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Geotechnics Subjects in the Curricula of Civil Engineering Courses in the University of Beira Interior (Portugal)

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ABSTRACT: Paper presents the experiences of the young Portuguese University in adaptation of the subjects from the area of geotechnics to the old 5 years curricula leading to the degree of Engineer as well as to the new courses prepared for the two – cycle education according to Bologna agreement. Division of subjects between 1-st and 2-nd cycle is discussed as well as the proportions of necessary knowledge as distributed between these two cycles are summarised. There are presented difficulties in arrangement of sufficient knowledge of the geotechnics into Civil Engineering Courses of various specializations and necessary compromises with other disciplines, which had to be undertaken in order to include in curricula all necessary subjects in certain limited number of subjects and credit hours, fixed for each of the cycles. Paper contains also some conclusions from this exercise, which was the restructure of present courses into two stage courses and justifies the necessity of expanding of the knowledge of Geotechnics by creation in our University of new specialised courses in the 3-rd cycle. Such suggestion is now under preparation for approval by Portuguese Government. Finally there are presented also the possibilities of expansion of Civil Engineering exchange and mobility of students and faculty between UBI and other European Universities.

1 INTRODUCTION

Civil Engineering course at UBI was established only a dozen or so years ago in the University, which is also not very much older. After major social movements in Europe, and particularly the “25 of April of 1974” political revolution in Portugal, new universities were created in different locations of the country. Civil Engineering education was already well established in Portugal, lectured in several public universities as Engineering Faculty of University of Porto (FEUP), Technical Higher Institute (IST) at Technical University of Lisbon and also consolidated at Technology and Science Faculty at University of Coimbra (UC). After joining to European Union in 1986, younger universities were able to build their own facilities and acquire equipment in order to provide a high quality teaching with experimental support. These “New Universities” established during the 70’s and 80’s, were responsible, at the time, for a complete change at the higher education panorama in Portugal. These universities were located, mainly, in the interior or economically less developed regions of the country in order to accelerate local development and also to increase higher education capacity, in these regions. As the result Civil Engineering courses beside being offered at the three older schools in Portugal (FEUP, IST and UC) are presently taught at UBI, UM, UTAD, UNL, UA and UE (Table 1). There were also attempts to start such courses at Azores and Madeira universities. Civil Engineering is also lectured at the same level at ISEL (Lisbon Engineering Higher Institute) and is also taught in

military Academies (Military Engineering at Army Military Academy and Airfield Engineering at Air Force Academy). All universities have their curricula approved (except UE) by the Engineering Association (OE, 2008). The Engineering Association (OE) is a public association representing all engineering licensees (with a 5 year learning total) and professionally active. The OE is not dependent on the government and has administrative, financial, scientific, disciplinary and regulation autonomy. The OE main objective is to contribute to the progress of engineering by stimulating efforts from all associates at scientific, professional and social levels, as well as to verify the use of professional ethics. It possesses a set of procedures allowing for students to become members and only those professionals which are approved have the right to use the title on Engineer, and so to exercise the profession. The particular case of civil engineering is that to perform the profession it is absolutely necessary to be a member of OE. It should be noted the existence in Portugal of about 10 other courses in civil engineering presenting the same number of study years, approximately the same number of ECTS credits, similar teaching program but not certified by the OE due to lack in quality.

From Table 1 it is noticeable that for the scholar year of 2007/08 UBI offered 60 vacancies for 1st year 1st cycle. The vacancies were occupied with students that were evaluated on Mathematics (M), Physics and Chemistry (F-Q) or Mathematics and Descriptive Geometry (M+GD).

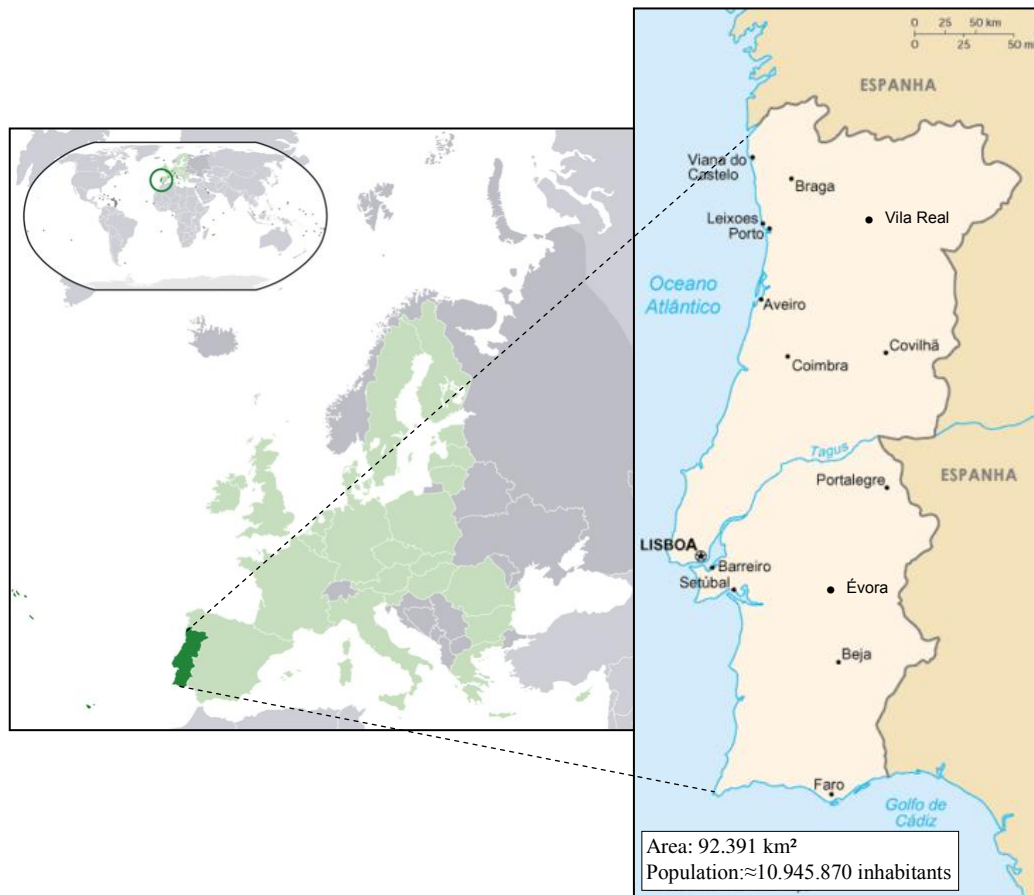


Figure 1. Location of towns offering major civil engineering courses in Portugal (adapted from Wikipédia (2008)).

Table 1. Major characteristics of main Civil Engineering courses in Portugal.

Institution (*i)	FEUP	IST	UC	UBI	UM(*ii)	UTAD	UNL	UA	UE
Inaugural Date	1885 (*iii)	1911	1972	1980	≈1980	>1980	1996 (*iv)	>1996	>1996
Vacancies on 1st year 2007/2008	175	185	125	60	105	30	125	60	30
Specific evaluation tests (*v)	M and F-Q	M and F-Q	M or B-G +M or F-Q+M or GD+M	M or F-Q or M + GD	M or GD + M or F-Q+M	M or F-Q+M or GD+M	M or B-G + M or F-Q + M	M or F-Q + M	F-Q or GD or M
Year of study total (*vi)	5	5	5	3+2	3+2	3+2	3+2	3+2	3 +2
Total ECTS credits	300	300	300	300	300	300	300	300	300
1-st cycle									
Year of study	3	3	3	3	3	3	3	3	3
ECTS credits	180	180	180	180	180	180	180	180	180
2-nd cycle									
Year of study	2	2	2	2	2	2	2	2	2
Total ECTS credits	120	120	120	120	-	120	120	120	120
ECTS credits to Thesis / Project	30	30	30	42	-	42	42	42	42

(*i) Institution: FEUP- Engineering Faculty of the University of Porto, IST- Technical Superior Institute (Lisbon), UC- University of Coimbra, UBI – University of Beira Interior, Covilhã; UM-University of Minho, Braga; UTAD- University of Trás-os-Montes e Alto Douro, Vila Real; UNL – New University of Lisbon; UA- University of Aveiro, EU – University of Évora. (*ii) Data concerning this university are not complete as it was adequate to Bologna model for 2008/2009 and still is waiting for superior decision (UM,2008). (*iii) it is considered to have begun at this date admitting that this course started as what it was then called Public Construction Engineering at the ancient Porto Politechnical Academy (adapted from UP, 2008). (*iv) date of creation of civil engineering department (UNL, 2008). (*v) Evaluation tests for admittance (DGES,2008): M – Mathematics, F-Q – Physics and Chemistry, B-G – Biology and Geology, GD – Descriptive Geometry. (*vi) – Courses with 5 years are considered to have integrated masters degree.

The selection criteria are not the same for all universities due to their degree of autonomy and therefore the universities are trying to accept the maximum number of students, without lowering the quality requirements fixed for particular course. It is noticeable an increased difficulty on several courses to fill up all vacancies as, besides the large number of courses offered, the three more classical courses absorb most of the candidates. If special measures are not undertaken, some of the courses described in table 1 will eventually be closed for lack of students. It has to be emphasized that Portuguese government finances universities on the basis of the number of students, therefore it is important to present the high number of vacancies. At the end of this paper we will discuss some guidelines that can help to solve this situation.

2 CIVIL ENGINEERING COURSES AT UBI

2.1 Situation of 1st and 2nd cycles

Civil Engineering course at UBI, with a 5 year program, started in 1980/81, at a stage where students were only presented with the so called “preparatory”, the first 2 years of the course, and continued with their training at IST (Lisbon).

Meanwhile, the Department of Civil Engineering (DEC) was created at UBI and all 5 years of the course were taught at this university and the first students completed their degree in 1992/1993 in the specialization Planning and Urbanism. During the 90’s the study plan was restructured and three specializations were established: “Planning and Urbanism”, “Structures and Construction”, and “Geotechnics”. In 1996 the course was admitted by the Engineering Association (OE) and later on was evaluated by an external, governmental commission for verification of teaching quality that presented very favorable results, and classified UBI Civil Engineering course among the top 5 civil engineer courses in Portugal.

Aiming for the adaptation of the course to the Bologna process, in 2007 DEC has elaborated the new Civil Engineering programs for following courses:

- i) Civil Engineering Licenciatura - LEC (3 years), 1st cycle,
- ii) Civil Engineering Master - MEC (2 years), 2nd cycle, with “Structures and Construction” and “Geotechnics and Environment” specializations.

These new courses (LEC and MEC) are the result of a reorganization of the previous 5 years course which has been divided in two parts (3+2 years). In general, most of the curricula was maintained discarding some curricular units, particularly at exact sciences (Mathematics and Physics) and some

at specialization areas as “Planning and Urbanism” (where DEC has encountered greater difficulties to consolidate). The major reason for eliminating some curricular units is due to the introduction of a very large one, the “Thesis/Project” that occupies one semester and part of another at a total of 42 ECTS credits. The main characteristics of the new courses as to its length, ECTS credits, designation of curricular units (subjects or course unit), work hours, are presented at Tables 2 and 3.

The ECTS value for each unit is defined based on the estimated work load on the students. The number of hours to be considered includes all forms of predictable work as contact hours, and projects, field work, study and evaluation. The number of credits corresponding to the work of a curricular year at full time is 60 ECTS credits, for a 1600 hours of student work, that is 1 ECTS credits corresponds to 26,7 work hours.

The 1st cycle is composed of 12 curricular units concerning base subjects, most of it with a basic level, thirteen core curricular units concentrated on professional subjects of civil engineering, on intermediate level, and five core curricular units of civil engineering with an advanced level as illustrated on Table 2. The subjects are divided in semesters with five curricular units per semester and 20 hours of weekly contact. Each semester has a span of 17 weeks (one of each is reserved for evaluation) and each curricular unit has a total of 64 hours of contact, 86 to 88 hours of independent work, 10 to 8 hours of evaluation, totaling 160 hours of work, and so 800 hours of work per semester for all 5 curricular units.

Generally speaking the main objective of the first cycle of studies is to assure a partial education in civil engineering starting with the some enrichment of the knowledge in base subjects, proceeding on learning core subjects (engineering sciences), and ending on training on applications and syntheses tasks on specific domains. As an example, at Structures in civil engineering, after a deeper knowledge in mathematics and physics the student is presented with mechanics and materials resistance including the contact with laboratory experimentation followed by an advanced level of structures theory curricular unit. On the sub domain of Constructions the core subjects at an intermediate level are Building Materials and Building Technologies and at an advanced level Reinforced Concrete and Directing and Managing of Constructions. At Geotechnics, Hydraulics and Planning and Urbanism the intermediate level subjects correspond to Hydraulics, Soil Mechanics and Regional and Urban Planning, on and advanced level subjects are Water Supply and Drainage and Transports.

The 2nd cycle, master in civil engineering (MEC), with 120 ECTS credits and duration of 2 years, is presented with two profiles: “Structures and Construction” and “Geotechnics and Environment”, assuring that the student acquires an academic specialization aided by research activity, innovation or widening of professional skills. This study cycle conducting to the degree of master in civil engineering includes:

a) a specialization course including 13 curricular units with 65% of total ECTS credits of the cycle; from this group 7 are of an advanced nature in such a way that besides complementing the student formation as civil engineer of the first cycle also make a transition for the following 6 curricular units of core specialized nature (30% of total ECTS credits) either at “Structures and Construction” profile or “Geotechnics and Environment”.

b) a final report of scientific nature or project work, of original nature and specifically conceived for this propose, corresponding to 35% of the total ECTS credits of this cycle.

The dissertation of scientific nature or project work is integrated on a single scientific area named “Civil Engineering” covering all scientific domains of the specialized core curricular units.

The main objective of MEC is to offer a global and systematic course for education of professionals competent both at the level of conception and technical leadership. The future masters in civil engineering should present a high capacity for assuring responsibilities particularly at conception and engineering solutions, to be able to perform their work in civil engineering enterprises, local and central public administration, design offices and fiscalization, exercising their skills, among others, in project conception and evaluation in the main specialization areas: Construction, Geotechnics, Hydraulics and Environment and Mechanics and Structures.

2.2 Contents of Geotechnical curricular units on Civil Engineering Courses

2.2.1 Licenciatura-LEC (Bachelor degree), 1st Cycle

As presented in Table 2, the LEC study plan at UBI has only 2 curricular units integrated at Geotechnics Area with a total of 12 ECTS credits, representing 6,7% of the total course. Geotechnical Area curricular units at Portuguese main universities can be compared at Table 4 along with its ECTS credits; it can be observed that the number of curricular units varies between 1 and 4 (with an average of 2,6) and from 6 to 22 ECTS credits. At Table 5 these curricular units are identified and it is noticeable that UBI has an average position with the more common ones: Engineering Geology and Soil Mechanics.

2.2.2 Master degree - 2nd Cycle

As presented at Table 3, the MEC study plan presents: i) for “Structures and Construction” profile only 2 curricular units from Geotechnics area, with a total of 12 ECTS credits representing 10% of the entire cycle; and for ii) “Geotechnics and Environment” profile there is the possibility of a total of 6 curricular units integrated in the Geotechnics area, with a total of 36 ECTS credits representing 30% of the entire cycle. In order to compare with the other Portuguese main universities Table 4 presents the number of curricular units from Geotechnics span and its ECTS credits; for the more generic courses or profiles not including Geotechnics designation, it is verified that the number of curricular units varies between 0 and 4, being the most frequent 2; for courses that have Geotechnics in its designation (FEUP, IST, UC and UNL) the number of curricular units varies between 5 and 8; UBI’s MEC is at the most frequent situation with 6 curricular units. At Table 6 it is presented the designation of these curricular units and it can be noticed that UBI is in an average position. The most common designations are Soil Mechanics II (or equivalent as Soil Mechanics Complements and Advanced Soil Mechanics), Foundations, Support Structures or similar and Rock Mechanics. To be noticed that UBI possesses curricular units from environment area as Environmental Geotechnics I and II.

2.3 Civil Engineering Course – 3rd Cycle

It is an objective of UBI – DEC to promote research conducting to the doctorate degree, being conscious that this would be the only way not only to establish the formation and growth of its own teaching staff and training of external students, but also strengthen the scientific capacity of department in the several domains this department has already developed, both nationally as internationally. Therefore with accordance with Bologna guidelines DEC has prepared a proposal for a course for the 3rd cycle of CE education leading to doctor degree in CE, as presented on Table 7. The total number of ECTS credits requested for PhD in Civil Engineering is 180, divided in 6 semesters. The doctoral program consists of a curricular phase (4 post-graduation curricular units corresponding to 30 ECTS credits) and the preparation of a thesis (corresponding to 150 ECTS credits). The duration of this cycle is in accordance to the minimum duration observed at Portuguese and European universities for this degree. Both the curricular part and the original thesis that contributes for the advance in that particular field of knowledge should be performed in a span of 3 years. It is pointed out that of the 4 post-graduation curricular units available, 3 are options. These 3 optional curricular

units can be chosen from the 18 different subjects available. It is assumed that after acquiring the PhD degree, a young scientist who completed his specialized study at UBI can continue to develop, and expand the knowledge he gained in his research work at the university either working at enterprises or I&D institutions, and contributing in a significant way to the development of technological and scientific research.

The study cycle leading to the PhD in Civil Engineering has as an objective to develop researchers in the area of Civil Engineering, with high scientific qualifications and capacity to undertake research work in an independent way, oriented for academic environment as well as for enterprises and commercial ones.

3 MOBILITY OF CIVIL ENGINEERING STUDENTS

DEC fully understands how important for the future is student mobility particularly in European Union. To promote this a publication was produced (UBI, 1998) that describes the different courses, study plans, curricular contents and respective ECTS credits, developed at SOCRATES program. At Table 8 the number of students involved on mobility with the course of Civil Engineering and their home countries and universities are presented. There are shown the curricular units, either from 1st cycle or 2nd cycle of studies. It can be noticed a strong presence of students originating from different universities of Poland. This can be explained by a well developed mobility of teachers and researchers and long lasting co-operation between DEC at UBI and several Polish universities. It could be also noticed that the number of foreign students is quite high taking into consideration the relative modest dimension of the DEC at UBI.

4 CONCLUSIONS

The DEC, where civil engineering courses are taught at UBI, is a relatively young department but already matured, has about 40 teachers, where approximately 50% have at least PhD degree. It has grown based on its continuous and intensive search for new teaching-learning methodologies of theoretical and professional subjects supplemented by extensive laboratory work and research and partnerships with specialized and strategic enterprises of the region where it is located, as well as partnerships with researchers from all over the world. It offers a high quality courses in civil engineering that, from its beginning in 1980 as based on 5 years curricular plan aiming for good prepared graduates for the work market have been certified by the Portuguese Engineering Association since 1996.

Following this line of development, and considering the Bologna guidelines, DEC has organized its curricular plan in civil engineering in two cycles: 1st cycle (LEC) – Civil Engineering Bachelor with 3 years duration and 180 ECTS credits; and the 2nd cycle – (MEC) – Master in Civil Engineering with a 2 years duration and 120 ECTS credits.

The 2nd cycle includes a curricular unit called “Thesis/Project” totaling 42 ECTS credits, where the student must produce a research or high level design project. Besides individual formation of the student it simultaneously favors the development of young researchers and teachers in partnership with their junior researchers. The research made in frames of these thesis/projects, or masters dissertations increases the scientific output of DEC that can be continued in 3rd cycle of civil engineering studies. This was already proposed to the Portuguese government for approval, as a 3 year and 180 ECTS credits doctoral course.

Geotechnics subjects representation in the 1st cycle of curricular plan can be understood that in any civil engineering course taught in UBI there should be a total of 15 ECTS credits of geotechnical subjects, which corresponds to the average situation of the 9 Portuguese universities. Those 15 ECTS credits, according to the authors, should be organized in 3 curricular units named: 1. Engineering Geology, 2. Soil and Rock Mechanics, 3. Geotechnics. The first curricular unit, of a Basic level, should contain geology elements as well *in situ* investigation, among other subjects. The second unit, of intermediate level contains the classical soil mechanics (identification, physical indexes, percolation, tension, shear strength and compressibility) it should also include a general chapter on rock mechanics. The 3rd curricular unit, of a moderately advanced level, should include elements of foundations, constructions and support structures and slope stability.

Participation of geotechnics subjects in the 2nd study cycle, for the various profiles of master courses in civil engineering, excluding those specifically oriented for geotechnics can be understood that there should be a total of 10 ECTS credits corresponding to 2 curricular units, the most common situation at the Portuguese universities. The subjects to be presented in this course should be a development at a higher level of the subjects presented at the 1st cycle and should depend on the specifics of the profile. In the case of geotechnical oriented master degree there should be a “2+3” curricular units profile, where the first 2 units are similar to other profiles, and the other 3 are more specific units and are dependent on the evolution line followed by each institution.

Table 2. Course plan for 1st cycle of Civil Engineering according to Bologna guidelines at UBI, Portugal (*).

Curricular Unit	ECTS credits	Scientific area	Type	Level	Class type (*i) - contact hours per week						
					T	TP	PL	TC	OT	total	
<i>1st year/1st semester</i>											
Linear Algebra	6	M	Related	Basic	2	2	-	-	-	4	
Chemistry	6	Q	Related	Basic	2	1	1	-	-	4	
Introduction to Computer Programming	6	I	Related	Basic	2	2	-	-	-	4	
Introd. to Civil Eng. and Tech. Design	6	DT	Core	Basic	2	-	2	-	-	4	
Calculus I	6	M	Related	Basic	2	2	-	-	-	4	
										20	
<i>1st year/2nd semester</i>											
Engineering Geology	6	G	Related	Basic	2	-	1,4	0,6	-	4	
Design for Civil Engineering	6	DT	Related	Basic	1	-	3	-	-	4	
Mechanics and Waves	6	F	Related	Basic	2	2	-	-	-	4	
Calculus II	6	M	Related	Basic	2	2	-	-	-	4	
Building Materials I	6	C	Core	Intermediate	1,25	1,25	0,75	-	0,75	4	
										20	
<i>2nd year/1st semester</i>											
Probabilities and Statistics	6	M	Related	Basic	2	2	-	-	-	4	
Statistics	6	ME	Core	Intermediate	2	-	2	-	-	4	
Mechanics of continuous solids	6	ME	Core	Intermediate	2	2	-	-	-	4	
Calculus III	6	M	Related	Basic	2	2	-	-	-	4	
Topography	6	DT	Core	Intermediate	1	1	0,75	1,25	-	4	
										20	
<i>2nd year/2nd semester</i>											
Computational Mathematics	6	M	Related	Basic	2	2	-	-	-	4	
Management and Economy	6	EG	Related	Intermediate	-	4	-	-	-	4	
Hydraulics I	6	HA	Core	Intermediate	-	3,8	0,2	-	-	4	
Urban and Regional Planning	6	PU	Core	Intermediate	2	2	-	-	-	4	
Material Resistance I	6	ME	Core	Intermediate	3	-	1	-	-	4	
										20	
<i>3rd year/1st semester</i>											
Material Resistance II	6	ME	Core	Intermediate	3	-	1	-	-	4	
Soil Mechanics	6	G	Core	Intermediate	2	1	1	-	-	4	
Hydraulics II	6	HA	Core	Intermediate	-	3,8	0,2	-	-	4	
Building Materials II	6	C	Core	Intermediate	1,25	1,25	0,75	-	0,75	4	
Building Technology	6	C	Core	Intermediate	2	-	2	-	-	4	
										20	
<i>3rd year/2nd semester</i>											
Structures Theory	6	ME	Core	Advanced	3	-	1	-	-	4	
Reinforced Concrete	6	C	Core	Advanced	2	-	2	-	-	4	
Managing and Directing of Work Sites	6	C	Core	Advanced	2	-	2	-	-	4	
Water Supply and Drainage	6	HA	Core	Advanced	-	1,7	2,3	-	-	4	
Transportations	6	PU	Core	Advanced	2	1,6	-	-	0,4	4	
										20	
Total ECTS credits	180		% of total contact hours		43%	34%	20%	1,5%	1,5%	100%	
ECTS credits distribution by Scientific Areas											
Basic and Complementary Sciences	ECTS credits	%	Engineering Sciences				ECTS credits	%			
Mathematics (M)	36	20,0	Construction (C)				30	16,7			
Physics (F)	6	3,3	Geotechnics (G)				12	6,7			
Chemistry (Q)	6	3,3	Hydraulics and Environment (HA)				18	10,0			
Computer Science (I)	6	3,3	Mechanics and Structures (ME)				30	16,7			
Design and Topography (DT)	18	10,0	Planning and Urbanism (PU)				12	6,7			
Managing and Economy (EG)	6	3,3									
Total 1	78	43,2	Total 2				102	56,8			

(*i) Type of Class: T-Theoretical, TP-Theoretic-practical, PL – Laboratory practice, OT- Tutorial guidance.

(*)1st cycle, at Portuguese universities is designated by “Licenciatura”, equivalent to the “Bachelor degree”.

Table 3. Course Plan for 2nd cycle of Civil Engineering according to Bologna guidelines at UBI, Portugal.

CURRICULAR UNIT	ECTS credits	Scientific area	Type	Level	Class type (*i) - contact hours per week					
					T	TP	PL	TC	OT	Total
<i>1st year/1st semester</i>										
1. Matrix Analysis of Structures	6	ME	Core	Advanced	3	-	1	-	-	4
2. Complementary Reinforced Concrete	6	C	Core	Advanced	2	-	2	-	-	4
3. Metallic Structures	6	ME	Core	Advanced	3	1	-	-	-	4
4. Hydrology and Hydrological Resources	6	HA	Core	Advanced	2	-	2	-	-	4
5. Advanced Soil Mechanics	6	G	Core	Advanced	3	-	1	-	-	4
	30									20
<i>1st year/2nd semester</i>										
1. Building physics	6	C	Core	Advanced	2	-	2	-	-	4
2. Foundations	6	G	Core	Advanced	2	1,1	-	0,5	0,4	4
Profile: Structures and Construction										
3. Reinforced Concrete	6	ME	Core	Specialized	3	-	1	-	-	4
4. Dynamics and Seismic Engineering	6	ME	Core	Specialized	2	-	2	-	-	4
5. Building pathology	6	C	Core	Specialized	2	-	2	-	-	4
Profile: Geotechnics and Environment										
3. Environmental Geotechnics I	6	G	Core	Specialized	2	-	1,3	0,1	0,6	4
4. Fluvial Hydraulics	6	HA	Core	Specialized	3	-	-	-	1	4
5. Environmental Sanitation	6	HA	Core	Specialized	-	3,9	0,1	-	-	4
	30									20
<i>2nd year/1st semester</i>										
Profile: Structures and Construction - EC (choose 18 ECTS, 3 out of 8 curricular units)										
i) Evaluation and Quality of Buildings	6	C	Core	Specialized	1,5	-	1	-	1,5	4
ii) Durability of Building Materials	6	C	Core	Specialized	-	2,0	1,2	-	0,8	4
iii) Special Structures	6	ME	Core	Specialized	3	1	-	-	-	4
iv) Laminar Structures	6	ME	Core	Specialized	3	-	1	-	-	4
v) Study and Application of Special Concretes	6	C	Core	Specialized	2	-	2	-	-	4
vi) Structural Rehabilitation	6	ME	Core	Specialized	2	2	-	-	-	4
vii) Seminar in Structures	6	ME	Core	Specialized	2	-	-	-	-	4
viii) Constructive Systems Technology	6	C	Core	Specialized	2	-	2	-	-	4
Dissertation or Project EC – I	12	ECV	Core	Specialized	-	-	-	-	8	8
	30									20
Profile: Geotechnics and Environment - GA (choose 18 ECTS, 3 out of 5 curricular units)										
i) Environment and Planning	6	HA	Core	Specialized	-	4	-	-	-	4
ii) Environmental Geotechnics II	6	G	Core	Specialized	2	0,8	-	1,25	-	4
iii) Environmental Impacts	6	HA	Core	Specialized	2	2	-	-	-	4
iv) Rock Mechanics	6	G	Core	Specialized	2	2	-	-	-	4
v) Soil Constructions	6	G	Core	Specialized	2	0,6	0,8	-	0,6	4
Thesis or Project EC – I, GA - I	12	ECV	Core	Specialized	-	-	-	-	8	8
	30									20
<i>2nd year/2nd semester</i>										
Thesis or Project EC – II, GA-II	30	ECV	Core	Specialized	-	-	-	-	20	20

ECTS credits distribution on the different scientific areas

Scientific Areas	ECTS credits: Profile Structures and Construction			ECTS credits: Profile Geotechnics and Environment		
	Elective	facultative maximum	total	Elective	facultative maximum	total
Construction – C	18 (15 %)	18 (15%)	36 (30%)	12 (10%)	0	12 (10%)
Geotechnics – G	12 (10 %)	0	12 (12%)	18 (15%)	18 (15%)	36 (30%)
Hydraulic and Environment – HA	6 (5 %)	0	6 (5%)	18(15%)	12 (10%)	30 (30%)
Mechanics and Structures – ME	24 (20 %)	18 (15%)	42 (35%)	12 (10%)	0	12 (10%)
Civil Engineering – ECV	42 (35%)	-	42 (35%)	42 (35%)	-	42 (35%)
Total	102 (85%)	18 (15%)	120 (100%)	102 (100%)	18 (15%)	120 (100%)

(*i) Class Type: T-Theory, TP-Theoretical-Practical, PL – Laboratory Practice, OT- Tutorial Guidance.

Table 4. Geotechnics curricular units and respective ECTS credits for different civil engineering courses in Portugal.

Institution (*i)	FEUP	IST	UC	UBI	UM	UTAD	UNL	UA	UE
1st Cycle									
Scientific Area	General	General	General	General	General	General	General	General	General
Number of Geotechnics curricular units (*ii)	1	2	3	2	3	2	3	4	3
Geotechnics ECTS credits (*ii)	6	12	18	12	15	10	17.5	22	18
2nd Cycle									
Scientific Area or Profiles (*iii)	C E G H MPC P VC	C E G HRH TSI	C E G HRHA ME UTVC	E and C G and A	EC	ECV (iv)	E and G RE	ECV (*iv)	C HRH
Number of Geotechnics curricular units at different profiles (*ii)	C:3 E:3 G:8 H:2 MPC:3 P:2 VC:2	C:2 E:2 G: 6 HRH:2 TSI:2	C:2 E:2 G:6 HRHA:2 ME:2 UTVC:2	E and C: 2 G and A: 6	EC:2	1+2	E and G:5 RE:0	2+1+1 (*v)	C:1 HRC:1
Geotechnics curricular units ECTS of different profiles (*ii)	E:15 G:40 H:10 MPC:15 P:10 VC:10	G: 31,5 TSI:10,5 C:10,5 HRH:10,5 E:10,5	C:9 E:9 G:33 HRHA:9 ME:9 UTVC:9	E and C:12 G and A:36	EC:11	5+8	E and G:28 RE:0	12+6+6	C:6 HRC:6

(*i) Institution: to see Table 1. (*ii) References: IST,2008; UA,2008; UBI,2008; UC,2008; UE,2008; UM,2008; UNL,2008; UP,2008; UTAD,2008. (*iii) Scientific Area or Profiles: A - Environmental, C - Construction, E - Structures; ECV – Civil Engineering; G - Geotechnics; H- Hydraulics; HRH-Hydraulics and Hydric resources; HRHA-Hydraulics and Hydric Resources and Environmental; ME-Structural Mechanics; MPC-Materials and Construction Processes; P-Planning; RE-Building rehabilitation; TSI-Transportations, Systems and Infra-structures; UTVC-Urbanism, Transports and Communication Routes; V-Communication Routes. (*iv) It does not presents any profiles, it is a single profile with some optional curricular units at different areas. (*v) The student must attend 2 curricular units, all others are optional.

Table 5. Comparing the number and designations of different curricular units on Geotechnics between different civil engineering courses – 1st cycle, in Portugal (*).

FEUP	IST	UC	UBI	UM	UTAD	UNL	UA	UE
1 – Engineering and Geology	1- Mineralogy and Geology	1- Engineering Geology	1- Engineering Geology	1- Geology for Civil Engineers	1- Geology	1- Geology for Civil Engineers	1- General Geology	1- General Geology
	2 -Soil and Rock Mechanics	2- Soil Mechanics I 3- Soil Mechanics II	2- Soil Mechanics	2- Geotechnics I 3- Geotechnics II	2-Soil Mechanics	2-Geotechnics fundamentals	2- Engineering Geology 3- Soil Mec. and Foundations I 4- Soil Mec. and Foundations II	2- Engineering Geology 3- Soil Mechanic and Foundations I

(*) note: some curricular units of general nature as Mineralogy and Geology and General Geology, due to their close relationship with Geotechnics, were considered at the same group.

It has to be recognized that it's not possible to include more of geotechnical curricular units to the civil engineering curriculum as the formation of the future civil engineer must be well balanced with other professional units necessary for a graduate well prepared to its professional life and broad area of activity in civil engineering (as other subjects must also be learned).

As far as it is concerned the competition for the annual 60 vacancies for potential students by such

a modest department as UBI-DEC due to its geographical situation, away from main population centers on a very asymmetric country, solution must go through the offer of higher quality of a specialized civil engineering courses developed locally, as well as by policy of avoiding of a big concentration of teaching only in universities with great tradition, and allowing students to be dispersed in smaller universities.

Table 6. Comparison of different civil engineering courses - 2nd cycle in Portugal and the number and curricular units in Geotechnics area. (*)

FEUP	IST	UC	UBI	UM	UTAD	UNL	UA	UE
Scientific Area or Profiles (*i)								
C; E; G; H; MPC; P; VC	G; TSI; C; HRH; E	C; E; G; HRHA; ME; UTVC	E and C G and A	EC	ECV (general)	E and G RE	ECV (general)	C HRH
Curricular units on Geotechnics between different civil engineering courses								
C: 1-Soil Mechanics I; 2-Soil Mechanics II 3-Geotechnical works E: 1-Soil Mechanics I; 2-Soil Mechanics II 3-Foundations and Support Structures H=P=VC: 1-Soil Mechanics I; 2-Soil Mechanics II MPC: 1-Soil Mechanics I; 2-Soil Mechanics II 3-Application of Geosynthetics in Civil Engineering G: 1-Soil Mechanics I; 2-Soil Mechanics II 3-Foundations; 4-Rock Mechanics 5-Models and Safety in Geotechnics 6-Soil Supporting Structures; 7-Soil Constructions 8-Underground Constructions	TSI=C= HRH=E: 1- Geotechnical Structures Analysis 2- Geotechnical Constructions G: 1-Analysis of Geotechnical Structures 2- Geotechnical Constructions 3-Advanced Modelling in Geotechnics 4- Geotechnical Seismic Engineering 5- Foundations and Embankments 6-Escavations and Underground Constructions	C = E= HRHA= ME =UTVC: 1-Foundations 2- Geotechnical Seismic Engineering G: 1-Foundations 2- Geotechnical Seismic Engineering 3-Rock Mechanics 4-Critical State Soil Mechanics 5-Escavation and Retaining Constructions 6-Soil Constructions	G and A: 1-Advanced Soil Mechanics 2- Foundations 3- Environmental Geotechnics I 4- Environmental Geotechnics II 5- Rock Mechanics 6-Soil Constructions E and C: 1-Advanced Soil Mechanics 2- Foundations	EC: 1.Foundations and Support Structures 2- Foundations Technology E and C: 1-Advanced Soil Mechanics 2- Foundations	1- Complementary Soil Mechanics 2- Mechanics 3-(Optional): Foundations 4- Geotechnics 5- Geotechnical Engineering 6- Geotechnics	E and G: 1. Soil Behaviour 2- Foundations I 3-Foundations II 4- Advanced subjects of Structures and Geotechnics 5- Geotechnical Seismic Engineering RE:0 (There is not curricular units of Geotechnics)	1-Road Geotechnics and Pavements 2- Foundations and Support Structures + 1- Rock mechanics 1- Observation and Monitoring of Geotechnical Works + 2- Underground Constructions and Excavations or 2-Massifs Remedies and Reinforcement and Retaining Constructions	C= HRC: Soil Mechanics and Foundations II

(*) Institution: to see Table 1. (*i) Scientific Area or Profiles: A - Environmental, C - Construction, E - Structures; ECV – Civil Engineering; G - Geotechnics; H- Hydraulics; HRH-Hydraulics and Hydric resources; HRHA-Hydraulics and Hydric Resources and Environmental; ME-Structural Mechanics; MPC-Materials and Construction Processes; P-Planning; RE-Building rehabilitation; TSI-Transportations, Systems and Infra-structures; UTVC-Urbanism, Transports and Communication Routes; V-Communication Routes.

Table 7. Synthetic Study Plan – 3rd Cycle on Civil Engineering at UBI.

Year	Semester	Curricular units	ECTS credits	Option 1, 2 and 3 (To choose 3 curricular units this group)
1°	1°	1. PhD thesis schedule	PTD 12	C1 – Inspection , Diagnostic and Intervention in Buildings C2 – Sustainable Construction Technology
		2. Option 1	Op1 6	C3 – Materials and Structural Composites
	1°	3. Option 2	Op2 6	C4 – Development of Environmental Sustainable Materials C5 – Advanced Material Technology
		4. Option 3	Op3 6	DT1- Advanced Topographical methods G1- Advanced Elements of Environmental Geotechnics
2°	2°	1. Thesis 1	TD1 30	G2 – Slope Stability and Contemning Techniques G3 – Improvement and Reinforcement of Soil Massifs
	1°	1. Thesis 2	TD2 30	G4 – Geomechanics of Rock Massifs
	2°	1. Thesis 3	TD3 30	G5 – Critical State Theory in Soils G6 – Factorial Analysis in Geotechnics
3	1°	1. Thesis 4	TD4 30	HA 1 – Fluvial Systems Modelling
	2°	1. Thesis 5	TD5 30	HA 2 – Modelling and Evaluation of Sanitary Systems ME1 – Advanced Analysis of Structures ME2 – Pre-Stressed Concrete Structures ME3 – Research on Buildings Structural Behaviour PU 1 – Historical Constructions Preserving and Protection

Table 8 (*). Civil engineering mobility students at UBI (Portugal) on the previous 10 years (1998 - 2008).

Year	Students from UBI abroad				Foreign students at UBI			
	Country	University	Number of Students		Country	University	Number of Students	
			partial	total			partial	total
1998/99	PL	RTU	1	3	-	-	0	0
	PL	SUT	2		-	-	0	
1999/00	PL	RTU	2	8	PL	RTU	2	2
	PL	SUT	6		-	-	-	
2000/01	PL	RTU	2		PL	GUT	3	
	PL	SUT	9	19	PL	SUT	2	5
	Es	UM	8		-	-	-	
	PL	RTU	1		PL	GUT	1	
2001/02	PL	SUT	2		PL	SUT	5	
	PL	GUT	1	12	PL	BTU	1	10
	PL	BTU	2		PL	RUT	3	
	Es	UM	5					
	I	PM	1					
2002/03	PL	RTU	2		PL	SUT	2	
	PL	SUT	7	16	PL	BTU	2	11
	PL	BTU	2		PL	RTU	1	
	Es	UM	5		Es	UM	6	
2003/04	Es	UM	2		PL	SUT	2	
	PL	BTU	2	8	PL	RTU	1	10
	PL	STU	4		PL	BTU	2	
2004/05	-	-	-		Es	UM	5	
	Es	UM	7	10	PL	SUT	2	10
	PL	PS	3		Es	UM	8	
	PL	BTU	2		PL	CUT	1	
2005/06	PL	RUT	1		PL	GUT	2	
	PL	SUT	6	19	PL	SUT	2	13
	PL	GUT	4		Es	UM	8	
	Es	UM	6		-	-	-	
	PL	GUT	3		PL	GUT	3	
2006/07	PL	BTU	4		PL	RTU	3	
	PL	RUT	7	18	PL	BTU	1	20
	Es	UM	4		PL	CUT	4	
	-	-	-		PL	SUT	5	
	-	-	-		Es	UM	4	
2007/08	I	UST	2		Es	UM	4	
	PL	BTU	8	13	PL	BTU	4	16
	PL	GUT	3		PL	GUT	7	
-	-	-		I	USP	1		

(*)Elements supplied by International Relations and Programmes Office at UBI. I-Italy, P- Poland, Es – Slovenia; BTU- Bialystok Technical University, CUT - Cracow University of Technology, GUT- Gdansk University of Technology , PM-Politecnico di Milano, PS- Politechnika Slaska, RTU -Rzeszow Technical University, SUT- Silesian University of Technology, UM-University of Maribor, USP - Università degli Studi di Palermo, UST- Università degli Studi di Trento.

There should be also elaborated policy to increase students interchange programmes with different countries, not only from European Union, but particularly also those with official Portuguese language as Brazil, Angola, Mozambique and Timor among others.

The SOCRATES programme on students interchange is already a reality at DEC-UBI with a growing future.

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