Portfolio

JUSTIN WAN

*Columbia University, G.SAPP* M.S.AAD | 2023
*USC, School of Architecture* B.Arch | 2022

Selected Works
2020 - 2022
01 Haze Cartography
Experimental design to rethink ecological role of invasive plants
GSAPP Advanced Architecture Design Studio

02 The House of Falling Waters
Experimental theater design in San Giorgio Maggiore
GSAPP Advanced Architecture Design Studio V / HP Joint Studio

03 Haline Vessels
Experimental Pavilion as biomonitor
GSAPP Advanced Architecture Design Studio VI

04 Loofah Squattah
Experimental furniture design using natural materials
GSAPP Making with Earth
Haze Cartography is an experiment to explore the capacities of "invasive species" in benefiting their ecosystems through designed interventions. The two studied plant species are the Norway Maple and English Ivy, showing reactivity to chemical pollutants in the air. The English Ivy has air-purifying properties, absorbing VOCs and greenhouse gases. On the other hand, anthocyanin, the red pigment found in the leaves of Norway Maple trees, is a pH indicator that reacts to changes in soil and atmospheric conditions. The proposal becomes an ambitious way to combine the properties of the English Ivy and Norway Maple Tree that focuses on intervening with the air in New York's Central Park, the supposed lungs of the city. With a mesh dyed with anthocyanin placed over the maple trees, the mesh changes colors through acid-base reactions between the dye and the pollutants, signaling the presence of matter suspended in the air. The project constantly evolves, corresponding to the pollutant levels and types varied by climatic and environmental conditions.
New York City is one of the most polluted cities in the United States. The high pollution levels are attributable to fossil fuel consumption in vehicles, powerplants, and buildings. The pollutants produced contribute to adverse health effects on its residents annually.

- **Buildings**: Give off up to 55 tons of pollutants in NYC daily.
- **Powerplants**: Give off up to 8 tons of pollutants in NYC daily.
- **Vehicles**: Give off up to 21 tons of pollutants in NYC daily.

**Urban Air Pollution and Health Effects**

**Air Pollutant Distribution by pH levels**

**New York City**

- **Ozone**, **NO\textsubscript{3}**, **SO\textsubscript{2}**, **NH\textsubscript{3}**, and **VOCs** contribute to 3400 deaths by respiratory diseases annually in NYC.
- **SO\textsubscript{2}** can contribute to developments of anxiety and depression.
- PM\textsubscript{2.5} and NO\textsubscript{2} can increase risks of osteoporosis and stroke and cardiac arrest.
- **PM\textsubscript{2.5}**, **NO\textsubscript{2}**, **Alkaline**, and **Acid** contribute to adverse health effects on residents annually.

**Pollutant Distribution by pH levels**

- **Acid**: Airborne pollutants that contribute to acid rain.
- **Alkaline**: Airborne pollutants that contribute to neutralizing effects.

**Pollutant Movement**

- **Prescription**
- **Inhalation**
- **Ingestion**
- **Intravenous**

**Environmental Impact**

- **Land**
- **Ecosystem**
- **Agriculture**
- **Sea**
- **Ecosystem**
- **Marine Life**
Site Context and Urban Environment

The project begins at the Driprock Arch of Central Park, where two invasive plant species, Norway Maple & English Ivy, were found. The two species are considered invasive due to their nature to deprive other species of access to essential nutrients. As a result, the New York Park Conservancy implements strict regulations on where these plants are allowed to grow within the park.

The Norway Maple tree is located next to the Driprock Arch, with an ivy plant clinging to its bark. The arch is a stone bridge designed to divert vehicular and pedestrian traffic and connect other park features with the landscape. The vehicular activity above produces numerous pollutants harmful to the human body and natural environment.

Since the Norway Maple is known for its hardiness and resistance to urban pollution, they are primarily found in clusters distributed along the main roads going through the park. While the Norway Maple trees are also found in the city, they are mostly concentrated within Central Park to offset the air pollution vehicular traffic brings to the green space.

The English Ivy absorbs harmful pollutants such as greenhouse gases, VOCs, and ozone. The stomata on its leaves open to absorb moisture and particulate matter to photosynthesize. In indoor environments, its leaves can remove up to 89.8% of Benzene and other VOCs.

The Norway Maple leaves contain Anthocyanin, a chemical component that gives the leaves its signature red color during Autumn. It is a pH-sensitive chemical that changes colors on a red to purple to green spectrum going from acid to base.

Reducing & Revealing the haze

The Norway Maple and the English Ivy possess properties that allow the plants to survive in air-polluted environments and remove harmful particulate matter from the air. The design intervention intends to utilize these unique traits of the invasive species to reduce and visualize these otherwise unseen harmful clouds in the air New Yorkers breathe every day.

From experiments, silk fabric dyed with the anthocyanin extract demonstrates an ability to change color with the presence of various airborne chemical substances.

The net forms a surface for the ivy vines to climb on, reducing the damage on the tree by the ivy vines.
Homogenization
Maple leaves collected are homogenized in distilled water.

Extraction
Homogenized mixture is boiled and filtered to yield an anthocyanin solution.

Dyeing
Squares of natural silk are sewn and dyed with the anthocyanin extract.

Preparation
Nets are tied to the trunk to give ivy a surface to climb on and minimize damage on tree.

Installation
The dyed mesh is laid over tree canopies.

Assembly
The net is fastened to the overhead mesh and the system is completed.
Year 1
Project begins with attaching the ivy net to the pigmented mesh. Pollutant levels are lowest in the Summer, and are mostly alkaline from farming.

Year 5
The English Ivy begins populating the net. Pollutant levels begin to rise in Autumn, and air acidity increases, giving a slightly red hue.

Year 10
The English Ivy continues to grow, putting stress on both the net and mesh. Pollutant levels are highest in the Winter, giving a strong red color.

Year 15
The weight of the ivy pulls down on the net and mesh. The densely ivy grown environment purifies the air, giving the mesh a purple hue (pH neutral).

Year 20
The mesh sustains damages from the overgrown net. The sagged net forms new habitats for small mammals and birds to inhabit.
Studio Title: Enacting Entanglements - Climate Adaptation of Venice's Green Theater
Project Type: Experimental Performance and Theatrical House
Site: San Giorgio Maggiore, Venice, Italy
Instructor: Jorge Otero-Pailos, Mark Rakatansky

The House of Falling Waters centers around redefining the performative experiences under the existential threat of the acqua alta and a shortage of potable water on the site of San Giorgio Maggiore. The House of Falling Waters becomes a way to focus on the circulation, distribution, and manipulation of water on the site to improve the functionality as well as the theatrical experience of the existing theater. The project takes into account the local climate, environment as well as site context to allow theatrical performances to take place in both wet and dry conditions. The programs are designed in a sequence that communicates the different processes water is handled and used on the site, and the project focuses on two primary functions: as a water collection facility and, as an experimental theater that produces holograms by projecting digital media onto mist.
The site is located in the island of San Giorgio Maggiore in Venice. The existing green theater, or Teatro Verde, is under the threat of annual acqua alta. The theater gets flooded every year during the rain season and is only in use very occasionally.

The design takes into account the rising sea levels as a result of the acqua alta. The design considers “water” as a main theme in the project in the way that water is circulated, redistributed, and processed.

The famous invention of the Venetian Well was designed to provide the city with a safe source of drinking water through rainwater collection and provide the Venetians with drinking water for centuries. The main mechanism of the design is inspired by the Venetian well’s ability to collect, filter, and distribute water.
Programs & Water Network

The new addition is designed to integrate with the current programs of the Green theater and stage whilst extending its functions and improving the experience to accommodate the current conditions of the Acqua Alta – moving its visitors from the entry to spaces of gathering, pleasure, and finally entertainment.
Haline Vessels explores the possibility to render visible, and help ease, the effects of anthropogenic activities on the marine environment of Cabo Verdenian oceans. The work investigates the increasing concentration of haline elements and foreign metals in seawater attributable to unsustainable practices related to construction and water desalination industries within the archipelago. Loggerhead sea turtles (caretta caretta), an annual visitor of the Cabo Verde islands, consume its seawater to stay hydrated, but rid themselves of the excess salt & minerals from the seawater through their tears. Scientific analyses of the tears discovered that there are heavy metals and harmful chemical substances in the seawater where the turtles roam. The content of the tears become artifacts that tell a story about the ocean and establish an implied correlation between land activities and marine pollution. The design intervention becomes an investigation that explores the possibilities of architecture behaving as an artificial bioindicator while pushing the boundaries of building technology using haline materials.
The loggerhead sea turtles are found most abundant on the eastern coasts of the islands. Through scientific analysis, heavy metals have been discovered in the tears secreted from the turtle's salt glands.

Unsustainable practices on the island of Santiago contribute to distribution of heavy metals on its top soils. The same heavy metals are present in the habitats of the turtle's nesting grounds.
Heavy Metals Distribution by Ocean Currents

Heavy metals are distributed into the water through the ocean currents in the archipelago. The proposals are seen as nodes placed in the ocean to allow qualitative assessments of the water through the color of salts crystallized on the design.

Program & Post-Collection Processes

The pavilion is made out of bamboo structures with hemp strings hung from the roof into the ocean water to allow crystallization to take place. The salt collected is processed to be made into pressed salt bricks.
Loofah Squattah
Experimental furniture design made with natural materials

Studio Title: Making with Earth
Project Type: Natural material research & design; Exhibition Curation
Site: 1014 - Space for Ideas, New York, U.S.A
Team Members: Tim Ting-Hao Chen, Paul Edward Liu
Instructor: Lola Ben-Alon, Khadijia Ann Tarver

The Loofah Squattah explores the potential application of plant-based products, or their subsequent food wastes, as alternative materials for design and construction. The investigation primarily focuses on creating an improved understanding of both the physical properties of the loofah fruit in enhancing the structural strength and durability of earthen designs. The Loofah Squattah challenges the possibilities of applying the fruit to load-bearing purposes operating at the human scale, specifically as furniture, to test its strength and constructibility. In conceiving the concept for the furniture piece, the design considers all components of the fruit, using it as formwork, fibers for construction, and cushioning for comfort and support.
Research & Fabrication

The loofah fruit has complex networks of interconnected fibers that, once dried, lignify to form a rigid and sturdy structure. The design considers the physical structure and fibrous nature of the fruit for the investigation. The stool piece is made from 3 main materials namely, loofah fruit, clay-rich soil, and spent coffee grounds.