Asynchronous Architecture

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Computer culture creates new demands on the process of making architecture. Both academia and practice are undergoing rapid changes due to the impact of information technology, and one of the most significant phenomena which has resulted from this transformation is collaborative design in a networked environment. Many researchers in the field have focused their efforts on minimizing or eliminating an apparent shortcoming of networked collaboration, namely the difficulty of immediate interaction between participants [Mahe, Gero and Saad, 1993]. In an ongoing experiment in collaborative design we have taken a different approach. Instead of trying to work in a synchronous environment, we have taken the asynchronous nature of networked collaboration to be one of the important features of this ethereal medium, a feature whose consequences need to be explored.

Architectural design collaboration over a large-scale digital network is starting to be confronted in a handful of academic and professional experiments [Wojtowicz, Davidson and Mitchell, 1992]. We will give a brief account of a recent addition to this effort, consisting of two projects in design collaboration. The first one involved a group of five architects working over the Internet network on a design competition. Each of us was located at a node in Barcelona, Boston, Seattle or Vancouver, using different software and hardware platforms, but constantly sharing documents through a common "digital pin-up board" and a naming convention as shown in figure 1. The second is a similar effort at the academic level which combined a joint studio headed by William Mitchell between the Massachusetts Institute of Technology and the Harvard Graduate School of Design with studios at

Figure 1: The Digital Pinup Board asynchronously accessed for reading and writing. Note the divergent login times for each workstation.
the University of British Columbia, Hong Kong University and Washington University at St. Louis in a three week design workshop.

The asynchronous model of design activity provides basic insights about designing in general. It also points the way towards a more subtle use of information technology, which not only tailors the available resources to the participants’ traditional work habits, but which proposes a new and different method of working adapted to collaboration in a more abstract medium.

Ultrafax to Internet

Norbert Weiner, the MIT Professor of Mathematics who coined the word cybernetics writes [Weiner, 1954]:

To see the greater importance of the transportation of information as compared with mere physical transportation, let us suppose that we have an architect in Europe supervising the construction of a building in United States... Under these conditions, even

Figure 2: Faxed design concept sketch and the resulting vector drawing. High rise study. Hong Kong, S.S. Lau, J. and M. Wojtowicz, J.N. Davidsen, 1992.
without transmitting or receiving any material commodities, the architect may take an active part in the construction of the building. Let him draw up his plans and specification as usual. Ultrafax gives a means by which a facsimile of all the documents concerned may be transmitted in a fraction of a second and the received copies are quite as good a working plans as the originals. The architect may be kept up to date with the progress of the work by photographic records taken every day or several times a day and these may be forwarded back to him by Ultrafax. Any remarks or advice he cares to give his representative may be transmitted by telephone, Ultrafax or teletypewriter. In short, the bodily transmission of the architect and his documents may be replaced by the message-transmission of a particle of matter from one end of line to the other.

Today the fax—if not the Ultrafax—is present in every architect’s atelier. The fax revolution witnessed in the construction industry over the last few years has involved only simple, one-way digital image transmission. In this typical use of the fax, a document on paper must be scanned into digital format and then translated into an analog signal which can be carried over normal phone lines. At the receiving end, these signals are translated back into a bitmap and printed out on paper. Figure 2 shows a faxed sketch representing an initial design idea for a Hong Kong high rise project developed by designers working in three different locations across two time zones. The fax served to convey a static document containing an idea clearly evident in the final project shown in figure 3.

With the introduction of fax-modems this paper-to-paper process can be replaced by a direct transmission of an image generated by one machine.

Figure 3: Preliminary design as developed over the network between distributed collaborators. High rise study, Hong Kong, S.S. Lau, J. & M. Wijuntsz, J.N. Davidson, 1992.
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To the screen of the other one, blurring the distinctions between a fax and an electronic communications network to some extent.

But the distinctive aspect of sending a "drawing" over an electronic network, as opposed to faxing an image, is the ability to receive and edit information directly, rather than editing only a limited representation of the information.

Convergence Versus Simultaneity

Collaborative interactions can take many forms. One useful classification strategy makes use of two independent concepts of simultaneity - the temporal and the spatial [Gibbs, Rein and Ellis, 1991]. A collaborative effort can take place in one location or in many, and it can take place with all the collaborators working at the same time or at different times. One of the four different combinations of these two binary variables of space and time is the traditional "face-to-face" collaboration where participant work together at the same time and place. What is the opposite of face-to-face interaction? We will propose two answers. If the traditional face-to-face collaboration is the least technology-intensive type of interaction, then the "distributed synchronous" collaborative effort is its opposite in the sense that it requires high-tech solutions to have people working together in real time while in different locations. It is clear, however, that the most radical departure from traditional constraints associated with collaborative work takes place in the "distributed asynchronous" mode, where participants are free to work not only in different locations, but also at different times. We will call "non-distributed asynchronous" the fourth type of collaboration which involves participants working at different times but in one location, taking shifts at a given workstation to work on a common project for example.

Hidden in the origin of the word "synchronous" is the possibility that things which take place synchronously transpires beneath the same sun, in the same light (Greek: sunkhronos; sun, same; khrinos, time). Work that occurs asynchronously comes to light under the gaze of a different globe. When individuals collaborate there is no legitimate method that would enable the participants to hide their own readings and intentions associated with the work. A different sun will illuminate separate minds in different places and at different times. To the extent that the designers' interactions with an evolving design document (and with the characteristics of the medium) play an important role in a design effort, the ethereal medium of a distributed network has particular qualities. Different ways of interpreting an evolving design play a particularly important role in this extended working environment. But it is quite usual in architectural collaboration to experience excellent group dynamics despite the common use of design criteria which are neither completely shared nor commensurable [Papazian, 1993].

In any communication about a design artifact, or an evolving project, each participant tends to have a particular understanding of the objects which serve as documentation. These partially compatible metaphors are superimposed, brought into conflict, and merged, in a creative process of collaboration [Fargas and Papazian, 1992]. Because of the physical and temporal lag between participants in an asynchronous design process, the particularity of each way of interpreting the incomplete design is exacerbated, giving rise to a rich variety of alternative interpretations. Much of the interest of this kind of work comes from the challenge of reconstructing the rationale of other designers through their drawings and constructions, and even returning to them transformed drawings highlighting aspects of the design which they were not aware of. The rapid exchange of the creative design notions may result in a very unpredictable and unstable design space.

The challenge of asynchronous collaboration then is not to mimic the dynamics of traditional group interactions, replacing its physical simultaneity by the virtual presence made possible by communications technology. Rather, the need is for a work dynamics which in addition to generating valuable design explorations, will encourage convergence in design options.
Distributed Asynchronous Design: Two Projects

In a recent project in collaborative design, four architects located in Boston, Barcelona, Seattle and Vancouver connected via the Internet network, modified and exchanged design ideas in the form of object files and bitmaps as well as text messages. The familiar conventions of the architecture workshop were translated to the networked environment and resulted in a working concept of "digital pin-up-board" (see figure 4). Libraries of geometric models and renderings depicting elementary design notions, built up from the individual contributions, served as a formative source for the design proposals.

![Diagram showing connections among locations and design modules](image)

Figure 4: Structure of the Shophouse Project virtual studio. The current version of the project is kept in STATUS; past versions in HISTORY, and evolving design material in PINUP.

The project agenda was both theoretical and pragmatic. The first item was to test the conviction that a geographically distributed and asynchronous practice of architecture is about to become practical in the professional environment. The second was to collectively design a row of very narrow townhouses and make a street facade out of it. The unit lot size was 15 x 40 feet, with a maximum of three floors. The first floor was to be used for a shop, a garage or a passage. A scanned photo of the site was posted on the Digital Pinup Board, together with the vector drawing of the site plan. The site was located along a typical North American strip, it included a shut down gas station. By re-introducing the shophouse typology, the aim was to reconstitute the vitality of the street and to challenge the existing zoning. The computational environment was not made consistent as the collaborators depended on a variety of platforms and software. The selection of tools was left up to the individual architect. Files were transferred in TIF format for bit maps and in DWG or DXF format for the vector files. The account named "CONFIER" was set up in the computer lab at the University of British Columbia site exclusively for the purpose of the experiment. A password was given to each of the four participants so that the account could be remotely accessed by the designers. In order to send text or binary files while connected to Internet participants could use an electronic mail service or the standard file transfer protocol. The overall strategy was open to the individual initiative of each participant. Only two rules were agreed upon a priori:

1. The use of a consistent file naming procedure. (For example the file name "parti.07.jw" stood for: the image name "parti," revision "07," last edited by "jw.")

2. When a new design file was posted on the Digital Pinup Board, a brief description of it was always issued via email to all.

A rigorous record of the design process was kept in order to make possible future evaluations of the method which emerged during the collaboration. The aim of the effort, beyond the pragmatic one of generating a design competition entry, was to avoid imposing a highly structured methodology in order to discover successful strategies and problematic aspects in the evolving process. It is beyond the scope of this paper to give a full account of this particular design project, or to analyze all the aspects of the collaboration. Rather we will limit ourselves here to presenting one of the simplest (and easiest to illustrate) cases of cross fertilization which took place during the project.

Figure 5 shows one of the main shophouse design alternatives and its development. Figure 6 shows how a detail of this alternative, namely the trapezoidal pillar shown in the plan inset at the top right of the figure, is used both in plan and as a facade element in a second alternative. The pillar is transformed into a fireplace in this new alternative, and its shape is repeated for the chimney and in order to generate a tilted grid.

After another cycle of collaboration, this grid is adjusted and used to transform the windows of some of the shophouses. The same window elements are then adopted by the author of the first alternative in order to produce some variants of the initial
alternative. Figure 7 shows a street-level elevation with different combinations and mutations of two groups of alternatives combined to produce the full set of shophouses.

We have tried to illustrate an aspect of collaborative design which is particularly appropriate to a distributed asynchronous network. There are many situations, however, where a more hybrid approach

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Figure 5: Development of one of the main shophouse design alternatives.
is necessary, combining real-time interaction (such as telephone conversations), face-to-face meetings and even parallel channels such as faxes and courier services within the otherwise distributed asynchronous structure of the large scale electronic network. As an example of a hybrid approach, let us

Figure 6: A case of cross-fertilization and shape mutations during asynchronous design.
now look at the design studio carried out over the internet network in Cambridge, Vancouver, Hong Kong and St. Louis. The subject of the studio was an intervention in a historic village on the border of China and Hong Kong.\textsuperscript{3} Figure 8 shows a model of the village and a plan indicating existing structures to be preserved. For the final crit of the studio, there was a need for a more real-time interaction between the assembled jury member and students.

As a result, a four-way conference call was initiated using speaker phones, while participants referred to the digital documents available to all of them.\textsuperscript{4} These documents, such as the one showing a proposed design in figure 9, were simultaneously displayed on the computer monitors at each site. In addition to this synchronous interaction, the studio also used a non-distributed asynchronous mode. Students working at each of the sites, in addition to face-to-face collaboration, could follow independent

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure7.png}
\caption{Combination of shophouse proposals as a tactic for convergence in design alternatives.}
\end{figure}
schedules, accessing common files, and posting contributions in the studio archives. This kind of collaboration was particularly evident in the Cambridge site which itself consisted of two separate institutions collaborating to form a common node of the studio.

Design Culture and Network Culture

For architectural computing to be more than a set of drafting and modeling tools, it must be placed firmly in the design culture, both in professional education and practice. The essence of this culture is rooted in the sense of collective collaboration, explicit and implicit. By designing in a distributed network we are, at the same time, recreating and modifying this collaborative aspect of architectural practice. One way in which these changes can be addressed, is by considering the characteristics of network culture in general, and considering some changes resulting from the proliferation of communications technology in businesses and institutions. To take an example which has particularly strong implications for designing, consider the freedom from inhibitions brought about by the potential anonymity of

Figure 8: A global view of the Virtual Village.

Figure 9: The form of the Virtual Village is the product of the collective contributions on design McKay too numerous to credit to particular authors. The last designers of the rendered images were from HKL and LRC.
electronic messages [Kiely, 1985]. Even when network correspondence is not actually anonymous, it is very common to see initiatives, criticisms, and creative ideas whose authors would typically keep to themselves in a more traditional context. In design collaboration, the freedom to edit another participant's work, and the consensus on the free exchange of results turns out to be a major advantage of asynchronous networks.

Where computer assisted design is involved, the interaction with the media tends to be rigorous and formal. It assumes the form of a structured dialogue, analogous to the iterative process of reading and writing. "For design literacy has to do with the ability to read and write architecture." Design activity, however, is far from a simple sequence of reading and writing states; it seems closer to game of re-reading and re-writing where the rules of the game are part of what is being re-read and re-written.

When designing is practiced in a distributed group, an architect assumes in turn the distinct role of critic and creator. This condition leads to a rather slow feedback loop between idea and critical judgment. In the case of a conventional design activity both conditions, re-reading and re-writing, can seem parallel or overlapping in time and thus difficult to isolate. In the case of a distributed machine driven design effort, the steps are more conscious, formally structured and distinct. The articulation of these steps is accentuated by sending the information over a network in batches, where the process of elaboration of any given proposal remains invisible to the design group, while the proposal itself has the total accessibility characteristic of publications.

Today, design collaboration is of particular interest due to the growing importance of distributed, high-performance computing, high-speed data transfer, and the emergence of global networks. These networks are analogous to the railroads in the XIX century or highways in the mid XX century. In architecture the importance of being networked cannot be underestimated. Today it is practical to perform asynchronous, two-way transmission and re-editing of the digital image or model. The proliferation of electronic mail, remote file transfer, bulletin board systems and interactive computing are evident. "In contrast to broadcasting, networking enables many users to pool information. In networking, the information is processed and new information is generated." [Lucky, 1991].

Robert Khan comments on building an informational infrastructure and on one of its properties. According to him it is important to make the distinction that information networks are transparent but not virtual: "Something is transparent if you cannot see it, but it is there. Something is virtual if you can see it, but it is not there. The informational infrastructure, networks or information highways belong to the first category of transparent" [Kahn, 1991]. By the nature of multiples, images have different virtual existences in different minds. We desire a transparent exchange of ideas, what we have are parallel virtual images which become separate editions. More work needs to be carried out in order to study the characteristics of distributed asynchronous media, ethical issues related to the lack of direct control and the blurring of original authors intentions, and the burden of coherence resulting from potentially diverging design directions. It is likely that such investigations will be as fruitful for understanding design activity as they will be for understanding asynchronous distributed architecture.
Notes

1 Mitchell highlights the implicit and personal nature of "design worlds," pointing out their dependence not only on media and instruments, but on the design "primitives" which are used [Mitchell, 1992]. In the heterogeneous and open environments described above, the resulting design world is likely to be a changing space of partially compatible approaches.

2 For research addressing the technology needs of synchronous design collaboration and its theoretical foundations see Harrison's account on recent efforts at Xerox PARC [Harrison, 1993].

3 For a detailed discussion of this project involving the architecture students and faculty of HKU, GSD, MIT, UBC and Washington University see: Wojtowicz, J., "The Virtual Village Studio", Hong Kong University Press (in print).

4 The initial intention was to use video phones, but the idea was postponed until the next experiment due to technical considerations.

5 The skill of reading is more than just appreciating and intuitively recognizing the formal quality of the object. "Reading architecture has to do with the process of parsing and resolving the elements and parts of a building and describing them grammatically." [Wojtowicz & Fawcett, 1985].

References


