

Editorial: Sustainable innovation in Minimal Mass Structures and Lightweight Architectures

Alessandra Zanelli, Carol MonticelliPh.D, and Marijke Mollaert

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EDITORIAL



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The special issue *Sustainable innovation in Minimal Mass Structures and Lightweight Architectures* of the *Journal of Architectural Engineering and Design Management* selects the most significant topics that were at the center of the discussion during the international symposium 'Softening the habitats' organized by the Politecnico di Milano and the Association European TensiNet. Today, there are two key questions driving research and development in the field of lightweight membrane constructions and textile architecture. What innovation can we still expect in the light of consolidated technological level and the renewed design-manufacturing tools? And what disruptive changes will make this area more and more coherently aligned with the environmental sustainability objectives of the entire construction?

The two volumes of this special issue offer answers to the above questions and help to bring the spotlight to a construction niche, which has always operated according to the principles of mass minimization and efficiency maximization that are today widely rediscovered and enhanced in terms of green economy.

The first volume projects to the distant future of textile architecture, focusing on the experimental works to overcome the current technologies, discover new materials, new weaving and knitting techniques, and envision novel structural concepts and installation procedures, as well as unusual hybridizations between technical textiles and other lightweight materials.

The second volume is situated in the near future of membrane structures. That is, today's production techniques and materials that are considered the most reliable and durable in the field of tensile structures. From this privileged observatory, it focuses on incremental innovation approaches, on best practices for enhancing environmental sustainability, comfort, thermal, acoustic and light efficiency, as well as on the ways of assessing their impact on our common planet.


In **Volume I**: The paper by **Julian Lenhard** (University of Kassel), '**From design to construction, architectural advancements, new shapes, new design tools, new materials**' focused on the case study of a new filament-based timber material, as a new frontier of hybridization between building components. It prompts that these new experiments can only start from a deep knowledge of the principles of simplicity and lightness which are the basic rules of tensile membrane constructions. The paper by **Martin Tamke** (Royal Danish Academy of Denmark) discusses an experimental case of design and manufacturing conducted by an innovative computational design process. This paper thus introduces one of the most promising processing techniques for the future development of membrane architecture: knitted fabrics and bending active structures. On a similar topic, the paper by **Alessandra Zanelli et al.** (Polytechnic of Milan) proposes a path of design, experimental installation and laboratory validation of a textile-hybrid structure based on a knitted fabric that is customized for a historic building. Another experimental path from design to installation is the focus of the paper by **Carlotta Mazzola et al.** (Politecnico di Milano) with an experimentation of simplified installation methods for ultra-light temporary structures with reduced metal elements. The first issue concludes with two research works. First by **Mesrop Andriasyan** (Politecnico di Milano) that reviews the state of the art in the design of temporary structural systems. Then by **Elena Kriklenko** (Politecnico di Milano) on the algorithmic design of emergency shelters - and on the other hand imagining unconventional uses of three-dimensional fabrics.

In **Volume II**: the paper by **Carol Monticelli et al.** (Politecnico di Milano), **'Performances, Sustainability, comfort, Life Cycle Assessment of membrane structures'**, frames the topic of the environmental sustainability of membrane structures and underlines how important this topic is in view of the development of new materials on the one hand and of new structural and architectural models on the other. The design principles proposed therein will therefore be crucial in the near future, to raise the comfort levels of membrane buildings, and to initiate a green transformation of conventional materials, such as coated fabrics and ETFE sheets, without stopping the advancement of performance levels. Two papers explore the increase in performance at the material scale. The paper by **Jörg Uhlemann** (University of Duisburg - Essen), focuses on the resistance of woven polyester fabrics, as well as at the scale of the structural component. Whilst the paper by **Jean-Christophe Thomas** (University of Nantes) focused on verifying the reliability of pneumatic masts and columns. The volume also deals with the complex and challenging theme of the comfort of membrane architecture. Three papers explore the application and verification in the field and in the laboratory of the light textile-based technologies most used on the market. The theme of acoustic comfort measured comparatively on transparent glass surfaces and ETFE membranes is discussed in the paper by **Vojtech Chmelik** (Slovak University of Technology). Whilst the paper by **Adriana Angelotti et al.** (Politecnico di Milano) explored the thermo-hygrimetric comfort of multi-layer textile envelopes. Finally, **Aldina Silvestri et al.** (University La Sapienza, of Rome) explored the topic of indoor quality for seasonal sport facilities.

In conclusion, we hope that the special issue **'Sustainable innovation in Minimal Mass Structures and Lightweight Architectures'** of the *Journal of Architectural Engineering and Design Management* will contribute to spreading knowledge and the most avant-garde experimental works that combine the criteria of minimum mass and maximum efficiency in the innovative and sustainable use of technical textiles for architecture.

We encourage the readers of these articles and those in subsequent issues to positively engage with the authors and their work and consider submitting articles of their own for publication in this journal.

Lastly, we are very grateful to all the reviewers for their invaluable contributions to these papers, and to the journal.

Alessandra Zanelli
Politecnico di Milano, Milan, Italy
 alessandra.zanelli@polimi.it

Carol Monticelli
Politecnico di Milano, Milan, Italy

Marijke Mollaert
Free University of Brussels, Scientific Secretary of TensiNet, Belgium