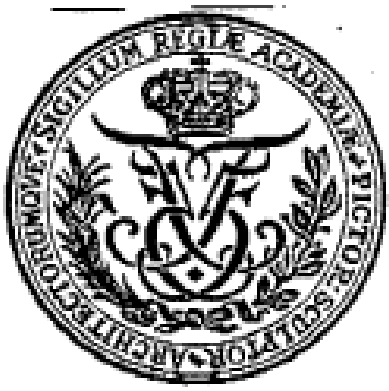
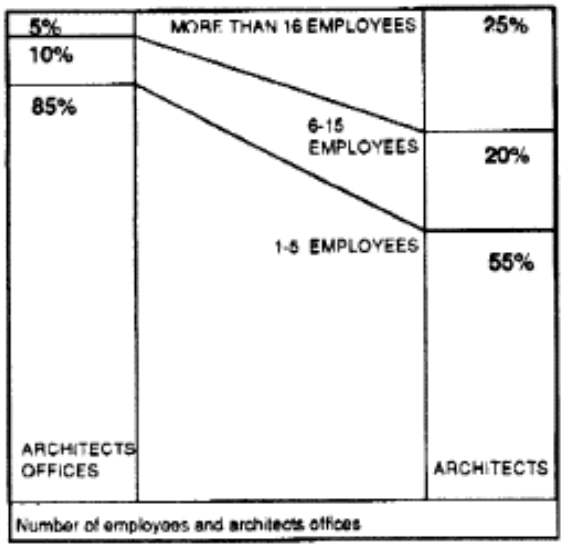


SCHOOL OF ARCHITECTURE
DATACENTRET
COPENHAGEN



Computing at the Architects School

The establishment of Datacentret (the Data Centre) in summer 1985 was preceded by 15 years' slow-moving, arduous work from the early experiments in what was then the computing laboratory under the supervision of architect Per Jacobi, author of the Danish 3D drawing system MONSTER, until 1984, when a special committee was commissioned to draw up proposals for the introduction of teaching in computing at the Architects School.

In spring 1985 the school administrators decided that a central computer workshop should be set up and in cooperation with the school's institutes placed jointly in charge of instructing teachers and students, carrying out research and development within the field of architecture and taking steps to work out a curriculum of supplementary training for practising architects.

With the aid of a special grant, 12 PC's were successfully acquired in the 2 years that followed, as well as a screen projector and other peripherals.

PC or workstation

Throughout the introductory phase there was a broad consensus on commitment to the PC, for several reasons. Firstly, there were at the lime a number of indicators that PC's would develop more quickly than other types; secondly, the size of investment required for an operational system would be affordable for most Danish drawing offices; and finally there was the obvious advantage that within the amount granted, the school could simply acquire a greater number of units and thus give more students a chance to acquaint themselves with the tool.

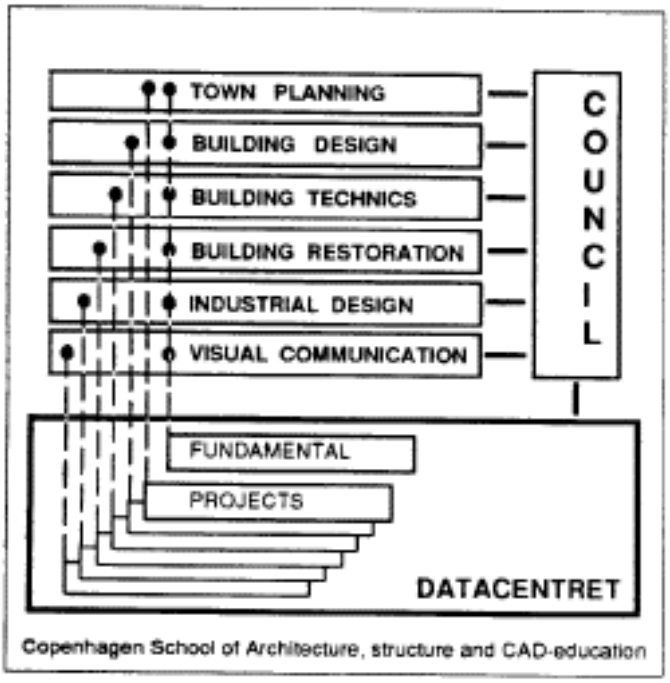
So far this has proved to be the right choice. The anticipated growth in the field of PC's has materialized and several drawing offices are now acquiring machines of this magnitude. The number of programs for use within all aspects of the projecting process has developed at an explosive rate, while at the same time machine capacity and performance has more than doubled within recent years. It should be noted, however, that the powerful PC's are those best suited to handling the often large data volumes involved in a building project.

CAD training for students of architecture

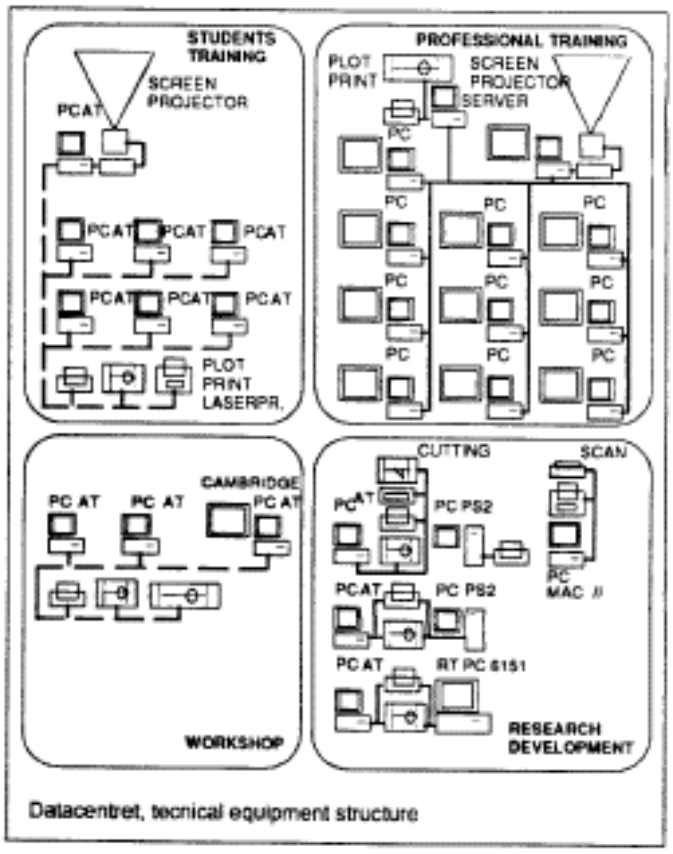
Owing both to as "peculiar" nature and to the institutional structure of the Architects School, Datacentret was not placed under the statutory structure, but directly under the specialist board of the Architects School under the leadership of a selected computing committee.

In liaison with the Centre, the committee draws up guidelines and a framework for the development of the Contro and proconto those to the specialist board for approval.

The daily administration, teaching and research is undertaken by 7 architects and 2 secretaries.



Copenhagen School of Architecture, structure and CAD-education



Datacentret, tecnical equipment structure

Teaching of the school's students falls into 3 categories.

A number of courses are offered for which all students may enroll. Teaching includes the very basic introduction to general electronic data processing such as hardware appreciation, operating system, wordprocessing and the commonest routines and commands in a CAD system.

Project courses are a form of syllabus planned and implemented in cooperation with teachers and students from the school's institutes and departments. The course at Datacentret forms part of a longer, ongoing assignment, where parts of the sketching and completion phases are implemented using CAD with the support of teachers from Datacentret.

The workshop is used by students and teachers to carry out study assignments independently, with occasional guidance from Datacentret's teachers.
The workshop has 3 computers in addition to the course machines, when these are not being used for courses.

CAD training for practising architects
At the turn of 1988/89, the Architects School decided to establish supplementary training in CAD at Datacentret. This step was taken largely as a result of a business amalgamation called "AutoCAD Users in the Building Sector" being set up.
The year saw an increase in the introduction of CAD on PC's at drawing offices and other building enterprises and hence in the demand for the training required.
Training is carried out using equipment specially acquired for the purpose.
A course structure has been devised consisting of basic CAD projecting with various applications for advanced students, including POINT applications for project design and planning.

CAD systems
The central CAD system in the educational structure of Datacentret is AutoCAD, complete with its numerous applications.
However, the smaller program SCRIBE is used by some students in connection with sketching exercises or project courses.
In addition, Datacentret has MONSTER, VERSACAD CC-CAD, PROXIMA and a variety of programming and wordprocessing tools.

RESEARCH AND DEVELOPMENT

During the past few years Datacentret has been involved in a number of research and development projects. This is due partly to the pivotal importance of the computer medium and party to the vast majority of the school's computing equipment being located at Datacentret. But it is also due to the continuous updating and information work necessitated by rapid advances within computing.

Research activities take place in three different contexts.

-At Datacentret, where a series of different projects are administered by the Centre's employees.
-Under the aegis of the institute, where Datacentret offers assistance with projects in progress.
-Commissioned, funded research, often in conjunction with other institutes of higher Learning and research centres.

The aim of the development work is to improve the potential applications of existing equipment and programs in architecture.

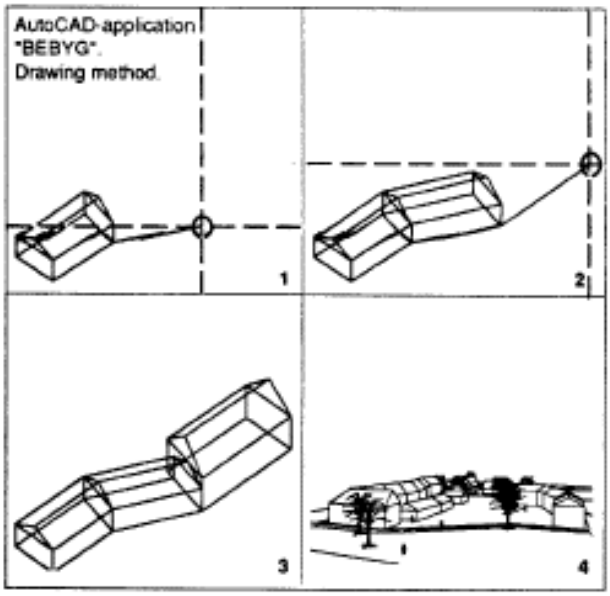
The development and research work which has been conducted at Datacentret during recent years is discussed below.

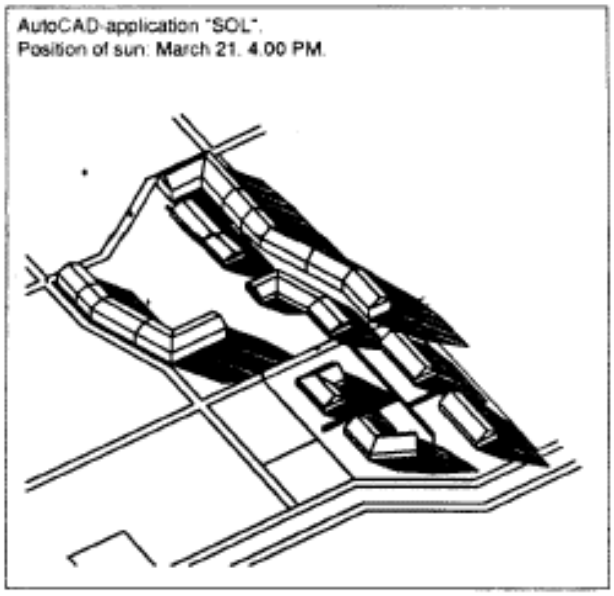
The AutoCAD applications

BEBYG

Designing a 3D model for any building can be a very demanding task, particularly if urban renewal is involved, where existing conditions very rarely take the form of standardized developments. To solve such specialized problems, AutoCAD allows individualized routines to be constructed to solve special tasks.

Having been written in a form of LISP, the routines then function as ordinary commands in AutoCAD. With the aid of a routine which has been labeled BEBYG ("CONSTRUCT"), the user simply has to "draw" the facade line, either with a point for each individual property or for each bend in the facade line.
The houses are automatically designed as a 3D model by the routine, which calculates inter alia the correct intersections at corners and oblique gables.
The definition of the houses' depth, height, roof pitch, roof shape and, where applicable, the number of storeys, can be changed by the user at his discretion. The user can choose whether or not floor partitions are to be drawn in.
The routine is particularly well suited to sketching. Sectional sketches are quickly transformed into 3D model sketches merely by "drawing" the plan on the digitalization desk.





The shade area is also depicted in AutoCAD using a special routine called SOL ("SUN"). The user selects the time of year and the time of day. The routine provides the correct slant image, where the point of the eye corresponds to the position of the sun at the time stated.
By definition, all concealed elements are in the shade, and the user can thus see what is in the shade and what is in the sun. The user can draw shaded areas by outlining the contours of the buildings on the horizontal reference line.

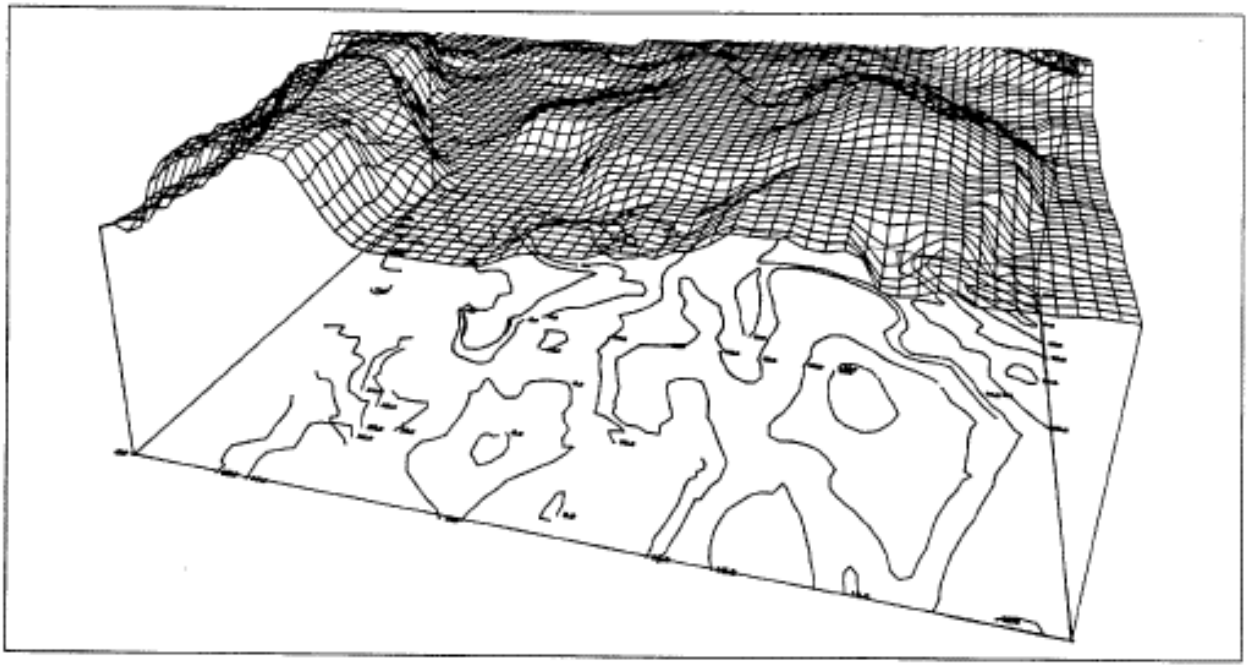
TERRAEN
The construction and imaging of digital terrain models is effected by transferring basic data from an analog card. The elevation curves have been digitalized in AutoCAD. Points from the elevation curves are automatically transferred to an interpolation program, which calculates the height of the points along the grid network.

The results of the interpolation can either be fed back to AutoCAD for further use or mapped out simply by using a special program devised for the purpose, in which the image definition (colours, concealed lines, exaggeration of heights, point of the eye, sighting point, etc.) can be interactively determined to portray the terrain in perspective.

UDSIGT
('VIEW") is an application enabling hidden or visible areas of a landscape to be pinpointed.
Those areas of the landscape hatched light and dark are the areas from which an object (the black dot on plan and section) are visible and hidden, respectively.
The program, which takes a digital terrain model as its starting point, makes it possible to evaluate the siting of large-scale installations in the landscape or to show how far a view extends from a specific point in the landscape. By repeating the process a number of times, it is possible to find the most expedient route for e.g. high-voltage lines and roads.

Cartograms
Cartograms are often used in the making of recordings and analyses. With the aid of cartograms, it is possible to highlight the geographical structure of geodata.
Geodata can originate from central registers or from own recordings, and must contain one or more geographical identification codes.

Today there are any number of database and computation programs which enable sorting and intermediate computations to be performed, but only few can produce geodata graphically in the form of cartograms.

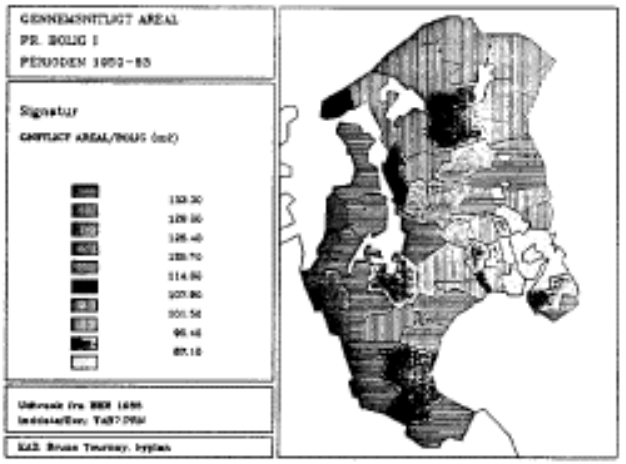


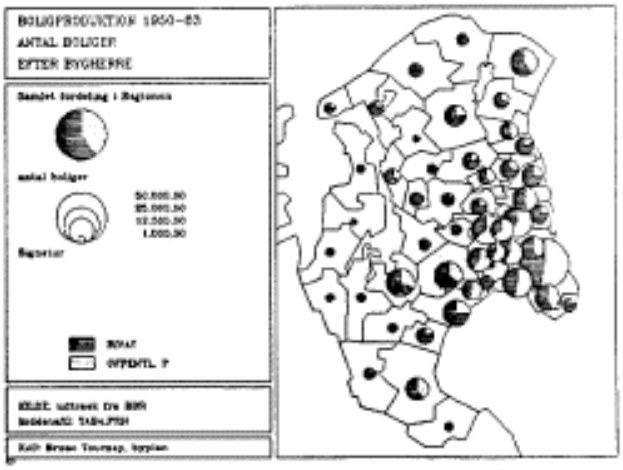
SAS-graph, which is accessible through UNI-C, enables cartograms to be produced within the same program. The drawback with an SAS graph is that at present it can only run on a mainframe.

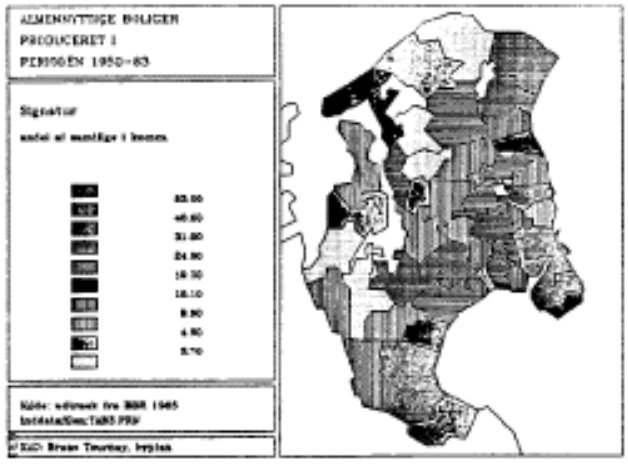
At PC level, the process has to be divided up into two phases. The first phase consists in processing the geodata in a computational or database program and dumping the finished data in a temporary file, which is subsequently read in the second phase by the programs producing the cartograms.

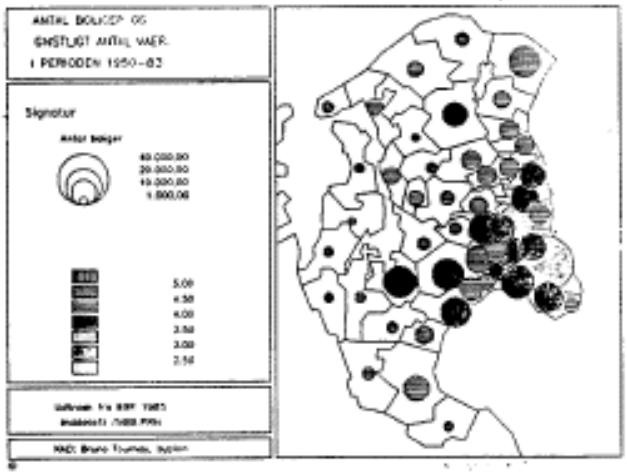
Signature cards, circle cards and sector cards can be generated. The programs are written in FORTRAN and make use of UNIRAS sub-routines.
All 3 programs can produce printed 3-colour or B/W cartograms and in the form of raster images or line drawings.

In the case of both circle and sector cards, the scale for the circles can be locked to ensure that different cards are assigned the same gauge - a feature which is useful in comparing a number of different cards.









FUNDED RESEARCH PROJECTS

Translational shell designs

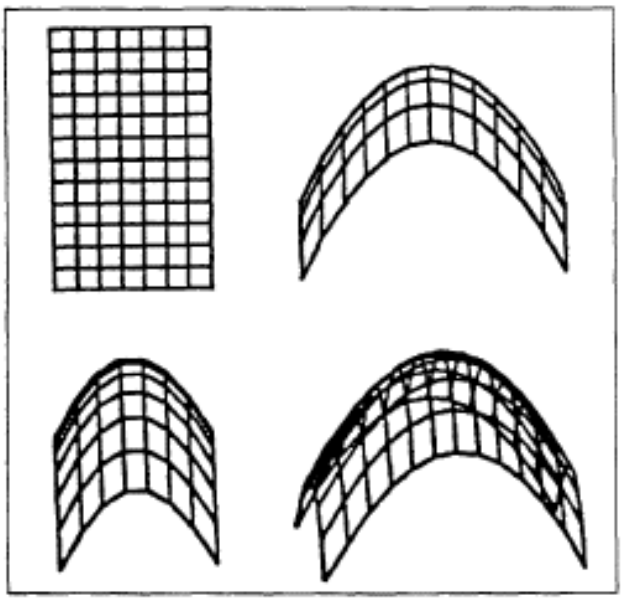
The NORDSAF program has been developed by the Datacentret of the Architects School of the Royal Danish Academy of Fine Arts in connection with the Nordic research project "Translational shell designs". The purpose of this project is to help make this shell form more readily accessible for practical use in the building trade.

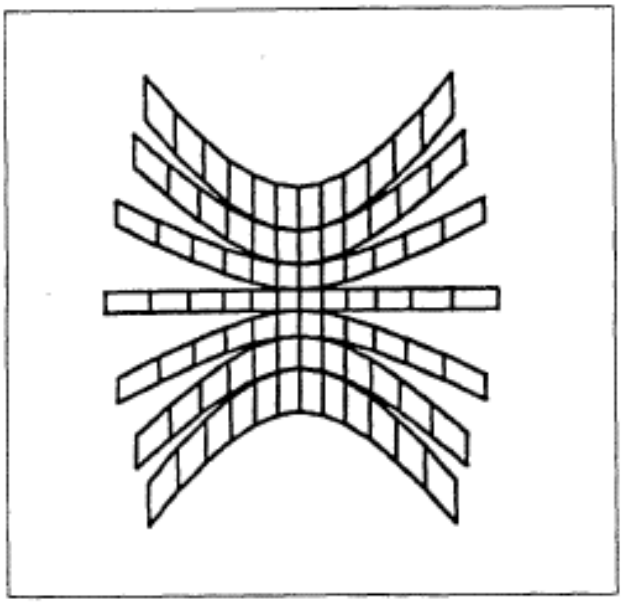
The purpose of NORDSAF is to enable the geometric definition of a translational shell and its individual elements to be executed quickly and simply.
The program designs shells on the basis of the parameter values entered and supplies the images and data generated to monitor, printer and plotter.
The program is interactive, so that a shell can be styled and modified directly on-screen by altering parameters such as front and lateral curve types, height, length, width, number of front and lateral elements, etc.
Furthermore, NORDSAF can generate composite projections of the shells' individual elements to facilitate the making of cardboard models of the shells.
Previous versions of the program have been used as part of courses in supporting structures for students at the school.

New system

The American-developed Architecture and Engineering Series (AES) has been made available to Datacentret through a training contract for a period of one year.
In collaboration with IBM, Datacentret is running a project with the twofold aim of gaining insight into the system and compiling a Danish user's manual, primarily for students' use.
The project is now at the halfway stage, and a rough edition of a user's manual has been prepared, which is currently being tried out by 2 students of architecture.
A spatial project, consisting of the construction of a 3D shell model of Frederik's Church (the marble church) and Amalienborg Palace, both in Copenhagen, is undergoing completion. The model is to be tested in the rendering module of the system with a view to assessing the system's lightening and shading facilities.
Another spatial project will be carried out in the form of an experiment on a small-scale universal spatial model.

The completion of the AES project also includes the construction of a spatial symbol library (a tool-kit), a simplification of the command structure in the form of various assign statements and synonyms, and finally reporting/lecturing dealing with, amongst other things, a comparison with other systems, including AutoCAD.





Design of human computer interfaces

As the computer gains increasingly widespread use as a tool, communications between the human operator and the computer become more and more important. At the Architects School, we consider the design of human computer interfaces as a new field for designers, and we place the research at the Institute of Visual Communication, the Institute of Graphic Design and Datacentret. Over the past two years, the architects Steen Agger and Henrik Jensen have worked on interface design for two research projects, the Book House at Risø National Laboratory and the Multilevel Flow Modeling System at the Technical University of Denmark.

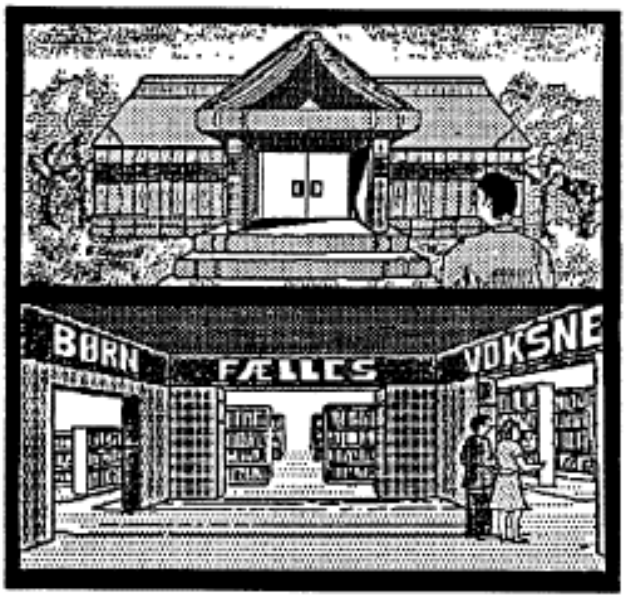
Book House project marks the end of fifteen years' research in organizing a database which can answer the questions most often met by the librarian. Thus, the database has thirteen registers ranging from the plot through time and place to the colour and picture of the front cover. For example, a search can be made for an exciting book with blue and ships on the cover. The starting point for the design of the Interface was the database accessed through the command language taught at the Royal School of Librarianship. The Book House is an interactive, self-explanatory graphic interface to a fiction database, which addresses itself to the general public library user. Inspired by computer adventure games, the Book House is an environment in which the user moves around by placing persons in front of doors, and then selects by pointing at objects. The illustrations show the path: entering the Book House, selecting a database (children, grown-ups or both), sitting down at the work-table for selecting registers.

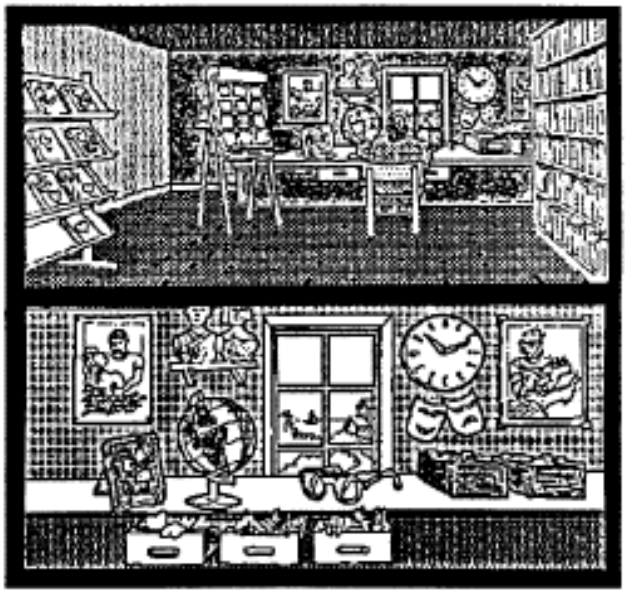
The evaluation of the Book House shows that the users like the interface, and that dead books (books never lent out) have found borrowers at. The prototype of the Book House can be tried at most major Danish libraries.

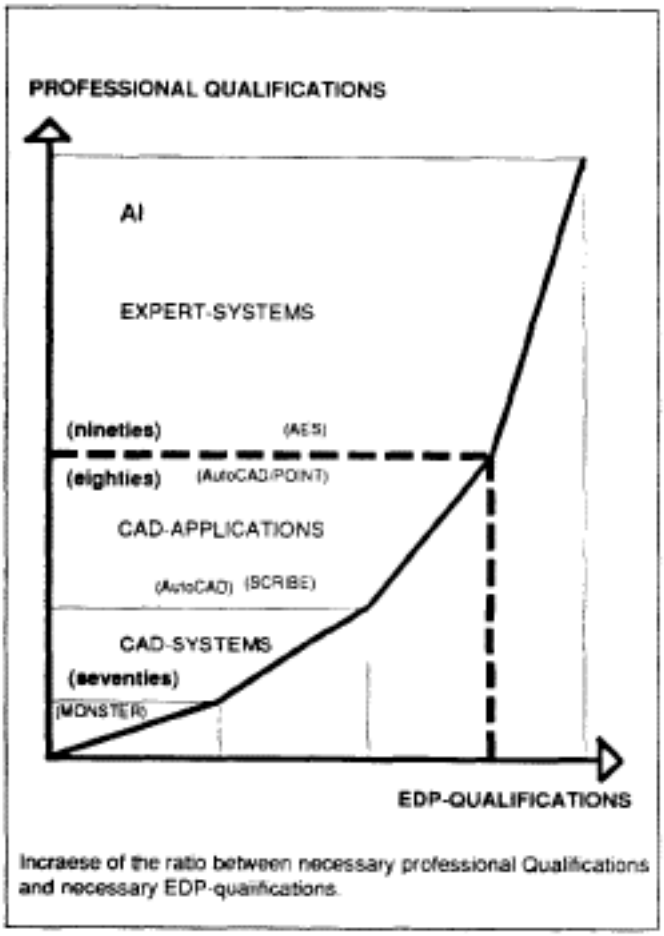
The Multilevel Flow Model is an analog computer model of the flows of materials in a plant. The model is built by the planner by combining signs denoting materials in different conditions. When built, the model forms the basis for setting up the plant hardware. Once set up, the hardware is interfaced to the model, which contains the software for running the plant. The model is then used for monitoring and adjusting the process in the plant.

The interface is being designed as an independent graphical interface to the programming language Smalltalk. All objects in the Smalltalk environment can be displayed as movable and scalable. The interface does not work with menus; instead, the functions are shown as independent tools, which are collated to match the different work situations. This concept offers a general purpose graphical interface that can be tailored to any task.

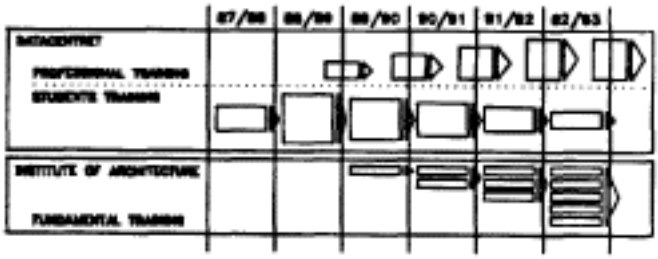
The structures built by the MFM-interface can later be translated to the structures used by architects, e.g. for functional planning or project control.







Increase of the ratio between necessary professional Qualifications and necessary EDP-qualifications.



Proposed model for the development of CAD-education.

New structure to CAD training

Today the CAD training at the Academy's Architec School faces new demands and challenges.

Even at PC level, the new CAD systems and CA applications offer more and more facilities for us within all phases of a building process.

The use of previous drafting programs made grea demands of the user in terms of computing knowledg programming skills and mathematical insight. Nowaday these skills are built into the applications in the for of macros and automated routines.

Teaching in the use of CAD was formerly dominated t a large extent by computer training, whereas th designing aspect, i.e. how to tackle concrete problem specific to the profession using CAD, has been more less neglected.

Students encountering computers for the first tim have to enroll for courses held outside of their ow study environment and are taught not by their ow teachers but by teachers (computer experts) wh have been involved in specialized architectur teaching.

Datacentret therefore finds itself in a situation wher having made provisions to guarantee the introductio and exchange of CAD at the school, it now runs th risk of also becoming an obstacle to advancement, particular to developing the CAD tool into an integr part, a natural part, of students' daily work.

The way to implement this lies in decentralizing th structure of computing facilities and teacher resource at the individual institutes.

This will ensure that the conditions required for usir the CAD tool in study assignments are also created.

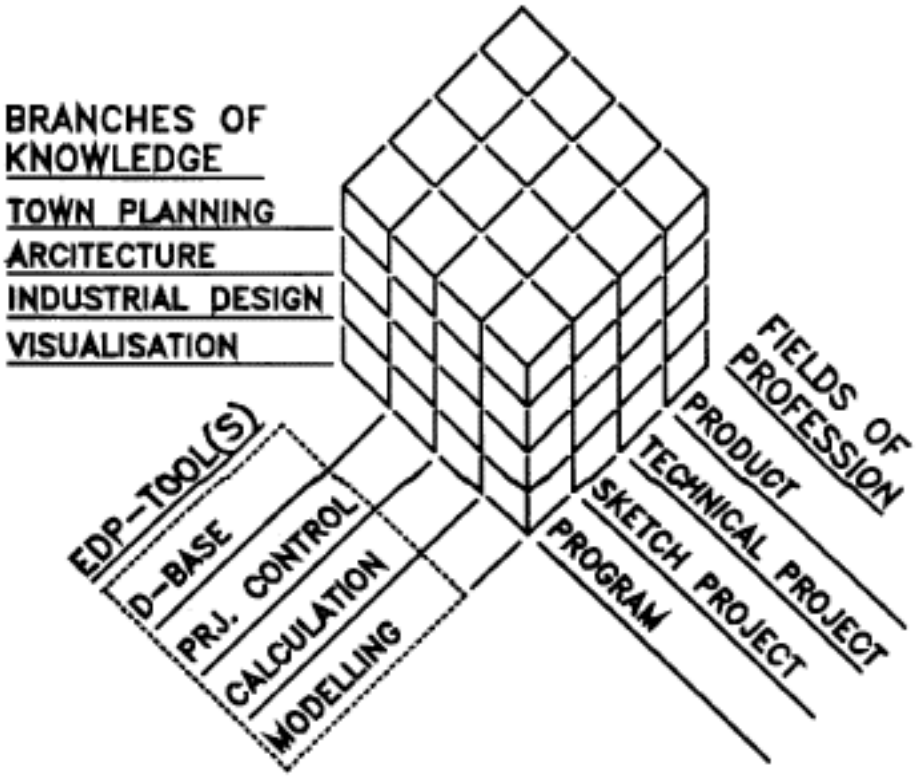
The machines are present in the study environmer and the local teachers are able to provide th necessary basic tuition.

This year, in order to encourage this developmen Datacentret will attempt to establish a number specialist computer working groups together wi colleagues from the school's various specialis departments. These groups will investigate ways integrating CAD courses into study assignments ar involving Datacentret's employees to a greater exte in teaching work, not just in the field of CAD bu across the entire spectrum of the assignment togeth with the other teachers.

In this connection, Datacentret's teachers must als provide support and guidance with a view to procurir the resources needed to set up decentralize computing environments.

In the longer term, these initiatives will be instrumental in gaining Datacentret the necessary time and consolidated research and development commitment within the field of expert systems and AI.
During the period 1990-92, development work in particular will be concentrated on what we consider to be the most important computer applications within the discipline of architecture: the universal digital 3D model and exchange of information in digital form.

Such a project can only be executed through collaboration between many different parties, within the building sector and the educational sector alike.
In the future our work will focus on extending and strengthening the cooperation with our present contacts in Denmark and Sweden. But we greatly hope to establish new connections with other institutions or drawing offices in Europe; and we anticipate that this conference will help fulfil that expectation.



Proposal for the basis of the universal 3D-digital model. (DC 1987)