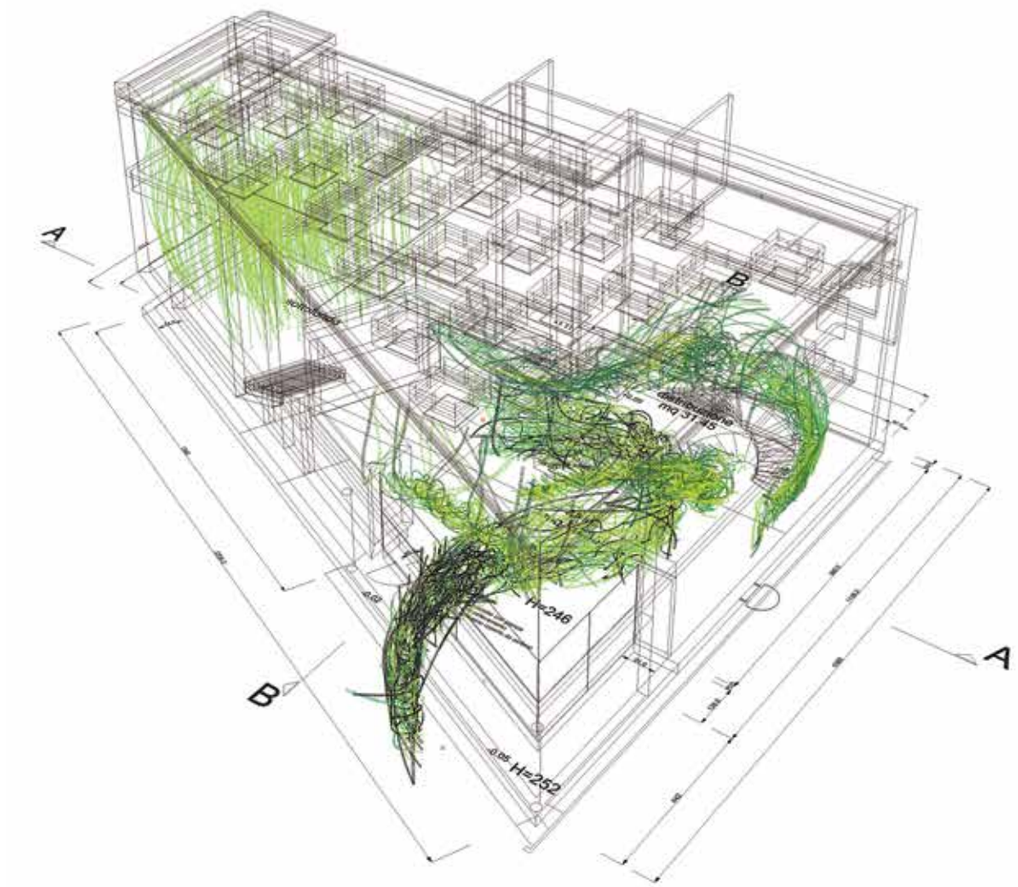
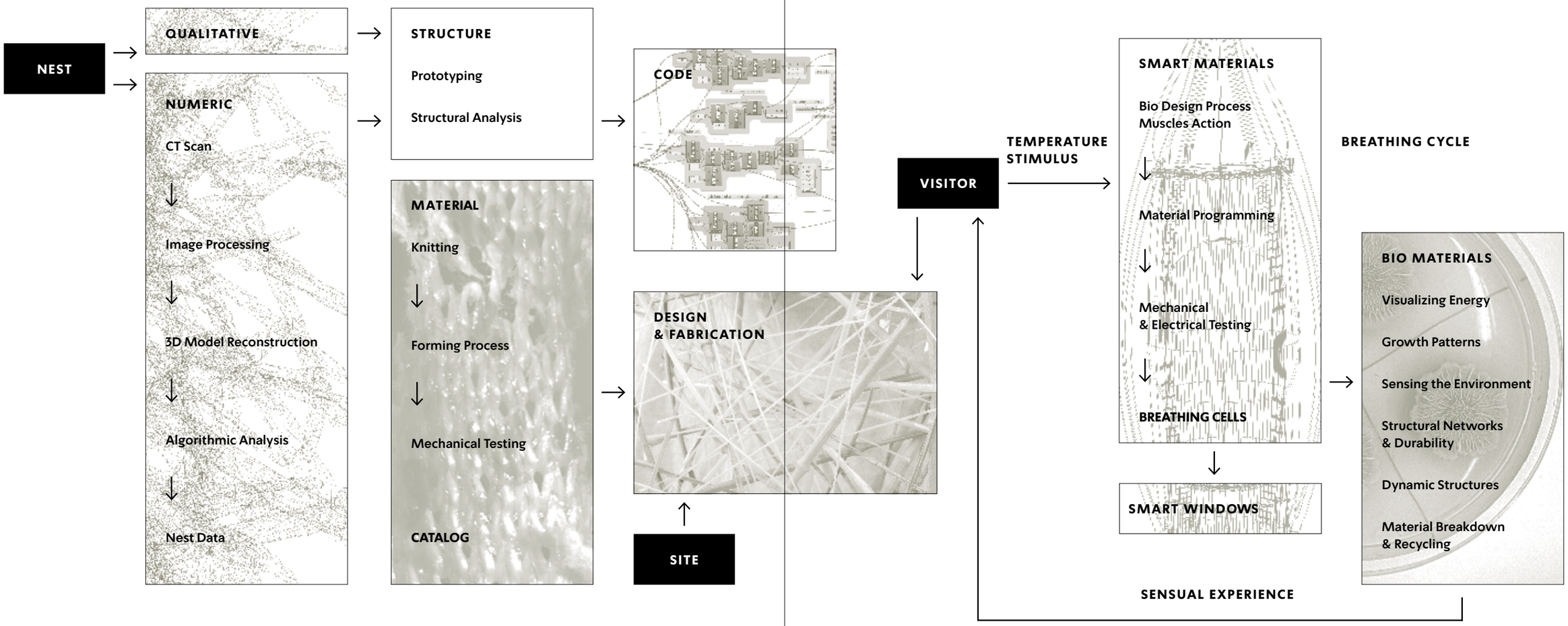
# LIFE OBJECT




NEST
QUALITATIVE
NUMERIC
CT Scan
Image Processing
3D Model Reconstruction
Algorithmic Analysis
Nest Data
STRUCTURE
Prototyping
Structural Analysis
MATERIAL
Knitting
Forming Process
Mechanical Testing
CATALOG
CODE
DESIGN
& FABRICATION
SITE
VISITOR
TEMPERATURE
STIMULUS
SMART MATERIALS
Bio Design Process
Muscles Action
Material Programming
Mechanical
& Electrical Testing
BREATHING CELLS
SMART WINDOWS
BREATHING CYCLE
BIO MATERIALS
Visualizing Energy
Growth Patterns
Sensing the Environment
Structural Networks
& Durability
Dynamic Structures
Material Breakdown
& Recycling
SENSUAL EXPERIENCE

**ADAPTABILITY**
APOPTOSIS
AUTOIMMUNE DISEASE
BIOMINERALIZATION
BUDDING
COMMENSALISM
**COMPOSITE MATERIALS**
**CONTROL**
DEATH
**DIFFERENTIATION**
ECOSYSTEM
**EMERGENCE**
**FEEDBACK**
GENOTYPE-PHENOTYPE
**FIBERS**
**FOLD**
GANGRENOUS NECROSIS
**HIERARCHY**
HYBRIDITY
HYPERTROPHY
IMMUNE SYSTEM
**INTELLIGENCE**
ISOMERS
**LIQUID CRYSTALS**
MEMBRANE
MEMORY
METABOLISM
MITOCHONDRIA
**MOVEMENT**
PARASITE
REFLEX
**RESILIENCE**
RESUSCITATION
RHIZOME
SCAR
SKELETON
**SELF-ORGANIZATION**
SYMBIOSIS
**SYNTHESIS**
TRANSPORTATION SYSTEMS
TUMOR
**VARIATIONS**

# A MATTER OF RESILIENCE

ARIELLE BLONDER

*LifeObject* is an architectural installation that transposes the resilient properties of a bird's nest, through scientific analysis, into a spatial form rich with new architectural perspectives. At the core of the installation are free-form volumetric airy surfaces undulating in space that are composed out of over 1500 slender and light components, inspired by twigs; relying on tension only, they form a light-weight, porous and resilient structure. The *LifeObject* combines smart, composite and biological materials in the formation of a 'living structure' that responds to its environment. Human presence around it triggers the opening of 'cabinet de curiosités,' revealing a variety of innovative biological elements to visitors.

The *LifeObject* materializes a series of abstract ideas, preoccupations and potentials in the present and future architectural field. The concepts proposed by the structure sketch alternative formal and structural languages informed by external disciplines. It hints at future applications and integration of biologically inspired materials that originate from various settings, scales and orientation.

Starting from the study of a biological structure, the *LifeObject* spans across all levels of animation, from the bio-inspired design of inanimate material, through dynamic inorganic material, to living material itself.

The *LifeObject* binds materials, technologies and alternative modes of design and fabrication in the creation of a complex system.

## NEW MATERIALITY

The meaning of complexity in architecture has changed considerably in the past few decades, and in tandem, so has the manner with which we approach and treat complexity; the focus has shifted from visual formalism to a material perception of the world that deals with pragmatism, mechanisms of performance and processes of morphogenesis. This new position towards matter[1] serves as the backdrop for the *LifeObject*. It is tightly linked to the introduction of digital media into architecture in the mid-1990s, placing fabrication and generative design processes as core concepts in architectural discourse. Computation, alongside concerns of sustainability, replaced compositions and semantics with matter and performance. New practices of material-making[2] that blur the boundaries between processes of digital fabrication, bring closer together design, fabrication and material research to take a central position in the architect's work today.[3] The revisited approach to craftsmanship, especially as relates to new possibilities engendered by the development of digital fabrication as digital craft, adds another dimension to these new architectural preoccupations.[4]

These new areas of architectural interest are not merely perceived as the expansion of the architect's palette of expression, but rather as the contemporary understanding of his duty and professional responsibility.[5] As such, materials' properties and their modes of transformation become motors of design, integrated as experimental research in material and fabrication; the architect now plays an active role in the development of materials and their making.

## [*LifeObject*] NEW MATTER

As an experiment of material research, the *LifeObject* evolved from the biomimetic study of a bird's nest into a new material system.[6] Depending on its framing, the installation can be understood either as matter, as a structure or as system. We manipulated fiber-composite material to make components that are assembled into a structure, which in turn, when seen as a whole, can be regarded as a porous structural substance that makes free-form volumes in space. Extremely light, comprised of a multitude of similar but varied components of low material density, it creates a stable yet flexible and resilient volumetric matter. In a process of learning through the material, rather than by a parametric control over it to optimize performance, matter becomes a generative force[7] that informs the design and construction processes, as modes of material making. Rather than integrating biological principles within a mechanical framework as a typical biomimetic process, we wish to embrace

1. For more elaborate discussion of the philosophical aspects of the new approach to materiality see opening text by Y. Eylat Van-Essen, "*LifeObject*, Merging Biology and Architecture" in this volume.

2. A leading example of bio-inspired material making using digital fabrication tools of rapid prototyping is the work of Neri Oxman with Variable Properties Rapid Prototyping (VPRP). For example, see Neri Oxman, "Variable Property Rapid Prototyping," *Virtual and Physical Prototyping* 6, no. 1 (March 1, 2011): 3–31.

3. For a review of different approaches to material based computational design, see Rivka Oxman, "Informed Tectonics in Material-based Design," *Design Studies* 33, no. 5 (September 2012): 427–55.

4. See, for example, architectural explorations of digital fabrication in the works of Marc Fornes at https://theverymany.com; Andrew Kudless at http://matsysdesign.com; and Lisa Iwamoto, *Digital Fabrications: Architectural and Material Techniques* (New York: Princeton Architectural Press, 2009).

5. Thomas Schröpfer, *Material Design: Informing Architecture by Materiality* (Basel: Birkhäuser GmbH, 2010).



biological values across all levels, not only in its design but also in the design process and construction method. The essential shift we have made towards the adoption of the biological paradigm by architecture lies in abandoning deterministic control in favor of an open-ended fabrication and construction process that is attentive to the qualities of this new matter-structure.

## [*LifeObject*] A MATTER OF BIOLOGY

This new materiality that we are presenting with the *LifeObject* is the product of dialogue between architecture and biology. A possible approach to portrait it is through common biological characteristics, suggesting that we can read The *LifeObject* as a biological material and a living organism.

The richness of natural materials and living organisms can be characterized by several common traits,[8] which by and large stand in contrast to the mechanically engineered world; bottom-up processes of growth contrast top-down traditional design approaches; multifunctionality diverges from optimized efficiency; and the biological adaptive qualities can be seen as the absolute opposite of planning and control. These deep concepts of design and operation constitute the core of living materials and indicate the biological qualities of the *LifeObject*. It is structured as a **hierarchical material***, building up from the fiber, through the knit surface, to the overall spatial aggregation that makes up the volumetric porous elements. A strong interrelation between all hierarchical levels directly affects the overall performance of the material. The fundamental natural process of **self-organization*** is reflected on several levels of hierarchy, implemented through processes of design, fabrication and assembly. The knit material finds its form by gravity to make the components, which in turn are assembled following a design code that combines randomness with preset values; these derive from the algorithmic analysis of the nest. Just as the distinct form of the bird's nest emerges from the random arrangement of twigs under mutual bending stresses, the overall form of the *LifeObject* is achieved by the **adaptability*** of its structure. Its free-form shape results from the mutual bending forces of its components, pressed between floor and ceiling. On the component level, its morphology is the outcome of its adaption to gravitational forces and boundary conditions. The mold-free fabrication process through which the components were made exemplifies **low-energy synthesis***, echoed in the joint-free construction process. As a multifunctional material, it combines structure with the functional elements of the 'breathing cells', into an integral system.

Taking "the indifference to one's surrounding"[9] as the distinctive element between the living and the non-living, a kind of re-visited vitalism, opens-up the possibility of regarding the *LifeObject* with its integrated 'breathing cells,' as a living system. Concepts such as movement, feedback and intelligence that distinguish the living from the inanimate, demonstrate

* For definition of these terms, see phrasebook in the following *LifeObject* section.

6. Material system describes "... the complex reciprocity between materiality, form, structure and space, the related processes of production and assembly and the multitude of performative effects that emanate from the interaction with environmental influences and forces"; it is extensively researched by Michael Hensel, Achim Menges and Michael Weinstock, *Emergent Technologies and Design: Towards a Biological Paradigm for Architecture* (Oxon, U.K.; New York, NY: Routledge 2010) 48.

7. Theorizing the new understanding of matter as possessing morphogenetic powers of its own through a revisited approach to causality, space and structure; see Manuel DeLanda, "The New Materiality," *Architectural Design* 85, no. 5 (September 1, 2015): 16–21.

8. An example for the characterization of biological materials can be found in the work of Marc Meyers; for example: Marc A. Meyers and Po-Yu Chen, *Biological Materials Science: Biological Materials, Bioinspired Materials, and Biomaterials*, 1st edition (New York: Cambridge University Press, 2014).

9. Exemplified by Catherine Ingraham's comment "Why all these birds? Birds in the sky, birds in the hand," in Alessandra Ponte and Antoine Picon, *Architecture and the Sciences: Exchanging Metaphors*, (New York; Princeton, N.J: Princeton Architectural Press, 2003), 238.

* For definition of these terms, see phrasebook in the following *LifeObject* section.

the *LifeObject*'s hybrid nature. It comes to life providing a kind of **feedback*** to human presence, activating both structure and space. 'Pores' in the structure open up to reveal biological wonders, and translucent glass surfaces in space change opacity to expose the outdoor natural setting. The opening of the 'pores' is facilitated by stripes of shape-memory material that form a moving screen. Programmed changes in molecular organization of the material create non-mechanical **movement***. The dynamic behavior of shape-memory materials acts as a material embedded motor, as a kind of material **intelligence***. The potential future integration of biological materials within the system, insinuated by the living matter displayed within the 'pores,' bears the promise of enhanced material intelligence, merging architectural materiality with the biological one.

[*LifeObject*] A MATTER OF RESILIENCE

The different characteristics of the *LifeObject* as reflected in its design, fabrication and behavior, relate it to living systems and biological materials. Standing in contrast to the architectural-mechanical paradigm, it is the system's natural properties that make up its resilient nature. In the same way that the redundancy of twigs in the bird's nest creates its resistance, the multitude of light and weak elements that compose The *LifeObject* enhance its robustness. The structure reaches ultimate stability by the multiple interactions between the elements as points of friction, contributing to its overall resilient nature.

"Diverse at its edge, while simple at its core",[10] it is the slight variation within the wide array of similar yet individual components that ensures the resistance of the structure to failure. Its design and construction, combining the pre-determined and the emergent, makes it insensitive to local errors and minor deficiencies.

10. Andrew Zolli and Ann Marie Healy, *Resilience: Why Things Bounce Back* (New York: Simon and Schuster, 2012).

**An iconic natural model of a home, the bird's nest was intentionally chosen for the enduring interest this structure has raised among architects and engineers in various perspectives, from the Beijing 2008 stadium of Herzog and De Meuron, to its CT scanning and computation as part of the Emergent Technologies and Design program.[11] For us, the starting point for the questioning of relationships between the artificial and the natural in the future built environment had to be the home. From there, through an experimental process of algorithmic analysis, coding, material research, alternative fabrication and design, the LifeObject has evolved to become a new matter of resilience.**

11. *Ibid*. 6, 21



A bird's nest, achieving complex form and resilient structure by simple components.