Dear Reader,

As usual TensiNet describes here the current status of achievements and future plans of the communication platform for tense structures.

The most effective tool to distribute information is the website and the database. Companies, detailed data on projects and corresponding literature can be consulted there. Here we would like to encourage you to complete the database with extra project descriptions. Send information on your membrane project to jhaase@vub.ac.be. Thank you very much.

Besides TensiNet is strongly involved in events related to membrane structures. On the trade fair "Techtextil" TensiNet is exhibitor and arranges the morning session of the Techtextil symposium. Several partners will give lectures on forthcoming events such as the workshop "Textile Roofs" in Berlin and the conference "Structural Membranes" in Barcelona. Furthermore, TensiNet is the sponsor of the international symposium "Designing Tensile Architecture" in Brussels, September 2003. You are warmly invited to participate. More information and the possibility to register are available on www.tensinet.com

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**Table of Contents 03/2002**

1. News
2. Forthcoming Events
3. Benzoni Fair
4. Space Grid Structures
5. A Membrane, A Demountable Canopy
6. Partners of TensiNet
7. Literature

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**Forthcoming Events**

- Benzoni Fair 03/2003
- Space Grid Structures 03/2003
- A Membrane, A Demountable Canopy 03/2003
- Partners of TensiNet 03/2003
- Literature 03/2003

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**Literature**

Membrane Designs and Structures in the World

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<tr>
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The projects include Shanghai Stadium, Osaka Pool, Millennium Dome, Passenger Terminal, and many others. Several articles are also included as well as a Data List by Roof Structures.

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**Membrane Design and Structures in the World**

Werner Sobek: Art of Engineering - Ingenieurskunst

This book by Kazuo Ishii features 64 built and planned projects from around the world. Its more than 300 pages are generously filled with hundreds of colour photos and architectural drawings.

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**Werner Sobek: Art of Engineering - Ingenieurskunst**

Werner Sobek’s buildings located in places like Lima, Chicago, Bangkok and Shanghai, show what state-of-the-art engineering is capable of: structures of fabric, glass, titanium, steel, timber or concrete will appear at home and virtually devoid of mass. They pioneer new methods of building construction and impart astonishing aesthetic qualities to architecture. This book (filled with beautiful photos and illustrations) introduces the reader to Werner Sobek’s work and professional career while showing the buildings which result from a close cooperation between architect and engineers.

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**TensiNet Academic Institutions**

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**TensiNet Academic Institutions**

The School of the Built Environment constitutes the Institute of Architecture, Institute of Building Technology and the Institute of Urban Planning. The School of the Built Environment is a leading centre for research and teaching with excellent facilities and a wide range of research programmes. It is a research-led School providing a teaching and learning environment of the highest quality, and attracting the highest quality students. The School has also been extremely successful in attracting significant funding from UK research councils, the EU and industry for conducting work in the area of renewable technology and energy, and sustainable cities.

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**TensiNet Academic Institutions**

The School of the Built Environment has 33 academic staff, 40 PhD researchers, 14 research staff and 15 support staff to facilitate the research and teaching. Dr. John Chilton, senior lecturer at the School, supports the education not only with regard to space structures and textile architecture.

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**TensiNet Academic Institutions**

There are approximately 500 students studying towards undergraduate degrees within the School. The School also maintains close relationships with its accrediting professional bodies, CIEMA, RIBA and the RIBA.

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**TensiNet Academic Institutions**

Hans Hopper Engineers www.hanshopper.com
Canobbio S.p.A. www.canobbio.com
Tensa International www.tensa-international.com
Techno University of Berlin www.techno-berlin.de
Tensotech Consulting www.tensotech.com
Laboratorium Blum www.lab-blum.de
Tensotech GmbH www.tensotech.com
Techno University of Berlin www.techno-berlin.de
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University of Bath www.bath.ac.uk
University of Technology, Magdeburg www.et.de
University of Nottingham www.nottingham.ac.uk
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Building (large) Scale Models of Tensile Structures.

Synthesis of Form, Structure, and Material

“What is lightweight construction?” One of the many possible definitions is “optimizing the loading capacity of the construction without consideration of additional loading”, or somewhat more theoretically stated, “the optimization of the path of forces in order to reduce the construction volume.” Lightweight construction and form-optimization are central themes in the construction technology of today.

The proposal for the Cologne Zoo Elephant House is the lightweight membrane construction of a transparent “roof cloud” over a free plan geometry. The aim was to design a shelter for temporary use, which should fulfill the requirements of comfort and an optimal view to the animals.

Primary Structural System: Caterpillar Cocoon and Spatial Framework

Evolution of a Structural and Structural Optimization

The design concept was to develop a structural system optimised as an irregular spatial structure over a free plan, a cocoon and a spatial framework in the form of a “roof cloud.” Spatial frameworks are systems that operate on the basis of the interaction between singular tension and compression members. In this case, the positioning of the elements is a result of the direction of external loads and the vector forces in the elements.

The automated development of an optimized structure, as opposed to conventional design methods, allows one to deal directly with forces as required. The creation of the structural design is thus analogous to the growth of organic structures on the grounds of structural-mechanical regulations. Important parameters are the avoidance of stress at the middle of the fields, and the optimization of the load bearing elements in their scale and dimension.

Secondary Structural System: Fluoropolymer Shading Pillow

As a result of the complex geometry and dynamic qualities of the roof structure, the roofing material chosen was a triply layered transparent pneumatic membrane construction made of fluoropolymer sheathing (Ethylene-Tetrafluoroethylene). Glass, or other stiff transparent materials, could not be used because of the material qualities (limited spanning capabilities, weight, aesthetic qualities).

The pneumatic fluoropolymer sheathing pillows are filled with clean, dry air through flexible, sealable tubes that run along the steel elements. The air pressure of the film is approximately 300 Pa. The inflation level of the pillows is computer-controlled, dependent on the external forces from wind and snow. Minor damage to the membrane can be compensated for through an alteration in the load of inflation. The connections to the steel and glass façade must be able to withstand the large deformations of the roof, and for this reason planned as pneumatic duct-shaped pillows. The steel and glass façade itself is self-supporting and not structurally connected to the roof construction.

Conclusion

The combination of form-optimized structural systems with an extremely light and flexible material creates an extremely low ratio of steel per square meter. Naturally, tent or cable systems are still lighter, yet the construction system presented here becomes an additional possibility in the realm of optimized space structural systems.
**GENOVA TRADE FAIR**

Placing a large textile cover as a part of the restoration works of Piazza Mure was a fundamental choice to give an architectural "lightness" highly visible from the land and from the sea besides letting sunlight (translucency) get inside the pavilion. The canopy covers an area of about 9000 m² and its dimensions are 124.50m x 73.50m – with a maximum height of 20m.

The membrane is divided into 5 sections of 20.40m x 7.20m and it is manufactured with fibreglass fabric, PTFE coated, with the typical characteristics of lifetime and resistance to weathering, as already demonstrated with the tensioned structure called "Grande Bips", realised in 1992 in the old port (Porto Antico) in Genoa.

**Pneumatic Hybrid Roofs Expo 2002 Neuchatel**

Once every generation Switzerland hosts a National Exhibition - the last one being held in Lausanne in 1964. The most recent Expo took place in the year 2002. For the first time, the exhibition was not held at a single venue, but spread out at four "arteplage" sites. The expression "arteplage" combines the words "art" and "plage" (French for beach) and refers to the structures in which the exhibitions are located. The site of the Expo, located in the historic quarter of Neuchatel, is an exceptional setting for the event.

Magdeburg's Town Square Under Textile Roofing

As an upcoming trade show and congress city, the town which is nearly 1200 years old and located on the Elbe river is also interested in documenting its high cultural and tourist claim. In the remodelling of the town square, which at the same time is the station square, is a project in this context. Here, a weather protected area was established by means of textile roofing, offering an optimum framework, not only for temporary events. Also an additional advantage is created for the station square since railway passengers can change to buses or taxi cab and stay dry in case of rain and the path to the Central Bus Station 20B are both roofed. Also the "bike & ride" commuters were included in the considerations - the railwaystation bike depot was also roofed.

A plastic coated polyester fabric type IV (tenacity strength warp/weft - 800/700 daN/5 cm) with a double-sided acrylic final coat was selected for the membrane roof. This material, supplied in the colour light-grey (RAL 7035), complies with the regulations of fire protection class B1 (DIN 4102). In order to achieve a particularly light and friendly illumination of the structure, the membrane design was combined with a particularly shallow dip and the narrowness of the sculpture’s "backbone" resulted in extremely high membrane stresses.

To cope with this as well as trying to limit the potential for wrinkling between adjacent panels of fabric we incorporated a particularly light and friendly illumination of the structure, the membrane design was combined with an approx. 40 m long shroud arch made of a special safety glass. The supporting structure consists of two steel pylons (a triangular "backbone" and the steeply curved "funnel") which support the sculpture. The hall is a vast space 150m long and over 8 storeys high inside. As the sculpture was to be large the artist invited Arup to advise him on the structural viability of his ideas.

The final piece is in essence a 10m thick Type II P/C/PES membrane surface prestressed between a pair of closed steel rings having diameters up to 28m and positioned at either end of the hall giving it a clear unsupported span of 135m. A third horizontal ring hovers 2.8m above a mezzanine level.

The 135m clear span when combined with a particularly shallow dip and the narrowness of the sculpture’s "backbone" resulted in extremely high membrane stresses.

These belts also served the very useful purpose of supporting the membrane’s weight during site installation. Membrane prestress ratios vary significantly throughout the structure allowing us to create the rates of change in curvature and shape desired by the Artist. This is visible in the long backbone and the deeply curved "funnels" that spill out at each end of the sculpture. B + O Hightex fabricated the structure into a single piece of 3500m² using only two warp-to-warp splice lines in the entire structure.

The membrane's prestress force is resisted by compression forces running through the building's framework from end to end. The sculpture is to be dismantled in April 2003 to make way for the next commission by another artist.

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Dynascape is a proposal for new sport- and sport-shop-centre in the Region Rotterdam in the Netherlands. In a parklike environment between Schiedam and Maasland lies this building on the junction of the A4 freeway and the new metro and a new tram track. This location was chosen after a study in the USA about the location of event centres. In the USA these centres are situated on the junctions of car infrastructure, good accessible from the city and from the region.

The program of the building consists of Run and funmeowing (transferring), Run and funshopping (consuming) and Run and funperforming (recreation).

In contrast to the closeboole entertainment buildings in the USA this event centre is an open structure where the interior and the people that move through it are visible from the outside.

The closed American box is turned inside out.

Important in Dynascape is the integrated design approach. Integrated design is a specific way of thinking, doing and designing. Aesthetics and the initiation phase become less important than the experience and demand of the user in the urban place. The building is designed as a flexible and changeable structure that will hopefully never reach an end situation. The construction is an integrated steel-concrete structure, concrete where mass is needed, steel where flexibility is needed. Traditional building methods are replaced by assembling on site, if needed parts of the building can be dismantled and reused. Parts of Dynascape physically move to meet the demands of its users. But also to absorb different changes in program and adjust to it. The building can move to react on the surrounding environment such as climate changes, but also a reaction to the streams of cars and people that go through the building. And last but not least, the building can react on the changes in our culture, trends, and the wishes of many people to be able to influence the surroundings, to be in interesting places that make you wonder. Dynascape is shaped like a human machine. The building has a skeleton and a skin. On the inside there are muscles, organs and bloodvessels that regulate the heating and cooling of the building. The skin of Dynascape and BIO-DYNA-SCAPE-2001 can open and close in many different ways, it generates energy and provides the moisture-exchange with the environment. Because of this moveable skin, the positioning of the columns and the free-floating floor/roofs flexibility is generated. For example the skin of the sportspanes on the outdoors of Dynascape are made of inflatable tissue cushions supported by a structure of steel cables connected with steel dampers. The basic form of the cushions is a hexagon, the structure of the steel cables a square. This structure is supported by pneumatic cylinders or columns that get their energy from their own fluidity. By for instance lowering or raising the pneumatic columns the skin will reshape itself. The steel cables, which are three dimensionally woven through steel castings that are separated by dampers, will follow the movement and the cushions will stretch or shrink a little. Space can become larger or smaller or different in shape. Energy consumption, the use of the space and the response to the climate can be adjusted at any time, like a human body. Dynascape. Principal: MOVEYOU is looking for any principal to do a feasible study.