General syllabus for third-cycle subject

Subject	Adopted	Registration number	Ks-kod
Civil and Architectural Engineering	**10 May 2017** *Revised* *26 September 2018*	**V-2019-0288**	**3.2.3**

General syllabus

Established by the Faculty Council/Education Committee: 10/05/2017

Revised: 26/09/2018

The name of the subject in Swedish and translated into English

Also indicated whether the subject has any specialisations.

Byggvetenskap (Civil and Architectural Engineering)

The subject Civil and Architectural Engineering has eight specialisations:

• Concrete Structures

• Structural Engineering and Bridges

• Building Materials

• Building Technology

• Hydraulics and Hydrologic Engineering

• Building Service and Energy Systems

• Soil and Rock Mechanics

• Fluid and Climate Technology

Subject description Main content of the programme

The third-cycle subject Civil and Architectural Engineering includes academic studies of buildings as technical systems. The subject relates to both buildings and facilities. The societal focus of the construction sector has traditionally been placed on new production, but has now shifted to also include the operation and maintenance stage. This is reflected in the research profile for Civil and Architectural Engineering. The broad expertise at the Department of Civil and Architectural Engineering provides excellent conditions for advanced studies of buildings as technical systems, but also for processing and solving technical issues relating to construction.

Programme objectives based on the Higher Education Ordinance, Annex 2, Qualifications Ordinance.

Each doctoral student's individual study plan shall be designed to guarantee the possibility of attaining the qualitative targets in the Higher Education Ordinance and KTH's objectives. Attainment shall be evaluated for each individual doctoral student. This shall be done annually by monitoring the individual study plan. The latter shall comment on progression vis-à-vis the objectives based on the programme's courses and student's thesis work. Other activities, such as supervision and external activities in line with education and public outreach shall also be factored into this.

State the programme elements for promoting goal attainment. Other details are to be given in an appendix to the subject's study plan.

Knowledge and understanding
For a Degree of Doctor, the doctoral student must
- demonstrate broad knowledge within and a systematic understanding of the research area as well as deep and up-to-date specialist knowledge within a defined part of the research area, and
- demonstrate familiarity with scientific methodology in general and with the methods of the specific research area in particular.

The overarching goals "knowledge and understanding" are attained primarily through participation in courses and one's own supervised research.

Skills and abilities, including communication ability
For a Degree of Doctor, the doctoral student must
- demonstrate skills in scientific analysis and synthesis and ability to independently and critically consider and assess new and complex phenomena, questions and situations,
- demonstrate ability to critically, independently, creatively and with scientific meticulousness identify and formulate questions as well as plan and conduct research and other qualified tasks using adequate methods within given time frames and review and evaluate such work,
- write a thesis to demonstrate their ability to make significant contributions to knowledge development through their own research,
- demonstrate ability in both national and international contexts, verbally and in writing, to confidently present and discuss research and research findings in dialogue with the scientific community and society in general.
- demonstrate an ability to identify needs for further knowledge, and
- demonstrate ability, both in research and education and in other qualified professional contexts, to contribute to society's development and support the learning of others.

The overarching goals "competence and skills" are attained primarily through thesis work, but with support in the courses and seminar activities. This includes training in reading, understanding and commenting on scientific texts and in arguing for or against findings and standpoints, both one's own and those of others. Communicating is also practiced through presentations at scientific conferences, as well as through the compulsory course FAF3008 Research in Civil and Architectural Engineering. Most doctoral students have departmental duties in the form of teaching, which provides another occasion for communication training.

When it comes to goal attainment in regard to communicative skills for both licentiate and doctoral degrees in Civil and Architectural Engineering, special emphasis is placed on the ability to communicate research within the subject to various professional groups and actors in the urban planning sector, such as government agencies, clients and users. In regard to research ethics, it is important in both degrees that the student is able to make well-founded assessments of societal consequences of the decisions, for example regarding the design of infrastructures and buildings, that the research may lead to. The student must also, for both degrees, have good insight into the relationship between public policy decisions and knowledge based in research on Civil and Architectural Engineering. For a Degree of Doctor, the doctoral student must have the ability to independently review the interaction between building science and engineering decisions and other assessments on one side, and values and interests in the urban planning process on the other.

Judgement and approach
For a Degree of Doctor, the doctoral student must
- demonstrate intellectual independence and scientific integrity as well as the ability to make ethical research assessments, and
- demonstrate a profound insight into the possibilities and limitations of the discipline, its societal role and the responsibility people bear for how it is used.

The overarching goals "judgement and approach" are attained in supervision, collegial contexts and in courses and thesis work. The ability to make assessments based in research ethics is trained through the supervised thesis work and through the ethics element of the compulsory course 1N5113 Theory of Science and Research Method. Intellectual independence is trained and examined both through article publication and during the thesis work.

Sustainable development
For a Degree of Doctor, the doctoral student must
- demonstrate knowledge of, and an ability to make relevant environmental and ethical assessments in order to be able to contribute to sustainable societal development.

The general objectives relating to "sustainable development" are attained through examination in course elements on sustainability issues and on the meaning and definition of the sustainability concept. This is done primarily within the scope of the compulsory course FAF3008 Research in Civil and Architectural Engineering, but there are also opportunities for advanced studies within the field through other, elective courses. A series of seminars are organised by the Department of Civil and Architectural Engineering to discuss current issues relating to sustainable development.

Specialisation: Concrete Structures

The specialisation in Concrete Structures focuses on mode of action, modelling, dimensioning and constructive design of reinforced and pre-stressed constructions in concrete, fibre-reinforced concrete, lightweight concrete and other cement-based materials as well as masonry constructions. It also includes analysis of methods of execution, maintenance, repair and reinforcement.

The aim of the third-cycle specialisation in concrete structures is for the student to acquire academic knowledge of methods that are necessary for research and qualified investigative work within the discipline and its applications in the private and public sectors.

Specialisation: Structural Engineering and Bridges

The specialisation in Structural Engineering and Bridges focuses on design and construction of new bridges and buildings as well as renovation of existing structures, taking into consideration loads, load bearing capacity, reliability, function and durability. The specialisation also includes condition assessment using modern monitoring techniques as well as design and stress analysis for structural elements of steel, aluminium and wood and for steel interacting with other materials.

The aim of third-cycle specialisation in Structural Engineering and Bridges is for the student to acquire academic knowledge of methods necessary for research and qualified investigative work within the discipline and its applications in the private and public sectors.

Specialisation: Building Materials

The area of knowledge for the specialisation of Building Materials includes theoretical and experimental analysis of the general and long-term properties of building materials and components, with particular emphasis on use and environmental factors. Both analysis and modelling of degradation processes for individual materials and products in intended use, for example measurement, characterisation and modelling of the degradation environment. Research within this area of knowledge aims to create a basis for material choices in planning, maintenance planning and life-cycle evaluation and for estimations of life-cycle costs. Environmental considerations, resource optimisation and the urban environment are strong driving forces for the research.

An essential area of third-cycle research and education in the specialisation Building Materials is studies of the properties and behaviours of building materials in different environments based on

fundamental materials physics/chemistry. There are more possible focuses within this area of specialisation today, such as the environmental impact of building materials and the long-term properties of materials, components and buildings. The specialisation also includes characterisation and modelling of the degradation environment and life-cycle planning for buildings. In conjunction with studying the degradation and long-term properties of materials/products, research is also conducted on alternative raw materials, such as wood composites, in material manufacturing, use of residual products from industrial processes and reuse of construction materials, for example filter materials after it has been used to fill its main purpose.

Specialisation: Building Technology

The area of knowledge for this specialisation includes development by design, construction and dimensioning, and also by the building process, to improve building constructions and in particular the building envelope to achieve moisture safety, energy efficiency and a healthy indoor climate. Also building acoustics is included.

The scientific basis for research within the specialisation includes building physics, i.e. transport of moisture and water, heat and air, sound transmission and transmission of vibrations in constructions and construction parts, and how these are influenced by the properties of the materials in the constructions. The aim of research in this field is to adapt the properties of building constructions to the needs of their users within the limits provided by a sustainable society and with regard to the aspects mentioned above.

Specialisation: Hydraulics and Hydrologic Engineering

The specialisation Hydraulics and Hydrologic Engineering comprises fluid mechanics applied to natural aquatic environments and hydroengineering works, especially integrated with the subjects of geomechanics and geochemistry. Technical applications include the mechanical interaction of water with constructions in soil and rock, such as embankment dams and outlets, evaluation of the capacity of ground and surface water resources, flood risks, hydropower regulation and water quality. The research is based on a technical development of hydrology, mathematical model studies, field tests and hydraulic laboratory experiments. Examples of experimental techniques are different types of trace element tests in watercourses.

Specialisation: Building Service and Energy Systems

The specialisation Building Service and Energy Systems focuses primarily on indoor climate, installation and energy systems in buildings, with special emphasis on low-energy buildings (passive, nearly zero and positive energy buildings). Central areas of operation include modelling of energy systems and services for buildings/districts, resource-efficient building renovation, reliability and optimisation of installation and energy systems, inventory of building performance, smart control systems and user-building interaction.

The aim of the third-cycle specialisation in building service and energy systems is for the student to acquire academic knowledge of methods that are necessary for research and qualified investigative work within the discipline and its applications in the private and public sectors.

Specialisation: Soil and Rock Mechanics

The area of knowledge for the specialisation of Soil and Rock Mechanics comprises theoretical and experimental studies of different soil and rock mechanical problems relating to construction and urban planning.

The aim of third-cycle education in soil and rock mechanics is for the doctoral student to acquire a sufficiently firm grasp of the knowledge area to work with advanced assignments with a clear focus on expertise or academic work in the private and public sectors.

Specialisation: Fluid and Climate Technology

The specialisation Fluid and Climate Technology includes theory, models and technical solutions that contribute to a favourable development of health, comfort and safety aspects within construction and the built environment. In order to succeed in studies within this area, where traditional measuring techniques face difficulties of both an economic and technical nature, new and advanced simulation programmes are being developed and used. Computational fluid dynamics (CFD) and modern visualisation methods have created significant new conditions for understanding important correlations within this area. The theoretical work includes use of the finite volume method and associated turbulence modelling. Central elements of the research methodology include mathematical modelling and analysis, numerical computational techniques and methods for validation of calculated results. Thermodynamic processes and heat transferring mechanisms for efficient and sustainable energy solutions are also included. Technical solutions are developed in collaboration with the industry. Research is to contribute to creating an optimal air quality and thermal comfort in indoor environments and promote a healthy use of energy while improving human health, well-being and productivity at work in the long term.

Specific entry requirements

Subject knowledge requirements and any language requirements are specified here

To be admitted to the third-cycle programme within Civil and Architectural Engineering, the applicant must have passed courses resulting in at least 60 higher education credits at minimum second-cycle level within Civil and Architectural Engineering or other subjects deemed directly relevant to the chosen specialisation. These entry requirements can be also be considered fulfilled by an applicant who has acquired essentially the equivalent knowledge in a different order.

A doctoral student is expected to read and write scientific English and to speak English fluently.

Selection rules

Selection for third-cycle education is based on assessed ability to assimilate such education. The ability assessment is primarily based on having passed courses and programmes that satisfy the entry requirements. Particular consideration is given to the following:

1. Knowledge and skills relevant for thesis work and the subject. These can be demonstrated via attached documents and, potentially, an interview.

2. Assessed ability to work independently

   a. ability to formulate and tackle scientific problems

   b. ability to communicate well in speech and writing.

   c. maturity, judgement and ability to analyse critically and independently

The assessment may be based, for example, on degree projects and discussion of these at a possible interview.

3. Other experience relevant for third-cycle education, e.g. professional experience.

Contents and examination of course element

The Degree of Licentiate comprises a course element of 30 HE credits and a dissertation component of 90 HE credits which make up a combined total of 120 HE credits.

The Degree of Doctor comprises a course element of 60 HE credits and a thesis component of 180 HE credits, which make up a combined total of 240 HE credits.

Compulsory courses

All specialisations within Civil and Architectural Engineering require the completion of compulsory courses corresponding to at least 22.5 HE credits for both the licentiate and doctoral degree. The advanced course varies with specialisation, and is specified under each specialisation in the next sections. The compulsory courses must be completed prior to the award of a Degree of Licentiate and before 50 per cent of the doctoral thesis is finished, with the following distribution of credits:

1N5113 Theory of Science and Research Method 7.5 credits

FAF3008 Research in Civil and Architectural Engineering 7.5 credits

Recommended elective courses

Courses that are recommended for each specialisation are indicated below as recommended advanced courses. The following courses are also recommended for all specialisations within Civil and Architectural Engineering.

Doctoral students teaching on a first-cycle or second-cycle programme must have completed introductory training in higher education teaching.

SF2739 Partial Differential Equations 7.5 credits

SF2950 Applied Mathematical Statistics 7.5 credits

SF3626 Mathematical Analysis for PhD Students 7.5 credits

SF2520 Applied Numerical Methods 7.5 credits

LS2429 Technical Communication in English 7.5 credits

Courses for the specialisation Concrete Structures

Compulsory course

1L5101 Project in Concrete Structures 7.5 credits

Recommended advanced courses

AF3212 Non-Linear FEM Civil Engineers 7.5 credits

AF3115 Concrete and Other Cement Based Materials 7.5 credits

AF3201 Advanced Structure Dynamics, Modelling and Measurements 7.5 credits

Courses for the specialisation Structural Engineering and Bridges

Compulsory course

FAF3005 Project in Structural Engineering 7.5 credits

Recommended advanced courses

AF3201 Advanced Structure Dynamics, Modelling and Measurements 7.5 credits

AF3212 Non-Linear FEM Civil Engineers 7.5 credits

1C5034 Qualified Bridge Structures 7.5 credits

Courses for the specialisation Building Materials

Compulsory course

FAF3302 Project in Building Materials Technology 7.5 credits

Recommended advanced courses

1D5104 Degradation Mechanisms & Service Life of Building Material 7.5 credits

1D5109 Moisture Mechanics 7.5 credits

1L5303 Wood Physics 7.5 credits

1D5132 Wood Science 7.5 credits

Courses for the specialisation Building Technology

Compulsory course

1D5223 (FAF3411) Low-energy and Sustainable Construction 7.5 credits

Recommended advanced courses

1L5401 Modelling of Thermal Processes in Building 7.5 credits

AF3401 Dampness in Buildings 7.5 credits

1D5224 Building Physics Measurement Techniques 7.5 credits

Courses for the specialisation Hydraulics and Hydrologic Engineering

Compulsory course

AF3801 Hydrological Transport Processes

Recommended advanced courses

AF3802 Hydrology for Hydropower Purposes 2.0 credits

Courses included in the third-cycle programme within the Swedish Hydropower Centre (SVC).

Courses for the specialisation Building Service and Energy Systems

Compulsory course

1D5998 (FAF3509) Project in Building Services Engineering 7.5 credits

Recommended advanced courses

1D5304 Climate Technology, Systems 7.5 credits

1D5302 Heat Transfer 7.5 credits

1D5301 Fluid Mechanics 7.5 credits

Courses for the specialisation Soil and Rock Mechanics

Compulsory course

FAF3604 Soil Mechanics 7.5 credits

Recommended advanced courses

AF3605 Underground Excavation in Rock 7.5 credits

AF3602 Theoretical Rock Mechanics 7.5 credits

1B5422 Geotechnology 7.5 credits

AH3452 Risk Analysis 7.5 credits

AF3603 Information Based Design in Soil and Rock Mechanics 7.5 credits

Courses for the specialisation Fluid and Climate Technology

Compulsory course

FAF3704 Fluid and Climate Theory 7.5 credits

Recommended advanced courses

AF3703 Computational Fluid Dynamics, CFD, in Design and Development 7.5 credits

1D5302 Heat Transfer 7.5 credits

6L5025 Technology and Health 7.5 credits

Qualification requirements

Degree of Doctor

A Degree of Doctor comprises 240 credits. At least 120 credits must consist of the doctoral thesis.

Thesis

Quality requirements and possible other requirements for the thesis.

The dissertation/thesis is a compulsory part of the third-cycle programme. A doctoral thesis can either be written as a monograph or as an aggregation of scientific articles. In the latter case, there must be a separately written summary. The thesis must normally be written in English with a summary in Swedish. The doctoral thesis can be based on the licentiate dissertation.

A doctoral thesis must contain new theoretical or empirical research results within the chosen field, which the student has produced through theoretical or empirical research. It must also contain an overview of earlier research within the chosen field. Regardless of whether the doctoral thesis is presented as a monograph or as a compilation of scientific papers, it must be of such quality that it is deemed a suitable basis for at least four regular articles that can be published in internationally recognised, peer-reviewed journals.

Courses

A Degree of Doctor requires 60 credits obtained through courses.

Degree of Licentiate

A Degree of Licentiate comprises at least 120 credits. At least 60 credits must consist of the licentiate dissertation.

Dissertation

Quality requirements and possible other requirements for the dissertation.

The dissertation/thesis is a compulsory part of the third-cycle programme. A licentiate dissertation can either be written as a monograph or as an aggregation of scientific articles. In the latter case, there must be a separately written summary. The dissertation must normally be written in English with a summary in Swedish.

A licentiate dissertation must contain an application of established scientific knowledge within a field, which the student has developed through theoretical or empirical research. It must also contain an overview of earlier research within the chosen subject area. Regardless of whether the licentiate dissertation is presented as a monograph or as a compilation of scientific papers, it must be of such quality that it is deemed a suitable basis for at least two regular articles that can be published in internationally recognised, peer-reviewed journals.

Courses

A Degree of Licentiate requires 30 credits obtained through courses.

Appendix
Qualitative targets, including KTH's objectives, as per the Higher Education Ordinance (Appendix 2 – Qualifications Ordinance) for concretising the subject and information on how the programme has been structured to help the doctoral student reach the targets.

Degree of Doctor

Objectives based on the Higher Education Ordinance, Annex 2 – Qualifications Ordinance *For a Degree of Doctor, the doctoral student must*	**Concretisation and adaptation of targets to the third-cycle subject area**	**Programme elements that promote goal attainment**
demonstrate broad knowledge in and a systematic understanding of the field of research and deep and up-to-date specialist knowledge in a delimited part of the field of research	The overarching goal is attained primarily through participation in courses and one's own supervised research.	General and systematic understanding of the subject is developed in the compulsory course FAF3008 Research in Civil and Architectural Engineering and the compulsory advanced course specified for each specialisation. In addition, each specialisation has at least three specific elective advanced courses. Training is also provided through supervision and seminar participation. The student demonstrates attained ability via examination in said courses, presentations at seminars and by writing the background section to the summarising, introductory chapter of their thesis. Specialist knowledge is developed through individual study as per the supervisor's suggestions and instructions and through discussions with the supervisor and others. This is primarily presented in the papers in the thesis.
demonstrate familiarity with scientific methodology in general and with the methods of the specific research area in particular.	The overarching goal is attained primarily through thesis work, supported by courses and seminar activities. This includes training in reading, understanding and commenting on scientific texts and in arguing for or against findings and standpoints, both one's own and	General and more specialised knowledge of scientific methodology is acquired through the compulsory course 1N5113 Theory of Science and Research Method. More specialised methodological knowledge is acquired through the compulsory course FAF3008 Research in Civil

Objectives based on the Higher Education Ordinance, Annex 2 – Qualifications Ordinance *For a Degree of Doctor, the doctoral student must*	**Concretisation and adaptation of targets to the third-cycle subject area**	**Programme elements that promote goal attainment**
	those of others. Communication training also occurs through presentations at scientific conferences. Most doctoral students have departmental duties in the form of teaching, which provides another occasion for communication training.	and Architectural Engineering and through various recommended elective courses such as LS2429 Technical Communication in English. It is also acquired through supervision and participation in seminars and conferences.
demonstrate skills in scientific analysis and synthesis and ability to independently and critically consider and assess new and complex phenomena, questions and situations,	The overarching goal is attained primarily through thesis work, supported by courses and seminar activities. This includes training in reading, understanding and commenting on scientific texts and in arguing for or against findings and standpoints, both one's own and those of others. Communication training also occurs through presentations at scientific conferences. Most doctoral students have departmental duties in the form of teaching, which provides another occasion for communication training.	Supervision is structured so that the student increasingly becomes more independent in analysing the data generated by their own research. The ability to critically review the research results and observations of others is practiced at the department seminars and courses. This is primarily done within the course FAF3008 Research in Civil and Architectural Engineering.
demonstrate ability to critically, independently, creatively and with scientific meticulousness identify and formulate questions as well as plan and conduct research and other qualified tasks using adequate methods within given time frames and review and evaluate such work,	The overarching goal is attained primarily through thesis work, supported by courses and seminar activities. This includes training in reading, understanding and commenting on scientific texts and in arguing for or against findings and standpoints, both one's own and those of others. Communication training also occurs through presentations at scientific conferences. Most doctoral students have departmental duties in the form of teaching, which provides another	This is practiced primarily through supervision and independent research. In addition, we strive to have doctoral students participate in discussions to identify research questions and plan future research. This relates to both internal meetings and meetings with colleagues from other universities as well as other external parties of importance to our research.

Objectives based on the Higher Education Ordinance, Annex 2 – Qualifications Ordinance *For a Degree of Doctor, the doctoral student must*	**Concretisation and adaptation of targets to the third-cycle subject area**	**Programme elements that promote goal attainment**
	occasion for communication training.	
write a thesis to demonstrate their ability to make significant contributions to knowledge development through their own research,	The overarching goals "competence and skills" are attained primarily through thesis work, but with support in the courses and seminar activities. This includes training in reading, understanding and commenting on scientific texts and in arguing for or against findings and standpoints, both one's own and those of others. Communicating is also practiced through presentations at scientific conferences, as well as through the compulsory course FAF3008 Research in Civil and Architectural Engineering. Most doctoral students have departmental duties in the form of teaching, which provides another occasion for communication training.	In addition to the individual study plans, we use the supervision meetings to plan the doctoral students' research. We also use seminars for continuous follow-up and discussion of the doctoral students' work. Supervisor meetings are used to discuss the doctoral students' progress and to identify supervisory measures and other actions that are required to further assist the doctoral students in attaining this central goal in the third-cycle education.
demonstrate ability in both national and international contexts, verbally and in writing, to confidently present and discuss research and research findings in dialogue with the scientific community and society in general.	In Civil and Architectural Engineering, special emphasis is placed on the ability to communicate research within the subject to various professional groups and actors in the urban planning sector, such as government agencies, clients and users.	We attach great importance to doctoral students presenting their research not only in research contexts, but also to stakeholders and other interested parties. Our principle is that a full-time doctoral student must give an external presentation, for example at an international conference, at least once a year
demonstrate ability to identify needs for further knowledge	The overarching goals "competence and skills" are attained primarily through thesis work, but with support in	In conjunction with the annual review of their study plan, the doctoral student is encouraged to present their own proposals

Objectives based on the Higher Education Ordinance, Annex 2 – Qualifications Ordinance *For a Degree of Doctor, the doctoral student must*	**Concretisation and adaptation of targets to the third-cycle subject area**	**Programme elements that promote goal attainment**
	the courses and seminar activities. This includes training in reading, understanding and commenting on scientific texts and in arguing for or against findings and standpoints, both one's own and those of others. Communicating is also practiced through presentations at scientific conferences, as well as through the compulsory course FAF3008 Research in Civil and Architectural Engineering. Most doctoral students have departmental duties in the form of teaching, which provides another occasion for communication training.	for how to plan the continued research. These proposals are discussed with the principal supervisor as part of the work to review the study plan. The continuing supervision places great emphasis on the doctoral student independently identifying what needs to be done to move their research forward.
demonstrate ability, both in research and education and in other qualified professional contexts, to contribute to society's development and support the learning of others.	In Civil and Architectural Engineering, special emphasis is placed on the ability to communicate research within the subject to various professional groups and actors in the urban planning sector, such as government agencies, clients and users.	Doctoral students are afforded opportunities to participate in both scientific conferences and in meetings with external interested parties. When possible, they are also afforded opportunities to gain teaching experience. Most doctoral projects in the programme is financed entirely or partly by the construction industry and/or concerned government agencies. Reference groups are established for this purpose with industry representatives to provide support and ties to the industry. A relatively large proportion of the programme's doctoral students are industry-employed doctoral students. Doctoral students are offered the possibility, as part of their programme, to take the course LH3000 Basic Communication and Teaching.

Objectives based on the Higher Education Ordinance, Annex 2 – Qualifications Ordinance *For a Degree of Doctor, the doctoral student must*	**Concretisation and adaptation of targets to the third-cycle subject area**	**Programme elements that promote goal attainment**
demonstrate intellectual independence and scientific integrity as well as the ability to make ethical research assessments	In regard to research ethics, it is important in both degrees that the student is able to make well-founded assessments of societal consequences of the decisions, for example regarding the design of infrastructures and buildings, that the research may lead to. The overarching goals "judgement and approach" are attained in supervision, collegial contexts and in courses and thesis work. The ability to make assessments based in research ethics is trained through the supervised thesis work and through the ethics element of the compulsory course 1N5113 Theory of Science and Research Method. Intellectual independence is trained and examined both through article publication and during the thesis work.	Supervision as well as research seminars bring up issues relating to scientific integrity and research ethics. The compulsory courses 1N5113 Theory of Science and Research Method, and FAF3008 Research in Civil and Architectural Engineering, both contain elements relating to research ethics.
demonstrate a profound insight into the possibilities and limitations of the discipline, its societal role and the responsibility people bear for how it is used	The student must also, for both degrees, have good insight into the relationship between public policy decisions and knowledge based in research on Civil and Architectural Engineering. For a Degree of Doctor, the doctoral student must have the ability to independently review the interaction between building science and engineering decisions and other assessments on one side, and values and interests in the urban planning process on the other. The overarching goals "judgement and approach" are attained in supervision, collegial	Questions relating to the possibilities and limitations of science are discussed continuously during supervision and seminars. The doctoral students are expected to bring up questions relating to social relevance in the introductory chapter of their thesis. These questions are also considered in the compulsory course FAF3008 Research in Civil and Architectural Engineering.

Objectives based on the Higher Education Ordinance, Annex 2 – Qualifications Ordinance *For a Degree of Doctor, the doctoral student must*	**Concretisation and adaptation of targets to the third-cycle subject area**	**Programme elements that promote goal attainment**
	contexts and in courses and thesis work. The ability to make assessments based in research ethics is trained through the supervised thesis work and through the ethics element of the compulsory course 1N5113 Theory of Science and Research Method. Intellectual independence is trained and examined both through article publication and during the thesis work.	
(KTH's objectives for MHU) demonstrate knowledge of, and an ability to make relevant environmental and ethical assessments in order to be able to contribute to sustainable societal development.	Students gain an awareness of how knowledge within the field of Civil and Architectural Engineering can be used to contribute to the development of an ecologically, technologically, socially and economically sustainable society. Students are examined on course elements regarding sustainability issues as well as the meaning and definition of the sustainability concept. There are possibilities for more advanced course studies in this field. There are also possibilities of influencing how questions regarding sustainable development are included in the programme. The thesis project must discuss how the student's research relates to the objective of a sustainable development of society.	Questions relating to sustainable development are always relevant to the research area, and will be brought up in supervision, seminars and third-cycle courses. They are considered, for example, in the compulsory third-cycle course FAF3008 Research in Civil and Architectural Engineering, but also in the courses that are compulsory for each specialisation. Course seminars will bring up questions relating to sustainable development. The Department gives a series of seminars on how knowledge within the field of Civil and Architectural Engineering can be used to contribute to the development of an ecologically, technologically, socially and economically sustainable society.

Degree of Licentiate

Objectives based on the Higher Education Ordinance, Annex 2 – Qualifications Ordinance *For a Degree of Licentiate, the doctoral student must*	**Concretisation and adaptation of targets to the third-cycle subject area**	**Programme elements that promote goal attainment**
demonstrate knowledge and understanding within the research field, including current specialist knowledge within a part thereof, as well as advanced knowledge of general scientific methods and the methods of the specific research field in particular	The overarching goal is attained primarily through participation in courses and one's own supervised research.	General and systematic understanding of the subject is developed in the compulsory course FAF3008 Research in Civil and Architectural Engineering and the compulsory advanced course specified for each specialisation. In addition, each specialisation has at least three specific elective advanced courses. Training is also provided through supervision and seminar participation. The student demonstrates attained ability via examination in said courses, presentations at seminars and by writing the background section to the summarising, introductory chapter of their thesis. Specialist knowledge is developed through individual study as per the supervisor's suggestions and instructions and through discussions with the supervisor and others. This is primarily presented in the papers in the thesis.
demonstrate ability to critically, independently, creatively and with scientific meticulousness identify and formulate questions as well as plan and conduct limited research and other qualified tasks using adequate methods within given time frames, thereby contributing to knowledge development, and review and evaluate such work.	The overarching goals "competence and skills" are attained primarily through thesis work, but with support in the courses and seminar activities. This includes training in reading, understanding and commenting on scientific texts and in arguing for or against findings and standpoints, both one's own and those of others. Communicating is also practiced through presentations at scientific conferences, as well as	This is practiced primarily through supervision and independent research. In addition, we strive to have doctoral students participate in discussions to identify research questions and plan future research. This relates to both internal meetings and meetings with colleagues from other universities as well as other external parties of importance to our research.

Objectives based on the Higher Education Ordinance, Annex 2 – Qualifications Ordinance *For a Degree of Licentiate, the doctoral student must*	**Concretisation and adaptation of targets to the third-cycle subject area**	**Programme elements that promote goal attainment**
	through the compulsory course FAF3008 Research in Civil and Architectural Engineering. Most doctoral students have departmental duties in the form of teaching, which provides another occasion for communication training.	
demonstrate ability in both national and international contexts, verbally and in writing, to clearly present and discuss research and research findings in dialogue with the scientific community and society in general.	The overarching goals "competence and skills" are attained primarily through thesis work, but with support in the courses and seminar activities. This includes training in reading, understanding and commenting on scientific texts and in arguing for or against findings and standpoints, both one's own and those of others. Communicating is also practiced through presentations at scientific conferences, as well as through the compulsory course FAF3008 Research in Civil and Architectural Engineering. Most doctoral students have departmental duties in the form of teaching, which provides another occasion for communication training.	We attach great importance to doctoral students presenting their research not only in research contexts, but also to stakeholders and other interested parties. Our principle is that a full-time doctoral student must give an external presentation, for example at an international conference, at least once a year up until the licentiate degree.
demonstrate such skills as are required to independently participate in research and development work and to work independently in other qualified activities	The overarching goals "competence and skills" are attained primarily through thesis work, but with support in the courses and seminar activities. This includes training in reading, understanding and commenting on scientific texts and in arguing for or against findings and standpoints, both one's own and those of others. Communicating is also practiced through presentations at	Doctoral students are afforded opportunities to participate in both scientific conferences and in meetings with external interested parties. When possible, they are also afforded opportunities to gain teaching experience. Most doctoral projects in the programme is financed entirely or partly by the construction industry and/or concerned government agencies. Reference groups are established for this purpose with industry representatives to provide support and ties to the industry. A relatively large proportion of the programme's

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	scientific conferences, as well as through the compulsory course FAF3008 Research in Civil and Architectural Engineering. Most doctoral students have departmental duties in the form of teaching, which provides another occasion for communication training.	doctoral students are industry-employed doctoral students. Doctoral students are offered the possibility, as part of their programme, to take the course LH3000 Basic Communication and Teaching.
demonstrate the ability to make research ethical assessments in their own research.	In regard to research ethics, it is important in both degrees that the student is able to make well-founded assessments of societal consequences of the decisions, for example regarding the design of infrastructures and buildings, that the research may lead to. The overarching goals "judgement and approach" are attained in supervision, collegial contexts and in courses and thesis work. The ability to make assessments based in research ethics is trained through the supervised thesis work and through the ethics element of the compulsory course 1N5113 Theory of Science and Research Method. Intellectual independence is trained and examined both through article publication and during the thesis work.	Supervision as well as research seminars bring up issues relating to scientific integrity and research ethics. The compulsory courses 1N5113 Theory of Science and Research Method, and FAF3008 Research in Civil and Architectural Engineering, both contain elements relating to research ethics.
demonstrate an insight into the possibilities and limitations of the discipline, its societal role and the responsibility people bear for how it is used	The student must have good insight into the relationship between public policy decisions and knowledge based in research on Civil and Architectural Engineering.	Questions relating to the possibilities and limitations of science are discussed continuously during supervision and seminars. The doctoral students are expected to bring up questions relating to social relevance in the introductory chapter of their thesis. These

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		questions are also considered in the compulsory course FAF3008 Research in Civil and Architectural Engineering.
demonstrate the ability to identify their need for further knowledge and to take responsibility for their own knowledge acquisition.	The overarching goals "judgement and approach" are attained in supervision, collegial contexts and in courses and thesis work. The ability to make assessments based in research ethics is trained through the supervised thesis work and through the ethics element of the compulsory course 1N5113 Theory of Science and Research Method. Intellectual independence is trained and examined both through article publication and during the thesis work.	In conjunction with the annual review of their study plan, the doctoral student is encouraged to present their own proposals for how to plan the continued research. These proposals are discussed with the principal supervisor as part of the work to review the study plan. The continuing supervision places great emphasis on the doctoral student independently identifying what needs to be done to move their research forward.
(KTH's objectives for MHU) demonstrate knowledge of, and an ability to make relevant environmental and ethical assessments in order to be able to contribute to sustainable societal development.	Students gain an awareness of how knowledge within the field of Civil and Architectural Engineering can be used to contribute to the development of an ecologically, technologically, socially and economically sustainable society. Students are examined on course elements regarding sustainability issues as well as the meaning and definition of the sustainability concept. There are possibilities for more advanced course studies in this field. There are also possibilities of influencing how questions regarding sustainable development are included in the programme. The thesis project must discuss how the student's research relates to the objective	Questions relating to sustainable development are always relevant to the research area, and will be brought up in supervision, seminars and third-cycle courses. They are considered, for example, in the compulsory third-cycle course FAF3008 Research in Civil and Architectural Engineering, but also in the courses that are compulsory for each specialisation. Course seminars will bring up questions relating to sustainable development. The Department gives a series of seminars on how knowledge within the field of Civil and Architectural Engineering can be used to contribute to the development of an ecologically, technologically, socially and

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	of a sustainable development of society.	economically sustainable society.