Fabware:

Thinking about design software in support of an age of Digital Making

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Department of Architecture and Planning

MIT

Fabware

Fabrication Software

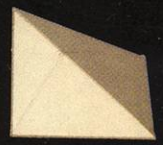
Proposal Overview & Problem

2 Projects

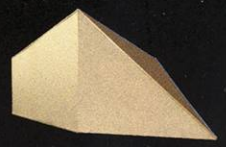
173_012M Cardboard
11.5 × 10.5 × 25.5 cm

173_013M Cardboard
14.5 × 9.5 × 25.5 cm

173_014M Cardboard
11.5 × 9.5 × 25.5 cm



173_012M Cardboard
11.5 × 10.5 × 25.5 cm



173_013M Cardboard
14.5 × 9.5 × 25.5 cm

173_014M Cardboard
11.5 × 9.5 × 25.5 cm

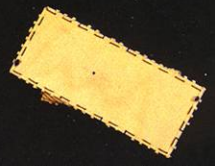
173_006M Linden wood
11 × 6 × 5 cm

173_007M Linden wood
11 × 6 × 5 cm

173_025M Wood and rubber bar
14 × 6 × 15 cm

173_006M Linden wood
11 × 6 × 5 cm

173_007M Linden wood
11 × 6 × 5 cm



173_025M Wood and rubber bands, 14 × 6 × 15 cm

173_024M Cardboard and wood
14.5 × 6 × 27 cm

173_027M Cardboard and wood
15 × 6 × 26 cm

173_020M Cardboard and wood
15 × 6 × 25 cm

173_024M Cardboard and wood
14.5 × 6 × 27 cm

173_027M Cardboard and wood
15 × 6 × 26 cm

173_020M Cardboard and wood
15 × 6 × 25 cm

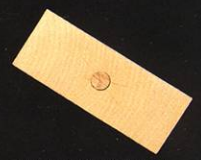
173_015M Cardboard
18 × 8.6 × 27.5 cm

173_017M Cardboard and copper mesh, 18 × 8.5 × 28 cm

173_023M Linden wood
14.5 × 5.5 × 25.5 cm

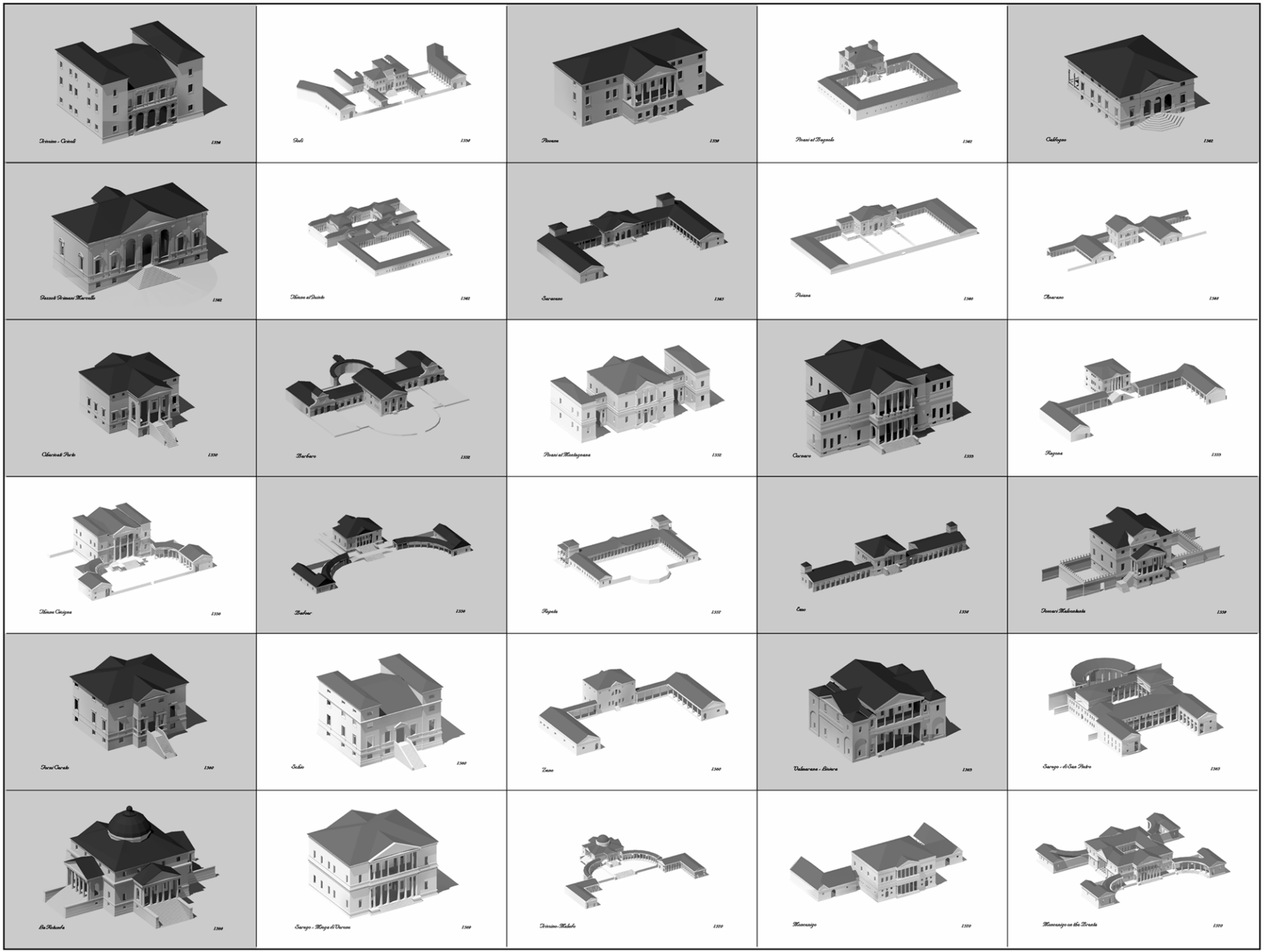
173_015M Cardboard
18 × 8.6 × 27.5 cm

173_017M Cardboard and copper mesh, 18 × 8.5 × 28 cm

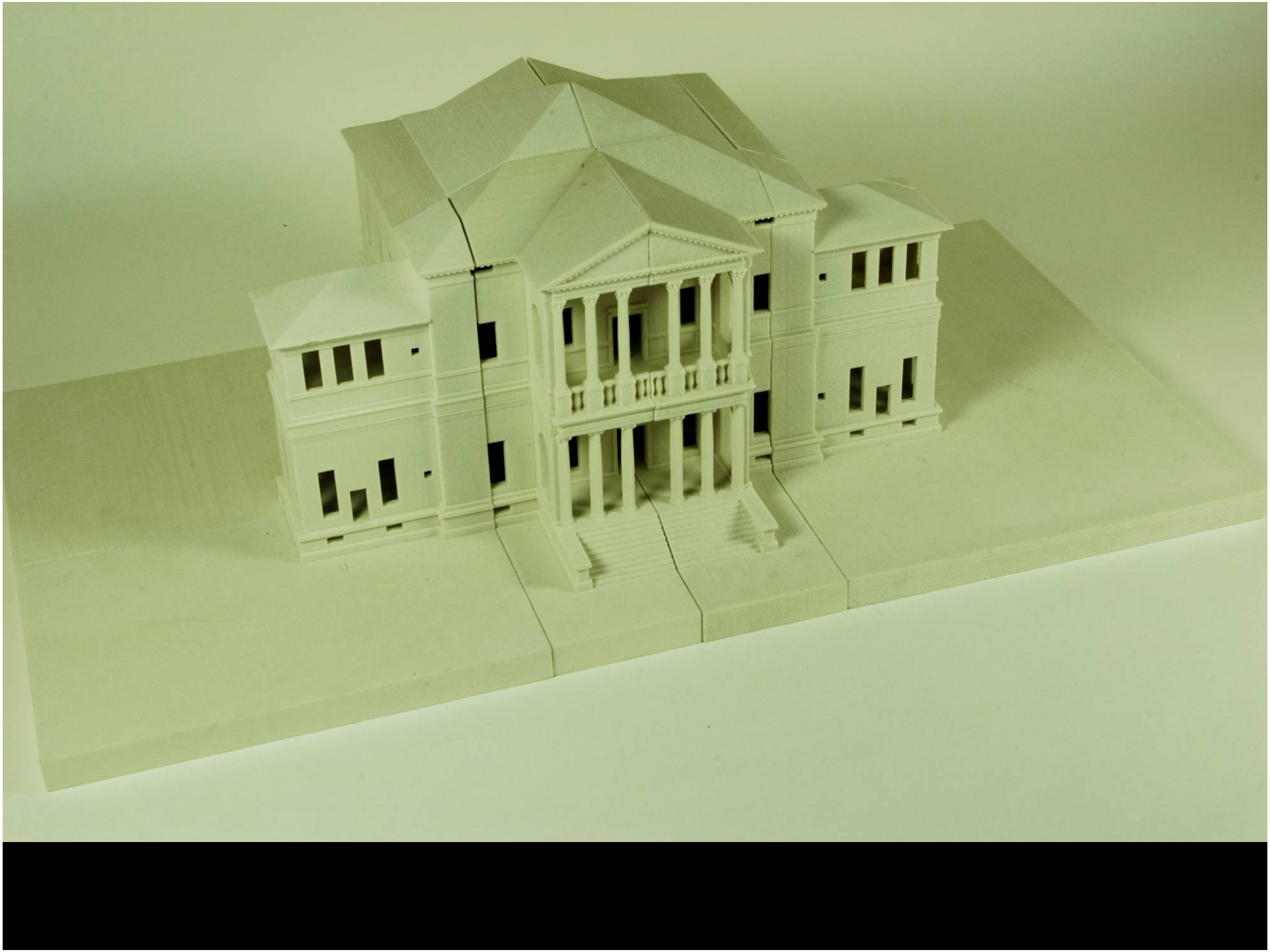


173_023M Linden wood
14.5 × 5.5 × 25.5 cm

Herzog & de Meuron
New de Young Museum, California (1999– →173)


Trissino - Cricoli 1534
Gioli 1538
Piovana 1539
Pisani al Bagnolo 1542
Caldogno 1542
Fazzoli Primani Marcello 1542
Nicola al Quinto 1542
Saracano 1543
Poiana 1548
Monarano 1548
Chiericati Porto 1550
Barbaro 1552
Pisani al Montagnana 1552
Cornaro 1553
Ragona 1553
Nicola Cicogna 1556
Badoer 1558
Rapata 1557
Emo 1558
Foscari Malcontenta 1559
Forni Curato 1560
Sclio 1560
Zeno 1560
Valmarana - Lisiera 1565
Sarego - di San Pietro 1565
La Rotonda 1566
Sarego - Monga di Verona 1569
Trissino-Malado 1570
Mancanigo 1570
Mancanigo on the Brenta 1570

MIT



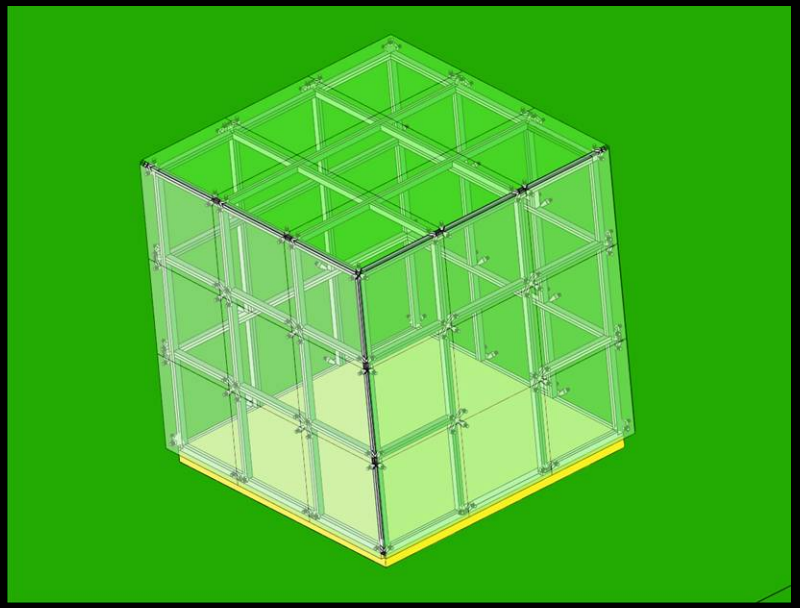
Design Descriptions

Software – Studio

- Solid Modeling
- Scripting
- Surface Modeling

Software – Construction

- Parametric Modeling
- Finite Element Analysis
- G Code



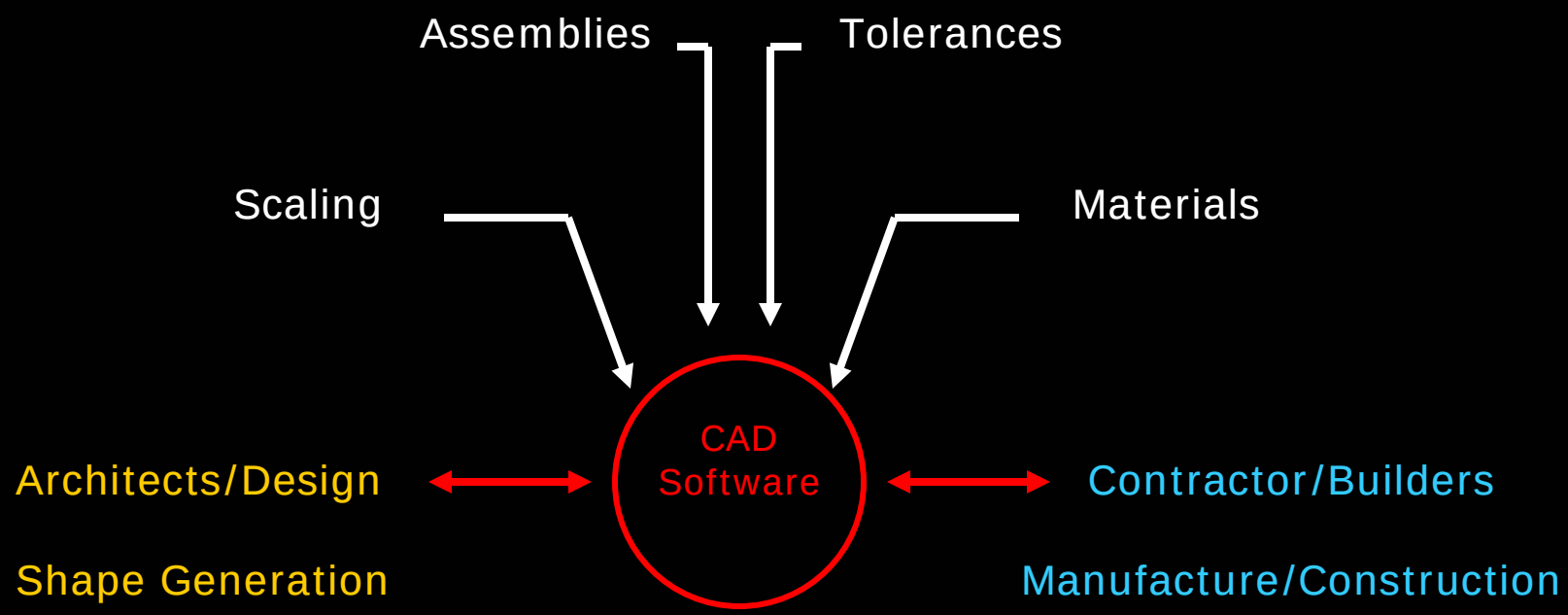
Machines – Studio

- Laser Cutter
- Stratasys Printer
- Zcorp Printer
- SLS
- Stereolithography

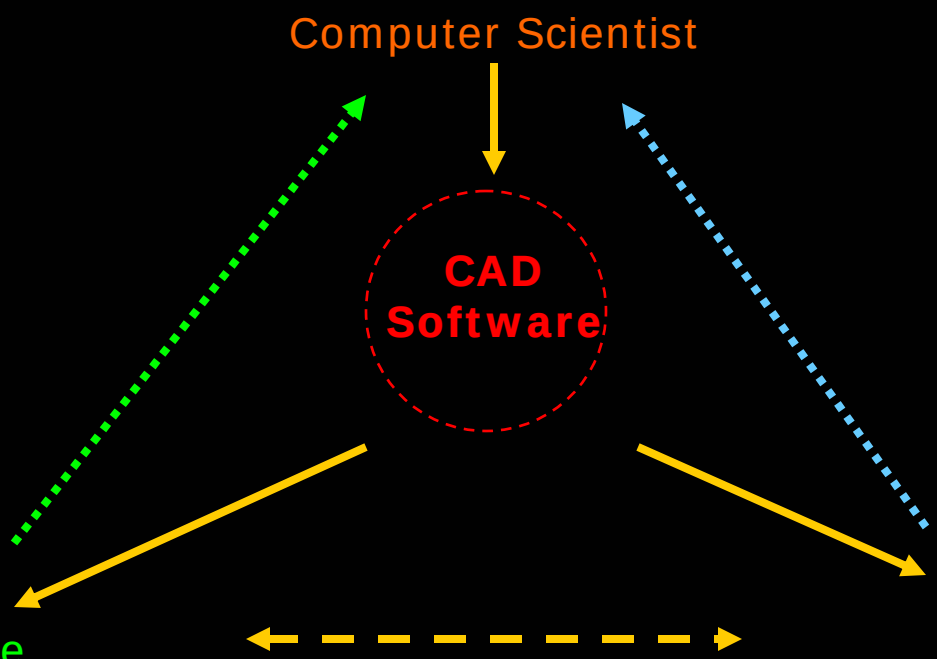
Machines – Construction

- NC
- Milling
- Routing
- Plasma Cutting
- Lathe

Digital Fabrication Process



Current Use of Software



Architecture

Autocad
CATIA
RhinoIllustrator
Modela Milling
Stratasys
Zcorp
Universal Laser
Feature CAM
Omax Layout

Construction

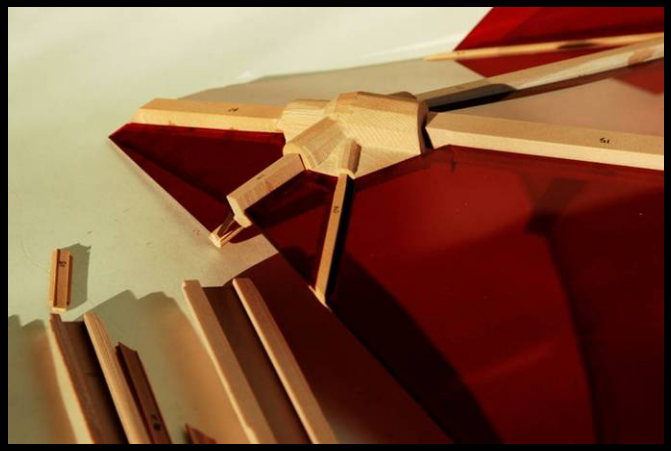
XSteel
MasterCAM
Finite Element Analysis
Machine Languages
Parametric Modeling

1

3

2

4

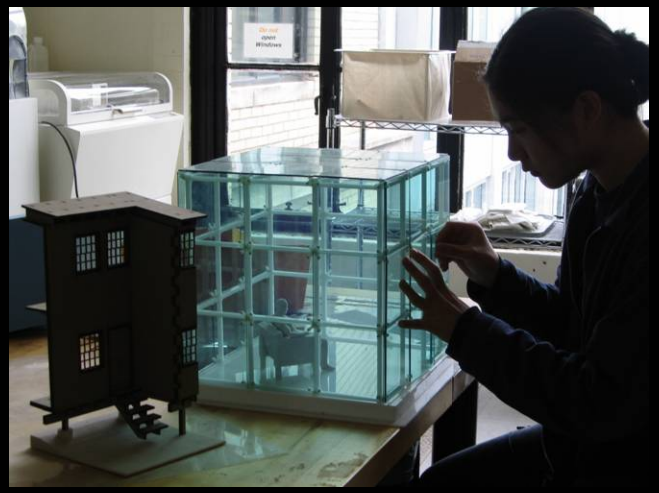


Rapid Prototyping Lab

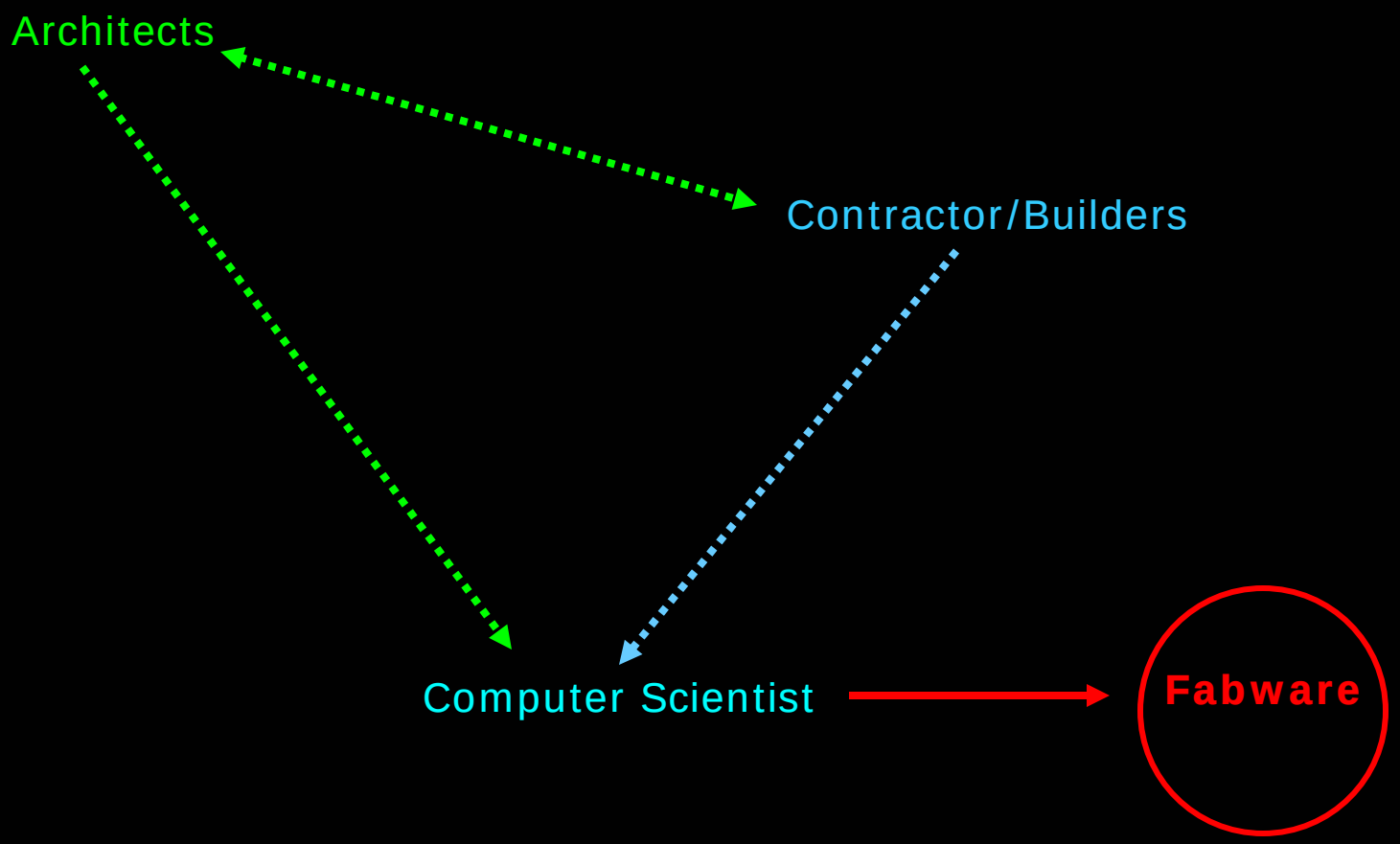
Digital Design Fabrication

Rapid Prototyping & CAD CAM Devices

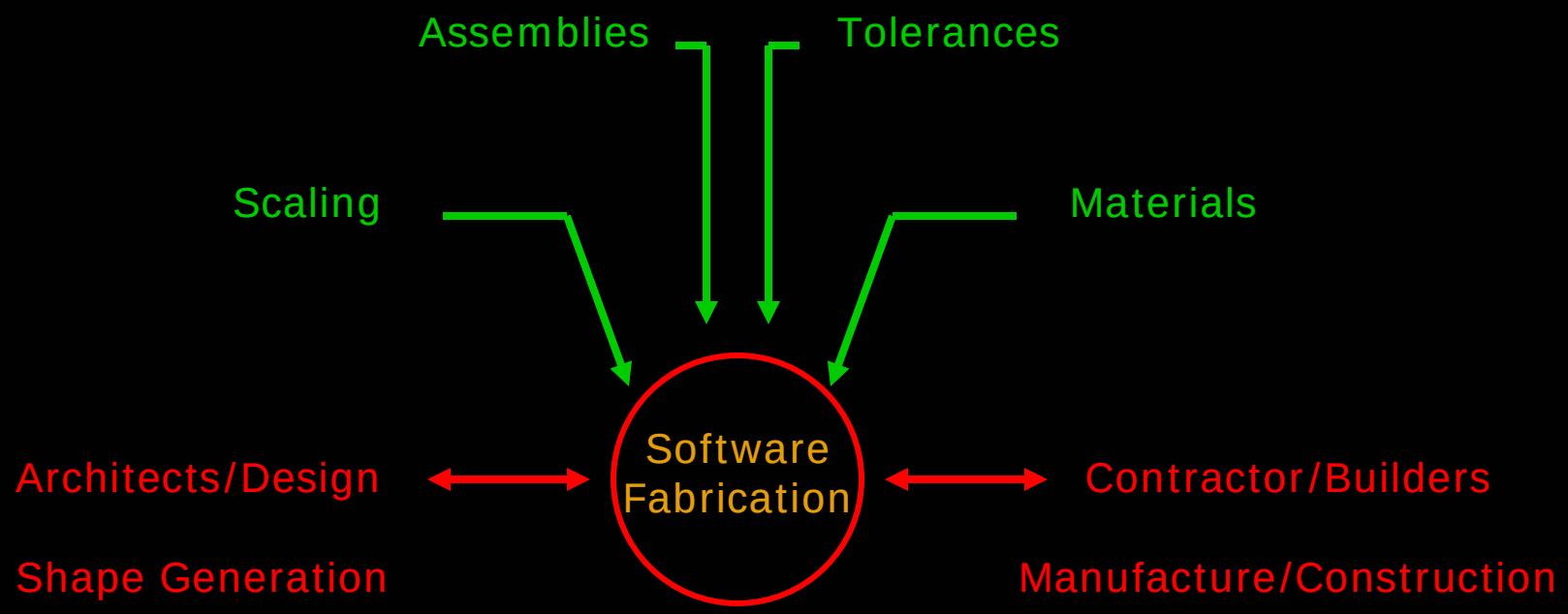
2 CAM Cutters	Laser Cutter/Paper Cutter
2 Mills	Denford & Modella
2 3D Printers	Stratasys & ZCorp
2 NC Cutters	Techno-Iesle Router & Omax Water Jet Cutter



New software focused on fabrication for creative exploration
(Research)



Digital Fabrication Process



Fabware

Criteria

1. Builds geometry (generative)
2. Builds geometries at different scales
3. Generative constraints are based on the materials library
4. Designs assemblies between defined geometries
5. Accounts for tolerances between parts
6. Prepares geometries for a particular machine

Candidate Ideas

Candidate Ideas

Construction File

Architects/Design

Contractor/Builders

Projects

Fabware

Rule Building

Yanni Loukissas

Emergency Housing

Han Hoang & Victoria Wang

“We can hardly expect to be able to make machines do wonders before we find how to make them do ordinary, sensible things”

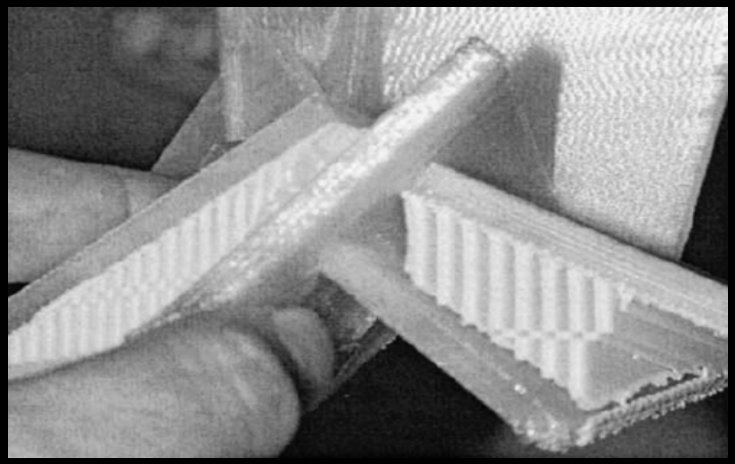
Minsky
1986

Background

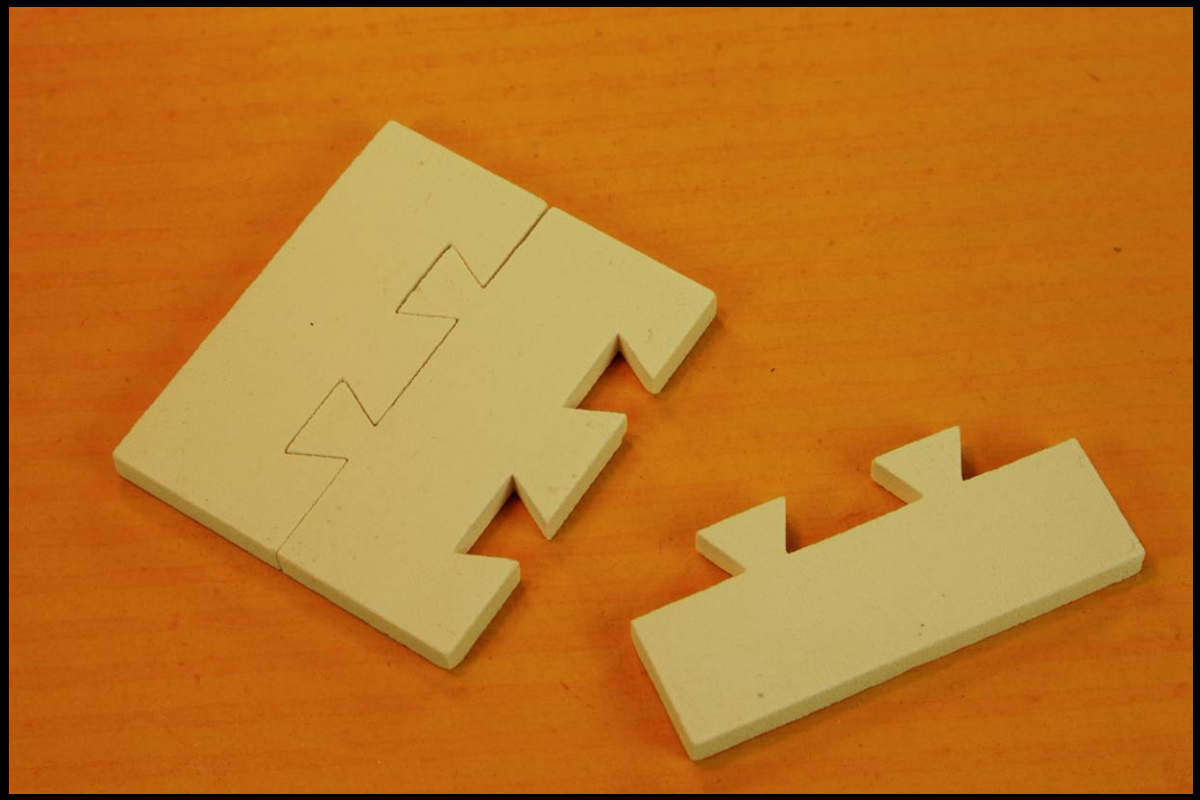
Wang, Yufei, and José Pinto Duarte. 2002. Automatic generation and fabrication of designs. *Automation in construction* 11: 291–302.

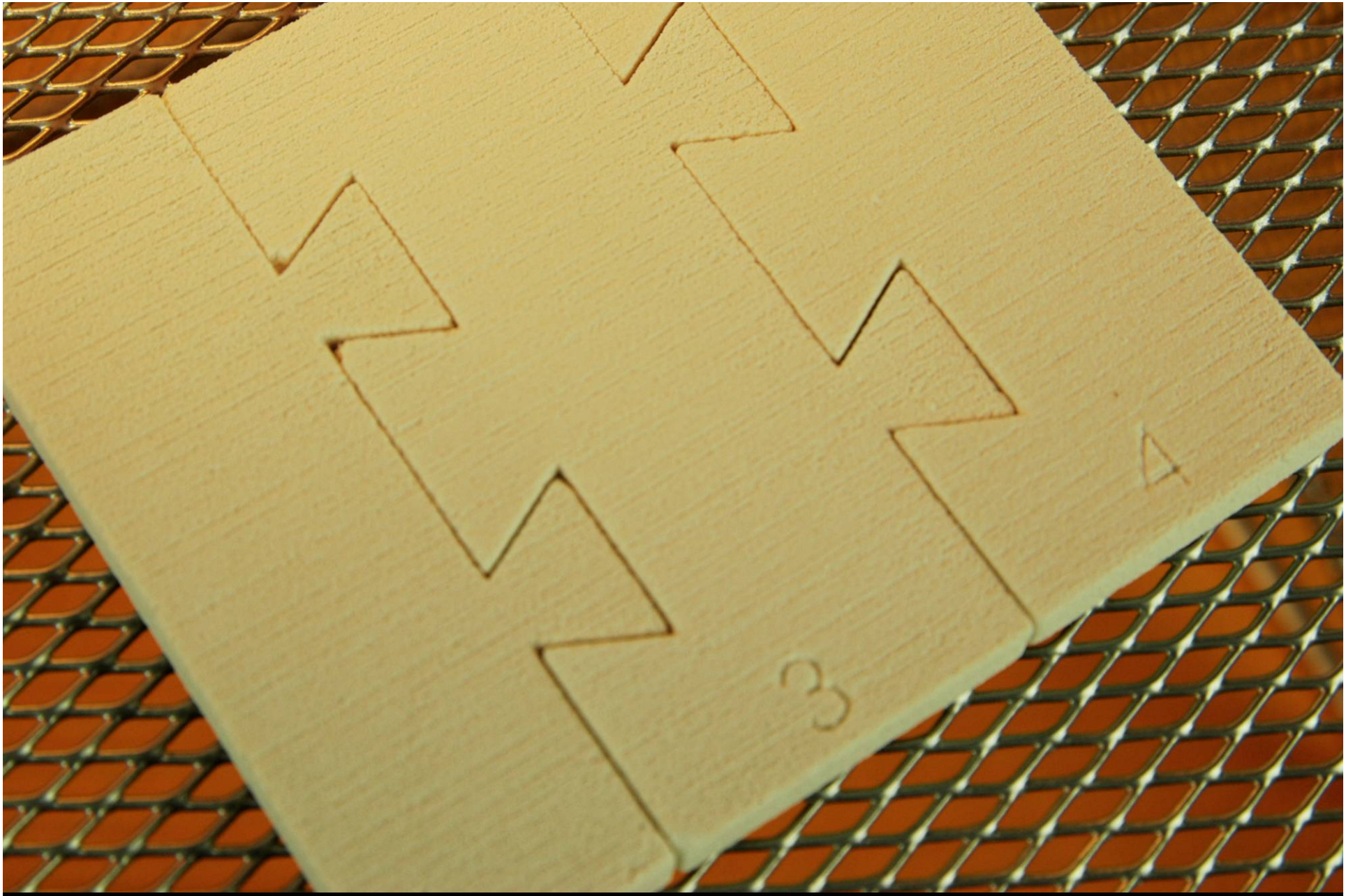
Kilian, A. 2003, Fabrication of partially double-curved surfaces out of flat sheet materials through a 3d puzzle approach, In “ACADIA 2003: Connecting Crossroads of Digital Discourse,” Muncie Indiana, Pages 74-81

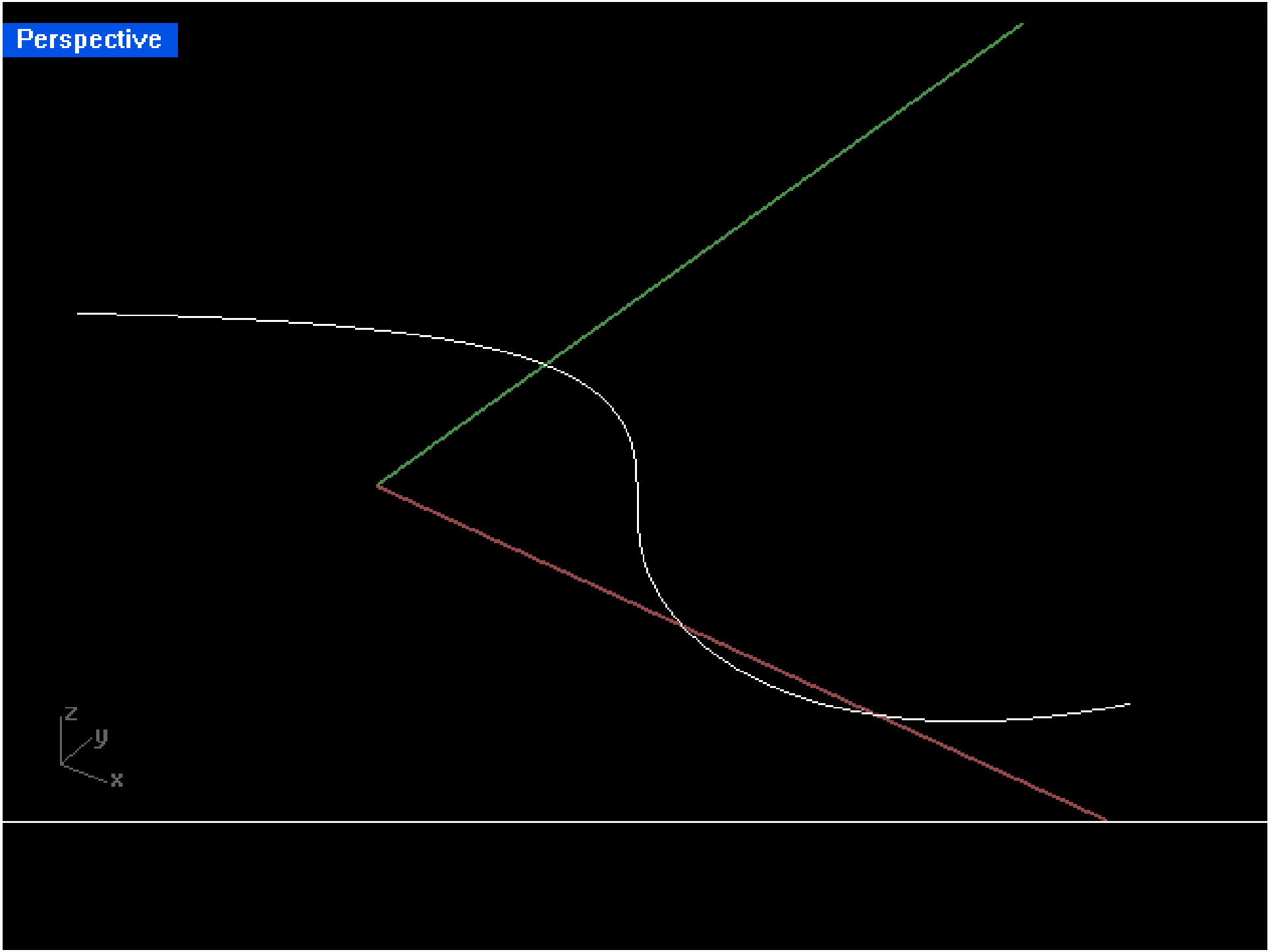
Soman, Aditya, Swapnil Padhye, and Matthew I. Campbell. 2003. Toward an automated approach to the design of sheet metal components. *Artificial intelligence for engineering design, analysis and manufacturing* 17: 187–204.

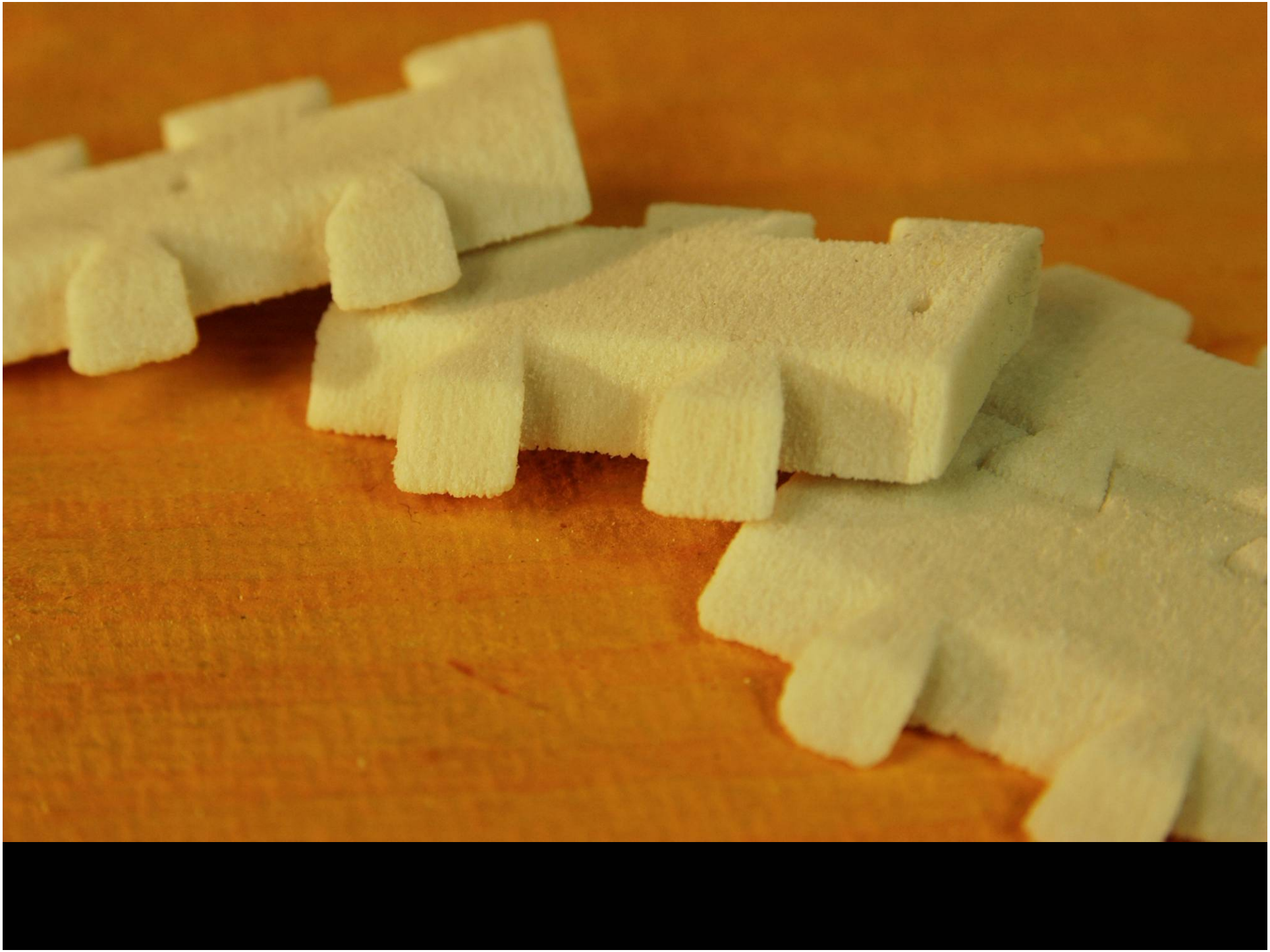


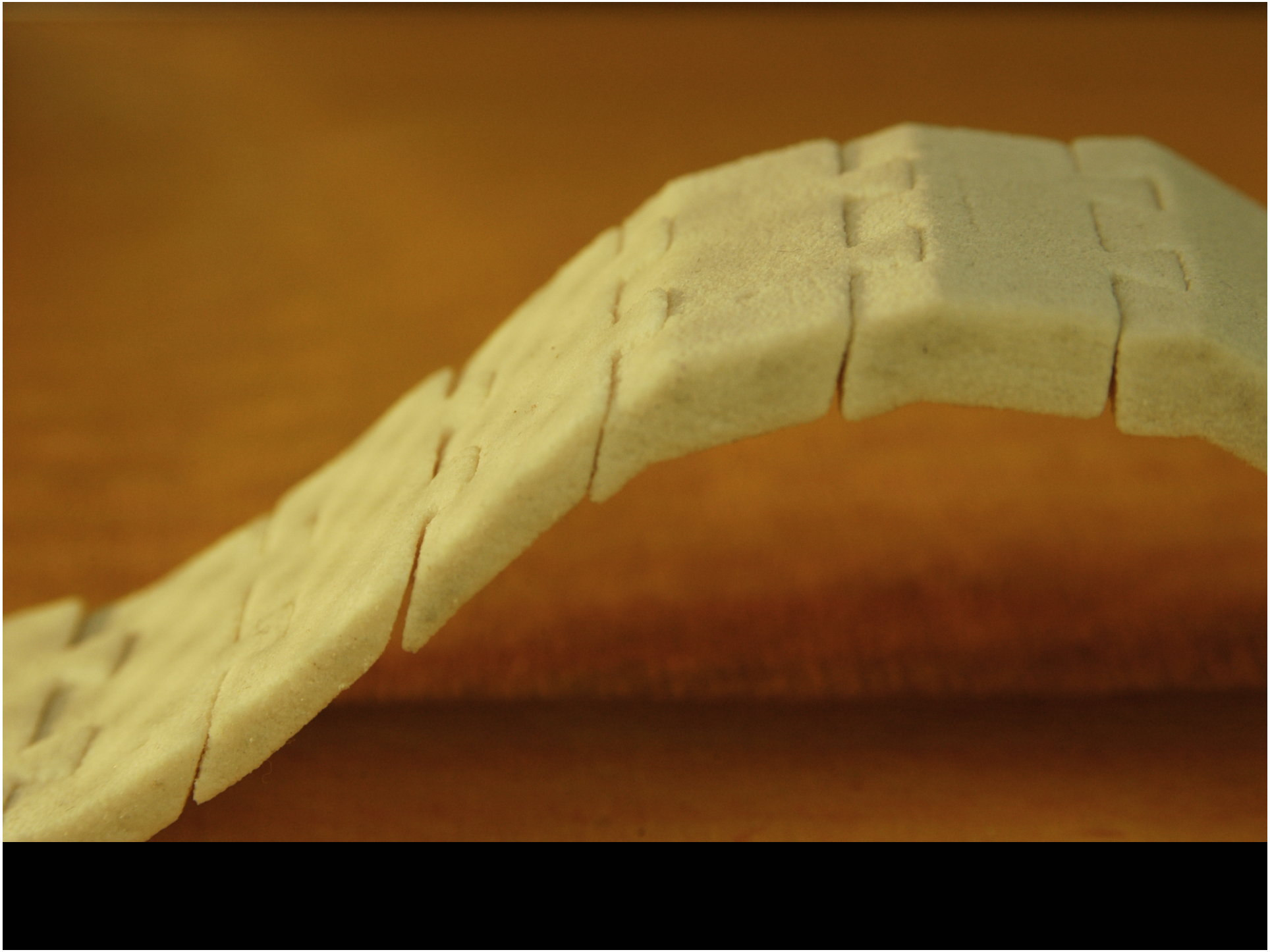
Rule Building

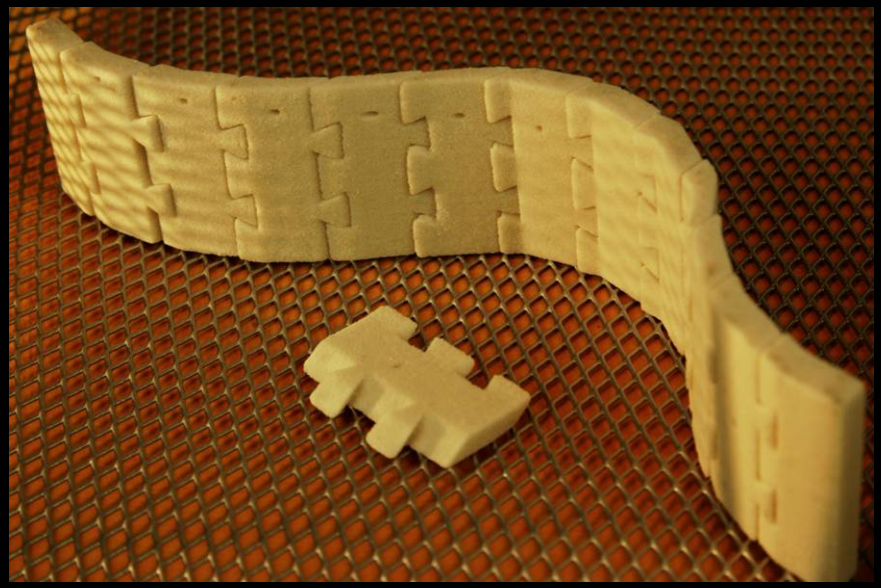



3
4


Perspective
z
y
x







1. Builds geometry (generative)
2. Generative base is from material
3. Designs assemblies between defined geometries
4. Prepares geometries for a particular machine

1. Builds geometries at different scales
2. Accounts for tolerances between parts

Emergency Housing

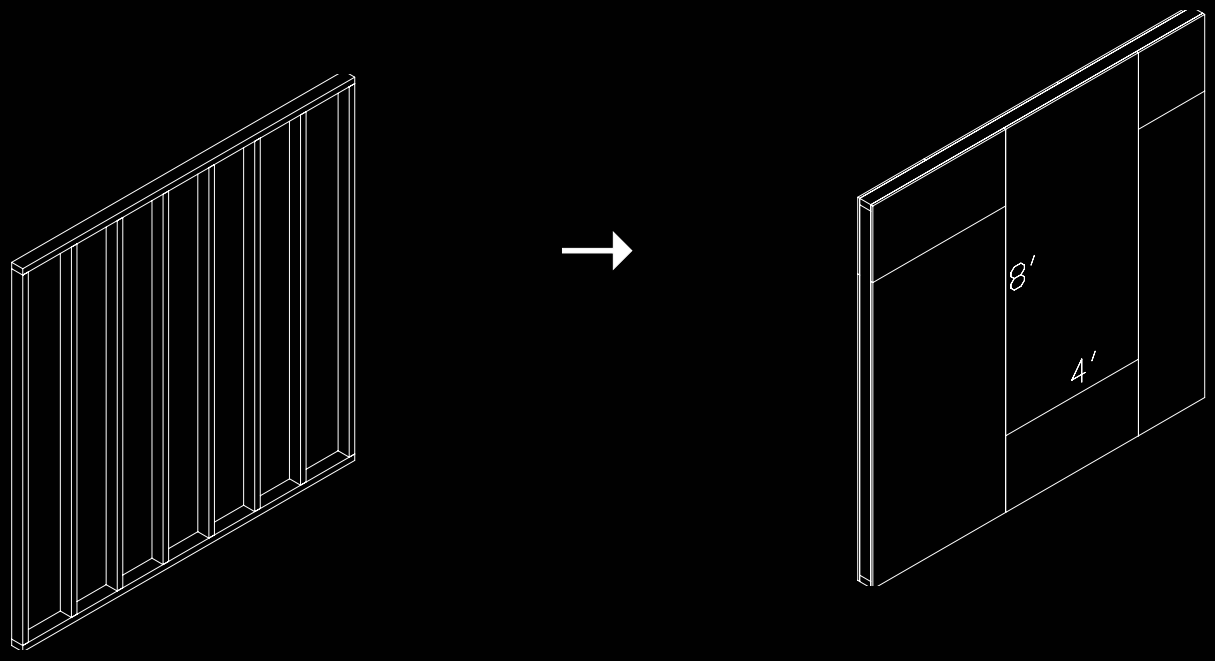
Building low cost housing using computation

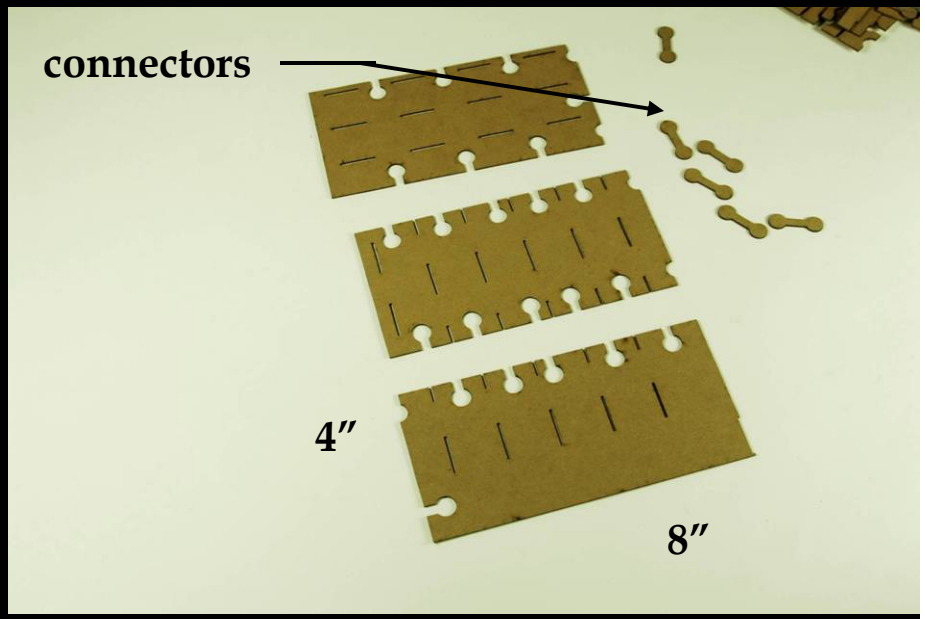
image shelterproject.org
www.shelterproject.org

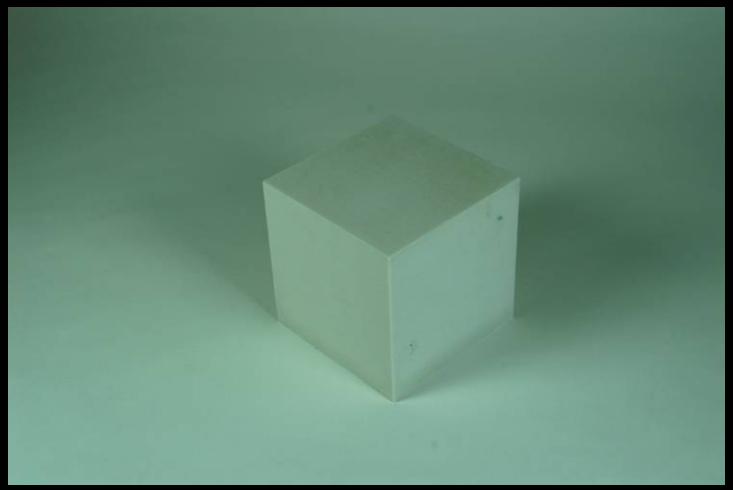
Motivation

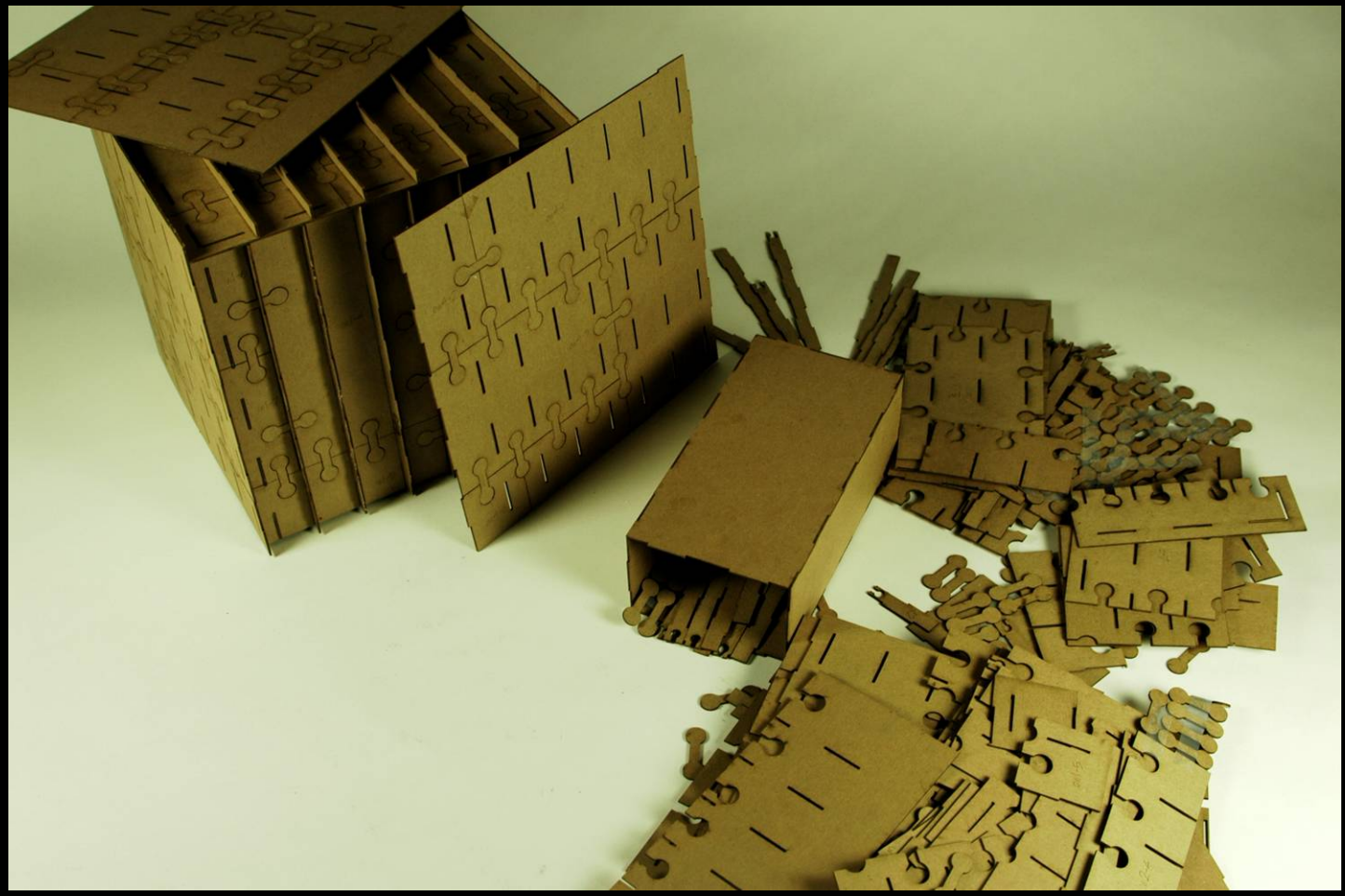
- Houses of one material Plywood or OSB (oriented structural board) 4’ x 8’ x ¾”
- Friction fit connections
- Computer program to generate the files for CAD CAM fabrication based on shape rules
- Can be built anywhere with or without insulation
- Manufacturing Waste can be recycled

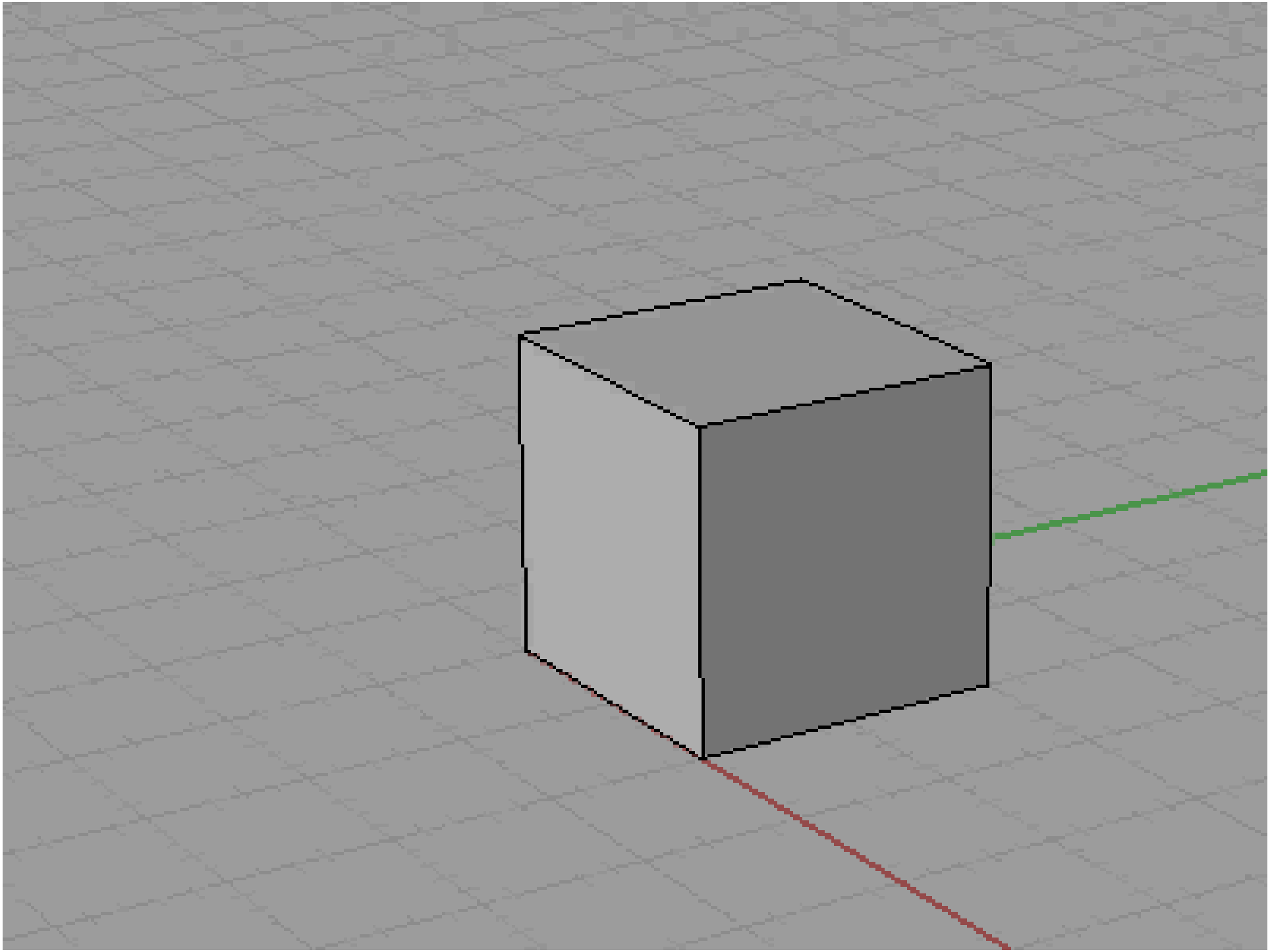
- Rules for traditional walls

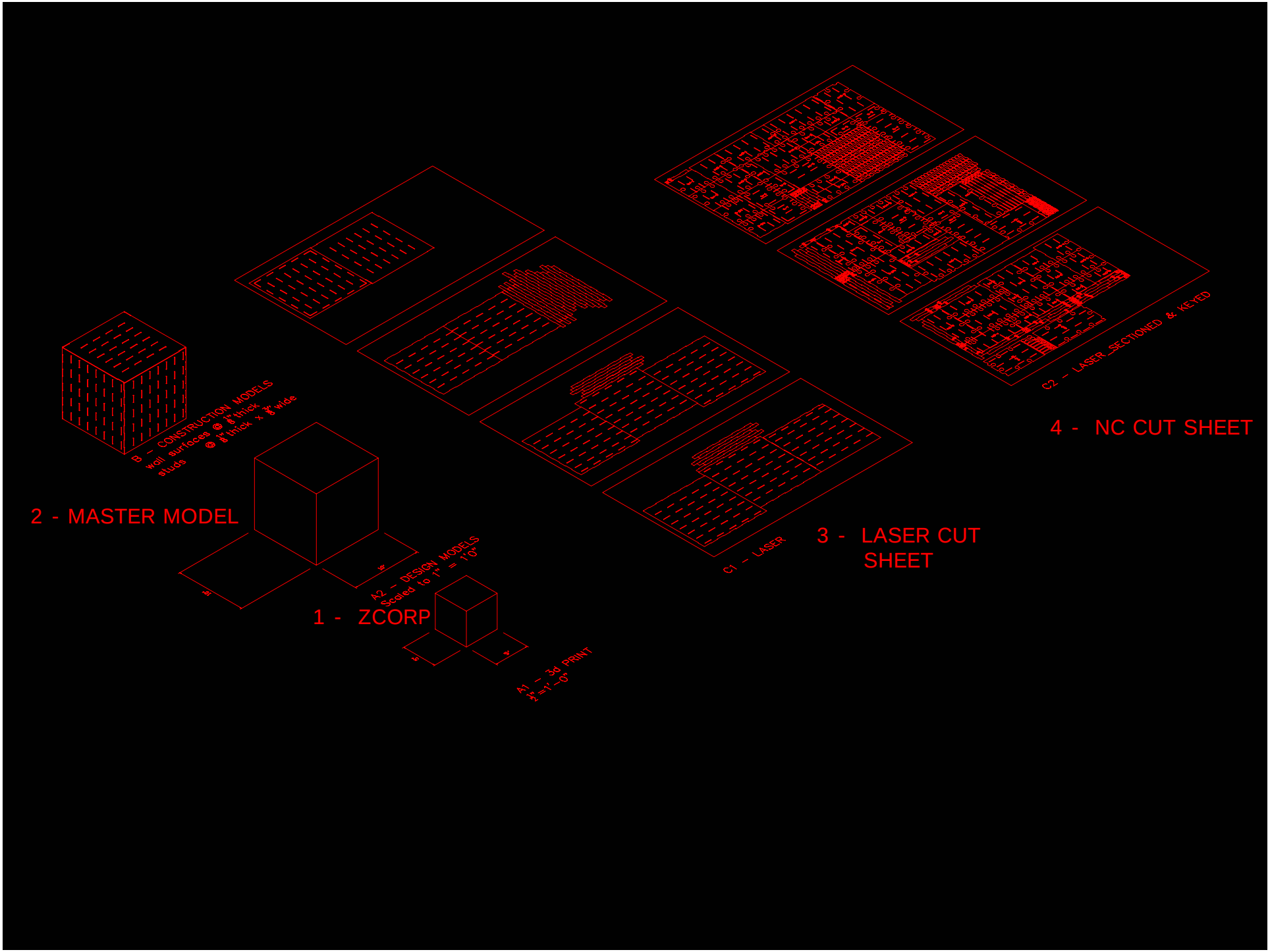



connectors
4″
8″

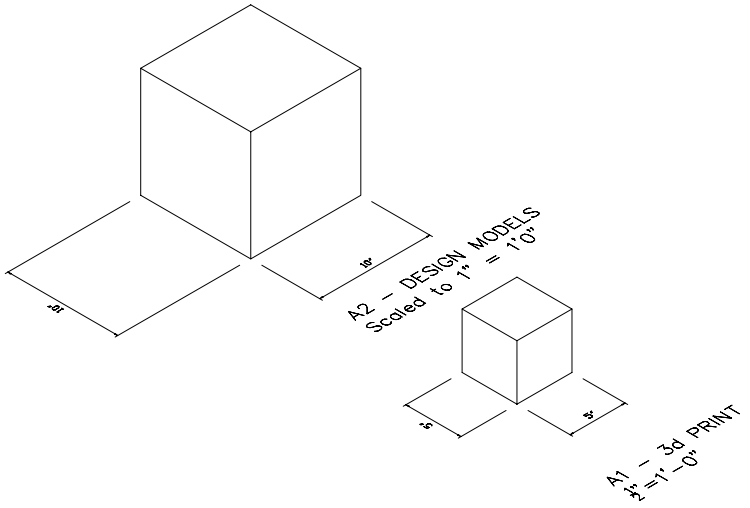


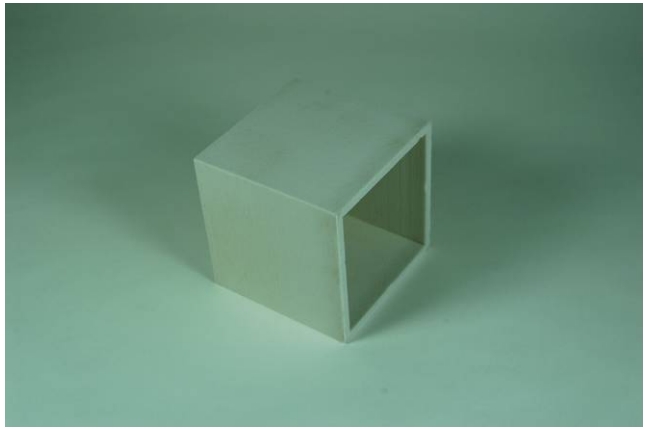




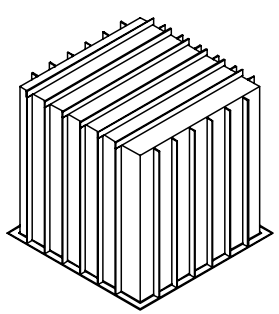

B – CONSTRUCTION MODELS
wall surfaces @ ⅛" thick
studs @ ⅛" thick x ½" wide
2 - MASTER MODEL
A2 – DESIGN MODELS
Scaled to 1" = 1'0"
1 - ZCORP
A1 – 3d PRINT
3" = 1'-0"
C1 – LASER
3 - LASER CUT SHEET
C2 – LASER SECTIONED & KEYED
4 - NC CUT SHEET

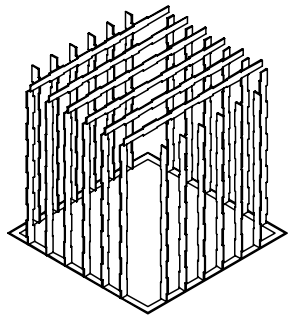
1 - Design Model

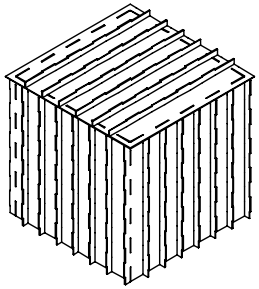


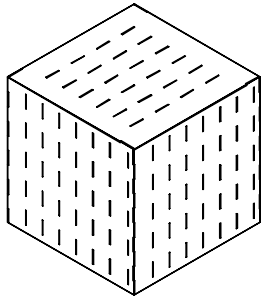


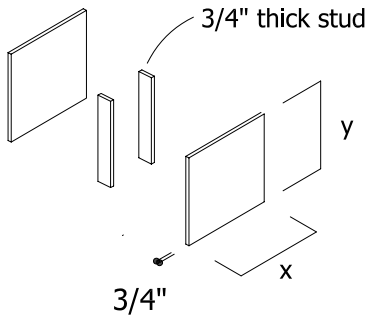
2 - Master Model



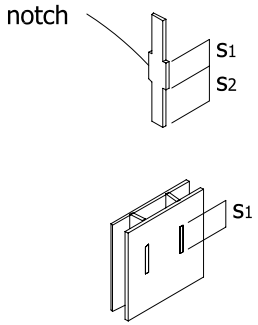




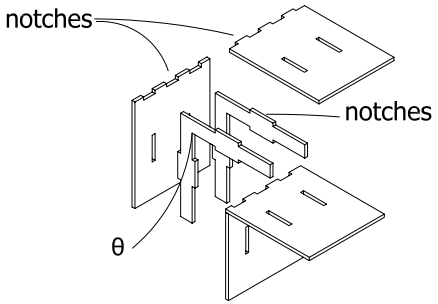




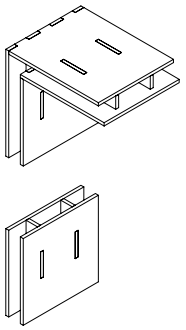
common wall



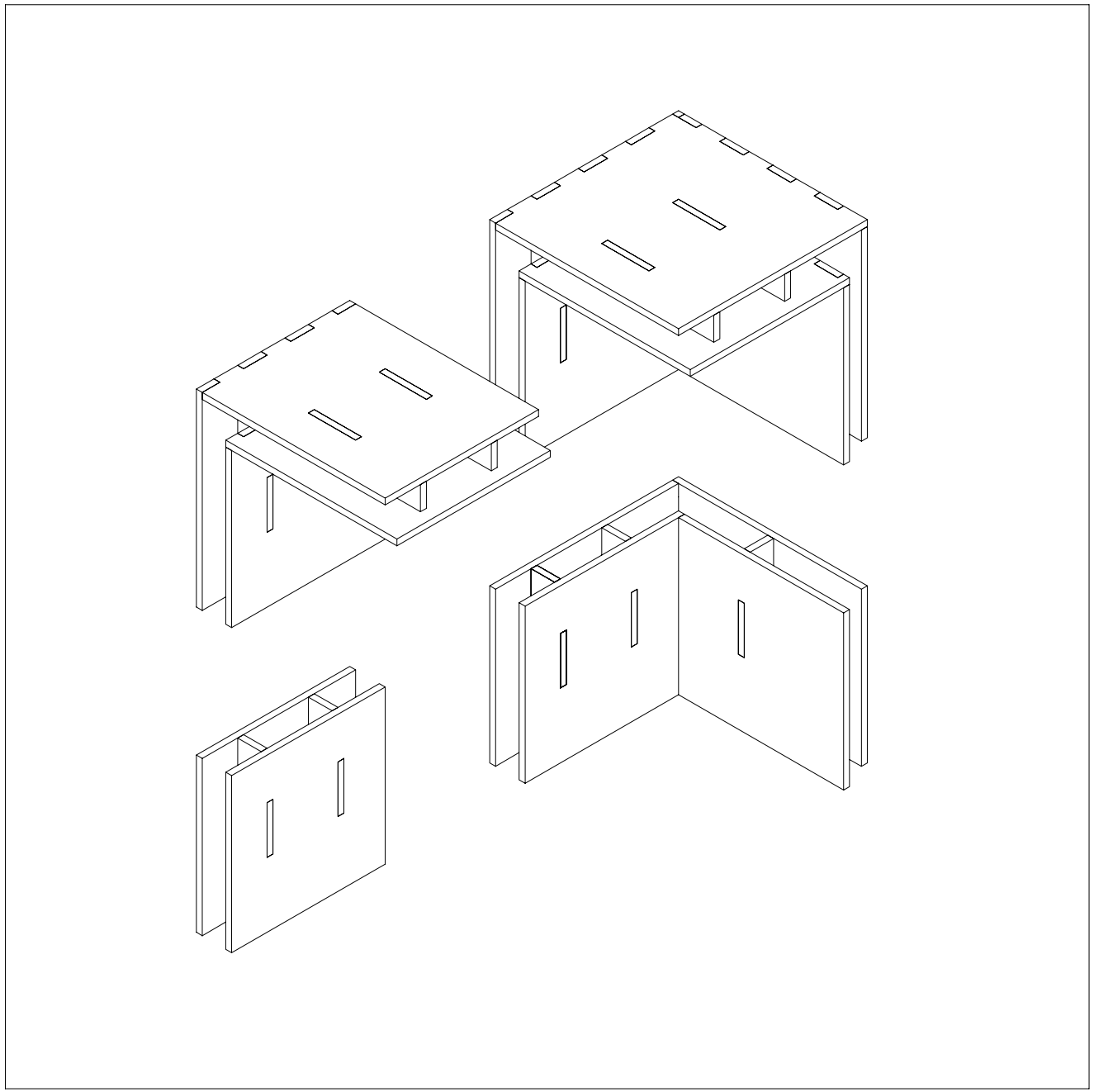
machine wall



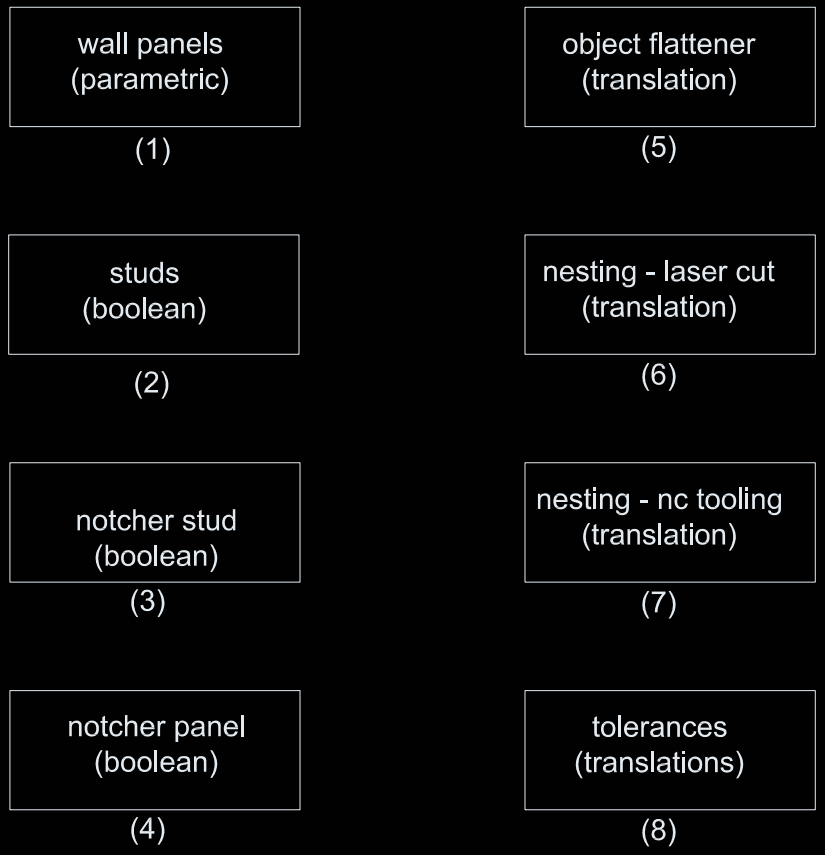
end assembly

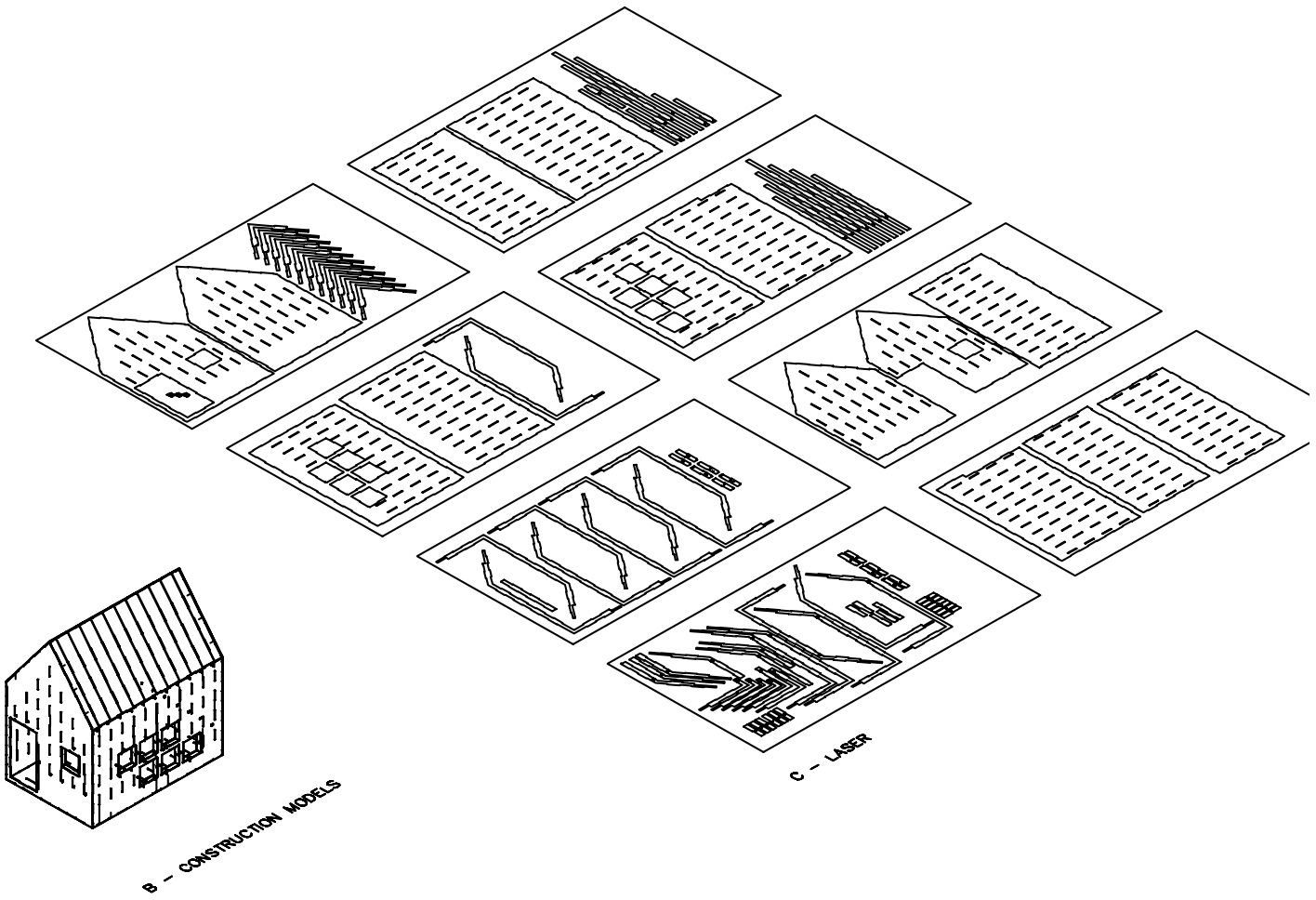


wall and end assembly

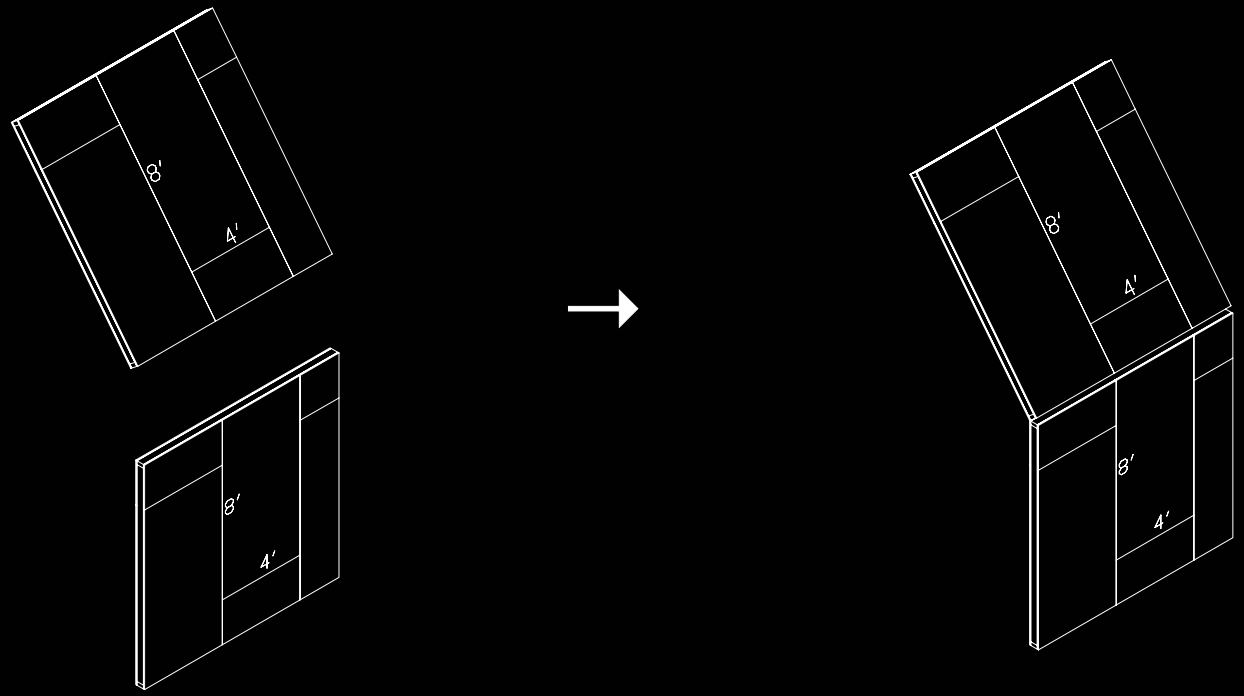


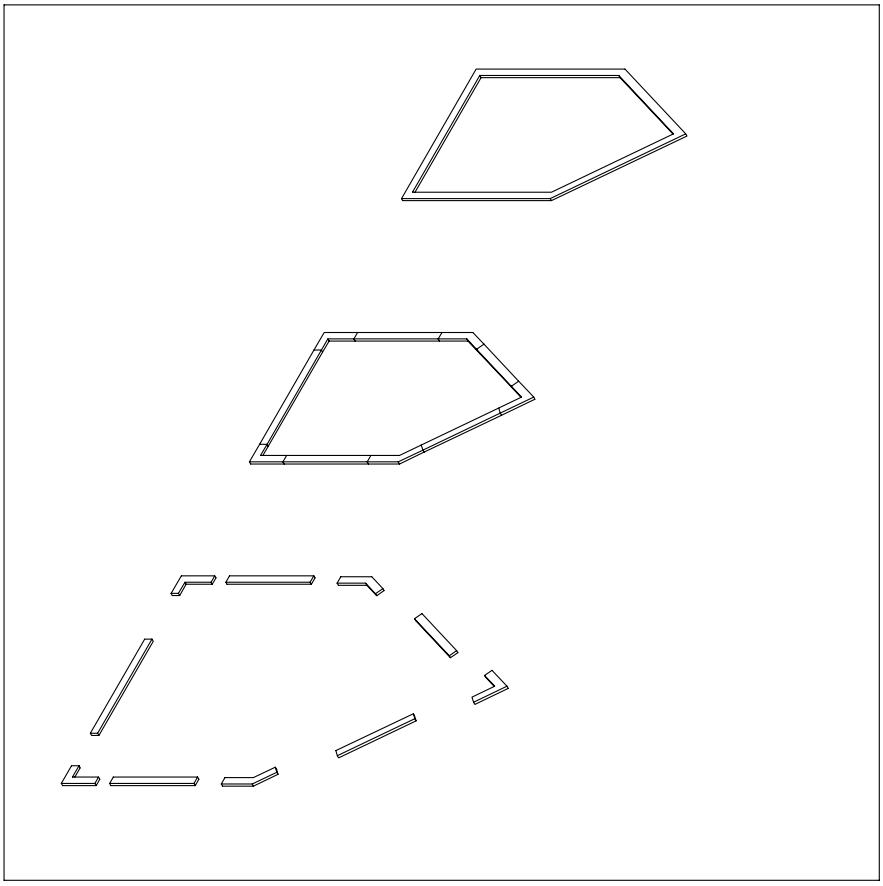
2 – Master Model Program Functions

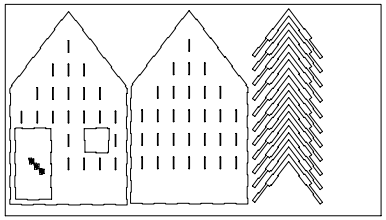
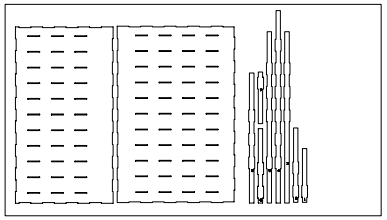
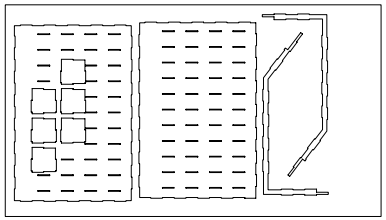
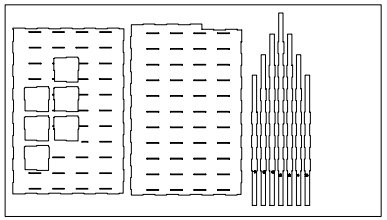
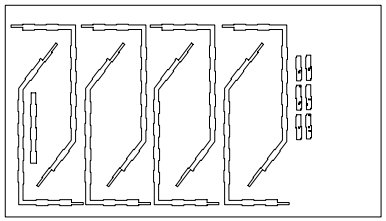
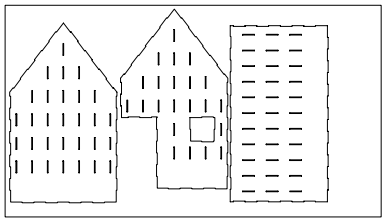
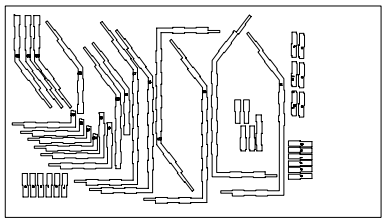
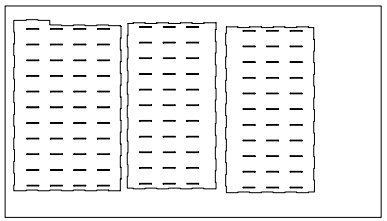


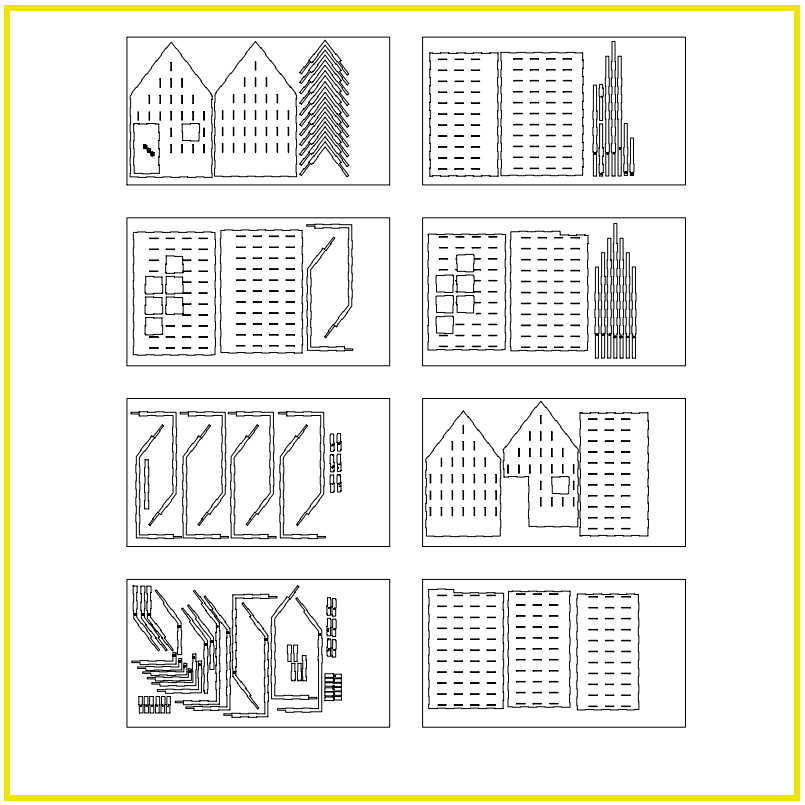

B – CONSTRUCTION MODELS
C – LASER

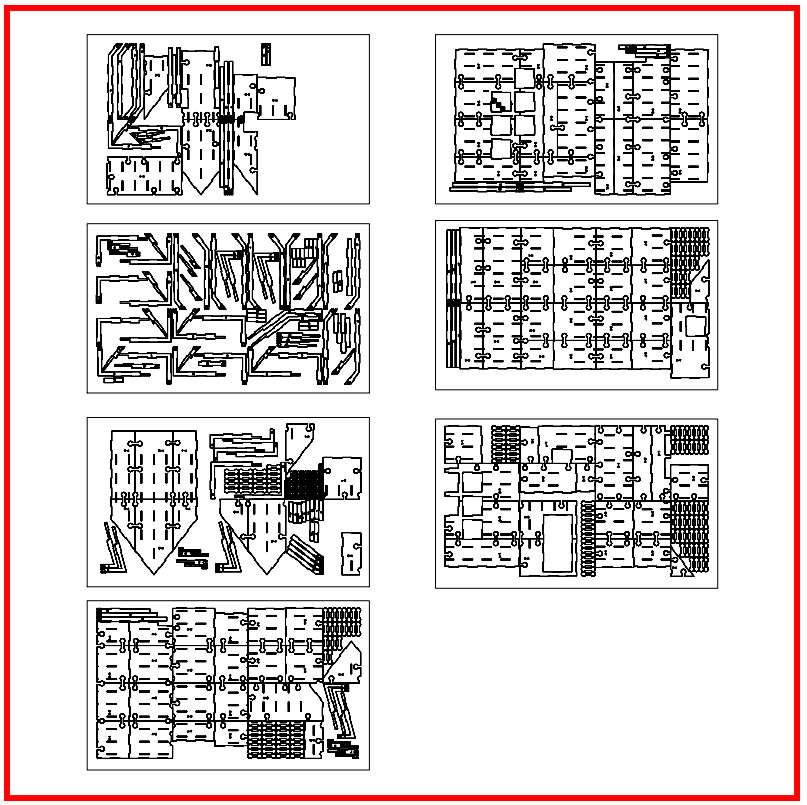
- Traditional wall section

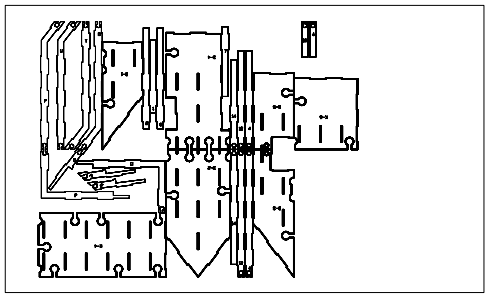


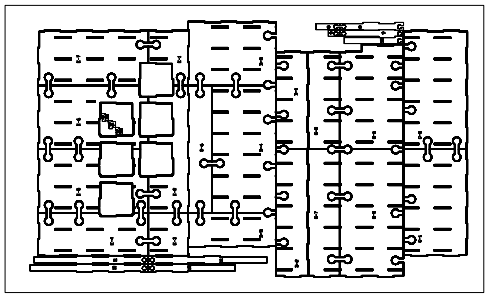


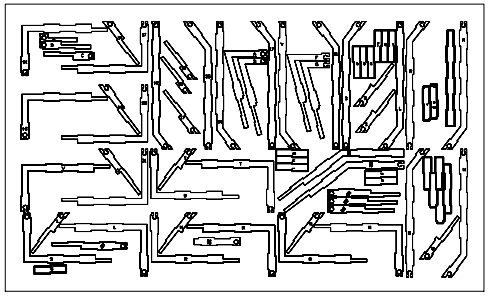









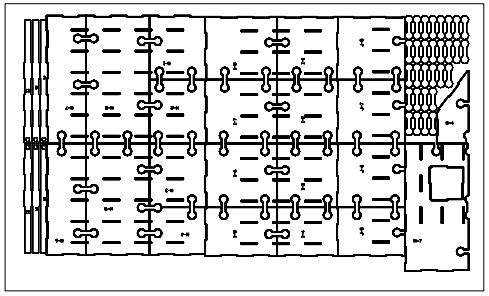


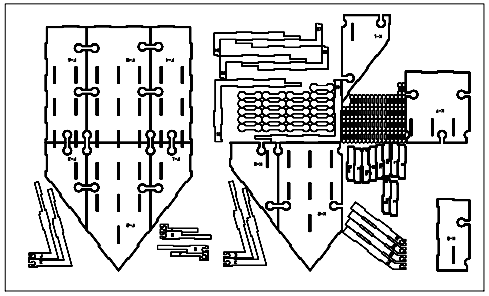


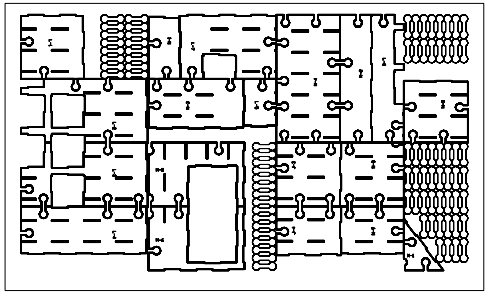


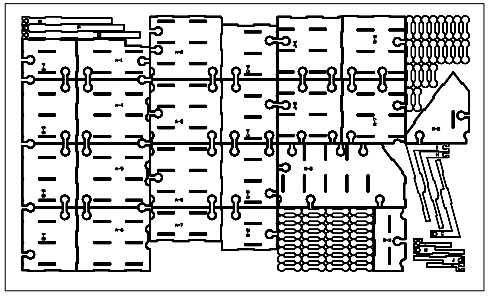


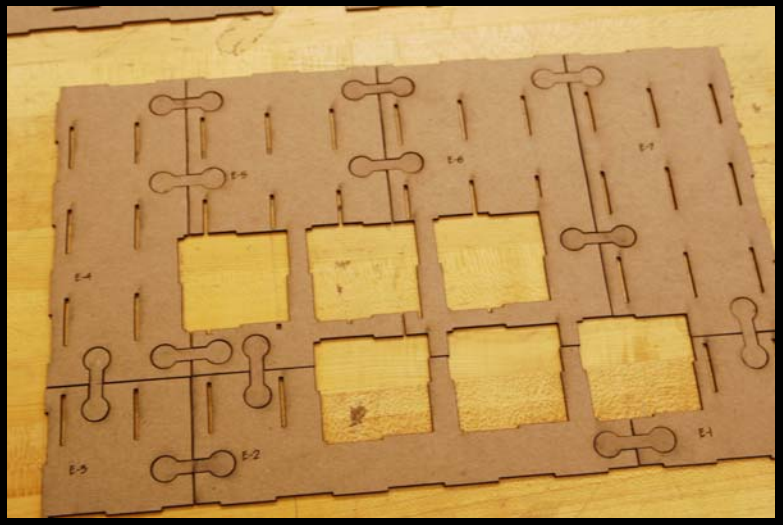


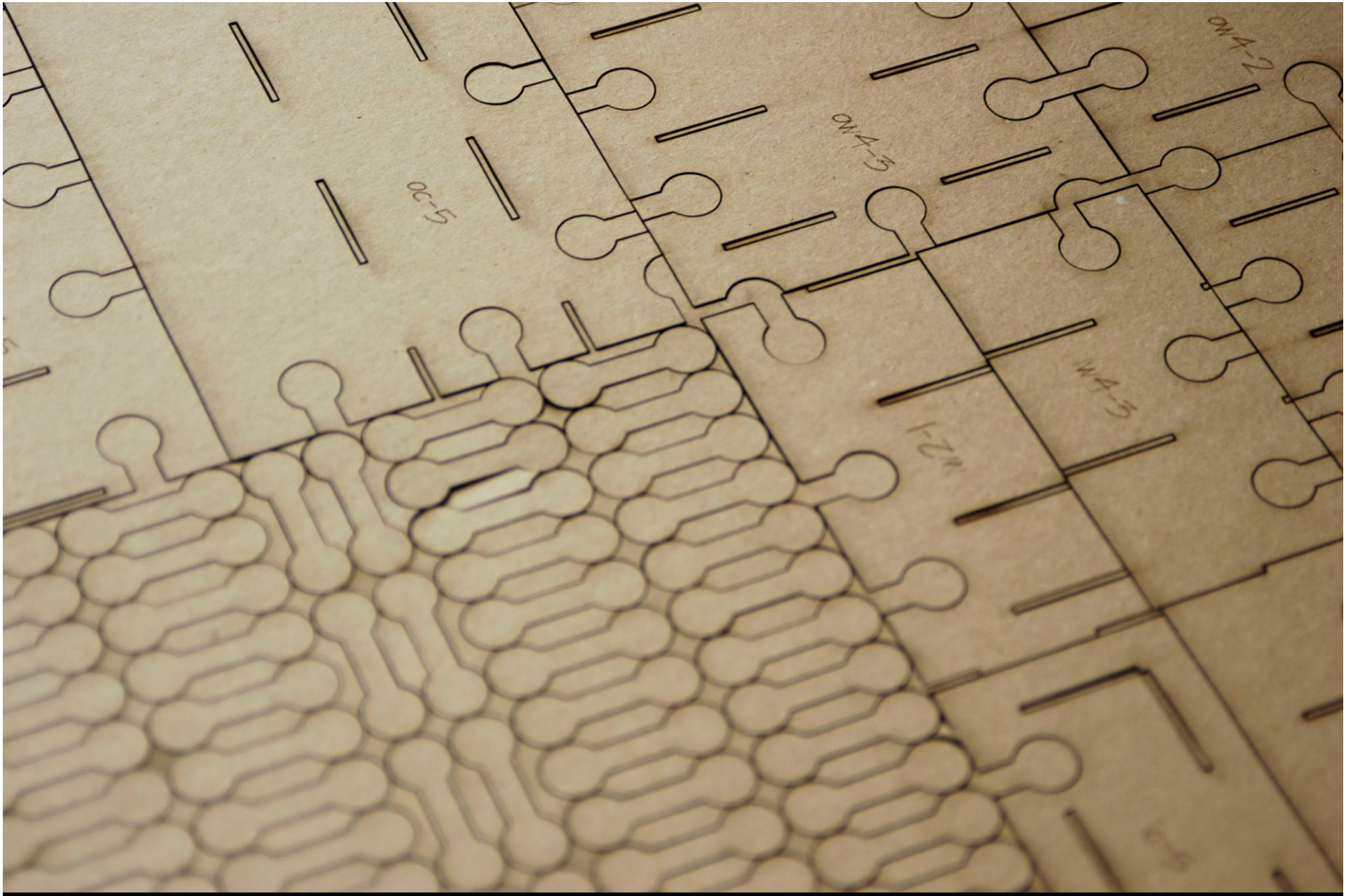








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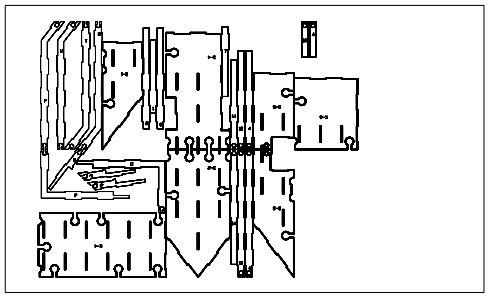
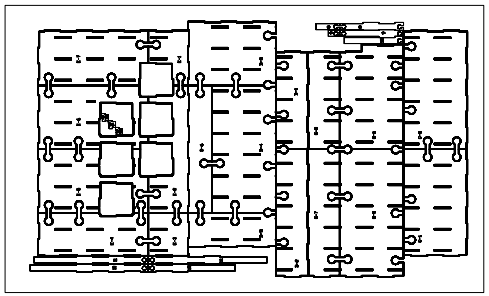
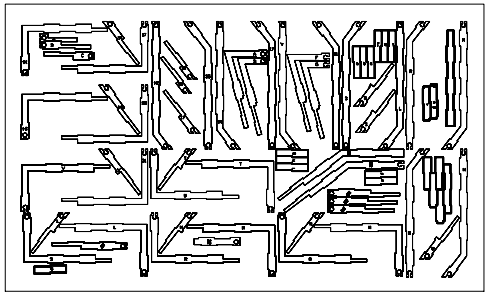
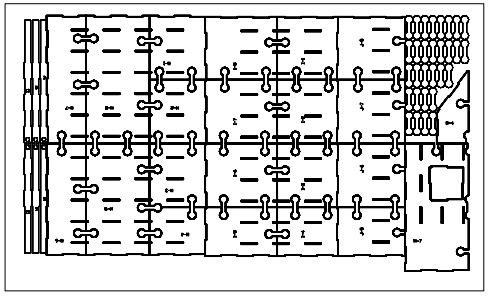
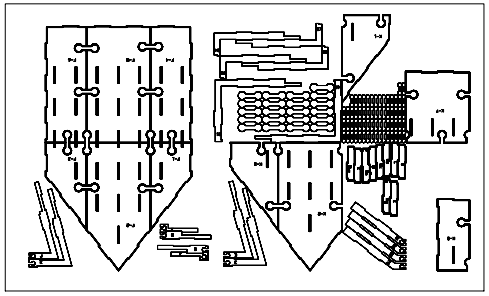
OW4-2
W4-3

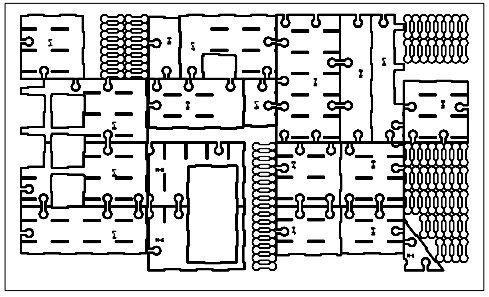


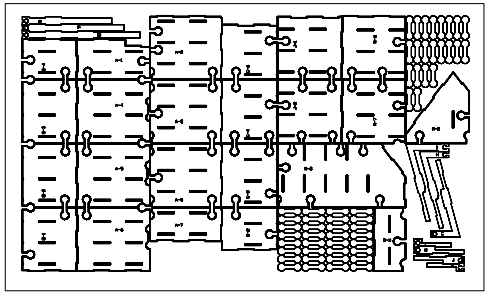


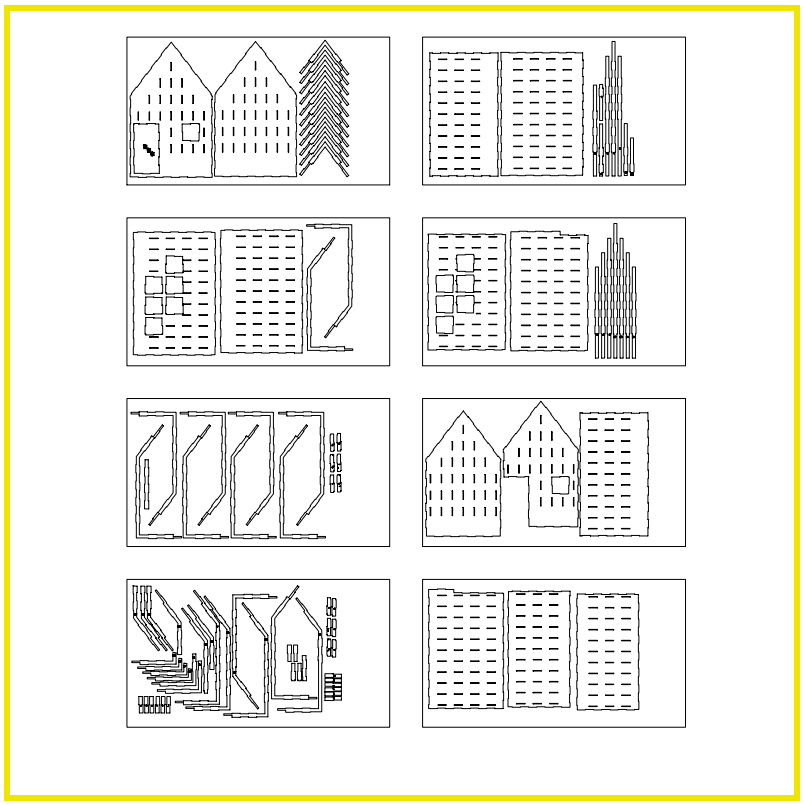


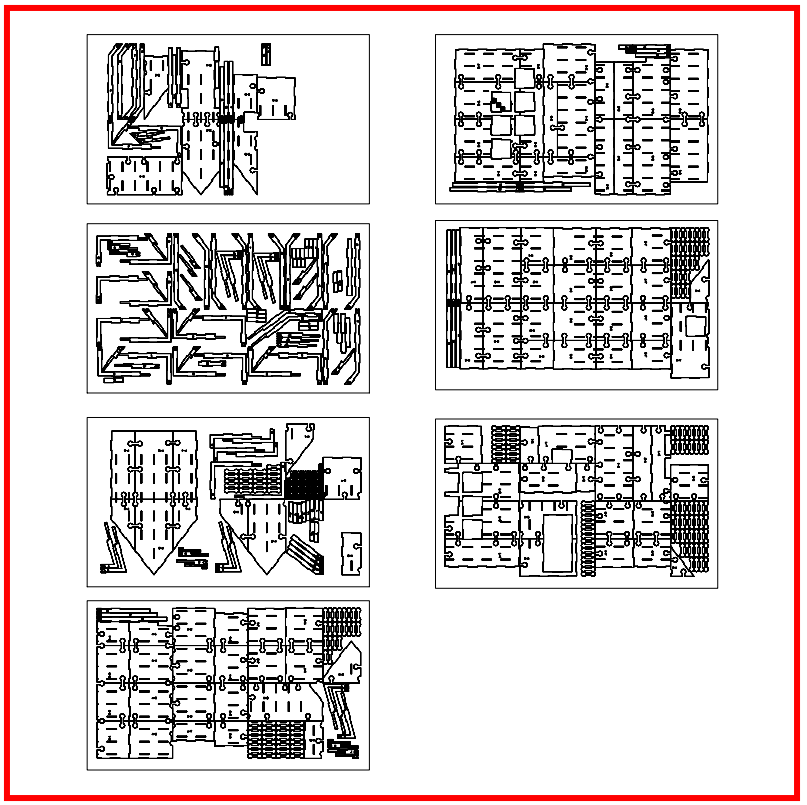


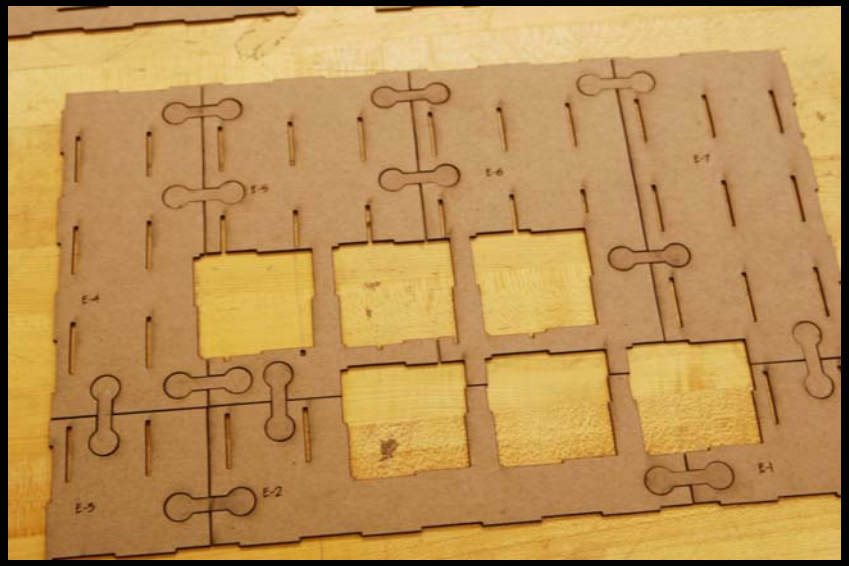






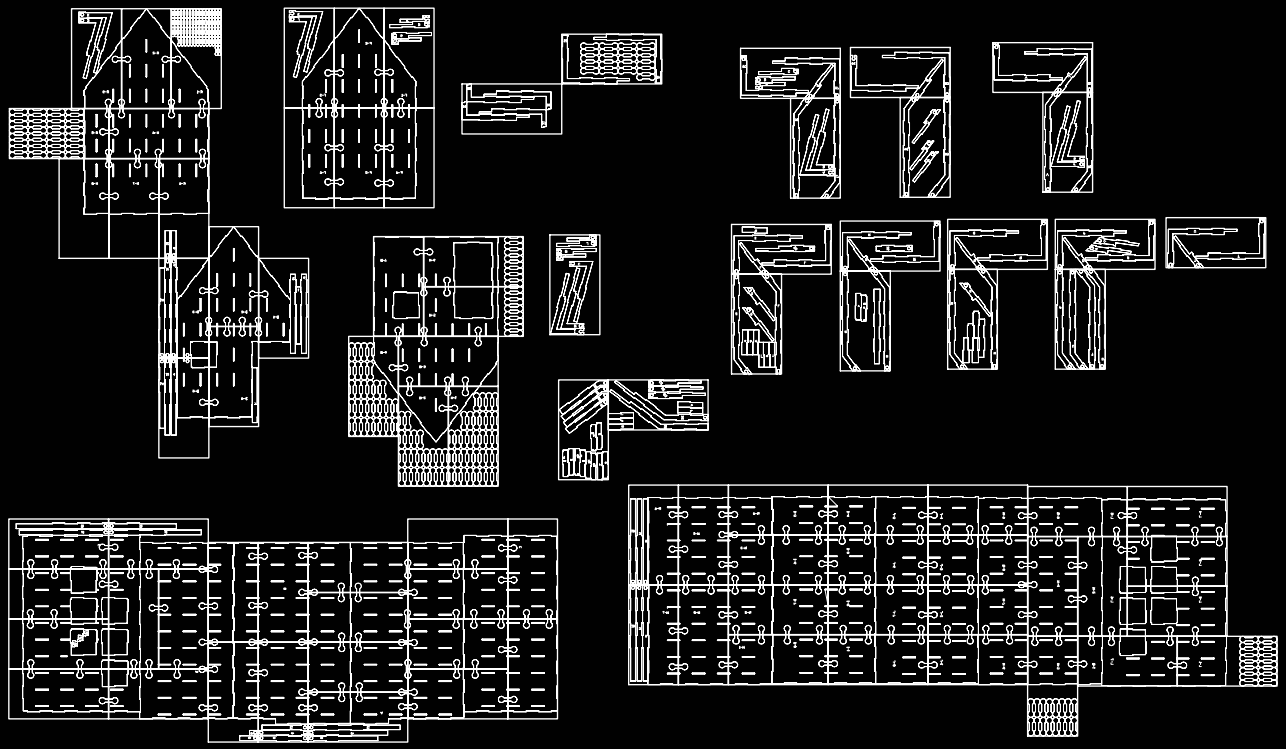






Plywood Sheets

- **Cut Sheet for House**
- Layout for 4’ x 8’ x ¾” Plywood Boards
- Each Board is $22.00/Sheet (Home Depo-Boston)
- 93 Boards x $22.00 = $2046.00



Proposed
Emergency Housing
Fabware

1. Builds geometry (generative)
2. Generative base is from material
3. Designs assemblies between defined geometries
4. Prepares geometries for a particular machine
5. Builds geometries at different scales
6. Accounts for tolerances between parts

Digital Fabrication Software

Fabware

1. Generative
2. Scalable
3. Material Constraints
4. Assemblies
5. Tolerances