Abstract

This paper presents a development work which aims at practical applications of ideas built on experiences in practise and education and the theoretical development in the BAS• CAAD project. The important difference between BAS• CAAD and CAD programs of today is the possibility to handle user organisation, building design and site in the same program. This means that design today has to be done in at least 3 separate programs with different ways of defining objects. It is then a computer technical problem to mix and study the relations between objects of separate origin. In a recent project our method to overcome this difficulty in CAAD computing was using a Multimedia program making visual simulations to analyse consequences of form etc. As the process went on and forms where more concrete it was possible to make simulations worth showing and discussing to involve colleagues, clients and users.

Problem solving model

This project is part of the BAS• CAAD program which has the overall objective to develop theoretical foundations and
methods for computer-aided design in the early stages of the design process (Ekholm 1995). To structure this presentation I have chosen to modify a model on problem solving by Mario Bunge (Bunge 1983). My model could be developed much further but is useful to sort out some of the activities in design work (fig 1).

![Diagram](Image)

**Fig. 1 - Model built on Mario Bunge’s description of the problem solving process**

- In a design the *background knowledge* consists of the specified design and its surroundings as well as more general knowledge of existing buildings, building techniques etc.
- Procedure: The designer selects a *problem* to solve - from his point of view the most crucial one.
- He invents a *hypothesis*, an idea of a solution. My experience is that many studies of design theory concentrate on this activity.
- The designer collects *empirical* data by sketching, aiming at clarifying the consequences of the invented solution. If needed he also makes complementary *theoretical studies* on for example calculation methods for light.
- Next step is to *control or test* if this is a working solution. I want to stress that this activity has to include functional and aesthetic qualities as well as different quantities.
- Then the solution is *evaluated* in relation to the selected problem and the design as a whole. If it is acceptable, the solution is integrated, the design is modified and the next problem is chosen. If it is not it is integrated in the background knowledge anyway.

Working as an architect I am not as strict as outlined in this procedure. Presentation of the empirical survey plays a more obvious role when clients, user representatives, public authorities etc are involved in the control/test and evaluation. It is then also an important pedagogical tool.

**Example of design using CAAD.**

Using CAAD for traditional plan-, elevation and perspective views is today almost trivial. Our ambitions though are to use the computer medium for an even closer support of the process of evaluation by for instance simulations. This is not possible with the CAAD programs of today but it can be simulated with multimedia technics.

I am going to use my own practical work and reflections (Schön 1987) to illustrate some of the ideas of BAS•CAAD. I will use visualisations from a design made with CAAD and a design with traditional sketching tools to be able to discuss some features using Multimedia and CAAD.

I will use a project made in connection with the City of Östersund applying for the Olympic Winter Games 2002. The idea is to create an Ice Hockey Hall for 12,500 spectators which can be transformed to a "Center for Development" for the region after the games. The localisation of the hall, which is part of the attraction of the project, is to be on the shore of lake Storsjön. The our CAAD department was engaged for making a visualisation to be presented to the public authorities as well as the local organisation committee.

For the visualisation of the idea a design in brief had to be made. After having studied some examples of Icehockey halls of the actual size I decided to use the circular plan form of the Scandinavium in Gothenburg. Analysing it I had found that all necessary spaces could be included in a cylinder volume with a diameter of 100 meters and height of 18 meters. One crucial problem is the flow of spectators getting to and from their places (fig 2). This could be studied in a simple animation, showing the consequences of letting the audience in on the second floor.
The section of the roof of the Scandinavium though is not suitable for a climate where snow is covering the ground for half of the year. The roof has to be convex and I tried some bow constructions. Using a CAAD system I first modelled the floor plane, some galleries and an icehockey rink, then the first bow in an elevation projection view, changed to plan view and duplicated it rotating the copies to the right position. Making a model of the dome roof is also supported by the system. So far the modelling did not take more time than an early manual sketch! Making alternatives was even quicker. Comparisons of alternatives was made by using a gradual transformation tool in the program between images of designs with different shape from the same view point.

Trying different shapes of the hall calls for a study of its relations to the Site. For the purpose of making full use of my CAAD system I have to put some efforts into building a geometrical model of the site and its elements. This is a way of getting to know the place although it occupies much more time than it takes to make just a site plan. One actual problem is to get all the information of heights from the Department of planning which is mainly working in 2D plans and maximum stories for height. In this case we could relate on arial photos and for an early stage this can be good enough.
Visiting Östersund for the project I was struck by the overview you get of the city from the surrounding hills and the impact of illumination at night. During the winter it is night most of the day! Lanterns in the roof for daylight can be used to make the hall shine at night.

The situation close to the railway encourages the use of trains to transport spectators from parking lots outside the city directly to the entrances of the hall. This can be visualised by animations (fig 4) which we have used in work environment projects (Johansson 1994).

Getting back to the building my interest is focused on the loadbearing system of bows. Birch trees are very significant to the Östersund region. I am attracted to using birch wood for the construction of the bows. The CAAD system supports a gradual development of the design of the bows analysing them visually from different view points (fig 5 and 6). It also makes it motivated to look into how to form the interior of the "Center for development".

Fig. 5 - Birch wood bow loadbearing system.

Fig. 6 - Building model, inside the Icehockey hall.
The Vision of the "Center for development" is at this stage a gathering of Institutions and Companies in the city with an outspoken interest of development in some of the typical topics of the Region - Tourism, Education and Services using Information Technology. Creativity is to be increased by a closer contact between individuals and new development projects should grow out of unconventional meetings of people.

The Client’s vision of the physical environment is one of those office buildings with an Open square like space in the middle (fig 7). To visualise this I build a summary model with window walls and galleries in three stories. The open square in the middle and communication spaces are getting daylight from the same lanterns as the Icehockey hall. Both alternatives are presented the same way. I chose a "staccato" animated walk from the entrance to some important places inside the building. I do not use the more "computer like" fly through because I like to concentrate on the experience of the house rather than the flight. Consequently I would have liked people to move about in my images but without support in the CAAD program that takes too much time to execute.

**Presentation of the project in Multimedia.**

For the presentation of the project I designed a Multimedia show. It was programmed to serve two different situations – for a fluent presentation of the Visions and for a more spontanious visualisation of almost any question in the following discussion (fig 8).

For the fluent show image sequences for overview of the site, communications, the Icehall, the Center of Development, architectonical ideas and methodes were prepared.
For the discussion crucial images, ariel photos, maps and other background material were to be directly accessible. The presentation was built up gradually as the design developed and was used both for internal discussions within the Computer Studio and with the Client.

Result of the presentation to representatives of the local authorities.

The final test was presenting the project to the local Gouvernment Board of Östersund. My Client has tried several times to make them interested. This time there was a lifefull discussion with references made to the images and those present were showing interest in further discussions of the idea. My client was very pleased and after evaluation of the event we agreed that all the different sequences had well served there purposes.

Closing the case a "Client version" of the show was made. This meant concentrating on the important sequences and simplifying the operating tools.

What had been done on the same design with traditional sketching tools?

In my nowadays limitted practise I always use CAAD. So outlining what I would have done using traditional tools has to be hypothetical and reflective. On the other hand most of my practise was aquired when CAAD did not exist. To start with I would have consulted my journals of Architecture for similar projects. I would even now find the Scandinavium as a good example and probably also use its plan form as a model.

My first sketching would be on the carrying system, inventing the idea of a system of radial wooden bows. I would sketch in plan projection, making a section view now and then. I would consult a catalogue from a manifacturer of wooden bows for dimensions and other construction facts. I would make a site plan to find out how much space needed and where to place the building. I might even have put some efforts in constructing a perspective view or having an employee to do it as I am not so keen on doing it.

I would work integrating the invention of new ideas and evaluating them until I had found something worth presenting to my client. My control/test would be depending on my imagination of a 3D reality based on 2D drawings. I might have made some simple, complementary perspective views to investigate uncertain points. I would make sure that I had got the dimensions of the bows farely right.

Fig 8 - Manual sketches on a wooden bow design.

Now, I would not make more careful drawings until I would like to be able to discuss further actions with my client (fig 9). If I had not seen it before I might find that though a bow construction solves the loadbearing problem it will take a lot of extra space in the periphery of the hall and unless very high at the top it is aestetically flat and a bit uninteresting. So I might have made a new round and try some other forms before I went to my client.

For the developping process to final project proposal 1 would have to make modifyed or new drawings for each presentation to my client.

For the final presentation I would have put in a lot of efforts making stylish sketches /drawings in all projections including some perspective views. I would have put them all on a suitable wall and made the presentation pointing at actual places on the drawings.

Discussion

To begin with most of the background knowledge could be stored in a database. The "Computer Aided Building Box" by researchers at Chalmers in Göteborg is one example of ongoing work to develop such tools. The impact is to make information outside the design team accesisable and better known.

Multimedia technics are already there for making database interfaces. So far computers have little competence in making creative or intelligent suggestions much due to the fact that the architectural problems are difficult to thoroughly define. Possibilities to browse the background database for good examples on different solutions though could be most useful to the designer as he invents the solution of his specific problem.

A common remark about sketching on computers is that the computer is slower than the imagination of man. The
understatement is that creativity is depending on speed and easiness. My experience which is at least partly a result of my practise as an architect tells me that creativity demands a tremendous amount of work and it is not necessarily fast at all. Given the means to make simulations and to encourage more images invites the architect to make a more comprehensive survey even if just communicating with himself. Even a solution, that does not match the problem is a result and it might be well worth working through. In many cases this also might inspire new inventions. Using manual methods rather invites to making fast conclusions and rush on to making a new invention. Most CAD programs are designed for producing drawings and rendered perspective views. To present them other programs have to be used. This could be experienced as a serious disadvantage. It makes the process more complicated and slower, especially when the architect is using it while "communicating with himself". On the other hand it makes the boundary between sketching and testing/evaluation sharper, possibly stressing the awareness of the switchover from creative invention to more critical analysis.

If the CAAD program is used for making traditional drawings they can be used just as manually made ones. For example the sequential working presentation program "Play-back" for Archicad is just a small step towards making a computer show. But if the presentation of the empirical survey can be made as an interactive show where formal and perspective views etc. can be called upon then the computer media is adding something of its own. Animation can be used as visual simulation to stimulate the human brain to understand a dynamic situation or process which is especially useful for visualising user activities. But even for instance a flow of objects like traffic or products, changes in light or colour, immediate comparison of two materials etc.

With the interactive multimedia show the information can be formed by the architect to serve his purposes. To be more "democratic" the interactivity should be used even by audience. However a bit technical this problem is possible to solve. On the other hand we have made a lot of "shows" for different audiences and found that when discussing a problem people have a astonishing capability to remember images and refer to them (Johansson 1994).

This spring term a lot of students at our school have used CAAD and made their final presentation using a computer and a large overhead screen. We have found that professors without experience of CAAD going through students projects find it very difficult to understand the project. They seem to be used to make up their view of a project by "scanning" all the drawings hanging on a wall - having the whole material available at the same time. Is it something like our demand for overview making us make a print out every now and then when wordprocessing?

As a lot of the visual evaluation is depending of the possibilities to compare two or more images it is questionable if this can be done with only one image on the screen at the time. The wordprocessed document is aimed at being read the same way has a typed or handwritten one. The screens of today are not big enough for a computer presentation as an exhibition of drawings. The comparatively small but flexible computer screen has to be used in another way like with interactive multimedia.

Conclusions

Multimedia technics are of great interest in the concept of CAAD. Technics for interactivity, animation and visual presentation were originally developed for entertainment and advertising but they have now grown into more serious implementations. Most CAD programs are designed for producing drawings and rendered perspective, rendered views. Other programs have to be used to present them in an interactive way and interactivity is one of the key concepts of multimedia.

Background knowledge can be stored in a database or a series of databases. There are already a lot of Multimedia tools for making database interfaces to make information more accessible.

For more comprehensive support of the evaluation of design solutions the lack of tools in the CAD programs can be helped by the use of a multimedia program. The user needs more computer knowledge, but this is compensated by the impact on the evaluation and creating process.

User activities can be visualised. Simulations of traffic, spectators flows etc. can create a better understanding of dynamic situations. Video-like directed animations can be used to create virtual experiences of the environment and stress the characteristics. Comparisons of alternatives can be made by using a gradual transformation between images of designs with different shape from the same view point.

A presentation should be prepared for a fluent show as well as a support to a spontaneous discussion. In the future it will be important for the audience to be able to bring up on the screen images to support their arguments.

The presentation of a design project with multimedia technics cannot imitate the traditional exhibition of drawings. It has to find its own dynamic ways to display the project on a smaller and flexible space using interaction.

References

The programs used in this project are: Archicad schoolversion 4.5 for CAAD and Macromind Director version 3.1 for multimedia on the Macintosh.


computer-aided architectural design”. To be presented at the eCAADe conference in Palermo nov. 1995.
