POLITECNICO DI TORINO
FIRST SCHOOL OF ARCHITECTURE
Master of Science in Architecture (Construction)
Honors theses

Membrane architecture for the open space: analysis, comparison and guidelines

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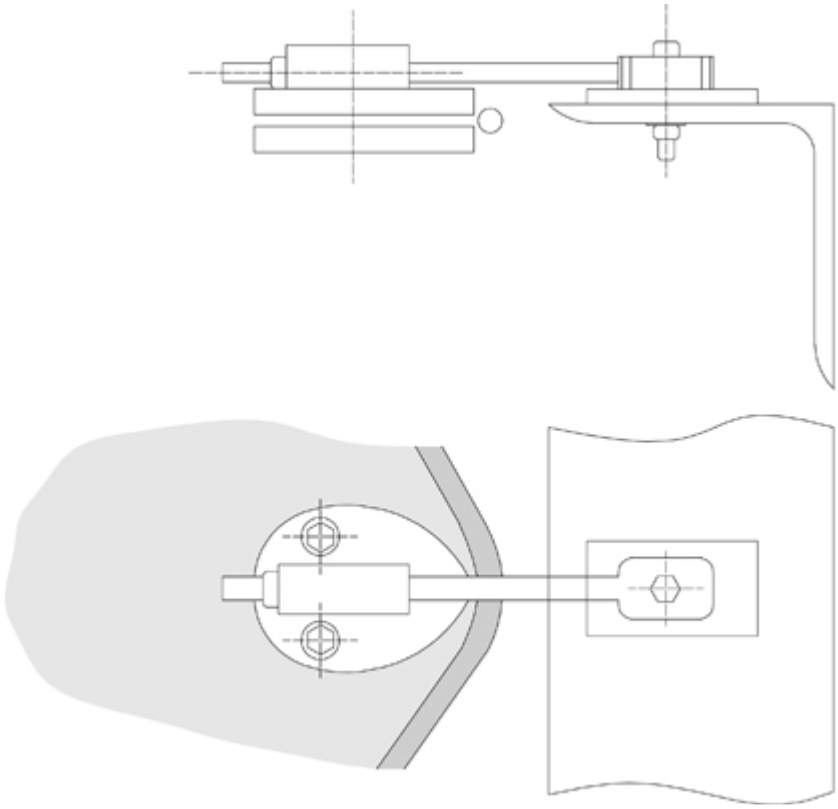
The attention for technical textiles is due, firstly, to their technical features, such as performance stability, lightness, translucency, long life; secondly, to their expressive possibilities, such as the capability to be shaped in complex figures.
The first experiments with these materials in open spaces were done in the great expositions of the second half of the twentieth century. There the work of lots of researchers led to the conceptual and technical development of the membranes and to their further application, this time going beyond the theme of large exhibition "enclosure".
This thesis aims to analyse the main typologies of membranes used in construction field, showing the differences and design possibilities of each technical textile, in order to develop some basic guidelines for the designers who are not acknowledged about these materials, and to allow them to take an informed choice during the preliminary design process. I based my studies of membranes not only on manuals and specialized journals, but mostly on publications concerning the researches developed by universities and research centres. This way, I could gather and summarize in my thesis different specialized knowledges.
My analysis of membranes begins considering how these textiles are synthesized and produced, shifting from the chemical field, referring for example to the employed polymers, to the physical field, showing the different woven structural base materials and their features, and the various coating techniques. Then I examined some of the most important phases of a design process employing membranes.

The thesis analyses the three main categories of technical textiles used today, that are polyester/PVC, fiberglass/PTFE and ETFE, highlighting the difference between membranes of the same category but of different composition.
I particularly analyzed the main features of membranes (resistance, elongation, weight, etc), their behavior with the passing of time from microscopic to macroscopic level, and their applicability in different design contexts and climatic situations.
The case studies, based on drawings and information provided by several architectural and engineering firms (I particularly wish to thank FTL Design, Ingenhoven Architects, Ney & Partners and Tillner & Willinger), are showed in the end of each material table and analyze requests, objectives, design choices, structures, the membrane used, the possible reasons that led to the final choice and other peculiar aspects of the projects, such as lighting design, microclimate and movement possibilities. Moreover in each table an analysis is provided of the technical details of the membrane, that showing how some problems were solved.

Ingenhoven Architects, Kapuzinercarèe, Aachen, 2002

My thesis ends with four simple guidelines organized in four steps, through which the designer can access a more acknowledged level of choice during the preliminary design phase. The first one shows the difference between the current products available on the market and it is aimed to help making a first choice based on project requirements; the second one shows the different building possibilities that allowed by the use of membranes; the third one analyses the elements that can be built using membranes, highlighting the critical issues and benefits connected with landscape and architectural and urban context; the last one deals with the most common construction problems that occur with designing membranes, showing different possible solutions and explaining advantages and disadvantages.



Detail of a coupling between the membrane and the structure

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