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Didactics

Drawing, Form and Architecture: Two Projects for First-Year Students

Abstract. Two recent projects for a first-year course in drawing for architecture students have been organized by Sylvie Duvernoy, Michela Rossi and Kay Bea Jones. The first, a four-phase program centering around a tour of the architecture of the Midwest in the United States, was implemented in Spring 2008. The second, a day-long seminar on designs for temporary architecture, took place in December 2008. In both, the use of mathematical concepts to provide an underlying organization for the generation of architectural form was fundamental.

A Grand Tour in reverse

The four-phase program for students in a first-year course of drawing and representation for architecture was a joint effort between Sylvie Duvernoy at the University of Florence, Michela Rossi at the University of Parma, and Kay Bea Jones at Columbus, Ohio, campus of The Ohio State University. Prof. Jones's students had spent time the previous year in Florence, and now it was the turn of the Italian professors to accompany their students to the United States. The program was organized in four parts that variously emphasized aspects of reception (lessons in fundamental concepts and visual awareness) and activities of production (on-site sketching and architectural design). The lessons given during first phase were intended to provide the theoretical structure to be used as the "key" to reading and interpreting architectural designs, both historic and contemporary. Significantly, these particular lessons were firmly grounded in mathematics. Michela Rossi explains the relationship between architecture and mathematics in these terms: "Thinking of the future always implies referring to the past: for this reason history can be flanked by mathematics, whose models are capable of explaining the formal definition of innovative suggestions that emerge from the ongoing process of research" (2008: 5).

It is quite likely that many of these young Italian architecture students, fresh from high school, considered mathematics to be remote from the architecture they intended to study. The various seminars they attended presented mathematical concepts that were carefully tailored to their formation. Prof. Rossi, for instance, in discussing geometries from Euclid and beyond, points out that "while Euclidean geometry may be the most convenient one for explaining and studying the form of everyday objects, it is also true that it is not able to explain all the situations that surround us" [2008: 6]. She goes on to mention other geometries, such as hyperbolic and elliptic, or Riemannian. The lesson that follows, by Sylvie Duvernoy, is a discussion of number and proportion connecting the mathematical ideas of Plato and Pythagoras to the treatise of Vitruvius, which represents the beginning of Western architecture's theoretical structure.

The connection between historical and contemporary architecture is made via a discussion of numbers and shapes in a seminar by Celestina Cotti and Giovanni Ferrero (fig. 1).

Fig. 1. Illustrations from the lesson on numbers and shapes by Celestina Cotti and Giovanni Ferrero

The students were introduced to the implications of modern geometries through an examination of the formation of letters in the alphabet, classically formed, as in Pacioli's work, from geometry based on circle and square, and today based on higher-order geometry, which makes possible curves that are more dynamic. Domes were then used to illustrate a similar evolution in architecture, contrasting, for example, the domes of Guarino Guarini for San Lorenzo and the Chapel of the Holy Shroud with Norman Foster's Reichstag Dome in Berlin.

Because architecture is first and foremost a spatial art, emphasis was placed on organization and order first in two, then in three dimensions. The lessons by Donatella Bontempi begin with two-dimensional symmetry groups and proceed to three-dimensional polyhedra and nested polyhedra. These ideas are further developed in lessons by Sylvie Duvernoy on the reciprocal structures designed by Leonardo da Vinci (see the *Nexus Network Journal* vol. 10, no. 1 for more on these). They are reinforced by Michela Rossi's presentation of Escher's graphic works and Fuller's geodesic structures.

Contemporary mathematical concepts from topology and fractals form the basis of much of the latest architecture. Erika Alberti examined topological operations such as curving, folding and twisting in the expressionist architecture of Mendelsohn, Taut and Michelucci while pointing out that in many cases the drawings were more effective than the built works because of limits imposed by reality.

Cecilia Tedeschi explained the ever-popular fractal and hyperbolic geometry and topology in her lesson, comparing the mathematical theory with the architecture inspired by it. Examples of fractals include the historic works of Borromini and Guarini and the Castel del Monte, and contemporary works such as Jørn Utzon's Sydney Opera House and Richard Meier's Chiesa di Dio Padre Misericordioso (Jubilee Church) in Rome. The principles of topology are examined in relationship to "blob architecture" and deconstructivism. A detailed lesson focused on the genesis and description of form of the "Cloud Gate" (nicknamed the "Bean") in Chicago, the bubble-shaped stainless steel sculpture that dissolves into distorted reflections of the surrounding urban landscape.

Thus prepared with these notions, the two groups of architecture students from the universities of Parma and Florence set off for the second part of the program, eleven days in the United States on a "reverse Grand Tour". The itinerary of the tour centered around Chicago, the Mecca of early modern architecture in the United States, and the classic works of Wright, Burnham, Jenney, Mies and SOM, but visits to Cincinnati and Columbus also allowed the students to see the recent work by Hadid, Eisenman, Mayne, Tschumi, Gehry and the team of Scogin and Elam. Each student was required to keep a diary of their travels in the form of drawings and sketches. This phase was a combination of receptive (looking and observing) and productive (drawing and sketching) activities. As Kay Bea Jones says, "drawing is everything that photography is not – immediate, elemental, non-mechanical – and one's sketch can privilege personal perception to establish a selective hierarchy of relevant information" [2008: 79]. In this case, students were encouraged to use drawings to discover the generation of shape and form.

The third part of the program was the "charrette" in collaboration with architecture students from The Ohio State University. This was the phase of the project that was most oriented towards production. A charrette is a design problem that has to be solved in a short period of time.

Fig. 2. Illustrations from the lesson on symmetry groups and polyhedra by Donatella Bontempi

Fig. 3. Illustrations from the lesson on Escher and Fuller by Michela Rossi

The term originated at the Paris Ecole des Beaux Arts, when student projects were carried from design studios to the school in a cart, or *charrette* (with students aboard, hurriedly putting final touches on their drawings, according to legend). A charrette is a familiar concept to architects but foreign to mathematicians: imagine giving a problem to mathematicians with instructions to post a creative solution 48 hours later, to be judged by a jury! Like a gesture drawing, the charrette method forces holistic thinking, and rapid execution emphasizes the necessity of discussion in the iterative process.

The collaborative design exercise that asked visitors and residents to act together on the terrain heightened their critical and analytic sensibilities. Although the experience was brief, the responsibility for presenting a product raised awareness of cultural similarities and differences among both groups of young architects, while allowing for public discussion of the insights offered by guest jurors and others.

The students were divided into teams of three to five students from a mix of universities and asked to design a project for a new building on the Ohio State campus to provide a gateway and information center for campus visitors. The projects were posted, and of the fourteen presented, four were selected for discussion by a distinguished panel of jurors. The results show that the students had indeed absorbed the lessons presented to them. The design projects, all responding to the particular project context, that is, a modern university campus, exhibited forms that are skewed, bent, twisted and sinuous. However, because of the kind of didactic itinerary the students had followed, these forms were not arbitrarily generated on the sole basis of aesthetics, but were rather inspired by a new awareness of mathematical models.

The fourth part of the program was the publication of a book. The program as a whole – theoretical underpinnings, travel diary, and charrette – are presented in a volume entitled *Oltre i grattacieli – appunti di viaggio*, edited by Michela Rossi, Sylvie Duvernoy and Kay Bea Jones [2008]. The book, most of which is in Italian but with some English text, is really two books in one. The first part, entitled like the book itself, “Oltre i grattacieli – appunti di viaggio” (Beyond the Skyscrapers – travel diary) was edited by Michela Rossi and appears on pages 4-60. Then the book is flipped over, and the second part, “Design Charrette at OSU”, edited by Sylvie Duvernoy and Kay Bea Jones, appears on pages 84-61.

Spazi dell’effimero – Spaces of the ephemeral

Sylvie Duvernoy and Michela Rossi – who in the meantime have both left their previous universities and are now teaching drawing and representation at the Politecnico di Milano – once again teamed up and, along with other instructors of first-year courses in drawing – organized a end-of-term seminar for first-year students entitled “Spazi dell’effimero: allestimenti temporanei e simulazioni”, which took place on 19 December 2008 in the Department of Design on the Politecnico’s Bovisa campus. A rich program of brief (and not so brief) presentations on the architecture and interior design of places and spaces especially designed to be temporary (such as world fairs) was complemented by others about techniques that evoke illusions, such as anamorphosis (presented by João Pedro Xavier) and perspective (presented by Giampiero Mele). It is not surprising that many of these presentations included the discussion of applications of mathematical concepts. Of particular interest were the works of Luciano Baldessari, presented by Gabriella Curti and again by Leyla Ciagà.

Fig. 4. Illustrations from the lesson on topological operations by Erika Alberti

Fig. 5. Illustrations from the lesson on fractals and hyperbolic geometry by Cecilia Tedeschi

Fig. 6. Student sketches from the "Grand Tour" in reverse

The program of the seminar was a bit ambitious given the limited time and attention span of the students. Speakers who presented later in the day were penalized by having to rush through their presentations and a much diminished audience.

Those who took in the whole day's fare, however, had more than enough to digest, an intellectual precursor to the traditional Italian holiday feast that followed. The theme of "ephemeral design" was amply treated from many angles, and the inspiration provided by mathematics was never far from center.

Final reflections

These two initiatives show – both deliberately and unintentionally – the close relationships between architecture and mathematics. I say deliberately and unintentionally because, if on the one hand the "Grand Tour in reverse" program was deliberately designed with a mathematical underpinning, this was not the case with the seminar on ephemeral spaces, which did not focus at all on mathematics but in which mathematical concepts were nevertheless very much in evidence. Raising students' awareness of mathematical concepts in form generation allows them to see the use of mathematics even when it isn't the focus of the topic being presented to them. Initiatives such as the ones presented here, well thought out and effectively implemented, are fine models for those who want to incorporate applications of mathematical concepts into courses for students of architecture and art.

References

DUVERNOY, Sylvie, Kay Bea JONES and Michela ROSSI. 2008. *Oltre i grattacieli – appunti di viaggio*. Florence: Alinea Editrice. (Those wishing to obtain a copy of the book should contact Sylvie Duvernoy at syld@kimwilliamsbooks.com.)

About the author

Kim Williams is editor-in-chief of the *Nexus Network Journal*.