CLIMATIC ECOLOGIES

HUANSHI EAST CBD IMPROVEMENT 3.0
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.
Background of Yuexiu District

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.
Site

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
Surrounding Context

Baiyun 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), 718 rooms

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

Guangzhou World Trade Center
- Office, 34 storey (north tower), 30 storey (south tower), >90% rented, 5-Star Hotel (top standard), about 7500 at the same time
- Senior Clients, office workers, average 12m² per person, office area: about 100,000m²

Zhengjia East International Plaza
- Office, 62m, >90% rented, 5-Star Hotel (top standard), about 1260 at the same time
- Senior Clients, office workers, average 12m² per person, office area: about 16,800m²

Haoshijie Tower
- Office, 36 storey, >90% rented, 5-Star Hotel (top standard), about 2250 at the same time
- Senior Clients, office workers, average 12m² per person, office area: about 29,965m²

Zhengjia East International Plaza
- Office, 36 storey, >90% rented, 5-Star Hotel (top standard), about 2250 at the same time
- Senior Clients, office workers, average 12m² per person, office area: about 29,965m²

Friendship Store (south pavilion)
- Mall, 7 storey, luxury goods, high level department store, about 3270 (apartment), high level apartment, number of apartments: 1048, 3.21 people per family in Guangzhou, area about 35,000 Yuan per m² (around 4,375 euro)

Friendship Store (north pavilion)
- Mall, 7 storey, luxury goods, fashion goods, high level department store, area: around 27,000 m²

Guangzhou NO.21 Middle School
- 628 rooms, about 800 offices and apartments

Libai Plaza
- Mall, 3 storey, luxury goods, fashion goods, area: around 10,000 m²
### Important Context

- **Baiyun 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)
  - 718 rooms

- **Garden Hotel**
  - Hotel, Apartment, Office, Mall
  - 107m
  - Very high, up to 90% during Canton Fair
  - Senior Clients, office workers
  - About 800 offices and apartments

- **Haoshijie Tower**
  - Office
  - 36 storey
  - Senior Clients, office workers
  - About 2250 at the same time
  - Jia standard office building
  - Average 12m² per person
  - Office area: about 29,965 m²

- **Guangzhou World Trade Center**
  - Office
  - 34 storey (north tower), 30 storey (south tower)
  - Very high, up to 90%
  - Senior Clients, office workers
  - About 7500 at the same time
  - Jia standard office building
  - Average 12m² per person
  - Office area: about 100,000 m²

- **Friendship Tower**
  - Office
  - 62m
  - O.R > 90%
  - Senior Clients, office workers
  - About 1260 at the same time
  - Jia standard office building
  - Average 12m² per person
  - Office area: about 16,800 m²

- **Zhengjia East International Plaza**
  - Apartment, Mall
  - 213m
  - 90% rented, Apartment sold out
  - Senior Clients
  - About 3270 (apartment)
  - High level Department Store
  - High level apartment

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

- **Libai Plaza**
  - Mall
  - 3 storey
  - Fully rented
  - Senior Clients, Luxury goods
  - Area: around 10,000 m²

- **Guangzhou World Trade Center**
  - Office
  - 34 storey (north tower), 30 storey (south tower)
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  - Luxury goods, fashion goods
  - Area: around 27,000 m²
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.
Due to the development of other areas of Guangzhou such as Zhujiang New Town and Tianhe District, the Huangshi East CBD has been facing fierce competitions. 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.

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.

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.
above the ground?

*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
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 thunderstorm. 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>
<tr>
<th>Month</th>
<th>Average maximum temperature (°C)</th>
<th>Average minimum temperature (°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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<td>7</td>
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<tr>
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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>UV 8-10</td>
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<td>UV 10+</td>
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<td>UV 10+</td>
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<td>♦</td>
<td>♦</td>
<td>♦</td>
<td>UV 3-6</td>
</tr>
</tbody>
</table>
Direct Sunlight Exposure - summer (7.23)
Noise Level

Wind Tunnel

Graduation project / msc 4 / hyperbody / guangkai liang
Visibility

Viewing angle of each building

Structure concerns

Potential positions for support

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

Square / Green
Existing structure
Green belt
Accessibility

Connection to program

Connection of Urban Network
Baiyun Hotel
Hotel
117m
occupation 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. > 90%
users: Senior staff, office workers
about 1260 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. > 90%
users: Senior staff, office workers
about 7500 people at the same time
Jia standard office building,
area about 100,000 m²,

Libai Plaza
Mall
5 storey
fully rented
users: Senior Clients, businessman
Luxury goods
area: around 10,000 m²

Podium of Baiyun Hotel
Podium
3 storey
restaurant & hall
users: Senior Clients,

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

Vital Context
1 : unused roof
2 : unused roof
3 : unused roof

Podium of Baiyun Hotel
Podium
3 storey
restaurant & hall
users: Senior Clients,
**Podium of Garden Hotel**

4 storey

1st-3rd floor: commerce, restaurant & hall, 4th floor open space

users: senior Clients, citizens

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**Podium of Haoshijie Tower**

8 storey

1st-2nd floor: commerce, 3rd-8th floor: parking

users: senior Clients, office workers

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**Zhengjia East International Plaza**

213m

Apartment sold out

Senior Clients, citizens (rich)

people: about 3270 (apartment),

High level Department

---

**Garden Hotel**

Hotel (right), Office (left); revolving restaurant 107m

O.R up to 90% during Canton Fair (Hotel), >90% (office)

users: senior Clients, office workers, business man

hotel: up to 1600 at same time, office: around 700

40,000 visitors per year (whole building).

5-star Hotel (top standard)

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**Haoshijie Tower**

Office

36 storey

O.R >90%

users: senior Clients, office workers

2250 people at the same time

A standard office building.
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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<tbody>
<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 data from Noise Map of Guangzhou
Visibility analysis with components in Grasshopper
Connectivity analysis with components in Grasshopper
Wind data from Vasari
Sunlight simulation by Ladybug
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 (outdoor recreation space / view from the high-rise building)

**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

<table>
<thead>
<tr>
<th>Not Good</th>
<th>Medium</th>
<th>Good</th>
</tr>
</thead>
</table>

Site Evaluation
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
### Actors Overview

<table>
<thead>
<tr>
<th>Actors</th>
<th>Number</th>
<th>Separation</th>
<th>Area</th>
<th>Vital Parameters</th>
<th>Preferred Neighbour</th>
<th>Avoided Neighbour</th>
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<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</td>
<td>Conference / Interface</td>
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<tr>
<td></td>
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<td>Bar / Cafe</td>
<td>Multi-Funtion Room</td>
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<td>Exhibition Space</td>
<td>12</td>
<td>8M</td>
<td>950</td>
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<td>Info Center / Lobby</td>
<td>GYM / Recreation</td>
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<td></td>
<td>Bar / Cafe</td>
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<td>Office / Administration</td>
<td>10</td>
<td>4M</td>
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<td>Sunlight Exposure, Structure, Noise, Accessibility (Hotel)</td>
<td>Technical Space</td>
<td>Multi-Funtion Room</td>
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<td>Conference / Interface</td>
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<td>Bar / Cafe</td>
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<td>4M</td>
<td>300</td>
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<td>Multi-Funtion Room</td>
<td>Green / Open Space</td>
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<td>4M</td>
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STEP 3  Local Interaction among Actors

- ATTRACTION
- REPULSION

Diagram showing connections between different spaces:
- Shop/Commerce
- Conference/Interface
- Multi-function Room
- Technical Space
- Gym/Recreation
- Exhibition Space
- Info Center/Lobby
- Office/Administration
- Bar/Cafe
- Green/Open Space

Connections indicate interactions between these spaces.
STEP 4  RUN SIMULATION
**STEP 5** Different Configuration

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<th>Lunch break:</th>
<th>Afternoon:</th>
<th>Evening:</th>
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**Office** | **Open space / Green** | **Bar / Cafe** | **Conference** | **Recreation / Gym** | **Technical Space** | **Commerce** | **Exhibition** | **Information Center** | **Connection**
Selected Configuration

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 sides 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 continuous landscape.
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
Formation

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

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.
Formation

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 layer. 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.
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.
Second Floor

- Circulation
- Circulation (going down to first floor)
- Circulation (going up to roof)
Experience

View of fast path - second floor
Experience

View of fast path - second floor
Experience

View of Atrium - second floor
Construction System

Challenges
- Non-Standard Shape
- Climate Condition
- Surrounding Context

Thermal Insulation
- Lightweight
- Noise Reduction
- Easy for Fabrication

Steel Skeleton
- CNC-cut Polystrene

Material

File-to-Factory Production
- Mass-Customization
- On-site Assembly
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 (truss) 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)
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
1 Laminated safety glass  
2 Light vegetation  
3 Soil  
4 Gravel combined with drain pipe  
5 Thermal insulation  
6 Waterproofing layer  
7 Floor with profiled steel sheet I beam  
8 Coating  
9 Epoxy-resin coating  
10 Floor with profiled steel sheet I beam  
11 Noise reflection pocket  
12 Stainless-steel hinge bolt in sliding bearing  
13 Cast-steel element fixed in foundation  
14 Pre-fabricated steel element (connected to structure)  
15 Laminated acoustical glass with low-e coating  
16 Coating  
17 Floor with profiled steel sheet I beam  
18 Epoxy-resin coating  
19 Floor with profiled steel sheet I beam  
20 Noise reflection pocket  
21 Stainless-steel hinge bolt in sliding bearing  
22 Cast-steel element fixed in foundation  
23 Pre-fabricated steel element (connected to structure)  
24 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. Coating (reinforced mesh, CNC-cut EPS with cement coating)
4. Ceiling Cooling
5. Filling thermal insulation
6. Pre-fabricated steel component
7. 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
14: Coating
reinforced mesh
CNC-cut EPS with cement coating
Steel Structure

15: Coating with reinforced mesh
Filler thermal insulation material
Pre-fabricated element for connecting EPS components
Steel Structure

16: CNC-cut pockets for showing products and storage
Experience

View of exhibition space - second floor
HYDROTECT is an innovative solution for a cleaner environment both outside and inside homes and businesses through photocatalytic processes that use only natural resources such as water and light. It has self-cleaning effect for building facades and also cleans air by removing nitrogen oxides (NOx) emitted by cars and industrial activities.

Just as plants harness light for photosynthesis in nature, Hydro-tect nanotechnology does the same for man-made surfaces. An integrated part of the manufacturing process, Hydro-tect uses nontoxic titanium dioxide (TiO2) in the glazing and coating process. It’s invisible whether applied to tiles or glass or embedded in paint mixtures. And this photocatalyst initiates a reaction between oxygen and humidity in the presence of light, both outdoors in the sunlight and indoors under normal levels of UV light. The chemical reaction yields three results that keep interiors and exteriors clean, as well as improve the environment around us.
THANK YOU FOR YOUR ATTENTION