RICE UNIVERSITY
Under the Broad Masses

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Abstract

This thesis explores the application potentials of thin, pliable surfaces to generate and study form in architecture. Based on the comparative narrative of “linear” to “painterly”, pliable form is situated as an intermediary state between these two historical extremes. It shares the qualities of linear and nonlinear, while merging them into a coherent whole. The theater building typology serves as an apparatus to study the implications for pliable forms in public architecture. Traditionally, theater buildings situate two surface wrappers, one on the interior and one on the exterior. These two surfaces mediate the urban, performance, and service components of a public building and are the main focus of design inquiry. The design seeks to establish a dynamic reciprocal relationship between interior and exterior through formal, organizational means — allowing conventional parts of a theater to interact with one another to generate spatial and representational effects at both human and urban scale.

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The transitioning of architecture from Renaissance to Baroque is the linear style versus the painterly style. In the linear style, every object has an unbroken outline and the main expressive element is the contour. In the painterly style, every object works in the form of masses, where the contour line do not exist at all.

There is an intermediate state between the linear and the painterly, where edges are visible but “tentative and hidden underneath the vague broad masses”. This intermediate state shares both the linear and painterly qualities and yet manage to reconcile them through some particular methods.

Images: Drawings created by the author

2. Wölfflin and Murray, Renaissance and Baroque, 32.
2. Case Studies

- Linear
  maintains sharp expressive contours

- Painterly
  completely eliminates identifiable lines

Top Left Image: Image from internet https://www.brunomurias.com/about/
Bottom Left Image: Sou Fujimoto, House NA
Top Middle Image: So-il, Blueprint at Storefront
Top Right Image: Toyo Ito, Taichong Opera House
Bottom Right Image: Zaha Hadid Architects, Heydar Aliyev Centre
Bottom Middle Image: So-il, Breathe – MINI Living
During the baroque, Borromini used complex geometric tools to merge the linear with the painterly as demonstrated in his project of the San Carlo. “Blueprint at storefront” shares similar formal qualities to San Carlo, but unlike San Carlo, its relies on the material behavior of the shrink-wrap to “loft through” the linear structure hidden behind.

Other than the shrink-wrap, pliable surfaces are capable of generating other types of vague masses between linear and painterly through surface tension that works with creases and wrinkles, such as demonstrated in the experimental projects of contemporary architects MOS, LADG etc.
Case Studies

under the broad masses

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Case Studies

Kinetic Wall
Barkow Leibinger

Blueprint at Storefront SOL

Shrink Wrap
Toyo Ito

Superforming
Heather Roberge

Vacuum Forming

Tightened membrane

Pressured metal/plastic

Shrink wrap is applied over or around the intended item, often by automated equipment. It is then heated by a heat gun or sent through a shrink tunnel or oven for shrinking.

Superforming is a hot metal forming process that uses similar principles to thermoforming plastics, where a sheet of material is heated and forced onto a male or female form using gas pressure.

Vacuum forming is a simplified version of thermoforming, where a sheet of plastic is heated to a forming temperature, stretched onto a single-surface mold, and forced against the mold by a vacuum.

Vacuum

Installation

Museum of Modern Korean History
Andrew Zago

Model for Stuttgart Train Station
Frei Otto

Study Model

Study Model SOL

Study Model Toyo Ito
Garment Construction

1. Pattern cutting
Pattern cutting is essentially a series of body measurements that ultimately creates a three dimensional shape that fits a human body.

2. Draping/Moulage
This method allows clothes to be created directly on the mannequin with aid of simple tools, and does not rely on the aid of a pattern to create designs.

Between the Sheets
Heather Roberge

Clothing Design
Winifred Aldrich

Clothing Design
Rachel Vickers

Bagsvaerd Church
Jorn Utzon

A Tent without a Signal
MOS

Fashion Design
Comme des Garçons

Drapery
Sci-Arc Visual Study Seminar

Luster (top); Lumen (bottom)
Jenny Sabin

Houses and Figures
LADG

loose fabric
3. Formal Experiments

These experiments test on single flat canvas. They are digital simulations of the behavior of pliable materials. The canvas is subject to movements such as push, pull and shear. The material registers the forces in forms of wrinkles, loose creases or taut stretched surfaces.

These tests established a language parallel to the geometrical “loft” that Borromini used, or other physical tools applied in more contemporary settings such as draping or shrink-wrap. The purpose of using physical simulation is not to fully recreate the shape of a cloth. Acknowledging the gap between real and simulation, these outcome forms are regarded as a hybrid of digital interpolation and physical laws. Most importantly, it provides a set of useful and stable tools for me to begin engaging with the soft forms.

3.1 Setup and Constraints

1. axes

2. fabric and plates

Plates anchored to the backside of flat fabric surface creating edges.
3. movement
Plates' movement is constrained to xyz axes. No rotations allowed.

4. edges
fabric edge
anchored edges
pushed in
pulled out

5. volumes
aligned* edges create flat surfaces. Flat surfaces push out/pull in create volumes#.

6. cut

7. unstable
loosen fabric is not stable without fastening.

* or partially aligned
# or hidden volumes
3.2 Test Results

flat surface

transformed surface

simulation
Formal Experiments

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Test Results

flat surface

transformed surface

simulation
Formal Experiments

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Test Results

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Flattened Surface

Transformed Surface

Simulation
Formal Experiments

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Test Results

Flat surface

Transformed surface

Simulation
Formal Experiments

Test Results

flat surface

transformed surface

simulation
Formal Experiments

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Test Results

flat surface

transformed surface

simulation
The site is located on the shared edge between the Bowery and Lower East Side in New York City. It is a corner lot facing Delancy St. from south, which is a major road in this area, and Orchard St. on the west.

This area is historically known for its immigrant culture. The rows of low residential buildings which used to be flophouses are still a significant architectural feature of these neighborhoods. In this area, there are also visible marks of gentrification. New buildings are rising in the old context. The appearance of the project in its context thus became a critical design problem.
The program areas identifies the project as a commercial theatre with two auditoriums, small and large. The boundary restrictions of the site and the size of the auditoriums predetermines a vertical arrangement with major spaces stacked upon each other and vertical circulation paths.

**Front of House**
- large auditorium (capacity 550-700, multipurpose) 900m²
- small auditorium (capacity 200-350) 400m²
- public area 850m²
  - lobby
  - box office
  - reception (merchandise, information, coat check)
  - bars and catering
  - workshops

**Back of House**
- performers 400m²
- dressing room
- green room
- performance support 300m²
  - loading dock
  - storage
  - control rooms (audio/light/etc)
- rehearsal
- management 300m²

**Net Area**
- circulation, HVAC, cores (50% of net area) 2000m²

**Total** 6000m²
As the most precious space of a theatre, the auditorium is embedded in the center of the building like a jewelry box. The auditorium is tightly wrapped by a continuous interior surface, creating an immersive space isolated from the outside world. The openings - entrances and exits - are often relatively unnoticed compared to the scale and opaqueness of whole surface. Since its origination from the ancient outdoor theaters, the boundary walls suggest already some level of enclosure. As theaters progressed from outdoor to indoor, the interiority became a key feature of its typology. The cause can be both pragmatic - for acoustic and lighting requirements - and cultural, as it has long established itself as man-made fictional world untouched by the reality.

Historically, the exterior facade of the theatre is less expressive and much humbler compared to the interior. Despite the magnificent look of the interior, the exterior facade is usually designed to blend in well with the surrounding buildings, except for the extruded marquee and the decorative neon signs that differentiate itself from the homogeneous context. The contemporary theaters buildings, however, have abandoned such format as the “decorated shed”, and have aligned themselves more with “the duck”. To achieve its iconographic values as large public buildings, the exterior envelope has gained increasing significance during the years. This shift demands for the design of the exterior skin, not merely as building facades, but to assert itself as an important image of the urban-scape.

When the interiority and exteriority are combined into one, an unique condition emerges - the architecture essentially becomes a double-sided poche. To guarantee the structure-free appearance both interior and exterior, the supporting structure has to be kept solely inside the cavity space. Moreover, as the envelopes turn into critical prerequisite of design, their spatial and structural impact has to be negotiated through this thickened poche in-between. Captured between the back side of two mostly opaque envelopes and segmented by structural components, this secondary cavity space is hard to grasp unlike the interior or the exterior. Yet it is highly functional, accommodating not only all of the “back of house” programs, but also the entrance lobby and the circulation paths leading towards different seating areas of the auditorium. For the audience, traversing the poche into the auditorium makes an important part of theater-going experience.
The In-between space is filled-in with floor plates and structure.

Left Image: OMA, Casa de Musica (section)
Middle Image: Herzog and de Meuron, Elbphilharmonie Hamburg (section)
Right Image: MAD architects, Harbin Opera House (section)
The theatre has a relatively stable and clear structure as an architecture typology. This basic structure consists of the stage and backstage area, where only performers and staff can access, and the front of house, areas open to the public. The parts, which are designated for different use in the theatre, have developed into certain conventional forms with specific terminologies to further clarify their distinction.

The theatre terminology, however, does not coincide with the underlying structure of double envelopes and poche. These conventional terminologies differentiate the parts as their functional purpose from the utilitarian standpoint, more or less related to theatre management; whereas the double envelope scheme is closely associated with architectural design.

Image: Radio City Music Hall (cut axon)
4.3 Design Strategies

- Audtorium
- Back of house
- North
- Adjacent building
- Orchard St.
- South
- Delancy St.
Appendix A  Final Drawings
A-3 Small Auditorium Surface Maps

Small Auditorium Unrolled Surface 1

Small Auditorium Unrolled Surface 2
Level 3
Large Auditorium Second Level
Level 4
Large Auditorium Balcony Entrances and Flytower
Level 6
back of house
A-6 Vignettes
A-6 Vignettes
A-6 Vignettes
A-6 Vignettes