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Eco-friendly technologies in the Japanese Pavilion at EXPO 2005 in Aichi, Japan

**Expo 2005 Aichi Japan: Der japanische
Pavillon in umweltfreundlicher Tech-
nologie**

**Technologie ecologiche nel padiglione
giapponese, EXPO 2005 Aichi Japan**

Document in English

Eco-friendly technologies in the Japanese Pavilion at EXPO 2005 in Aichi, Japan

We had created two real Japan Pavilions in the World Exposition 2005 in Aichi, both of that were to be expected as Eco-friendly architectural models in near future, environment conscious society.

As follows, introducing various architectural experiments related to materials, building elements, construction methods, and interaction between ecological approach and design would lead to new art form of architecture.

1 Location of EXPO 2005 Aichi JAPAN

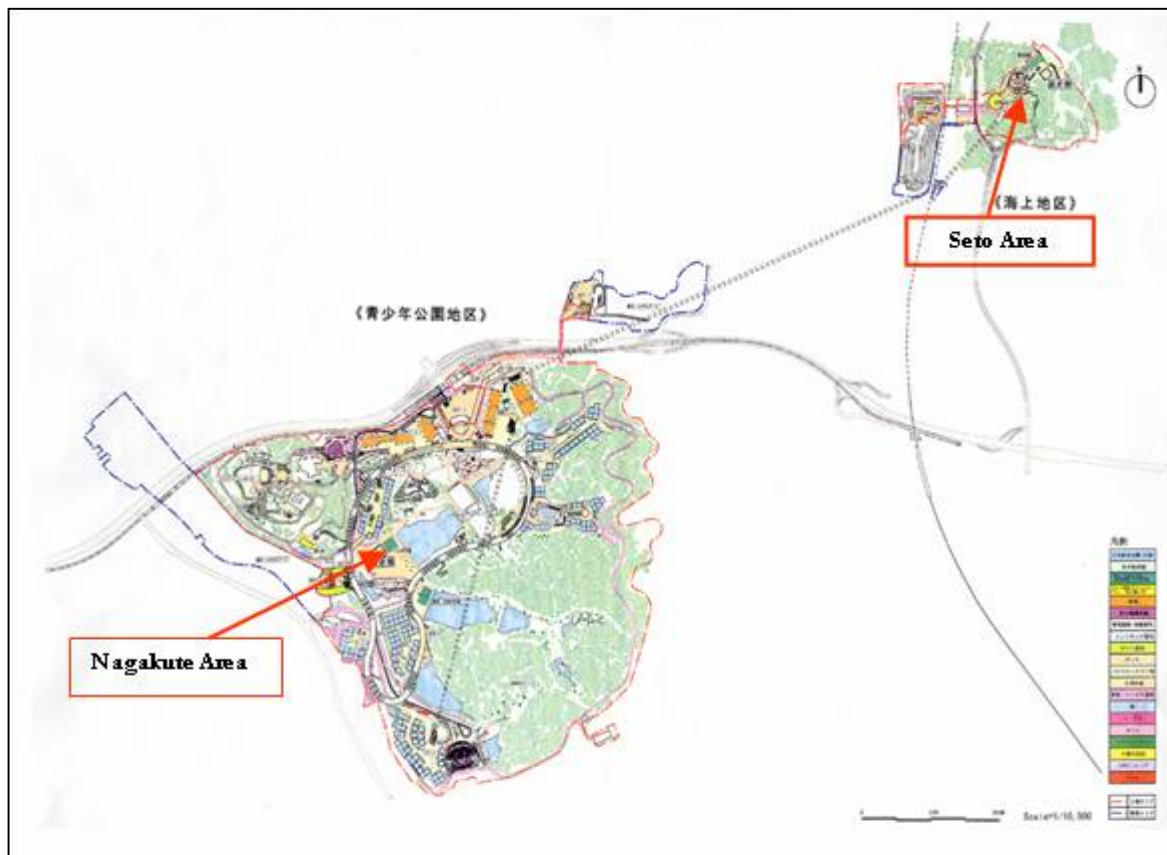
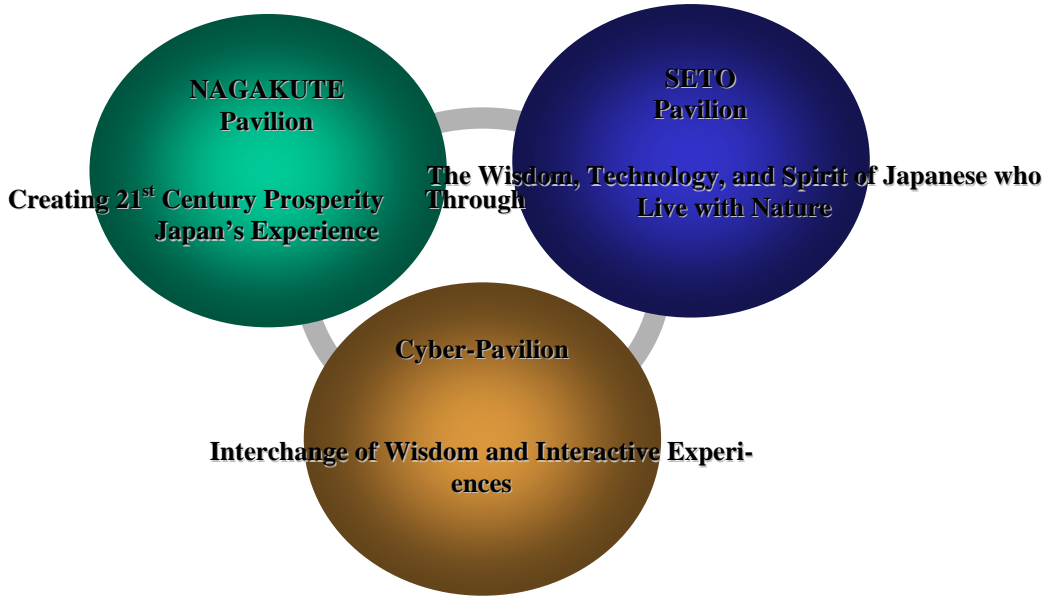


Illustration 1: Location at the EXPO 2005 Aichi, Japan

Japan Pavilion Nagakute is located near the west gate in the past Youth Park (EXPO 2005 main site), while Japan Pavilion Seto at the border of huge Kaisho forest-mountain where is approximately 3 km distance from Nagakute, connected by aerial rope-way transportation and exclusive road for shuttle vehicles.

1.1 Three Pavilions



Functional relationship of two real pavilions (both are temporary) and cyber pavilion (Japan Pavilion on the Web).

2 Japan Pavilion Nagakute

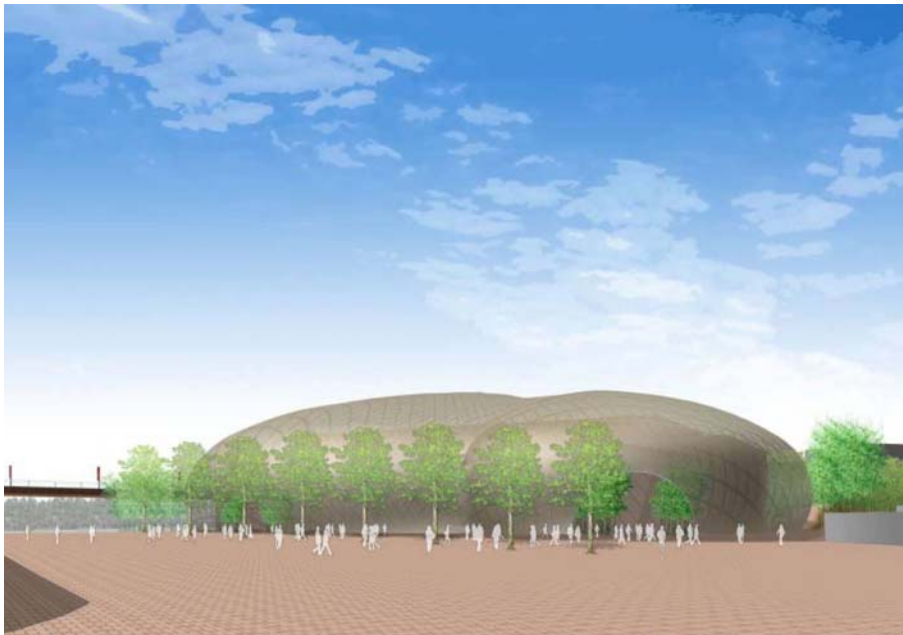


Illustration 2: Preliminary image of Japan Pavilion Nagakute

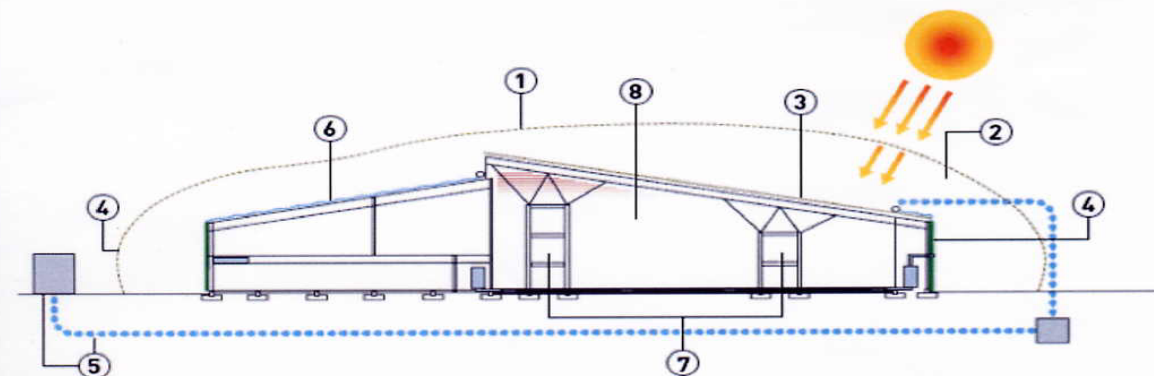
Architectural area is 6,000m², 2 stories, wood structure.

New technologies that you can see in the pavilion

- Electricity generated 100% by new energy.
- Cooling mechanism by photo-catalytic steel roofing and sprinkling of water.
- Use of recycled wastewater(not for drinking) output by an ozone treatment system.
- Biomass construction (use of timber from thinning, roof constructed of bamboo slats and plywood, and wall surfacing made of biodegradable plastics)
- Various schemes to reduce the impact on the environment.

[The bamboo cage cuts solar heating, wall greenery decrease the thermal load, and cooling only the space where people spend time reduces energy consumption.]

Eco-friendly schemes



① Bamboo cage

The bamboo cage will reduce the quantity of solar energy striking the building. The cage will suppress the thermal load and, at the same time, will merge in well with the natural environment.

② Biomass construction

Wooden building made of timber from forest thinning.

③ Roof

Air trapped between the bamboo tiles and the plywood shingles will reduce heat transmission from the outside air.

④ Walls

The effectiveness of the thermal insulation will be enhanced by biodegradable plastics that will degrade to soil and by air pockets trapped between the materials. Green walls will reduce the thermal load.

⑤ Ozone treatment system

This system will produce recycled wastewater(not for drinking) from sewage.

⑥ Room made of photo-catalytic steel plates

Photo-catalytic steel plates and a sprinkling system using recycled wastewater, which has undergone ozone treatment will enhance the effectiveness of cooling of the building.

⑦ Bundled pillars

Pillars made of bundled timber from forest thinning.

⑧ Space where people spend time

Only the places where people spend time will be air conditioned to reduce energy consumption.

Illustration 3: Cross Section Diagram of Japan Pavilion Nagakute which has double-skin (membrane) composition

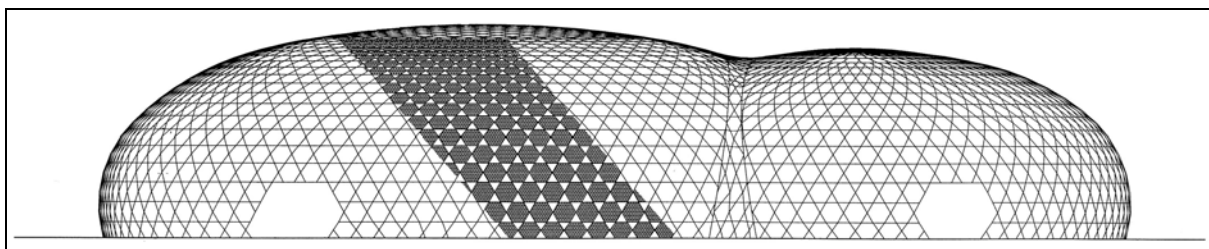


Illustration 4: Front Elevation of Japan pavilion Nagakute

Front Elevation of Japan pavilion Nagakute. Bamboo Cage were knitted by hexagonal pattern which has been used in small-scale traditional bamboo craftwork in Japan. Size of Bamboo Cage : 90m×70m×20m-high.



Illustration 5: Appearance of Japan Pavilion Nagakute making us imagine some memories of cocoon and so



Illustration 6: Interior space under construction

4 Bundled pillars (span=3m) ,forming structural tower unit, support a large wood ceiling.



Illustration 7: Top joint of Bundled pillars



Illustration 8: Waiting slope area of pavilion

Left is wall-greening. Wood thinning (mainly cedar) is used here and there.

2.1 Bamboo Cage: construction in progress



Illustration 9: Bamboo Cage, construction in progress



Illustration 10: Bamboo Truss



Illustration 11: Bamboo construction (inside Cage) on the roof

Illustration 10: Bamboo Truss which consists of 4 smoked bamboos is basic structure of Bamboo Cage.

Illustration 11: Bamboo Cage fixing and reinforcing the whole bamboo structure.

Bamboos themselves had been already smoked at 200 degrees centigrade for a couple of hours, called Eco-Dry-System, to make them stronger and avoid against cracking and corruption. As for quantity, over 40,000 domestic bamboos to be cut and splied.

2.2 Construction process of Bamboo Cage

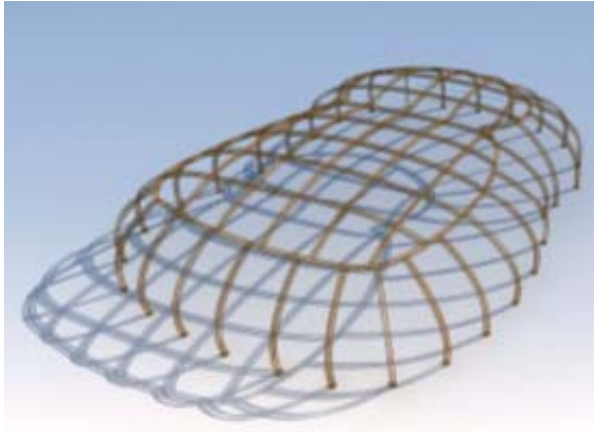


Illustration 12: Basic structure - Bamboo Truss System

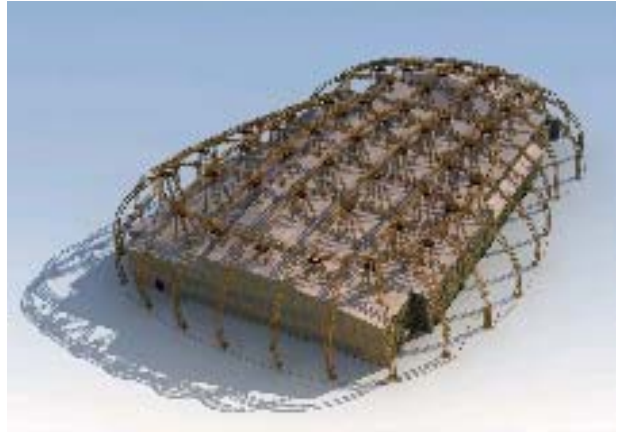


Illustration 13: (1) Covered and jointed to the main building by Bamboo Truss

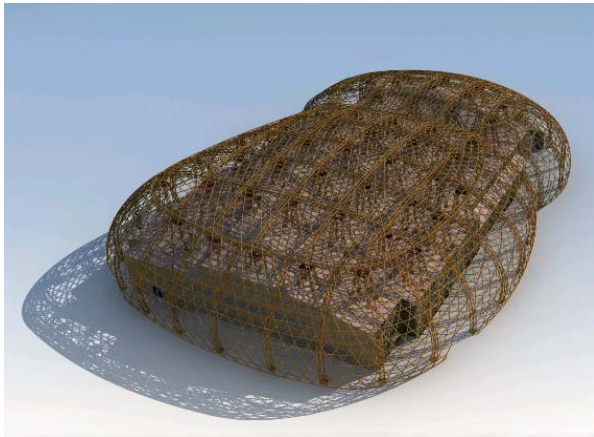


Illustration 14: (2) Each double bamboos' stem of Bamboo Cage assembled hexagonal pattern



Illustration 15: (3) Finally, Bamboo Mesh (functioned as trellis, also knitted into the same hexagonal pattern) covering makes biomorphic surface shape



Illustration 16: Interior of the corridor in VIP zone - Bamboo-screen-wall



Illustration 17: Back zone room

Back zone room: bright but opaque wall behind is biodegradable plastic, on the other hand, carpet, blind and insulation invisible in the wall are fabricated by bamboo-fiber materials.



Illustration 18: Main exhibition space

Main exhibition space is supported by long-span Box beams of reinforced plywood.



Illustration 19: Wall greening

Building has actually become same-scale showcase for Wall greening (plants are bamboo grass), Bamboo tile roofing, Bamboo Cage, biomass structure and so on.



Illustration 20: Japan Pavilion Nagakute at night (Under construction)

3 Japan Pavilion Seto



Illustration 21: Preliminary image of Japan Pavilion Seto.

Architectural area is 3,000m², 4 stories round shape (diameter=40m) built on the slope land having 13m difference of elevation. 4 giant steel columns support the entire building being able to reduce the transformation of existing nature.

Merging with nature that you can experience in the pavilion

- Coconut husk mats used for the roof as a biomass material of native species.
- Natural ventilation by a solar chimney called the Tower of Wind.
- Use of natural energy (a system using geothermal energy and air-cooling utilizing outside air and by changing the air during the night).
- Four steel-framed pillars will support the building to minimal topographical change.

Eco-friendly schemes

- ① Natural ventilation system
Air will be ventilated naturally by a combination of a solar chimney called the Tower of Wind and a system using geo-heat.
- ② Roof
Coconut husk mats, which are a biomass material, will be used for the roof.
- ③ Walls
External walls made of fire-resistant wooden panels will be designed to harmonize with the natural environment.
- ④ Appearance
The SETO NIPPON-KAN building will be circular to harmonize with the rectangular-shaped pavilion of Aichi Prefecture.
- ⑤ Auto-responsive sun-sensor glass
This glass reacts to temperature change in the outside air (becoming transparent or milky) and creates shade.

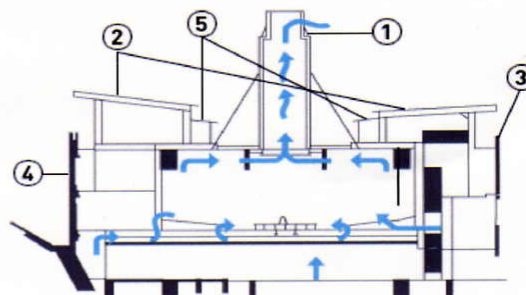


Illustration 22: Section Diagram of Japan Pavilion Seto which celebrates various ventilation systems without environmental load

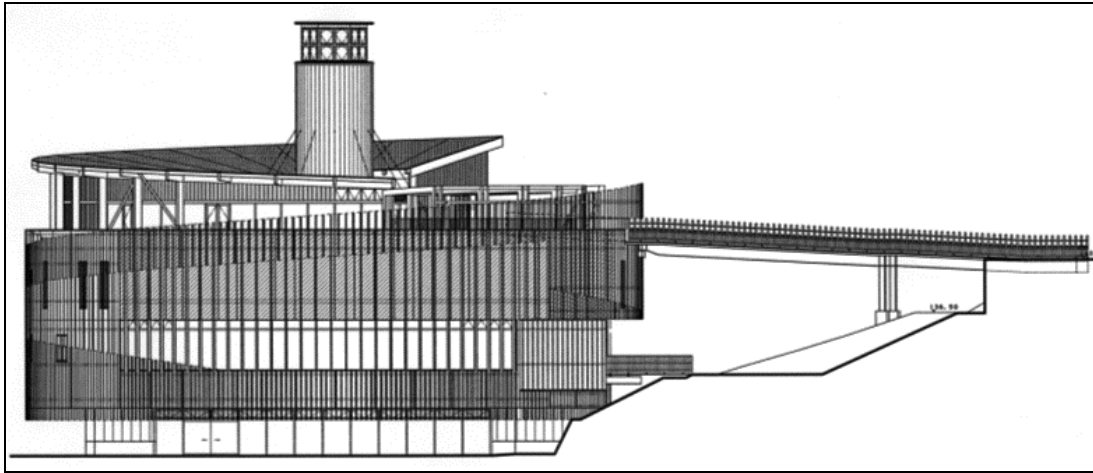


Illustration 23: Elevation of Japan Pavilion Seto (south elevation)



Illustration 24: Appearance of Japan Pavilion Seto, backdrop of that is landscape of Kaisho forest-mountain



Illustration 25: Wood curtain wall (exterior wall wooden panel)

副	
建築基準法第2条第7項のうえの規定に基づき認定に供する 準耐火性能評価試験成績書(準耐火構造)	
試験名称	建設省 建築研究所 防火試験センター
依頼者名	国土交通省 中部地方建設局 安濃町 建設課
受託番号	試験依頼第044110号
試験場	所在地 愛知県名古屋市中区三の丸2丁目1番1号
構造名	構造用集成材パネル(120mm)外壁
商品名	木質準耐火パネル(4559)
試験物の部分	外壁(自重力)
耐火性能	4.5分
材料	試験体製作後6日
検査法	構造用集成材(からまつ) : 0.42 (絶乾)。(10.5℃・5日間乾燥)
含水率 (Wmax)	構造用集成材(からまつ) : 11.5 (絶乾)。(10.5℃・5日間乾燥)
備考	試験体の材料および構成(水平断面図、単位:mm) 詳細を別図1~3に示す。(依頼者の提出資料による。)
試験規格	当ペネトレーティング制度「防耐火性能試験・評価業務方法書」
加熱炉の熱源	電熱ガス(48,205kJ/m ³)
加熱速度の測定	加熱炉から100mm離れた位置の火炎温度
温度測定位置	別図-4に示す。
試験作業	
検査方法	
取外し方法	別図-4に示す。(撤下したパネルと試験体との距離を金属製定規で測定)

Illustration 26: Specifications of Wood curtain wall

Illustration 25: Experiment for fire-proof at Tsukuba Building Test Laboratory.
 Illustration 26: Panel is made by 5 laminated latch (sort of pine tree growing in local nature) boards, its thickness is 120mm.



Illustration 27: Pergolas on the top floor (4th floor=roof terrace), that would be easy to remove by own joint details

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Illustration 28: Roof greening with palm-husk-mat replacing a heavy soil



Illustration 29: View of Japan Pavilion Seto from opposite side of audience's approach

4 Eco-friendly technologies of architectural element of both Pavilions

長久手日本館
NAGAKUTE NIPPON-BAN

Japan Pavilion Nagakute

Nature's Wisdom

 壁面緑化/Wall greening <small>東洋シオール/TOHO-LEO CO. 03-5307-5300 http://www.toho-leo.co.jp/</small>	 バイオマスプラスチック/Biomass plastic <small>フタ化成工業株式会社/FUKUICHEI INDUSTRIAL CO., LTD. 0774-38-8080 http://www.fukui.co.jp/</small>	 ボックス梁/Box beams <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>	 竹コネクター/Bamboo connectors <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>
 竹ケージ/Bamboo cage <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>	 編成材の柱/Laminated pillars <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>	 束ね柱/Bundled pillars <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>	 光触媒鋼板屋根/Photo-catalytic plate steel roofing <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>
 茶室の屋根/Tea house roof <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>	 土に還るレンガ/Bricks that return to the soil <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>	 竹の瓦屋根/Bamboo tile roof <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>	 両日本館 Japan Pavilions <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>

瀬戸日本館
SETTO NIPPON-BAN

Japan Pavilion Seto

Nature's Wisdom

 外壁木質パネル/Exterior wall wooden panels <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>	 屋根緑化/Roof greening <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>	 白濁反射鏡光ガラス/Mirror glass <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>	 ソーラーチムニー/Solar chimney <small>株式会社ニエ工業/NIEMYAMA CORPORATION 03-3300-8518 http://www.kontyama.co.jp</small>
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Illustration 30: Eco-friendly technologies of architectural element of both Pavilions

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