Cover:
Disruptive

MArch 2012

UC Berkeley CED

insert your icon here

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re·fuse

Anthony Giannini

Statement

Material Research and Development

Computational Design and Materialization

Large-Scale Fabrication

Presentation Transcript

Sed ut perspiciatis unde omnis iste natus error sit voluptatem accusantium doloremque laudantium, totam rem aperiam, eaque ipsa quae ab illo inventore veritatis et quasi architecto beatae vitae dicta sunt explicabo. Nemo enim ipsam voluptatem quia voluptas sit aspernatur aut odit aut fugit, sed quia consequuntur magni dolores eos qui ratione voluptatem sequi nesciunt. Neque porro quisquam est, qui dolorem ipsum quia dolor sit amet, consectetur, adipisci velit, sed quia non numquam eius modi tempora incidunt ut labore et dolore magnam aliquam quaerat voluptatem. Ut enim ad minima veniam, quis nostrum exercitationem ullam corporis suscipit laboriosam, nisi ut aliquid ex ea commodi consequatur? Quis autem vel eum iure reprehenderit qui in ea voluptate velit esse quam nihil molestiae consequatur, vel illum qui dolorem eum fugiat quo voluptas nulla pariatur?

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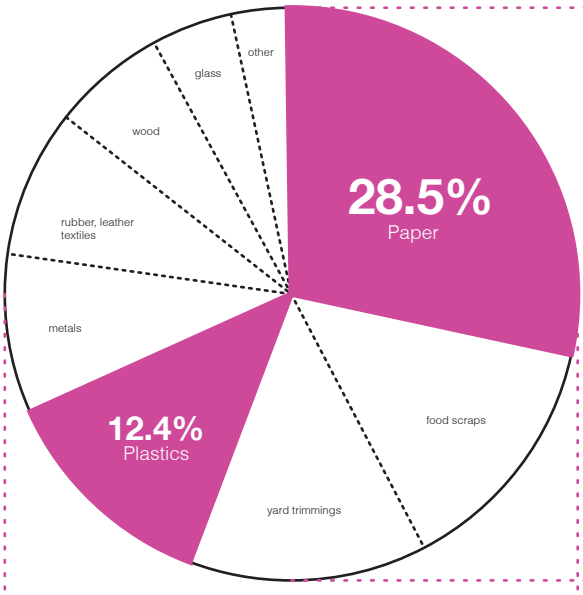
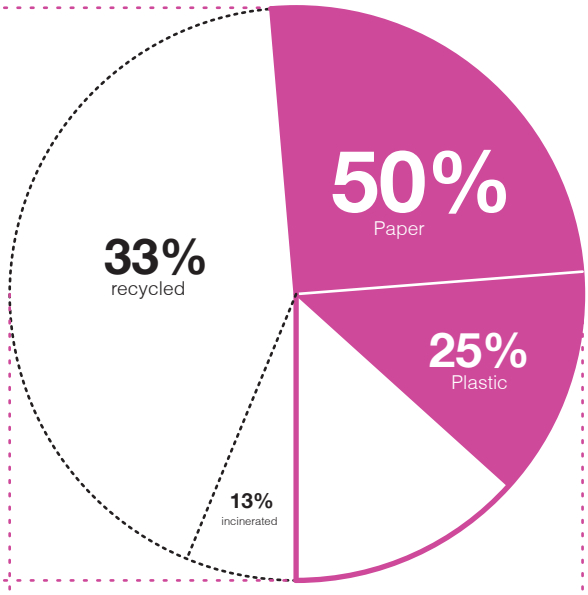
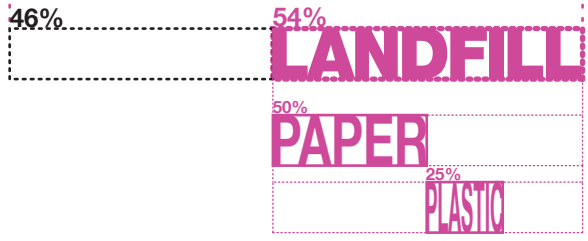
2010 United States Total MSW Generation
250 Million Tons (before recycling)

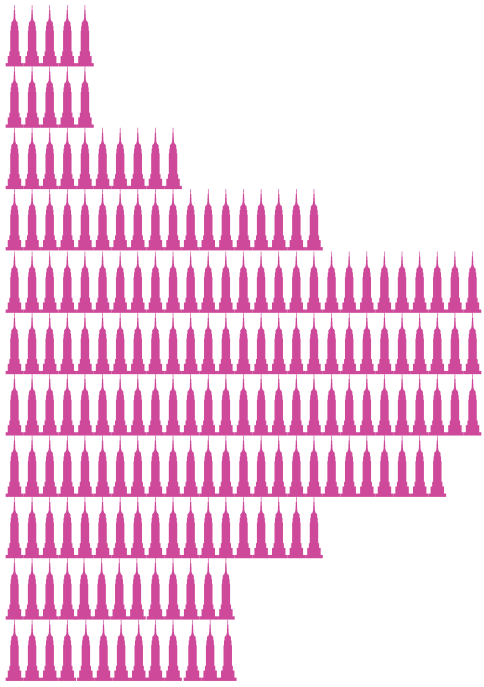


United States Landfill Resources





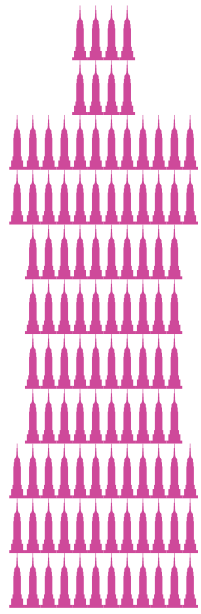
188.88
Empire State Buildings



72 million tons of paper/year

258.84 million cubic yards

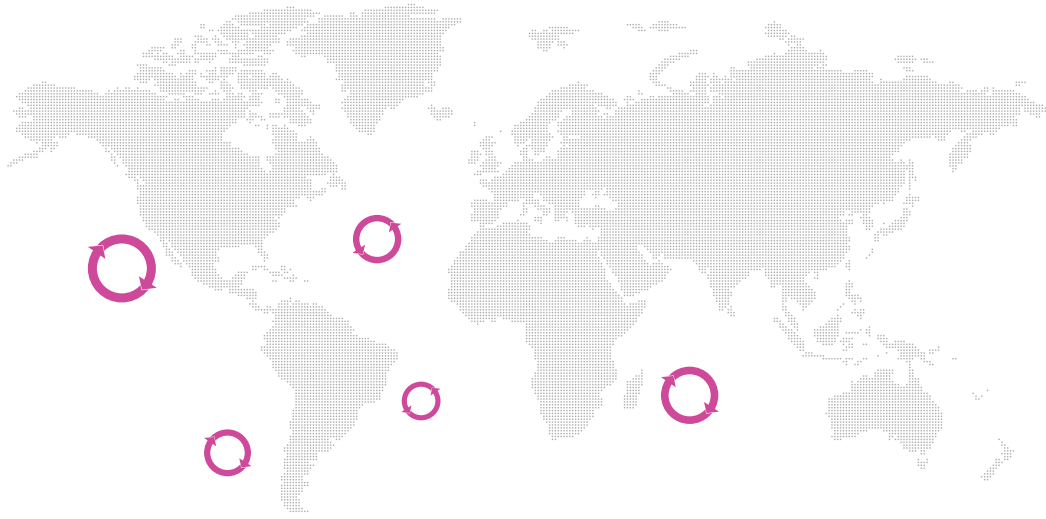
108.61
Empire State Buildings

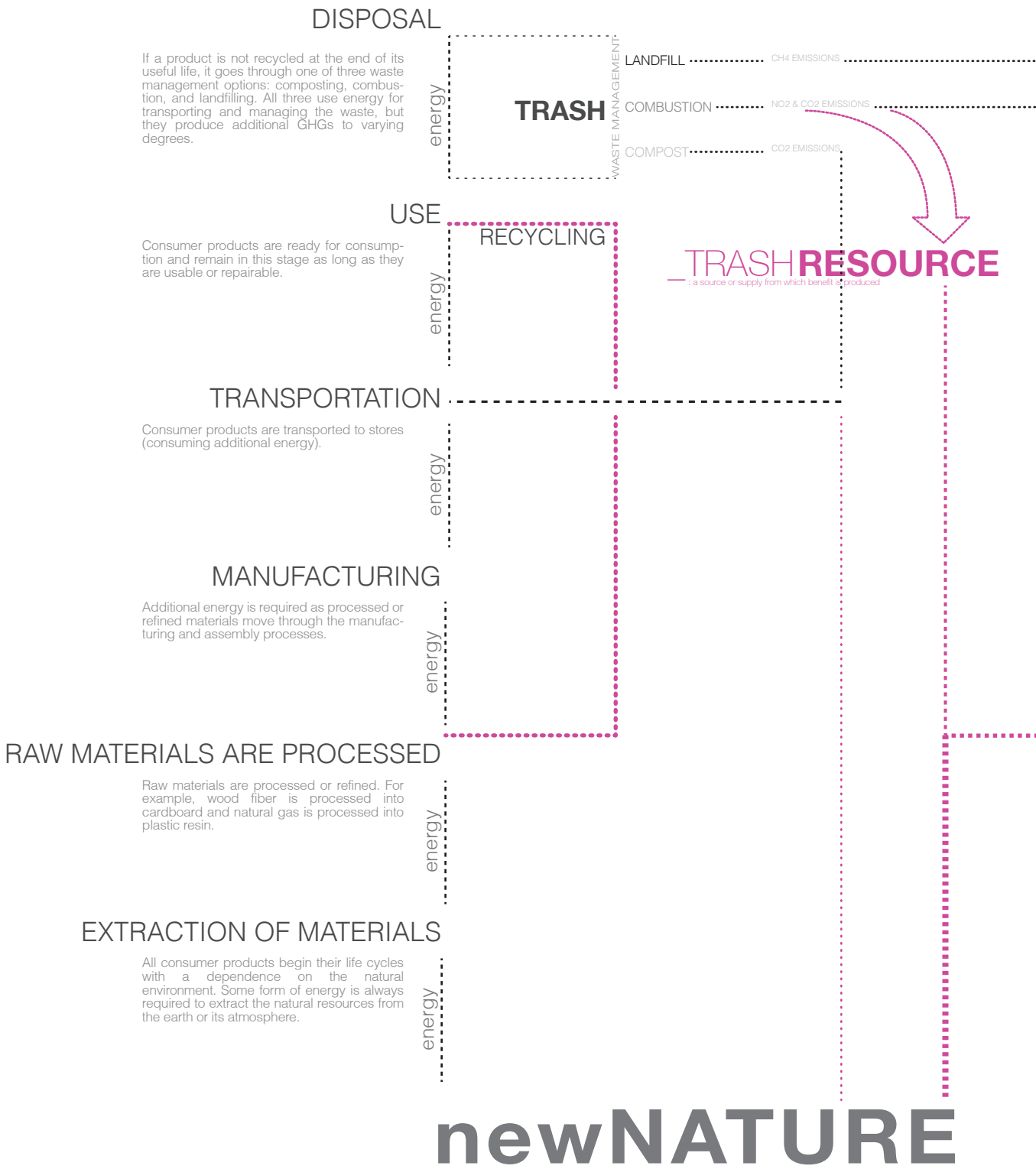


41.4 million tons of plastic/year

148.833 million cubic yards

Ocean Garbage Patches




DISPOSAL
If a product is not recycled at the end of its useful life, it goes through one of three waste management options: composting, combustion, and landfilling. All three use energy for transporting and managing the waste, but they produce additional GHGs to varying degrees.
energy
TRASH
WASTE MANAGEMENT
LANDFILL
CH4 EMISSIONS
COMBUSTION
NO2 & CO2 EMISSIONS
COMPOST
CO2 EMISSIONS
USE
Consumer products are ready for consumption and remain in this stage as long as they are usable or repairable.
energy
RECYCLING
_TRASH RESOURCE
: a source or supply from which benefit is produced
TRANSPORTATION
Consumer products are transported to stores (consuming additional energy).
energy
MANUFACTURING
Additional energy is required as processed or refined materials move through the manufacturing and assembly processes.
energy
RAW MATERIALS ARE PROCESSED
Raw materials are processed or refined. For example, wood fiber is processed into cardboard and natural gas is processed into plastic resin.
energy
EXTRACTION OF MATERIALS
All consumer products begin their life cycles with a dependence on the natural environment. Some form of energy is always required to extract the natural resources from the earth or its atmosphere.
energy
newNATURE

the demise

INPUTS

_LOCAL VARIABLES

- climate
  - sun
  - humidity
  - temperature
  - rain
  - wind loads
- structure
  - lateral loads
  - gravitational loads
  - building type
- local materials
  - trash
    - paper
    - plastic
- local knowledge
  - skills
  - building techniques
  - tradition
- culture
  - traditions
  - privacy
  - spirituality
  - aesthetics

_TECHNOLOGY

- additive manufacturing
  - 3D-printing
  - fused deposition modeling
  - laser sintering
- computational modeling
  - parametric design
  - structural analysis
  - minimize material
- speculative
  - 3-Dimensional scanning
  - augmented reality
  - robotics

Natural Materials

hand-shredded newspaper and wheat-based glue

Natural Materials

sand and wheat-based glue

sand and wheat-based glue

New-Natural Materials

mechanically-shredded newspaper and polyvinyl acetate glue

mechanically-shredded newspaper and polyvinyl acetate glue

hand-shredded newspaper and lemon-based glue

fallen leaves and wheat-based glue

sand and wheat-based glue

sand and wheat-based glue

sand and wheat-based glue

sand and polyvinyl acetate glue

mechanically-shredded newspaper and polyvinyl acetate glue

mechanically-shredded newspaper and polyvinyl acetate glue

Material Samples

Resin Identification Code

The resin identification coding system for plastic, represented by the numbers on the bottom of plastic containers, was introduced by SPI, the plastics industry trade association, in 1988. Municipal recycling programs traditionally target packaging containers, and the SPI coding system offered a way to identify the resin content of bottles and containers commonly found in the residential waste stream. Plastic household containers are usually marked with a number that indicates the type of plastic. Consumers can then use this information to determine whether or not certain plastic types are collected for recycling in their area. Contrary to common belief, just because a plastic product has the resin number in a triangle, which looks very similar to the recycling symbol, it does not mean it is collected for recycling.

SPI Resin Identification Codes

1	PET
2	HDPE
3	Vinyl
4	LDPE
5	PP
6	PS
7	OTHER

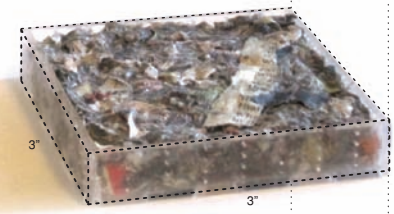
How Plastic Is Made

Plastics can be divided in to two major categories: thermosets and thermoplastics. A thermoset solidifies or “sets” irreversibly when heated. They are useful for their durability and strength, and are therefore used primarily in automobiles and construction applications. Other uses are adhesives, inks, and coatings.

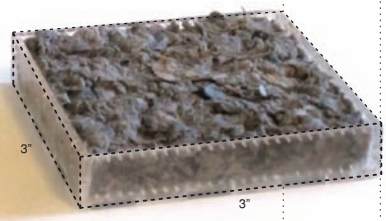
A thermoplastic softens when exposed to heat and returns to original condition at room temperature. Thermoplastics can easily be shaped and molded into products such as milk jugs, floor coverings, credit cards, and carpet fibers.

Environmental Protection Agency

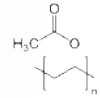
material
high-density polyethylene (HDPE)
(plastic grocery bags)
polyethylene thermoplastic made from petroleum
binder
wheat-based glue
sugar & unbleached wheat flour

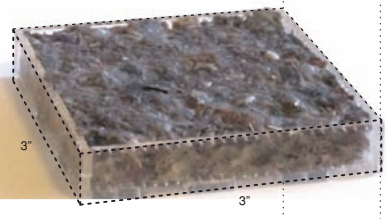


material
newspaper
newsprint
binder
wheat-based glue
sugar & unbleached wheat flour

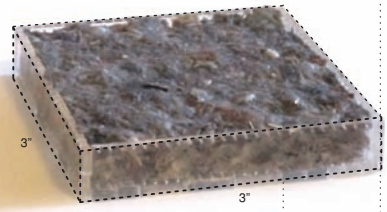


material
newspaper
newsprint
binder
polyvinyl acetate (PVA glue) (C4H6O2)n



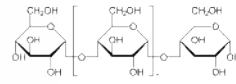


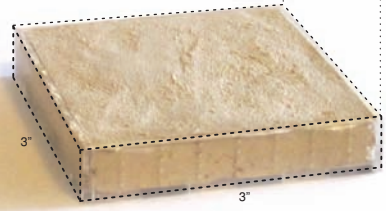
material
newspaper
newsprint
binder
wheat paste (powder-based)
vegetable starch



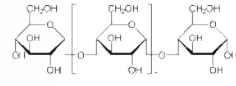
material
2 parts newspaper
newsprint
1 part paper mache
paper, clay, plaster
binder
dextrine
low-molecular-weight carbohydrates produced by the hydrolysis of starch or glycogen.

Dextrins are mixtures of polymers of D-glucose units linked by α-(1->4) or α-(1->6) glycosidic bonds.





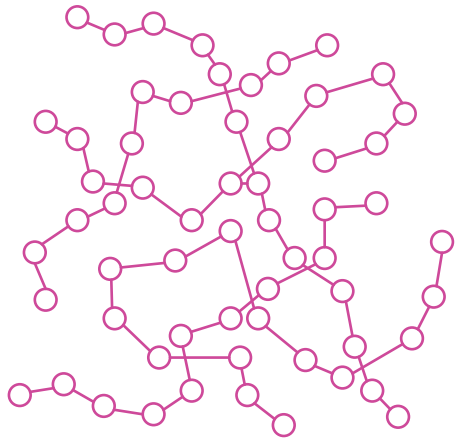
material
paper mache
paper, clay, plaster
binder
dextrine
low-molecular-weight carbohydrates produced by the hydrolysis of starch or glycogen.
Dextrins are mixtures of polymers of D-glucose units linked by α-(1->4) or α-(1->6) glycosidic bonds.



Plastic

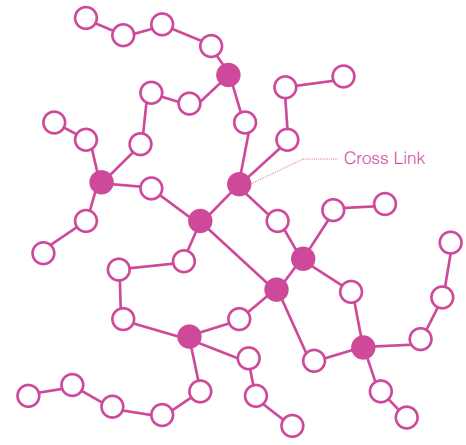
THERMOPLASTICS

80%
VOLUME



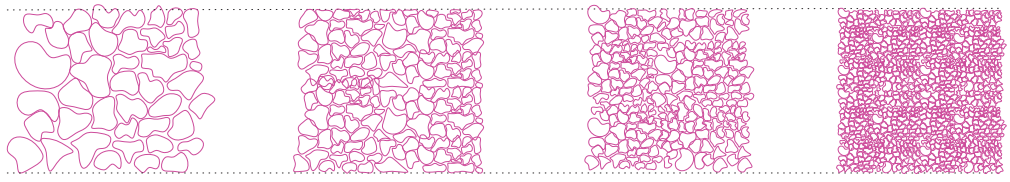
THERMOSETS

20%
VOLUME

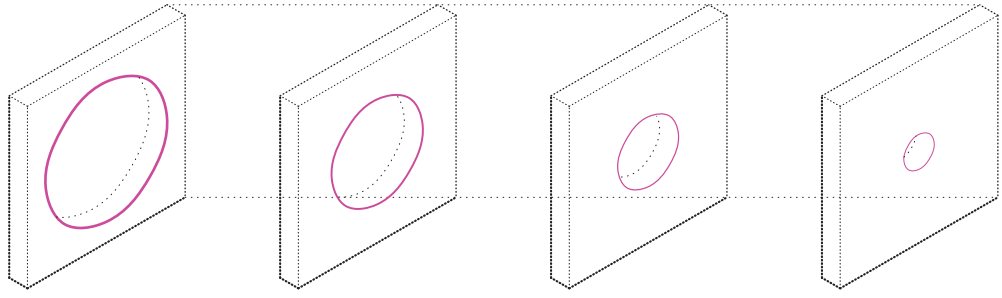


Paper

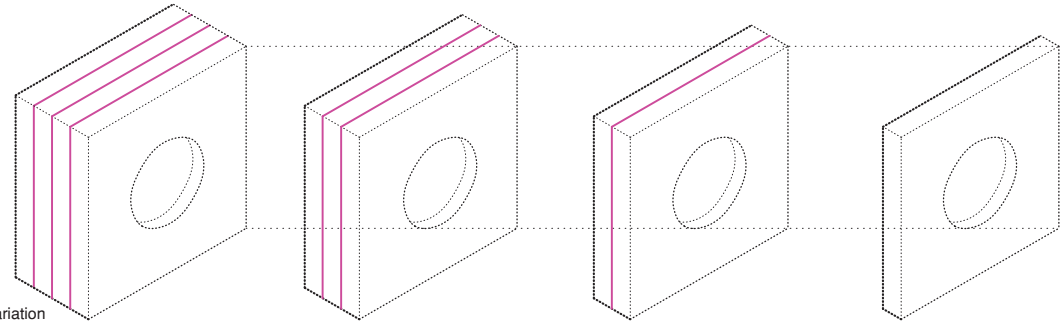
material variation



paper density



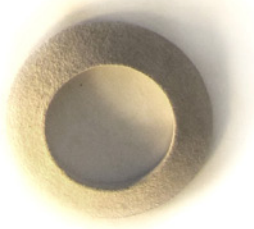
aperture variation



module thickness variation



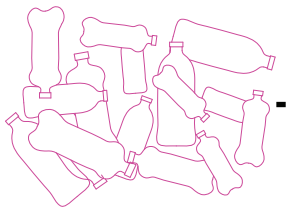






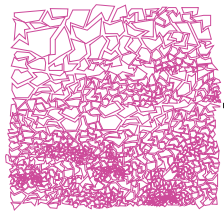
Plastic

raw plastic



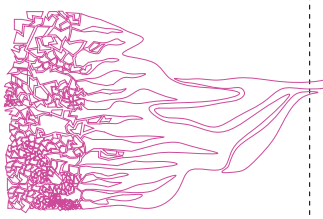
GRIND

grinded plastic

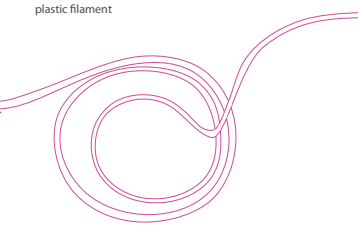


MELT

melted plastic



plastic filament

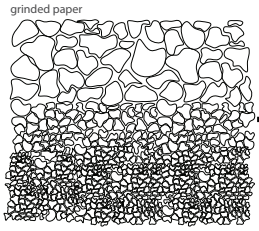


Paper

raw paper

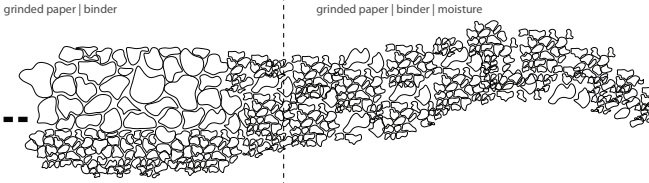
GRIND

grinded paper



FILTER

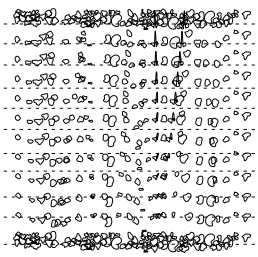
grinded paper | binder



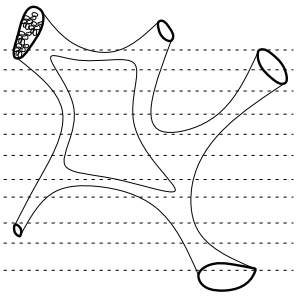
grinded paper | binder | moisture

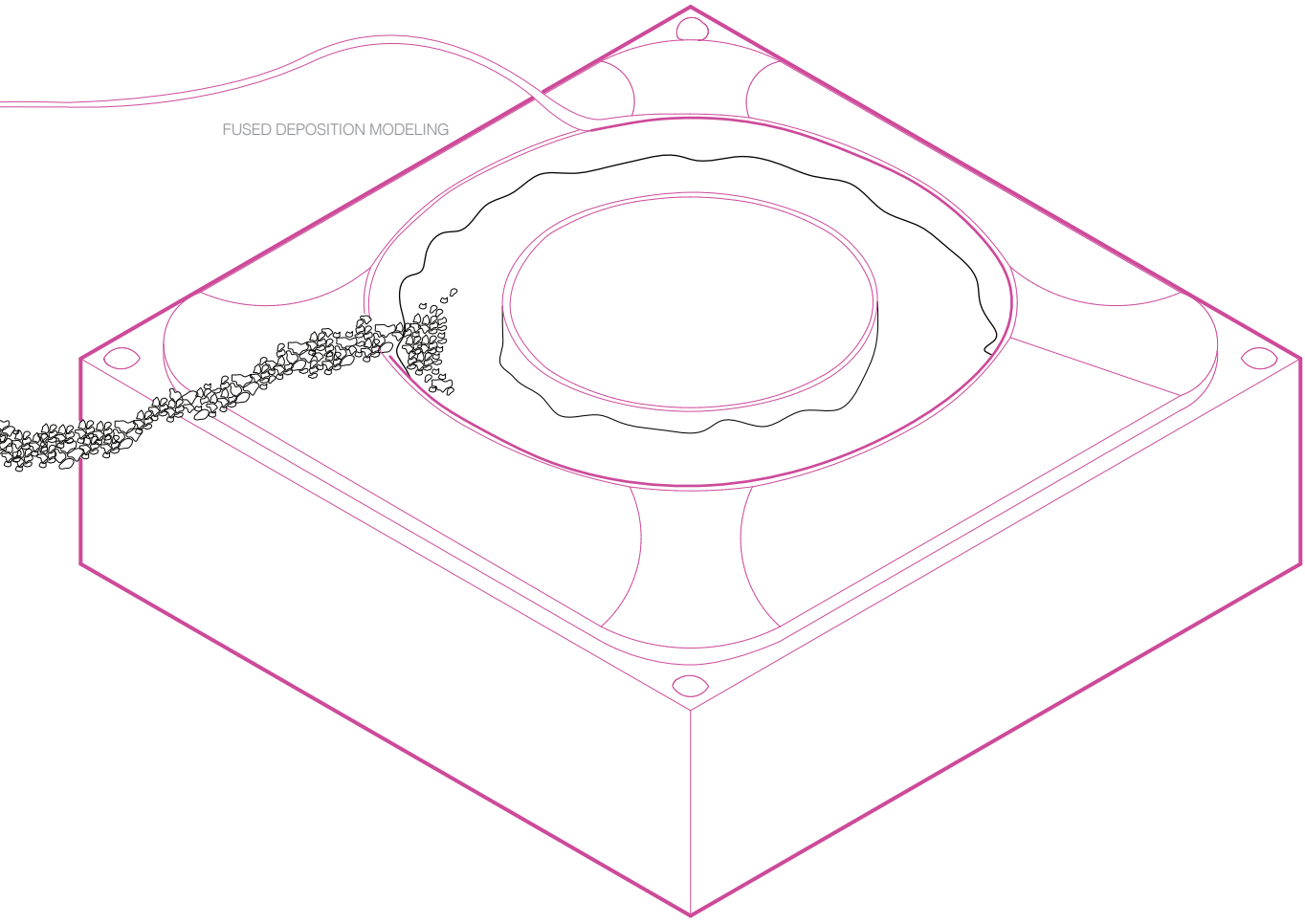
contact time

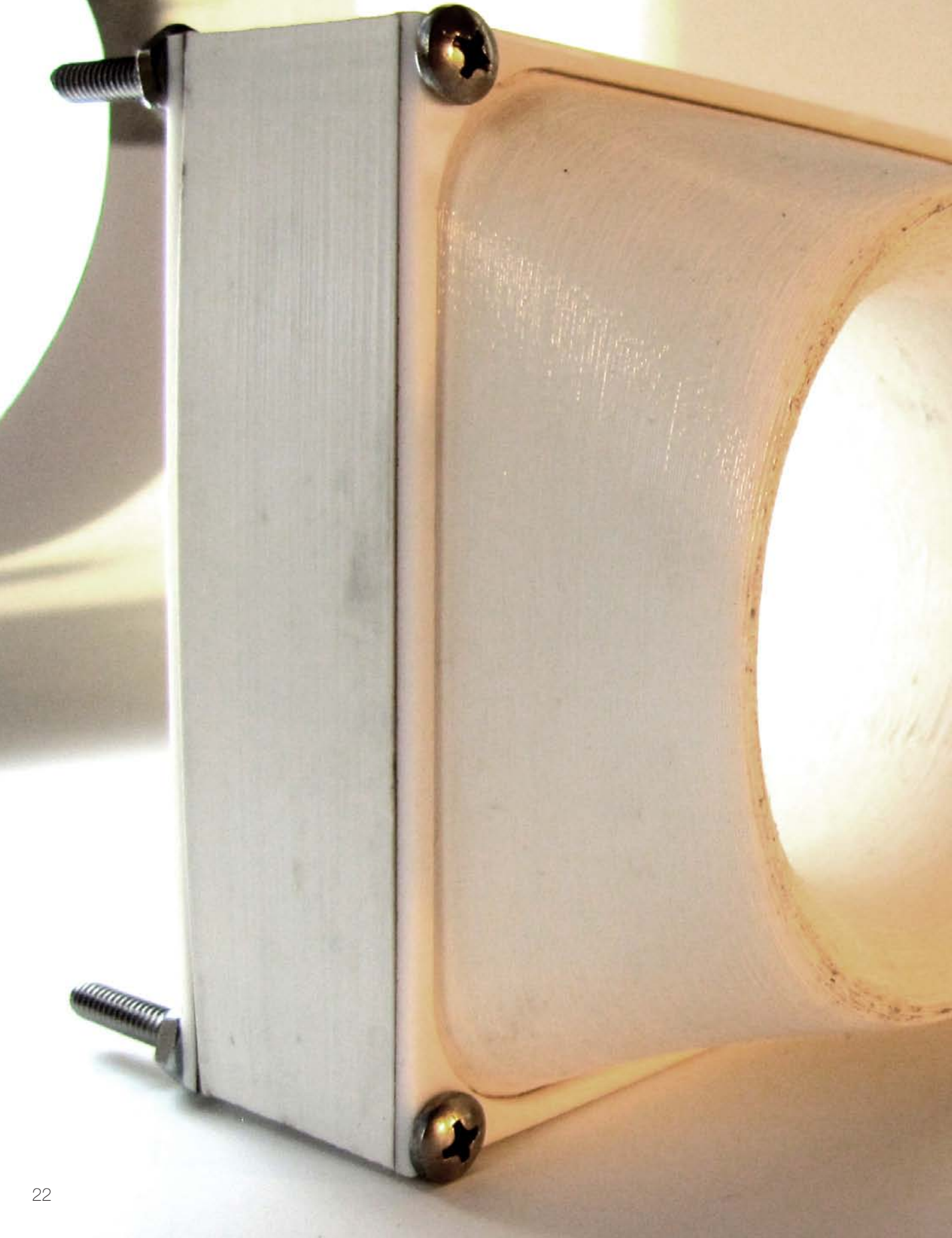
ultra-fine paper powder

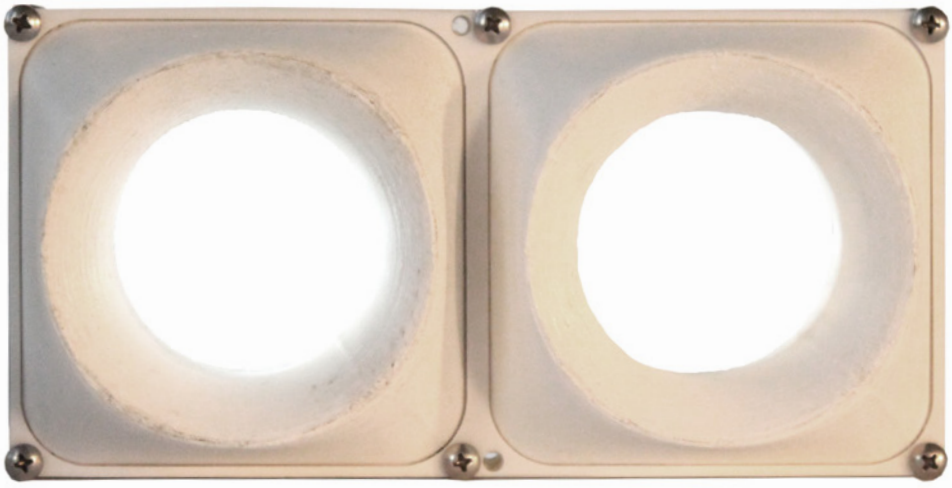


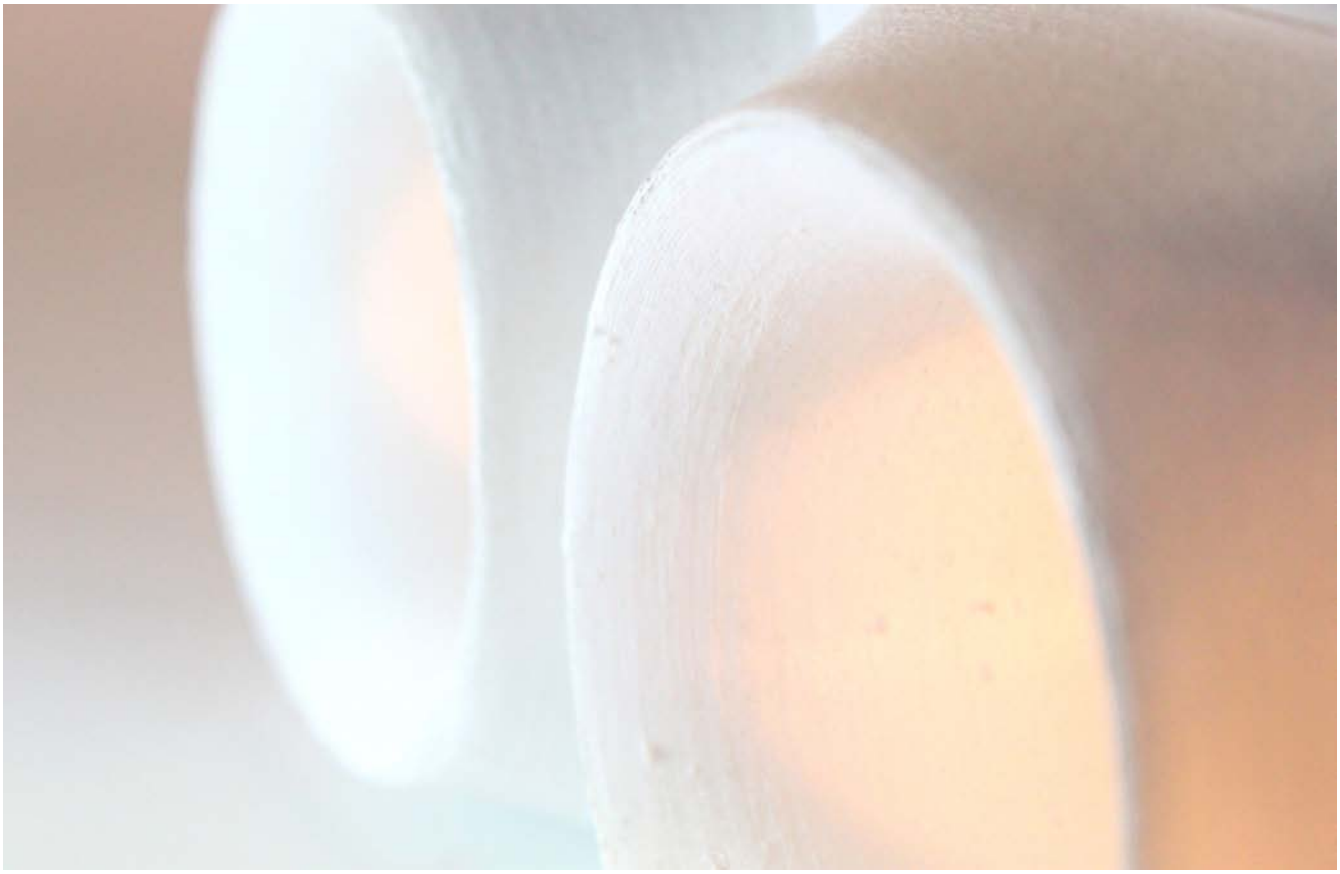
3D-PRINTING

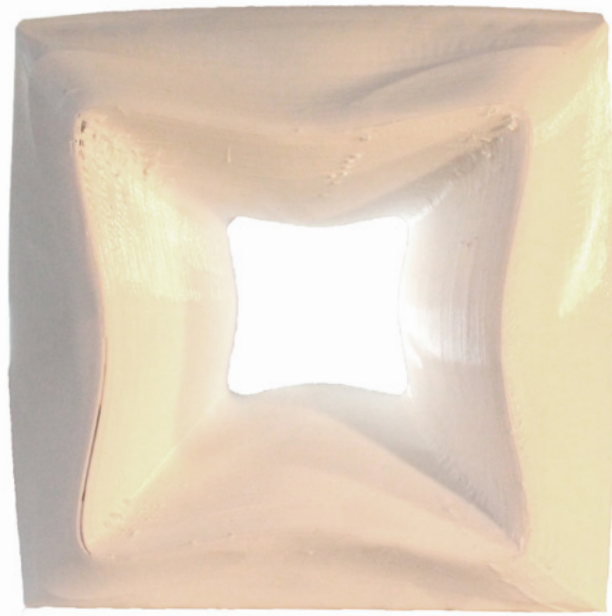


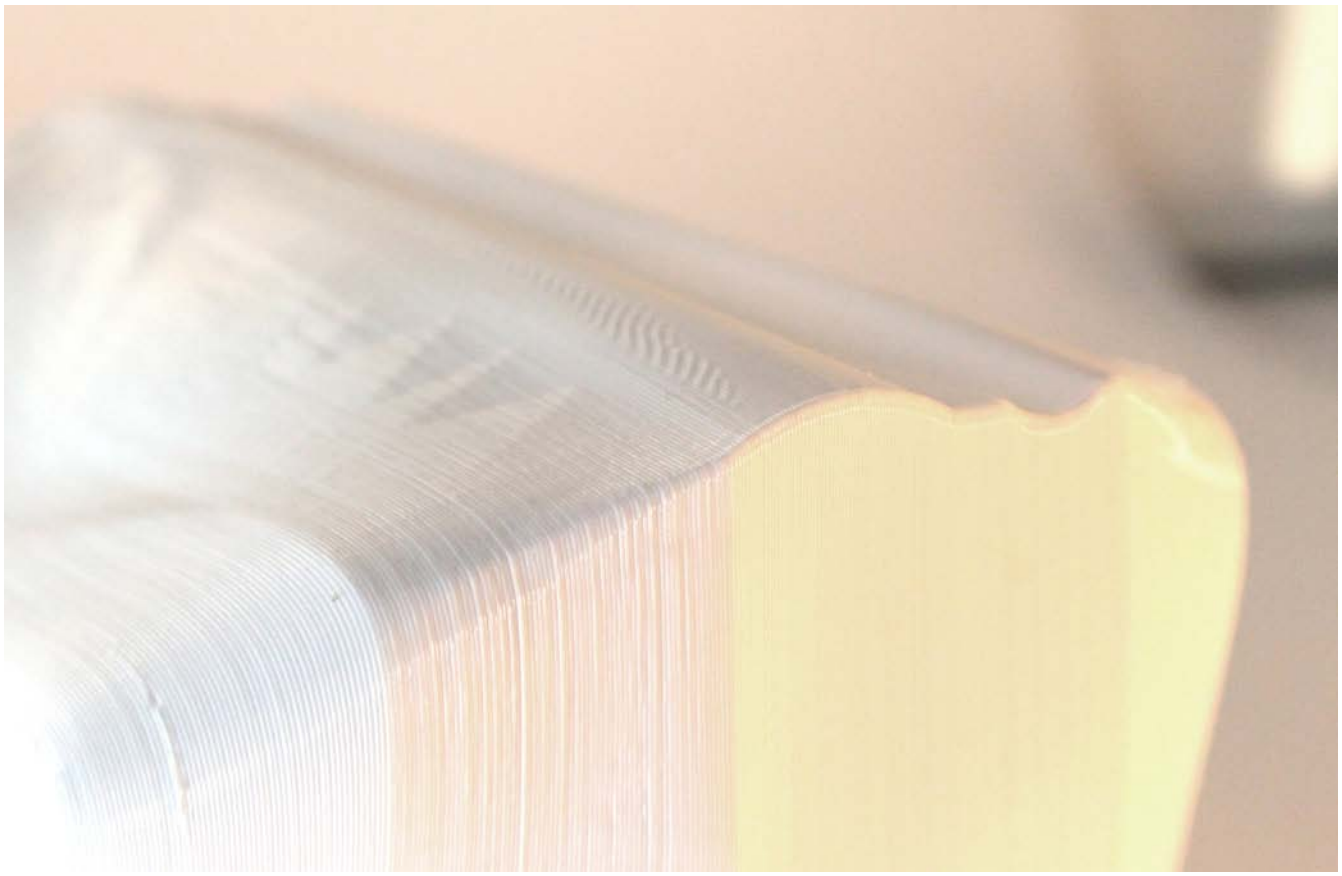

FUSED DEPOSITION MODELING

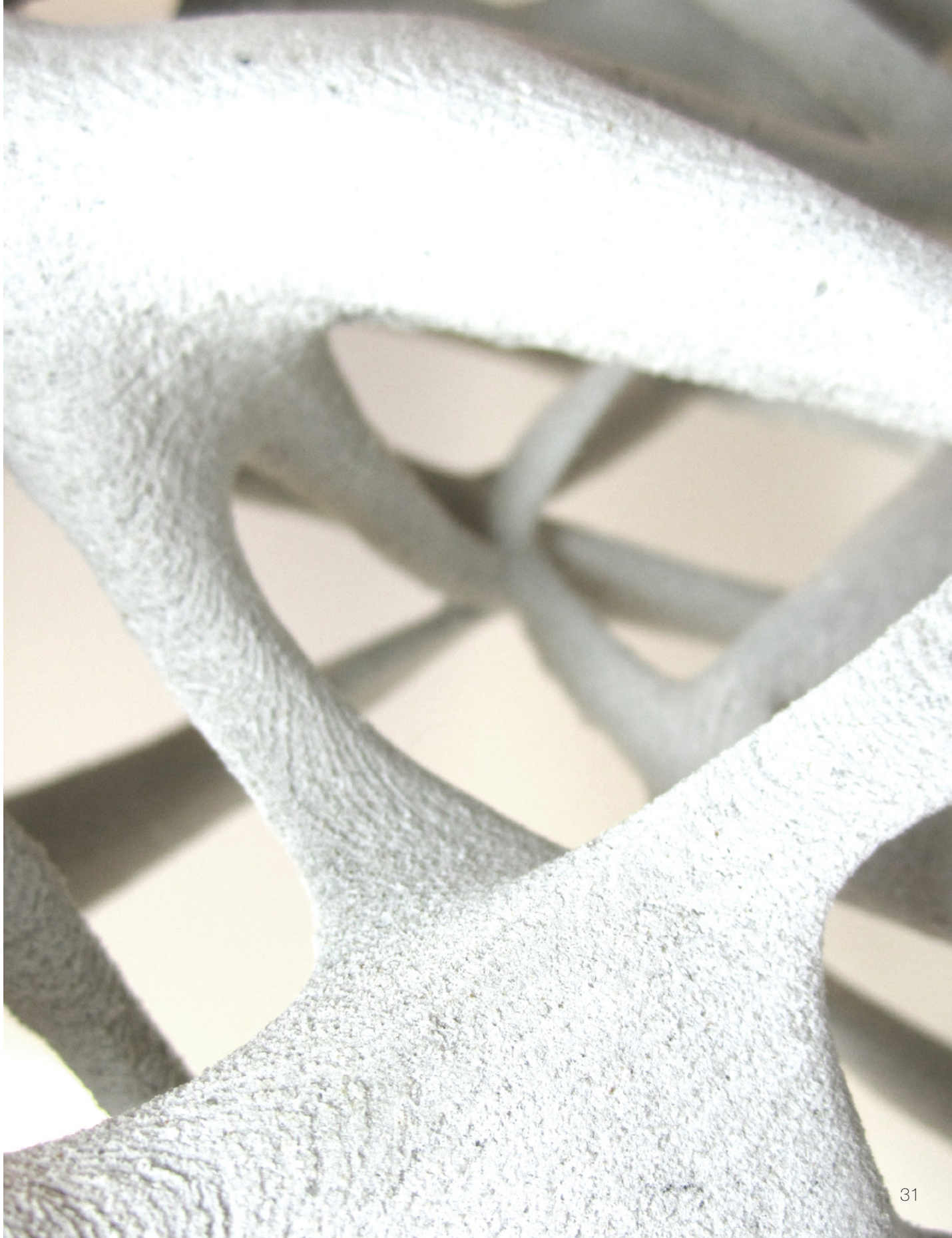


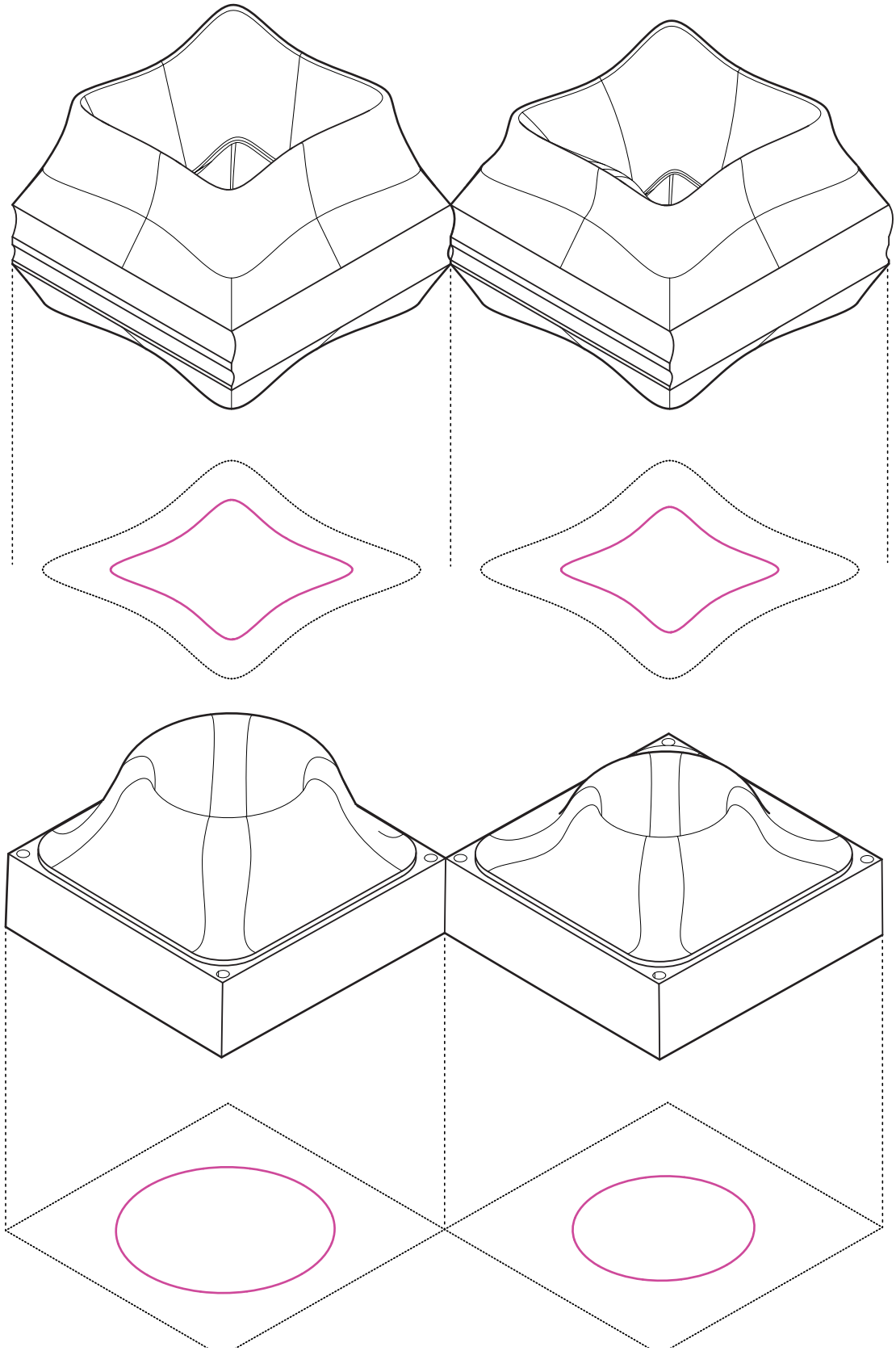


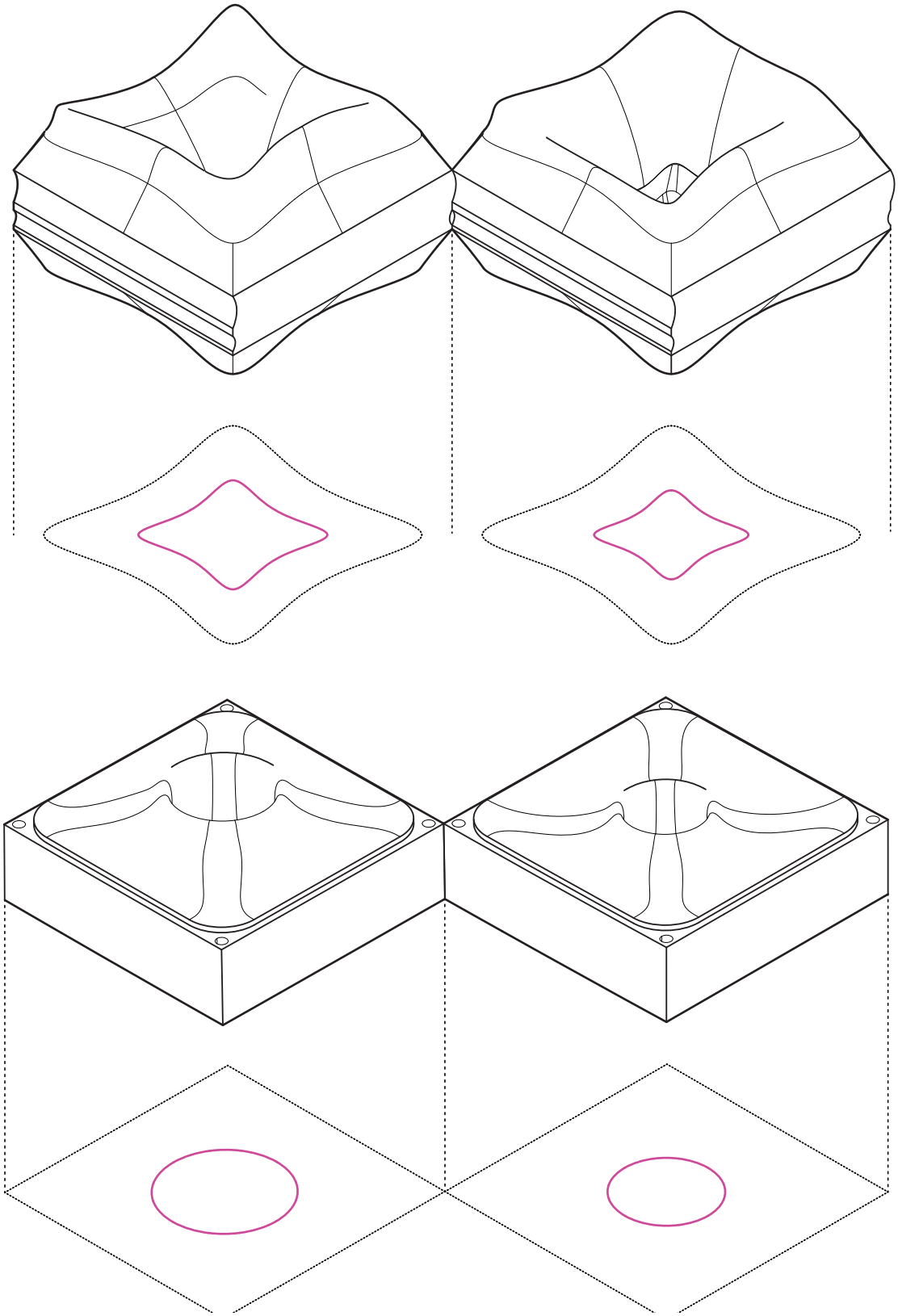


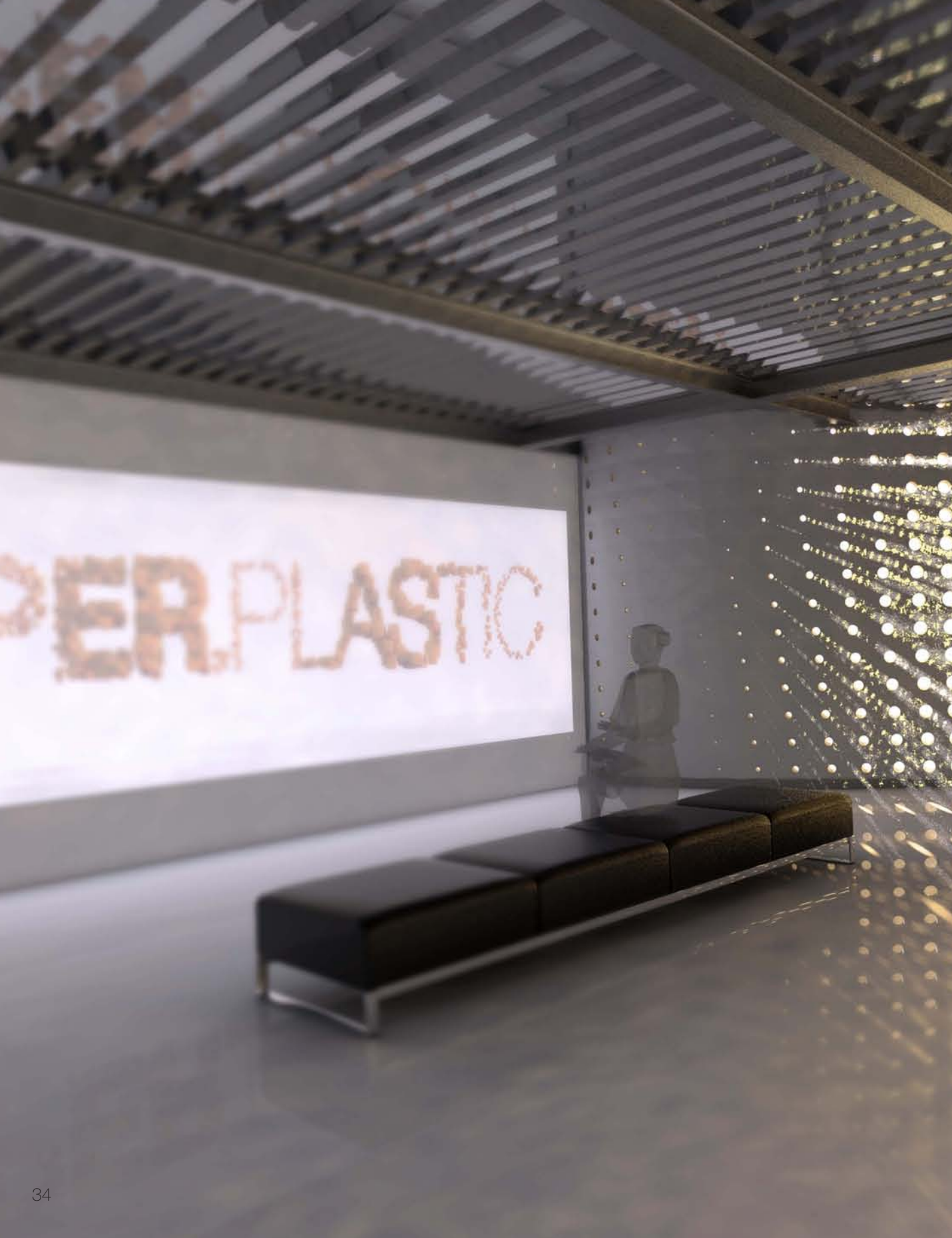


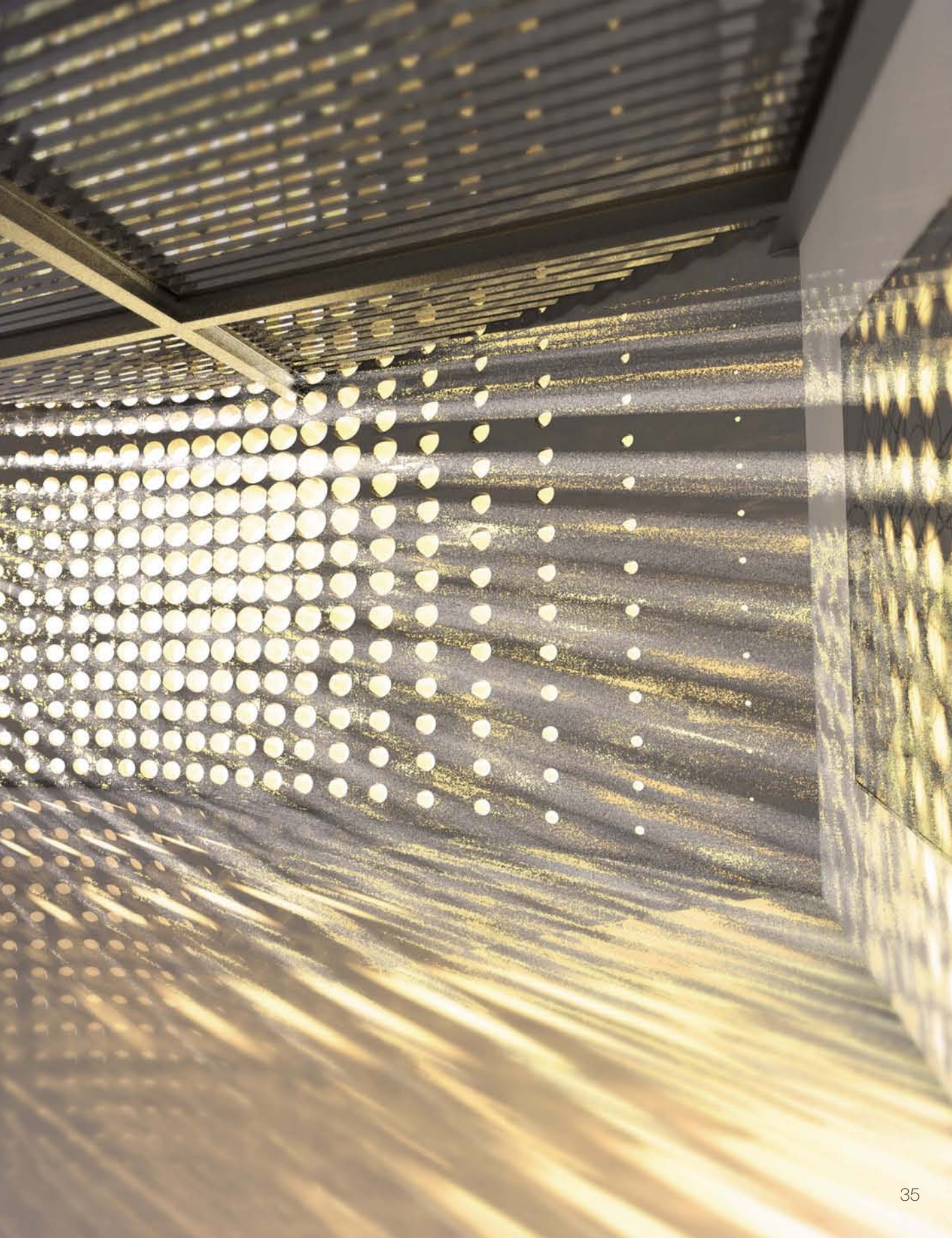


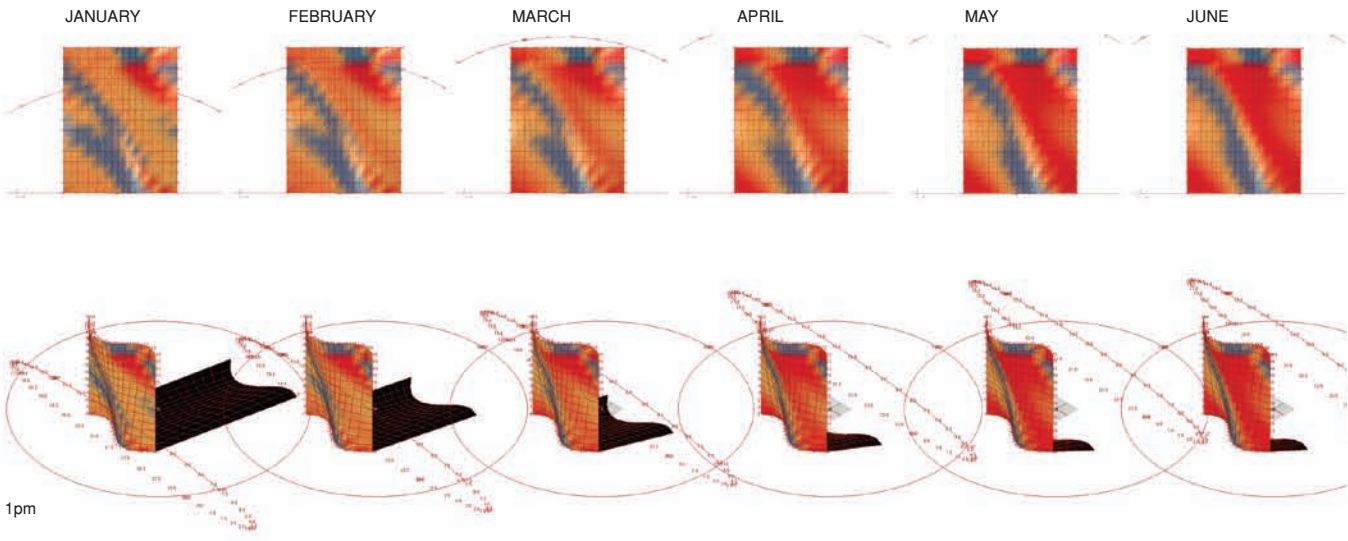






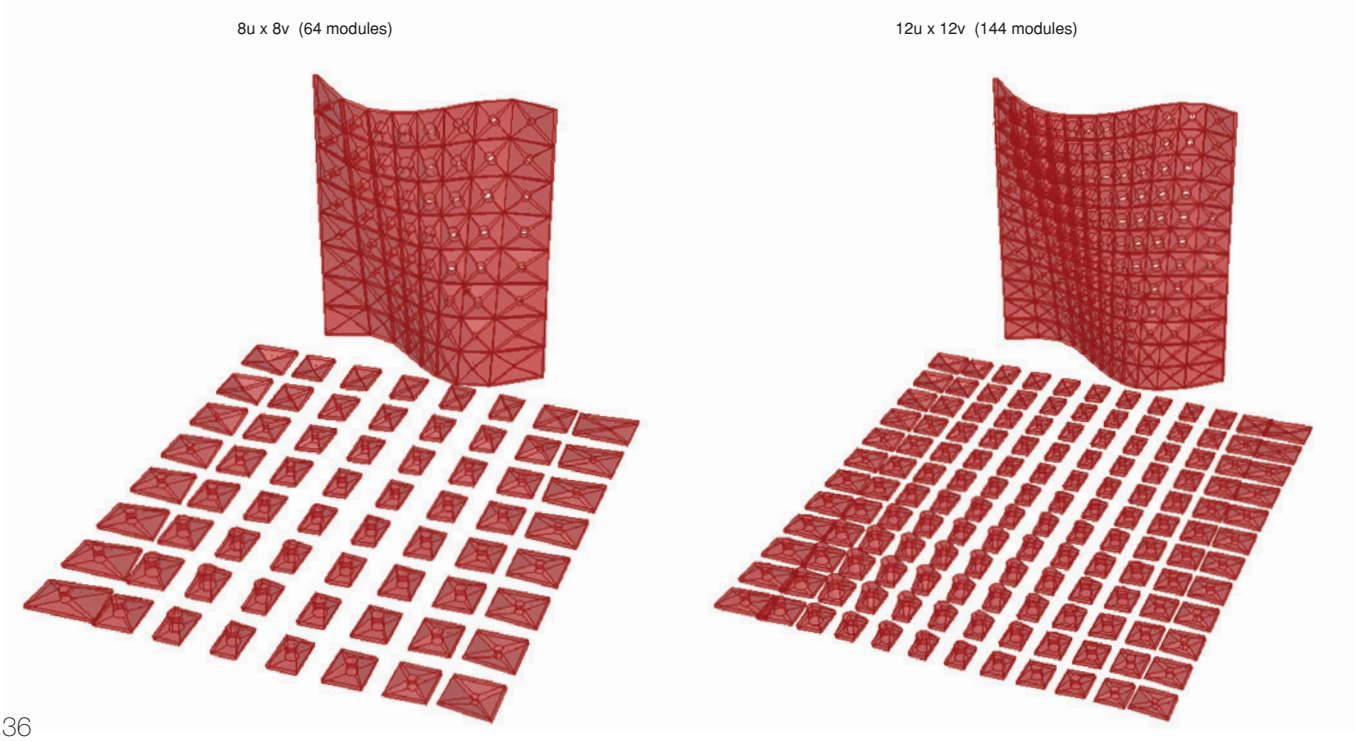

ER.PLASTIC

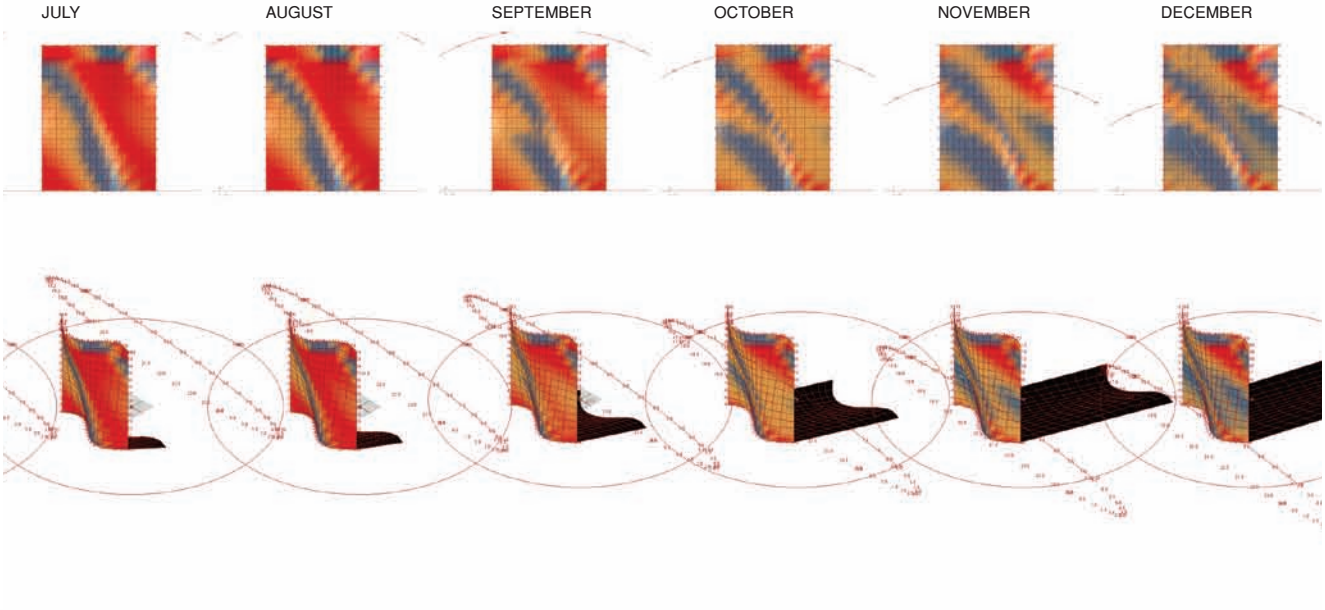




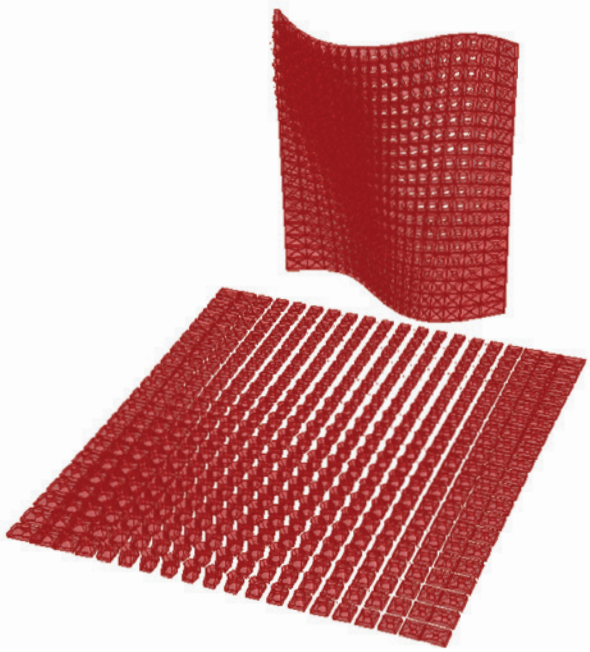
Incident Radiation Analysis on Double-Curved Facade Surface

Automatic Module Layout and Labeling for Fabrication

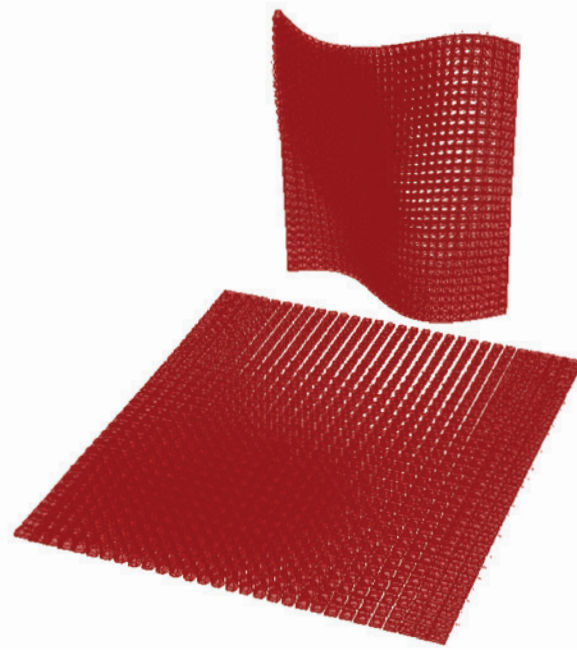


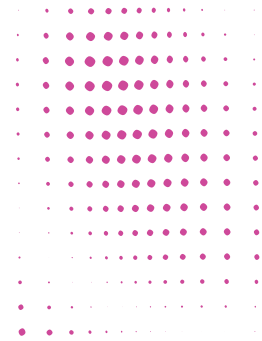
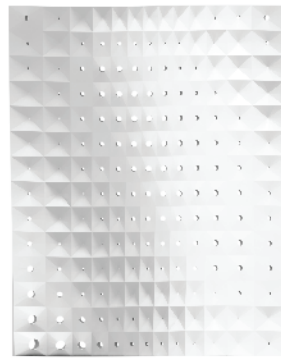
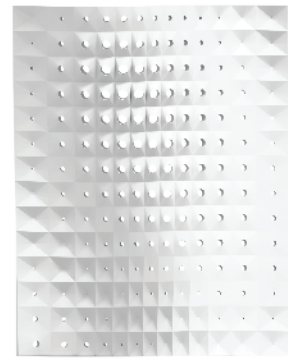


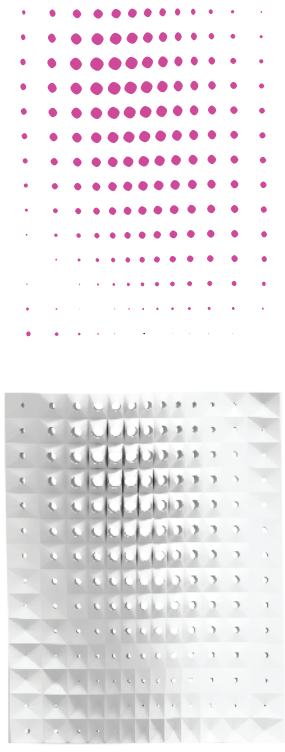
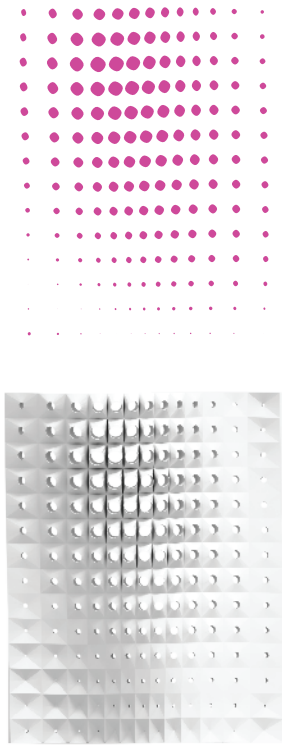
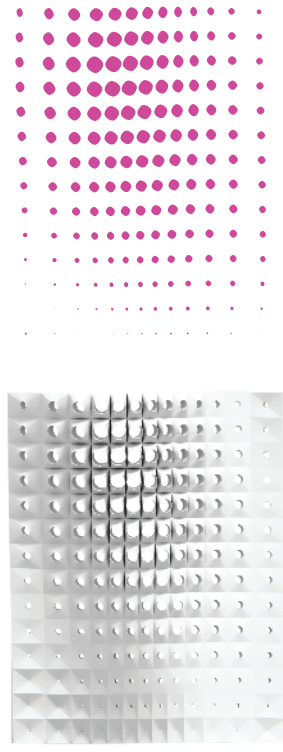
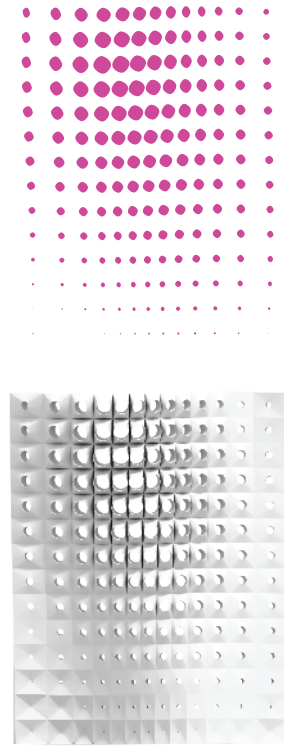
20u x 20v (400 modules)

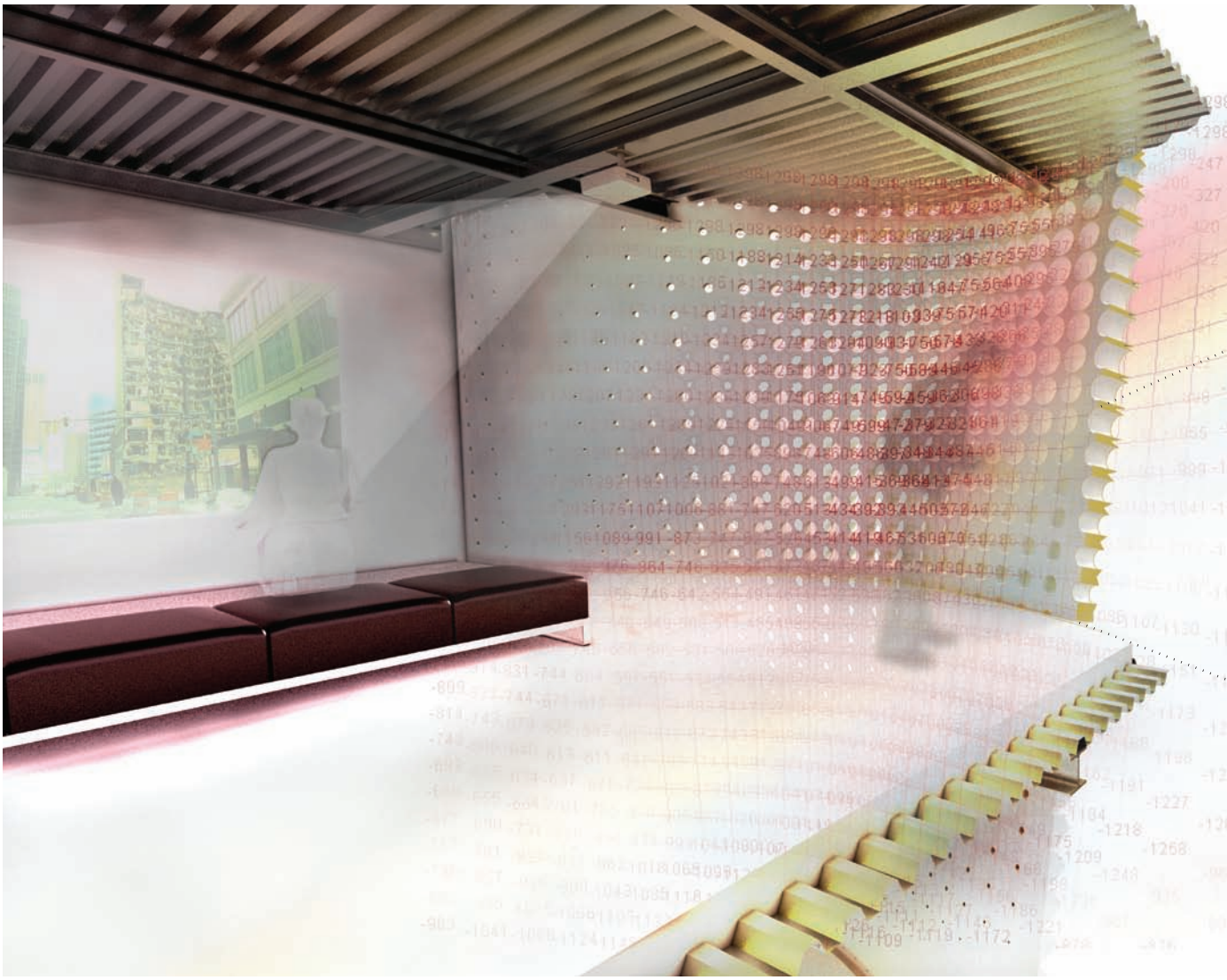


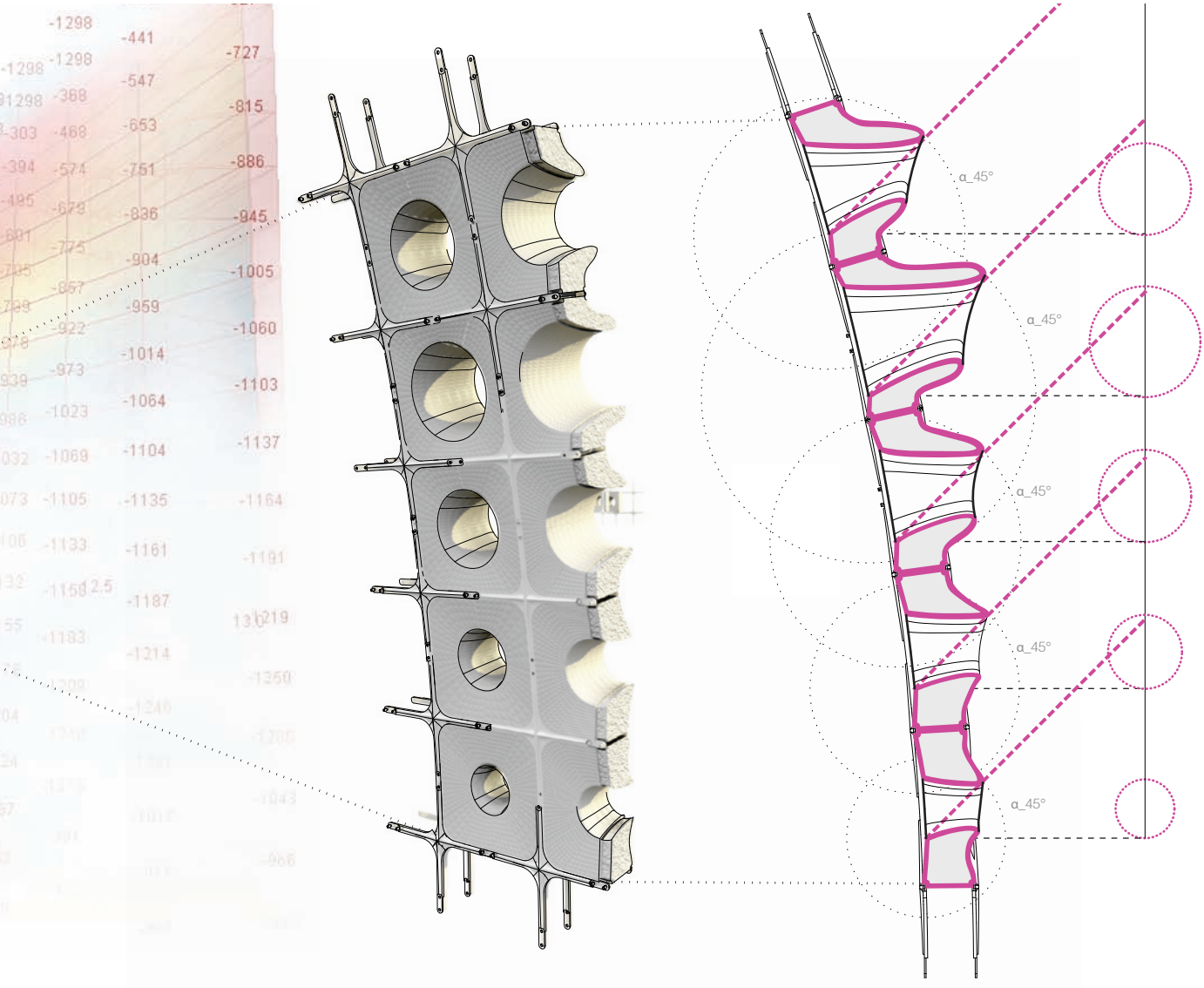
30u x 30v (900 modules)



	30	40
		
		
Total Paper Volume (cubic inches)	439,871	505,894
Total Paper Volume (cubic yards)	9.427962	10.84
Total Paper Weight (lbs)	7,542.37	8,674.45
Total 12” high Stacks of Newspaper Needed	215.59	247.84
Total Plastic Volume (cubic inches)	182,360	191,549
Total Plastic Volume (cubic yards)	3.91	4.11
Total Plastic Weight (lbs)	5,242.68	5,506.89
Total 20oz PET Plastic Bottles Needed	99.611	104.631

50	60	70	80
			
564,988	600,709	622,467	635,830
12.11	12.88	13.34	13.63
9,687.72	10,300	10,673	10,902
276.79	294.29	304.94	311.48
203,742	214,958	224,501	232,511
4.37	4.61	4.81	4.98
5,857.42	6,179.89	6,454.21	6684.53
111.219	117.418	122.630	127.006



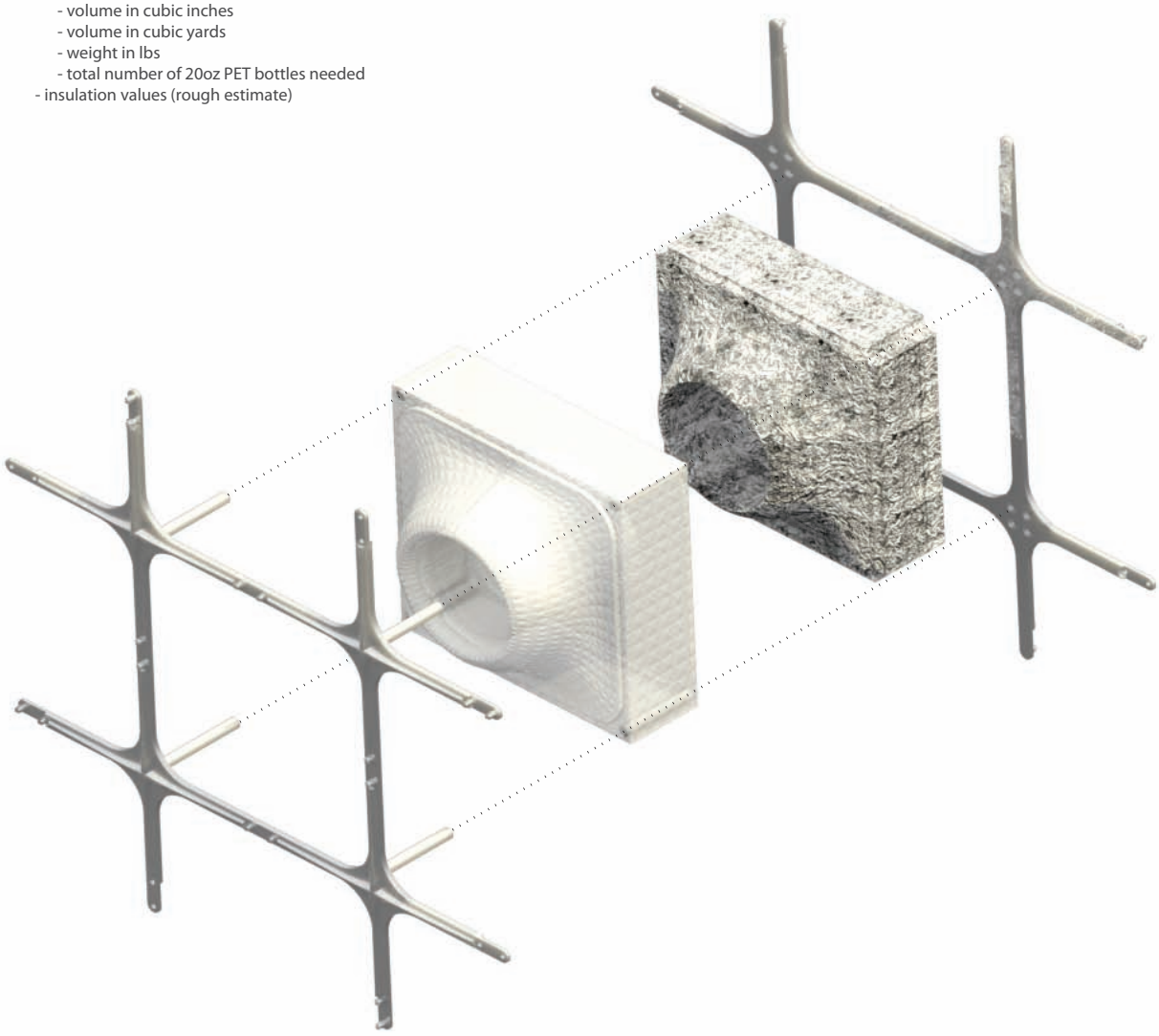

α_45°
α_45°
α_45°
α_45°
α_45°

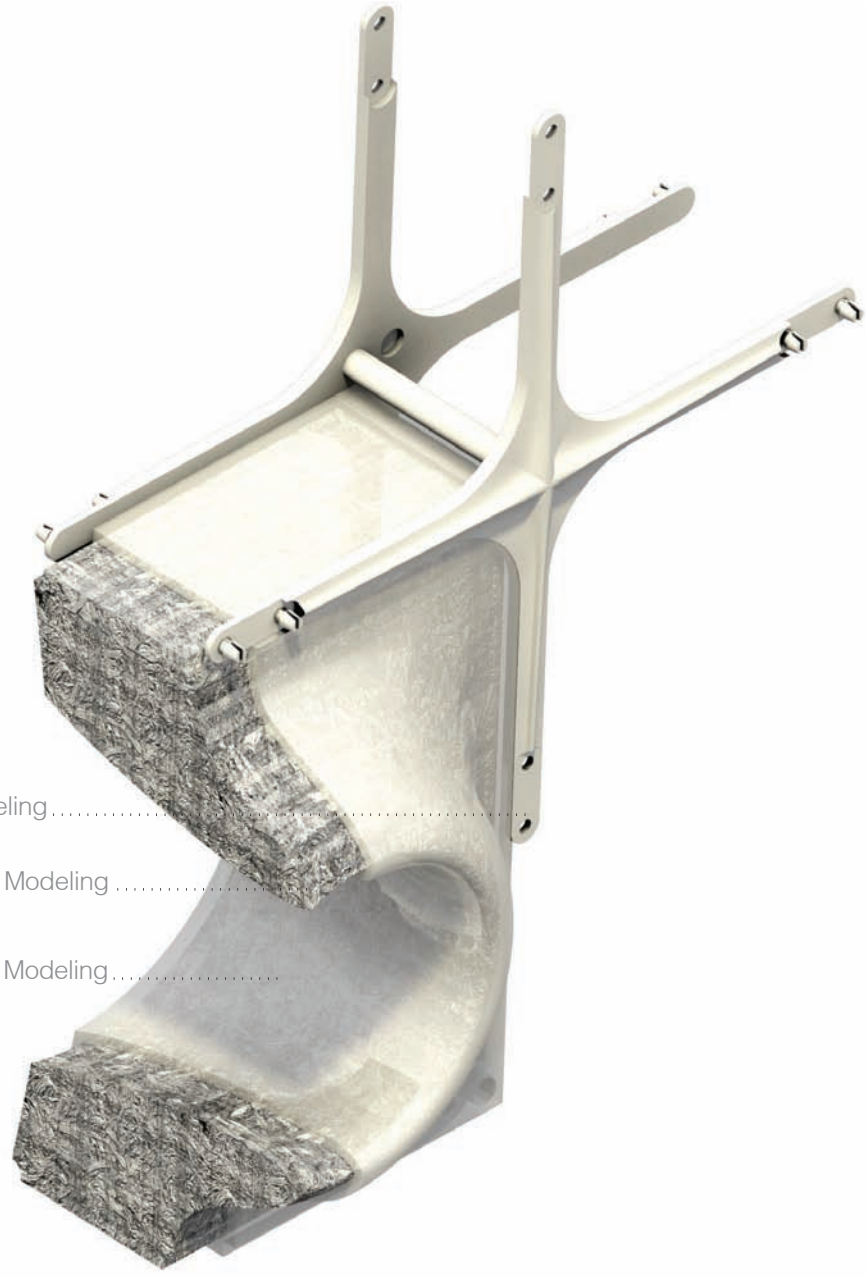
PARAMETRIC INPUTS

- initial form
- module size
- amount of modules in UV directions (height and width)
- climate data
    - location
    - month
    - day
    - time
    - orientation
    - incident radiation
- wall thickness
    - total thickness
    - plastic shell thickness
- view preferences

PARAMETRIC OUTPUTS

- module form
- fabrication layout of modules
- labeled modules
- amount of paper needed
    - volume in cubic inches
    - volume in cubic yards
    - weight in lbs
    - total (12" tall stacks) of Newspaper Needed
- amount of plastic needed
    - volume in cubic inches
    - volume in cubic yards
    - weight in lbs
    - total number of 20oz PET bottles needed
- insulation values (rough estimate)





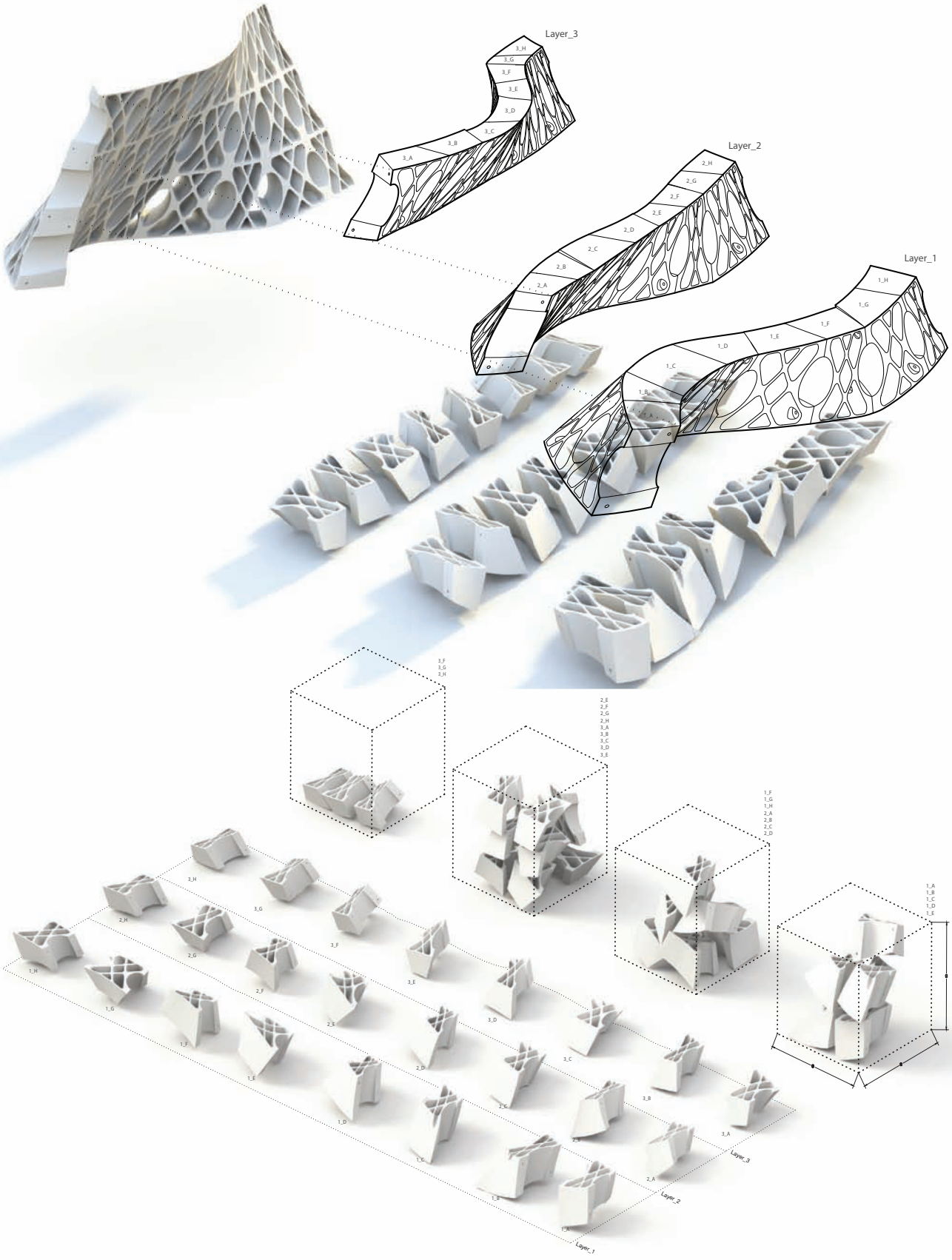
Plastic: Fused Deposition Modeling
high resolution: tensil structure
lateral loads

Paper Core: Fused Deposition Modeling
variable coarseness: changes density
insulation: 3.5R/inch

Plastic Shell: Fused Deposition Modeling
variable thickness: ≥ 1mm
waterproofing

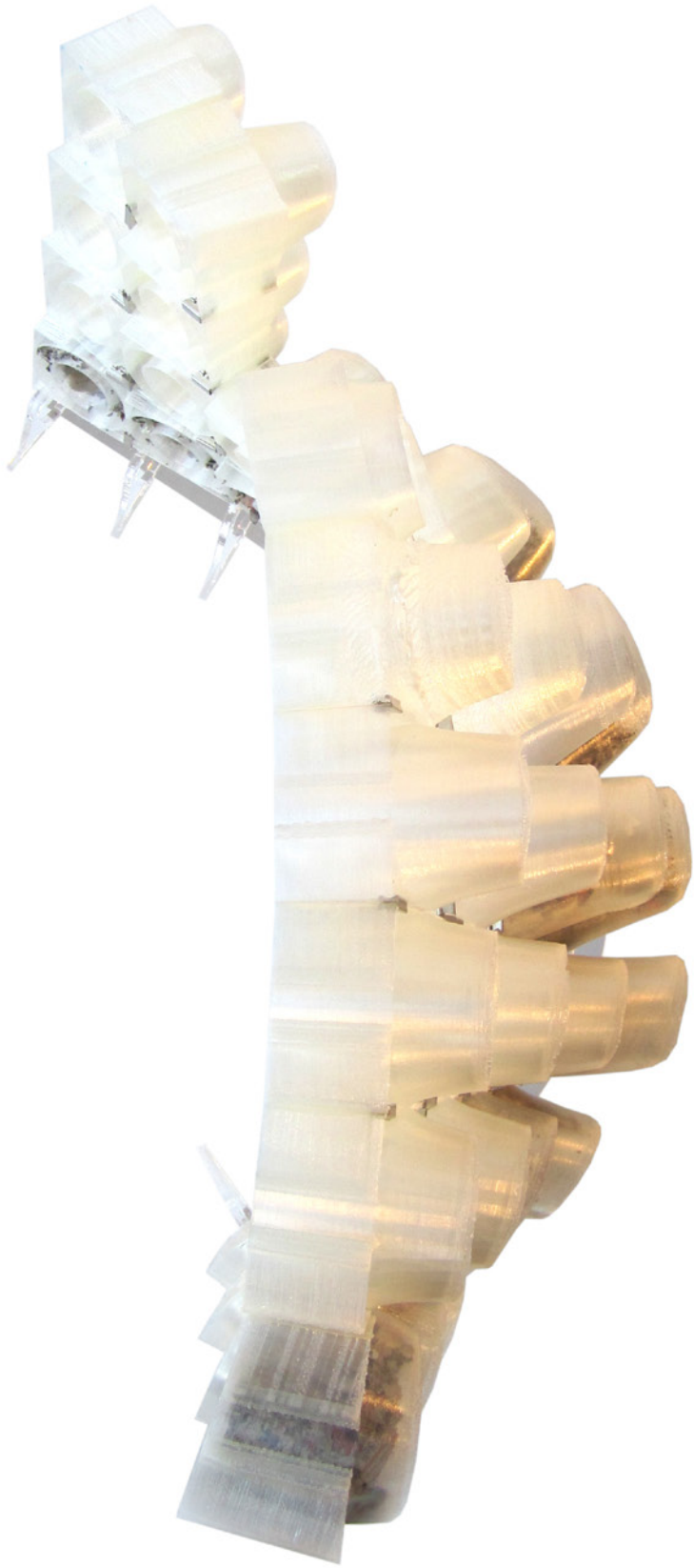

Talbots
Kearny
charles SCHWAB
GALLERIA
NO STOPPING

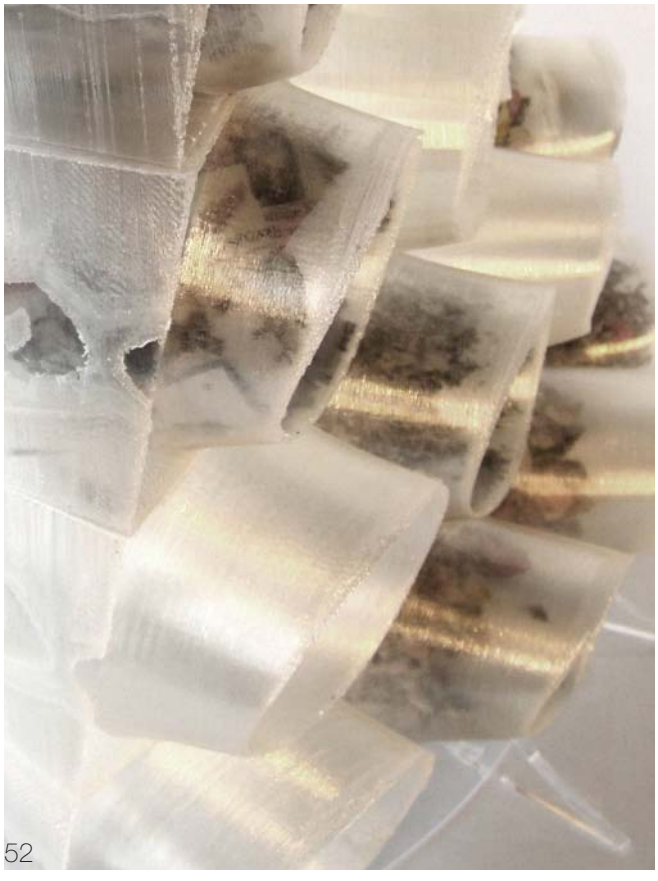

MANGO
MANGO

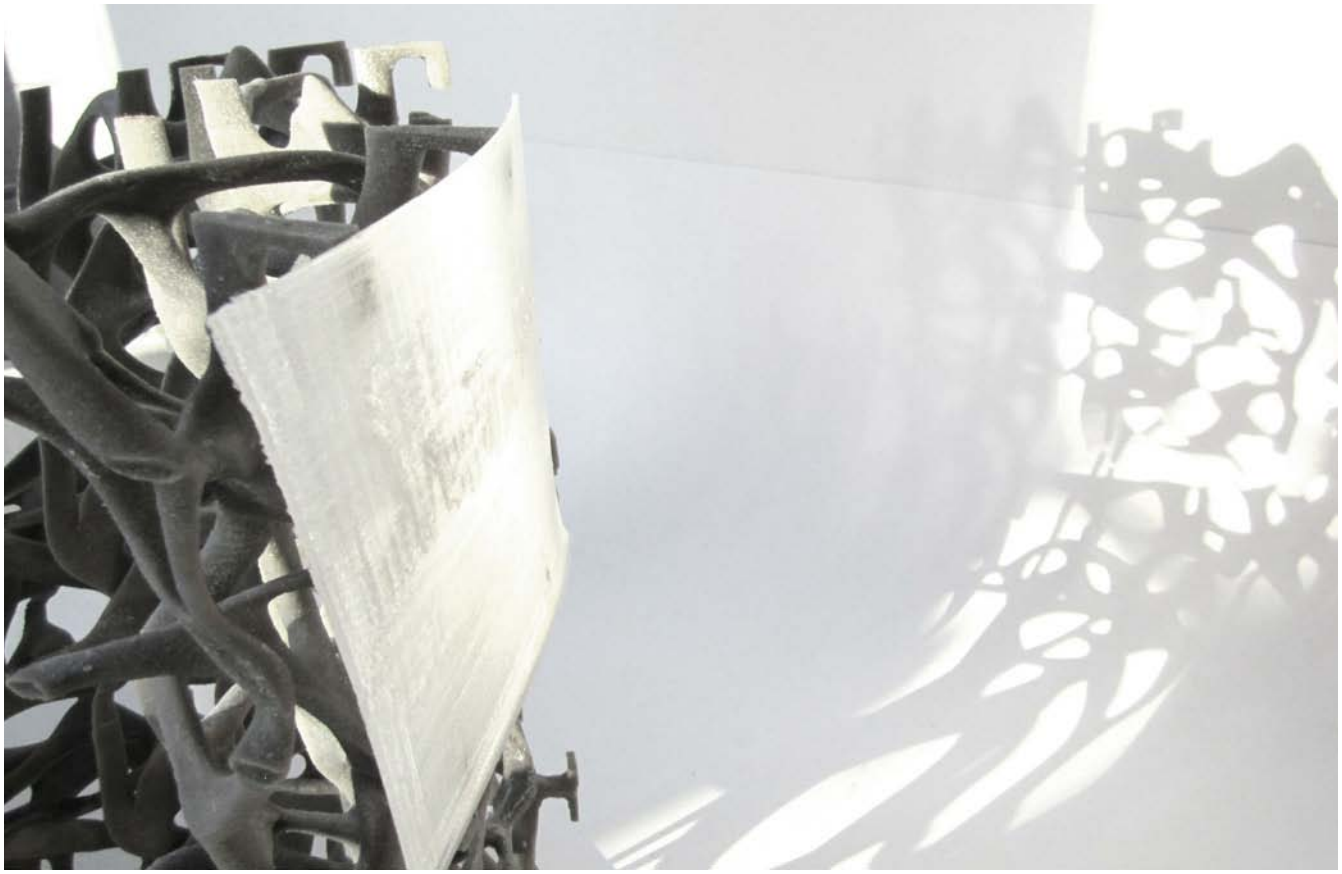

Layer_3
3_H
3_G
3_F
3_E
3_D
3_C
3_B
3_A
Layer_2
2_H
2_G
2_F
2_E
2_D
2_C
2_B
2_A
Layer_1
1_H
1_G
1_F
1_E
1_D
1_C
1_B
1_A
Layer_3
Layer_2
Layer_1

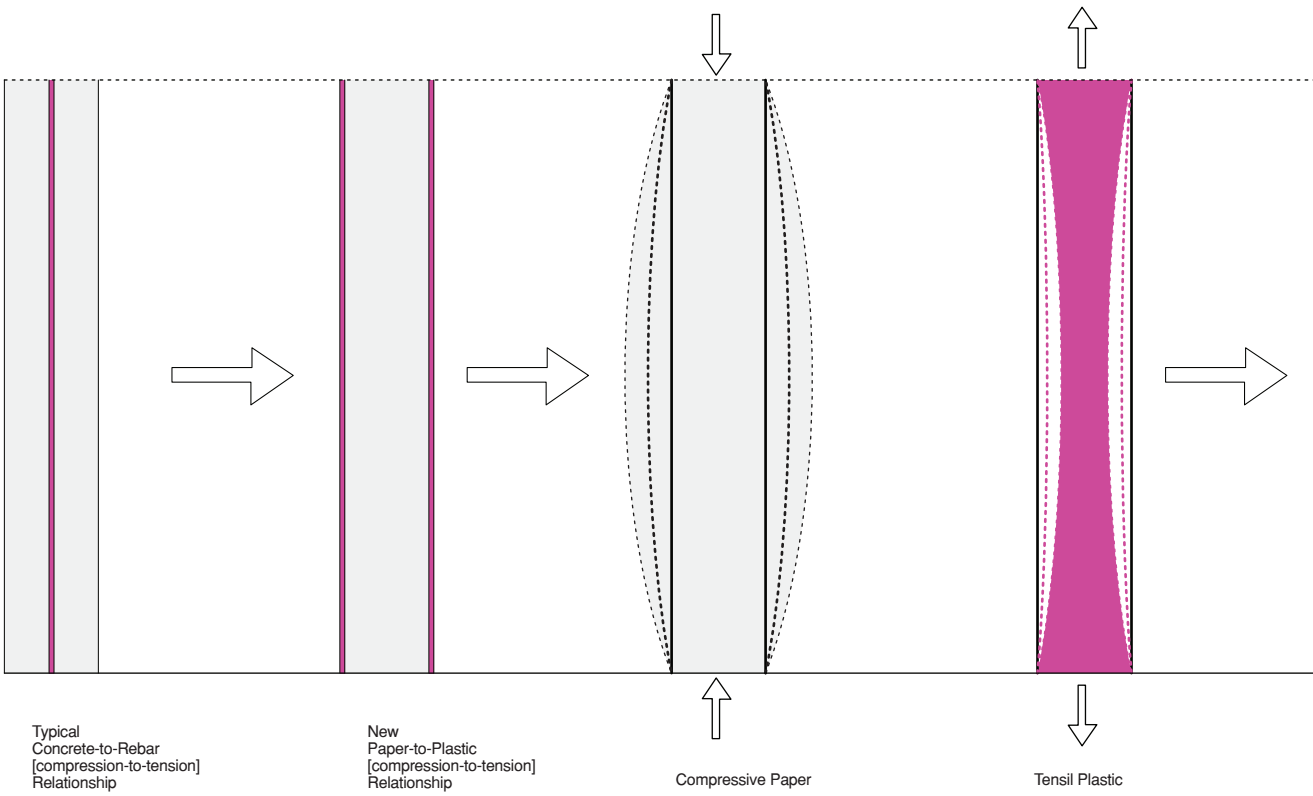
Digital Representation

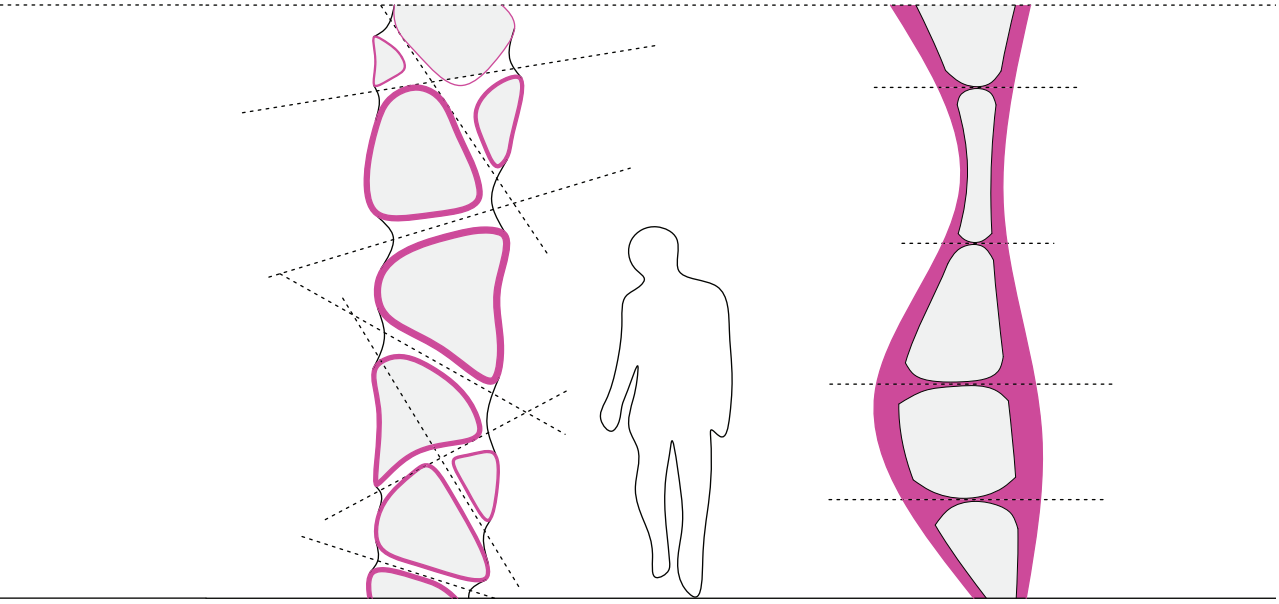
Physical Realization





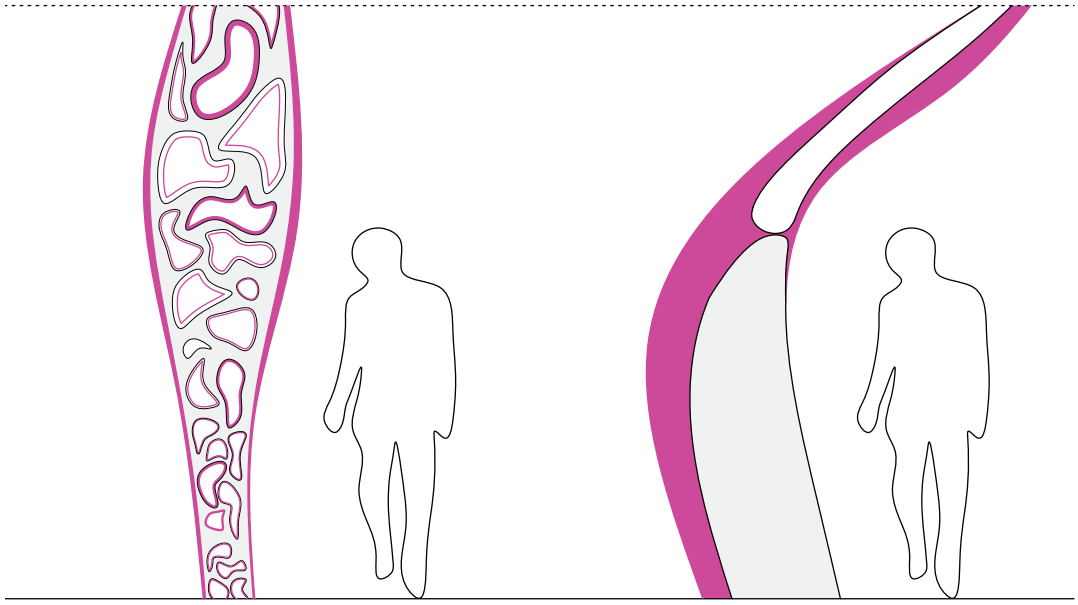



Typical
Concrete-to-Rebar
[compression-to-tension]
Relationship
New
Paper-to-Plastic
[compression-to-tension]
Relationship
Compressive Paper
Tensil Plastic



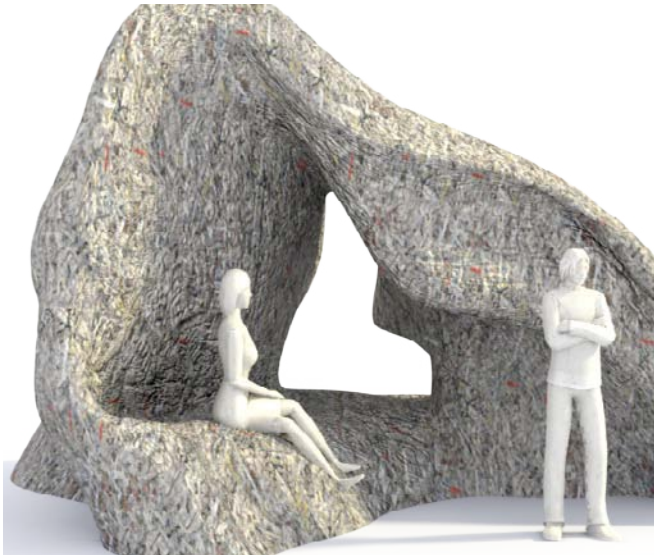
Internal Diagonal Bracing
for Optimal Lateral Resistance

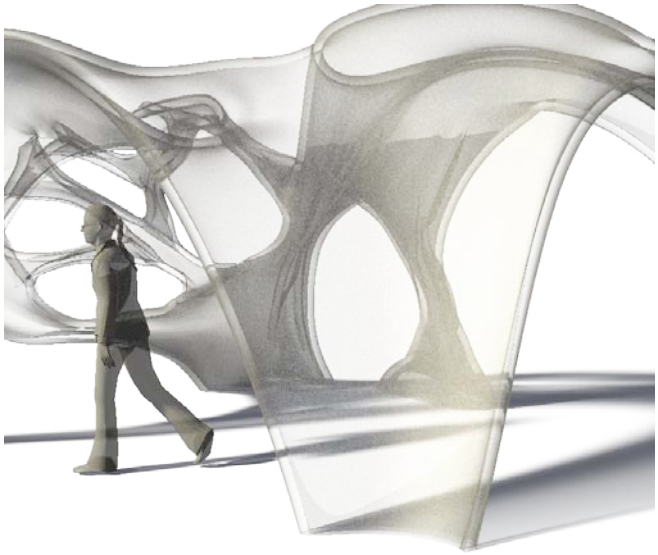
Variable Wall and Shell Thickness
With Horizontal Lateral Ties

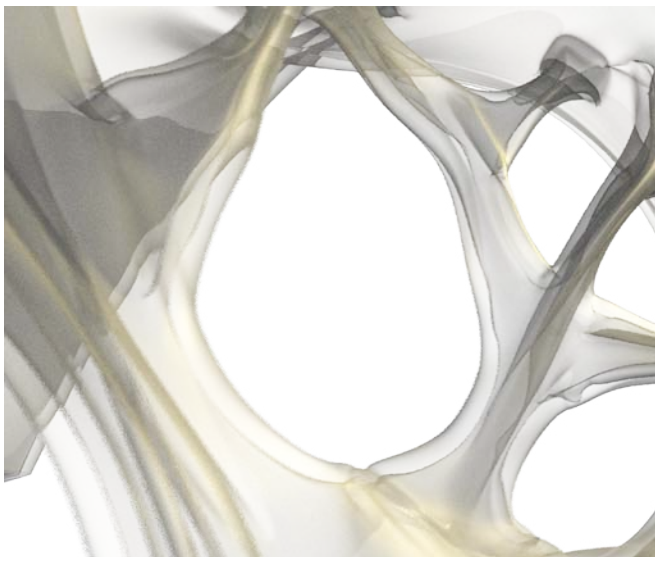


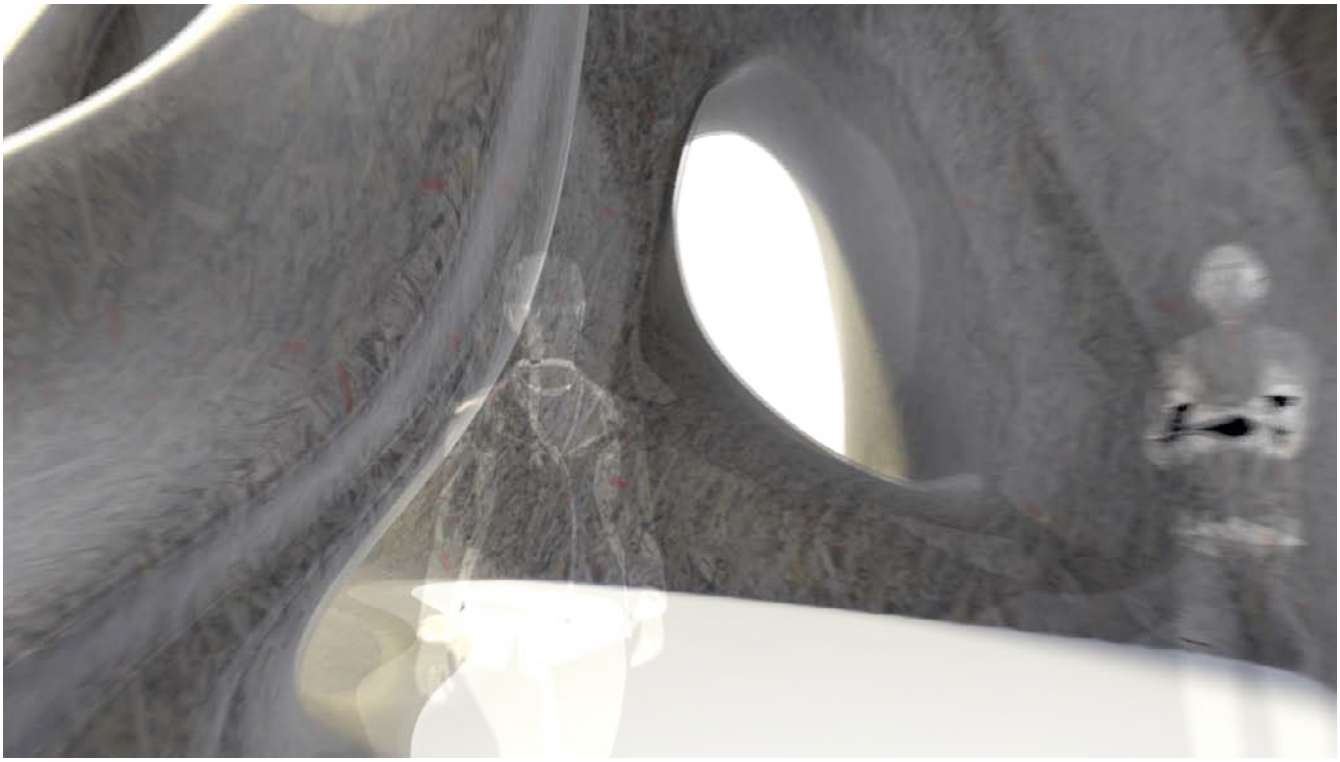
Air-Pocket Insulation Wall

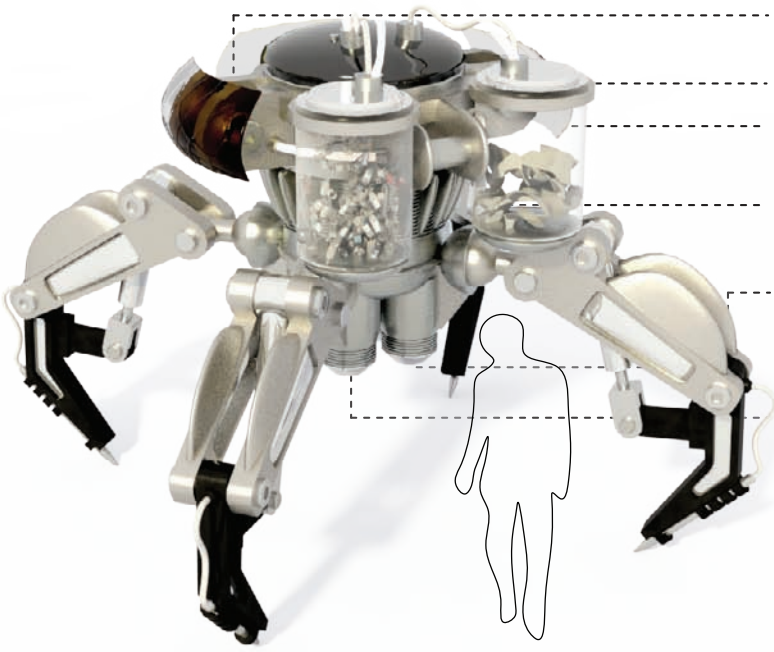
Plastic-In-Tension Wall











3-Dimensional Scanners:
spatializing existing spaces

Raw Plastic Storage:
faster printing: low precision

Raw Paper Storage:
faster printing: low precision

Material Processing Chamber:
paper: grind, sift, binder, moisture
plastic: grind, melt, extrude

Plastic Extruder 1: Fused Deposition Modeling
faster printing: low precision

Plastic Extruder 2: Fused Deposition Modeling
slower printing: high precision

Paper Extruder 1: Fused Deposition Modeling
faster printing: low precision

Plastic Extruder 2: Fused Deposition Modeling
slower printing: high precision