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# Geotechnics and the University Degree Structure Reform in Helsinki

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**ABSTRACT:** In consequence of the Bologna Declaration a degree structure reform was carried out at Helsinki University of Technology in 2005. A new degree structure is made up of modules ranging between 10 and 80 cr. The structure is the same in each department and only the contents of the modules vary. Geotechnics is taught at the Department of Civil and Environmental Engineering in parallel with rock engineering. They separate only in the specialization stage at the end of the studies.

## 1 INTRODUCTION

After the Bologna Declaration was signed in 1999, planning of a degree structure reform covering all the universities in Finland was started. Each university carried out this work independently but following the principles of the Bologna Declaration, and the new degree structures came into force on 1.8.2005. At the same time also the old credit system was abandoned in favour of an ECTS-based (European Credit Transfer System) method of measuring progress in studies in order to improve international comparability.

At present, as the third year is going on after the reform at Helsinki University of Technology (HUT), experiences on the new degree structures already exist, but much more will be gained and fine adjustments for the degree structures will evidently be necessary.

## 2 DEGREE STRUCTURE REFORM AT HUT

Studies in a reformed degree structure are allotted credits according to the amount of work required; the average number of hours demanded by one academic year of studies, 1600 hours, is equivalent to 60 credits. The Bachelor's degree consists of 180 credits (ECTS) and the Master's degree is 120 credits.

At HUT, a module based two-cycle degree structure was selected aiming at a bachelor degree in three years, Fig.1, and a master degree in two additional years, Fig. 2. A module based structure means

that after general studies (80 cr) the courses are divided into elective modules (20 cr). Education should be organized in such a way that a full-time student can graduate in three academic years. The studies leading to the Bachelor's degree shall consist of:

- scientific, mathematical and other basic studies needed for the degree programme (80 cr)
- general studies module for the Bachelor's degree (20cr)
- three modules, at least one of which shall be a level 2 module in the student's own degree programme (20+20+20 cr)
- elective studies (at least 10 cr)
- Bachelor's thesis and seminar (total of 10 cr)

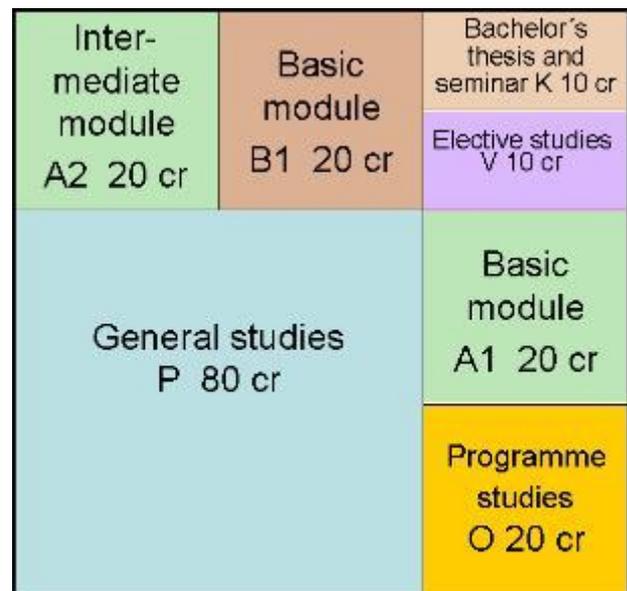


Figure 1. Bachelor's level studies, 180 cr.

Education for the Master's degree should be organized in such a way that a full-time student can graduate in two academic years. The studies for the Master's degree, Fig. 2, consist of:

- studies of scientific method (10 cr)
- three modules, of which at least one shall be a level 3 module in the student own degree programme major subject (20+20+20 cr)
- elective studies (at least 20 cr)
- Master's thesis (30 cr)

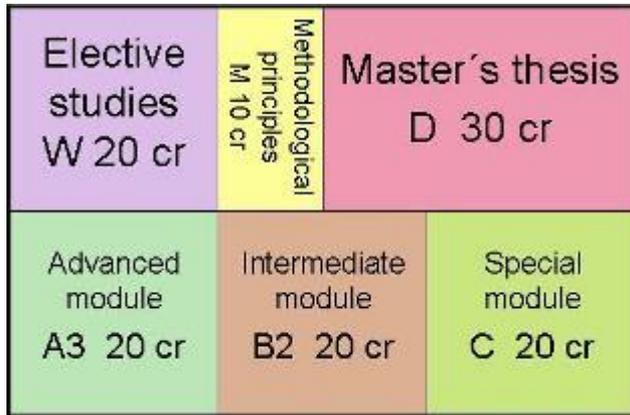


Figure 2. Master's level studies, basic structure 120 cr.

The modules start from level 0 and proceed to level 3 and finally to Special module which is the most specialized module in the major subject studies. A student has selected her/his major subject during Bachelor's level studies (module A2), but for the master studies the major subject can be changed according to the structure in Fig. 3.

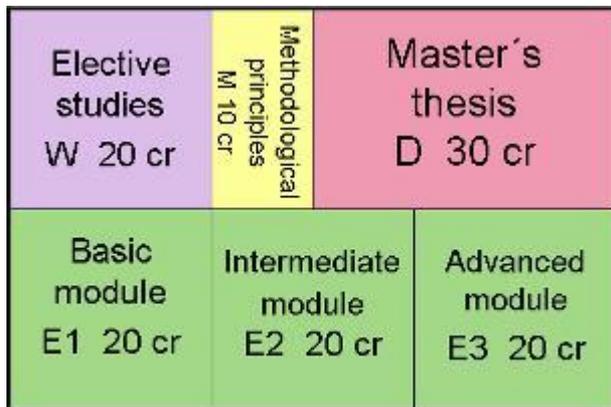


Figure 3. Master's level studies, an alternative.

The combination of modules presented in Fig. 2 is a basic combination, but also other combinations are possible provided that the requirements listed above are fulfilled.

### 3 STRUCTURE AT DEPARTMENT LEVEL

#### 3.1 Bachelor's degree

All the departments have organized their internal study structures independently following the principles above. The departmental studies are sets of courses forming the modules from level 0 to level 3

described above, including also a number of special modules. The study structure of the Department of Civil and Environmental Engineering is presented in Fig. 4.

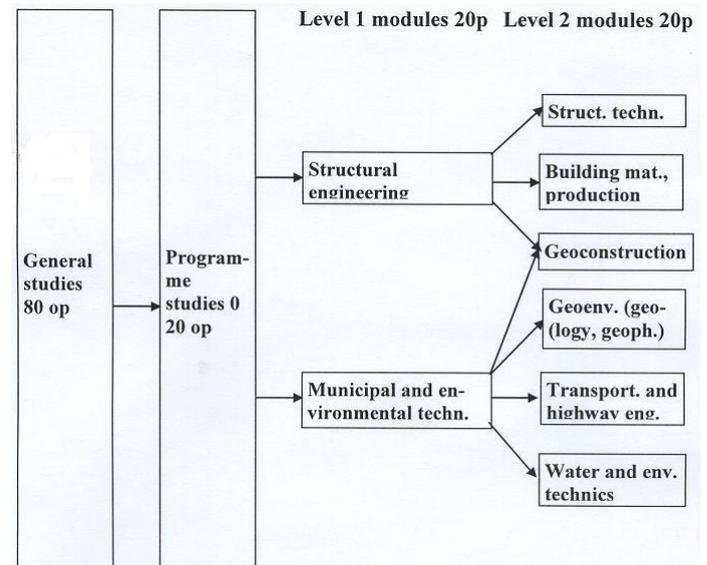


Figure 4. Bachelor's level studies at the Department of Civil and Environmental Engineering.

General studies (80 cr) are composed of basic sciences such as mathematics, physics, chemistry etc., including also the course Basics of engineering geology. Programme studies (20 cr), level 0 include (Study programme, 2007):

- Basic course in structural engineering and building technology (3 cr)
- Basic course in municipal and environmental engineering (3 cr)
- Basic course of transportation and highway engineering (4 cr)
- Building materials (3 cr)
- Introduction to the design of load-bearing structures (4 cr)
- Basics of geomechanics (4 cr)
- Planning and building law 83 C)

A student selects and follows a main path on the study chart (Fig. 4) from module to module (20 cr each). At level 1 the path is divided into two branches: structural and municipal ones. A student cannot make a selection between them, because the intake of students is separate and determines the module at level 1. A normal way is to take the other one for B1 (see Fig. 1), which means that the student takes both modules of level 1.

Level 2 modules include six major subjects, one of which is Geoconstruction, which differs from the others because access to it is possible from both of the level 1 branches. Geoconstruction is a combination of geotechnics and rock engineering. Elective studies can be selected freely, but the Bachelor's Thesis and seminar have to be made in the field of the major subject.

### 3.2 Master's degree

After the bachelor's degree the student follows normally the major subject path from level 2 to the corresponding module at level 3, Fig. 5, and selects the minor subject at level 2. As discussed above, the main subject can be changed and the studies go on as presented in Fig. 3.

If a student wants to go deeper into the major subject, a special module can be taken as shown in the basic structure, fig. 2. At this stage there are several alternative ways to take the Master's degree. In all the alternatives also elective studies have to be passed and the final step is the Master's thesis.

Level 3 modules 20p	Special modules 20p
Struct. techn	Structural mechanics
	Bridge eng
	House building eng
	Steel structures
	Building physics
	Building materials
Building mat., production	Remedy of buildings
	House tehcnics
Geoconstruction	Building economy
	Real estate management
Geoenv. (geology, geoph.)	Geotechnics
	Rock construction
Transport. and highway eng	Applied Hydrogeochemistry
	Applied geophysics
Water and env. technics	Traffic eng
	Road eng
	Geoinformatics
	Water resources manag.
	Hydraulic eng
	Water supply techn.
	Etc.

Figure 5. Master's level studies at the Department of Civil and Environmental Engineering.

### 3.3 Doctor's degree

Postgraduate education is planned and organized as entities according to the area of research; the goal is scientific thinking and the development of new knowledge in a certain area of civil and environmental engineering.

Also the Doctor's degree is done in modules. A doctoral student shall carry out the studies that prepare the student for scientific methods of work, for the application of research results and their communication (10 cr). She/he shall acquire wider and deeper knowledge of the research field than required by the previous degrees (20+20 cr) and become fa-

miliar with at least one subject area that supports the student's own thesis work (20 cr).

## 4 GEOTECHNICAL STUDIES

In the degree structure there are two major subjects related to geosciences (levels 2 and 3). As discussed above, the module Geoconstruction comprises both geotechnics and rock construction. The module Geoenvironmental technology is made up of geology and geophysics and is thus in a close connection to geotechnics.

Geotechnics is taught for the first time in the study programme at level 0 in the Programme studies. There is a course Principles of geomechanics. Being at level 0 it is mandatory for all the students at the Department. The course includes both soil mechanics and rock mechanics.

The studies of geotechnics continue at level 2 in the module Geoconstruction, Fig. 4. The courses in this module (20 cr) are:

- Basic course in geotechnics, 5 cr
- Geotechnics of structures (for structural engineering students), 5 cr
- Community geotechnics (for municipal end environmental engineering students), 5 cr
- Rock mechanics, 3 cr
- Blasting engineering, 2 cr
- Rock engineering, 5 cr

A normal way for a geotechnical student after Bachelor's degree is to follow the programme structure in the major subject from level 2 to Geoconstruction module at level 3. The courses in this module (select 20 cr) are:

- Geotechnics of structures or Community geotechnics, which has not yet been passed, 5 cr
- Geotechnical design, 5cr
- Advanced soil mechanics, 5 cr
- Advanced foundation engineering and geotechnical design, 5 cr
- Rock construction, 5 cr
- Design of underground excavations, 10 cr

In the Bachelor's degree, the level 2 geotechnical courses Geotechnics of structures and Community geotechnics are directed to structural and municipal students respectively. At level 3 the students takes also the other course of those two. This is because a geotechnical engineer needs education from both areas. At this stage also the minor subject has to be selected. All the level 2 subjects presented in Fig. 4 are possible.

If the student wants to have deeper knowledge in geotechnics, she/he takes the special module Geotechnics as one of the Master's degree modules. This module is a combination of all the courses in geotechnics and rock engineering, which have not been passed, including also:

- Environmental geotechnics, 3 cr

- Numerical methods of geotechnics, 5 cr
- Arctic geotechnics, 4 cr
- Seminar in foundation engineering and soil mechanics, 5 cr
- Foundation engineering and soil mechanics, special assignment, 3-6 cr

The course combination (20 cr) is of the student's choice.

## 5 PRACTICAL ASPECTS

The degree structure reform has led to many practical difficulties. Almost all the courses had to be adapted to the form and size compatible with the module structure. This process has proceeded together with the class of the year 2005. In the universities of Finland studies can be carried out following a student's own time schedule, known as "the academic freedom". Therefore, there are always students who do not follow the class and this causes special arrangements for them. It is obvious that this together with the course reform have provided teachers with extra work. This will be continued up to the next decade.

## 6 CONCLUSIONS

A university degree structure reform is being made at Helsinki University of Technology. The new structure is composed of modules containing courses from the same area of education. The degree structure has been build up in such a way that a full-time student can graduate as a Bachelor in three and as a Master in two academic years after that.

At the department level the modules have been put into a level order in such a way that a student can follow a path of his own choice from level 0 to levels 2 and 3 as the studies proceed toward graduation. At level 2 a student selects her/his major subject for the Bachelor's degree and at level 3 also a minor subject is selected. Both of these can be changed during the studies.

Education of geotechnics is given mainly in the modules Geoconstruction at levels 2 and 3. Geoconstruction is a combination of geotechnics and rock engineering and a path to it comes from both the main branches, which are Structural engineering and Municipal and environmental engineering. If a student wants to go deeper into geotechnics, a special module in geotechnics can be taken. The studies for both degrees end to the Thesis and seminar.

The reformed degree structure increases, to a certain degree, the possibilities for a student to select courses and direct the studies to a desired combination. The transitional phase from the old structure to the new one takes a lot of time and requires a lot of extra work from the teachers, and it is anticipated

that adaptation of the new degree structure will be continued up to the next decade.

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