On the 28th of September, 15 people representing 13 of TensiNet’s Partners gathered at the Technical University of Delft, The Netherlands, for another of the partner meetings. Aim of the meeting was first and foremost to review the Association’s activities of the last year and to decide on the approach for upcoming events such as the TensiNet International Symposium next year, or the next edition of the Student Competition on “Textile Structures for New Building”. 2007 will also bring us the next editions of the Textile Roofs workshop in Berlin in June, the Techtextil Trade Fair in Frankfurt, also in June, and the Structural Membranes International Symposium in Barcelona in September.

The TensiNet Symposium 2007 will be organized at the Politecnico di Milano from the 16th to the 18th of April 2007. The title of the conference is “Ephemeral Architecture. Textiles and Time”. Main themes will be related to “Building and Environment” and “New Materials and Applications”. Topics might include the durability and life cycle analysis of membrane constructions, environmental aspects of tensile structures, pneumatic structures, new or non-conventional materials and applications, including research results and PhD reports. More information on the symposium can be found on the TensiNet website. You can also register online.

In cooperation with TensiNet, Techtextil, the International Trade Fair for Technical Textiles and Nonwovens, organizes the 9th Student Competition on “Textile Structures for New Building”. This competition is designed to identify innovative thinking and innovative solutions to problems, featuring construction projects capable of concrete realization which use textiles or textile-reinforced materials. A further aim is to encourage students and new entrants to the professions. The competition is further intended to strengthen contacts between the younger generation, the universities, the technical-textiles industry and broad sections of the building industry. TensiNet will be providing the competition prize money worth 8,000 EUR. The competition will be run under the professional and technical supervision of Werner Sobek, Professor of Engineering at the Institute of Light Construction Design and Building (ILEK), University of Stuttgart. More information on the Student Competition can once again be found on the TensiNet website.

As far as the state of the TensiNet Association is concerned, we are pleased to say that we have welcomed several new members over the last few months. Also, we can announce that we are working on Chinese, Italian and Spanish versions of the European Design Guide for Surface Tensile Structures. The publication of the Spanish version is anticipated for the end of May 2007.

TensiNet members on the Iberian Peninsula, under the impetus of Juan Monjo Carrió and Josep Llorens, are also negotiating the possibility of an Iberian Branch of the TensiNet Association. Already two strategic meetings, one in Madrid and one in Porto, have been organized to coordinate this subsection of the Association. Provided a sufficient number of new registrations from Spain and Portugal have been confirmed, this Iberian Section of TensiNet will soon be organizing meetings and workshops on a more local basis.

Finally, we have a few more announcements to make. The Association’s Annual General Meeting for 2006 will be organized before the TensiNet Symposium in Milano; the Annual General Meeting for 2007 will be planned as to precede the Structural Membranes Symposium in Barcelona in September 2007.
Mississippi State University, Mississippi, has been collaborating with an international group of engineers and researchers on the development of new computational methods in membrane structures. This work is part of the Master of Engineering (M.Eng.) program in Membrane Structures, which is offered by the Anhalt University of Applied Sciences, Germany.

The program, which started in March 2007, is designed to provide students with a comprehensive understanding of the theory and practice of membrane structures. The curriculum includes a range of courses, from basic mathematics and structural mechanics to advanced topics such as computational fluid dynamics and computer-aided design.

The program is led by Prof. Dr. Robert Off, Director of the IMS e.V., and is supported by a team of experienced educators and industry partners. The program is designed to be flexible, allowing students to study on a part-time basis and to work from home countries to continue with their professional activities, as well as with their studies via the internet. The program is also very popular internationally, with participants coming from all over the world, including Mexico, Netherlands Antilles, Germany, Guatemala, India, Belgium, Brazil, Chile, Thailand, and the USA.

The lectures are given by well known academics, namely, Professors Pohl, Beltzinger, Barnes, and Kretzler. The course modules taught range from architectural design of membrane structures to the numerical theory of form finding. Due to the fact that the University has suitable on-campus accommodations for both students and staff, most of them have already been working in the field of membrane construction. They belong to diverse professional disciplines, e.g., architects, engineers, confectioners, and even designers.

Initially both the course participants and the organizers were very curious about the degree of success of the distant learning concept as described. The experience of the first week’s obligatory presence at the university and the constant teacher-student contact through the WebCT platform has been an overwhelming success. It now appears that the whole group of international students and companies all over Europe, internet media allow the students and the teachers to stay in contact for continuing their studies and teaching.

As the 4-semester course has been organised as a part-time program through internet media, the participants are required to attend the university at Dessau for only one week per semester, or two weeks initially, in case they also book into the optional introductory course on structural engineering. This is a refreshers’ course on basic mathematics, structural mechanics, analysis, and design, which is helpful for understanding the principles of membrane structures.

The new master program will start in March 2007. A number of applications for 2007 course have been received already, and many more have asked for further information about the master program. Initially the course participants and the organizers were very curious about the degree of success of the distant learning concept as described. The experience of the first week’s obligatory presence at the university and the constant teacher-student contact through the WebCT platform has been an overwhelming success. It now appears that the whole group of international students and companies all over Europe, internet media allow the students and the teachers to stay in contact for continuing their studies and teaching.

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Introduction

For the ruins of Ggantija on the Island of Gozo, Malta, a weather protective covering has to be designed. The roof should be a membrane construction, to protect the excavation site against rain and wind. Either a permanent or a temporarily structure can be considered.

We have decided on a two-layered ETFE-cushion structure with a high transparency, fixed to a flexible belt net, clamped on two circumferential steel rings as a permanent construction. The transparency of the cushions can be adjusted by surface prints. There is also the possibility to close the structure with temporary or permanent walls, composed of membrane or glass.

All dimensions of the structure are an approximate estimation and have to be confirmed or corrected by the statical analysis.

Structure

The system consists of a PUR-coated belt with several steel cables, and a double layered ETFE-foil, inflated with air to form a cushion. The wide span cable belt works as a support for the ETFE-foil, therefore the distance between the belts depends on the strength of the foil applied. Typically, this will be about 3.00 - 3.50 m for the ETFE-foil used here. In this project, we have opted for a belt distance of about 2.90 - 3.00 m.

When cushions are constructed, it is sufficient to joint the foil and the belts in the crossing points. The whole covered area can as such be considered as one big cushion. Air is allowed to pass from one cushion field to the other. Therefore, no tube connections are necessary, as would have been the case in constructions with rigid aluminum girders.

Furthermore, we have implemented an important improvement in this project: if we consider small wrinkles to be acceptable, we can skip the very expensive and complicated patterning process. The air pressure in the cushions and the elasticity of the ETFE-foil enables us to leave out the patterning.

On the edge, the cushion is clamped on a tube with an estimated size of 610x20 mm. The two tubes have a parabolic shape and are founded on independent bases. In addition, and in order to reduce bending moments, both beams are guyed to the ground with several pre-tensionable cables.

Materials

Cushion:
The cushion consists of a two-layered ETFE-foil with a thickness of 0.25 mm, filled with air. The air pressure is about 0.2 - 0.3 kN/m².

- transparency of about 95 %
- using the daylight without losses
- self cleaning by rain
- resistant against UV-radiation
- longevity more than 30 years

Belt:
The belt consists of several steel cables, lying side by side and coated with PUR or ETFE. The belt is a development of the Company Bekaert from Belgium.

- nearly every strength of the belt is producible
- very large spans possible
- very flexible in one direction
- high corrosion resistance because of the coating
- no damages due to scrubbing of the foil on the belt

Dipl.Ing.(FH) Wolfgang Warisch
Master of Engineering in Membrane Structures
University of Applied Science, Dessau
wolfgang.warisch@t-online.de
Contex-T: Textile architecture

TEXTILE STRUCTURES AND BUILDINGS OF THE FUTURE

Contex-T, the EU-funded integrated project for SMEs, brings together a consortium of 30 partners from 10 countries. The project started the 1st of September 2006, and the kick-off meeting took place in Ghent on the 19th and 20th of September. Contex-T is coordinated by Monique Thienpoint (mthienpoint@bexco.be) from Bexco NV, with the support from Jan Laperre (jan.laperre@centexbel.be) and Michael Catrysse (michael.catrysse@centexbel.be) from Centexbel.

A multidisciplinary group with high-tech SMEs, research institutes and universities will integrate their activities to develop a new generation of multifunctional textile materials in order to reshape the complete chain of values of textile architecture. The consortium will address the development of new concepts and knowledge in multifunctional technical textile materials, using nanotechnology and nano-structured materials, as well as the intelligent use of textile materials.

The TensiNet members Rainer Blum and Heidrun Bögner (Labor Blum), Michael Jänecke and Barbara Weiszäcker (Techtextil), Roberto Canobbio and Stefania Lombardi (Canobbio), and Marijke Mollaert (Vrije Universiteit Brussel) are partners of the Contex-T consortium.

The following main topics in the field of textile architecture will be considered:

- The development of multifunctional inner and outer membranes (figure 1)
- The study of the use of novel textile based components (structural elements) for textile based buildings and textile architecture (figure 2)
- Modeling building physics and fire safety (figure 3)
- Testing and modeling structural behavior and architectural aspects of tensile structures (figure 4)
- The set-up of a demonstration building (figure 5)

www.contex-t.eu

INVITATION AND TERMS AND CONDITIONS OF ENTRY TO THE NINTH STUDENT COMPETITION

"Textile Structures for New Building 2007"

The international association TensiNet and Techtextil - International Trade Fair for Technical Textiles and Nonwovens - are holding the Ninth Student Competition on "Textile Structures for New Building". We cordially invite all students of architecture, building engineering, product design or any other relevant subjects, to apply. We also hereby invite all new entrants to their professions who are practising these subjects, providing they took their degree after 1 January 2006.

This competition is designed to identify innovative thinking and innovative solutions to problems, featuring construction projects capable of concrete realisation which use textiles or textile-reinforced materials. A further aim is to encourage students and new entrants to the professions. The competition is further intended to strengthen contacts between the younger generation, the universities, the technical-textiles industry and broad sections of the building industry. The competition will be run under the professional and technical supervision of Werner Sobek, Professor of Engineering at the Institute of Light Construction Design and Building (ILEK), University of Stuttgart.

Jury

The international jury judging the "Textile Structures for New Building" competition will include well known representatives from the training sector, eminent architects (textile building) and engineers. A representative of TensiNet will serve on the jury on behalf of the organisers. The chairman of the jury will be Professor Werner Sobek.

Prizes and categories

TensiNet will be providing the competition prize money of € 8000. The jury will award prizes in the following categories:

- Macro-architecture
- Micro-architecture
- Environment and ecology
- Composites and hybrid structures

The prize money will be divided as follows:

First Prize: € 1250.00 per category
Second prize: € 500.00 per category
Third Prize: € 250.00 per category

Prizes will be awarded at Techtextil from 12 - 14 June 2007. The study of the use of novel textile based components (structural elements) for textile based buildings and textile architecture (figure 2)

Scope of competition

The competition covers all areas of textile building:

- Earth-moving, road building, landscaping, environmental protection
- Civil and industrial engineering
- Structural engineering - from construction using textile-reinforced concrete or plastics, to construction using membranes for permanent and temporary, adaptable and mobile buildings
- Interior finishings - including such developments as the use of polymer fibre-optic cables for light transmission, textile air-channel systems for draught-free air conditioning in rooms, movable sound-insulation walls in production facilities, etc.
- Product design for architecture.

An additional focal theme has also been included: "Suitability for re-use and recycling."

The subject of the project submitted is a free choice. Work is accepted which has been produced either under a supervisor or without a supervisor.

Submission of work

The closing date for return of the registration form is 31 January 2007. Please submit your work to arrive in the ninth calendar week, from 26 February to 2 March 2007 (the date of receipt will be decisive, not the postmark):

Messe Frankfurt Exhibition GmbH
Katrin Müller
B6 Textilmessen
Ludwig-Erhard-Anlage 1
D-60327 Frankfurt am Main

Submission in person will only be possible on 28 February and 1 March 2007; please make a binding appointment in good time with Ms. Müller (e-mail: Katrin.Mueller@MesseFrankfurt.com or telephone +49 69-75 75 65 53).

Exhibition of the winning projects 2005

www.tensinet.com/
documents/general/
STW_Einladung2007_GB.pdf
Organization and Keynote speakers

Adaptables 2006 was held from the 2nd to the 5th of July at the campus of the Eindhoven University of Technology in the Netherlands. It was supported by the CIB (International Council on Research and Innovation in Building and Construction), the FFD/SMG of the IASS (Free Form Design / Structural Morphology Group of the International Association of Shell and Spatial Structures), and TensiNet. The conference was organized by Karin de Louw, Arno Pronk, Frits Scheublin, Alexander Suma, and Jan Westra of the TU/e. Andrew Borgart and Rogier Houtman organized the FFD/SMG and the TensiNet sessions.

Keynote speakers where: John Chilton, Pieter Huybers, Axel Kilian, Erik Moncrieff, René Motro, Kas Oosterhuis, Jouke Post, Werner Sobek, Bernd Stimpfle, Rosemarie Wagner and Wolfgang Rudorf-Witrin.

General objectives

One reason for organizing Adaptables 2006 was the fact that the Eindhoven University of Technology (TU/e) celebrated her 50th anniversary. Therefore the Faculty of Architecture Building and Planning organized a conference around the theme of adaptability in design and construction of buildings.

The conference was focused on two main topics, “Open-Building” and “Lightweight Structures”. Due to the wide scope of the conference, the audience had the possibility to choose between many subjects in a number of parallel sessions.

Exhibition

In addition, there was an outside exhibition by Dutch artists, students and researchers. We would especially like to mention the Blob by studio jurgenbey, Tree House by Dré Wapenaar, and Geometrical Sculpture by Rinus Roelofs. All projects were designed and developed with students of the TU/e.

INFLATABLE DONUT

Also for this occasion, Arno Pronk and his students designed and developed a large inflatable donut. The donut was placed at a height of 30m, attached with cables around a 70m-chimney on the campus site. The shape of the donut, manufactured in PVC coated polyester membrane, is achieved through air pressure, and stabilized by a constant air supply.

This project was realized as a workshop for students of the TU/e, supported and assisted by Buitink Technology. Moreover, Buitink Technology provided the necessary space, materials and machinery in order to complete the donut.

Client/Building Owner: TU Eindhoven
Concept and Design: Arno Pronk en Gerald Linders (TU/e)
Engineering: Tentech BV, Delft, The Netherlands
Manufacturing: Buitink Technology, Duiven, The Netherlands
Material: PVC coated polyester

Project designed and produced with students from the TU/e (Robin Boenning, Pieter Derks, Joost Huigen, Ruben Smittenaar, Ties Wielinga)
Taiyo Kogyo Corporation is pleased to present TiO2 - the revolutionary self-cleaning membrane which utilizes titanium dioxide technology and the photocatalytic process to preserve and maintain product cleanliness and beauty. Photocatalytic technology [SEE CAPTION] provides improved benefits for membrane materials. These benefits include:

1. Using the natural power of sunlight and rain to continuously clean the membrane, removing even the most stubborn dirt;
2. Maintaining high light transmittance levels; and
3. Reducing the temperature rise within the interior space, maintaining a comfortable environment.

Membrane Types

There are three types of photocatalyst membranes offered by Taiyo Kogyo Corporation: “Ever Fine Coat”, “Sky Clear Coat”, and “Self Max” (Fig. 1). Each membrane has different characteristics and should be selected based on project application and scale.

“Ever Fine Coat” consists of PTFE-coated glass fibre fabrics and a TiO2 layer (fluorocarbon resin and TiO2 particles). “Sky Clear Coat” (SCC) and “Self Max” (SMX) consist of PVC-coated polyester fibre fabrics and a TiO2 layer. The TiO2 layer consists of a protective adhesive layer and a photocatalyst.

Ageless Brilliance

Self-cleaning properties reduce maintenance costs. Photocatalyst membrane has self-cleaning properties that inhibit contamination from adhering to the membrane’s surface. This property allows rainfall to wash away dirt and grime, even stubborn stains, maintaining the structure’s clean exterior.

Effect of Room Temperatures

TiO2 reduces the interior temperature rise with approximately 12°C (22.6°F). This value is based on testing at a “Self-Max” warehouse with an external temperature of 35°C / 95°F. It is substantially less than other membranes, providing a more welcoming interior space while creating energy efficiencies.

TiO2 photocatalytic technology significantly improves the solar reflectance properties of the white color membrane, minimizing the rate of temperature rise within the interior space. This results in maximized energy efficiencies (especially with regard to cooling systems), reduced operating costs, energy savings and minimized environmental impact.

TiO2 photocatalyst membrane blocks approximately 98% of harmful UV rays, preventing membrane deterioration and discoloration.
Light and Airy Interior Environment

Light transmittance is approximately 15% (using “Ever Fine Coat”). Interior illumination is optimized due to membrane’s continual self-cleaning properties.

Photocatalyst membrane brings the outdoors in! Self-cleaning properties minimize the decrease in light transmittance, allowing the bright and welcoming interior environment to endure while minimizing lighting costs and energy consumption.

Air Purification

Photocatalyst membranes provide cleaner air through the decomposition of nitrogen oxide (NOx) emissions found in exhaust fumes and other pollutants.

Nitrogen oxide (NOx) found in exhaust fumes and other sources causes air pollution. Significant environmental concerns stem from the fact that 60% of air pollution in large cities is a direct result of exhaust fumes. Photocatalyst membranes facilitate a cleaner environment through their ability to eliminate harmful nitrogen oxide particles from the air.

Photocatalyst Membrane Cooling System Minimizes Urban Heat Island Effect

(TiO2) technology has still another benefit - cooling both internal and external building environments through vaporization, providing relief from heat island phenomenon, as shown in fig. 7. Further, evaporation cooling, which occurs due to the hydrophilicity of photocatalyst membranes, reduces interior air-conditioning loads.

Examples:

Ex. 1: Nara Women’s University
Architect: Nakagawa Architect
GC: Nakagawa Construction
Membrane: Ever Fine Coat

Ex. 2: Mannou National Government Park
Architect: Urban Design Consultant, Inc.
GC: Uchiyama Landscape Construction Co., Ltd
Membrane: Ever Fine Coat

Ex. 3: Hyatt Regency Osaka - garden chapel
Architect: Obayashi Corporation
GC: Obayashi Corporation
Membrane: Sky Clear Coat

Ex. 4: Hourai-ken
Architect: mg studio
GC: Shoei Sangyo
Membrane: Sky Clear Coat

Ex. 5: Tokyo University Laboratory
Architect: Taiyo Kogyo Corporation
GC: Taiyo Kogyo Corporation
Membrane: Sky Clear Coat

Ex. 6: Fukuoka Island City
Architect: Nakagiri landscape
GC: Kashi, Toshizoen JV
Membrane: Sky Clear Coat

Ex. 7: Tent warehouse
Design: Taiyo Kogyo Corporation
GC: Taiyo Kogyo Corporation
Membrane: Self Max

Caption:

Photocatalysis Applications of Titanium Dioxide

Many studies have been published on the use of TiO2 as a photocatalyst for the decomposition of organic compounds. TiO2 is active under UV light. Photocatalytic activity is the ability of a material to create an electron hole pair as a result of exposure to ultraviolet radiation. The resulting free-radicals are very efficient oxidizers of organic matter. Photocatalytic activity in TiO2 has been extensively studied because of its potential use in sterilization, sanitation, and remediation applications. The photocatalytic activity of titanium applied in coatings, results in self-cleaning and disinfecting properties under exposure to UV radiation. TiO2 can be coated on many building materials, including membranes. Surface finishing technology for TiO2 photocatalytic materials is based on results produced by Professor Emeritus Akira Fujishima and Professor Kazuhito Hashimoto, Tokyo University.
TEXTILE CLUBBING

The Charly Max Club in Eivissa Island includes an open air terrace for late night dining. This terrace is now protected by a textile roof (fig. 1). The roof plan is triangular (fig. 2). Two sides are open to the sea view, and the third is closed by the main building. Starting from the open sides as horizontal edges, a HP was designed, raised to the out-of-plane point, anchored indirectly to the façade. In doing so, the building closes the raised elevations, and prevents the protected space from escaping towards the sky. In addition, the horizontal borders frame the view, and improve the perception of distance and depth.

The masts are made of double CHS in order to avoid ties (fig. 3), and scalloped edges act as intermediate space, creating a smooth transition and increasing openness (fig. 4).

The main function of the roof as a night dew shelter is complemented by its eye-catching effect, attracting consumers who can easily recognise the place (fig. 5).

Client: Charly Max Club
Location: Eivissa Island (Spain)
Architects: Llorens & Soldevila
Membrane: PVC coated polyester
Manufacturer: Metex (Granollers, Spain)

Installation process

The formfinding of tensile structures was explained by Prof. Marijke Mollaert. During the discussion it was mentioned that from the very beginning additional technological aspects (such as acoustic and thermal problems) should be included. Work will be structured around specific ‘cases’, developed. Variable section members will be designed and three dimensional geometries either made from the inversion of funicular shapes or from anticlastic pretensioned forms will be analysed and tested.

The characteristics of the surface finishing will be studied and the possibility to obtain specific ‘textile’ patterns will be improved.

During the kick-off meeting (5th September 2006) architectural examples were presented by Prof. Hera Van Sande.
The proposal for the Eco-boulevard of Vallecas can be defined as an operation of urban recycling that consists of the following actuations: the installation of three social revitalizing “air trees”, placed along the existing urbanization; the densification of trees within the existing concourse; the reduction and asymmetric disposition of the traffic routes; and small interventions within the existing urbanization (such as perforations, paint, etc.) that help to achieve a reconfiguration of the executed urban development.

The three pavilions, or “air trees” as they are called, function like open structures to multiply resident-selected activities. Installed in the non-city as temporary prostheses, they will be used only until air-conditioned spaces are no longer needed, when the area becomes “fixed”. When a sufficient amount of time has passed, these devices should be dismantled, leaving remaining spaces that resemble forest clearings.

The air trees are lightweight structures, easily dismantled, and energetically self-sufficient: they only consume what they are capable of producing by means of systems designed to capture and use solar photovoltaic energy. The simple climatic adaptation systems installed in the trees of air are of the evapotranspirative type, which is often used in greenhouses. This aerotechnical practice or artificial adaptation is not a part of a commercial strategy. On the contrary, it tries to undo the leisure - consumption binomial, and reactivate the public space by creating climatically adapted environments (8ºC-10ºC cooler than the rest of the street in summer), where citizens will be once again active participants in public spaces.

Air is inhaled in the top of the chimneys and freshened by action of water micronizers and nebulizers. By means of a ventilator, powered by the energy from the photovoltaic cells, the air is impelled through these chimneys, being expelled through nozzles at the bottom to the interior of the tree.

The chimneys are sixteen PES/PVC membranes, inner thorus-shaped, patterned and prestressed in order to resist wind action (even without the outer lobes). Surrounding them are sixteen lobes made of double layered polypropylene shading mesh. The outer meshes of these lobes have different shading percentages (made of aluminium sheets), depending on the façade orientation; the inner is a typical greenhouse mesh. They are cylindrically shaped, prestressed and anchored to the structure by means of steel bars inside pockets and webbings.

This proposal tries to affect the problem of the design of urban spaces as places for life, being one of the characteristics of the Mediterranean cities. It has been cofinanced by the Municipal Company of Housing (EMV) of the City Council of Madrid and the European Union within program LIFE-2002 (ENV/E/000198).

Belinda Tato, Jose Luis Vallejo, Diego García-Setién, [ecosistema urbano] Javier Tejera, BAT [Buró Arquitectura Textil]
LANVEOC-POULMIC IN FINISTERE

A HELICOPTER HANGAR AT

"These are public service and combat helicopters on day and night watch over the seas of the near Atlantic", says base commander, sea captain Denis Bigot. This hangar (also used for ongoing aircraft maintenance) is covered with two Ferrari membranes: Précontraint® 1352 for the roof and Précontraint® 1002 for the walls and the three motorized sliding doors.

These very large (3m x 21m x 7m) fabric-covered doors are light and easy to use, but nonetheless presented some major design and fabrication headaches. Open more or less all the time on the front of a 68 m-long building they gulp in sweeping wind pressures of up to 159 daN/m² (184 km/h winds) in this Region 4 zone.

The challenge taken up by Toile et Structures was to maintain a variable-geometry, three-dimensional arch solution, using cables for the bottom booms and diagonal cables between tubular spreaders.

The general solution to this type of problem would be to compress the bottom booms to allow inversion of the loads. With a three-dimensional beam, for instance, the top boom is compressed and the bottom booms are "drawn out" for descending loads or the other way round for lifting.

The result here, however, is striking: a lightweight structure, savings in materials, simplified assemblies (only toggles and axes). It is transportable, easy to fabricate and install.

"This work made it possible to deliver a 12-meter-high building, with 3 150 m² of floor space, that weighs about 24 kg per m² (including the walls) - the equivalent of a traditional roof without even counting the framework!" as Dominic Owen-Jones, Head of the Toile et Structures architectural textile department put it.

An innovation in terms of Ferrari textile membrane fittings - kedar on the outside of the pockets - enabled delivery in jumbo rolls and installation by unrolling, thus reducing wind resistance.

The building has an anticlastic roof with design stability ensured by the tension in the membrane (200 daN/linear m pre-tensioned).

Daylight really does penetrate all through the building providing comfortable lighting conditions for the technical staff in their daily work. As it is to be taken down, this translucent Architectural Textile construction was chosen, knowing it could be taken away and put up elsewhere.

---

**FERRARI PRECONTRAINT: A COMFORTING STATE-OF-THE-ART TECHNOLOGY**

**Longevity.** Maintaining the mechanical characteristics of composite membranes over time is directly proportional to coating layer thicknesses at the top of yarn. Here’s the tour de force: the Ferrari® Précontraint technique means a much thicker layer than on traditional coated fabrics. Design stability. The textile is strictly controlled throughout the coating operations. The membrane is subjected to regular balanced tension, both warpwise and weftwise. This specific Précontraint® biaxial tension process is a total guarantee of straight yarns. Elongation is thus similar in both directions. Strict homogeneity from batch to batch. Compensation calculation and cutting plans set up for a standard run are valid for all the batches of textile used. The Ferrari® Précontraint technique guarantees faultless applications. Ferrari textiles are 100% recyclable, using the Texyloop® technology. This recycling process of PVC composite textiles is exclusively patented by Ferrari, and was developed in conjunction with the Solvay group.

**TECHNICAL PROPERTIES OF FERRARI TEXTILE MEMBRANES**

<table>
<thead>
<tr>
<th>Thread</th>
<th>Précontraint® 1002</th>
<th>Précontraint® 1352</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100 Dtex</td>
<td>100/2200 Dtex</td>
<td>PES HT</td>
<td>NF EN ISO 2286-2</td>
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<tr>
<td>Width</td>
<td>180 cm</td>
<td>180 cm</td>
<td></td>
</tr>
<tr>
<td>Resistance (to traction)</td>
<td>420/400 daN/5cm</td>
<td>800/700 daN/5cm</td>
<td>NF EN ISO 1421</td>
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<td>Resistance (to tearing warp/weft)</td>
<td>55/50 daN</td>
<td>11/13 daN</td>
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<tr>
<td>Adhesion</td>
<td>12 daN/5 cm</td>
<td>13 daN/5 cm</td>
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<tr>
<td>Reaction to fire</td>
<td>M2</td>
<td>NFP 92.503</td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>surface varnish with PVDF alloy for better dirt resistance</td>
<td>ISO 9001</td>
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Finmeccanica, the main Italian industrial group operating globally in the aerospace, defense and security sectors, is presented on the 45th Farnborough International Air Show with a futuristic pavilion.

The oval shaped structure measures 1000 m$^2$ with another 300 m$^2$ on the upper level. The shape of the pavilion follows curved lines both in plan and section, creating a unified image, smooth and rounded everywhere. The air-filled cladding - cushions made out of double layered PVC membrane, white on the inside, and transparent on the outside - add up to that appearance. The smoothly sculptured shape, with a skin made of transparent bubbles, reflects the sky and clouds, creating a continuously changing exterior, which catches the visitor’s interest.

This temporary pavilion represents a link between scaffoldings and permanent buildings in the most modern and contemporary way: the pavilion has no internal columns, is geometrically demanding, can be dismantled and used several times. It is as well as stable in value, economical and resource-saving.

Already in 2002, IPL designed a similar, box-shaped pavilion for BMW at the IAA 2003 (Internationale Automobil Ausstellung) in Frankfurt. It consisted of Nüssli-trusses and horizontal membrane cushions. Until the second usage in 2005, the membrane cushions had been put in storage. The trusses, on the other hand, have been used for a number of different applications.

The Finmeccanica pavilion was assembled for the first time in spring 2006. After four weeks, it was dismantled, cleaned, and stored. It will be assembled again for a second and a third time at the Farnborough International Air Show of 2008 and 2010.

The sections and dimensions between axes were already fixed when we advised on the cover. The pavilion is much more organically shaped than the BMW pavilion, and is based on a screwed steel structure. It has a horizontal gutter frame with stiff screwed 3-chord trusses which form the backbone of the hall. The curved pipes for both roof and façade are connected to it.

In plan view and in section the pavilion has an oval shape, with a horizontal gutter, and bended façade profiles. Roof girders have only small load reserves for the absorption of the membrane forces. Therefore we opted for a one-piece roof cushion which was welded airtight in the factory. The height of the cushions was limited by the help of nine wind suction pairs of cables with 12 to 16 mm diameter each. The cable forces have been adapted with a Y-shaped spread to the 3-chord border girder.

The façade was defined as a row of 48 vertical membrane cushions on a structure with vertical and horizontal trusses. The cushions are connected to a vertical sliding section. Like the roof cushions, all horizontal connections of the façade cushions are laced.

Although apparently a vacuum geometry, the façade consists of pressure cushions: this impression results from the transparent outer skin, which allows to see the inner cushion layer.

Client/ Building owner: Finmeccanica Italy
Event planner & Structural design: Grupo Bodino, Italy
Membrane design: form TL Ingenieure für tragwerk und leichtbau GmbH, Germany
Membrane manufacturer & Assembly: Canobbio S.p.A., Italy
Dimensions: Base area 1250 m$^2$ - Oval: length 49 m, width 34.6 m
Height of valley gutter 8 m - Width of façade field: 1.8-2.4 m
Steel structure: roof girder: twin pipe d=219mm with spread rod stabilization, dimensions between axes 4.8 m
Span up to 30 m
Valley gutter frame: 3 chord-girder with pipes d=168mm d=88.9mm; with about 1.5m width and 1m height
Façade pipes d=101.9mm
Membrane and façade: roof: 1250 m$^2$, roof cushion: PES/PVC Type 1
Façade cushion outside: transparent PVC-foil
Façade cushion inside: PES/PVC Type 1
Design: May 2006
Manufacturing: June 2006
Assembly: July 2006
Farnborough Air Show 2006: 17-23 July 2006
At the 2006 Football World Championship in Germany, the Bundestag presented itself to an international audience in the "Bundestagsarena", which was modelled after the dome of the Reichstag building.

"The Bundestagsarena is a worldwide unique parliamentary object: Visitors to the World Championship will have the opportunity to get information on the work and the functionality of the Bundestag under the glass dome", said the President of the Bundestag, Dr. Norbert Lammert, on the 22nd of May 2006, when he formally set his hands to the assembly of the last film.

Ideally situated between the Bundeskanzleramt (Office of the Federal Chancellor) and the Reichstag, a system building made of braced girders was temporarily erected. Roof and façade were divided into 21 fields, stringed with a single-layer of ETFE film. Each field comprised an area of approximately 69 m².

ETFE film is crystal clear, offering a translucency degree of about 97%, and a transparency to UV rays of almost 100%. In order to reduce the blinding effect and the interior temperature rise due to excessive solar radiation, the upper areas of the film had been printed in a special reflecting silver colour. The print was implemented in shadowing degrees of 70%, 50% and 20%. The lower part remained transparent.

CENO TEC used a total of approximately 1,800 m² of material. The surface of the dome was 1,500 m². The challenge was to stretch this flimsy film (200 μm) in such a way, that it would resist atmospheric exposure (e.g. thunderstorms). For this purpose, a combination of an appropriate language of shapes and technical elements was used. This was realised by using a linear profile attachment along the supporting binding stones, as well as a lower edge formation made of chain-like clamping profiles. One shaping and stabilising cable each is provided in the centre of the path.

The conceptual design was developed in close cooperation with the event contractor GU Nüssli and FormTL, with whom CENO TEC has already carried out various outstanding projects over the past few years.

<table>
<thead>
<tr>
<th>Name of the project:</th>
<th>Bundestagsarena, Berlin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client/Building owner:</td>
<td>Deutsche Bundestag</td>
</tr>
<tr>
<td>Design:</td>
<td>dasFiedler, Berlin</td>
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<tr>
<td>Engineering:</td>
<td>formTL, Radolfzell</td>
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<td>Contractor:</td>
<td>GU Nüssli, Berlin</td>
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<td>Manufacture:</td>
<td>Ceno Tec, Greven</td>
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<td>ETFE film</td>
</tr>
<tr>
<td>Year of Construction:</td>
<td>2006</td>
</tr>
</tbody>
</table>

a.bosse@cono-tec.de – www.ceno-tec.de

In September this year the so-called Meilenwerk, which has successfully been established in Berlin several years ago, has also been opened in Düsseldorf. On a surface of 19,000 m², a fascinating forum will be offered to all vintage car enthusiasts in North-Rhine Westphalia.

Apart from restaurants, event and shopping areas, there will be a large exhibition space, and workshop areas for vintage car and other vehicle enthusiasts on the listed premises of the former engine shed. Visitors will be able to see selected classical vehicles in museum-like areas, as well as a vivid trading centre for vintage cars.

Thanks to its roof structure, this area will also be an architectural attraction, since an area of approximately 2,500 m² will be protected by an exceptional transparent air cushion roof of ETFE films.

The following is a quotation from the press release from the Meilenwerk: "The air-filled chambers lie like a cushion between the steel braces, transforming the former track yard into an elegant platform. When you look up, you will be amazed by the impressive perspective: The run of the steel braces is bundled in the centre of the former turntable, where the restaurant is now situated. The incomparable architecture of the building is specially highlighted by the radial layout of the lines".

Due to the translucent, air-filled film cushions, the individual roof construction, made of steel trelliswork girders, easily attracts the observers' attention. Each cushion consists of 4 film layers each layer being printed in a different way, in order to enable only diffuse light to pass.

1st layer: ETFE film, 200μm, printed all over in silver;
2nd layer: ETFE film, 100μm, transparent;
3rd layer: ETFE film, 100μm, matt finished;
4th layer: ETFE film, 200μm, decorative blotch printing, silver.

Thus, visitors can enjoy the exhibition in a light and pleasant atmosphere without being blinded by direct sunlight. The light passage amounts to approximately 25%, including a large proportion of diffused light. Altogether, approximately 10,500 m² ETFE film was used in the Greven factory for the multi-layer cushions.

In case of snowfall, the permanent cushion pressure will be increased automatically from 300 Pa to 800 Pa. Thus, the construction can bear a snow pressure of 0.75kN/m².

After its successful assembly by CENO TEC engineers, the roof could be taken over by the customer according to schedule at the end of July. The Meilenwerk Düsseldorf was inaugurated on the 16th and 17th of September 2006.

<table>
<thead>
<tr>
<th>Name of the project:</th>
<th>Meilenwerk, Düsseldorf</th>
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<tr>
<td>Client/Building owner:</td>
<td>Insignium gebaute Marken GmbH</td>
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<tr>
<td>Design:</td>
<td>RKW, Düsseldorf</td>
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<tr>
<td>Engineering:</td>
<td>formTL, Radolfzell</td>
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<tr>
<td>Manufacturer:</td>
<td>Ceno Tec, Greven</td>
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<tr>
<td>Membrane:</td>
<td>ETFE film</td>
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<tr>
<td>Covered Area:</td>
<td>2500 m²</td>
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<td>Year of Construction:</td>
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</table>

info@cono-tec.de – www.ceno-tec.de – www.meilenwerk.de
UNIVERSAL FABRIC STRUCTURES - MPOWERDOME

An Australian-first fitness and tennis complex, mpowerdome, which opened in Canberra, Australia recently has revolutionised the industry in terms of design and flexibility. mpowerdome is the largest tennis sport hall of its kind in Australasia and was provided by Universal Fabric Structures.

But it’s not just tennis that is benefiting from this unique and stunning complex. mpowerdome is home to a variety of sports and activities including soccer, cricket, netball, dance, Australian Football League and even a model aeroplane flying club!

“The world-first multi-purpose flooring system gives us tremendous flexibility in terms of hosting a variety of sports, as well as functions. And the overall design, which truly lets the light and the outdoors into the complex, make it a real showpiece,” mpowerdome Managing Director Gail Aiken said. The eight-court tennis and multi-sport facility, measuring 156 metres in length, 12 metres in height and with a span of 38 metres, also includes a mezzanine café and reception centre.

The entire complex is clear span, offering an unobstructed arena to suit a multitude of purposes. Made from heavy duty PVC, called Ferrari 702S, premium architectural PVC, the complex includes curtained side walls which quickly and easily slide back, allowing spectators to view matches from outside as well as giving the facility plenty of natural light and air. The construction with aluminium and steel framework is built to withstand even the most severe wind loads.

The benefits of the sport hall are numerous, including:
- Creating an outdoor effect in an indoor setting with a fun, bright, and airy recreational atmosphere;
- Delivering an immediate and affordable solution;
- Delivering a more cost-effective maintenance solution;
- Modular or custom designs to suit new or existing facilities.
- Solutions for temporary, semi-permanent or permanent shelters.

KONGSBERG JAZZ FESTIVAL

The main stage canopy is a landmark bandstand structure for sheltering outdoor musical performances at the annual Kongsberg Jazz Festival. The client was Kongsberg Jazzscenar AS (Norway). Canobbio SpA (Italy) has been contracted to manufacture the membrane and the inflated beams. Engineering was done by Airlight Ltd, engineer A. Pedretti (Switzerland), while architectural concept and design was provided by Snøhetta AS, architect Joshua Teas, Oslo, (Norway).

The construction consists of a membrane structure of tensioned polyester-PVC fabric over an inflated frame. The main stage can easily be mounted for temporary use in outdoor musical performances at the Festival, as well as for other events. The PVC membrane is particularly well suited to achieve dramatic lighting effects, and is acoustically neutral. The shape of the structure looks like a large saxophone, as the architect’s idea would have it.

The structure is 38 m long, 22 m wide and 19 m high. The fabric is supported by two steel arches and a steel ring. The steel ring is supported on the smaller arch by two steel profiles. The dimensions of the smaller arch are 7m x 14m. The bigger one, more like a tongue shape, is about 33m x 22m. Both ends of the arches are pinned on the ground. The steel ring diameter is about 12m.

Particular attention has been paid to the installation design. The client’s requirement was to be able to erect and dismantle the structure in a short time, because the Festival is annually held in the central plaza of the city. Due to the complexity of the structure, it has been pre-assembled in Italy, in order to verify the functionality of all the components. The entire installation is completed in about 5 working days.

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Everything has been prepared for the final match in July: the newly refurbished Olympic Stadium in Berlin, Germany, gives 74,000 spectators a clear, unobstructed view of the soccer field. The new lightweight roof construction, made of woven fiberglass membranes coated with Dyneon PTFE and Dyneon Fluorothermoplastics, ensures that everyone is protected from rain and other weather conditions.

The conditions associated with the construction of the new roof of the Berlin Olympic Stadium were extremely challenging for the Berlin architects Gerkan, Marg and Partners: the entire structure of the roof was to stay within the boundaries of the ground plan of the existing stadium. Because it is classified as a historical monument, its original appearance was to remain as unaffected as possible. At the same time, the spectators’ view of the playing field was to be as unobstructed by supporting structures and columns as possible. To make things even more complicated, all of the reconstruction work was to be accomplished without interrupting regular-season matches.

The architects decided on a lightweight cantilevered steel construction for the U-shaped roofing over the stands. It does not form a closed ring but remains open in the middle and in front of the historical Marathon Gate Arch, in order to preserve the view from the stadium seats to the Maifeld (May Field) and the Glockenturm (Bell Tower), all in line with the wishes of historical monument preservation. In the upper regions of the stands, 132 outer steel posts and 20 slender steel posts positioned in the stands, having a pedestal diameter of only 250 mm, are essentially all that is supporting the steel construction of the roof, which looks like it is floating over the stadium.

Hightex GmbH of Rimsting, Germany, a company that specializes in textile architecture, covered the outside surface of the supporting structure with 27,000 m² of woven fiberglass membrane in 77 membrane sectors. These membranes are made of coated woven fiberglass having a tensile strength of up to several tons per linear meter width, and they themselves weigh only one to one-and-a-half kilograms per square meter. The coating with Dyneon PTFE and Dyneon Fluorothermoplastics is what gives this material these all-important properties for heavy-duty use in architectural applications: the surface of the coating is very smooth and has a long-lasting resistance to varied weather conditions, which has been demonstrated in many years of use in very different climate zones. In addition, Dyneon PTFE possesses a nearly universal chemical resistance and exceptionally good mechanical properties.

A key advantage of PTFE coatings is that they require neither softeners nor stabilizers, which can evaporate over time and can cause the coatings to become brittle. The PTFE allows the membranes to remain elastic and smooth so that even after a number of years of service, dirt and contamination are unable to find cracks to settle into. Rain showers are typically all that is needed to clean the roof even after many years of use. The translucency of the woven material guarantees during daylight hours that the lighting conditions inside the stadium are ideal for both spectators and players.

Hightex GmbH also lined the lower side of the roof construction with a Dyneon PTFE coated, open-grid woven fiberglass matting. This lower side serves as maintenance gangways for the glare-free floodlight system installed under the roof, as well as for the sound system that has more than 150,000 watts of power. This installation technique eliminates the need for distracting masts around the borders of the playing field. The open-structured fabric of the lower side allows sound and light to pass through, while at the same time ensuring ideal pressure compensation through to the upper membranes under windy conditions, thus also helping to reduce the static load on the steel construction of the roof. Taken altogether, soccer fans visiting the Olympic Stadium will have a perfect view of the final match in July.
For the Olympiastadion Berlin, the central building to the historical 1936 Olympics sports complex, design problems between the historical preservation requirements, careful modernization and current requirements for a multifunctional use, including that of a pure football arena, have been addressed and transformed into a synthesis.

The stadium is conceived as a uniform entity relating to the entire spatial context. The master plan proposed by Werner March in 1936 remains under urban historic preservation, with the new plans emphasizing the quality of the original structure. All necessary additions have been placed underground, outside of the stadium, to prevent obvious visual intervention to the stadium’s graceful appearance.

The modifications cover the following areas:
- Damage survey and renovation of the concrete structure;
- Modernization of all technical and athletic areas;
- Construction of VIP lounges and refreshment areas;
- Construction of outer, underground areas, supporting technical functions and circulation, consisting of bi-level underground garages for ca. 630 parking spaces, an entrance tunnel, main technical and maintenance facilities, a warm-up hall with a 100 m track, and VIP entrance areas to the stadium.

For the renovation works on the façades and the cladding of the columns consisting of Muschelkalk (fossil embedded limestone) and Gauinger Travertine, utmost attention was paid to preserve the material. Before the deconstruction, an accurate record of the condition, placement and registration of each stone is kept in order to restore the original appearance.

The lower stand, which could not be saved within reasonable financial means, has been completely rebuilt in stages. With the construction of the lower tier, the playing field was lowered ca. 2.6 m to settle the conflict between the distance required of the multifunctional track and field arena and the necessary proximity of the mono-functional football arena. Approximately 1,600 seats were gained through 2 extra spectator rows, which neared the viewers to the football field. In the future, the stadium will offer 76,000 seats.

With the modernization of the stadium, new, independently accessible VIP areas have been developed. Underground entrances and allocated parking guarantee direct connections to the VIP areas. The VIP boxes have been carefully installed with consideration for the existing structure and can be de-installed if required.

The design of the stand roof fulfills the functional requirements, considering both artistic significance and preservation conditions. At the forefront lies the intention to support the existing architectural qualities through an equally high quality roof element.

The new roof structure, with its open-ended ring towards the Marathon Gate, sets itself apart from stadium typology with its simple construction and choice of surface material, emphasizing the urban axis from the Olympic Square to the Bell tower.

The roof is designed as a light cantilevering steel construction with an upper and lower membrane. The total length of the steel truss work functioning as the main support is estimated at 68 m and is visible through the translucent membrane. The construction height is minimized in the inner and outer edges so that the parapet of the stadium is accompanied by a minimally visible, low horizontal. This way, the roof construction does not dominate the stadium and the architecture of its historical façades remains intact.

From the interior, the roof rests on 20 steel columns, which each have a slim profile of 25 cm in diameter, allowing as little obstruction to spectator view as possible. The necessary constructions to bear the roof loads are integrated into the upper tier construction, hidden underneath the natural stone facing.

A special installation integrates the field lights with the stadium’s acoustics close to the inner roof edge and omits the use of unsightly floodlight and loud speaker masts. The new stadium roof will illuminate itself and become a recognizable icon in the media.

The construction works began in May 2000 and were finished, despite the ongoing games held therein, in May 2004. The construction of the steel supports began in June 2002 along the north side and has progressed around the east curve as the south stand area continues towards the Marathon Gate.

http://www.gmp-architekten.de
The relationship between membrane architecture and the concept of time can be illustrated by the following:

Those spaces again.

Ephemeral Architecture not only responds to the needs of contemporary society for flexible and lightweight building, but is also the result of an ecological design strategy, where temporary constructions can be disassembled after use, leaving future generations free to decide how to use membranes, which respond to the principles of firmness, commodity and delight, distancing themselves from the classical interpretation embodied by everlasting, monumental architecture.

On the other hand, Ephemeral Architecture has always been considered a construction of necessity, a temporary and minimal shelter used by man in ancient times and also today by nomadic peoples. It is a form of architecture which uses lightweight materials such as textiles and local raw materials, and construction techniques which can be easily disassembled and transported to create adaptable spaces for different environments and climatic situations.

For these reasons, architectural history books have largely neglected primitive Ephemeral Architecture and likewise Textile Architecture until now. We believe that the moment has come to re-evaluate both Ephemeral and Textile Architecture since they possess characteristics which prove extremely interesting for our non-migratory but ever increasing transient lifestyle. Since textile architecture has seen a period of great innovation in form, technology and materials in the last fifty years, it's time to take stock of the present situation and propose alternative solutions which are more consistent with a new need for flexibility, a new aesthetic concept and last but not least, new obligatory environmental safeguards.

The objective of the Symposium therefore, is to underline the close relationship between membrane architecture and the concept of time, and to emphasise how this relationship is constantly evolving, giving new life to all ephemeral architectural expressions.

Ephemeral Textile Architecture not only responds to the needs of contemporary society for flexible and lightweight building, but is also the result of an ecological design strategy, where temporary constructions can be disassembled after use, leaving future generations free to decide how to use those spaces again.

The relationship between membrane architecture and the concept of time can be illustrated by the following:

The main theme of the TensiNet Symposium 2007 will be Ephemeral Architecture and in particular, the relationship between membrane architecture and the concept of time.

The association of the adjective ephemeral with architecture is relatively recent, starting from the “structural revolution of architecture” (René Sarger, 1967), which is about “180 generations since man built the Pyramids” (Bruno Zevi, 1997). Ephemeral Architecture describes, on the one hand, tensile structures built with lightweight membranes, which respond to the principles of firmness, commodity and delight, distancing themselves from the classical interpretation embodied by everlasting, monumental architecture.

For more information please contact ephemeral.architecture@polimi.it

Marijke Mollaert

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