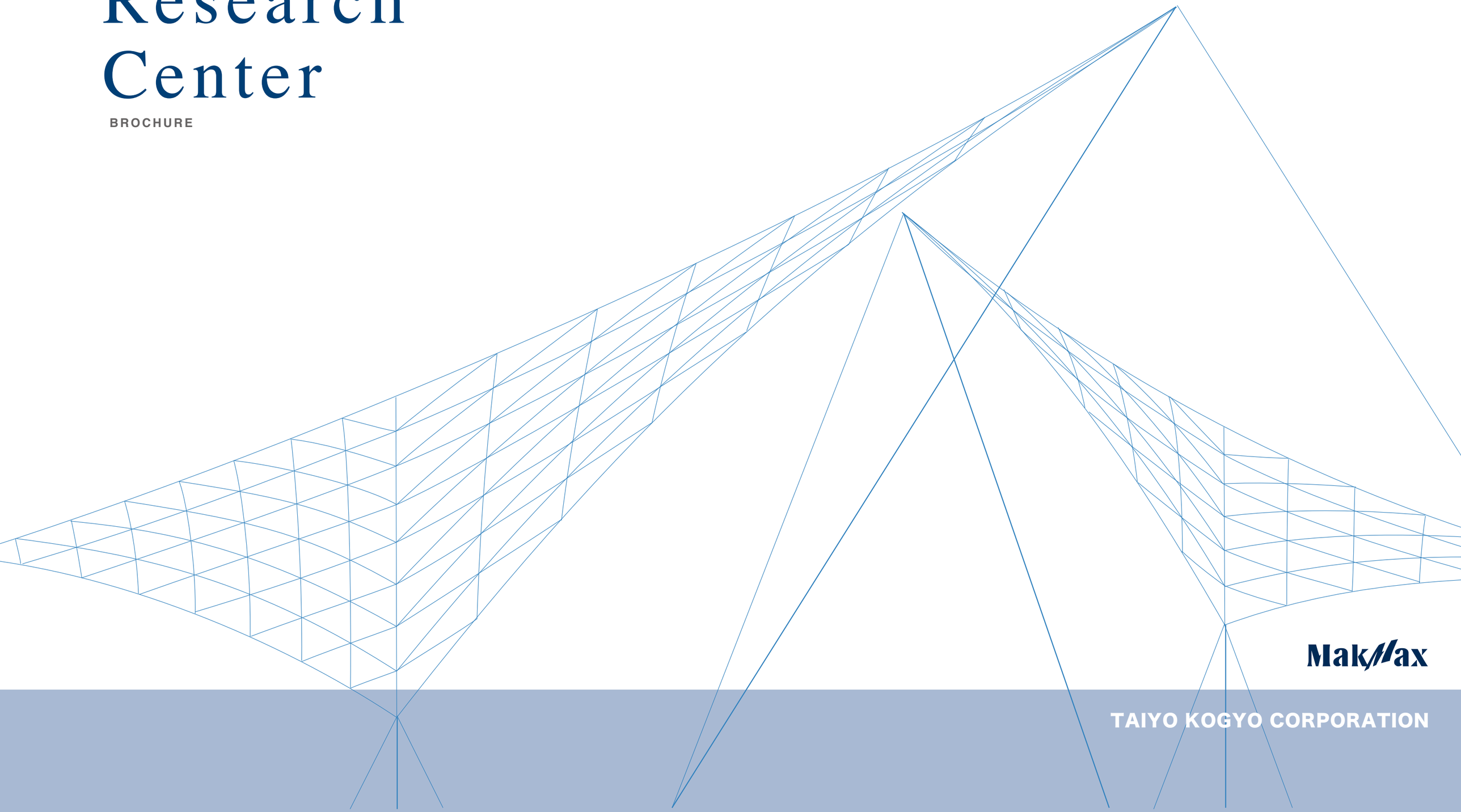
Technical Research Center

BROCHURE



MakMax

TAIYO KOGYO CORPORATION

Maximizing Membrane

Our mission is to provide products with convenient technology to customers all over the world. We believe that utilizing the newest and best technology makes it possible to achieve our corporate vision.

Testing and Evaluation

We are able to provide products with confidence to customers due to our evaluation technology.

Patterning Finding Analysis

Our designs and manufactures beautiful, wrinkle-free, curved membrane structures by studying three-dimensional cutting drawings based on our shape analysis.

Production Technical Support

The development of an integrated production aid program is an important task of ours.

Materials Development

We have a commitment to developing fabrics useful for outdoor applications. We design and evaluate these materials based on strength, durability, and environmental functionality.

Fieldwork

We verify the product is functioning as designed through on-site measurements.

Structural Analysis

We conduct extensive structural analysis on models of the proposed structure, incorporating both the steel cable support structure and the membrane. Based on these results and our evaluation of the wrinkling of the membrane material, we are able to select the optimal material sizes.

Expo Axis

Makmax

The Future of Membranes

Taiyo Kogyo Group is constantly striving to increase membrane possibilities through research and technological development.

The incorporation of new technology is possible due to our wealth of knowledge and flexible thinking.

Environmental Contribution

We focus on the development and usage of recyclable materials.

We analyze the effects of the constructed membrane structure on the surrounding environment.

Construction

We put out the best technology to maintain our high reputation in the market.

We propose new products in a new way.

Overseas Technical Support

We support our overseas clients by evaluating and developing our material technology.

We have the most advanced and unique membrane technology in the world.

Logistics

Numerical analysis contributes to the development of our logistics.

An example is AIR STYLE

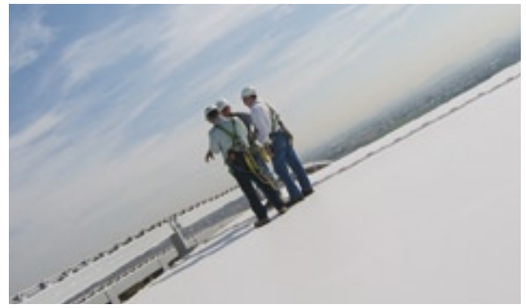
Aerospace

We help research institutions develop space technology.

In the future, membrane structures will be used in space.

Exploring New Technology

We explore new technology through our wealth of knowledge and innovative ways of thinking.



Worldwide

We work in collaboration with worldwide sites, and use the most modern technology available to provide the highest level of technical support to fit the needs of each of our clients.

Supplied by JAXA

We are asked to provide many types of technical support for the construction of membrane structures. Due to our advanced technical developments in design, manufacturing, construction and materials, we are always able to meet the needs of our consumers. As a result, news of our superior performance has spread domestically and worldwide.

Design, manufacturing and construction support features.

Technical Support

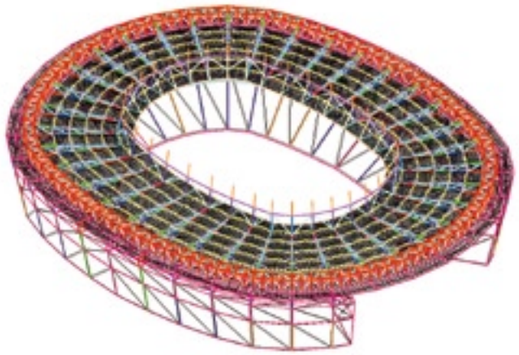
We work with the imaginative designs and concepts of designers to help them make their dreams a reality.

We conduct verification experiments and fundamental research on membrane structures in various environments in order to meet the desires of architects that wish to use our durable and malleable materials in the construction of membrane structures.

YAS Marina Circuit United Arab Emirates

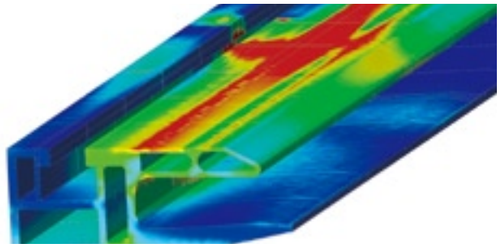
Development and Achievement of Original Design Tools

In recent years, the technology gap has shrunk with the development of information technology. Due to improvements in information and communication technology, the quality, price and the delivery of our products has improved. In the course of this progress on the IT front, we have been developing tools for the design and manufacturing of innovative features that will improve our overall manufacturing ability. In addition, we have been developing new software and detection systems. MAGESTIC was developed as an in-house software program used in the design of membrane structures. We sometimes use commercially available software programs in combination with MAGESTIC, enhancing the effectiveness of our own software.



Strength Analysis for Anchoring

Applications have evolved with the improvement of the performance of computers, contributing to the advancement of analysis technology. Previously, local stress analysis of materials could only be conducted with large machines and full-scale testing. With new technology, we are able to evaluate and determine member sizes through stress analysis conducted on personal computers.



ETFE Film Membrane Structures

Membrane structures using films can be found in the composition of air-mats in roofs and walls. We call it the ETFE film membrane structure. Although originally developed in Europe, we have redeveloped it using our original in-house technology to create safer, more beautiful and more functional structures. Some of the ETFE applications are constructed abroad.

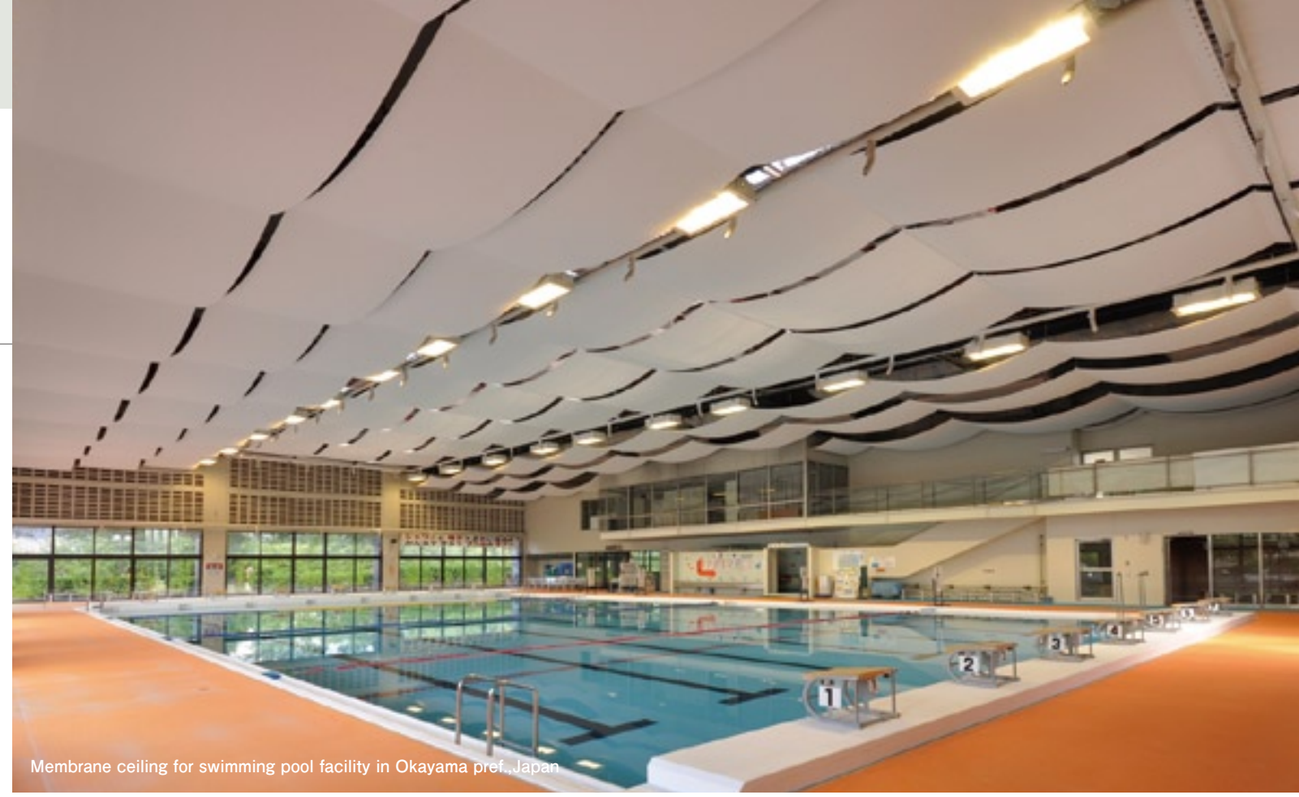
Experimental Verification

In addition to basic research and experimentation on the membrane structures related to environmental changes, experimental verification is required for the installation of the membrane structure. This is done through the usage of planning, implementation and evaluation technology that we have developed.

Technology development in accordance with the social demands

We quickly incorporate changes into our products in response to the changes of global conditions and technological progress.

It is important to understand the usage of the developed product.
Therefore, we conduct experiments and measurements on our products.
For us, where there are products, there are laboratories.



Membrane ceiling for swimming pool facility in Okayama pref.,Japan

Environmental Evaluation

We assess the effects of our products on the environment through model and numerical experiments.

▸Light, Heat, Sound, Wind

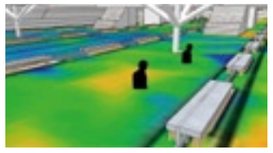
Through the usage of CAE (computer-aided engineering), we have been focused on the research and development of structure analysis. We are currently doing research and development on environmental analysis and photo thermal fluid analysis.
Membrane structures are affected by indoor environmental conditions. We do numerical analysis relating to the specific condition, such as a change in the room temperature, acoustic measurements, the wind environment around the membrane structure, and the thermal environment. We conducted a study with a Tokyo Institute of Technology to establish these analysis techniques and measurement technologies.
We contribute to the structure's environment by improving the numerical analysis techniques for the development of the spatial structure. Examples of the analysis techniques are: impact assessment of the product's surrounding environment, wind and thermal fluid analysis, and optimization of the structure, such as through weight reduction.

▸Fieldwork

In order to develop environmentally-friendly products we respond to changes in technology and environmental conditions, such as global warming and increased Nitrogen Oxide emissions. We also introduce new numerical analysis techniques, measurement technologies and work on the development of new materials.

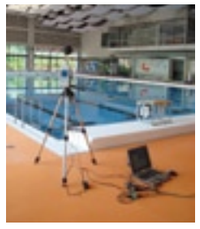
Wind speed distribution

Luminance distribution

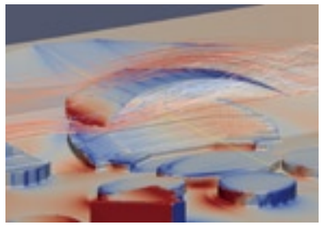


Temperature distribution

Numerical simulation for the environment of light and heat

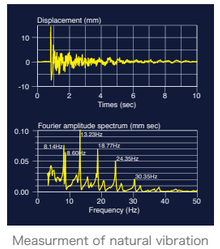


Measurement of reverberation time



Wind load analysis

Measuring device for membrane tension

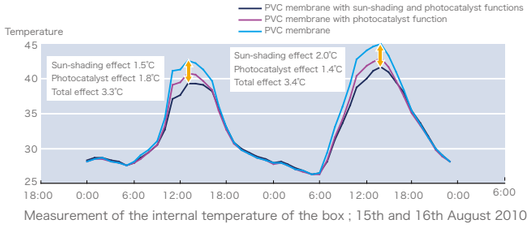


Measurment of natural vibration

Evaluation of New Materials

▸Sun-Shading Membrane

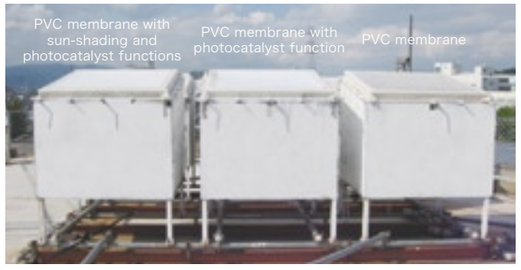
White membrane has a high sun-shading performance value because of its solar reflectant properties. The self-cleaning properties of the photocatalysts in the membrane allow it to keep white and maintain its high sun-shading performance. We are constantly working to develop newer membranes to keep the inside of the structure cooler and more comfortable.



Measurement of the internal temperature of the box ; 15th and 16th August 2010

▸Outdoor Exposure Testing

We are committed to providing membranes that provide the highest level of durability available. We conduct research and evaluate the durability of our membranes through outdoor exposure.



Measurement of the internal temperature of the box

Kuala Lumpur,Malaysia

Okinawa,Japan

Technology development in accordance with the social demands

Material Design

We work to develop new membranes and materials that respond to the environmental demands of today. We strive to meet each customer's needs by designing, developing and evaluating new products that help contribute to a greener and healthier environment.

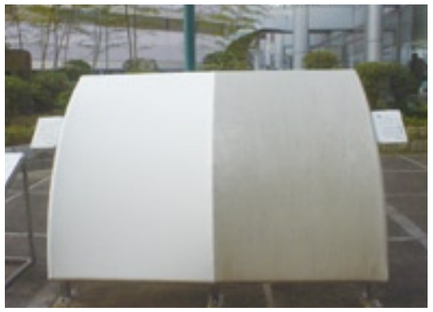
▶Photocatalysts

Titanium dioxide (TiO_2) photocatalysts are known to show self-cleaning, anti-fogging, air-purification, antibacterial, and anti-mold properties through the redox reaction under UV irradiation. Utilizing the light-sensitive photocatalyst, and adding various other functions, we are now pursuing the next generation of new materials.

The effect of photocatalyst varies according to the environment condition

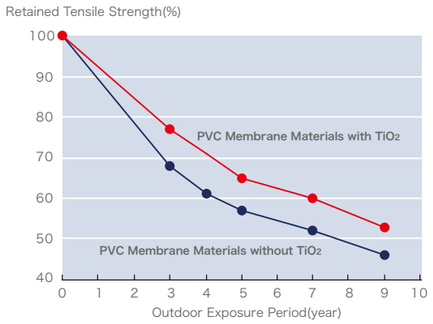
Category		PTFE Membrane	PVC Membrane
Decomposition Activity Index :R (μmol/L/min)		>27	>14
Water Contact Angle (degree)	Initial	110	83
	After UV Irradiation	105	21

Membrane materials with TiO_2 show excellent decomposition activity.
The PVC membrane has the washed-out, self-cleaning effect of a photo-induced hydrophilic TiO_2 surface."



Three-year outdoor exposure test at KAST (Kanagawa, Japan)

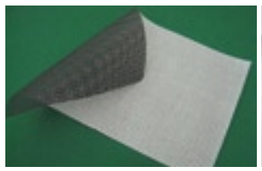
Membrane material with TiO_2 (left side) shows an excellent self-cleaning ability for an extended period of time."



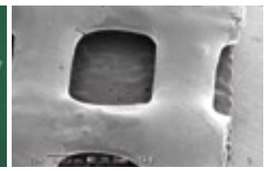
TiO_2 absorbs ultraviolet ray under 400nm and this protects PVC coating to some extent. Therefore, the durability of PVC membrane material with TiO_2 improves, compared to material without TiO_2

◎Purify Mesh™

TiO_2 coated membrane materials show excellent self-cleaning properties. We have developed new TiO_2 coated membrane materials that also have NOx (Nitrogen Oxide) removal properties. Purify Mesh was the first membrane certified by PIAJ to show NOx removal properties.



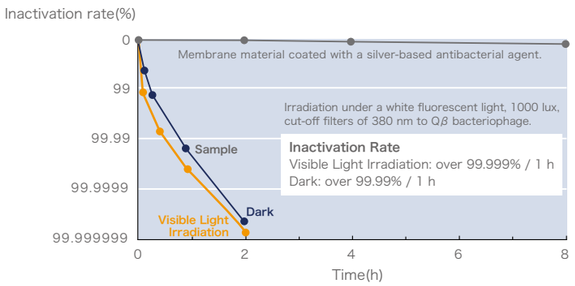
Purify Mesh Sample



SEM image of purify mesh surface

◎Visible Light-Sensitive Photocatalysts

By utilizing materials developed by NEDO, we have created photocatalytic membranes which exhibit antibacterial and antiviral properties in response to indoor lighting.

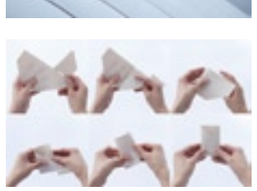


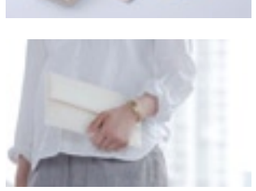
Trial of the Three R's: Reduce, Reuse, Recycle

Coated fabrics are soft composite materials which consist of a coating material and base fabric. We are committed to finding an effective recycling procedure to help reduce industrial waste and to diminish the effects of global warming.

▶Reuse and Recycling of the PTFE-Coated Fabrics

Unfortunately, there is currently no easy and effective recycling method for these fabrics due to the difficulty in separating each of the materials. We are researching recycling techniques, such as the compression molding method. Research into the reapplication and reuse of the PTFE-coated fabric is also now being carried out.





▶Kenafine™

We have developed Kenafine which consists of a coating material and base fabric made of kenaf bast fibers, a popular biomass. As kenaf has a high cellulose content, Kenafine can easily be recycled into paper products.

Kenaf Flower

Kenafine and Its Yarn

Recycled Paper from Kenafine

▶Unifine™

Unifine is made of an olefin coating material and an olefin base fabric which allows for the materials to be easily recycled and reproduced into sheet and molding products.

Unifine

Recycled Pellets from Unifine

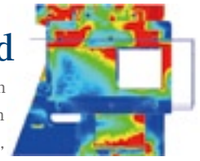
Shades of Kenafine used in the Expo 2005 AICHI, Japan

The Future of Membranes

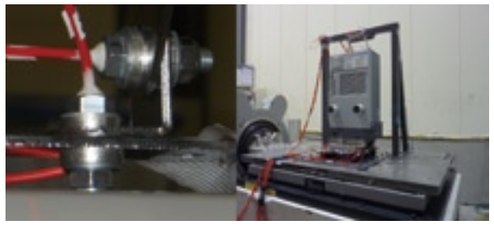
Taiyo Kogyo Group's ultimate goal is to create products that go beyond the current concept of membrane structures. Our company, and specifically our Technical Research Center, work to advance new and innovative methods to create newer and more efficient materials which help us produce a better product and opens up new uses to our customers.

Logistics / Civil Engineering Field

We are working on developing new features in our membrane materials for their use in applications such as tent warehouses, geo-textiles, and container bags.



Stress analysis for component design



Vibration Test

Aerospace

Membrane material is lightweight, high-strength, and extremely durable, so it can be used in the aerospace field on projects such as airships and balloons.

We want to develop reliable membrane materials that can be used in the severe environment of space. In the near future, membrane structures may be installed in the stratosphere and outer space.

We have, and will continue to cooperate with various research institutions to develop more advanced membrane structures for use in the aerospace industry.

Solar Cells

We are presently developing a flexible power generating membrane which can be obtained through the inclusion of amorphous silicon solar cells in the membrane material. In the future, we are looking to the use of organic solar cells which would be easier for designers and architects to incorporate into their plans.

Photo by Dr. Mikio Kurita, Associate Professor in the Department of Astronomy, Kyoto University

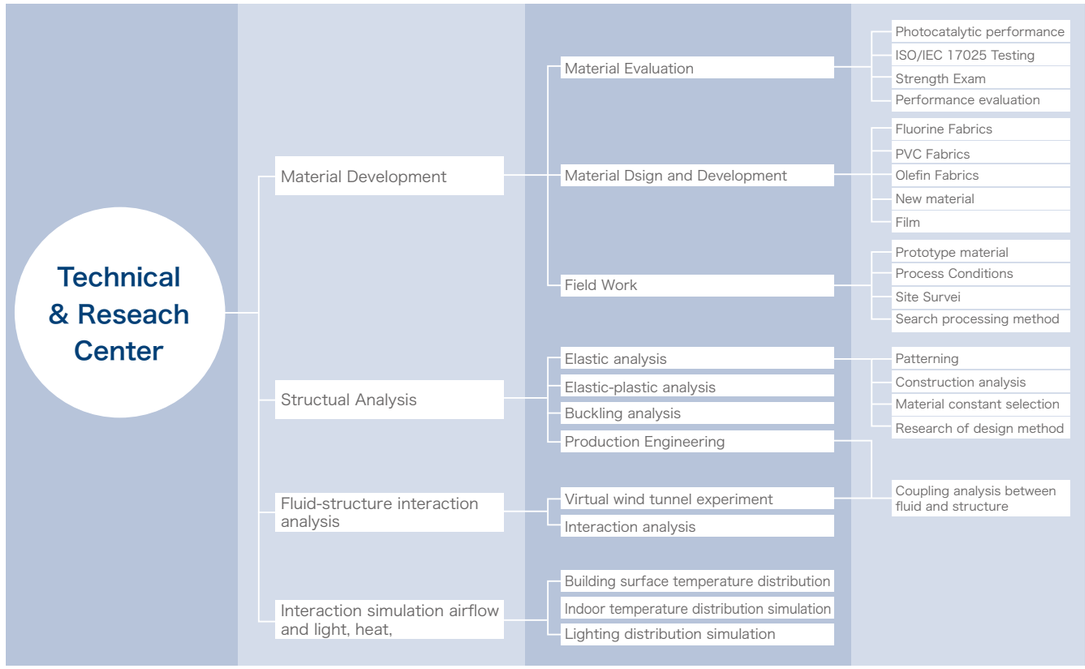
TM Truss astronomical telescope mount.

Overseas Technical Support

We are a global company and we work with all of our customers to create unique products. It is our aim to provide a wide range of structural designs to meet their varied needs. Because our membrane structures require advanced technology in their design, manufacture and installation, we are committed to providing the technical support to make sure our customers needs are met.

Initiatives with External Organizations

Along with our internal research and development, we take part in industry-academia collaboration in order to produce further innovation. We are also actively engaged in joint research projects with external companies.



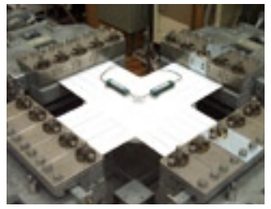
Technical Research Center has a variety of skills testing capabilities
and many experimental design evaluation techniques.
We receive required tests and experiments in order
to assist and meet the needs of our customers.

Tests and Experiments List

We do testing on materials such as fabric, textile, and film, and can evaluate the durability and strength of membrane structures. We also evaluate the property of photocatalysts. For more information, please contact us by telephone (+81 72 856 9118) or on our website.

Tensile Test

By using uniaxial tensile testing on materials, we are able to evaluate mechanical properties such as tensile strength, elongation at break and yield point.



Biaxial Tensile Test

We measure the tensile stiffness and the Poisson ratio from the result of the relation of the stress-strain when the material is slowly pulled in a biaxial direction.

Creep Test

We measure strain and the presence or absence of breaking in the material by applying a constant tensile load over a long period of time at a constant temperature.

Creep test by hydraulic control method

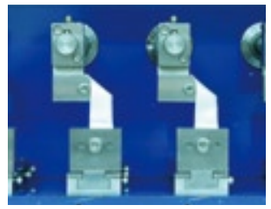
We measure the creep rupture of the materials by water pressure, keeping membrane surface with uniform tension in all directions.

Resistance to Folding and Abrading Test

We evaluate the change in appearance and ease of peeling of the coating due to folding and abrading.

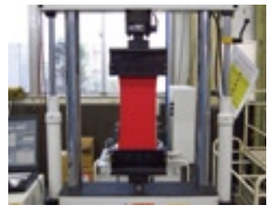
Resistance to Repeated Folding Test

We evaluate the damage, change in appearance, and flex fatigue resistance of the material by submitting the material to repeated bending deformation.



Resistance to Low Temperature Flexing Test

We evaluate the damage to the surface and change in the appearance of the material by repeatedly bending the material at a below-freezing temperature.



Fatigue Test

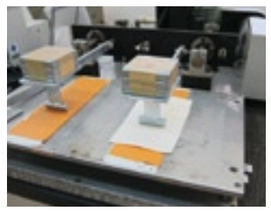
We evaluate the cyclic fatigue resistance of the tensile and compressive nature of the material.

Accelerated Weathering Tester

It is necessary to evaluate the durability of membrane materials quickly. To achieve this, we test the durability of membrane materials by using the strong Xenon lamp weathering tester.

Tensile Test for Clamping

It is necessary to measure the clamping strength of membrane panels for the design of membrane structures. We evaluate clamping strength by using the large-load type tensile tester.



Abrading Test

We use abrading testers to evaluate the material's resistance to abrasion. After the abrading test, we evaluate the material for cracks or changes in its appearance.

Incombustibility Test

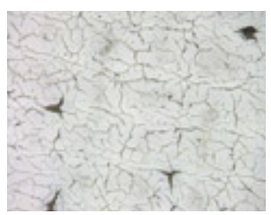
We evaluate the incombustibility of architectural materials based on the JIS A 1322 testing method.

Thickness Measurement

We have various thickness meters. We are able to evaluate the thickness of membrane materials as well as another materials.

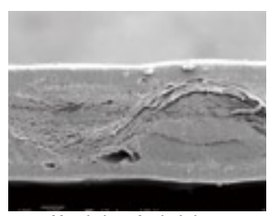
Mass Measurement

We have various electric balances to evaluate the quality of the mass of the material.



Morphology Analysis by Optical Microscope

We observe the damaged areas or surfaces of materials by using an optical microscope.



Morphology Analysis by Scanning Electron Microscope (SEM)

We analyze the membrane material's surfaces and cross sections by using SEM.

Main Equipments

Test Items	Equipment
Tensile Test	Tensile Tester, Load capacity:10kN, 20kN (with thermostat bath and freezer), 100kN (with thermostat bath)
Mass	Electric balance
Thickness	Compressive Elasticity Tester
Creep Resistance Test	Uniaxial Creep Testing Machine 2units, Biaxial Creep Testing Machine, Water-Pressed Creep Test
Resistance to Creasing and Folding Test	Scott Type Crease-Flex Abrasion Tester, MIT Folding Endurance Tester, Demattia Flex Cracking Tester
Resistance to Low-Temperature Flexing Fest	Flexo-Meter (with freezer)
Biaxial Tensile Test	Biaxial Tensile Tester
Abrading Test	Abrading Tester
Fatigue Test	Fatigue Testing Machine
Optical Property	Spectrophotometer
Accelerated Weathering Tester	Xenon Lamp Accelerated Weathering Tester (UV irradiance 180W/㎡ (max.)), Metaling Vertical Weather Meter (UV irradiance 530W/㎡ (max.))
Incombustibility Test	Incombustibility Tester
Observation for Morphology	Microscope, Scanning Electron Microscope
Others	Temperature and Humidity Testing Chamber, High-Temperature Oven (up to 500℃), High-Temperature Oven (up to 800℃), Fluttering Tester, Constant Loading Durometer, Colorimeter

ISO/IEC 17025：2005

We have an ISO/IEC 17025:2005 certification. The results of our tests are valid worldwide.
We conduct tests based on ISO/IEC 17025:2005 standards below.

Tests based on ISO/IEC 17025:2005

Items	Test Standard
Mass	JIS K 6404-2-2:1999, Method A
	ISO2286-2:1998, Method A
Thickness	JIS K 6404-2-3:1999, Method B
Tensile strength	JIS L 1096:2010, 8.1.4.1; JIS method a) Method A; Strip test method
	JIS L 1096:2010, 8.1.4.1; ISO method a) Method E; Strip test method
	ISO 13934-1:1999
	ISO 1421:1998, Method 1 This standard includes BS,NF,DIN

Testing Laboratory, Accreditation Certificate for ISO/IEC17025:2005

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Maximizing Membrane

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Registration №2013-A-0248