

Commemoration of Maurizio Brocato 57th SNP meeting

The Architected Materials session of 57th Society for Natural Philosophy meeting is dedicated to Maurizio Brocato, professor at School of Architecture Paris-Malaquais since 2008 and professor at the École de Ponts, who unfortunately passed away last January.

After obtaining his degree in civil engineering at Catania university in 1985, Maurizio continued his academic journey between France and Italy. First, he pursued a *Diplôme d'études approfondies en mécanique appliquée à la construction* from the University Pierre et Marie Curie in collaboration with the *École nationale des ponts et chaussées* in 1987. He then completed his Ph.D. at the *École nationale des ponts et chaussées* in *Structures et matériaux* in 1994. Finally, he received his habilitation to supervise research at the University de Marne la Vallée in the field of *Génie civil - mécanique des structures et des matériaux* in 2002.

In 1995, he met Edoardo Benvenuto, professor at the Faculty of Architecture in Genoa, and obtained a post-doctorate at the Department of Construction. During these two years, he had the opportunity to develop the historical aspects of the Strength of materials and began teaching statics and structural design. During these years, he also taught in the PhD programme "History of Sciences and Techniques of Construction" at the Faculty of Architecture in Florence.

Between 1997 and 2002, he served as a researcher at the CNR - *Consiglio Nazionale delle Ricerche* - at the Institute for Information Science and Technology in Pisa. In the following three years, he worked as an engineer-researcher at the Commissariat à l'énergie atomique (CEA) in the Department of System and Structure Modeling. His scientific career began in the 1980s and continued uninterrupted until the end of his days. The richness of his scientific output, his cultural knowledge, and his innovative talent are documented by numerous scientific publications, the valuable books he left us, and the invention of two patents, of which he was rightfully proud.

He had a unique way of thinking. Instead of seeing differences as obstacles, he saw them as opportunities to find connections. What others saw as opposing forces, Maurizio saw as connected and mutually involved. He believed in the continuity between tradition and innovation, between what happened in the past and what might happen in the future. He considered innovation to be an essential component of a larger historical continuum. He had a talent for reading in the past the anticipation of the future and for understanding how history could give hints for a technique or a system that hadn't been fully discovered or developed yet.

The title of his HDR (*Habilitation à diriger des recherches*), "*Microstructure et modèles continus en mécanique des matériaux: des questions d'hier, quelques contributions pour aujourd'hui, une proposition pour demain*", directed by Gianfranco Capriz, already highlighted this idea of continuity between the past, present, and future.

During the last years of his life, Maurizio was passionately engaged in stone design structures, a journey that began with the discovery of an 18th-century patent by Joseph d'Abeille for stone-cut flat vaults." Maurizio's study of local interactions among stones led him to comprehend the global functioning of these structures and to develop a new method for designing. He called this approach "Stereoplexy: non-traditional design of stone structures". In the continuity of this line of research, his latest work published posthumously in the "Mechanics of Materials" journal proposed a design method for structures composed of blocks in contact based on the analogy between kinematic compatibility and force equilibrium, inspired by the study of origami. This method aimed to unlock the formal imagination of these structures through the exploitation of stone's tensile strength and the development of an informed and digital process, based on mathematical and geometric modeling as the foundation for decision-making.

Maurizio never pitted artistic and formal research against scientific research, art against science. For this reason, he never set architects against engineers, or artists against scientists. Maurizio once wrote in a paper: "Architecture is set at the center of this question; it has to deal with individuals and communities, answering to their needs, interacting with their rules, and it has to deal with the environment, which must no more be seen as a simple set of inflexible - and partly

unknown - 'Laws of nature,' but rather as a complex body of interconnected systems (?) Although the need to deal with subjective statements and unpredictable facts makes architecture be surely not an exact science, a lot is usually accomplished during the planning and construction stage using exact scientific tools." For him, architecture was a discipline at the crossroads of science, art, and technology, strained between principles and practice but capable of combining these two.

Driven by this belief, Maurizio managed to link fundamental research with applied research. For instance, in his doctoral thesis, directed by Alain Ehrlacher, on the modeling of metallic polycrystals through the representation of these materials using a 6-dimensional differential variety - which he referred to as "deep spaces" - we could perhaps find an approach that laid the foundation for 3D printing modeling.

Maurizio believed that research had a purpose when it materialized in concrete achievements. In addition to the more than 12 large-scale prototypes he created, he also led industrial research, especially in the fields of reuse and circular economy in various sectors, from construction to food production.

These few examples of his research demonstrate the breadth and diversity of Maurizio's interests in various research domains, from materials mechanics to building physics, from the history of science and technology to robotics. In this methodological approach to science, enriched by a deep knowledge of various fields, from rugby to sailing, from the history of religions to differential mathematics, by sharing tools and knowledge, Maurizio was able to connect his unbridled ambition and innovative genius to make unique contributions to research and teaching. For example, during the Solar Decathlon competition, he came up with the idea of using textile cables from the naval field to build cantilevered apartments over 8 meters long with a Haubannée structural system. This allowed us to create a much lighter structure than the initially planned steel one and saved us about 10,000 euros, which was invaluable given our limited budget!

So far, I have focused on the content and methods of his scientific research, the subtlety of his reasoning, the clarity of his conclusions, which were sometimes divergent from mainstream thought and often considered unconventional. Lastly, but certainly not least, I would like to remember Maurizio's human qualities that allowed him to infuse his scientific work with enthusiasm, conviviality, a lack of self-importance, dedication, passion, a willingness to listen, and an unwavering commitment to creating human relationships before anything else. Thanks to all of this, our GSA laboratory was born and grew under his leadership, becoming a joyful exchange of ideas, opinions, and positive and constructive feelings. Anyone who knew Maurizio, anyone who had the honor of working with him, had witnessed how he managed to forge human connections beyond differences, whether they were in academic status or social standing, and constantly valuing the qualities of young people.

"If we don't believe in young people, how can they grow and improve?" Maurizio always said. For him, teaching young people did not mean academically transmitting his knowledge but conveying knowledge and developing skills based on trust in each individual's capabilities and valuing them throughout their formative process.

This is the most powerful and demanding lesson that Maurizio left us. Over the years, I built a friendship with him based on mutual respect beyond any differences in age or gender, founded on shared values that are often perceived as fragile in today's world. For this reason, I hope that this session dedicated to him can transform into an opportunity to deepen and strengthen human relationships, scientific exchanges, and interactions between people, transcending all differences.

Roberta Zarcone