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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 Technologie

Technologie ecologiche nel padiglione giapponese, EXPO 2005 Aichi Japan

Document in English

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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

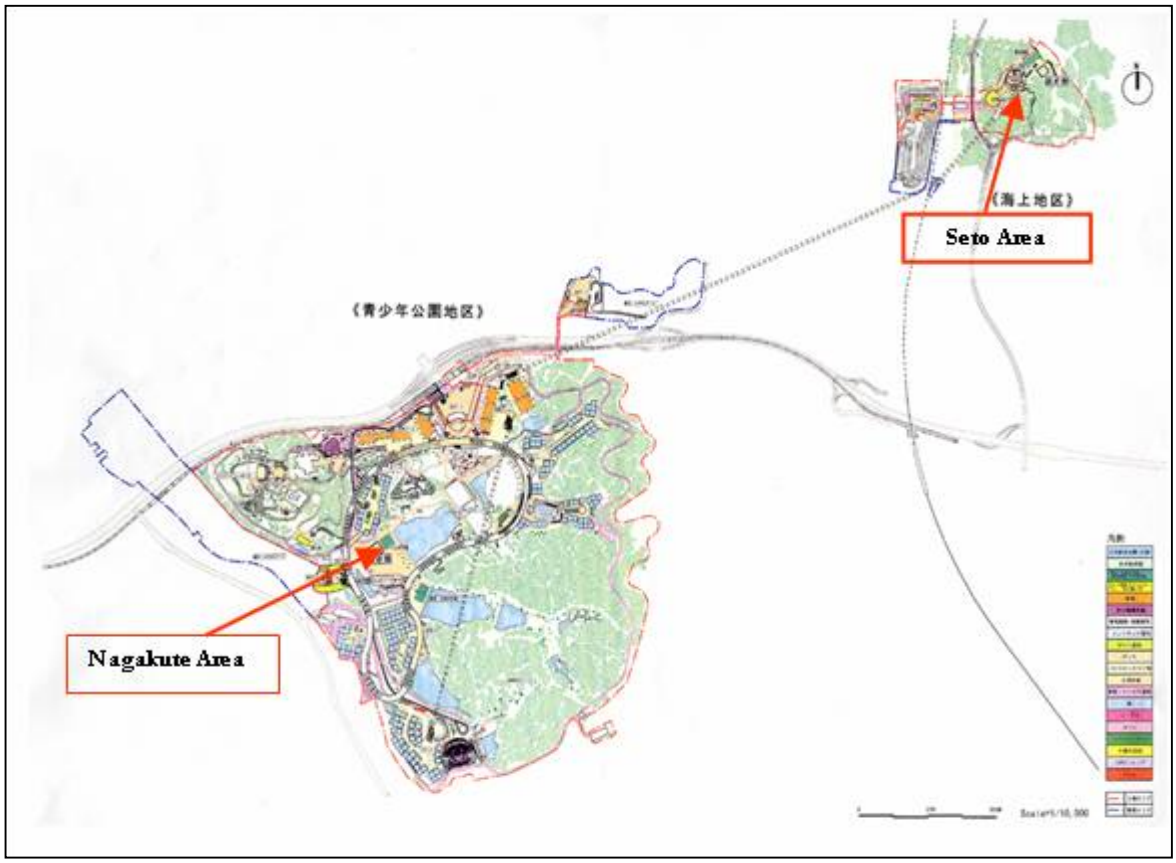
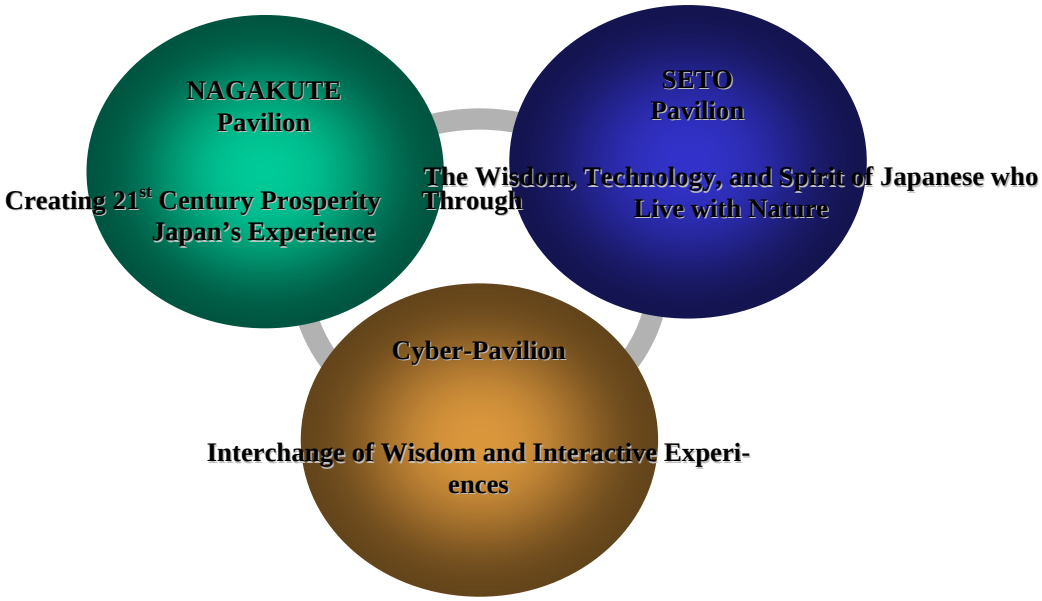


Illustration 1: Location at the EXPO 2005 Aichi, Japan

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

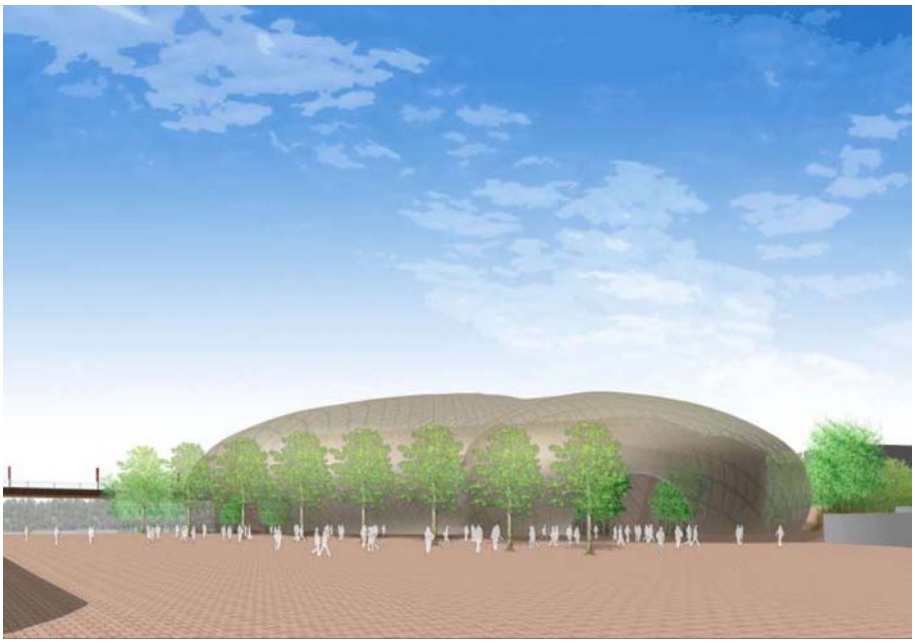


Illustration 2: Preliminary image of Japan Pavilion Nagakute

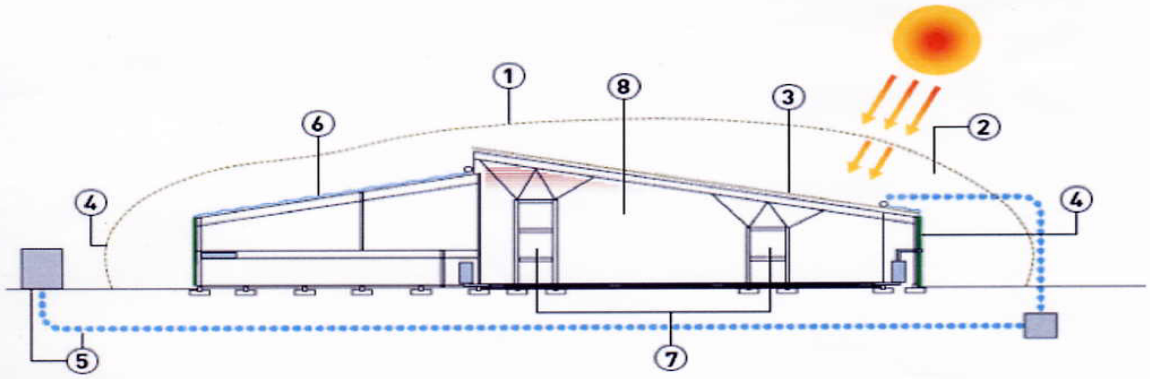
Architectural area is 6,000㎡, 2 stories, wood structure.

New technologies that you can see in the pavilion

- Electricity generated 100% by new energy.
- Cooling mechanism by photo-catalytic plate 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

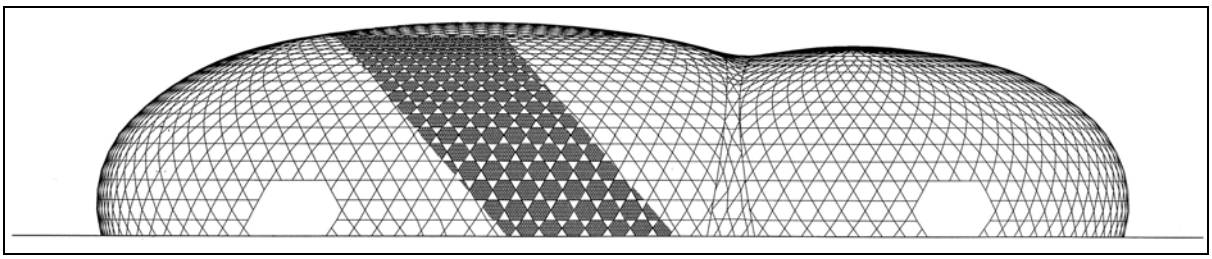


Illustration 4: Front Elevation of Japan pavilion Nagakute

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 spplied.

2.2 Construction process of Bamboo Cage

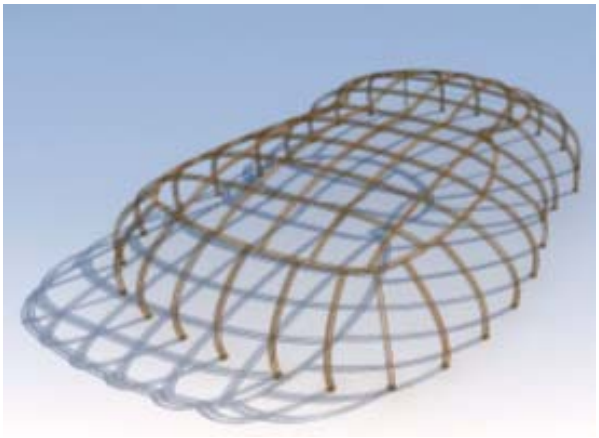


Illustration 12: Basic structure - Bamboo Truss System

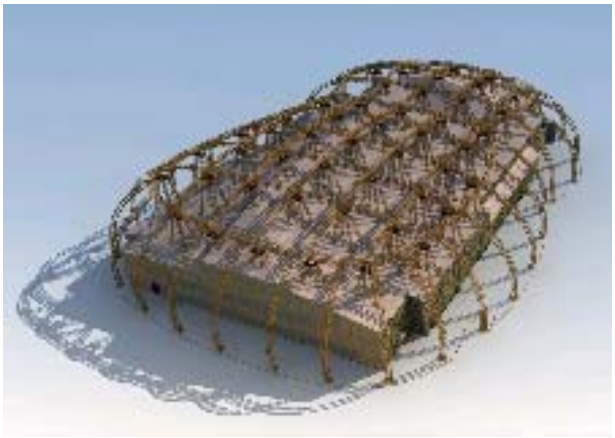


Illustration 13: (1) Covered and jointed to the main building by Bamboo Truss

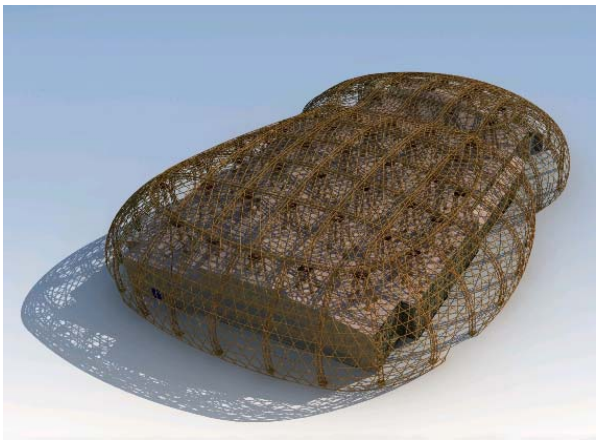


Illustration 14: (2) Each double bamboos' stem of Bamboo Cage assembled hexagonal pattern

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 3,000m^2, 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.

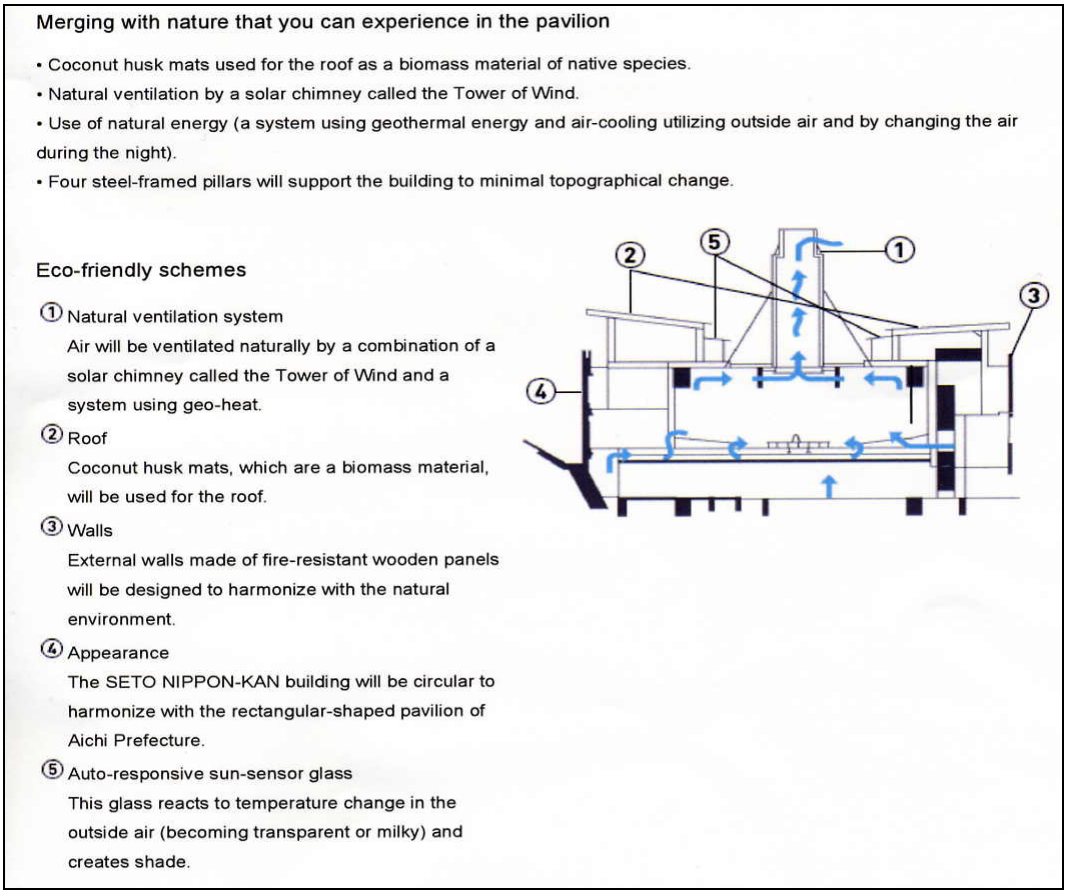


Illustration 22: Section Diagram of Japan Pavilion Seto which celebrates various ventilation systems without environmental load

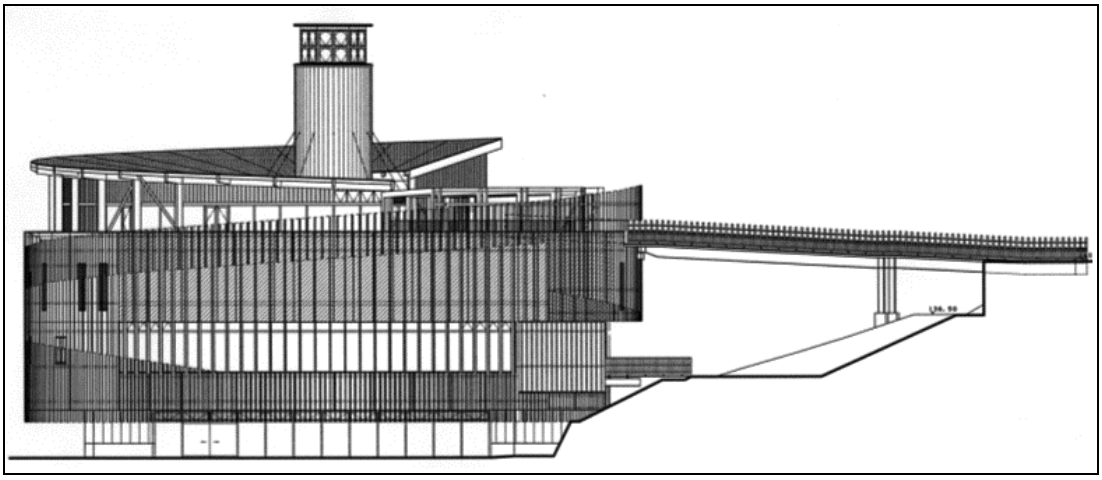


Illustration 23: Elevation of Japan Pavilion Seto (south elevation)

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

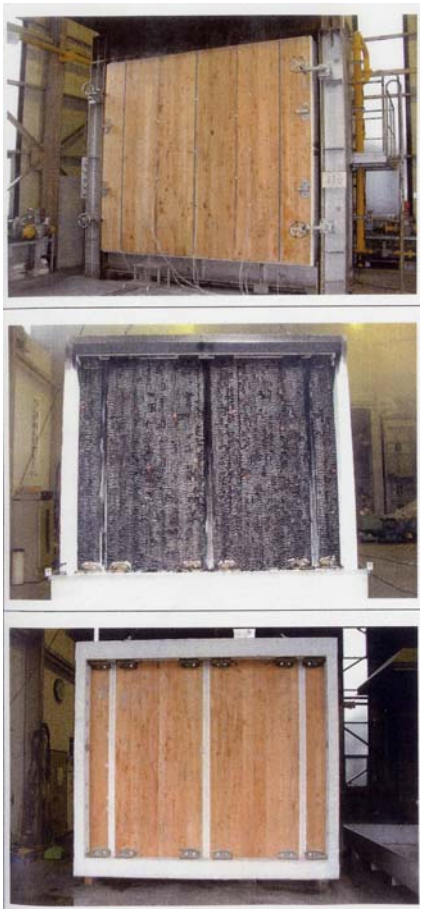
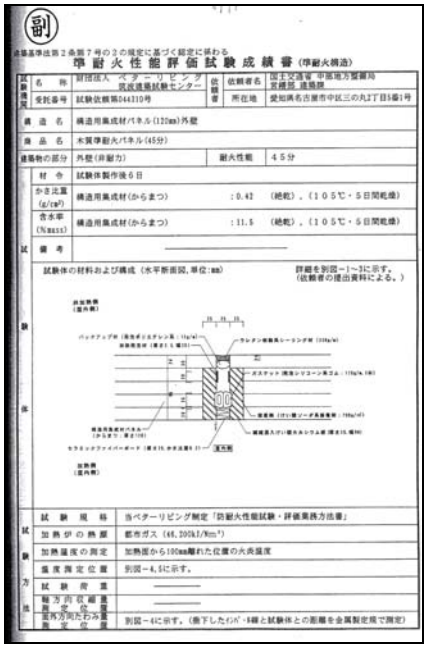


Illustration 25: Wood curtain wall (exterior wall wooden panel)



準耐火性能評価試験成績書（準耐火構造）

試験依頼者	名称	財団法人 ベターリビング 筑波建築試験センター	依頼者	依頼者名	国土交通省 中部地方整備局 営繕部 建築課
	受託番号	試験依頼第044310号		所在地	愛知県名古屋市中区三の丸2丁目5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(45分)			
建築物の部分		外壁(非耐力)		耐火性能	45分
試験体	材令	試験体製作後6日			
	かさ比重 (g/cm³)	構造用集成材(からまつ)		:0.42	(絶乾)，(105℃・5日間乾燥)
	含水率 (%mass)	構造用集成材(からまつ)		:11.5	(絶乾)，(105℃・5日間乾燥)
	備考				
試験体	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。)
試験方法	試験規格	当ベターリビング制定「防耐火性能試験・評価業務方法書」			
	加熱炉の熱源	都市ガス（46,200kJ/Nm³）			
	加熱温度の測定	加熱面から100mm離れた位置の火炎温度			
	温度測定位置	別図－4,5に示す。			
	試験荷重	―――			
	軸方向収縮量測定位置	―――			
	面内方向たわみ量測定位置	別図－6に示す。(垂下したﾜｲﾔｰ1箇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

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

Illustration 30: Eco-friendly technologies of architectural element of both Pavilions