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
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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

Architectural area is 6,000 m², 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

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.
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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
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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 applied.
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 bamboo 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
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.

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

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.

Illustration 21: Preliminary image of Japan Pavilion Seto.

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

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
4 Eco-friendly technologies of architectural element of both Pavilions

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