IMPLEMENTATION OF THE FRAMEWORK FOR QUALIFICATIONS OF A CIVIL ENGINEER BASED ON LEARNING OUTCOMES AND COMPETENCES

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SECTION 1. INTRODUCTION

This report is written mainly for an audience of members of departments of faculties of civil engineering, who may be at different stages of familiarity with the concept of outcome-based courses and curricula, or in general outcome-oriented education. Some readers are mostly familiar with content-based structuring of a course or a curriculum (type 1 audience). Others may be aware of existing outcome-based frameworks of qualifications, which are implemented either for the purposes of accreditation or for quality/accountability purposes (type 2 audience). Yet others may have gone through the exercise of structuring or restructuring courses and curricula at their universities following the guidelines of a specific framework, as a result of an imposed university-wide practice or out of their own initiative (type 3 audience). Finally, some readers may have gone through the exercise of demonstrating that a curriculum designed to satisfy a particular framework of qualifications indeed produces these intended outcomes (type 4 audience).

Appendix 1 is a summary of a questionnaire given to delegates at the 2nd General Assembly Thematic Network in Warsaw, October 2008. It can be seen from the distribution of answers questions 1 and 2that that most of respondents are familiar with the OBE and that european universities are encouraged its adoption to Civil Engineering Programs.
Given the variety in audiences, this section provides a brief overview on outcome-based education, starting with the relevant definitions. The following four sections present existing frameworks of qualifications (Section 2: EUR-ACE, Section 3: ASCE, Section 4: EUCEET, Section 5: Tuning). Finally, Section 5 provides examples of good practices at university level (Romania, UK), program-level (France) or course-level (Greece). It should be stressed early on, addressing type 1 audience in particular, that content-driven and outcome-driven approaches are not conflicting but complementary. Following the one or the other approach those lead to better or, necessarily, different results. However, an outcome-driven approach makes it easier for instructors to explain what they have achieved by teaching a course.

1.1. Term definitions

The OBE model which as been proposed by Spady [1] is showed in figure 1. This figure is complemented with following definitions.
Learning objective is a detailed description that states the expected change in student learning, how the change will be demonstrated and the expected level of change [1].
Learning outcome refers to the knowledge, skill or behaviour that is gained by a learner after instruction is completed and may include the acquisition, retention, application, transfer, or adaptability of knowledge and skills [2]. Outcome-based education (OBE) is education based on learning experiences designed to meet specific learning outcomes and competences.

Finally, in this report, the term *framework* refers to a two-dimensional matrix defined by a vertical axis that lists the desired competences and skills (outcomes) and a horizontal axis that specifies the desired level of achievement for each outcome.

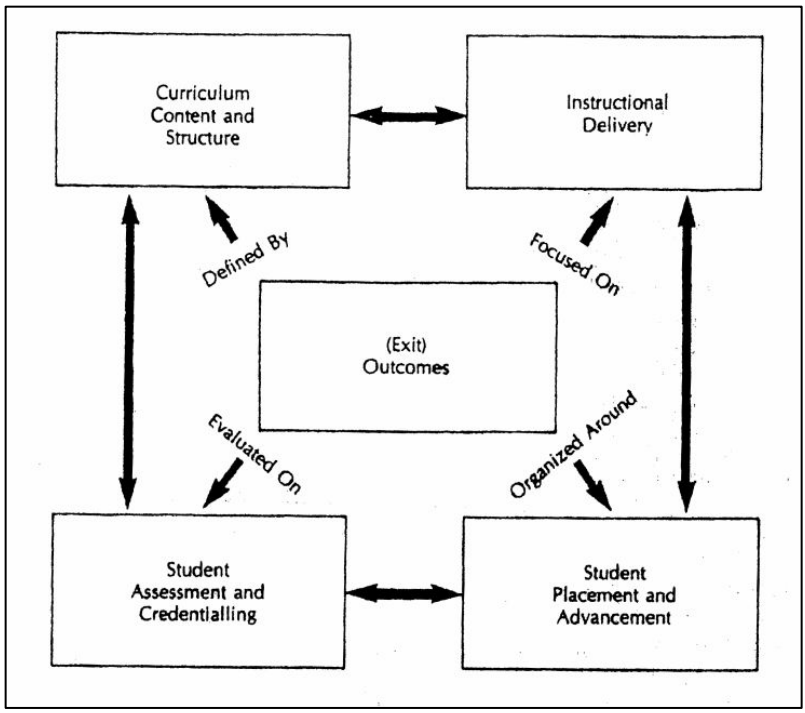


Fig.1 The OBE model - after [1]

The desired level can be described either on a numerical scale (e.g., Tuning) or qualitatively (e.g., ASCE).

1.2. Scales of OBE approaches

Outcome-based education is suitable at any scale. It can be applied at a course level to tailor assignments and assessment to specific learning outcomes and objectives. By defining objectives and outcomes OBE takes plays the role of some sort of contract between students and the instructor, a contract that is more transparent than a list of topics to be covered in a course. At the other end of the scale, a whole program can be designed so that it corresponds to broad competences and skills of program graduates. The program can be an integrated undergraduate program, a two-cycle program or a separate masters program. In the case of two-cycle programs, the structure of the framework (as defined above) can be the same, with differences in the desired level of achievement on the horizontal axis.

1.3 Reasons for adopting OBE

The motivations for adopting an outcome-based approach are of different kinds. In some countries (e.g., UK) it is a legal requirement both at a course and program level. Such legislation is prompted primarily to fulfill the accountability obligation of educational institutions. On the other hand, outcome-based education is better suited to produce market-relevant degrees or, in general, address the needs of the society. Other times, OBE is adopted because the industry demands it. Finally, OBE is sometimes adopted by individual instructors as they become familiar with literature on instruction and cognition.

1.4 Advantages and drawbacks of OBE

The most obvious advantage of OBE is the clarity of the end goals of education. In addition, it enables the development of defendable links between education outcomes and program accreditation. What is more, it promotes a close relationship between outcomes of individual courses and of the entire program. This close relationship makes possible the emphasis on horizontal skills, such as modeling or design, which can be developed in a series of courses and at different levels in each tier of two-cycle programs.

At the same time, OBE approaches may become too prescriptive. Some instructors may feel that the OBE structure is an imposition on their freedom to design and deliver a course. Another problem is that because an outcome-based curriculum is not as unambiguously defined as a content-driven one, an OBE curriculum may, in fact, be outcome-driven on paper only. This is possible if existing course contents are mapped to or forced into framework components. In this case, a content-driven curriculum is newly baptized as an OBE curriculum, but without instituting any changes in educational philosophy, only changes in procedures.

1.5 Activities complementary to OBE

It would be a mistake to imply that a desired set of competences can only be achieved through an outcome-based curriculum. Profession-oriented skills can be achieved through practical training of students, which, however, presupposes a suitable administrative structure some universities lack. In addition, profession-oriented skills can be fully developed at the desired level through a training period of graduates (as envisioned in the ASCE framework).

1.6 Responses from the EUCEET OBE Questionnaire

Once more reference will be made to Appendix I and in particular for the answers to questions 3 and 4. No attempt will be given to reproduce individual answers, but strong themes have emerged to give substance to the subsections, in Section 1.

The respondents considered the overwhelming disadvantage of OBE is that it is considered to be too specialised, and descriptive, which results in a rigid course structure.

Statements might look like OBE, but are they in practice and how can then be judged. They should be applicable to the design, delivery, support and assessment of programs. There is a lack of student involvement and a considerable work effort is required to transform existing programs into OBE equivalents.

Amongst the most advantages, the respondents considered that OBE promotes discussions about contents, teaching methods, assessment, and clarifies what is needed to know. Thus required skills

and competencies are defined, OBE is ideal for life Long Learning with no OBE is independent of the level of input and it is easy to demonstrate that this level has been achieved. An OBE approach indorse a label of quality.
All UK/spec compliant Programs are examples of good OBE practice. There are also examples of university civil engineering programs, which employ the principle of OBE, throughout a good deal of Europe. Good practice can be seen at individual and Faculties levels.

SECTION 2. EUR-ACE FRAMEWORK STANDARDS FOR THE ACCREDITATION FOR ENGINEERING PROGRAMS

EUR-ACE is the first of the four existing frameworks of qualifications to be considered into this report. In its current form the content of EUR-ACE are applicable to general engineering education therefore it is not difficult to extend this application to Civil Engineering programmes [5]. An objective of the report is to develop links between the content of EUR-ACE and the other existing frame works of qualifications towards recommendations which are specific to Civil Engineering education.
The six Programs Outcomes of accredited engineering degree programs are:

- Knowledge and Understanding;
- Engineering Analysis;
- Engineering Design;
- Investigations;
- Engineering Practice;
- Transferable Skills.

2.1 Knowledge and Understanding

The underpinning knowledge and understanding of science, mathematics and engineering fundamentals are essential to satisfying the other programme outcomes. Graduates should demonstrate their knowledge and understanding of their engineering specialisation, and also of the wider context of engineering.

2.2 Engineering Analysis

First Cycle graduates should have: the ability to apply their knowledge and understanding to identify, formulate and solve engineering problems using established methods; the ability to apply their knowledge and understanding to analyse engineering products, processes and methods; the ability to select and apply relevant analytic and modeling methods.

Second Cycle graduates should have: the ability to solve problems that are unfamiliar, incompletely defined, and have competing specifications; the ability to formulate and solve problems in new and emerging areas of their specialisation; the ability to use their
knowledge and understanding to conceptualise engineering models, systems and processes; the ability to apply innovative methods in problem solving.

2.3 Engineering Design

Graduates should be able to realise engineering designs consistent with their level of knowledge and understanding, working in cooperation with engineers and non-engineers. The designs may be of devices, processes, methods or artefacts, and the specifications could be wider than technical, including an awareness of societal, health and safety, environmental and commercial considerations.

2.4. Investigations

Graduates should be able to use appropriate methods to pursue research or other detailed investigations of technical issues consistent with their level of knowledge and understanding. Investigations may involve literature searches, the design and execution of experiments, the interpretation of data, and computer simulation. They may require that data bases, codes of practice and safety regulations are consulted.

2.5. Engineering Practice

Graduates should be able to apply their knowledge and understanding to developing practical skills for: solving problems, conducting investigations, and designing engineering devices and processes. These skills may include the knowledge, use and limitations of materials, computer modeling, engineering processes, equipment, workshop practice, and technical literature and information sources. They should also recognise the wider, non-technical implications of engineering practice, ethical, environmental, commercial and industrial.

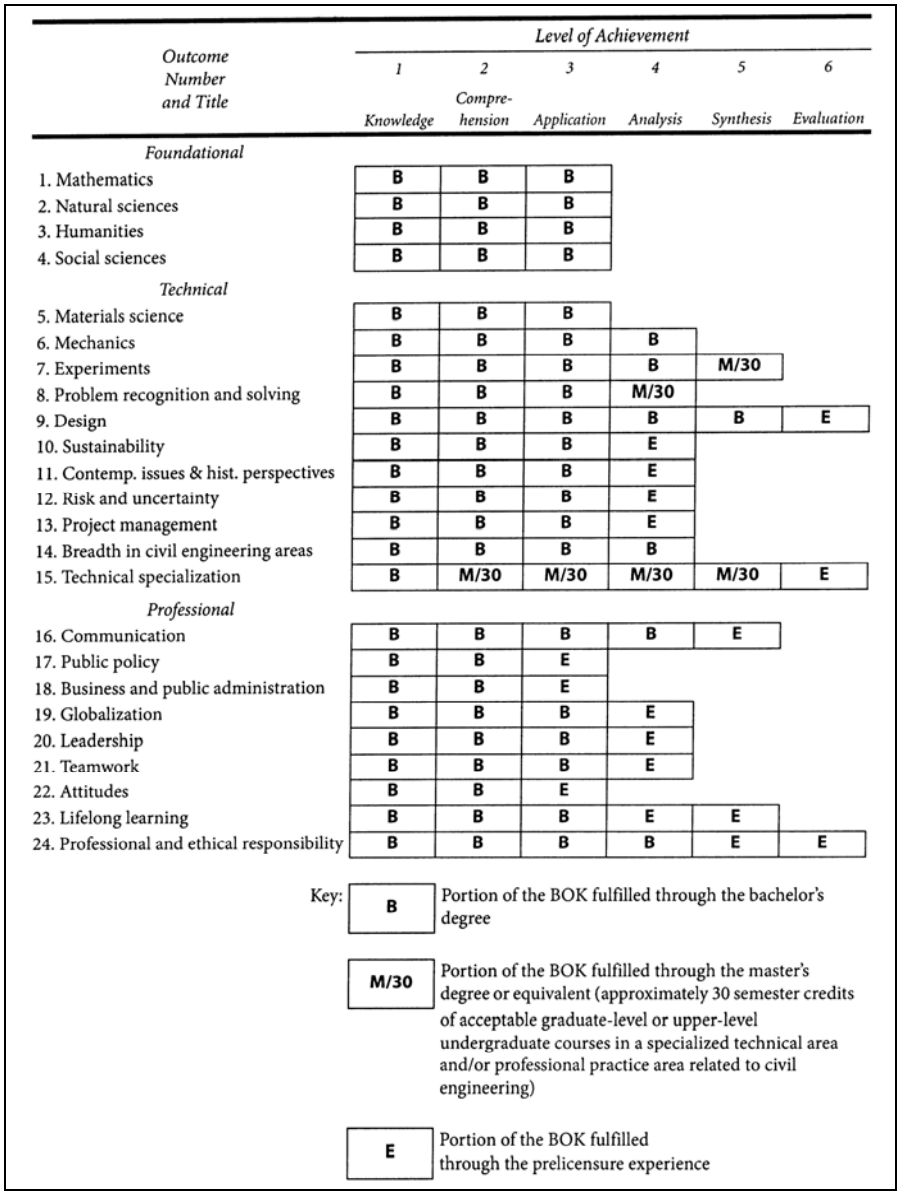
2.6. Transferable Skills

The transferable skills are the skills necessary for the practice of engineering, and which are applicable more widely; these should be developed within the programme.

SECTION 3. CIVIL ENGINEERING BODY OF KNOWLEDGE FOR THE 21ST CENTURY

The American Society of Civil Engineering have produced a document entitled “Civil Engineering Body of Knowledge for the 21st Century” [4]. This comprehensive document addresses the necessary educational response to the essential changes what are expected to occur in the practice of Civil Engineering in the 21st Century.

Of particular relevance to this report is Figure 2, (Figure ES-1 in the original document) to Body of Knowledge (BOK) will be fulfils by mean of toward education an experience through the 1st and 2nd cycle process, the role of the two cycles is shown in the Figure. In attempt to compare the BOK to EUR-ACE, Table 1 which has been reproduced by BOK shows the 24 BOK outcomes. These are more detailed that the EUR-ACE outcomes of section 2. However the essential details of the OBE approach have been maintained in both frameworks.



Outcome Number and Title	Level of Achievement 1 Knowledge	2 Comprehension	3 Application	4 Analysis	5 Synthesis	6 Evaluation
Foundational						
1. Mathematics	B	B	B			
2. Natural sciences	B	B	B			
3. Humanities	B	B	B			
4. Social sciences	B	B	B			
Technical						
5. Materials science	B	B	B			
6. Mechanics	B	B	B	B		
7. Experiments	B	B	B	B	M/30	
8. Problem recognition and solving	B	B	B	M/30		
9. Design	B	B	B	B	B	E
10. Sustainability	B	B	B	E		
11. Contemp. issues & hist. perspectives	B	B	B	E		
12. Risk and uncertainty	B	B	B	E		
13. Project management	B	B	B	E		
14. Breadth in civil engineering areas	B	B	B	B		
15. Technical specialization	B	M/30	M/30	M/30	M/30	E
Professional						
16. Communication	B	B	B	B	E	
17. Public policy	B	B	E			
18. Business and public administration	B	B	E			
19. Globalization	B	B	B	E		
20. Leadership	B	B	B	E		
21. Teamwork	B	B	B	E		
22. Attitudes	B	B	E			
23. Lifelong learning	B	B	B	E	E	
24. Professional and ethical responsibility	B	B	B	B	E	E

Key:

B — Portion of the BOK fulfilled through the bachelor's degree

M/30 — Portion of the BOK fulfilled through the master's degree or equivalent (approximately 30 semester credits of acceptable graduate-level or upper-level undergraduate courses in a specialized technical area and/or professional practice area related to civil engineering)

E — Portion of the BOK fulfilled through the prelicensure experience

Fig. 2. Entry into the practice of civil engineering at the professional level requires fulfilling 24 outcomes to the appropriate level of achievement [1]

Table 1. Entry into the practice of civil engineering at the professional level requires fulfilling 24 outcomes to the various levels of achievement [4]

Outcome number and title	To enter the practice of civil engineering at the professional level, an individual must be able to demonstrate this level of achievement.
Foundational Outcomes	
1 Mathematics	***Solve*** problems in mathematics through differential equations and ***apply*** this knowledge to the solution of engineering problems. (L3)
2 Natural sciences	***Solve*** problems in calculus-based physics, chemistry, and one additional area of natural science and ***apply*** this knowledge to the solution of engineering problems. (L3)
3 Humanities	***Demonstrate*** the importance of the humanities in the professional practice of engineering (L3)
4 Social sciences	***Demonstrate*** the incorporation of social sciences knowledge into the professional practice of engineering. (L3)
Technical Outcomes	
5 Materials science	Use knowledge of materials science to ***solve*** problems appropriate to civil engineering. (L3)
6 Mechanics	**Analyze** and solve problems in solid and fluid mechanics. (L4)
7 Experiments	***Specify*** an experiment to meet a need, conduct the experiment, and analyze and ***explain*** the resulting data. (L5)
8 Problem recognition and solving	***Formulate*** and solve an ill-defined engineering problem appropriate to civil engineering by ***selecting*** and applying appropriate techniques and tools. (L4)
9 Design	***Evaluate*** the design of a complex system, component, or process and ***assess*** compliance with customary standards of practice, user's and project's needs, and relevant constraints. (L6)
10 Sustainability	***Analyze*** systems of engineered works, whether traditional or emergent, for sustainable performance. (L4)
11 Contemporary issues and historical perspectives	***Analyze*** the impact of historical and contemporary issues on the identification, formulation, and solution of engineering problems and ***analyze*** the impact of engineering solutions on the economy, environment, political landscape, and society. (L4)
12 Risk and uncertainty	***Analyze*** the loading and capacity, and the effects of their respective uncertainties, for a well-defined design and ***illustrate*** the underlying probability of failure (or nonperformance) for a specified failure mode. (L4)

Table 1 continued

13 Project management	***Formulate*** documents to be incorporated into the project plan. (**L4**)
14 Breadth in civil engineering areas	***Analyze*** and solve well-defined engineering problems in at least four technical areas appropriate to civil engineering. (**L4**)
15 Technical specialization	***Evaluate*** the design of a complex system or process, or ***evaluate*** the validity of newly created knowledge or technologies in a traditional or emerging advanced specialized technical area appropriate to civil engineering. (**L6**)
Professional Outcomes	
16 Communication	***Plan, compose,*** and ***integrate*** the verbal, written, virtual, and graphical communication of a project to technical and non-technical audiences. (**L5**)
17 Public policy	***Apply*** public policy process techniques to simple public policy problems related to civil engineering works. (**L3**)
18 Business and public administration	***Apply*** business and public administration concepts and processes. (**L3**)
19 Globalization	***Analyze*** engineering works and services in order to function at a basic level in a global context. (**L4**)
20 Leadership	***Organize*** and ***direct*** the efforts of a group. (**L4**)
21 Teamwork	***Function*** effectively as a member of a multidisciplinary team. (**L4**)
22 Attitudes	***Demonstrate*** attitudes supportive of the professional practice of civil engineering. (**L3**)
23 Lifelong learning	***Plan*** and ***execute*** the acquisition of required expertise appropriate for professional practice. (**L5**)
24 Professional and ethical responsibility	***Justify*** a solution to an engineering problem based on professional and ethical standards and ***assess*** personal professional and ethical development. (**L6**)

SECTION 4. EUCEET (EUROPEAN CIVIL ENGINEERING AND TRAINING)

The EUCEET Thematic network has coordinated several studies during the first and second phases of his existence (EUCEET I and EUCEET II). The current phase, EUCEET III, is examining frameworks of qualifications with particular application in Civil Engineering education.

The study of working group SPI in EUCEET II produced a core curriculum for Civil Engineering, which was agreed by the network members [6]. Table 2 shows a list of 25 subjects which forms recommended core curricula. The list is not exhaustive but contains the most important subjects what should be included in the education of Civil Engineering within the first and second cycle.

Table 2

No	CORE SUBJECTS IN CURRICULA FOR CIVIL ENGINEERING	Credits for course:		
		Integrated	Two-tier system	
		10 sem	1st cycle 8 sem	2nd cycle 2 sem
1.	Mathematics and Applied Mathematics	19.0-27.0	13.0-19.0	5.0-7.0
2.	Applied Chemistry	3.0-4.0	2.5-3.5	
3.	Applied Physics	5.5-7.5	4.5-6.5	
4.	Computer Science and Computational Methods in C.E.	7.0-9.0	5.5-7.5	1.5-2.5
5.	Drawing and Descriptive Geometry	4.0-6.0	3.5-4.5	
6.	Mechanics	5.5-7.5	4.5-5.5	1.0
7.	Mechanics of Materials	8.0-11.0	6.5-8.5	1.5-2.5
8.	Structural Mechanics	9.0-13.0	7.0-10.0	1.5-2.5
9.	Fluid Mechanics & Hydraulics	5.0-7.0	4.5-6.5	1.0
10.	Engineering Surveying	4.5-6.5	4.0-6.0	1.0
11.	Building Materials	5.5-7.5	4.5-6.5	1.0
12.	Buildings	3.5-5.5	3.5-4.5	
13.	Basis of Structural Design	3.5-5.5	3.5-5.5	
14.	Engineering Geology	3.5-4.5	3.0-4.0	
15.	Soil Mechanics and Geotechnical Engineering	7.5-10.5	5.5-7.5	1.5-2.5
16.	Structural Concrete	8.0-11.0	6.0-9.0	1.5-2.5
17.	Steel structures	6.5-9.5	5.0-7.0	1.5-2.5
18.	Timber, Masonry and Composite Structures	3.5-5.5	3.0-4.0	
19.	Transportation Infrastructure	3.5-5.5	3.5-4.5	
20.	Urban and Regional Infrastructure	2.5-3.5	2.5-3.5	
21.	Water Structure and Water Management	3.5-5.5	3.0-4.0	
22.	Construction Technology & Organisation	6.0-8.0	4.5-6.5	1.5-2.5
23.	Economics and Management	6.0-9.0	5.0-7.0	1.5-2.5
24.	Environmental Engineering	3.5-5.5	3.5-4.5	
25.	Non-technical subjects	7.5-10.5	5.0-7.0	2.0-4.0
Core subjects total		**175.0**	**140.0**	**30.0**
Specialisation subjects total		**125.0**	**100.0**	**30.0**
Total		**300.0**	**240.0**	**60.0**

The approach adopted by the working group SP1 contained a content-based curriculum and OBE based review methodology. These approaches were complementary and ask attention. Thus a clear framework has been defined within the ECEET Thematic Network.

SECTION 5. TUNING - QUESTIONS FOR PROGRAMME DESIGN AND PROGRAMME DELIVERY, MAINTENANCE AND EVALUATION IN THE FRAMEWORK OF THE BOLOGNA REFORM

Both ECEET II and EUCEET III have been involved in the project. An exercise was conducted during EUCEET II to establish the generic and subject specific competences in civil engineering programs. Academic employees and graduates were asked to express their views in respect of set of questions.

Table 3. Generic Competences

Competence number	Shorter label	Descriptor
1.	work in an interdisciplinary team	Ability to work in an interdisciplinary team
2.	diversity and mulficulturality	Appreciation of diversity and multiculturality
3.	knowledge area	Basic knowledge of the field of study
4.	knowledge profession	Basic knowledge of the profession
5.	analysis and synthesis	Capacity for analysis and synthesis
6.	applying knowledge in practice	Capacity for applying knowledge in practice
7.	generating new ideas	Capacity for generating new ideas (creativity)
8.	adapt to new situations	Capacity to adapt to new situations
9.	learn	Capacity to learn
10.	critical abilities	Critical and self-critical abilities
11.	decision-making	Decision-making
12.	computing skills	Elementary computing skills (word processing, database, oth
13.	ethical commitment	Ethical commitment
14.	interpersonal skills	Interpersonal skills
15.	second language	Knowledge of a second language
16.	oral and written communication	Oral and written communication in your native language
17.	research skills	

Table 4. Specific competences

Competence number	Shorter label	Descriptor
1.	To apply knowledge of mathematics	An ability to apply knowledge of mathematics and other basic subjects
2.	The mechanics, applied mechanics	An ability to use knowledge of mechanics, applied mechanics and of other core subjects relevant to civil engineering
3.	To design a system to meet desired needs	An ability to design a system or a component to meet desired needs
4.	To solve common civil engineering problems	An ability to identify, formulate and solve common civil engineering problems
5.	To solve complex civil engineering problems	An ability to identify, formulate and solve complex civil engineering problems
6.	The interaction between technical and environmental	An understanding of the interaction between technical and environmental issues and ability to design and construct environmentally friendly civil engineering works
7.	To design and conduct experiments,	An ability to design and conduct experiments, as well as analyse and interpret data
8.	To identify research needs and necessary resources	An ability to identify research needs and necessary resources
9.	To use the techniques, skills and modem tools	An ability to use the techniques, skills and modern engineering tools, including IT, necessary for engineering practice
10.	To apply knowledge in a specialized area	An ability to apply know ledge in a specialised area related to civil engineering
11.	The management of common works	An understanding of the elements of project and construction management of common civil engineering works
12.	The management of complex works	An understanding of the elements of project and construction management of complex civil engineering works
13.	The professional and ethical responsibility	An understanding of professional and ethical responsibility of civil engineers
14.	The impact of solutions	An understanding of the impact of solutions for civil engineering works in a global and societal context
15.	To communicate effectively	An ability to communicate effectively
16.	The role of the leader	An understanding of the role of the leader and leadership principles and attitudes
17.	The need for life-long learning	A recognition of the need for. and the ability to engage in, life-long learning

18.	To function in multi-disciplinary teams	An ability to function in multi-disciplinary teams

In order to provide comprehensive guidance for the design of programs the following tables provide information on the items and key questions what should be considered. When the contents of this table are generic, the information provided in the previous sections of this Report, can be used in a Civil Engineering specific approach.

Table 5

Items	Key questions
Degree profile	• Has the **need for and the potential** of the (new) degree programme been established comprehensively fully and clearly? • Does it aim to satisfy established or new professional and/or social demands? • Was there a **consultation** with stakeholders? Did they identify the need for the degree programme? • Was the **approach** used for the **consultation adequate?** Were the groups selected relevant ones for the degree programme considered? • Are the **definition** of the profile, the identification of the **target groups** to be address and its place in the national and international setting **clear?** • Is there convincing evidence that the profile will be **recognized** in terms of **future employment?** Is it related to a specific professional or social context?
Learning outcomes	• Have **clear and adequate learning outcomes** been identified at the level of the programme as a whole and of each of its components? • Will they result in **the profile** identified? Are they adequately distributed over the various parts of the programme? • Is the progression and coherence of the programme and its units sufficiently guaranteed? • Are the learning outcomes **formulated in terms of subject-specific and generic** com**petences** covering knowledge, understanding, skills, abilities and values? • What guarantee is there that the learning outcomes will be **recognized and understood** within and outside Europe?

Competences	• Are the **competences** to be obtained by the student clearly **identified and formulae** both subject-specific and generic? • Is the **level** of the competences to be obtained appropriate for this specific degree programme? • Are the competences to be gained expressed in such a way that they can actually **be measured?** • Is **progression guaranteed** in the development of the competences? • Can the competences obtained be assessed adequately? Is the **methodology of assessment** of the competences clearly specified and suitable for the **expressed learning outcomes?** • Are the approaches chosen for **learning and teaching** the competences clearly **spe| tied?** What evidence is there to assure that the results will reached? • Are the approaches chosen sufficiently **varied and innovative / creative?** • Are the competences identified **comparable and compatible** with the **European reference points** relative to the subject area? (if applicable)
Level	• Has the **entrance level** of potential students been taken into consideration when identifying their learning needs? • Does the level of learning outcomes and competences correspond to the **level(s)** of degree (cycle) foreseen in the **European and National Qualification Framework** • If sublevels are included, are these described in terms of learning outcomes expressed in competences? • Are levels described in terms of: - acquiring knowledge, understanding, skills and abilities - applying knowledge, understanding, skills and abilities in practice - making informed judgments and choices- - communicating knowledge and understanding - capacities to continue learning

Credits and Workload	• Is the degree programme **ECTS based?** Is it in alignment with the **ECTS key feature?** • Have **credits** been allocated to the programme? How is the adequacy of this **allocation** guaranteed? • How are credits related to the **learning outcomes** of this programme? • How is the **correlation** between **workload and credit** allocation checked? • How is a **balanced** student workload guaranteed during each learning period in term of learning, teaching and assessment activities? • What mechanisms are used for **revision** of credit allocation and learning, teaching and assessment activities? How are the students involved in this process? • Is **information** on the programme (modules and/or course units) presented as described in the **ECTS Users' Guide?** • How is **student mobility** facilitated in the programme? • How are **students advised** about mobility? • How are the **key documents of ECTS** used for mobility? • Who is responsible for **recognition** and which are the procedures used?
Resources	• How is the **formal acceptance** of the programme and the resources required to deliver it, guaranteed? • Is the staffing (academic and supporting staff and workplace supervisors) for deliver the programme guaranteed? Does the programme require the use of teaching staff from outside the department/institution? • Is **staff development** foreseen in terms of (new) approaches to learning, teaching or assessment? • How are the necessary **structural, financial and technical means** (class rooms, equipments, health and safety procedures etc.) guaranteed? In the case of workplace learning/placements, are there sufficient and suitable **placements** guaranteed?

Programme delivery, maintenance and evaluation
Table 6

Monitoring	• How is **the quality of delivery** of the programme and its components monitored? • How is **staff quality and motivation** for the delivery of the programme monitored? • Are there systems in place to **evaluate** the quality of the learning environment in **work** place learning/placements? • Is the quality of class rooms and the equipment (including workplace environment required to deliver the programme sufficient? • How is the entrance level of potential students monitored? • How is student performance monitored in terms of quality of learning outcomes to be obtained / competences to be achieved and time required to complete the programme and its components?
Updating	• How is the system for updating / revision of the degree programme organized? • In what way can changes related to external developments in society be incorporate in the programme? • How is staff development related to programme updating organized and guaranteed
Sustainability and responsibility	• How is the sustainability of the programme guaranteed? • How is it guaranteed that the relevant bodies take responsibility for sustaining and updating of the programme?
Organisation and Information	• How is the updating of information regarding the degree programme organized and guaranteed? • How is the adequacy of the system of student support, advising and tutoring ensured? • Is a Diploma Supplement issued to the students automatically and without charge in widely spoken European language?

SECTION 6. EXEMPLES OF GOOD PRACTICES

6.1. Programme specification for Bachelor in Civil Engineering taught at City University, UK

PROGRAMME SPECIFICATION - BEng Civil Engineering

Introduction
This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. More detailed information on the learning outcomes, content and teaching, learning and assessment methods of each module can be found in the programme handbook. The accuracy of the information contained in this document is regularly reviewed by the University.

The specification also shows how the programme outcomes can be related to the outcomes given in the QAA's subject benchmark statement by indication with: **(B)**.

1. AWARDING INSTITUTION	City University	**AWARD NAME** BEng (Hons) Civil Engineering
2. TEACHING INSTITUTION	City University	**AWARD HIERARCHY**
3. HOME SCHOOL	School of Engineering and Mathematical Sciences	**Award** / **Rank** BEng (Hons) 1 BEng 2 Diploma HE 3 Certificate HE 4
4. UCAS CODE	H200	
5. QAA BENCHMARKING GROUP(S)	Engineering	
6. DATE OF INTRODUCTION	21 NOV 2002	
7. DATE OF REVIEW/APPROVAL	27 FEB 2003	
8. ADDITIONAL AWARD TITLES	Civil Engineering with Approved Industrial Placement (USCIPB)	

9. ADMISSIONS REQUIREMENTS, INCLUDING AP(E)L ARRANGEMENTS (WHERE APPLICABLE)

Typical offers:
A/AS-level: At least 230 UCAS tariff points (160 of which to come from 6/12 unit awards), including A-level mathematics at grade C or above
BTEC: 7 Merits, including mathematics at level (NIII) N/H or level H
IB: 26 including mathematics at higher level
Irish Leaving Certificate: BBCC at higher honours level including mathematics at grade C or above
Successful completion of the Westminister-Kingsway engineering foundation course
Successful completion of other equivalent engineering foundation courses

AP(E)L:
Direct entry into Part 2 will normally be considered for students who satisfy one of the following:
Successful completion of the first year of a similar accredited BEng course
HND in Civil and Structural Engineering with 6 Merits, including mathematics at level H
NCEA Diploma at Merit Grade 2 or above
Other HND equivalencies (e.g. Cyprus, Hong Kong and Singapore Diplomas)

10. EDUCATIONAL AIMS

The programme aims to produce graduates who:

- are equipped to pursue effective careers in industry, the professions and public service
- are equipped to solve technical problems with confidence
- are able to apply problem solving skills to design problems
- are able to communicate effectively
- have a practical understanding of management in a professional environment
- are capable of taking into account wider issues relating to the practice of Civil Engineering

Learning Outcomes: Subject Knowledge and understanding

Knowledge and Understanding

- PA1 Comprehensive knowledge and understanding of analytical engineering subjects(B)
- PA2 Wide knowledge of Civil Engineering operations(B)
- PA3 An understanding of the design process and the ability to carry out a design task(B)
- PA4 A good understanding of management principles as applied to engineering(B)
- PA5 An awareness of the role of the professional engineer and the wider issues relating to society, the environment and sustainability(B)

Learning and teaching methods

Acquisition of core knowledge and understanding (PA1 to PA4) is achieved mainly through lectures, tutorials, laboratories and coursework. Learning is consolidated through design projects, field trips and industrial visits.

Acquisition of PA5 is through lectures, essay type coursework and industrial visits.

Students are encouraged to join the Institution of Civil Engineers. Membership provides an opportunity for them to consolidate and broaden their knowledge and understanding through independent reading and attendance at external lectures and events.

Assessment Methods

Assessment is through unseen written examinations, seen and unseen tests, coursework and design projects(PA1 to 5).

Learning Outcomes: Skills and other attributes

Cognitive/intellectual

- PC1 Plan, conduct and report work of an investigative nature
- PC2 Use analytical and experimental techniques to solve problems in engineering (B)
- PC3 Design a system or element to meet specifications taking a range of constraints into account (B)
- PC4 Synthesize and evaluate critically, information and data from various sources (B)

Learning and teaching methods

Cognitive/intellectual skills are promoted via lectures, tutorials, experimental work, design classes and individual projects.

Analytical and problem solving skills are developed through worked examples, tutorial sheets and examination questions.

Research, design and experimental skills are developed through individual and group projects and through laboratory work.

Assessment Methods

Analysis and problem solving is assessed through unseen written examinations, seen and unseen tests, and coursework.

Research, design and experimental skills are assessed through individual and group projects reports and presentations.

Learning Outcomes: Values and attitudes

Values and Attitudes	Learning and teaching methods
PB1 Maintain a professional engineering attitude PB2 Enhance the welfare, health and safety of the community through engineering solutions.	Values and attitudes are promoted through industrial involvement, design projects and essay type coursework. **Assessment Methods** The learning outcomes are not directly assessed.

13. PROGRAMME STRUCTURE, LEVELS, MODULES, CREDITS AND AWARD REQUIREMENTS

Parts	Credit Value
1	125
2	130
3	135

Programme Structure Summary Description

The programme, which is only offered as a full time course, is divided into three Parts (Parts 1, 2 and 3), each occupying a full academic year. The programme normally lasts for three years and leads to a BEng degree that is accredited by the Institution of Civil Engineers and the Institution of Structural Engineers. At the end of Part 2, students who meet the required criteria have the option of transferring to the MEng (Hons) degree. Students who wish to gain practical experience have the option of spending a year on paid industrial placement, usually between Parts 2 and 3.

The core civil engineering subject areas, Structures, Geotechnics, and Hydraulics are studied in all years of the programme. Mathematics, Surveying and Management are the other key subjects areas. Design, which runs through from Part 1 to Part 3, is at the heart of the course and it correlates the theoretical concepts studied in each part with the practical experience gained.

Industrial involvement is a key feature of the programme. Lecturers from industry are invited to make presentations in all parts of the programme. In Parts 2 and 3 of the programme, design projects, which familiarise students with professional practice, are set and reviewed by practicing consulting engineers. Students are encouraged to take up opportunities available through the Open Door to Industry scheme and organised site visits.

Mode of delivery	Duration in years
Full Time	3
Full Time (Sandwich)	4

Part 1

Programme Structure

Part 1 consists of 10 compulsory HE1 level modules, totalling 125 credits. Students are required to take all modules at this level.

The Geology module includes a compulsory residential field trip.

Modules are assessed by written examinations, tests, coursework, and laboratory and design reports. Submission dates for coursework, laboratory and design reports, which are assessed throughout the year, are published in a coursework schedule. Seen and unseen tests are carried out at the start of the second term and unseen examinations take place in the third term.

Students are required to take the following core modules in this part:

Group	Code	Title	Level	Credit Value	Compensation Permissible
COM1	CV1301	Geology for Engineers	1	20	N
COM1	CV1302	Hydraulics	1	10	N
COM1	CV1303	Structural Mechanics	1	20	N
COM1	CV1304	Surveying & Statistics	1	5	N
COM1	CV1305	Design & Graphics	1	15	N
COM1	CV1306	Materials	1	15	N
COM1	CV1307	IT Computing & CAD	1	10	N
COM1	CV1308	Civil Engineering Practice	1	5	N
COM1	ET1051	Engineering Management 1	1	5	N
COM1	EX1001	Engineering Mathematics 1	1	20	N

Outcomes developed/assessed in this Part include:

PA1	Comprehensive knowledge and understanding of analytical engineering subjects(B)
PA2	Wide knowledge of Civil Engineering operations(B)
PA3	An understanding of the design process and the ability to carry out a design task(B)
PA4	A good understanding of management principles as applied to engineering(B)
PA5	An awareness of the role of the professional engineer and the wider issues relating to society, the environment and sustainability(B)
PB1	Maintain a professional engineering attitude
PB2	Enhance the welfare, health and safety of the community through engineering solutions.
PC1	Plan, conduct and report work of an investigative nature
PC2	Use analytical and experimental techniques to solve problems in engineering (B)
PC3	Design a system or element to meet specifications taking a range of constraints into account (B)
PC4	Synthesize and evaluate critically, information and data from various sources (B)
PD1	Plan and carry out experimental work(B)
PD2	Use a range of laboratory equipment to obtain data, carry out an analysis of it and comment on the results(B)

PD3	Prepare technical reports and drawings, and make technical presentations(B)
PD5	Use computer packages for analysis and design(B)
PE1	Communicate effectively through writing, drawings and oral presentations(B)
PE2	Solve problems using analytical and mathematical skills(B)
PE3	Work effectively in teams(B)
PE4	Make use of Information Technology tools(B)
PE5	Manage resources and time(B)

Requirements for progression to the next part and interim award regulations

PB2	Enhance the welfare, health and safety of the community through engineering solutions.
PC1	Plan, conduct and report work of an investigative nature
PC2	Use analytical and experimental techniques to solve problems in engineering (B)
PC3	Design a system or element to meet specifications taking a range of constraints into account (B)
PC4	Synthesize and evaluate critically, information and data from various sources (B)
PD1	Plan and carry out experimental work(B)
PD2	Use a range of laboratory equipment to obtain data, carry out an analysis of it and comment on the results(B)
PD3	Prepare technical reports and drawings, and make technical presentations(B)
PD4	Interrogate published scientific literature effectively(B)
PD5	Use computer packages for analysis and design(B)
PE1	Communicate effectively through writing, drawings and oral presentations(B)
PE2	Solve problems using analytical and mathematical skills(B)
PE3	Work effectively in teams(B)
PE4	Make use of Information Technology tools(B)
PE5	Manage resources and time(B)

Requirements for progression to the next part and interim award regulations

Class I minimum 70%
Class II Upper Division minimum 60%
Class II Lower Division minimum 50%
Class III minimum 40%

Award of Ordinary Degree
To qualify for the Ordinary Degree of the same title as the Honours degree, the student must satisfy the requirements for Part 1 and have failed no more than 20 credits at Part 2. Additionally, the student must have acquired at least 60 credits at Level HE3 and achieve a minimum of 300 credits overall.

Curriculum map

The map is intended to identify where the programme outcomes are being developed and assessed within the programme. It also helps students n own learning, personal & professional development. The map shows only the main measurable learning outcomes.

Part 1	PA1	PA2	PA3	PA4	PA5	PB1	PB2	PC1	PC2	PC3	PC4	PD1	PD2	PD3	PD4	PD5	PE1	PE2	PE3	PE4	PE5
EX1001	x								x									x			
ET1051				x	x												x				
CV1301	x					x			x		x	x		x			x	x	x		x
CV1303	x								x			x	x					x			
CV1304	x								x			x	x					x	x	x	
CV1305			x		x	x	x	x		x	x			x			x		x	x	x
CV1306	x								x			x	x							x	
CV1307														x		x	x			x	
CV1308		x		x	x												x				
CV1302	x								x			x	x					x			

Part 2	PA1	PA2	PA3	PA4	PA5	PB1	PB2	PC1	PC2	PC3	PC4	PD1	PD2	PD3	PD4	PD5	PE1	PE2	PE3	PE4	PE5
EX2002	x								x												
CV2301	x		x						x			x	x	x			x	x		x	
CV2302	x								x			x	x	x				x			
CV2303	x											x	x			x		x		x	
CV2304	x								x			x	x	x		x		x	x	x	
CV2305		x	x		x	x	x	x		x	x			x	x	x	x		x	x	x
CV2306			x						x	x	x			x		x	x	x		x	x
CV2307	x								x							x				x	
CV2318		x		x													x				
Options																					

Part 3	PA1	PA2	PA3	PA4	PA5	PB1	PB2	PC1	PC2	PC3	PC4	PD1	PD2	PD3	PD4	PD5	PE1	PE2	PE3	PE4	PE5
CV3303	x								x		x					x		x			
CV3301	x					x	x	x	x	x	x	x	x		x	x		x		x	
CV3302	x		x		x	x	x	x	x	x	x	x	x			x		x		x	

Part 3	PA1	PA2	PA3	PA4	PA5	PB1	PB2	PC1	PC2	PC3	PC4	PD1	PD2	PD3	PD4	PD5	PE1	PE2	PE3	PE4	PE5
CV3305		x	x		x	x	x	x	x	x	x			x		x	x	x	x	x	x
CV3308		x		x													x				
CV3309		x			x	x	x	x			x				x		x			x	x
CV3310		x			x	x	x	x						x							
Options	x		x		x				x	x			x			x		x			

6.2 Example of Basic information on the course at Civil Engineering Faculty, Technical University of Cluj-Napoca, ROMANIA English medium

Earthquake engineering Subject presentation form

UNIVERSITATEA TEHNICĂ DIN CLUJ-NAPOCA

SUBJECT PRESENTATION FORM

Subject name	**Earthquake Engineering**
Field of study	Civil Engineering
Main field of study	Civil, Industrial and Agricultural Constructions
Subject code	41304208
Subject main teacher	Professor Doina VERDES
Colaborators	Eng. Claudia TURCU
Department	Civil Buildings and Foundations
Faculty	**Civil Engineering**

Sem.	Type of subject	Course	Applications			Course	Applications			Individual Study	TOTAL	Credits	Type of examination
		[classes/week]				[classes/semester.]							
			S	L	P		S	L	P				
	Specialisation	2		2	-	28		28		48	-	104	Exam

Prerequisits:
Theoretical knowledge, (What the students must know)
- to understand the earthquake's mechanism and the territory's seismicity; - to know the seismic response of buildings using elastic and inelastic analyses - know and understand specific criteria for earthquake resistant design - new systems for seismic protection of buildings
Achieved skills
The computation of seismic response for various structural systems; The basis of buildings and structural elements design complying with seismic design principles, The modern seismic protection systems.
Achieved abilities: (What types of equipments and instruments they know how to use)
•to calculate the seismic response of single and multi level buildings having the structural system with moment resistant frames and shear walls •to calculate the seismic forces including the torsion effect -to use the laboratory shake table testing equipment

Previous requirements (if necessary)
Dynamics, Mechanics, Reinforced Concrete

A. Course	
1.	Basics of seismological and engineering study of the earthquakes
2.	Linear Seismic response of Single Degree of Freedom System
3.	Nonlinear Seismic response of Single Degree of Freedom System
4.	Linear Seismic response of Multi Degree of Freedom System
5.	Nonlinear Seismic response of Multi Degree of Freedom System
6.	Basics of conceptual design of buildings
7.	The torsion effect on the structural system
8.	The concepts of seismic protection: traditional design to accomplish the requirements for ductility, resistance and strength.
9.	The displacement analysis and nonstrctural elements
10.	The Basics of seismic response control
11.	The passive control systems
12.	The base isolation
13.	The active control systems
14.	The hybrid control systems

B1. Applications – WORKS (list of works, seminar works, contents of the year end project)	
1.	The submitting of the seismic Code P100-2006
2.	The seismic response for a cantilever roof structure –the equivalent static seismic load
3.	The calculation of the equivalent static seismic force for a one level building – industrial building
4.	The calculation of the seismic response of an one level building using numerical integration procedure: the Vrancea 1977 earthquake

5.	The seismic response for a multi level reinforced concrete framed structure – calculation of the base equivalent seismic load
6.	The calculation of seismic level loads
7.	The calculation of the level stiffness
8.	The calculation of the torsion effect
9.	The distribution of seismic load to the vertical structural system
10.	The seismic response for a multilevel reinforced concrete shear walls structure
11.	The calculation of seismic level loads
12.	The calculation of the torsion effect
13.	The practical laboratory work: the seismic response of a system with one mass attached dumper ; the presentation of the installation
14.	The test on the shake table of the one mass attached damper system.

B2. Laboratory room (Room/surface, address) Room 212 Baritiu 25/40 sqm

Equipment	Equipment description	Year of purchase
- Shake table	•Facilitates hands-on student involvement •Downloads and replays real-life earthquake data from various motion databases •Integrates high-performance Real-time Control ;Includes Extensive Data Acquisition features •Several optional structures for extended capabilities; Features Single (x-axis) configurations; Supports LabView or MATLAB & Simulink software for highly flexible, diverse functionality	2008

C. Individual study (topics of the bibliographical studies, summarized materials, projects, applications etc.)

1. The seismic response of the 1DOF and MDOF sistems using the procedure of statical equivalent force. The seismic design of reinforced concrete structures. Systems for seismic protection of the buildings.

Structure of the Individual study	Course study	Solving homeworks, labs, projects	Training, applications	Time allowed for examinations	Bibliographical supplementary study	Total number of classes for individual study
No. of classes	30	5		10	3	48

D. Teaching methods and strategies

- Lectures starts with the subject to be discussed and its connection in the general context of the course;
- The new issues are demonstrated through demonstrations performed step-by-step at the blackboard, in order to give an understanding of the physical phenomenon and the calculation model;
- Interactive style (questions and answers);
- Continuous learning: each week the students must solve a homework which represent a base for the evaluation of their activity;

Tutorial activity: 1 hour/week, individual or group consultations.

Examination procedure	The examination consists in a written test and oral defence of the laboratory works (applications – 2 hours and theory – 2 hours).
Components of the grade	Theory (note T); Lab Applications (note A);
Formula for calculating the grade	N=0,7T+0,3A; Condition: T≥5 , A≥5

Bibliography

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2. Al Negoita si colectiv – Inginerie Seismica, EDP 1985
2. James KELLY - Resistant Earthquake Design with Rubber, second edition, Springer 1997
4. The P100-Romanian Code for earthquake resistant design of dwellings and buildings 2006
7. James KELLY - Resistant Earthquake Design with Rubber, second edition, Springer 1997
8. Y. Bozorgnia, Vitelmo Bertero - Earthquake engineering: from engineering seismology to performance-based engineering, CRC Press, London, New York, Washington DC, 2005
9. Anil CHOPRA - Dynamics of Structures – Theory and applications to Earthquake engineering, Prentice Hall, 2007

Exemple of the Sillabus
The fourth year of study – first cycle

TECHNICAL UNIVERSITY OF CLUJ-NAPOCA
THE FACULTY OF CIVIL ENGINEERING
FIELD: CIVILE ENGINEERING
SPECIALISATION

VALID FROM

SYLLABUS

Nr. crt	Cod	Name of the subject	Commun with	Forth year Sem 7 14 s					Sem 8 14 s					Evaluation			Nr. of hours/subject				Credits/ sem		Notes
				C	S	L	P	P	C	S	L	P	P	E	C	A/R	Tot	C	Apl.	St.ind	1	2	
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18	20	21	22	23
1		CONSTRUCTION MANAGEMENT (I)		2			3							7			130	28	42	60	5		
2		BUILDINGS (III)		2			2							7			130	28	28	74	5		
3		STEEL STRUCTURES (III)		2			2							7			130	28	28	74	5		
4		FOUNDATIONS		3			3							7			156	42	42	72	6		
5		MANAGEMENT AND THE CONSTRUCTIONS ACTIVITIES CONDITIONS		2		2									7		130	28	28	74	5		
6		OPTIONAL COURSE NR.3:		3											7		104	42	0	62	4		
7		STEEL STRUCTURES (III)							2			2		8			130	28	28	74		5	
8		MANAGEMENT AND THE CONSTRUCTIONS ACTIVITIES CONDITIONS							2		1			8			104	28	14	62		4	
9		FIRE SECURITY OF THE CONSTRUCTIONS							2						8		52	28	0	24		2	
10		MIXTES AND COMPOSITES STRUCTURES							1		1				8		52	14	14	24		2	
11		TECHNOLOGY IN CONSTRUCTION ACTIVITY							2						8		78	28	0	50		3	
12		OPTIONAL COURSE NR.IV : INDUSTRIAL AND AGRICULTURAL STRUCTURES							2		2				8		104	28	28	48		4	
13		GRADUATION DIPLOMA PROJECT- OPTIONAL COURSE NR.V										9				8	260	0	126	134		10	
																	1560	350	378	832	30	30	

TOTAL	14	1	5	6	0	9	2	2	13	0
	26					26				
Nr. ex/ Nr. col										

Rector, Dean, Field responsible,

6.3 Course taught at the Civil Engineering Department, Postgraduate Program Aristotle University, Thessalonica, GREECE

“Protection and Restoration of Groundwater”

Protection and Restoration of Groundwater is a course taught at The Postgraduate Program “Environmental Protection and Sustainable Management” of the Civil Engineering Department of the Aristotle University, Thessaloniki, Greece

http://ppva.civil.auth.gr/content/en/courses/ppba6.html

Instructors: Latinopoulos P., Katsifarakis K.

Aim

The acquisition of theoretical and practical knowledge and experience in order to solve problems concerning the protection and restoration of groundwater regarding all crucial cases of harm and types of pollution.

Objectives

After successfully attending the course the postgraduate student should be capable of:

- Distinguishing the various types of pollutants and the degrees of groundwater pollution.
- Understanding the transport mechanisms of the pollutants in aquifers and the importance of the natural and chemical parameters and processes.
- Dealing with and solving problems related to the protection of groundwater
- Applying restoration methods and techniques of groundwater for various types of pollutants and aquifers.

All courses of this program are described in terms of course aim and course objectives.

http://ppva.civil.auth.gr/content/en/program.html
In the Greek version, the course contents are included as well. For example, see:
http://ppva.civil.auth.gr/content/courses/ppba6.html

6.4 Course taught at the Civil Engineering Department, National Technical University of Athens, GREECE

Environmental Geotechnics

The overarching goal of the course is to develop environmental thinking related to (1) assessing the severity of a contaminant release in the subsurface, (2) recognizing the physical-chemical-biological mechanisms that affect the fate and transport of the released contaminant and, (3) selecting appropriate remedial measures and/or technologies.

Course objectives are met if at the end of the semester students:

(a) can locate reliable data on the effects of contaminants on human health,

(b) are confident in applying principles of mass transfer, groundwater flow and contaminant transport to problems of contamination and restoration of the subsurface,

(c) are able to address the geoenvironmental aspects of landfill and clay barrier design, (d) are familiar with a wide range of remediation technologies,

(e) are able to take initiatives related to modeling (i.e., related to the formulation of a simplified problem that admits solution) and,

(f) are aware of some social or public policy dimensions of subsurface contamination and restoration problems.

Course contents include the following. Cases of restoration of contaminated sites. Legislation. Sources and characteristics of contaminants. Risk assessment. Groundwater flow. Soil-contaminant interaction. Mechanisms affecting the fate of contaminants, contaminant transport, applications (practice in the use of an educational software in the School’s PC lab). Landfill liner design and materials. Remediation technologies for contaminated sites.

Instructor: Marina Pantazidou

Environmental Geotechnics is a course taught at the 5th year of the Civil Engineering School, National Technical University of Athens, Greece

Course website (material in Greek): http://www.civil.ntua.gr/ggeotechenviron/

6.5 Specialisation Post Master taught at the Higher Institute of Building and Public Works (ISBA-TP) of Marseille (FRANCE) : Bridges design or Infrastructure and Geotechnical design.

Outcome Based Courses

National Qualifications Board **Summary Description of the Certification**	

Title

Ingénieur Diplômé de l'Institut Supérieur du Bâtiment et des Travaux Publics Spécialité « ouvrages d'art »	
Authority responsible for certification	**Quality (es) signatory (s) of certification**
Higher Institute of Building and Public Works	Higher Education Minister Chamber of Commerce President ISBA-TP Dean

Summary of reference or job skills acquired elements

List of activities covered by the diploma, title or certificate :

The Higher Institute of Building and Public Works aims to specialise and certify qualified engineers. They can perform the following tasks, classified by type of position in civil engineering and construction :

Structural engineers in design department or control office :

- Studies of technical design and construction of buildings, civil works or bridges
- MOT
- Technical assistance

- Coordination of operations
- Asset Tracking
- Conducting research and development activities

Engineer on construction sites :

- Develop markets
- Negotiates costs with subcontractors
- Organises construction
- Anime oversees and manages the teams work
- Prepares invoices and work situations

Proven skills or abilities :

Certification involves verifying the following qualities:

- Ability to mobilise resources from a wide field of basic sciences.
- Knowledge and understanding of a range of scientific and technical expertise.
- Control methods and tools for engineers : identification and resolution of problems, even in unfamiliar and not completely defined, collection and interpretation of data, use of computer analysis and design of complex systems experimentation.
- Ability to integrate into an organisation, to animate and make the change : commitment and leadership, project management, project contracting, communication with experts as with non-specialists.
- Taking into account the challenges facing industry, economic and business : competitiveness and productivity, innovation, intellectual and industrial property, compliance with quality procedures, safety.
- Ability to work in international environment : control of one or more foreign languages, security, intelligence, cultural openness, international experience.
- Respect for societal values: knowledge of social relationships, environment and sustainable development, ethics.

Knowledge, skills or special abilities developed in the certification :

- Ability to study the feasibility of contracting projects of large scale construction (buildings and structures) including seismic zone;
- Ability to manage these projects by optimising the cost, quality and deadlines and coordinate their implementation;
- Ability to develop technical and administrative assistance to these projects and carry out the study execution;
  - Ability to provide leadership responsibilities of a team study
  - Ability to provide technical expert mission;
  - Knowledge of tools and methods for determining how comprehensive or interim technical processes, methods of organisation and the cost of construction operations;
  - Ability to plan and organise, from a file, the various tools and resources to perform the work, to ensure accountability technical, administrative and budgetary one or more sites.

Companies or types of jobs available by the holder of such diploma, title or certificate :

Companies :

These professionals are employed by construction companies or public works, engineering companies, offices or government control.

Job Type :

Project manager structure in design department or office supervision;
Project leader in construction methods;
Supervisor.

Program Description – 2009/2010	
ISO 9001 V2000 certified by	ISO 9001 DNV n°0016–2004–FR

- Update 18/06/09
- Training Unit : HIGHER INSTITUTE OF BUILDING AND PUBLIC WORKS
- Program Title : Specialisation in Structures Design or Infrastructure and Geotechnical Design.
- Goal : To train senior-level specialised structure calculation of structures or structural calculation in contact with the ground.
- Program design : B. LE TALLEC - G. LAPLACE
- Duration: 1445 hours

- **Courses: (456 hours)**

Common Core				
Subject		Schedule	**Coef**	ECTS
Soil mechanics 1	1 internal teacher	60 H + 10 H	1	2
Earthquake Engineering	2 external teachers	36 H	1	2
Steel structures	1 external teacher	40 H	1	2
Concrete structures 1	1 external teacher	68 H + 10 H	2	2

Structure modelling	1 internal teacher	32 H	1	2
Building design	1 external teacher	36 H	1	2
Construction cost	1 external teacher	24 H	1	1
Construction law	1 external teacher	20 H	1	1
Contracts	1 external teacher	16 H	1	1
English language	Individual work		1	1

Bridges design specialisation				
Concrete structures 2	1 internal teacher	36 H + 4 H	2	3
Bridge design	1 internal teacher 2 external teachers	64 H	2	4

Infrastructures and geotechnical design specialisation				
Soils mechanics 2	2 external teachers	28 H + 4 H	1	2
Marine Works (harbour design)	2 external teachers	28 H	1	2
Tunnels	2 external teachers	28 H	1	2
Dams	1 external teacher	16 H	1	1

- **Lectures and Site visits : (60 hours)**

The Eurocodes – Eurocode 0	4 H - October
Mission of the engineer in Civil Engineering	4 H - October
Eurocode 1	16 H - November
Human resources - EXPECTRA	4 H - November
Prefab concrete products – KP1	4 H - November
Soils consolidation – SOLETANCHE/KELLER	4 H - January
Steel products used in Civil Engineering - Piling - Rolled products - ARCELOR/MITTAL	4 H - January
Site visits	16 H

- **Exams** : (48 h)

- **Final projects** : (300 h)

		Schedule	**Coef**	ECTS
Building project	3 external teachers	150 h	3	10
Specialisation project	1 internal teacher 3 external teachers	150 h	3	10

- **Individual technical study** : (56 h)

- **Company training** : (525 h)

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link : http://www.isba.fr

REFERENCES

[1] Spady W. Outcomes Based Education; Critical issues and answers Arligton , VA; American Association of School administrators, 1994.
[2] http://www.utexas.edu/academic/diia/assessment/iar/glossary.php
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[6] Inquiries into European Higher Education in Civil Engineering EUCEET, Edited by Iacint Manoliu ISBN 973-85112-8-3 Vol.5.-2006.