Teleplasty: The basis of chemosynthetic design

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Abstract

Is it possible that psychoanalysis, a discipline that allegedly deals with abstract or invisible entities, and entomology, a discipline that predominantly taxonomizes insects by type, can offer us an insight into the nature of digital design processes and emergent material phenomena? One of Roger Caillois' most controversial psychoanalytic theories, "teleplasty," shows that psychoanalysis and entomology can indeed suggest an alternative perspective of how bodily or other material substances are initially fabricated by insects and how they can further transform. In several of his case studies, Caillois claims alliances between material and psychical structures in his psycho-material teleplastic theorem and eventually questions spatial distinctions: distinctions between geometry and material, purpose and function, cause and effect, between the imaginary and the real.
Can digital media help us redefine the static relationship between a window and a wall as an interaction of chemical substances rather than a process of assembling joints and components?
Can we perceive material, not as an application to predetermined geometries, but as an inherent condition, a subatomic organization of matter that precedes geometry?
The aim of this paper is to problematize such distinctions as a discussion emerging through the prolific use of digital design processes.

> From whatever side one approaches things, the ultimate problem turns out in the final analysis to be that of distinction: distinctions between the real and the imaginary, between waking and sleeping, between ignorance and knowledge -- all of them, in short, distinctions in which valid consideration must demonstrate a keen awareness and the demand for resolution.[1]

Among distinctions in the production of space, one assuredly clear-cut is that between a wall and a window, the former a solid, the latter a void. Always, in the design of exterior building envelopes, this distinction is comprehended by the discrete demarcation of transparent and opaque areas; an envelope is partially pierced, framing perimeters of transparent and opaque areas.

However, along the lines of his influential essay "Mimicry and Legendary Psychasthenia,"[2] where Roger Caillois problematizes the scientific validity of clean-cut distinctions in the field of entomology, he proposes an alternative definition for a synthetic three-dimensional articulation of solids and voids that he identifies as *teleplasty*. Caillois, whose work idiosyncratically crossbred literary criticism, social sciences and psychoanalysis with his concurrent studies in biology, mineralogy and geology, particularly examines the process of transformation in certain species of insects on their way to "acquiring the morphological character," arguing that the objective for skin coloring and ornamentation of certain insects could not be interpreted crudely as the defensive reaction of a subject in its survival struggle. Due to pragmatic factors, which many biologists had pointed out at the beginning of the 20th century, predators are not all fooled by homomorphy or homochromy, other senses besides vision guide predators to track their preys. Further, inedible species, which would have nothing to fear from predators, are also mimetic.[3] In light of this evidence, Caillois sustained that the primary cause of mimetic transformation is *fascination.* In parallel, it indicates a multivalent disorder between the insect and its environment, or more precisely a pathologic display of amalgamation with space, as the subject enters into a psychology of depersonalization—psychasthenia—and attempts to achieve a biotic *de-synthesis* with its surroundings. Callois concluded that survival was in effect an "epiphenomenon whose utility appears to be null."[4] In the course of the metamorphic procedure, the subject retroverts to a primitive stage of development, turning back to previous life stages, as in the return of a primitive era, where the relationship between the subject and the environment was structured in different terms. This return is of such dramatic nature that the subject is diffused in space and time, whereas it distills entirely different organic behaviors and capacities that make one realize inconceivable phenomena under normal circumstances. In regression, there is a loss of functional unity and the various ego systems, both sensory and executive, operate in an asynchronous fashion.[5]But ahead of explanations in the sphere of a *psychospatial* turmoil, Caillois was effectively immersed in the nature of the very transformative process of the insects, *teleplasty:*

> Morphological mimicry could be, after the fashion of chromatic mimicry, an actual photography, but of the form and the relief, a photography on the level of the object and not on that of the image, *a reproduction in three-dimensional space with solids and voids*: sculpture-photography or better *teleplasty*, if one strips the word of any metapsychical content.[6]

One could argue that the proclaimed *teleplastic* articulation of solids and voids defies deeply rooted disciplinary assumptions in regards to form and materiality, as it unearths a decisive distinction: the contours that clearly delimit a separation between solids and voids, windows and walls. In its place, the process of *teleplasty* puts forward a bottom-up material

distribution, a composite deep skin where borders are of no relevance to its spatial composition. Essentially *teleplasty* rejects the adjunct process of defining perimeters in a greater master plan, suggesting a morphology "built into the very structure of matter"[7] as latent material; an argument which Caillois later elaborates in his 1960 *Mask of Medusa*, in which such inherent potential is claimed to be embedded into the anatomy of living things.[8] The metamorphic creature changes in such a seemingly random manner that one can barely distinguish which of the alterations regard its body and which its texture, which are superfluous and which are meaningful. It resembles an indeterminate mass of distributed, variable substances defying the qualitative presence of organs and systemic functions. One can only assume that for the creature in question, form and material intermingle in unorthodox, non-hierarchical ways such that certain parts of its body can be excessively, and others inadequately, structural and/or ornamental.

Figure 1: Membracides; Heteronotus Vulnerans. Courtesy of the Natural History Museum, London.

The mechanism of this phenomenon is unclear; the position of bodily organs, as well as their purposefulness is also unclear. It is crystal clear, however, that if we analyze the insect's pathologic transformation as a psycho-spatial structure, there are no distinct lines between its anatomical structure and its bodily matter; in other words, there is a fusion of form and material. This conceptualization of matter undergoing evolutionary transformations renders a counterpart model of architectural practice to the combinatorial multiplicity and the propagation of complexity through recursive unitary logic. t In the latter case, the unit represents a primary monad that can endlessly be repeated in multiple configurations, yielding overall complexity to a system. This logic though, although promoting variability, encompasses standardization as a technique for the monad and acknowledges the occurring variability as an effect of a larger system consisted or regular subsystems. With historical underpinnings in the theories of atomism,[9] this orthodoxy was introduced intact in computational processes that began to infiltrate architectural practice in the 1960s. On the other hand, *teleplasty* offers a counterpart to this orthodoxy, putting forward a variability of the bodily organ, the unit itself, that we may tentatively call "psycho-material" or "chemical change," suspending our thought from combinatorial logic. We may then identify *teleplasty* as a *smectic* material state, derivative from the Greek word "σμεκτός" meaning smeared, as in the case of liquid crystals in a *mesomorphic* phase, where molecules align in series of layers, form alliances and coalesce.

In a lecture given to Manchester University in 1952, Alan Turing speculated upon the chemical basis of morphogenisis. He suggested that "a system of chemical substances, called morphogens, reacting together and diffusing through a tissue, is adequate to account for the main phenomena of morphogenesis. Such a system, although it may be originally quite homogeneous, may later develop a pattern or structure due to an instability of the homogeneous equilibrium, which is triggered off by random disturbances."[10] The scope of that theoretical paper was to describe how patterns observed in animals could be explained as a result of the interactions between chemical substances operating within a mass of tissue.

> What laws are to control the development of this situation? They are quite simple. The diffusion follows the ordinary laws of diffusion, i.e. each morphogen [chemical substance] moves from regions of greater to regions of less concentration, at a rate proportional to the gradient of the concentration, and also proportional to the 'diffusability' of the substance.[11]

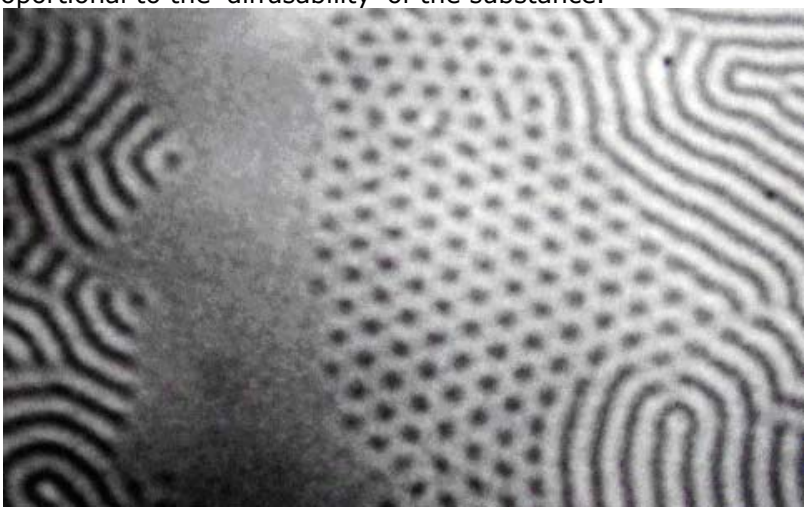

Figure 2: Turing patterns, J. Boissonade, E.Dulos, and P. De Kepper.

The Belousov-Zhabotinsky type reaction introduced by Belousov in the early 1950s and further investigated by Zhabotinsky in 1964, proved Alan Turing's speculations to be true.[12] Wave-like patterns emerged from the catalytic oxidation of malonic acid by potassium bromate.[13] By changing the properties of the environment through exposure to different lighting conditions, or by changing the concentration of either substance in the mixture, the system appeared to produce steady states.[14] Further investigations by J. Boissonade, E.Dulos, and P. De Kepper in 1995 have substantiated the relationship between conditions in the environment and the results of such reactions. Narrow, uniform regions, regions of clear spot exhibiting a hexagonal arrangement, striped areas, and areas of intricate mixtures of stripes and spots, all coexist in one sample, depending on the variation in concentration of the substances. By varying the section of the container in which the reactions take place, they trigger non-homogeneous pattern formations. They go on to make explicit, that the geometry of the container does not participate in any way in this process; its role is to control the concentration of substances within it.[15] Phenomena such as the above, have given rise to theories of self-organization and complexity.

The digital has often been criticized as being devoid of physical materiality[16] but such criticism may prove to be premature, and the medium, instead, should be interrogated for its capacity to redefine materiality.[17] The study of Caillois' psychoanalytical approach of mimicry and *teleplasty*, as well as Turing's mathematical speculations on the chemical basis of *morphogenesis* present alternative tectonic paradigms; still through the investigation of computational models, like incremental local adjustments in the case of mimicry and calculated emergent patterns in the case of Turing's chemical morphegenetic models. As an offspring of this discussion, many questions of relevance to contemporary computational modes of production surface:

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Caillois' *teleplasty* and Turing's chemical *morphogens* suggest an algorithmic process of incremental local adjustments none of which are individually spectacular or unique; but rather produce overall, through a sum of small insignificant details, a spectacular chemosynthetic material topography. Although in mimicry, for instance, the creature assays to match a given setting (or a given other creature), the manner in which this shift is accomplished numerically, pixel by pixel—for instance matching one green dot of its skin with one of the target image and so forth—reveals an infinite number of new possibilities, in the course of the morphological character being established. The collapse of multiple scales of formal adjustments, the parallel and seemingly random adaptation process of diverse members and substances are instances of such local textural complexity. This is a complexity produced not by "genius, inspiration, determination or evolution," but by a modest action of simple substitutions[18] "which cannot be caught up in any mystique of creation," to paraphrase Roland Barthes in his celebrated allegory of the Argo ship.[19] On the irrelevance of the greater master plan and the resurfacing of a reciprocal topography, Caillois notes it is not the presence of the elements that is perplexing and decisive, it is their mutual organization, their reciprocal topography.[20]

Despite the fact that Caillois' analysis concerns the surface articulation of certain species of insects, such alternative definitions are dissident to normative disciplinary assertions and correspond to a current open debate on the emergence of new creative models of production through computation and programming languages in digital media. Yet it is significant to note that if such a discussion is resurfacing after decades of exiling rule-based systems, this is not due to the fact that new utilities has been scavenged to legitimize these operations, but rather to the breakthrough of effective new means of expression within the realm of the digital medium. Embedded within the logic of the medium lies also the coming to the forefront of algorithmic functions, which have partially unearthed both material and formal doctrine, meaning that either form is derivative from the innate properties and potential of specific materials or that material is an application to predetermined forms.

Afar from the illustration of an indexical process to which many critics would disagree (including the current authors), this paper posits a tentative theorem on *teleplasty*, on the foundations of Roger Caillois' and Alan Turing's observations, via two design-research projects. Its ultimate scope is to problematize distinctions, especially as these are manifest in a priori conventions for the design of exterior envelopes. In the projects presented – *23° degrees*, *WindoWall*- one could lay claim that in many cases, the products necessitate an enhanced degree of tactile, optical and engagement from the user, who is urged to discover new ways of spatial occupation and senses of viewing through complex filters —envelopes— that mediate the relationship of exterior and interior in multivalent ways. *Teleplastic* space can hardly be a given space for consumption; it is nothing but a work in progress, a space, which forcefully requires its own reinvention.

WindoWall; From Wall to Gradient

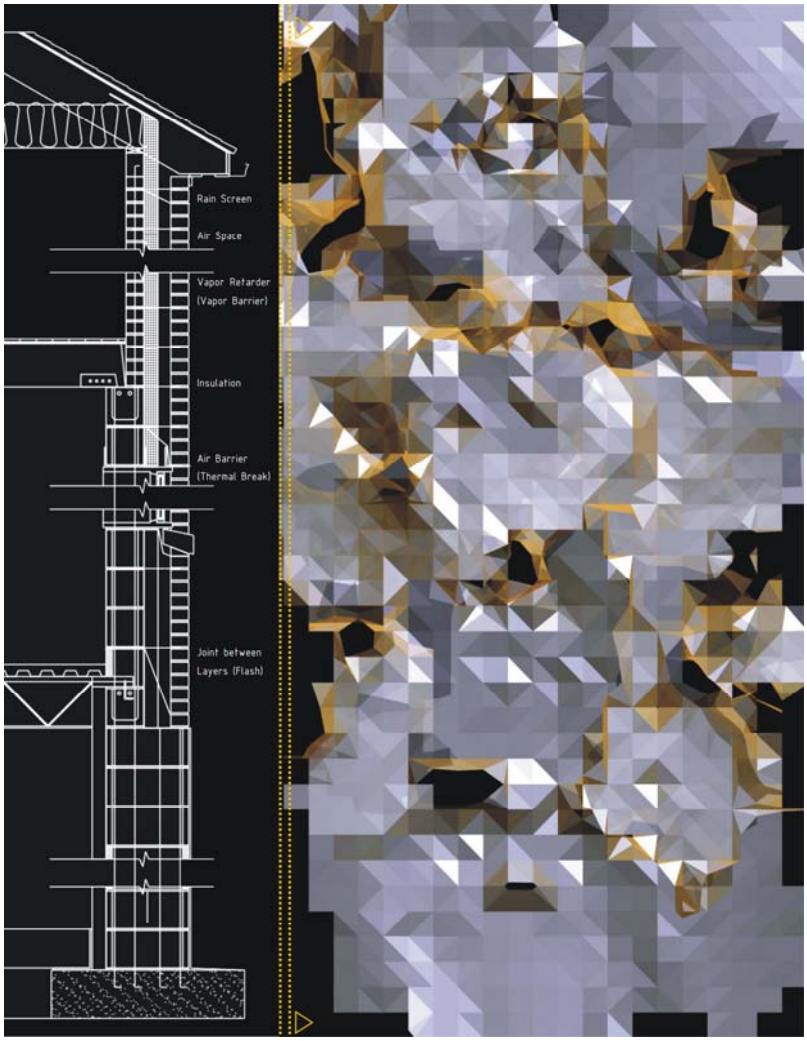

Figure 3: Conventional Section of a window and a wall versus *WindoWall* (Kallipoliti, Tsamis)

WindoWall is a composite component part for an exterior envelope assembly. It aims to eliminate the joints between a window and a wall, as well as to shift the notion of an 'edge' to that of a 'gradient'. WindoWall essentially substitutes the assembly as a third mediating piece that joins two elements with an area of gradient transition in a singular composite surface. By incorporating different properties within the same gradient surface-element, the component retains only these necessary material constituents that yield a specific local performance. The selection of materials, finalized in a combination of thermoplastic polymers, was decisive to the development of the project. From a wide range of polymer composite materials, selection was grounded on the exact mechanical and thermal properties of each, in combination to optical attributes in order to distribute transparent and opaque areas. For the precise measurement of extrapolated material properties in the new component, we used CES software, an application in the fields of nanotechnology and material science. Finally, we designed and manufactured a numerically computer-controlled electronic device, in order to facilitate the fabrication of complex components that assemble the WindoWall component.

Mass customization, as a concept, offers a conduit for investigation into the possibilities of a new digital tectonic. Our critique of their contemporary use is based on its adoption of a basic principle- the production of *single-purpose parts,* a relic from the period of mass production. With WindoWall, we aim to revisit John Ruskin's notion of the "chunk" where structure, infill, window, wall, insulation, ornament, etc. would be dealt with within a piece's variable material properties. We can always substitute the notion of structure and surface with the equivalent structural and non-structural body, the notion of the window and the wall with a relationship between transparent and non-transparent areas, changing the point of view from parts to properties.

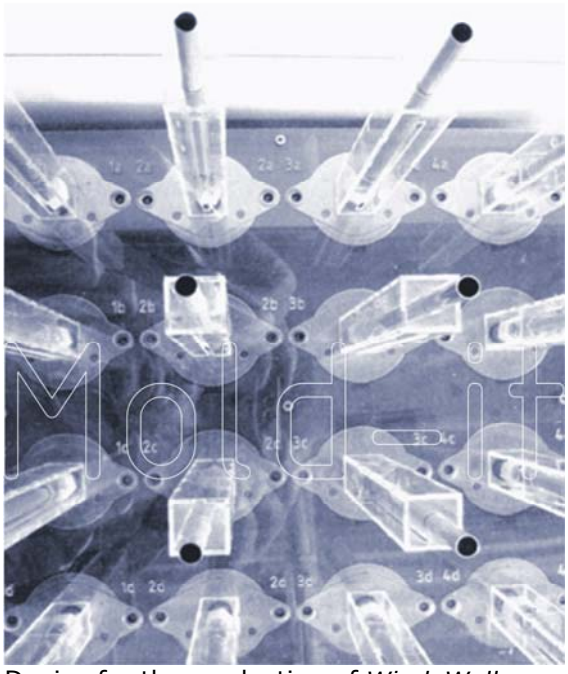

Figure 4: Mold it Device for the production of *WindoWall* components (Tsamis)

23° degrees; the rupture of the cataclitical space-frame

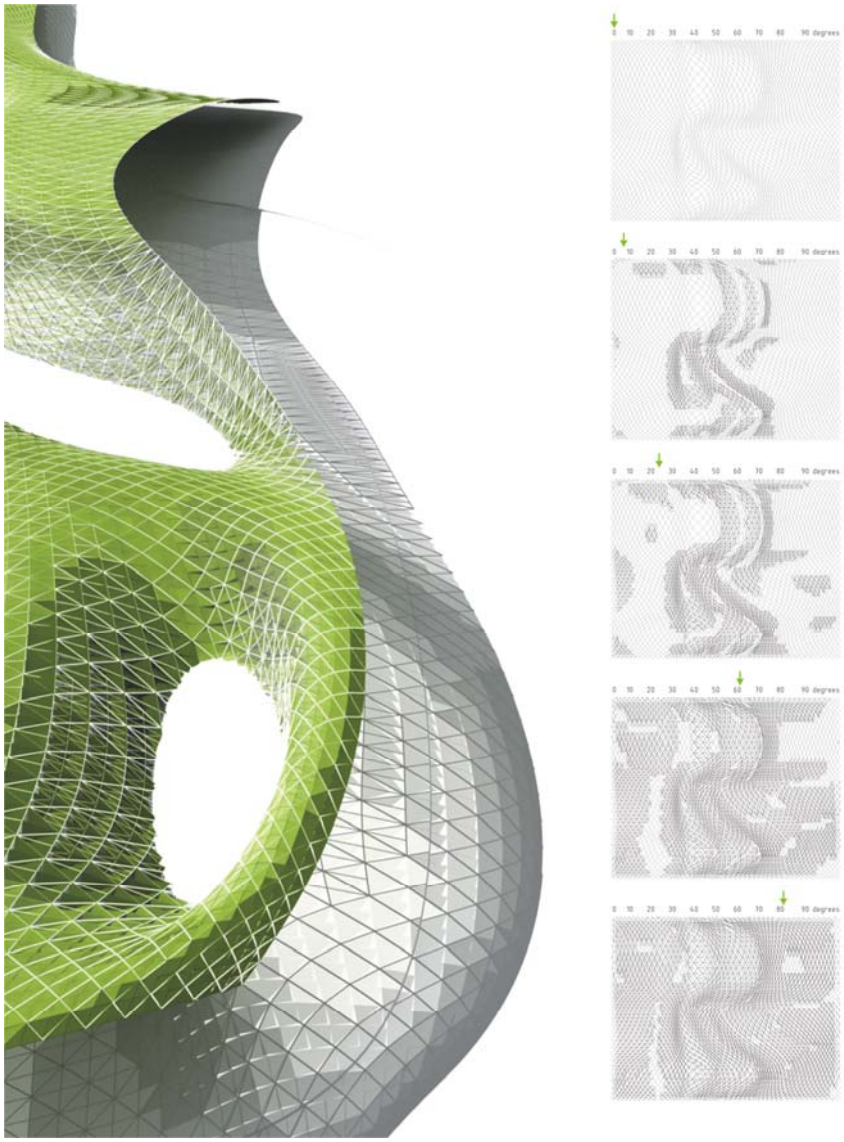

Figure 5: 23 degrees, cataclisis diagrams (Kallipoliti, Tsamis)

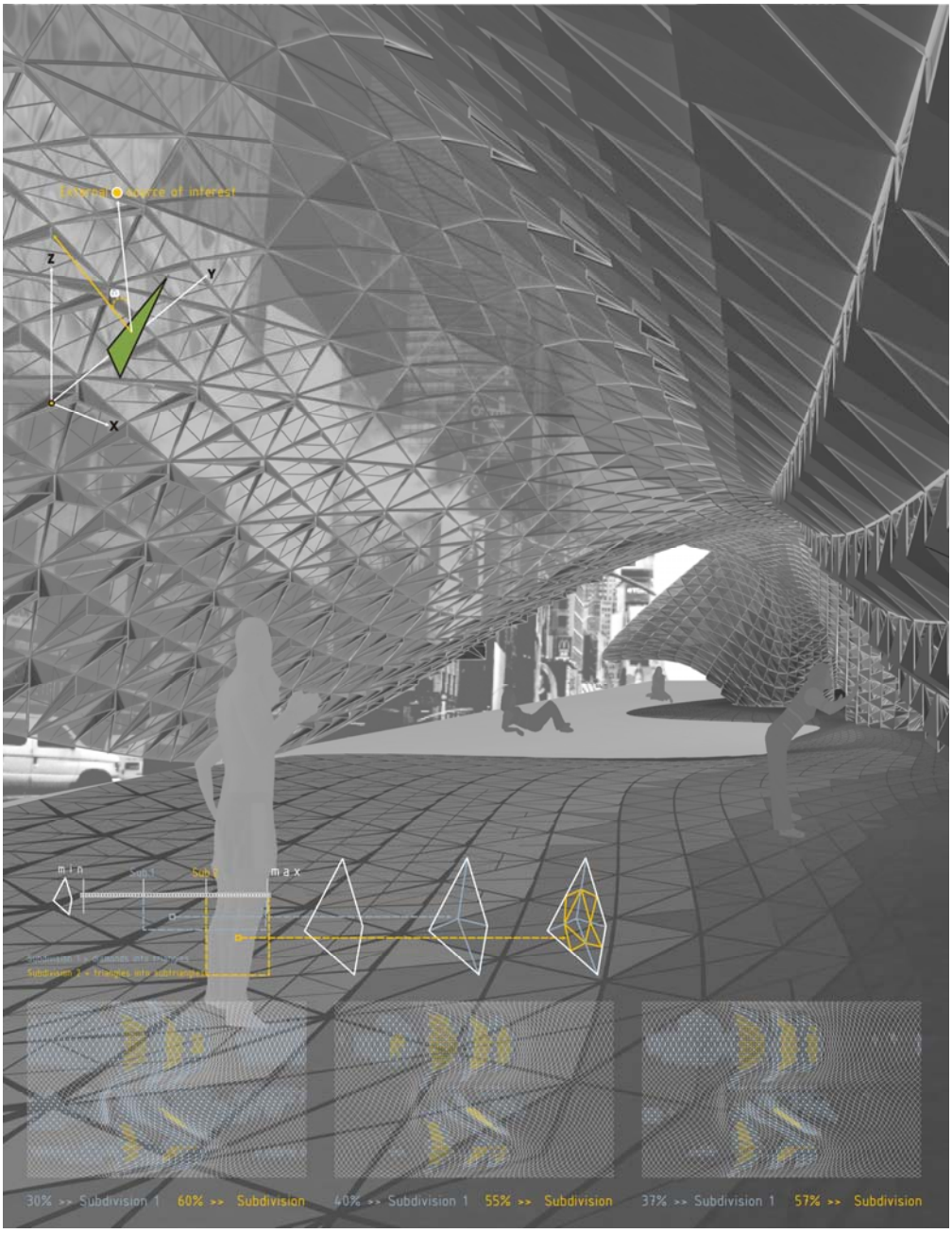

Figure 6: 23 degrees (Kallipoliti, Tsamis)

23º degrees is a design experiment for an exhibition space, redesigning the Crystal Palace. Rather than a design project, 23º degrees is a rule-based strategy of geometrically articulating the topography of complex surfaces. The variable, non-homogenous material allocation of the canopy emerges from precise rules and constraints that relate to a number of parameters including program, structure and vision. Methodologically, different design operators were created through the use of computer programming languages in order to

control and enhance the local structural capacity of the surface and the direction of vision through distributed apertures.

Endnotes

[1] Roger Caillois, "Mimicry and Legendary Psychasthenia" (1936) trans. John Shepley in *October 31* (1984):12-32.
[2] Ibid.
[3] Ibid.
[4] Ibid.
[5] Peter L. Giovacchini, "Somatic Symptoms and the Transference Neurosis" in the *International Journal of Psychoanalysis*, No. 44 (1963), p 148.
[6] Ibid.
[7] Roger Caillois, *The Mask of Medusa* trans. G. Ordish (New York: Clarkson N. Potter, Inc./Publisher, 1960), p. 12.
[8] Ibid.
[9] Democritus, the ancient Greek philosopher who articulated the theory of 'atomism,' was teaching and writing that all physical objects were created from different arrangements of atoms and voids that were never created and will have no end.
[10] Alan Turing, "The Chemical Basis of Morphogenesis," *Philosophical Transactions of the Royal Society of London, Series B, Biological Sciences*, Vol. 237, No. 641. (August 14, 1952), p.37
[11] Ibid, p.40
[12] See Nicholas G. Rambidi, "Chemical-Based Computing," *Molecular Computing* in Tanya Sienko, Andrew Adamtzky, Nicholas G. Rambidi, and Michael Conrad (Eds), (Cambridge, MA: MIT Press, 2003), p.109.
[13] Rambidi, "Chemical-Based Computing," in *Molecular Computing*, p. 109
[14] Ibid.
[15] Ibid, pp. 242-246.
[16] See Kenneth Frampton, *Tectonic Culture* (Cambridge: MIT Press, 1995).
[17] See Antoine Picon, "Architecture and the Virtual: Towards a New Materiality," *Praxis: Journal of Writing and Building*, No. 6 (March 2004), pp.114-121.
[18] Barthes is cited for his model on *substitution* and *nomination* by Rosalind Krauss in *The Originality of the Anant-Garde and Other Modernist Myths* (Cambridge, Mass: MIT Press, 1985), p. 2.
[19] The exact quote is the following: "To illustrate this notion of structure, Roland Barthes like to use the story of the Argonauts, ordered by the Gods to complete their long journey in one and the same shi- -the *Argo*- against the certaintly of the boat's gradual deterioration. Over the course of the voyage the Argonauts slowly replaced each piece of the ship "so that they ended with an entirely new ship without having to alter either its name or its form. This ship *Argo* is highly useful," Barthes continues. "It affords the allegory of an eminently structural object, created not by genius, inspiration, determination or evolution, but by two modest actions (which cannot be caught up in any mystique of creation): *substitution* (one part replacing another as in a paradigm) and *nomination* (the name is in no way linked to the stability of the parts): by dint of combinations made in one and the same name, nothing is left of the origin: Argo is an object with no other cause than its name, with no other identity than its form." In Krauss *The Originality of the Anant-Garde and Other Modernist Myths*, p. 2.
[20] Caillois, "Mimicry and Legendary Psychasthenia."