

REPORT

SLTE 2018

PROJECT

KNITCANDELA  
COP22 VILLAGE



LABOR



-  Asma Germe  
[www.asma-germe.com](http://www.asma-germe.com)
-  Canobbio S.p.A.  
[www.canobbio.com](http://www.canobbio.com)
-  Dyneon  
[www.dyneon.eu](http://www.dyneon.eu)
-  Form TL  
[www.Form-tl.de](http://www.Form-tl.de)
-  Hightex GmbH  
[www.hightexworld.com](http://www.hightexworld.com)
-  Mehler Technologies GmbH  
[www.lowandbonar.com](http://www.lowandbonar.com)  
[www.mehgies.com/mta/](http://www.mehgies.com/mta/)
-  Messe Frankfurt  
Techtextil  
[www.techtexsil.com](http://www.techtexsil.com)
-  Saint-Gobain  
[www.sheerfill.com](http://www.sheerfill.com)
-  Sefar  
[www.sefar.com](http://www.sefar.com)
-  Serge Ferrari sa  
[www.sergeferrari.com](http://www.sergeferrari.com)
-  Sioen Industries  
[www.sioen.com](http://www.sioen.com)
-  technet GmbH  
[www.technet-gmbh.com](http://www.technet-gmbh.com)
-  Verseidag  
[www.vsin dutex.de](http://www.vsin dutex.de)
-  WinTess Software  
[www.wintess.com](http://www.wintess.com)

**Tensinet**newsINFO

**Editorial Board**

John Chilton, Evi Corne,  
Peter Gosling, Marijke Mollaert,  
Javier Tejera

**Coordination**

Marijke Mollaert,  
phone: +32 2 629 28 45,  
[marijke.mollaert@vub.ac.be](mailto:marijke.mollaert@vub.ac.be)

**Address**

Vrije Universiteit Brussel (VUB),  
Dept. of Architectural Engineering,  
Pleinlaan 2, 1050 Brussels, Belgium

ISSN 1784-5688

All copyrights remain by each  
author  
Price €15  
postage & packing included

# contents



**PROJECTS**

PAGE

- 4 Mexico** KNITCANDELA  
AT MUAC
- 8 USA** UC GARDNER NEUROSCIENCE INSTITUTE  
TRANSFORMING COMPLEX CARE WITH TECHNICAL TEXTILES
- 9 Morocco**  
CHRIFIA GOLF CLUB HOUSE



- 16 Morocco** COP22 VILLAGE  
THINKING SUSTAINABLE  
FOR A TEMPORARY SPINE  
MADE OF CANOPIES

- 16 USA** ALLIANZ FIELD STADIUM  
CHOOSING THE PERFECT FIT

- 19 USA** SEA MONSTERS HERE  
INFLATABLE ART INTERVENTIONS

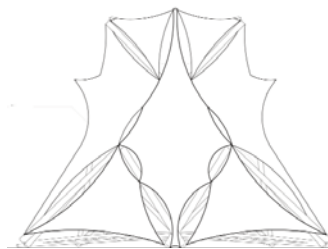


**RESEARCH**

- 6 FILM TECHNOLOGIES**  
FOR ADVANCING BUILDING SKIN FEATURES

**REPORT**

- 7 4. Essener Membranbau Symposium 2018**



- 10 SLTE 2018** SEVENTH  
LATIN AMERICAN SYMPOSIUM  
OF TENSILE STRUCTURES

**MISC**

- 14 TENSINET WORKING GROUP  
GOOD PRACTICE**



- 18 THE 6TH INTERNATIONAL TENSINET SYMPOSIUM**

- 20 APETISER UPCOMING SYMPOSIUM 2019 KEYNOTE SPEAKER  
CHRISTOPH PAECH MOVEABLE STRUCTURES**

## Edito

Dear Reader

Very soon, beginning of June, our next TensiNet Symposium "Softening the Habitats: Sustainable Innovations in Minimal Mass Structures and Lightweight Architectures" will take place at the Politecnico di Milano. Organizing and scientific committee have worked hard and prepared an inspiring event for you. We have received abstracts covering a wide range of interesting topics, which you should not miss. You find more details here and on the conference website.

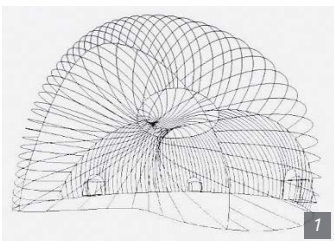
Another important event this year is the joint symposium Structural Membranes together with IASS which will take place beginning of October. It is celebrating the 60th anniversary of the IASS, and it is the 9th Structural Membranes Symposium, this year held in Barcelona. This year is also the year of Techtextil, where many of our partners and members participate. We are glad to support again the student competition. The Textile Roofs symposium is this year back to Berlin, and hosting many interesting presentations and workshops.

This TensiNews is again full of recent projects, actual research topics, new developments in our industry and conference reports. A Candela shell made of concrete on flexible knitted formwork is presented, as well as new developments in the film industry, such as multilayer film, and Nano technology applied to film. Jörg Uhlemann was so kind to provide a summary of the 4th Leichtbau Symposium in Essen, and Joseph Llorens has written an enthusiastic report about the 7th Latin American symposium of tensile structures. Two projects in Morocco are presented and a textile façade realised last year in USA.

I am very proud that our TensiNet working group "good practice" has finalised the preparation of the code of conduct on good practice in the tensile architecture. I invite you to follow these rules and declare "We follow the approved standards of good practice rules of TensiNet", which is the first quality seal in our industry and a very important statement that you provide good quality. You find more details here and on our website.

I hope you enjoy this issue of TensiNews. I am glad to see you on one of the events this year, especially on our Symposium in Milan.

Yours sincerely, Bernd Stimpfle



Architect **Arata Isozaki** wins the Pritzker Prize 2019 and with this he continues the tradition of Japanese prize winners such as Shigeru Ban (2014), Toyo Ito (2013) and Sanaa (2010). Isozaki starts his practice in the early 60ties and his projects are spread all over the world. The architecture of Arata Isozaki has been considered visionary and futuristic.



Figure 1. Visualisation Ark Nova © Anish Kapoor  
Figure 2. Ark Nova © Anish Kapoor

One of his more recent realisations is "Ark Nova", a travelling concert hall. Together with the British-Indian artist Anish Kapoor he designed this expressive orb-like pneumatic structure. The membrane structure can be quick erected and later on dismantled, folded

up, loaded on a truck and brought to another site. During the Lucerne Festival Ark Nova travelled through the areas in Japan affected by the tsunami. Referring to the intentions of the designers: "We named the Project Ark Nova, or 'new ark', with the hope that it will become a symbol of recovery immediately after the great earthquake disaster".

<http://anishkapoor.com/961/ark-nova-2>

<http://anishkapoor.com/949/installing-ark-nova>

## Forthcoming Events

**TECHTEXTIL 2019** | "Space For Innovation"  
14-17/05/2019 | Frankfurt am Main, Germany |  
<https://techtextil.messefrankfurt.com/frankfurt/en.html>

**TEXTILE ROOFS 2019** | International Workshop on the Design and Practical Realisation of Architectural Membrane Structures | Archenhold Observatory, Berlin, Germany | 20-22/05/2019 | [www.textile-roofs.de](http://www.textile-roofs.de)

**6th International TensiNet Symposium** "Softening the Habitats: Sustainable Innovations in Minimal Mass Structures and Lightweight Architectures" | 3-5/06/2019  
Politecnico di Milano, Milan, Italy |  
[www.tensinet2019.polimi.it/](http://www.tensinet2019.polimi.it/)



**ICSA2019** | The 4th International Conference on Structures and Architecture | 24-26/07/2019 | Lisbon, Portugal | [www.icsa2019.com](http://www.icsa2019.com)

Joined International conference **IASS SYMPOSIUM 2019 & STRUCTURAL MEMBRANES 2019**  
**FORM and FORCE 2019** | 7-10/10/2019 | Barcelona, Spain | <http://congress.cimne.com/formand-force2019/frontal/default.asp>



**Nonwovens Innovation Academy 2019** | 16-17/10/2019 | Deutsche Institute für Textil- und Faserforschung Denkendorf | <https://www.edana.org/education-events/conferences-and-symposia/event-detail/nonwovens-innovation-academy2019/>

**International Conference on Advanced Building Skins** | 28-29/10/2019 | Bern, Switzerland | [www.abs.green](http://www.abs.green)

## TensiNet Meetings

**TensiNet Meetings** | TensiNet Partner Meeting 1/2019 | 04.06.2019 at 18.00 (during TensiNet symposium, Politecnico di Milano) |



Mexico City

# KnitCandela AT MUAC

*KnitCandela is a thin, sinuous concrete shell built on an ultra-lightweight knitted formwork that was carried from Switzerland to Mexico in a suitcase!*



Figure 1. General view on the finished structure © Mariane Popescu

## Context

Built at the Museo Universitario Arte Contemporáneo (MUAC) in Mexico City as part of the first exhibition of Zaha Hadid Architects in Latin America (20.10.2018 - 03.03.2019), KnitCandela is an homage to the famous Spanish-Mexican shell builder Félix Candela (1910 - 1997). It reimagines his spectacular concrete shells through the introduction of novel computational design methods and the KnitCrete formwork technology.

The shell's dynamic geometry is inspired by the fluid forms of the traditional and colourful dress of Jalisco, Mexico. The builders' nickname for the project was 'Sarape', which is a scarf or poncho with a stripe pattern. The shape also pays homage to Candela's famous restaurant at Xochimilco, a trope he repeated in several subsequent projects.

While Candela relied on combining hyperbolic paraboloid surfaces (or "hypars") to produce reusable formworks and thus reduce construction waste, KnitCrete allows for the realisation of a much wider range of anticlastic geometries. With this cable-net and fabric formwork system, expressive, freeform concrete surfaces can now be constructed efficiently, without the need for complex moulds.

KnitCandela's thin, doubly-curved concrete shell with a surface area of almost 50m<sup>2</sup> and weighing more than 5 tonnes, was applied on a KnitCrete formwork of only 55kg. The knitted fabric of the formwork system was brought to Mexico from Switzerland in a suitcase.

## Collaboration

Designed and constructed by multiple teams in Europe and Mexico, the realisation of KnitCandela is the result of a collaborative effort that harnessed collective expertise in computational design, engineering and fabrication. The architectural design is the latest expression of the evolving search of the Computational Design Group of Zaha Hadid Architects (ZHCODE) for designs that utilise structural and constructional features to enhance the spatial experience of the user. For the realisation of this expression, the Block Research Group (BRG) of ETH Zurich introduced the KnitCrete formwork technology and developed the structural design and construction system. Architecture Extrapolated (R-Ex) managed the execution of the project on site in Mexico City as part of its continued engagement in the digitisation of building trades in Mexico.

## KnitCrete

KnitCrete is a novel, material-saving, labour-reducing and cost-effective formwork system for the casting of doubly curved geometries in concrete. The KnitCrete technology is being developed at ETH Zurich by the Block Research Group in collaboration with the Chair for Physical Chemistry of Building Materials, as part of the Swiss National Centre of Competence in Research (NCCR) in Digital Fabrication.

KnitCrete formworks use a custom, 3D-knitted, technical textile as a lightweight, stay-in-place shuttering, coated with a special cement paste



2a



2b



2c

Figure 2a. Cable-net and knit formwork tensioned in between the external frame © Maria Verhulst

Figure 2b. Balloons being inflated and inserted into the fabric formwork pockets © Mariane Popescu

Figure 2c. Concreting of the sophisticated waffle shell with stiffening ribs in two directions © Mariane Popescu