LETTER FROM THE EDITOR

Analysis in Architecture and Mathematics

Kim Williams

Abstract Co-Editor-in-Chief of the Nexus Network Journal, Kim Williams, introduces sixteen papers in vol. 17, no. 1 (2015).

Since its very inception, the *Nexus Network Journal* has reported on analysis. Analysis at all phases of a building's life, from concept to built artefact to ruin, brings to light the many roles that mathematics can play in architecture—symbolic, governing, ordering. This issue of the *NNJ* is dedicated to a wide range of analytical techniques and results. Of the group of papers presented here, about half were presented during the course of the tenth international, interdisciplinary conference "Nexus 2014: Relationships Between Architecture and Mathematics", which took place from 9 to 12 June 2014 in Ankara, Turkey, hosted by the Department of Architecture of Middle Eastern Technical University (METU). All of these articles clearly demonstrate the fundamental importance of analysis for our field.

While the researcher can choose among a plethora of techniques for analysis, two approaches can be distinguished. On the one hand, contemporary methods and techniques are able to provide us with information about ancient works of architecture that could never be obtained before, and are thus valuable, even though such methods were unknown (even undreamed of) by the original architects. On the other hand, some researchers prefer to conduct analyses using only the techniques and tools that period architects and artisans might have used, and these can still lead to original results. Both of these approaches are found in this issue, along with a wide variety of tools, methods and techniques.

Two papers in this issue exemplify what I mean. In keeping with the venue of the Nexus 2014 conference, two papers presented in Ankara concerned works of Ottoman architecture from the same historic period. At the same time, they are

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illustrative the two different approaches just described. In "Measuring Form, Ornament and Materiality in Sinan's Kiliç Ali Paşa Mosque: an Analysis Using Fractal Dimensions", Özgür Ediz and Michael Ostwald use a technique aimed at overcoming the difficulty of quantitatively analysing these characteristics in order to permit the testing of theories to explain visual properties of Sinan's works. This is a fine example of using contemporary analytic techniques to shed light on architecture of the past. In contrast, a geometric analysis using methods available to architects of the period was used in "Nonagons in the Hagia Sophia and the Selimiye Mosque" by Antonia Redondo-Buitrago and Dirk Huylebrouck, whose observations of the patterns found in sixteenth-century Turkish architectural ornament provide mathematical arguments for original results regarding the regular nonagon and suggest practical ways to approximate its construction.

A first group of papers in this issue illustrate analyses of buildings, and in one case an urban landscape, that cover the entire span of architectural history, from ancient Egypt to the Roman Empire, from the fourteenth to the seventeenth century in Europe and North Africa, from the early twentieth century to present-day Lisbon and Zurich.

The analysis described in "Geometry and Proportions in the Funeral Chapel of Sarenput II" by Juan Antonio Martínez Hermoso, Fernando Martínez Hermoso, Francisco de Paula Montes Tubío and Alejandro Jiménez Serrano was carried out with the utmost respect for ancient sources, and in particular for Egyptian mathematical knowledge. Carlo Bianchini and Filippo Fantini, in "Dimensioning of Ancient Places for Spectacle through *Stereometrica* and *De mensuris* by Heron of Alexandria", presented at Nexus 2014, used new and accurate surveys of ancient buildings produced through 3D laser scanners and 3D point cloud models to explain through numerical examples formulas given by Heron for calculating the capacity of Roman buildings such as theatres, circuses and amphitheatres. Lionel March, in "Pal(l)adian Arithmetic as Revealed in the Palazzo Della Torre, Verona", presented at Nexus 2014, has undertaken a numerical analysis of Palladio's Palazzo Della Torre, no longer in existence, to suggest Palladio's fascination with the cube root. In "The Geometric Principles of Warped Rib Vaults in Central European Baroque Architecture from Guarini to the Dientzenhofer Family and Balthasar Neumann" Víctor Compán, Margarita Cámara and Francisco González de Canales have undertaken an evolutionary analysis of a particular form of a structural element— the warped ribs of seventeenth-century vaults—underlining the principles behind them and their description. Kenza Boussora, in "Formal Style of Medersa Buildings in North Africa", presented at Nexus 2014, aims to define the form of building facades and renew the empirical methods of style analysis by means of new tools for definition and analysis drawn from modern mathematics, namely topography and graph theory, aided by computer tools. To show that concern with proportion is not merely a thing of the past, Michael G. Smith and Rachel Fletcher have conducted a geometrical analysis of a Detroit landmark of the 1920s, which they present in "Proportioning systems in Wirt C. Rowland's Union Trust Guardian Building". Finally, José Nuno Beirão and Anastasia Koltsova, in "The Effects of Territorial Depth on the Liveliness of Streets", presented at Nexus 2014, illustrate the methods used and the results of their analysis of how the relation of building entrances with

the public space and entrance density determines the liveliness or liveliness potential of city streets.

A second group of papers in this issue concern analyses of techniques of representation. In "On the Use of Perspective by Juan de Herrera, Architect of Philip II of Spain", presented at Nexus 2014, Ana López Mozo performed a two-phase analysis: a geometric restitution performed to test the graphical construction and locate the position of the original station point for Herrera's perspective, then a 3D modelling of the actual dome based on a laser survey. Adding further to the discussion of perspective, Andrés Martín-Pastor and Gabriel Granado-Castro performed a critical analysis of an anonymous Spanish treatise on perspective dated 1688, finding that it represents a valuable contribution to the fields of perspective, architecture, geometry and the study and representation of architectural orders. Their results are presented in "A Contribution to the Study of Instruction in Geometry and Architectural Representation in Spain during the 17th Century". Perspective comprises a set of techniques intended in some way to trick the eye. We tend to think of it as being used in past ages in two-dimensional representations, but today anamorphic perspectives are being newly analysed for their ability to create modern optical effects in three dimensions. Francesco Di Paola, Laura Inzerillo, Pietro Pedone, and Cettina Santagati have carried out one such analysis, in "Anamorphic Projection: Analogical/Digital Algorithms". A final study regarding representation in this issue regards the development of a technique that will allow historians to reconstruct and analyse artefacts of the past through the use of spherical panoramas and epipolar geometry to create a 3D model. In the paper presented at Nexus 2014, "Toward the Interactive 3D Modeling Applied to Ponte Rotto in Rome", Carla Nardinocchi and Wissam Wahbeh describe a two-step photogrammetric process which leads automatically to the creation of the model.

Three contributions conclude this special issue. In our Didactics column, Tugrul Yazar's paper, "Design of Dataflow", presented at Nexus 2014, addresses the issue of how design education can reflect the use of dataflow programming as a promising platform for studying contemporary parametric modelling techniques in design, since architects and designers increasingly use it as their algorithmic sketchbooks. Maria Teresa Bartoli reviews Matthew Cohen's beautiful book, *Beyond Beauty: Reexamining Architectural Proportion through the Basilicas of San Lorenzo and Santo Spirito in Florence*, winner of the 2012 Premio James Ackerman for the History of Architecture. The issue closes with long-time *NNJ* collaborator Reza Sarhangi's "A Report on the Bridges Seoul 2014 Conference".

It was a great pleasure to edit this group of papers, and I am sure there is much here that will lead to further research for all those who love architecture and mathematics.

Kim Williams is the founder and co-editor-in-chief of the *Nexus Network Journal* and the international conference series entitled "Nexus: Relationships Between Architecture and Mathematics". She has published many articles in scholarly journals on the use of mathematical principles in architecture, and has edited a number of books on the topic. Her latest book, co-edited with Michael Ostwald, is the two-volume *Architecture and Mathematics from Antiquity to the Future* (Springer, 2015).