Attainment targets for Dutch Bachelor's degrees in Built Environment

EINDKWALIFICATIES
DOMEIN BUILT ENVIRONMENT

hoger onderwijs groep
bouw & ruimte

Contents

Cover illustration
'untitled (Europoort, June 2006)'
Wouter van Buuren

Foreword

The Dutch system for higher education has a strict distinction between professional and academic programmes. In the Netherlands professional Bachelor's and Master's degrees are taught at 'universities of applied science' (in Dutch: *hogescholen*). Although these degrees are formally defined as level 6 and 7 programmes, respectively, in the International Standard Classification of Education 2011, they do not carry the same weight as academic university degrees. Dutch 'academic' universities award the titles BA, BSc and LLB, and MA, MSc and LLM, whereas applied universities simply offer B and M.

To allow for easier recognition of Dutch professional degrees abroad, a range of internationally used titles was assigned to clusters of thematically related courses, ranging from Bachelor of Engineering (BN) to Bachelor of Theatre Arts (BTA). In the past decade there has been a growing call, however, to put a stop to the proliferation of technical courses. The industry in particular felt that there were too many specialised courses.

In response the Dutch government and the applied universities offering technical courses have agreed on a new classification. From September 2015 the current 65 Bachelor courses are rearranged into 34 courses covering a broader array of subjects. They are clustered into 6 thematic fields: Applied Science, Built Environment, Creative Technologies, Engineering, ICT and Maritime Operations. This new classification requires an update of the attainment targets agreed upon in 2006.

The *Hoger Onderwijs Groep* (Higher Education Groep) is the umbrella organisation for all applied universities offering Built Environment courses. We have asked a committee of lecturers to draft new targets for the field. Considering the rapid internationalisation of both higher education and the building industry, their final report has been summarised in English in this brochure.

The first chapter gives an overview of the field and its programmes. Chapter 2 concerns the educational standards that underlie the attainment targets. In the third and fourth chapter the targets themselves are discussed.

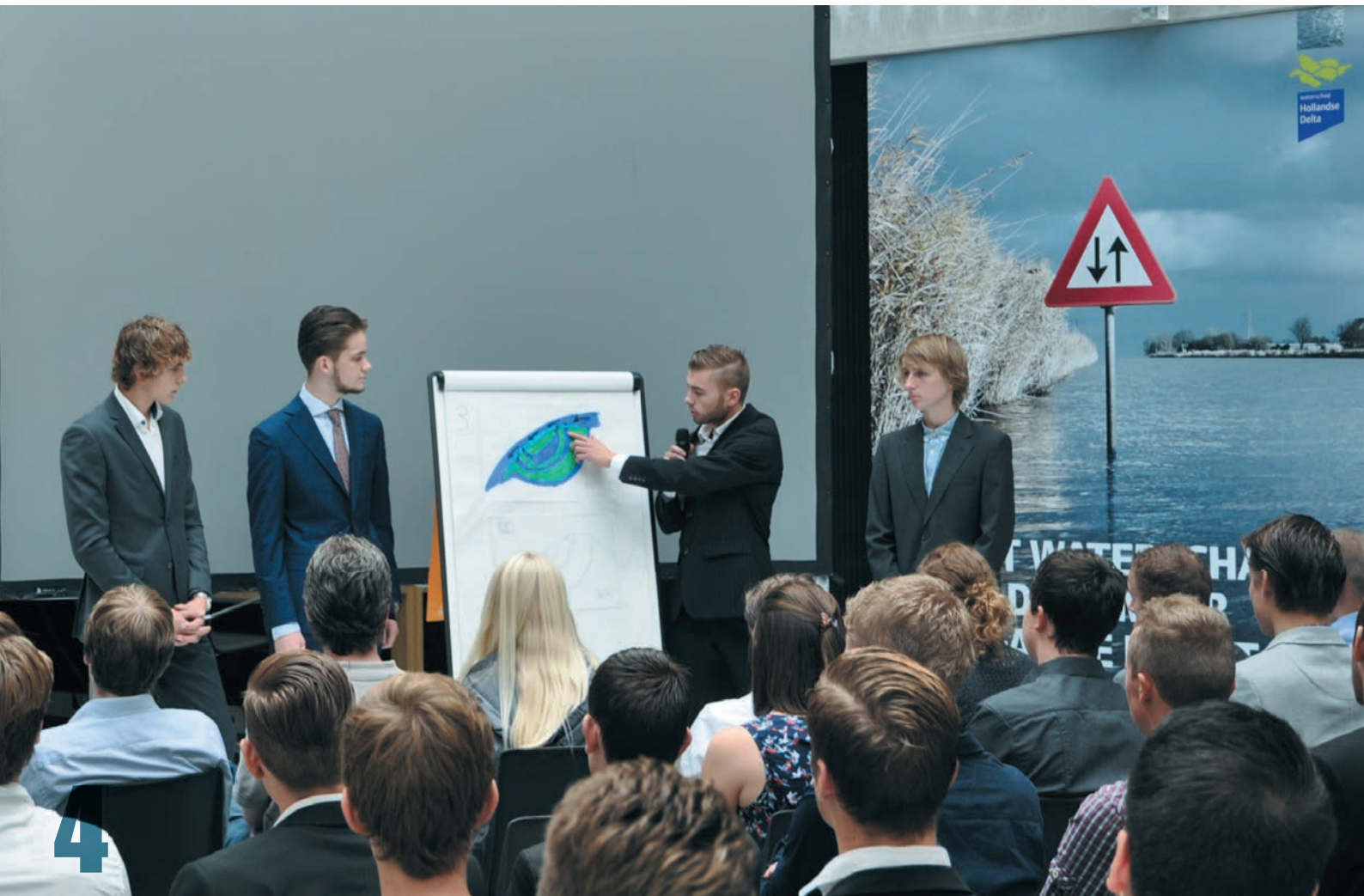
Bert Schroën
President Hoger Onderwijs Groep

1 An overview of Built Environment

The field Built Environment focusses on the development, design, realisation and use of public space and built environment, paying particular attention to issues in sustainability and innovation in the past, present and future. What defines Built Environment is the close cooperation with a wide range of disciplines within and outside its field. There is a strong awareness of operating in a societal context.

Professionals in the field work together with others from the service economy, healthcare, tourism and government. As such, professionals in Built Environment are accustomed to working on complex projects in multidisciplinary teams.
Graduates in Built Environment have a broad and deep understanding of technical, political and social developments. They are dedicated to working in teams, finding solutions and getting results.

They are proactive, flexible and aware of the various roles and responsibilities that stakeholders and decision-makers have. They can think outside the box and reflect critically on solutions for complex issues. They work on integrated, sustainable and future-proof designs, with advanced digital tools. They have good social and communication skills, focus on their clients and surroundings and can be employed in a wide range of disciplines.



Built Environment is formed by six Bachelor's programmes: Archaeology, Construction, Civil Engineering, Spatial Development, Water Management and Built Environment. Each of these has its own focus and subjects, which are described below.

ARCHAEOLOGY

The Bachelor's programme Archaeology trains students to become archaeologists in the field of Built Environment. The archaeologist has a broad and interdisciplinary perspective on research. As a generalist, she plays an important role in conducting archaeological and cultural-historical research and implementing policy, in keeping with the relevant legal framework. The archaeologist is familiar with conducting the technical, organisational and logistic aspects of archaeological research. She has a broad knowledge of archaeological periods and materials, is skilled in the digital and analogue acquisition, processing and storing of research data and can translate scientific information to a wider audience. In this, the archaeologist is aware of his responsibility to society.

CONSTRUCTION

The programme trains engineers to work in a multidisciplinary setting, in all phases of a building's lifecycle: design, construction, management, maintenance and demolition or redevelopment. A structural engineer is familiar with trends and developments in construction, such as falling cost price, client focus, strict legislation, new forms of collaborations, automation and sustainability, and knows how to respond to them. The programme allows for specialising in business and management, for all-round managers with a broad knowledge of construction techniques and processes as well as marketing, business and communication.

CIVIL ENGINEERING

Civil Engineering seeks integrated solutions for complex technical challenges that involve various disciplines. These are projects that can have great impact on society. The programme focusses on the development, design, building and management of infrastructure for land use. It is a combination of engineering and process and project management, aimed at improving the entire infrastructure, both underground and overground. Project are generally large-scale, one-off and on an international level.

SPATIAL DEVELOPMENT

what defines the programme Spatial Development is an integral approach to complex spatial challenges. The programme offers seven specialisations, which cover a wide array of subjects. What they have in common is a broad, integral perspective on spatial developments and a focus on seeking out connections. To connect with others, a professional must have a reasonable grasp of a range of topics. The programme allows universities to put together their own profile: they can opt to train as dedicated generalists, or as specialists with sufficient general knowledge to play a mediating role. Compared to other programmes, there is a strong focus on the following areas of expertise: Spatial Planning and Design, People and Society, and Government, Policy and Law.

WATER MANAGEMENT

within the field of delta technology the programme Water Management trains professionals as overall managers that shape sustainable and climate-proof water management in an international and multidisciplinary context, and develop safe, habitable and viable delta areas across the globe. Water managers focus on catchment areas, water systems and the water chain, and their relation to the designated functions of the delta areas. Students of the programme learn to formulate solutions that are technically, economically and socially feasible, drawing on the fields of hydrology, physics, chemistry, ecology, spatial design and business administration.

BUILT ENVIRONMENT

The programme focusses on the built environment as a whole. The challenges in the fields of the living environment, infrastructure and construction call for an integral approach. Different areas of knowledge must be brought together to form multidisciplinary collaborations. This calls for professionals who are familiar with all phases of the construction process and can deal with the administrative, political and social forces at play in the field of built environment. To train these 'deep' generalists or 'broad' specialists, universities may assemble a programme based on specialisations from the other five programmes.

2 Educational standards

There are two formal requirements for attainment targets for bachelor programmes in The Netherlands. The Dutch ministry of Education requires the targets to be drawn up in consultation with the professional field. The Accreditation Organisation of the Netherlands and Flanders (NVAO) requires the targets to comply with international educational and professional standards.

DUBLIN DESCRIPTORS

To improve and align higher education in Europe the joint ministers for Education ratified the Framework for Qualifications of the European Higher Education Area in 2005. The Qualification Framework provides a common understanding of the learning outcomes of a programme as represented by an awarded degree. Within the framework, the so-called Dublin descriptors define the requisite learning outcomes at each level. Qualifications that signify completion of a Bachelor's degree are awarded to students who:

1 have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study;

2 can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competencies typically demonstrated through devising and sustaining arguments and solving problems within their field of study;

3 have the ability to gather and interpret relevant data (usually within their field of study) to inform judgements that include reflection on relevant social, scientific or ethical issues;

4 can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences;

5 have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy.

EUR-ACE

The European Network for Accreditation of Engineering Education (ENAEE) has developed standards for engineering education. The 'Standards for the Accreditation of Engineering Programmes' (EUR-ACE) define six programme outcomes for Bachelor's programmes:

1 Knowledge and Understanding

- knowledge and understanding of the scientific and mathematical principles underlying their
- branch of engineering;
- a systematic understanding of the key aspects and concepts of their branch of engineering;
- coherent knowledge of their branch of engineering including some at the forefront of the branch;
- awareness of the wider multidisciplinary context of engineering.

2 Engineering Analysis

- 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 modelling methods.

3 Engineering Design

- the ability to apply their knowledge and understanding to develop and realise designs to meet defined and specified requirements;
- an understanding of design methodologies, and an ability to use them.

4 Investigations

- the ability to conduct searches of literature, and to use data bases and other sources of information;
- the ability to design and conduct appropriate experiments, interpret the data and draw conclusions;
- workshop and laboratory skills.

5 Engineering Practice

- the ability to select and use appropriate equipment, tools and methods;
- the ability to combine theory and practice to solve engineering problems;
- an understanding of applicable techniques and methods, and of their limitations;
- an awareness of the non-technical implications of engineering practice.

6 Transferable Skills

- function effectively as an individual and as a member of a team;
- use diverse methods to communicate effectively with the engineering community and with society at large;
- demonstrate awareness of the health, safety and legal issues and responsibilities of engineering practice, the impact of engineering solutions in a societal and environmental context, and commit to professional ethics, responsibilities and norms of engineering practice;
- demonstrate an awareness of project management and business practices, such as risk and change management, and understand their limitations;
- recognise the need for, and have the ability to engage in independent, life-long learning.

ADDITIONAL REQUIREMENTS

A committee of lecturers from universities offering Built Environment programmes have taken the Dublin descriptors and the EUR-ACE standards as starting point for the attainment targets. The committee has reflected on the profile, expertise and skills of the future professional, and how these relate to the professional field. Three additional requirements have been formulated.

Firstly, the competencies must be relevant for universities and students. For the universities the competencies serve as a guideline for preparing the attainment targets for their programmes. It should be remembered that this document does not prescribe the exact structure of a Bachelor's programme in Built Environment, but only describes the learning outcomes.

Within this framework, universities have the freedom to formulate programmes with a specific emphasis and/or character. *Secondly*, the industry should be able to identify with the terminology used. It is vital that companies have a good understanding of what they can expect from a Bachelor's graduate as a prospective employee. *Thirdly*, the wording of the competencies should be robust enough to remain relevant for a period of at least 6 years.

The result is a new set of attainment targets, which will guide students, universities and the industry. The set has been discussed extensively with representatives from the Dutch engineering industry. As a result, the targets have been split into two categories: *competencies* and *areas of expertise*.

3 A new set of competencies

Based on the requirements discussed in the previous chapter, a competency has been defined as a combination of knowledge and understanding, skills and attitude, applied in a professional context. In response to the diversity of programmes in the field of Built Environment, the nine competencies have been split into two types: technical and generic. Both are discussed below.

SIX TECHNICAL COMPETENCIES

These competencies are relevant to all programmes, but can be further specified by universities to suit the requirements of an individual programme. As such, the technical competencies are to be taken as a general guideline.

1 **Initiate and direct** – With a bird's-eye view and a broad market orientation, you can identify and track tasks and projects relevant to society. You are capable of formulating conditions, requirements and targets. You can describe, monitor and fine-tune the process.

2 **Design** – A design can be a plan, model or advice. It can be a spatial or technical design. You can design from a schedule of requirements, compare different solutions and make a balanced choice.

3 **Specify** – You can develop a specification, taking into account the ambitions, conditions and feasibilities, that provides direction for the product. You can specify the design from the set requirements. These requirements are unique to the profession and constitute the quality requirements for the product to be delivered.

4 **Realise** – You can carry out a design by preparing, maintaining, monitoring and fine-tuning the realisation.

5 **Manage** – You can write a management and maintenance plan to maintain the quality delivered.

6 **Monitor, assess and evaluate** – You can monitor and judge the delivered results objectively. Furthermore you can suggest adjustments and improvements and put these forward.

THREE GENERIC COMPETENCIES

Besides the specific technical competencies there are three generic competencies that a Bachelor's graduate will have developed. These generic competencies are not unique to Built Environment - or even to technical education in general. They describe the professional and intellectual ability that may be expected of a Bachelor's graduate.

1 **Research** – You can analyse a problem and formulate a research question. You can initiate and execute practice-oriented research.

2 **Communicate and collaborate** – You can communicate work-related information to co-workers, other professionals, clients and stakeholders. You are adept at internal and external communication, adjusting your tone-of-voice to the audience. You are focussed on and constructive coordination and cooperation with stakeholders.

3 **Coordinate and innovate** – You can guide and direct processes to reach the objectives. You can reflect on your performance independently. You are self-starting and can think outside of the box.

ATTAINMENT LEVELS

The programmes in Built Environment are quite varied in their technical complexity. This diversity is poorly served by a one-size-fits-all approach. Students must be allowed to specialize in certain professional profiles, and this means they cannot be expected to command all competencies at the same level. Using the aspects task, context and degree of independence, three attainment levels have been defined. The table below gives an overview. Level three is the highest.

Level	Type of task	Type of context	Degree of independence
I	· Simple · Structured · Applying methodology in familiar situations	· Familiar · Simple · Monodisciplinary	· Directive supervision
II	· Complex · Structured · Applying methodology in varying situations	· Familiar · Complex · Monodisciplinary · In practice	· Coaching supervision
III	· Complex · Unstructured · Applying methodology in unfamiliar situations	· Unfamiliar · Complex · Multidisciplinary · In practice	· Independent · Supervision on request

Table 1 Definitions of the three attainment levels

Upon graduation a student will have attained the highest level in a number of competencies and a lower level in the others. It depends on the programme and the chosen profile which ones. For a bachelor's degree the standard is that for 5 of the 9 competencies the highest level is required, and at least 2 of these 5 must be generic competences. This allows students to choose to broaden or deepen their skills and knowledge. A student of Spatial Design, for instance, may focus on the competencies Initiate and direct, Design, Specify, Research, Communicate and collaborate, and Coordinate and innovate. For a student of Construction, on the other hand, it may be Design, Specify, Realise, Research, and Communicate and collaborate. But both students will have achieved the highest level in five competencies, of which two generic. Both now have the necessary professional and intellectual capabilities to work in their chosen field.

At the same time, the competencies allow universities to respond to preferences from the (local) industry in how they design their programmes. Of course, it is their responsibility to ensure their Bachelor's students acquire the relevant competencies upon graduation. But within this framework they should have the freedom to differentiate, so that universities can adopt a profile to cater to specific groups of students or companies. As long as they ensure that students qualifying for a Bachelor's degree in Built Environment can be expected to meet the standards set by the EU and ENAEE.

4 Ten areas of expertise

As discussed before, the attainment levels are made up of competencies and areas of expertise. The primary reason to introduce these two categories is that the industry felt that, by themselves, the competencies were too broad and indistinguishable. The areas of expertise are meant to counteract the abstractness of the competencies: it should give companies and students a clearer view of the programmes and the differences between them.

The areas of expertise will help students in acquiring the competencies in their proper context. They do not apply to each programme to the same extent. Table 2 (see below) lists whether they are mandatory, optional or not relevant. The part that is mandatory forms the body of knowledge (BoK). The areas of expertise can thus be used as a kind of 'table of contents' for defining a BoK.
The ten areas of expertise cover the following fields: methodology (1), technical and physical aspects (2-4), business and society (5-7) and Bachelor's education (8-10). All necessary professional skills and knowledge have been arranged into these areas:

1 Spatial planning and design

2 Water, soil and environment

3 Infrastructure and mobility

4 Structures and technique

5 People and society

6 Government, policy and law

7 Economy

8 Applied research

9 Communication

10 Management

THE SCOPE OF THE AREAS

Defining a number of areas of expertise in a way that does justice to the entire field is a challenge, for two reasons. Firstly, the various programmes have their own profile, with their own specific technical knowledge and skills. Having many and narrowly defined areas leads to a subdivision that is too broad and unclear. But having a few and broadly defined areas carries the risk that programmes, students and the industry cannot identify with them.

Secondly, it may be so that a certain area of expertise is relevant for all programmes, but in different ways. A subject as design techniques will of course be taught differently in Spatial Development than Civil Engineering. Built Environment happens to be a broad and wide-ranging cluster that includes both partially as fully technical programmes.

THE AREAS OF EXPERTISE IN PRACTICE

For reasons of practicability and clarity, each of the ten areas are subdivided into a number of subareas. For each subarea has been determined to what extent it is mandatory for each of the programmes. In the table below, 'green' means mandatory, 'blue' optional and 'red' not relevant for the programme.

Programmes Areas of expertise		Built Environment	Construction	Civil Engineering	Spatial Development	Water Management	Archaeology
1	Spatial planning and design						
1.1	Spatial structure and typology						
1.2	Methodology						
1.3	Local development						
1.4	Vision and strategy design						
1.5	Integral design approach						
1.6	Design techniques						
2	Water, soil and environment						
2.1	Water systems and the water chain						
2.2	Water management						
2.3	Hydraulic engineering						
2.4	Soil science and geotechnics						
2.5	Ecology and environment						
2.6	Climate change and energy						
3	Infrastructure and mobility						
3.1	Traffic						
3.2	Distributions						
3.3	Dry infrastructure						
3.4	Wet infrastructure						
3.5	Cables and lines						
4	Construction and technique						
4.1	Construction science						
4.2	Building methods and installation technique						
4.3	Works of art and buildings						
4.4	Surveying and geodesy						
4.5	Building physics and installations						
4.6	Materials						
4.7	Maintenance, management and renovation						
5	People and society						
5.1	Social dynamics and processes						
5.2	Lifestyles and behaviour						
5.3	Cultural history and heritage						
5.4	Globalisation						
5.5	Sustainability, innovation and ethics						
5.6	Stakeholders						

Programmes Areas of expertise		Built Environment	Construction	Civil Engineering	Spatial Development	Water Management	Archaeology
6 Government, policy and law							
6.1	Public administration						
6.2	Law and regulations						
6.3	Spatial planning						
6.4	Governance						
6.5	Safety						
7 Economy							
7.1	General and spatial economics						
7.2	Business administration and entrepreneurship						
7.3	Marketing						
7.4	Market economy and feasibility						
7.5	Funding						
7.6	Cost estimation and quotation						
8 Applied research							
8.1	Research methods						
8.2	Research techniques						
9 Communication							
9.1	Verbal and written communication						
9.2	Visualisation						
9.3	Networking skills						
9.4	Social sensitivity						
10 Management							
10.1	Project management						
10.2	Process management						
10.3	Coordination						
10.4	Collaboration						
10.5	Risk management						
10.6	Management and maintenance						
10.7	Information management						

Acknowledgements

The attainment targets were developed by a committee of lecturers from applied universities offering courses in Built Environment. Alongside the writing process there has been an extensive consultation process: in four regional sessions the targets were discussed with a wide array of representatives from the industry.

The attainment targets have been formally validated by the relevant Dutch government bodies and a number of trade organisations. From September 2015 they will contribute to the education of international, socially aware, collaborative and creative professional in the field Built Environment.

COLOPHON

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