
九典
BaF
BI: the origin of architectural creativity
BIOLOGICAL
BI
INTELLIGENCE
the origin of architectural creativity
Design the way Nature creates itself
ORO
EDITIONS
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九典 BaF

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temporal – Taipei Flora Expo Entrance Pavillion
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interior – BaF's Workplace

FOREWORD

For the last 20 years, Bio-architecture Formosana (BaF) has produced an incredible body of work within Taiwan's architecture scene. It has become one of the country's most prestigious architecture firms and one of the forerunners for international recognition in Taiwanese contemporary architecture. The partnership was penned in 1999 by Ching Hwa Chang and Ying Chao Kuo; both experienced academicians, talented creative architects, and recipients of several individual and collective architecture awards.

Sustainable practice is their leading priority and it is this concern for sustainability that lead them to spearhead buildings such as the Beitou Public Library, the Pavilions for the Flora Expo both in Taipei, and the Taijiang Visitor Center.

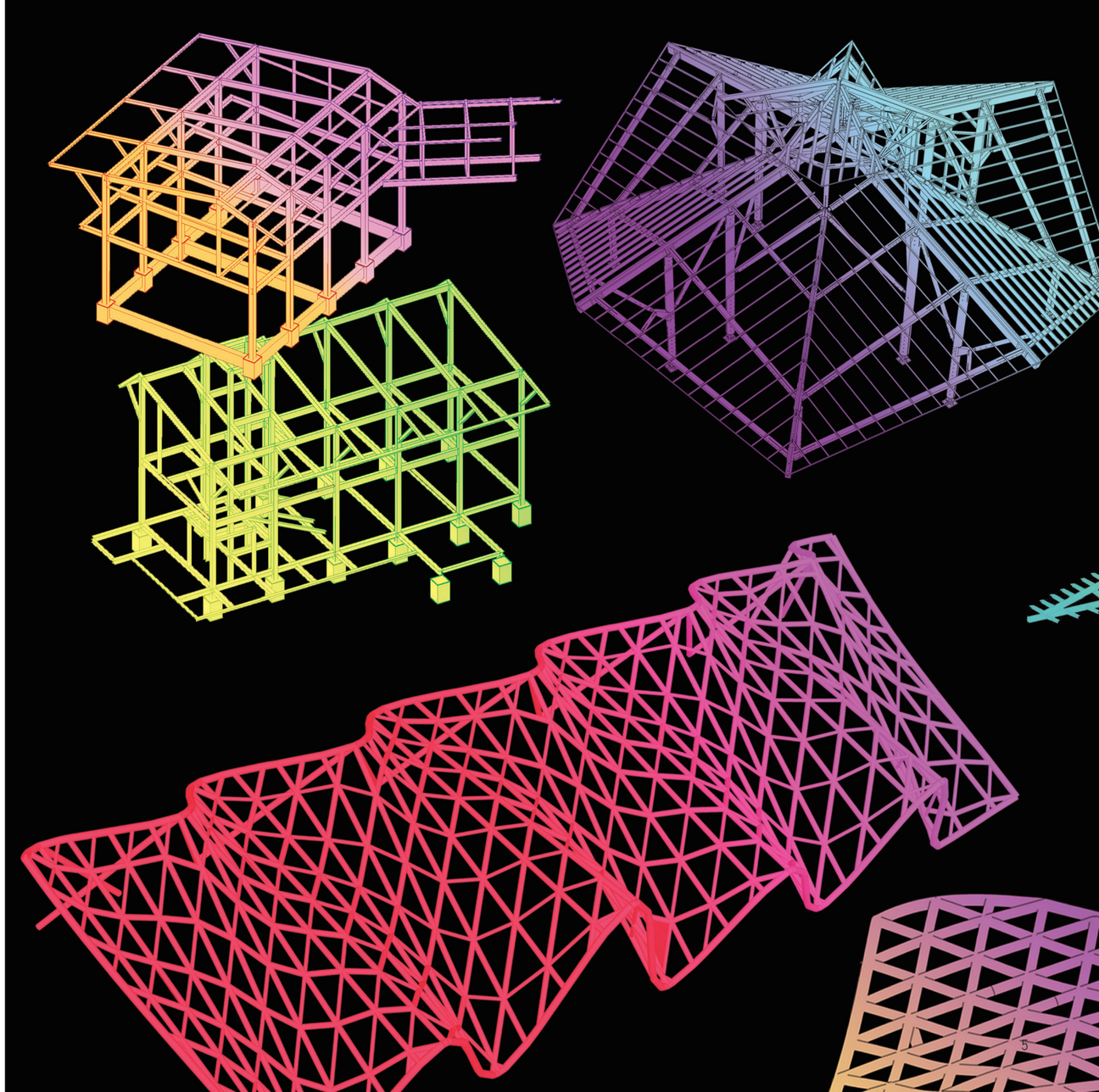
This publication explores the concept of Biological Intelligence: which can be defined as an attempt at understanding nature's *life* forms systems and replicating them within the architectural realm. The goal here is to create a sustainable cycle of design by first learning the way life works in the natural world in order to achieve a circular design.

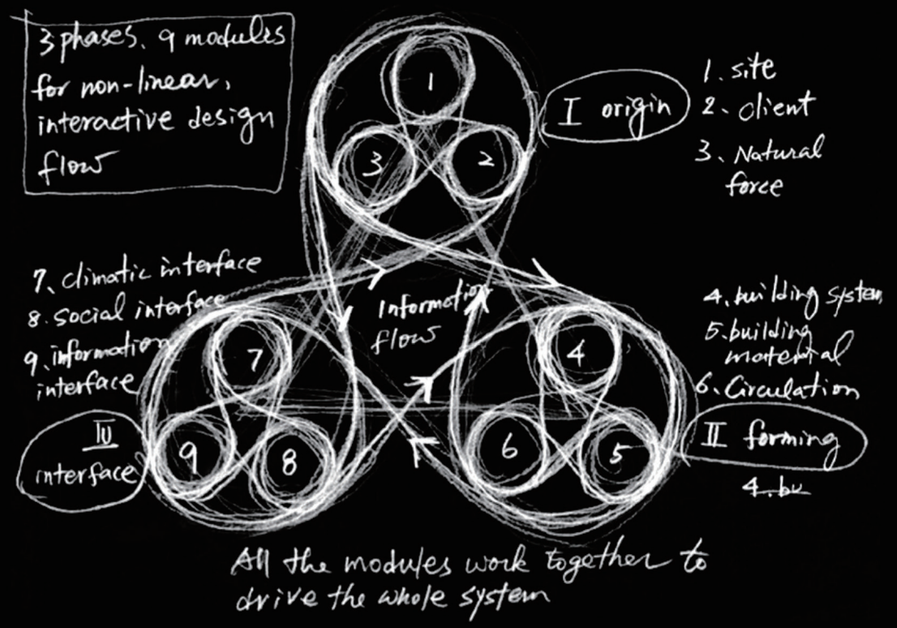
BaF's creative flow is a design process inspired by Biological Intelligence based on three key elements: origin, form, and interface, which in total contain nine different modules. Although it seems to be a complex system it is actually a simple, straightforward, and efficient design methodology. It is a structured design approach where the nonlinear connections between its simple modules leads to an information flow shelled by a circular design envelope that uplifts the standards for creative architectural design.

At the core of the practice's principles there is a devotion to high-quality international standards in architectural environmental and sustainable design, in order to ensure that the buildings are places that are welcoming to everyone. This devotion disseminates throughout all their projects and acts as a sort of motto for BaF.

On the whole, this book is a celebration of a fresh approach to new ideas and explorations into sustainable, responsible design that can be a useful teaching tool for other architects, professors, or architecture students. It naturally stands out as a perfect example that good practices lead to excellent buildings.

Tiago Costa, DArch
Assistant Professor, NTUST





Initial draft of the modules that determine the design process.

THE "MIND" BEHIND NATURE'S CREATIVITY

Nature never intends to be creative, while its mere creativity never stops engaging our admiration. Not only does it create millions of life forms that exude absolute beauty and delicacy, but all its creations fit into a ceaselessly elaborate network that begs the question of how such engineering could even exist.

The "mind" behind all this we call: Biological intelligence. There is a great similarity between architecture and life form. They are both made of skin, supporting structures and life-sustaining organs. They are both interconnected and driven by intrinsic energies as well as external pressures. Life itself is originated from single cell organism that eventually evolved into tens of millions of species through genetic mutations (intrinsic energies) and nature's selections (exterior pressures). Architecture began with the fundamental principal of providing shelter with primitive materials and evolved, through main selection, into metropolises with varieties of functions that can accommodate tens of millions of people. It is the response to the needs of an ever-evolving human civilization that fuels the evolution of architecture. In this book, we seek to explore the underlying mysteries of this billion-year-old intelligence and learn to create architecture that parallels how nature creates itself.

Ying Chao Kuo, Ching Hwa Chang
Founding Partners

THE ROAD MAP FROM BI TO ARCHITECTURAL CREATIVITY

1 BIOLOGICAL INTELLIGENCE

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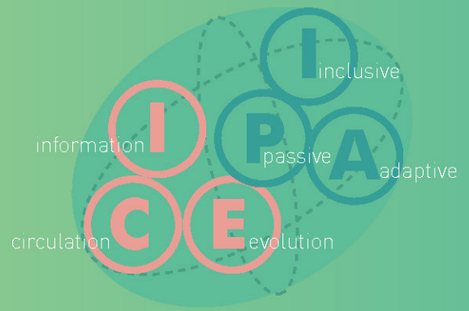
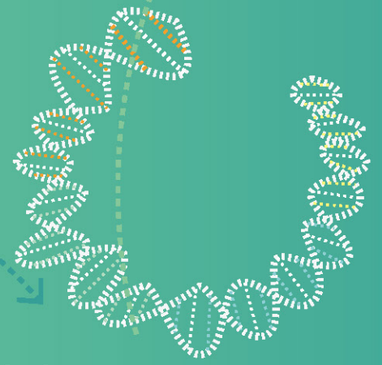
The "mind" behind nature's creativity

2 3x2 6 PRINCIPLES OF BI

p.16

ICE: Fundamentals of Life
IPA: Strategies for Sustainability





3 4x4 16 PATTERNS OF LIFE

p.18

16 patterns in 4 groups: OFIC
(Origin, Form, Interface, Circular)
As interface for BI and architecture

4 3x3 9 DESIGN MODULES

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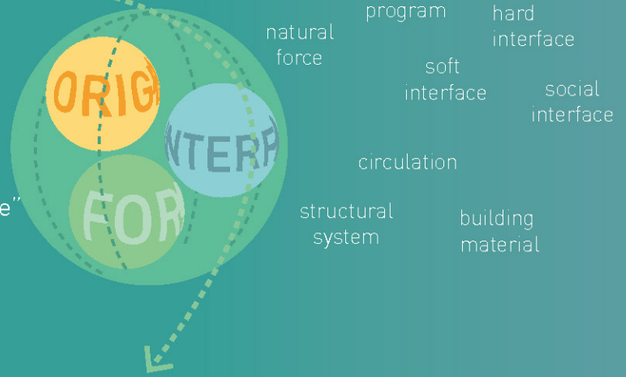
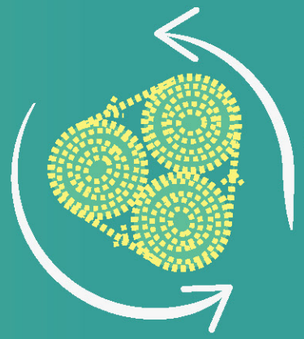
work together and improved by the information flow, very much like "struggle for existence" and "nature's selection."





5 +1 CIRCULAR LOOP

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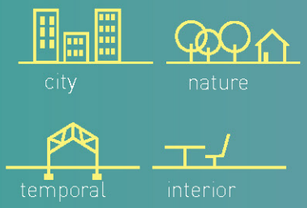
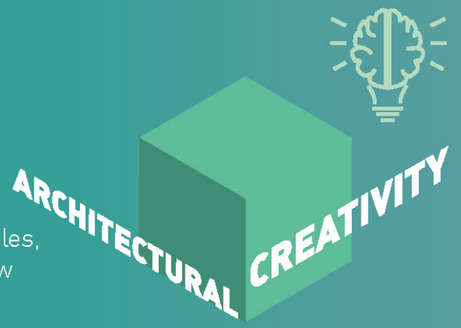
how nature renews itself and how architecture achieves sustainability.



6 ARCHITECTURAL CREATIVITY

creative design solution emerges through the exercise of the design modules, as beautiful life forms emerge from a few simple rules in nature.

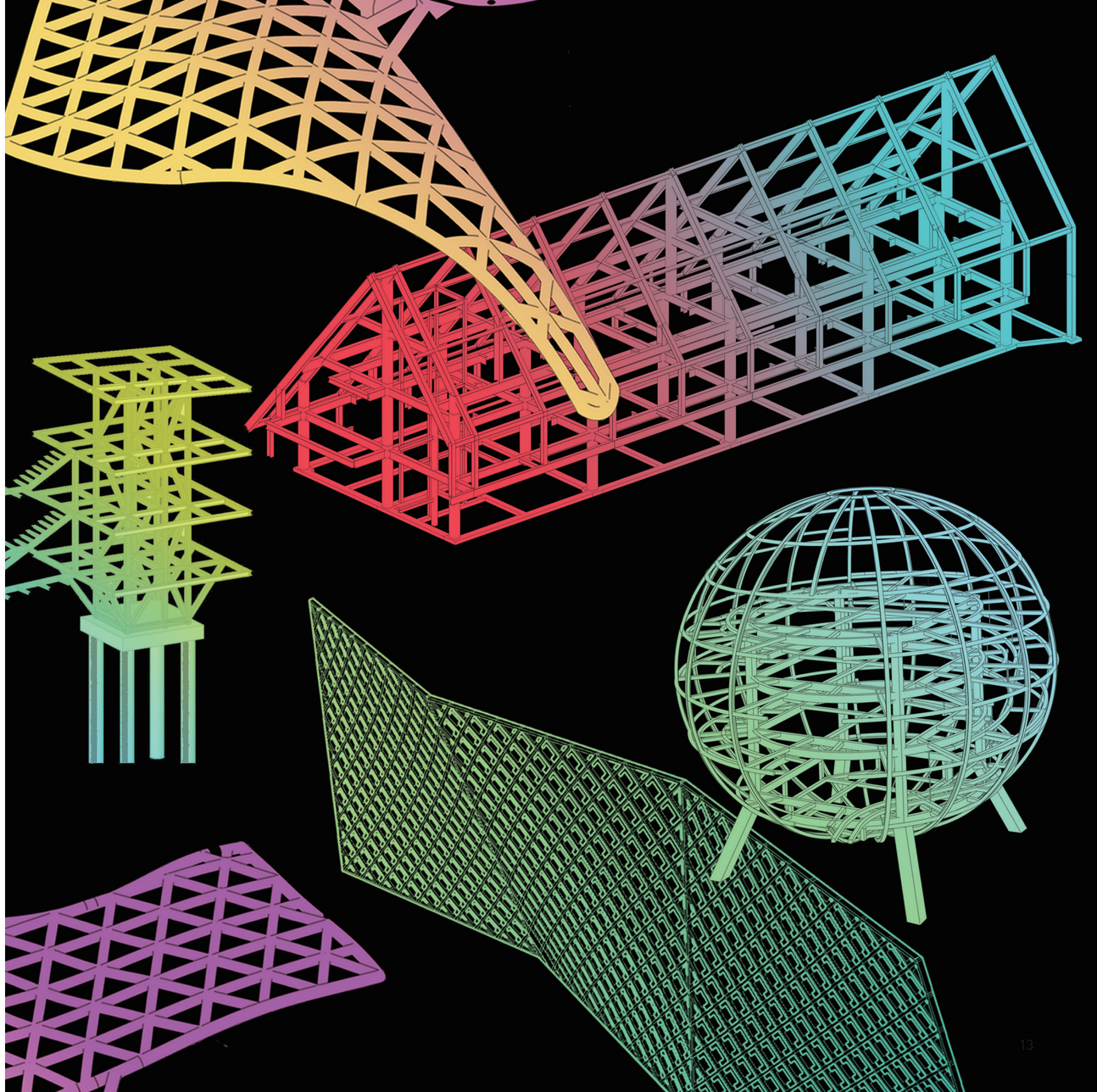


BI: BIOLOGICAL INTELLIGENCE

Nature has given us a colorful yet delusive expression on the surface of earth: day and night, seasonal changes, droughts and floods, not to mention thunder and lightning, earthquakes and tsunamis, tornados and hurricanes. This interchanges of phenomena form an enormous complex system. But for every complex system, there's always simplicity residing deep within in order to stabilize and sustain the system. Some simple patterns and principles can always be found beneath the bewildering surface of natural phenomena, that is the reason why we are able to forecast the weather and the rhythm of the tidal change; and because of it, life gets an opportunity to develop under relatively more predictable conditions.

Life seems to take the same footsteps as nature: organic beings acquire complex systems to respond to the multiple challenges from nature, and the same simplicity is also needed to make the complicated life-sustaining tasks imaginable. One of the perfect examples is the hereditary information of all organic beings which is recorded by merely four bases, ATCG. The other example is all of the trillions of cells of hundreds of specialized types from one single origin: the fertilized egg; Nature does not design a complex system, instead it uses some simple rules and the complex system emerges naturally. For us, this could be the true meaning of BI, that gave birth to the diversity of ecosphere we admire today.

Homo sapiens are arguably one of the most successful life form in our ecosphere, a part of this can be attributed to our ability to explore, identify, and understand the simple rules well veiled within the complex environment to improve our chance in the struggle for existence. In some respects the advancement of technology unshackled us from the limitation of evolution. We use technology to create materials that don't exist in nature and products that are designed to satisfy our endless desires.



SIX PRINCIPLES OF BIOLOGICAL INTELLIGENCE

ICE: FUNDAMENTALS OF LIFE

1 Information

It is understandable to say that a life's chapter consists of only four letters: the four nucleotides that constitute the information chains of DNA. Tens of thousands of proteins, responsible for the proper function of life, can be created through only about 20 types of amino acids that are composed from these four letters. Information is the essential core for the creation and function of life, its perseverance, duplication, and distribution is the source of life's self-consciousness as it gets stimulated externally while commanding bodily functions through the distribution of messages internally.

2 Circulation

For every life form, there is a network structured by a circulatory system that is responsible for organizing and transporting life-sustaining resources, and the expulsion of the waste created during this transportation process. However, there is no difference between resources or waste in an ecosystem, as the waste of one species can be the nutrition of another. All matters are confined into a continuous cycle of oxidation, decomposition, and re-composition, allowing the ecosystem to sustain itself indefinitely.

3 Evolution

As life evolves from a single-cell organism through the exchange and integration of genetic information, the ability to harness the light as life-sustaining energy and the capability to be mobile came to fruition. Evolution is not unlike a great musician who composed a magnificent symphony with only a limited amount of notes to work with.

IPA: STRATEGIES FOR SUSTAINABLITY

4 Inclusive

An ecosystem and its life forms contain a closely connected network that is dynamically balanced. The relationship inside of this network is both self-serving and mutually beneficial, competitive and cooperative, cruel and pleasant. As more members are included into the network, the more resources will be available and the more complex the system will become. However, as a result the network will become increasingly more stable.

5 Passive

As a self-organized system, life forms—and their ecosystem—are driven by the power provided by the sun; life forms use such power to produce elements and energy necessary to sustain life. On the other hand, an ecosystem can utilize the solar power to activate the mechanism of composition, decomposition, and distribution; or as others would call it, a sustainable cycle. Taking full advantage of the energies provided by nature—such as solar, heat, wind, and hydro—is the fundamental ability for all living creatures.

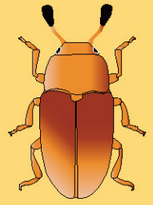
6 Adaptive

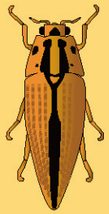
Evolution allows for life forms and ecosystems to transform according to its external condition. By transforming we are referring to the ability to efficiently acquire external resources for the purpose of sustaining life, and to reflect this ability on the external appearance, internal transmission of messages, management of bodily function, and self-perseverance mechanism.

IN NATURE...

ORIGIN

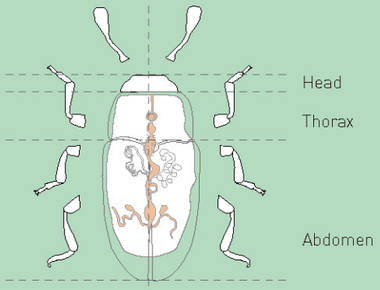
There are beetle species for any environment, but the majority live on land. Generally they prefer a humid location with availability of food.

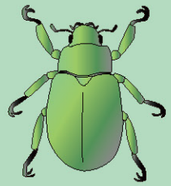




FORM

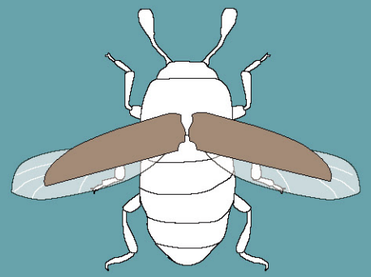
Beetles don't have an internal skeleton, their main structure is composed of an exoskeleton, which is their large shell, that provides support and protection. They have an opened circulatory system and their composition can be separated into three major parts: the head, the thorax, and abdomen.

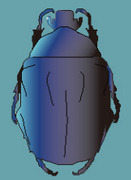




INTERFACE

Some beetles share their habitat with other species such as ants or termites. In order to be socially accepted they produce attractive secretions that please their co-habitants. Also, the adaptation to this habitat modifies their interface needs, causing them to lose their wings.Their exosleleton works as their protective shield.





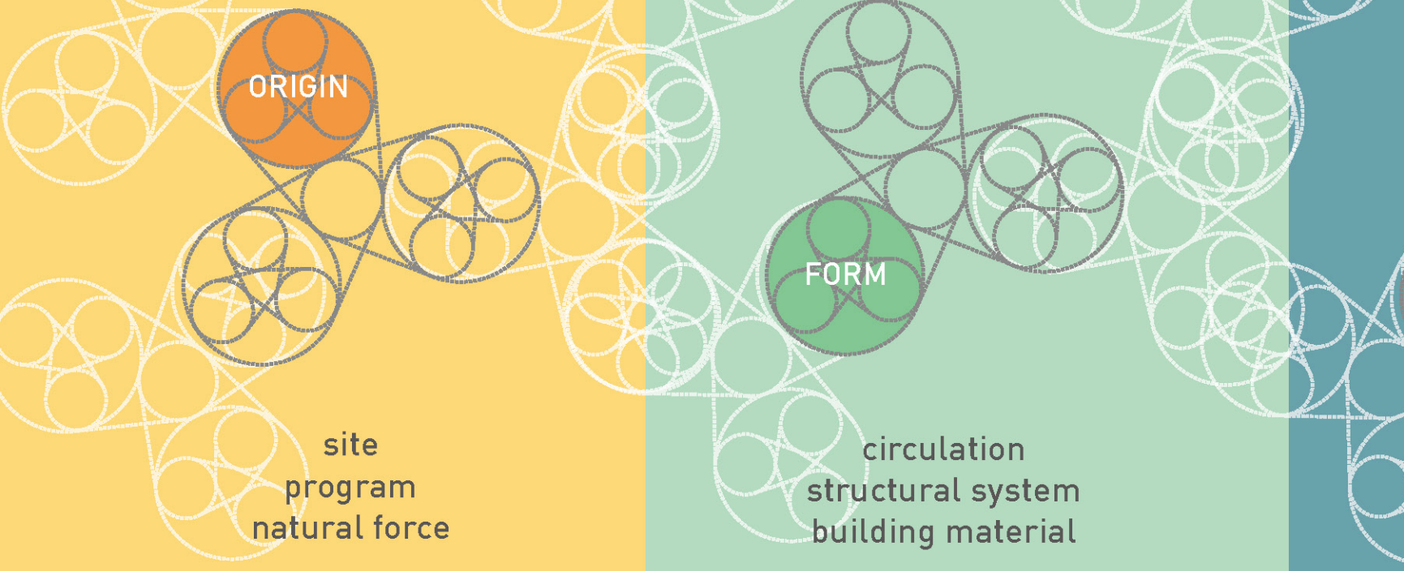
CIRCULAR

After going through four life stages in their development (from egg to larva to pupa to adult) just like any life form, the beetle becomes soil and fertilizer for new life.

IN ARCHITECTURE ...

ORIGIN

The birth of life: Three core issues corresponding to the design proposal phase: the condition of the site, the needs of the client, and the condition of the surrounding environment.



site
program
natural force

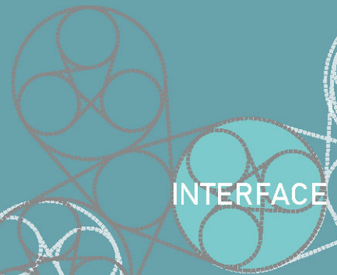
FORM

The evolution of life: Three core criteria corresponding to the design development phase that transforms abstract concepts into actual architecture: circulatory system, building system, and building material.

circulation
structural system
building material

INTERFACE

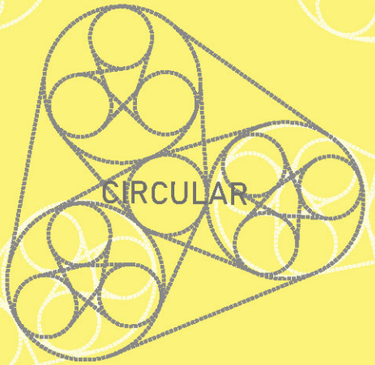
The relationship between life and its external surrounding: how architecture negotiates itself in a contextual setting; from its immediate surroundings, community, to a greater urban context.



hard interface
soft interface
social interface

CIRCULAR

The circular flow of life: the balanced loop of give and take, using prefabrication modular systems.



temporal
city
nature
interior

CREATIVE DESIGN FLOW INSPIRED BY BI

nine design modules for non-linear interactive design flow

As we look closer at how organic beings are constructed and function, we can find the significance of the hierarchical structure of modules. Modules from small to large: amino acids constitute protein, which is in charge of the operation of cell, cells constitute organs, organs constitute systems (such as the digestive system, the cardiovascular system, the respiratory system, the skeletal systems) which collaboratively constitute and sustain life. Arguably, life relies on modules to run daily operations, in so that modularization would simplify the preservation and duplications of genetic information and contain the risk of modification within the module.

The design process of transforming special requirements into physical form is a similar process to how life is formed. This is a highly complex design process that weaves together various needs, limitations, and abstract values into a seamless balance between estheticism, sociology, culture, and environmental concerns. To use nature as a teaching model, learning from the principle of hierarchical modular structures of organic beings, we can establish a hierarchical structure of interconnected modules within the complex architectural system that can enable us to create rich, diversified architecture.

A BI-inspired (Biological Intelligence) design process can be categorized into three steps and nine modules, which are driven by the 6 principles of BI: Information, Circulation, Evolution, Inclusive, Passive and Adaptive.