Enkeboll Foundation
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Sponsored Project:

Architectural Restoration and Conservation (ARC)
of Carved-Wood Interiors,
2004-2005

Final Report
Volume 2

Carnegie Mellon University, School of Architecture

Administrator: Laura Lee
Lead Faculty: Kai Gutschow

Date:
11 November 2005
Project:

Architectural Restoration and Conservation (ARC)
of Carved-Wood Interiors,
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STAGE III Report

Carnegie Mellon University, School of Architecture

Team:

Administrator: Laura Lee
Faculty / Instructors: Kai Gutschow
Student Assistants: Joshua Cummings, Design
Elizabeth MacWillie, Design
Jared Langevin, Design
Chang Zhang, Design
Zach Hartle, Editing
Participants: Rebecca Rahmlow
Francisco Restrepo

Date:
11 November 2005
PROCESS
Teamwork
Tools/Technology
Precedents
Following the precedent and analysis phases, we began the transformation phase with new input, new ideas, and a new process. Ultimately our goal was to find some way to incorporate technology into traditional design.

With this focus in mind, we approached this process like any other design problem: through discussion, collaboration, and sketching.
Teamwork

With a large, new group of people, we each began our own design schemes, focussing on our individual abilities and skills. During weekly meetings we would meet and discuss our work as a group.

Approaches to design were often vastly different. Some people continued to work mainly through hand drawing while others began developing form in digital resources. Often though, overlaps in schemes were present as ideas of manipulating technology began informing our ideas.
As the weeks progressed, we gathered all our work and began to organize it. We pinned up our work, made corrections and edited as we moved along in the design process. In the final phase we began to lay everything out into chapters to prepare for our final product.
Eventually, all of our designs began to incorporate the use of computers and technology to generate our design. Through the use of computers, the manipulation of forms became easier and more precise than ever before in our process. Translations, rotations, and reflections could be generated by the simple input of numbers and degrees.

Through the transformation of basic unit shapes, unique and varied arrangements could be formed.
After developing our schemes in various three dimensional modeling programs, we had to prepare separate digital cad files for transfer to rapid prototyping equipment.

Three dimensional forms had to be translated to a series of two dimensional files representing slices of the actual form. Eventually these sectional slices are compiled in consecutive order to generate the form.

Because of the precision of the laser cutter, designs could take on much more complex shapes. Before, multiple cutouts and changing angles were limited to what could be produced by an exacto knife and the hand.
TRANSFORMATION
ENKEBOLL FOUNDATION
PROJECT PHASE III
Using the Laser Cutter
Harvard

(Left) Gateway to Infinity is composed of 504 triangles that when combined form a funnel. Constructed of mylar laminated over nylon reinforcing yarn and joined by polycarbonate rivets.

(Middle) Represented is Toshiko Mori, whose research considers traditional modes of mechanical production, but also explores digital technologies such as CNC, CAD/CAM, stereo lithography, and three dimensional printing.

(Right) Becoming Wall/Becoming Chair by Coggan & Crawford Architectural Design was originally designed for an exhibition of concept chairs. The maple plywood-and-solid poplar bench, was originally conceived for a yoga studio.
Harvard

Organized by Toshiko Mori, the Edge Exhibition attempts to radicalize the materials’ spatial, tactile, and experiential potentials. Edge studio designs an enclosure to: be made of a single enclosure, use a consistent and systematic method of construction, design three joints by the turning of three corners, include three types of apertures to be designed in the enclosure. Constructed by laser cutting 192 individual panels of thin sapele mahogany and joining them with rivets and its own complex system.
The Virgin Atlantic Clubhouse by SHoP Architects is an upperclass airport lounge that overlooks a retailing concourse reasonably described as a shopping mall. Mass produced non-structural slats of medium-density fiberboard and steel pipe columns make up the structure of this lounge.
Dunescape

Designed by SHoP Architects for the P.S. 1 Summer Courtyard Installation, Dunescape created an oasis in the middle of Queens New York. Slats of wood undulated to create a landscape that provided places to lounge, sit, and wade, in the sun or the shade.
Florence Loewy Bookstore

Three undulating grid forms that act as stacks for books with concealed storage spaces within. Conceived digitally and then produced using a CNC machine.
The technology of digitally manufacturing materials has become very prevalent at Georgia Tech. In this instance they are digitally manufacturing wood to create a seat in one of their halls. Using machines such as a CNC and a Laser Cutter, Georgia Tech can produce many products such as this one with very little effort involved.
Columbia
A new room is being added in the center of the faculty office area. Students are manufacturing this room by the use of a CNC machine. The machine allows them to produce multiple slightly altered versions of these wood panels.
Transformation:
Early Design Experiments
Kevin Wei  
Rug Design

Reacting to the obtuse angles present in the Hagan House, this rug is meant to “hug” any such angle and serve as a threshold marker when transitioning from one space to another.

The rug design is based off of a triangle/hexagon grid, just like the existing Hagan grid; however, the first process sketch shows triangles transcribed within a hexagon, whereas the Hagan grid omits such triangles.

Principles such as repetition, layering, and interlocking geometries helped generate the rug design, and were derived from the plan and interior view sketches, but undoubtedly it is a whimsical creation loosely tethered to any Hagan-esque aesthetic.

In the design, shapes imply lines and direction, and lines evolve into shapes. Those shapes then combine into other shapes, with other lines react to their intersection by changing direction or opacity.
Carole Aspeslagh
Chair Design

A proposed chair design based on previous analysis of Hagan House.
Becky Rahmlow
Desk and Coffee Table

This table design demonstrates the possibilities of transforming a diagrammatic analysis of zones created by overlapping architectural experiences generated by light, materiality, height, and textures (i.e. carpet). In keeping with Wright’s themes of overlapping and continuous space which can be subdivided with the addition of architectural elements into smaller spaces, this furniture design functions as multiple pieces that can serve separate functions as well as larger ones. The two-dimensional analysis creates a three-dimensional form by extending, folding and extruding elements of the analysis.
These drawings explore a visual means of representing the experience of inhabiting Kentuck Knob as a relationship between plan and section. Through graphic depiction (up representing increased experience and down representing decreased experience), they demonstrate how dynamic the relationship to nature is in each part of the house as influence by architectural elements such as windows and light, relationship of the ground plane to the house and significance of overhangs. Despite their articulation as separate objects, these diagrams begin to explore how they work dynamically to draw the user through the space and restrict the user from accessing the private zones of the house by experiential rather than physical barriers.
concept:
Kentuck knob is a unique combination of stone and wood placed in a
way to grow out of the natural landscape into an organic Wrightian
architecture. Therefore, I wanted the chair to embody principles of these
materials and create an experience of sitting that would allow the user
to better understand the qualities of the Kentuck knob house.

result:
The chair I designed is both linear and fractal. It utilizes a continuous strand of
copper tube bent into cubic frames based on a specific module. That module is a
translation of the primary module used in the construction of the house. Each
bending the copper tube begins to address the nature of wood employed in the house while the complexity of the weave into a
volumetric shape and structure creates an experience of a solid base. The user
begins to understand how the solid stone and wood begin to interplay in the
house systems based on this chair.
Josh Cummings

Carnegie Mellon University

Architecture

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ENKEBOLL FOUNDATION
PROJECT PHASE III

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Jared Langevin
Third Year, Architecture
The final design of the seating area derives its formal qualities from the manipulation of a hexagon. The motion of the object allows for one seating area in the grass, enclosed by loose horizontal wood slats, and one on a cantilevered platform, made of densely positioned vertical wood slats. The interplay of the horizontal and vertical slats is intended to give the object a dynamic quality, using the concept of point, line, and plane to give the seating area a beginning, middle, and end.
Horizontal slats would be made of a darker wood such as oak, emphasizing the heavy structural nature of the skeleton that they form for the seating area. Vertical slats would be made of a lighter colored wood like pine, emphasizing their light, dynamic qualities as they condense along the length of the horizontal slats and eventually form solid sitting planes. Each of the slats would need to be cut exactly to form the structure to work as a larger unit, something made possible by using laser cutting technologies.
Elizabeth MacWillie
Fourth Year, Architecture
Concept Development

The beginning of the design process was spent developing a system on which to base the initial design for the piece going into the house. The concept was generated from the original analysis of the house that we had done. The hexagon plays an important part in the floor plan design, but was not used as much in section or to create three dimensional objects. I began to investigate the possibilities and limitations of using a hexagonal system to create three dimensional objects out of wood.
Concept Development
Scheme Development

In the next part of the design process, I looked at the types of objects that could or could not be used or the house. The various layers of the house that filter light through the house in the cutout play an important role in the experience of the different rooms. I considered the implications of creating an object within the room that would act as a filter of other light in place while serving a functional role. One function that I considered in the scheme is to create a place to store or place things in reaction from right light, like clutter in situations minimising inclusion of the place.
I continue with the screen on the one I leave to example in nature there are on the one on the the molecule of the snowflake bond to one another and enable infinite rotation in intricate to look at the one in the one where pieces fixed together at certain corner. The two could shrink on through the house touch and leave the floor at certain point even rotate on level to the point the one on were one to either certain portion could rotate out to create new to tore or place thin. Also in many minutes this procedure implicating certain elements in the connection of the object. The use of tool or else they could through the entire process and repeat the lice and out one more place with the use of loser cutter.
ench Stu

en r ro e o n the t pe o o ect th t e oul e e i nin to no ect on hich one coul it it en ith tem imi r to the one I h een loo in t ith the creen Cert in corner o the he on ere con necte ith o el or ro th t llo e them to ro te out th t point A the oo en he onpir le to ether the e n to orm ur ce hich oul erve the pl ce to it on top o
For the next phase, the intention is to combine the movement of multiple pieces, each with a different rotation and position in relation to one another.
In the first part of the project, I conceived how to create a piece that would suit our chosen location: the hill near the house. The initial envelope I loosed movement of the different piece of the ench on the hill to settle into the hill and hich part of the hill have been placed on the hill. This is where the hill connects the outer piece to the central piece. They allow them to lie on the north and to connect to each other. This is an occupation that can exist in continuous or on one of the pieces in turn.
Computer Model

The next part of the process is to model in Form Iu e tool to figure out the proper connection or the individual piece to orient the mechanism which connect them.
AutoCAD Dr in

in AutoCAD I l out II
the irr i u I piece The e
r in e u e to pl n
n cut out the piece or the
ph ic I mo el hich ere
cut u in the I er cutter
Fin Model

This model is made out of a thin metal piece of museum or cut in the lower cutter. The hinges are active to create the hinge to another metal more in depth, to create more unique experience dependent on the end of the pattern to create more unique experience dependent on the end of the pattern.
Fin Model
Settlin’ into the hill
Chang Zhang
Third Year, Architecture
The Hexagonal grid is by far the strongest geometric characteristic of the Hagan house. However, despite its dominance, the hexagonal grid system seems only to be consistent in plan, in other words this dominant formal rigor only works on parallel 2D planes. The following series of exercises seeks to create organic form from this highly ordered and geometric system that does not refer directly to a 2D hexagonal grid.
A simple process of overlaying multiple copies of a typical hexagonal grid (right middle) gives the perceived visual sense of a three dimensional 120 degree array. This exercise raises the possibility of deriving three dimensional form from the 2D grid.
Further studies of overlaying 2D hexagonal grid upon three dimensional objects yields alternate interpretations on how 3D forms may be derived from the manipulation of an originally planar surface.
In this study, semi planar rectangular prisms are arrayed on offset parallel planes upon the Z axis. On the X and Y, the prisms are seen as vectors arranged as the original 2D grid. In this arrangement, the grid once again begins to dissolve and give insight on how 3D form may be derived.
This is no longer a study of perceived three-dimensional connections. In the next four studies, the 2D planar arrays from the previous studies are converted into multiple arrays on multiple coordinate orientations. The resultant forms are a system of how the initial 2D hexagonal grid may be manipulated to create three dimensionality.
Taking a break from exploring the relationship of 3D axes derived from the original hexagonal grid, this study begins to ask what happens at the intersections of the three-dimensional axes. Here, a simple orthogonal grid system defines points in space. Points are individually represented by cubes - the only regular six-sided polygon. As the previous studies of overlaying 2D hexagonal grids began to imply hierarchies of node intersections, scaling of cubes within the orthogonal array also begins to hint at node priorities.
Solid form is derived from the 3D vector array studies and 3D nodal studies. The derived form is an organic structure built of modules of cubic elements twisted and contorted from the tensions of invisible 3D vectors. Individual cubic nodes differ in characteristic of scale and orientation. While the relationship of individual nodal points relate rigorously to nodes in its proximity, the arrangement possibilities of the final solid form are infinite. Thus a truly 3D system of solid form giving is grown from a simple 2D grid.