Design as Digital Correspondence

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This chapter is concerned with illustrating the potential and limitations of structured, "long distance" design collaboration utilizing computational and telecommunication tools. Digital design collaboration makes new demands on both the computational tools and the process of making architecture.

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The development, control, and assembly of design knowledge is a highly structured process when computational tools are engaged. It is structured in the case where the designer engages the machine in the creative process as a sort of "collaborator", and it is structured in the case where two or more designers collaborate from separate locations. To deserve to be labeled creative, this type of collaboration has to allow for unpredictable, non-deterministic procedures during the initial stages of design formulation.

In the project discussed here, two computational design studios, whose members were literally a continent apart, worked together on the same design task. Connected by a network, designers modified and exchanged ideas in the form of one, two, and three dimensional representations. The familiar conventions of the design studio were translated into the networked environment and resulted in concepts like a digital pin-up board, group work, electronic jury (the world's first?), and arguments about studio space (on server). The library of geometric models and renderings depicting the elementary design notions was built up from individual contributions, and served as the formative source for the final project.

This experiment, involving the creative application of digital design tools, addressed important issues related to long-distance, networked design collaboration and correspondence both in educational and professional contexts.

Correspondence as design collaboration

Design, we suggest, is accomplished through the acts of simulation and induction. To simulate we make a picture of the future. This creation is a single episode in the recursive activity of designing. We see. We create. We instantiate. Observation initiates this cycle of design. Through successive acts of simulation (analog or digital), vision becomes deeper and of higher resolution. However, the lens of choice, or compulsion, always betrays another dimension. Regardless of the medium of simulation, what is induced back into the design proposition is always affected by the framework or method of simulation. The problem of induction is to have access to the correct ideas in the first place. According to Johnson-Laird, "If the right ideas are not amongst your available repertoire, you will have to create them out of whatever building blocks are at your disposal." Such formative elements need a more deliberate structure where many designers come together, rather than one modeled by a single mind.

Correspondence can be understood as a creative process of collaboration. This practice of creative collaboration or correspondence is of particular interest here, since "The criteria for evaluating acts of creation are not automatically available to the generative process", and, since "people are better critics than creators". It works like this: the sole designer generates an idea making use of some initial constraints. The outcome calls for a revision or elaboration. The new proposition introduces new constraints, which did not exist at the initial stage, prompting a new or different idea, initiating the review again. This process is
magnified during the act of collaboration, where
the role of the critic and the role of the creator
are substituted, and interchanged between the
key players. Ultimately it leads to the formulation
of a feedback loop between idea and critical
judgment.

Where more than one designer is involved, the
collaborative aspects of the design process cause
the initial formalization to be more complex.
Ideally it should assume the form of a structured
dialogue. In practice it is more analogous to the
recursive process of reading and writing, or
Correspondence. The design process, however,
is far from a simple sequence of reading and
writing states; it is in fact a process of re-reading
and re-writing, deeply fertilized by several factors
of creativity. In the case of a solo activity both
conditions, re-reading and re-writing, might be
parallel or overlapping in time and thus difficult
to isolate. In the case of a collaborative design
effort the steps are more conscious, formally
structured and distinct. Any new notions induced
into a design may be unpredictable, but the
generative simulation will be quite conscious
where collaboration is concerned.

The design model proposed here is one in which
the current status of the design problem is in
principle being critiqued and edited by each of
the participants sequentially. The acts of reading
and writing for an individual, however, can occur
synchronously. The sole designer makes a mental
or graphic proposition which is then responded
to. When the notion is entirely cognitive and is
circumscribed by the single mind, the “reading”
and “writing” cycles may happen almost
instantly, “in real time”. A gesture of the hand
induces an immediate reading which informs the
delineation of the artifact. When the cycle
includes the use of a graphic image, or visual
aid, this loop may take only a few minutes or
several hours; consider a quick sketch compared
to a complex section. When the condition involves
multiple minds the conveyance of the idea must
by necessity be structured. If the medium of
exchange is robust enough and the collaborators
have sufficient graphic sophistication, then the
visual image can become a host for the
architectural idea, which then can be edited and
critiqued by the various participants, enroute
to the instantiation of the architectural idea. Figure
1. represents this model where the cognitive
design worlds of each player can overlap through
the collaboration.

FIGURE 1: Model of ideal cognitive design
correspondence

Teaching design is parallel. It is a form of
cognitive apprenticeship and it involves role
playing when dealing with an uninformed client
or student. The case of cognitive collaboration
is not dissimilar, particularly since in the act of
making design, ambiguity is clarified when form
manipulation is dealt with visually.

The condition of confronting the unforeseen
in design is amplified in the case of creative
collaboration. The protagonist of collaboration
in architecture, Walter Gropius, spoke of this
during his 1961 lecture at Columbia:

There is no doubt that the creative spark
always originates with the original, but while
he works in close cooperation with others
and is exposed to their stimulating and
challenging criticism, his own work matures
more rapidly and never loses touch with the
broader aspects which unite a team in a
common effort.4

The problem well understood in the Bauhaus
over half a century ago remained evasive for a
long time. But recent advances in cognitive
science and the development of computational,
networking, and telecommunications tools make
the issue of creative collaboration important and
timely once again. The real time vs. delayed
sharing of design ideas, or creativity in
synchronous and asynchronous modes, is
becoming increasingly important.

Today the notion of a “Society of Design”5 is
the next logical step after computers gain
acceptance in the creative design process. The
question is: “How can intelligence emerge from
non-intelligence?” One can build a mind from
many little parts, each mindless by itself. I’ll

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call 'Society of Mind' this scheme in which a mind as made out of many smaller processes. 6 Minsky calls those processes agents which are simple by themselves but if joined in societies result in the formation of true intelligence. 7

There are many questions. Can an intelligent, complex design emerge from an elementary, simple-minded one? Could one build an intelligent designer out of small, less intelligent parts? The analogy with music (orchestra, improvisation) might be distant, yet the ability to sing a tune versus the ability to write down its notation exists. In music (like in architecture) these are distinct skills. Furthermore, in music, digital technology has overcome the conventional limitations of acoustic instruments. "With digital technology we can already store, analyze, modify and recreate sounds with accuracy equal to that of the human auditory system." 8 In spatial and formal design we could conceive of devices analogous to those in the area of digital musical technology. For example: composition controllers and shape generators are not dissimilar to music controllers and sound generators. Music theory is far more developed and measured than the theory of the visual arts.

Yet, there is no simple, tractable, and direct procedure for innovation in either music or architecture. We can depend only on unique cases.

Case study

A case study was orchestrated to focus on these issues, and explore the notion of design collaboration over long distances. It was also concerned with exploring standardization and prefabrication in architecture - a timely issue in light of recent advances in the use of robotics in the construction industry. To illustrate the condition of these two concerns, and their demands on the conceptual stage of design, a simple design problem was used as a vehicle.

Students in two design studios were asked to address a project dealing with the particular construction technique of concrete tilt-up panels. The following excerpts are fragments of a handout given to the two groups of twelve designers, located at two universities, thousands of miles apart, and called here as Studio East9 and Studio West.10

The title of the étude was Robo-House. "Your client is Robo-Works Ltd. - a small, but successful robotics R&D company. Its staff consists of 6 nerds ... and one B-School neo-granola type (who's family runs a construction business specializing in tilt-up concrete technology). You are asked to design a simple warehouse using tilt-up concrete technology. It should accommodate casual office space, an exercise room and a multi-purpose large area for development and testing company products - industrial robots. Robo-Works believes in prefabrication and in a sustainable future. Its seven directors instructed you to develop a solution in the form of a kit to facilitate collective participation in the assembling of the final proposal.”

The maximum dimension for a tilt-up panel and for a footprint of the warehouse were given. The nature of tilt-up concrete construction process was discussed and illustrated as part of the handout. "The impetus for tilt-up concrete construction lies in its efficiency of time, material, and consequently, money. Normally the floor slab of the building is used as a casting bed for the tilt-up wall panels. In this case the panels already cast become the casting bed for the next series of panels. When the lower panels have holes formed into them for doors or windows then those apertures are filled up flush with the surface of the panel to prepare for the next pour. When the panels are poured, the finished side can either be the upper or lower face. If the exposed, or finished, side is poured face down this allows for any number of relief effects to be cast into the panel. The steel imbeds are placed to allow for the connection of panel to panel, panel to floor slab and the roof structure to panel; in addition, cast into the panel are also a series of steel pick point connections used exclusively for the erection of the panels. The tilt-up process for quite a large building can be completed in only a few days.”

The project’s aim was to form a structure for the sharing of design ideas and to create an opportunity for design collaboration and the exchange of criticism in a networked environment. The mechanism, or structure imposed on this assignment was a digital design pin-up board. Figure 2 represents the ideal conditions planned for the execution of this study where the design correspondents, (Studio East and Studio West), and the relationships between the collaborators, are facilitated by a network.

The design process for both studios was structured and executed in stages.
1. During the first week the students were expected to contribute bit map images to the Tectons/Materials palette, to develop a design for a tilt-up panel and to model and render it's front elevation. They were also expected to model the robo-house schematically.

2. At the end of the first week the geometric models, renderings and Tectons/Materials palette were posted in the Pin-Up Library.

3. The initial pinup consisted of an informal exchange of Pin-Up Libraries between the two studios. The students exchanged comments (via e-mail and speaker phone).

4. During the second and third week the students were expected to re-compose the design of their warehouses using some of the posted materials and continued to place reiterates solutions into the Pin-Up Library. Informal access to the Pin-Up Libraries between Studio East and West (via Internet) was developing.

5. The design process was concluded by an electronic, long distance jury.

The success of the undertaking was to be measured not so much in the efficiency of the proposed structure as in the quality of the design works emerging from this environment. Material developed at each stage was scrutinized, organized, and purged by the studio pin-up board postmaster. This was a potentially new role for the design tutor, who acted not only as a critic but also as an editor, occasionally providing janitor-like maintenance of the digital environment. After the individual and studio accounts were established students could post questions or opinions at any time regarding the project on the BB (bulletin board) or send them directly via e-mail. The networks connection was set up with two bulletin boards, one at each site where the files were placed and accessed by each studio remotely (see Figure 3).

Due to the large selection of platforms and software at both institutions it was decided not to place a restriction on the digital media by insisting on a common computational environment for both studios. Instead the choice of appropriate computational tools was left up to the user. The transfer and posting of files went smoothly. Rendered images and bit maps were exchanged in TIFF format while 2D and 3D models were transferred as DWG or DXF files. To accelerate the transfers, the files were compressed before posting. The effort to control the format of the file exchange by coordinating the file naming conventions was not as successful as the exchange itself. The initial file naming strategy was logical. It was to indicate in the file name the origin, encoded name of author, image category and version of revision. It would have produced files like: "StudioEast7eb010101.dwg". This was found to be too demanding on the overburdened students and was quickly substituted by an alternative strategy using the designer's first names at the head of the file resulting in more descriptive conventions like "Joann_elevNorth".

There were problems with maintenance of the Digital Design Pinup Board, under charette conditions. Students do not edit their own work and need help in purging historical material. They do not adhere to naming procedures, and there is great need for automated file naming procedures. This long distance collaboration produced unexpected but creative formal encounters. The essence of a studio environment based on sharing, discussing and reusing design
ideas was amplified. Digital editing could be further explored as a teaching method. It was
clear that for collaboration on a digital network
to be successful, the logical structure needs to
be maintained, yet it has to provide for a more
fluid and even intuitive exchange of ideas
encapsulated in the visual data.

Numerous images and models were generated
and exchanged between Studios East and West.
The 2D and 3D geometric models, renderings,
composite images textures, scanned photographs,
parametric procedures, programs and animation
were among the materials exchanged between
the two sites. A selection of images produced
during the étude are assembled as plates below.

Conclusions and implications for the future

In the beginning we outlined a simple system
for creative interaction taking advantage of the
constraints of computational tools. The explored
and applied methods confirm the potential of
design networks between designers in creative
collaboration, even when they are spatially and
temporally displaced. The case illustrated here
is interesting in that it was structured according
to both the tool and the need, not by an a-priori, fixed
mechanizing method. Perhaps that is why some
are creative.13

Collaborative design utilizing modern
computational and telecommunication tools is
seen as a continuous feedback loop between
reading and writing within the boundaries of a
given universe of forms. The challenge is to
create a way to communicate digitally the
metaphors and cultural innuendoes embedded
in the nascent architectural idea.

Today the state of the digital collaboration or
correspondence 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.
They are in process of becoming “the highways
of the mind” - to quote Senator Gore’s speech
writer.

Over the past twenty years, a wide area network
of computers, linked by high speed lines, has
grown in North America and spread throughout
the world. As computer and communications
technologies have evolved so have ways in which
the network has been used. TCP/IP14 protocol
used in this exercise grew out of DARPA.net,
originally designed for the US Department of
Defense researchers to share computing resources
at a distance. This network has now evolved
into a new kind of collaboration medium and in
some disciplines it is already well entrenched:
“Indeed, the current generation of major particle
physics experiments, run as international
collaborations, could not have come to fruition
without computer networking”15.

In architecture the importance of being networked
cannot be underestimated. The fax revolution
witnessed in the construction industry over last
few years has involved only simple, one-way
digital image transmission. 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
and interactive computing is evident. “In contrast
to broadcasting, networking enables many users
to pool information. In networking, the
information is processed and new information is
generated16. The modern network not only
connects workstations to each other and to
the collective storage devices, but it also enables
creative collaboration eliminating the necessity
for corresponding machines to be in physical
proximity. In the near future, digital image
transmission and digital voice will merge into a
single technology, while multimedia networking,
remote visualizations and computer supported
cooperative labs are already attracting interest
beyond the theoretical realm.

The technology for networking in design is at
hand. For architects of the next generation, digital
design in the networked environment begins with
re-introducing the collaborative act to design.
The plates at the end of this paper attest to it. The
images they contain crossed the continent,
frequently more than once, and connected distant
minds. Today certain of those transcontinental
voyages took over 15 minutes, but in the near
future with the development of DDS/ISDN17
working at the speed of up to 128,000 bps the
same file will transfer in one second.

Will those new techniques and tools be seminal
in making a significant architecture? According
to Diodor Sicilian, over two thousand years ago
two Greek sculptors were working on the statue of Apollo. The sculpture was made in two parts, with one of the artists working on the island of Samos and the other in Ephes. In spite of this separation, when the parts of the monument were brought together they fitted perfectly. "This result was due to the certain rigorous method of work, common to both collaborators."\(^{19}\)

Modern computational tools impose new collaboration methods, and when applied in the creative process confirm the importance of correspondence as a constructive method in design.

References

2 ibid., p. 258.
3 ibid.
7 He also sees the interaction of minds and relationships as important. The methods of making decisions range from negotiation of equality to influence. On higher levels negotiation is governed by rules.
9 Studio East was Professor William Mitchell's Design Studio at Graduate School of Design, Harvard University, Cambridge, MA. The Teaching Fellow was Takehiko Nagakura.

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10 Studio West at University of British Columbia School of Architecture in Vancouver consisted of: Eileen Albang, Gordon McClure, Rami Ghaleb, Fatima Hirji, Andrea Jung, Gordon Kipping, Stefane Laroye, Henry Lau, Pedric Chris, Perkins John, Si Tai, James Wu. UBC Electronic Design Tutorial was offered by Dr. Jerzy Wojtowicz with James N. Davidson as Sessional Lecturer in Design.


12 Proposed file naming conventions: *origin:* The last editor, or in other words who worked on it last. **Name of author:** Number tagged to class list, but abbreviations for the name of the author would work as well. **Image category:** based on the a list of standard abbreviation to shorten the name: sec - section, mas - massing, pin - plan, pel-panel, elv - elevation, etc… this list could be edited and added to as we proceed. **Version of revision:** a four digit number with a built in structure rather than a straight sequential list. E.g. a file name would be "XXX/section1301.dwg". The four digits would be such that the first two digits would be the primary model, image or drawing, and the second two digits would be a version of that primary file. For example, XXX/section1301.dwg would be the first edited version of the drawing "XXX/section1301.dwg." If the editors were in ZZZ than the next version would be ZZZ/section1301.dwg. And so, "XXX/section1301.dwg" would talk of Primary version: 1301## and Secondary version: #01.

13 Gestalt psychologists (Meier, 1931) argued that the repetitive experience has a mechanizing effect on thinking, and that it
is, in effect, counter-creative. The more recent creativity techniques, Brainstorming (Osborn, 1957), and Synectics (Gordon, 1961) were based on the notion of using group minds in a collaborative, creative, and highly structured effort.


17 ISDN; Integrated Services Digital Network.

PLATE I: Image array of: the tilt-up concrete process; selections from the Tectons/Materials palette; and preliminary panel studies.
Plate II: Plate shows two facade proposals based on a given palette of panel types shown above; each facade has a particular esthetic which is the result of composing and re-editing by several designers at separate times and in remote locations.
PLATE III: Plate shows two facade proposals based on a given palette of panel types shown above; each facade has its particular esthetic which is the result of composing and re-editing by several designers at separate times and in remote locations.
Plate IV: Plate contains a number of vignettes showing various panel, facade and warehouse project proposals resulting from the digital correspondence process.
Plate V: Plate contains a number of vignettes showing various panel, facade and warehouse project proposals resulting from the digital correspondence process.
Plate VI: Two evocative images delineating the possibilities of the prescribed building technique and design medium.