Title:

"Concepts of CAAD-Instruction"

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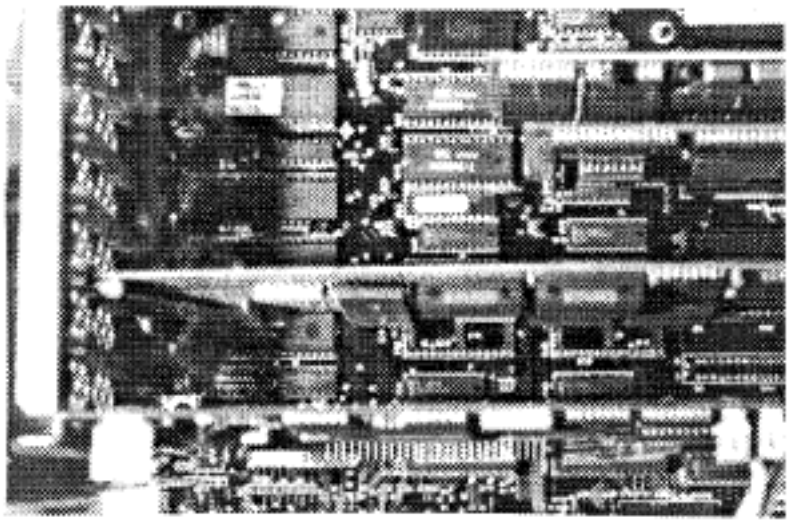
Preface

Today we can look back on several years of data processing support in architecture. When computer aided architectural design - CAAD - entered the field there was a lot of utter confusion in the beginning, a lot more than usually in other more technical application-fields of CAD. The architect is a very special CAD-user, as he is a very special member of all those other very analytical and scientific faculties around.

There is a lot of tradition involved, tradition that has got its roots far back in medieval and classic periods and is rich of art and creativity and intuition. Mostly lots more of this than scientific analysis, exact research, and similar stuff. We could spot a large number of architects who would have been horrified when they are confronted with the analytic research of the very basic problem as how architects are designing - the methods, the procedures and the ways of thinking.

And there CAAD was entering the architects' studios. No question that this caused a lot of trouble. CAD in architecture is a very provoking subject as the new tool is going to gain ground against the tradition of centuries of handmade architectural designs and drawings. And there we don't even touch the future aspects of the computer's architectural design support -what about the imminent threat of computer support in the holy domain of architectural creativity and intuition. What about the uneasy idea of CAAD in connection with artificial intelligence?



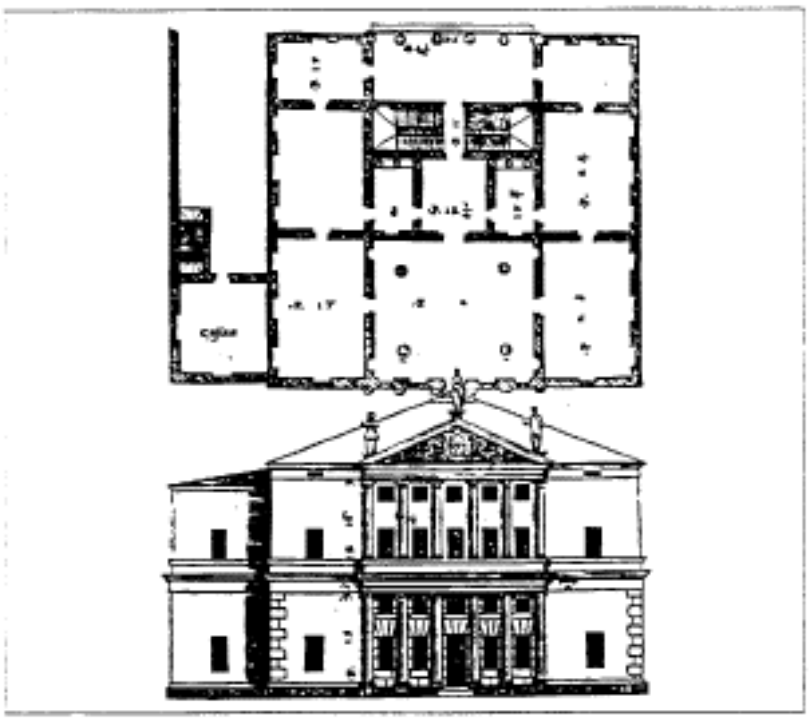
Pict. 1. View on microchips of a PC's mainboard

The problem of CAAD-education has been largely neglected through a number of years. If there existed a certain horror looking at the mere idea of CAD-support in architecture, horror became to outrage, when university-education was discussed.

In our days we can stay a good deal more relaxed, when we speak of CAAD-education - we not only got used to it, we are convinced, that the whole subject is of high importance.

1. Introduction

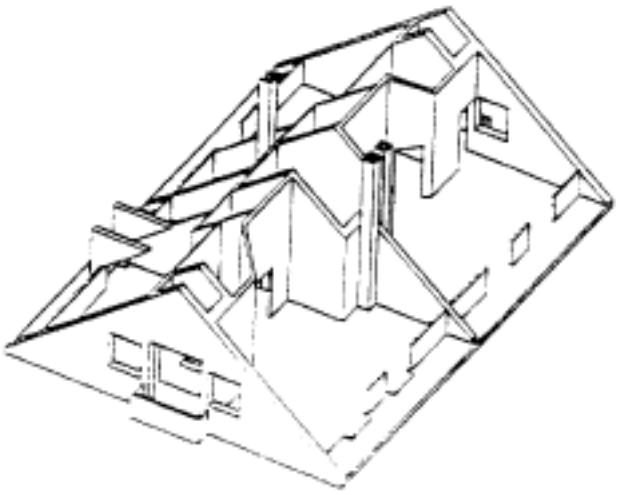
1 want to start my thoughts against the background of the rich tradition of architectural drawing work. We could often fall into deep meditation looking at those wonderful and artful products.



Pict. 2. Palladio, Palazzo Antonini di Udine

It is interesting to reflect upon the fact that this tradition reaches back into medieval centuries and even into antique times. The process of building up a helenistic column was only recently detected, and showed up that there were lots of brainwork and drawing skills involved. Drawing had been performed not with paper and pencil but sometimes the antique architects and designers scratched their constructions directly onto the marble areas of their buildings.

There came centuries and centuries of rising skills. And then - in our days - CAAD entered the stage. Everywhere practicing architects stepped back with enormous scepticism and some of the first results of CAAD-support would not really produce an encouraging impact on the further development of the tool.



Pict. 3. Axomometric view of roof -level without roof-cover: typical CAD-result

Only education could help. But this caused a new a painful period of helplessness: How should we come to solid concepts of education?

This question emerged some 10 years ago in Germany after the US schools were already heavily experimenting with partly outstanding equipment. It is nice to have a look at the different approaches resulting out of profoundly different tradition and an equally different mentality,

The US teachers installed ACADIA, the Germans IVAR, the Europeans found themselves in ECAADE and the research partition was mostly concentrated in "CAAD futures".

The Germans painfully followed their mentality and focused on questions as

- What are the goals of teaching?

- How should we teach?

- Who should teach?

- Should we develop a CAD-system which follows the traditional design method of architects or

- Should we develop a tool regardless of architectural traditions or

- Would a compromise be best

Against the background of all these crucifying questions it was very difficult to see the basic problem - but looking back, we should confess, that it was simply impossible to spot it.

2. Methods of Education

Analyzing the general possibilities of CAD-support in architecture we can try a rather simplified view as follows:

CAD support can be

- construction oriented
- representation oriented
- design oriented

We could talk about these innocent three lines for about two hours easily. The first aspect of this overview - the construction oriented support - seems to be readily achieved nowadays in most of the available systems. The second aspect is actually in the course of being highly developed, only the third aspect is just arriving *in statu nascendi*.

There are lots of experiments running, using intelligent support in the design process - but usually CAD-systems in practical architecture are limited to the first and eventually to the second aspect.

It is funny to look back at the beginnings of CAD-support. As to me - I bumped into CAAD-teaching in 1974. One of my faculty colleagues at the Munich University of Technology was the first user of a self-developed simple CAD-system, which required an awful lot of punched cards with hundreds of space-coordinates and lots of edge-information. But after having generated the 3D-model fun came up: One data-set could produce any perspective view and -using red and green plotting pens - even stereoscopic views.

Everybody who developed CAD-systems in those days knew that only a much better user-interface could rescue the architectural CAD-support. The way from the virtual view in the designees brain to the screen or to the plotted output must not involve the calculation of space-coordinates or edges. The more sophistication was involved the more it normally was impossible to develop a handy CAD-system - at least in Germany with the well-known horrifying ratio of students to faculty-members. The only way getting on with actualized tools was by purchasing professional software.

And it was a rather long way from there to persuade the software houses to make good prices for universities and - even more difficult: to persuade the faculty to pay even those low prices. CAAD in the first years had to fight for its existence. Many argued that all this machines involved could not be good for the architectural results.

Having heard about a lot of brainwork at a lot of congresses and having made a lot of good and bad experiences with a lot of student instruction I got to see the outcome of the analysis of possible methods of CAAD-education as follows:

software specific
experimental
tool oriented

I think it's useful to consider the main structures of these concepts.

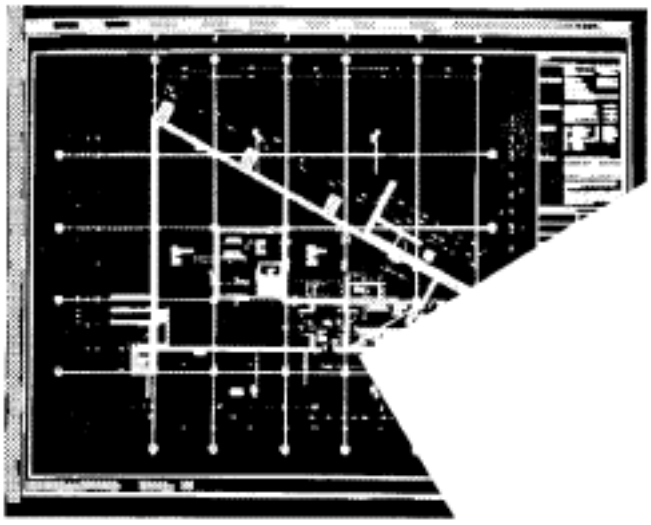
2.1 Software -specific method

What are the outlines of this method? This method is aiming at the handling of a specific CAD-software, that has been chosen to provide the 3D-model of an architectural design.

To select a CAD-system for schools there are mainly two possible criteria of selection:

- To build up a list of requirements in the first stage, that promises to fit the needs perfectly and in the second stage to select that CAD-system which fits the best into the list.

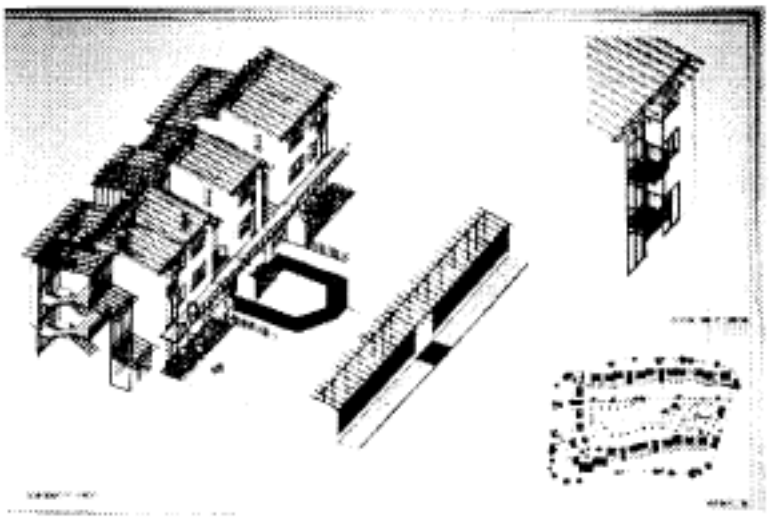
- To select that CAD-system that meets statistically the best acceptance in practical use. Curricula which emphasize on practical orientation might prefer that approach, stating that students should be optimally trained for practice at their schools. I admit that we started with this concept at Munich, but we revised our decision and improved our education after a number of years.



Pict. 4. Screen menu, work in progress (RIBCON)

The example shown above may only demonstrate what builds up the bulk of educational work: to help students find their way through more or less complex menus - screen menus or menus printed on digitizing tablets. It is of high value, if the training is performed on the base of an own design-project. A problem may come up if design and CAD-training must get along in a somehow parallel procedure.

You can easily guess that we started with the software-specific method in Munich. We managed somehow to have a good equipment, some powerful programs and a lot of enthusiasm. The results in some cases were really nice:



Pict. 5 Plotted result of a student's design, drawn by J. Leppert (RIBCON)

We considered it as the very top of educational quality to provide a number of different CAD-systems in order to enable the students to see the systems working and to get a good idea of the different input-philosophies and of the overall-performance. We did not know better in those days.

2.2 Experimental Method

Contrasting sharply against the software-oriented method we can define the experimental approach. Neglecting widely the needs in practical use the teachers who emphasize on this method state that any specific software-instruction has to be done by the system developers. To get acquainted with a sophisticated CAD-system mostly has nothing in common with fun. Contrasting to that the experimental method tries to involve a lot of fun: Some start with a training of mouse handling by motivating the students to try to produce a freehand image of the neighbour's face. A useful experiment to get a feeling for the mouse performance.

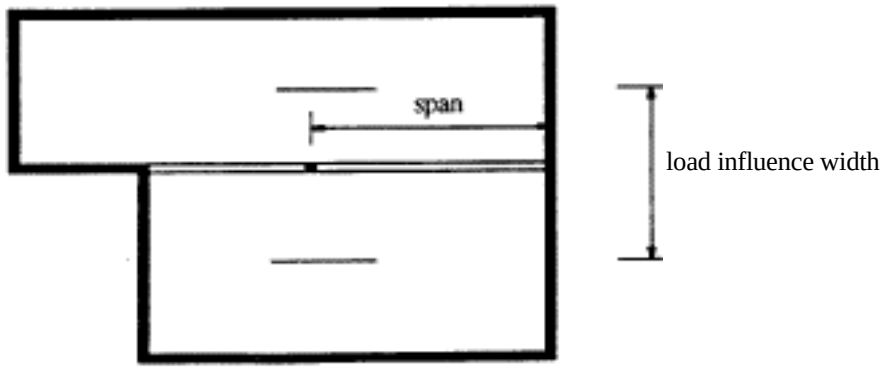
This education concept is widely spread in US schools. Research is mostly a matter of universities - again a dream in Germany, considering the student numbers.

How could we get an idea of experiments in this area?

Very interesting classic experiments are studies on the shape grammars of well-known architects. Palladio and Mies van der Rohe were really fine examples, they could nicely been studied. It is an interesting question anyway, how all this might have an influence on future CAD-applications in architectural design studios.

Another experiment might be to try getting design variations by help of the computer. Even without emphasizing too much on the outcome of the experiment, it is highly valuable to focus on the mere procedure of watching the behaviour of the feasible solutions; or on the procedure of looking up the restraining criteria, ending up with a list of rules and facts.

Looking back at these experiments there is one thing very obvious: Artificial Intelligence will have a very strong component in future CAD-applications. At the ECAADE-Conference in Munich last year we had shown rudimentary aspects of expert systems based on thumb-rules of structural analysis, giving rough size-parameters of design components.



Pict. 6. Example of structural analysis expert system, G.Pittioni (AutoCAD)

I could give a lot more additional details, but let us come back to the conception and to the limits of this special essay: the methods of CAD-education.

2.3 Tool-oriented Method

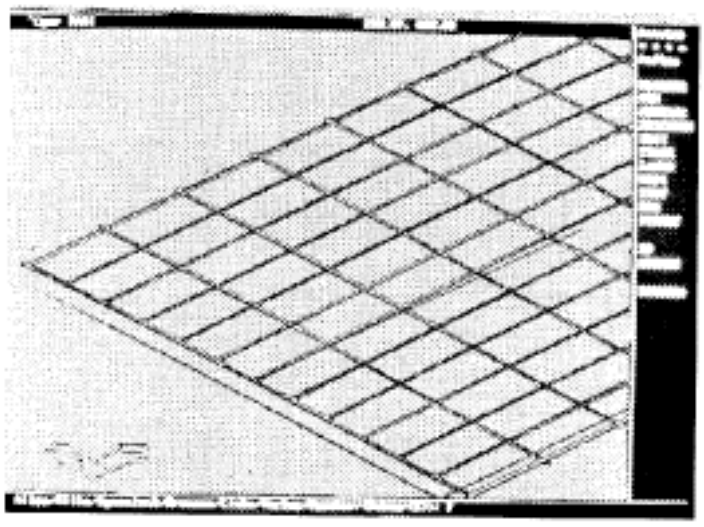
I hope I succeeded in finding a handy title for this extremely exciting method. Exciting, because we have come to the solution, that it is of substantially high value to teach with this method. And we cannot lean back, light a cigarette and tell the Software-houses to do this job. It may sound extremely provocative, but I strongly emphasize on the statement, that as long as we refuse to teach CAD with this or some similar method, CAD will ever be used in a wrong way or at least in a very inefficient manner.

What do I mean by "tool-oriented method"?

In simple words I want to prevent CAD-users of using the system in the same way they are using paper and pencil. We have an entirely new tool and we have to get a lot of special knowledge about the abilities of this new tool. Only then I can use the tool correctly and - efficiently. You can use a tucker by loading one single clamp before each blow - but you can only work efficiently by loading a whole set and do a serie of blows

To use a CAD-system efficiently will afford, that the CAD-user spends some time structuring his design. There may be one, two or more days, where there is nothing really spectacular happening on the screen. It is not very easy, to accept this: the tool is such powerful and you could really make a lot of things going on in a few days.

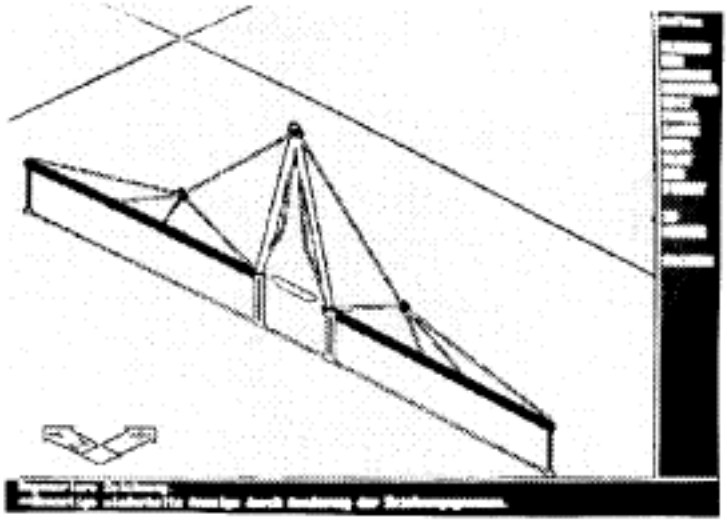
Let us have a look at some examples I picked out of our curriculum.



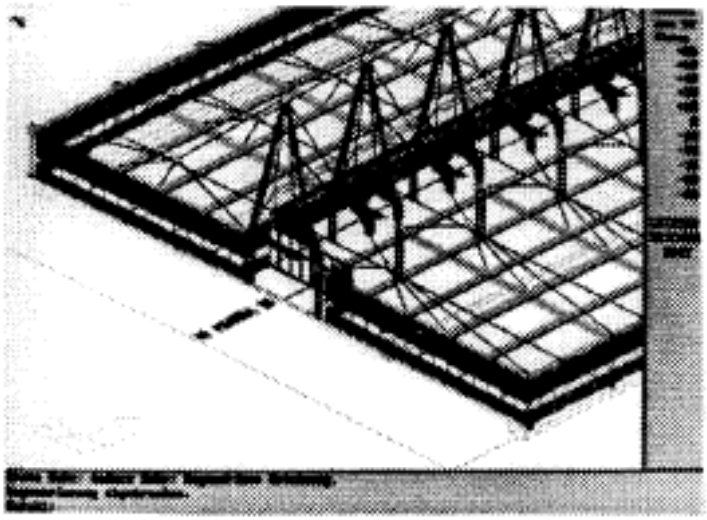
Pict.7. CAD basic training (AutoCAD), intelligent grid

An innocent construction grid for instance, possibly will be not built up by simple lines but by_elements, that are able to bear a lot more information. You create an intelligent grid. This grid will enable you later to build up magically constnictions and alternatives and to change them by simply pressing a key.

Everybody who ever violently plunged into some voluminous CAD-application, will know about the danger of getting Megabytes and Megabytes of uncontrolled data, behaving more and more clumsily until at a certain point nothing goes any more. This situation happens nearly to every newcomer - that's why we recommend to just throw away the result of the first two or three weeks. The accumulation of handling errors mostly, lethal in itself.



Pict. 8. CAD basic training (AutoCAD), structure on one axis

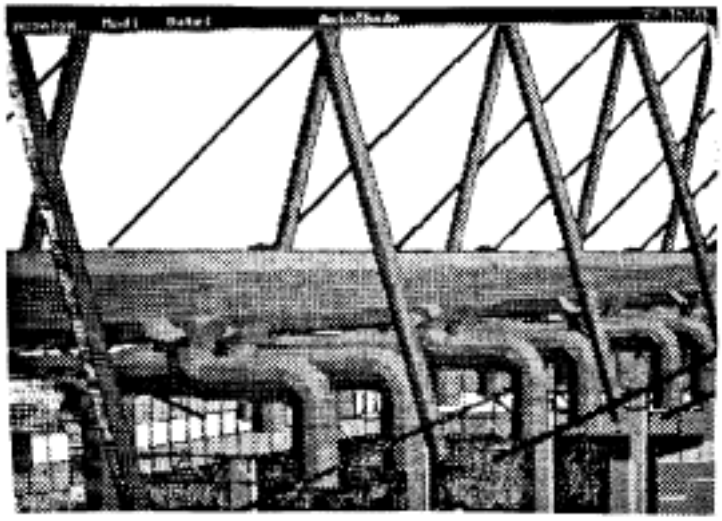


Pict. 9. CAD basic training (AutoCAD), completed structure

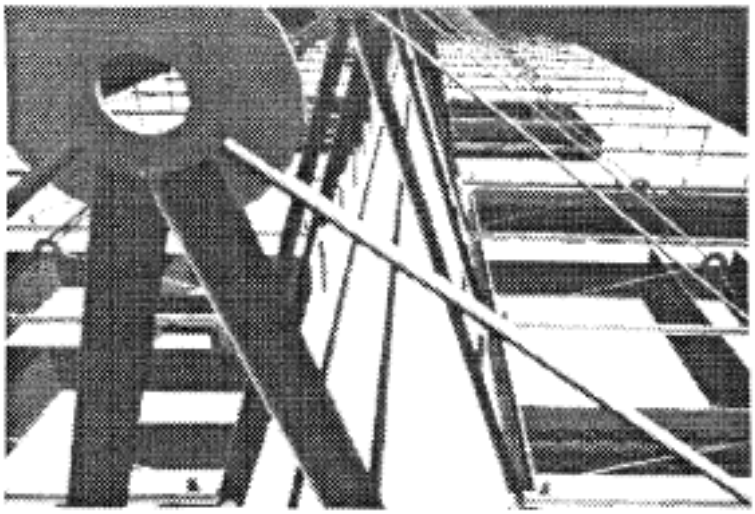
4. Some Critical Thoughts, some Expected Results

What can we expect of an instrument, what we could not do with conventional Methods?

Let us look at some examples:



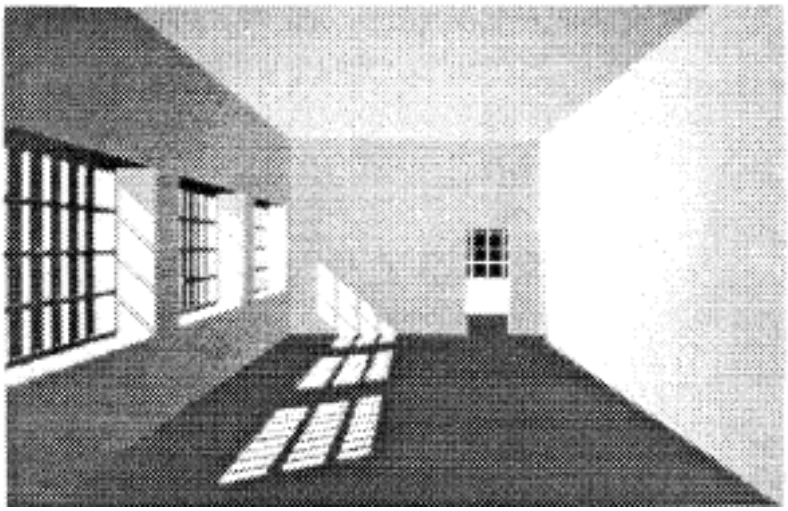
Pict. 10 Results of CAD basic training, AutoShading



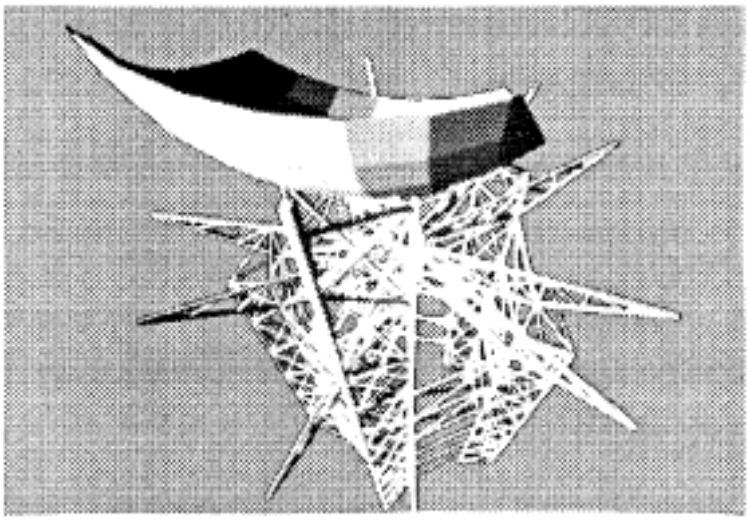
Pict. 11 Results of CAD basic training, DIAMO after data-conversion

Looking at those pictures, is a question justified that asks whether experimental aspects are not likely to be seen with the tool oriented method? Let me explain to you that students coming to a level of knowledge which can produce the above shown results have had hundreds of hours of CAD-training behind them. In many cases they are so familiar with the programme that they even dare to support their design-process by using the system; this procedure is mostly looked at very suspiciously. Practicing architects hold the opinion that CAD-support starts only with producing the drawings for site-planning.

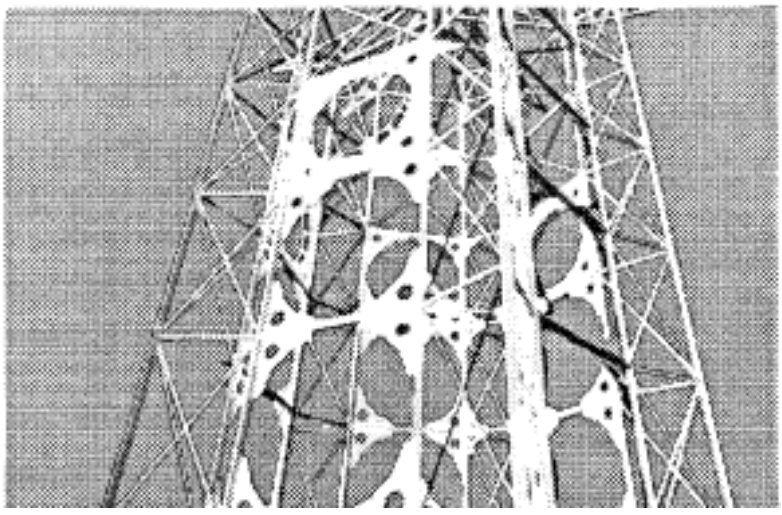
Beyond the limits of our education - meaning the restrictions built up by the available education time - sometimes fantastic results can be watched. Let us have a look at the following pictures:



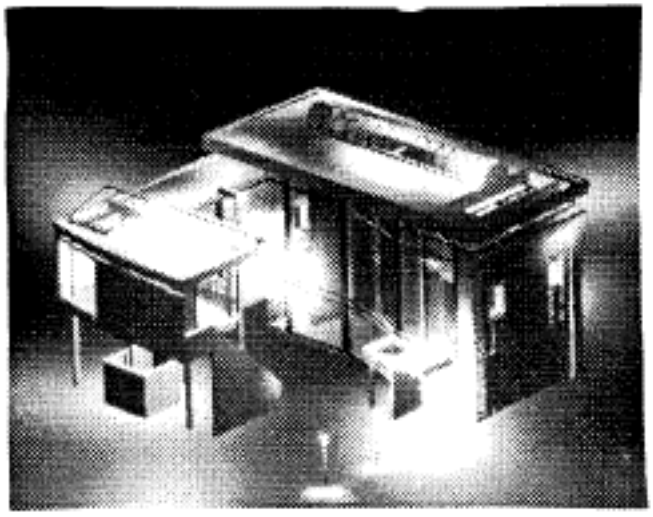
Pict. 12. Lightstudies on Loos-project, drawn by F.Wenz (ALLPLAN)



Pict. 13. Underwater Station, drawn by F.Wenz (ALLPLAN)



Pict. 14. Zoomed screen of 13, drawn by F.Wenz (ALLPLAN)



Pict. 15. Richard Meier: Museum of Modern Art, (Drawn by T. Bachmayer (STAR)

I think, even seen by very critical eyes, you cannot accuse our education method, that there is no room for experimental activity. We consider it as the optimum, when CAD-trained students start to use their knowledge doing their work for the design studios. There is no Lime left to discuss the reactions there, I only want to tell you that we have made experiences everywhere between outrage, amusement and enthusiasm.