University
of Ljubljana
Faculty
of Civil and Geodetic Engineering

Presentation of the study programme

2nd CYCLE MASTER STUDY PROGRAMME

BUILDINGS (MA)

Valid from study year 2018/2019

1. Information about the study programme

The 2nd cycle master study programme *Buildings* consists of 2 years (4 semesters) and amounts to 120 ECTS points. The study program does not include orientations. The study program is carried out as a regular and a part-time study.

The framework of the proposed study programme is buildings. Their design, construction, use and removal represent a large part of the construction area. The proposed study programme is based on the Construction Products Regulation No. 305/2011 [1], which deals with construction products and structures: buildings and engineering structures; and the recast Energy Performance of Buildings Directive 2010/31/EU [2].

[1] Regulation (EU) No. 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC
[2] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings

2. Basic goals of the programme and general competences

The primary goal of the 2nd cycle master study programme *Buildings* is a new designer and planner profile of living and working environment, who will be capable of independent design and execution of simple and less demanding constructions and will be able to cooperate in the design and execution of demanding constructions according to the relevant legislation of Republic of Slovenia and EU (organically connected planning + execution + removal).

The goal of the new designer and planner profile of living and working environment activity is:

- improved built environment quality,
- improved functioning of this environment with the aim to reduce adverse impacts on the environment,
- orientation into the design of such buildings that take into account the principles of sustainable development by creative and responsible behaviour with healthy built environment based on efficient use of sources and ecological principles,
- acquisition of knowledge, technical skills and innovative abilities to raise the quality of projects for planning, execution, distribution, use and removal and for the assessment of physical feasibility, economic justification and financial possibilities,
- realisation of the most important skills for civil engineers according to the opinion from practice:
    1. Ability to use knowledge in practice.
    2. Ability to adapt to new situations.
    3. Decision-making.
    4. Basic mastering of the relevant field of science.
    5. Ability to create new ideas.
    6. Basic knowledge from the area of civil engineering.
- creating a study environment that will allow rational and efficient transfer of knowledge among individual universities and between university and civil engineering practice,
- organisation of the study in the way that follows the requirements of the Bologna two-tier system.

Several years ago it has become clear that there exists a considerable gap between the civil engineering education process and the practice, which can no longer be bridged by the existing study programmes. From the first energy crisis in the 1970's until today the structure of constructional complexes has changed more than in the whole history of built environment before that. After more than thirty years most players in the area of architecture and civil engineering are still not aware of that. The principle of learning on tested ("traditional") recipes by heart can simply no longer follow the technological development on the level of materials, or on the level of information technologies that have quickly been making their way into built environment.

In a large part of civil engineering – and this is the target area of the study programme ***Buildings*** – investments are spread to smaller projects, where instead of synergetic actions there appear to be constant conflicts, mainly due to lack of knowledge of all players, i.e. investors, designers and contractors, including the administrative services. Successful projects within large systems, e.g. the highway program, are exception, because the investors have (must have!) a good organisation and knowledge for managing relatively standard projects.

3. General competences

General competences acquired by the graduate of the master's study programme *Buildings* are:

General knowledge and understanding:
- mastering of basic knowledge from the areas of mathematics and physics, mechanics, methodology,
- of engineering design,
- mastering of specific professional bases from the area of building physics, knowledge about materials, mechanics of building structures,
- understanding that development should be in the foreground,

Engineering analysis:
- ability to solve problems in accordance with the methodology of engineering design,
- ability to use and select the available instruments at the theoretical level, use of computer software and experiments,

Engineering design:
- ability of independent execution of project for the design and implementation at the level of simple buildings and ability to join groups engaged in the design of demanding structures,
- ability of perceiving external influences, such as influences of environment, health, safety, culture,

Studies and evaluations:
- ability to use adequate methods for learning, design, calculation, analysis and processing as well as presentation of data,
- ability to follow legislation,
- ability to follow the development of technical regulations and standards,

Engineering practice:
- readiness to cooperate in the transfer of theoretical knowledge into construction designs on the level of execution, their physical feasibility, economic value and financial feasibility,
- development of social competences including mainly the area of communications is the aim and integral part of the study programme, while their assurance and assessment are not.

4. Course-related competences

With the master's study programme *Buildings*, the graduate acquires mainly the following subject-specific competences:

Knowledge and understanding:
- students master the basic knowledge in the areas of mathematics and physics,
- they master specific knowledge in the areas represented by specific basics for the field of civil engineering, building materials, building physics, building mechanics, system analysis, building-architectural informatics,
- mastering of professional areas covering the design, execution, maintenance and removal of buildings: design of living and working space, load-bearing structure, envelope structures, project management and the related information-communication technologies,
- they understand the genesis of built living and working environment,
- they master the procedure of functional analysis,

- ability to use basic, specific and professional knowledge to solve engineering problems of simple and less demanding buildings and working in groups engaged in the design of demanding structures,
- ability to use and select analytical methods and tools,
- ability to carry out critical, comparative analysis of problems emerging at design, execution and use of load-bearing and envelope structures of buildings,
- ability to follow the development of new procedures, materials and technologies in the area of civil engineering and at other complementary areas,

Engineering analysis:
- ability to analyse component elements of buildings: load-bearing structure, thermal, hydro, sound, psychophysical and fire protection on the level of the building and to upgrade it mainly within dynamic systems,
- ability to conceive problems,

Engineering design:
- ability of independent elaboration of designs according to the competences of the Construction Act, ability to cooperate in the elaboration of designs of demanding structures,
- ability to cooperate in the development,
- ability to use methods for the conceptual design on the level of protective structures,
- ability to connect with other professional areas, mainly to those dealing with building installations,

Studies and evaluations:
- ability to join in the manufacturing-consumer socio-ecological circle by using methodological instruments (system analysis) acquired in the area of engineering analysis and engineering design,
- knowledge about the basic research methods,
- ability to identify problem areas and fields,
- managing the use of functional analysis,
- ability to find adequate sources,
- knowledge about the philosophy of engineering design,

Engineering practice:
- student acquires overview and some experience about the processes/projects within the design in an engineering firm and field work,
- knows how to organise, manage and estimate simple and less demanding projects and join groups working with demanding project,
- is ready to accept new sources: building materials and systems,
- is able to relate theoretical bases of project management with practice,
- acquires the ability to use different methods for decision making process.
- development of social competences is the goal and integral part of the study programme, while their provision and assessment are not,
- ability of independent work and joining work in groups,
- ability of passing their ideas and products to other adequate selections of communication media,
- are aware of their personal responsibility within activities making decisions of large financial consequences in environments, where destructive management is becoming a virtue,
- ability of recognising different interest groups that appear in the process of design and construction,
- ability of creative and responsible cooperation with all factors affecting the life cycle of a building,
- are aware that study programme curiculum is only part of the study process that has to be assumed uninterruptedly in their professional career.

5. Conditions for enrolment

The second cycle master study programme Buildings of is according to Articles 38a, 38b and 41 of the Higher Education Act and according to Article 115 of the Statute of UL is available to the graduates from:

a) 1st cycle study programme from the area of buildings,

b) 1st cycle study programme from other expert areas, if before the enrolment the candidate completes other study obligations which are essential for the continuation of the study, totalling 10-60 ECTS; these obligations shall be defined according to the nature of expert area, and the candidates may complete them during the first cycle study, in programmes for additional education and by passing exams before the enrolment to the master study,

c) higher education professional study programme of civil engineering before the introduction of the Bologna programmes,

d) higher education expert study programme according to the old study programme of other expert areas or; before the enrolment the candidate completes study obligations which are essential for the continuation of the study, totalling 10-60 ECTS, and the candidates may complete them during the first cycle study, in programmes for additional education and by passing exams before the enrolment to the master study.

Obligations of individual transfer programme are defined by the Study Board of the Department of Civil Engineering UL FGG according to the missing knowledge that the candidate did not acquire within prior education. The same is also valid for the enrolment from other higher education institutions in Slovenia, EU and elsewhere.

The number of places is determined in the Call for enrolment into second cycle study programmes of the University of Ljubljana individually for each academic year.

6. Selection criteria when enrolment is restricted

In case of restricted enrolment the following conditions shall be considered: grade obtained in the 1st cycle study (100%).

7. Criteria for recognising knowledge and skills acquired before enrolment in the programme

The student can be acknowledged the knowledge that matches the contents and scope of the study in master's study programme *Buildings*. The Study Board of the Department of Civil Engineering UL FGG takes decisions regarding the acknowledgement of knowledge and skills acquired before the enrolment, based on the student's written application, the enclosed certificates and other documents evidencing the successfully acquired knowledge and contents of this knowledge, and in accordance with the Rules on the procedure and criteria for the acknowledgement of informally acquired knowledge and skills, adopted on 29 May 2007 at the 15th meeting of the Senate of UL.

For the acknowledgement of knowledge and skills the following shall be considered:

- certificates and other documents (acknowledgement of »nontypical certificates«, portfolio, documents evidencing finished courses and other forms of education),
- evaluation of finished products, services, publications and other original works of the student (possibility of completing study obligations – e.g. exams, partial exams, etc. – with the evaluation of products, e.g. projects done by the student before enrolment),

- evaluation of knowledge acquired by the student based on self-education or learning from experiences (possibility of completing study obligations without participation at lectures, practical work, seminars),
- adequate work experiences (e.g. acknowledgement of practical training and other parts of the programme that are based on practical work and experiences).

Shall the Study Board of the Department of Civil Engineering UL FGG establish that the acquired knowledge may be acknowledged, this shall be evaluated with the same number of points according to ECTS as the number of points in the subject.

8. Methods of assessment

The assessment methods are in accordance with the Statute of University of Ljubljana and listed in the Course Syllabi.

9. Conditions for progression through the programme

9.1 Conditions for the progression from one year to another

The student may enrol to subsequent year, if they complete by the end of the study year all the obligations foreseen by the study plan, amounting to at least 45 ECTS.

Exceptionally, students may enrol to the next year also when failing to complete all obligations defined by the study programme for the enrolment to the next study year, by providing justified reasons as defined by Article 153 of the Statute of UL (maternity, longer illness, extreme family and social circumstances, certified status of a person with special needs, active participation in top professional, cultural and sports events, active participation in the university bodies).

Under the conditions from the above paragraph the student may enrol to subsequent year with at least 40 ECTS points collected. The Study Board of the Department of Civil Engineering of UL FGG adopts the decisions about the enrolment from the above paragraph.

Faculty of Civil and Geodetic Engineering has been offering tutorship and supervision for its students for several years. We are planning to introduce similar system of help to students also within the master's study programme *Buildings*, which is in accordance with item 9 of Article 7 of the Criteria on Accreditation. From the first year onwards students will have mentors of the year, and smaller groups of students will also have individual tutors represented by teachers or students of higher years, who will help them, choose orientation, elective courses etc.

Students with above average study results will be allowed faster advancement. Based on the student's application and justified opinion of the Study Board of the Department of Civil Engineering UL FGG the final decision about such advancement is adopted by the Senate of UL FGG. With its decree the principles of faster progress shall be defined.

9.2 Conditions for repeated enrolment in the same year

Failing to meet all the obligations defined by the study program for the advancement in the subsequent year, students may enrol in the first year for the second time, provided that they have obtained at least 30 credit points according to ECTS.

10. Transfers between study programmes

Transfer between programmes shall mean termination of education in the student's original study programme (first programme) and continuation of education in the 2nd cycle master study programme of

Buildings (second programme), in which a part of the completed study requirements from the first study programme are recognised as completed.

Transfers are possible from the second cycle study programmes, and until their expiration also from the undergraduate academic study programmes adopted before June 11 2004, where the competences of the finished studies are comparable and according to the acknowledgement criteria at least half of the obligations according to ECTS from the first study programme related to compulsory courses of the second study programme can be acknowledged. Considering the scope of acknowledged obligations from the first study programme in the Republic of Slovenia or abroad student may enrol to the same or higher year in the second study programme. Transferring students shall fulfil the conditions for the enrolment to the second study programme.

Applications of candidates for the transfer to the 2nd cycle master study programme Buildings and the scope of acknowledged obligations in the study programme will be examined individually by the Study Board of the Department of Civil Engineering UL FGG. If in the procedure of acknowledging obligations for the purpose of transfer the candidate is approved at least the amount of credit points and those point that are required for the enrolment to the second year of the 2nd cycle master study programme Buildings, the candidate may enrol to the second year of the 2nd cycle master study programme Buildings.

11. Conditions for completion of the study

Students finish the study by accomplishing the foreseen obligations totalling 180 credit points according to ECTS, including practical training and diploma thesis.

12. Conditions for completion of individual parts of the programme

The Study is uniform.

13. Qualification, professional or academic title

- magister inženir stavbarstva
  (second cycle graduate in buildings)

- magistrica inženirka stavbarstva
  (second cycle graduate in buildings)

14. Qualification, professional or academic title (abbreviation)

- mag. inž. stavb

15. Classifications

- KLASIUS-SRV: Master's education (second Bologna cycle)/Master (second Bologna cycle) (17003)
- ISCED: architecture, urbanism and civil engineering (58)
- KLASIUS-P: Building and civil engineering (broad programmes) (5820)
- Frascati: Technical sciences (2)
- Level SOK: Level SOK 8
- Level EOK: Level EOK 7
- Level EOVK: Second cycle

16. Study programme courses, Syllabus

1st YEAR	Contact hours								
1st semester	**L**	**S**	**T**	**LT**	**FW**	**OW**	**IW**	**ΣSO***	**ECTS***
Differential Equations and Geometry	60			30			90	180	6
Daylight	30			60			90	180	6
Design of Load-bearing Structures of Buildings: Conceptual Design and Seismic Engineering Design of Concrete Buildings Design of Steel Buildings Design of Timber Buildings Geotechnical Design	80		80	80			240	480	16 (4) (3) (3) (3) (3)
Total 1st semester	**170**		**80**	**170**			**420**	**840**	**28**
2nd semester									
Structural Building Physics	60		60	60			180	360	12
Fire	30			60			90	180	6
BIM in Sustainable Design	30			30			60	120	4
Practical Training	6					80	34	120	4
Elective course 1	45		45				90	180	6
Total 2nd semester	**171**		**105**	**150**		**80**	**454**	**960**	**32**
Total 1st year	**341**		**185**	**320**		**80**	**874**	**1800**	**60**

2nd YEAR	Contact hours								
1st semester	**L**	**S**	**T**	**LT**	**FW**	**OW**	**IW**	**ΣSO***	**ECTS***
Advanced Materials	30			60			90	180	6
Efficient Energy Use	45			90			135	270	9
Living Environment	45			90			135	270	9
Elective course 2	45		45				90	180	6
Total 1st semester	**165**		**45**	**240**			**450**	**900**	**30**
2nd semester – MASTER MODULE									
Automatic Management of Systems	45			45			90	180	6
Building Sustainability Assessment	30			30			60	120	4
Smart House	30			30			60	120	4
Master Seminar		30				60	90	180	6
Master Thesis						150	150	300	10
Total 2nd semester	**105**	**30**		**105**		**210**	**450**	**900**	**30**
Total 2nd year	**270**	**30**	**45**	**345**		**210**	**900**	**1800**	**60**

Total 1st and 2nd year	**611**	**30**	**230**	**665**		**290**	**1774**	**3600**	**120**

L – lectures, S – seminar, T – tutorial, LT – laboratory tutorial, FW – filed work, OW – other work, IW – individual work, SO – study obligations
*workload amounting to 60 ECTS/year, i.e. 1800 hours/year, hours include contact hours + individual work
** beside other possible elective course of the professional courses at FGG

ELECTIVE COURSES									
Technology of Installations **	30		30	30			90	180	6
Information and Communication Technologies in Built Environment **	45		45				90	180	6
Physical Education **							45	90	3

L – lectures, S – seminar, T – tutorial, LT – laboratory tutorial, FW – filed work, OW – other work, IW – individual work, SO – study obligations
*workload amounting to 60 ECTS/year, i.e. 1800 hours/year, hours include contact hours + individual work
** beside other possible elective course of the professional courses at FGG

17. Possibilities of elective courses and mobility

The master's study programme *Buildings* foresees elective courses: in the 2nd semester of 1st year, FGG and other (6 ECTS), in the 1st semester of 2nd year, FGG and other (6 ECTS). External elective courses are foreseen in the 1st semester of 2nd year (6 ECTS). Beside other courses the study programme also proposes two elective courses from this field of science. Among elective courses from other members of UL, students are recommended to select mainly contents from the areas of architecture, mechanical engineering and electrotechnical engineering (control systems). Students can freely select contents, subject to the approval of the Study Board of the Department of Civil Engineering UL FGG.

18. Presentation of individual courses

DIFFERENTIAL EQUATIONS AND GEOMETRY (6 ECTS)
Ordinary differential equations: LDE of order n, linear systems, boundary value problems, Fourier series, numerical methods. Partial differential equations: heat and wave equations, initial and boundary value problems, Laplace transformation, numerical methods. Vectors in space and operations with them. Linear and affine transformations, matrices. Curves in plane and space: parameterisation, approximation, Bezier curves, B-splines. Surfaces: elementary smooth surfaces, parameterisation, piecewise smooth surfaces, ruled surfaces, surfaces of revolution, approximations, Bezier surfaces, two dimensional cubic B-splines.

DAYLIGHT (6 ECTS)
Bioclimatic building design within defined space constituents (location, geography, climatic conditions), human (psycho-physiological human needs and the design of living and working environment), building (indoor environment, building envelope systems). Configuration of influential factors (daylight, insolation). Methods for the calculation and verification of insolation and daylight illuminance. Components: glass, glazing, shading devices, control systems. Elements of transparent constructional complexes: horizontal and vertical systems. Strategies for the design of living and working environment on the basis of insolation and daylight illuminance.

DESIGN OF LOAD-BEARING STRUCTURES OF BUILDINGS (16 ECTS):
Conceptual design and seismic engineering (4 ECTS)
Design of concrete buildings (3 ECTS)
Design of steel buildings (3 ECTS)
Design of timber buildings (3 ECTS)
Geotechnical design (3 ECTS)
Lectures are organised in two parts – before students start to work on projects and during the work on projects, considering specific needs and wishes of students and specifics of buildings under consideration. General introductory lectures deal with: 1. Basic principles of conceptualisation of constructional systems, first in general, then by considering specifics of individual materials (concrete, prestressed concrete, steel, composite solutions steel/concrete, wood and masonry solutions). The focus is on connections among elements and the functioning of construction as a whole. 2. Principles for the selection of the basic system and mechanisms of their functioning. 3. Providing ductility and principles of planning the load-bearing capacity of seismic resistance of buildings. 4. Presentation of theoretical bases for software equipment to be used for the elaboration of seminar work.

BIM IN SUSTAINABLE DESIGN (4 ECTS)
Introduction to building information model. BIM execution planning and implementation. BIM collaboration and management. Methods of modelling load-bearing and non-load bearing elements. BIM for Sustainable Design. Methods of modelling Building Systems. QA procedures in BIM and overview of BIM aspect and framework models. OpenBIM protocols for exchange of BIM. Standardization: BS 1192, IFC, CIS, IFD10. Advanced BIM parameterization techniques.

STRUCTURAL BUILDING PHYSICS (12 ECTS)
Diffusion equation, boundary and initial conditions, and dynamical response parameters of building envelope. Detailed analysis of thermal bridges and convection. Thermal radiation heat transfer between structural components of building envelope and radiation characteristics of the corresponding materials (absorptivity, emissivity, and scattering cross-sections). Condensation, moisture transport and its influence on thermodynamic properties of the building envelope. Light, radiation flux, propagation, reflection and absorption of light on various surfaces of structural components forming the building envelope. Sound in enclosed spaces, noise and noise control, measuring equipment and measurement techniques in acoustics and noise analysis.

FIRE (6 ECTS)
Introduction to fire engineering. Overview of basic concepts. European standards and regulations. Fire load. Models of standard and real fires. Measures of active fire protection. Evacuation routes, fire detection and fire fighting. Measures of passive fire protection. Influence of high temperatures on material behaviour. Determination of temperature field in a structure. Computing determination of the fire resistance of timber, reinforced concrete and steel structures.

PRACTICAL TRAINING (6 ECTS)
Student is introduced to the performance of work done by graduate in practice. Especially, students are: aware of the organizational structure and technology of building companies, familiar with the regulations about safety at work and their implementation in practice, familiar with current developments in a construction company, introduced to executive aspect of work when undertaking field work - current site, or in office - self- performed work on current project under the guidance of a mentor; they develop the use of scientific research methods in a broad spectrum of problems in the profession, develop critical reflection, social and communication skills for teamwork management, show initiative and independence in the management of most complex work systems under the supervision of mentor.

ADVANCED MATERIALS (6 ECTS)
The correlation between chemical structure and properties. Polymer materials with a high thermal stability and resistance to UV radiation. Protection against overheating of polymeric materials: thermotropic and thermochromic coatings, coatings with low thermal emissivity. Coatings with changeable absorption, "cold" colors, radiant cooling. Coatings and nanocomposite coatings with multifunctional properties (antisoiling, self-cleaning), "Hard" nanocomposite coatings. Use the rehabilitation of buildings and for the protection of cultural heritage. Optical permeable polymeric materials (PTFE, Mylar). Protection against corrosion of metal nanocomposites (corrosion processes of decay measurements, spectroscopy, etc.). The storage tanks (PCM). Overview of test methods for determining the stability of the materials (accelerated aging tests). Green roofs. Carbon footprint, global warming potential (GWP). Foundations on thermal insulations. Construction pathology. Photovoltaic, Photothermics. Ventilated panels

EFFICIENT ENERGY USE (9 ECTS)
Methodology for the calculation of integrated energy performance of buildings: methods, sizing of thermal insulation on the level of building and individual constructional complexes. Requirements regarding minimum energy performance for new and renovated buildings. Energy certification of buildings. Thermal bridges. Overheating protection of buildings. Strategies and measures for energy efficiency: building and constructional complexes. Solar energy utilization in buildings. Directive on the energy performance of buildings. Regulations on energy efficiency in buildings.

LIVING ENVIRONMENT (9 ECTS)
Physical active space, ergonomics, human physiology. Sources: geomorphology, climate type characteristics, human wellbeing. Thermal environment: thermal comfort, operative temperature, metabolic rate, effective clothing insulation, process of adaptation. Visual environment: visual comfort. Air quality: physiological minimum, pollutant emissions. Dampness related problems, noise issues, genesis of bioclimatic environment, technology development, concept of bioclimatic orientation. Healthy building (SBS), examples of best practice.

AUTOMATIC MANAGEMENT OF SYSTEMS (6 ECTS)
Systems: systematic approach, basic concepts about systems, systematic approach to management planning. Modelling and simulation: types of models and principles of modelling, cyclic procedure, valuation and verification, basic records (diff. equations, transfer functions and block diagrams), object-oriented modelling, basics of simulation, simulation methods, tools: Matlab-Simulink, Dymola-Modelica, modelling and simulation of thermal and light flows in a building. Automatic management of systems: engineering approach with block diagrams and technological schemes, basic concepts (control, regulation, monitoring, troubleshooting, effects of return loop on steady state, stability), basic regulation structures: gradual, PID (algorithms, tuning, variable estimators, setup rules, simulation- optimisation approach), fuzzy regulator, automatic management of thermal and light flows in a building

BUILDING SUSTAINABILITY ASSESSMENT (4 ECTS)
In the course the students will get acquainted with principles of environmental and sustainable engineering planning, design and systematic approach to problem solving and management of iterative development processes from abstract ideas to concrete solutions of structural components, as well as the buildings as a whole, and vice versa. The students learn about the processes of evaluating sustainable construction, environmental evaluation of the building as a whole, the correct selection of materials and the resulting assembly of structural assemblies and devices, learn about risk factors, the wrong choice of materials or inappropriate combinations of materials in any structural elements. Taking into account all the parameters of a comprehensive design and engineering requirements for the design of buildings. As a part of laboratory exercises students perform calculations using appropriate computer software.

SMART HOUSE (4 ECTS)
Relation between concept and technology. Interactivity of various influence factors on the building location. Schemes of smart house systems: environment, systems of user behaviour, regulation, implementation. Role of individuality in the process of design: health, comfort, efficiency. Space and time interactivity in the built environment and its integration with information technology. Impact of culture and technology, physiology, energy use issues and new information technology on the system performance. Topology of communications. Smart products, subsystems and automated living environment. Influence of dynamically regulated façade envelope. Daylight/artificial light control. Review and critical presentation of real life examples.

MASTER SEMINAR (6 ECTS)
Students at the Masters seminar attend a series of lectures on the subject of scientific research and professional work presentation (hypothesis, experimental work, modelling, repeatability of experiments,...), data and literature search and preparation as well as research ethics and intellectual property. The basic approaches for writing and conceptualization of master's thesis topic, search for literature and the preparation and design of scientific and technical texts are presented. Through regular individual meetings with supervisors, co-supervisors and the leader of the seminar, students develop their own master thesis topic. During the seminar they prepare master thesis disposition, which is publicly presented and defended at the end of the semester.

MASTER THESIS (10 ECTS)
MSc thesis is done under supervision of a selected teacher. The work is publically presented at the end of the study. It shall include Introduction, Working hypothesis, Overview of sources, Materials and methods, Results, Discussion and Conclusions. The thesis deals with practical and theoretical problems from the area of buildings and gives solutions arrived at with the help of study and findings of own professional and research work.

TECHNOLOGY OF INSTALLATIONS (6 ECTS)
Introduction to topics, aims of the course and program, competences. Indoor environment in buildings. Indoor environment modelling. Concepts of efficient and innovative systems for occupant's living and working environment, and for other purposes of spaces. Occupant's response to the perceptible indoor environment parameters – studies of functions and models. Advanced technologies and systems for HVAC and hot water preparation. Fundamentals of regulation and feedback control of HVAC systems to achieve the required (desired) parameters in indoor spaces of buildings. Fundamentals of measurements

and HVAC monitoring. Problem solving, planning fundamentals, and quality assessment of the HVAC systems.

INFORMATION AND COMMUNICATION TECHNOLOGIES IN BUILT ENVIRONMENT (6 ECTS)
The advances in digital technology are the factor that is most strongly changing kinds and types of work in occupations working on the built environment. Changes are occurring on four fronts. The first is the increasing computing power, leading to a more faithful simulation of natural phenomena and artificial intelligence. Computers are winning at chess, driving cars, writing reports on sporting events ... Why not design buildings? The second is increasingly structured information. Engineers no longer draw line drawings, but build content-rich information "BIM" model and produce realistic simulations. Will this limit or augment creativity? The Third front is improved communication between people. Examples of this are the social networks and the Internet. The fourth front is the penetration of information technology in physical environment through sensors, cameras and the like. All this significantly changes the way we design. From local participation around drawings we are transitioning to a global collaboration around digital information.

PHISICAL EDUCATION (6 ECTS)
General theoretical part contains lectures, which are common to all sports programs made collectively for all students (basic function of the human body, movement of the body and cardiovascular system, psychomotor and functional abilities, prevention and curative activity for developing health, basic nutrition and healthy diet, regulation of body weight and other medical aspects of sports, checking methods and assessment of psychomotor and functional abilities). Special theoretical part is linked to the selected sport (specificity of sport, human development through sport, technique, tactics and rules, fundamentals of physical and technical preparation) and is implemented through practical exercises. Practical work: Students choose between the offered sport branches. For each sport have a program of learning and skill training. Students have to do: five guided multi-day sports activities in nature and aerobic endurance test.