Breathing Architecture

Yichao Kang

Follow this and additional works at: https://surface.syr.edu/architecture_tpreps

Part of the Architecture Commons

Recommended Citation
https://surface.syr.edu/architecture_tpreps/314

This Thesis Prep is brought to you for free and open access by the School of Architecture Dissertations and Theses at SURFACE. It has been accepted for inclusion in Architecture Thesis Prep by an authorized administrator of SURFACE. For more information, please contact surface@syr.edu.
Contention:
Breathing architecture use the physical property of nature to solve the problem from environment and replace the traditional mechanical system of the existing building in Beijing. Architecture is the expression of the nature and interaction with people. It is a system with emotion.

Traditional architecture solve the problem from the environment according to its mechanical system, such as boilers, chillers, pumps, heat exchangers and ventilate. It against the nature property to provide comfortable living space. In this way, a lot of energy was used by operation and product pollution to environment.

Unfortunately, cause of the “crazy” real estate development and economical situation, most architecture built in Beijing use the traditional mechanical system, especially for the residential building.

Control Nature
These architectures were changed the on facade or element for saving energy. Although the mechanical system is still the principal method to control the living environment, but the partial function of mechanical system was replaced.

Control Nature/Utiliz Nature
Just change the facade cannot satisfy the requirement of saving energy. Architecture became to be designed integrated with the nature property, such as the wind channel and the new material. The envelope, the form and the structure were changed to fit the nature property.

Controlled by Nature
Architecture should conform the property of the nature for saving energy and solve the environmental problem. In this situation, architecture will provide the “intuitive sense” of nature to user.

Architecture is the expression of the nature.
Contention:

Breathing architecture use the physical property of nature to solve the problem from environment and replace the traditional mechanical system of the existing building in Beijing.

Architecture is the expression of the nature and interaction with people.

It is a system with emotion.
Content

1. Contention
2. Pollution Haze
3. Addition
4. Algorithm
5. Interaction
6. Site Analysis
7. Solution
Pollution Haze is a huge air quality problem in China from 3 years ago. It is the combination product from factory pollution and poisonous substance. It is constituted by normal haze and industrial pollution, such as particulate matter, nitrogen oxide and sulfur dioxide. The particulate matter which is smaller than 2.5mm could damage the human health according to the respiratory tract and cause disease, such as asthma, cerebral hemorrhage and cancer.
Pollution

Haze

Industrial Pollution

Particulate Matter (PM)

Nitrogen Oxide (NO2)

Sulfur Dioxide (SO2)

Coal Combustion 32%

Motor Vehicle 23%

Agricultural Activity 7%

Dust Aerosol 7%

Industrial Fuel Oil 5%

Agricultural Burning 3%

Dweller’s Daily Activities 2%

Other Industrial activities 4%

Others 17%

Electrostatic Adsorption

Pharyngitis

Asthma

Trachitis

Hypertension

Carcinogenic

Impair Reproductive Capacity

Influence Psychological Health

Negative Effect on Traffic Safety

Cerebral Hemorrhage

Pollute Environment

Conjunctivities

Impair Reproductive Capacity

Influence Psychological Health

Negative Effect on Traffic Safety

Cerebral Hemorrhage
The average annual concentration of PM 2.5 Beijing in 2014, 

There is no effective solution to protect people in this disaster. The best way to avoid the pollution haze is hide in the building and close the window. People have to stop the outside activities in winter because the pollution is heavy from October to April.

Architecture should not just be regarded as the "safety island". Since many years ago, more and more architecture shoulder the responsibility to solve the problem from environment.
Traditional architecture solve the problem from the environment according to its **mechanical system**, such as boilers, chillers, pumps, heat exchangers and ventilate. It **against the nature property** to provide comfortable living space. In this way, a lot of energy was used by operation and product pollution to environment.

Unfortunately, cause of the "crazy" real estate development and economical situation, most architecture built in Beijing use the traditional mechanical system, especially for the residential building.
Control Nature

These architectures were changed on facade or element for saving energy. Although the mechanical system is still the principal method to control the living environment, but the partial function of mechanical system was replaced.
Electrical system to control nature ventilation

The Arab World Institute is famous for its fantastic facade. This high technology facade controlled by electrical system and inspired from the traditional arabian envelope. There is a lot of light sensors intalled on the facade which were designed for air ventilation, shading and private protection in terms of visualization. But this facade just work for 6 months because of its noisy and high operation fee.
The Menil Collection

Architects: Renzo Piano
Location: Houston, U.S.A
Date: Built in 1987

Integrated traditional mechanical system and manual operation to control nature.

Menil Collection Museum of Art is another great example which solve the problem from daylighting and air ventilation at the same time.

Cause of the requirement of the client, this manual adjustment roof can be changed according to the different exhibition.

This roof was enclosed by clear glass which can block the UV rays. Supported by iron truss which was installed the air ducts in it. The most important part is the manual adjustment leaves which can change the angel to let the daylight enter into the museum or reflect for shading. There is also gallery task lighting under the leaves used for special artwork.
Control Nature/Utiliz Nature

Just change the facade cannot satisfy the requirement of saving energy. Architecture became to be designed integrated with the nature property, such as the wind channel and the new material. The envelope, the form and the structure were changed to fit the nature property.
The HEW customer center add an additional Facade with new material to modify the temperature in different seasons. Cause of the nature ventilation, the panels on the facade were changed the angle follow the air channel.

“Most importantly, the PV facade actively generates electricity and heat year-round.

The “second skin” approach has the further environmental benefit of eliminating the need for demolition and disposal of the existing facade. The new skin is a complex curving form comprised of over 1,200 custom glass and PV modules. One of the most complicated curtain walls ever constructed, this project will demonstrate that PVs can perform in the most demanding architectural applications.”
The Federal Building in San Francisco use the manual control and Building management system to provide nature and normal ventilation in different floor of the building. Create nature ventilation in floor and the ceiling for human comfort. Part of this building already abandoned the mechanical system for ventilate.
30 St. Mary Axe

Architects: Foster + Partners
Location: London, UK
Date: 2004

30 St. Mary axe, the Greater London Authority Building, which has the significant symbol for air ventilation, use wind channel to design the whole building, the form, structure and interior space. The oval form is better than general cubic building for wind flowing. The atriums of this building was constructed by different circle floors which was changed 5 degree in each one. These atriums working for increasing the wind speed to form the interior ventilation. This building is a good project which was combine the wind-driven ventilation and the stack ventilation.

After a short time. This building stoped working. First, the wind flowing in the interior space too directly so that make people uncomfortable. More and more people block the wind in each floor. Second, the louvers which were installed on the atriums, sometimes do not working and broken. But in this project, the nature property—wind channel, became an "algorithm" in architecture Design.

Ventiform

Architects: Foster and Partners
Date: Designed in 2002

"The Ventiform research project was an attempt to integrate an electricity-generating wind turbine into a mixed-use, high-rise building. Its name was inspired by ventifacts, rocks that are carved into aerodynamic forms by wind-blown sand.

The aerodynamic form of the building enhances the energy-generating capability of the turbine, increasing the building’s self-sufficiency."

The Ventiform experiment project change the whole architecture form for wind power generation.
Controlled by Nature

Architecture should conform the property of the nature for saving energy and solve the environmental problem. In this situation, architecture will provide the "intuitive sense" of nature to user.

Architecture is the expression of the nature.
Dustyrelief, use the hairiness facade to collect the dust in the air according to electrostatics system. The "dirty" facade which symbols the Exacerbating climate contrast with the interior block to express the environment problem and the local society. The change of the facade, I mean the shape and the color are random and controled by dust.
unplug office building use solar panels to get energy for the operation. In this project, the designer regard the solar panel as an "algorithm" to observe the deformation of the reactive facade to respond to contact with solar energy.

The architecture is the result of the radiation.
Breathing Wall: One Hundred and Eight Installation

Artist: Nils Volker
Date: 2010

“Although each plastic bag is mounted stationary the sequences of inflation and deflation create the impression of lively and moving creatures which waltz slowly around like a shoal. But as soon a viewer comes close it instantly reacts by drawing back and tentatively following the movements of the observer. As long as he remains in a certain area in front of the installation it dynamically reacts to the viewers motion. As soon it does no longer detect someone close it reorganizes itself after a while and gently restarts wobbling around.”

From the Artist, Nils Volker

Breathing Wall, a facade controled by electrical system, convey the flowing of the wind according to the air bags. Also react the human performance when people come closer. It is a medium for human and the nature.

Kinetic Sculpture:
Moves And Changes According To The Weather

Artist: John Grade
Date: 2013

“This is a Project Moves and Changes according to the Weather. It provide the “intuitive sense” of nature to user and make user feel the weather directly according to this "architecture”

“Weather sensors placed on the roof of the center feed back to the coil, causing it to move and shift in response to wind direction and change luminosity in response to changes in temperature. The design of the coil is inspired by a microscopic marine plant called coccocithophore, with each flute representing an individual organism—as these brighten or dim and shift around the sculpture will look like its alive.”

From John Grade
Buildings That Breathe:
Doris Sung's living architecture

Architecture: Doris Sung

“dynamic, "breathable" exteriors that can regulate the temperature in buildings the way human skin regulates body temperature — consuming zero energy and requiring no switches or other controls.”
HygroSkin – Meteorosensitive pavilion

Artist: Oliver David Krieg, Steffen Reichert
Location: Permanent Collection, FRAC Centre Orleans, France, 2011-13

“The project HygroSkin – Meteorosensitive Pavilion explores a novel mode of climate-responsive architecture. While most attempts towards environmental responsiveness heavily rely on elaborate technical equipment superimposed on otherwise inert material constructs, this project uses the responsive capacity of the material itself. The dimensional instability of wood in relation to moisture content is employed to construct a meteorosensitive architectural skin that autonomously opens and closes in response to weather changes but neither requires the supply of operational energy nor any kind of mechanical or electronic control. Here, the material structure itself is the machine.

......

Nature has evolved a great variety of dynamic systems interacting with climatic influences.”
Breathing Architecture

In conclusion, breathing architecture is designed integrated with the physical property of nature to provide the cheaper and zero energy solution to solve the environment problem. It is the expression of nature and controlled by nature. Also make people feel the change of the climate directly.

It is a building with emotion.
Site Analysis
Because of the "crazy" real estate development since 10 years ago, there is a lot of high rise building with traditional mechanical system built in there. According to the real estate analysis, the best solution is change the existing building rather than build new building.
Solution
Architecture: Wangjing Center
Location: Beijing, China
Architecture: Wangjing Center
Location: Beijing, China
Architecture: Wangjing Center
Location: Beijing, China
Section A-A

Original Mechanical System
1. Normal shape with out smog
2. Collect the dust
3. Change the shape cause of the weight and wind
4. Full with wind
5. hairiness interior
6. Collection of the dust
7. Use the original Mechanical Space to transfer the dust
Bibliography

1. http://img1.mydrivers.com/img/20141011/80579943ca3a443cb939c4bcf1eba569.jpg

2. http://image.baidu.com/search/index?ct=201326592&z=9&tn=baiduimage&ipn=r&word=%E5%A6%82%E4%BD%95%20%E6%8B%8D%E5%87%BA%20%E5%A5%BD%E7%85%A7%E7%89%87&pn=0&istype=2&ie=utf-8&oe=utf-8&cl=2&lm=-1&fr=&fmg=1441593347328_R&ic=0&se=&sme=&width=0&height=0&face=0

3. http://img1.mydrivers.com/img/20141011/963772101de14589bd50a60deb7c6c35.jpg


