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Architecture Connects

Ryan DeSilva

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ARCHITECTURE CONNECTS
ryan douglas desilva
**MY CLAIM**

The envelope is the transaction zone between the ideal climate and the natural climate. The envelope has an important use as a driver for adaptive building use.

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**MY CONTENTION**

- The Envelope acts as the facilitator of Community Engagement. (Housing)

- The Envelope acts as a driver for Economic Performance and Stability. (Restaurant)

The human body’s largest organ is the skin. Skin protects body tissues against injuries and helps regulate body temperature by making the pores larger or smaller. The nerves in skin receive the stimuli that are then interpreted by the brain as touch, heat, and cold. Skin is composed of three layers: epidermis, dermis, and subcutaneous fatty tissue.

The typical body has between 20 ft² to 25 ft² of surface area which serves as a radiator for releasing heat via radiation to lower the body temperature or as an absorber to take in radiant energy to raise the body temperature.

“Skin is the principal organ for dissipating heat: the human body dissipates approximately 85% of its heat loss through the skin under normal environmental conditions (Zhang 2003).” Holopainen, R., A human thermal model for improved thermal comfort, Doctor of Science in Technology Thesis, Aalto University, VTT, December 2012

**Layers of Skin**

1. **Epidermis**: the outermost layer of skin, provides a waterproof barrier and creates our skin tone.
2. **Dermis**: beneath the epidermis, contains tough connective tissue, hair follicles, and sweat glands.
3. **Hypodermis**: is made of fat and connective tissue.

**Physiological Reactions**

- 110°F: Brain Damage, Fainting, Nauseous Feeling
- 100°F: Sweating Begins, Normal Body Temp, Shivering and Goosebumps
- 98.6°F: Treatment Required for Exposure
- 90°F: Lose Power of Speech
- 80°F: Potentially Irreversible Cooling
- 70°F: Lowest Temperature with Recovery
- 60°F: Cooling

**Body Temperature**

![Fevers and Chills Diagram](chart.png)

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**Skin**

- **Skin**: Provides a waterproof barrier and creates our skin tone.
- **Sweat Gland**: Ejects sweat to help cool the body.
- **Fat**: Absorbs excess heat through insulation.

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**Diagrams**

- **Layers of Skin**
- **Evaporation**

---

**Table of Physiological Reactions**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>110°F</td>
<td>Brain Damage, Fainting, Nauseous Feeling</td>
</tr>
<tr>
<td>100°F</td>
<td>Sweating Begins, Normal Body Temp, Shivering and Goosebumps</td>
</tr>
<tr>
<td>98.6°F</td>
<td>Treatment Required for Exposure</td>
</tr>
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</tr>
<tr>
<td>80°F</td>
<td>Potentially Irreversible Cooling</td>
</tr>
<tr>
<td>60°F</td>
<td>Cooling</td>
</tr>
</tbody>
</table>
precedent study | THE ORGANISM
MOSS TABLE: “When the moss photosynthesize, they release nutritious fats, carbs and proteins into their roots to feed colonies of helpful, symbiotic bacteria. In the process of breaking down these compounds of bacteria release electrons. Created by Alex Driver, Carlos Peralta, Paola Bombell, this prototype Moss table produces enough energy to power a small lamp.”

ALGAE LAMP: “The idea was inspired by a scientific breakthrough by scientists from yansei and Stanford University that allows a small electrical current to be draw3n from algae during photosynthesis. Placing the lamp outside in the daylight, the algae use sunlight to synthesize foods from CO2 and water. The energy produced is stored in a battery to be called upon at night.”

BIQ House: With 200m³ of integrated photo-bioreactors, this innovative passive-energy house generates microalgae biomass and heat as renewable energy resources.

Marcos Cruz: “Architecture is starting to absorb and generate and host nature in its skin. The Conclusion rather than biomimicry or Bionic thinking is the joint venture of both. I think there is a synthetic approach, a sy.biotic Approach. Biomimicry is the imitation of the models, systems and elements of nature for the purpose of solving complex human problems. Architects always have the difficulties of scales.

“How I defign FLESH” - marcos cruz
Human Flesh- The Body
Aesthetic Flesh- Disgusting Flesh
Architectural Flesh- Inhabitable Interfaces
Digital Flesh- The Sacred and the Sublime
Neo-Biological Flesh- Synthetic Neoplasms

Source: nextnature.com
Source: Marcos Cruz: Biomimicry
Steve Pike, Contaminant, 2003

Interaction Vessels are controlled environments in which different micro-organisms were introduced and manipulated. By the application of facilitators and inhibitors bespoke devices affording some influence over the microbial growth, the outcome could be partially designed with other parameters established by the self determination of the colonies themselves. For containment, Steve Pike designed and crafted a structure of Monitor Cells and Monitor Vessels that set out to apprehend and develop locally present microbes. Providing to be a significant investigation into the monitoring capability and responsiveness of the structure, the installation also exemplified an emergent, morphological aesthetic.
The modular wall system provides habitat for multiple types of plants including English Ivy, Boston Ferns and Dieffenbachia, which are all fed water and nutrients through a hydroponic system. CASE and SOM’s AMPS Living Green Wall Promises to reduce Air Pollution and Energy Costs Active Modular Phyto Remediation System. (AMPS) The biologically active surface can absorb 200 times the pollutants through the roots or leaves of the plants, thus dramatically improving the systems capacity. The system can provide 60% of the fresh air required. Typically that air would need to be sourced from the outdoors, and would then need to be heated or cooled at a high energy penalty before being circulated. Thus the reduction in the amount of incoming air required provides a large cost savings.

Air moves through a perforated air intake duct—a series of mini-jets are being developed to encourage airflow—and directly over the root system. This allows the rhizomes on the roots to essentially digest airborne toxins—VOCs, particulate matter, and other biological and chemical pollutants.

**TECHNIQUE:** Active Phyto Remediation

Organic process of growth (Photosynthesis) allows for individual cells of a plant to grow. As the cells multiply and grow they begin to fan out, optimizing the maximum surface area needed for growth. The organism takes in CO₂ and through photosynthesis gives off O₂ which Humans need. (17 mols of sunlight required over a 24 hour period) (Phytoremediation) is a process by which the plants root structure is exposed, cleaning the air which passed through it. This technique cleans the air 200-300%. 

**INPUT**

H₂O  CO₂

**OUTPUT**

WATER VAPOR  O₂  CLEAN AIR

**Diagram Description**

- Water input port
- Open port for motor access/ventilation
- Gear motor
- Core hooks onto motor
- Platform for motor, wires, and nutrient feed tube
- Plug with driver powers lights, pump, and motor on a timer
- pH/ppm access port
- Water seal
- Float valve connected to side reservoir, auto-fill base reservoir
- Submersible pump
- Threaded water seal for easy cleaning
BRIDGEPORT 1935 Factories + industry
1- General Electric
2- Remington Arms
3- Singer Sewing Machine
4- Bridgeport Brass
5- Warner Corset
6- Bryant Electric
7- Bullard Machine
WARNER CORSET FACTORY
production line, Bridgeport CT

Brothers Dr. Lucien and Ira De Ver Warner became concerned with the use of the modern corset in women’s fashion. In turn, they designed and proposed a more comfortable alternative design. The traditional corset design was tight, uncomfortable and made of steel and fabric which would break women’s ribs. After designing the first flexible corset out of string and layered fabric together, the new design caught the attention of women and designers worldwide. The Warner brothers moved their expanding company to Bridgeport, Connecticut in 1876 and became “part of the nation’s most productive centers of industry.” Over one thousand employees crafted 6,000 corsets on a daily basis, quickly becoming the largest and most popular corset manufacturer in America. The Warners employed consisted of large numbers of immigrant women (2200) and were provided housing in newly developed housing projects west of the factory building. The company provided the immigrant women workers meals, library and classes taught by organizations such as the YWCA (Young Women’s Christian Association). The company strived to fight the modern connotation of factory labor issues and bad working conditions.

By 1913 sales reached $7 million and profits averaged $700,000 annually.

Sources: Bridgeport’s Socialist New Ideal 1915-38, Cecelia Bueck 2001
Image of America, Bridgeport At Work, Mary K. Witkowski, 2002
Bridgeport Library, Warner Brothers and their Amazing Corsets
The Seaside village homes built in 1918 offer a colonial facade with a raised entry to evoke a sense of primadame entering a living space. The front yard is divided by the sidewalks and there are no other formal means on division of lots. Trees have been planted in between housing apartments to delineate a break in unit. Shrubbs are planted at the concrete foundation reveal line. Consistent dormers and bump out bay windows are also deployed on the facade as formal gestures.

The housing authority's residential housing project was built in 1950. The facade is clad in brick face with a gable roof above the entry way. Foliage such as trees are planted in between tenants lawn space to delineate lots. A small metal knee fence is implemented, demarking the square footage for the front yard. Each tenant's front yard space is approximately 20ft x 10ft (200sqft). The public sidewalk runs parallel with the housing unit. There is no raised entry but a covered portico.

The Atlantic street housing units were built in 1910. They are an all wood construction clad in wood shingles. The front portich is covered by a second story overhang. This acts as a raised social space overlooking the street and the front lawn. The property has a clear demarcation of property lines with use of metal chain link fence. The sidewalk runs parallel to each abutting property. Each Unit houses 3 families depending on size. The property line can be demarcated by use of fences or shrubbery or ornamental pieces.
**PERFORMANCE | human scale**

- **Diet**
- **Exposure**
- **Clothing**
- **Social**
- **Incentive**
- **Activity**

**Reciprocatve Factors**

- **Organismic Factors**
- **Physical Factors**

**Sound**

**Light**

- **Area-Volume**
- **Radiation**
- **Atm Pressure**
- **Air Movement**
- **Temp-R.H**

**Genetics**

**Psyche**

**Rhythmicity**

**Age-Sex**

**Sensory**

**Drive**

**Body Type**

**Clothing**

**Social**

**Incentive**

**Activity**

**Sleep**

- **Sedentary at Rest**
- **Standing at Ease**
- **Walking 2mph**
- **Walking 4mph**
- **Max Exertion**

**Metabolic Heat Production**

<table>
<thead>
<tr>
<th>Human Activity</th>
<th>BTU - per hour</th>
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<tr>
<td>Sleep</td>
<td>250</td>
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<tr>
<td>Steeped at rest</td>
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</tr>
<tr>
<td>Sedentary</td>
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</tr>
<tr>
<td>Standing at ease</td>
<td></td>
</tr>
<tr>
<td>Walking 2mph</td>
<td></td>
</tr>
<tr>
<td>Walking 4mph</td>
<td></td>
</tr>
<tr>
<td>Max exertion</td>
<td></td>
</tr>
</tbody>
</table>

\[
Q = U \times A \times \Delta T \quad \text{THERMAL COMFORT}
\]

**Q** = energy

**U** = conductance

**A** = area (skin surface area)

**\Delta T** = change in temp (interior vs exterior)

**Conduction** (very little)

**Convection** (about 40%)

**Evaporation** (about 20%)

**Radiation** (about 40%)

**Relative Humidity**

**Air Temperature**

**Air Motion**
### PHYSICAL DECISIONS IN ENVELOPE SYSTEM DESIGN

**Exterior Wall/Root/Floor**
- Exterior Surface, Material Properties

**Composite Materials, Thickness**
- Interior Surface

**Form: Planar, Curved**
- Slope, Orientation
- Module, Size, Shape
- Connection of Envelope Components

**Windows/ Openings**
- Material Properties
  - Size, Shape, Spacing
  - Slope, Orientation
  - Module, Size, Shape

**Connection of Envelope Components**
- Orientation
- Control Systems, Sunshading
- Control Systems, Heat Loss
- Control Systems, Security/ Privacy
- Frame Connections, Plan/Sec/Elev.
- Access, Visual and Physical
- Expansion Potential, Horiz & Vert
- Change Potential, Horiz & Vert
- Change Potential for Access & Image
- Color, Texture, Ornament

### PERFORMANCES PRIORITIES | BUILDING TYPES

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Spatial</th>
<th>Acoustic</th>
<th>Thermal</th>
<th>Air Quality</th>
<th>Visual</th>
<th>Integrity</th>
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<td>NURSING HOMES</td>
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<tr>
<td>BUILDING TYPE</td>
<td>WINDOW AREA</td>
<td>GLAZING TYPE</td>
<td>SECTION</td>
<td>INSULATION THICKNESS</td>
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<tr>
<td>low-energy housing</td>
<td>&lt;30%</td>
<td>2 pane insulating glazing</td>
<td></td>
<td>15-25 cm</td>
<td></td>
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<tr>
<td>low-energy housing</td>
<td>&gt;30%</td>
<td>3 pane insulating glazing</td>
<td></td>
<td>15-25 cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>passive house</td>
<td>&gt;50%</td>
<td>3 pane insulating glazing</td>
<td></td>
<td>25-35 cm</td>
<td></td>
<td></td>
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<tr>
<td>office building</td>
<td>&lt;50%</td>
<td>2 pane insulating glazing</td>
<td></td>
<td>&gt;15 cm</td>
<td></td>
<td></td>
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<tr>
<td>office building</td>
<td>&lt;50%</td>
<td>3 pane insulating glazing</td>
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<td>&gt;15 cm</td>
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<td>office building</td>
<td>&lt;70%</td>
<td>2 pane insulating glazing</td>
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<td>office building high internal loads</td>
<td>&gt;70%</td>
<td>3 pane insulating glazing</td>
<td></td>
<td>&gt;10 cm</td>
<td></td>
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<tr>
<td>office building high internal loads</td>
<td>&gt;70%</td>
<td>3 pane insulating glazing</td>
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<td>office building thermoactive ceiling</td>
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<td>3 pane insulating glazing</td>
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<td>&gt;15 cm</td>
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Shearing layers

<table>
<thead>
<tr>
<th>Description</th>
<th>Typical Lifespan/ activity</th>
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<tbody>
<tr>
<td>Site</td>
<td>Location + Context</td>
</tr>
<tr>
<td>Structure</td>
<td>Bones</td>
</tr>
<tr>
<td>Skin</td>
<td>Envelope</td>
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<tr>
<td>Services</td>
<td>Lifeblood</td>
</tr>
<tr>
<td>Space Plan</td>
<td>Interior Layout</td>
</tr>
<tr>
<td>Stuff</td>
<td>Furniture + Equipment</td>
</tr>
<tr>
<td>Souls</td>
<td>People</td>
</tr>
</tbody>
</table>

Layers of Change

- **SITE**
- **STRUCTURE**
- **SKIN**
- **SERVICES**
- **SPACE PLAN**
- **STUFF**
- **SOULS**

**PERIOD:**

- **pre | post 1600’s**
  - solid masonry walls (bare or painted / rendered)
  - solid ground floor (bare earth)

- **mid 1700’s**
  - solid masonry walls (inner linings to walls and ceilings)
  - solid ground floor (timber boarded finnish)

- **from mid 1800’s**
  - cavity masonry walls uninsulated (inner linings to walls and ceilings)
  - uninsulated ground floor (stone slabs | concrete boarded finish)

- **from 1950-1999**
  - insulated cavity| framed | panel walls
  - internal lining to walls and ceilings
  - insulated solid or suspended timber precast concrete floors
  - raised floor systems
Metal Building Systems

Description:
Pre-engineered metal building integrates lightweight structural and envelope components at the connected level, but the result is a structure and envelope that combine to produce a common structural effect. Each component adds strength and rigidity of the overall form.

Key integration issues:
- Building corners and edges are particularly subject to wind induced uplifting.
- Sheet metal and steel structural members carry little to no insulative properties, attention to proper thermal barriers must be taken into account.
- Metal building systems are very lightweight.

Lightweight Steel Frame + Brick Veneer

Description:
Structural, interior and envelope systems are connected in lightweight steel frame construction, while the mechanical systems are meshed within the structural walls, floor and roof. Connections between the brick and the cold-rolled steel structural frame are minimal, to permit nearly independent movement of the two systems.

Key integration issues:
- Anchoring the veneer to the steel frame should permit free and independent movement of the two materials.
- The brick veneer is self-supporting and serves almost exclusively as envelope.
- Sheathing both side of the frame provides some lateral stability as the free standing brick facade cannot brace the structural laterally.

Wood Floor + Roof Truss

Description:
Open-Web wood truss and stud frame construction produces natural voids within the structure for placement of mechanical systems. The basement slab unifies structural, envelope, and interior systems. Open web wood trusses permit framing, leaving greater flexibility in the location of interior partition walls that need not be load bearing. The plywood veneer exterior siding unifies the structural system with the thermal envelope because the sheets act as both a structural sheathing for the roof frame and as an integral element of the envelope.

Key integration issues:
- Wood can and will erode faster than metal. Wood construction is also subject to easy structural failure under fire conditions.
- Inspection of truss units for uniformity of depth and camber and for general tightness is encouraged prior to lifting into place.
BUILDING ANALYSIS
Type: Warehouse
Built: 1910
33,000 sq FT

Steel vertical column
Steel cross member
Steel King-Post truss
Steel floor truss
Brick-face cadding
7’x8.5’ window frame
SITE | climate data

Bridgeport, Connecticut DATA

LARGEST DESIGN STRATEGIES:

- 42.0% = Heating and Humidification (4199 hours)
- 23.0% = Internal Heat Gain (2014 hours)
- 11.0% = Natural Ventilation Cooling (956 hours)
- 10.5% = Passive Solar Direct Gain Low Mass (924 hours)
- 10.0% = Sun Shading of Windows (867 hours)

Temperature Range Data:
- Average High = June (84.2 Degrees F) (Design High= 92F)
- Average Low = February (25.3 Degrees F) (Design Low= 3.5F)

Bridgeport lies within the transition zone between a humid subtropical and a humid continental. The coastal location of Bridgeport on Long Island Sound results in Bridgeport being several degrees cooler in summer and milder with less snowfall in winter than locations further away from the coast. Bridgeport is a relatively sunny climate, averaging more than 2400 hours of sunshine annually. In summer, hot and often sultry tropical weather conditions are typical, with high temperatures in the 80s and occasionally in the 90s. Brief, but intense late day thunderstorms are common in the hottest months. Fall and spring months are cool to warm with high temperatures from 50 to 70 F. The winter months have daily high temperatures in the upper 30s F and overnight lows in the mid 20s F. Winters in Bridgeport are modest, with a mix of rain and snow, though in some years Bridgeport can receive heavy snow.

SOURCE: Climate Consultant

| WEATHER DATA SUMMARY | MONTHLY MEANS | Location: Bridgeport, CT, USA
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<tbody>
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<td></td>
<td>JAN</td>
<td>FEB</td>
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<td>83</td>
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<tr>
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<td>Diffuse Radiation (Avg Hourly)</td>
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<td>Global Horiz Heat (Max Hourly)</td>
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<td>Wind Direction (Monthly Mode)</td>
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</tr>
<tr>
<td>Ground Temperature (Avg Monthly of 3 Depths)</td>
<td>45</td>
<td>39</td>
</tr>
</tbody>
</table>

Source: Climate Consultant
MUTUAL HOUSING ASSOCIATION  
parkside gables, Stamford ct

Located in Stamford Connecticut, it was the first mutual housing community to be built in Connecticut. More than 75% of the Parkside families purchased their first homes. 

Resident participation: 20 hours a week are required. Tasks include: participation on the community housing board, organizing events, cleaning common areas, property cleaning, lawn and building cleaning.

“I recently drove by Parkside Gables and became nostalgic. I was amazed at how orderly, clean and well maintained the community is 20 years later, a cleaner testament to the residents who take pride in their homes and treat it like a homeowner.” - Jeffery Rutishauer

Mutual Housing caused a change in our entire neighborhood and gave our community new stability. New businesses and other non-profit organizations moved in and the lifestyle for the people in our community improved fast. And it was all because Mutual Housing broke the barrier and saw the potential of the space and the people. - Debbie Joyner (First resident of Parkside Gables)

### Housing and Connecticut's Economy

<table>
<thead>
<tr>
<th>people are struggling to <strong>buy a home</strong></th>
<th>Median Value of a home</th>
<th>Monthly mortgage payment</th>
<th>Estimated % of CT households unable to afford a house</th>
</tr>
</thead>
<tbody>
<tr>
<td>$157,000</td>
<td>$1,265</td>
<td>60%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>people are struggling to <strong>buy an apartment</strong></th>
<th>Average rent</th>
<th>Annual income needed</th>
<th>Estimated % of CT renters who cannot afford rent</th>
</tr>
</thead>
<tbody>
<tr>
<td>$815</td>
<td>$32,600</td>
<td>42%</td>
<td></td>
</tr>
</tbody>
</table>

FOR EVERY $10 MILLION INVESTED IN CONNECTICUT'S HOUSING INDUSTRY, THE STATE'S ECONOMY WILL BENEFIT FROM

<table>
<thead>
<tr>
<th>Connecticut</th>
<th>New jobs created</th>
<th>New wages created</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial impact</td>
<td>190</td>
<td>$6,058,150</td>
</tr>
<tr>
<td>Leveraged impact</td>
<td>1,711</td>
<td>$54,523,350</td>
</tr>
<tr>
<td>Total impact</td>
<td>1,901</td>
<td>$60,581,500</td>
</tr>
</tbody>
</table>

source: home sweet home: Why America needs a National Trust Fund, Center for community change. 2001
MOLECULAR GASTRONOMY

moto restaurant, Chicago IL

Moto is a Molecular Gastronomy restaurant in the Fulton River District of Chicago. "The restaurant is known for making high tech dishes which incorporate elements such as carbonated fruit, edible paper, lasers and liquid nitrogen for freezing food." The restaurant features a 15 course meal which are downsized into bite-size portions. Forbes magazine put Moto at #44 on its list of "100 best US restaurants" making it a top restaurant attraction in the country. Mr. Cantu (Moto’s chef) wants to use technology to change the way people perceive (and eat) food, and he uses Moto as his laboratory. "Gastronomy has to catch up to the evolution in technology," he said. "And we’re helping that process happen."

Moto grows all of their produce in house using vertical hydroponic techniques as well as composting which they call "micro greens". The current scheme utilizes a NFT (Nutrient Float Trofts) system with LED string lighting to minimize wattage consumption.

Mr. Cantu argues "In the future, you will be able to go to a website, a contractor will come out, and build a similar system in your home, which will save you a substantial amount of money by eliminating packaging, processing, refrigeration and food miles."

Molecular Gastronomy describes the scientific exploration of food and the cooking process. "For us, it’s a way to create forward-thinking food that can either make the world a better place, or make food much more fun to enjoy," - Homaro Cantu

Sources: Bernstein, David (02-03-2005), "When the Sous-Chef Is an Inkjet", The New York Times
Pasona O2 Tokyo is a 10,000 sq ft space of underground farmland located in Otemachi Headquarters building. It showcases city farming initiative.

The company took over a 50-year-old structure and renovated it into the urban farm and eco office. Pasona elected to dedicate considerable space inside the building to hydroponic and soil-based farming, which is interspersed throughout the entire building.

There are a total of 100 different types of produce grown throughout the 10,000 sq ft office environment.

Through their urban farm and headquarters, the recruitment company is also supporting the education of Japan’s next generation of farmers who work in internships to learn about food production.

“The green space comprises 43,000 square feet with 200 species, including fruits, vegetables, and rice. (Seriously, the main lobby has a rice paddy—and a broccoli field!) “It is the largest and most direct farm-to-table of its kind ever realized inside an office building in Japan,” -Kono Designs

Source: architizer.com | Pasona O2