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ARTICLE

SUSTAINABILITY AND COMFORT
THE RE-ACTIVATION OF THE WORKING GROUP

RESEARCH

GRINDOOR
MASTER THESIS PROJECT

PROJECTS

DESIGNING NATURE

THE GROWING PAVILION AT THE DUTCH DESIGN WEEK, EINDHOVEN © ERIC MELANDER

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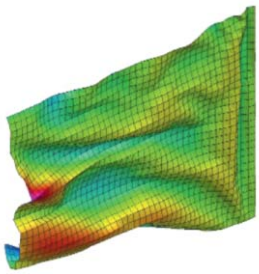

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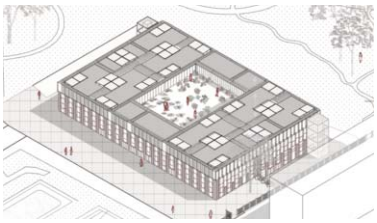


4 grINdoor
MASTER THESIS PROJECT

MISC

16 BUBBLES TO LIVE AND WORK IN
LOOKING AT THE PAST ... AND LOOKING FOR THE FUTURE?

Edito

Dear Reader

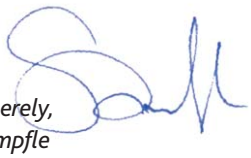
I am glad to announce that this May the deed of incorporation to transform TensiNet into an international non-profit association has been signed. We are now on our own feet, and thank the VUB very much for being our home since the beginning in 1999.

This TensiNews presents again actual projects, research topics as well as new developments in our industry. The simulation of flying flags, a modular sail concept, a sun and rain protection in India and two projects made of growing material, such as mycelium and willow. Two ETFE projects are shown, one is a second skin in front of a glazing façade, and the other is a master thesis with sliding cushions covering a green court yard.

Back in the history of our industry, we show the temporary pneumatic structure which covered in 1971 a Mies van der Rohe villa in Krefeld. The statement was "survival in a polluted environment". After a longer period the WG Sustainability and Comfort is reactivated. I hope that many of you will join this working group.

The Covid19 pandemic this year changed our live and schedules. Most of the conferences have been postponed to 2021 or even cancelled; only few are still scheduled. So it was hard or almost impossible to meet this year. We hope to be able to meet also physical in the near future.

I hope you enjoy this issue of TensiNews and wish you all the best. Stay healthy.



Yours sincerely,
Bernd Stimpfle

Forthcoming Events

Please verify if events hasn't been cancelled, postponed or replaced by a tele-conference due to COVID 19 virus

Textile Roofs 2020 | *Postponed to 10th – 12th May 2021* | Berlin, Germany | www.textile-roofs.com

IASS Annual Symposium and Spatial Structures Conference 2020/2021 - Inspiring the next generation | *Postponed to 23-27 August 2021* | University of Surrey, Guildford, UK | https://www.surrey.ac.uk/iass2021

VIII Latin American Symposium of tensile structures | *Postponed* | Buenos Aires, Argentina | http://www.latensored.org/

5. Essener Membranbau Symposium | *Cancelled* | Universität Duisburg-Essen | https://www.uni-due.de/iml/ems2020.php

International Conference on Advanced Building Skins | *26 – 27/10/2020* | Bern, Switzerland | www.abs.green |

TECHTEXTIL 2011 | *4-7/05/2021* | Frankfurt am Main, Germany | https://techtextil.messefrankfurt.com/frankfurt/en.html

CALL
IASS Surrey 2021 Expo

Competition and exhibition of innovative lightweight structures: Organized by the new IASS Working Group 21 "Advanced manufacturing and materials" in close cooperation with the IASS Symposium 2021 and the 7th international conference on Spatial Structures in Surrey.

The expo, symposium and conference will take place in Surrey from 23 to 27th August 2021. Deadline for entries is January 31st, 2021.
https://www.jjo33.com/surrey2021

ADVANCED BUILDING SKINS

TensiNet Presentations & Meetings at Advanced Building Skins

26-27/10/2020

PRESENCE TENSINET POSTPONED TO 2021

TensiNet will be represented at the 15th Conference on Advanced Building Skins with two [illegible] "**Skins from fabrics and foils**" and "**Building Membrane Cladding Systems**", [illegible] signed by our associate partner POLIMI and lastly we will organise the TensiNet Meeting "**TensiNet and friends**".

TensiNet members receive a reduction on the registration fee. https://abs.green/registration/

Centre Pompidou-Metz @ wordpress.

FLYING FLAGS ESI Group

HOW DO THE WORLD'S LARGEST FLAGS ACTUALLY FLY?

Flags are designed to display a message!

Do you ever see an enormously large flag and think to yourself, "how does that flag actually fly?". Ok, maybe you don't – but I bet you do ask yourself how you can save money and time on building lightweight structures. Discover eight of the world's tallest flags and how wind velocity exposure affects flying performance. It is essential that the flag, pole and attachments are designed to ensure optimum display and safe performance in varying natural winds. These studies, performed by SL Rasch, can help save time, energy and cost when deciding how to build similar extraordinary and lightweight structures in the future.

SL Rasch GmbH, a German architecture firm that specializes in extraordinary constructions and lightweight structures, explored the performance of large national flags hoisted on very tall flag poles flying in the natural winds of their respective locations. A list of the world's tallest flags:


1

NB PLACE	YEAR	POLE	FLAG SIZE	FLAG WEIGHT
0 Dubai	not built	200m		400kg
1	2014	170m	33x49.5=1633m²	570kg=0.35kg/m²
2 Dushanbe Tajikistan	2011	165m	30x60 =1800m²	700kg=0.39kg/m²
3 Baku Azerbaijan		162m	35x70=2450m²	
4 Panmunjom North Korea		160m		270kg
5 Ashgabat Turkmenistan	2008	133m		
6 Dubai Sharjah Airport		123m	70x35=2450m²	
7 Tashkent Uzbekistan	2018	65m	10x20=200m²	

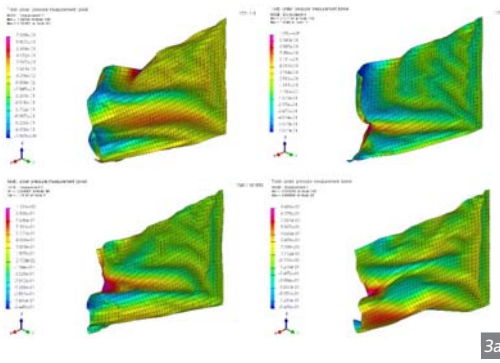
Ever-increasingly large flags require even heavier, more tear-resistant fabrics, but nevertheless should present as consistently flying even under moderate winds. In a pilot study, SL-Rasch chose to simulate the behaviour of a tall flag at scale 1:3 to determine the design requirements for the fabric´s tensile strength and weight, its attachments, and the flag pole dimensions to guarantee the effective and safe performance of such tall flags both at low and high average wind speeds.

Figure 1. Flying masts © ESI, 2020

Figure 2. SLR Flying Flag in CFD domain at height 150m © SL Rasch GmbH, 2020

Figure 3 a-b. SLR Flying Flag snapshots at 30m/s wind speed at 150m © SL Rasch GmbH, 2020

Figure 4 a-b. Ashgabat 133m © E. Haug, 2020, Flag and calculated SLR Flying Flag snapshots at winds decreasing to 15m/s, 3.77m/s and 1.25m/s © SL Rasch GmbH, 2020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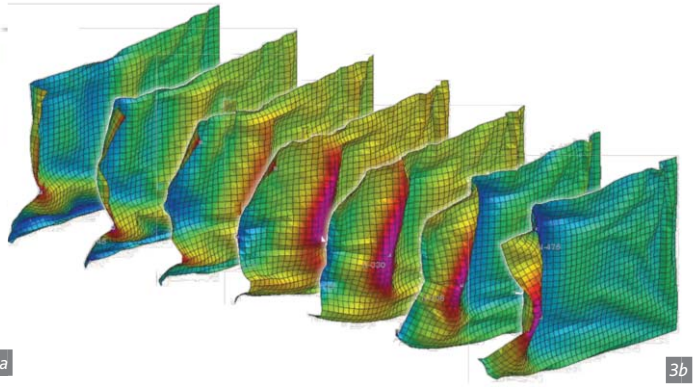
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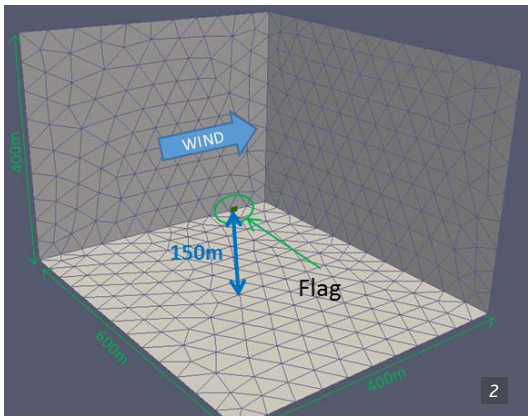

2


4b

The challenge was for SL Rasch to represent numerically the sustained motion of the flexible fabric, waving in the air under different average horizontal wind velocities, and over sufficiently large time intervals for statistical relevance.

Fluid-Structure Interaction (FSI) simulations – coupling Computational Fluid Dynamics (CFD) and Computational Structural Dynamics (CSD), make it possible to track the complex waving motions of the flexible fabric in the winds and the stresses in the fabric, as well as the flag pole's bending moments caused by the horizontal drag forces from the flag. The flag's CSD model was placed in a 600x400x400m CFD domain (Fig. 2)

The safe average wind speed before bringing the flag down was assumed to be 30m/s at a height of 150m. Using ESI's Virtual Performance Solution and CFD codes in coupled FSI mode, produced the time snapshots at 30m/s average wind speed shown below (Fig. 3).

The lowest average wind speed under which the flag still displays its message was determined in subsequent simulations under decreasing wind velocities. To this end, the average high wind velocity was suddenly reduced from 30m/s to 15m/s, 3.77m/s and 1.25m/s.
The results suggest that the flag will no longer display its message at wind speeds below about 5m/s.


4a

Dr. Eberhard Haug
Eberhard.Haug@esi-group.com
www.esi-group.com

Eberhard Haug is one of the founding members of ESI Group, the well-known virtual prototyping company, where he held the position of Scientific Director. He is now retired and acts as a consultant.

vinyl plus®
COMMITTED TO SUSTAINABLE DEVELOPMENT

VINYLPLUS® PRODUCT LABEL FOR VERSEIDAG-INDUTEX GMBH

COMMITTED TO SUSTAINABLE DEVELOPMENT

For more than 25 years now, Verseidag-Indutex GmbH has been actively promoting environmental protection. Sustainable thinking and sustainable actions provide the motivation for Verseidag's investments in the most advanced, resource friendly technologies.

In March 2020, Verseidag was honoured for its proactive approach and proven contribution towards sustainable PVC processing, making it the first company in the PVC coating industry to be awarded the VinylPlus® Product Label.

VinylPlus® is the European PVC industry's commitment to sustainable development. It was launched in 2011 on the basis of a voluntary commitment and has since been developed in an open process of stakeholder dialogue with industry, NGOs, regulators, public representatives and users. VinylPlus® aims to enhance the sustainable production, processing and use of PVC across the entire value chain. The robust criteria for the VinylPlus® Product Label certification process assess and document sustainable raw material sourcing, reductions in emissions, energy saving production methods and controlled material loops. This Verseidag initiative emphasizes the responsible and sustainable use of PVC, which is a particularly ideal material for permanent and temporary applications in construction trades. All certified products are 100% recyclable and hence integrated in the circular economy. This latest Verseidag benchmark once again confirms the manufacturer's reputation as a pioneer in sustainable products.

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DESIGNING NATURE

NATURAL AND SUSTAINABLE MATERIALS FOR THE DESIGN OF TWO AMAZING AND 'LIVING' STRUCTURES.

THE GROWING PAVILION

The demand for a more biobased and circular economy has never been so great and necessary. The idea of the Growing Pavilion was to make a building from as many natural and sustainable materials as possible. The basic design of the Growing Pavilion was a circular wooden skeleton building with mycelium facades and a funnel-shaped cotton membrane roof.

Figure 1 – 2: Outside and interior view. / Figure 3: Detail of the mycelium facade and the funnel-shaped cotton membrane roof © Erik Melander

Request from client

The client, Company New Heroes, wanted to develop a structurally and constructively feasible concept of the Growing Pavilion from as many natural and sustainable products as possible without losing sight of safety. They asked Tentech to take care of translating the sustainable idea into a technically and constructively feasible concept during the design. Furthermore, they wanted to use cotton fabric for the roof of the pavilion. It was up to Tentech whether this was possible (Figs 1-2).

Which boundaries were pushed during the process?

Cotton is not a standard material for use on large roof membranes. In particular, the low tensile strength and the shrinkage behaviour of the material (approx. 4%) presented a major challenge.

Due to fixed end points, excessive tension forces would occur in the fabric and these would generate large internal forces in the ring beam and the anchoring. Tensile tests on the material with and without seams showed that the fabric could not resist these forces. A solution had to be found in which the fabric could be sufficiently deform without deformed excessive forces.

The wooden skeleton with the panels of mycelium would not be strong enough to guarantee the stability of the building. Stability cables were required in the walls. However, when we started looking for natural materials for the stability cables, such as rope and hemp, it soon became clear that very large cross-sections would be needed. On top of that, the ropes' elongation was too high to solve within standard tensioning systems.

Design

In the final design it was decided to exclude the tensile roof from contributing to the stability of the pavilion. This made a flexible fastening of the roof possible. Stretchy connections were created with elastic cords for fastening the roof edge and for tensioning the low point. In this way, larger deformations can be absorbed and the fabric can return to its original shape. The membrane was executed with 2 to 4 layers of fabric towards the funnel to absorb the occurring forces (Fig. 3).
In the end, steel cables had to be used for the stability tension elements. However, in the scope of durability, the steel cables are reusable and are therefore acceptable for this application.

Name of the project:	The Growing Pavilion
Location address:	The Growing Pavilion could be seen and experienced for ten days in the beating heart of the Dutch Design Week in Eindhoven, the Netherlands in October 2019. /From August 1st 2020, the Growing Pavilion can be visited at Floriade Preview in Almere.
Client (investor):	Dutch Design Week
Function of building:	Challenge to build an iconic biobased pavilion
Type of application of the membrane:	Roof cladding
Year of construction:	2019
Architects:	Pascal Leboucq (Company New Heroes) in association with Krown.bio
Multi-disciplinary engineering:	Tentech, Fiction Factory, Buitink Technology
Structural engineers:	Tentech
Consulting engineer for the membrane:	Tentech
Main contractor:	Dutch Design Week
Contractor for the membrane (Tensile membrane contractor):	Buitink Technology
Supplier of the membrane material:	TenCate Outdoor Fabrics BV
Manufacture and installation:	Buitink Technology
Material:	A large number of biobased materials, such as wood, hemp, mycelium, lisdodde and cotton.
Covered surface (roofed area):	60m^2

THE WILGENBORG

A second project is the open-air theatre the Wilgenborg which is located in the surroundings of the Blauwestad, Groningen. The design of Merijn Vrij (architect/artist) is an organic piece of art and living structure that is constantly in motion, developing and growing. The structure is a hybrid construction of living willow branches supported by a (partially temporary) structure. Over time, the structure will grow into a fully green and living structure where the willows are dominant over the steel structure.

Figure 1. Growing process of the living construction.

Figure 2. Construction detail.

Request from client

Tentech was committed to support Merijn Vrij in the final design and realization of the Wilgenborg. Tentech was responsible for the structural realization of the Wilgenborg. Furthermore, the static analysis, engineering of the steel parts and 3D-modelling was executed by Tentech.

Which boundaries were pushed during the process?

The project started with the pre-engineering of the structure, in this stage the steel structure was dimensioned on a preliminary base. The stiffness and structural capacity of the willows was neglected during the pre-engineering stage of the project. The geometry of the design of Merijn Vrij was used as starting point for the geometry of the structure.

At a later stage, the ambition was expressed to use the load-bearing capacity of the willows as much as possible. After planting, the willows will increase in cross section and length. Therefore it is likely to assume that the load-bearing capacity will increase.

Since it was unclear how this growing process of the willows would develop, several base principles needs to be stated. According to varies meetings with the willow supplier and literature studies a plan was written for the coming years of the hybrid steel-willow structure.

The challenge of the project was managing the growing process and predicting it in the right way for the longer term. A 4-year grow-strategy was drawn up for this purpose. In the first year it was stated that the willows would grow approximately 6-7m. The willows needed to be guided around the steel structure and reinforcement bar cages, these are cladded with dead-willow branches. The load-bearing capacity of the living willows is limited in this stage of the project. The load-bearing capacity of the structure is predominantly obtained from the hybrid of steel and dead-willow branches. In this stage, the Wilgenborg cannot be closed with a textile roof because the load-bearing capacity of the hybrid structure is still limited (Figs 1-2).

In the second and third year of the growing process the willows will continue increasing in length and cross section but are still not capable of supporting the textile roof. It is very important that the willows are weaved around the steel structure and guided in the way the structural model is designed. Furthermore it is important to cut all the leaves and make the willow predominantly grow in length in the right direction. The goal is to finally connect the willows in the top of the structure.

It is assumed that the in the fourth year the willows will reach the desired length and cross section. Because of the increased bending stiffness of the willows, the ratio in stiffness between willow and steel will change. The dead-willow branches can be neglected because of the limited cross section, the living willows will take over this load-bearing capacity. In the 4-year plan it is assumed that the textile roof can be installed in the fourth year. First, validation tests need to be executed to proof the load-bearing capacity of the hybrid structure.

Name of the project:	Wilgenborg
Location address:In the landscape near Blauwestad in Groningen, the Netherlands: Elfenbank 9685, Blauwestad (NL)	
Client (investor):	Stichting de Wilgenborg
Function of building:	Living artwork and open-air theatre
Type of application of the membrane:	When the Wilgenborg is fully grown a membrane will be attached to protect the visitors from rain.
Year of construction:	2017
Design:	Merijn Vrij
Concept:	Pascal Leboucq & Lucas De Man (Company New Heroes) & Eric Klarenbeek (Klarenbeek & Dros)
Structural engineers:	Tentech
Consulting engineer for the membrane:	Tentech
Main contractor:	Van Aalsburg (Willows)
Contractor for the membrane (Tensile membrane contractor):	membrane not yet installed
Supplier of the membrane material:	membrane not yet installed
Manufacture and installation:	membrane not yet installed
Material:	steel, wood (willow)
Covered surface (roofed area):	Dimensions of pavilion 36x22m (length x width)

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ARTICLE

SUSTAINABILITY AND COMFORT

THE RE-ACTIVATION OF THE WORKING GROUP AND NEXT ACTIONS

After one and half year of inactivity, the Working Group "Sustainability and Comfort" organized a web meeting in July 2020 with the aim to activate the debate between the TensiNet members on the sustainability and the life cycle approach of lightweight membrane architectures, on the possible comfort improvements. Potential topics and working areas have been proposed as a starting point for the discussion:

1. Life Cycle Design
- LCA-data (catching up from the beginning of the WG in 2012);
- Tools to be used in order to design and evaluate aspects of sustainability and efficiency for and during the design of membrane structures;
- Focus on end-of-life-scenarios, especially on re-use, re-manufacturing and recycling.

2. Comfort
- Outdoor comfort, status quo and future research demand;
- Looking into insulated membrane structures (including acoustic properties);
- Challenges for heat protection due to climate change: strategies for membrane materials and structures.

3. Material innovation and eco-efficiency
- Low-tech approaches for membrane structures to broaden application potential;
- Leaving fossil-based raw materials, towards bio-based membrane materials.

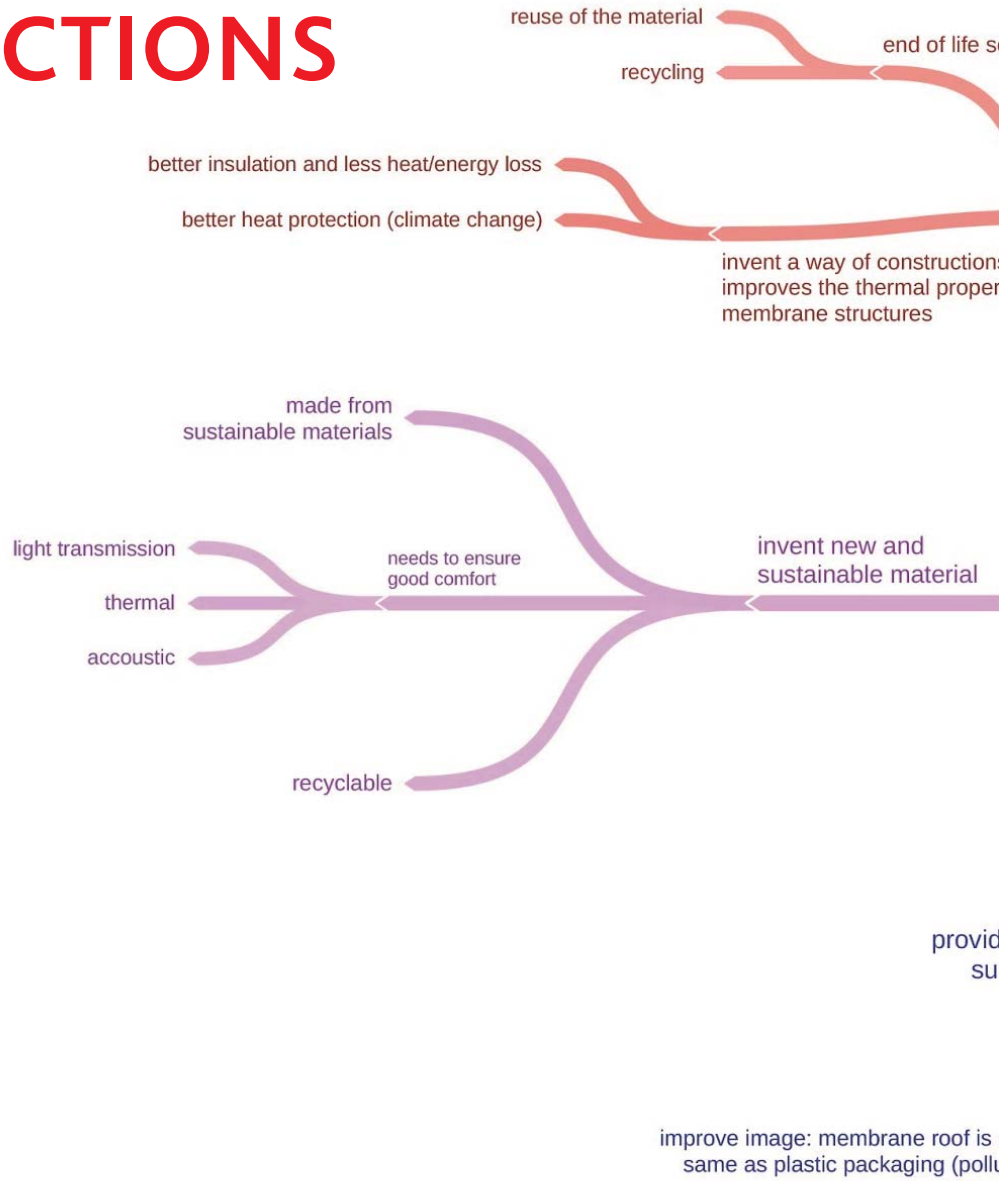


Figure 1: The mindmap of the topic related with the sustainability of Membrane Architecture (@ Lea Bath - Low and Bonar)

The first meeting has revealed really promising thanks to the huge participation and the collaborative intention of the old and many new WG members. The aim is to find concrete aspects to work on, sharing the intentions of industries, companies, designers and academics. The WG participants cover all the needed knowledge sectors, both the sustainability and eco-efficiency, both the outdoor and indoor comfort (thermal, acoustic, day lighting, etc.).

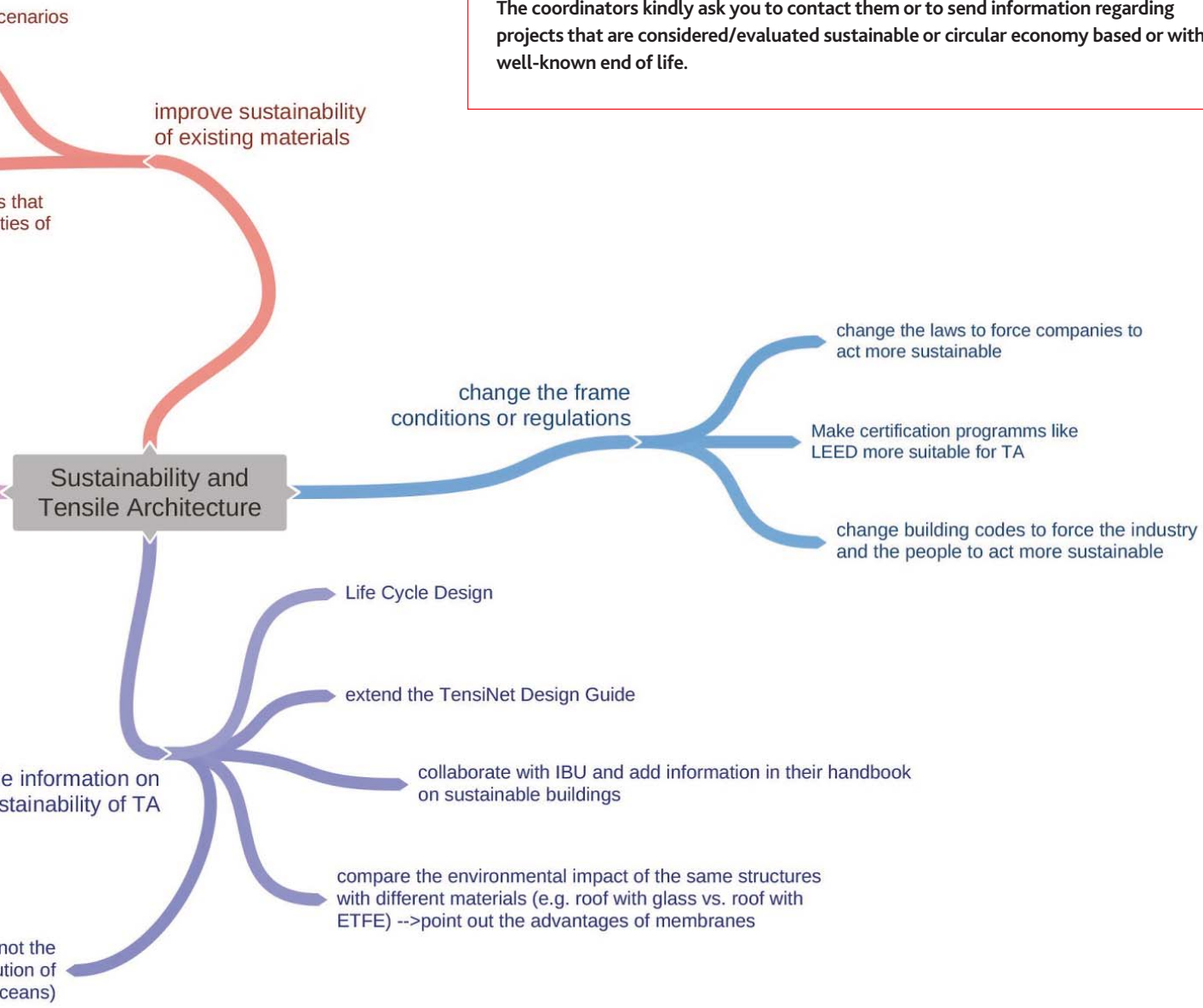
During the discussion some inputs raised up. The idea to organize all mentioned points in a mindmap has been a proposal; it means to try to cluster the individual statements and ideas. By this approach it will become more clear, for the next meetings, in which areas we as a TensiNet working group can take actions (Fig. 1). In particular the clusters "Provide information on sustainability of tensile architecture" and "Changing the frame conditions or regulations" will be topics to focus on.

The other two clusters, defined during the web meeting, "Improve sustainability of existing materials" and "Invent new and sustainable materials" are really important, although less suitable to work on directly in the TensiNet parterre: they need further actions and TensiNet could define some guidelines for industries and companies, and individual members (e.g. material manufacturers , universities or research Institutes) have to search on. For the two first topics probably the TensiNet working group could analyse the need for more sustainable products and the corresponding expectations (e.g. prices, service life) from the market and address this to the industry. Or we could discuss about topics for research to focus on re-use, re-manufacturing, recycling, new materials etc.

CALL FOR ALL THE TENSINET MEMBERS

A first concrete action, focused to the end of life scenarios of membrane architecture, is proposed to all the TensiNet members, the request is to collaborate to complete the TensiNet Database, adding the date of dismantling/replacement of the membrane and information on the end of life of the dismantled textiles/foils (to the disposal in a landfill, re-used, re-manufactured, recycled,…), considering the project's specifications (context lifespan, material, possibility to reuse or recycle).

The coordinators kindly ask you to contact them or to send information regarding projects that are considered/evaluated sustainable or circular economy based or with a well-known end of life.



The mindmap in the figure 1, edited and elaborated after the meeting by Lea Bath - Low and Bonar, who we thank, aims to be completed and refined by adding more details and especially grading the priorities of TensiNet actions, finding out much more ideas and concrete actions, drawing connections between topics and finding parallels. The starting point to organize the discussion of the second meeting in September.

An additional aim of the TensiNet WG S&C for the future is also to provide a living list of all available certifications, e.g. showing the materials for which there is an EPD, listing effective ways of recycling, etc. to support the industries and companies and going as well towards legislative actions.

Other proposals dealt with finding partners within this TensiNet group, aiming to apply for a common research project in this field. It will be discussed in the next meeting.

The WG is defining the next web meeting on the second half of September 2020, if you are interested to take part, do not hesitate to contact carol.monticelli@polimi.it and jan.cremers@hft-stuttgart.de.

Last but not the least, for the next conference MEMBRANES 2021 (13-15 September, Munich, https://congress.cimne.com/membranes2021) an Invited Session on the topic "The end-of-life scenarios of tensile surface structures - circular use?" will be co-organized by Carol Monticelli and Marijke Mollaert. We kindly ask you to contribute!

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SATTLER PRO-TEX GMBH


1

Dhoran, Gujarat, India

TORNASCENT CARE HOSPITAL ENTRY CANOPY

A sun and rain protected area welcoming relatives, friends and care-takers of the patients.

The membrane canopy structure was the first application in India of the new ATLAS fabric developed by Sattler Pro-tex Gmbh, which gives greater strength without increasing the material weight, therefore binging down the tonnage of the steel, as well as gives overall better dimensional stability. Since this is a premier institute which has to weather all conditions to be able to offer services in all sorts of calamities and conditions, it was intended to go for the best available material and specifications for the project. The project will be used to treat patients of the lesser privileged in the surrounding areas and is intended as a Corporate Community Service project.

Design

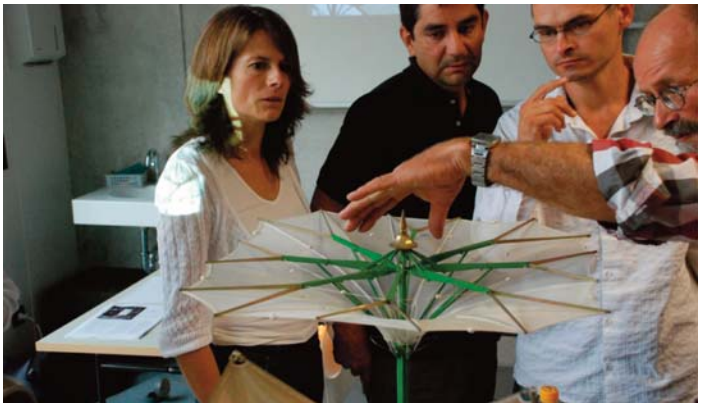
In India it is quite normal for the whole family (and indeed sometimes a greater part of the village) to accompany an ill person to a hospital. Since professional medical services are expensive and most of the time inaccessible, villagers tend to not seek hospital services unless the person is suffering from a terminal or serious illness. Since the power plant is based about an hour away from the nearest city, it was intended to put up a hospital that would be able to offer pro-bono services to the nearby villages. This meant tthat there was a need for "holding area" near the hospital where relatives, friends and care-takers of the patients could wait and be protected from the hot blazing sun as well as the torrential rain that the area gets.
Further, the staging area needed to be iconic and glamorous so that the villagers (most of which are sparsely educated) are able to identify the structure from afar as well as establishing the brand as premier institute in the area.

It also had to be functional, hence the fabric had to be able to block as much UV as possible, while offering as much natural light and ventilation in the space so that the people could be waiting for long periods of time without experiencing discomfort.

This had to be achieved by having as less as columns as possible (it resulted in just two columns) and an area cover as big as the budget would offer. This meant that there were repeated iterations between the architect and the membrane designer to get to the magical number of the expected budget. Finally, from a structure of 30m x15m it came down to the final size of 24mx12m (Figs 1-3).

ARTICLE

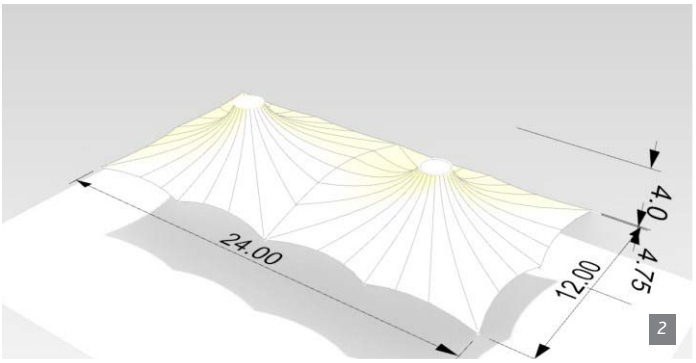
15 YEARS ACADEMIC EDUCATION



in membrane construction at IMS BAUHAUS® in Dessau-Rosslau

The next first semester will start online only!

Since 2006 the IMS BAUHAUS® Archineer® Institute e.V. has been running the Master and Archineer® programme in Membrane Structures.



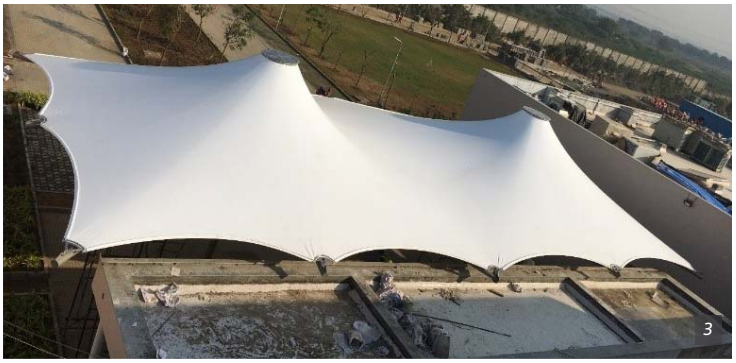


Figure 1. Interior view of the canopy © sbdw.
Figure 2. Designing the twin canopy © sbdw.
Figure 3. Bird view of the twin canopy © sbdw.
Figure 4. unpacking of the membrane on site (left) and connection detail (right) © sbdw.

Membrane

Having been a membrane manufacturer since 2002, SCHAFBOCK has been at the forefront of employing innovative materials for their projects, many times before they are formally launched to be able to give a technical feedback to the manufacturers about how the material behaves in the Indian context. Besides the general technical updates, which were verified by rigorous lab testing, this material showed exemplary characteristics over a period of installation and a year since the installation. Elongation of fabric due to creep, dirt behaviour, fungal attack scratch and crack resistance are some of the dominant issues that plague most membranes. This membrane showed exemplary behaviour, outperforming expectations. The membrane has a higher tensile strength up to 16% higher compared to a regular panama weave fabric, better resistance to the UV-rays thanks to the new lacquers, which has a major positive impact on the durability of the fabric and are whiter than conventional fabrics and have a beautiful shiny surface. The even surface of these high-quality fabrics ensures their elegant look and a homogeneous light transmission.

Prof. Shehzad Irani, SCHAFBOCK DESIGN WORKSHOP
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Name of the project:	Tornascent Care Hospital Entry Canopy
Location address:	near SUGEN power plant. Dhoran, Gujarat, India
Client (investor):	Tornascent Care
Function of building:	Hospital
Type of application of the membrane:	Entry Canopy, waiting area
Year of construction:	2019
Architects:	Munjal Bhatt
Multi-disciplinary engineering:	Torrent power projects department
Consulting engineer for the membrane:	SCHAFBOCK DESIGN+WORKSHOP
Tensile membrane contractor:	SCHAFBOCK DESIGN+WORKSHOP
Supplier of the membrane material:	Sattler PRO-TEX Gmbh
Manufacturer of membrane:	B&V Membranes, Mumbai, Maharashtra, India
Material:	Sattler ATLAS Architecture Type II TFL, art.739.11C
Covered surface (roofed area):	285m²

Every year a new course of studies starts at the institute, which is affiliated to the Anhalt University of Applied Sciences in Dessau-Rosslau. More than 340 students from over 64 nations were trained in the field of membrane construction and learned how to design, calculate, detail, build and maintain lightweight textile constructions.
Prof. Dr. Robert Off, director of the institute, describes his mission as follows: "The aim of IMS BAUHAUS® is to teach the world how to build membranes, that is our only aim".

In March of this year it was planned to celebrate the 15th start of this worldwide unique program. Due to the Covid19 pandemic, the start of the program had to be postponed to the summer semester 2021 and due to the travel restrictions the first semester will start online only.
It is planned to initially run only the first semester as a completely online course. The second and third semester will be continued with the corresponding attendance lecture weeks at the Anhalt University of Applied Sciences as usual. If this still is not possible at this current time, these semesters will also be adapted to online courses. Each programme once started will be completed in any case.
Parallel, the short version of the master's program "Archineer® Certificate" will take place in Dessau.

TENSILE intense, the one-week certificate course in Archineering® is scheduled for September 2021 for the next time.

Dates:
March 12, 2021: 15th Master- and Archineer® Membrane Structures Archineer® Certificate program

September 2021 4th TENSILE *intense*
The exact date will be announced as soon as available.

Location: IMS BAUHAUS® Archineer® Institutes e.V.
At Anhalt University of Applied Sciences, Dessau-Rosslau, Germany

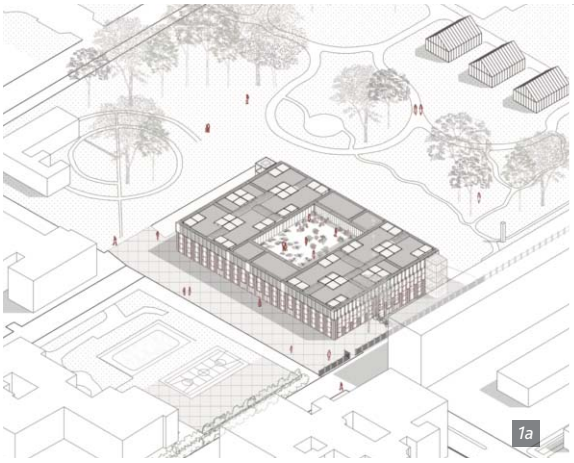
Contact for more information, application/registration:
Heike.kleine@ims-institute.org,
Membranestructures.de

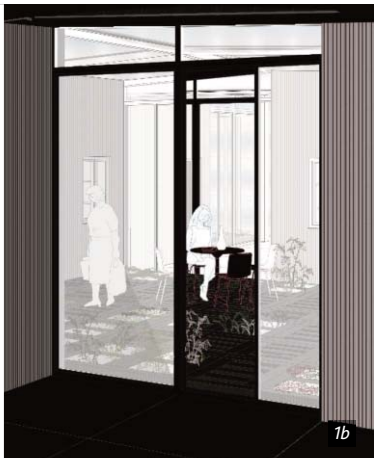
MASTER THESIS PROJECT

grINdoor

A college on the roof.
The light house for students and plants!

The master thesis "grINdoor" has been conceived as a lightweight experimental supra-elevation within the Politecnico di Milano Leonardo Campus. Due to the structural conditions of the existing building underneath and to the inherent properties of a supra-elevating residential green roof, it has been designed for being the most lightweight possible, balancing the materials used for the vertical and the horizontal elevation structures and taking advantage of an ETFE roof coverage.


1a


1b

Project concept

The project aims at combining a green roof with an additional residential level, in order to increase the green into the city of Milan, as well as to provide a bigger offer of beds for students.
The idea of supra-elevating an existing building derives from the necessity to increase the number of accommodations offered within the city of Milan, whose population is steadily increasing, while at the same time from the will to turn the existing roofs into green ones, in order to contribute to the absorption of Co2 emitted by our cities. The city of Milan aspires indeed to increase its green coverage of the 625% within the next 10 years: turning existing roofs into green ones seems to be a great option for doing so, although, into the process, it is necessary to consider the additional weight that green roofs will carry to the existing structure. Therefore, it becomes fundamental to plan a light-weight supra elevation.

Project description

The project considers all the aspects, from a structural point of view, a compositional one and a bio-climatic one. It establishes an interconnection between the residential modules and the green roof through the presence of green courtyards covered by sliding ETFE cushions that would work as bioclimatic greenhouses.
The whole supra-elevation area of almost 3300m² has been subdivided into four symmetric districts with a central courtyard completely opened hosting the real green roof. Each section is characterised by the presence of 2 units of bedrooms attached two by two and linked together by a central courtyard. Each bedroom faces an openable and closable courtyard covered with square sliding ETFE cushions of 3,35m side length: the whole system would allow the light penetration for illumination reasons guaranteeing, as well, the adequate ventilation for the bedrooms. Additionally, the presence of the ETFE cushions for the roof would allow the courtyards to work as greenhouses, mitigating the internal conditions of the bedroom throughout the whole year.

Technical description

In order to make the whole supra-elevation the most lightweight possible each element has been balanced, obtaining prefabricated residential boxes whose weight has been minimised in toto, looking for a solution that reduces the total weight of almost 100kg per m². In the whole study, the use of the ETFE for


2a


2b

covering the courtyards, instead of glass panels, contributes to diminishing the total weight of the system of 15kg per m², letting the whole supra-elevation floor to reach a final weight of 105kg per m², instead of 120kg per m² if only glass panels would have been used for covering the courtyards.

ETFE cushions have been used not only for covering the openable and closable courtyards, but also for covering the corridors. They have therefore differently studied according to their use.
A system of sliding ETFE cushions has been used for the courtyards: cushions have been slightly sloped through a rail system towards the residential boxes, in order to automatically slide, thanks to the gravitational force, on top of the opaque roof covering the residential boxes and leaving the courtyards exposed to the natural conditions; a mechanical motor would later govern a rope system that, turning, would mechanically put back on place the ETFE cushions, covering again the courtyards. The whole system has been studied in order to allow the courtyards for being easily opened and closed according to the external atmospheric conditions and the internal necessities.
The corridors of the residential college instead have been conceived for being covered by fixed ETFE cushion with integrated photovoltaics. As already experimented in the AWM carport in Munich (Germany), PV cells have been fixed in a removable way onto the middle layer of the 3-layers cushions. Being enclosed by transparent ETFE-films, the PV modules are kept safe from external exposures, although the whole system will affect the overall solar radiation gain of a 10%. With a total area of around 850m², the fixed ETFE cushions with integrated photovoltaic of amorphous silicon solar cells will produce around 59500kWh, that would correspond to the 113% of the needed energy by the 48 students living into the residential college.
In addition, the pattern generated by the integrated photovoltaic into the ETFE cushions will determine specific shadows that, besides creating a game of lights and shadow, will reduce the thermal impact in summer into the corridors below.

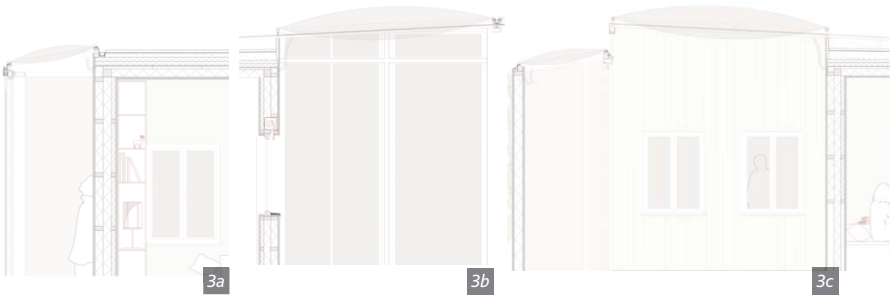
Conclusion

In conclusion, the master thesis focusing on the design of a light-weight supra-elevation floor, hosting both a college for students and a house for plants, aspires to be an experiment in regards to the need of transforming the existing roofs into green ones and to increase the number of accommodations into nowadays cities taking advantage of the existing structures. It explores new technologies and design methods for adapting these solutions even to existing buildings that presents critical conditions for supporting additional weights. The thesis discloses how a well-balanced design would open up several possibilities and how ETFE membranes can be used for multiple solutions, satisfying different needs.

Giulia Procaccini
Politecnico di Milano
www.textilearchitecture.polimi.it

Name of the project:	grINdoor. A college on the roof. The light house for students and plants
Location address:	Via Camillo Golgi 20, 20133, Milano MI
Client (investor):	Politecnico di Milano
Function of building:	Residential college
Type of application of the membrane:	Roof coverage
Year of construction:	Architectural Master thesis
Author:	Giulia Procaccini
Technical consultant:	ing. Giorgio Piantato
Supporter:	TextilesHub DABC
Material:	ETFE cushions
Covered surface (roofed area):	1500m²


4a


3a 3b 3c


4b

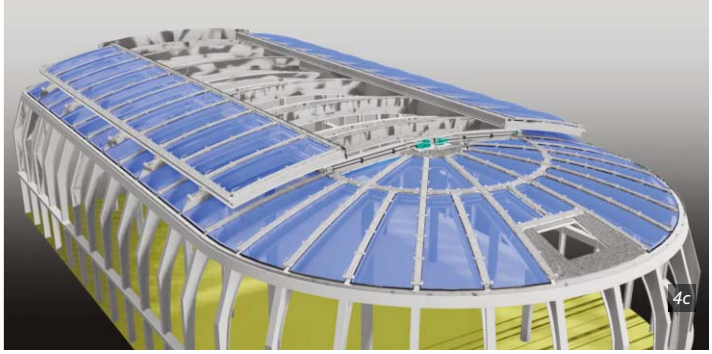

4c

Figure 1.Visualisation of the building in its context (a) and towards the courtyard (b) © Giulia Procaccini.

Figure 2. Plan view of the whole building (a) and roof view of one section (b) © Giulia Procaccini.

Figure 3. Details of the fixed opaque ETFE cushion (a), the sliding ETFE cushion (b) and combined fixed – sliding ETFE cushion (c) © Giulia Procaccini.

Figure 4. Reference projects of existing ETFE cushions: AVW Munich as a reference for the fixed ETFE with integrated photovoltaic into the middle layer of a three layers cushions (a) © Michael Fischbacher; Beyazit Library courtyard covered with ETFE, subdivided into four cushions (b) © Emre Dörter and AIDA Deck: sliding ETFE cushions covering the pool. The sliding method is similar to the one I conceived for this project (c) © Seele Holding GmbH.

INSTALLING OPEN CANOPIES AT DESINGEL

An opportunity for cultural centres to organise autumn events

Antwerp, Belgium

At the website of deSingel, the main cultural center and art school in Antwerp, the following can be read: 'We re-open the doors of our art center and offer the artists again their stage. We are happy to receive visitors in a completely corona-proof environment. Visitors are welcome, not only in the large halls - which by their size allow to do distancing - but also in the courtyard garden which is covered with a unique tent.'

The tent is a combination of Duvel Dreamship sails, one of the best-known sail sculptures of The Nomad Concept (previously installed at festival of Gooik, Gentse Feesten, Jazz Ghent (Bijloke), Jazz Middelheim and numerous other festivals in Belgium and abroad). Amandus VanQuaille created this special 'Duvel' tent exclusively for brewery Moortgat. The new model has been launched in 2010. Simplicity and playfulness are combined in this minimalistic, repetitive structure.

The architect adds to that: 'It is a fantastic setup. The confrontation with the modernist architecture of Léon Stynen is really very good. The building - with orthogonal volumes and lines, except for the organic shapes of the windows - and the forms of the membranes are both modernist, but with an opposite design. Initially the design of the canopies was based on a piece of minimalism music by Yannis Xenakis, a musician and architect who co-designed the Philips pavilion at expo 58. And now these sails are used to embrace for two months electronic classical minimalist music. It is an ode to the music. It's nice to make a modest contribution to that.'

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Amandus VanQuaille
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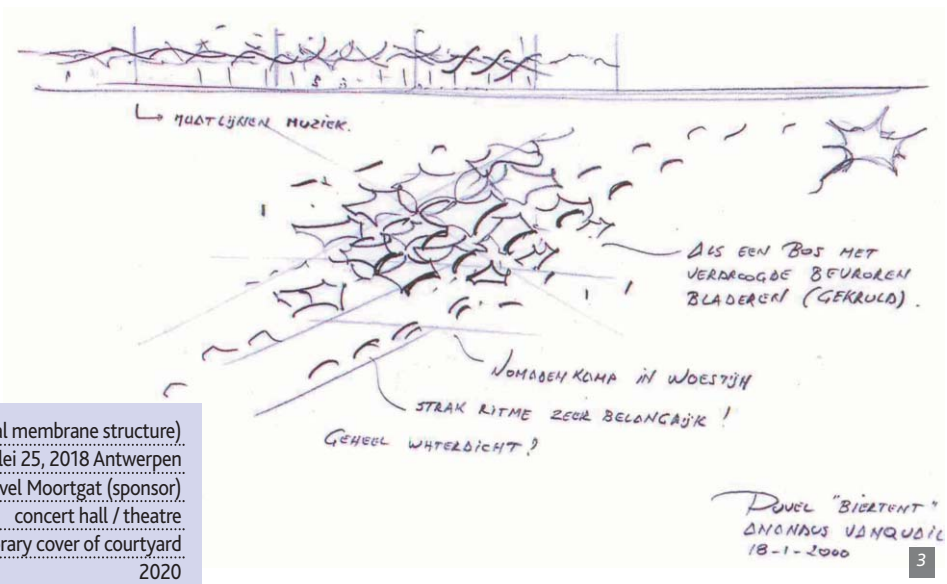
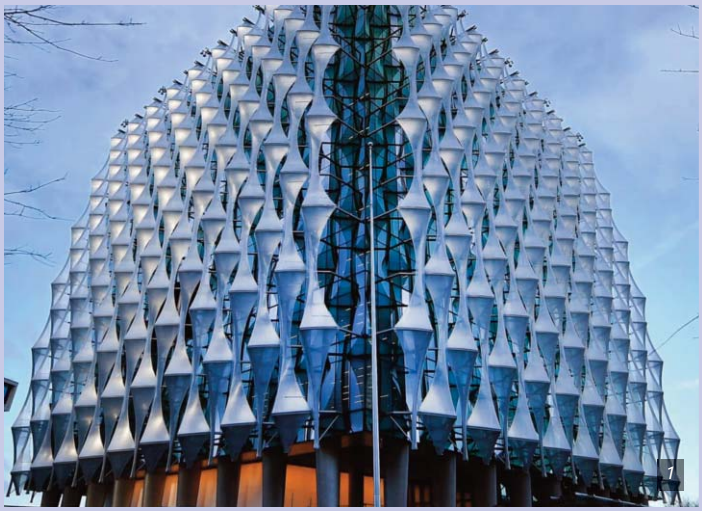
www.nomadconcept.com



Name of the project:	Duvel Honeycomb (hexagonal membrane structure)
Location address:	Desguinlei 25, 2018 Antwerpen
Client (investor):	deSingel vzw / Duvel Moortgat (sponsor)
Function of building:	concert hall / theatre
Type of application of the membrane:	temporary cover of courtyard
Year of construction:	2020
Architects:	Amandus VanQuaille
Manufacture and installation:	The Nomad Concept
Material:	lightweight summer textile
Covered surface (roofed area):	800m²

Figure 1. The covered courtyard as corona-proof environment © Andras VanQuaille
Figure 2a-d. The temporary structure in contrast with the orthogonal buildings of the art center deSingel © Robert De Wilde
Figure 3. Original sketch in which the vertical masts are compared with the bars of music, with a modern notation of music in between (2000) © Amandus VanQuaille



US EMBASSY IN LONDON

Distinctive building envelope made of ETFE

London, United Kingdom

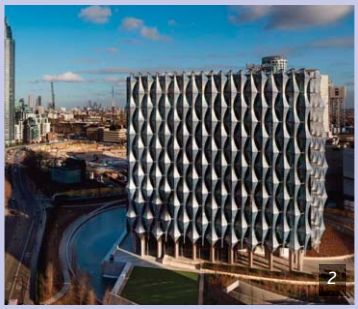


Figure 1. View on the US Embassy in London © BIRDAIR / Figure 2/3. Views on the membrane façade made of single-layer ETFE-sails © BIRDAIR

Building / Envelope

In January 2018 the US Embassy in London was relocated from the Mayfair area to the urban district Nine Elms. The new building, designed by Kieran Timberlake architectural office, found the balance of transparency and the requested high security. The building is a 65m tall glass cube cladded by a flexible translucent ETFE second skin, allowing a splendid view to the River Thames. 12-storys provide sufficient room for 800 staff and approximately 1.000 visitors per day.

The architects summed up their design idea as follows: "How can we build an embassy that reflects the core values of democracy - transparency, openness, and equality - and is welcoming, secure, and highly sustainable? [1]

They solved this task perfectly: With high sensitivity and precise knowledge of the materials used, they designed a pioneering envelope for the building with a double-shell façade: The inner shell is made of solid multiple-layer laminated glazing. It guarantees the security required for this utilization. The outer shell, constructed as a curtain façade, consists of a large number of organically shaped flexible sail surfaces made of ETFE-foils and a light supporting structure made of steel ropes, aluminium rods and carbon steel. Since both, the inner and the outer shell, are transparent, the view from inside to outside remains intact despite the double shell structure.

Material / Functions

For the 399 sail surfaces the TensoSky-System from TAIYO was selected. The very thin film (here 250µm) made of the fluoropolymer material Ethylene Tetrafluoroethylene (ETFE) offers many advantages: it is transparent, light weight, elastic, flame retardant and weatherproof. As a rule, it does not require any special cleaning, as the rain washes away dirt particles from the smooth surface. In addition, the material is largely resistant to chemical and biological exposures. As a thermoplastic material, the clear ETFE foil can be 100% recycled. At the end of its lifetime the film can be completely returned to the material cycle. However, it is mostly reused in form of other products, rather than foils for architectural applications.

The sails have a special function here: The ETFE foils are printed with different grades of silver patterns, letting only a part of the sunlight pass. The printing reduces the glare from the sun and minimizes the heat gain of the building. Despite the printing, one can look through the film as long as it is lighter on the other side than on the side of the viewer. The spectrum of visible light is hardly changed by the films. As a result, the colours behind ETFE foils remain almost unchanged. Since the north facade is not exposed to direct sunlight, it has no ETFE sail area. Even without the north façade, the sails form a total surface of 8.125m². They are held in place by a light supporting structure made of steel ropes, aluminium rods (180t) and carbon steel "headmounts". The supporting structure transfers the wind loads and the dead weight of the curtain facades into the building structure.

Assembly

Detailed design, execution planning and assembly of the curtain façades were done by a joint collaboration of two companies of Taiyo Group: BIRDAIR Inc. (in North America) and TAIYO EUROPE GmbH. The assembly of such membrane structures, i.e. technical fabrics and foils, requires precise design engineering, high quality in fabrication and full knowledge of the respective construction methods and materials used. The installation on site must be carried out by specially trained climbers. Such installations follow a precise plan of positioning the elements of the supporting structure and the stretching of foils and steel ropes, component by component. The installers do this work while hanging on a climbing rope and secured with personal protective equipment. It is a sophisticated job for professionals.

Resume

While the solid inner shell made of multiple-layer laminated glazing offers the security required for such a building, the light and flexible outer shell made of ETFE foils robs the building of its severity and detachment. The almost identical sails form an open, consistent and harmonic structure. While glass facades are nowadays a familiar sight in urban environment, membrane sails made of the sustainable material ETFE give this building an unmistakable identity. Congratulations to the architects: The US Embassy in London has received an all-round successful building envelope, which expresses the design idea they formulated in the forefront in a special way. TAIYO group has been honoured to have successfully executed the curtain facade for this outstanding landmark.

Karsten Moritz, TAIYO EUROPE GmbH
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https://taiyo-europe.com/
https://www.birdair.com/

Name of the project:	US Embassy
Location address:	Nine Elms, London
Client (Investor)	US Department of State
Function of building:	Embassy
Type of application of the membrane:	Curtain façade
Year of construction:	2017
Architects:	Kieran Timberlake
Structural engineers:	Weidlinger Associates
Consulting engineer (membrane):	Arup
Main Contractor:	B.L. Harbert International & Sir Robert McAlpine
Contractor:	Permasteelisa
Contractor (curtain façade):	Birdair Inc.
Installation (curtain façade):	Taiyo Europe GmbH
Manufacturer (membrane):	Flontex.eu.sp. z o.o. Sp.k.
Supplier of the membrane material:	Nowofol GmbH & Co. KG

Sources: [1] https://kierantimberlake.com, 2020-09-09

Looking at the past … and looking for the future?

BUBBLES TO LIVE AND WORK IN

Two of the founders of Verseidag (Dr. Josef Esters and Hermann Lange) had the superb idea to request almost 100 years ago (in 1927) the architect Ludwig Mies van der Rohe to build for them the modern urban private residence villas 'Haus Esters' and 'Haus Lange' located in Krefeld. When both villas turned into a museum in the early '70ties they became venues for contemporary art. Haus-Rucker-Co, a Viennese group of young architects and artists, made for 'Haus Lange' a very interesting installation named "Cover. Survival in a Polluted Environment 1971".

This temporary pneumatic structure made from translucent polyvinyl covered the entirely villa. The idea behind this temporary project was to create a protected and isolated space against pollution and climate changes. A wake-up call.

Today COVID 19 confronts the world with lockdown restrictions. We work from home, we stay in our family bubble.
Time to redefine and redesign all sort of lightweight bubbles for the private as for the public atmosphere!

Temporary pneumatic structure for 'Haus Lange', 1971 © Kunstmuseen Krefeld – Manfred Vollmer - ARTOTHEK

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