Design Analysis: Methods and Results

Abstract. *NNJ* editor-in-chief Kim Williams introduces the papers in *NNJ* vol. 15, no. 1 (Spring 2013).

This Spring 2013 issue of the *Nexus Network Journal* (vol. 15, no. 1) is dedicated to “Design Analysis: Methods and Results”. Examined here is the broad range of questions regarding what and how to design that architects in every epoch and every culture have tried to answer. What lies at the basis of an architectural design? Is it a philosophy of design, or is it a structure that the design plays off of? It can be either, and it can be both. What is important is that mathematics often provides both meaning and structure for architectural designs, and this was as true in Antiquity as it is today.

Most of the paper published here were presented at the Nexus 2012 conference (see the Conference Report in this issue). We open with the Nexus 2012 keynote lecture given by Fulvio Irace and Anna Chiara Cimoli, entitled “Triennial 1951: Post-War Reconstruction and ‘Divine Proportion’”, about the landmark post-war meeting that brought together the leading lights of that epoch’s world of design: Le Corbusier, Rudolf Wittkower, Bruno Zevi, Pier Luigi Nervi, Max Bill, James Ackerman, and others. At a moment when Europe was struggling to rebuild and shape a new society following the devastation of World War II, the topic hotly debated at that historic conference was what system of proportion, if any, should be used by architects. At the time, Le Corbusier was promoting his own system of proportions, the Modulor, which he evocatively likened to a musical scale. In the paper by Radoslav Zuk entitled “Three Musical Interpretations of Le Corbusier’s Modulor”, we learn that since the dimensional ratios of Le Corbusier’s “scale” are much larger than the pitch ratios of the latter, the Modulor comes much closer to another structural element of music, that of harmony. By adjusting the Modulor ratios to the corresponding musical ratios of chords, three variants, Chromatic, Major and Minor, of a “musical” Modulor can be generated. Of course, the attempt to underpin architectural design with musical principles is nothing new. Michela Costantini presents another debate over design philosophy that took place two hundred years earlier: does the use of the so-called musical proportions guarantee that a work of architecture will be beautiful? In “Architecture and Music: Signs of an Eighteenth-Century Debate on the Harmonic Theory in Piedmont from Magnocavalli’s Manuscripts to the Reflections in the Academies in Turin” she shows how careful archival research has turned up evidence of that debate in the writings of Piedmont architect Magnocavalli.

One of the most frequently used tools to govern architectural design is geometry. One of its many ways in which geometry appears is in the form of a grid. The Romans, of course, were masters of the grid; knowing this provides a tool for analyzing their remains. In “Grid-Based Design in Roman Villas: A Method of Analysis” Eliana Manuel Pinho and João Pedro Xavier studied Roman villas in Portugal and used grids as tools for the analysis and the reconstruction of their plans. Grids are the object of another study presented here. The casual violence with which the various parts of the Tiburtine Villa of the emperor Hadrian crash one into the other seems to belie any possibility of a rational plan, but architect Michael Ytterberg believes that there is indeed an underlying order based on grids that overlap and rotate relative to each other. Once he had identified this,

he examined examples of modern architecture to find analogies. He outlines his findings in “The Hidden Order of Hadrian’s Villa, and the Order of Modern Architecture”.

Geometry can also serve a symbolic role. In “The Hidden Face of the Vault: Unveiling The Expression of the Avant-Garde Through the Use of the Sphere in Teposcolula’s Open Chapel”, Benjamin Ibarra-Sevilla shows how a complex ribbed vault designed on a hexagonal plan forming a semi-spherical dome lent both structural stability and a sense of meaning to a religious building constructed at a time when disparate cultures were blending.

Sometimes, however, geometry is not seen in a positive light. In his highly influential book *Languages of Art* American philosopher Nelson Goodman argued that that all visual experience is merely a cultural construct and that there are no a priori systems awaiting human discovery. Branko Mitrović, in “Nelson Goodman’s Arguments Against Perspective: A Geometrical Analysis” examines the faulty geometric reasoning that led to this thesis.

Searching for underlying systems and revealing the spectator’s experience in using a design is challenging work, but new technologies and new fields of knowledge are enriching the researcher’s toolkit. A rather recent new tool is fractals. In “The Design Evaluation of the Green Space Layout of Urban Squares Based on Fractal Theory”, researchers Jiang Liang, Yanqin Hu and Hui Sun from Dalian University of Technology in China have applied fractal theory to a comparison of four urban green spaces. The method they propose allows for quantitative measures, convenient evaluation, and potential feedback to improve the fractal quality of the green space design. Michael Ostwald and Michael Dawes compare and contrast two aspects of another recent tool, Space Syntax, to architectural analysis. Their results are presented in “Differentiating between Line and Point Maps Using Spatial Experience: Considering Richard Neutra’s Lovell House”.

Tools for understanding architecture and for determining the ramifications of a given architectural design can be borrowed from a number of fields. Chemist David Avnir and mathematician Dirk Huylebrouck have teamed up to give us a fine explanation of the trait known as chirality, an object’s property of potentially having a left-handed and right-handed form. In their paper, “On Left and Right: Chirality in Architecture”, they take examples of chirality from today’s spiraling structures such as those by Calatrava and Petra Architects.

This issue also includes a Conference Report of “Nexus 2012: Relationships between Architecture and Mathematics” written by conference co-directors Kim Williams and Michela Rossi.

Finally, we close with a book review by Terry Dwan of Sylvie Duvernoy’s *Elementi di disegno, 12 lezioni di disegno dell’architettura*, a book which discusses fundamentals of architectural drawing, a necessary tool for design methods and results.

About the author

Kim Williams is the director of the conference series “Nexus: Relationships Between Architecture and Mathematics” and the founder of the *Nexus Network Journal*.