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The teaching of subjects of construction is important in architectural education, because all practising architects create structures and use construction methods, and because architectural and structural concepts are closely linked. Teaching must therefore consist of knowledge, methods and theories, and of innovative work on constructional matters. Knowledge, methods and ideas are mainly at the School of Architecture in Copenhagen given in courses, whereas work with concepts of construction mainly is related to work in the design studios. It is an important and difficult task to bring these two elements together in the mind of the students (as well as in the mind of the studio-teachers).

The fundamental theory in teaching is technical-scientific, but it is viewed in an architectural -artistic light. The subjects will therefore have to be developed in other directions, than is usual in the technical field. The development of structural morphology as done by Frei Otto is an example of how the general engineering concepts of membranes were changed by an architectural/technical development. Research and development in the technical field are different from the similar type of work done at the technical universities.

All students at the School of Architecture in Copenhagen are attached to a studio design department. The Institute of Building Technology at the School of Architecture, gives short terms courses to the students, and assists the studio-design departments with technical consultations in the studios.

The same teachers basically deal with the two areas of teaching, but it must be emphasized, that the studio design teachers also play an important role in the construction teaching with close relation to the architectural design exercises in the studio.

The courses play a major role in the beginning of the study, whereas the consultations in the design studio are of growing importance towards the end of the study. The resources used to the two methods are about equal.

The structural teaching in the first and second year is basically founded upon a phenomenological experience. Students make models and see how they break, or study nature and buildings around them. Technical theories and general construction methods are also introduced, but mathematical development is generally limited. It is our experience, that only a minority of the students can combine the mathematical and the architectural thinking. All our teachers in structures have a formal structural engineering background, and some of them have the opposite problem of understanding the architectural concepts, while daily dealing with technical, mathematical solutions. Training engineers to understand architectural thinking and methods is a particular problem among our teaching staff.

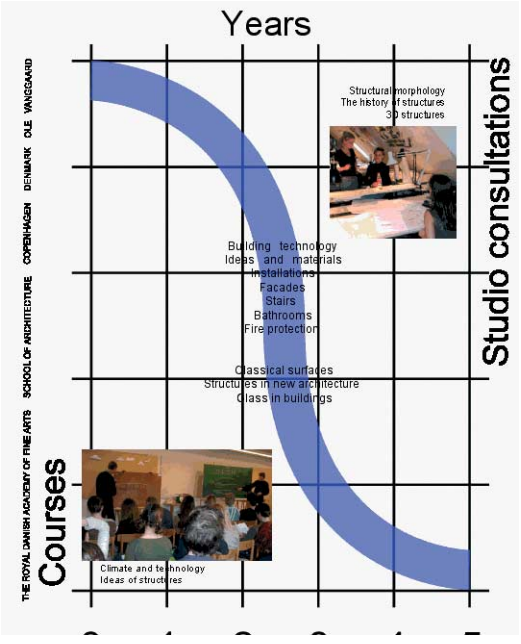
Courses planned for third and fourth year have a specialised aim. Courses in spatial structures, optimal and minimal structures or structural morphology are related to the research of the staff, and give students an insight into more specialised technical and structural thinking. Models and experiments are equally valid at this stage.

The staff in the department is both architects and structural engineers. The department of structures has only engineers. This is not a part of our goal, but it has in praxis shown, that it is easier for an engineer to collaborate with a master of architecture in the studio based on students' design work, than for a specialised architect. The engineer and the architect teachers' collaboration reflects the professional situation in the building situation, and is easily accepted especially in relation to older students. The final responsibility for the constructional teaching is thus joint between the parts.

The idea of constructional concepts in architecture was introduced in Europe by the Modernists in the beginning of the 20th century, and has developed greatly in the second half of the century. The interaction between the scientific and technical development and the architectural concepts raises new challenges for building technology and for the application of different structural principles. These realities must be a part of our teaching fundamentals. The teachers in the construction area must be highly aware of this development. The law of static's, and the principle of joining may be undisturbed, but they are only one part of the teaching in construction at a school of architecture.

The teaching in construction at the School of Architecture in Copenhagen is as described due to an interaction of two different principles. A special knowledge and experience is given through courses with lectures, examples and experiments, and the experience the students gain from their studio work. The constructional teachers are concerned with the development of technological courses, often related to their research work, but they are also involved in consultation work in the studios.

The relation can be illustrated by an S-shaped curve, by plotting the resources used in the courses/resources used in studio consultative towards the students' level in years. The S-shape in the poster shows this relation during a full architectural study. The courses account for a relatively large working load in the beginning of the study, whereas the studio consultation increases largely towards the end of the study.




## Technological Courses

The following lists of the courses were offered in the academic year 2001-02. The following gives a picture of the work:

*Basic technical courses for all first and second year students:*

*Ideas and principles in structures* (4 weeks - first year)

The course gives an introduction in how to sketch a structure, insights in the principles of structures and how to size structural members on an architectural basis. The understanding of strength stiffness and ultimate loads introduced through simple physical tests on models.

*Climate and technology* (4 weeks - second year)

The course gives an overview of the technical aspects in building, from the material and the spatial perceptual point over the aspects of building physics and production technology to the practical realisation in build architecture.

Special technical courses mainly for three to five years students - by choice. Some of the activities are closely related to the studio work, others with more general perspective.

*Series of lectures:*

- Ideas and materials
- The understanding of structures seen in newer architecture

*Technological seminars 1 - 2 days*

Installations in buildings

The building physics of the facades

Stairs

Fire protection of buildings

The bathroom problems

Classical surfaces

Glass in buildings

*Technological courses of 1 - 2 weeks:*

The history of structures

Building technology

3D structures and geometry

Morphology, patterns, optimalizations and structures