

Events

Nexus 2025

Relations Between Architecture and Mathematics

Maria Zack

The international conference *Nexus 2025: Relationships Between Architecture and Mathematics* convened from June 3-6, 2025, in the historic city of Andrea Palladio, Vicenza, Italy. Continuing a tradition of innovative interdisciplinary research, this year's meeting was hosted by the Department of Civil, Environmental, and Architectural Engineering (Ingegneria Civile Edile e Ambientale, ICEA) of the University of Padova and held in the elegant Palazzo Barbaran da Porto, the headquarters of the Palladian Museum.

Conference co-directors Kim Williams (Founder of Nexus) and Cosimo Monteleone (Professor at Università degli Studi di Padova) collaborated with a dedicated planning team and scientific committee to organize four days of intensive scholarly exchange.

The Nexus conference series, which fosters dialogue on the intersection of architecture and mathematics, began in Fucecchio, Italy, in June 1996. Subsequent meetings have been held every two years: 1998 in Mantua, Italy; 2000 in Ferrara, Italy; 2002 in Óbidos, Portugal; 2004 in Mexico City, Mexico; 2006 in Genoa, Italy; 2008 in San Diego, USA; 2010 in Porto, Portugal; 2012 in Milan, Italy; 2014 in Ankara, Turkey; 2016 in San Sebastián-Donostia, Spain; 2018 in Pisa, Italy; 2021 in

Kaiserslautern, Germany (but held online due to the COVID pandemic of 2020) and 2023 in Torino, Italy. The 2025 gathering in Vicenza marked the continued growth of this international community, bringing scholars together to present research and engage in wide-ranging conversations.

The first day commenced with formal welcomes from the co-directors, Kim Williams and Cosimo Monteleone. Guido Beltramini, Director of the Centro Internazionale di Studi di Architettura Andrea Palladio (CISA Andrea Palladio), welcomed the participants to Vicenza and Andrea Giordano, Professor at Università degli Studi di Padova and Dean of Civil, Environmental and Architectural Engineering Department, provided a welcome on behalf of the University. Ornella Zerlenga, Professor at the Università degli Studi della Campania Luigi Vanvitelli and President of Unione Italiana per il Disegno (UID), sent greetings on behalf of the scientific and cultural association.

The scientific program began with the keynote lecture, *Palladio's soave armonia*, delivered by eminent Palladian scholars Guido Beltramini and Deborah Howard. This lecture offered critical insights into the architecture of the Veneto during Palladio's era, effectively establishing a thematic connection

between the conference's core topics and its historical setting in Vicenza.

Following the keynote, the conference proceeded with contributed paper sessions. The extended abstracts of the presentations can be found in *Nexus 2025 Relationship Between Architecture and Mathematics Conference Book*.

Day one centered on architectural analysis and mathematics behind design. Sessions titled *Architectural Analysis I and II* focused on the examination and interpretation of numerical and geometric principles in specific structures. The case studies were wide-ranging, covering the design work of Frank Lloyd Wright, Andrea Palladio, Aldo Rossi, Kazunari Sakamoto and Carlo Scarpa. The second session employed geometric analysis and digital reconstruction to interpret historical architecture and texts, including Guarini's Chapel of the Holy Shroud, Girona Cathedral, and military architecture treatises from the 16th and 17th centuries. The session *the Mathematics Behind the Design* explored the underlying mathematical structures used in architectural design, often utilizing computational tools to analyze structures such as Gothic cathedrals, medieval monasteries, and Byzantine brick vaults.

Day two began with the session *Algorithmic Design*, which addressed



Fig. 1. Poster of the event.

the application of algorithmic, computational, and recursive methods to architectural modeling including soft curved folding and Gothic microarchitecture. This session *Rule-Based Design* followed. The session focused on generating and analyzing architectural forms using formal systems such as shape grammars and classification rules integrated with computational methods and artificial intelligence. Applications included modeling bridges and designing oval stadiums. The afternoon featured a session on *Didactics* which explored geometric models, digital tools, and creative exercises for teaching mathematical concepts to architecture students. Topics included curve tracing, anamorphosis, and complex surfaces. *Perspective and Projection* was the final session of the day. Presentations in

this session analyzed theoretical and practical applications of perspective in historical architecture and art, including works by Sebastiano Serlio, Andrea Pozzo, and Masaccio's *Holy Trinity*. A final demonstration showcased how relief perspective and 3D printing are being used to enhance students' spatial understanding.

Day three began with a session on *Surveys and Models*, which centered on applying digital and geometric methods to accurately survey, measure, and model existing historical buildings. These presentations featured highlighted several different digital tools and provided case studies of their use. This was followed by *Urban Design*, which explored the mathematical, geometric, and structural principles in urban planning. The representation of Portuguese cities and the design of adaptive cities were among the examples presented. The afternoon featured a session on *Structures*, which considered the role of mathematics in structural design and construction. The use of a three-dimensional version of the catenary for the construction of a roof and the building of tile vaults were among the examples presented. *Geometric Design* was the final session of the day. These presentations highlighted use of polyhedral forms in several settings including art, housing, and sacred spaces. In keeping with Nexus tradition, the conference organizers hosted a social evening on the third day of the conference. Participants enjoyed a light dinner in the Palladian Museum's garden, followed by a private concert at Palladio's spectacular Teatro Olimpico.

Pianists Stefania Redaelli and Maria Grazia Bellocchio performed a four-hands piano concert featuring the *Hungarian Dances* of Johannes Brahms. This lovely evening was one of the highlights of the four-day meeting.

The final morning began with a session on *Reconstruction and Modeling*, where presenters explored the use of geometric and digital tools to analyze both historical architectures, such as the Teatro San Giovanni Crisostomo, and modern works, including those by Giuseppe Samonà. The morning concluded with a session dedicated to PhD researches. This session offered students who are currently enrolled or recently graduated (2023-2025) an invaluable opportunity to present their work and receive feedback from an audience of professional scholars and architects. The conference officially closed with an afternoon tour of Vicenza's architectural treasures, including the Basilica Palladiana, the Church of Santa Corona, and the Civic Art Gallery at Palazzo Chiericati.

Founded by Kim Williams in 1996, the Nexus conference series has long served as a forum for interdisciplinary dialogue. Williams directed the series through 2023. Following her retirement in 2024, the *Nexus Network Journal* was acquired by Springer Nature, which will continue its publication. In 2025, the no-profit association Nexus Architecture and Mathematics APS was founded to coordinate future conferences. The meeting in Vicenza was the first organized by the association. The next meeting is scheduled for the summer of 2027 in Cartagena, Spain.

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