Location

Guangzhou is the capital of Guangdong province, People's Republic of China. Located on the Pearl River, about 120 km (75 mi) north-northwest of Hong Kong and north-northeast of Macau, Guangzhou is a key national transportation hub, important trading port, the third largest Chinese city and southern China's largest city. As of the 2010 census, the city had a population of 12.78 million.
Yuexiu District is a district in Guangzhou, Guangdong, China. It was located at the west of Tianhe District and the east of Liwan District. It was the commercial, political and cultural centre of Guangdong province. The Guangdong provincial government and the Guangzhou city government are both located in Yuexiu District. The district was established in 1960, and Dongshan District was merged into it in 2005.

In recent years, due to the development of other CBD in Guangzhou (such as Zhujiang New Town and Tianhe North), the Huanshi East CBD is facing fierce competition. What's worse, because of the urban planning mistake, the Huanshi East CBD has some inborn weakness when compared to the others. As a result, the economic development of this area slowed down.

The dominated industry in this area is tertiary industry. In other words, most people are brainworkers in this area. With the booming economy of China, the workers here are stressful and need public/recreation space. Also, for the sake of attracting more enterprises and other investors or clients, the living environment has to be improved.
Huanshi East Road
People flow per day: around 350,000
Traffic flow per hour: around 2,000

Huanshi East CBD
area of commerce: around 60,000m²
sale: over 4,000,000,000 Yuan
67,000 Yuan per m²,
GDP per km²: 3,600,000,000, 20 times more than the average of Guangzhou
1/3 headquarters of big enterprise in Guangzhou
Important Context

Bayun Hotel
- Hotel
- 117m
- very high, up to 90% during Canton Fair
- Senior Clients, business man
- up to 1300 at the same time
- 5-Star Hotel (top standard)
- 716 rooms

Libai Plaza
- Mall
- 3 storey
- fully rented
- Senior Clients, Luxury goods area: around 10,000 m²

Friendship Tower
- Office
- 62m
- Q.R=90%
- Senior Clients, office workers about 1260 at the same time
- Ja standard office building, average 12m² per person
- office area: about 16,800 m²

Guangzhou World Trade Center
- Office
- 34 storey (north tower), 30 storey (south tower)
- Senior Clients, office workers about 7501 at the same time
- Ja standard office building, average 12m² per person
- area: about 190,000 m²

Friendship Store
- Mall
- 7 storey
- fully rented
- Senior Clients, business man
- Luxury goods, fashion goods area: around 27,000 m²

Zhengia East International Plaza
- Apartment, Mall
- 217m
- 100% rented, Apartment sold out
- Senior Clients, about 3275 (apartment), High level Department Store
- High level apartment

Garden Hotel
- Hotel, Apartment, Office, Mall
- 107m
- very high, up to 90% during Canton Fair
- Senior Clients, office workers, business man
- 40,000 per year (hotel), 5-Star Hotel (top standard)
- 828 rooms, about 800 offices and apartments
Existing Problems

Because of the fault of urban planning, the core of Huanshi East CBD is cut into two parts by the Huanshi East Road. The important buildings in this area were disconnected and the people in this area suffer from low efficiency and uncomfortable internal connection space.
Former Proposals of Improvement

Due to the development of other area of Guangzhou such as Zhujiang New Town and Tianhe District, the Huangshi East CBD has been facing fierce competions. Improving this area by addressing the aforementioned problem is increasingly important. Actually, two solutions were proposed in recent years. However, both of them were left in the basket because of different reasons.

On ground - 1.0

The first design was proposed in 1999. The concept was to sink a part of the Huanshi East Road during the excavation for the subway construction. By using the original ground area of this road to combine the open space in front of each building, a big pedestrian plaza was created.

This design was appreciated by most citizens and shop owners nearby. And it was planned to executed in 2004 so as to keep pace with the construction of Line 5 (metro) which is under Huanshi East Road. However, due to some political reasons, this project was shelved.

Underground - 2.0

The second solution was proposed in 2009. The idea was to keep the current situation of Huanshi East Road and connect the malls on both sides of the Huanshi East with a underground plaza. The main functions of this plaza were parking (600 cars), pedestrian space and 4,000 square meters commerce area.

This solution suffered from huge resistance from the citizens and some urban planners due to its huge cost and long construction period for the excavation. Further, the underground space does not work well in the humid and hot climate in Guangzhou.
What can be a solution for this area?
General Background of Huanshi East Area

**Urban Development Plan**  According to the “Twelfth Five Year Plan” (2011-2015)
1: Have more recreation / leisure function
2: Improve the environment of doing business
3: Make full use of the advantage that over 1/3 experts who have phd degree live around the Huanshi East area

**Current Situation**
1: Lack enough land for new development because it is at the downtown
2: Lack amazing space that can attract more people to this area
3: Require recreation space
Climate

Guangzhou weather is generally warm and humid all year round without a clear division between the four seasons. It has a humid subtropical monsoon climate, characterized by warm winters, hot summers, little frost and snow, sufficient rain and sunshine. Guangzhou has a long Summer with frequent thunderstorms. The Summer temperature can reach 39deg.C in July, consequently, heat exhaustion is a potential hazard for citizens / tourists. Furthermore, the solar radiation is quite high. Winter in Guangzhou is short, with little frost. The lowest temperature is in January when the average temperature is 12° C. The all-year average temperature is 20 to 22deg.C.

Climate Challenge: the main concern will be the sun-shading in summer (especially in the afternoon), ventilation and energy-saving harvesting.

<table>
<thead>
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<th>Month</th>
<th>Average max temp (°C)</th>
<th>Average min temp (°C)</th>
<th>Average hours of sunshine per day</th>
<th>Average days with precipitation per month</th>
<th>Average mm precipitation per month</th>
<th>Average sea temperature (°C)</th>
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<th>Chance of very cool weather</th>
<th>Chance of long-term precipitation</th>
<th>Chance of hurricanes (cyclones)</th>
<th>Chance of sunny days</th>
<th>UV-index</th>
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<td>🌞</td>
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</tbody>
</table>
Direct Sunlight Exposure -summer (7.23)

09:00

11:00

13:00

17:00

16:00

15:00
Visibility

Viewing angle of each building

Structure concerns

Potential positions for support

Square / Green
Existing structure
Green belt

Blocking the sight from surrounding high-rise building to the road
Accessibility

Connection to program

Connection of Urban Network
**Vital Context**

- **Baiyun Hotel**
  - Hotel
  - 117m
  - Occupancy rate very high, up to 90% during Canton Fair
  - Users: Senior Clients, businessman up to 1300 people at the same time
  - 5-Star Hotel (top standard)

- **Friendship Tower**
  - Office
  - 62m
  - O.R: R0%
  - Users: Senior staff, office workers about 1250 people at the same time
  - Jia standard office building, office area about 16,800 m²

- **Guangzhou World Trade Center**
  - Office
  - 120m (north tower), 102m (south tower)
  - O.R: R0%
  - Users: Senior staff, office workers about 7500 people at the same time
  - Jia standard office building, area about 100,000 m²

- **Podium of Baiyun Hotel**
  - Podium
  - 3 storey
  - Restaurant & hall
  - Users: Senior Clients

- **Libai Plaza**
  - Mall
  - 5 storey
  - Fully rented
  - Users: Senior Clients, businessman
  - Luxury goods area: around 10,000 m²

- **Friendship Store**
  - Mall
  - 7 storey
  - Fully rented
  - Senior Clients, business man
  - Luxury goods, fashion goods area: around 27,000 m²
## Outcome of Urban Research and Climatic Study

### Function Category

<table>
<thead>
<tr>
<th>Exhibition</th>
<th>Commerce</th>
<th>Club</th>
<th>Information / Administration</th>
<th>Public Space / Activity</th>
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<tr>
<td>Product Exhibition 550m²</td>
<td>Commerce 1500m²</td>
<td>Senior bar / cafe 500m²</td>
<td>Info center / hall 500m²</td>
<td>Green / open space 2000m²</td>
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<tr>
<td>Media Room 400m²</td>
<td></td>
<td>Gym / Recreation 400m²</td>
<td>Offices 200m²</td>
<td>Multi-function Room 400m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conference 300m²</td>
<td>Technical space 300m²</td>
<td>Circulation space</td>
</tr>
</tbody>
</table>

### Vital Parameters

- Noise Level
- Visibility
- Accessibility for people
- Wind
- Sunlight Exposure
- Structure Concerns / support point

![Noise Level](Noise data from Noise Map of Guangzhou)
![Visibility](Visibility analysis with components in Grasshopper)
![Accessibility for people](Connectivity analysis with components in Grasshopper)
![Wind](Wind data from Vasari)
![Sunlight Exposure](Sunlight simulation by Ladybug)
![Structure Concerns / support point](Structure optimisation by Karamba)
Objectives

**Architectural ambitions**
1: Solve the internal connection problems of the CBD
2: Improve the living quality of surroundings
3: Have landscape effect

**Technical ambitions**
1: Be sustainable during operation in terms of climatic and ecological issues
2: Minimize side-effect on ground space and reduce time for construction (structural design, component design)
DESIGN RESEARCH

WITH THE AID OF ADVANCED DIGITAL TOOLS
Computational Strategy

**Challenges:**
1: The site is very big with complicated context.
2: Huge amount of information to deal with due to the programs and parameters.
3: Need to place the right program at the right position exactly because of the objectives of the design

**Applied generative approach:**

**Self - Organizing System:** Let the programs act as agents so that they can find their positions themselves

step 1: Define the site as the stage where the programs can perform
step 2: Analyze the site according to the parameters to get different global attraction points for different programs
step 3: Defined the programs as different actors that have different characters and behaviours
step 4: Run simulation and get different outcomes
step 5: Analyze the outcomes
STEP 1 Stage Overview

Research Area
STEP 2 Site Evaluation

- Noise Level
- Visibility
- Accessibility for people
- Wind
- Sunlight Exposure
- Structure Concerns / support point

Legend:
- Not Good
- Medium
- Good
STEP 2 Site Evaluation

ACCESSIBILITY FOR PEOPLE
RED: GOOD; BLUE: NOT GOOD

STRUCTURE
RED: GOOD; BLUE: NOT GOOD

VISIBILITY
RED: GOOD; BLUE: NOT GOOD

WIND
RED: GOOD; BLUE: NOT GOOD

SOLAR RADIATION (SUMMER AFTERNOON)
RED: NOT GOOD; BLUE: GOOD

NOISE LEVEL
RED: GOOD; BLUE: NOT GOOD
STEP 2-2 Global Rules for the Simulation System

- ACTORS (PROGRAM)
- ATTRACTION POINTS
- REPULSION POINTS
- ATTRACTION
- REPULSION
<table>
<thead>
<tr>
<th>ACTORS</th>
<th>NUMBER</th>
<th>SEPERATION</th>
<th>AREA</th>
<th>VITAL PARAMETERS</th>
<th>PREFERED NEIGHBOUR</th>
<th>AVOIDED NEIGHBOUR</th>
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</thead>
<tbody>
<tr>
<td>SHOP / COMMERCE</td>
<td>20</td>
<td>4M</td>
<td>1500</td>
<td>SUNLIGHT EXPOSURE STRUCTURE, VISIBILITY ACCESSIBILITY (ALL USERS)</td>
<td>INFO CENTER / LOBBY BAR / CAFE GREEN / OPEN SPACE</td>
<td>CONFERENCE / INTERFACE MULTI-FUNCTION ROOM</td>
</tr>
<tr>
<td>EXHIBITION SPACE</td>
<td>12</td>
<td>8M</td>
<td>950</td>
<td>SUNLIGHT EXPOSURE STRUCTURE, NOISE VISIBILITY ACCESSIBILITY (HOTEL VIP)</td>
<td>INFO CENTER / LOBBY GREEN / OPEN SPACE</td>
<td>GYM / RECREATION</td>
</tr>
<tr>
<td>OFFICE / ADMINISTRATION</td>
<td>10</td>
<td>4M</td>
<td>300</td>
<td>SUNLIGHT EXPOSURE STRUCTURE, NOISE ACCESSIBILITY (HOTEL)</td>
<td>TECHNICAL SPACE MULTI-FUNCTION ROOM CONFERENCE / INTERFACE BAR / CAFE GREEN / OPEN SPACE INFO CENTER / LOBBY</td>
<td></td>
</tr>
<tr>
<td>TECHNICAL SPACE</td>
<td>10</td>
<td>4M</td>
<td>300</td>
<td>STRUCTURE</td>
<td>MULTI-FUNCTION ROOM GYM / RECREATION OFFICE /ADMINISTRATION GREEN / OPEN SPACE</td>
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</tr>
<tr>
<td>INFO CENTER / LOBBY</td>
<td>1</td>
<td>12M</td>
<td>400</td>
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<td>INFO CENTER / LOBBY SHOP / COMMERCE</td>
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<tr>
<td>MULTI-FUNCTION ROOM</td>
<td>2</td>
<td>8M</td>
<td>400</td>
<td>SUNLIGHT EXPOSURE STRUCTURE, VISIBILITY ACCESSIBILITY (ALL)</td>
<td>OFFICE /ADMINISTRATION TECHNICAL SPACE</td>
<td>SHOP / COMMERCE GYM / RECREATION</td>
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<tr>
<td>GREEN / OPEN SPACE</td>
<td>20</td>
<td>8M</td>
<td>2000</td>
<td>SUNLIGHT EXPOSURE STRUCTURE, VISIBILITY ACCESSIBILITY (ALL), WIND</td>
<td>EXHIBITION SPACE INFO CENTER / LOBBY SHOP / COMMERCE</td>
<td>TECHNICAL SPACE OFFICE /ADMINISTRATION</td>
</tr>
<tr>
<td>BAR / CAFE</td>
<td>4</td>
<td>8M</td>
<td>500</td>
<td>SUNLIGHT EXPOSURE STRUCTURE, NOISE ACCESSIBILITY (HOTEL OFFICE)</td>
<td>CONFERENCE / INTERFACE OFFICE /ADMINISTRATION SHOP / COMMERCE</td>
<td>MULTI-FUNCTION ROOM</td>
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<tr>
<td>GYM / RECREATION</td>
<td>9</td>
<td>6M</td>
<td>450</td>
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<td>TECHNICAL SPACE BAR / CAFE OFFICE /ADMINISTRATION</td>
<td>INFO CENTER / LOBBY EXHIBITION SPACE MULTI-FUNCTION ROOM</td>
</tr>
</tbody>
</table>
STEP 3  Local Interaction among Actors

- **ATTRACT**
- **REPULSE**

Diagram showing the interactions between different spaces:

- GREEN / OPEN SPACE
- SHOP / COMMERCE
- EXHIBITION SPACE
- INFO CENTER / LOBBY
- OFFICE / ADMINISTRATION
- MULTI-FUNCTION ROOM
- TECHNICAL SPACE
- BAR / CAFE
- GYM / RECREATION
- CONFERENCE / INTERFACE
STEP 4 RUN SIMULATION
The outcome shown above is the selected configuration for further research. The interesting elements of this configuration are the level of clustering and the distribution of the functions on both side of the road. Also, when compared to the other configurations, the height differences of adjacent actors are much more acceptable. Therefore, it has a good potential to be used for generating contintued landscape.
Selected Configuration with Internal and External Connection

Create internal connection as well as the link to urban network according to the type of program and desired connection positions from urban study.
Translate the Simulation Outcome into 3D Space
Clustering Space

Blending Level: Low

Blending Level: Medium

Blending Level: High

Blending Level: Very High
The output shown above is the selected level of blending for further research. The interesting elements of this configuration are that the programs that are more public are easy to be noticed by the users and the programs that are more private are well clustered. Also, this outcome can still keep the space under it bright enough for drivers and citizens.
Formation

Challenge 1: Keep the simulation outcome valid
Challenge 2: Achieve the objectives of the design

Architectural ambitions

Technical ambitions

Reasonable Form
With respect to the objectives, to get the geometry of the building from the simulation outcome, first of all, the circulation route are combined to get a smaller footprint. And the paths are generated following the positions of the program. The circulation system is divided into two layers. One is for public. The other one is a fast path connecting the hotels which provides the people of the hotel with conveniences and can be temporarily closed to public for security reasons. Secondly, circulation space and program space are regarded as a whole to generate the initial geometry.
Optimization - light environment of cloudy day

Adjustment in Rhino

Initial Geometry

Optimized Geometry

Ecotect Daylight Analysis

Initial light environment on ground

Optimized light environment on ground

To ensure the quality of light environment under the building, the ecotect is applied to simulate the daylight level of ground space and provide indications for creating light shaft for the ground space. By iterative simulation and modification, the daylight level of ground space can be improved and optimized.
With respect to different types of space and environmental need, different types of relations among different layers of the building are required. The first type shown above is a shaft throughout the building that used for noise reduction and daylight level improvement. The second type is bridging the roof and the floor so as to create connection as well as communication between these two layers. The third kind is a simple skylight that make sure enough daylight and to some extent improve the communication (sight). The forth type of is a light shaft that combined with indoor garden. It can not only provide the interior with enough daylight but also keep the quality of privacy. The last type is a result of taking the local climate condition into consideration, it makes sense to creates some pavilion on the roof. With these pavilions, some semi-open space is generated, which enable people to enjoy the roof when is very hot.
Formation

Based on the logic of previous slide, the initial geometry was transformed. Different types of space were created with respect to the program.
Formation

Green

To maximize the effect of landscape, the parts of roof that have program under them are assigned more green elements. These green cover can significantly keep much heat from going into the interior so as to reduce the cost for cooling in summer.

Pavilion

Combined with the pavilion, people can access the green area under different weather condition.
The facade openings are based on the direct solar exposure hours, type of program and privacy. In principle, the hot parts of the building have smaller openings. The relatively private parts like meeting rooms also have smaller openings.
Aerial View
Experience

View of pavilion and landscape - roof
Experience

View from ground
The main part of the circulation happen in this layer. People can go to any position of surrounding context (ground and high-rise building) easily in this layer. The circulation space in the middle of the building is surrounded by the public programs like information center, exhibition and commercial space. Temporary cafe or exhibition can take place in this circulation space. Light shaft in the middle keep the space bright enough. And the connections to the second floor and roof are well distributed in this floor. There are also some rest platform above this floor, people of these two layers can see each other and to some extent create the communication of different layers of the building.
Experience

View of circulation space - first floor
Experience

View of circulation space - first floor
The fast path in this floor directly connect two hotels. Normally, this path is open to the public. But it can be temporarily closed for security reasons when important people come to this building. This path is well connected to the program like commercial space, information center and roof. Some semi-open space like small cafe was created between them to provide people with a place for rest and communication. And people on this path and rest platform can have a good view about the building. The space of the club is relatively private, with the atrium and the garden, people can still enjoy a bright and interesting space.
Experience

View of fast path - second floor
Construction System

Challenges

Non-Standard Shape
Climate Condition
Surrounding Context

Thermal Insulation
Lightweight
Noise Reduction
Easy for Fabrication

Material

Steel Skeleton
Cnc-cut Polystrene

File-to-Factory Production
Mass-Customization
On-site Assembly

CNC-cut Polystrene
Steel skeleton
Structural Concept

1. Make full use of existing structure
2. Minimize the side effect on the road and circulation
Structure System

Step 1: create archs and support at appropriate positions

Step 2: create the framework (the part based on pillars)

Step 3: create roof framework based on the archs and pillars

Step 4: create the framework (suspension part)
Communication with Engineer

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Department: Structural Design, AET, BK, TU Delft

Comment
structural system: Possible

Suggestions and direction of further improvement
1: Triangulate more parts of the steel framework
2: Truss-like Arch
Typical Construction Order of Facade Element

Step 1: Steel structure, floor and pre-fabricated steel element for suspending the EPS component

Step 2: Put the bolt through the steel element and fixed it

Step 3: Put the EPS component with pre-cnc-milled hole through the bolt

Step 4: Put the nut and U-Profile through the bolt

Step 5: Fixed the EPS component

Step 6: Fill the hole and gaps, reinforce it with mesh, coating
Detail 1

1. Laminated safety glass
2. Light vegetation
   Soil
   Gravel combined with drain pipe
   Thermal insulation
   Waterproofing layer
   Floor with profiled steel sheet
   I beam
3. Epoxy-resin coating
   Reinforced mesh
   CNC-cut EPS with 15mm cement coating
4. Ceiling cooling
5. Filling thermal insulation
6. Pre-fabricated steel component

12. Epoxy-resin coating
13. Floor with profiled steel sheet
14. I beam

Detail 2

7. Epoxy-resin coating
   Floor with profiled steel sheet
   I beam
8. Epoxy-resin coating
   Floor with profiled steel sheet
   I beam
9. Noise reflection pocket
10. Stainless-steel hinge bolt
    in sliding bearing
11. Cast-steel element fixed in foundation
12. Pre-fabricated steel element (connected to structure)
13. Laminated acoustical glass with low-e coating
1 Laminated safety glass
2 Light vegetation
   Soil
   Gravel combined with drain pipe
   Thermal insulation
   Waterproofing layer
   Floor with profiled steel sheet
   I beam
3 Epoxy-resin coating
   reinforced mesh
   CNC- cut EPS with cement coating
4 Ceiling Cooling
5 Filling thermal insulation
6 Pre-fabricated steel component
7 Carbon composite coating
   Floor with profiled steel sheet
   I beam
8 Epoxy-resin coating
   Floor with profiled steel sheet
   I beam
9 Noise reflection pocket
10 Stainless-steel hinge bolt
    in sliding bearing
11 cast-steel element fixed in foundation
12 Pre fabricated steel
   element (connected
to structure)
13 Laminated acoustical
   glass with low-e coating
THANK YOU FOR YOUR ATTENTION