Entering a Third Decade of ‘Nexus: Relationships Between Architecture and Mathematics’

Kim Williams¹ · Michael J. Ostwald²

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The eleventh edition of the on-going conference series “Nexus: Relationships Between Architecture and Mathematics” took place 6–9 June 2016, in Donostia-San Sebastián, Spain. The conference was hosted jointly by the E. T. S. Arquitectura UPV/EHU and Kim Williams Books. The beautiful image on the cover of this issue is based on the competition-winning design for the Nexus 2016 conference logo by Vincenzo Fresta, featuring the skyline of Donostia-San Sebastián wrapping around its bay (Fig. 1).

The 2016 meeting celebrated the twentieth anniversary of our Nexus community, and followed the conferences held in 1996 (Fucecchio, Florence, Italy), 1998 (Mantua, Italy), 2000 (Ferrara, Italy), 2002 (Óbidos, Portugal), 2004 (Mexico City), 2006 (Genoa, Italy), 2008 (San Diego, USA), 2010 (Porto, Portugal), 2012 (Milan, Italy) and 2014 (Ankara, Turkey).¹ The Nexus conferences, out of which was born the *Nexus Network Journal* which you are now reading, are dedicated to the relationships between architecture and mathematics, explored through the broadest possible panorama of topics. That panorama is well represented by the first group of papers presented in this issue, *NNJ* vol. 19, no. 2, which were initially selected from among the twenty-three

¹ A more detailed history of the Nexus conferences can be found in Kim Williams, ‘Twenty Years of “Nexus: Architecture and Mathematics” 1996-2016’, *The Mathematical Intelligencer* **39**(2): 85–96, 2017.

✉ Kim Williams
kwb@kimwilliamsbooks.com

Michael J. Ostwald
michael.ostwald@newcastle.edu.au

¹ Kim Williams Books, Corso Regina Margherita, 72, 10153 Turin, Italy

² School of Architecture and Built Environment, The University of Newcastle, University Drive, Callaghan, NSW 2308, Australia

Fig. 1 The logo for Nexus 2016 designed by Vincenzo Fresta. Reproduced by kind permission

talks given at Nexus 2016 for development and refereeing. From these revised papers, eleven were chosen for the present issue.

Two of these eleven papers deal with the historical and contemporary influence of music on architecture. For the historical, João Pedro Xavier maintains that the oval-plan church of Clérigos in Porto was itself conceived as an instrument. His analyses 'The Church of Clérigos in Porto as a Baroque Musical Instrument' draws a comparison between the Portuguese work and others being built at the time in Rome and Malta. For the contemporary, the research team of María Carmen del Gómez-Collado, Rafael Rivera Herráez and Macarena Trujillo Guillén discuss 'Anna Bofill's Use of Mathematics in Her Architecture'. The team not only analysed the projects of the Spanish architect/composer, but spoke to her in person. Parts of that interview conclude the article.

A set of five papers represent research concerning vaulting. In 'Geometrical Analysis of the Coffers of the Pantheon's Dome in Rome', Licinia Aliberti and Miguel Ángel Alonso-Rodríguez present the results of contemporary metric restitution techniques employed to survey the soffit of this ancient vault, results that shed light on the possible laws governing the design. Authors Luca Cipriani, Filippo Fantini and Silvia Bertacchi also examine ancient Roman vaulting in 'The Geometric Enigma of Small Baths at Hadrian's Villa: Mixtilinear Plan Design and Complex Roofing Conception'. New materials and advances in centring made innovations in dome design possible, as witnessed by works built in the ages of Hadrian and Nero. Moving many centuries forward, Ana López Mozo and Rosa Senent-Domínguez bring us 'Late Gothic Asymmetrical Diamond Vaults in Spain', carefully analysing the geometry of seven cases in Spain of a particular kind of vault also found elsewhere in central Europe. Elena Pliego de Andrés, in 'The Germ of the Prinzipalbogen Concept in Bartel Ranisch', compares the descriptions of vaults published by Ranisch in 1695 with built exemplars in order to show the development of a technique for layout and construction of vaults based on a main

arch, or '*Prinzipalbogen*'. Vault construction continued to develop further in the seventeenth and eighteenth centuries. Architect Gian Giacomo Plantery developed new forms in the Savoy capital of Turin. Thanks to an extensive survey of Plantery's existing vaults, Marco Vitali has developed '3D Parametric Models for 'Planterian' Vaults in Turin', which includes original reflections on the comparison of parametric models with mathematical models.

The decoration of architecture provides very interesting examples that inter-weave architecture and mathematics. Sibel Yasemin Özgan and Mine Özkar have discovered one such example in medieval Seljuk architecture. Their in-depth analysis of it appears in 'A Thirteenth-Century Dodecahedron in Central Anatolia: Geometric Patterns and Polyhedral Geometry'. Sylvie Duvernoy and Giampiero Mele have looked for such examples in 'Early Trompe-l'oeil Effects in the Last Supper Depictions by Domenico Ghirlandaio'. Their results focus particularly on the relationship between the shape of the room that the frescoes decorate and the shape of the space that they depict.

Mathematics was used in architecture not only for beauty, but also for utilitarian purposes such as those of war. Roberta Spallone presents 'The 'Regular Fortress' by Guarini and the Citadel of Turin', in which, using the tools of graphical analysis and history of representation, she compares the models for the regular fortress described in Guarini's 1676 *Trattato di fortificazione* to the citadel of Turin as it appeared in his day.

New techniques of analysis often provide a reason to revisit works that we thought we knew everything about, overturning previous theories about them. Ju Hyun Lee, Michael J. Ostwald and Ning Gu, in 'A Combined Plan Graph and Massing Grammar Approach to Frank Lloyd Wright's Prairie Architecture', have applied a computational and mathematical approach to examine both grammatical and syntactical aspects of the style, thus taking into account social and functional properties that had been excluded from earlier analyses.

This issue of the *NNJ* also contains three research articles that were handled through the *NNJ*'s conventional submission and review processes. The research team of Jiang Wang, Jilong Zhao, Tianyu Wu and Jin Li present 'A Co-Evolution Model of Planning Space and Self-Built Space for Compact Settlements in Rural China', in which they define generative rules governing planning and self-built spaces in spatio-temporal evolution to determine a model that can help to build a new countryside in an intensive, compact and proven way and contribute to reducing farmland loss and related rural environmental impacts. In 'The Façade of Paolo Soleri's Solimene Factory', Adriana Rossi's careful geometrical analysis deciphers the unusual shape of the forms that compose the innovative building envelope designed in 1954 by architect Paolo Soleri. Finally, Angel Candelas Gutierrez, in 'The Power of Geometric Relationships in Mudéjar Timber Roof Frames', presents evidence of a geometrical system so strong that it permits a large portion of a roof frame geometry to be reconstructed based solely on a tiny fragment of the structure to which it belongs.

This issue concludes with a book review by Iryna Volynets of *Stan Allen: Four Projects*, edited by Benjamin Wilke. Allen's work on landforms is widely recognized now, and mathematical concepts and forms are an important part of it.

Our collective research is now entering its third decade, and we look forward to continuing to bring our readers high-quality, in-depth research that sheds light on the many aspects of the “nexus” of architecture and mathematics.

Kim Williams is the founder of the *Nexus Network Journal: Architecture and Mathematics*. She also founded and directs the international conference series ‘Nexus: Relationships Between Architecture and Mathematics’.

Michael J. Ostwald is Professor and Dean of Architecture at the University of Newcastle, Australia. He is a Visiting Professor at RMIT University and a Research Fellow at SIAL (Melbourne). He has held past academic positions in the USA and Hong Kong and worked for architectural practices in Australia, the UK and the USA. Michael has a PhD in architectural theory and history and a higher doctorate (DSc) in design mathematics. He is Co-Editor-in-Chief of the *Nexus Network Journal: Architecture and Mathematics* (Springer) and a member of the Editorial Boards of *ARQ* (Cambridge) and *Architectural Theory Review* (Taylor & Francis).