Liberate the Body of Architecture

by
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Submitted to the Department of Architecture in partial fulfillment of the requirements for the degree of Master of Architecture at the

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Submitted to the Department of Architecture on January 29, 2016 in Partial Fulfillment of the Requirements for the Degree of Master of Architecture

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ABSTRACT

Architecture is not a machine. It is part of the body; it contains life. This project is to invent a new system of architecture which grants people the freedom of space, structure, and material. Inspired by the Statue of Liberty in New York, the system liberates the body of architecture from architectural authority by exploring new construction methods. Stitched laminate fabric which is filled with earth materials is inflated according to the gravity of material. After hardening a layer of earth material and fabric, the filled sand is pulled out. Consequently, the mass, volume, and properties of the material form a space naturally. This is an architectural dream that everyone can tailor their own house built from what is beneath their feet.
Azra
Thank you for your incredible advice to break up the boundary between art and architecture.

Caitlin
Thank you for your unbelievable encouragement and structure feedback to push this project.

Brandon
The work experience with you makes me strong.

Mark
Thank you for your amazing advice on project as well as life

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Thank you for your help and participating this experiment.

Chris
Thank you for your support of material and space at N51.

Statue of Liberty
My muse, I love you.

And
Thank you, everyone, for your support.
Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>MANIFESTO</td>
<td>11</td>
</tr>
<tr>
<td>STATUE OF LIBERTY</td>
<td>35</td>
</tr>
<tr>
<td>CHILDREN OF STATUE OF LIBERTY</td>
<td>47</td>
</tr>
<tr>
<td>FABRICATION PROCESS</td>
<td>57</td>
</tr>
<tr>
<td>PROTOTYPES</td>
<td>69</td>
</tr>
<tr>
<td>FINAL PROTOTYPES</td>
<td>105</td>
</tr>
<tr>
<td>RENDERING</td>
<td>137</td>
</tr>
<tr>
<td>DREAM OF ARCHITECTURE</td>
<td>151</td>
</tr>
<tr>
<td>APPENDIX</td>
<td>171</td>
</tr>
</tbody>
</table>
Manifesto
Architecture

Panoramic diagram, "Burden of Architecture"
1. Architecture

"Architecture" is not a machine, but it is part of body containing life and be with life. Everything is changing at a rapid pace, but architecture which has to embrace people's lifestyle does not catch up with the development speed because of its heaviness, rigorous system, and hierarchical structures to finalize design. Now the freedom of architecture as a framework addressing issues of entire society is suffering from the conventional system from design to structure. Inspired by the Statue of Liberty in New York, this project is to invent a new system of architecture which grants people the freedom from banal space, heavy structure, and restrictive materials.
2. I + S

"IS" represents the interrelation between architectural form and human body. In English language, Is is the third-person singular present tense. What the architecture wants to be? It is highly materialized icon shaping people's experience. It is an anatomical organ working together in the execution of human life. It is flexible form work coping with change of life style over time. It is living thing which has life cycle. It is a spiritual space crying and laughing with people. It is an emotional place carrying one's thought pack to the past. For example, a wall is not a dry concrete but the sensitive media where people can put their memory.
3. NOT

“Not” strongly deny the legacy of Le Corbusier’s modern architecture: boring space, monolithic structure, and highly embodied materials. First of all, the newly invented system provides a simple way of sewing fabric for everyone to design their own space easily, which declares the freedom of space. Secondly, the structure is very light compared to concrete structure that can be transportable and transformable to different site condition, which is freedom of structure. The last declaration is the freedom of material. Employing local earth materials, such as sand and gravels is to save time and cost considering emergency shelter for refugees.
Panoramic diagram: "The God of Architecture"
4. A

"A" is often used to denote something (architecture) or someone (architect) of a better prestigious quality of status: A-, A or A+. Nowadays, the only way for young architects to succeed in the league of architecture is to participate in competition. Their proposals are spread out of wall and graded by a few star architects, which is like surveillance in panopticon. The world of architecture is controlled by a star architect and the culture of competition aggravates the exclusive right of architecture. How hilarious it is that even the design of refugee camp is selected by competition. To make things worse, they lure developers into financing projects with vacuous fancy rendering.
Machine

Panoramic diagram. "Form Follows Meaning"
5. Machine

"Machine" is the scientific matter, but life is magical imitation of organization of different meaning. A house is not a machine for living in. It is a form of life for living with those meaning. Therefore, the form of architecture follows the gesture of body of human life as well as material itself. Modern architecture has been constructed by modular system which can be replicable by the aid of Computer-aided Design. This old architectural method has to be re-interpreted in the way that process of construction and design should be closely connected to the meaning of life.
Panoramic diagram. "Free Manual"
6. IT's

“IT’s” an instruction manual how to build and design their own housing. Everyone is eligible for opening the book. Freedom is a state of being capable of making decisions without system. On the other hand, liberty is freedom which has been granted to a people by the system. The academic field of architecture is already inventing the system that allows people have the liberty of design. The design platform has been easier and simpler more and more and eventually there will be no clear boundary between designers and users. It is architecture without architects.
Panoramic diagram. "The whole is other than the sum of the parts."
7. Part

Each “part” of the Statue of Liberty was fabricated once in France and shipped across the Atlantic to New York with 350 sections placed in 214 crates. In the name of liberty, the ideology was also transplanted to the Third World with those parts. This great achievement illustrates the possibility of pre-assembled and transportable architecture conveying meaning of liberty and human right over the border. The dissected parts of body represent independent meaning, but when it comes to the whole assembled body, people recognize it as global figures instead of just collections of elements.
Panoramic diagram: "Encounter with unfamiliar object"
8. OF

"Of" is a bridge mediating between the heterogeneous lifestyle and architecture. Although countless communication facilities enable people correspond easily, communication between human beings and the architecture closely connected to them had always been an issue. Traveling in a strange city encourages people to introspect and know themselves more deeply. Encounters with the Statue of Liberty in their ordinary lifestyle create the same effect as traveling dose. The new approach to architectural methods would provide a field of opportunity in which people can engage in retrospect on the present.
Panoramic diagram. "Toilet"
9. Body

"Body" of architecture is a space where there is full of sensual interaction between people, nature, and material. Each element, such as wind, light, humidity, concrete, and brick has its own characteristic and brings integrated ambience with human emotion. However, standardized dimension in architecture annihilates individual freedom to enjoy the unique right of body of architecture. All the space is uniform, clean, and political for the sake of function of human behavior. There is no ambiguity: the more conventional forms of expression are, the less scope they allow for interpretation. What if people can relieve themselves on foot of the Statue of Liberty? Liberating the body of architecture is a method to perceive links between things which rationally are not linked.
Panoramic diagram. "Role of Architects"
10. Containing

"Containing" inquires a role of architect for social refugee. We’ve seen that prefabricated system conceived by star architects was failed to improve people’s life and their housing condition after World War 2. Should the work of the architect be limited to design? What should be contained in the design? In the early 1900s, there was self-help housing movement which provided a minimal guideline for local people to build their own house. Their eagerness to build their one houses led them to communicate with the process of fabrication. The role of architecture is to give them aspirations to be homeowner in demands of local construction and materials. “Build your architecture from what is beneath your feet.”
– Hassan Fathy
Panoramic diagram: "Afterlife of Architects"
11. LIFE

“Life” span of architecture continues to decrease. Times are changing and the need for diversity has led to an applicable structure for short-term projects, installations, events, and specifically refugee. Architects are recognizing not only the long-lasting buildings, but also temporary as well as recyclable design. Decomposable local fabric and reusable earth materials are the inflatable structure that can be emerged into existing social context. Infilled earth materials contribute to form works of next generation with the memory of people who have lived, which is the afterlife of architecture.
Statue of Liberty
Time line of U.S history and Statue of Liberty
Original

In order to reinterpret the statue in terms of structure and material, the objects, such as light, head, and book supported by body become load points. And steel frames consists exterior copper shells can be anchor points to generate form of statue.
Replicate

The statues generated with topology optimization program is to be installed within urban infrastructure. The statues are prototyped according to mother's genes, points of loads and supports. After several reproduction, children are going to have mixed genes and disseminate into the urban structure.

<table>
<thead>
<tr>
<th>Foundation</th>
<th>Body</th>
<th>Object</th>
<th>Gesture</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td></td>
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<td>Z1</td>
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<tr>
<td>A2</td>
<td></td>
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<td>A10</td>
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<td></td>
</tr>
</tbody>
</table>

Diagram shows the replication process with various stages.
Children of
Statue of Liberty
Semantic Field

Ambiguity is the product of the contravention of established conventions of expression: the less conventional forms of expression are, the more scope they allow for interpretation.
Semantic Field

"God does not play dice with the world." Albert Einstein
"Einstein, stop telling God what to do." Niels Bohr
Semantic Field

After the French philosopher, Gilles Deleuze, provided his thoughts about aleatorism, great controversy has surfaced regarding whether the incident has occurred accidentally or necessarily. Aleatorik theory is based on accidental creation: The adoption of aleatorism offers criticism regarding one's consciousness that had been a basis of thought since classicism, and to deconstruct aesthetic criterion of modern times.

Form and Forces

#5 Burden

#6 Convey
Semantic Field

Signifiers have regulated humans' behavior patterns, and social norms and law have strengthened their power. However, the signifier recognized consciously in our daily life implies weakness.

#7 Idolize

#8 Flatter
Semantic Field

German philosopher, Walter Benjamin quoted the concept of aura in his dissertation, *The Work of Art in the Age of Mechanical Reproduction,* which discusses the genuine mode of perception, unique characteristics, and aesthetic beauty of works.

Form and Forces

#9 Conceal

#10 Reveal
Semantic Field

Irish-born British painter Francis Bacon's painting explicitly shows all of the aforementioned concepts: Aleatorik, aura, and simulacre. He drew detailed paintings at first, and transformed the elaborate paintings by driving the brush. His process is similar to that of Jackson Pollock's in terms of imposing a contingency to his works. However, Francis Bacon drew third elements, such as a nose and an eye, in the final stage, which completed the painting in contrast the original.
Semantic Field

Infrastructure + Code + Icon

Land Forces

#13 Walk

#14 Taste
Fabrication

Prepare Fabric Pocket

Fill

Linen
Carbon Polymer
Silk
Nylon

Gravel
Paper
Fine Sand
Sea Gravel
Process

Harden

Pull Out

Epoxy Resin

Urea

\( \text{O} \)

\( \text{H}_2\text{N} - \text{NH}_2 \)

Esters of acrylic acid

\( \text{H}_2\text{C} = \text{CH-COOH} \)

\( \text{H}_2\text{C} = \text{CH-COOR} \)

Acrylic acid
Material lists

1. Sand: infill two sheets of fabric
2. Epoxy Resin: Harden layer of sand and fabric
3. Concrete: Reinforce the joint of blocks
4. Fiber Glass: Reinforce the edge
5. Fabric: Form work
6. Wood: Temporary Frame work
7. Blue foam: Insulator maintaining minimum temperature for epoxy
8. Brick: Temporary frame work and leveling

1. Sewing
2. Frame Work
3. Earth Fill
Insulator

Maintain Temperature: 30-35°C
Cost: $3 (All materials are recyclable)
Dimension: 2'x8'x4'
1. Sewing
2. Frame Work
3. Earth Material Fill
Computer Simulation of Inflation by sand filling

Computer Simulation of Material Distribution
4. Hardening
5. Pull out Earth Material
6. Reuse
7. Transport
Prototypes
1st inspiration
Two sheets of fabric + Glued bricks + Infilled sand

Two sheets of fabric are glued within layered bricks and filled with sand in order to analyze material distribution.
Gravity of infilled material

Wrinkle of sand and fabric within brick
2nd inspiration
Two sheets of fabric + Glued bricks + Infilled sand

Instead of gluing brick mold, the fabric is stitched by simple straight line
3nd inspiration
Two sheets of fabric + Glued bricks + Infilled sand + Hardening

Apply hardener (Epoxy Resin) to the inflated fabric. As a potential substitute of hardener, material scientists are investigating bio synthetic sandstone with bacillus pasteurii.
Hardened layer of sand and fabric
4th inspiration
Two sheets of fabric + Glued bricks + Infilled sand + Hardening + Pull out sand

The challenge of hanging structure is that it is hard to flip over on account of its heaviness. However, if the material which makes form work can be pulled out after hardening, the structure becomes light so that it can be easily flipped.
Inside view after pulling out sand
5th inspiration
Two sheets of fabric + Glued bricks + Infilled sand and Casting Concrete

In order to reinforce the thin shell structure, several paths for pouring concrete are added between sand layers.
Casted concrete and infilled sand layer
Penetrated concrete into sand
In order to reinforce the edge of shell structure, GFRC (glass fiber reinforced concrete) is applied.
7th inspiration
Two sheets of fabric + Sewing + Infilled sand + Hardening (white glue) and Pull out sand

The critical point of the structure is to increase the thickness of sand layer considering scale up. In this case, high absorbable solution, such as white glue mixed with water makes thicker layer of hardened sand.
7th inspiration
Two sheets of fabric + Sewing + Infilled sand + Hardening(white glue) and Pull out sand

Broken piece

Hollowed structure
Applying Epoxy Resin after removing fabric
Casted concrete base
8th inspiration
Two sheets of fabric + Casting Concrete and Pull out sand

The different properties of material: sand, stretchy fabric, and concrete make hollowed concrete shell structure.
8th inspiration
Two sheets of fabric + Casting Concrete and Pull out sand

The different properties of material: sand, stretchy fabric, and concrete make hollowed concrete shell structure.
9th inspiration
Two sheets of fabric + Sewing + Infilled sand + Hardening and Pull out sand + Brick

In this test, fabric form work is guide line to layout brick.
10th inspiration
Two different kinds of fabric + Glued bricks + Infilled sand + Curved Frame work
10th inspiration
Two sheets of fabric + Glued bricks + Infilled sand + Curved Frame work
10th inspiration
Two sheets of fabric + Glued bricks + Infilled sand + Curved Frame work

https://youtu.be/iMBxkpqKiHg
https://youtu.be/eKdneLI2gEw
The weight of the prototype is 150g and peaked 1800lb.
11th inspiration
Two sheets of fabric + Glued bricks + Infilled sand + Curved Frame work + Floor system
12th inspiration
Two sheets of fabric + Glued bricks + Infilled sand + 3 points joint
13th inspiration
Two sheets of fabric + Glued bricks + Infilled sand + Opening
13th inspiration
Two sheets of fabric + Glued bricks + Infilled sand + Opening
13th inspiration
Two sheets of fabric + Glued bricks + Infilled sand + Opening

3d scanned plan and section
3D scanned plan and section
Final Prototype

https://youtu.be/bUBbf4EA8F8
Fabrication Process

1. Suspended Fabric with sewing line
2. Framework
flipped block
Fabrication Process

1 Suspended Fabric with sewing line
2 Casted Block 1
3 Frame work
4 Brick to compensate level
Pouring Sand Sequence # 1

Pouring Sand Sequence # 2

Pouring Sand Sequence # 3

Pouring Sand Sequence # 4

Pouring Sand Sequence # 5

Pouring Sand Sequence # 6

Pouring Sand Sequence # 7

Pouring Sand Sequence # 8

Flip over
Fabrication Process

1. Suspended Fabric with sewing line
2. Casted Block 1
3. Frame work
4. Brick to compensate level
5. filled sand
Joint Process

Inflation of fabric form work with sand filling

1. Suspended Fabric with sewing line
2. Casted Block 1
3. Frame work
4. Filled sand
After hardening sand and fabric, the color of fabric turns into gray.
Joint Process
Joint with pre-casted block

1. Suspended Fabric with sewing line
2. Casted Block 1
3. Frame work
4. filled sand
Fabrication Process
Joint Process
Forming Male and Female mold joint

1 Suspended Fabric with sewing line
2 Casted Block 1
3 Frame work
4 filled sand

Hardening with Epoxy-Resin

1 Hardened layer of sand and fabric
Fabrication Process

Detail of joint system
Joint Process

Detail of joint system with light
Fabrication Process

Pulling out filled sand

Since the fabric form work was filled with fine sand, the 0.5 inch diameter hole is enough to pull out sand.
Joint Process
Pull out filled sand within 0.5 inch hole

1 Suspended Fabric with sewing line
2 Casted Block 1
3 Frame work
4 Filled sand
5 Pulling out sand
Fabrication Process
Joint Process
Pull out filled sand within 0.5inch hole

1 Suspended Fabric with sewing line
2 Casted Block 1
3 Frame work
4 filled sand
Fabrication Process
Joint Process

1 Suspended Fabric with sewing line
2 Casted Block 1
3 Frame work
4 filled sand
5 Reuse of sand
Fabrication Process
Joint Process

Translucent 1    Translucent 2    Translucent 3

Translucent 4    Translucent 5    Translucent 6
Fabrication Process
Joint Process
3rd Block

1 Suspended Fabric with sewing line
2 Casted Block 1
3 Frame work
4 filled sand
Fabrication Process
Joint Process

3rd Block

1 Suspended Fabric with sewing line
2 Casted Block 1
3 Frame work
4 Filled sand
Fabrication Process

Two different joint system
Fabrication Process
Joint Process
Fabrication Process
Joint Process
RENDERING
Dream of Architecture
Experiment

This chapter is an experiment with classmates tailoring their own housing with sewing machine. Since they have different sewing skills and design idea about their house, it was amazing to see the unexpected results. It is our architectural dream that everyone can design their housing.
Fabrication with classmates tailored housing
Sewing process
Sean
SoYeon
Appendix
Final boards and models
Final Review Jury

Amale Andraos, Dean of the Columbia University Graduate School of Architecture

Kristy Balliet, Assistant Professor of Architecture at the Knowlton School

Dora Epstein Jones, Ph.D., Coordinator of General Studies at SCI-Arc

Keith Krumwiede, Associate Professor of Architecture at the New Jersey Institute of Technology

Joel Lamere, Assistant Professor at MIT
**Transport**

Transport the big prototype model with Sean.
Thesis committee

Azra and Caitlin
Gifts
Player 1

Mr. Buddha

Strength ★★★
Dex ★★★★★
Int ★★★★★
Luck ★
Player 2
Mr. Sphinx
Strength ★★★★★
Dex ★★★★★
Int ★★★★★
Luck ★

Player 3
Stone-Head
Strength ?
Dex ?
Int ?
Luck ?