“LIFE IS ARCHITECTURE AND ARCHITECTURE IS THE MIRROR OF LIFE.”

I.M. PEI
01  STOP. TO HEAL
   TRUCK STOP | EMOTIONAL SPACE | PROTOTYPE
   P4  GRADUATE | 2023

02  RICE ECOLOGY
    FACTORY | SILO | PROTOTYPE
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03  EXPERIMENTAL ISLAND
    URBAN PLANNING | PROTOTYPE
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Over the next decade, the trucking industry is transitioning from diesel to electric-powered vehicles, resulting in the need for more frequent stops and refueling. To ensure safe trucking operations, the government and industry leaders have collaborated to revise regulations with a focus on the health and safety of truck drivers. As part of this shift, truck drivers are required to take a break and refuel every 3.5 hours, with each stop lasting up to 1.5 hours. During this waiting time, drivers can use the break to relax both physically and mentally. This policy adjustment presents an opportunity for architecture designers to rethink the design of truck stops, taking into account the unique needs of electric-powered trucks and their drivers.

My vision is to establish a series of small-scale truck stops situated strategically between large travel centers. These stops will be designed to offer a distinctive experience that evokes positive emotions and fosters deeper engagement. In this scenario, the physical and mental well-being of individuals serves as a catalyst for slowing down the accelerating world. The aim is to create spaces that encourage truck drivers, moreover for everyone from all walks of life, to take a moment to refresh their bodies and minds by truly "STOP". This design helps people counteract the adverse health effects of their job and promotes a more relaxed and rejuvenated mindset for the journey ahead.
The world is suffering a food crisis nowadays. There is no doubt that rice takes the most appropriate position to cease this disaster. In the meantime, we are facing two problems: the first one is that the food suppliers prefer to burn the rice into biofuel with no carbon-saving benefit to relieve inventory pressure, which causes an increase in the unit price of rice products; Other one is that rice production is always regarded as a high carbon emission process.

In the scenario of rice ecology, the Government initiates, operates, and funds a program cooperating with National Farmers Union. The program encourages farmers to store more grains and sell them at lower prices to underdeveloped countries to mitigate the food crisis. More importantly, we consider how to convert carbon emissions into carbon sinks and contribute to the program in this scenario from the perspective of architectural designers. We help farmers to design a comprehensive prototype with multifunction including rice storage, material manufacture, and biogas generation. Through selling bio-friendly architectural and commercial products to the world, more carbon is sequestered in the media of products, so that it contributes to the 40% of global carbon emissions that are due to buildings.
2024
The ongoing food crisis persists as approximately 40% of the grains produced in the U.S. continue to be used for biofuel. Unfortunately, to prevent a decline in food prices, the U.S. government-controlled major grain traders still prioritize burning the grains as biofuel over exporting them to countries in need. This practice has resulted in higher food prices while reducing inventory pressure.

2028
The U.S. government is taking action to address the global food crisis by exporting surplus grains at a reduced cost to countries in need. In response to the government’s appeal, food agencies across the nation are planning to construct numerous grain silos near rice fields for storage purposes. However, this increase in grain production will inevitably lead to a significant rise in straw production. As a result, the government has mandated that the construction of these grain silos should prioritize minimizing carbon emissions and take into account the environmental impact of straw burning. The government has implemented several regulations to control carbon emissions, including carbon taxes for steel and concrete and government subsidies for biomaterials.

2032
An architectural team is embarking on the ‘Prototype Incubator’ project, set to take place in California’s rice fields. The project seeks to create a comprehensive prototype that includes grain silos, factories, paper production, distribution centers, and bioelectricity generation. The team is currently researching the potential of rice straws as building materials, as well as the integrated utilization and recycling of these straws. Rice straws can serve as insulation for grain silos, and straw-made paper boxes can be used for packaging, while the straw processing system can generate electricity for transportation and building needs. The system is designed to allow for the replacement of modular straw building products throughout the building cycle.

2034
The successful implementation of the Prototype Incubator project has led to the development of a thriving Rice Economy that is now being replicated in all rice-growing regions throughout the United States. By 2034, it is expected that approximately 1,500 prototypes will be operational, mitigating the world food crisis and reducing carbon emissions in the U.S. by a total of 3 billion tons through the innovative utilization of rice straws. The project is expected to expand globally, with a target of creating around 5,000 prototypes and storing billions of tons of carbon in buildings around the world.
RICE ECOLOGY

GOVERNMENT REGULATION

01: CARBON TAX
- Charging extra carbon at a rate corresponding to $100 per ton of fossil carbon dioxide emitted.

02: PREFERENTIAL POLICY
- Program and project participants get tax deductions.
  - Up to $0.5 deduction per sack of rice
  - Up to $500 deduction for gross income for qualified contribution.

03: BIO-FRIENDLY MATERIAL POLICY
- Program and project participants using bio-friendly materials get tax deductions.

FARMER

GOVERNMENT

PUBLIC SUPPORTS

INTERNATIONAL REPUTATION

CO2 EMISSION REDUCTION

ENVIRONMENTAL IMPROVEMENT

LABOR

POWER PLANT FACTOR

PROTOTYPE INCUBATOR

DISTRIBUTION

SILO

STRAW INPUT

RAW STRAW (800 - 1000mm)

CUT STRAW (300 - 500mm)

CHOPPED STRAW (100 - 150mm)

MILLED STRAW (10 - 20mm)

COMMERCIAL PRODUCT
- The factory in the proposal can produce different commercial products. In this scenario, the paper mill factory is plugged into the building and products are packaging boxes for the ship.

INDUSTRIAL PRODUCT
- Raw materials are processed into different sizes and further manufactured into different products depending on the type of plant in factory.
THATCHING
Thatching comprised of rice straw is widely used as roof material. Thatching roof has an angle of at least 50° which allows precipitation to travel quickly down slope. The roof can last from 15 to 40 years if properly maintained.

TIMBER
Timber is used as structure in the building. Timber is also carbon friendly material that could sequester certain amount of carbon. It’s also used as part of prefabricated panel unit.

RICE STRAW
Rice straw is a carbon negative material which is widely used in this project in form as building materials, industrial products, and energy resource.

RAMMED EARTH
Rammed earth mixed with rice straw is used to create tall silica units. This material have very low carbon emissions comparing to aluminium which typically is used to make Alto containers.
**RICE ECOLOGY | AAD STUDIO V 2022 | RICE STRAW PROCESSING SYSTEM**

**INPUT 01: STRAW**

**INPUT 02: RICE**

**OUTPUT: RICE TO SILO**

1. **CUT STRAW (300 - 500mm)**
   - Silo Filler
   - Paper
   - Straw Briquettes
   - Prefabricated Panel
   - Horticulture Products
   - Packaging
   - Folding Panel
   - Straw Bale
   - Animal Feed
   - Composite Wood

2. **CHOPPED STRAW (50 - 150mm)**
   - Straw Chopper
   - Preliminary shredding of straw
   - Straw Miller
   - Stretching straw to five lengths
   - Blender
   - A mixture of the treated straw, sand, and additives is formed in the blender to form the annealed straw material. This is also the main material for the silo.

3. **MILLED STRAW (10 - 20mm)**
   - Straw Milling
   - The straw is milled into smaller pieces.
   - Cyclone/Filter
   - To ensure that the straw is of uniform length, the system is equipped with a centrifugal filter. Longer straws are grounded again. Sand is also removed in this step.

**RAW STRAW (830 - 1000mm)**

- Straw Cutter
  - The straw is broken up and the stones are filtered out.

**BIOMASS POWER PLANT**

Although carbon emissions are generated at this step, we do not generate carbon sinks indefinitely. Making full use of these biodegradable materials is a more appropriate option.

**BRIQUETTING PRESS**

- The treated rice straw is compressed and processed into briquettes that can be fermented and degraded.
RAW STRAW (800 - 1000mm)
THATCHING ROOF

DENSITY OF STRAW:  
50 KG/M³

FIRE RESISTANCE:  
100 MIN

PART:

ASSEMBLY:

Note: Make sure the bundle have a thickness of 18 inches.

Note: Roof is at a slope of 30 degrees to prevent rainwater down into the building.

LABOR X 3

CARBON SINK: 25,022 KG
PRODUCTIVITY: REQUIRE 10 ACRE OF RICE FIELD
1. **CUT STRAW (300 - 500mm)**

**FOLDING PANEL**

- **Density of Straw:** 75 kg/m³
- **Fire Resistance:** 60 min
- **Insulation Coefficient:** $U = 0.12 \text{ W/m}^2\text{K}$
- **Airborne Sound Insulation:** 32 dB

**PART:**

- **Note:** No binder is needed.

**REPLACEMENT:**

- **Labor** X 1

**Carbon Sink:** 15.8 kg/panel

**Productivity:** 208 panels/acre of rice field

**Note:** Please replace straw bale 1 or 2 years when the annual average relative humidity in your area is higher than 80%.
2 CHOPPED STRAW (50 - 150mm)
PREFABRICATED PANEL

DENSITY OF STRAW: 110 KG/M³
FIRE RESISTANCE: 120 MIN
INSULATION COEFFICIENT: U = 0.12 W/M²K
AIRBORNE SOUND INSULATION: 54 DB

PART:

ASSEMBLY:

BINDER:
Corn Starch 50% Water 10%
Corn Starch 30% Water 10%
Corn Starch 10% Water 10%
Paper Pulp 50% Water 10%
Paper Pulp 30% Water 10%
Paper Pulp 10% Water 10%

LABOR X 3
Note: Plastering the exterior of straw bale walls is inaccessible. This action allows the wall to last more than 15 years.

CARBON SINK: 15.3 KG/PANEL
PRODUCTIVITY: 30 PANELS/ACRE OF RICE FIELD
MILLED STRAW (10 - 20mm)
SILO FILLER

DENSITY OF STRAW: 30 KG/M³
FIRE RESISTANCE: 240 MIN

PART:
- Conveyor
- Seal
- Ladder
- Control Valve
- Cell
- Ventilation

ASSEMBLY:
- Bolt
- Frame
- Rammed Straw
- Concrete
- Openings

CARBON SINK: 157,059 KG
PRODUCTIVITY: REQUIRE 65 ACRE OF RICE FIELD
CARBON FLOW

60% APPLICATION 01
MANUFACTURING TO BUILDING MATERIALS

10% APPLICATION 02
MANUFACTURING TO INDUSTRIAL MATERIALS

10% APPLICATION 03
MANUFACTURING TO COMMERCIAL MATERIALS

20% APPLICATION 04
RETURN TO FIELDS

TOTAL CARBON SINK:
THATCHING ROOF 25,022 KG
FOLDING PANELS 7,543 KG 15.3 KG/PANEL
PREFABRICATED PANELS 47,817 KG 15.8 KG/PANEL
SILO FILLER 157,059 KG

TOTAL CARBON SINK IN THIS BUILDING: 237,441 KG

CARBON SINK IS CONTINUING...

YEAR ONE

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YEAR TWO

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2032
START OF THE FIRST PROTOTYPE.
- 5 LABORS
- 1 PROTOTYPE
- 237,441 TONS CARBON SINK/YEAR

2033
EXPANSION OF THE PROTOTYPE IN CALIFORNIA.
- SALE OF THE ARCHITECTURAL PRODUCTS IN CALIFORNIA
- 700 LABORS
- 100 PROTOTYPES
- 2,000 ARCHITECTURAL PRODUCTS
- 27 MILLION TONS CARBON SINK/YEAR

2034
EXPANSION OF THE PROTOTYPE TO ENTIRE AMERICA.
- SALE OF THE ARCHITECTURAL PRODUCTS TO ENTIRE AMERICA
- 15,500 LABORS
- 1,500 BUILDINGS
- 50,000 ARCHITECTURAL PRODUCTS
- 3 BILLION TONS CARBON SINK/YEAR

2038
EXPANSION OF THE PROTOTYPE ALL OVER THE WORLD.
- SALE OF THE ARCHITECTURAL PRODUCTS ALL OVER THE WORLD
- 70,500 LABORS
- 3,000 BUILDINGS
- 1 MILLION ARCHITECTURAL PRODUCTS
- 12 BILLION TONS CARBON SINK/YEAR
Water and land are tightly associated with each other. As the surface area with most human interaction with water, Shoreline became our focus of studying the relationship between water and land. We looked at the properties of land and water around the site and concluded that the material exchange process between geological and hydro-geological entities was our proxy condition. We have created a proxy by assembling a non-fictional historical core sample of Randall’s and Wards Island that tells the story of how New York’s filled shorelines are simultaneously eroded and sediment.

We consider flood as design element. Our projection is to utilize different flooding/water cycles in different future scenarios of sudden flooding events and long-term sea level rise on Randall’s and Wards Island. Accommodating three shoreline conditions and human occupancy, we see Randall’s and Wards Island as a test site for finding strategies and programs that could work with water coming to the land. Our proposal is based on several crucial time points in the future of sea level rise and the consequential hydrological events and the material exchange processes. In our project, Randall’s and Wards Island will arguably become a testimony for this relationship of collaborating with water that is usually considered harmful in today’s context.
Randalls and Wards Island is a transitional zone with littoral and inter-tidal zones, a hybrid, political ecology that tells us of unwanted people and communities—and materials.
**1850s**  
*Survey of the Coast of the United States (1851)*  
City of New York bought Randall’s Island in 1835 from Jonathan Randall. Meanwhile Wards Island was mainly used as a relocation site for Manhattan potter fields.

**1940s**  
*NYS Gov Maps (1948)*  
In 1930, Dept of Parks and Recreations owns both island and focused on the public services. As the expansion of value and landmass, Robert Moses made plans to connect Randall’s and Ward using landfill. It was filled starting in 1955 when the city allowed construction companies to dump debris in between the islands for free.

**2020s**  
*US Dept of Commerce (1996)*  
Landfill II to Randall’s and Wards Island was completed in 1988. Randall’s and Wards Island was connected by a new shoreline was shaped. Sunken Meadow was transformed into baseball fields and recreational parks.

**2050s**  
*National Oceanic and Atmospheric Administration (2022)*  
In 2050 with 5 ft sea level rise, Bronx Kill will be permanently under water. As well as some parts of Wards Meadow which is covered by landfill and is football fields.

**2100s**  
*National Oceanic and Atmospheric Administration (2022)*  
With 10 ft sea level rise. Public amenities such as sports fields and stadiums will be covered by sea water. Combine with tidal events make land will formed.
UPLAND
Conditions allow for a wide variety of salt-tolerant plants, including sand-dune grasses, heath, heather, and conifers. The land is generally flat and dominated by sand dunes and heathland.

UPPER BORDER
This zone provides the transition for the upland area. Different types of vegetation can be found here.

HIGH MARSH
The high marsh is typically understory dominant, with a mix of grasses and sedges. It often supports a variety of birds and small mammals.

LOW MARSH
Low marsh is characterized by the presence of high tide and a brackish water body during low tide. Vegetation here includes grasses, sedges, and rushes.

TIDAL MUDDY FLATS
A muddy zone below the zone during high tides, it supports a variety of plant and animal life. It is often used as a feeding ground for wading birds.

SUB TIDAL
This zone is covered by the tide. It supports eelgrass, seagrass, and a variety of invertebrates and fish. The zone is vital for marine life and supports various ecosystems.
2020s
SLR LE 2" - HE 10"

- **RIPRAP SHORELINE**
  - Museum of land use.
  - Dome structure for protecting itself from hurricanes and flooding.
  - Floating pier for kayaking.

- **MARSH SHORELINE**
  - Salt Marsh sediment laboratory and collection sample points.
  - The structure that enhances the sediment collection and designs the growth of salt marsh.

- **BULKHEAD SHORELINE**
  - Soil displacement.
  - Poor drainage soil covered with fabric becomes the seating area and the wave energy breaker for flooding events.
2050s
SLR LE 8" - HE 30"

- **RIPRAP SHORELINE**
  Sea level rising is intruding more inland areas, the original floating museum still works, but the theater will be altered with a seminar classroom. Kayaking area is added.

- **MARSH SHORELINE**
  The area of salt marsh keeps growing.

- **BULKHEAD SHORELINE**
  The first set of mud fill contacted the sea water level and the sediment collection started forming.
2080s
SLR LE 13" - HE 58"

RIPRAP SHORELINE
The program of theater is moved to an inland area.
Access from the Bronx area will be added.

MARSH SHORELINE
Salt marsh keeps growing and pavement will be added for accessing.

BULKHEAD SHORELINE
The second set of mud piles contact with water, marshland starts forming, second stage sediments will cover the first stage.
2100s
SLR LE 15° - HE 75°

- **RIPRAP SHORELINE**
  Kayak harbor is added.
  Access to Randall’s Island is added.
  A water park area is planned.

- **MARSH SHORELINE**
  Area of salt marsh keeps increasing, and pathways and more laboratories will be added.

- **BULKHEAD SHORELINE**
  The last sets of mud pile contact with water, and salt marsh will form on the surface level of the land.
  Marshland creates the surface for the path.
TO BE CONTINUED

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