Contextual Hypermedia in the Design Studio

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Abstract

The focus of this paper is on the development and use of hypermedia applications for the presentation of design studio projects, based upon the author's own recent experience of teaching CAD at both undergraduate and postgraduate level. The contention of this paper is that this activity cannot be reduced to routine Hypercard stack development. Instead, the development of applications in this area need to give support to the expression of the design-theoretical issues that are central to the presentation of any design studio project, by exploiting the many issues of concern that are emerging from the field of human-computer interaction (HCI) The hypermedia application i.e. in this case design-theoretical views of a design project, will inevitably influence the specification of a user-interface, and hence the presentation and appearance of the design project. This paper will investigate the extent to which the interface can be separated out from the application and the converse issue, namely, whether non-contextual hypermedia environments restrict design applications.

Introduction

Contemporary architectural education in Britain specifically deals with the teaching of design theory and building technology through a series of lectures and projects, with little if any formal training in the area of architectural presentation. While this approach encourages students to develop their own style and philosophy of design presentation, the learning process is slow and often accompanied by many badly presented projects. It is generally the case that students who develop good graphical and verbal communication skills within criticism sessions (crits), tend to have favourable design project assessments. A well-structured presentation typically consists of moving from a general description of the background material, towards a discussion of more specific project details. Hypermedia systems for the presentation of architectural design projects should offer environments in which much more *context-sensitive information* can be represented, without distracting from the details of the scheme itself. It is just this wider context that is typically lacking in poorly presented projects, in which response to criticism becomes much more verbally based, thus requiring the audience to visualise the building in their imagination.

Most design students' initial encounters with hypermedia, at least in the University of Sheffield School of Architectural Studies, is through Hypercard (more hypertext than hypermedia), primarily because of its availability on all Macintoshes. Hypercard, being essentially a scripting system for the construction of run-time databases using a macro language called Hypertalk, is beginning to be used by certain students in our department for the presentation of design studio projects. With Hypercard, even inexperienced users can construct, or at least customise, personal card indexes, often with sophisticated visual touches, sound effects, and high-resolution bit-mapped graphics. It appears, however, that ever since Hypercard was introduced into design schools, a sort of second-hand software industry has been developed by the academic research community. This has resulted in the generation of run-time Hypercard databases (stacks) for use by students who can't be bothered to create their own, or are simply unable to. Hypercard is potentially a wonderful program, and has been used to do wonderful, but sometimes quite useless things. It has been proposed as a front-end for optical storage media - a technology which hasn't yet really arrived. By the time students have learned how to use this second-hand 'stackware', they might as well have learned Hypertalk and written their own stack. Furthermore, very few architectural practices make use of this piece of software. In the educational applications that have so far been developed (see most of the papers in §A: Multimedia & Course Work, ECAADE '92 Barcelona), it always appears that the input from students has been reduced to nothing more than TV channel-hopping to view pretty-picture slide shows.

User Orientation

The central point of this paper is that we should be aiming to develop a much more useroriented approach to hypermedia interface design. We must respond to what students need to be able to achieve rather than considering what students might be able to do with a given technology. Much existing hypermedia research has been disappointing partly because of a concentration on exploratory presentation approaches (slide shows) rather than on investigations of how hypermedia can improve the presentation of studio project work. More research needs to be carried out into knowledge-based support for non-deterministic hypermedia situations (contexts) that arise in student projects.

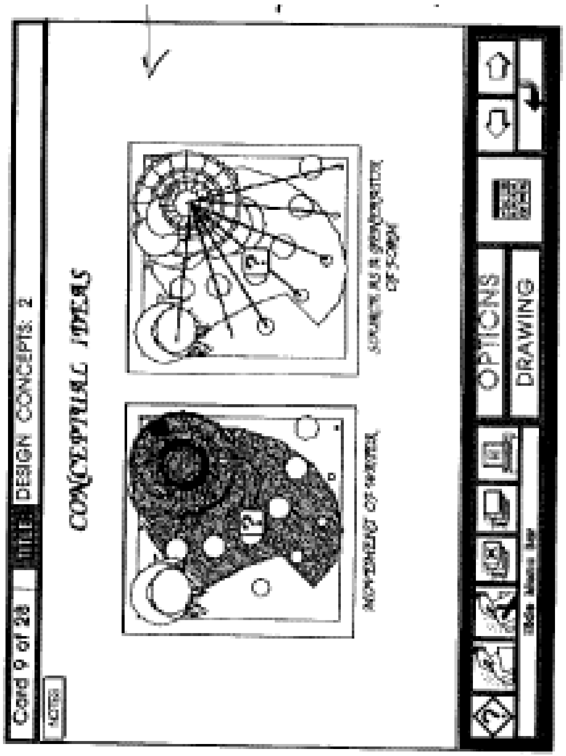
Architectural design is a subject that requires not only the creation and development of design ideas, but also the effective communication of these ideas from the architect to the intended audience. Traditionally, students of architecture are encouraged to develop a high level of skill at presenting their design ideas during criticism sessions where the project is explained and then assessed by a number of tutors and fellow students. In general, the most successful students of architecture are those that:

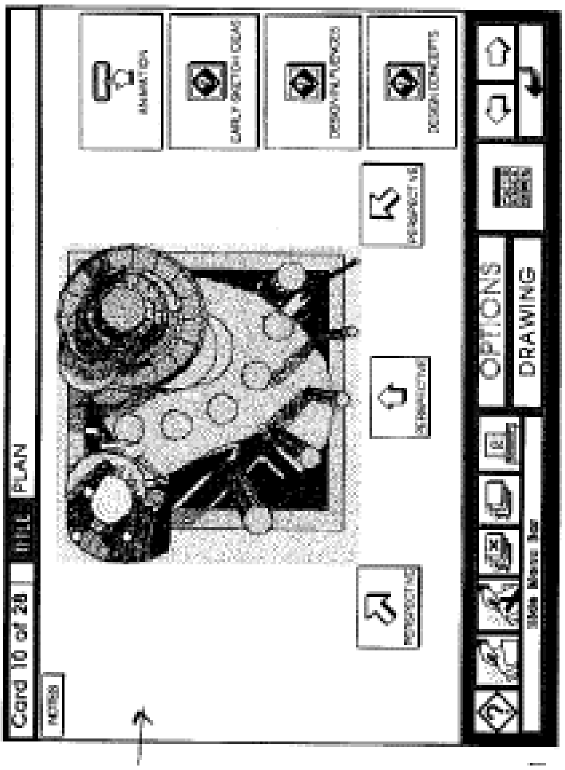
- Develop and apply their creative imaginations fully within the context of design.
- Develop a sound knowledge of building technology, and the principles that underlie good architectural design.
- Develop their abilities to express their creative ideas to a high standard.

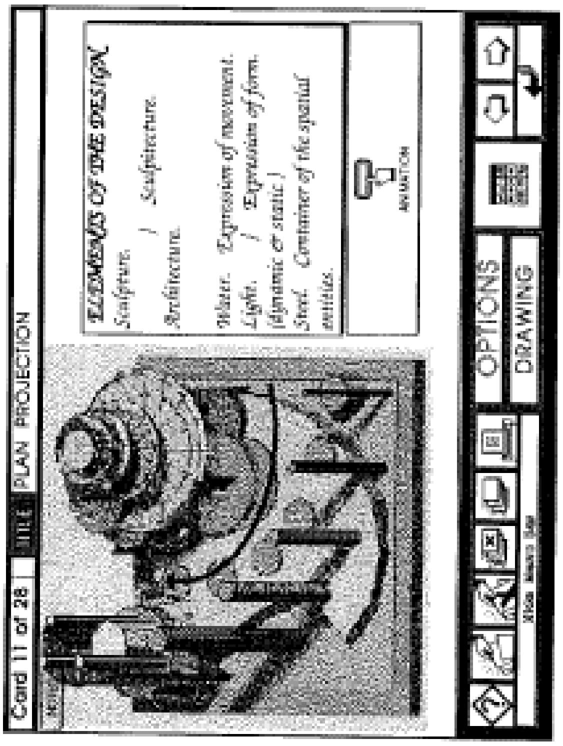
The latter quality provided the main focus of a recent M.Arch dissertation at the School of Architectural Studies at Sheffield University by Jonathan Reeves. The central ambition of this project was to exploit the rich but implicit structure of design development that is always present in a criticism environment. This structure can then be used to guide students in the presentation of their own project work. A demonstration of this Hypercard stack was presented recently at the Creative Edge exhibition, Heriot-Watt University, 28th August, 1993. This event was an informal gathering of hypermedia and Multimedia system developers. Figure 1 illustrates some of the cards from this stack.

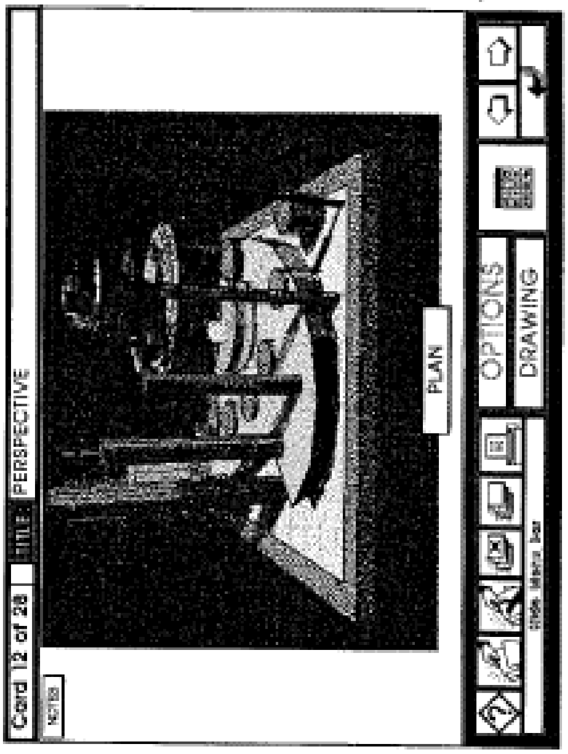
An important observation to be made from the project described above is that this particular piece of software development has at least attempted to view its hypermedia interface from an appropriate, user-oriented perspective, rather than from a technological one. The commonly used technological perspective is typically defined through lists of common technical characteristics of systems claiming to he hypermedia systems such as multidimensional presentation techniques (integration of text, pictures, sound, video etc.) multimodal interaction (the use of different modalities such as voice, gesture, pointing etc.) or conventional hypermedia techniques (non-linear data structures composed of nodes and links). The focus in the technology perspective is on the medium or on the technology. A user-oriented perspective, on the other hand, focuses on the possibilities offered by the technology. In the presentation of studio project work, the emphasis should be on what such an approach offers to students rather than what it technically comprises.

The development of computer applications in design has often been seriously hindered by technological approaches (Bijl, 1993). Very often we work outwards from the technology asking "what might the user be able to do with this new technology?" rather than "what might the user want to do with this new technology?" Many developments in the hypermedia area illustrate this point. People start with the concept of linking many different types of information. Technologically this is certainly possible. They then suggest new ways of improving the education of students using these highly linked systems. Grand scenarios are developed in which new and exciting ways of mixing text, graphics, and


Card 9 of 28
TITLE: DESIGN CONCEPTS: 2
CONCEPTUAL IDEAS
OPTIONS
DRAWING


Card 10 of 28
TITLE: PLAN
PERSPECTIVE
OPTIONS
DRAWING


Card 11 of 28
TITLE: PLAN PROJECTION
ELEMENTS OF THE DESIGN
Sculpture. / Sculpitecture.
Architecture.
Water. Expression of movement.
Light. / Expression of form.
(dynamic & static)
Steel. Container of the spatial entities.
ANIMATION
OPTIONS
DRAWING


Card 12 of 28
TITLE: PERSPECTIVE
PLAN
OPTIONS
DRAWING

sound are proposed. Users are encouraged to browse, annotate, link and elaborate on information in a non-linear, multimedia database with the ambition of allowing the exploration and integration of vast libraries of information.

Whether design students actually want to do this is never questioned. The result has been a set of hypermedia applications which are of dubious value for the presentation of studio project work. Such systems are based upon the assumption that exploration is a very normal way of developing our information base in the real world. Thus, the argument goes, we should concentrate upon providing a set of rich knowledge sources and allow users to browse. However, we know that this approach is slow and prone to errors, and that formal teaching methods have been developed to partly by-pass and speed up this process. There is, of course, an important place for exploration in the teaching process, but the issue is much more complex than some hypermedia developers would have us believe. Tools for the construction and manipulation of collections of multimedia material are becoming widely available on successively cheaper hardware platforms. According to many sources (e.g. Elsom-Cook 1991), however, in terms of the educational use of these systems, it is unclear that any progress has been made. The effort in developing the technology has not been matched by a similar concern with the pedagogy. At present it is an article of good faith that multimedia is a good thing for education and training. There is no evidence that multimedia enhances learning, or makes it more cost effective.

The emphasis on these rather artificial exploration and educational aspects of hypermedia and multimedia has obscured other, perhaps more important, applications. Although students do not, as a rule, get urgent desires to examine high definition pictures or watch snippets of video whilst reading books, they do frequently exploit multimedia aspects to improve understanding of the world around them. For example, it is well known that using both visual and audio channels simultaneously to explain a complex diagram is better than using only one channel. It is also true that students use the redundancy offered by multiple channels to improve their understanding of situations, an example being the use of gesture, audio and visual cues whilst taking part in a multi-user conversation. The importance of such cues is illustrated by the fact that tape recordings taken of what were apparently perfectly understandable group meetings turn out to be virtually unintelligible.

Contextual Hypermedia

The following images are taken from a 2nd year CAD option project that was carried out by two students (Jens Meyer and Steve Parnell) using Minicad+ for modelling their design ideas. One can imagine designing an architectural object, focusing on some particular structural component of this object. In observing the generation of drawings for this project, it appears that this design task can be described in a fairly autonomous and self-contained way *(figure 2(a)).*

Next, the presentation of this object requires it to be situated somewhere in a particular, previously designed, context. For example, it will often be necessary to relate an object back to the context outlined in a design brief. This particular example was concerned with the design of a water sculpture in steel, and hence would require the expression of movement of water to/from this construction. There will still perhaps be a number of features of the original object that may be preserved in this new situation. Other design features will need to be adapted to the new context *(figure 2(b)).*

Next, suppose that the focus of attention for further development of this design shifts to the base component of this composite object. One needs a way of focusing upon the new object to be developed within the context of the composite object, resulting in *figure 2(c),* from which *figure 2(d)* can be derived for more detailed design development.

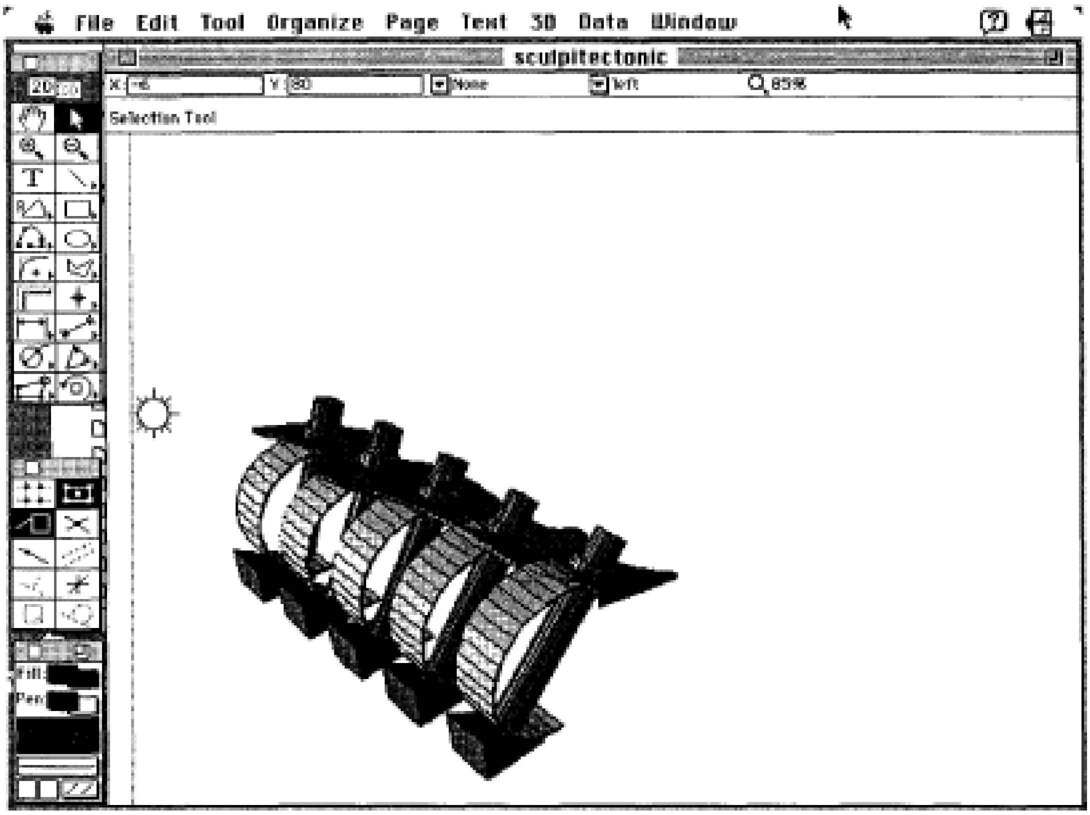


figure 2(a)

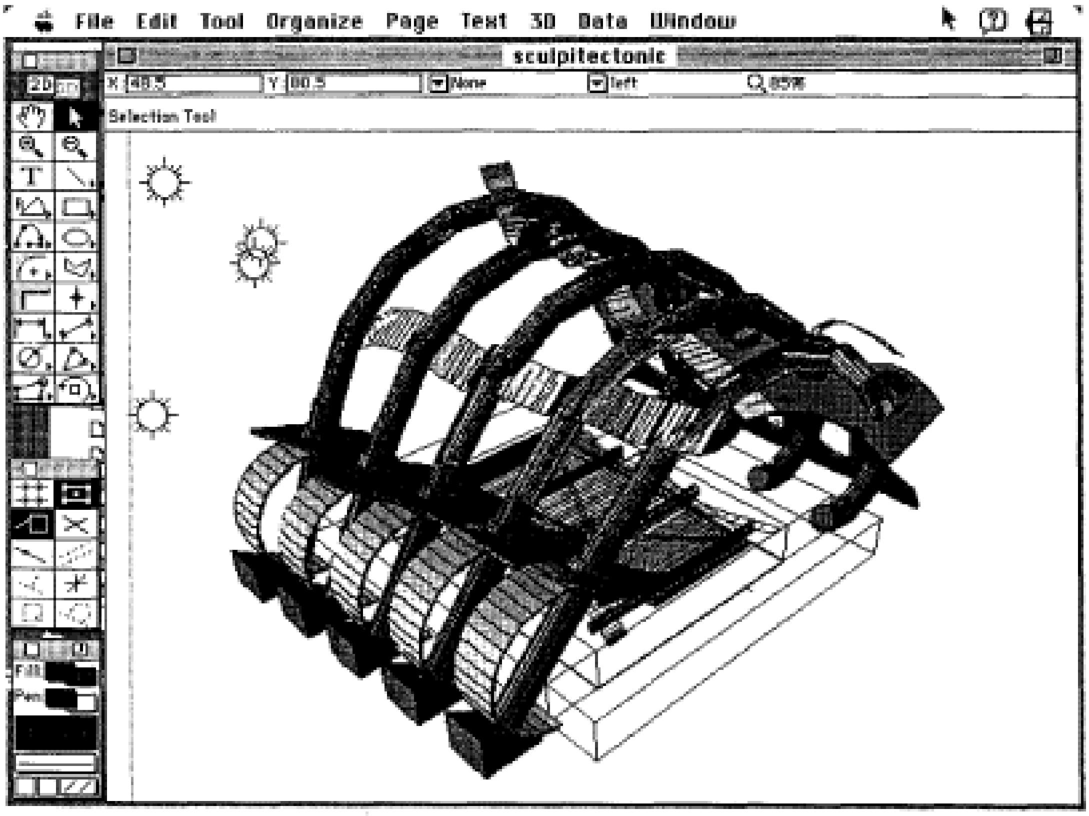


figure 2(b)

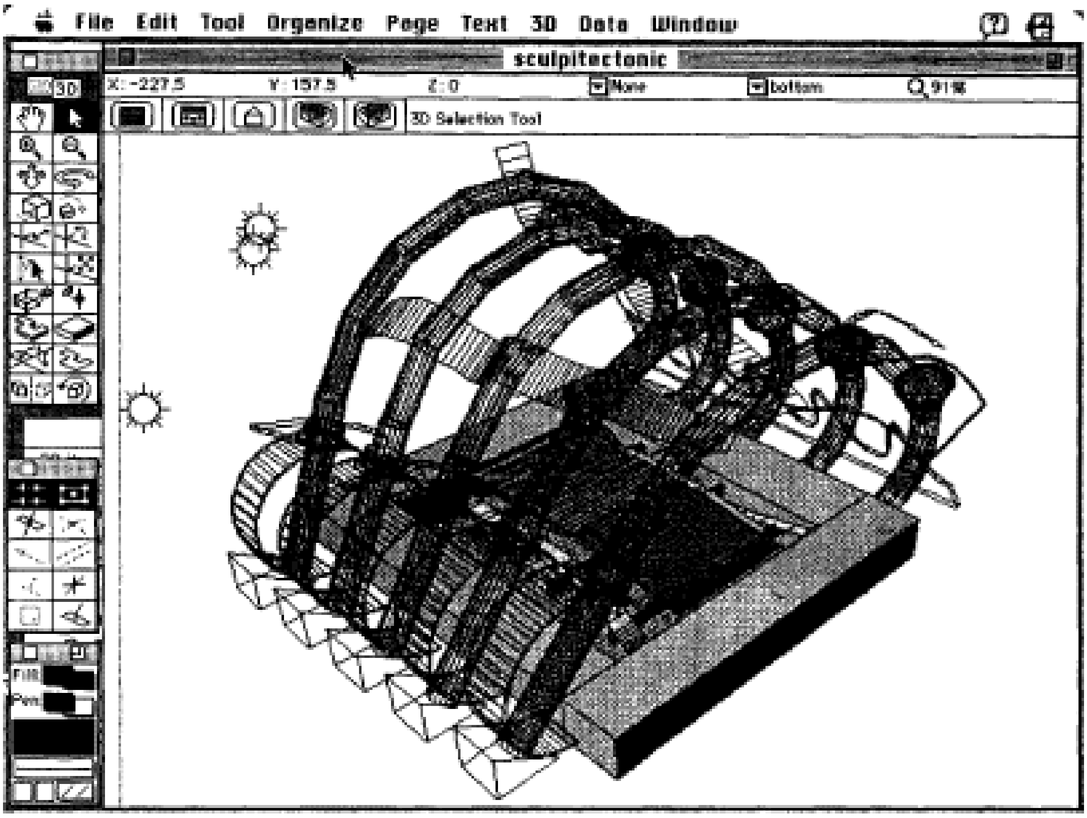


figure 2(c)

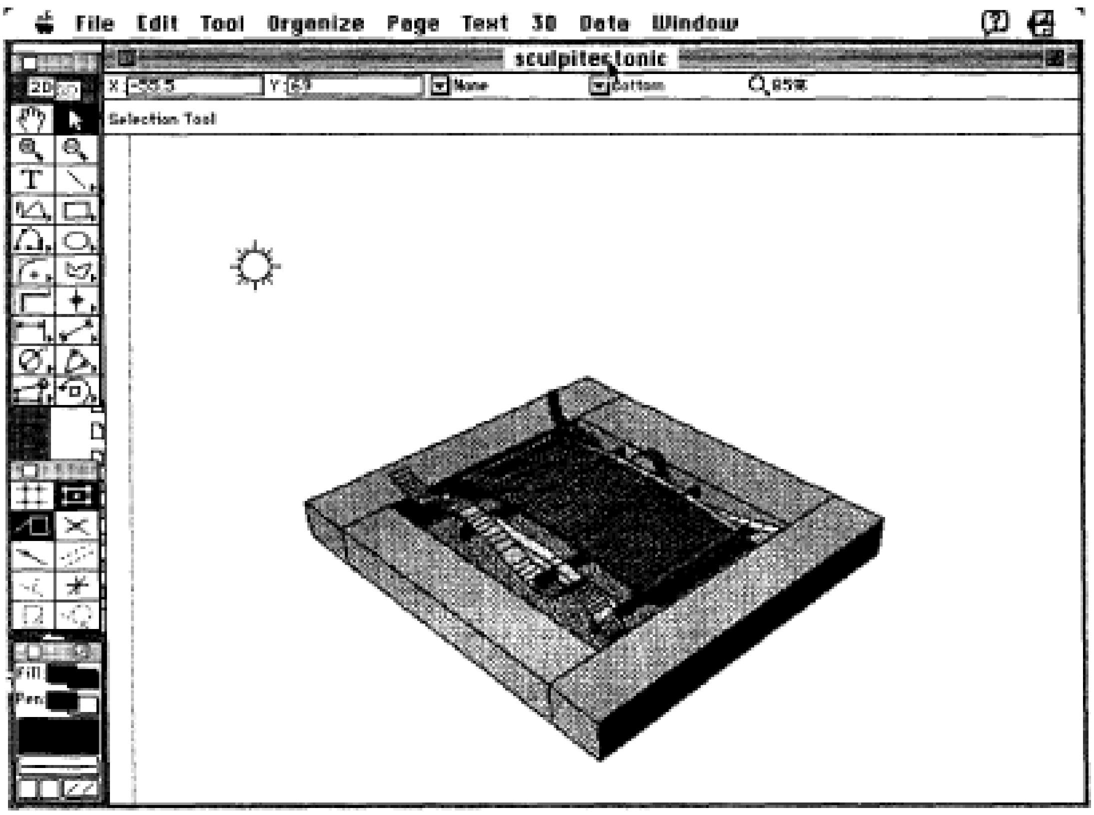


figure 2(d)

In the context of a studio crit situation, none of these illustrations are somehow more significant than any other. No drawing is somehow 'more final' nor is it the 'end product'. What is important in the presentation of project work are the relationships between drawings. In tile absence of a superimposed verbal channel of communication, these relationships could best be expressed textually in a hypermedia environment in which the expression of a detailing context is supported. Indeed, this is just one of the contexts supported by the Hypercard environment referred to earlier. Other contexts include those of design influences, design concepts (e.g. *figure 1*, card 9); various contexts for viewing designs (e.g. animation), and early sketch ideas. The latter context is particularly valuable since some or many sketches may have been rejected in the development of the final design. However, this does not mean that they are unimportant in a crit situation, since the reasons for rejection of proposals are often just as illuminating as the actual adopted proposals, sometimes more so. It is very often this type of information that is missing from crit presentations.

The point of this exercise is just to remind ourselves that design development always evolves within a certain context that also requires expression, and that this context often constrains any presentation in ways that are not usually explicitly thought of. The context of a design object is often likely to depend upon the immediate physical environment, and this is also likely to influence the conceptual ways of thinking about and presenting this object. It seems, therefore, that the cognitive processes involved in design development often exploit tills embedding in the real world.

Conventional hypermedia applications, on the other hand, have been preoccupied with the presentation of strict causal relationships between drawings, often in the form of an idealised sequence of images that bear no relation to the contexts in which the design was actually developed. The technological perspective that is typically adopted by many conventional hypermedia applications, results in the presentation of images as if they were unrelated and independent of design contexts and constraints. By contrast, people reside in the world, they view and reason about the world from a perspective within it, and they interact with the very situations about which they reason. By contextual *hypermedia,* therefore, we mean the development of hypermedia systems when these aspects are taken into consideration. Contextual hypermedia has to do with the fact that design is a situated activity, an activity carried out by people situated in a complex environment about which they reason. The situatedness of design includes effects of context, but it goes beyond context in various ways.

There are both disadvantages and advantages to the situatedness of design. The disadvantages are to do with limitations imposed on the designer, and the enormous complexity of the real world. A student working on a studio design project limited in time, cannot spend too long on it, and has to make sure that it doesn't take up too much of their resources (to what extent do green issues get handled, for example). Furthermore, the complexity of a design task typically far outstrips a student's ability to grasp it. These limitations complicate the design task, and keeping track of them can also complicate design theory, since a host of seemingly non-logical issues arise. This disadvantage was partially responsible for the idealisations away from situatedness in the development of hypermedia systems based upon technological perspectives.

But there is also a positive side to the situatedness of design, a side that has gone under appreciated in the development of hypermedia systems. The example of designing a house by exploiting the supporting environment is analogous to a student presenting their own project work in a context-sensitive hypermedia environment. A contextual hypermedia environment should provide students with many resources that are not available in conventional forms of presentation. Two of these bear special mention.

One obvious advantage of contextual hypermedia is that the environment in which a design is developed, and towed which design thinking is directed, is richly structured and lawlike. It obeys "constraints". Designers can exploit these constraints in countless ways. The other advantage is the fact that designers can control and manipulate their environment, changing it in ways that they cannot change the structures of computer systems. Indeed, this ability to have an effect on the environment is a major motivation for reasoning about it. Controlling the environment and reasoning about it are complimentary activities: the ability to do one enhances our ability to do the other.

It is these positive aspects of contextual hypermedia that are interesting and exciting. It seems that in idealising away from the situatedness of design, we ignore some very powerful properties of design that can be used to good effect by design students, initially for purposes of presentation, and perhaps subsequently for actual design development. But first we need to understand them and to develop hypermedia tools for modelling them. These are not easy tasks, but I think they will be worth the effort.

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A new framework for teaching computer-aided design at the Faculty of Architecture, Delft University of Technology

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Abstract

The paper describes the new organization of computer-aided design courses at the Faculty of Architecture, Delft University of Technology. The main characteristics of the new organization are emphasis on both technical skills and methodical knowledge, and a wide spectrum of subjects and applications distributed in the thematic structure of the first and second years. As a representative of the new courses the paper outlines Schematic Design, the first computer course in the second year.

Introduction

Since the beginning of the 1990's the Faculty of Architecture, Delft University of Technology, is undergoing a radical revision focused mainly on the teaching curriculum. Based on the concept of *problem-based. learning* the new curriculum consists of blocks with a duration of six weeks (six blocks per year). [1] The twelve blocks of the first two years aim at delivering the basics of architectural education in a thematic series. These blocks are taught by a multidisciplinary group of staff members who cater for the full spectrum of knowledge and skills required by the block theme.

Computer-aided design forms a major subject ill the second year, with courses in five of the six blocks. The courses follow the thematic subdivision of the year, beginning with schematic design and ending with visualization and presentation. Starting with the academic year 1993-94 these courses are subdivided into (i) specialized applications such as Cost and structural analysis and (ii) a core of more general design courses given by the Sector Computer-aided Design (Bouwinformatica) under the title "Design representations, design processes". The purpose of this core is to provide not only computer literacy and practical skills but also the methodology of computer-aided design. The core courses are meant as a general introduction that is essential for the indepth understanding of specialized applications and courses and for the relevant and meaningful use of the computer in architectural design. The courses comprising "Design representations, design processes" are:

[1] For a comprehensive overview of the teaching curriculum and of its pertinence to the teaching of computer-aided design see A.H. Bridges, "Computing and problem based learning at Delft University of Technology, Faculty of Architecture". *Proceedings ECAADE´92.*

0 Schematic design
1 Analysis and evaluation
2 Two-dimensional design representations
3 Three-dimensional design representations
4 Visualization and presentation

The courses form an obvious series that starts with the development of a basic design, proceeds with its evaluation, improvement and evaluation, and concludes with the presentation of the results (on-line and hard copy). Designs and analyses produced by the students in one course form the basis for the following course.

The main departure of the 1993-94 curriculum is that tile computer is much more than a new technology for visualization and calculation. "Design representations, design processes" concentrates on the methodological aspects of computer-aided architectural design. Practical skills, i.e., the ability to use computer programs efficiently and effectively, constitute a basic form of computer literacy that is in itself insufficient for a designer who is expected to take decisions on the built environment using computer tools. What is moreover needed is a deeper understanding of the computer and of the way it can complement human perception and human reasoning. The new courses. aim at acquainting students with currently available computer tools and, through these tools and their capabilities, link the potential of the computer with the requirements and necessities of architectural design, thus making the use of' computer-aided design meaningful and relevant to the architectural student. (For a more detailed presentation of the relationships between the computer and architectural design methodology see A. Koutamanis, "On the correlation of design and computational techniques", elsewhere ill this volume.)

The changes in the curriculum are accompanied by changes in the organization and infrastructure of the Faculty. These focus on the function of the *CAD-Atelier,* the central computing facility for teaching purposes. The CAD-Atelier was originally envisaged as a central general-purpose facility that provided the necessary infrastructure for computer courses given by any staff member It soon became clear, however, that tile support the CAD-Atelier should provide was substantially bigger than a smoothly running network, a number of properly functioning computers and correctly installed software. The development and teaching of computer courses required specialist computer knowledge that is generally unavailable in areas other that computer-aided design. Moreover, as courses were given from a perspective other than computer-aided design using the computer as a mere tool, students obtained a fragmented picture of the possibilities and limitations of the computer that missed several important Pieces and in particular a strong cohesive backbone.

"Design representations, design processes", the main series of courses taught in the CAD-Atelier, is conceived as the main ingredient of this backbone. This, together with practical considerations concerning the development of computer- related courses in general, have led to the decision to transform the CAD-Atelier into the teaching laboratory of the Sector Computer-aided Design. The transition of the CAD-Atelier from general to specific also serves as a framework for the re-organization and improved coordination of all computer courses. For this purpose during it transition period the CAD-Atelier is governed by three committees whose. task is to establish a coherent and comprehensive framework for the near future oil the basis of existing courses and resources. The, committee structure aims at ensuring pluriformity in the decision-making around computer-aided design and promotes interaction between the general methodological and technical aspects of design computing and needs or requirements for specific applications.

The first committee is responsible for the current operations of the CAD-Atelier and comprises staff members of the Sector Computer-aided Design technical and managerial staff of the Faculty The activities of this committee concentrate on the organization of teaching in the current academic year and on the improvement of the infrastructure available in the CAD-Atelier. The second committee consists of representatives from all related and attempts to structure a policy concerning computer-aided design in the Faculty. The purpose of this committee is to develop a long-term plan for the future development of computing facilities and computer courses. The third committee is formed out of teaching staff who are currently giving computer courses. The main task of this committee is to improve these courses by integrating the computer tools used in the courses on both conceptual and technical levels.

Schematic design

Schematic design, the first Course of "Design representations, design processes", marks the true beginning of Computer-aided design for the students who, after a general familiarization with the computer and architectural design in the first year, are expected in the second year to design using the computer as their main vehicle. *Schematic design* concentrates on the following themes:

- Familiarization with computer-aided drafting (programs used: AutoCAD 12 and MiniCAD+ 4.0v3).
- Literature research in the early stages of the design process, with particular emphasis on the role of design precedents.
- Correlation of programmatic requirements and schematic designs through the comparison of geometric and topologic representations.
- The structure and meaning of design representations in general and of computer aided design representations in particular.

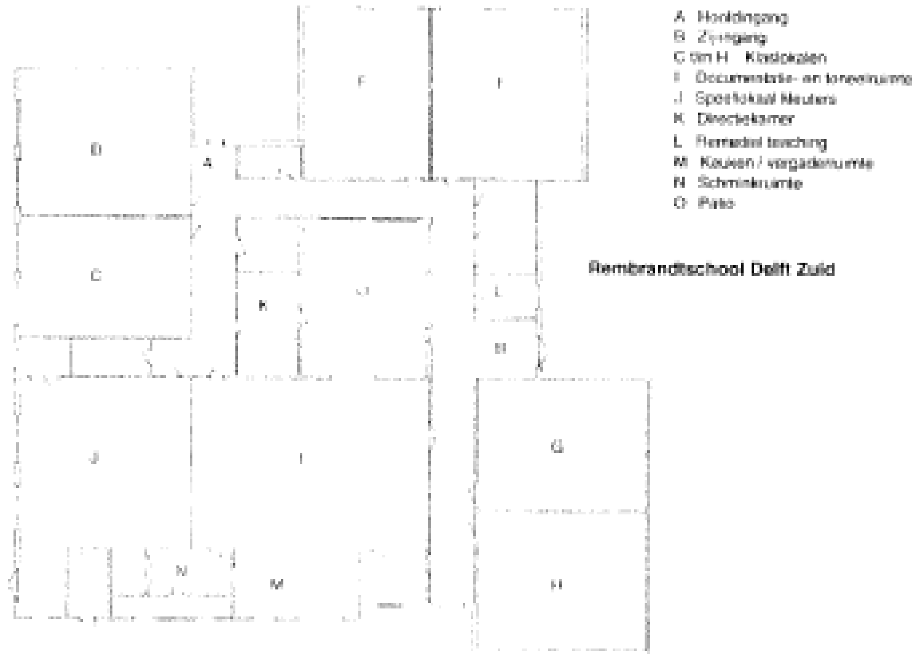
Students are asked to design a new building for an existing elementary school in Delft on the basis of a simplified building programme and a number of precedents. The precedents are:

0 The Open Air School, Amsterdam, by J. Duiker.
1 The Montessori School, Delft, by H. Hertzberger
2 The Agios Dimitrios High School, Athens by T.Ch. Zenetos

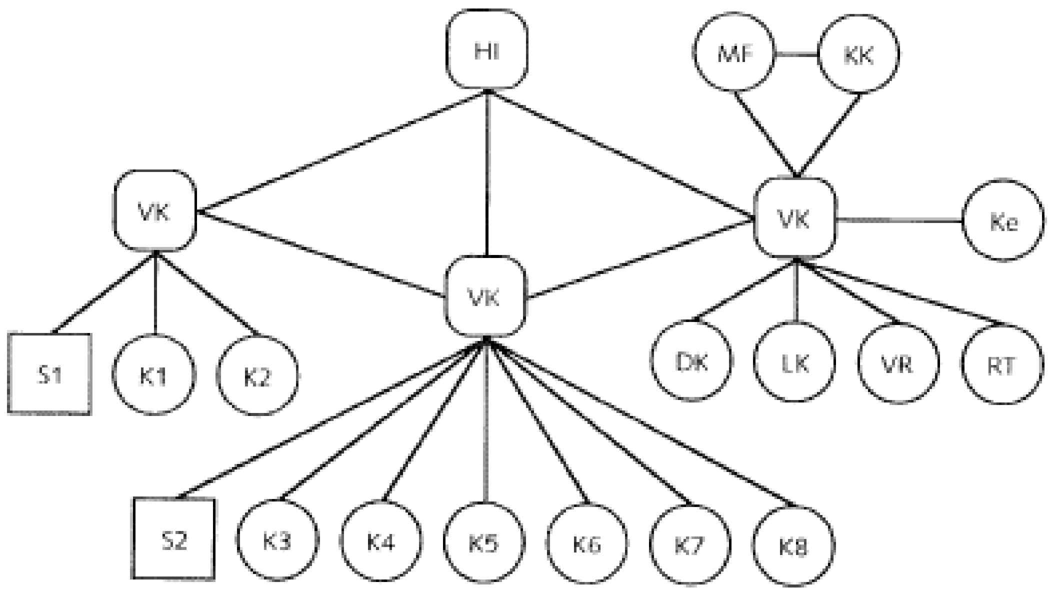
These school buildings represent different approaches to the resolution of similar problems- All three were derived from traditional precedents and attempted, through a transformation of these precedents, a renewal and improvement of the traditional school building type. As the existing building is a rather typical representative of elementary school buildings in The Netherlands, students may also use the existing building as a precedent.

The use of precedents in the course is motivated by the attention paid to precedents in recent research [Gero, 1990; Schmitt, 1993], as well as in traditional architectural theory [Collins, 1971]. In addition as these precedents are supplied to the students as AutoCAD and MiniCAD files, the first contact make with computer-aided drafting is one of meaningful manipulation of design representations rather than the more usual mechanical drawing of geometric shapes.

The building programme is derived from the existing school building with a couple of additions the school actually requires, such as two additional classrooms and a multifunctional space. The following illustrations are of the existing building, the list of spaces ill the flew programme and the required topological relationships between the spaces in the programme file.



HI	Hoofdingang	
K1	Klaslokaal groep 1	40 M2
K2	Klaslokaal groep 2	40 M2
K3	Klaslokaal groep 3	40 m2
K4	Klaslokaal groep 4	40 M2
K5	Klaslokaal groep 5	40 M2
K6	Klaslokaal groep 6	40 M2
K7	Klaslokaal groep 7	40 m2
K8	Klaslokaal groep 8	40 M2
SL	Speellokaal kleuters (groepen 1 & 2)	50 M2
MF	Multifunctionele zaal / gymzaal	180 m2
KK	Kleedkamers en andere hulpruimten voor MF	50 M2
DK	Directickamer	1O M2
LK	Leerkrachten	20 M2
VR	Vergaderruimte	20 M2
RT	Remedial teaching	10 m2
Ke	Keuken	6 m2
S1	Speelplaats kleuters (groepen 1 & 2 -buiten)	
S2	Grote speelplaats (buiten)	
WC	Wc's: 2 per klaslokaal + 2 voor leerkrachten	
VK	Verkeersruimten	



For the design of the new building students, may choose between the following options:

0 Make a totally new design, using the supplied precedents as general knowledge on school buildings.
1 Adapt one of the precedents to the new programmatic requirements.
2 Create a new design out of elements from more than one precedents.

Superficially seen the first option is the easiest of the three. Nevertheless, after studying the supplied precedents students generally realize that starting without a clear central idea of their design is in fact time-consuming and rather dangerous for the quality of the design. Most students therefore choose for either an adaptation of one of the precedents or for a fusion of two precedents. Adaptations remain generally faithful to the spatial organization of the precedents, while fusions are often daring and amusing combinations of, for example, the curvilinear overall organization of the Agios Dimitrios School and the L-shaped classrooms of the Montessori School.

Analysis and evaluation of a design are the subject of subsequent courses in the same year. In *Schematic design* student designs are evaluated merely with respect to the space sizes and space connectivity as indicated in the building programme. Space connectivity is evaluated by means of the superimposition of the above topological representation of the new building on the floor plans produced by the students, in the manner of the dual graph representation [Steadman, 1976, Steadman, 1983].

Future development

Future development of the computer curriculum of the Faculty of Architecture, Delft University of Technology, evolves around the integration of the core courses given in the framework of "Design representations, design processes" with specialized courses that analyse and evaluate a design with respect to e.g. cost, structural stability, climatic performance or circulation. This integration is both technical and conceptual. Technical integration means that representations used in one course should be usable in other courses too. Importing and exporting data currently poses few problems which can nevertheless be irritating and time consuming. More intricate is the active linking of different applications so that the results of an evaluation can automatically modify a design, especially with respect to the structure of a design representation in drafting and modelling programs. The significance of this structure indicates that the conceptual integration of the courses should be the focus of attention: by developing a comprehensive and consistent framework for all aspects of computer-aided design we can expect improvement in the technical integration and, more significantly, improvement in the students' understanding of computer-aided design in general.

Future development of *Schematic design* concentrates on the issues of literature research and programmatic analysis. The four precedents that are currently supplied are a mere substitute of a proper literature research through which the designer identifies not only a larger and more varied number of precedents but also technical and legal documentation. We are currently working on the development of on-line precedent databases that offer extensive retrieval support [Koutamanis and Mitossi, 1992], through which attributes of the precedents (and hence programmatic requirements) can be related to technical and legal specifications. At a later stage we also intend to use automated recognition for inputting and indexing precedents in the database [Koutamanis and Mitossi, 1993; Koutamanis and Mitossi, 1993]. The immediate plans concerning programmatic analysis involve improvement and adaptation of an internally developed cluster analysis programme, through which spaces in a programme can be organized in a topological representation and then automatically matched to precedents in the database.

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