Innovation Inspired by Nature

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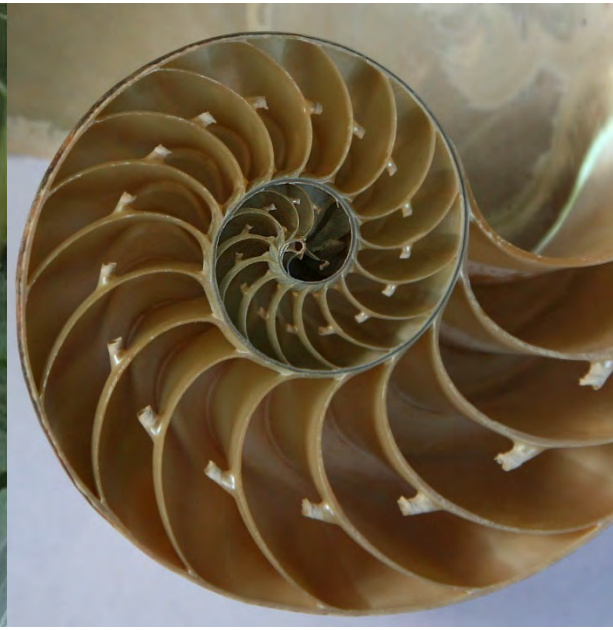
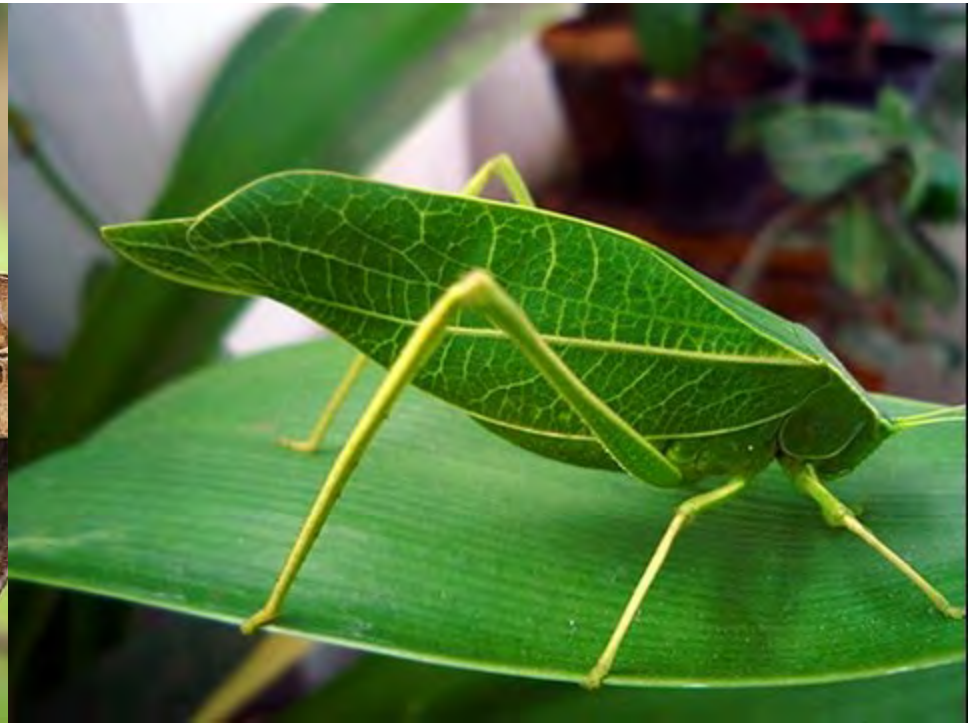
BIOMIMICRY 3.8

Nature is organized.



Nature solves problems.

How does Nature disguise?



How does Nature disguise?

How does Nature disguise?

Glen Raven IOTV (Improved Outer Tactical Vest)

Glen Raven ULCANS (Ultra Light Weight Camouflage Net Systems)

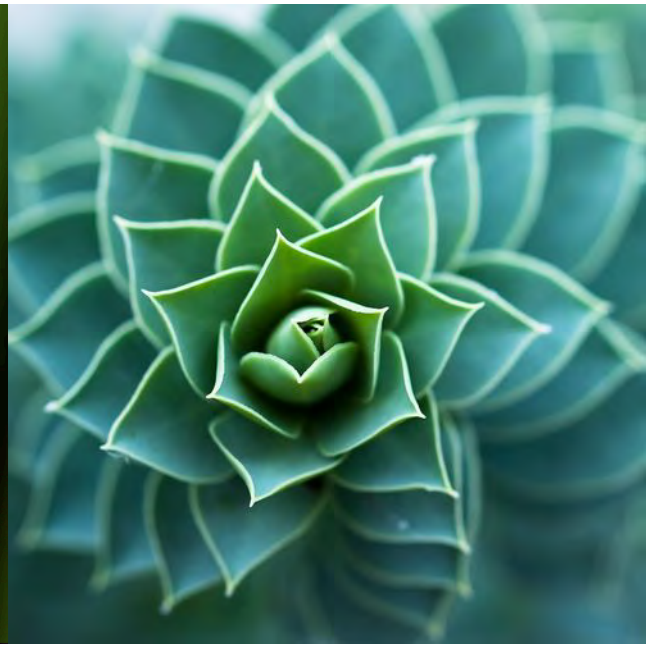
How does Nature collect water?

QinetiQ Beetlejuice Fog Harvesting Screens

Warka Water

How does Nature collect water?

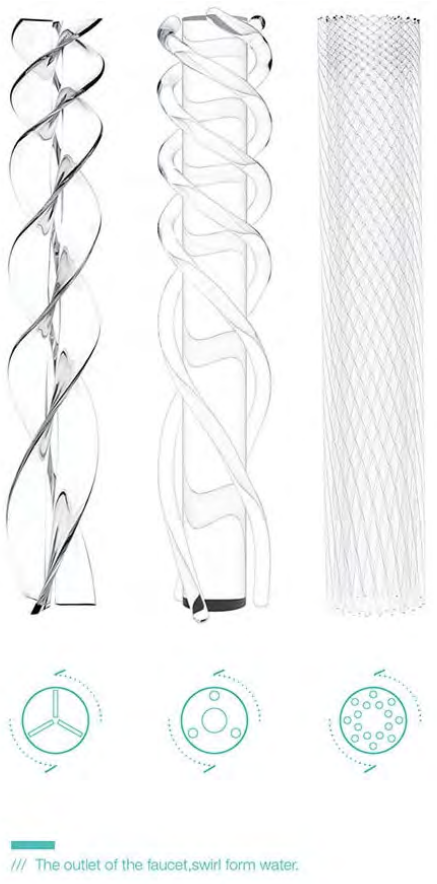




How does Nature move water?

Pax Technologies Water Mixer

How does Nature move water?



Water faucet designed by London Royal College of Art student

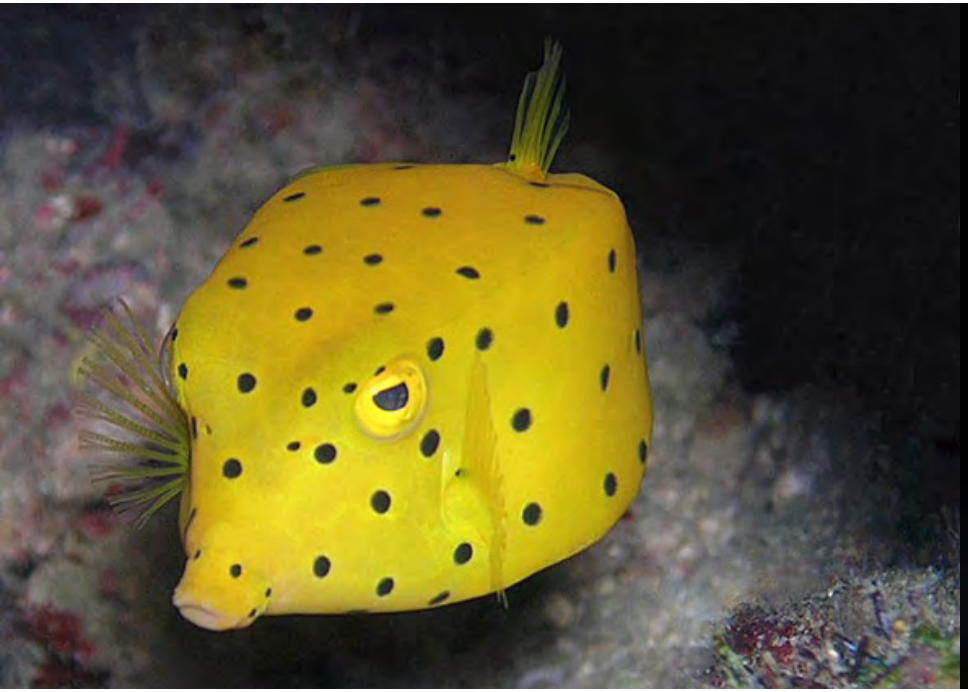
How does Nature move?

Japan’s Bullet Train

How does Nature move?

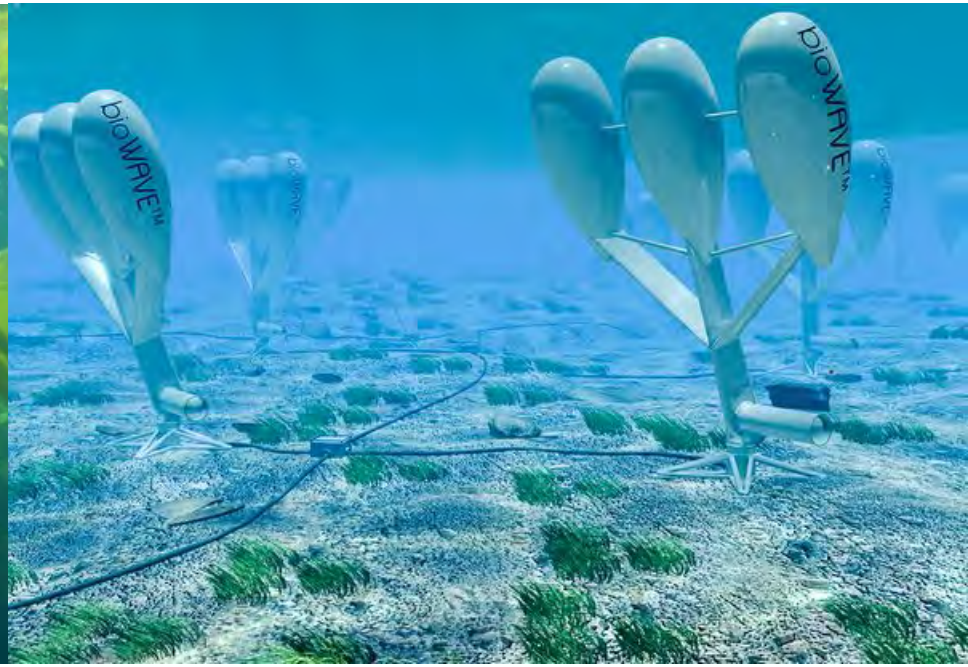
WhalePower Wind Turbine Blades (Tubercle Technology)

How does Nature move?



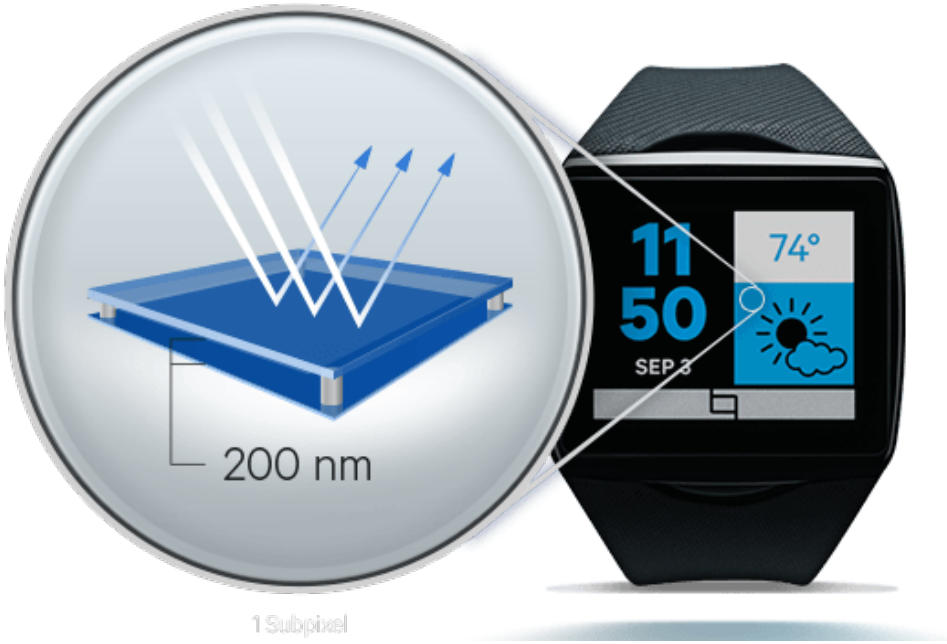
Mercedes Benz Bionic Car Concept

How does Nature move?



BioPower Underwater Turbines

How does Nature display color?

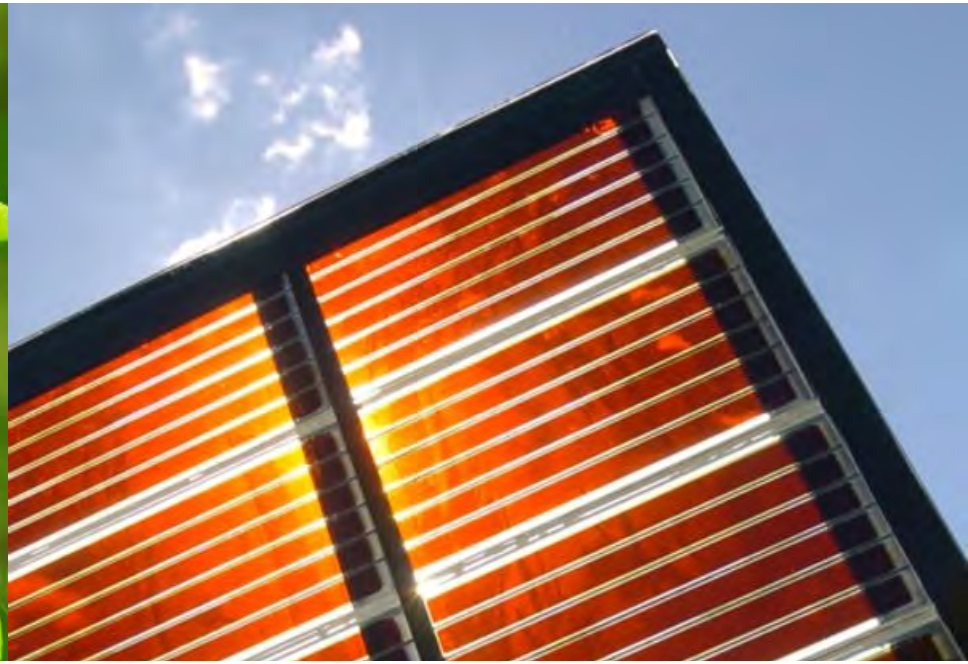


Qualcomm Electronic Display

How does Nature display color?

Morphotex Fabric by Teijin Fibers Limited

How does Nature make energy?



Dyesol Photovoltaic Technology

How does Nature make energy?

SMIT Grow Solar Ivy

How does Nature make energy?

Solar Roof tiles by Tesla: https://vimeo.com/189402941

How does Nature store energy?



How does Nature store energy?

bioPCM Phase Change Material for Buildings

Cryopak Phase Change Material for Food Service

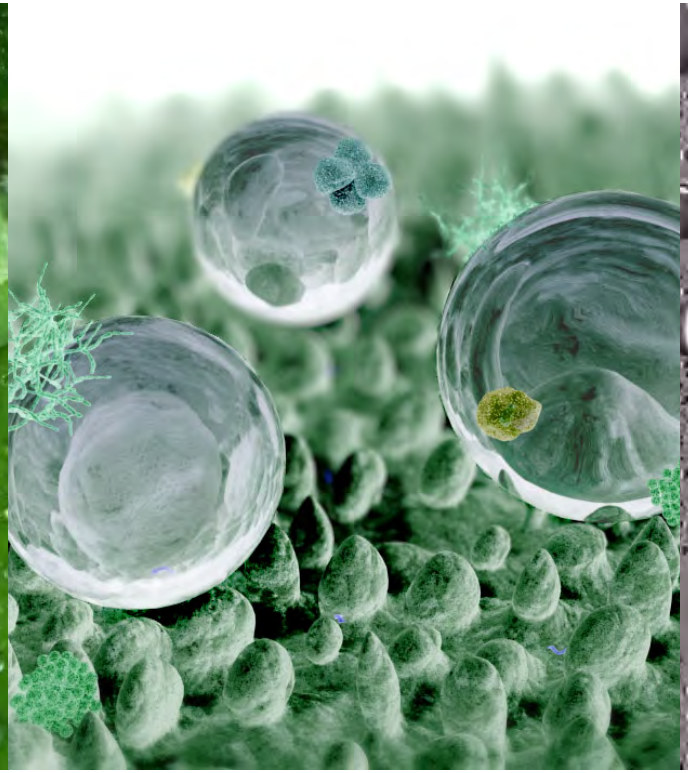
How does Nature resist bacteria?

BioSignal Antibiofilm

How does Nature communicate?

Regen Energy Management Device

How does Nature clean?



Ferro Lotus-Effect Self-cleaning Glass

How does Nature clean?

Sunbrella Clarity

Orchestra Max with PERMACLEAN

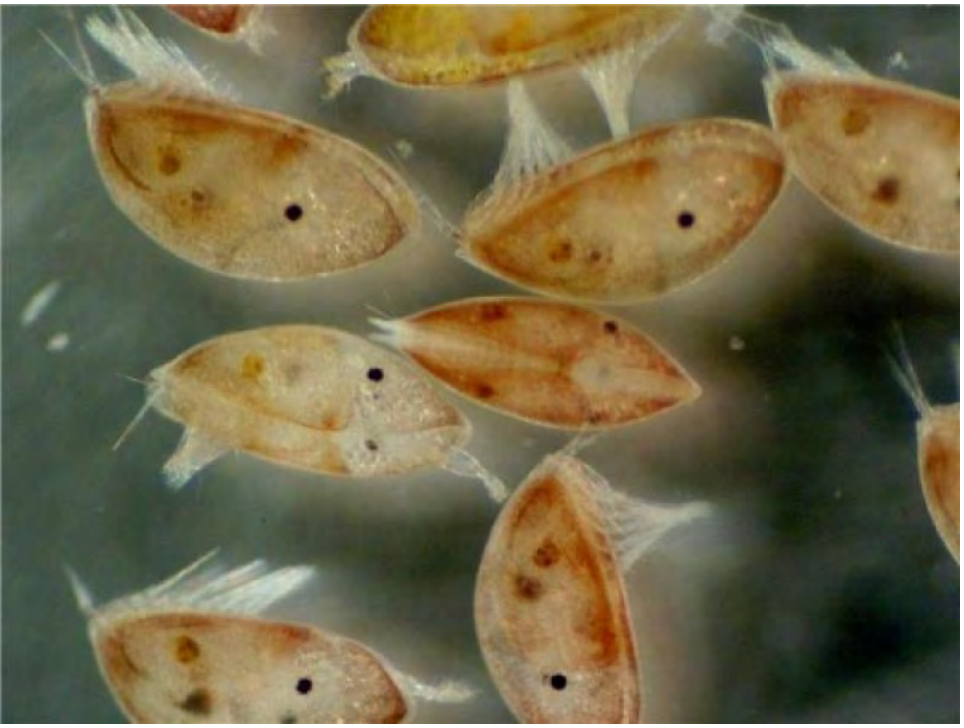
How does Nature adhere?

Nike Goatek Traction Sole

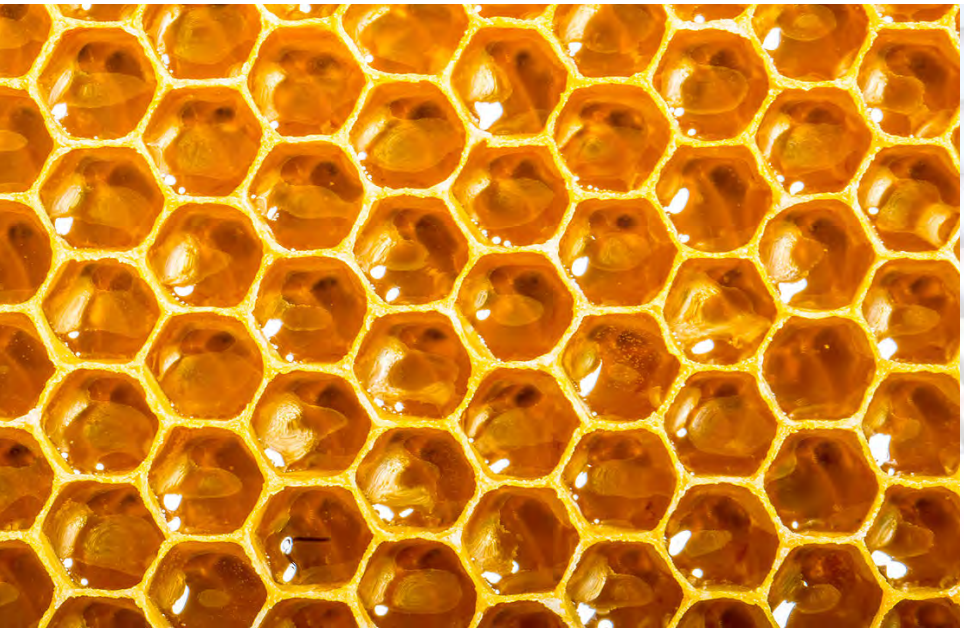
How does Nature adhere?

Columbia Forest Products PureBond Plywood

How does Nature adhere?



How does Nature strengthen with less?



Panelite Cast Polymer Products

How does Nature strengthen?

Spiber's Qmonos thread used to make Moon Parka for The North Face: https://vimeo.com/141755563

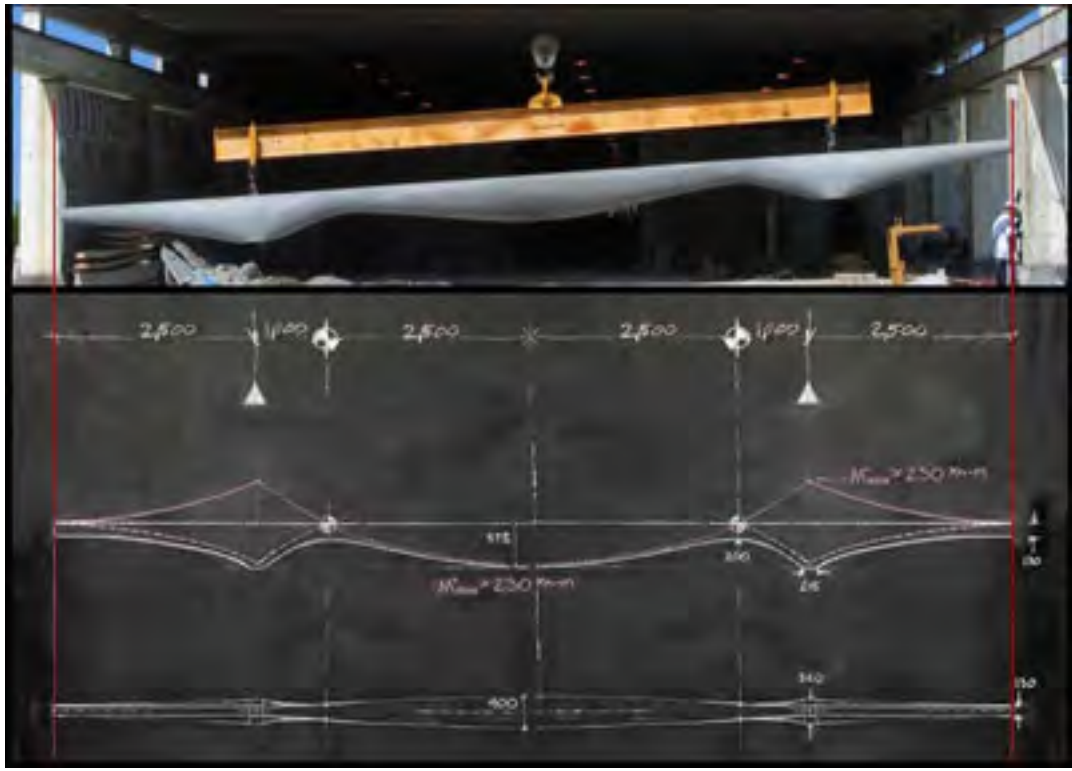
How does Nature strengthen?

MX3D

How does Nature strengthen?

University's Wyss Institute for Biologically Inspired Engineering bioplastic

How does Nature strengthen?



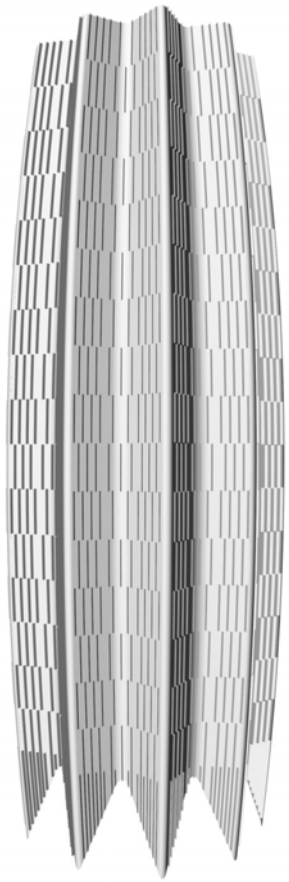
How does Nature heal?

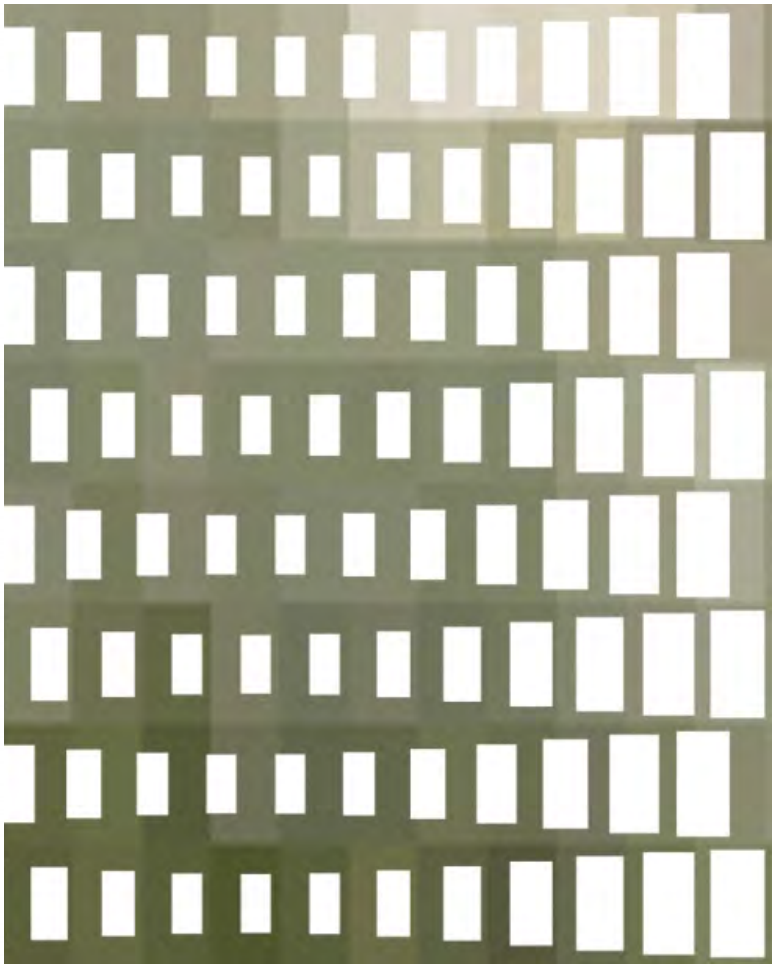
Natural Process Design Self-healing Polymer

How does Nature clean water?

Living Machine at Port of Portland, Portland, OR

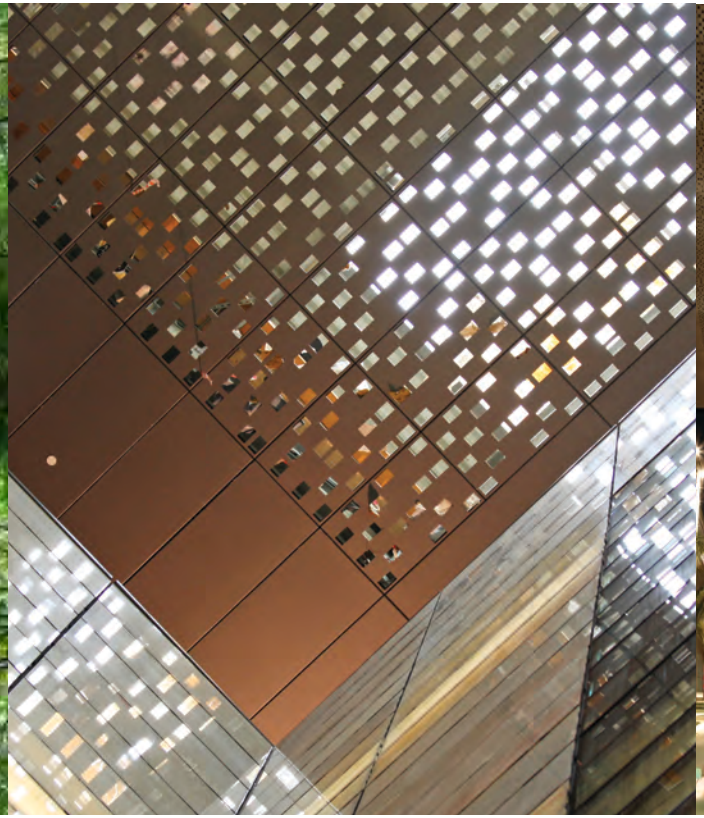
How does Nature protect?





Prototype building form and skin for desert hotel, HOK

How does Nature protect?



King Abdullah University of Science + Technology (KAUST) Jeddah, KSA

How does Nature adapt?

Rimba Papua Hotel at Timika, Papua, Indonesia, HOK

Managing Water: Lavasa Mugaon Valley, Maharashtra, India

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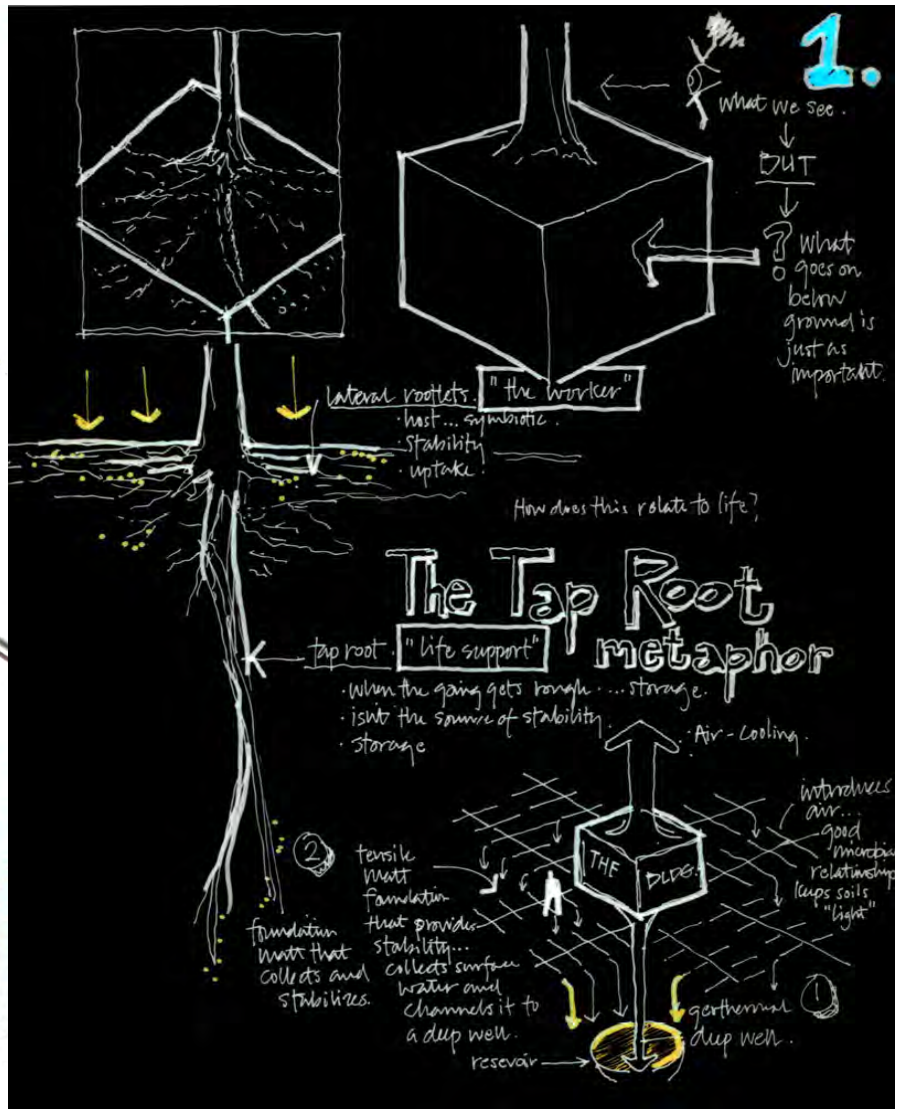
Managing Water: Lavasa Mugaon Valley, Maharashtra, India

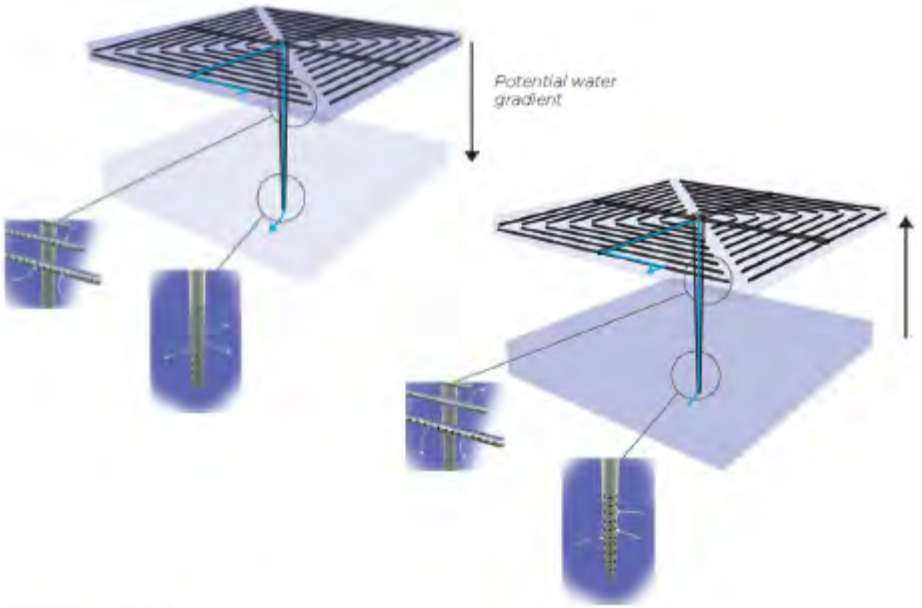


Managing Water: Lavasa Mugaon Valley, Maharashtra, India

Species of the Manilkara tree grow in tropical rainforests

mechanism

Lateral roots absorb excess moisture from surface layer soil and the tap root sends the collected moisture downward to recharge groundwater. During the dry season, the reverse happens.



design principle

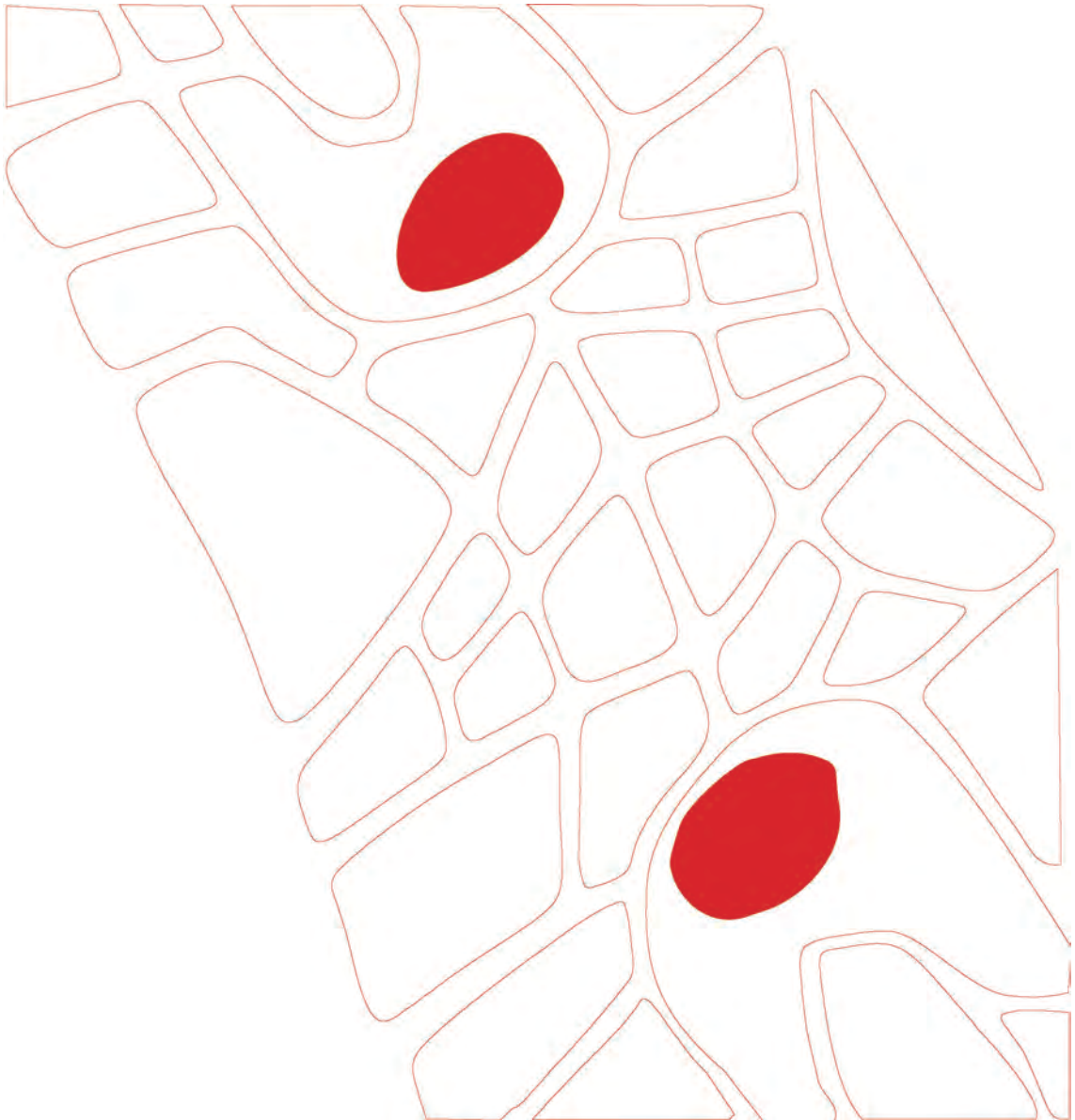
Water gradients can be leveraged to move water from wet to dry.

possible design avenues

Take advantage of moisture gradients to passively move water from wet soils to dry soils by employing perforated piping systems within disturbed soils as part of their restoration. This should foster the recharging of the groundwater more rapidly and ensure longer availability of water beyond the monsoon season.

Managing Water: Largo da Batata

Commercial Center, São Paulo, Brasil



Managing Water: Largo da Batata

Commercial Center, São Paulo, Brasil

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‘Tank bromeliads’ can store as much as a gallon of water.

Managing Water: Largo da Batata

Commercial Center, São Paulo, Brasil

1. Ecosystem

From Nature >>>

Life's Principles: How Nature Does It

Desired Outcome

Maintains and fosters the health and integrity of the native physical and ecological landscapes.

In the delicate balance of an ecosystem: how the success of one species depends on the interactions and interdependencies with others.

The foundation of the ecostructure that supports São Paulo is the Native Atlantic Forest ecosystem. In this forest, 5 Tiers of vertical complexity support a multitude of species. Each layer provides water, food and shelter that create an integrated environment for all species in the forest. In an effort to integrate with this natural system and accommodate similar complexity in the human habitat within and surrounding the building, numerous features of life-sustaining native plantings, natural materials and specialized niches are incorporated into the interior and exterior of the building. The building is also integrated with the surrounding human ecosystem in its connectivity with the existing urban fabric of the surrounding community.

Optimizes Rather than Minimizes

Rooftop surfaces are multi-functional to create habitat for humans and other species and create ambient cooling.

Leverages Interdependence

Planned niches on the exterior facade support a multitude of species.

Uses Benign Manufacturing

Use resources that are renewable recyclable and low-embodied energy

Resilient

The incorporation of the ecosystem is not merely a display in one location, but is demonstrated in a diversity of ways throughout the building.

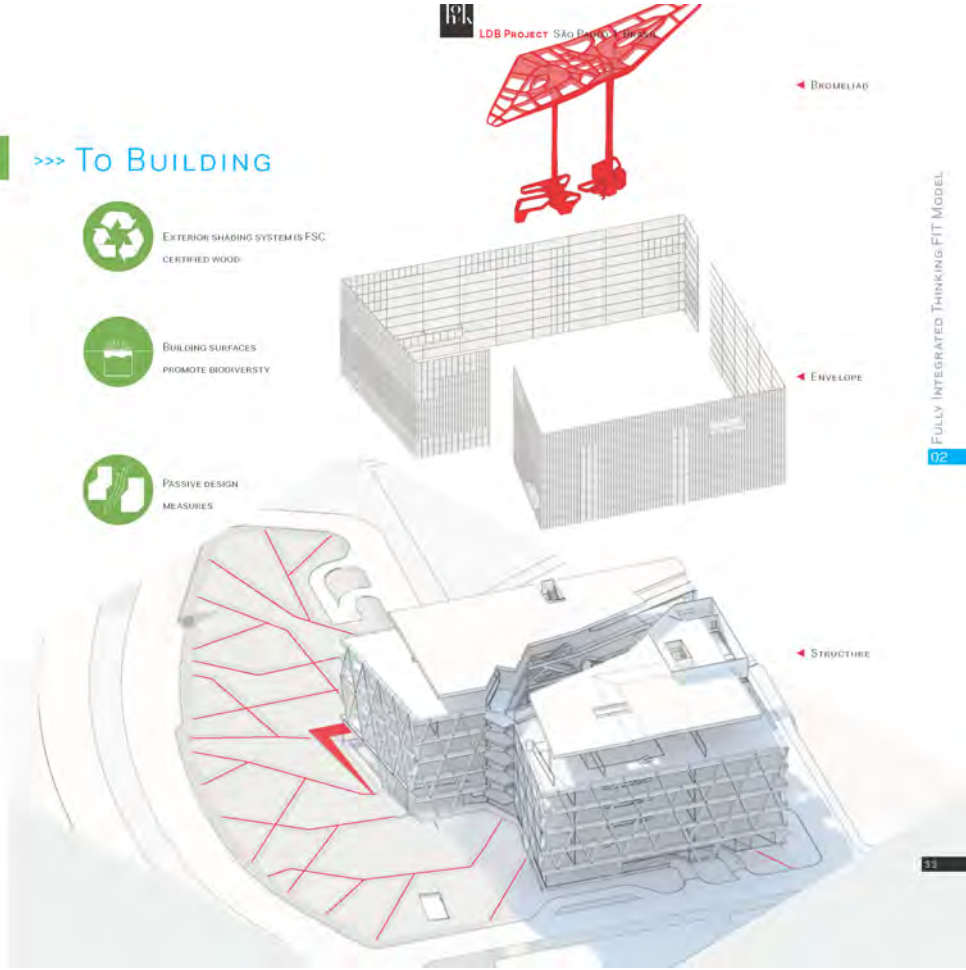
Integrates Cyclic Process

Annual cycles of growth, weathering and decay are part of building program.

Locally Attuned and Responsive

Building responds to solar, wind and precipitation conditions.

>>> To Building



Managing Water: Largo da Batata

Commercial Center, São Paulo, Brasil

2. Water

From Nature >>>

Life's Principles : How Nature Does It

Desired Outcome

Protect and enhance water quantity and quality. The water system includes how the water is collected, how it is used, how it is cleaned and how it returns to the ecosystem from which it came.

All plants and animals depend on water. Even in the rainforest, where precipitation is plentiful, many species have evolved special adaptations to retain and utilize precipitation. Imagine every piece of a city contributing to water management.

Bromeliads do not depend on their roots to get water. Water held within the "tank" formed at the base of the Bromeliad forms

a pool in which invertebrates and fallen leaves decompose. The nutrients from the decomposition are absorbed by the bromeliad. Like the Bromeliad, the building structures and systems themselves collect, store and purify much of their own water. The shape of the roof is designed to channel water into a storage area at the base of the building and a 'Living Machine' system is used to treat wastewater.

Optimizes Rather than Minimizes
Water is used many times before it is released back into the environment.

Leverages Interdependence
The same water is shared amongst systems. Greywater is used for irrigation throughout the building.

Uses Benign Manufacturing
On site purification does not use chemicals (i.e., living machine).

Resilient
Supplies come from city system as well as from rooftop collection.

Integrates Cyclic Process
Closed loop water use whenever possible.

Locally Attuned and Responsive
Activities of heavy water use (i.e., building exterior cleaning) are done during rainy season.

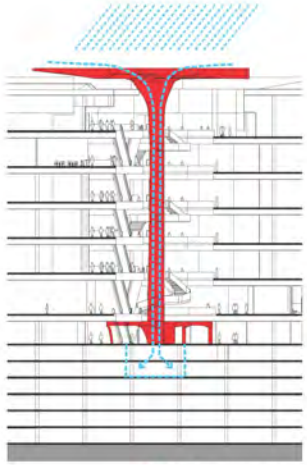
>>> To Building

◀ Interior View of the Bromeliad Columns and Roof Structure

Collect Rain water

Measure collected water and site water run-off

Store and reuse water



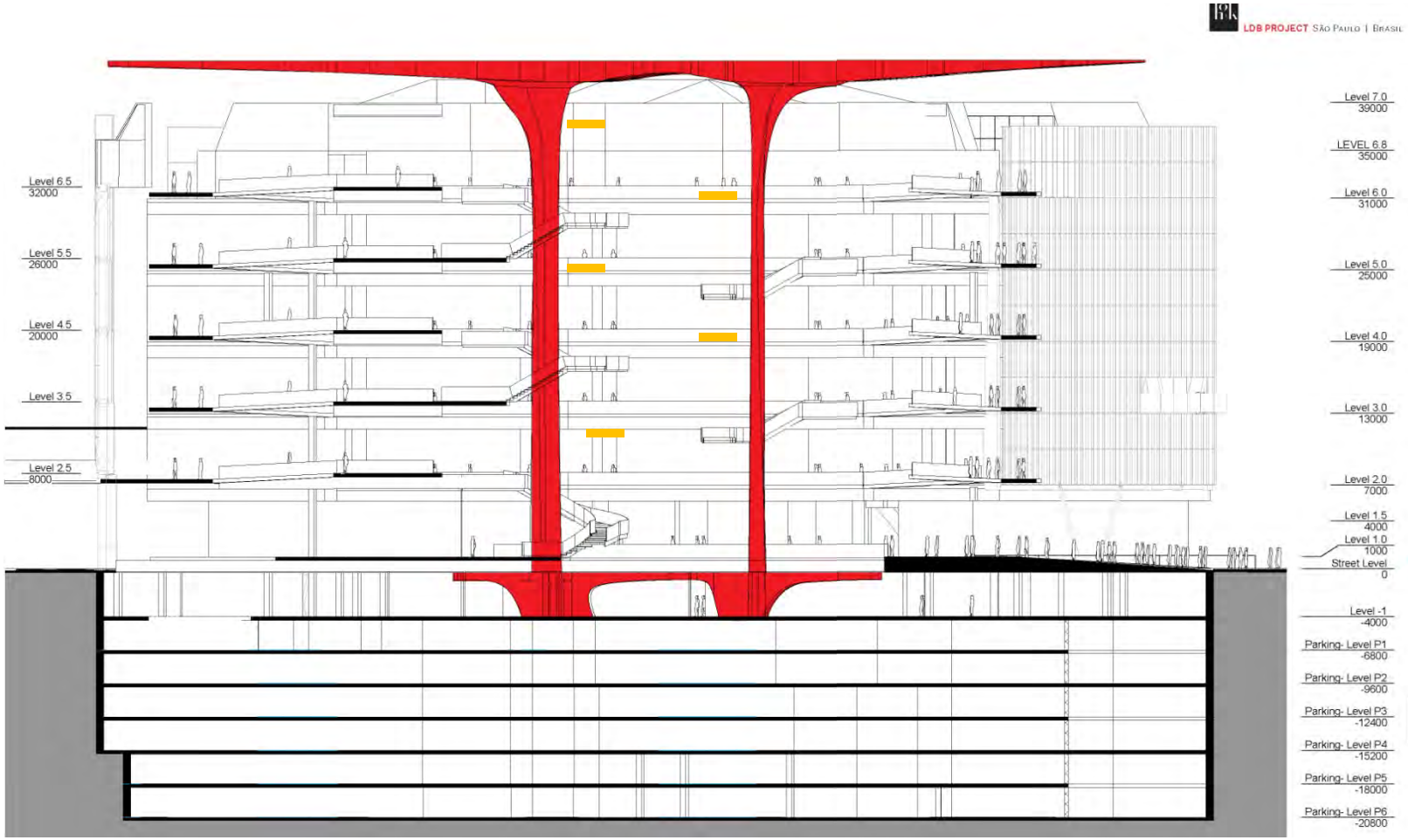
▲ Water Collection Diagram

Rain water collection and recycling

The City of São Paulo cannot keep up with its growing demands for public infrastructure. The LDB Project will incorporate various water collection, reuse and recycling strategies that will not place an added demand in an already stressed infrastructure.

Managing Water: Largo da Batata

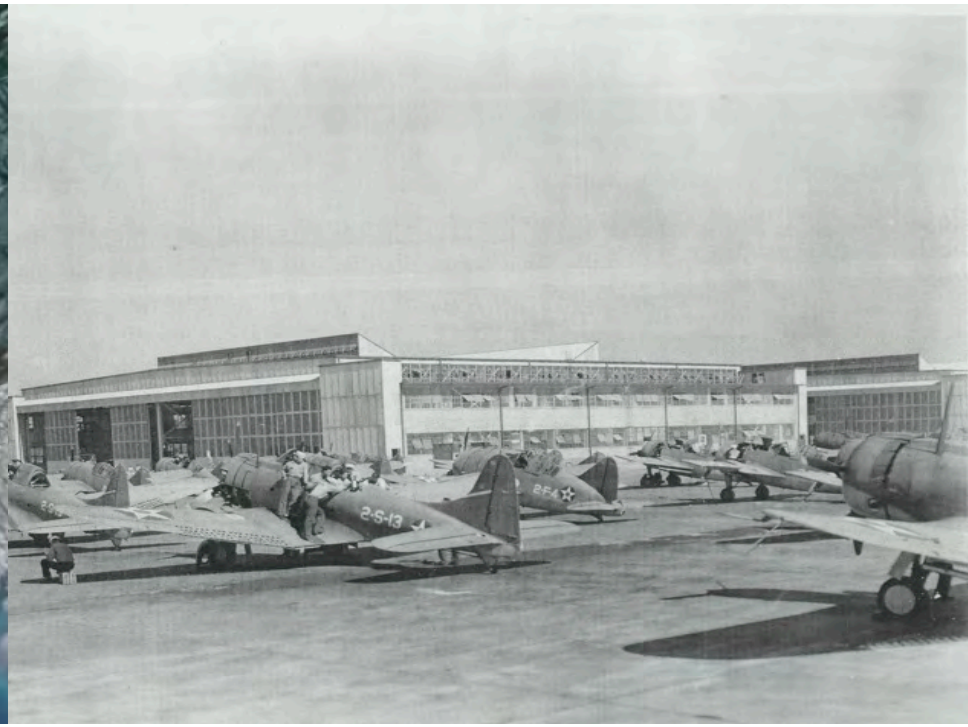
Commercial Center, São Paulo, Brasil



Managing Water: Largo da Batata

Commercial Center, São Paulo, Brasil

Keeping Cool: NOAA Inouye Regional Center, Pearl Harbor, HI



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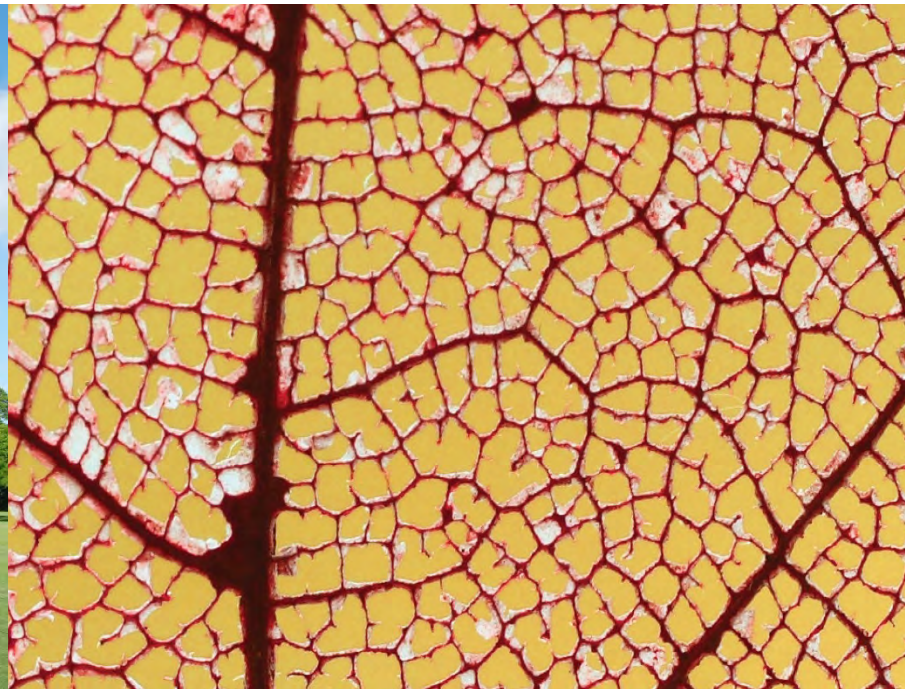
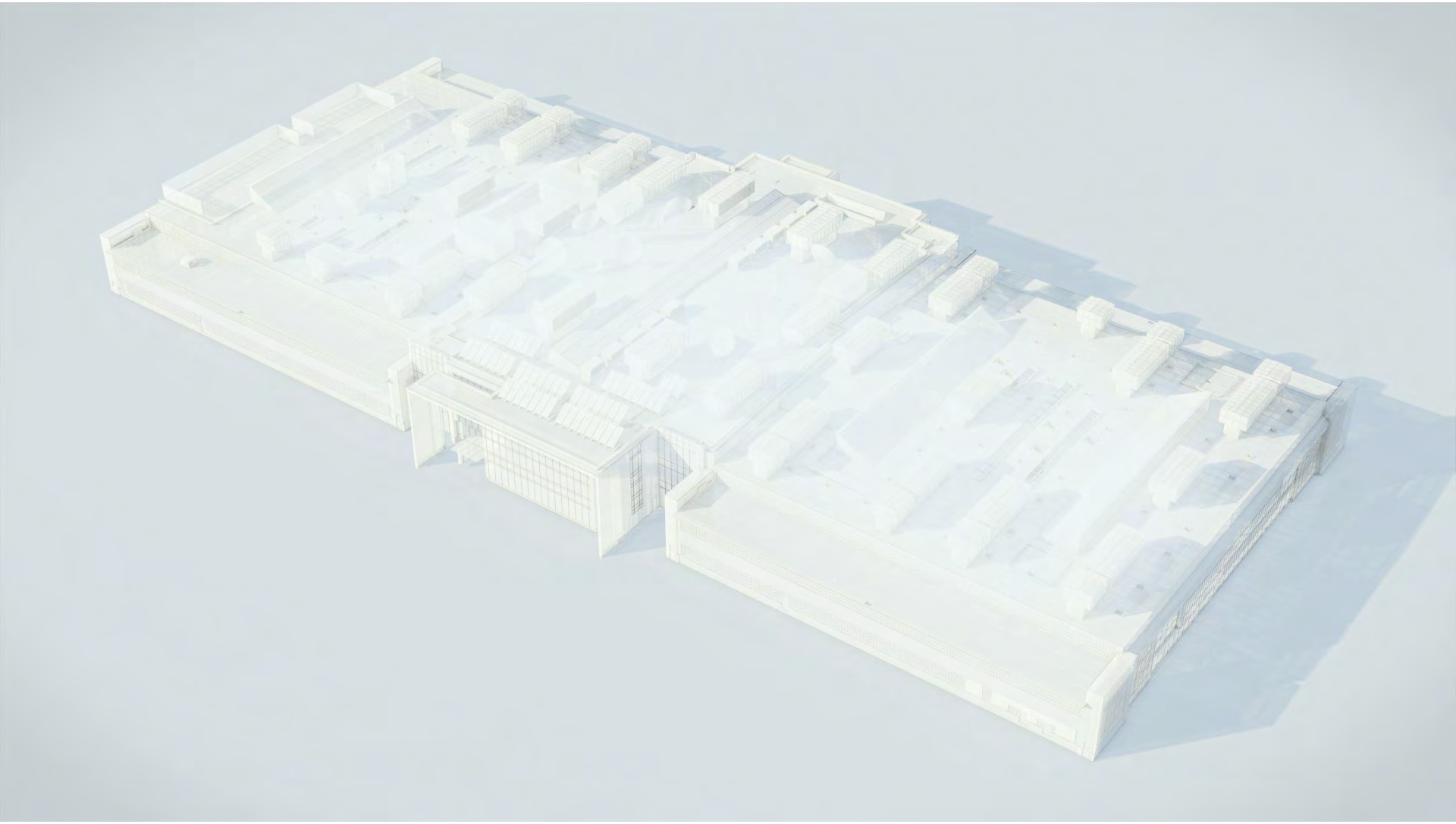


Monkey Pod Tree

Keeping Cool: NOAA Inouye Regional Center, Pearl Harbor, HI



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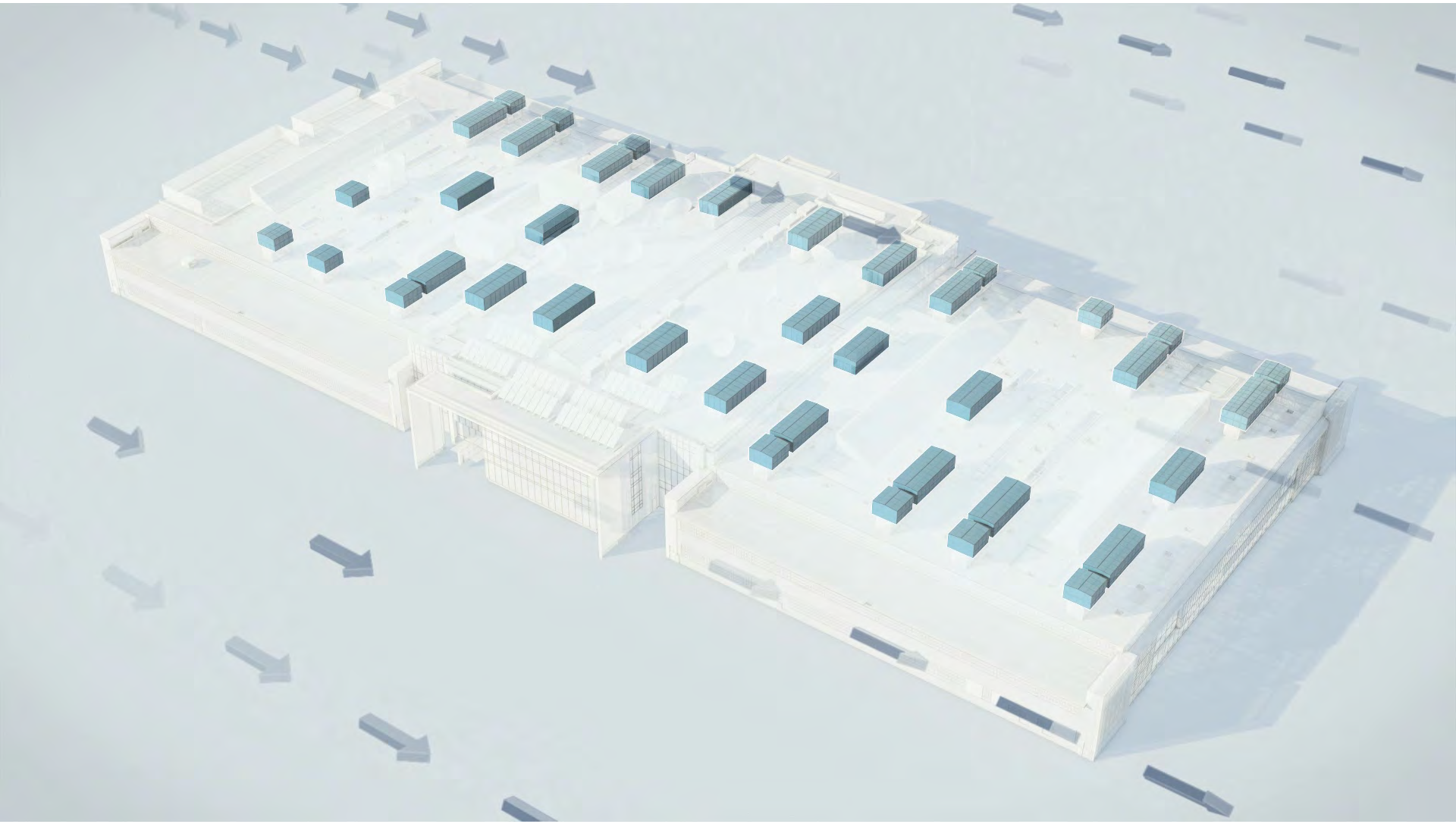

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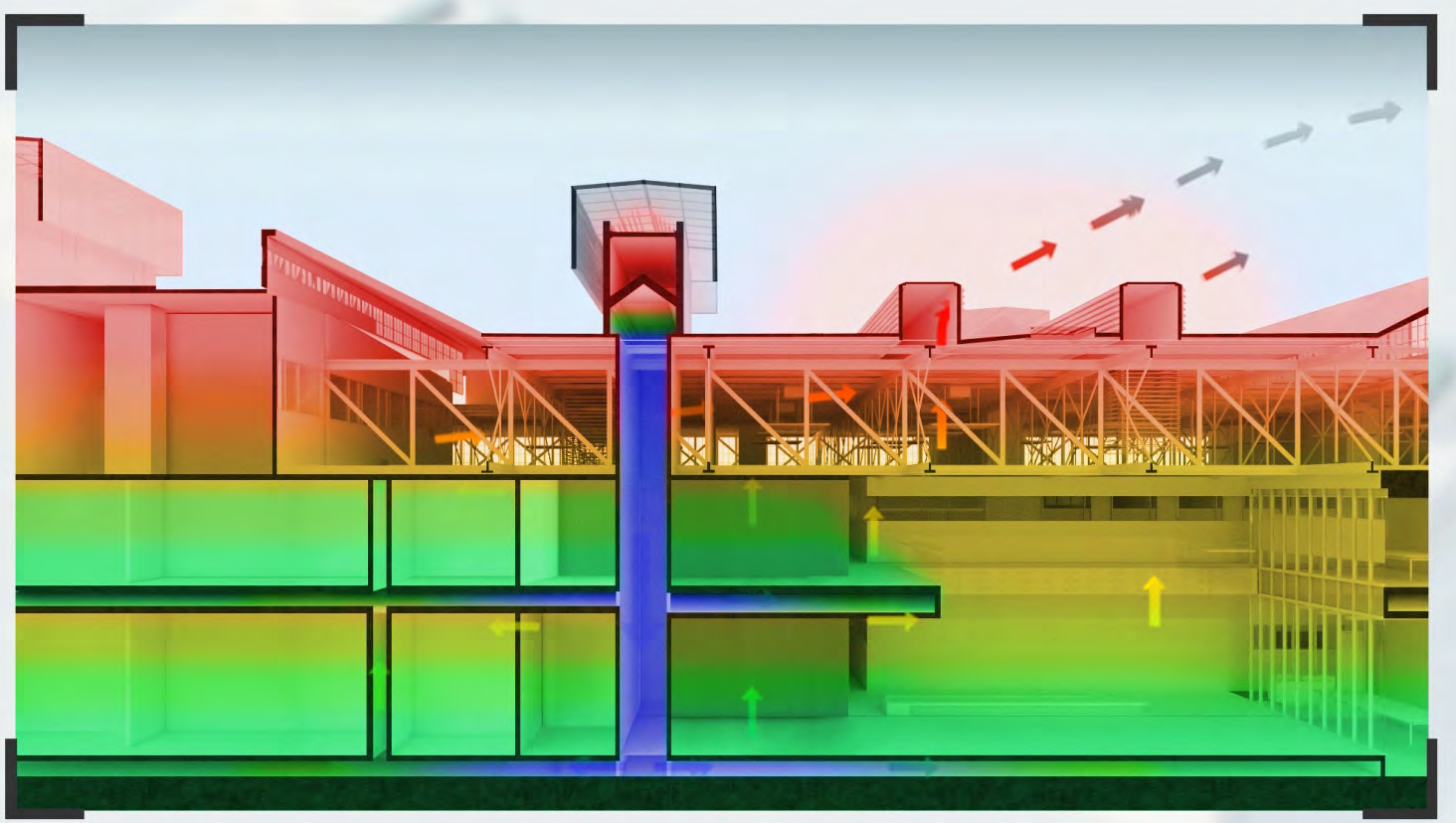

Keeping Cool: NOAA Inouye Regional Center, Pearl Harbor, HI

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What will you see?

Coconut Trees

What will you see?

Mangroves

What will you see?

Kapok Tree

Miracle Leaf

Breadfruit

What will you see?

Pitahaya

Boat Lily

Bromeliad

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