

# Synthetic Ecologies

## THE IMBALANCING ACT OF ENTROPIC ARCHITECTURE

The use of drawings or codes to exactly translate virtual instructions to their material actualization has historically played a decisive role in architecture. The current use of algorithmic design tools and computerized, numerically controlled fabrication technologies would, seemingly, all but eliminate the chance of an external

influence corrupting exactitude. Paradoxically, the seduction of algorithmic precision has become partially exhausted in the fulfilled promise of its own fidelity. The absolute control of geometry and its materialization suppresses the potential of that which exceeds the firmitas of inert matter. This exhaustion leads to a particular strain of contemporary design practice obsessed with capturing qualities that lie outside the realm of computational control, and would appear to be incongruous to the processes and tools used to generate them. It is the pursuit of the apparent and actual vagaries of matter in flux, albeit through the use of highly controlled algorithmic and machinic processes. The precisely figured melts into “the fragile border where identities do not exist or only barely so—double, fuzzy, heterogeneous, animal, metamorphosed, altered, abject.”<sup>1</sup> In some cases this incongruous state is reached through contamination, whereby synthetic architectural systems become informed by the integration of organic substances. In other instances, the incompatibility is the result of endowing material with sensing and actuating potentials, physically programming it to envelope and channel more evanescent forms of matter, producing differential atmospheres. Rather than an adherence to the “lawful inscription of information”—as some proponents of a parametric approach to design would advocate—this sensibility embraces that which disturbs identity and challenges our engagements with matter.<sup>2</sup>

The relationship between synthetic systems and organic matter can be, and has historically been, considered in terms of entropy. “Construction = minus entropy” was the equation formulated by metabolist architect Kisho Kurokawa in his 1969 essay “Capsule Declaration.” The job of the architect was “giving geometric order to a state of disorder.”<sup>3</sup> The metabolist agenda promoted an imbalance in the above equation on an organizational level through the encapsulation of architecture into units that could be reconfigured differentially over time. It is instead a potential imbalance in the equation on an energetic level that plays a critical role

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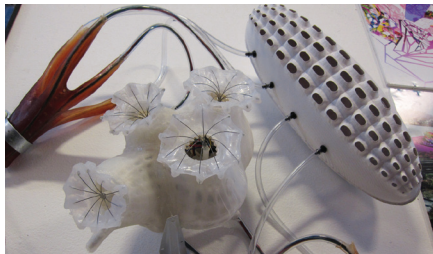


Figure 1: Ketii Carapuli—*Skin Fluctuation*—silicone and resin model of pneumatically inflated water filtration bladders

Figure 2: Jacques Lesec & Christopher Martin—*Transient Threshold*—silicone and wire detail model of condensation capturing surfaces

Figure 3: Jacques Lesec & Christopher Martin—*Transient Threshold*—silicone model of condensation capturing and water storage vessels

in the contemporary architectural discourse. Recent discussions centering on a more conscious and resilient administration of energetic and material resources in the production of habitable environments suggest a radical rethinking of the equation. How does the design of architectural environments, with the capacity to embrace entropic tendencies, breed a new strain of architecture? What effects do the latent responsiveness of energetic exchanges—specifically, the transfer of heat, moisture, sound and light through an architectural medium—have on more extensive ecologies? The attitude toward states of balance (and the lack thereof) is relevant not only in terms of the statics of bodies in space but, more importantly, in an ecological sense. Imbalances become active as the impetus of design innovation. A composite approach to material and environmental architectural systems emerges in this work.

A studio course I taught as part of the Emerging Systems, Technologies and Media (ESTm) postgraduate program at the Southern California Institute of Architecture (SCI-Arc) in the spring of 2012 explored these issues further in terms of what we referred to as synthetic ecologies. The studio, entitled *The Imbalancing Act of Entropic Architecture*, sought to design synthetic systems, taking into account their inherent material and physical biases and integrating them with performances gleaned from the biological realm. This calls for a novel understanding of the relationship between architecture, technology, and materiality—or what Alejandro Zaera-Polo has referred to as “the interferences between nature and the artificiality of its physical support.”<sup>4</sup> In his text, *The Politics of the Envelope*, Zaera-Polo proposed the incorporation of latent environmental and atmospheric performances into buildings in the interest of producing an architecture that is able to incorporate multiple forms of nature.

The application of digital technologies into design, information processing, and fabrication introduces an unprecedented level of precision into our transactions with matter. In this climate of assumed extreme technological precision, there are inevitably aspects of our environment that elude control, that compromise and exceed the firmity of inert substance. These aspects may be biotic, as in the case of vegetation. They may be climatic, as in a gradual engagement with the surrounding atmosphere through the filtering and exchange of air or water. The current paradigm is shifting from one in which architecture has historically tended to suppress the agency of matter in flux to one that engages with it. It is changing from control over, to complicity with, these fluctuating systems.

The studio developed a contemporary attitude toward the Vitruvian principle of firmity, or solidity through the use of materials that undergo shifts in their identity during the fabrication process. Various forms of composite materiality were investigated, such as the casting of fluid materials infused with microstructural elements for channeling air, water, and light. We conducted research into materials and modes of fabrication, emphasizing design techniques where morphological and material properties become allied to generate structural, environmental, and affective performance. In particular we considered the qualities and structure of material organizations in vegetation, identifying how specific features

augment various modes of performance: water flow and storage, shading and cooling, responsivity to sunlight, efflorescence, and color transformation. The hydrophilic and hydrophobic qualities of silicone and resin composites were activated as watershedding or channeling devices. In some projects, responsive systems were integrated into the building envelope in order to generate, amplify, or tamper with atmospheric effects in the specific region in which it is located. A focus was placed on transmitting different forms of energy (moisture, light, sound, air pressure) through a material envelope. These exchanges of energy are a driver for design performance, modulating atmospheric moods through varying shade, color intensity, lighting effects and sound ambience.

Taking as a starting point recent characterizations of the Los Angeles River as an urban freakology, the studio examined the potential for enhanced complicity between architectural and biotic systems in the context of a proposal for a vivarium housing vegetation indigenous to the Los Angeles River.<sup>5</sup> The vivarium site is adjacent to the river and the Los Angeles State Historic Park in downtown L.A. The vivarium was considered as a constituent of the adjacent park as well as a facsimile and intensification of the L.A. River biotope since the river itself is otherwise physically inaccessible to the public.

Landscape architect Gilles Clement's concept of the *Third Landscape and The Planetary Garden* were important references. The studio explored "the relation between humanity and the environment as a coherent system," taking into account the intermingling of climate, human activity, vegetal and inorganic substances.<sup>6</sup> Also, the aspect of interconnectedness that Timothy Morton raises in his formulation of a dark ecology was informative. The historical role of L.A. River flood control as a form of tampering with hydrological flows—and its both deleterious and ameliorative effects on the ecosystem of the Los Angeles River watershed—exemplifies the complex and sometimes radical performance of a synthetic ecology. The studio examined the role of synthetic ecologies in architecture, and considered how the constituents of a synthetic ecology may contribute to its fluctuating performance on a variety of scales.

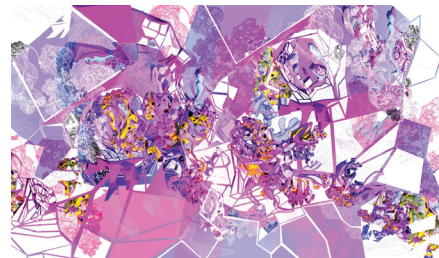
The projects *Skin Fluctuation* by Keti Carapuli and the *Transient Threshold* by Jacques Lesec and Chris Martin both deal with the filtration and collection of water and producing an awareness of water as a vital resource. *Skin Fluctuation* incorporates a series of pneumatically inflated silicone bladders, where water from the Los Angeles River is collected via capillary action and filtered through an evaporation process. The collected water is subsequently channeled to irrigate vegetation on the site adjacent to the bladders. Proximity sensors in the pneumatic bladders react to human interaction and trigger an increase in the internal air pressure when activated. The increased pressure tensions the silicone membrane, making it more transparent and thereby exposing the purification process. This is intended to increase awareness of the river as a beneficial constituent of the urban environment.



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Figure 4. Jacques Lesec & Christopher Martin—*Transient Threshold*—drawing illustrating information network indexing various LA micro-climates

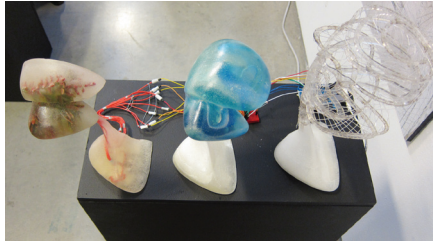
Figure 5. Tiffany Shaw-Collinge—*Salient Accumulation*—resin and wax model of surfaces in park for cultivating salt crystal growth

Figure 7. Christina Anton—*Synthetic Rhizome*—drawing of rhizomatic parkscape

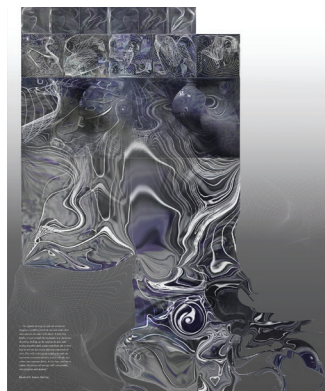
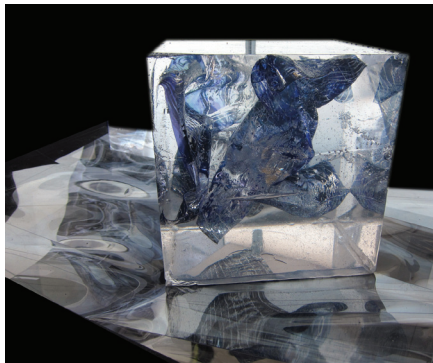
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Figures 7 and 8. Francisco Moure & Pablo Osorio—*Floating Garden*—resin and acrylic models of aeroponic vessels

Figure 9. Maya Alam—*Interference Fit Canyon*—entropic drawing and resin model of cube

*The Transient Threshold* project focuses on the collection, storage, and distribution of condensation that occurs during shifts in the ambient air temperature. A composite system is developed, using flexible silicone sheets that are infused with structural filaments to expand surfaces for the accumulation of condensation. These surfaces contract and enclose water within a permeable enclosure. Macroporosity and microporosity are used in the interest of maximizing water circulation for the cultivation of the synthetic vivarium. A parallel function that these units perform is their active participation in the indexing of microclimates found within Los Angeles' various ecologies. Sensors imbedded within the assemblages collect data about humidity and temperature, which contributes to a digital network stretching across the city. In conjunction with cultivating awareness about the fluctuation in water levels in the region, the site provides a dynamic interface for the public. The performance of these units pose interesting implications that call into question our conventional understanding of threshold. The circulation of water from the vessels, located on the exterior of a building envelope to the biocapsules found on the interior, effectively blurs the line between elements inside and outside.

*Salient Accumulation* by Tiffany Shaw-Collinge deals with hybridizing a brackish ecology that informs itself through the accumulation and evaporation of water. The vivarium is comprised of several small, semi-enclosed spaces for water filtration using a saline solution. Pressure and movements of fluid matter are captured and deposited into the volumes of the vivarium, where flows of water and salt crystal formation communicate growth within an expanding and contracting geometry. Multiple microclimates occur within the volume as each season passes, due to the formation and evaporation of water and accumulation of salt crystals. The salt crystals embed a novel, biologically productive environment on the site and create effects of reflection and transparency. Fluidity is captured within and outside of the cast objects as a reference towards multiple state changes found within the river, the envelope and the surrounding site. Alluding to the delicate balance between the exterior and interior space, reflectivity and layering between the envelope and salt growth question boundaries between the two paradigms. As the salt crystals spread out onto the ground surface, a delicate balance between brackish water and fresh water will occur, as it will alter and enhance the ambience of the vivarium and the vitality of the hybrid ecology.

The projects *Floating Garden* by Francisco Moure and Pablo Osorio and the *Synthetic Rhizome* by Christina Anton both deal with structures that become radically transformed due to their interaction with vegetation. *Floating Garden* is an urban parkscape that includes a field of lattice structures for aeroponically cultivating vegetation. These lattices are designed as permeable matrices that allow root systems and vines to surpass the envelope of the structure and create connections to adjacent lattices within the field. This produces an overhead canopy that becomes increasingly dense over time. This canopy reconfigures the existing park from a groundscape into a semi-enclosed architecture, and it simultaneously doubles the surface area for plant growth on the site.

The main concept in Christina Anton's *Synthetic Rhizome* project is to allow for different water levels in the Los Angeles River to influence the massing and the scale of a series of attachments to the concrete retaining walls of the river channel. These attachments act as anchors for root systems, and create various forms of habitat in the process. The project acts as a synthetic rhizome, gathering and storing water at various points, pulling the water through a fabricated root system via capillary action and using it to nurture various species of plant life. Some areas of the design are rigid, while others—which interact directly with water—are semi-rigid. This tension between various rigidities is enhanced by the negotiation between smooth, curved surfaces and hard, tessellated ones. The areas which are rigid include places for people to inhabit or structure needed to hold the rhizomes. In the flexible orbicular geometries, rigid volumes are nested inside these more fluid geometries for structural support. Depending on the water levels, these forms begin to float and the root system becomes engorged. In relation to the natural “freakology” of the region, elements native to the river, including detritus, will interact with the design, acting as an urban coral reef. The project is an interactive vivarium that fluctuates to adapt to different elements indigenous to the river. The form is never static: It may begin to move, swell, expand and contract as a result of the changing environment.

*Interference Fit Canyon* by Maya Alam uses an entropic drawing process to capture the coalescence of solid and fluid states of matter within a single object. The drawing is comprised of contours that delineate a cube with hard edges that appear to be soft from particular vantage points and soft edges that appear to be hard from others. These contours are mapped back onto the cube geometry in a transitional process whereby the legibility of the cube becomes progressively more inscrutable. The drawing process parallels the effects created by the presence of a cubic object within the L.A. River that disrupts the flow of water and accentuates the presence of detritus. A process of continual erosion acts differentially on the object over time, transforming its appearance and performance in relation to water flow.

These projects address the potentials of entropic architecture, broadly defined through a conscious embrace of corrupting influences—its engagement with organic substances, energetic exchanges, and matter in flux. Importantly, this points to a contemporary approach to design that challenges conventional notions of structural and environmental performance, solidity, and stasis. It also disrupts the discrete identities of what may be considered natural and artificial. As a process, this work involves a shift from the precisely figured toward a more entropic state, approaching the abject. The abject—literally a derivative of the Latin “to cast off” or “to jettison”—was described by Julia Kristeva in her text *Powers of Horror* as the reaction to a loss of distinction between the self and the other, involving a convolution of what we consider to be continuous or discontinuous.<sup>1</sup> The envelope of the body extends, its clear delimitation becomes viscid. In this work the envelope of architecture extends to encompass composite behaviors, conjuring the potentials of an architecture that embraces the fluxion of matter. ♦

## PROJECT CREDITS

### *Skin Fluctuation*

Project Design: Keti Carapuli  
Southern California Institute of Architecture (SCI-Arc)

### *Transient Threshold*

Project Design: Jacques Lesec & Christopher Martin  
Southern California Institute of Architecture (SCI-Arc)

### *Salient Accumulation*

Project Design: Tiffany Shaw-Collinge  
Southern California Institute of Architecture (SCI-Arc)

### *Floating Garden*

Project Design: Francisco Moure & Pablo Osorio  
Southern California Institute of Architecture (SCI-Arc)

### *Synthetic Rhizome*

Project Design: Christina Anton  
Southern California Institute of Architecture (SCI-Arc)

### *Interference Fit Canyon*

Project Design: Maya Alam  
Southern California Institute of Architecture (SCI-Arc)

## ENDNOTES

1. Julia Kristeva, *The Powers of Horror: An essay on Abjection*, trans. Leon S. Roudiez (New York: Columbia University Press, 1982), 207.
2. See Patrik Schumacher, “Parametricism—A New Global Style for Architecture and Urban Design,” *Architectural Design: Digital Cities*, Vol 79, No 4, (July/August 2009).
3. Kurokawa asserted, “The basic kinetic form in which space develops is metabolism, and its process is expressed as an increasing entropy. ‘Construction’ (minus-entropy) which is repeatedly put in during the development of space metamorphoses the ‘organization’ of the space. Modern architecture needs a methodology of metabolism and metamorphosis.” Kisho Kurokawa, “Capsule Declaration,” in *Metabolism in Architecture*, ed. Kisho Kurokawa (London: Studio Vista, 1977), 85. Originally published in *Space Design*, March 1969.
4. Alejandro Zaera-Polo, “The Politics of the Envelope: A Political Critique of Materialism,” *Volume 17: Content Management* (Fall 2008): 83.
5. David Fletcher, “Flood Control Freakology,” in *The Infrastructural City: Networked Ecologies in Los Angeles*, ed. Kazys Varnelis. New York: Actar, 2009.
6. Gilles Clement and Philippe Rahm. *Environ(ne)ment: Approaches for Tomorrow*. Montreal: Canadian Center for Architecture, 2006.
7. See Timothy Morton, *Ecology without Nature: Rethinking Environmental Aesthetics*. Cambridge, MA: Harvard University Press, 2009.
8. Kristeva, 1.