Rapid Delivery
Design and Construction of Homes

Prof. Larry Sass
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Motivation

Design & Build

*Bassett, Virginia 1960*
How to generate geometry for fabrication?

Alison Ramsey
Architects
Beaufort, South Carolina

CNC MIT
1949

CAD Sutherland
1963

MIT 2020
Why is Rapid Delivery Important?
Housing Shortage & Destruction
Conventional construction is impossible to measure

(cost & time)
There is no Delivery Technology in Prefab

*Epoch Homes (2012)*

- Not Scalable
- Driven by Manual Production
- Invented by Sears & Roebuck in 1920s
- Finished product must be rectangular
- Requires an indoor environment to build a large products
Need for Design Variation
Actions are manage by the exchange of information

*NOT software*
Digital Delivery

Design models are computable

Design for assemblies

Computing & Fab


Digitally Fabricated House for New Orleans
Design

3D Modeling
Error detection modeling
Prototyping

a) design

b) product

c) manufacturing
Fabrication

Laser Cutter

CNC (computer numerically controlled)
Hand-Guided Assembly
• Certified for a 75mph
• Can withstand a 140mph

Daniel Bonardi PE, Cambridge, MA
Bi-Directional Contouring

3D CAD Model

8" thick walls
pier

[0,0]
cont_z
[0,0]
cont_x
[0,0]
cont_y

3D CAD Model

cont_z
external surface

internal surface

[0,0]

Contouring

Plates

holes for ornamental assemblies

mortise tenon
finger joints

part number
Sets
01. Shape (exterior)
02. Reference Grid
03. Contours (interior)
04. Panels
05. Frieze
06. Rail
07. Stair
08. Ornament
09. Trim
10. Medallion
11. Window Frame
12. Door Frame
13. Window
14. Door
15. Crescent
16. Floor
Results
(2008)

1. 375 Square foot building (35 sq meters)

2. Assembly sustained by friction only

3. Model (Error detect & correct) 5000 components – 20 days to assemble

4. Building 5000 components – 22 days to assemble

5. Structure – Approved for 75mph winds – Max tested winds – 140mph

6. Materials:
   • Plywood (BC & AC Grade)
   • Polyethylene
   • Concrete Base
Advantages
Fast
Accurate
Flexible
Scalable
Productive

Disadvantages
Keyboard driven
Unclear system
3D Printing was on the rise
Materializing Design

D-Process

Blackbird

Factors in learning through the body and mind

1. The Situation (New Problem)
2. Time Pressure
3. Off-loading cognitive work onto the environment
4. The environment is part of the cognitive system
5. Cognition is for action
6. Offline cognition is body based


Planar Modeling Research
2012-14
Lu Ban

Design Fabrication Software
Lu Ban
Planar Modeling Software

MIT
Department of Architecture
Prof. Larry Sass & Dr. Lujie Chen
Contouring

Bi-Directional Contouring

Plate Forming
Contouring

Model Notes:
Method: Stack
Unit: mm
Model size X: 900
Model size Y: 286.999
Model size Z: 566.493
Dowel size: 5
Ring width: 15
Parts: 436
Machine time: 10 h
Assembly time: 37 h
Total time: 48 h
Nesting: ordered

1.77m

LuBan
176 Layers
(536mm)

3D Printing
265mm Max
Plate Forming
Future of LuBan
2020
Make It BIG

LuBan

www.luban3d.com

About LuBan

Interactive CAD/CAM software that helps designers and their creations. LuBan automatically generates 3D files as lithophane stack bake plate relief models.
Rapid Delivery as a collaboration between people and machines (learning)