Chapter 20

Platonic Solids and Spatial Visualization: Generating Complex Shapes Using Basic Three-Dimensional Operations

Beniamino Polimeni
Abdullah Gül University, Turkey

ABSTRACT

In the last decades computer graphics design systems emerged as key players in architectural design, on the one hand leading to a combination of parametric, process-driven architecture and applied geometry, and on the other hand, to a new role of architects as makers, and craft-people, able to bring together architecture as an interplay between art and craftsmanship. This unique dual perspective about architectural practice and education inspires this paper, which tries to analyze how a set of basic volumetric transformations can generate complex spatial outcomes. Using platonic solids as base volumes, we will explore different ideas, applying generalized extrusions, remesh schemes of subdivision and multiplication of the object’s faces, and a set of tools to create high-genus meshes. Starting from these new objects, a set of solid wireframe structures will be created as well. The goal of this process is to create a basic guideline to explore the spatial design language: a set of illustrated steps to activate architectural inquiry and to generate innovative design solutions.

INTRODUCTION

For the last 20 years, the significant impact of tridimensional digital modeling techniques on architecture has been well charted. From the use of ordinary drafting software to the more experimental use of generative design tools and parametric modeling, digital technologies challenged contemporary practice, playing a major role in architectural production from the initial form-finding stages to the final construction.

One of the main advantages of using these tools has been the possibility of creating and exploring complex shapes and geometries that have never been realized before.

The advance of computer graphics has fostered the interaction of architects, mathematicians and artists as well, giving birth to a series of interesting experiments in which geometry is used as a tool to model and fabricate an extraordinary variety of artworks and design solutions.

Many contemporary artists such as George Hart, David Brisson (Brisson, 1992), Helaman Ferguson, Bathseba Grossman, have combined art and geometry to create unusual and high-genus pieces of art (Akleman, Ozener & Yuksel, 2006).

Investigations and researches into geometries has been carried out also by architects such as Andrew Kudless, Marjan Colletti, and Michael Hansmeyer who have explored the use of algorithms and computation to generate original architectural forms.

In this work, we will try to describe and analyze one of the methods commonly used by these artists to construct interactively a wide variety of shapes. Starting from Platonic Solids as base volumes, we will define two design guidelines based on a set of topological mesh modeling operators used as tools to explore different creative possibilities. The aim is to put together the technical possibilities and an operative working knowledge of these methods, bringing new energy to the study of architectural forms. Interdisciplinary fields such as architecture and industrial design can benefit from this approach.

Figure 1. The lamp “Quin” realized by Bathseba Grossman is an interesting combination of art and geometry applied to an industrial object. (Grossman, 2012). Quin. [Online image]. Retrieved May 1 2015 from: https://www.bathsheba.com/gallery/mgx/quin/