Digitally Fabricated

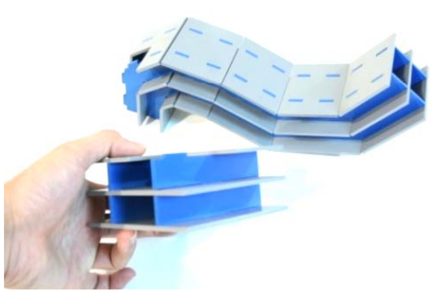
Building Delivery through Kits

Lawrence Sass
Associate Professor
Department of Architecture, MIT

Building Production

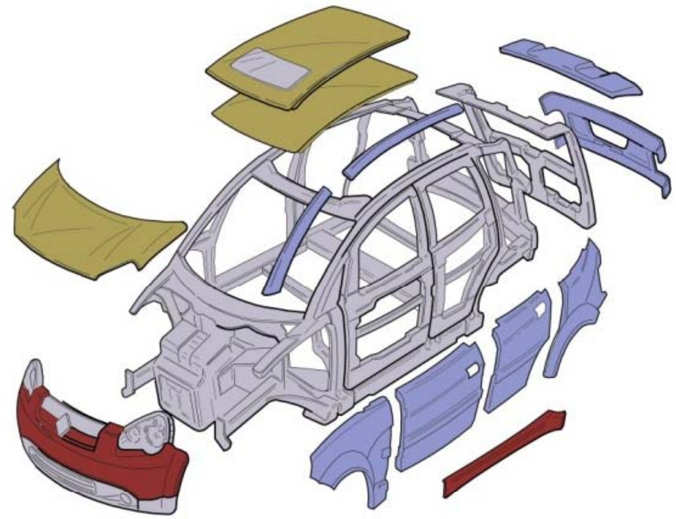
“Any building can be produced from digital data with computer controlled machinery”

Examples: Structural Models

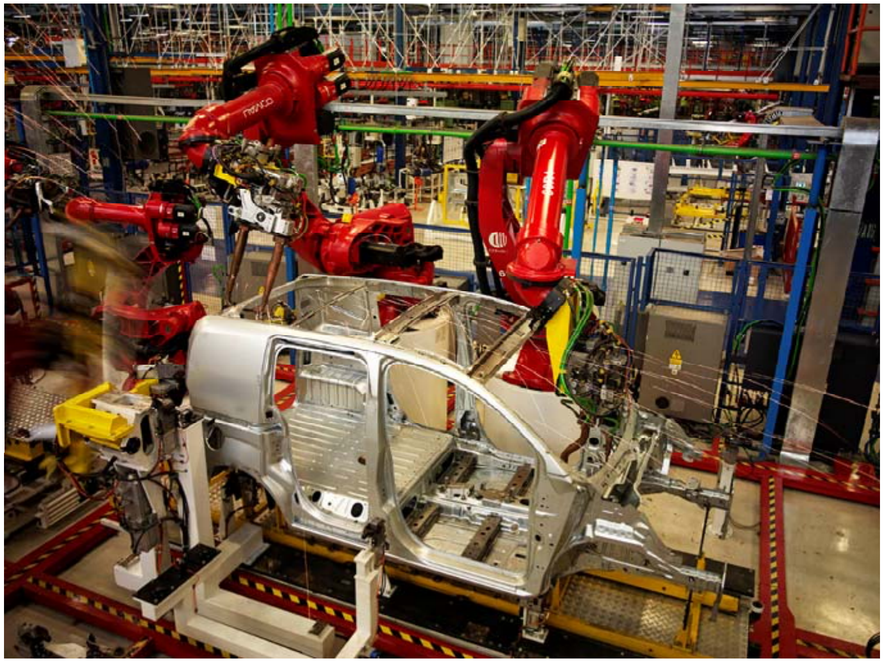


Digitize Building Production

Lower the complexity of design and production

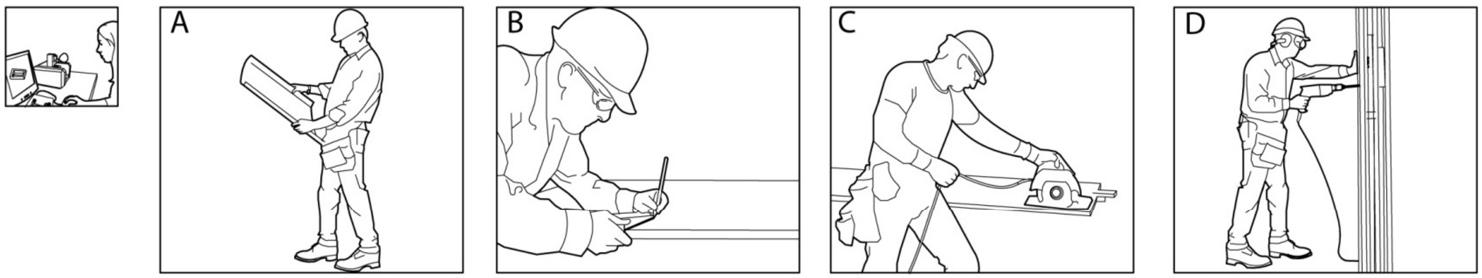


- International manufacturing
- More participants in design
- Higher quality through precision
- Programmable Components



Conventional Construction

The Limits - Why is house production complex?



Error prone production

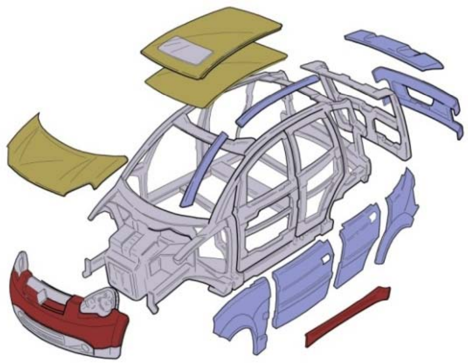
a) Construction workers interpret drawings (errors when interpreting drawings)

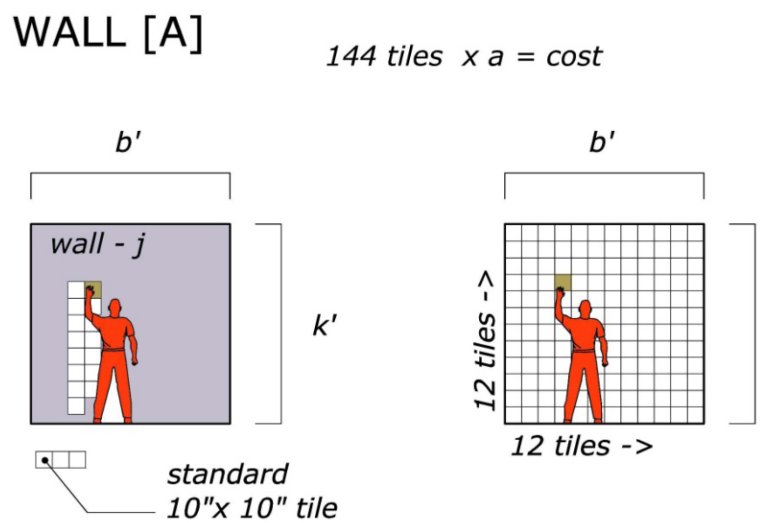
b) Transfer measurements to material (errors in measuring)

c) Manufacture components by hand (errors in manufacturing)

d) Non-Formal assembly (no assurance of quality)

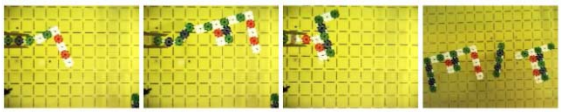
Community of Designers
Example of error

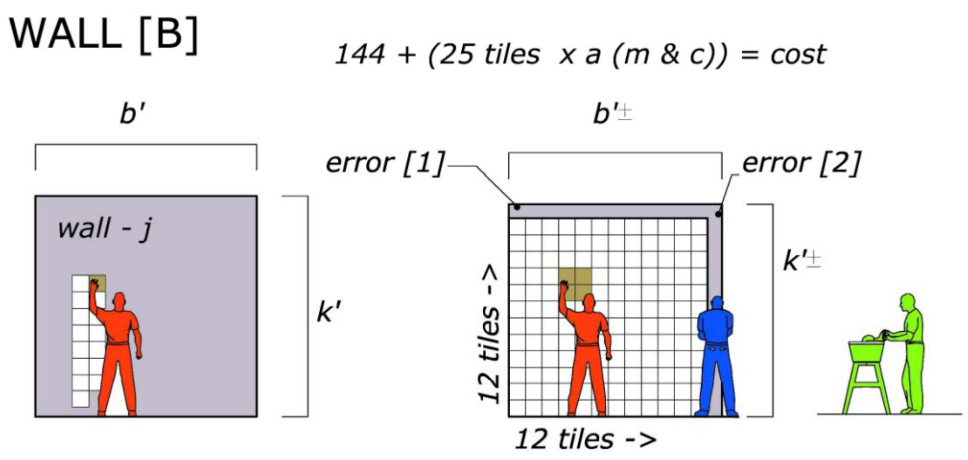




Building with Logic
(error-corrected additive assembly of digital materials), and "programming with math"

Error Reduction
non-intersecting path to fold an arbitrary structure [Saul Griffith]



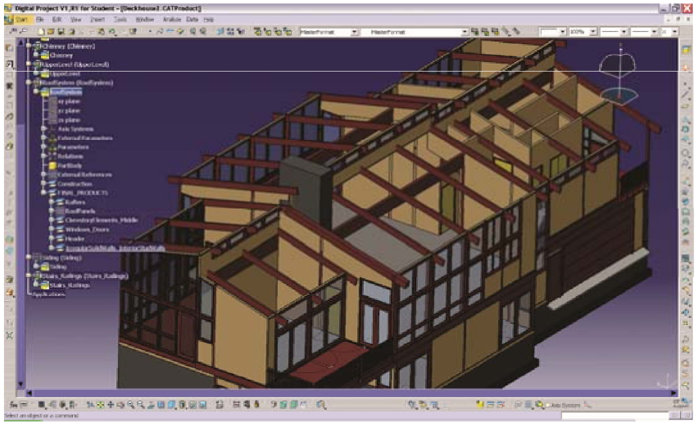


Conventional Construction

High energy delivery

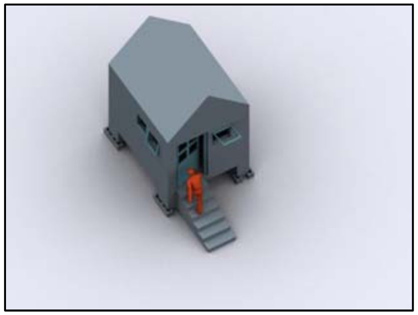
Prefabrication in Factories

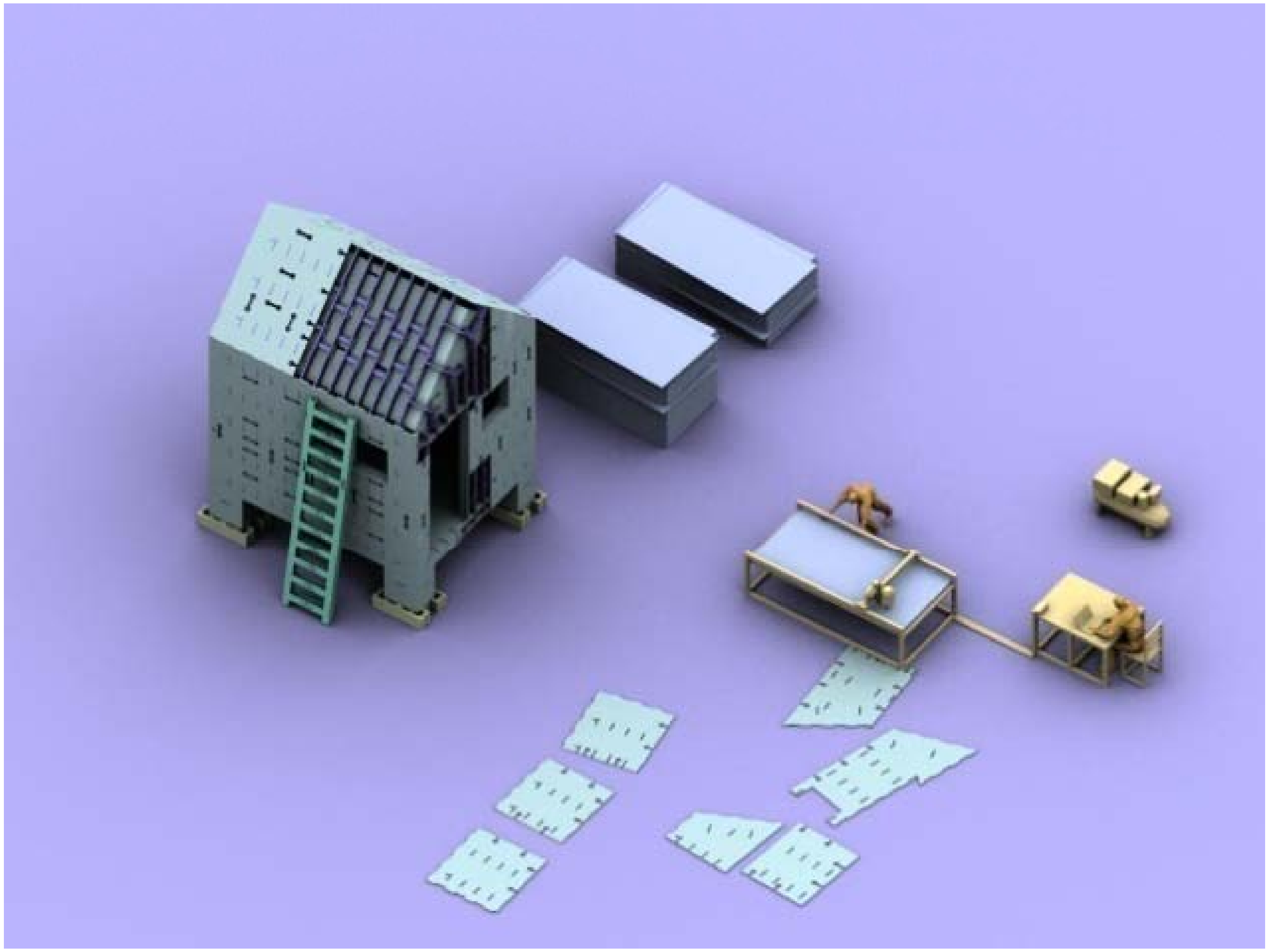
- Century old system - Method was invented by Sears & Roebuck in 1920s
- Limited designs - Finished product must be rectangular
- High energy - Requires an indoor environment to build large products
- Western environments only - Requires finished roads for delivery



Digitally Fabricated Buildings

Low energy production
(100 Houses per Day)





The Instant Cabin

Press fit building kit

CBA Research
Summer 2005

Sass, L. “Synthesis of design production with integrated digital fabrication.” *Automation in Construction,* Vol. 16, No. 3, 298–310, 2007.

Low energy assembly

Digital Fabrication

A digitally fabricated
House for New Orleans

Modern Museum of Art
Summer/Fall 2008

Initial Design Shape

Step 1

Designing the Building

Materializing

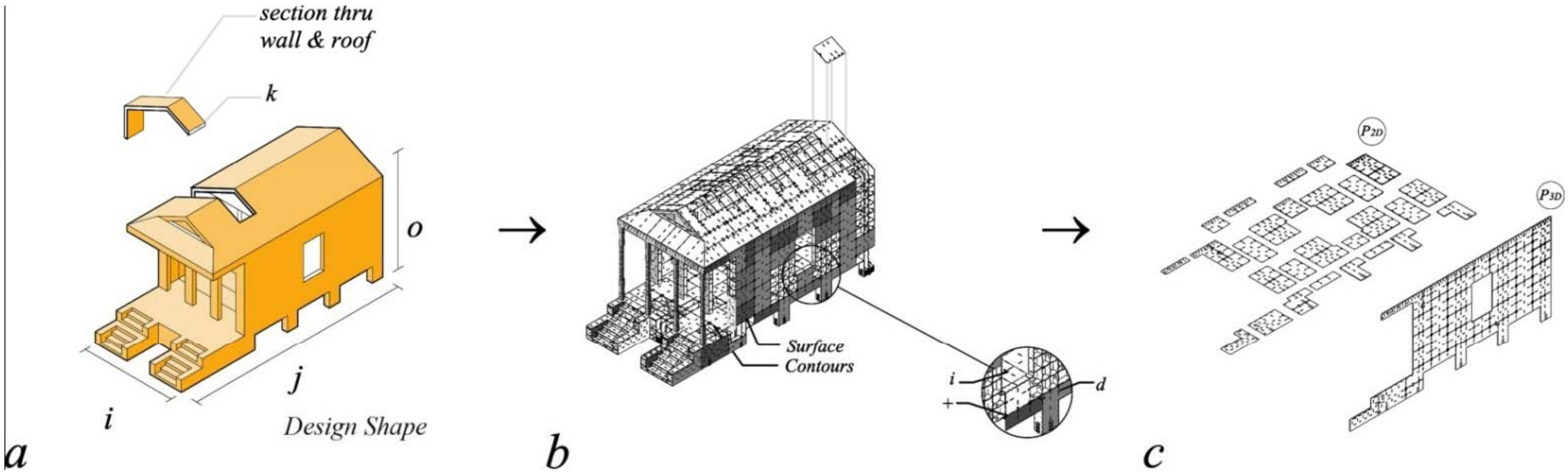
Step 2

Prototyping and Mockups

Materializing

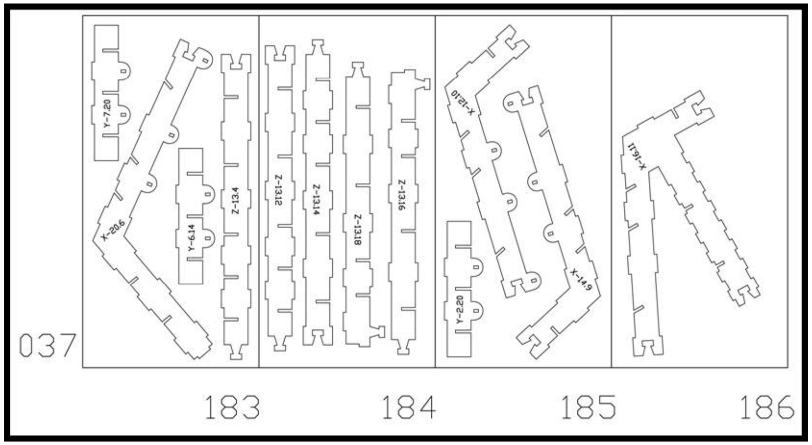
Step 2

Computer Modeling



Manufacturing

Step 3

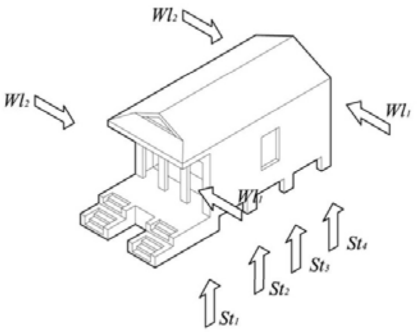


Assembly

Step 4

Assembly

Step 4

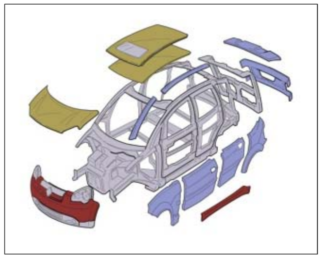


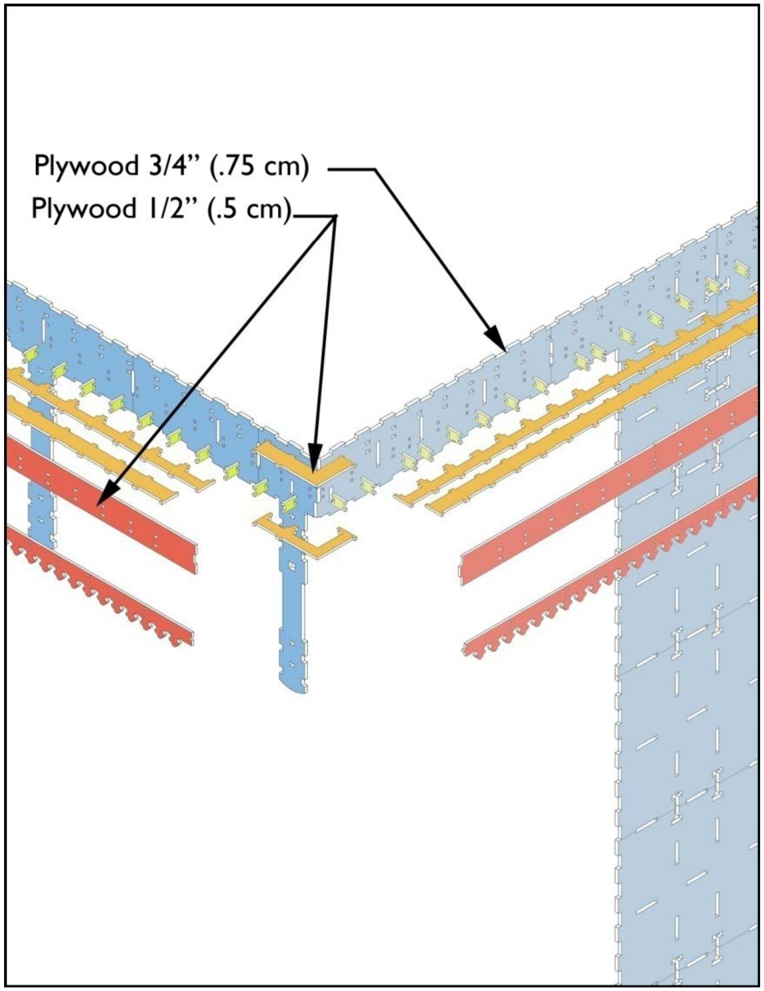
- Certified for a 75mph
- Can withstand a 140mph

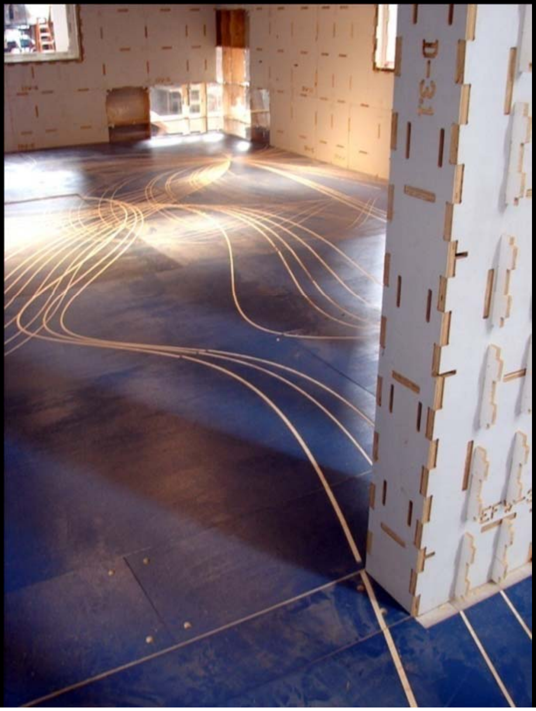
  Daniel Bonardi PE, Cambridge , MA

Second Skin - Ornamentation

Step 5



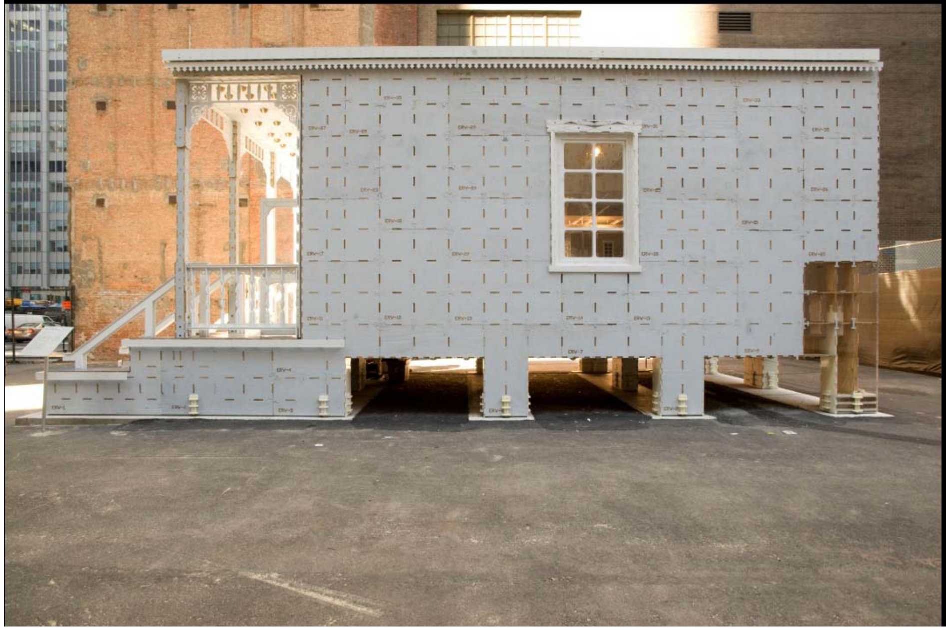




A digitally fabricated

House for New Orleans

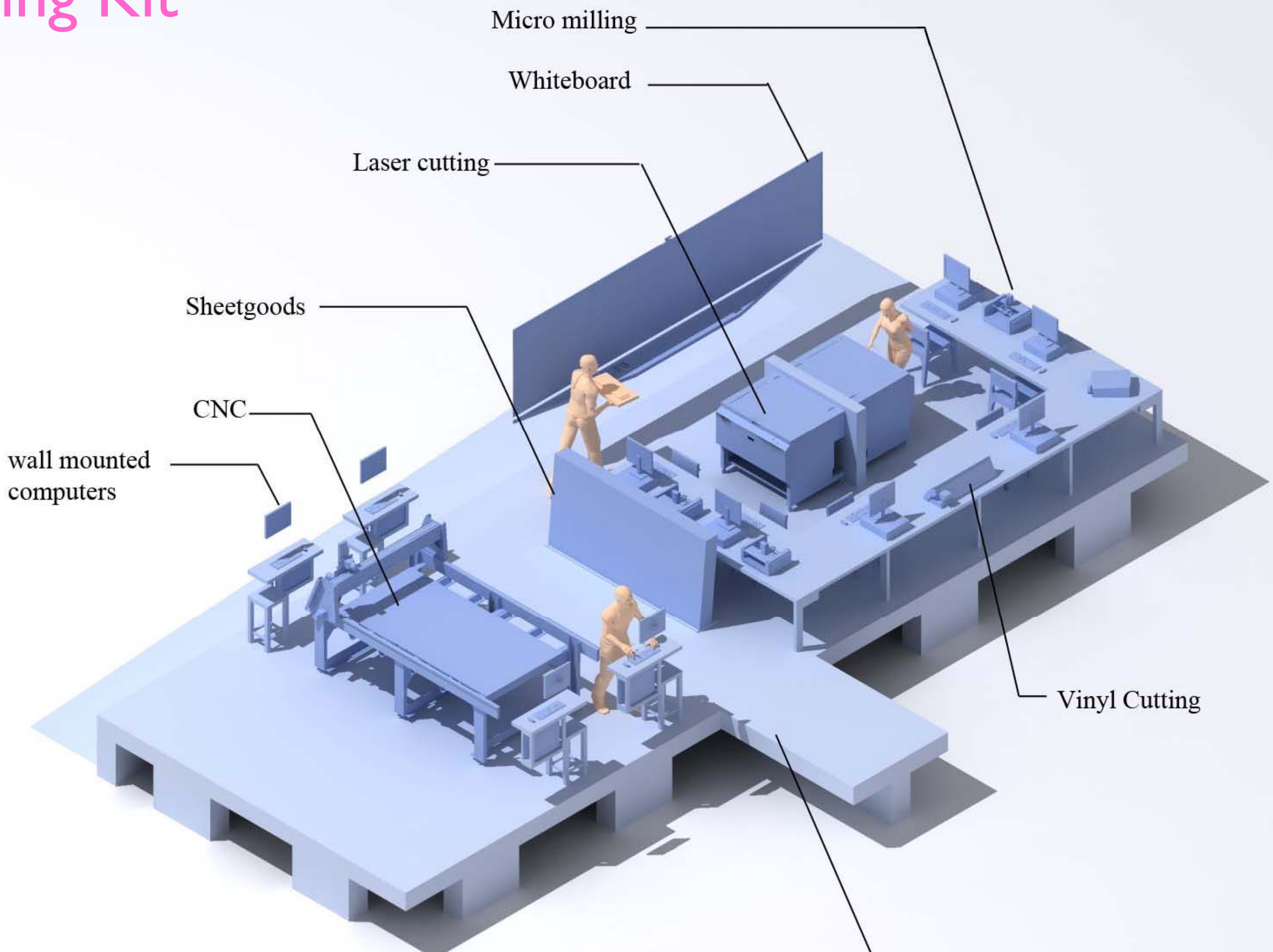
Modern Museum of Art
Summer/Fall 2008

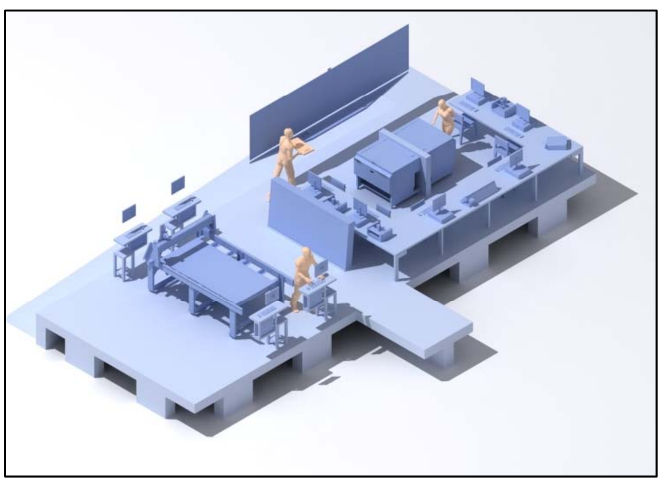


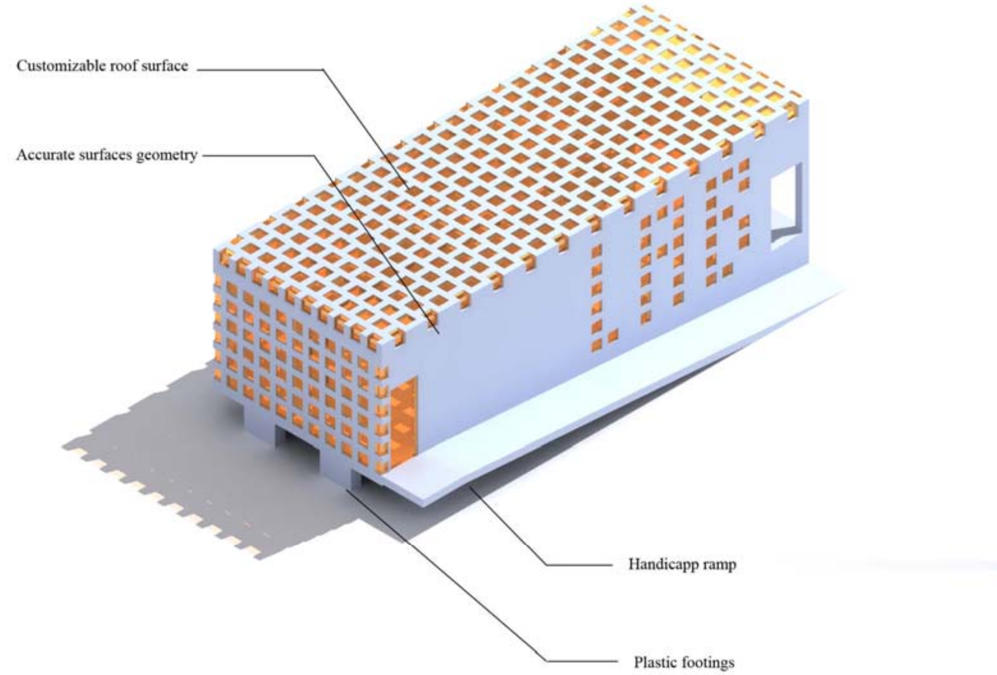
A digitally fabricated

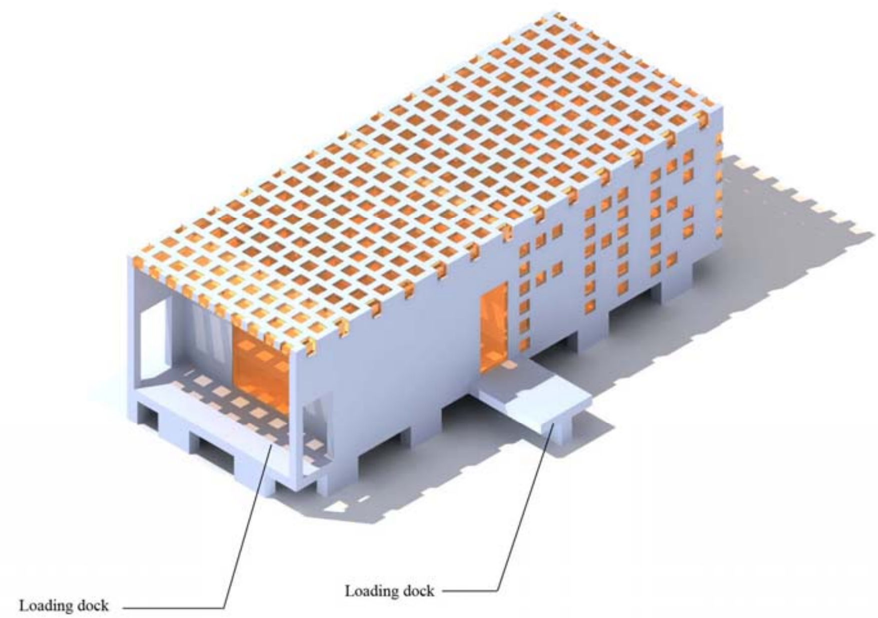
Fab Lab – Building Kit

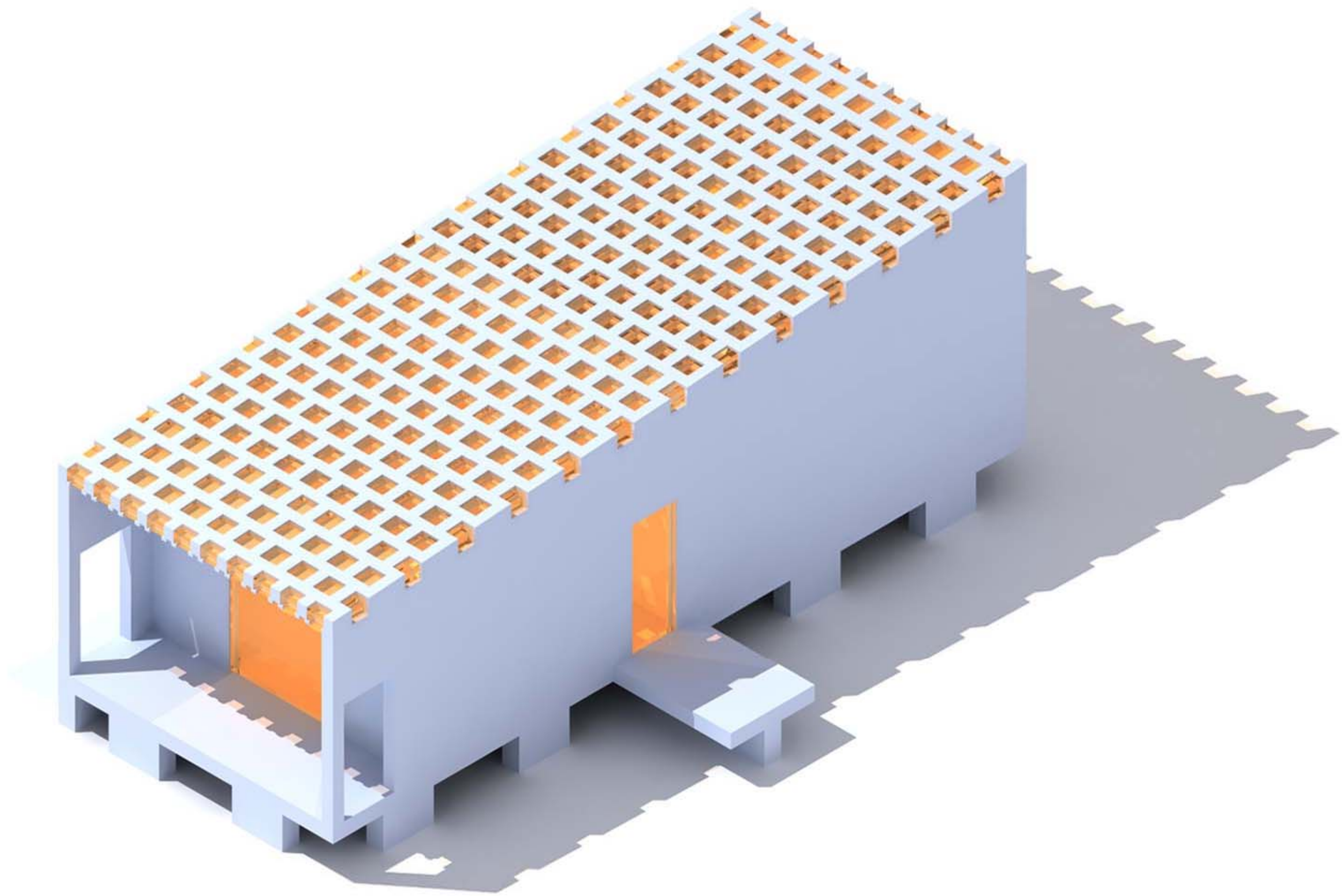
Summer 2012

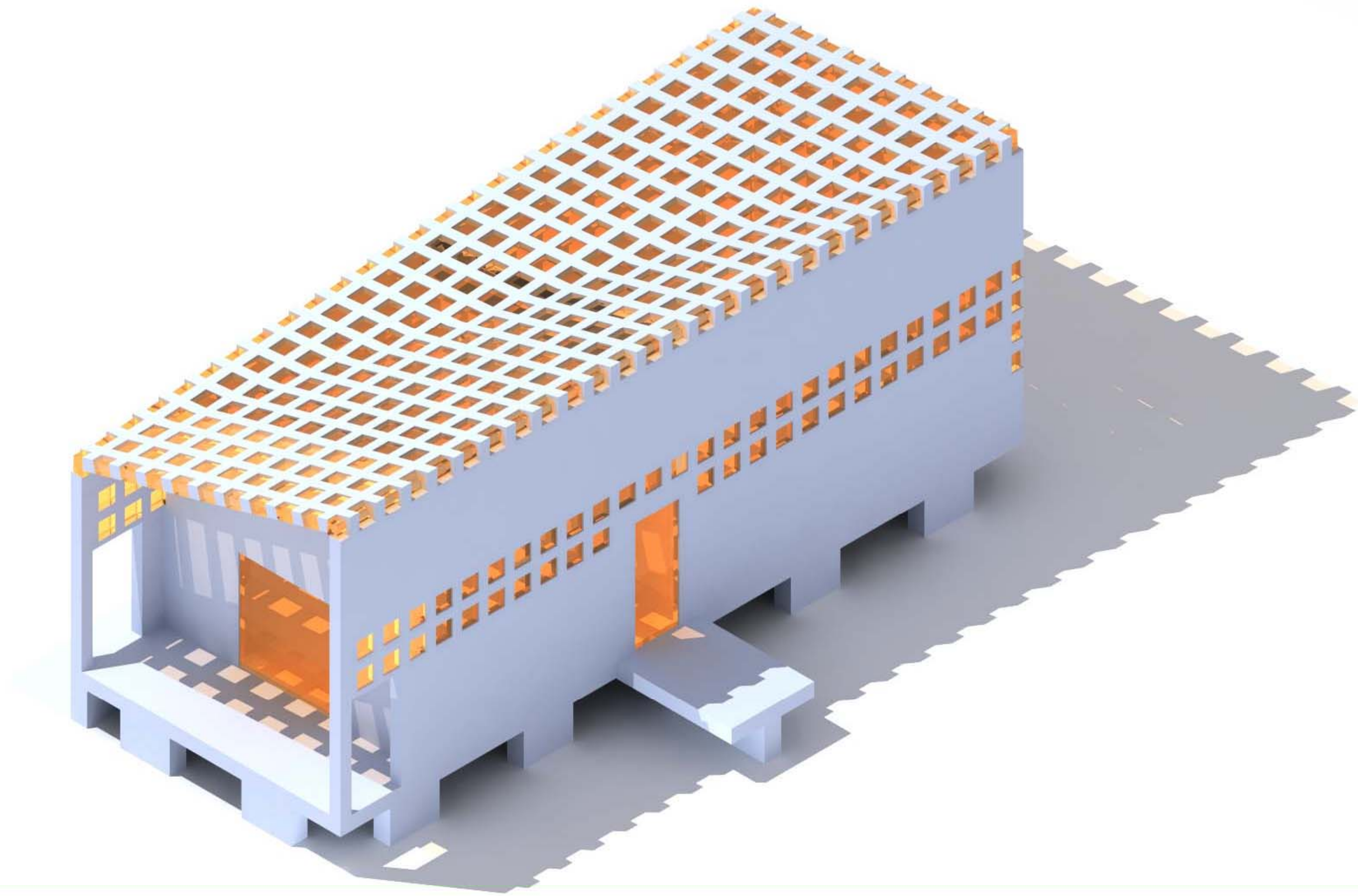


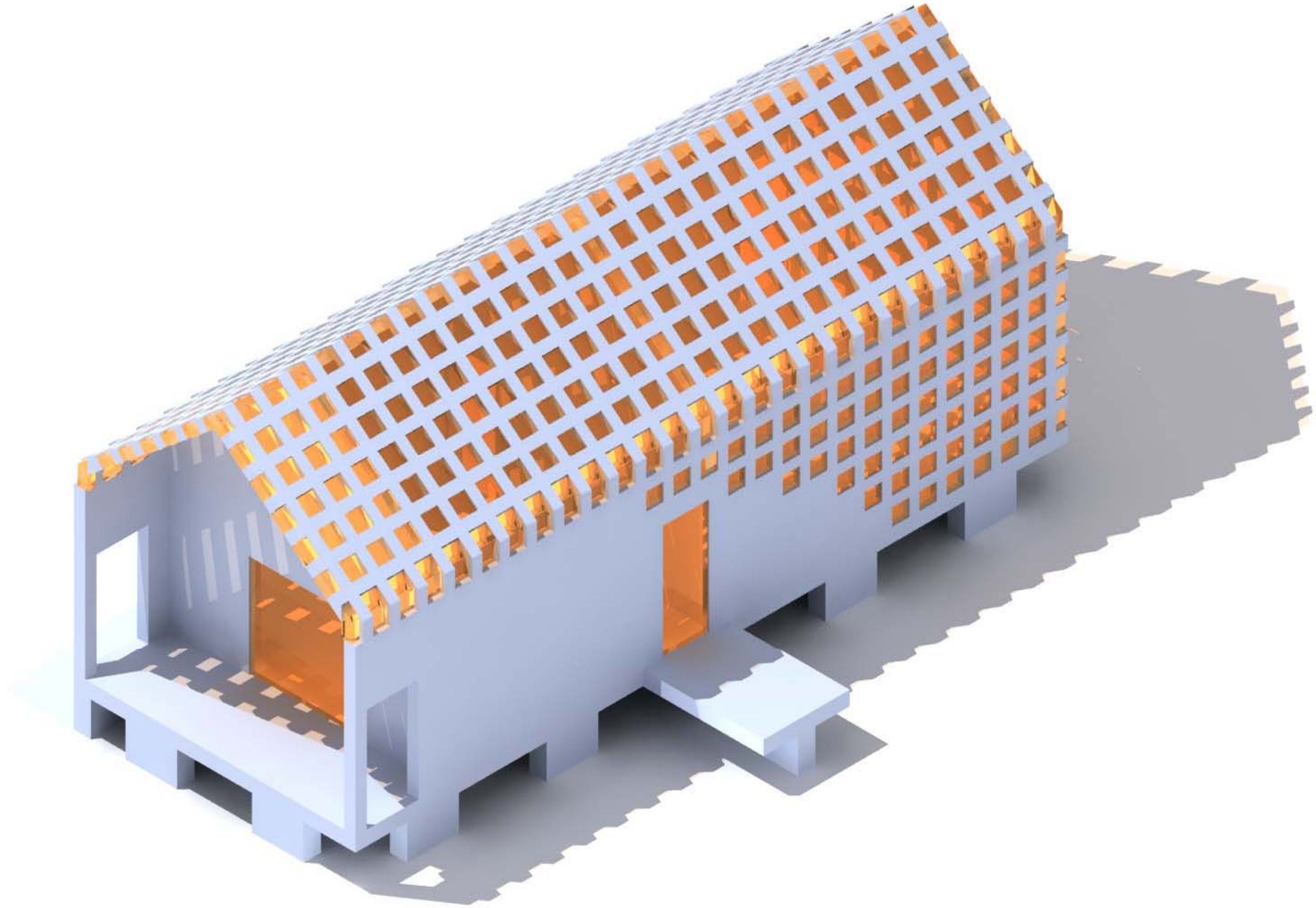


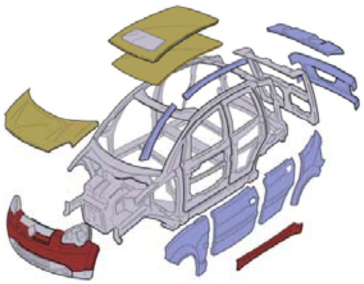

Customizable roof surface
Accurate surfaces geometry
Handicapp ramp
Plastic footings


Loading dock
Loading dock

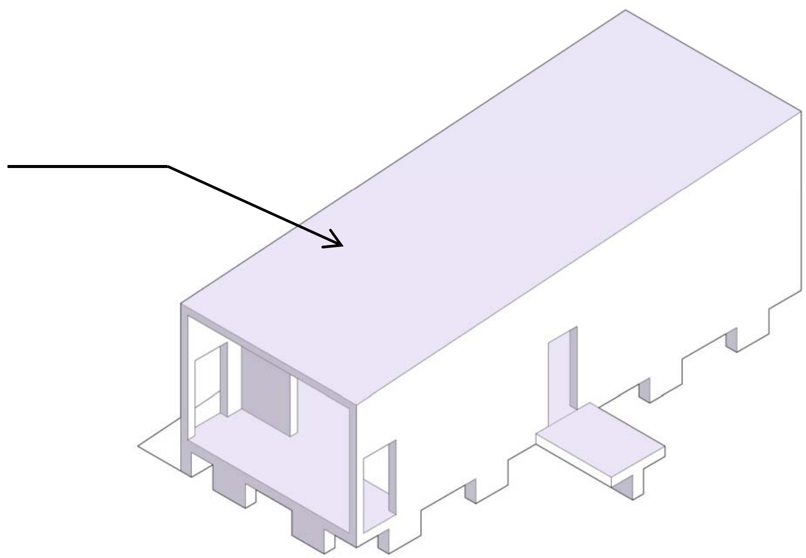


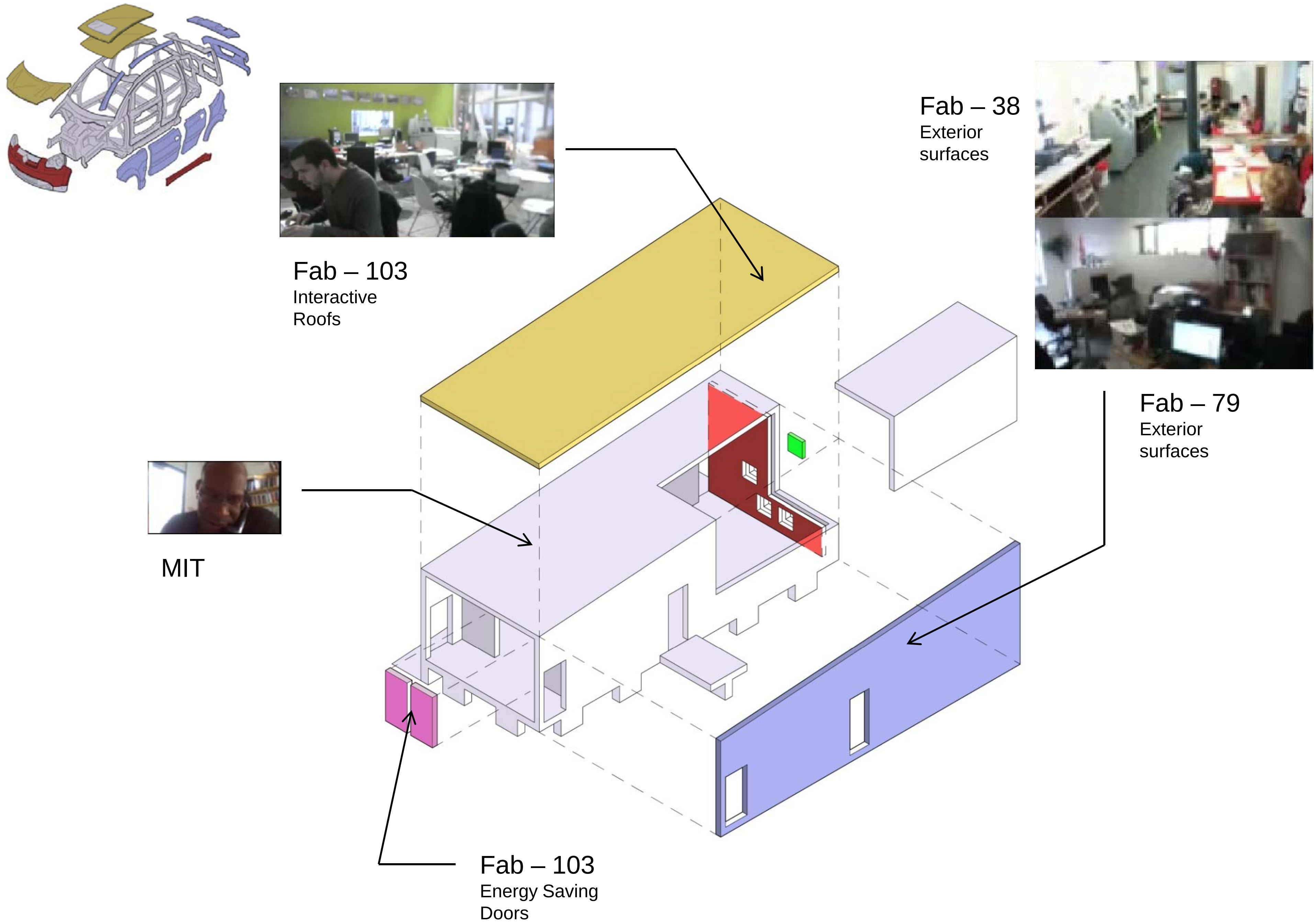






MIT

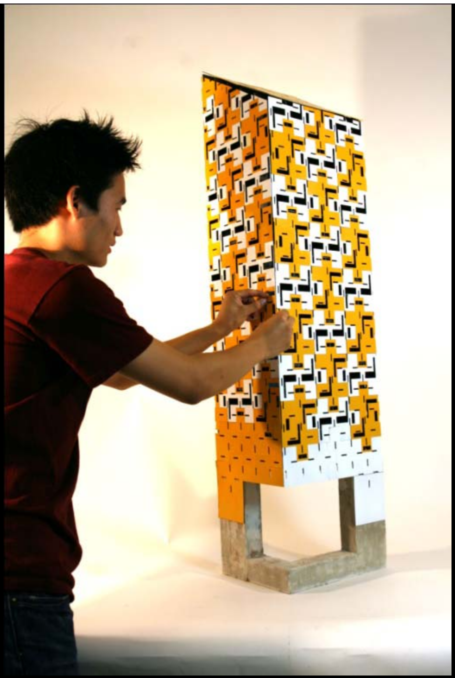


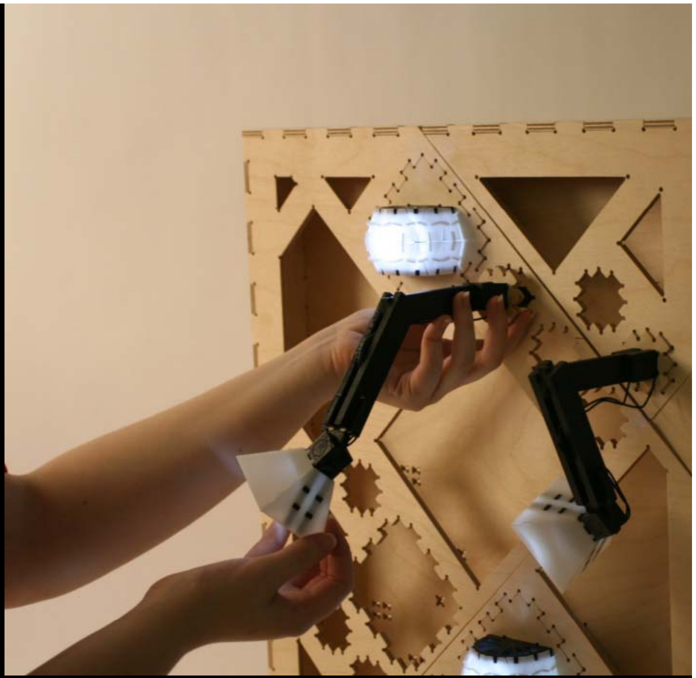

Fab – 103
Interactive
Roofs
Fab – 38
Exterior
surfaces
Fab – 79
Exterior
surfaces
MIT
Fab – 103
Energy Saving
Doors

A digitally fabricated

Fab Lab – Building Kit

Summer 2012





Integrated Systems –
Programming Surfaces

a) Exterior - Water capture

b) Interior - Lighting

c) Interior – Electrical

d) Interior – Heating and Cooling