TensiNet

Prof. Em. dr. ir. **Marijke Mollaert**
Vrije Universiteit Brussel, Architectural Engineering
Marijke.Mollaert@vub.be

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Content

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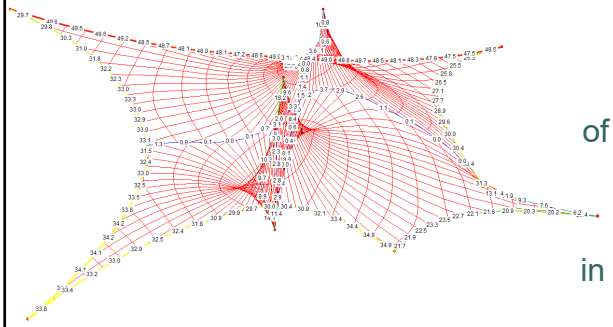
Tensile Surface Structures



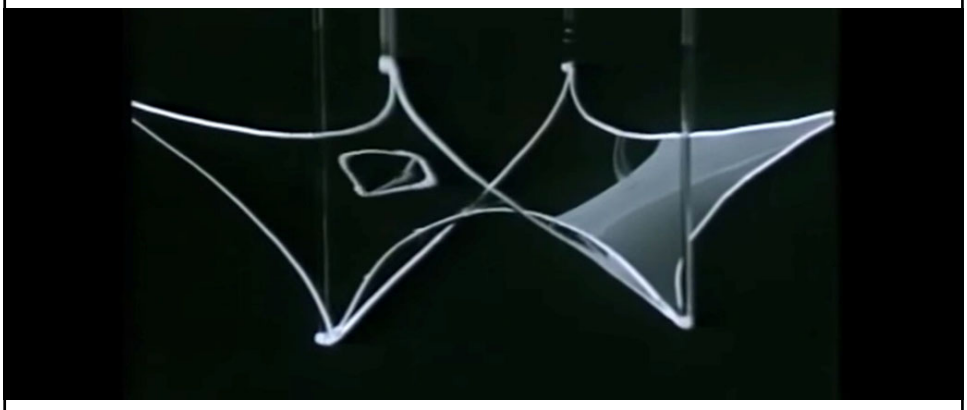
Formfinding

Geometry
of the equilibrium form
+
Internal forces
in this equilibrium form

3

Tensile Surface Structures

Formfinding: physical models



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Tensile Surface Structures

Formfinding: physical models

5

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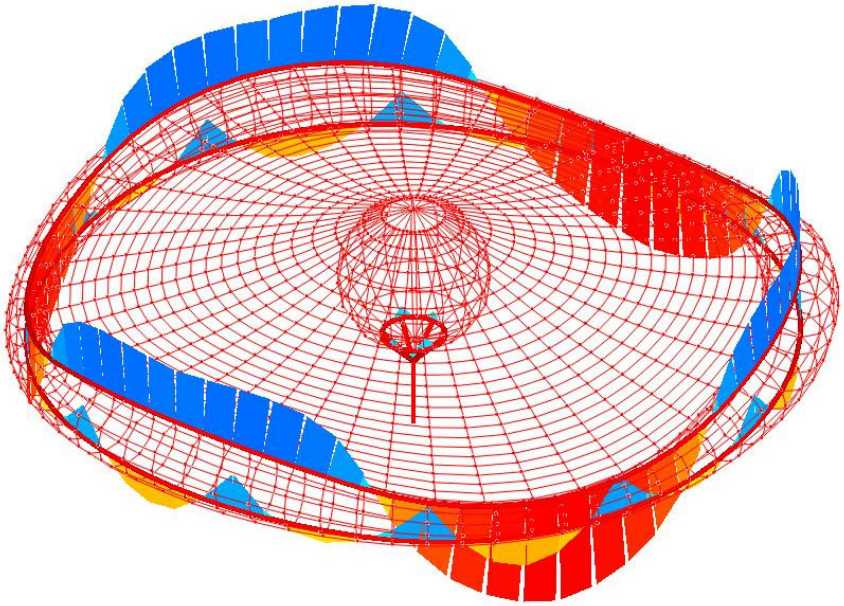

Inno-WAVE-tion, TensiNews 28

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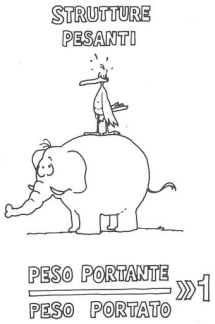
Conventional Structures



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Tensile Surface Structures

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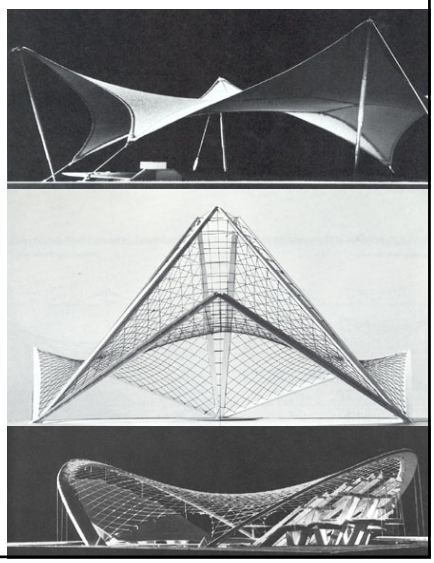
Tensile Surface Structures

Integrate
the supporting structure

- transfers the actions
to the foundation -

in the analysis model



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Content

What are membrane structures / tensile surface structures?

TensiNet Association: an INPA since 2020

What is the aim of the TensiNet Association?

TensiNet Working Group Sustainability and Comfort

TensiNet Working Group Specifications and Eurocode

TensiNet Working Group Good Practice

Examples

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TensiNet Association

1999 – 2004: European thematic network for tensile structures (Growth)

2004 – 2020: TensiNet Association is founded under the wings of the Vrije Universiteit Brussel

2020: TensiNet Association became an international non-profit association

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Partners TensiNet

an interdisciplinary team

Architecture and engineering offices
- formTL ingenieure für tragwerk und leichtbau GmbH – Germany

Manufacturer and fabricator
- Asma Germe - Turkey
- Canobbio Textile Engineering Srl – Italy
- Sefar AG – Switzerland
- Vector Foiltec GmbH - Germany

Material producer, Coater and Weaver
- Mehler Texnologies – Germany
- Saint-Gobain – United States
- Serge Ferrari sa – France
- Sioen Industries - Belgium

Software Companies
- Softraxa Arquitectura i Software, SL - Spain
- technet GmbH - Germany

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Associate Partners TensiNet

an interdisciplinary team

Architecture and engineering offices
- SBP - Germany
- Tensotech - Finland
- Tentech – The Netherlands

Universities
- HFT Stuttgart – Germany
- Nantes Uiversité - France
- Newcastle University - UK
- POLIMI - Italy
- UPM - Spain
- University of Nottingham - UK
- VUB - Belgium

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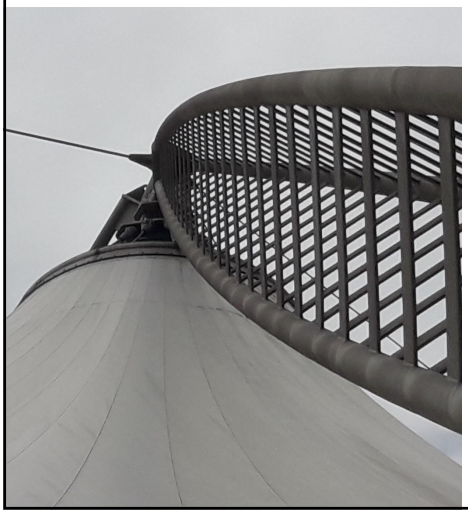
TensiNet Association



It is an advantage
that all areas
of the membrane business
are represented in TensiNet

Even competitors
are working together
to develop
the state-of-the-art documents

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TensiNet Working Group Good Practice
Examples

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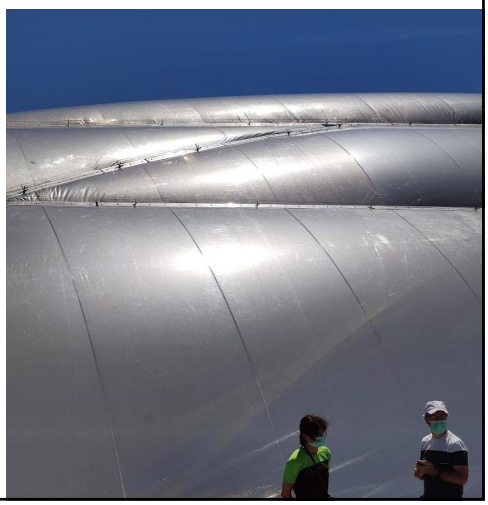
TensiNet association is a platform for all parties interested in tensile membrane structures

- Provides information and advice
- Informs about research to support such advice
- Aims to improve the quality of membrane structures
- Increases the range of applications
- Stimulates research initiatives
- Helps to get scientific results into practice



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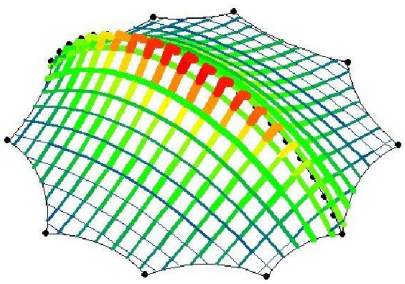
TensiNet association is a platform for all parties interested in tensile membrane structures

- Supports teaching and training activities
- Supports workshops organised by one of its members and provides information about events (like Textile Roofs)
- Disseminates information about ongoing research
- Publishes the TensiNews newsletter twice a year



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TensiNews is published twice a year, TensiNews 47 is being prepared

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TensiNet association is a platform for all parties interested in tensile membrane structures

- Organises the **TensiNet Symposium** every three years
- Publishes the proceedings of the TensiNet symposium
- Several **Working Groups** focus on specific topics
- Publishes reference documents and Working Group reports
- Maintains the **website** www.tensinet.com, containing a projects database, reference documents, research reports

TENSINANTES 2023
TensiNet Nantes Université GeM

TENSINANTES2023 : TensiNet Symposium 2023 at Nantes Université

Membrane architecture: the seventh established building material. Designing reliable and sustainable structures for the urban environment.

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The last symposium was organised in Nantes in 2023, 134 participants attended

TensiNet – the multi-disciplinary association for all parties interested in tensioned membrane construction

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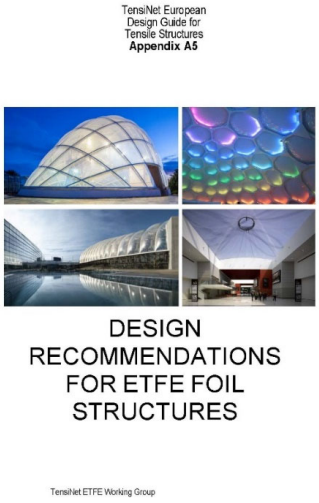
TensiNet Working Groups

Discuss specific issues
and prepare state-of-the-art documents

WG analysis & materials
WG ETFE
WG Sustainability & Comfort
WG Pneumatic structures
WG Specifications & Eurocode
WG GOOD PRACTICE



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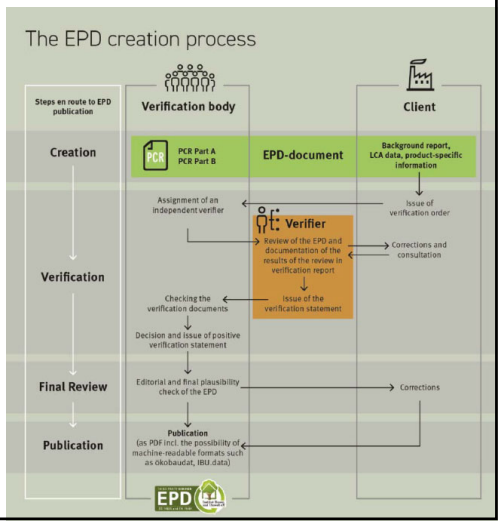
Working Group Sustainability & Comfort

In 2022 TensiNet became a member of the German Institut Bauen und Umwelt (IBU) in order to develop the specific Product Category Rules (PCR) for structural membranes

PCRs are the basis for writing The Environmental Product Declarations (EPDs)



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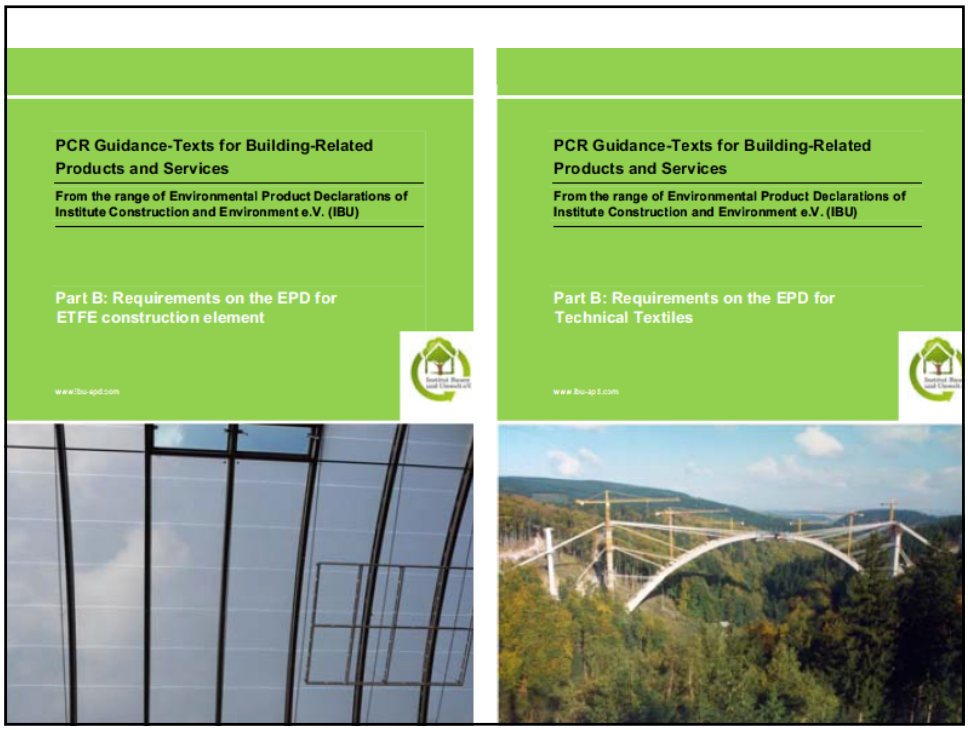

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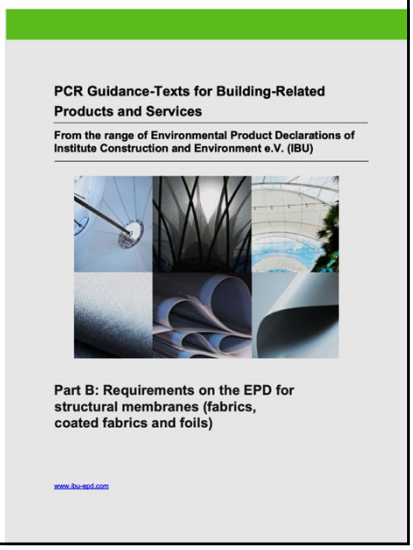
Working Group Sustainability & Comfort

The Product Category Rules
(Part B) developed by
TensiNet
were published on
5 January 2024!

These rules specify
the EPD requirements
for structural membranes
(fabrics, coated fabrics and foils)
Aim: develop a group EPD
for PVC-coated polyester



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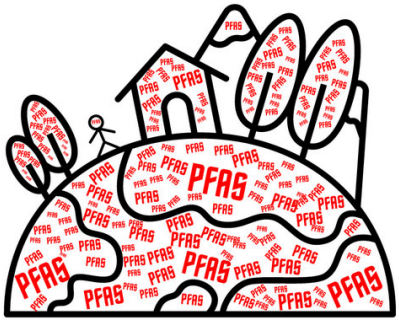
Working Group Sustainability & Comfort

For the PFAS Ban from ECHA
a 6 months consultation
was foreseen (till 25/9/23):

- TensiNet expressed an opinion against the PFAS restrictions with respect to the fluoropolymers used for textile architecture
- Over 50% of the TensiNet members signed the online petition

Still no feedback/information



https://banpfasmanifesto.org/en/

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Working Group Sustainability & Comfort

Topics to be explored
in the future

- Circular economy of membranes for architecture
- The need for biodegradable materials

Uncoated Abaca Fabric, Tensinews 17

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TensiNet – the multi-disciplinary association for all parties interested in tensioned membrane construction

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Working Group Specifications and Eurocode

+ CEN/TC 250 WG 5

Standard

- reduce the risk of failures
- help to increase
  the acceptance of membrane structures

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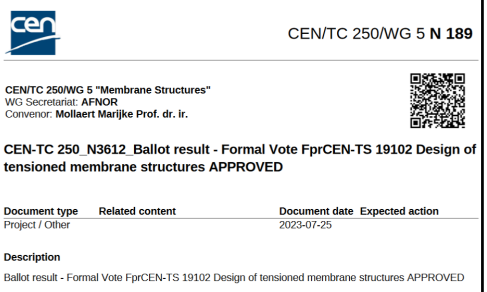
Working Group Specifications and Eurocode

CEN/TC 250
unanimously approved
the Technical Specifications
prCEN/TS 19102
Design of tensioned membrane structures



CEN/TC 250/WG 5 **N 189**

CEN/TC 250/WG 5 "Membrane Structures"
WG Secretariat: **AFNOR**
Convenor: **Mollaert Marijke Prof. dr. ir.**

CEN-TC 250_N3612_Ballot result - Formal Vote FprCEN-TS 19102 Design of tensioned membrane structures APPROVED

Document type	Related content	Document date	Expected action
Project / Other		2023-07-25	

Description

Ballot result - Formal Vote FprCEN-TS 19102 Design of tensioned membrane structures APPROVED

can be ordered at
https://genorma.com/en/project/show/cen:proj:64546

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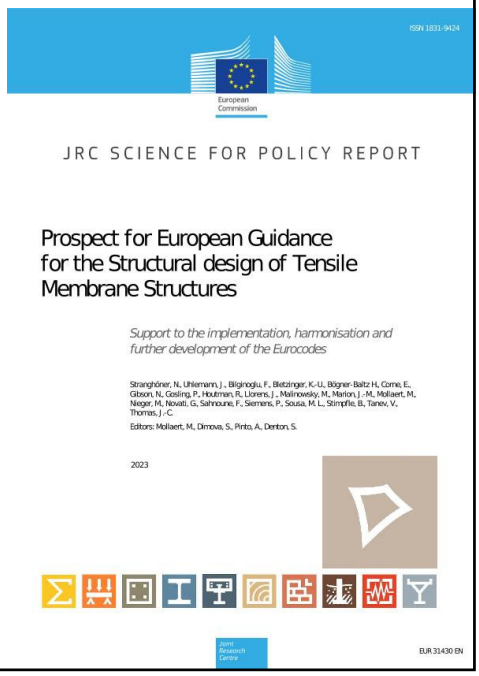
The Science and Policy report
is still the main
Background Document

New edition 2023
ISSN 1831-9424
is available online
www.tensinet.com



ISSN 1831-9424

European Commission

JRC SCIENCE FOR POLICY REPORT

Prospect for European Guidance for the Structural design of Tensile Membrane Structures

Support to the implementation, harmonisation and further development of the Eurocodes

Stranghöner, N., Uhlemann, J., Bilginoglu, F., Bletzinger, K.-U., Bögner-Balz H., Corne, E., Gibson, N., Gosling, P., Houtman, R., Llorens, J., Malinowsky, M., Marion, J.-M., Mollaert, M., Nieger, M., Novati, G., Sahnoune, F., Siemens, P., Sousa, M. L., Stimpfle, B., Tanev, V., Thomas, J.-C.

Editors: Mollaert, M., Dimova, S., Pinto, A., Denton, S.

2023

Joint Research Centre

EUR 31430 EN

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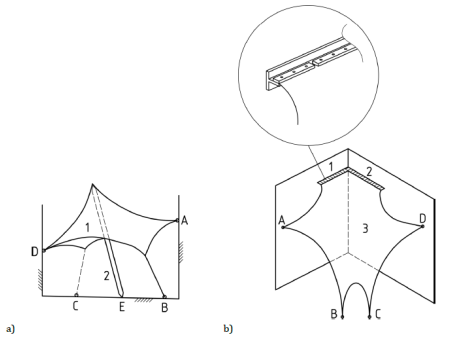
Working Group Specifications and Eurocode

WG 5 is preparing
a working document
on the execution matters
upon which the design rules rely



a)

Key

A, B, C, D, E	Fixing points to the external structure
1	Structural membrane
2	Membrane supporting structure (pole)

b)

Key

A, B, C, D	Fixing points to the external structure
1, 2	Supporting structure with fixing lines to the external structures
3	Structural membrane

Figure 3.3 Examples of supporting structures: (a) Fixing points to the external structure, (b) Fixing lines to the external structure

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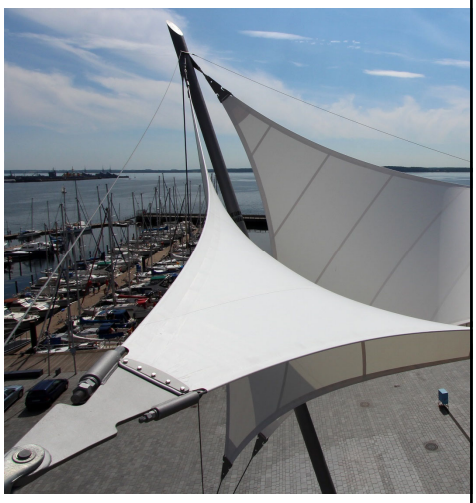
Working Group Good Practice

Promoting quality
in design and
construction performance
by providing
industry
best practice requirements



Membrane “Harbour Point”, TensiNews28

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Working Group Good Practice

Rules for
- Raw Material Producers
- Membrane Material Producers
- Membrane Manufactures
- Designers/ Engineers
- Architects
- Testing Laboratories

have been formulated
as well as general rules
for all involved parties

The quality label reads:
We follow the approved standards
of good practice rules
of TensiNet
Members can subscribe
this Code of Conduct

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Seasonal canopy

De Persgroep covered terrace / Amandus VanQuaille / The Nomad Concept © Amandus VanQuaille

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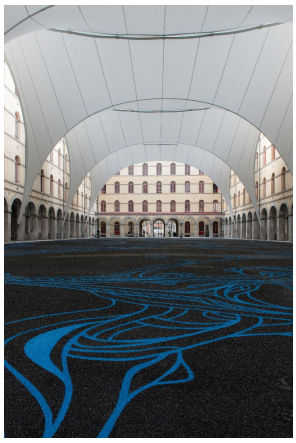
De Persgroep covered terrace / Amandus VanQuaille / The Nomad Concept © Amandus VanQuaille

Roof in an inner court

Carré des Arts / AGWA – Ney & Partners / Ney & Partners / Veldeman Structure Solutions / Buitink Technology © FM PLISSART



Carré des Arts / AGWA – Ney & Partners / Ney & Partners /
Veldeman Structure Solutions / Buitink Technology © FM PLISSART

Shelter at a cemetery

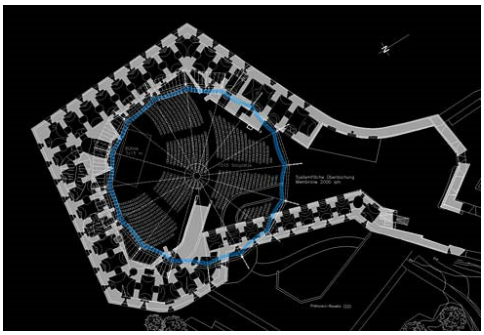
Chapel of Rest / J. Desablens / Ney & Partners © J. Desablens

Chapel of Rest / J. Desablens / Ney & Partners © J. Desablens

Art pavilion

Chateau La Coste, Aix-en-Provence / Renzo Piano Building Workshop, Tangram Architectes / Arup, Tony Hogg Design / Serge Ferrari / Architen Landrell © Stéphane Aboudaram, Weare Content(s)

Retractable roof



Retractable roof – Kufstein / Kugel + Rein Architects and Engineers / Hightex GmbH © Kugel + Rein Architects and Engineers

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Retractable roof – Kufstein / Kugel + Rein Architects and Engineers / Hightex GmbH © Kugel + Rein Architects and Engineers

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Temporary structure

Temporary structure Grand Palais Éphémère / Wilmotte & associés / IASO,SL © Jean-Philippe Dollet - DCOMDRONEE

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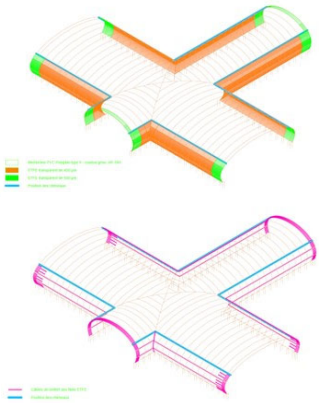

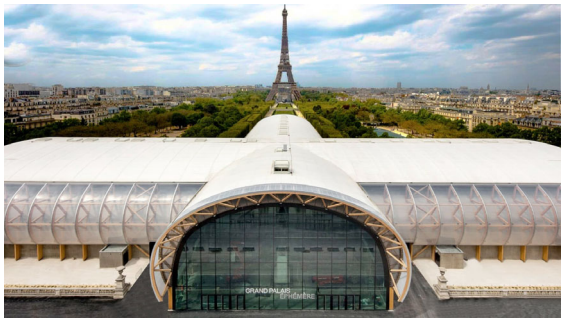

Temporary structure Grand Palais Éphémère / Wilmotte & associés / IASO,SL @ IASO S.L.

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Inflatable double skin pavilion

Modern Teahouse / Kengo Kuma / formTL / Canobbio © formTL

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Modern Teahouse / Kengo Kuma / formTL / Canobbio © formTL

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Knitted fabric

Isoropia – Danish pavilion at the Venice biennale / Centre for IT and Architecture / str.ucture / AFF, DSM Dyneema © Anders Ingvartsen

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Cushion skin

Facade Sports and Wellness Centre, Le Nuage / Ph. Stark / C. Destenay / Abaca - Nicolas Pauli © Abaca - Nicolas Pauli

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Facade Sports and Wellness Centre, Le Nuage / Ph. Stark / C. Destenay / Abaca - Nicolas Pauli © Abaca - Nicolas Pauli

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Flexible PVs integrated on the internal layer

ETFE film cushions roof for carport / Ackermann und Partner Architekten BDA / Taiyo Europe / 3M Dyneon © Taiyo Europe

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ETFE film cushions roof for carport / Ackermann und Partner Architekten BDA / Taiyo Europe / 3M Dyneon © Ackermann und Partner Architekten BDA

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Inflated cushion as canopy for a bus station

Canopy Bus Terminal Aarau / vehovar & jauslin / form TL / Arge Foliendach RUCH AG + Vector Foiltec © Niklaus Spoerri

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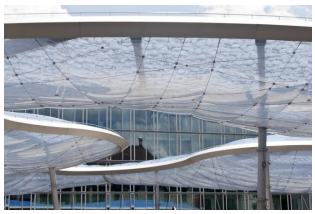

Canopy Bus Terminal Aarau / vehovar & jauslin / form TL / Arge Foliendach RUCH AG + Vector Foiltec

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Second fabric skin

Textilakademie NRW, Mönchengladbach / slapa oberholz pszczulny architekten / form TL / Koch Membranen, Verseidag © thomasmeyerarchive.de

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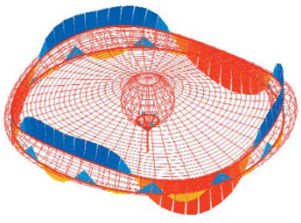
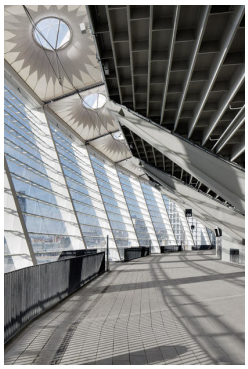
Tensairity ring

Inno-wave-tion / Silvain Dubuisson Architecte / Tentech / High Point Structures & Buitink Technology / Serge Ferrari © Tentech



Inno-wave-tion / Silvain Dubuisson Architecte / Tentech / High Point Structures & Buitink Technology / Serge Ferrari © Tentech

Large-span structure



National Sports Complex Olimpiyskiy / Architecten von gerkan, Marg und partner / form TL / Hightex

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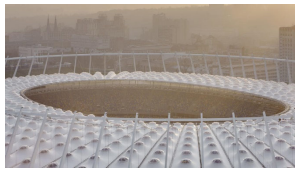

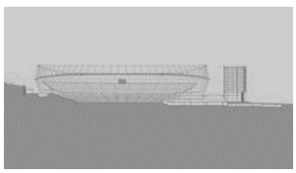

National Sports Complex Olimpiyskiy / Architecten von gerkan, Marg und partner / form TL / Hightex © Marcus Bredt

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Roof extension at the inner tension ring

Mercedes-Benz Arena / Weidleplan, Siegel & Partner, schlaich bergerman und partner © Herr Storck

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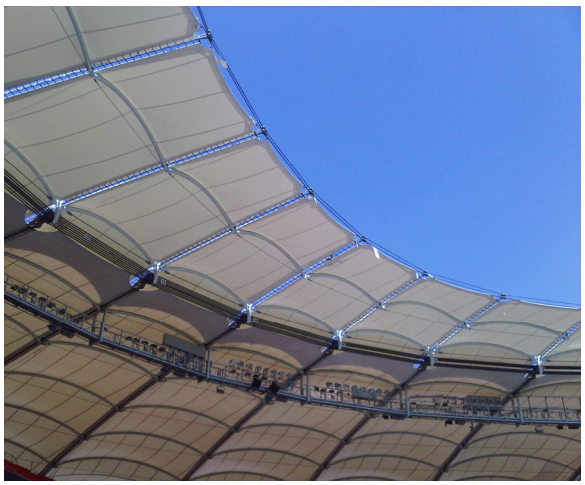

Mercedes-Benz Arena / Weidleplan, Siegel & Partner, schlaich bergerman und partner © schlaich bergerman und partner

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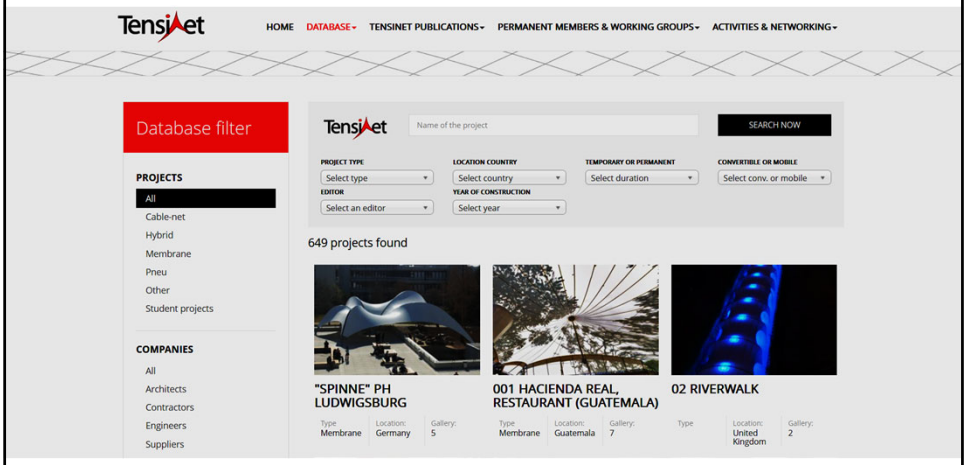

Visit the TensiNet database for more interesting projects
www.tensinet.com

TensiNet – the multi-disciplinary association for all parties interested in tensioned membrane construction

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Sustainability

In every design, we must try from the start to optimise

- the production,
- the use phase, and
- the end-of-life treatment of components and materials

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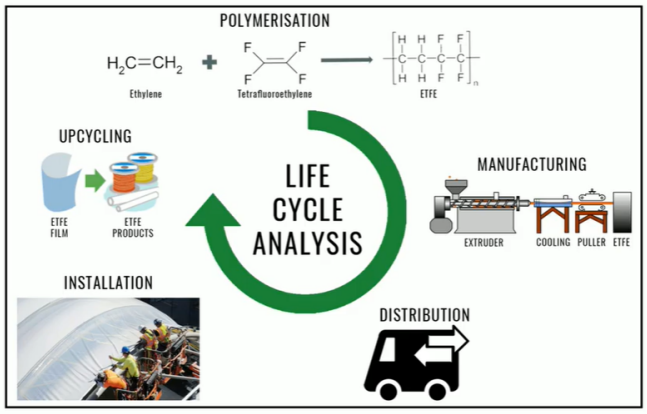
Vodafone project

Vector Foiltec takes back all old foil material to recycle it,
and purchases flexible pipes and valves made from recycled ETFE



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SEEMEE

At the Gacilly Photography Festival works have been printed on a Seemee Frontlit Ultra Mat fabric from Serge Ferrari

- 100% recycled PET yarns from post-consumer wastes (according GRS 4.0)
- 100% recycled polymers from post-consumer wastes

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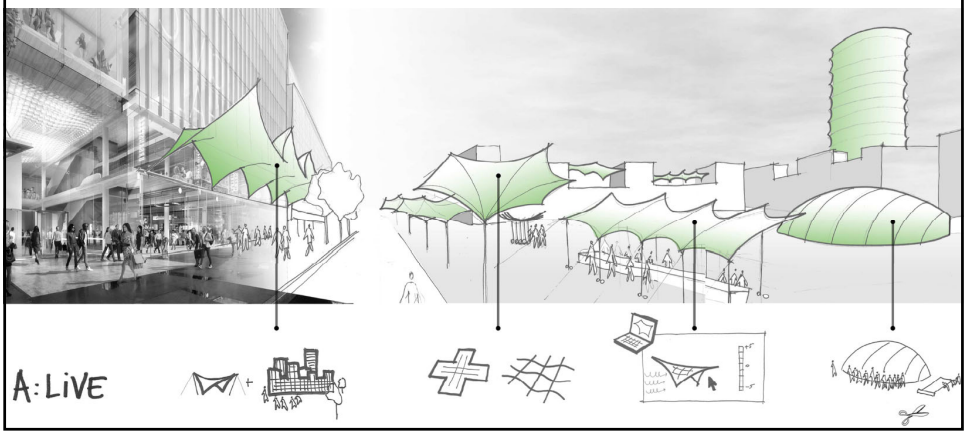
Challenges

Consider climate change and look for sustainable cities
Membrane structures have
the potential to provide solutions



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TensiNet

Prof. Em. dr. ir. **Marijke Mollaert**
Vrije Universiteit Brussel, Architectural Engineering
Marijke.Mollaert@vub.be

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