



“We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect.”



BILKENT UNIVERSITY  
Faculty of Art, Design and Architecture  
Department of Architecture



ARCH 402: Architectural Design Studio VI  
SPRING 2020  
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## 01. Site Analysis

## 02. Literature Review

## 03. Case Studies

## 04. Project



The Al Wathba Wetland Reserve is a nature reserve consisting of both natural and man-made bodies of water located 40km southeast of central Abu Dhabi. Covering a total of 5 square km, the wetlands are comprised of wetlands, sabkhas (- salt flats), fossilized sands and dunes and are densely packed with animal and plant life.



More than 250 species of birds, including these greater flamingos, can be found at the Al Wathba Wetland Reserve in Abu Dhabi.

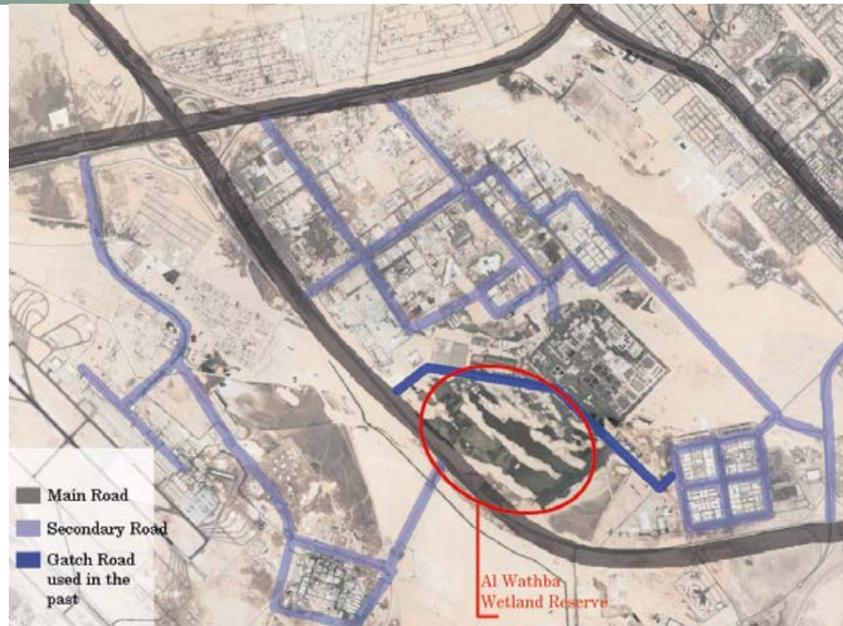




There is the main road, Al Ain, near the Al Wathba Wetland Reserve however the gatch road that was used during the construction of Al Mafrq Waste Water Treatment Plant is no more used today.

Covering over 14,500 hectares, Bul Syayeeef is the United Arab Emirates' sixth Ramsar Site.

Its tidal mudflats are home to over 80 migratory and resident birds. In 2009, it hosted one of the largest breeding events of the greater flamingo (*Phoenicopterus roseus*), with a record of 2,000 breeding pairs and 801 hatchlings.



Recently, the construction of Al Ain truck road caused a natural depression, which led to the accumulation of water.

## Land Use

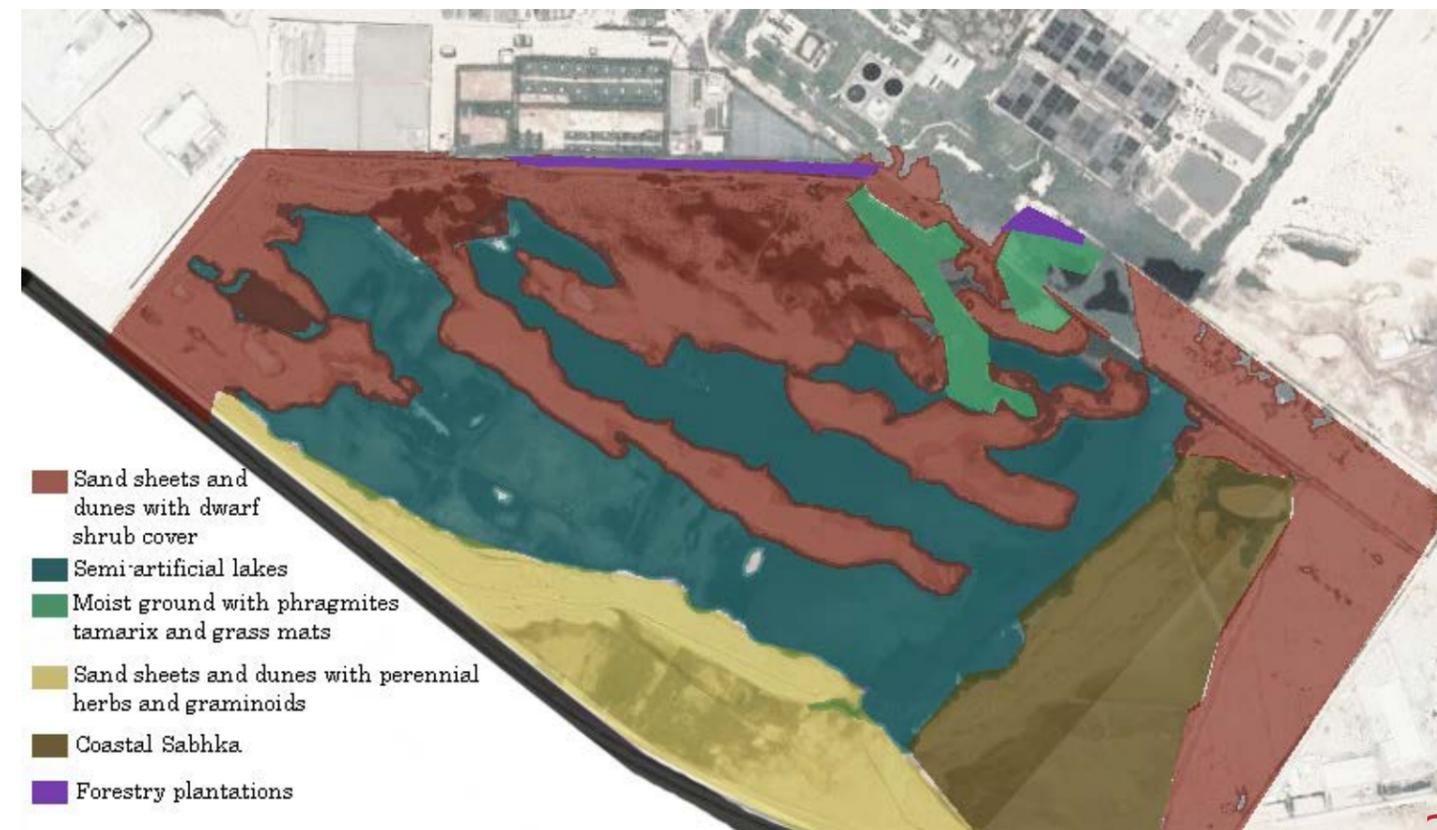


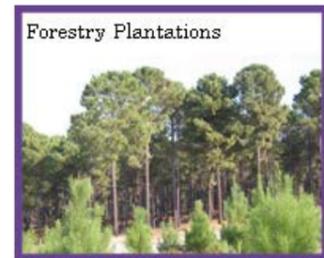
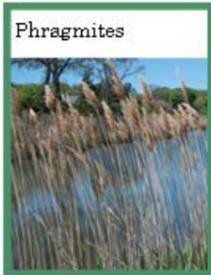
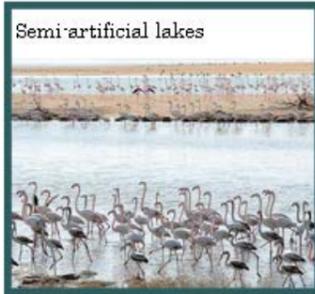
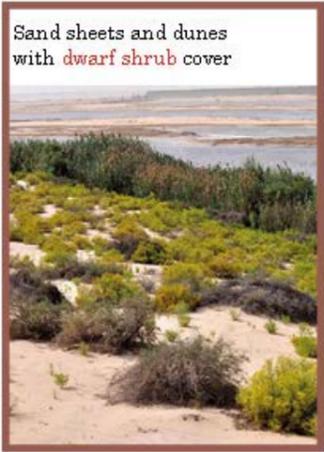
Accumulation of water is the result of sub-surface flow and the release of the sewage water from Al Mafrq Waste Water Treatment Plant.

Today, Al Wathba is supplied with regulated amounts of tertiary treated waste water from the Al Mafrq water treatment facility.

By controlling three outlets from the treatment plant, the team is able to regulate the output of water to create welcoming habitat for birds and other animals.

So, the wetland is a combination of natural and man-made water bodies.





## Al Wathba's Potential for Improvement:

### Education and Awareness

There is great demand from schools, universities and colleges to visit Al Wathba Wetland Reserve as part of their educational curriculum. Due to the current lack of facilities and infrastructure, school trips to the reserve are limited. There is tremendous scope for Al Wathba to serve as a first class educational resource.

### Eco-tourism and recreation

Due to its size and location, the site had potential for ecotourism, especially if well promoted for bird watching activities and recreation. There is already demand from local tour operators and tourism companies to visit the reserve, mainly for bird watching activities, as part of their tourism programme.

### Research

The site has significant potential to aid in the research of hydrology, aquatic invertebrates and ornithology.



Al Wathba Wetland Reserve Habitat Rehabilitation Programme

By Environment Agency – Abu Dhabi (EAD) , over 2500 native trees planted. Forming a barrier around the reserve, the trees, including hardy desert natives, will help shield the park from winds, produce more cover for various species and reduce noise from surrounding roads.

## Biological Features

**Flora:** Of the 37 species of plants recorded in the proposed site (Brown et al 2005), the three dominant species in the reserve are *Cyperus conglomeratus*, *Haloxylon salicornicum*, and *Zygophyllum qatarense*.

**Fauna (excluding birds):** A key non-avifaunal species is the Brine Shrimp (*Artemia* spp.) since this is the main food source for the Greater Flamingo. Also, there are at least 6 species of dragonflies and damselflies at Al Wathba.

**Avifauna:** With more than 250 species of birds recorded in the area, birds remain the single most important element of the wetland biodiversity. The first ever breeding of flamingos in 1998-1999 led to the establishment of the area as a protected area and was an important conservation landmark. The reserve also hosts one of the biggest concentrations of breeding Kentish Plovers and is also a site where Avocets breed.

<p><b>FLORA</b></p> <p><i>Cyperus conglomeratus</i></p> <p><i>Haloxylon salicornicum</i></p> <p><i>Zygophyllum qatarense</i></p>	<p><b>FAUNA</b></p> <p>Brine Shrimp</p> <p>Wasps</p>
<p><b>AVIFAUNA</b></p> <p>Flamingos</p> <p>Kentish Plovers</p> <p>Black-winged Stilt</p>	<p><b>HABITATS</b></p> <p>Tall-reed marshes</p> <p>Saline Lakes</p>

**Typical Habitats:** There are various habitats such as fresh water bodies, saline lakes, tall-reed marshes, gravel plains, sand dunes and sabhka, which make it a natural refuge for a high diversity of flora and fauna.

## What is Ramsar Convention?



The Convention on Wetlands, known as the Ramsar Convention provides for national action and international cooperation regarding the conservation of wetlands, and wise sustainable use of their resources.

Al Wathba Wetland Reserve, declared as a protected area in 1998 by Environment Agency-Abu Dhabi since it offers ideal habitat for migratory birds and a significant breeding site for the greater flamingo. Designated as a Ramsar Site in 2013, Al Wathba Wetland Reserve offers visitors a true understanding of the importance of conservation in Abu Dhabi.

# Why Al Wathba is suitable site for flamingo breeding?

## 1. Landscape characteristics of the breeding site:

Flamingos are birds from "open landscapes": they breed in open lakes, lagoons, artificial salt pans, seashores and even freshwater marshes and avoid closed habitats (i.e. with higher vegetation) that prevent them from seeing predators and from taking-off easily.

## 2. Substrate quality of the nesting site:

Flamingos nest on low islands of mud or sand, surrounded by water, and construct a nest-mound of the material surrounding the nest. If the surface of the island is hard or dry, there will be no mound, or either no nest at all

## 3. Water levels around the nesting site:

The water level must be sufficient to prevent any terrestrial predator intrusion but also not so high nests flooding.

## 4. Foraging resources:

Brine shrimps (*Artemia* spp.), one of the main food of flamingos in salt waters, is present in Al Wathba lake.

## 5. Predation/disturbance:

Flamingos are very sensitive to disturbance and predation when breeding.



Sedge

Salt Bush

Salt Cedar



Toothbrush Bush

Red Thumb

White Saxaul

## Detailed examples of Native Plants



Desert Hyacinth



Bean Caper



Dipterygium Glaucum



Turnsole



Sidr Tree



Aquatic Reeds

## OFFERED PLANT



Phoenix Dactylifera

# LITERATURE REVIEW

## Landscape Urbanism

**The priority:** The existing landscape of the site respecting the nature rather than arrangement of objects and buildings.

**Aim:** The sensitivity about the ecological functions and consideration of the horizontal field over the vertical figure-ground.



**Landscape urbanism** is the theory of urban planning through the medium of landscape. It promotes the general idea that cities are best planned and organised, not through building and infrastructure design, but through the design of landscape.

As a theory, landscape urbanism originated in the late-1980s, when landscape architects and urbanists such as Peter Connolly, Richard Weller and Charles Waldheim began to explore the perceived boundaries and limits of their respective disciplines within the context of complex urban projects.

These theorists sought to 'claim landscape as urbanism' and viewed the concept as a reaction to 'architecture and urban design's inability to offer coherent and convincing accounts of contemporary urban conditions'.

In essence, the theory suggests that **landscape should supplant architecture from its traditional role as the foundation for urban form**. In terms of a project this may be achieved through managing infrastructure, water, biodiversity and human activity, and examining the ecological and environmental implications of the urban development.



One of the leading theorists, James Corner, suggested the most important ideas for landscape urbanism are:

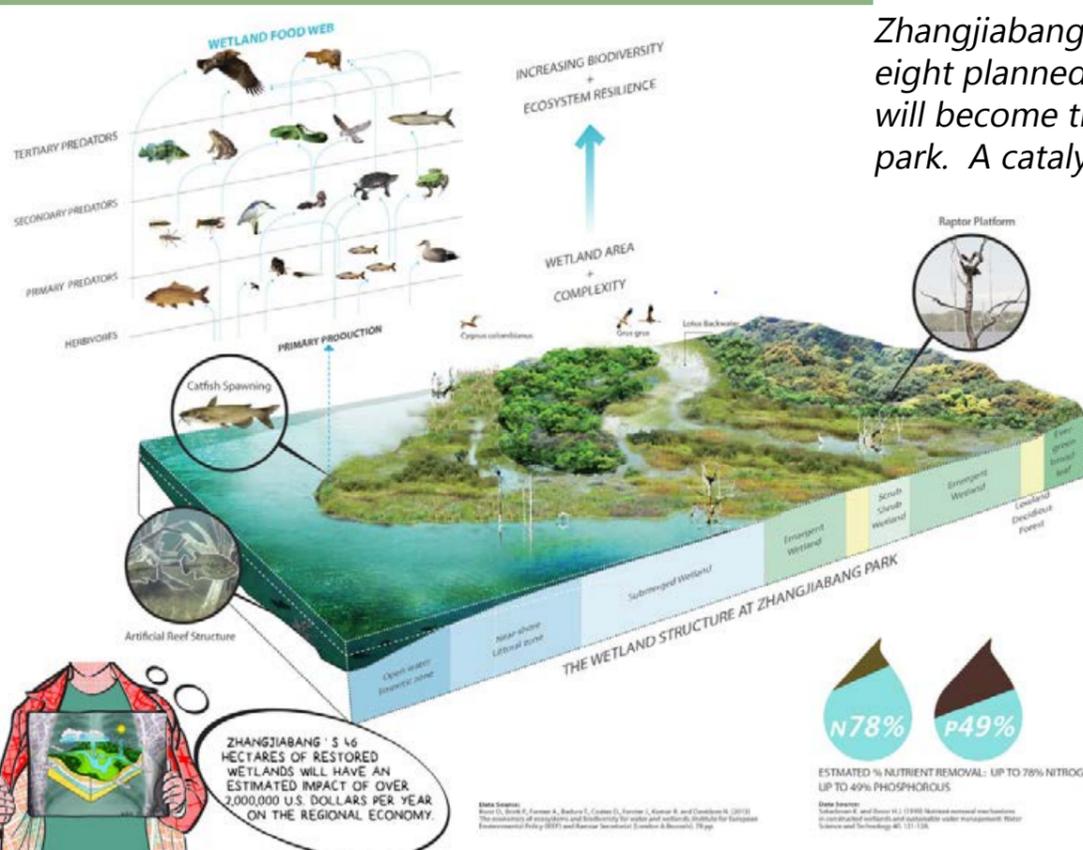
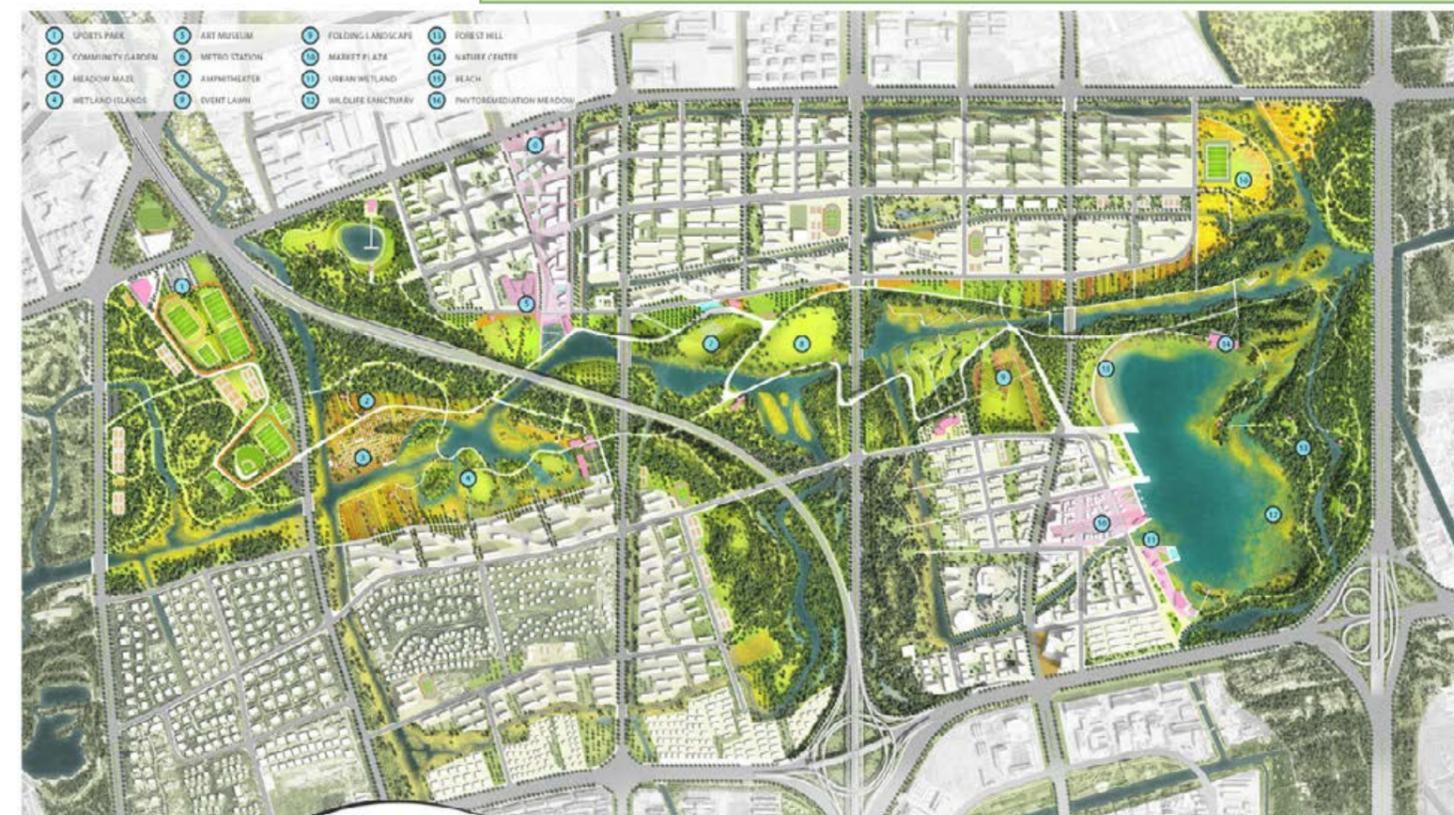
**Process over time:** Ecological awareness with regard to the built environment.

**Horizontality:** Horizontal alignment in landscapes, as opposed to vertical structuring.

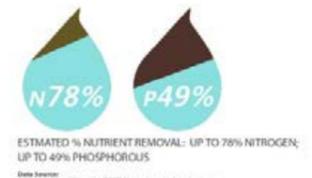
**Working methods/techniques:** Techniques should be adapted to the relevant environment.

**Imaginary:** The failure of 20th century planning is a result of 'the absolute impoverishment of the imagination to extend new relationships and sets of possibilities.'





Zhangjiabang is the first of Shanghai's eight planned "green wedges", and will become the city's largest public park. A catalyst for ecological and urban renewal, the park creates an unprecedented amount of wetland and woodland habitat that redefines the natural environment in a city whose residents have increasingly fewer opportunities to experience nature.



Landscape Urbanism is: "... more than a singular image or style: it is an ethos, and attitude, a way of thinking and acting ... landscape urbanism views the emergent metropolis as a thick, living mat of accumulated patches and layered systems, with no singular authority or control..." James Corner, (2003)

Landscape Urbanism is: "... a call to turn the traditional practice of urban design inside out, starting with open spaces and natural systems to structure urban form, instead of buildings and infrastructure systems."



Central Park

Tao Zhang, Sasaki Principal:

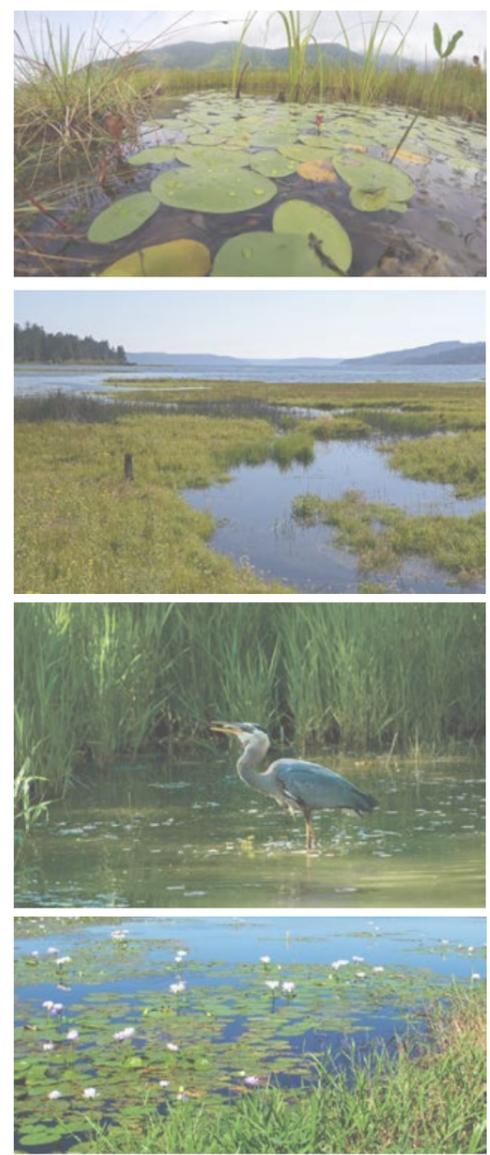
"A great project that showcases the interplay of architecture, urban fabric and landscape space is Central Park in New York City. Central Park sits in sharp contrast to the densely-packed surrounding buildings. The juxtaposition creates tremendous value to the surrounding neighborhoods and all of Manhattan. Without Central Park, the surrounding skyscrapers are no more iconic than those in some emerging cities; by the same token, Central Park is no more than a picturesque large man-made park without its surrounding skyscrapers. It is the juxtaposition, at once complementing and contradicting each other, that makes an iconic Manhattan scene, and a textbook case for numerous urban studies and design inspirations."

**Landscape Urbanism endeavors:**  
 "...to incorporate the processes and techniques that have historically modulated the landscape into the domain of urbanism, empowering its ability to cope with the wider range of scales, the diversity of domains and the rapid changes at which it is currently being challenged to operate."  
*Ciro Najle, (2003)*

**Landscape Urbanism has:**  
 "...emerged primarily from landscape architecture, widening its focus on processes to include those that are cultural and historical as well as natural and ecological."  
*Linda Pollak, (2006)*

**WETLANDS**

Wetlands are highly productive and biologically diverse systems that enhance water quality, control erosion, maintain stream flows, sequester carbon, and provide a home to at least one third of all threatened and endangered species. They are among the world's most productive environments; cradles of biological diversity that provide the water and productivity upon which countless species of plants and animals depend for survival.



**Wetland biodiversity matters**

- For the climate**  
30% of land-based carbon is stored in peatlands
- For clean water**  
Swamps and marshes remove pollutants
- For jobs**  
One billion people depend on wetlands for their livelihoods
- For economies**  
Wetlands provide USD 47 trillion in essential services annually

**Loss of wetlands = Loss of biodiversity**

- 87% of the world's wetlands have been lost globally in the last 300 years
- Key drivers of wetland loss**
  - Pollution
  - Drainage
  - Land conversion
- One million animal and plant species threatened with extinction**
  - Reptiles
  - Amphibians
  - Water birds
  - Mammals

**End biodiversity loss, restore wetlands**

(Image taken from <https://www.worldwetlandsday.org/materials>)

**Functions of Wetlands**

- Water purification - sediment and toxicant removal
- Water storage
- Nutrient cycling
- Prevent saline intrusion
- Groundwater recharge and discharge
- Flow regulation/flood mitigation
- Shoreline protection, storm protection & erosion control
- Windbreak
- Critical habitats for plants and animals

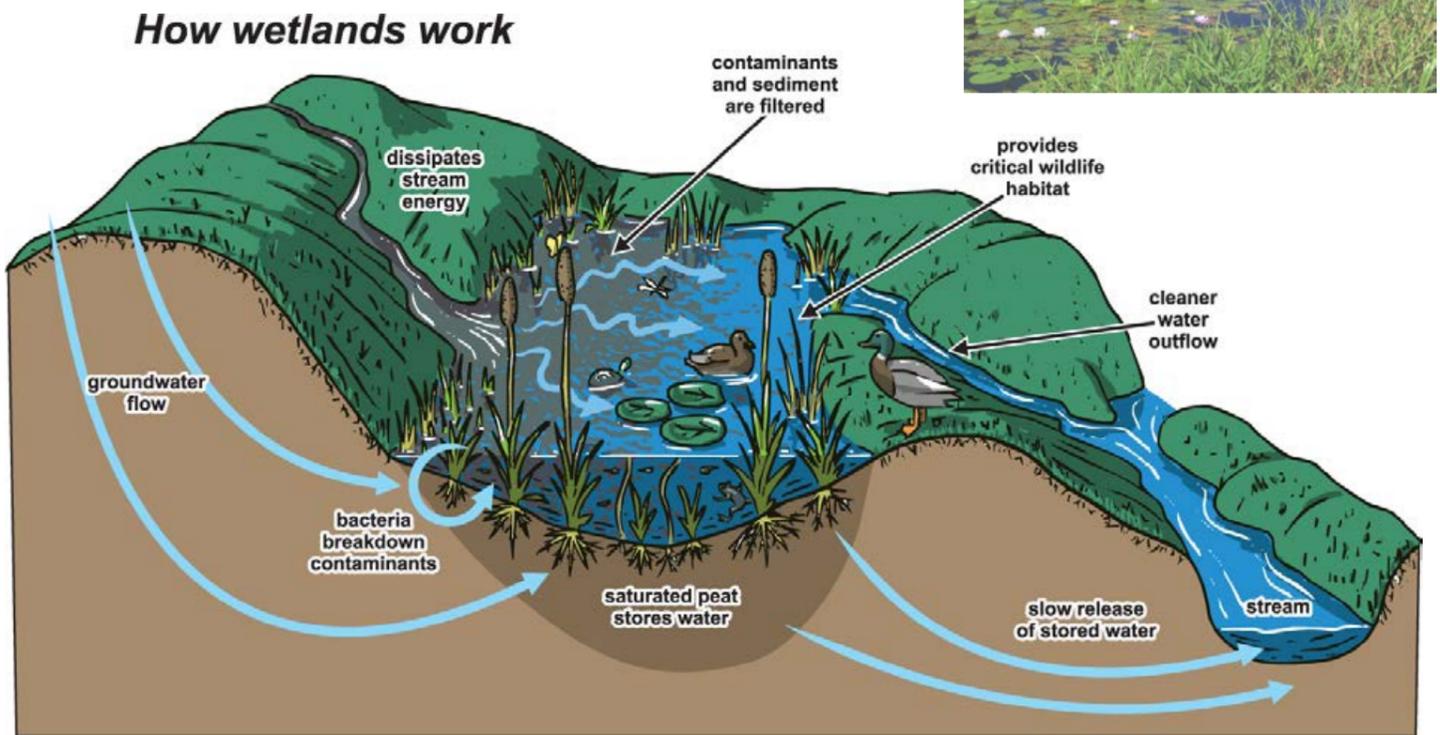
**Benefits of Wetlands**

- Water supply and transport
- Research and education
- Gene bank
- Recreation and tourism
- Energy resource
- Aesthetic
- Food resource
- Sediment trap and carbon sink
- Wastewater treatment



**Characteristics of Wetlands:**

- Occupy a transitional zone
- Diversity varies according to origin, geographical location, water regime and chemistry, dominant flora and soil or sediment characteristics
- Sustainability of wetlands depends largely on the dynamics of water supply and loss
- The ecosystem function of a wetland is dependant on its biogeochemical processes



(Image taken from <http://www.kanabecswcd.org/wetlands/>)

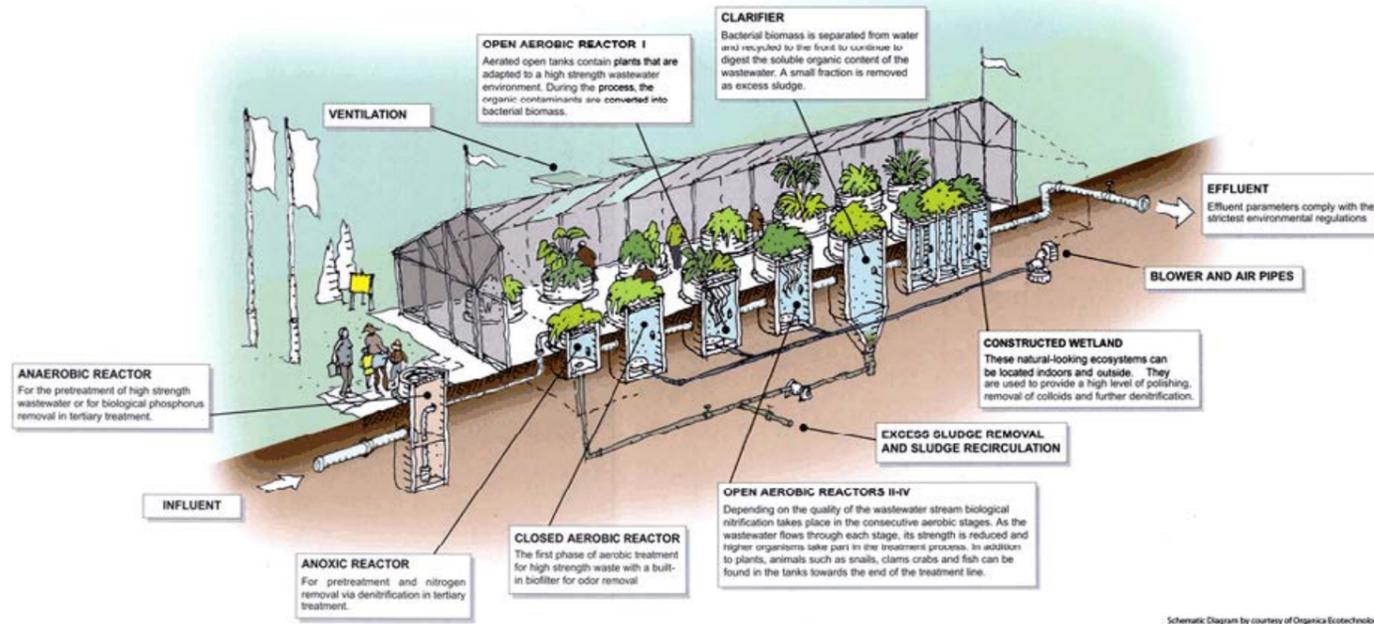
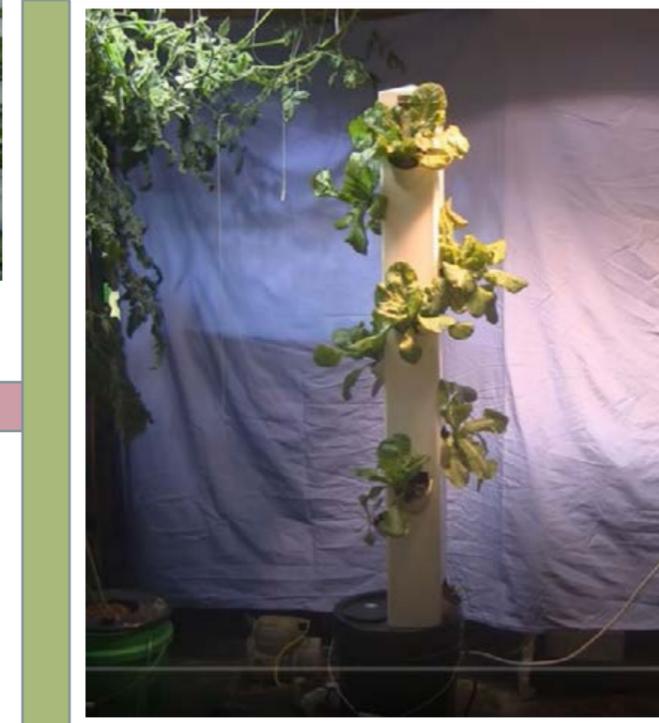
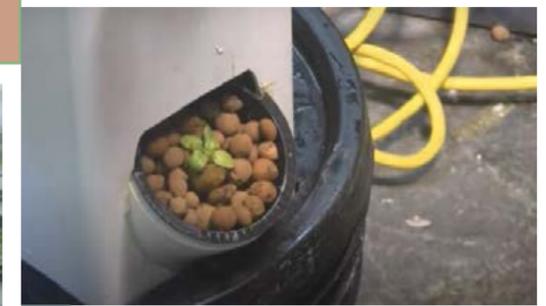
## Living Machine System

A "living machine" is a self-sufficient polluted water treatment and phyto-purification system that mimics the natural purification process of rivers and wetlands. Part natural, part artificial, the system relies on a series of basins, each forming a specific ecosystem, connected by pipes and containing hundreds of plant and animal species (varying in size from bacteria to trees) which coexist in perfect symbiosis.

The whole system is based on a food chain. As wastewater passes through this system, it is exposed to various living organisms which feed on pathogens and pollutants.



Innovation and new ideas don't always need fertile soil to take root.



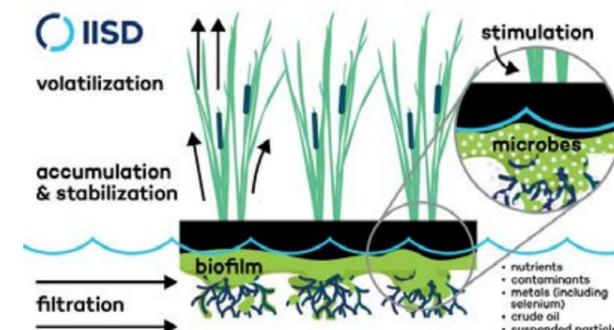
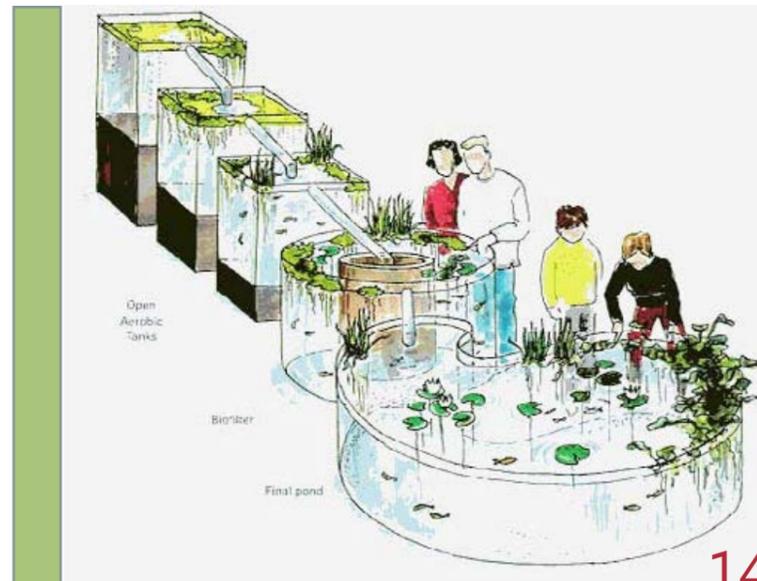
Living Machine system can be also used working vertically which creates more spaces around.

## Floating Wetlands

The purpose of the floating wetlands is to provide an enhanced treatment above and beyond existing water quality. Floating treatment wetlands (FTWs) or islands are small artificial platforms that allow these aquatic emergent plants to grow in water that is typically too deep for them. Their roots spread through the floating islands and down into the water creating dense columns of roots with lots of surface area.



The Living Machine incorporates many of the same basic processes (e.g., sedimentation, filtration, clarification, adsorption, nitrification and denitrification, volatilization, and anaerobic and aerobic decomposition) that are used in conventional biological treatment systems.



# CASE STUDIES

## Margus Larsson- "Turning dunes into architecture"

"Architects create spaces that accommodate human activity, as opposed to many of its contemporary counterparts, dune is not so much focused on the styling of that activity, as on the supporting of it. While designed to visually seduce, dune is not primarily a formal exercise, but a social, ecological, cultural one. How are we to live with the desert, in the desert, within the desert?"

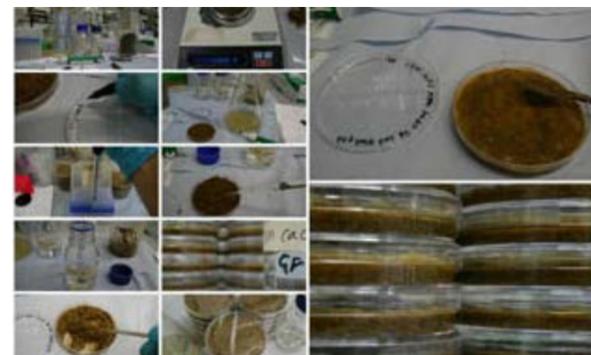
-Magnus Larsson



### How to turn sand into sand stone?

1. Injection piles are pushed down through the dune
2. Bacillus Pasteurii filling up the voids
3. Chemical process produces calcite, kind of natural cement, which binds grains together

Larsson has proposed using bacillus pasteurii, a "microorganism, readily available in marshes and wetlands, [that] solidifies loose sand into sandstone," he explains.



## Qunli Stormwater Wetland Park / Turenscape



This project presents a stormwater park that acts as a green sponge, cleansing and storing urban stormwater, which can be integrated with other ecosystem services including the protection of native habitats, aquifer recharge, recreational use and aesthetic experience, thus fostering urban development.



### Red Ribbon Park / Turenscape

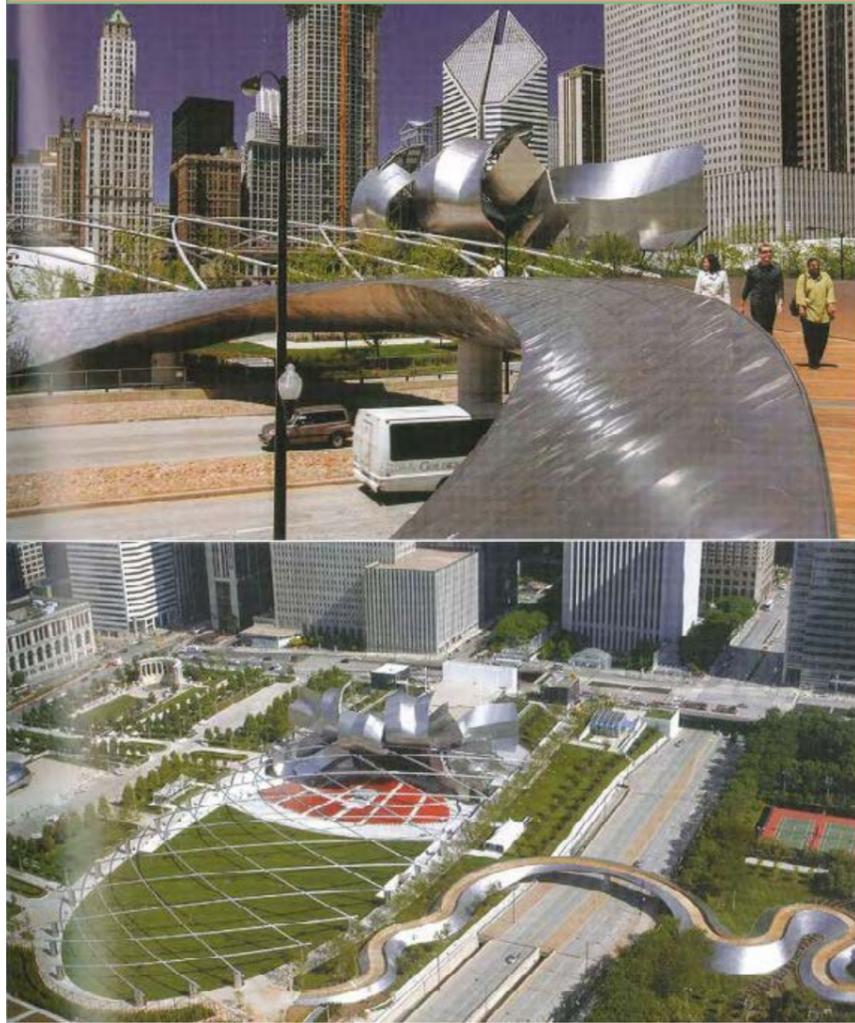
Against a background of natural terrain and vegetation, a "red ribbon" spans five hundred meters, which integrates the functions of lighting, seating, environmental interpretation, and orientation. While preserving as much of the natural river corridor as possible during the process of urbanization, this project demonstrates how a minimal design solution can achieve a dramatic improvement to the landscape.



## Bridge, Pritzker Pavilion, and Great Lawn, Millennium Park, Chicago, Illinois

Jay Pritzker Pavilion, also known as Pritzker Pavilion or Pritzker Music Pavilion, is a bandshell in Millennium Park in the Loop community area of Chicago in Cook County, Illinois, United States.

In terms of design, the bridge has harmony with its environment and shows its curvilinear form in a continuous way.



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## Sand Dune Stabilization

### Stabilization Methods

- Sand fences
- Straw (checkerboard and bales)
- Mats and netting
- Chemical spray
- Brush
- Vegetation – preferred method worldwide worldwide



### Straw Checkerboards

- Wheat or rice straw or reeds (50 – 60 cm in length) length) length) length) are placed vertically vertically vertically vertically to form the sides of the checkerboard, checkerboard, which are typically typically 10 – 20 cm high.



### Wooden Sand Fences

- Most effective configuration – single linear fence perpendicular to the predominant sand transport direction
- Fences 1.2 m (4') high with a vertical – single linear fence perpendicular to the predominant sand transport direction



“Resistance towards Wind”



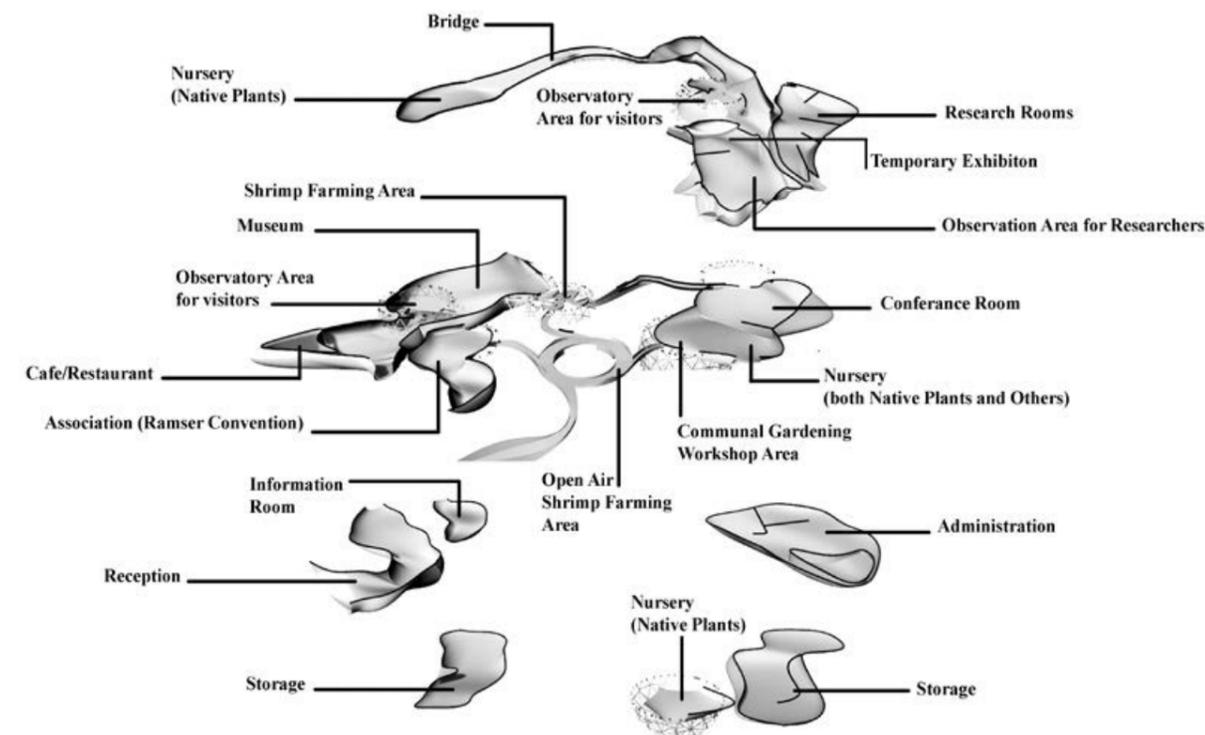
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### Plans and Diagrams

- Reception
- Administration
- Ramser Association
- Research Center
- Museum(botanic and animals)
- Information Room

- Nursery(Native Plants and Others)
- Brine Shrimp Farming Area
- Conference Room
- Communal Gardening
- Workshop Area
- Therapeutic Garden
- Storage
- Observatory Area

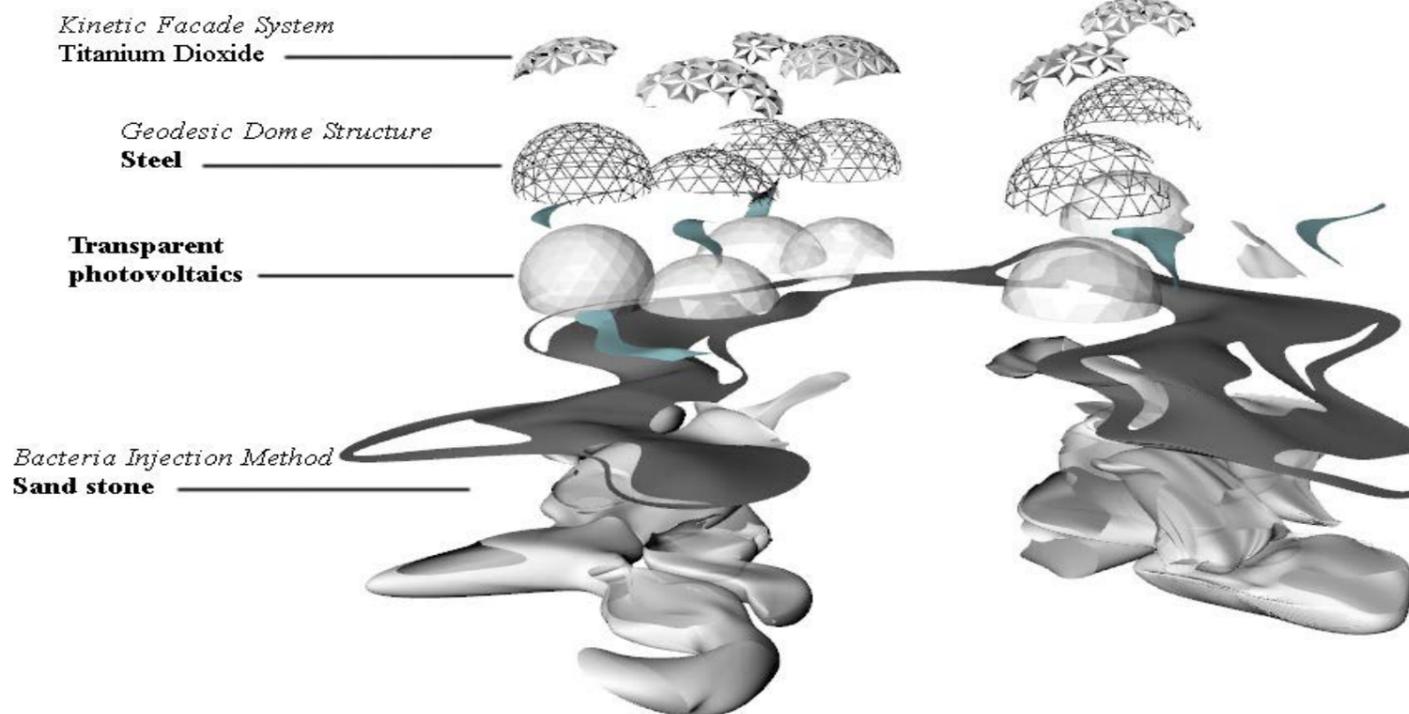
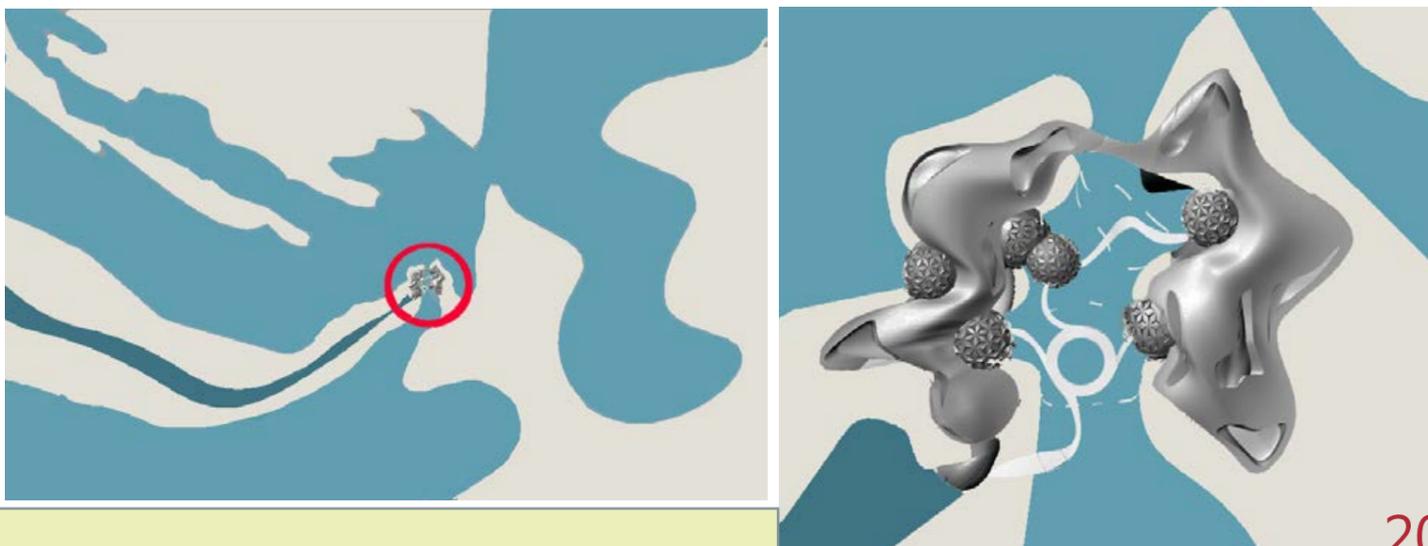
- Observatory Research Room
- Ornithology Laboratory
- Temporary Exhibition
- Restaurant/Cafe
- Wooden Sand Fences and Straw Checkerboards Workshop



- Bul Syayef and Al Wathba Wetland Reserve are connected, which make Al Wathba Wetland no more semi-artificial, but totally natural one that does not depend on additional artificial water. Also, expansion of water offers flamingos more habitats.

- Road shift and offered boat road which starts from the city center make the wetland area more natural.

- Floating wetland areas are detected and centralized.



# Sand to Sand Stone

**Sand Dune in the site**



**Solidify the part we need, Have the structure**

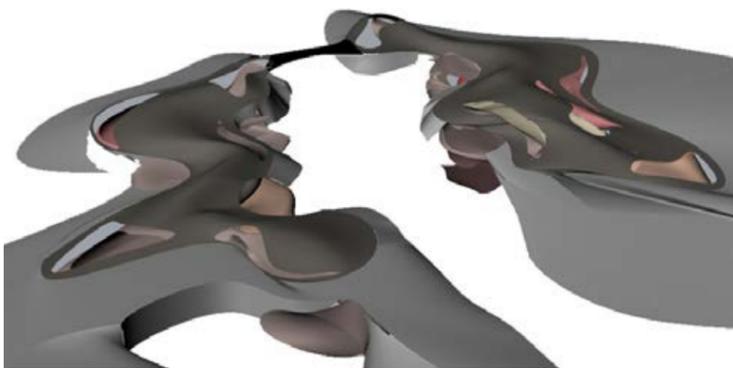


**Carry redundant sand away ...and have architecture**



Bacillus Pasteurii that can be easily found in wetlands, have an ability to create a chemical process which offers turning sand to sand stone. The result is cave-like structure.

In Flamingo Visitor Center, this method is used to have the main structure, sand stone, and then the geodesic dome structure, called as "architecture", stuck to this cave-like structure.



# Section Perspectives



# Environmental Consideration

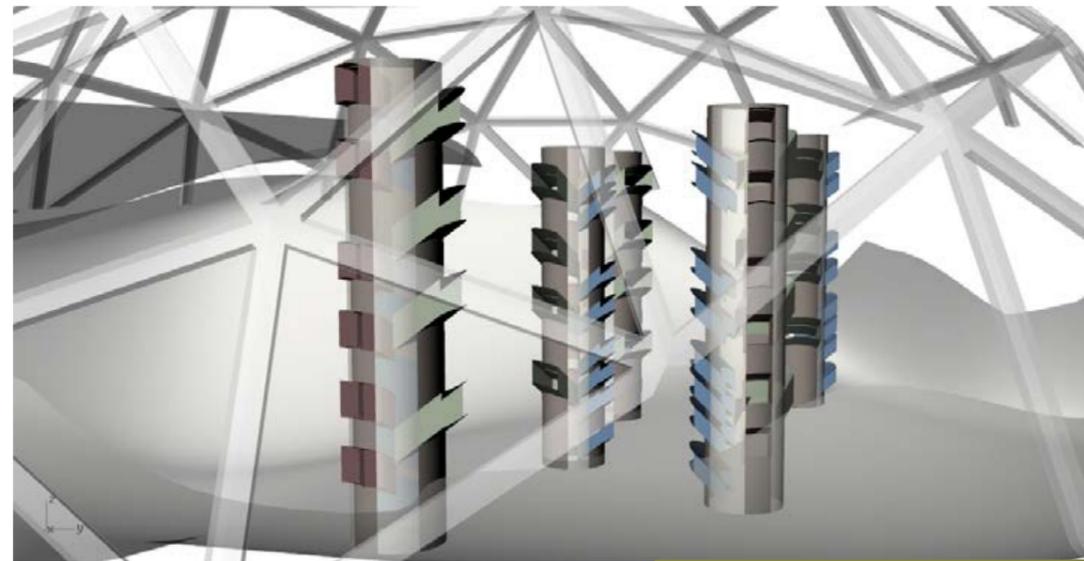
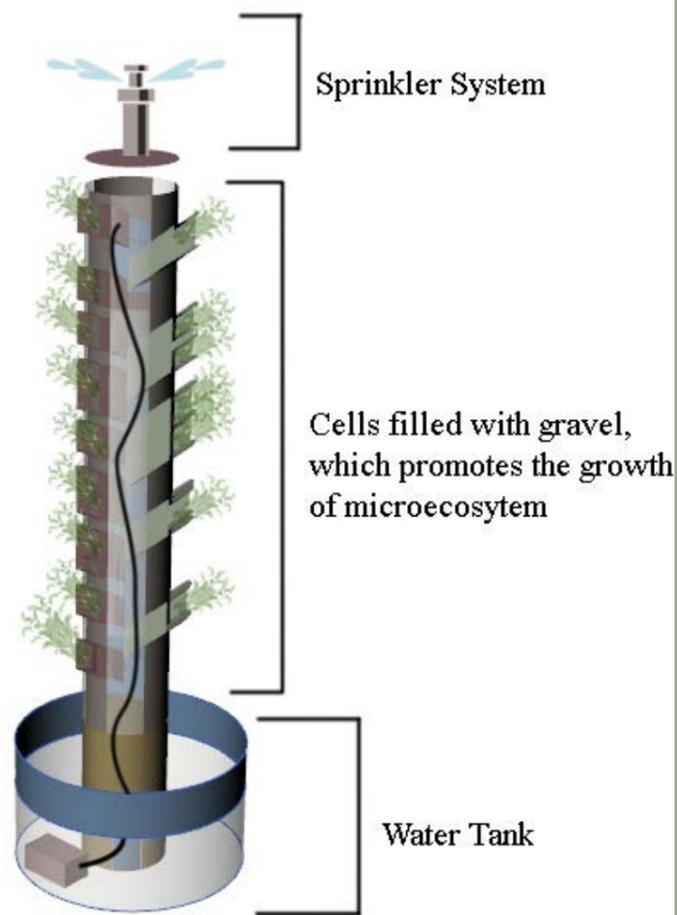


**1** Connecting two wetlands and expanding water

Expansion of water prevents desertification and makes Al Wathba Wetland Reserve totally natural wetland, not semi-artificial wetland as it was before, independent from water treatment plant.

## 2 Living Machine System

- a) Collecting all grey water from toilets and rainwater
  - b) Purifying water by nursery plants and microecosystem
  - c) Using clean water for irrigation, toilets and sprinkler
- Tank 1 (Debris settles and degrades)
- Tank 2 (Equalization)
- Cells (Organisms eat and purify black/grey water to remove microscopic sediment.)
- Tank 3 (Water treated with ultraviolet light)



## 3 Translucent Photovoltaics

Turning sun rays into electricity that is used for:

- a) artificial lighting in museum
- b) sprinkler mechanism in nursery
- c) solar attic fans in observatory areas in museum
- d) living machine tanks mechanism

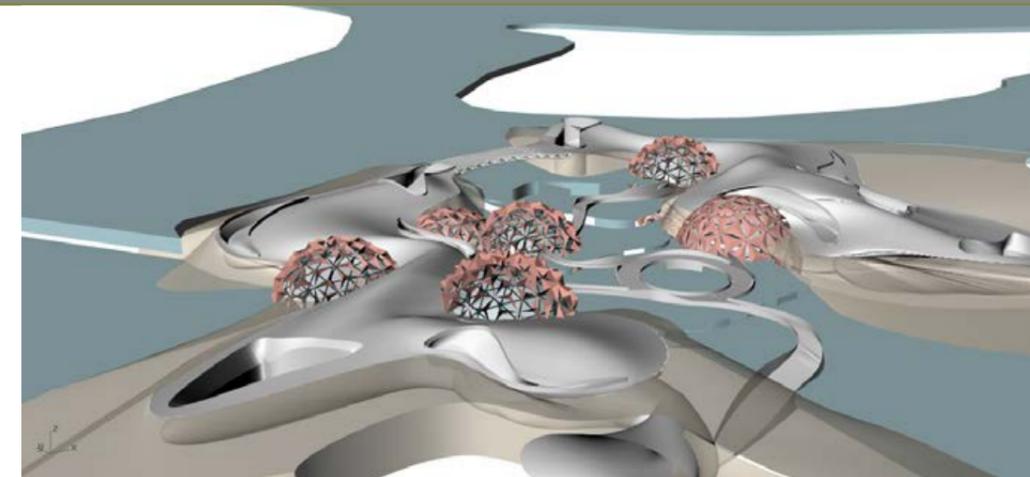
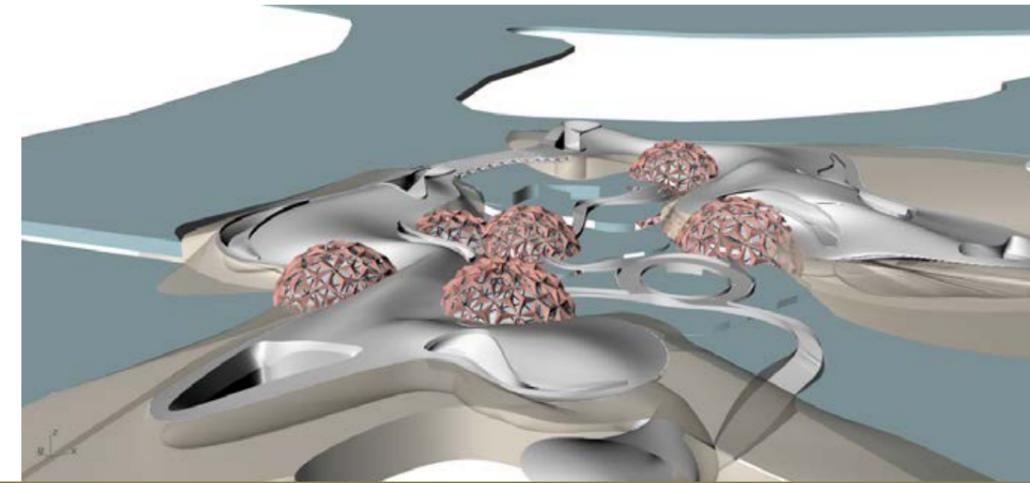


## 4 Kinetic Facade for Active Cooling

According to sun angles, kinetic panels over the geodesic domes open and close and improves the capability of having a good atmosphere inside of the building

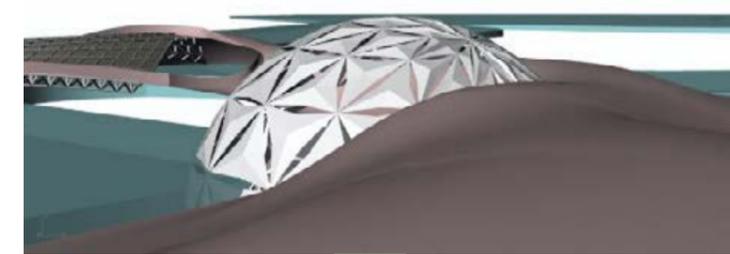
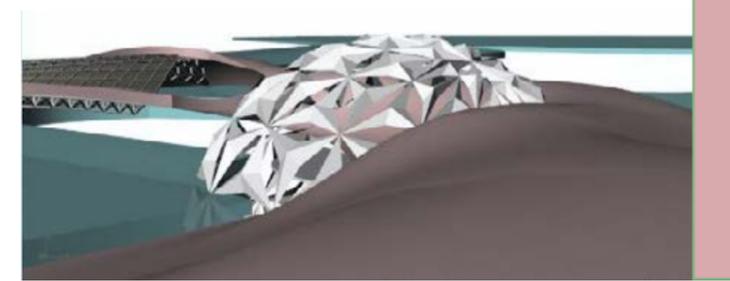
### Kinetic Building Skin

A quick glimpse at the upcoming weather for Abu Dhabi will show a week of intense sunshine, temperatures steadily above 100 degrees Fahrenheit with 0% chance of rain. In such extreme weather conditions, even architects listing environmental design as their top priority are up against a tough battle. Never mind that the sand can compromise the structural integrity of the building, the intense heat and glare can render a comfortable indoor environment relatively impossible if not properly addressed.



## 5 Thick Stone Walls for Passive Cooling

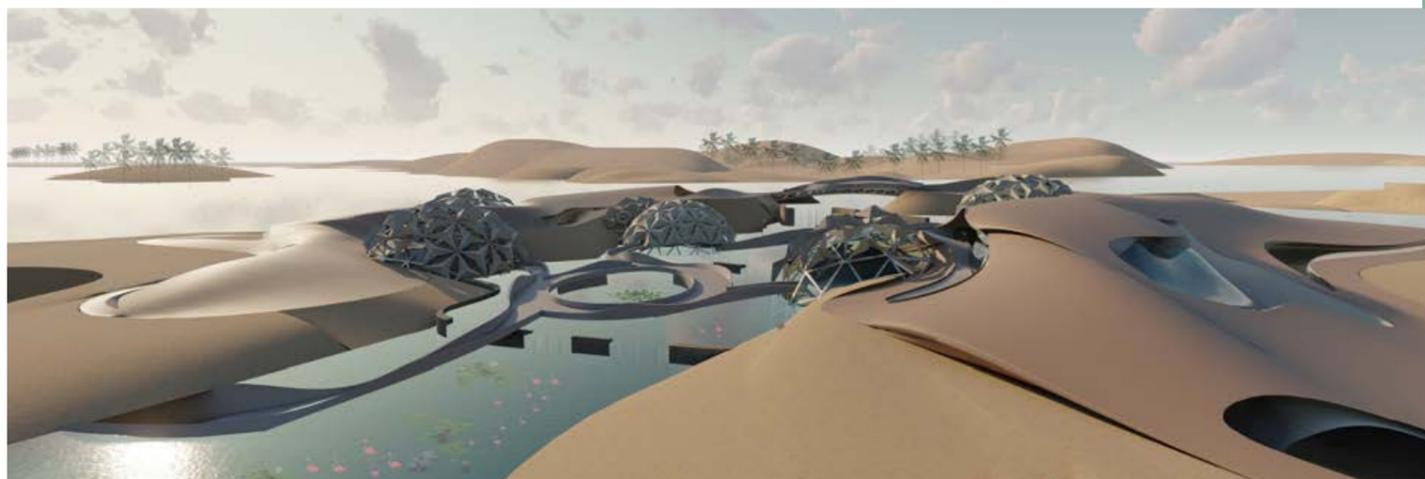
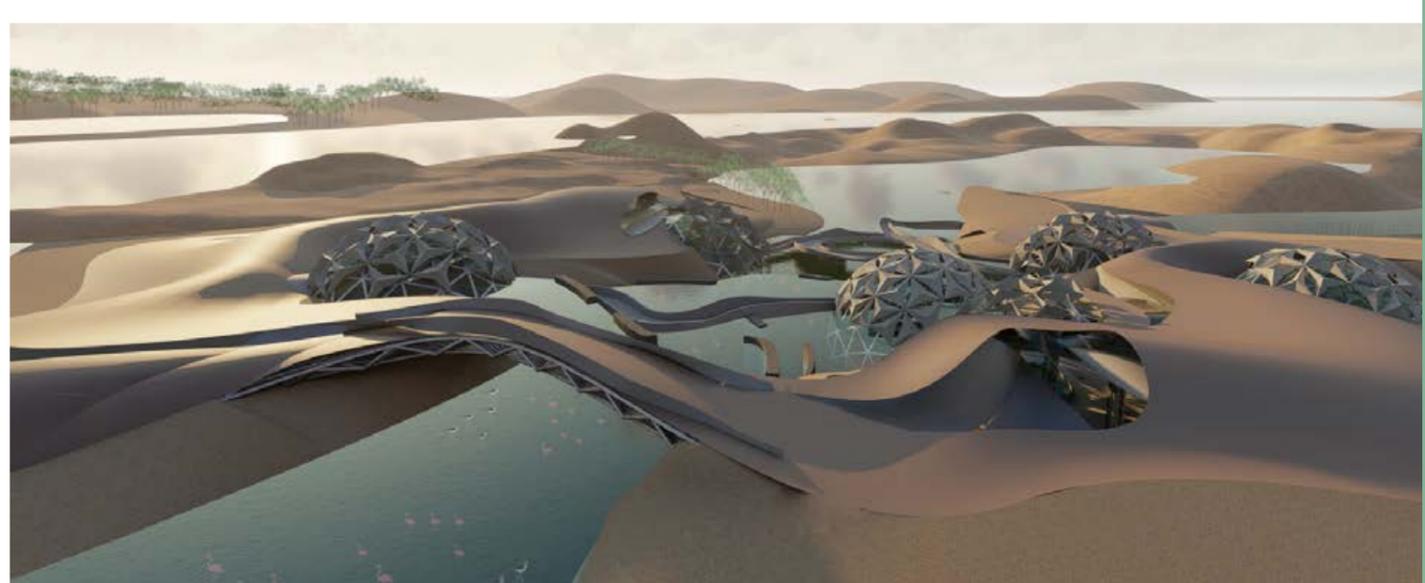
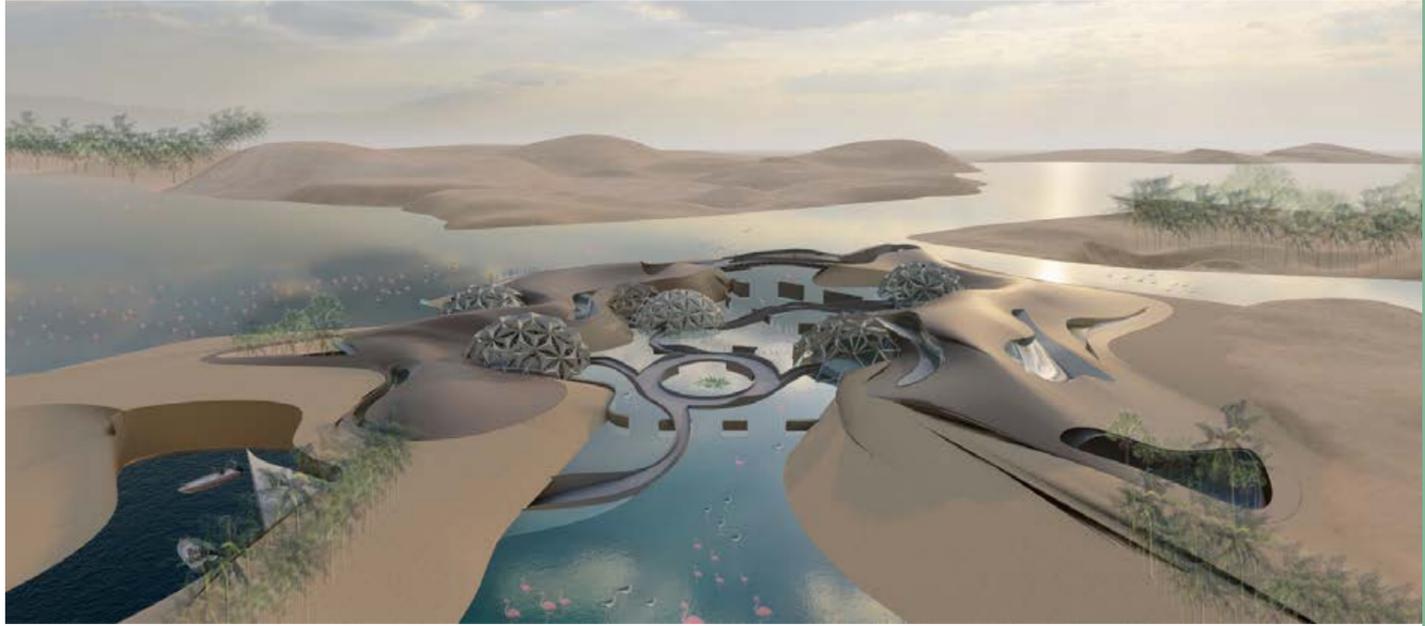
In Abu Dhabi which has a hot climate, having thick stone walls works as a insulator and makes the atmosphere inside the building cool while outside is hot.



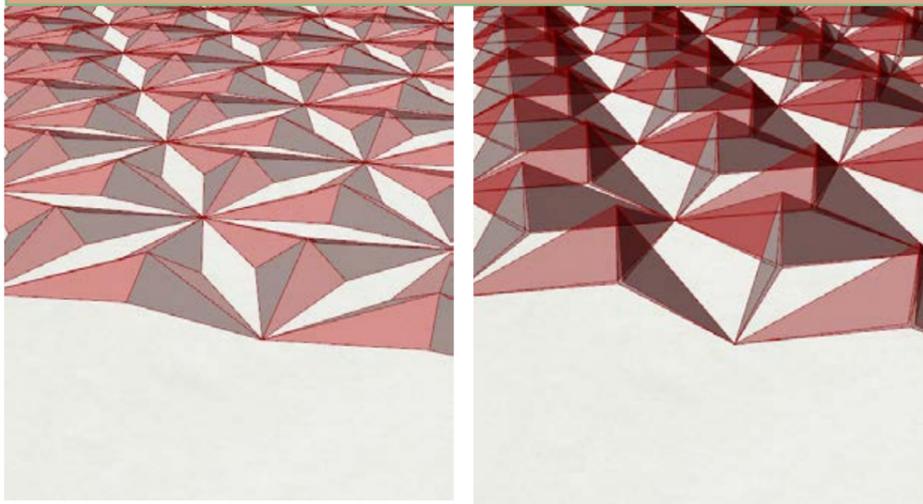
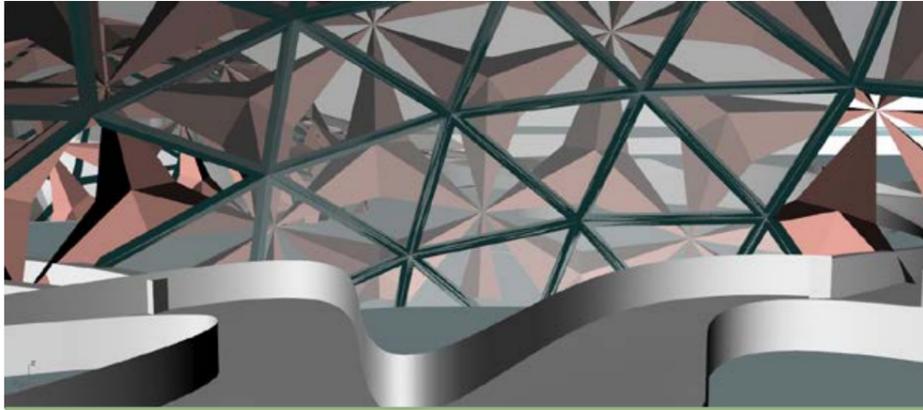
The panels respond dynamically and automatically to the angle of the sun, which improves the control over energy consumption, solar radiation, and glare with the ability to allow natural light into the building.

# RENDERS

## Exterior Renders

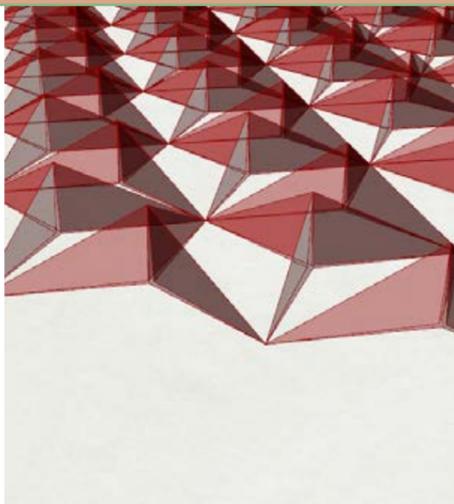
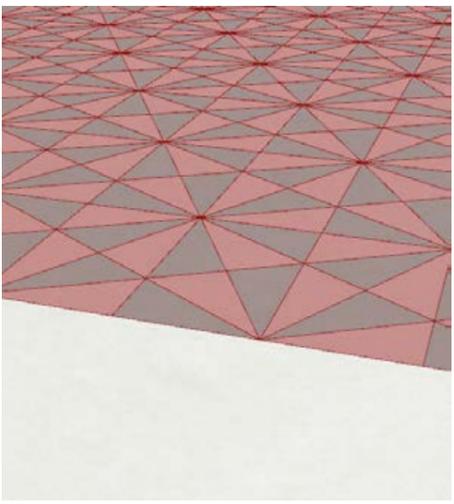


Using a parametric description for the geometry of the actuated facade panels, it is possible to simulate their operation in response to sun exposure and changing incidence angles during the different days of the year.



"It (the screen) allows us to use more naturally tinted glass, which lets more light in so you have better views and less need of artificial light. It's using an old technique in a modern way, which also responds to the aspiration of the emirate to take a leadership role in the area of sustainability,"

Oborn



- Main Components:**
1. Actuator + Power & Control: cable connection back to the tower
  2. Strut Sleeves: penetrates the curtainwall & connects to the main structure
  3. Supporting cantilever Struts: hooks on the sleeves
  4. Star Pin Connection: receives the unitized Y-Arm ends
  5. Actuator Casing: protects the actuator
  6. Y-Structure Ring Hub: joins the Y-Arms and actuator together
  7. Y-Structure Sleeves: connects the Y-Arms to the Hub
  8. Y-Structure Arms: supports the whole mechanism
  9. Y-Mobile Tripod: drives and supports the fabric mesh frames
  10. Actuator Head Pin Connection: pins to the Mobile Tripod
  11. Stabilizer: takes the loads to the hub releasing the actuator shear forces
  12. Slider: allows the Mobile Tripod to travel along the Y-Arms
  13. Fabric Mesh Frame & Sub-Frame: supporting the fabric mesh
  14. Fabric Mesh

It is estimated that such a screen will reducing solar gain by more than 50 percent, and reduce the building's need for energy-draining air conditioning.

# Interior Renders

