Course guide

Technical building design

Master's degree in architecture – year 4 - subsidiary subject

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Faculty of Architecture

Department of Building Technology

Chair of Architectural Engineering (Constructional Integration & Coordination)

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Introduction

The subsidiary subject Technical building design forms an integral part of the final year (MSc 4) course leading to a master's degree in architecture. The course is mainly concerned with technical building design and the conceptual interaction between building technology and architectural design.

Subject matter and content

Integration and coordination

Design is an iterative process, dealing with ambiguity, stratification, mutual relationships and interdependence. A preliminary phase, in which inspiration can be provided by literally anything, is followed by the preparation of a spatial concept and a physical concept. These concepts can be developed more or less in parallel, and so benefit from mutual interaction. Choices are based on philosophical, spatial, functional and physical considerations, taking into account what is structurally, physically and climatologically possible (or impossible).

In practice the design process is multidisciplinary. All manner of different specialists (structural engineers, installation consultants etc.) come up with partial solutions which need to be designed and fitted into the spatial plan. Different levels of information, e.g. load-bearing structure (columns, girders, floors etc.), climate control (heating, cooling, lighting etc.), partitions (elevations, roofs, inside walls etc.) and a dimensioning system (grid lines, sizing etc.) all need to be designed. All these elements need to be integrated and coordinated and be given their place in the spatial plan.

The aim of materialisation, the process of integrating technical features, is to develop the initial concept into an actual physical building, in which the quality of the initial concept is not lost in everyday issues, but is reinforced and enriched by interaction with and influence from physical considerations. After all, even physical considerations can provide a source of architectural inspiration.

> *The student's final design, as presented orally and visually, must show that he or she has knowledge and understanding of:*
>
> - *the interaction between an architectural concept and the building technology applied in its development*
> - *technical and physical considerations.*
>
> *Thus the student must present reasoned solutions and demonstrate skill in incorporating the technical building design effectively in the design process as a whole.*

Approach

It is possible to distinguish in broad outline a number of fields bearing on a the design process:

- social, cultural and historic context
- geographical context, urban or rural
- space and shape
- function and use
- material, climate and structure

The position the designer adopts in these fields will be affected by the task, the personalities involved and the relevant society or culture. The position on materialisation can range between somewhat neutral to extremely individual. But the process of developing an original concept into an actual building will always involve the materialisation of a particular space.

The design method will always be directly related to the position adopted. Does the design follow an existing tradition and design methodology, which the design will take further? Was the

process of developing the design mainly intuitive? What reference sketches were made during the design process to make clear the designer's intentions?

> *For the final design the student must determine his or her position in the design process on a number of different aspects (specialties). More specifically, the student must show the relationship, in this particular design, between the materialisation (the technical building design) and the architectural concept.*

Research and investigation

Regardless of the position adopted and the method chosen, design involves putting questions to oneself and carrying out research. The designer must prepare, substantiate and support a list of alternatives. Ultimately a multitude of design decisions must fit into a consistent whole, with the chosen solutions expressed more clearly and in greater detail.
There is a multitude of questions that can be asked. The most interesting questions affecting the design are those involving mutual relationships.

> *The student must set himself or herself questions, devise alternatives and select arguments, present advantages and disadvantages. The need to maintain the consistency of the whole must be kept in mind each time a choice is made.*

Course aims

Technical building design
The ability to integrate the different aspects of technical building design in the design as a whole; designing and identifying the interaction between space, appearance, function, light and material, structure, building mechanics and climate control arrangements.

Load-bearing structures
The ability to design and dimension a building's load-bearing structure; a knowledge of building mechanics, load transfer, structures, systems, structural cohesion and methods of execution appropriate to the particular architectural design.

Climate control
The ability to produce a design incorporating a combination of architectural devices and building services appropriate to the desired physical and spatial properties of the various spaces, to achieve a comfortable indoor climate.

Facades
The ability to design a facade zone that will take account of various features such as image, ability to exclude wind and water, insulation, ventilation, outlook, admission of natural light, building mechanics, clearance and installation space etc.

Social considerations
The ability to set any necessary building technology in a social and cultural context and to make choices which are consistent with other aspects of the design. Sustainability is especially a theme.

Process

Technical building design
In principle work can begin on a spatial concept and a physical concept as soon as the preliminary idea has taken shape. Initially the two concepts will not overlap completely. The process which brings the two concepts together is design; during the design process each concept defines and influences the other more and more precisely until each totally complements the other. Only then is it proper to speak of an architectural plan. This kind of iterative approach is a characteristic of the design process.

The physical design must in any event take account of three areas:

- the main load-bearing structure, stabilising structure and the overall dimensioning system; the structure will combine structural, spatial and functional features
- the character and materialisation of the facade; a typical fragment of the building, possibly a cross-section, combining features affecting the character of the facade, e.g. its proportions, textures and colours, and its functions, e.g. insulation, installation space, ability to exclude water etc.
- the basic principles underlying the design of the HVAC installation; the achievement of the required characteristics will also involve the application of architectural devices.

If a coherent, consistent whole is to be produced, there must be frequent opportunities to stand back from the solutions chosen so that they can be judged in a wider conceptual context.

Supervision
Each student will be supervised throughout the year (MSc 4) by a lecturer in technical building design. This will involve one daily period a week for each group of 15 students for 2 x 7 weeks. The lecturer in question will not only provided supervision but will also act as examiner and will guide and examine students in all aspects of building technology. Each of the three aspects of building technology already mentioned – load-bearing structure, climate control and facade – need to be considered in connection with space, appearance and function. The student, in consultation with the lecturer, will be able to place his or her own emphasis on these different aspects to suit the particular design involved.

Consultation
Each student will also have access to guidance from specialists in the fields of load-bearing structures and climate control installations in the form of two 30-minute consultations on each subject. While such consultations can in principle be individual, students are encouraged to consult in groups of two or three and indeed to run separate consultations together. It will also be possible to hold an introductory or instructional session for a whole group of final year students at the beginning of the semester.

Students will need to organise group consultations or instruction for themselves. Students are recommended to prepare a list of questions in advance, to ensure that time is used efficiently.

Products

Presentation
Drawing is communicating. Each scale drawing has its own purpose, information density and target group.
The main issue is always the relationship between space, appearance, function and materialisation (ranging from structure to detailing), both in the design and in the communication of that design. In other words, these main subjects should always be the central features of each drawing and explanation.

A drawing provides a demonstration, to oneself and others. Thus presentation is not only an important part of the end of the design process but is important to the design process as a whole. The drawings to be selected will vary from outline sketches to floor plans and cross-sections with complete technical information.

The following list of products gives a good indication of the kind of information and the level of detail required. All the information listed must be available, but an attempt should be made to find the most suitable way of presenting the particular plan. Drawings can be supplemented – or replaced - by diagrams, plans, three-dimensional drawings, materialisation models, pictures of the materials applied etc.

General
- concept in words and pictures; a description of underlying design ideas with keywords, arguments, analyses and outline sketches and diagrams
- the concepts underlying the load-bearing structure, the climate control arrangements and the facade of the building
- the relationship between the architectural concept and its physical development, and between appearance, function, space, load-bearing structure and climate control.

Load-bearing structure and climate control
- floor plans and cross-sections of the whole building including the elements making up the load-bearing structure and elements related to climate control (on a scale of 1:100 or 1:200).
- floor plans and cross-sections of the part of the building that has been developed architecturally, on the scale of 1:50 or 1:20.
- a three-dimensional representation of the structure and a 3-dimensional representation or diagram of the climate control principles and installation
- a justification of the load-bearing structure and the climate control principles and features of the installation, in terms of the dimensioning of the main elements of that structure and climatic requirements, including details of the global dimensioning with rules of thumb and where necessary calculations.

Facade
- views, cross-sections and floor plans of a part of the building which contributes to its characteristic appearance, including a corner (on a scale of 1:50 or 1:20).
- horizontal and vertical details of the facade fragment in which joints are worked out in full detail, and demonstrating ability to exclude water, dimensions, materials, clearance, joints etc. (on a scale of 1:5 or 1:1)
- highly characteristic details from elsewhere in the design.
- Product information and photographic material relating to the materials chosen.

The quality of a design is determined by the degree of integration of its physical, spatial and functional characteristics.
This quality is demonstrated by the choice of the correct drawings, diagrams and texts.