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# Ornamental Atmosphere & Digital De-lights

## The Reactivation of Light Ornaments Through Digital Design

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*Abstract.* “Ornamental Atmosphere & Digital De-lights” focuses on the reactivation of traditional and cultural craftsmanship of ornamentation using contemporary digital modeling and manufacturing tools. Conducted in the framework of a Franco-Egyptian collaboration between Ain Shams University - Egypt and the Grenoble School of Architecture - France, this communication proposes to describe the experiential methodology of an intensive workshop that took place in ENSA Grenoble in September 2019. The aim is to parametrically design and digitally fabricate prototypes of architectural envelopes whose patterns and light effects are a reinterpretation of traditional Egyptian architecture and its light atmospheres, while introducing variants to adapt the design to different situations and usages.

*Keywords.* Ornamental Atmosphere, Egyptian Light Heritage, Digital Design, Prototypes

### Ornamental Atmospheres and Digital De-light

The theoretical context on which this paper is based is that of the envelope (skin, membrane) and digital contemporary ornamentation as evolving architectural elements. Linked to the traditional moucharabiehs (ornamental wooden carved window), and the jalis (carved stone screen), the status of ornament was subject to a major change during the 20<sup>th</sup> century. As for envelopes, their status changes in the 21<sup>st</sup> century, as they become skins and membranes. As Manuel Gausa said so well, “Contemporary architecture replaces the idea of façade with that of skin: an exterior layer mediating between the building and its environment. Not a neutral elevation, but rather an active, informed membrane; communicative and in communication [...] an authentic interface between individual and environment; and the façade, into an (inter) active screen, the frictional boundary between the building and a context which changes overtime” (Gausa et al., 2003). Today, performative membranes must deal with issues linked to: perception, to the environment, structure and usage.

The question is how may we use the contemporary parametric modeling and fabrication tools (robotics, CNC machines) available today in order to revive, reactivate and reinterpret traditional architectural forms (that were usually made by hand) so as to create singular atmospheres and usages that are linked to them.

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### *The Status of Ornament Over the Years*

From a historical perspective, Adolf Loos in his 1929 essay 'Ornament and Crime' classifies ornament as superfluous and criminal stating that "Ornament is no longer an expression of our culture" (Loos et al., 2015). In the era of the 2<sup>nd</sup> industrial revolution, modernist notions of ornament were more specifically derived from the manufacturing processes as we can witness in Le Corbusier's work at l'Unité d'Habitation de Marseille, 1952, or by the sensory richness of materials used, like in Mies van der Rohe's Barcelona pavilion (1929). As Antoine Picon reminds us, "the differences between today's ornament and the design that prevailed in the Vitruvian tradition is that in Renaissance architecture and Baroque architecture, the ornament was usually concentrated at certain key points" (2013).

The 19<sup>th</sup> century English theorist John Ruskin, specified that one of the main roles of ornament is to keep in mind the productive hand of the construction worker and the technique used in building. With the advent of digital modelling and fabrication tools, ornament in contemporary architecture has taken a new turn: a more ubiquitous nature, adaptive to users and the environment, less repetitive and non-standard, but is still linked to the manufacturing process as in modernist times. Today the tool, the tool path and the implementation method used in digital fabrication is part of the expressive, symbolic and ornamental dimension, inheriting (and redirecting) modernist notions of ornament resulting from manufacturing processes.

### *New Technical Sensibilities and Expressive Techniques*

It is worth mentioning that technology is here at the service of culture, in a prospective logic, (inciting design innovation) and a resilient posture, (prolonging symbols inherited from the past) rather than in a disruptive attitude. "Architecture needs mechanisms that allow it to become connected to culture" (Moussavi, 2006). The digital surface becomes a medium of cultural expression linking past and present. This ornamentation reflects the convergence of the technical, the cultural, and the experiential. "The digital surface is not just the technical expression of the production tool, and the tool path, it is also the cultural expression as a tool for restoring traditions of craftwork" (Pell and Hild, 2010).

Fundamental to this technological and material experimentation achieved by varying different parameters like depth, porosity, density and testing different materials and matter organizations, new material and phenomenological effects are created. It is important to note that these material effects are not only visual effects, but experiential ones that can be lived at a body-wide experience. "Why the emphasis on the body? The renewed topicality of corporeality in architecture is a renaissance, revisiting a development that commenced at the end of the 19<sup>th</sup> century. Heinrich Wölfflin established, for example, that the spatial shape of architecture was not merely a matter of what you see, but is rather experienced in and by the body. Architecture was no longer characterized by its load-bearing properties, its works were judged in terms of the movement of experiencing them" (Böhme, 2013).

### *Mass Customization or a Bespoke Approach*

By the early 1990s, digital design emerged as fresh territory for architectural innovation. Computer Numeric Controlled (CNC) fabrication technologies in the late 1990s further enabled the realization of complex digital work. In the 1990s, the architect Bernard Cache explored the decorative field of pattern, texture and relief. He defended a vision of design in which the user, until then simply free to choose pre-existing elements, can intervene in the manufacturing choices.

The modification of design parameters, allows the manufacture of unique objects in the same series, thus making mass customization, or a bespoke approach possible. In his book *Le Pli*, published in 1988, Gilles Deleuze introduced the term *objectile* to designate the ability of differential and integral calculus to generate an infinite number of objects in a continuous series. Bernard Cache proposed the concept of “non-standard architecture” in his book *Terre Meuble* in 1995, to designate both the form of the works and the prefabricated, non-repetitive and often complex parts that digital architecture allows to realize.

### *Building Atmosphere: an Embodied and an Empathetic Experience*

The differentiated serial production made possible by the expansion of digital design and fabrication technologies has generated an exploratory profusion of pattern-making. Digital patterns are no longer repeated identically, they are dynamic, non-standard and adaptive to the environment, to different usages, and to situations creating changing light effects and visual relationships with the context. The continuum Design - Fabrication - Experience process that digital tools make possible is conducive to creativity and innovation. This feedback loop between design and production creates an iterative process introducing variations in the initial design pattern that can be tested by the users and the designer, thus creating new forms of experience and building new atmospheres. According to the architect Pallasmaa, “atmosphere is immediately experienced as a unity, in which all senses are simultaneously at work. The experience of atmospheric quality in architecture, then, is by definition an embodied experience. However, since architecture is subject to use, atmosphere is by no means a merely individual task. [...] it is crucial for architects to empathize with users, clients and other perceivers of architecture. He thus considered, next to embodiment, compassion as a necessary skill for architects to be able to build atmosphere” (Havik, Teerds and Tielens, 2013).

### **Reactivating Light Ornaments in Traditional Egyptian Architecture**

Antoine Picon states that “pattern that used to play a relatively minor role in the Western ornamental tradition, contrary to the Islamic one, now appears as one of the most common forms taken by ornament in contemporary project” (2013).

On this basis, we proposed an intensive summer school on Ornamental Atmospheres and Digital De-light that aimed to revive and reactivate the know-how of craftsmanship, both cultural and ancestral, of traditional Egyptian ornamentation by means of architectural robotics and digital design.

This one-week workshop was conducted in the framework of a Franco-Egyptian scientific collaboration between Ain Shams University in Cairo and Grenoble School of Architecture - France. This partnership mobilizes the cross expertise between the Digital RDL Research by Design Lab Chair (Label of the French Ministry of Culture), the Cresson laboratory (UMR CNRS AAU), the Grands Ateliers de l'Isle d'Abeau (GAIA), the Ecole Nationale Supérieure d'Architecture de Grenoble in addition to those of the Department of Architecture and Urban Design - Faculty of Engineering - Ain Shams University. This workshop took place in September 2019 in Digital RDL Research by Design Lab at the Grenoble School of Architecture. It permitted twenty Egyptian architecture students to work together with French architecture students from the RDL Master program: *Architecture, Ambiances et Cultures Numériques*.

### **Methodology**

The workshop is based on an experiential learning methodology of architectural

atmospheres that have been developed for several years at Digital RDL at the Ensa Grenoble. The principle is to develop a protocol which combines: an in-situ experience, abstraction by digital redrawing, the integration of non-standard architecture parametric design methods in a mass customization logic to develop an “ergonomic” design adjusted to the user, control of the design-manufacturing continuum to develop a serial production of artifacts to be tested before proposing a finalized version of a prototype to be manufactured, and finally the real or scenographic setting to take “inhabited” photos by the students of their project.

The start of the workshop consisted in choosing in Cairo, references of traditional architecture, (such as moucharabiehs, claustra or zenithal lightning of engraved or sculpted patterns) from the Islamic, Coptic, Nubian or Pharaonic cultural heritage, to be photographed. We therefore realized, with 7 groups of students 4 reference fields that Noha categorized with Egyptian students into a set of emblematic prototypes of a reactivation of traditional ornamentation using contemporary modeling and manufacturing tools available in Digital RDL and in the GAIA. One of the qualities of this workshop is the collaborative work between the students of each of our universities for the drawing, the production, the staging in LEICA (an immersive space of architectural design) and the final presentation. Finally, as part of the “Resilience” exhibition for which Amal was the curator, she chose to show and make visitors experience the passage from the representation in mock-up to the sensitive space of the experience. Each project is presented according to this tensioning of the small scale and the scale of the moving body.



Figure 1. Fabrication with Robotic arm in RDL - ENSAG (to the left); Photos of the fabricated panels in “Resilience” exhibition

## Parametric Light Effects

This process has allowed new effects and forms of light to emerge: filtered, diffused and scattered light (Fig.2).

### *Lacework - Filtered Light*

The original motif is found in a wooden door located in a Coptic religious complex called the “Hanging Church” in Cairo. The lacework as a light effect defines a form of filtered light resulting from the complex geometric form of the ornament composed of numerous tiny voids. The usage of parametric tools has enabled to vary the degree of light porosity by differentiating the density of the apertures throughout the membrane, creating therefore a light gradient.

### *Dynamic Light - The Overlap*

Here, kinetic light is created by playing with the depth of the façade. Students designed a double-skin membrane with two variant scales in which one or both layers slide and may be adjusted according to the desire of the space users and the quantity of light needed. Two projects tackled the overlap concept. In the first, the motif is inspired from a moucharabieh located in the Qälwäoun complex, a building representing Mamluk Architecture in Fatimid Cairo. The superposition of the two layers creates a new form of light. Used as window panels, this device provides both intimacy and dynamism in the visual experience. The second project is a fusion of two pharaonic drawings: the lotus and the Horus' eye. Here, the motif is applied identically on two wall panels that are overlapped.

### *Scattered Light*

The scattered light is defined as streaks of light that are found at intervals or on various locations rather than all together. It is a small quantity or amount of light sprinkled over an object or a surface. This form of light appears in a pattern initiated from the Nubian motif, in which students chose the triangle form. Parametric tools have enabled an irregular change in the size of the triangle, which creates large and small spots of light that penetrate the shaded zones.

### *Diffused Light*

The diffused light defines a zone of light with a homogenous distribution. Diffused light is a soft light with neither the intensity nor the glare of direct light. It is scattered and comes from all directions. Thus, it seems to wrap around objects. This effect results from two forms of motifs, originating from a moucharabieh located in different mosques: one in the Hanging Church above the gatehouse of the Babylon Fortress, while the other is found in the Hussein mosque in Fatimid Cairo, Egypt.

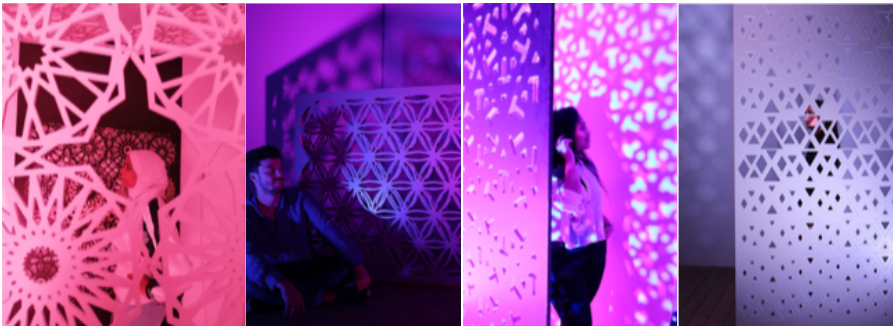


Figure 2. Panels: Lacework, Overlap, Scattered light, Diffused light

## **Conclusion**

The parametric redrawing of the existing geometric patterns enabled the regeneration of authentic geometric forms composing the architectural light elements through varying different parameters: depth, overlap, porosity and density. This process has allowed new effects and forms of light to emerge: filtered, diffused, and scattered light.

Digital design and robotic fabrication have played an important role in dealing with light as a design material for creating ambiances. The variation in densities and scales

of the geometric pattern provided a dynamic and adaptive non-standard pattern. The emerging pattern can respond to different environmental conditions and usages, offering therefore multiple atmospheres and various experiences.

The continuum “Design - Fabrication - Experience,” which singles out the experiential pedagogy offered by Digital RDL, has made it possible to develop a reflexive attitude in students’ thinking and has allowed them to explore the aesthetic qualities, as well as the ambiance and perception qualities of these contemporary envelopes.

This integration of non-standard architecture parametric design methods in a mass customization logic aims to develop an “ergonomic” design adjusted to the user, with a bespoke approach.

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