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STRUCTURAL MEMBRANES 2025

Form and structure in Osaka 2025

PROJECTS

Transformative Architecture

Renewing Membrane Roofs



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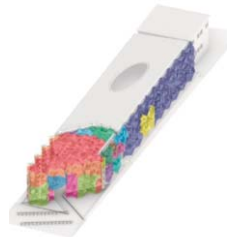
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chimney
that scrubs
pollution**



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While The Tensinet association has engaged Chemservice to collect information on the socio & economic impact of a PFAS ban and to prepare a dossier to reply to the Committee for Socio-Economic Analysis (SEAC) we have noticed that an industrial chimney that neutralizes air pollution was honoured with an award by the Membrane Structures Association of Japan (MSAJ). The material used is a PTFE membrane, which is considered as not 'environmentally friendly' in Europe. We have asked Ken'ichi Kawaguchi for some background.

The normal lifetime of the incinerator chimney is about 40 years as each incinerator boiler lasts about 40ys. They must be rebuilt about every 40 years. In Japan, the covers of the incinerator chimneys are mostly constructed by heavy concrete panels. So, these are heavy structures that require a lot of energy and CO2 emissions for

Edito

Dear Reader

Shortly after our 25th anniversary, which we celebrated last year, we are glad to share with you the next jubilee, the 50th edition of TensiNews.

Within these 25 years we have published many projects in tensile architecture, as well as promising research results and of course also the development in technology and materials over the year. Having contributed also to the technical specification for membrane structures we have done a lot to bring lightweight architecture out of the niche and become a more and more established building technique. We strongly believe in the future of textile architecture, which plays also an important role in the sustainable development of the building industry, by reducing material quantity and weight. Technical development led to longer lasting materials which allow for a much longer service life and if the end is reach, they can be easily renewed by just replacing the building skin.

Our webinar about PFAS in February this year initiated our series of webinars. It was a great success with a tremendous number of participants. The goal was to inform about the risk in the materials we use and initiated the socio economic analysis carried out by Chemservice. With their help, we are collecting data from our members in order to prove to the European Chemical Agency that building with Fluor Polymers is essential for our industry in order to keep our projects long-lasting and sustainable, and at the same time that their production, processing and use is save and not harmful.

This first webinar was meanwhile followed up by a webinar on Life-Cycle Assessment, and the next episode is already in preparation. We plan to have these webinars on a regular basis and with varying topics. We will inform about this in the upcoming TensiNewsflash.

Meanwhile please enjoy this jubilee edition of TensiNews. We present three milestone membrane projects of the 90s, which were currently renewed with a new membrane skin, and so enlarging with few new material the life span for another 20 or more years. Beside this a chimney made from light and easy cleanable membrane, a transformable Expo façade to be used on three Expos and a new ETFE covered climate house in Amsterdam is presented. Two reports complete the picture. Josep Llorens with an extensive report on the structural membranes conference in Munich and Julian Lienhard on lightweight architecture projects on the Expo in Osaka.

I will be glad to meet you soon in Frankfurt where we hold our General Assembly, in Turin at IASS or, as a must, in Essen at the TensiNet Symposium.



Yours sincerely,
Bernd Stimpfle



construction. In order to keep the durability, the concrete panels require special chemical paintings, which should be repainted every 15 years. Since we have earthquake, the heavy chimney should be designed very strong with much material just to stand against its earthquake loading. This is the background of why we needed a lighter chimney cover, and we awarded the project of PTFE panel cover for Incinerator Chimney. The expected lifetime of the chimney is about 40 years. The maintenance of a membrane chimney is also much easier than the conventional one and it has a much less environmental impact than a conventional construction with heavy concrete panels. It is true that chimney with flexible membrane also expands its design possibilities. Lighting up from inside at night may change the impression of an industrial chimney to a regional symbol tower.

The TiO₂ coating is also applied exterior surface of the membrane. They mention that it adds not only self-clean-

ing but also air-cleaning function by decomposing NO_x in the air. I suppose air-cleaning effect might be only additional and not so significant. A PTFE membrane is one of the best options as a permanent membrane material. On the other hand, it is true that PTFE is currently not a recyclable material so far. When the chimney finishes its function, about 40 years time, the situation might be changed. The technological development is always progressing very rapidly. There are many cases where a thing once thought to be impossible, became possible and even easy. We never considered that PTFE membrane has a negative effect directly to our health. Replacement all plastics to biodegradable ones might be another big future challenge for human being!

 Ken'ichi Kawaguchi, Institute of Industrial Science, University of Tokyo, President of MSAJ
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<https://fabricarchitecturemag.com/2025/11/01/taiyo-kogyo-honored-for-fabric-chimney-that-scrubs-pollution/>

Forthcoming Events



**Techtextil and Texprocess
2026** | 21-24/04/2026 |

Frankfurt, Germany |

<https://techtextil.messefrankfurt.com>

General Assembly TensiNet at Techtextil

22/04/2026

The General Assembly will be held at Techtextil (meeting room "Transparenz 1" in the Portalhaus) on Wednesday 22nd April from 14.00 till 15.30. Members who can't come to Frankfurt can join by Teams.

IASS Annual Symposium 2026 and IWSS

2026 | R-EVOLUTION OF SHAPES: SUSTAINABILITY, RE-USE, AND NEW DESIGN PARADIGMS |

14-18/09/2026 | Politecnico di Torino, Turin, Italy |

www.iass-iwss2026.org



8th TensiNet Symposium 2026

& 7th Essener Membranbau

Symposium 2026 | Shaping the

pathway to future tensioned

membrane design | 30/09-02/10/2026 | Institute for Metal and Lightweight Structures, University of Duisburg Essen, Germany |

www.uni-due.de/iml/tensinet-ems2026.php

21st Advanced Building Skins 2026 Conference &

Expo | 3-4/11/2026 | Bern, Switzerland |

<https://abs.green/home>



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Transformative Architecture

The Reuse and Transformation of an Architectural System

multiple World Expositions Dubai 2020 – Osaka 2025 - Yokohama 2027

Originally developed for the Japan Pavilion at Expo 2020 Dubai (Fig. 1), the facade has been reassembled for the Women's Pavilion in collaboration with Cartier at Expo 2025 Osaka, Kansai and is currently being repurposed for a third application at the Japan International Horticultural Expo 2027 in Yokohama. The reuse project, termed "transformative architecture", demonstrates how lightweight ball-joint structures and membrane materials can be reused across different sites, layouts, and scales (Fig. 2).

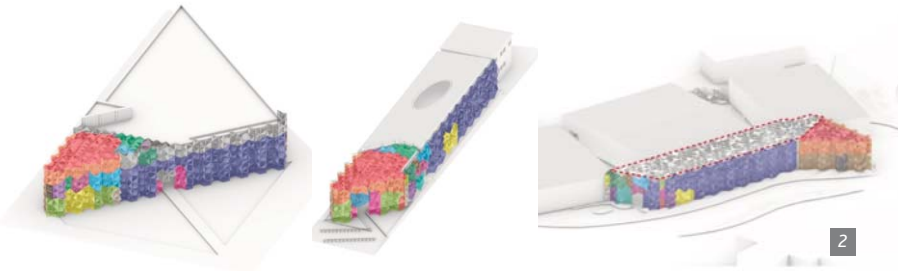


Figure 1. EXPO 2020 Dubai Japan Pavilion

Figure 2. Diagrams for Dubai, Osaka and Yokohama © Yuko Nagayama & Associates

The core architectural element is a three-dimensional geometrical lattice called the KUMIKO facade. The façade design was inspired by the similarity between the traditional Japanese asanoha (hemp leaf) pattern found in Japan's kumiko woodworking technique, and the arabesque in the Middle East. It was constructed using a technique called the ball-joint system. Much like a plastic model kit, this system enables multi-directional connectivity while maintaining structural efficiency through minimal material use.

From the outset, the pavilion was conceived as a demountable structure. The ball-joint system allows all primary components—tubes, nodes, and membranes—to be dismantled. This modularity is essential for reuse. The

PTFE membrane is selected for its low weight, high tensile strength, ultraviolet resistance, and long-term durability. It also functions as an environmental moderator rather than a sealed enclosure. In Dubai's hot climate, it filtered intense solar radiation, reduced heat gain, and allowed air movement through the facade. In Osaka too, the membrane unified interior and exterior zones, controlled daylight and glare, supported natural ventilation, and visually integrated diverse spaces (Fig. 3).

The technical challenge of reusing the KUMIKO façade in Osaka was reassembling the parts to fit a new site with a completely different footprint. At Dubai, we designed an isosceles triangular building on a large trapezoidal site using Japan's traditional silver ratio. In contrast, the Osaka site allocated for the Women's Pavilion was long and narrow, with a frontage of 18m and a depth of 110m.

This transformation required extensive digital coordination. In collaboration with ARUP Japan, we conducted extensive structural analyses and spatial simulations to determine how existing components could be placed within the new geometry. Approximately 70% of the original 10,000 components were reused, including both structural components and membranes. Our goal during this process was to solve this difficult puzzle without fabricating new parts. This task alone took us three months. Furthermore, the nodes had unique, individually identified shapes, and the tube wall thickness varied depending on the force distribution. Thanks to Obayashi Corporation's visual process management system, ProMIE, the team was able to sort the parts, ascertain the installation location, and manage the delivery and assembly of materials by attaching a QR code to each part while linking it to the BIM model (Fig. 4).

Through this consistent reuse project, we gained the expertise—from design to construction—to not simply relocate a building but to transform it into a different structure tailored to the next site. This knowledge is leveraged for the next reuse project – indoor exhibition shared facilities at the Yokohama GREEN × EXPO 2027 (Fig. 5). This new facility will be approximately three times the size of the Women's Pavilion, and the KUMIKO facade will have to be reassembled into a completely different form again. This is a yet new challenge for the second reuse project.

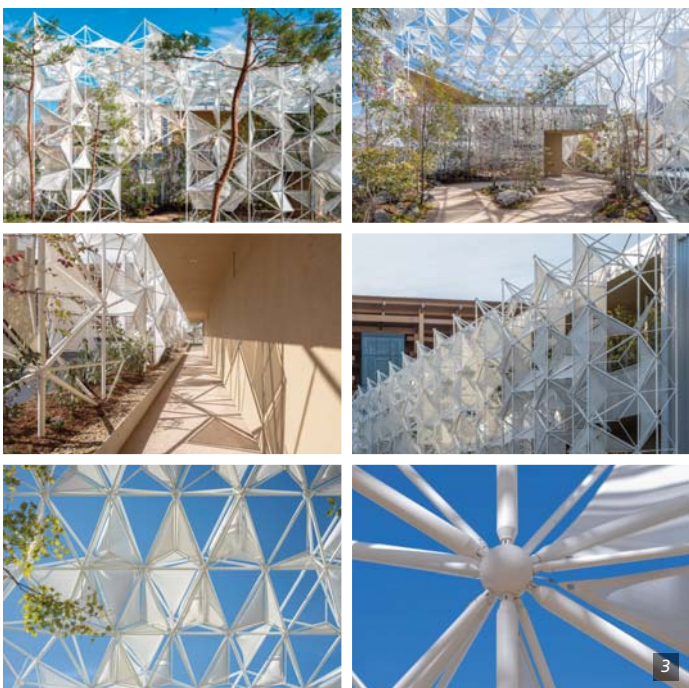


Figure 3. Women's Pavilion in collaboration with Cartier at Expo Osaka 2025, © OMOTE Nobutada