SOME COMPARISON BETWEEN THE CIVIL ENGINEERING EDUCATION IN AUSTRIA AND BRAZIL

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Abstract: *Some of the main features of the world economy in the 20th century has been the globalization of industries and services. The globalization increased the necessity of an international practice of engineering without regard to national or international boundaries.*
Our society is changing very quickly and the basic challenges to the society which includes urban infrastructure, housing and expanding population, maintaining our environment, dealing with the effects of natural disasters and climate change, transporting even more people and goods in a safe and efficient manner. These challenges will require civil engineers more talented and updated with such changes.
Developments occurring in the field of Civil Engineering of course affect also the geotechnical engineering education.
The present paper will bring some comparisons between different systems, the challenges for the European Community and some Declarations (Sorbone and Bologna) which bring important debates on the future of higher education in Europe.
A broader overview will be shonw as Austria is part of the European Community and the main actions happening in Austria are part of the whole European system.
Most of the information about European educational system in the present paper comes from the documents of the "European Civil Engineering Education and Training", Project EUCEET (**EU**ropean **C**ivil **E**ngineering **E**ducation and **T**raining), a *Socrates-Erasmus Thematic Network Project, as Austria is part of it, and from the Brazilian educational system from the Brazilian Ministry of Education web pages.*

Key words: *Engineering education, Sorbone Declaration, Bologna Declaration, Austria, Brazil.*

1. INTRODUCTION

In the past and present days engineers play an important role to answer to expectations to people everywhere for a better quality of life. By the calculations of the United Nations, the population of the world reached 6 billion last October 12th. It took all of world history up until the early part of the 1800s to reach the 1 billion mark. The second billion took nearly a century. The most recent billion was accomplished in about 12 years. Fortunately, contrary to what Thomas Malthus, the father of population prediction, foresaw, the birth rate around the world has already begun to slow. The next billion is projected to take 14 years instead of 12, and sometime during the latter part of the next century, the UN hopes the world population will peak at 10 billion, then begin to decline, CLOUGH, (2000).

However, the question remains of how to accommodate an additional four billion people in the next 50 years. Civil engineers have traditionally planned, designed and built what society required in the way of housing, transportation, water and energy supply, other infrastructure, air quality, response to natural disasters, and land use. Yet, it is unlikely that yesterday's technologies will suffice for tomorrow's challenges.

We must look to technology for most of our solutions, and while civil engineering may give form to the new solutions, the technology that drives them is unlikely to start with us. The arithmetic is simple. Research and development monies are in short supply in our field, because they are pouring into areas like biotechnology, nanotechnology, information technology, and advanced communications. Our response must be to draw from fields that are advancing faster than ours wherever possible, and use that technology as a springboard for our own progress. Given the circumstances, technology transfer will be the mother lode for our future and we have to be aware of it.

2. SOME HISTORY

The ERASMUS chapter on higher education of the SOCRATES programme, launched by the European Commission in 1995 included a new and distinct action: *Thematic Network projects* (or **“university co-operation projects on subjects of common interest”**). Thematic Network projects were aimed to the creation of forums to analyze and study the status of development in the different fields of education in Europe, with the objective of promoting the European dimension and of improving the quality of training. Also, they were meant to involve faculties and departments of institutions of higher education, as well as scientific and professional associations, in order to ensure a wide impact, both at institutional and at intra - and inter - disciplinary levels.

24 first - generation Networks, approved in September 1996, started to function in 1996/97. Eight second - generation Networks were approved in 1997 and nine in 1998, among which the Thematic Network Project EUCEET (**EU**ropean **C**ivil **E**ngineering **E**ducation and **T**raining) and most of the information in this paper comes from the documents available at TUG-Graz, Austria, as Austria is part of the Network, MANOLIU and BUGNARIU, (2001)

2. 1 Reasons for creating the thematic network EUCEET

• It is well known that engineering higher education in all European countries started with courses in civil engineering. For centuries, civil engineering schools have played a major role in the advancement of the European science and technology. Their contribution toward providing a civilised life in Europe was and continues to be tremendous.

• At present, civil engineering represents the branch (department) most frequently found in the structure of the technical higher education institutions in Europe. At the same time, due to traditions, to local circumstances, to demands of the economic environment a. s. o., there are significant differences in the civil engineering education programmes between various European countries. There is a strong and urgent need for a comprehensive review of existing academic curricula, for collecting and disseminating, relevant information, for identifying the elements of a European dimension for the civil engineering field.

• There is a wide spectrum of postgraduate forms of education in civil engineering, offered by the different academic institutions in Europe.

Postgraduate education relates intimately to continuing professional development, a process in which the involvement of universities is of major importance. Assessing the demand for and supply of continuing education for the construction industry in Europe and the role of higher education institutions to meet these needs represents a challenge of great actuality.

• The construction industry (which includes housing, non-residential buildings, civil engineering and industrial construction) is a major constituent of the European Union's economy. Among the actions to achieve a European strategy for the competitively of the construction sector, a main objective to improve education and training provision and includes the recommendation of the Commission to promote European networking of construction training and educational organisations.

• Like for other engineering schools, the quality assurance is a central issue on the agenda of civil engineering faculties and departments across Europe. The process of assuring and improving the quality of civil engineering education varies considerably from country to country. The mutual recognition of degrees and qualifications cannot be separated from the establishment by the civil engineering schools of a set of comparison criteria to assess their educational achievements.

• There are more than 20 years since the Commission of the European Communities took the initiative for elaborating an international set of Codes for structural design – EUROCODES. Today most of these Codes are already published as European Prestandards (ENV) and after a test period of several years are going to become European Norms (EN) replacing national standards. This represents a true revolution in the design practice which puts a serious challenge to civil engineering schools in Europe. Matters related to the contribution of these institutions to the implementation of EUROCODES into practice will be thoroughly considered by the Thematic Network EUCEET.

• In the recommendations for improved competitiveness, the Communication from the EC mentioned above, included the following:

Civil engineering schools have to contribute to the competitiveness of the construction sector in Europe by their active participation to the construction research. This should be done in synergy with the research institutes and the industry as steering research at all levels of the sector towards constructive processes: management aspects, construction methods and “sustainable” materials and structures and improving the dissemination of research findings.

• Civil engineering is, undoubtedly, the engineering field in Europe which bears the greatest responsibility for ensuring the quality, safety and the overall sustainability of the built environment and for protecting the natural environment. The dialogue between academic institutions, public authorities and professional associations is of paramount importance in this field, more than in any other engineering field.

3. THE SORBONNE AND BOLOGNA DECLARATIONS

Diversity and complexity are the key-words to characterize higher education in Europe, as a direct result of major differences in factors as type, breadth and duration of secondary education, the existence of sub-systems of higher education (short duration and long duration programs), access to higher education, systems of tuition fee, calendar of the academic year, frequency and type of examinations, number and type of degrees that can be earned etc.

Two official Declarations led in recent years to heat debates on the future of the higher education in Europe.

The first one was the Sorbonne Declaration of 25th May 1998 *"on harmonization of the architecture of the European higher education system"*, signed by the Ministers of Education of France, Germany, United Kingdom and Italy.

The second one is the Bologna Declaration of 19th June 1999 *"on the European higher education area"*, signed by Ministers of Education of 29 European countries.

The Sorbonne Declaration recommended that studies should be organized in two cycles: undergraduate and graduate, but did not provide an indication of their duration. So, implicitly rather than explicitly, the Sorbonne Declaration represented a plea in favour of a shift from the *"continental"* to the *"anglo-saxon"* 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.

The debate that followed the Sorbonne Declaration focused on the alleged emergence of a European *"model"* with 3 main levels of qualifications requiring 3,5 or 8 years of study, as was proposed in the *"Attali report"*, which made recommendations for changes in the French system of higher education.

Another aspect revealed by the Sorbonne Declaration was the challenge represented by the need for European higher education to retain its competitiveness in the world markets of knowledge production and dissemination. Also, the Sorbonne declaration is about *"qualifications"* (knowledge and skills acquired which can be applied in the labour market) rather than academic degrees.

A step forward for major changes in the European higher education system was made by the Bologna Declaration. It is worth to remind here the objectives considered to be, by the signatories of the Bologna Declaration, of primary relevance in order to establish the European area of higher education and to promote the European system of higher education world-wide:

- *Adoption of a system of easily readable and comparable degrees, also through the implementation of the Diploma Supplement.*
- *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 as an appropriate level of qualification. The second cycle should lead to the master and/or doctorate degree as in many European countries.*
- *Establishment of a system of credits as a proper means of promoting the most widespread student mobility.*
- *Promotion of mobility by overcoming obstacles to the effective exercise of free movement.*
- *Promotion of European co-operation in quality assurance with a view to develop comparable criteria and methodologies.*
- *Promotion of the necessary European dimensions in higher education, particularly with regards to curricular development, inter-institutional co-operation, mobility schemes and integrated programs of study, training and research.*

As one can see, basic ideas of the Sorbonne Declaration can be found in the Bologna Declaration, but in a more specific way. A figure: three years is given this time for the minimum duration of the first cycle considered as a prerequisite for the access to the second cycle. A term is also set up to reach the defined objectives: before the end of the first decade of the third millennium.
Both Declarations referred to the *"European higher education system"* or to the *"European higher education area"* without reference to any specific field.
It is, therefore, appropriate to take a closer look at the European engineering education and, in particular, at the civil engineering education, following the two Declarations.

4. ENGINEERING EDUCATION SYSTEMS

4.1 European case

As far as engineering education was concerned, only a few years ago things seemed to be quite simple. Two basic systems were present, MANOLIU, (2000):

- the *"continental"* (or binary) system characterized by the coexistence, in most European countries, of two parallel types of engineering education: of long duration, with nominal duration in almost all cases of 5 years and of short duration, with nominal duration of 3…4 years;
- the *"anglo-saxon"* (or two-tier) system, with undergraduate courses leading to Bachelor of Engineering degree after 3 years (in England and Ireland) and 4 years (in Scotland), followed by postgraduate studies leading to a Master of Sciences degree (1-2 years)

In figure 1 are represented various types of education belonging to the *"continental"* system. There are two main features:

- the *"parallel"* system (a, b) which is most common, with the short duration programme 3-4 yrs and the long one of 5 yrs (rarely 6);
- the *"tree"* or *"y"* system (c, d) where the two programmes have a common trunk of 1-2 yrs, which was used in some Universität-Gesamthochschulen in Germany offering simultaneously engineering degree courses of short and of long duration.

In figure 2 are represented various types of education belonging to the anglo-saxon system (the *"ladder"* system). The first degree could be attained, depending on the school, after 3 or 4 yrs and can represent a BEng or MEng degree.

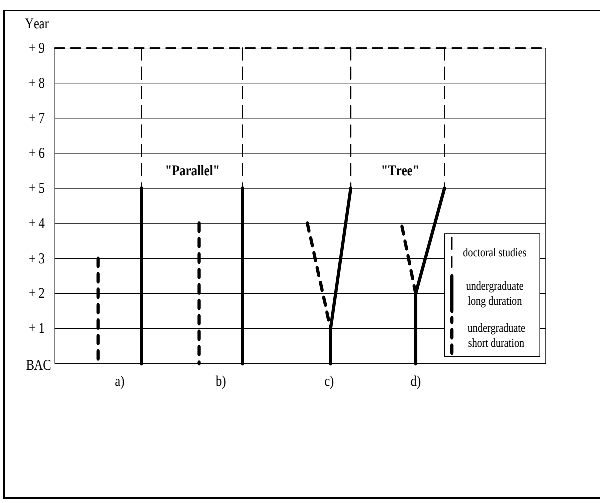

Figure 1. Continental system

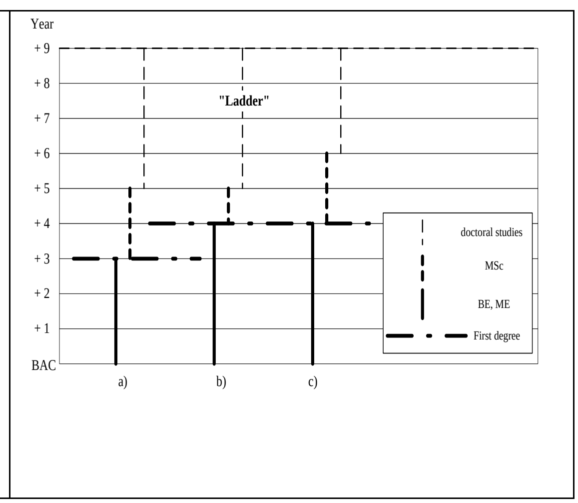

Figure 2. Anglo-saxon system

In recent years, changes have occurred in European engineering education, too.
For instance, a number of English universities, among which most notably Imperial College in London, ceased to offer BEng as a first degree and are offering instead a 4-year accredited Master of Engineering (M Eng) degree which is required by the Engineering Council as the educational base for the Chartered Engineer registration.
Speaking on the engineering education in U.K., one cannot ignore the important role played by the engineering Institutions in insuring engineering qualification. In the Standard route for registration (SARTOR), as defined by the Engineering Council in collaboration with engineering Institutions, including Institution of Civil Engineers and Institution of Structural Engineers, the accredited MEng degree course represents the educational base, to be followed by the Initial Professional Development and the Professional Review with Interview as a Final Test of Competence and Commitment in order to achieve the Registration as a Chartered Engineer.
As for the continental system, a most significant event occurred in Germany where an amendment to the federal law on higher education in 1998 allowed Universities and Fachhochschulen to set up new bachelor and master degrees. Bachelor courses may last from 6 to 8 semesters and master courses from 2 to 4 semesters; when offered as consecutive steps in a long curriculum their aggregate duration cannot exceed a total of 10 semesters. New courses may replace traditional ones or run in parallel, but no additional public money is provided.

A survey of the approximately 80 bachelor and master courses shows that most courses are in science and technology and most use English only or in various combinations with German.
Whether offered as separate programmes or as consecutive steps of a long programme, most bachelor are in 6 and most masters in 4 semesters, with various possibilities to earn a German *Diplom* on top of the bachelor or master degree, often after an additional period of study. The fact that most courses were offered in English shows the need to increase the attractiveness of the German universities for foreign students. And the the adopted a *Resolution* which begins with the following recommendation:
"Existing study courses finalised with a Diploma have been tested and enjoy a general recognition. With theirs Basic studies (Grundstudium), Basic engineering studies (Grundfachstudium) and specialized engineering studies (Vertiefungsstudium) they have an efficient, modern and clearly defined structure. The Diploma conferred by the universities is regarded on the international scale as a Diploma of high quality. There is no reason to give up and to replace existing Diploma study courses. Existing Diploma study courses and Diploma-Projects should be maintained".
Nevertheless, for the sake of internationalisation, the *Resolution* includes a proposal called: "*Scheme to bring about compatibility between diploma and bachelor master study courses in civil engineering at universities"*.
So far in no one of the 17 German higher education institutions (5 Universities and 12 Fachhochschulen), were bachelor and master courses introduced in parallel with the traditional ones in the field of civil engineering.
In Austria an amendment to the law on higher education along similar lines as in Germany was adopted, allowing the introduction of bachelor courses on a voluntary basis in replacement of existing curricula, bachelor in 3-4 years but masters in 1 year, no extra funding. In the Technical University of Vienna the continental system is preserved.
Italy seems to be the first country which introduced a major reform in line with the criteria defined in the agreement of Sorbonne and later in the Joint Declaration of Bologna. The new Regulation (*"Regolamento in materia di autonomia didattica degli Atenei"*) published in the

Official Gazette, introduces first level and second level titles: a diploma after three-year course (Laurea – 180 credits) and the two-year specialization course, following the first level diploma (Laurea Specialistica – further 120 credits). This is a drastic change in comparison with the existing system which provides for two paths in parallel, one leading to the Laurea (five years) and the other leading to the Diploma universitario (three years).
In France, which has one of the most complex and multilayer system of national *diplômes*, some steps have been undertaken as a result of Sorbonne and Bologna process. A new *"professional licence"*, aimed at providing a more effective access to the labour market after theoretically only 3 years, was introduced on a voluntary basis. A new degree, the *Mastaire* was introduced for students who complete 2 years after the *Licence* or graduate from a Grand Ecole. However, these measures have, apparently, no impact on the engineering education in France.

4.2 Brazilian case

The Engineering Courses in the Brazilian Universities have the minimum duration of four years and the maximum time is fixed by the University or Faculty.
The curricula for any of the Engineering specialities have a minimum didactic activities as 3000 hours except for the training and complementary activities.
The curricular training must be an obliged activity with the minimum duration of 160 hours and the will be supervised by the Institution through regular Technical Reports and the individual professional following during its realization.
For the topics and contents of studies the order of the contents does not need to be sequential in the curricula structure and the following items do not need to be individual topics but they can be distributed throughout the academic activities. The intensity of work in each topic depends on the "Pedagogic Project" of each Course.
Each Engineering Course, independent on its speciality must have in its curricula a basic contents core, which comprehends 35% of the minimum time, with the following topics:

- Scientific and Technological Methodology: science and technology. Planning and formulation of the scientific research and technological developing.
- Communication and Expression: utilization of the communication media, writing and oral presentation.
- Computation: utilization of the softwares and hardwares, formal programming languages.
- Graphical Expression: interpretation of drafts and technical drawings manually and with computers.
- Maths: introduction to basic and applied engineering, integral and differential calculus, vector, analytical geometry, linear algebra, numerical calculus, probabilistic and statistics.
- Physics: introduction to the basic theory, notions of modern physics.
- Transfer phenomena: basic theory, experiments, mass and heat movements.
- Solid Mechanics: static and dynamics of the rigid and deformable bodies, stresses and strains and it correlations.
- Applied Electricity: circuits, electrical and magnetically measurements.
- Chemistry: introduction to the basic theory, experimentation and applications, inorganic chemistry.
- Technology and Science of Materials: classification, properties and utilization of engineering materials.

- Administration: introduction to theory and application of technological innovations, marketing, production planning and control, costs.
- Economics: introduction to the basic theory, financial mathematics.
- Environmental Sciences: ecology, preserving and using the natural resources, environmental impacts and sustainable development, recycling and legislations.
- Humanities, Socials Sciences: philosophy, law, legislations, professional ethics, work safety and protection to the consumers.

In Chemistry, Physics and Computers it is obliged laboratory activities as in the basic topics if possible with emphasis in the engineering modality

All the Engineering Courses must have a professional core, comprehending 15% of the total hours, about some topics as follows:

• Algorithms and data Structure	• Topography and Geodesy
• Biochemistry	• Discreet Mathematics
• Materials Science	• Materials for Constructions
• Electrical and Logical Circuits	• Applied Mechanics
• Compilers	• Numerical Methods
• Civil Construction	• Microbiology
• Control of Dynamic Systems	• Mineralogy and Mineral Treatment
• Energy Conversion	• Systems Modelling, Analyses and Simulation
• Electromagnetism	• Computers Programming
• Digital and Analogical electronics	• Operational Research
• Product Engineering	• Fabrication Process
• Ergonomics and Work Safety	• Chemical and Biochemical Processes
• Organizations and Strategies	• Quality
• Physical Chemistry	• Analytical and Organic Chemistry
• Geoprocessing	• Chemical and Biochemical Reactors
• Geomechanics	• Structural Systems and e Theory of Structures
• Environmental Management	• Information Systems
• Economics Management	• Mechanical Systems
• Technology Management	• Operational Systems
• Applied Hydraulics and Hydrology	• Thermal Systems
• Instrumentations	• Transports

The engineering curricula must have some extensions and optional topics to characterize the specific modality. These contents, which complement the total hours for the Course will be proposed by the University or Faculty. They are important and necessary topics to define the engineering modality and the guarantee the ways for increase the abilities and competence for the engineer’s career.

In contrast to that happens in other countries, after having obtained a Civil Engineer degree forma University recognized and credited by the Ministry of Education, the professional is already considered a full licensed engineer. However, the engineer may be not be authorized to design or be responsible for certain types of work, depending on the courses he or she did not take while in the university (optional Courses), PALMEIRA, (2000).

5. HABILITIES REQUIRED FROM A CIVIL ENGINEER

5.1 European case

Engineering programs must demonstrate that their graduates have:

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Professional component specifies subject areas appropriate to engineering but does not prescribe specific courses. The engineering faculty must assure that the program curriculum devotes adequate attention and time to each component, consistent with the objectives of the program and institution. Students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier coursework and incorporating engineering standards and realistic constraints that include most of the following considerations: economic; environmental; sustainability; manufacturability; ethical; health and safety; social; and political. The professional component must include:

- one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline;
- one and one-half years of engineering topics, to include engineering sciences and engineering design appropriate to the student's field of study;
- a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.

5.2 Brazilian Case

The curriculum for the Civil Engineers Courses must give conditions to the undergraduate students to form a solid professional, technical and scientific formation capacitating him to absorb and develop new technologies, stimulating his critical and creative actuation to identify problems, considering its political, economical, social, environmental and cultural aspects, with an ethical and humanistic vision to attend the society needs.
It is part of the profile of a Civil Engineer a constant search for professional actualization.
The Engineering Civil Curriculum must give conditions to the engineers to acquire competence and ability for:

- to apply mathematical, scientific, technological ad instrumental knowledge to the engineering;
- project and conduct experiments and interpret its results;
- to project and analyses systems, products and processes;
- planning, supervising, elaborating and coordinate projects and engineering services;
- identify, formulate and solve engineering problems;
- develop and use new tools and techniques;

- supervise the operation and maintaining of systems;
- evaluate critically scale order and significance of the numerical results;
- communicate efficiently writing, speaking and graphically;
- actuate in multidisciplinary teams;
- comprehend and apply the responsibility and ethical for the engineers;
- evaluate the impact of the engineering activities in a social and environmental context;
- evaluate the economical viability for the engineering projects.

6. REVIEW OF ACADEMIC AND PROFESSIONAL QUALIFICATIONS THROUGHOUT EUROPE AS AN EXAMPLE FOR THE BRAZILIAN SYSTEM

Presently, there is no truly European system of recognition and accreditation of engineering degrees and professional qualifications of engineers. The academic qualifications are protected by law in most countries, including those in which engineering titles and the profession are not regulated. The right to award engineering degrees is limited to specific educational institutions in which case the recognition is practically automatic within the country concerned.

The engineering profession is regulated by law in three European countries: Italy, Greece and Portugal. Italy and Greece require not only an accredited degree, but also a formal examination before admittance to the Professional Association, while Portugal requires the examination only from graduates holding a non-accredited degree.

With few exceptions, accreditation agencies of a kind or another exist in all European countries. When compulsory or voluntary rules to which each degree course should conform are set up by a National Authority, accreditation (*de jure* or *de facto*) is practically automatic. In some countries, like Romania, degrees courses are accredited through an "*a posteriori*" evaluation process.

Registration of engineering professionals is required in most countries. A particular situation is in the UK where, although the engineering profession is free, only membership of a chartered professional institution (like Institution of Civil Engineers or Institution of Structural Engineers) give the right to the title of Chartered Engineer, as a professional qualification, requires a period of acceptable engineering experience after graduating with an accredited degree.

A trans-national system for professional qualifications has been set up since 1989 by FEANI – European Federation of National Engineering Associations). FEANI introduced the title of "European Ingenieur" (EUR ING) and established Standards for Registration. The minimum educational requirement is at least a 3-year engineering course at university level, with the entrance condition of a high level full secondary education up to the age of 18 years. The minimum professional requirement is at least 2 years of engineering experience. The registration can be obtained when the individual proves that the totality of education and subsequent approved professional experience is of 7 years and it gives the registrant the right to be called "European Ingenieur" (EUR ING).

In order to maintain the admission to the Register, FEANI has set up a List of School and Courses – the FEANI INDEX, listing all programs of engineering education from FEANI member countries which meet the FEANI minimum requirement and which have curricula enabling the graduates to develop towards professional experience expected by FEANI.

The number of universities for each FEANI country listed is about 780 universities and engineering schools are at present accredited by FEANI. Since the creation of EUR ING Register in 1989, FEANI has awarded more than 25000 EUR ING certificates to applicants from all member countries, more than 2000 awards per year.

7. ECCE AND THE REGISTER OF EUROPEAN CIVIL ENGINEERS

ECCE (European Council of Civil Engineers) was created in 1985 through the common belief among European civil engineers that they are better placed to advance Europe's built environment and protect its natural environment by working together. The EU institutions now recognise ECCE as the single voice for the profession. ECCE members are the professional Civil Engineering associations in individual European countries. The current membership is made up of members from Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Poland, Portugal, Romania, Russia, Slovenia, Spain, Turkey and United Kingdom.

ECCE discussed the broad principles of a framework which might enable progress towards removing artificial barriers to the free movement and practice of professional engineers amongst member countries at some meetings. As a result of these discussions, they decided to create and maintain a Register of European Civil Engineers.

ECCE will use its best efforts to ensure that persons are entered on the Register only when they have:

- *demonstrated, to the satisfaction of all signatories, a level of academic achievement at least equal to that of a graduate holding an engineering degree accredited by an organization holding full membership of, and acting in accordance with the terms of, the Washington Accord or 4 years in an institution of higher education and a system of Quality Assurance approved by ECCE.*
- *Having completed a period of training and experience, building on the academic phase, which will provide the graduate with the competence to analyse, solve and implement complex civil engineering problems. This will be normally 3/4 years duration.*
- *Been assessed by a competence assessment by the signatory organization, in accordance with agreed guidelines.*
- *Maintained their continuing professional development at a satisfactory level, in accordance with agreed guidelines.*

The implementation of the proposal is a two step process:

- *Stage 1 is agreement on the requirements of a Register of European Civil Engineers who posses the education, level of experience and competence set out above. Technically the Register will be held in a de-centralised form in order to minimise additional costs;*
- *Stage 2 is a statement of intent by all parties to recognise engineers on this register favourably in gaining access to practice in the member countries.*

To ensure consistency in application of the agreed criteria, ultimate authority for entering persons in the Register of European Civil Engineers will remain with a Steering Committee, comprising a Chairman appointed by a General Meeting of ECCE members and elected representative from each ECCE member who signed up. The primary objective of the Steering Committee will be to facilitate the compilation and operation of an authoritative decentralised Register of European Civil Engineers.

Each ECCE member organisation signing up to this system will undertake to develop and maintain a section of the Register in their country open to professional engineers whose qualifications and technical and professional expertise have been assessed as in compliance.

Each ECCE national member organisation will be responsible for certifying the qualifications and experience of individual professional engineers seeking entry to the register, whether or not the assessment of such candidates is delegated to an associated body. ECCE members will be obliged to recognise the equivalent qualifications of other organisations who have signed up to the ECCE process.

ECCE member organisations in one country will do their utmost to ensure that other individual members will be fully recognised in that country. The process of establishing a register will commence when at least four ECCE members have become signatories to the Agreement.

8. CONCLUSIONS

After two centuries of relative stability and slow change, the nature of the Civil Engineer now sought to undertake the tasks required by society at large has recently shown remarkable changes. The profile of the Civil Engineer sought must now include, apart form the two systems shown: ability and willingness to work in teams, managerial qualities, financial and economic skills, environmental issues, risk and quality management, aptitude in the use of new technologies, skills in communication and legal issues.

The European countries through its Committees is trying to harmonize the curricula, recognizing the equivalence between its professionals and equivalents requirements for the engineers in a market every day more competitive and more importantly, trying to follow the Industry needs to “release” good engineers in the market. English as a common language is used in most of the Universities to help the harmonization.

Some good examples of practice can be taken from the Sorbonne and Bologna Declarations for the Brazilian Civil Engineering education. By most, from the author’s opinion, mainly the practice of continuous improvement in the curricula and the guarantee of having Registered Engineers with high qualifications apart form the countries boundaries.

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