Masterbuilders: A Gallery for Making at the Edge of the Mockup

by

Andrew James Manto

B.S. Architectural Studies
University of Wisconsin-Milwaukee, 2008

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Signature of Author: ...
Department of Architecture
January 5, 2014

Certified by............
Joel Lamere
Assistant Professor of Architecture
Thesis Supervisor

Accepted by............
Takehiko Nagakura
Chair of the Department Committee on Graduate Students
Thesis Readers

John E. Fernandez
Associate Professor of Building Technology

Azra Akšamija
Assistant Professor of Art, Culture + Technology
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ABSTRACT
The term "master-builder" defines an individual who encompasses the skills to conceptually conceive of and physically manifest a piece of architecture. These individuals are as much interested in the formal and social outcomes of a design as they are in the materials and construction techniques that make them real. Despite this, contemporary architectural practice has veered away from the concept of masterbuilder, and into more limiting and bracketed professional roles. The rise in project complexity and evolving legal frameworks mean that architects now work as part of a much larger and divided design and construction team.

This thesis insists that designing and making are not two separate acts, but are rather one holistic process. It builds off of the contemporary momentum created by digital fabrication, rapid prototyping, and the maker movement but goes one step further. While it recognizes that the testing of design ideas through the construction of small scale models and mockups is important to the design process, this thesis argues that the 1 to 1 construction of buildings are an essential part of future architectural practice.

Thesis Supervisor: Joel Lamere

Title: Assistant Professor of Architecture
masterbuilder [S]

a gallery for making at the edge of the mockup
masterbuilder[s] proposes a new type of architectural design methodology through the design and fabrication of a small building.

Past
At its core, it challenges the separation between architects and builders described first by Leon Alberti, and later codified professionally by Sir John Soane.

Alberti believed that architects should not take part in the building process. Rather, he described a clear point at which design work ended, and building began. To transfer design information to builders, Alberti developed a system of two dimensional scaled drawings.
Unlike contemporary drawings, Alberti’s were free of dimensional annotation. Rather, they were understood relationally, with objects drawn as a multiple of an established base unit. In certain cases, such as his walking map of Rome, instructions were given as a series of polar coordinates which could be plotted out.
He designed buildings such that features were geometrically related to one another. The proportions between essential units were used rather than explicit measurements.
In the 18th century, Soane further cemented the split between design and building through the professionalization of the discipline via regulated building contracts.
Under these circumstances, architects began to work with other professional "design" disciplines, while contractors interfaced more directly with their "maker" counterparts.
Present

More recently, there has been an erosion to this formula prompted by a renewed interest in making as an act in which designers actively participate. Commonly, this is known as craft, which actually takes form around a distinct set of sub-themes.
Methodology: Digital Fabrication
Digital fabrication dissolves the barrier between digital design work and physical realization.
Environment: Fabrication Lab
The fablab offers a new space type that combines design and fabrication into a single space.
Means: Material Experimentation
Material experimentation offers a way of discovering novel forms, but at the expense of a premeditated plan.
**Testing Platform: Installation**

Installations have traditionally been the testing ground for design projects in the fablab.
Culture: Maker Movement
The culture of making and craft has fed a growing number of ad-hoc makers.
Future

Design methodology needs to leverage contemporary materials, tools, and culture. This is where premeditated architectural design meets a serendipitous process of making. More specifically, this thesis explores expanded polystyrene as design medium.

Most traditional building materials are actually quite old. Discovered by generations past, these materials [wood, concrete, and metals] experienced a transformation into the forms we see today during the industrial revolution. EPS foam represents a new starting point: a truly modern material.
Wood
Ancient
Wood Framing
North America
1830's
Wood
Ancient

Iron
Gerzah, Egypt
3500 BC

Steel
Luristan, Iran
1000 BC
Wood Framing
North America
1830's

Cast Iron
Abraham Darby
1709

Steel
Henry Bessemer
1856
Wood
Ancient

Concrete
Tiryns, Greece
1400 BC

Iron
Gerzah, Egypt
3500 BC

Steel
Luristan, Iran
1000 BC
Concrete
John Smeaton
1750

Wood Framing
North America
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Cast Iron
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Henry Bessemer
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Wood
Ancient

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Tiryns, Greece
1400 BC

Iron
Gerzah, Egypt
3500 BC

Steel
Luristan, Iran
1000 BC
Material Analysis
As compared to other contemporary materials, Expanded Polystyrene holds advantages in weight and cost per cubic foot.
Concrete
$7 per cubic foot
150 pounds per cubic foot

Steel
$175 per cubic foot
490 pounds per cubic foot
Concrete Block
8” x 16” x 8”
37 Pounds

Lightweight
EPS foam contains 52x volume at roughly the same weight as concrete. This allows components to be fabricated much larger, with no weight penalty.
EPS Foam Block
4' x 8' x 1'
32 Pounds
Foam Form Factor
Foam's lightweight yet fragile nature suggest that it be used differently than other building materials. Unlike traditional ‘stick’ and ‘sheet’ typologies, which rely on the ability of materials to resist tensile and buckling forces, foam is best used as large, monolithic blocks.
Stereotomic Operations
The large scale size of foam blocks are tooled stereotomically via methods of varying precision and expediency
[Robotic Hot Wire Cutting, Computer Controlled Milling, and Hand Carving]
Contemporary EPS Usage
EPS foam is commonly used in construction, but most typically as faux-ornamental architectural elements.
Projective EPS Usage
The lightweight and inexpensive nature of EPS foam makes it a candidate for whole building construction.
Working methodology as placetype

The thesis positions three distinct placetypes next to one another: the workshop, the gallery, and the studio.
Site

The prospective site is in inter-city Chicago, along the Milwaukee Avenue corridor. This strip is home to a collection of shops, galleries, and architectural offices.
The wedge-shaped site is part of an open brown-field, and directly adjacent to an abandoned freight railroad corridor being transformed into an elevated linear park.
Material

The primary material used was EPS foam. It was transported to the MIT shop via container truck, stored outdoors under secured tarps, and brought inside to be processed.
Jigs

A series of 3 jigs were used to cut out the vaulted blocks. They were constructed from a series of MDF pieces and clamped to the sides of a foam blank before cutting by hand.
Block 01
Side 01: Jig A
Side 02: Jig B

Block 02
Side 01: Jig B
Side 02: Jig C Flipped
Block 03
Side 01: Jig C Flipped
Side 02: Jig B Flipped

Block 03
Side 01: Jig B Flipped
Side 02: Jig A
Block 05
Side 01: Jig A
Side 02: Jig C Flipped

Block 06
Side 01: Jig C Flipped
Side 02: Jig A
Block 07
Side 01: Jig A
Side 02: Jig C

Block 08
Side 01: Jig C
Side 02: Jig A
Nesting

Final parts were cut from the drop pieces of previous cuts, ensuring that material did not go to waste.
Variable Draft Angle Cutting

Zero-waste cutting requires that all parts from a cut are usable. Sliding foam pieces apart requires that conic draft angles are used so that blocks can be easily separated.
Zigzag Cutting

A ruled surface cut between two guide curves creates a pattern with a deep texture and no undercuts.
View looking through gallery.
View of front entrance from street.
View from Bloomingdale embankment.
View looking into gallery from Bloomingdale embankment.
View into studio.
View looking from gallery into workshop
View inside of workshop.
Works Referenced


