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4.500 Introduction to Design Computing
Fall 2008

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Digitally Manufactured Housing

Larry Sass
MIT

Effective computing

Machining that is computer controlled

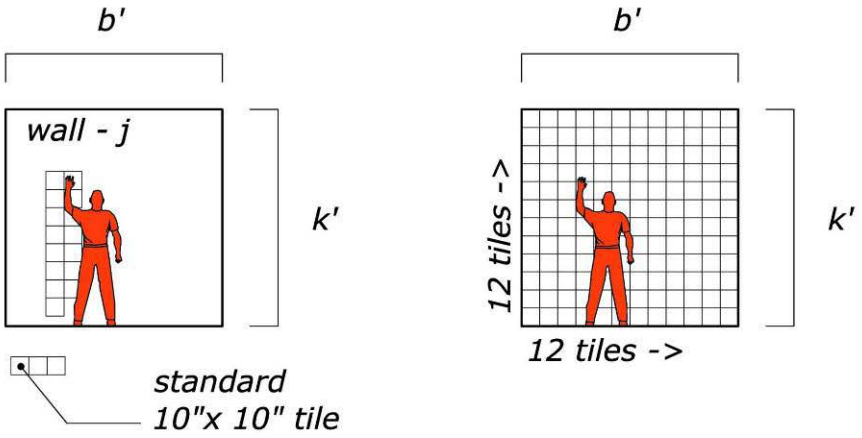
Assembly Only construction sites

Customized home delivery for culturally sensitive design

- *New Orleans – 109,000 House lost*
- *7 years @ 75/day*
- *Mass Customize 75 designs*
- *Mass Produce*

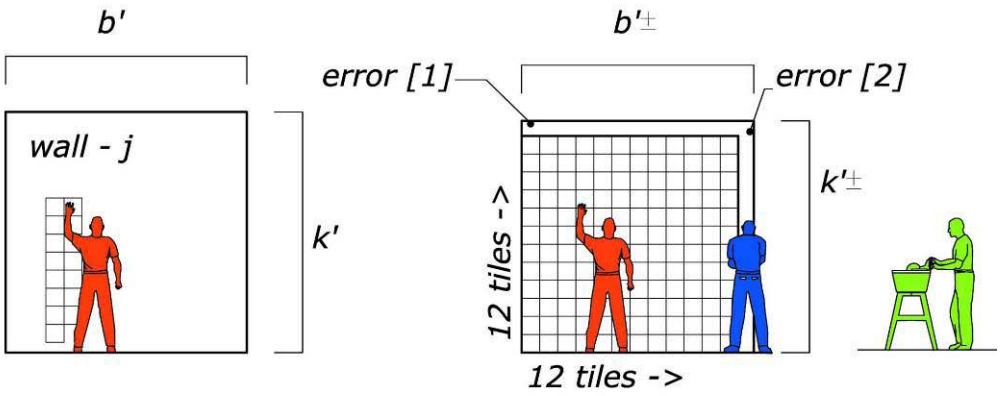
WALL [A]

144 tiles x a = cost



WALL [B]

144 + (25 tiles x a (m & c)) = cost



Cost of Error

House Construction = **Labor** + Materials

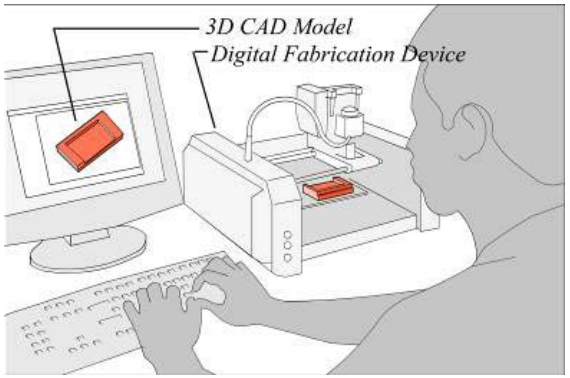
Labor [A] = - Assembly only

Labor [B] = Assembly + Measure+ Cut

House Construction = (*nLabor* x [A]) + (nLaborx [B]) + Materials

Vision of Materialization

[1]
CAD



Machine
Measuring
(MIT)

[2]
machine & material

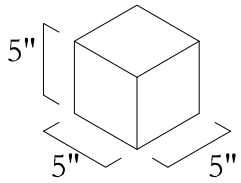
Machine
Cut or Build

[3]
assembly

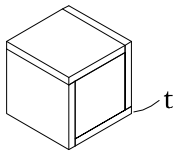
Machine
Assembled
(ETH)

Analogue

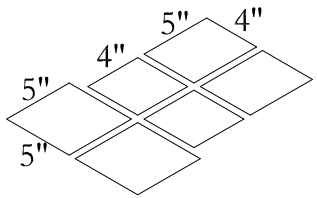
I
starting
shape



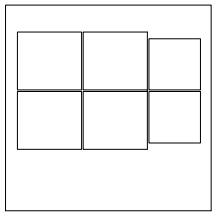
II
working shape
(1-modeling)



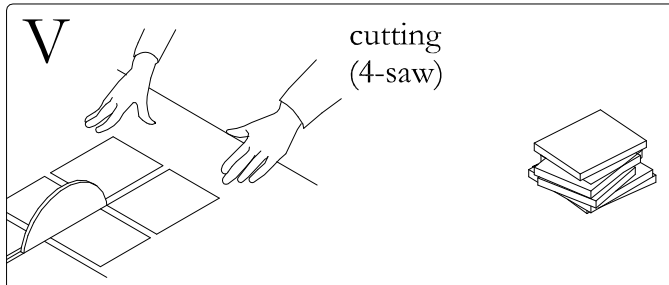
III
working documents
(2-drafting)



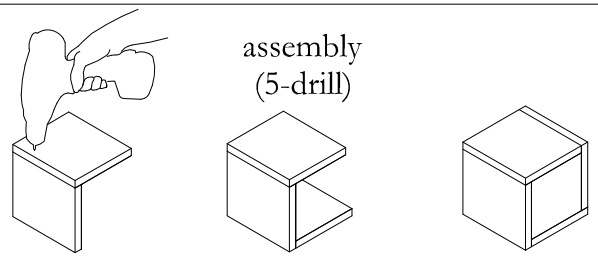
IV
drawing translation to material
(3-ruler/pencil)



V
cutting
(4-saw)



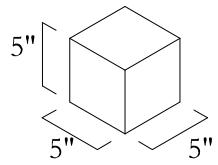
VI
assembly
(5-drill)



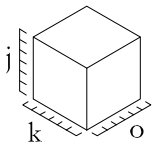
GP
GLASS GOLD
DENSGLASS GOLD
HomeWrap
DU PONT

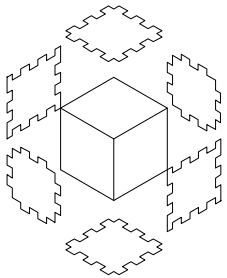
Digital

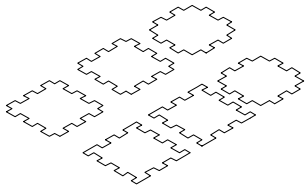
I
starting
shape

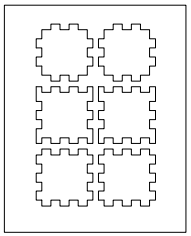


II
computer base shape
interpretation & translation
(1-modeling)

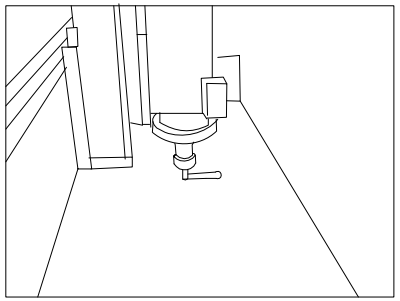




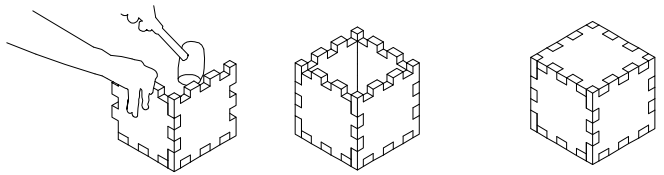




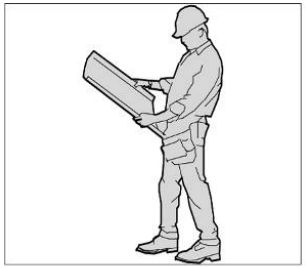
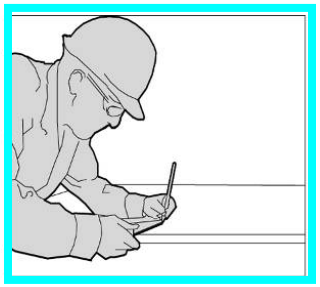
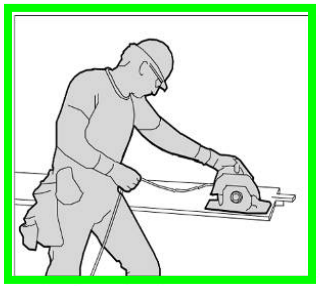
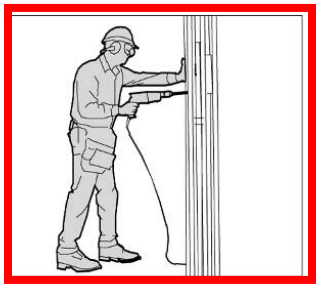
III
computer controlled
cutting
(2-cnc mill)



IV
self guided
assembly



Waste in Design & Construction

- Factory based construction
- Hand Operations
- High Energy
- Imprecise measuring
- Imprecise cutting
- Imprecise assembly

Instant House

Supports Non-Western Design & Construction

Marcel Botha
Nic Rader
Victoria Lee
Maggy Nelson
Diana Nee

Universal Technologies

Fab Lab MIT/India

Fab Lab MIT/India

Design System

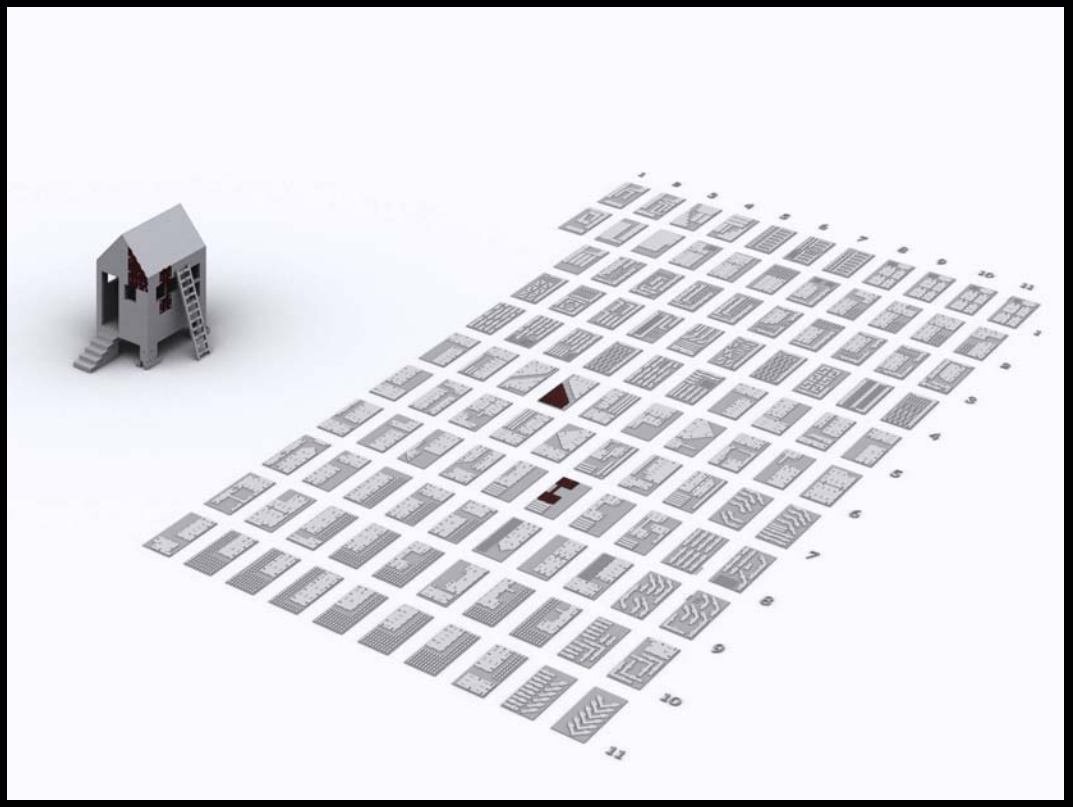
Integral Assemblies
(Plywood)
Summer 2005

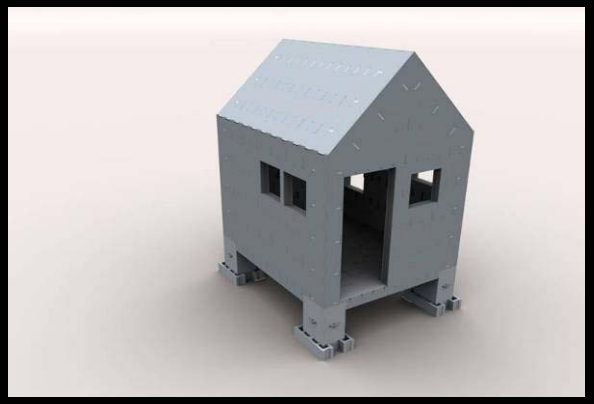
(a)
Box Joinery

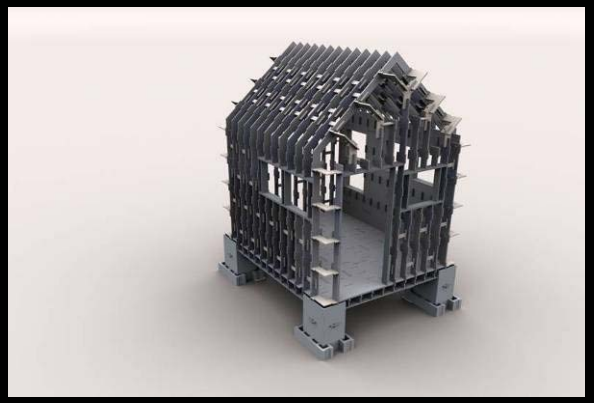
(b)
Dado Joint

(c)
Biscuit Joint

AutoCAD
Design Model

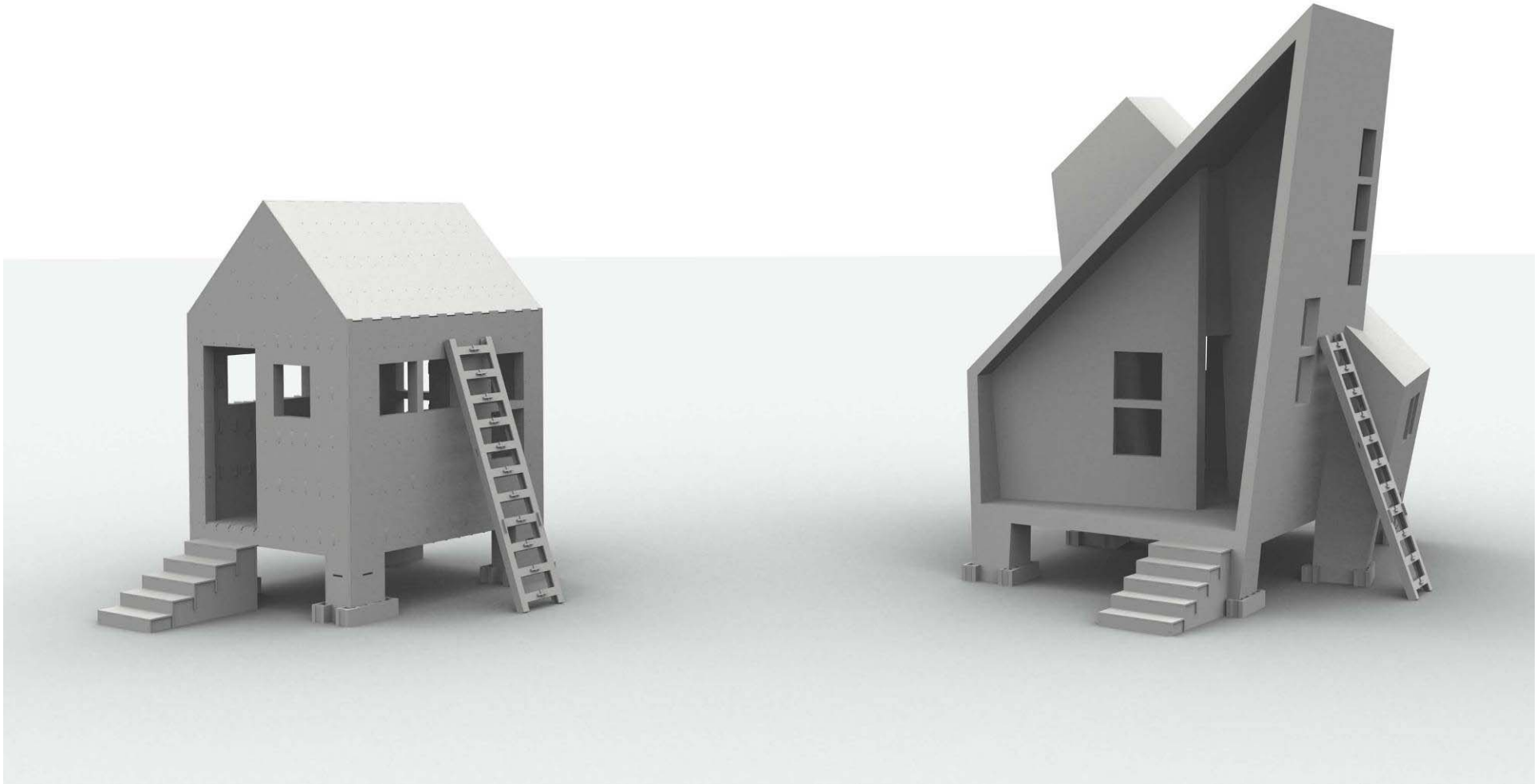






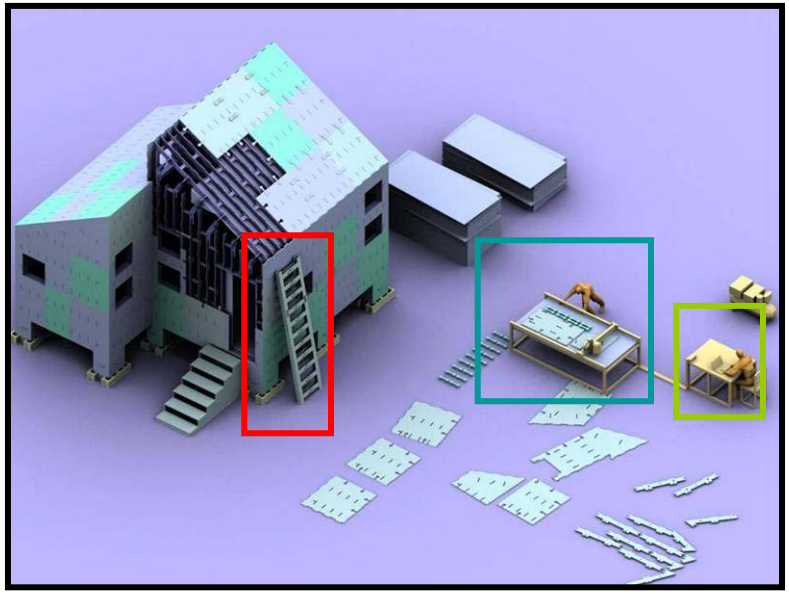
AutoCAD
Construction Model

17'
11'
9'

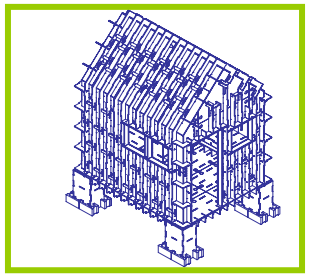


Digitally Fabricated

- Outdoor or Indoor Digital Factory
  - Any Shape
  - Machines Scale
  - Complexity is in the cutting
- Advantages
  - Design models used for cutting
  - Controlled manufacturing
  - Low Energy (Flat packed)
  - Controlled waste
  - Precise
- Impact
  - Broad approach to housing
  - Luxury or low cost housing
  - Process works with many materials



What is digital fabrication



→

→

Computer model
"Precision measuring"

"Laser cutting"
Precise Cutting in Studio

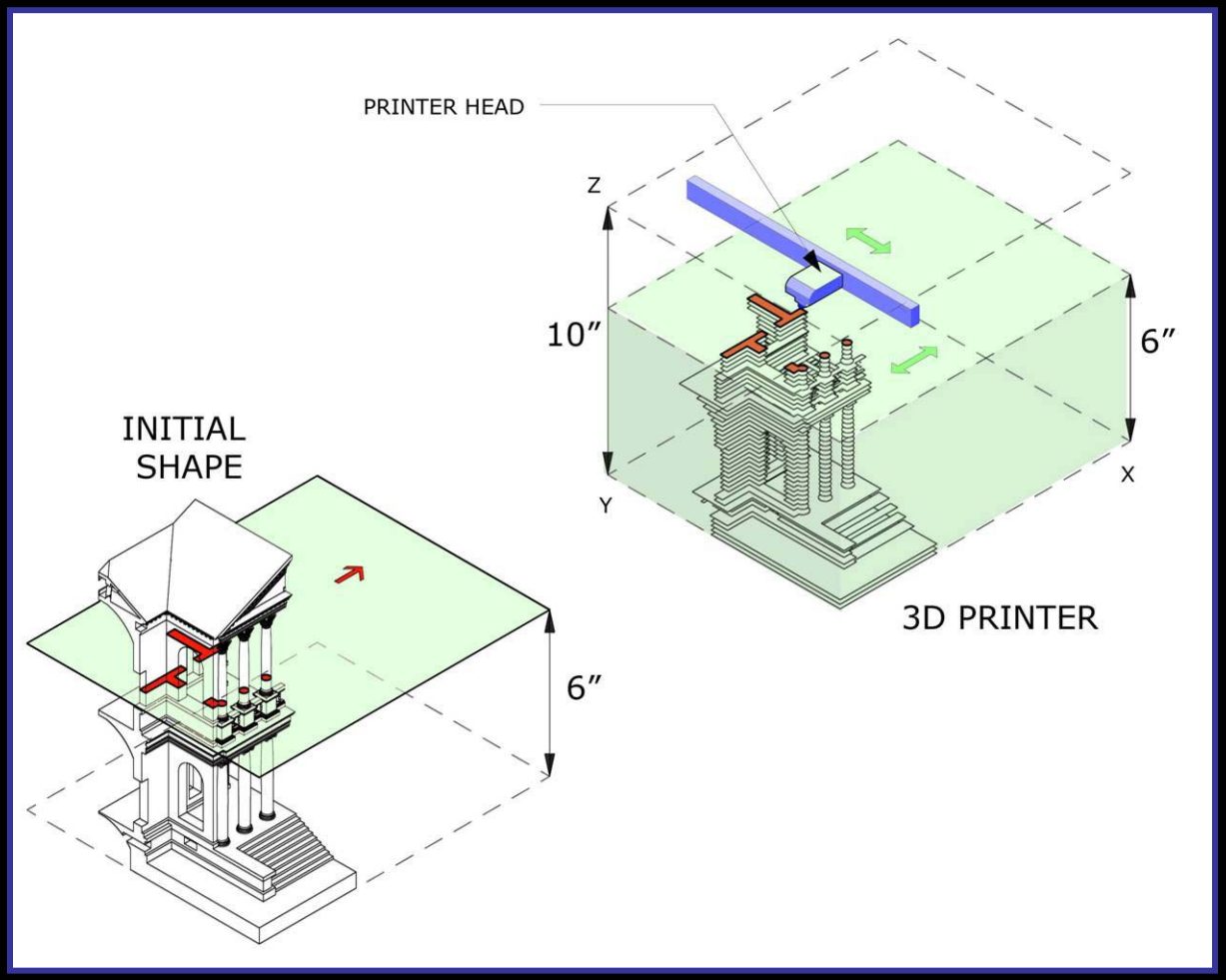
"Prototype"
Error Detection & Correction

↓ Scale Objects : 6

Inspiration

Computing a model

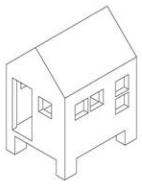
1. Precise measuring
2. Manufacturing Layered
3. Automated Assembly

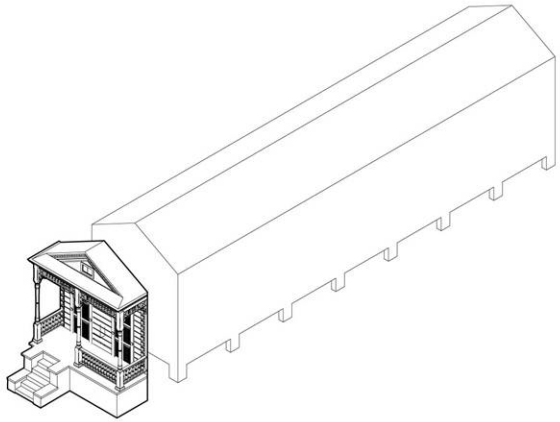


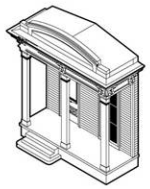
Production: Design

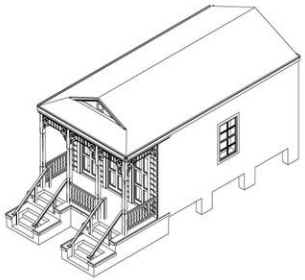
(Design Grammar)

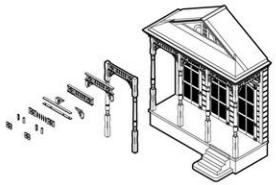
Step 1











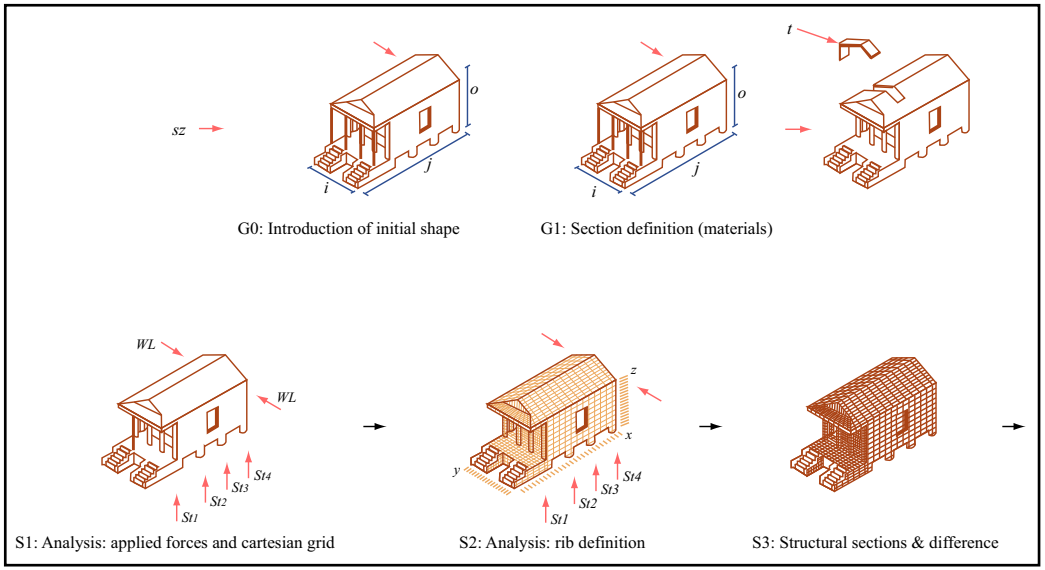
Stiny, G., *Palladian Grammar,* Environment and Planning B, Vol. 1975

Duarte, J., *Siza Grammar,* Environment and Planning B, Vol. 2004

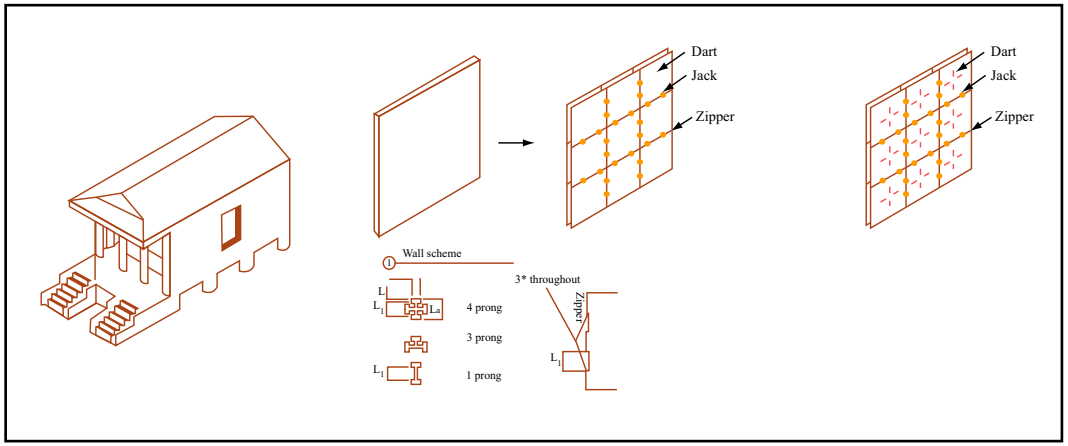
Production: Product Modeling

(Construction Grammars)

Step 2



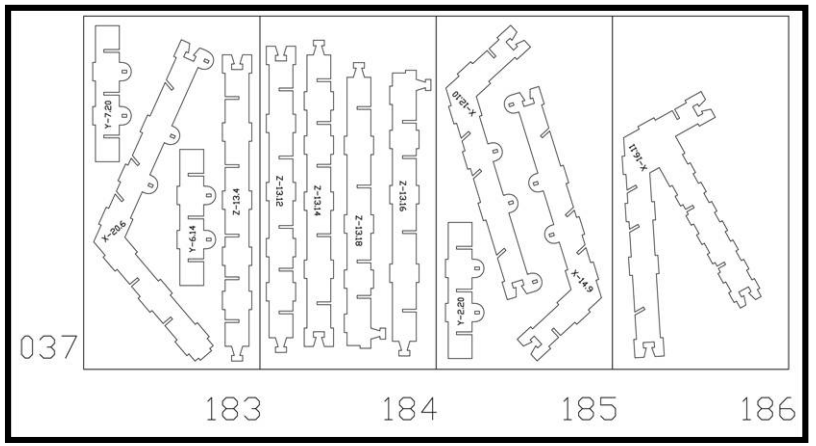
Figures by MIT OpenCourseWare.



Production: Manufacturing

(Computing for manufacturing)

Step 3



On-Site: Structure

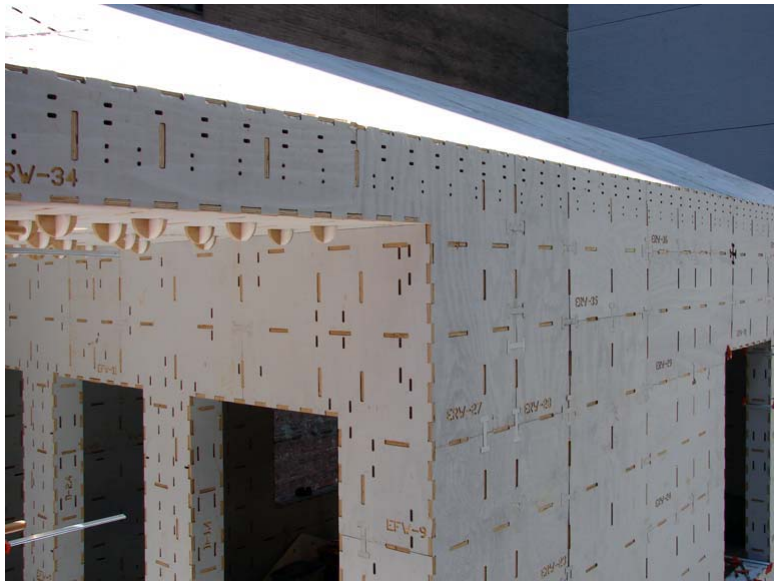
(Assembly Only)

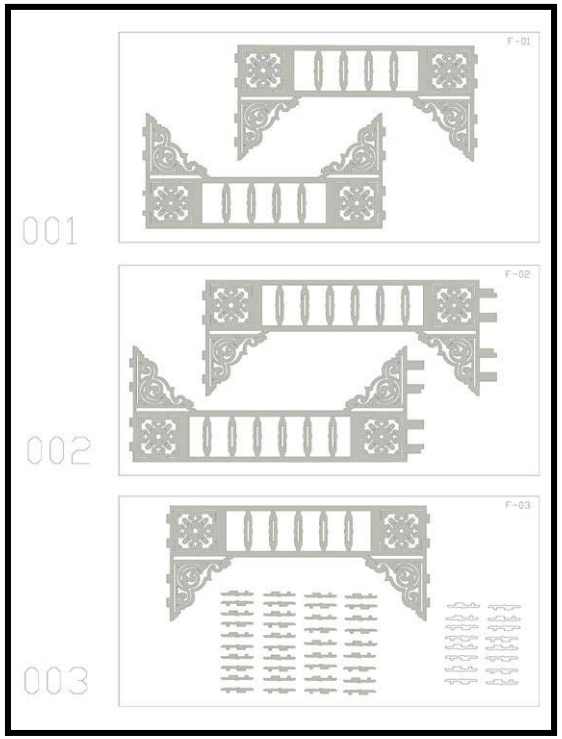
Step 4

On-Site: Ornamentation

(Multi-lateral Layering)

Step 5





Design and Machines