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Balancing Computer Use and Design Content in Studio Projects

Particular design approaches must be taught in order to take advantage of the strengths of computers in design rather than attempting to make computers conform to methods developed as by-products of manual design techniques. For the last three years our team of faculty teaching the second year design studio has been trying different approaches to the use of computers in design, in order to find the advantages and opportunities especially suited to electronic media.

There are several projects during the semester which use computers at different stages of the design process. One of these projects, called "A Spatial Sequence," uses information from a previous project as well as the knowledge from the computer class in parallel to design studio. The project asked students to create spatial archetypes based on the work of well-known architects. They explore the following topics as represented in the work of one particular architect: relationships of major spaces / minor spaces, approach / entry, and transition / threshold. Following the analysis, they create digital models to explore the spaces formed by their archetypes. Before committing to a physical study model, they look at the transitions between spaces by creating a sequence using the digital model and producing a series of shots through the digital model to show the flow of spaces. The use of computer through the process accelerates the options available to explore a sequence of elements, while simultaneously giving them a window to look into the spaces they have created. This hybridized approach of precedent analysis, digital modeling, and physical modeling was uniquely suited to the studio problem.

Comment faire l'équilibre entre l'utilisation de l'ordinateur et le contenu en design dans les projets studio

Des approches bien particulières au processus de conception architecturale doivent être enseignées afin qu'on puisse profiter des points forts de l'ordinateur en conception architecturale; plutôt que de faire en sort que les ordinateurs se conforment aux méthodes développées comme résultat de techniques manuelles de conception. Au cours des trois dernières années, notre équipe de professeurs du studio de design de deuxième année a essayé de différentes approches à l'utilisation de l'ordinateur en design, afin de trouver les avantages et opportunités que présentent les média électroniques.

Au cours d'un semestre, il y a plusieurs projets qui utilisent l'ordinateur lors de différentes étapes du processus de conception. Un de ces projets, nommé 'Une Suite Spatiale', utilise de l'information acquise lors d'un projet précédent, ainsi que des connaissances en informatique provenant d'un cours sur les ordinateurs qui se donnait en même temps que le studio. Durant ce projet, les étudiants devaient créer des archétypes spatiaux basés sur les travaux d'architectes bien connus. Ils examinaient les sujets suivants comme étant représentatifs du travail d'un architect donné: les relations espaces majeures / espaces mineures, approche / entrée, et transition / seuil. Suivant cette analyse, ils ont crée des modèles explorer les espaces formées par leurs archétypes. Avant des'engager pour un modèle d'étude physique, ils ont examiné les transitions entre les espaces en créant une suite utilisant le modèle digital et en produisant une série d'images à travers le modèle digital pour montrer l'enchaînement des espaces. L'utilisation de l'ordinateur au cours de ce processus accélère les options disponibles pour explorer une série d'éléments, tout en donnant une fenêtre pour regarder l'intérieur des espaces crées. Cette approche hybride comprenant l'analyse antérieure, le modèle digital, et le modèle physique, était très bien adaptée au problème présenté lors du studio.

vision

In the afternoon, after having lunch, John goes into his studio class; in which the other three members of his team are waiting. The four students take their laptops and leave for the site on which they are designing a housing project for low-income families. Once at the site they take pictures, using a digital camera, from different angles of the site. These pictures will be converted into image files to be used in the presentation of their solution to the housing problem when they create a 3D model of the buildings they are designing. While at the site they realize that they need some information about the location of different spaces given in the program. Using one of their laptop computers and a modem connected to a cellular phone in their car they send a message to their professor back in studio. The professor gets the message through E-mail and sends the information that they need to complete their site analysis. After returning to the studio and connecting their laptops to the internet, each of the members of the team access image libraries from other universities in France, Denmark, Mexico, and Germany to find projects similar to the one they are designing. With the research done, they can analyze the projects for conceptual ideas to help develop their own. That evening in his dorm, John logs in to the campus network checks his electronic mail; he does a literature search and places a hold on a book that he needs for his environmental analysis class. Since he still has some doubts about some concepts discussed in his morning lecture, he sends them to his structure professor through E-mail.

antecedents: the pre-computer years

The Design Fundamentals course has for years had the over-arching goal of bringing beginning students into the cycle of learning-from-doing in a way that meshes at first with learning processes that they have already mastered in secondary school; and then eventually allows a transition to less familiar ways of knowing.

The initial projects of the semester familiarize students with the vocabulary basic to all design fields. Then two sequential projects introduce students to ways of analyzing and understanding design work done by others. These exercises, which depend upon the vocabulary introduced in early projects, are meant to provide models for the students' own design processes and attempts at self-criticism. "Analysis of Precedent" requires the study of the work of a renowned architect, and the organization of a coherent visual analysis. To quote from one of the required texts for this problem:

> "The intentions are to assist the understanding of architectural history, to examine the basic similarities and differences of architects' designs over time, to identify generic solutions to design problems which transcend style, and to develop analysis as a tool for design. Of importance is the development of a vehicle for the discussion of design ideas through the use of example (Clark and Pause, 1996).

Each student chooses a building from a list provided by the instructor and works through the available drawings and photographs to form a set of diagrams that describe the place in terms of the design principles with which they are already familiar, as well as in terms of organizational, structural, and conceptual issues. They learn to communicate the important ideas and salient features of a building. They learn to look at the integral components of a building as well as at the building as a whole. The learning-by-doing exercise of preparing the diagrams from raw materials causes the analysis process to register with students in a way that can have permanent implications on their own design processes. The analysis skill of generalizing from a specific example allows them to later develop specific original ideas from a general diagram. They also learn a design strategy of decomposing a complex problem into smaller problems, solving the small problems, and recomposing the small solutions into an overall resolution.

"A Spatial Sequence" asks students to extend their understanding of one building to encompass the entire body of the chosen architect's work. Before the integration of the computer into the Design Fundamentals studio, students were required to construct three-dimensional study models of spatial events typified by the architect's work and present them with an annotated catalogue of the actual built examples. After this typology study was completed, students assembled a spatial sequence in the manner of the designer they had studied. The

emphasis was on the awareness and understanding of the ways in which various architects choreograph human movement through space. Students searched an architect's work for examples of major / minor space relationships, approach / entry spaces, and transition / threshold spaces. Through drawing and model building, these spatial events were documented and catalogued, thus bringing them into the students' own working vocabularies for consideration during their own design efforts. The formal issues of axis, circulation, spatial hierarchy, and spatial organization illustrated two-dimensionally in "Analysis of Precedent" along with the examples of sequences of space were brought to three-dimensional life as students physically interpret and construct the study models. The models were then be used to mock up various "new" spatial sequences as students composed in the manner of the master they had studied. The creative exercise that culminates "A Spatial Sequence" made the link between the learning and the doing, by asking students to use what they had absorbed in an original way.

When "A Spatial Sequence" was accomplished by handcraft alone, the students gained experience in building study models and sketching perspectival space from plans, sections, and their imaginations. Despite the value of learning to commit one's imagination to paper, there were many frustrations involved in this process. The first efforts at perspective drawings yielded distorted views of spaces with inaccurate proportions and barren context. Very often the limited time for the project did not allow for careful reworking of perspective drawings until the space portrayed finally resembled the design intentions. Missing from the students' repertoire of skills was a way to swiftly "look" at the spaces they created in order to revise the sequence as part of the design investigation. Usually their first attempt at designing a spatial sequence was the version they turned in for review. Another frustration was the inability to change scale as they worked in study model form. Once committed to a certain scale, all the models had to cleave to that decision, or the sequence appeared to be some assemblage of spaces that grew and shrank like Alice in "Through the Looking Glass". These limitations have been part of the learning process for ages, and are, arguably, necessary steps in the

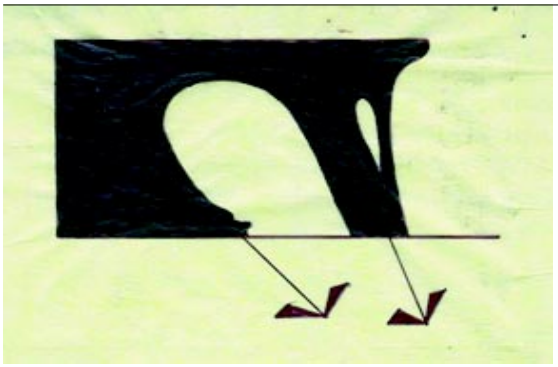

Figure 1. Diagram of Gaudi's Parque Guell (threshold).

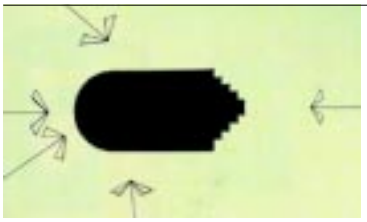

Figure 2. Diagram of Gaudi's Parque Guell (approach).

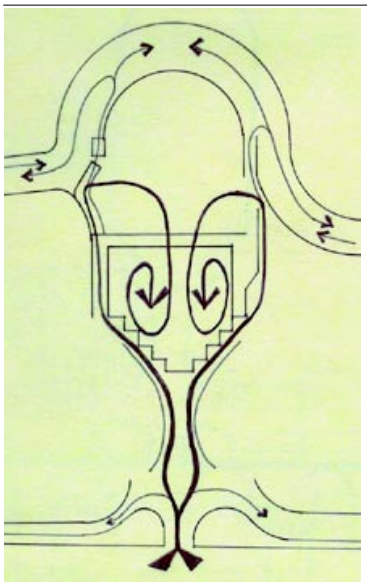

Figure 3. Diagram of Gaudi's Parque Guell (connection between spaces).

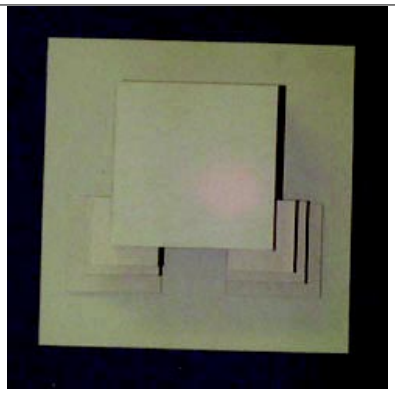

Figure 4. Archetype model (approach).

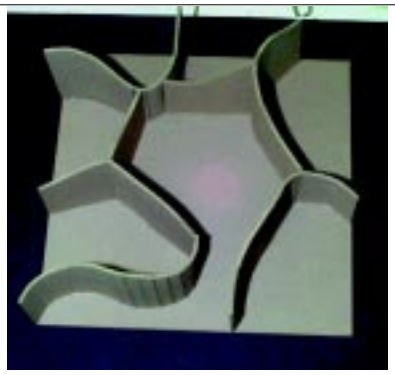

Figure 5. Archetype model (major to minor space relationship).

Figure 6 .Archetype model (threshold).

cycle of learning-from-doing.

antecedents: the computer years

In the spring of 1995 the College of Architecture was given approval from the Board of Regents to require incoming professional phase students to bring their own computer. In the fall of the same year three of our faculty were awarded a $150,00 grant to support the connectivity and peripherals needed for students to work in the studios with their own computers. This approval, along with the grant, has generated a series of challenges no one envisioned at the time.

One of the first challenges was to decide what software would be employed in the computer class as well as in the design studio for the first group of students arriving at our door steps with a $2,400 tool (that some of them had never used). Negotiations with different companies resulted in exceptionally low prices on software packages for students to draw and model their design ideas.

At this point in time we had not considered the studio assignments and the computer support. We designed the studio projects to comply with the goals of the semester and the students were supposed to use their new tools to produce what traditionally had been produced in studio. The results were not very accomplished due to the fact that several of the students had never used the computer software we selected for them. The learning curve and application of the software packages to the design problems were quite long versus using the traditional methods of communicating design ideas. It was at the same time very frustrating for the students to get feedback from faculty, who did not understand the use of computers in studio and did not yet feel the impetus to learn new ways of communication.

By the summer of 1996, the Design Fundamentals team assembled to teach the first semester studio for the incoming professional phase students. The team worked very hard creating a series of design problems in coordination with one of the members who taught the computer class parallel to studio during that semester. At this point, having the computer instructor as part of the team in the design studio was crucial. The results were very

promising, but the students were still having problems learning the software. The sophistication and strength of the software learned in the computer class made it hard for the students to apply it right away to their design problems. Students knew they could accomplish some of the tasks required in studio, but it was hard to figure out how.

After evaluating the fall semester studio and making some decisions for the following fall, the faculty evaluated different software packages accessible to students in cost and with the desired tools to support the assignments designed for the fall semester design studio. Deciding the assignments far in advance and coordinating with the computer class instructor has become an essential part of the working formula. Another piece of the puzzle, which has become very important, is the scheduling of the introduction of the software packages in the computer class ahead of the assignment that will use the application in the design studio.

To understand how the process has worked, the following case study will introduce the different steps for one of the studio assignments.

case study

As with the previous incarnation of this exercise, the pedagogical goals for this project were to broaden the students' knowledge of the work of a well-known architect and use this knowledge to understand spatial typologies. Once again, they were asked to revisit the work of the architect they had studied in the Analysis of Precedent exercise. They searched for concrete examples of such abstract spatial events as "transition," threshold," "approach," "entry," and "major / minor space relationships". Diagrams were produced to translate the concrete examples found in the architects' work to simplified drawings that described the essence of each spatial event (Figures 1-3). From the abstracted diagrams, students then produced small study models of each spatial archetype, and compared them with the spatial devices used by all other architects studied (Figures 4-6).

About one month before this exercise began, students were introduced to the fundamentals of Form-Z three-dimensional modeling software, and

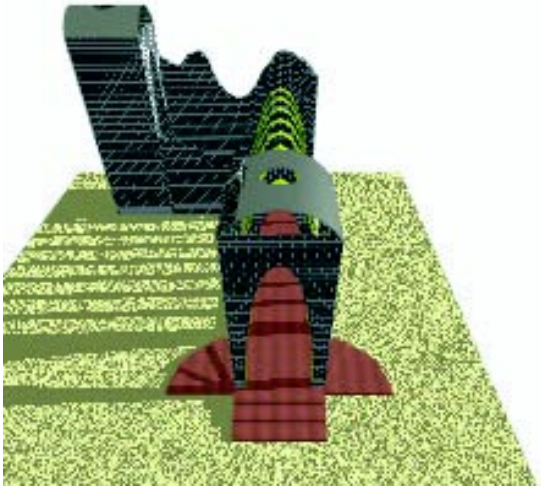

Figure 7. Perspective view of digital model (overall model).

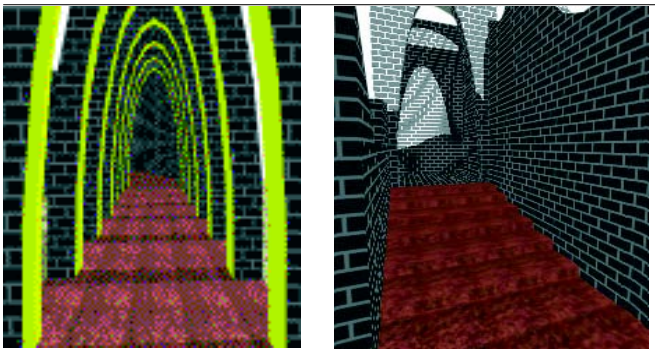

Figure 8,9. Perspective view of digital model (transition / threshold, and end of sequence).

Figure 10. Space sequence animation.

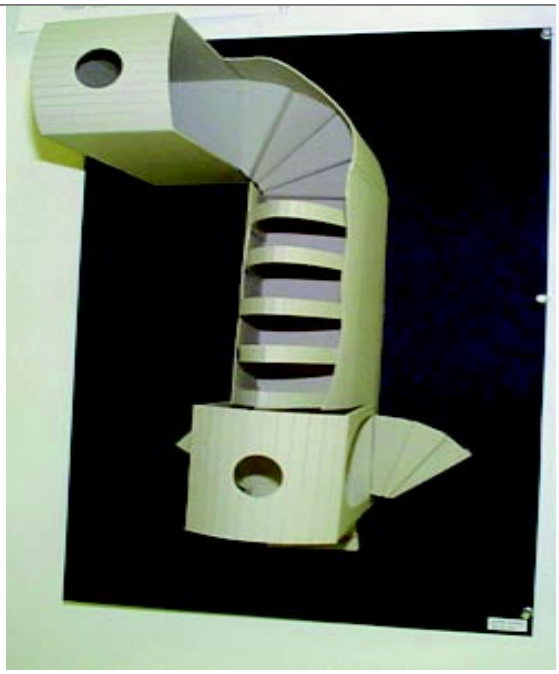

Figure 11. Physical model interpretation of the virtual model.

had built up some expertise through practice exercises in the companion computer class. A week before this exercise began; they were introduced to a method for manipulating the cone of vision in a perspective view of three-dimensional models. This enabled them to build digital three-dimensional models that resembled their physical study models and link them together. Using this method, the students created a series of shots from different points of view within the digital model they created for their Design Studio assignment to study the sequence of spaces (Figures 7-9). The process of linking the spatial events was guided by the directive to begin with an entry / approach event, continued with a transition / threshold event, and used a major space as the culmination.

Through this exercise, the students began to make decisions about the assembly of spatial archetypes into a coherent and meaningful sequence (Figure 10) As with the physical models, the digital models allowed them to try and tes.t their ideas rapidly by interchanging the order of the pieces. But the digital models had the advantage of being able to be replicated, changed in scale, and rendered to suggest materials and light qualities that were in the mind's eye. This accelerated the exploration process and enhanced the creativity brought to the project, as the students became enamored of their own work.

The excitement that grew within the studio / computer lab collaboration caused these students to work longer and harder on this exercise than previous groups had. The tangibility of the spatial sequences that were brought to life with the three dimensional modeling led to further development of ideas about light, materials and lived experience (Figure 11). The requirement of building a linked set of views for the computer class assignment also drove the necessity for new computer skills and cemented their development. When the digital images were printed out and used as components of the physical presentation for the studio review, the level of the graphic presentation was observed to be much higher than with previous student groups. Therefore, the studio assignment and computer lab assignment worked simultaneously to build new skill sets and new design process ideas. The mutual benefit of the collaboration

was obvious to the faculty studio team (Figures 12-13).

conclusion

It has become very evident that to bring computer skills into the design process of studio, the faculty generating these studio assignments must understand from the beginning how the computer and software application will interact with the assignment. The goals of the assignment will establish the use of computers to enhance the traditional methods of solving problems in the studio environment. For the case study illustrated here, traditional problem solving methods included: learning to communicate the important ideas and salient features of a building, learning to look at the integral components of a building as well as at the building as a whole, documenting and cataloguing spatial events, gaining experience in building study models and sketching perspectival space from plans, sections, and their imaginations. Computer enhanced problem solving methods included: manipulating the cone of vision in a perspective view of three-dimensional models (thus enabling them to build digital three-dimensional models that resembled their physical study models and link them together), visualizing the virtual space and moving through it, maintaining a consistent eye-level as they moved through the virtual model, and making the intellectual translation from a virtual model to a physical presentation model at an architectural scale.

The coordination with a support course, if any, has to be established in a timely manner. The benefits of the collaboration have to be for both classes; one supporting the other and utilizing the same base material. It is also useful, although not imperative, to have the same faculty involved in the studio as in the computer course. The continuity of thought, the confluence of goals, and the creation of challenging projects are best achieved with faculty who can participate in the realms of both the studio and the computer lab.

references

1 Clark, Roger H. and Pause, Michael, 1996. *Precedents in Architecture*. New York, NY: Van Nostrand Reinhold, p. i.

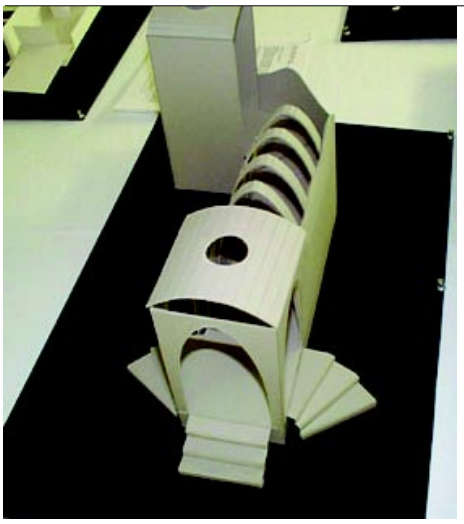

Figure 12. Final presentation model.

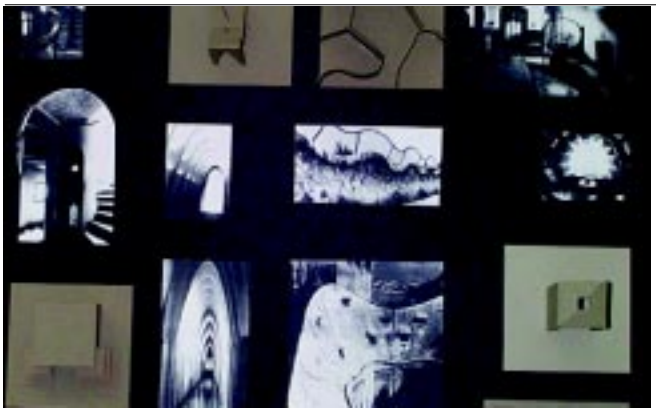

Figure 13. Final presentation board.