Virtual Design Studio: Multiplying Time: 3 x 8 = 24 hours

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This paper describes a Virtual Design Studio exercise involving three academic institutions—University of Hong Kong, Swiss Federal Institute of Technology in Zürich, and University of Washington in Seattle—whereby teachers and students, obviously on three different continents and in three different time zones, roughly eight hours apart, tried to "multiply time".

Students were asked to design a house for a Chinese painter and a Swiss writer on a small island in Puget Sound near Seattle. In a short and intensive design charrette, students explored in five different phases various dualities associated with the given design problem. In each phase students were asked to select someone else's design, thus implicitly forming design teams.

The paper describes the structure and goals of the studio exercise, the methodologies applied, the resulting design processes, and the lessons learned.

NOTE : A similar paper was submitted for presentation to ACADIA 1998 and ECAADE 1998 Conferences.

Introduction

With increasing globalization and specialization in the design and building industry, collaboration between partners in remote locations becomes crucial. Ideally, all of them could work on a building design at any place, simultaneously together (synchronously) or separately (asynchronously), while the latest state of the design would always be available to all team members. They could collaborate on a shared object and no information would thus be lost in transfer of project data.

As a result of these trends, the working environment and infrastructure in large architecture, engineering and construction (AEC) firms is changing dramatically. Computer supported communication and collaboration are no longer mere possibilities, but, given the will and know-how of the participating partners, a reality. What was first achieved in mid-1990s at universities and large AEC firms such as Norman Forster and Partners and Ove Arup and Associates, is now in the reach of small and medium size firms with access to the Internet. But in order to be successful, this type of cooperation requires new design and communication methods (Wojtowicz 1994, Schmitt 1996). This paper describes one possible approach.

Multiplying Time

The Virtual Design Studio (VDS) exercise described in this paper was a collaborative effort of three academic institutions—University of Hong Kong, Swiss Federal Institute of Technology in Zürich, and University of Washington in Seattle—whereby teachers and students, obviously on three different continents and in three different time zones, roughly eight hours apart, tried to "multiply time." [The term "Virtual Design Studio" was used for the first time and defined by William Mitchell in his talk at MIT's Media Lab in early 1993, as reported by Wojtowicz (1994). Early Virtual Design Studio experiments date back to the early 1990's, when typical applications were the collaborative work on design problems and the presentation and critique of a project through the network (Wojtowicz 1994, Lee 1998).]

The "Multiplying Time" project allowed the continuous work on a design or a set of designs through three different time zones around the world. The time difference between Hong Kong, Zürich, and Seattle - on the average eight hours each - was used to expand one working day period to a twenty four hour period, thus expanding one week of exercises to three weeks of design (see figure 1). Each day, there were video conferences between students and faculty at the places involved.

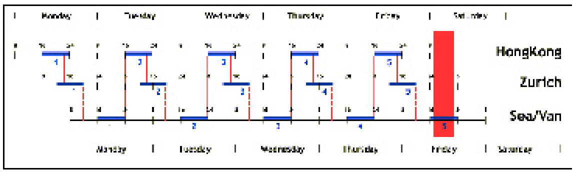

Fig.1
The 24-hour design cycle.

On the morning of the first day, students in Hong Kong started with the design. At the end of their 8-hour working day, they placed the results in the common database that could be seen by all partners through the browser interface. Students from Zürich began 8 hours later and could thus base their decisions on the results achieved by their Hong Kong partners. After 8 hours, they also placed their designs in the common database, so that the participants from Seattle were able to explore the designs from Zürich and Hong Kong by the time they started to work. In addition, video conferences took place about every 8 hours, during which students could share and explain their ideas. The setup thus created an intense global think-tank, operating 24 hours a day.

Every day a new phase was introduced along with a new design issue. In each phase, students could select a design to develop further from any of the three locations. On the last day, a video conference between all three locations took place for the evaluation of the final design proposals. Authors and critics discussed the individual designs and observed the design threads. Students from the three locations noticed that, although they had not known each other before, they found a common language to communicate. The basis for this language were the modeling program (Sculptor) and the individual designs. [Sculptor is a program developed by David Kurmann at ETH Zürich to support the early conceptual phase of object and architectural design (Kurmann 1997). It allows intuitive interaction with a virtual model and is based on known concepts and mechanisms of spatial composition and recognition. Sculptor offers the opportunity to model with spatial elements, or voids. Such negative volumes that create a void when intersected with a solid, can be manipulated and moved in the same manner as solids. Solids and voids have the same data structure. The interactive real time intersection of positive and negative volumes supports the direct composition of spaces.

The Project

Students at each school were asked to design a house for a young couple, a Chinese painter and a Swiss writer, on a small island in Puget Sound near Seattle. This way an element from each environment (China, Switzerland, USA) was present in the design brief, bringing into design the cultural similarities and differences present in the given geographic and temporal triangle.

The schedule of accommodation describing both living and working quarters was given with an additional requirement that the volume of the house must be recognizable as a cube of 12 x 12 x 12 meters (40 x 40 x 40 feet). The project brief required that all spaces and openings be “carved” out from the basic cubic volume.

The project was divided into *five* different phases each focused on different *dualities* associated with the given design problem. First, they investigated two principal dualities that permeate the clients’ lives: one is cultural—she is Chinese, he is Swiss, and they live in the United States; the second one is vocational—she deals with images and he deals with words. Next, students explored dualities associated with the building itself: solid and void, light and shadow, and material and immaterial. Finally, students investigated the relationship of the space and the place, that is, the relationship of the building and the site.

In Phase ONE of this project, we asked students to explore dualities evident in the design brief, and translate one or more of those dualities into an abstract 3D model, which did not have to resemble an architectural form (see figure 2). There were obvious cultural, ethnic, and vocational dualities associated with clients that students could investigate. There were also physical dualities associated with the site itself, such as liquid (water) and hard (rock), transparent and solid, reflective and diffuse, bound (island) and open (sea), etc. Then, there were dualities associated with the building itself, such as solid and void, light and shadow, and material and immaterial, etc.

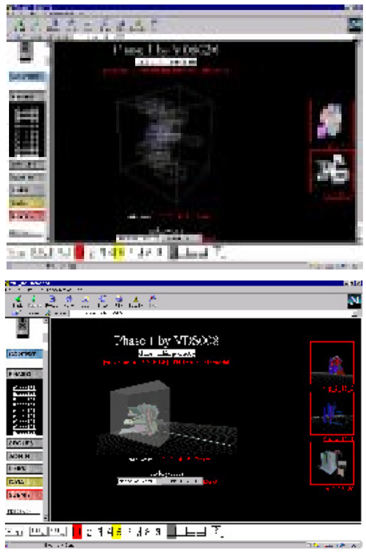

Fig.2 Abstract 3D models produced in Phase ONE.

In Phase TWO, titled “Solid and Void”, students had to actually design a house as an expression of the chosen duality (or dualities). They used Sculptor to create a 3D model of the house based on solids and voids that correspond to the programmatic requirements of the design brief (see figure 3).

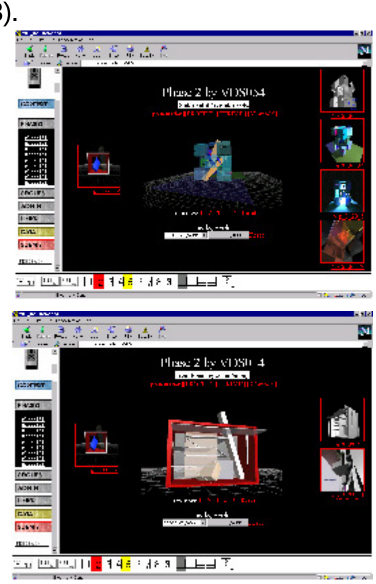

Fig.3 Conceptual designs created in Phase TWO.

In Phase THREE, "Light and Shadow", we asked each student to illuminate a 3D model of the selected house, and consider the effects of color, light intensity, transparency, translucency, and reflectivity. We asked students to explore dualities such as light and dark (shadow), transparent and opaque, reflective and matte, curved and flat, open and closed, wide and narrow, short and long, deep and shallow, and how they relate to our perception of space; in other words, we asked students to explore how created volumes (forms) interact with light (see figure 4). In this phase, students could, if necessary, make changes to the building model, such as the location, shape, size, or the number of the openings.

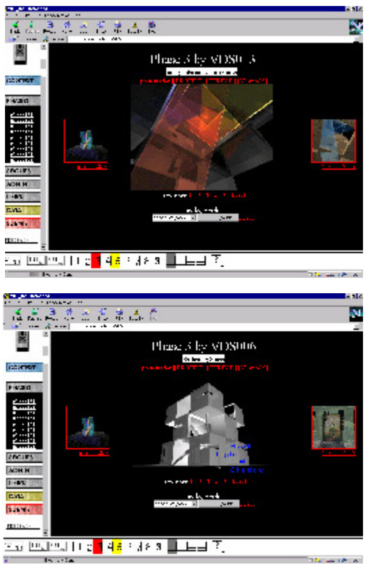

Fig.4 Images exploring illumination of created volumes/spaces produced in Phase THREE.

In Phase FOUR, "Material and Immaterial", students investigated how different materials, such as glass (clear, sand-blasted etc.), stainless steel, wood, stone, copper, concrete, brick, etc., affect our perception (the immaterial) of various spaces, as surfaces reflect, absorb, and transmit light (see figure 5). In this phase, students explored dualities such as bright and dark, transparent and opaque, reflective and matte, rough and smooth, liquid and solid, and how they relate to our perception of space; in other words, they explored how various materials interact with light to create environments conducive for acts such as painting, writing, reading, exhibiting, meditating, etc.

Fig. 5.Images produced in Phase FOUR.

In the last phase, titled "Space and Place", students explored the links between the house and the site: vistas, sun angles, access. They examined dualities associated with the site, such as liquid (water) and hard (rock), transparent and solid, reflective and diffuse, bound (island) and open (sea), and explored whether and how they relate to the location and orientation of the house (see figure 6).

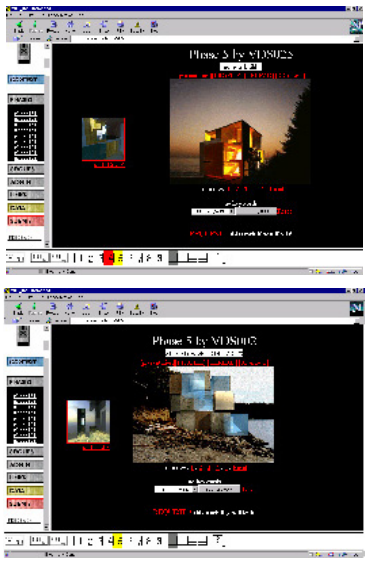

Fig.6 Situating the house on the site, Phase FIVE.

The Process

For this Virtual Design Studio (VDS) exercise, we developed several alternatives to the conventional approach used in collaborative architectural design. Three major differences to conventional approaches that we had implemented were:

- The center of attention in our VDS was not the group of collaborating people, but the common design project. It is supported by the database and appears as the same, virtual project to all participants. Spatial separation of the design partners objectifies collaboration and focuses on the project, rather than on idiosyncratic behavior.
- Authorship in extensive collaborative projects is often an issue of conflict. We therefore proposed to bundle individual authorship into a common design, and to trace the individual contributions using the database.
- Students were not simply encouraged to look at each other's work—they were required to select the work of another participant at the beginning of each project phase.

At the end of each phase students submitted their work into a MSQL database environment accessible through a web browser interface and located at a server in Zürich, at ETH. Students had to submit 3D models (in Sculptor and VRML format) and text and images to explain the principal ideas. All presentations had the same format. Students had to first upload the model and image files to the server, and then create a presentation using predefined HTML templates available on the VDS-server at ETH. There was no limit to the number of pages that students could include in presentations. A graphical representation of the work became visible immediately after it had been submitted. [The core of this setup has been developed to support an CAAD course at ETH Zürich called *Phase(x)* (Wenz and Hirschberg 1997). In that course the database system was used to browse through and exchange models of abstract formal exercises in geometric modeling. For this VDS the system was extended to allow the presentation of design content in a more flexible way. In addition to submitting the models of their designs, students could also use an unlimited number of template pages to make a presentation of design goals using text, sketches, and additional images, as they felt appropriate. The basic idea behind this *phase(x) setup* (as we've come to call it) was to shift attention from the authors to the individual project.]

After each phase, students selected the best work they could find in the previous phase by browsing through the database (students were not allowed to continue with their own design). To facilitate the selection process for each phase, we asked students to select a single most illustrative text statement and image as a "title-page" for their design when submitting the files for each phase. The selected image was used to represent each design in iconic form, and the text (maximum 60 words) had to capture the essence of the design. [An early predecessor to this system was the *Digital Pinup Board* (Wojtowicz 1994), the name given to a "networked environment where a group of designers could post, retrieve and edit their design notions leading toward a common project." Similarly to the *Phase(x)* setup, textual descriptions, 3D models, and rendered images were placed in the *Digital Pinup Board* for "all to examine and share at will."]

Since in each phase students had to select someone else's design, they implicitly formed design teams. They could contact authors of the selected design and inquire about their design intentions in each phase. Another implication of the selection process is that after each phase only the best designs were chosen by the students for further development. That way a continuous evolution of the best designs was highly probable. Students progressively refined the selected designs in each phase. The final results were design projects with shared authorship that could be traced back to the contributing authors and co-authors using the *thread* function. In this process, the authorship was not a question, as the contribution of all people involved in the design in terms of time and model was recorded in the database. Such treatment of the authorship is only possible in a networked, cooperative design environment.

Genealogy of Designs

The design process was intentionally discontinuous. It was comprised of five distinct, successive "reading" and "writing" sessions whereby each student had to "read" another student's design and then "write" his or her own design. Several students could "read" the same source, could have different interpretations of it, and thus could developed very different "writings." As a result, a hierarchical structure, a genealogy of designs—a genetic tree, depicting this discontinuous design development was constructed and recorded in a database.

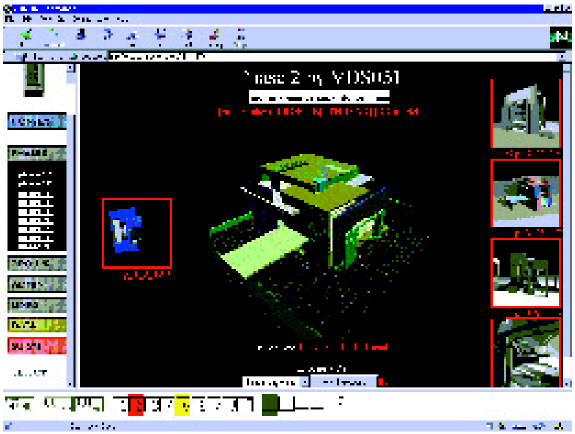

Fig. 7 In each phase, the parent (the precedent) and the children (the descendants) of each design are shown.

The database acted as a memory of the individual designs and it made them available in real time. In each phase students were able to see the direct vicinity of the selected design: its parent and its children (see figure 7). In addition to single project/single phase view, the database permits overall views of the projects and their relationships. Users could choose to see the projects ordered by genealogy and author (see figure 8), authors and connections, authors and connections and time, and genealogy, author and quality. They can study the development of each of the designs; they can study the time it took to generate a specific design; they can also have a quick overview of the work of an individual designer.

The approach we selected also introduced the notion of memes to design. British scientist Richard Dawkins first suggested in his book "The Selfish Gene" (Dawkins 1976) that cultural evolution is based on similar mechanisms as biological evolution. Ideas or memes, as the smallest units of memetic evolution tend to replicate by separating themselves from their authors and being picked up by the public. The Phase(x) setup tries to apply this theory to architectural content. By splitting a rather complex design process into clearly defined units (the phases), compatible memes are generated. [We see memes as an analogy to genes that contain crucial information for the replication and development of organisms. We assume that a design contains memes that have different qualities: they may be strong, so a design is chosen by many others for further development in the next phase; they may be strong and sustainable, so they influence not only the next but also the following design stages.] The memes are stripped from their authors by being placed into the public realm of the database and can then be copied as digital files by the next author without loss of substance. The attention is focused on how ideas develop under the hands of changing authors, rather than by any single author; the Phase(x) replaces single authorship through collective authorship because all relations between works, authors and timeline are recorded in the database and can be rendered and evaluated.

The database also provides partial encapsulation and a partial record of inheritance. In his reflections on a seminal VDS conducted in 1993 between the University of Hong Kong, University of British Columbia, Washington University, MIT and Harvard, Renato Garcia (1994) proposed Object Oriented Programming as a suitable paradigm for the process of that VDS project, and suggested encapsulation, inheritance, and polymorphism as useful guides. By encapsulating each design submission in the same format in each of the five project phases, integrity of disseminated information was assured. In each phase newly developed designs (children) inherited some, if not most, of the characteristics of the design selected in the previous phase (the parent). The results of design modifications (mutations) which took place from phase to phase were recorded by the database, but not the character or the sequence of modifications. *Polymorphism,* the third property of 'objects' was also not implemented. If we were able to somehow encode and record the modifications in the database, then it would mean that if any change were applied to any of the designs (in any phase), the 'children' could have been modified too.

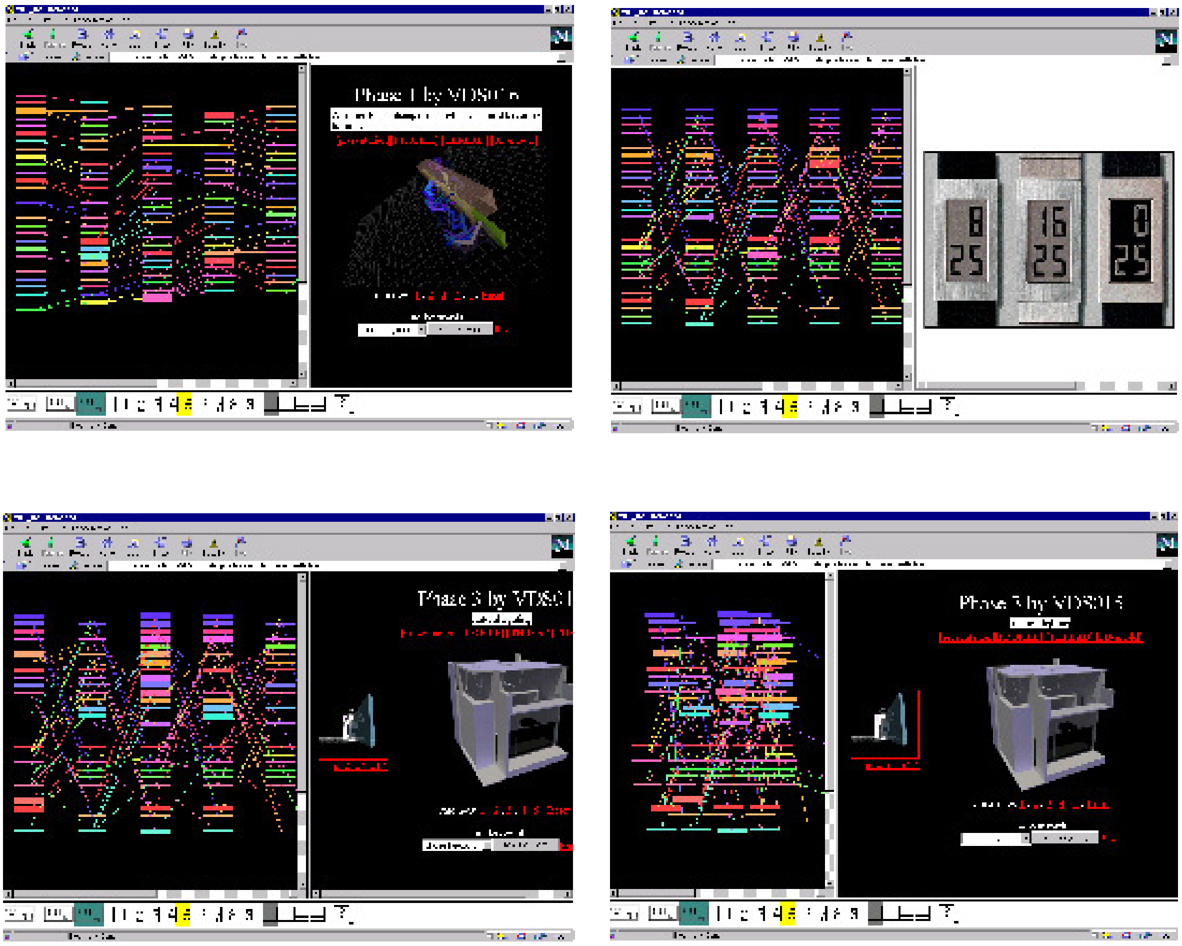

Fig. 8 (8a - 8b). Four views of the same database. Projects ordered by genealogy and author (top left), authors and connections (top right), authors and connections and time (below left), and genealogy, author and quality (below right).

Conclusions

The Multiplying Time experiment demonstrates that it is possible to work from a common database, taking advantage of different time zones and special capabilities of particular sites: Seattle provided the site, Hong Kong the first design models, Zürich the modeling program. The resulting designs are of shared authorship, but the individual contributions are clearly identifiable, along with the evolution of the design.

The notion of shared authorship had important implications for the design process. As Wojtowicz (1994) observed in a somewhat similar VDS experiment conducted in 1993, "designer privacy is breached […] a designer has to give up the privacy protecting his or her own design process and at the same time is exposed to a surrounding context […] which is constantly modified by other members." Surprisingly, in our experiment, the fact that no individual ownership of a design is possible seems not to pose a problem to anyone. Perhaps this is due to the difference in nature between the university environment and professional practice, and that the designs were abstract and of short duration. Yet the people we asked could imagine working in practice under similar conditions. Therefore, such an approach might be a strong hint to a possible future AEC working environment. The premise was that the development of a new design and collaboration environment, along with a new collaboration method, could result in a breakthrough of productivity and quality.

The results from all experiments show, that by solving the question of authorship in displaying each person's contribution in the data base and in different visualization schemes, there is much less competition of the negative kind between designers. In such an environment, designers are able and willing to choose and continue to develop the best solutions, rather than continuing on their own, sometimes weaker, solutions. The results of our VDS provide strong indications that this type of collaborative environment could bring an improvement to project development and to project management as well.

As with all experimental projects, there were difficulties—some technical, some cultural, and some temporal. Scheduling the VDS was a challenge, both in the macro sense (the week chosen for the VDS overlapped the Thanksgiving holiday in the U.S.) and the micro (the 8-hour time differentials between participants made it challenging to hold video conferences between participants that weren't in the middle of somebody's night). The pace of the overall project was such that many architectural concerns received only passing attention; there were limited opportunities to communicate with the authors of a previous phase's work. Finally, even with the best of intents and careful scheduling, the vagaries of Internet communications occasionally hampered some connections, while others worked quite well.

Acknowledgments

The Virtual Design Studio project described in this paper was a true collaborative effort, which couldn't have succeeded without the help of many dedicated individuals. At ETH, Eric van der Mark made sure that the database was in top condition at all times and that video-conferencing sessions worked. At the University of Hong Kong, Marc Aurel Schnabel and Tim Yeung helped students in various phases of the project and insured that we could see our partners. At the University of Washington, Dirk Donath from the University of Weimar in Germany helped motivate students to work hard during the Thanksgiving holiday when this project

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