THE ARCHITECT, CAD AND TEACHING
THE PEDAGOGICAL POINT OF VIEW AT TOURNAI'S ISA SAINT-LUC

AUTHORS

Couwenbergh, J.-P.
Croegaert, A.
Gallez, B.
Petit, P.
Tilman, M.
Institut Supérieur d'Architecture Saint-Luc de Wallonie
Chaussée de Tournai 50
B- 7520 Tournai
Belgium

ABSTRACT

Object-oriented approach to software development is discussed as a conceptual framework and working computational model for creative architectural design. Two modes of object orientation in design are elaborated. The more conservative mode is static, based on class-type/object-instance hierarchies. The other mode is dynamic, based on a modern view of computation as multi-threaded evolution of interacting objects.

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1. INTRODUCTION

The IT revolution has definitively entered the domain of architecture. If computers and software programs are extremely effective tools, their applications and uses offer a variety of choices which belong to the architect. Thus, if most architects have in varying degrees integrated computer technology in their work tools, it is necessary to underline the existence of two very distinct tendencies as to the general philosophy of computerization in architecture.

On the one hand, a proportion of the profession categorically refuses to fit the whole architectural practice in a computer. They claim that the accuracy imposed by the machine and its peripherals transforms the artistic process into a cold, almost scientific methodology.

On the other hand, the second approach considers the computer no longer only as an improved drawing board, but as a partner that is capable of enhancing consistency of design in architecture. Used at the early stage of sketching, the modelling of the plan enables the designer to ensure its spatial consistency and to evaluate it from various points of view:

integration into the site, exposure to sunlight, installation of the structure, calculation of surface areas, etc. This integration of all the elements of a plan, even if it is not yet fully achieved in practice, is, however, being set up.

Nevertheless, the true IT revolution in architecture will only be possible when future architects are better informed. Because they are too often viewed as separate disciplines, computer science and CAD in particular have too rarely been given access to the architect's workshop to be integrated naturally into project pedagogy. Learning any software program thus becomes an end in itself.

The purpose of the presentation will be to situate the pedagogical approach at ISA Saint-Luc Wallonie-Tournai, on the one hand, with regard to the learning of the architectural project, and on the other hand, as to the reality of the architectural profession.

2. PRESENTATION OF THE PEDAGOGICAL PROJECT

Is it necessary to teach future architects computer-aided drawing and design? The notions of computer-aided drawing and design have been fully and better defined elsewhere. We shall not mention this aspect. However, using a computer for drawing is far from easy. Numerous experiments and assignments suppose the knowledge and common use of one or more design software programs. None of them gives explanations as to how to reach that goal. Leaving it to the students does not seem to be an adequate solution. Even if they can quickly understand the technical aspect of the software, they need guidance on how to acquire the learning and organisation method to be concretely applied to the architectural project, and used later in their profession. This is the objective at St-Luc Wallonie-Tournai School of Architecture.

Our intention is to present our initiative and the modest conclusions that 4 years of teaching have enabled us to draw.
The intelligent use of a computer requires, on the one hand, necessarily structured qualities of a working and organisation method. On the other hand, it gives the student more autonomy in learning the various disciplines. We think these two characteristics are essential not only to the training of a future architect, but also to any training concerned with complex problems.

Our teaching method is based on the space of freedom afforded by the use of a computer and the opportunities of graphic expression it provides. We emphasize the learning of a working method rather than the learning and knowledge of a software program, even if the two aspects are interrelated.

3. TECHNICAL MEANS

The School has acquired 25 computers as well as a number of A1 and A0 plotting boards interconnected as a network and situated in a single classroom. The computer room also contains an A4-A2 printer.
In the near future, the workshops for the last two years will also be equipped with computers.
Basic software: AUTOCAD.
These machines are available to students 24 hours a day all year long.

4. ORGANIZATION OF TEACHING

Here is a brief reminder of the use of computer technology in the 5 years of architectural studies:
- 1st year: introduction to word processing. Individual coaching facilities for courses of mechanics, stability and languages.
- 2nd year: introduction to "Windows", management of peripherals and handling of files.
- 3rd year: compulsory CAD course, including 4 hours (half a day) a week during the two semesters.
- 4th year: elective: 3D practice in connection with architectural projects.
- 5th year: elective: practice of computer generated images in connection with architectural projects. Introduction to office automation software.

In addition, the library catalogue can also be consulted on computer, which makes students' research easier.

4.1 1st and 2nd years

The programme for the first two years is organized in such a way as to enable students to acquire the appropriate training for the use of a word processor and a spreadsheet as early as the end of the first semester.

At the end of the second year, the students have received a good introduction to everything to do with the use of a computer and its peripherals.

Through these various approaches to the PC, the first two years enable the student to use the computer for various assignments, without having to practise drawing. We believe indeed that they should not learn CAD before they are sure to have acquired the elements of precision, decision and sensitivity by means of such traditional drawing tools as the drawing table, the T-square and the set square, etc.

In the same way, we believe that the introduction of information technology in the teaching of architecture made it absolutely necessary to keep and develop such more "traditional" courses as sketch drawing, for instance.

4.2 3rd year

The practice of computer-aided drawing being introduced in the third year, our main objective is to give each architectural student, whatever their means, the opportunity to master the computer which will become their "pencil" in their professional life.
The number of 3rd year students varies between 40 and 50. They are divided up into two groups.

During the 3rd year, we endeavour to familiarize students with what will inevitably become their pencil and his work tool. For this purpose we use AUTOCAD. No software has been designed to be taught. But does this type of software need to be taught? We will not give a detailed account of the reason why we chose this software, as this could be the object of another debate. Knowing AUTOCAD as such is not actually useful. But thanks to it we orientate our teaching through an intellectual approach which consists in abandoning the traditional drawing table. At the beginning the immaterial aspect seems puzzling: no 20 centimetre ruler, no pencil, no eraser. The screen is nothing but a window which moves around on the plan, whereas in the past the full image was visible on the drawing table. In other words, all this boils down to the disappearance of all traditional tools to which the student has become very much used and from which, as experience has shown, he/she cannot break away. We thought it useful to begin with the teaching of two-D drawing, which provides a better link between the drawing table and the screen. After about 20 hours of teaching with AUTOCAD, we start the concrete application to a project in the planning stage in the architecture workshop.
- at Christmas, some students hand in the partial or full plan designed with the computer.
- the second term ends with the final plan. Students have to hand in at least one plate containing some element of the plan designed with the computer (plans, section or front).

4.3 4th and 5th years

Three-D and computer-generated images as design and communication tools

The new representation techniques, in the form of computer-generated images, provide drawing with a new dimension and a new reality, never achieved before. It is true that, even if in the architect's usual approach, drawing is both a design tool, which enables him to transpose his/her "IDEA" onto a concrete medium, i.e. the sheet of paper, and a communication tool, which enables him/her to transmit his/her plan to somebody else, traditional drawing cannot easily produce an overall perception of the plan situated in its context. Consequently, new representation tools are useful in that they provide an overall, virtual and three-dimensional vision of the project, compared with the classic two-dimensional approach split into plans. In addition, the visual exploration of the project, through successive sequences

of perspective views, seems to make it possible to reduce the distance between the project and its completion.

CAD tools combined with computer-generated images are thus above all, and beyond their visual attraction, on the one hand, design and study tools to visualize the plan, to check its overall consistency and detect possible flaws, and on the other hand, communication tools to present the project.

These two closely linked aspects are covered in the 4th year (Three-D design) and 5th year (computer-generated images).

Three-D representation

Until very recently the architect has always used the means of representation, such as perspective and the various plane projections, which date back to the Renaissance. Although this method has been used for a long time, one has to note its difficulty in representing architecture as a whole. As Bruno Zévi points out, it lacks the "fourth dimension". It is the latter which gives space its full reality.

Our spatial experience only depends on our progression in space The various spaces visited can only be fully perceived in terms of duration. Thus, mobility of a person in space-time is a vital necessity for the apprehension of this space.

Equally, no spatial configuration is limited to a static and unique space, but to a succession of interrelated spaces. It generates a "spatial sequence".

"Mobility" and "spatial sequence" cannot easily be represented with traditional means which are essentially two-dimensional and static.

It is at this point that the computer with its developments in CAD and image generation makes a significant contribution. By generating multiple three-dimensional views and emulating the movements of a person in the space, through a "path", the architect is in an almost real situation, and his/her tool acquires a conceptual value thanks to its functions of control and assessment of a project in the planning stage.

The present objective of the 4th year course is two-fold:

- first, helping the student to perceive and understand the plan as a whole in 3-D space
- then, making him break it down into simple geometric figures from graphic primitives or surface-generating curves.

This process, which should at first sight seem easy for 4th year architectural students, does not appear to be simple for some of them. Producing plans on the drawing table has probably taught them to think in two-dimensional terms. With a three-dimensional designing tool such as the one used at our school, the student no longer draws a two-dimensional representation of his/her plan, but actually designs a three-dimensional full-scale model.

This approach to 3D takes place during the first semester (about 12 weeks) at the rate of 2 hours a week. It is progressive, beginning with the design of simple objects and proceeding to more complex assemblies.

During the second semester the more theoretical course of the first semester becomes a free workshop activity where the student can be helped by the teacher to integrate the data he/she has acquired into his/her project. The

final objective is indeed for him/her to achieve his/her end-of-year project with the help of the 3D CAD tools.

The software used is AUTOCAD 14 in its basic version. It enables the student to break down his/her project into basic elements rather than using pre-programmed objects. In future it will be possible to supplement this preliminary phase with a more specific application to architecture.

Design and communication in the 5th year

As a natural complement to CAD, image generation enhances the architect's conceptual approach. He/She can supplement the volumetric image of the project with other elements such as material, colour or impact of light. In addition, if the project has to be integrated into an existing site or structure, the architect will be able to study it as a fragment of the landscape.

The objective of the 5th year course is also two-fold:
- first, dealing with the aspects which have an impact on the student's conceptual approach: external appearance (material, texture, colour, …), lighting (inside and outside), movements and perception.
- subsequently, tackling the communication aspects of the project with calculation of fixed and moving representations.

The course takes place during the first semester (about 12 weeks), at the rate of 2 hours a week. It covers the main elements of image generation: external aspect, lighting, visualisation, fixed images and animation.

During the second semester the more theoretical course of the first semester becomes a free workshop activity where the student can be helped by the teacher to integrate the data he/she has acquired into his/her own project. The final objective is indeed for him/her to achieve his/her end-of-year project with the help of the image generation tools.
The software used is 3D Studio Viz, the ideal tool to teach simulation. It makes it possible to establish a direct link with Autocad to appropriate 3D or to transform 2D elements into 3D. It is open, interactive, flexible, etc.

5. FUTURE PROSPECTS

The experience we have acquired over the last few years has enabled us to note that, generally speaking, students are increasingly open to using a computer because they have used one at home or at secondary school.

In addition, thinking of the very objectives of training for architects, we believe that the use of a computer cannot be restricted to the tasks which have until now been carried out with such traditional tools as the drawing table, for instance. In our view, the computer is too often used simply as a sophisticated transposition of the old drawing table, and its 3D potential is too often ignored. Whereas the ultimate aim of an architect's education is to teach him/her to see, think and work in space. The computer makes this possible, and this must be our objective.

Consequently, we are now considering restricting 3rd year student's training to the simple 2D operations with a view to dealing with 3D notions earlier, which corresponds to the architectural and town planning projects carried out in the

3rd year, i.e. the residential block integrated into its urban environment. Through manipulations of simple virtual volumes representing houses and blocks, students would be brought to directly handle positive as well as negative volumes. This stage is an adequate preparation for the scale model which, within the next few years, will be produced with the help of a computer.

In that event, 4th year students being used to the computer would more easily and rapidly go in depth into more complex 2D and 3D manipulations.