GSAPP Portfolio
Qingning Cao

Head
Peg
Ledge
Fret
String
Belly
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Garment District is an important historical district in New York City. It's important in history, but it's declining. I want to preserve this unique district in a special way. I want to compress it in one tall building, and make it like a combination of museum, factory and shopping mall.

Considering the global connection nowadays, it is harder for local producers to survive without global industrial chain. The advantage of local agency is the quick feedback for clients and the visibility and accessibility of production.

In my design, I want clients to have more feedbacks on the goods they want. They can intervene in an early stage of production, and even design by themselves with a reasonable price.
I choose the “Fashion Tower” to do my design. Its core is on two sides of the building, so I can make full use of the free center. Generally, I use the system of conveying belt. It is used in factories a lot for conveying goods. Also, this can convey visiting people. They can just stand on the belt and watch the production process of the garment industry. If they are interested in any particular process, they can just go down from the belt and participate in that process by themselves. To make the full use of the belts, I design a double layer belt system to convey people and products at the same time. The upper layer is for people and the lower layer for goods, they going in opposite directions.

To make the space more flexible and changeable in the future, I design three modes for different needs - public layer, semi-public layer, and private layer. Different modes have different space partitions and different movements of belts. The more public, the more consumers can participate in the process of the production. In case that there are still some processes that are not suitable for consumers to watch, the private layer is designed for this kind of usage.
PLAN PERSPECTIVE - PRIVATE MODE

The core and service rooms are on two sides of the plan, and the south part is the main functional areas. In this plan, I assume it as the personal studios for different designers. Clients can see their products in conveying belt, and they can enter some designers' rooms if they are interested in their designs. Also, conveying belt can help to convey materials and goods of those designs.

The middle part is a shared workshop for designers and consumers if they want.

MANUAL MODEL

- **Public Space**
- **Semi-public Space**
- **Private Space**

CONNECTION OF SYSTEMS

- **Upper Layer - for people**
- **Lower Layer - for materials and goods**
My project emphasizes on the efficiency of the school. I know that there are already many schools built for more people than just students, but for the sake of students' safety, they are allowed to enter only after school. I think this is a waste of the facilities and space. So, the core purpose of my project is to improve the efficiency. I will divide people into two groups in my following presentation, students and all other people, which I call “the public”.
I choose the “Fashion Tower” to do my design. Its core is on two sides of the building, so I can make full use of the free center. Generally, I use the system of conveying belt. It is used in factories a lot for conveying goods. Also, this can convey visiting people. They can just stand on the belt and watch the production process of the garment industry. If they are interested in any particular process, they can just go down from the belt and participate in that process by themselves.

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**Efficiency**

My project emphasizes on the efficiency of the school. I know that there are already many schools built for more people than just students, but for the sake of students’ safety, they are allowed to enter only after school.

**Prototype - Overlapping & Light**

This is the prototype. Several boxes are overlapped, which can generate many kinds of interactions between boxes. This prototype can be used in both section and plan, which can make interesting changes in interactions and light. The degree of openness is flexible by partitions. It can be totally open, only eye contact and no contact.
You can easily tell that there are two systems in the building. The middle core function part and the overlapping classrooms. Core functions are accessible for the public and students, while the classrooms for students mostly.

There are many functions suitable for the two groups to use together or separately in school. Like auditorium, gymnasium and many studios. So the core functions should be easy to access for both groups of people.

I want the public and students to use the school simultaneously. However, the safety of students can not be ignored.

I learnt from the doctor-patient model. Both groups can use the same space but with different routes to enter, which can ensure the safety of students in my case.
To distinguish these two systems, each part has its own material and structure. Generally, I want the core function part to be heavy and the overlapping classrooms to be light. So I use concrete for core functions, while classrooms with CLT.

Because the classrooms are distributed on different floors, it is also a natural distinction of different grades.

Because the overlapping system, the light for classrooms is ample, while the core function needs more artificial light, which is more controllable for different functions. Also, I use the combination of sky-lights and side windows to avoid blocking the light path into core functions.
In core function part, the vertical circulation is located similarly. Classrooms are overlapped on core functions. Although they have a unique route to reach inside themselves, they can also be reached through core functions when necessary.

Skylights are mostly located on the overlapping part of the classroom, which is also the vertical circulation space. I want to use these skylights to create some rhythm for the route and also bring light into the core function part.

To solve the light of core function, I also set some small courtyards around the middle part to let light in. Classrooms are overlapped on core functions. Although they have a unique route to reach inside themselves, they can also be reached through core functions when necessary.
LIGHT ANALYSIS

The combination of skylights, side windows and courtyards can make up the light loss brought by overlapping.

Here are several zoomed in sections to show light path to enter the building.

The interaction of two systems is flexible and can be controlled by different partitions.
In Bronx, the majority of the population is taken by immigrants from Caribbean region, while it has always been an issue of missing public space and community events. To create more opportunities for immigrants to meet people and integrate into the neighborhood, this project works from two aspects: adjacency, and hybrid space. Adjacency brings repetitive interaction between neighbors. Hybrid space is the mixture of multiple public programs, such as the laundry room, package delivery room, trash bin... The significance of these are often underestimated. This project sticks to existing programs and transfers the inessential space into a more occupiable room.
SITE PLAN - INTERACTIVE CORRIDOR

E 152nd St

Courland Ave

E 151nd St
SMALL SCENES

Gym + Laundry room

Doors
Closed

Doors
Semi-open

Doors
Open

Corridor
SITE: BLACK ROCK FOREST

When I went to Black Rock Forest, I noticed that there were many streams and lakes there. As it was winter, I couldn't hear much but the sound of running water. I always walked along the streams and rested near the lakes. They gave me the order and direction.

In the forest, there are two main streams with the biggest amount and species of fishes. I will choose the intersection of these two streams to be my site.

STREAMS AND FISHES

Fishes are important to the streams. Black Rock Forest also did some research about the water quality and different quantity and species of fishes in different streams of this forest. Also, there is an important species that represents the local - Brook Trout.
**FISH NET STUDY**

1. Easy to Build

2. Double Layer - Easy to get in, hard to get out

**Fish Net**

**Wood Processing**

Gigantic curved GLT

**STRUCTURE INSPIRED**

1. Bones - movable joints

2. Connections - immovable joints

3. Module Possibilities

4. Module Connections Possibilities
SITE: BLACK ROCK FOREST

This research center may open to the public at some specific time. To avoid the public from disturbing the researchers, I designed two routes for them, and they can also come together when it’s needed. Researchers use stairs and elevators to travel vertically, while the public use ramps.
São Paulo is an important transportation hub. Most lands here are occupied by buildings, which block the movement and activities of animals living on the ground. Rivers are extremely significant for the city, as they decide the direction of roads and buildings. Climate devices are inserted with elevated transportations to provide energy. This infrastructure is elevated not only for the influence on the ground, but also for the flooding situation. The research center is close to the river and ponds, with eco lodge and residential buildings scattered throughout the network. Other than bridges, a system of aerial connection is also an assumption to connect these programs.
**Input 1: Water**

With 3 inputs, water, CO2 and light, algae can grow incredibly fast and be collected for biofuel. Raindrops can be collected in the middle recessed part of the canopy. Water goes down through the water pipes on the top of the structure, and input to these photobioreactor pipes.

**Input 2: CO2**

CO2 is also needed for the growth of algae. This CO2 collector is put along the road, so it can collect surrounding CO2 with the fan, and inject it to a capsule with amine solvent. CO2 is released again by heating the solvent, in this way CO2 can be conveyed through this pipe to all photobioreactors.

**Output: Algae + Water**

After all these reactions, wet algae is collected through another pipe, and it can be processed for biofuel.
Chaos and Order

Gingning Cao

Academic Individual
2023 Spring
Instructor: LOT-EK: Ada Toll, Giuseppe Lignano
MASONRY
METAL
ICE STATION

Personal Project
2020 Fall
Instructor: Alexa Tsien-Shiang

Different construction period of Ice Station
Group member: Jean Tzeng
2021 Spring
Instructor: Tien-Shiang
7KM
Kaohsiung MRT

256KM
Shanghai–Nanjing Intercity High-Speed Railway

Shanghai House Price
AT I - ENVIRONMENT IN ARCHITECTURE
CLIMATE ANALYSIS

Personal Project
2020 Fall
Instructor: Rachel Ben Alon

1. Weather Data

2. Sun Path

3. Solar Radiation

4. Wind Rose

5. Psychrometric Chart

G. Some Passive Strategies

Evaporative Cooling

According to the readings, buildings can be cooled by evaporation, and it is useful to install water pans or pumps on the roof or the walls. Also, water can be sprayed on the surface of glass, and install fountains at the opposite corner. It is necessary to install fountains in the adjacent corner. This way, the process of the fountain will increase the number of water molecules in the air, and in order to increase evaporation, water from the fountain will be more effective. Therefore, the layout of the building should be designed to ensure that water from the fountain is not concentrated on the roof. The use of glass will allow more sunlight to enter the room.

Convection

In the same way, air collects near the roof and is cooled by the fountain. The air near the roof is cooled by the fountain. This way, the process of the fountain will increase the number of water molecules in the air, and in order to increase evaporation, water from the fountain will be more effective. Therefore, the layout of the building should be designed to ensure that water from the fountain is not concentrated on the roof. The use of glass will allow more sunlight to enter the room.

Energy Transfer Mediation

In addition to increasing evaporation, the roof can be covered with a roof that has a high specific heat capacity. This way, the roof will absorb heat from the sun, and the evaporating water will transfer heat to the roof, which then transfers heat to the air. This process will increase the number of water molecules in the air, and in order to increase evaporation, water from the fountain will be more effective. Therefore, the layout of the building should be designed to ensure that water from the fountain is not concentrated on the roof. The use of glass will allow more sunlight to enter the room.
1. Orientation Analysis

Original Orientation and its radiation:
Total radiation: 1798.92 Wh/m²
Orientation: Straight to North and South

Process:

Final Orientation and its radiation:
Total radiation: 1703.2 Wh/m²
Orientation: Right for good architectural aesthetics

2. Building Form Generation

Original Orientation and its radiation:
Total radiation: 893.7 Wh/m²
Form: Square opening efficiency

Process:

Final Orientation and its radiation:
Total radiation: 785.7 Wh/m²
Form: Square opening efficiency
The middle part of the building is quite far from the radiation.
Window to Wall Ratio

Total EUI

Energy Use Intensity

Energy Balance

Because the difference of 20-40% ratio of window to wall is too subtle, I choose the 0-50-100 ratio to analyze.

Generally, Nanjing, China is a hot place more than cold place. However, it is still cold during November to March.

1. It can be seen in the EUI chart that in winter, bigger the window is, the more energy it needs to heat the room.

   This seems a little bit contrary to common sense.

   This means in winter, windows lose a lot of energy.

   This can also be argued in the Energy Balance chart.

   Although the window always loses more energy than it lets in, the difference between letting in and out comes smaller in winter, which causes the shortage of windows in summer.

2. In summer, the bigger the window is, the more energy it needs to cool the room

   which seems reasonable as in summer window lets so much sunshine that would cause the room hotter.

   It seems that Nanjing, China is not suitable for too large window.

Nanjing is a hot place more than cold place, which can also be proven by the data in assignment 2.
Assignment 5 - Passive Design

2 Simulation Results

Window Configurations

- Windows at northern and southern sides
- Windows at northern, southern, and western sides
- Windows at northern, southern, and eastern sides

Simulation Results - EUI

<table>
<thead>
<tr>
<th>Uncomfortable Hours</th>
<th>Total EUI</th>
<th>Uncomfortable Hours</th>
<th>Total EUI</th>
<th>Uncomfortable Hours</th>
<th>Total EUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>215 hours</td>
<td>208.641 kWh/m²/yr</td>
<td>3514 hours</td>
<td>235.273 kWh/m²/yr</td>
<td>4159 hours</td>
<td>221.837 kWh/m²/yr</td>
</tr>
</tbody>
</table>

Comparison

The uncomfortable hours are clear: that without windows in the west side, there are more uncomfortable hours. The larger the window is, the more uncomfortable it will be. Also, this can be indicated in EUI chart. It shows that more energy of cooling is needed in the window configuration that there is large window at the west side. Therefore, the tradition mode of only windows at north and south side is best considered by EUI chart. But sometimes windows are needed for sake of beautiful view or the feeling of sunlight.

Simulation Results - Ventilation Schedules

- One Residential: Comfortable Hours of Temperature (18-25°C) and Hours of High Humidity (>60%) and >40°C
- The result seems similar: though this would be different because Beijing is in party of great humidity, in which case ventilation would help a lot.

Assignment 6 - Daylight Design

1 Basic Information of the Building

Appearance of the Building (see unit)

The building is in Beijing, China, a city of a high level of light intensity, a place where the sunlight is a great resource in winter. Also, in this area, there are many traditional ways to get natural light such as traditional ways to get light from the walls.

The building is the most western part of the building, which shows a great advantage of sunlight. A-Peris and B-peris each floor is an area. There are sunspaces connected to the whole building.

The external building is located in relatively high dense residential buildings but these buildings are not taller than 10 floors.

The room is on the second floor and has three windows on three walls, and in this assignment, we only consider on the front window and back wall. The roof window is not considered in this assignment. The presence of the roof window is to get light from the building in the winter.
2 Different window configurations

The three windows are all of the same size, but in different length-width ratios.

Window Configuration 1
- Daylight Class Probability (DWP): 0.92
- Immediate Class
- Spatial Daylight Autonomy (SDA): 12
- Annual Solar Exposure: (ASE): 1

In this window configuration, light is distributed uniformly across the height of the window, allowing for even illumination throughout.

Window Configuration 2
- Daylight Class Probability (DWP): 0.84
- Immediate Class
- Spatial Daylight Autonomy (SDA): 20
- Annual Solar Exposure: (ASE): 10

In this window configuration, light is most concentrated towards the bottom of the window, reducing the available light at higher levels.

Window Configuration 3
- Daylight Class Probability (DWP): 0.74
- Immediate Class
- Spatial Daylight Autonomy (SDA): 10
- Annual Solar Exposure: (ASE): 5

In this window configuration, light changes dynamically. This window has the least solar exposure of the three.

2 Different window shades

Window 1
- Shade 1
- Spatial Daylight Autonomy (SDA): 10
- Annual Solar Exposure: (ASE): 5

This shade allows some light to enter, filtering out the direct sunlight.

Window 2
- Shade 2
- Spatial Daylight Autonomy (SDA): 15
- Annual Solar Exposure: (ASE): 9

This shade blocks out most of the light, providing complete shade.

Window 3
- Shade 3
- Spatial Daylight Autonomy (SDA): 15
- Annual Solar Exposure: (ASE): 9

This shade blocks out most of the light, allowing for privacy and reduced glare.

3 Shade 1
- Spatial Daylight Autonomy (SDA): 20
- Annual Solar Exposure: (ASE): 9

This shade can block out the sun's light, ideal for reducing glare and improving comfort.

Shade 2
- Spatial Daylight Autonomy (SDA): 19
- Annual Solar Exposure: (ASE): 14

This shade allows for some light to enter, providing a balance between light and shade.

Shade 3
- Spatial Daylight Autonomy (SDA): 16
- Annual Solar Exposure: (ASE): 15

This shade filters out the direct sunlight, enhancing the comfort for interior spaces.

Leaving how much light comes in is not absolute. The amount of light to the light is based on the orientation and function. Different shades are most suitable for different environmental conditions.
CODING FOR SPATIAL PRACTICES

WEBSITE

Personal Website
2021 Fall
Instructor: Felicity Scott

Qingning Cao & Elena Yu

Professor - Benjamin Cadena

Benjamin Cadena is an architect and Founder of Nahui Cadenas, a charity and tech think tank based in Mexico. Founded in 2015, the studio is devoted to engaging contemporary Mexican theory and practice in designing new and supporting spaces, pieces and experiences for those who make them.

His work has been widely published since 2015, most recently by The American Institute of Architects for its biennial New Practices NY Award.
Group Member: Yiyi Gao, Shuyang Huang, Wenjing Tu, Linru Wang
2021 Fall
Instructor: Berardo Matalucci

AT IV BLDG SYSTM INTEG

REVIT
Group Member: Kristen Fitzpatrick, Brennan Hayward, Nicolas O. Shannon
2022 Spring
Instructor: Nicole Dosso
GENERATIVE DESIGN

ENVIRONMENTAL ANALYSIS

Group Member: Ruisheng Yang, Wanqi Jiang, Yifei Yuan, Martin
2022 Spring
Instructor: Nicole Dosso
RE-THINKING BIM

NEW MUSEUM

Group Member: Lesley Li, Kelly Hong
2022 Spring
Instructor: Joseph Brennan

INTRODUCE SUN RESULTS
- Import EPW weather data file
- Use Ladybug to analyze radiation on all panels
- Remap the radiation results to a range of numbers from 0 to 90 to be used as fin angles
- Set a threshold of 110 kWh per year per panel and eliminate PV films on panels below that line

PREPARE PANEL GEOMETRY
- Define floor edges and their length
- 2-foot wide panel at every 2', floor to floor height
- Use Grashopper to apply it to every facade on all four sides
- Merge all the resulting panels together

Result: Data-driven facade panels
- Each panel’s angle is individually defined by zone intensity, the higher the radiation, the smaller the angle to avoid over exposure
- Only 50% of panels needed (638 out of 1279) to generate 90% of energy (14.1731 out of 17.787 kWh)
DECOLONIZING THE ARCHITECTURAL IMAGINATION

Group member: Weiyu Xu
2022 Fall
Instructor: Muhammad Muzaffar