Scripting Shadows

Weaving digital and physical environments through design and fabrication

Eva Sopeoglou
Bartlett School of Architecture, University College London.
e.sopeoglou@ucl.ac.uk.

Abstract. This paper considers the opportunities of engaging in a creative dialogue between the physical and the digital, through the use of generative design tools and digital fabrication technologies. Digital iterations on an open-air installation for a pavilion take the shape of research in design. The design is partly driven by environmental parameters, such as the movement of the sun and shadows across a site in the Mediterranean. A fabricated microclimate is tailored through bespoke scripting and fabrication. In this project, rather than being used to optimise environmental parameters, scripting intents to offer a delightful milieu for human comfort.

Keywords. Scripting; digital fabrication; shading; environmental comfort.

DIGITAL DESIGN AND FABRICATION: BETWEEN HARD PHYSICALITY AND SOFT DIGITALITY

The physical aspects of architectural design are understood to be three-fold: the materials and the building itself, but also the people, as they take on active roles as the designer, fabricator and user; and, thirdly, the temporal aspects for the environment, such as weather, climate and natural elements, which in this case are the sun and shadows.

On the other hand, architecture consists of digital matter and exists inside digital drawings, fed with information [Figure 1].

In the condition of the digital drawing and the fabrication file, architectural design is able to navigate between hard materials and soft data. This paper will present a design case where both the digital and physical need to be considered.

DESIGNING WITH THE INVISIBLE PHYSICALITY OF ARCHITECTURE IN ENVIRONMENTAL DESIGN

There is always an inherent challenge when designing with invisible materials, such as the sun, wind, light and air. Working with such intangible, yet very physical materials, there is a need to visualise the information and place it in the design’s virtual environment.

Environmental parameters then enter the design not as physical, but as digital data. This digital data is, in turn, transforming the physicality of the project through fabrication. As a result architecture’s physical materials can interact with the environment and the building can interact with the site.
APPROACHING DESIGN THROUGH THE CREATIVE INTERPLAY BETWEEN CLIMATE AND ARCHITECTURE

There is a long history of designing with the climate, in vernacular and traditional architecture, where form is directly influenced by specific micro-climatic conditions. In more contemporary examples from architecture include experimentation in form-finding using scripting, parametric and generative digital tools, where again climatic data become a form-generator for architecture (Weinstock: 2011; Tsigkari et al: 2011).

Such examples demonstrate that is it possible to design with enough information from the site, architecture becoming more site-specific. However, often the aim of using scripting tools in design is in order to optimise a design, improving an aspect of its engineering performance. Often, environmental design becomes an instrument for optimisation. Other factors of sustainability and comfort, such as delight and the user's experience are given less priority in this process.

With the use of scripting there is an opportunity for the creative interplay between climatic data and fabricating materials, building components and the inhabitation of spaces. The project to be presented here is seeking to use digital aids as means to enhance creativity, at many levels: at the phase of design, also at the fabrication stage, and in the inhabitation, use and experiencing the place.

Thus, scripting and generative design becomes an opportunity for a creative architectural practise, where interplay is sought between design and the environment, rather than optimisation for engineering.

CASE STUDY: DRESSING THE BODY AND THE LANDSCAPE IN SHADOWS

The project presented here is of a summer house, in a rural seaside setting. Because of the wish to connect in a direct way to the place, there is very little distinction between inside and outside spaces. The structure is more of an outdoor pavilion and an architectural site-specific installation, with minimum requirements for an enclosure.

This project forms part of a larger research agenda, on the notions of environmental comfort and designing with the climate. This design-based research investigates architectural fabrics, in spatial enclosures between the body and the landscape. The thesis is formulated around the backdrop of Gottfried Semper’s (2004) tectonic theory on the principle of cladding and his suggestion of a decisive link between textiles and architecture [Figure 2].
A particular research focus is shadows and shading, conceived as ephemeral architectural fabrics which dress the city, the body and the landscape. Shad-
ows form a particular kind of architectural fabric, as they are temporary, ephemeral and nomadic ar-
chitectural entities. Moreover, shading contributes to time- and climate- sensitive design, at the same
time addressing aesthetic and performative aspects of a fabricated environment.
SCRIPTING SHADOWS AS DESIGN PROCESS

This on-going project is developed in a digital environment, using Rhinoceros design software [1], complimented by the plug-in scripting tool Grasshopper [2]. The scripts used so far in the project are mainly of three distinct categories:

- First, scripts to manipulate two-dimensional surfaces, which may represent a wall, roof or floor, representing architectural textiles. Digital manipulation enhances texture, in particular the texture of light and shadows. Scripts were used to read light and dark areas in images, which then generated surface textures for the project’s metallic panels [Figure 3].

- Second, the scripts were used as form-finding tools, in order to create three-dimensional shaded spaces. As the sun follows a set trajectory based on the location, specific spaces are equipped with tailored canopies, projections and vertical shading devices, in order to create a comfortable inhabitable shade for different times of the day.

- Third, scripting was used to track the sun and to visualise dynamic shadows as moving and nomadic temporal condition, in other words, a four-dimensional shaded space. Points of attraction are placed were people may interact with the architectural components, seeking an intimate perceptual experience of comfort. Because of the digital interface, it was possible to experiment with much iteration. Thus, versioning - or if using the fashion analogy, building a collection - becomes a process of architectural design. This mode of designing is an appropriate tool, since shadows are dynamic phenomena.

OUTPUT: WEAVING THE PHYSICAL AND THE DIGITAL

The design of the pavilion gives the opportunity to re-think how environmental principles are dealt with in a generative, parametric design context. This context is able to deal with the complexities of a dynamic system which develops over time.

The architecture generated using scripting design protocols is here aimed to explore options which offer variety, instead of narrowing down to an optimum best solution. Instead, it is used as means to creatively engage the designer, the fabricator and the user in collectively producing a playful mix of manufactured and hand-crafted environments.

In this sense, architectural digital design and fabrication extends from the production of objects to architecture, to describing a design process and a learning paradigm.

REFERENCES

Semper, G, Mallgrave, HF, Robinson, M and Getty Research Institute 2004, Style in the technical and tectonic arts, or, Practical aesthetics, Getty Research Institute, Los Angeles.

