland	Norwegian University of Science and Technology Trondheim
Poland	Stanislaw Majewski	Silesian Technical University Gliwice
Slovenia	Matej Fischinger	University of Ljubljana

CIVIL ENGINEERING EDUCATION IN EUROPE AND THE BOLOGNA PROCESS - AN OVERVIEW IN 2004

Iacint Manoliu[1]

1. Introduction

The papers coming from 26 European countries, included in this volume, give a good and broad picture of the state in the European civil engineering education. Some obvious traits are evolving from the picture, such as diversity and richness. But the picture is far from being static. A wind of change is blowing and seriously challenging the oldest, although of perennial importance, field of engineering education.

In the first EUCEET volume, the author included a contribution entitled "*Civil Engineering in the context of the European Higher Education Area - the role of EUCEET*". [1]

The syntagme "*The European Higher Education Area*" is associated with the Bologna Declaration, issued on 19th June, 1999, in Bologna, at the end of a Conference of the European Ministers of Education from 29 European countries. The first EUCEET volume refers to the first two years of the Thematic Network Project EUCEET (European Civil Engineering Education and Training), 1998-1999 and 1999-2000, which marked, indeed, the start of what is commonly called today as the "Bologna process".

Is beyond the scope of this paper to examine the Bologna process in its complexity. Its goal is to make a presentation, as dry as possible, of the changes already brought or about to be brought by the Bologna process in European civil engineering education.

Nevertheless, to better understand the speed and the profundity of these changes, it is appropriate to proceed, first, by reminding the situation just a few years ago.

[1] Professor, Technical University of Civil Engineering of Bucharest

2. Civil engineering education in Europe in 1999-2000, prior to the Bologna process

The theme assigned to the Working Group A of the Thematic Network Project EUCEET I, chaired by the author, was: "*Curricula in European civil engineering education at undergraduate level*". The Working Group A was founded and started to function at the first EUCEET I General Assembly, held in Barcelona on 21-22 February 1999, and concluded its work at the end of the second year of the Project, on 31st August 2000. It might be said, therefore, that activities undertaken by WG A coincided in time with the first steps in the Bologna process.

A questionnaire was prepared by the WG A and circulated among various institutions offering civil engineering education in Europe, asking information on both the organization of studies and on the curriculum. A total number of 113 answers were received from 26 countries. Since data thus obtained refer to the academic year 1999-2000, the situation they depict can be rightfully qualified as being "*prior to the Bologna process*".

EUCEET I survey confirmed the existence in the civil engineering education of Europe of two basic systems:

- the continental system
- the anglo-saxon or two-tier system

The continental system is characterized by two programmes put, in most cases, in parallel

- of long duration (4,5-5-6 years);
- of short duration (3-3,5-4 years).

A variant inside the continental system is the "*tree*" or "*y*" system, in which the two programmes have a common trunk of 1-2 years.

In fig.1 are represented various types of education belonging to the *continental system*.

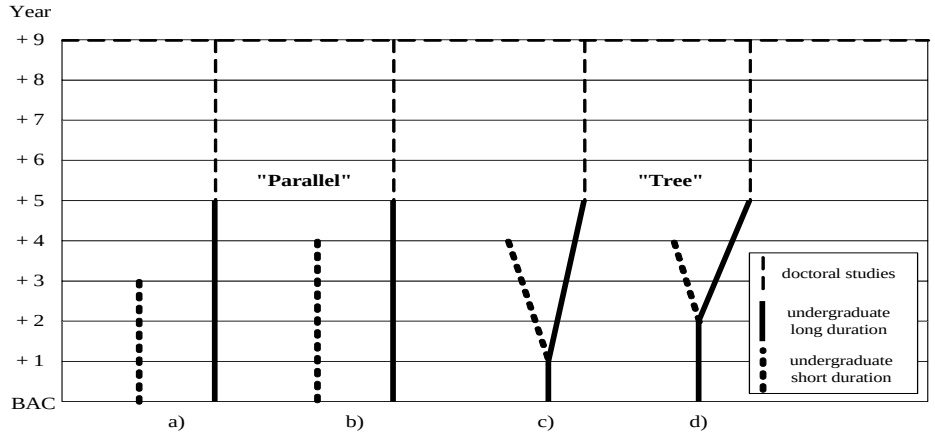

Fig. 1. The *continental* system

In the *anglo-saxon system*, the programmes are put in a ladder. The first step is of 3-4 years duration leading to a Bachelor of Engineering or Bachelor of Science degree or a Master of Engineering (MEng) degree (only when of 4 years). In Ireland, most civil engineering degrees are of 4-years duration (BEng/ BE /BAI), although there are some 5-years degree courses that build on a Diploma after 3 years. In Scotland, the BEng degree requires 4 years.

In figure 2 are represented various types of education belonging to the *anglo-saxon system*.

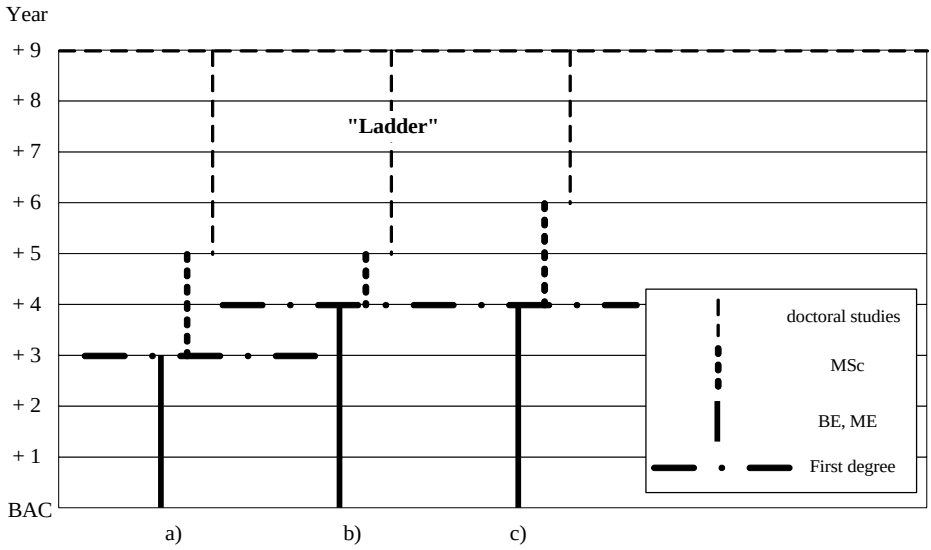

Fig. 2. The *anglo-saxon* system

The results of the survey undertaken by WG A of EUCEET I showed that in the academic year 1999-2000 in 21 out of the 26 countries civil engineering education belonged to the *continental system* (in AT, BE, BG, CZ, DE, DK, ES, FI, FR,GR, HR, HU, IT, NL, NO, PL, PT, RO, SE, SI, SK) and in 5 countries to the *anglo-saxon system* (EE, IE, LT, LV, UK).

From the 81 answers belonging to the *continental system*, 58 referred to the long duration programmes (56 of 5 years and 2 of 6 years) and 23 to the short duration programmes (16 of 4 years, 3 of 3.5 years and 4 of 3 years).

From the 32 answers belonging to the *anglo-saxon system*, 7 referred to programmes of 3 years, 24 to programmes of 4 years and 1 to a programme of 5 years.

As for the higher education institutions providing civil engineering education in Europe, they belong, according to the terminology commonly accepted at the level of the European Commission, to two distinct sectors:

- *university sector*
- *non-university sector*

In the *university sector* are found *Universities, Technical Universities* and (only in France) *Grands Ecoles*.

There is a much larger diversity of institutions in the *non-university sector*, such as: *Fachhochschulen* (AT, DE), *Hogescholen* (NL, BE-Flanders), *Instituts Superieur Industriels* (BE-Wallonie), *Engineering Colleges* (DK), *Polytechnics* (FI), *Technological Education Institutes* - TEI (GR), *Technical Colleges* (HU, IE), *Polytechnic Institutes* (PT), *University Colleges* (NO, RO, SE), *Polytechnic Schools* (ES) etc.

All Higher Education Institutions belonging to the *non-university* sector were aimed, in the pre-Bologna phase, to provide short duration, professionally oriented programmes, of 3-3.5 or max 4 years duration.

3. The Bologna process - a chronology

3.1 Sorbonne, May 25th, 1998

In fact, the Bologna process was triggered one year before Bologna. Ministers of Education of France, Italy, United Kingdom and Germany signed in Paris, on the occasion of the 800th anniversary of the Sorbonne, on 25th May 1998, the "*Sorbonne Declaration on harmonization of the architecture of the European higher education system*". The *Sorbonne Declaration* stated that a two-cycle system "*seems to emerge*" and "*should be recognized for international comparison and equivalence*". It mentioned also the need to have first cycle degrees which are "*internationally recognized*", as "*an appropriate level of qualification*" and a graduate cycle with "*a shorter master's degree and a longer doctor's degree*", with possibilities to transfer from one to the other.

One can consider, without any doubt, that the basic requirement of the Bologna process, *the adoption of a system based on two main cycles, undergraduate and graduate*, had its roots in the Sorbonne Declaration.

3.2 Bologna, June 19th, 1999

In "*The Bologna Declaration on the European Higher Education Area*" signed by Ministers of Education from 29 countries: 15 EU countries (AT, BE, DE, DK, FI, FR, GR, IE, IT, LU, NL, PT, ES, SE, UK); 2 EEA countries (IS, NO) 11 accession and candidate countries (BG, CZ, EE, HU, LV,LT, PL, RO,SK, SI, MT) and Switzerland, six main action lines were defined:

1. *Adoption of a system of easily readable and comparable degrees*
2. *Adoption of a system essentially based on two cycles*
3. *Establishment of a system of credits*
4. *Promotion of mobility*
5. *Promotion of European co-operation in quality assurance*
6. *Promotion of the European dimension in higher education*

3.3 Prague, May 19th, 2001

The Communiqué of the Conference of Ministers of Higher Education in Prague "*Towards the European Higher Education Area*" had 33 signatory countries (29 Bologna signatory countries, plus Cyprus, Turkey, Liechtenstein, Croatia).

To the 6 action lines from Bologna, 3 more action lines were added:

7. *Lifelong learning*
8. *Higher education institutions and students*
9. *Promoting the attractiveness of the European Higher Education Area*

3.4 Berlin, September 19th, 2003

Number of signatory countries of the Communiqué "*Realising the European Higher Education Area*" reached 40: 33 Prague signatory countries, plus 4 Tempus-Cards (Albania, Bosnia-Herzegovina, FYR Macedonia, Serbia-Montenegro), 1 Tempus Tacis - the Russian Federation; and Andorra and The Holly See.

To the 9 Bologna and Prague action lines, one more was added:

10. *Doctoral level (third cycle) included in the Bologna process*

Other important ideas in the Berlin document:

- commitment to having started the implementation of the two cycle system by 2005

- commitment for the design of an "Overarching Qualification Framework" for the European Higher Education Area.

3.5 Next step: Bergen, 2005

It is anticipated that the Bologna process will expand further to the East, including as potential signatories, at the conclusion of the Conference in Bergen in the summer of 2005, 6 countries participating in Tempus Tacis, which are party to the European Cultural Convention: Armenia, Azerbaijan, Belarus, Georgia, Moldova, Ukraine. In addition, 2 small European countries are expected to be represented at the 2005 Conference of European Ministers of Education: Monaco and San Marino, making the number of signatory countries to increase from 40 to 48.

3.6 Not only Conferences of Ministers of Education

The Bologna process does not mean only the Conferences of Ministers of Education, convened every two years since June 1999, no matter how substantial and rich in consequences are the Declarations or Communiqués they produce, but also a long chain of meetings, seminars, workshops, in which are engaged various stakeholders. The most notable events, undoubtedly, were the

Conventions of the European Higher Education Institutions organized by the *European Universities Associations - EUA*. The first EUA Convention took place in Salamanca in March 2001, in preparation for the Prague Conference, the second one in Graz, in May 2003, in preparation for the Berlin Conference, the third one will be hosted in 2005 by Glasgow, in preparation for the Bergen Conference.

4. The Bologna process - why and how

In a rather limited period of time, changes brought by the Bologna process are significant.

To better understand why and how these changes took place, it is worth to quickly review some aspects of the process.

4.1 Compatibility with a world wide spread system, a prerequisite for enhancing the competitiveness of European higher education

In a comprehensive document presented in Bologna on June 18th, 1999, in the eve of the meeting of Ministers of Education [2], and brought to a final version on 18th August 1999, dr. Guy Haug, an outstanding expert on European higher education matters, made the following plea in favour of the introduction of two-cycle system in Europe:

"*What the British and the US system, as well as those of the numerous countries which took inspiration from them (in the Commonwealth, Latin America and Asia and more recently in former communist countries) all share in common is a basic structure differentiating undergraduate and (post) graduate studies. Their definition, organization, content, respective role and size may be very different according to country and subject; the line of divide between them may be blurred and their articulation may be shifting. But the broad distinction between an undergraduate and a (post) graduate level is so widespread around the world that not also having it would make continental Europe an ever more isolated island of relative incompatibility. The Sorbonne Declaration was more than justified to promote a move in this direction*".

Another source for the lack of competitiveness of many European higher education institutions, resides in the long duration of studies, put into evidence by the comparison between the legal (formal, nominal) duration of studies and the actual one. In the EUCEET WG A survey, the percentage of the overrun period, as a mean value of received answers for different programmes, varied between 5% and almost 40%, but for some countries the common overrun period was quite high (45% for Italy).

According to dr. Guy Haug [2], amongst the negative consequences of this phenomenon are:

"- *high drop out rates, especially in the first years, as shown in surveys carried out by OECD;*

- late entry on the labour market (at the age of 28 or even 30 years), which is increasingly seen as a competitive disadvantage in the labour market, when graduates from other systems start their career, at age of 22 or 23, when obsolescence of knowledge is quicker than ever and when employers see time management as an indicator of future performance;

- lack of attractiveness for foreign students;

- unnecessarily high costs for students/ families and public resources;

- undemocratic aspect of systems where the sheer length of studies may discourage in particular students from less favoured social backgrounds and constitutes a formidable obstacle for lifelong learners;

- additional difficulties to attract students to such areas as science and technology, where enrolments fell in many countries, resulting in foreseeable skill shortages in key economic sectors."

Governmental push towards the reduction of the real duration of studies and, hence, of the costs, a major trend noticed in recent years, could explain the growing attractiveness of models featuring shorter first qualifications followed by postgraduate studies for a smaller number of students.

4.2 The general needs of higher education vs. the specific needs of engineering education

The action line 2 in the Bologna Declaration, defining the objective to promote the adoption of a two-cycle system of higher education, is the one that poses greatest challenge to engineering education.

Indeed as shown at p.3, in most European countries "*short duration programmes*" (3 ... 4 years), in which the content is more application oriented, developed in parallel, and were usually provided by separate institutions, with the "*long duration programmes*" (4.5-5-6 year), characterized by a strong theoretical base and a marked research orientation. The clear differences in content and orientation between the two types of programmes explain why the requirement for a transfer from the "short" to the "long" programme asked explicitly for additional time to be spent in order to correct the deficiencies in basic knowledge, i.e. to overcome the handicap of a weak theoretical background. This could not be the case for other fields, where going from "short" to "long" programmes of studies could require only for the time to be made up.

Asking if *the engineering education is concerned*, Prof. Torbjorn Hedberg, former SEFI President, made the following pertinent comments on the Bologna Declaration [4]:

"The Declaration talks about higher education and universities without making clear whether the intention is that it should be applied to all kinds post-secondary education or if there are some sectors that could be excluded. The authors of the Declaration seem, however, primarily to have had the general non-professional university education in mind - the classical faculties of arts,

letters and science - and not professional education, such as law, medicine, pharmaceutics, teacher training and engineering. As it turns out, nobody seems to think that medical studies should be reorganized according to the model proposed by the Declaration. The same arguments as for medicine also apply to engineering education ..."

4.3 A common misunderstanding: Bologna Declaration is NOT for a 3-5-8 system

Unlike the Sorbonne Declaration, where the call for a two-cycle system was made, but without an indication about the duration, the Bologna Declaration specified that the first cycle should be *at least* 3 years.

However, replacing on purpose "*minimum of three years*" with "*exactly three years*", some academic circles capitalized on the assertion found in the "*Attali report*" to the French government, about the emergence of a single European model of higher education based on a sequence of studies and degrees of 3-5-8 years, with 3 years for a Bachelor's degree, another 2 years for a Master's and 3 more for a PhD. On this model, Guy Haug [2] had the following comments:

"No significant convergence toward a 3-5-8 model was found. Whether traditional or newly introduced, bachelor type degrees require 3 to 4 years, and many European countries without bachelors have first degrees in 4 years; there is however a high degree of convergence towards a duration of about 5 years for master-level studies; but there is no 8-year standard duration for doctoral degrees. In addition, whereas the U.K., the US and most countries in the world-except in continental Europe - apply two-tier (undergraduate - postgraduate) systems, the length of studies and the degree structures vary considerably within and between these countries, and duration tends to be expressed in academic credits rather than in years".

4.4 The "anglo-saxon" model and the Bologna Declaration

The "anglo-saxon" system, such as it is in UK and Ireland represents obviously, a two cycles or two-tier system. However, there a large variety of first degree programmes offered by universties of the two countries, with differences related not only to the duration but also to the profile of the curriculum. Revealing these differences, the Engineering Synergy Group for Tuning [5], observed: "*The Bachelors degrees, although like a short degree in length, often have an underlying theoretical content closer in concept, even if not in quantity, to that of the continental European long-cycle degrees. However, the course of study is quite rigidly controlled, and most students graduate within the normal study duration. The picture is confused by the fact that there are also many short cycle degrees, with the title Bachelor, which are*

closer in content to practically oriented short-cycle of other European countries".

The diversity of the undergraduate programmes offered by U.K. universities implementing the two-tier system of engineering education finds, nevertheless, a correspondence in the routes for professional registrations established by the SARTOR III recommendation of the Engineering Council in collaboration with engineering professional institutions, including Institution of Civil Engineers and Institution of Structural Engineers. The "*educational base*" required to become "*Chartered Engineers*" is either a 4-year Master of Engineering (MEng) degree or a 3-year Bachelor of Engineering (with Honors) plus an additional one-year of further learning (named "*Matching sector*"). The "*educational base*" required to become "*Incorporated Engineer*" is a 3-year Bachelor of Engineering degree.

4.5 The BA-MA-DO structures or the full implementation of the Bologna action lines 2 and 10

The three tiers (cycles, levels) which result from combining action lines 2 and 10 of the Bologna process, lead to what is now recognized across Europe as BA-MA-DO structure, shown in fig. 3.

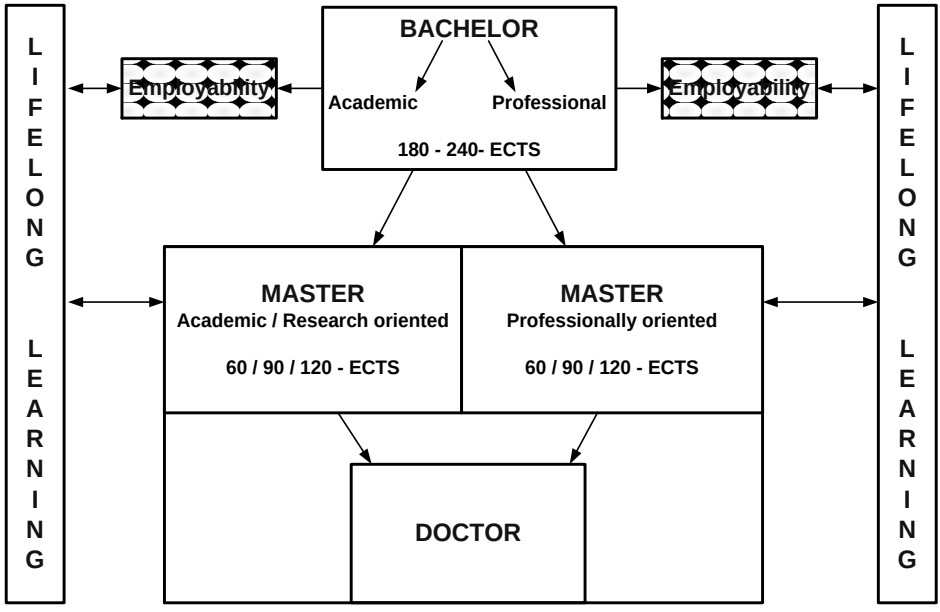

Fig. 3. The BA-MA-DO structure.

Knowing that one academic year corresponds to 60 ECTS credits, a Bachelor degree requires 3 to 4 years and a Master degree 1 to 2 years. As for the doctoral studies, having as main objective to elaborate and defend a doctoral

thesis, they require usually 3 to 4 years (full time work) and are not always credit-rated.

4.6 First, second and third cycle degrees in engineering education

The meaning of a doctor's degree is quite straightforward. Instead, there is no general use of the terms Bachelor and Master, even when the two-tier system is introduced. Therefore, is more realistic to speak in terms of degrees: first cycle degree, second cycle degree and third cycle degree.

Since the implementation over all Europe of a BA-MA-DO structure in engineering education is a rather long term objective, is better to use the scheme in fig.4, where, in fact, the continental system (fig. 1) and the two-tier system (fig. 2) were put together. The long one-tier study programmes of 5 years are named *"integrated"* programmes, leading straight to a Master-level degree.

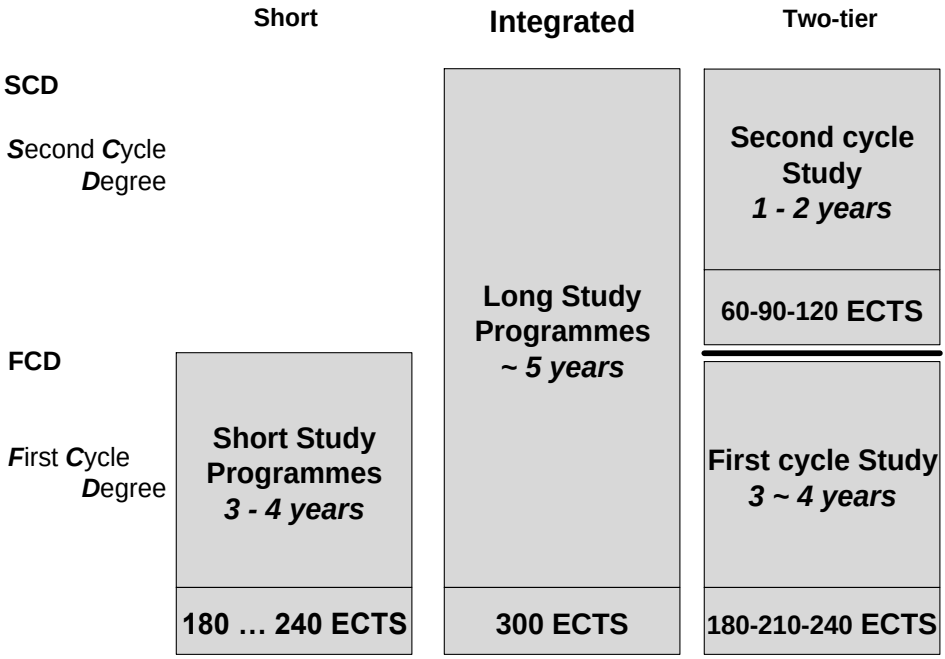

Fig. 4.

4.7 The Bologna process and the continental system of engineering education

As far as engineering education is concerned, it is obvious that the continental system is the one to be most affected by the Bologna process. As shown at p.2, the system comprises long duration programmes, more scientifically oriented, and short duration programmes, more application or vocationally oriented. Both types of programmes must change when a two-tier

system is adopted. Different ways in which such changes occurred or will occur and their implications will be discussed in the chapter 5.

4.8 Recommendations of CESAER and SEFI

CESAER (The Conference of European Schools for Advanced Engineering Education and Research) and SEFI (The European Society for Engineering Education) organised jointly in February 2003 a seminar at Helsinki University of Technology concluded with a "*Communication of CESAER and SEFI on the Bologna Declaration*" [5].

There are 8 recommendations of CESAER and SEFI in this Communication, from which the first three are the most relevant for this discussion:

1. *The special role and features of engineering must be taken into account in the Bologna Process.*
2. *In the scientifically oriented programmes the students should normally be educated to the level of the second degree. There must continue to be provision for an integrated route to second cycle Master level.*
3. *The specific qualities of the presently existing application oriented first cycle degree must be recognized and safe-guarded, with bridges to second cycle programmes being provided.*

4.9 EUCEET position on the implementation of the Bologna Declaration in civil engineering education

At a meeting of the Management Committee of EUCEET II which took place on 19th September 2003 in Ciudad Real, was raised for the first time the opportunity of adopting a *position statement* on the implementation of the Bologna Declaration in civil engineering education. The general lines of such a statement were defined and a draft was circulated among the MC members in the months following the Ciudad Real meeting.

At the next Management Committee meeting, held in Paris on 16th February 2004, the following statement was adopted with clear majority:

"EUCEET is supporting and encouraging the application of the idea of two-tier education system in Civil Engineering as suggested in Bologna Declaration.

The adoption of a system based on two main cycles, whenever takes place, must take into consideration the specificity of the civil engineering education and profession. Civil engineers perform and provide services to the community with significant implications for public safety and health. As a consequence, the first cycle in civil engineering education shall be relevant to the labor market and shall ensure graduates with a level of competences tuned to the substantial responsibilities of the profession. A duration of 4 years (or the equivalent of 240 ECTS credits) seems to fit that purpose.

A 4-year duration of the first cycle in civil engineering education is aimed also at facilitating transnational recognition of degrees and professional mobility of European civil engineers. In this respect, due consideration has to be given to the fact that various alliances between engineering organizations, such as Washington Accord and the Engineers Mobility Forum, have established that the required academic component of the qualification of a professional engineer should be 4 or 5 years full time study in University.

The existing integrated 5-year curricula in civil engineering, leading straight to a Master's degree, is also compatible with the letter and spirit of the Bologna Declaration and with the vision of a European Higher Education Area."

4.10 A clear rejection of the Bologna action line 2 coming from Greece

In the opening session of the First General Assembly of EUCEET II, on 20th February 2003, the then Rector of the National Technical University of Athens, Prof. Themistocles Xanthopoulos, gave a talk on "*Market Globalization, European University Education and the Bologna Declaration: Background Policy Analysis, Positions and Proposals*" [6] in which the position in Greece regarding the Bologna Declaration was clearly expressed. Here are some opinions regarding the action line 2:

*"Any splitting of the existing structure into two cycles, the undergraduate and the postgraduate, **de facto** downgrades the undergraduate cycle to that of the Schools of Higher Professional or Vocational Training, given that it is not possible to equip with substantial professional skills in the short period of this cycle without at the same time the shrinkage of the background scientific knowledge, that is without the actual betrayal of the scientific substance of the University degree.*

It is, besides, at least unreasonable to claim that it is possible to decrease the duration of studies without downgrading their university nature, at a time of pressing demands, both from students and academic staff, for an increase of the duration of university studies due to the explosive increase of knowledge in the applied sciences and technology, as well as the recognition, by the relevant professional bodies, of the inadequacies of the Bachelor's degree, as a university diploma, in the labour market.

***We reject explicitly the main objective of the Bologna Declaration, namely the compulsory and universal division of all University courses into two cycles** ..."*

5. Civil engineering education in Europe in 2003 - 2004, four years after Bologna

Comparing the situation in the academic year 2003-2004, as revealed by the report included in this volume, to the one existing in 1999-2000, presented

in the First EUCEET Volume [1], one can realize how numerous and important are changes which already took place or are going to take place in the near future.

Some comments are necessary on the changes brought by the implementation of the action line 2 of the Bologna Declaration, but before proceeding it is worth to remind in full extent the line 2:

"Adoption of a system of easily readable and comparable degrees, also through the implementation of the Diploma Supplement, in order to promote European citizens employability and the international competitiveness of the European higher education system. Adoption of a system essentially based on two main cycles, undergraduate and graduate. Access to the second cycle shall require successful completion of first cycle studies, lasting a maximum of three years. The degree awarded after the first cycle shall be relevant to the European labour market as an appropriate level of qualification. The second cycle should lead to the master and/ or doctorate degrees as in many European countries".

Table 1 presents the evolution of degree structures at university or university like institutions providing civil engineering education. A clear trend, form one-tier to two-tier, can be observed in the degree structures at universities. Since 1999-2000, the integrated, one-tier programmes leading straight to a degree equivalent to a Master degree, have been already replaced by two-tier programmes in the Czech Republic, Netherlands and Slovakia, but a similar move is expected in the near future in many other countries.

Data in table 1 are transposed in three maps showing the distribution of systems of civil engineering education in the *university sector* of Europe at three moments: 1999 - 2000 (fig.5), 2003 - 2004 (fig.6) and 2005 and beyond (fig.7).

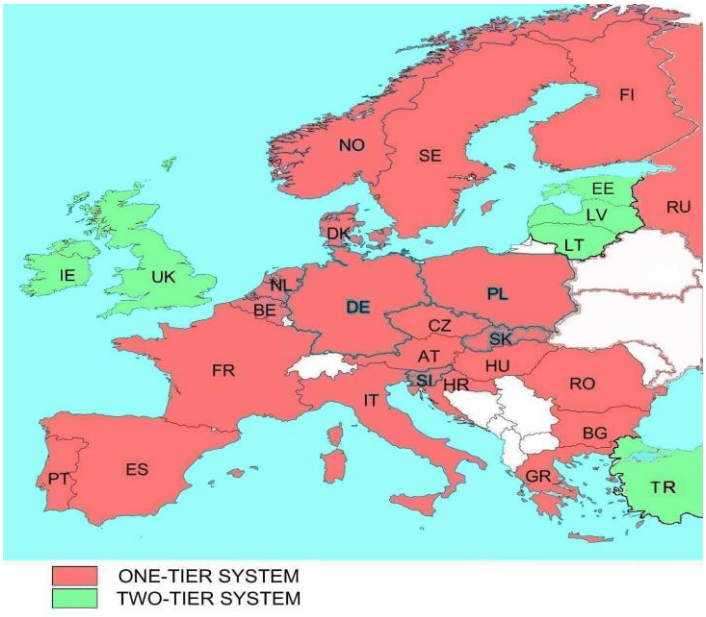

Fig. 5.
1999 – 2000

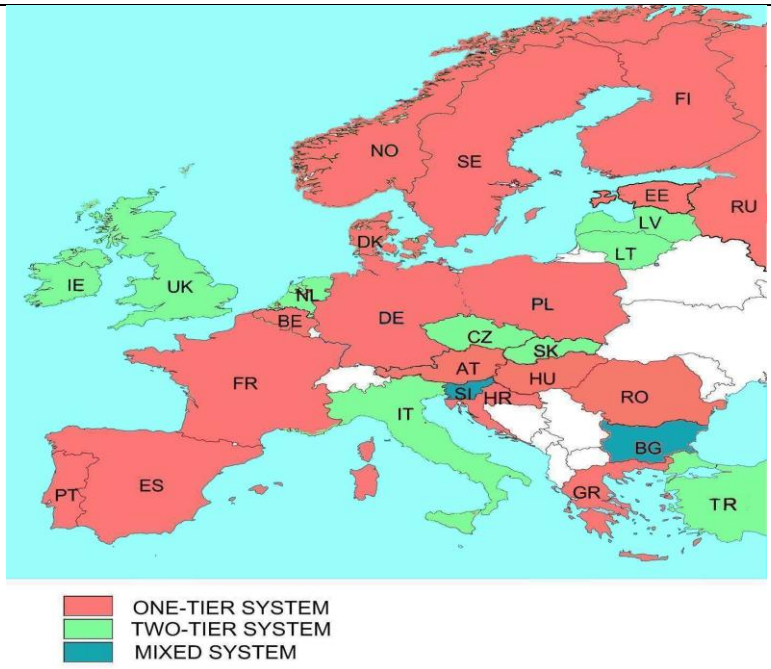

Fig. 6.
2003 - 2004

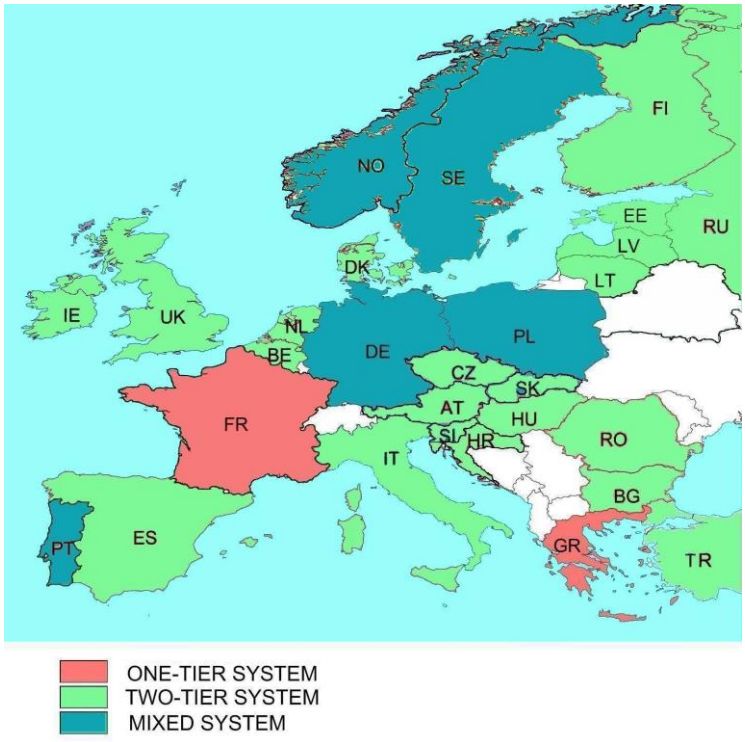

Fig. 7.
2005 and beyond

Table 1

Degree structures at universities

Country	1999 / 2000		2003 / 2004		foreseen for 2005 and beyond	
	One-tier	Two-tier	One-tier	Two-tier	One-tier	Two-tier
AT Austria	X		X			X
BE Belgium	X		X			X
BE Wall Belgium	X		X			X
BG Bulgaria	X		X[1]	X	X[1]	X
CZ Czech Republic	X			X		X
DE Germany	X		X		X[2]	X
DK Denmark	X		X			X
EE Estonia		X		X		X
ES Spain	X		X			X
FI Finland	X		X			X
FR France	X		X		X	
GR Greece	X		X		X	
HU Hungary	X		X			X
IE Ireland		X		X		X
IT Italy	X			X		X
LT Lithuania		X		X		X
LV Latvia		X		X		X
NL Netherlands	X			X		X
NO Norway	X				X[3]	X
PL Poland	X		X		X[4]	X[4]
PT Portugal	X		X		X[5]	X
RO Romania	X		X			X
RU Russia	X		X			X
SE Sweden	X				X	X
SI Slovenia	X		X			X
SK Slovakia	X			X		X
TK Turkey		X		X		X
UK United Kingdom		X		X		X

[1] Only at the University of Architecture, Civil Engineering and Geodesy, Sofia
[2] At certain Technical Universities
[3] Only at the Norwegian University of Sciece and Technology, Trondhein
[4] At certain Technical Universities
[5] At certain Universities

5.1 Shift from the integrated programmes to the two-tier programmes

5.1.1 The 3+2 formula

Table 2 presents a synthesis of the formulas adopted (or to be adopted) when the change from the one-tier to two-tier programmes in the degree structures of the universities is made.

As one can observe, the solution preferred in most cases is to split the existing 5-year programme by introducing a Bachelor degree after the first 3 years.

One immediate question to be raised is in which way the newly created 3-year degree will fulfil the Bologna requirement of being "*relevant to the European labour market as an appropriate level of qualification*".

Tabel 2

Shift from the INTEGRATED programmes to the TWO-TIER programmes

Country	Formula adopted (or to be adopted)						New Bachelor's degree	
	3 + 1.5	3+2	3.5 + 1.5	4 + 1	4 + 1.5	4 + 2	being in itself "relevant to the European labour market"	primarily a break or pivot points suitable for mobility
BE Belgium		X						X
DK Denmark		X						X
DE Germany (TU)		X						X
FI Finland		X						X
NL Netherlands		X						X
SE Sweden	X							X
IT Italy		X						X
CZ Czech Republic					X	X[1]	X	
LI Lithuania						X		
LV Latvia						X		
PL Poland			X[2]				X	
				X[2]			X	
					X[2]		X	
RO Romania					X		X	
SK Slovakia		X						X

[1] Only for the specialization "Civil Engineering and Architecture" at CTU Prague

[2] At certain Technical Universities

It appears that, in almost all cases when the formula 3+2 is adopted, the new Bachelor's degree is considered primarily as a **break** or **pivot** point, suitable for mobility and to less extent for employability. On the other hand, there seems to be an implicit assumption that all, or almost all, of the students getting the diploma delivered after 3 years, will continue studies at the same university, until the 3+2 programme is completed, in which case the employability matter is of no relevance.

5.1.2 The 4+... formulas

A different approach consists in building a Bachelor's degree being in itself "*relevant to the European labour market*", as required by Bologna.

In Latvia and Lithuania, a 4-year duration for the first cycle degree and a 2-year duration for the second cycle were adopted long before the Bologna process started.

In the Czech Republic, both the short duration programmes of 3-4 years and the long duration programmes of 5-5.5 year ceased to be offered beginning with 2003-2004, being replaced by a two-tier programme of 4+1.5 years.

In Romania, a 4+1.5 programme will be introduced starting with 2005-2006.

A preference for a 4 years duration for the first cycle in the university sector seems to prevail also in Hungary, Spain and Portugal.

Not only by duration, but also by the balance between the academic content and the skills orientation, the 4-years programmes offer to the graduates an option to enter the labour market. As a consequence, only a part of the graduates of the first cycle are expected to enrol for the second cycle.

One should mention, however, that *4+1.5 or 4+2 formulas are possible only when, by law or by other means, the cumulated duration of the first two cycles is not limited to 5 years.*

5.1.3 Difficulties in implementing the two-tier model

In a private communication with a distinguished representative of a German Technical University [7], the author has received the following message which expresses in a concise and clear manner the dilemmas faced by institutions belonging to the university sector in Germany, when trying to implement the two-tier system:

"*The Standing Committee of German speaking Civil Engineering Faculties at Universities has serious problems with accepting the political request of producing a professionally qualified Bachelor after only 3 years of study.*

On the other hand, 4 years of study for a B.Sc. are not feasible because in some German States a Dipl.-Ing. degree takes only 4 years plus Diploma thesis. In others it takes 4 and a half plus thesis.

So, with 4 years for a B.Sc. the period of specialization would be zero or by far too short. At Fachhochschulen, it takes 3 years of courses plus half a

year of practical work plus half a year for the diploma thesis to get a Dipl.Ing (FH) degree, which is well accepted by the German construction industry.

However, if this degree is to be equivalent to a B.Sc. at university level, according to the political concept, you would be entitled to enter a Master program at a University without sufficient theoretical background knowledge.

These are the major objections against the two-tier model in Germany".

5.1.4 The process can be reversible

A reform as complex and profound as the one taking place in European higher education could be neither an one way nor an irreversible process. Corrections and adjustments are necessary before reaching the planned outcomes. An example to illustrate this assertion is coming from Italy, the very first country to respond to the call of the Bologna Declaration for the adoption of a system based on two main cycles. By a law published in January 2000, a two-tier system was introduced in Italy based on the 3+2 model, with a three year course (180 credits) for a "*Laurea*" degree, followed by a two-year specialization course (120 credits) for a "*Laurea specialistica*" degree. A paper included in this volume describes the transition from the old system (in which two programmes, of 3 years and of 5 years, were put in parallel) to the new one [8].

Several years after the introduction of the new system, an adjustment is under way and concerns the first cycle. There will be one curriculum for the first year of study, after which a differentiation will be made between two distinct programmes: one more practically oriented, the other one more theoretically oriented. It can be assumed that only the graduates of the more theoretically oriented programme will have access to the second cycle. It results that the "*Y*" system adopted for the first cycle will, in fact, generate degree courses equivalent to "*Academic Bachelor*" and to "*Professional Bachelor*". The two-tier system is preserved, but employability is enhanced for the graduates of the first cycle who will make the option for the professional route. At the same time, considering that most, if not all, of the graduates of the "*academic bachelor*" will pursue studies for the last two years, it will be possible to design a better curriculum for the integrated route, which in fact will be also an "Y" route (1+4).

Another example of reversibility of the process is provided by Estonia. In 1995, the integrated programme of 5 years was replaced by a two-tier programme 4+2. By a law applied starting with the academic year 2002-2003, the two-tier system changed to 3+2 for all engineering fields, **except** civil engineering where only the integrated route of 5 years was reintroduced. The explanation can be found in the paper on civil engineering education in Estonia included in this volume [9], where is stated that "*the former educational system was not capable of educating engineers with appropriate knowledge and expertise in the field of civil engineering*".

5.1.5 Co-existence of the two systems

It is true that, due to its very general character, the Bologna Declaration did not make any reference to any specific field of higher education. The same applies to Communiqués from Prague and Berlin. When the implementation of the action line 2 was at stake, it was somehow self-understood that the so-called "*regulated professions*" at European level, such as medicine, veterinary medicine and architecture, could not make the object of a switch from the integrated programmes of 5-6 years to the two-tier programmes.

Since the engineering profession is not, unfortunately, a regulated profession at European level, it could not be left outside from the wave of changes brought by the Bologna process. As a consequence, as was clearly shown in previous paragraphs, the two-tier system is continuously spreading.

However, it was recognized at the early stage of the Bologna Process that "*in a small number of disciplines or at a small number of institutions, longer curricula leading straight to a master degree could be accommodated*" [10]. In other words, the integrated degree courses are compatible with the Bologna spirit and should not be replaced unless there are serious reasons in favour of such a replacement.

Among the countries where changes in the higher education system occurred as a consequence of the Bologna Process, there is at present at least one example of coexistence between the one-tier and the two-tier systems, offered by Norway or, more specifically, by the Norwegian University of Science and Technology, the only Norwegian institution with a broad offer in engineering [11], which continues to run integrated 5-year study programmes leading straight to a Master degree while, at the same time, admitting a limited number of students with a 3-year Bachelor degree (obtained elsewhere) for the last two years.

In Germany, where the legal frame for the adoption of a two-tier system was created before Bologna, the coexistence of existing integrated 5-year programmes (at Technical Universities or Universities) or 4-year programmes (at Fachhochschulen), with new degree courses for Bachelor and Master is for the time being possible.

Other examples of coexistence are coming from countries where the Ba-Ma system was introduced independent from the Bologna Process.

In Latvia [12], a two-tier system of 3 years for "*Academical Bachelor*", followed by 2 years for "*Academical Master*" coexists since 1995 with a "*Bachelor professional study programme*" of 4.5 years duration conferring the qualification of civil engineer. During this coexistence period, the "*Bachelor professional*" of 4.5 years proved to be much more attractive than the two-tier programme of 3+2, and the explanation cannot be separated from the recognition given by the labour market to the graduates of the integrated 4.5 years programme.

A situation somehow similar is in Russia [13], where a two-tier Ba-Ma route of 4+2 years, newly introduced in 1992, coexists with the integrated 5-year programme leading to "*Diploma - Engineer*" degree. Altogether, the structure is of Y type since the first two years of the Bachelor degree and of the "*Diploma - Engineer*" degree are common. The most popular proved to be the "*Diploma-Engineer*" route which, unlike the Bachelor route, was known and accepted by the employers.

One lesson can be drawn from the two last examples when both types of programmes, two-tier and one-tier, are present in the offer of the university: the factor which seems to control the option of the enrolees is the preference given by the employers to the programmes followed by the graduates, which, not surprisingly, goes towards the integrated programmes.

5.1.6 Not one, but a diversity of "Bachelor's" as a first cycle degree

Implementation of the Bologna action line 2 in the university sector and in the non-university sector as well, leads unavoidably to a diversity of first cycle degrees, named or not as Bachelor's degrees.

Several of such degrees were already referred to in some of the previous paragraphs.

- the more or less purely "*academic Bachelor*", in the 3+2 structure adopted by research universities, serving mainly as a "*stepping-stone*"
- the Bachelor "*being in itself relevant to the European labour market*" in the 4+... structures

In addition to these "*new Bachelors*", appearing as a result of the splitting of the integrated programmes, there are many others offered by the non-university sector, having a well established tradition and programmes recognized by the profession. In Denmark, for instance, a Bachelor degree after 3.5 years offered both in the non-university sector (at University Colleges) and in the university sector, is accepted for professional recognition by the Society of Danish Engineers, which is not yet case for the 3-year Bachelor in the 3+2 scheme introduced after Bologna by the universities.

Similar comparisons between existing Bachelor or Bachelor-type degrees, offered by the non-university sector and the new Bachelors created in the university sector, can be made in all countries where the two-tier programme of 3+2 is replacing the one-tier, 5-year programme, such as Netherlands, Belgium, Finland etc.

But even in a country such as England where, since the transformation of Polytechnics in Universities, the higher education system ceased to be binary and became an unitary one, there is a marked diversity of Bachelor programmes of equal duration (3 years), due to the inherent and great differences in the institutions providing the degree courses.

The conclusion is that one cannot speak in general about a "*First cycle degree*", be it called Bachelor or whatever, but only in the context of a given educational structure.

For the time being it can be stated that the large majority of bachelor degree course offered by higher engineering education institutions in Europe, both in the university sector and in the non-university sector, can be recognized as belonging to one of the following two categories:

- professional bachelor, more application oriented
- academic bachelor, more theoretical oriented

5.1.7 At Master's level, the picture is more complex

In first place, there are Master's or equivalent degrees provided in the continental system as the result of 5-year integrated programmes offered by universities or of the 2+3 type offered at the Grandes Ecoles in France. They can be named "*Integrated Masters*".

There are, of course, existing Master degrees offered in countries with centuries old traditions in the anglo-saxon system (UK, Ireland) or in countries in which the system was introduced in the early 90's (Baltic countries). They can be named "*Consecutive Masters*". To the same category belong the Masters resulting from the process of splitting the integrated programmes adopting formulas such as 3+2; 3,5+1,5; 4+1,5 or 4+2.

As for the *nature* of these Master's degrees, they can be *Research Masters* of *Professional Masters* in one specific field, but also "*Conversion Masters*" embracing two distinct fields, such as engineering + economics, engineering + law etc.

Programmes leading to Master's degrees can be organized in co-operation by several universities. These are "*Joint Masters*". A recent development in that direction is the "*Erasmus Mundus*" programme launched by the European Commission in December 2003 and whose implementation will start in the academic year 2004-2005. The purpose of the programme is not the creation of new Master courses but to provide support for existing courses to get the label "*Erasmus Mundus Master Course*". The consortium of institutions to apply for getting funds from the Erasmus Mundus programme should comprise at least 3 higher education institutions from 3 different countries, from which at least two Member States of the European Union. Graduate students participating in the programme, should study to at least two H.E. institutions and make use of at least two languages.

5.1.8 Several problems related to the second degree

There are a number of problems concerning in particular the new Master's degree courses.

One such problem is the *access* to the second cycle. The solutions can be very diverse, depending in first place on the type of the first degree and of

regulations at country or university level. In the university sector, in situations in which the first cycle is seen as a break or pivot point suitable for mobility (in the 3+2 formula), it seems that the second cycle will be open for all candidates holding a *relevant Bachelor diploma*. In this context *relevant* means a diploma issued by the same university of by an institution of equivalent status.

The situation could be different when the first cycle, with a 4-year duration, or 240 credits (in a 4 + ... formula), is considered of being in itself "*relevant to the job market*". In such cases, it is likely that the access to the second cycle will be based on some criteria (entrance examination, professional record at the end of the first cycle, etc).

Universities will certainly set up their own rules when faced to the demands of graduates of a first cycle in an institution belonging to the non-university sector to pursue a second cycle and to get a Master's degree at the university.

The problem of *access* is intricately related to the one of *funding*. There are strong reasons to believe that behind the support given by governmental authorities to the Bologna process was the open or hidden conviction that, somehow, economies for the funding of higher education in the country will be possible. And ways of getting such result could be the reduction in the number of students enroled for the second cycle degree, the reduction of the real duration of studies to their official length, or the extension of the gratuity of higher education only to the level of the first degree.

5.1.9 An increasingly blurred line of divide between the university and non-university sector in European engineering education

A visible and significant outcome of the Bologna process developed so far is the fact that the line of divide between the university and non-university system is blurring. In what follows there are a few examples in support of this assertion.

A novelty which the Bologna process is bringing about in civil engineering education is the extension of the Master's degree providers to the non-university sector.

The paper on civil engineering education in Norway [11], mentions the name of two University Colleges which are already providing education at Master level. Very probably, a similar pattern will be followed in other countries by institutions belonging to the non-university sector.

In Portugal, as shown in the paper included in this volume[14], while the Universities are not yet decided on the way in which to move to the two-tier system, the Polytechnic Institutes were authorised by law to offer by a 2-tier programme, resulting altogether in a "*Licenciatura degree*".

In Germany, even before Bologna, the Education Framework Law introduced in 1998 opened not only to Universities, but to the Fachhochschulen as well, the possibility to offer Bachelor and Master degree courses.

6. The reaction of the industry

A process of the extent and complexity as the Bologna process should interest other stakeholders besides the academics. For instance, the industry.

A first observation to make is that in most countries there is no a framework for a proper consultation and participation of the industry regarding the changes in the higher education.

Under such circumstances, it was hard to expect a reaction from the industry. On the other hand, too little time passed since the occurrence of changes, where they do occurred so far, to enable the industry to make a judgement.

Skepticism seems to be the word to best characterize the reaction of the industry towards the extension of the cycles system in engineering education in Europe. And "*wait and see*" attitude, until the cohorts of graduates of the new programmes will join the industry.

7. The reaction of the professional associations

Professional associations which are involved in the professional recognition of engineering graduates have strong reasons to watch the Bologna process.

In few countries, however, a public and official stance was taken. One such exception is the Institution of Engineers of Ireland (IEI) which launched in November 2003 a proposal called: entitled "*A New Structure for Engineering Education in Ireland - Implementation of the Bologna Declaration*" [15]. A five-year integrated Master degree is proposed, with a Bachelor degree (of "pivot" type) at the end of year three. Another proposal is for a three year engineering technology degree to run parallel, with possibility of transfer from engineering technology bachelor degree to year four of engineering master degree only on completion of bridging studies including mathematics. As one can recognize, in the vision of IEI the implementation of the Bologna Declaration means a move from the anglo-saxon system to the continental system, with programmes put in parallel.

In Italy, the Italian Engineering Board (Consiglio degli Ingegneri) was never in favour of a 3-year first level degree. However, a law allows holders of such a title to apply for the recognition as professionals.

In countries where new Bachelor's degrees are created by splitting the integrated 5-year programmes (3+2 formula) there seems to be a real concern of professional associations in respect to the length of the first professional degree. The prevailing opinion is that the first professional degree can only be the Master's degree.

8. Recognition and accreditation of civil engineering degrees - matters of concern

8.1 Definition of the terms

In a "*Glossary of Terms Relevant for Engineering Education*" [16], one can found several definition of relevance for the present discussion:

Recognition: "*The provision by which a body or institution (the recognizer) considers another body or institution (the recognized) appropriate or competent for a certain purpose*".

Academic **Recognition**: "*A formal acknowledgement, by a competent authority of a higher education institution, of academic qualification as an indication of the capabilities obtained in a study programme or part of it. Such recognition may refer to an individual or be included in a recognition agreement between education institutions or authorities. Usually this is sought as a basis for access to a further studies (cumulative recognition) or as a recognition allowing some exemptions in a programme offered by the host institution (recognition by substitution, such as in ECTS).*"

De facto **Professional Recognition**: "*Refers to situation where the profession is not regulated. In that case, after the completion of a study programme, Engineers may be recognized on the basis of their academic degree*".

De jure **Professional Recognition**: "*A formal acknowledgement by a competent authority of the professional qualifications and / or capabilities of individual applicants to practice their profession at a specified level of responsibility. It refers to the right to practice and the professional status accorded to a holder of a qualification.*"

Professional **Qualification**: "*The set of requirements necessary for access to a profession, especially a regulated profession*".

Regulated **Profession**: "*A profession which is subject to rules set by national legislation*".

Accreditation of programmes: "*The process by which a qualification, a course or a programme comes to be accepted by an external body to be a satifactory quality and standard. Accreditation involves a periodic audit against published standards of the engineering education at the appropriate level. It is essentially a peer review process, undertaken by appropiately trained and independent panels comprising both engineering teachers and engineers from industry".*

Accreditation of institutions: "*Accreditation is a formal published statement regarding the quality of an educational institution that provides some (but not necessarily only) accredited study programmes.*"

Diploma supplement: "*An annex to the original qualification designed to provide a description of the nature, level, context, content and status of the*

studies that were pursued and successfully completed by the holder of the qualification. It aims at improving the international transperency and the academic/ professional recognition of qualifications".

ECTS: "*Acronym for European Credit Transfer System, developed by the European Commission in order to increase the transperency of educational systems and facilitate the mobility of students across Europe through credit transfer. It is based on the general assumptions that the global workload of an academic year of study is equal to 60 credits*."

8.2 The present situation

8.2.1 Recognition

A system of recognition and accredition of engineering degrees and professional qualifications was not implemented so far in Europe.

The legal framework for the mutual recognition of professional qualifications was established in the past 15 years by a number of Directives of the European Union. Thus, the Directive 89148/ EEC put the bases of a general system for the recognition of higher education diplomas awarded on completion of professional education and training of at least three years' duration, for all regulated profesion that are not subject to a specific directive, including engineering. Other directives were enforced for certain professions such as medical professions and architecture.

In 2002 a new unified Directive, named "*Directive of the European Parliament and the Council on the Recognition of Professional Qualifications*" was proposed to the European Parliament with the aim of introducing a more uniform, transparent and flexible regime for the recognition of qualification in the regulated professions. The approval of the final session is pending, but efforts to introduce specific rules for civil engineers were not yet successful.

8.2.1.1 Professional recognition

Engineering profession is regulated by law in four European countries: Italy, Greece, Spain and Portugal. The admittance to the Professional Association in Italy and Greece is based on an examination for which are eligible only graduates holding an accredited degree. In Portugal, the examination is compulsory only for graduates holding a non-accredited degree.

In United Kingdom, the Engineering Council, established by Royal Charter, is the body that ensures national recognition of the engineering profession and sets standards of engineering education and training. The process of the *formation* of a professional engineer, as defined in the policy document *Standards and Routes to Registration* (SARTOR), 3rd edition, produced by the Engineering Council in 1997 [17], comprises three stages:

- *The educational base*, an accredited degree programme or equivalent, which is of 3 years for "*Incorporated Engineers*" (the support engineers or "know-how" engineers) and 4 years for

"*Chartered Engineers*" (the top-class engineers or "know-why" engineers).

- *Initial professional development* (IPD), designed to improve the acquisition and development of skills, specialist knowledge and competence needed to practice in a specific area of engineering; the duration of this stage is normally 4 years.
- *Professional review* in which the competence achieved through IPD is demonstrated and assessed by the requirement for the candidate to write a report and to undertake an in depth interview by two suitable qualified professional engineers; the review also requires the candidate to demonstrate a commitment to continuing professional development and a code of conduct and codes of practice.

After completing the process, the candidate is entitled to *registration* as *Incorporated Engineer* (IEng) or, if the case, as *Chartered Engineer* (CEng).

Similarly, in Ireland only membership of a Professional Institution gives the right to the title of Incorporated Engineer or Chartered Engineer.

One can consider that, although both in UK and in Ireland the engineering profession is formally free, due to the strict rules leading to recognition the profession is in fact regulated.

In most European countries, where the profession is not regulated, the right to award engineering degrees is conferred to specific higher education institutions, hence recognition within each country is practically automatic.

8.2.1.2 Academic recognition

It is expected that academic recognition across Europe will be enhanced by the development of the European Credit Transfer System (ECTS) into an over-arching pan-European credit *accumulation and transfer* framework, and by extending the use of the Diploma Supplement. In this respect, requirements were defined by the Prague Communiqué in the following terms:

"*Ministers emphasized that for greater flexibility in learning and qualification process the adoption of common cornestones of qualifications, supported by a credit such as the ECTS or one that is ECTS compatible, providing both transferability and accumulation functions, is necessary. Together with mutually recognised quality assurance mechanisms such arrangements will facilitate students' access to the European labour market and enhance the compatibility, attractiveness and competitiveness of European higher education. The generalisation of such a credit system and of the Diploma Supplement will foster progress in this direction*".

8.2.2 Accreditation

In few European countries accreditation of engineering programmes enjoys a long tradition and a well-established practice.

The first example which comes in mind is France, where the title of "*Ingénieur diplomé*" is protected by law and only institutions accredited by a national "*Commission des Titres d'Ingénieur*" are allowed to award it. CTI was founded by law in 1934 and has 32 members (half of them representing institutions awarding an engineering degree, the other half representing industry managers, the associations and trade of engineers) appointed by the government for 4 years.

In UK, Ireland and Portugal the accreditation of engineering programmes is done by the professional associations.

In some Central-Eastern European countries the foundation, after 1990, of new public universities and, particularly, the appearance for the first time of a large private sector in the tertiary education, obliged authorities to create accreditation bodies. This was, for instance, the case in Romania, as described in [18].

In the last few years which witnessed, as a result of the Bologna process, the establishment of new programmes and degrees, the need of accreditation increased and so did the number of agencies, bodies, councils etc. authorized to apply accreditation procedures.

Following recent developments, in most European countries is set in place a national system for the purpose of quality evaluation or accreditation.

8.3 A concrete step toward a coherent system of accreditation in European engineering education

8.3.1 "Participation Projects" contributing to the realisation of the European Higher Education Area

In the spring of 2004, the European Commission launched, within the Socrates and Tempus programmes, a number of so-called "*Participation Projects contributing to the realisation of the European Higher Education Area (Bologna process)*".

"*Participation Projects*", set up in order to monitor the Bologna process and test new ideas, were defined as projects in which all Bologna Signatory States may participate, as well as the countries eligible to become Signatory States in future.

A special feature of the "*Participation Projects*" was that they gave the possibility to bring together partners from both Socrates countries and Tempus countries.

Among the activities to be supported by the "*Participation Projects*" was the following one:

"*Developing European Cooperation in Accreditation in certain disciplines/ professional fields*."

In September 2000 was established ESOEPE (European Standing Observatory for the Engineering Profession and Education), aimed to build confidence in systems of accreditation of engineering degree programmes within Europe, to facilitate systematic exchange of know-how in accreditation.

Most ESOEPE members decided to seize the opportunity of the Call for proposal for "*Participation Projects*" and to prepare a project having as a goal the development of European cooperation in accreditation in the field of engineering. So was born the project "*EUR-ACE Accreditation of European Engineering Programmes and Graduates*".

8.3.2 Aims of EUR-ACE

In the application submitted on 16th April 2004 to the EU Commission, the objectives of EUR-ACE were summarized in the following terms.

"*EUR-ACE intends to propose a framework for setting up a European system for accreditation of Engineering education at the First Cycle and Second Cycle level (as defined within the Bologna process) with the following main aims:*

a) providing an appropriate "European label" for accreditation educational programmes and their graduates;
b) improving the quality of educational programmes in engineering;
c) facilitating trans-national recognition by programme validation and certification;
d) facilitating recognition by the competent authorities, in accord with the EU Directives;
e) *facilitating mutual recognition of agreements*."

8.3.3 Use of the results of EUR-ACE

On the use of the results of the project, the application shows:

"*In countries where a national accreditation system already exists, the relevant authorities might allow HEIs and professional bodies to seek and accepts European accreditation, as a complement or an alternative to the national accrediation. In countries at present without a national accreditation system, the European system may either be adopted diectly, or to be used as a framework for setting up a national system. Moreover, European accreditation standards can be a useful means whereby pre-existing trans-national agreements for mutual recognition of engineering degrees and qualifications can be assessed; additionally, they can facilitate the establishment of new agreements of this type. Finally, the existence of a widely accepted European accreditation system will help put an end to the growing trend of European HEIs seeking accreditation by non-European bodies. Ont the contrary, a well - functioning European Accreditation system will lead to worldwide readability and acceptance and to possible cross-recognition between EU and other regions (e.g. the Latin American countries)*."

8.3.4 Planned activities of EUR-ACE

The project is planned for 18 months, starting on 1st September 2004 and ending on 31st December 2005.

Five stages are previewed in the development of the project.

Stage 1: Defining common procedures, standards and templates (September 2004 - November 2004)

Stage 2: Testing EUR-ACE criteria and procedures in 10-12 European countries (December 2004 - February 2005)

Stage 3: Refinement of procedures and standards (March - April 2005).

Stage 4: Re-testing (May-October 2005)

Stage 5: Wrapping up the project (November - December 2005), leading to several outputs, among which:

- accredition standards, distinct for First Cycle and Second Cycle degrees but not "branch specific"
- template for publishing the results of the evaluation/ accreditation procedures
- make-up and terms of reference of the organisations that should run the award of the European Accredition
- database on accreditation procedures
- database on European-accredited engineering programmes

8.3.5 EUR-ACE consortium of partners

The applicant/ contracting institution for EUR-ACE project is FEANI (Fédération Européenne d'Associations Nationales d'Ingénieurs - European Federation of National Engineering Associations). The Coordinator (project manager) is Prof. Augusti Giuliano from Universita "La Sapienza" Rome, acting as Consultant to FEANI.

Besides FEANI, 13 other institutions are participating in the EUR-ACE project, namely:

- SEFI (Société Européenne pour la Formation d'Ingénieurs)
- CESAER (Conference of European Schools for Advanced Engineering Education and Research)
- EUROCADRES (Conseil des Cadres Européens)
- ENQHEEI (European Network for Quality of Higher Engineering Education for Industry)
- ASIIN (Accreditation Agency for Study Programs in Engineering, Informatics, Natural Science and Mathematics, Düsseldorf)
- C.T.I (Commission des Titres d'Ingénieurs)
- I.E.I (The Institutions of Engineers of Ireland)
- CoPI (Conferenza dei Presidi delle Facolta' di Ingegneria Italiane)
- UNIFI (Universita degli Studi di Firenze)
- Ordem dos Engenheiros, Portugal

- UAICR (Union of Associations of Civil Engineers of Romania)
- RAEE (Russian Association for Engineering Education)
- Engineering Council, United Kingdom

9. Concluding remarks

The impact of the Bologna process on civil engineering education is significant.

There is a clear trend toward the introduction of the two-tier system, which is expected to be the prevailing one in a few years.

One of the major results of this move is the appearance of a new kind of degree, the 3-year Bachelor's degree offered by Universities and meant as a stepping-stone in the route for the completion of 5-year studies, leading to Master's degree. The new 3-year Bachelor's degrees, named sometimes "*academic bachelors*", do not compare with already existing, shorter and application oriented degrees.

Another result of the process is provided by the first cycle degree of 4-year duration introduced in some universities which, unlike the new 3-year duration degree course, is being by itself relevant to the job market, fulfilling the employability requirement,

Some existing, 5-year integrated degree courses, will continue to be present in the offer of some universities, in some countries in parallel to the new degree courses.

Changes are occurring in the non-university sector, too, although not with the same extent as in the university sector.

Compared to the situation existing four years ago, the present situation is more complex and, possibly, more confuse.

To speak in terms close to the Civil engineering profession, one can say that a "*large scale experiment*" was initiated, whose results will require many years to be properly assessed.

Let's hope that, through the active involvement of all stakeholders, academics in first place, students, professional associations, industry, public authorities a.s.o., the results will lead to a stronger and more competitive European civil engineering education.

References

[1] Manoliu, Iacint "Civil Engineering in the Context of the European Higher Education Area - the Role of EUCEET" First EUCEET Volume, Bucharest, Independent Film, 2001

[2] Haug, Guy: "Trends and issues in learning structures in higher education in Europe", final version: 18 August 1999, http://www.rks.dk/trends3.html

[3] Hedberg, Torbjorn "The impact of the Bologna Declaration on European engineering education", European Journal of Engineering Education, vol. 28, No. 1, March 2003

[4] Augusti, Del Moral, Hagström, Heitmann, Maffioli, Manoliu, Mulhall, Pursala, Schimdt, Bricola: "TUNING Educational Structures in Europe. Report of the Engineering Synergy Group", E4 Thematic Network, Volume B, Firenze University Press, 2003

[5] - Communication of CESAER and SEFI on the "Bologna Declaration", in E4 Thematic Network, Volume C, Firenze University Press, 2003

[6] Xanthopoulos, Themistocles: "Market Globalisation, European University Education and the Bologna Declaration. Backgrounds Policy Analysis, Positions and Proposals", EUCEET II 1st General Assembly, Athens, February 2003, on: www.euceet.utcb.ro

[7] Herz, Raimund: "Private communication of 25 April 2004 to Iacint Manoliu"

[8] Lo Presti, Diego; Nelva, Riccardo; Tordella, Ludovica: "Civil Engineering Education in Italy: the Transition Phase from Old to New System", 4th EUCEET Volume, Bucharest, Independent Film, 2004

[9] Koppel, Tiit; Laur, Tomas: "Civil Engineering Education in Estonia", 4th EUCEET Volume, Bucharest, Independent Film, 2004

[10] Haug, Guy; Tauch, Christian: "Trends in Learning Structures in Higher Education (ii)", www. salamanca2001.com

[11] Bratteland, Eivind: "Civil Engineering Education in Norway", 4th EUCEET Volume, Bucharest, Independent Film, 2004

[12] Naudzuns, J. Rihards; Smirnovs, Juris: "Civil Engineering Education in Latvia", 4th EUCEET Volume, Bucharest, Independent Film, 2004

[13] Telitchenko, Valeri; Andreev, Vladimir; Gagin, Vladimir: "Civil Engineering Education in Russia", 4th EUCEET Volume, Bucharest, Independent Film, 2004

[14] Mendes, Jose; Silva, Luis; Kowalczyk, Ryszard: "Civil Engineering Education in Portugal", 4th EUCEET Volume, Bucharest, Independent Film, 2004

[15] - "A New Structure for Engineering Education in Ireland. Implementation of the Bologna Declaration", Institution of Engineers of Ireland, November 2003, www. iei.ie

[16] Augusti, Giuliano, Bricola, Valeria; Heitmann, Günter: "Glossary of Terms Relevant for Engineering Education", E4 Thematic Network, Vol. B, Firenze University Press, 2003

[17] - SARTOR Standards and Routes to Registration, 3rd edition, 1997, Engineering Council, 10 Maltravers St, London

[18] Manoliu, Iacint: "Civil Engineering Education in Romania", 4th EUCEET Volume, Bucharest, Independent Film, 2004