


# Membrane constructions for building refurbishment

People will need to grow accustomed to this term: “textile architecture”. Buildings such as the Munich football stadium or the swimming pool building in Beijing demonstrate new design and construction possibilities using textile architecture. At the same time, the innovative, lightweight and flexible structures made using sheeting or textile fabrics also allow buildings to be energy-optimised. Now solutions for the energy-oriented refurbishment of buildings are being developed and tested in a research project. The main task consists in combining structural, functional and design requirements. Building on this, the functional characteristics are then optimised and new kinds of components and systems are developed. An example that should be mentioned here is surface functionalisation using low-e coatings to improve the thermal insulation of membranes. These were developed as part of a previous project. The aim of this research project is to develop and produce standard solutions that are then used as modular components or systems. The intention is to install examples of the solutions in demonstration buildings, where they can be investigated further.



Fassade des Schulungszentrums der Bergwacht Bayern mit der auffälligen elementierten Membranfassade. Architektur: Herzog + Partner.  
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## Technology summary

<b>Formal project title</b>	Membrane-construction for energetic refurbishment of buildings
<b>Term of project</b>	02/2009 - 01/2012
<b>Technology status</b>	 Prototype Phase
<b>Key aspects</b>	Heat insulation, Facade systems, Atrium, Heat / cold storage, Control technology, operational management, building automation

## Project description

The Allianz-Arena in Munich and the Water Cube in Beijing offer a spectacular demonstration of the new capabilities of textile architecture. In the EnOB research project “Development of low-emissivity coatings in textile architecture”, sheeting, fabrics and membrane constructions are provided with a special coating that makes a significant improvement to their thermal properties. These are referred to as low-e coatings, which emit little heat and reflect incoming thermal radiation well.

As part of a new research project “Membrane constructions for the energy-oriented refurbishment of buildings” (MESG), the aim is firstly to develop new concepts in order to achieve significant energy savings for buildings in Germany through the use of sheeting or fabrics in refurbishment projects. This involves heating energy as well as cooling and lighting energy. Secondly, such concepts can also contribute to energy optimisation in new buildings.

### Focus

Ever since the architect Frei Otto carried out his fundamental work at the Institute for Lightweight Structures and Conceptual Design in Stuttgart, numerous outstanding buildings based on membrane constructions have been created around the world, in each case corresponding to the state of the art in planning and production technology at the time. The use of membranes for building envelopes that have a use-dependent requirements profile for increased thermal insulation and noise protection is more complex – here too there have been a number of examples of “premium” uses since the mid-1960s.

Since then, advances in material research, engineering know-how and computer technology for handling the complex geometric parameters and the spatial assessment of the flow of forces and load-bearing behaviour have significantly expanded the application areas of membranes as building envelopes. New powerful planning tools that can capture and process the membrane surfaces geometrically in three dimensions make their use economically feasible and are controllable in both planning and production terms.

In the current research project, first of all a typology for the application of membranes in building envelopes will be developed. The main task consists in combining structural, functional and design requirements. Building on this, the functional characteristics are optimised and new kinds of components and systems are developed. Standard solutions are created which are used as modular components and systems. The aim is to install them in demonstration buildings and investigate them further.

As well as optimising the functional characteristics of membranes, above all the aim is to develop new kinds of components and systems. Individual components that are already available on the market are combined into

new and innovative systems. Improved components are also developed and tested. The aspects of thermal insulation, energy storage and the buffering of heat peaks, passive and active (thermal) solar energy usage and the generation of electrical energy are to be worked on in detail.

The following standard solutions are to be developed:

Membrane as sun protection element

Membrane as thermal insulation element

Membrane as glare protection element

Membrane as an element for generating heat

Membrane as an element for generating cold

Membrane as an element for generating electricity

Membrane as an element for ventilation

Membrane as an element for information transmission (media facade)

In addition, an interdisciplinary approach is being pursued as part of the project. As well as the individual components, this will also look at their integration into the building and the control concept that is necessary for the heating and/or climate control system. For example, an increase in thermal mass with simultaneous reduction of the response time of the building's control system is desirable in order to enable an optimum control strategy in respect of ventilation, heating and cooling.

### **Successes**

To date, functional surface coatings have been developed that reduce heat emission into the environment.

Low-e fabrics of this kind can significantly improve the thermal insulation of membrane constructions, thereby contributing to increasing energy efficiency in the building. At the same time it has become possible to combine the low-e characteristic with any desired colour effect, which yields flexible architectural design possibilities.

### **Milestones**

A further aim of the project is to prepare a pilot application and implement individual innovations and developments in connection with real buildings after the project ends. The intention is to install the modular solutions and standard solutions that are developed in demonstration buildings in order to enable practical tests to be carried out and present the optimised membrane constructions for energy-oriented refurbishment to a wider public.

### **Application**

Further information will be made available here as the project progresses.

 **Projektinfo by BINE Information Service**

 **Project-website MESH**

 **Project-website FunTM**

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