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## **Architectural strategy promoting the Japanese local forestry**

**Architektur - strategischer Partner der  
einheimischen Forstindustrie**

**Architettura - Partner strategico  
dell'industria forestale indigena**

**document in english**



# Architectural strategy promoting the Japanese local forestry

## 1 Japanese architecture and forestry

In Japan, trees would be considered as media through which spirits of ancestors would come to this world, so that I personally believe that ancient skeleton used a log or a log-like column. The architecture began in the fifteenth century, was squared its post and the timber framing with fine wood grain brought a new aesthetic to the architecture and an additional value to forestry. This influence still remains in Japanese forestry today. I consider, the material with the aesthetic role in itself caused a weak point in structural material producing from Japanese man-made forest, and the fact to plant fast growing trees made it more after the Second World War. Japanese wood material, mainly the Japanese cedar and cypress has matters: at the low level and not uniform for material strength, large heartwood which is low strength, a different diameter between top and bottom of the log, distortion and a large shrinkage, comparing to pine wood as major imported material. Therefore it decreases the efficiency of lamination and lumbering, too. That would be the biggest obstacle against recovery for a demand of timber products.



Figure 1: Gujohachiman sports center, Hachiman town, Gifu 2001



Figure 2: Oketo national district forest office, Hokkaido 1993



Figure 3: Roadside station, Asaji town, Oita 1999

## 2 Linkage between forestry and architecture

Japanese forest is, as it were, 'a green dam' for rice crops. Japan would be proud of it to the world as an advanced country in forestry. And it would be a ground for an enriched wooden architectural culture. Though after the War, Japan aimed towards powerful economic country, now it has become the biggest importing country on foods, also on lumbers. For that reason, the following issues is recently being supported by tax. One is the preservation of the forest areas, occupying over 60% of the country, which have a role of cultivation for water supply to big cities. Another is sustainable cultivation of man-made forest to protect the global warming. My opinion is that, if "reconstruction of the linkage between architecture and forestry" is realized, it will not only bring recovery of forestry but diverse functions of forest.

## 3 Problems on the existing Japanese post and beam construction

Post and beam construction as a major construction method in Japanese wooden architecture today, is called 'existing' method but it came just after the War. I think that it was influenced by the platform construction method. In other words, resisting gravity to put beams with joints onto thin and short posts which stand close together on each floor, it secures earthquake and wind-resistance by braced walls. The method to calculate length of walls dividing into two different axes had been formalized under the law, nevertheless there was a confusion to be the pin jointed posts and the rigid walls as the same time in one skelton. It had not been controlled the gap between the center of gravity and the center of rigidity until the Hanshin-Awaji big earthquake in 1995. However it is considered there is still danger to cause a big difference between the regulation and structural calculation about an allowable stress, because the gap gradually increases under the current regulation just roughly outlined when there are many floors one into another.



Figure 4



Figure 5: Taio gold mine museum workshop, Nakatsue village, Oita 1998



Figure 6: Woodwork products store, Yufuin town Oita 1997

## 4 Problem in the increasing wood frame construction and the timber frame construction using glued laminated timber

From this autumn in Japan, it started to allow to build four-story wooden building by the wood frame construction. Although the size of sapwood of the Japanese cedar and cypress is not enough for the wood frame construction material, so that all of timbers for this construction are imported. Therefore it cannot help increasing the import of timbers in Japan including plywood if the wood frame construction goes more. It has been planning a wooden building up to five-story, that is a high standard in the advanced countries in both wooden architecture and forestry: in Europe, North America and Oceania. To realize it, I would suggest that it needs to use Semi-rigid timber framed structure and to supply the appropriate glued laminated timber. Japanese cedar and cypress had grown at the level of a medium sized tree in the 90's, though it is still difficult to laminate them. The point is not only about strength and distortion but also there is a weak point that it is hard to dry a part of large heartwood. And the efficiency is just around 10 to 20% of the original log volume, so that it causes a big difference on price against laminated timber gluing imported laminar. I think, therefore the scheme, to increase a number of wooden building, hardly expands a demand of timber products from the afforestation in Japan.

### 4.1 Skeleton and Infill in Japanese tradition

Japanese traditional wooden architecture is based upon timber framed structure which is known as a prototype of Modernism architecture. In the ninth century, there was a highly flexible 'skeleton' made of thick timber material, and 'infill' which is originated from the Japanese culture as compact : a sliding door, a portable heating device and a lighting instrument and etc. All those elements had combined together and there had been a completed a life style. In the fifteenth century, large trees disappeared because of the war disturbances, on the other hand the lumbering technique and the process developed, so that Sukiya-style came out with skeleton in which thin and slim timber was used very often.

People who developed the timber frame construction after the Second World War also might used thin timber because of a shortage of timber, however their research theme before the War was to use thick timber, that is "Modernization of Semi-rigid joint framed structure using nature of denting deformation on timber", which had been being developed 'Minka' farmhouses since the seventeenth century.





Figure 7: Kamitsue village healthcare center,  
Oita 1996



Figure 8: Mukawa village covered croquet ground,  
Yamanashi 2004



Figure 9: Oyabe municipal Mizushima dome,  
Toyama 2003



Figure 10: Oyabe municipal Mizushima dome,  
Toyama 2003

## 4.2 Advantage of cedar and cypress to pine

Pine tree, which has been characterizing scenery in Japan, is an introduced species only around 1600 years ago. Pine trees in the west of Japan have been in a destructed condition by pine weevils, also for architectural material they get damaged easily by white ants and germs. So it was limited to use them in Minka only for a roof structure and so on.

The Hanshin-Awaji big earthquake has given not a little damage to the houses, which were made of thin pillars. In Japan with plentiful rainfall and high humidity, rot-resistance is relating to earthquake-resistance: a post with a heartwood is 'strong' in terms of that heartwood keeps more rot-resistance than sapwood. I consider that it would be a reason why we have been keeping the timber-framed structure using mainly cedar and cypress with less sapwood as a tradition. Then I considered that a Semi-rigid timber framed structure with large sized cedar and cypress as ecology in Japanese architecture, and I started thinking to revive the culture to use the Japanese cedar and cypress in such a way.

## 5 Development and practice of a method for the use of wood in public architecture utilizing locally available lumber and technology



Figure 11: Oketo national district forest office, Hokkaido 1993



Figure 12: Sayama park resting place & public lavatory, Tokyo 1994

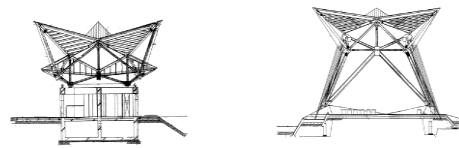


Figure 13: Kamitsue village clinic, Oit 1996

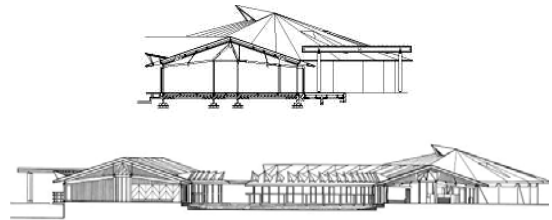


Figure 14: Kamitsue village healthcare center, Oita 1996

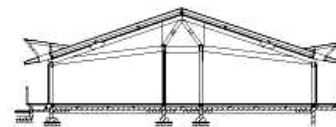


Figure 15: Noda carpentry shop, Nakatsue village, Oita 1996





Figure 16: Kamitsue village covered croquet ground, Oita 1997

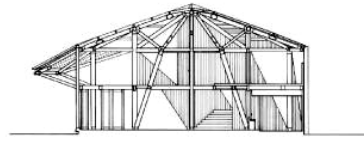


Figure 17: Woodwork products store, Yufuin town Oita 1997

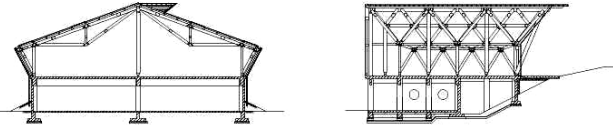


Figure 18: Oita municipal boathouse, Oita 1998

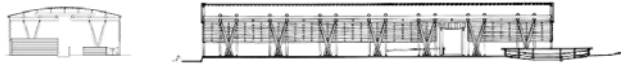


Figure 19: Taio gold mine museum workshop, Nakatsue village, Oita 1998



Figure 20: Roadside station, Asaji town, Oita 1999

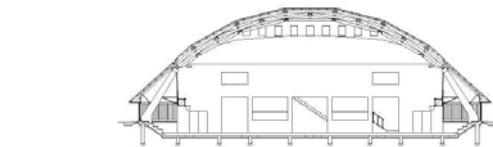


Figure 21: Prefectural Hita senior high school gymnasium, Oita 2000



Figure 22: Nakatsue village food processing shop, Oita 2000



Figure 23: Nakatsue village covered futsal ground, Oita 2001





Figure 24: Ogouchi dam park resting place, Tokyo 2001



Figure 25: Usuki municipal Kita junior high school gymnasium, Oita 2001

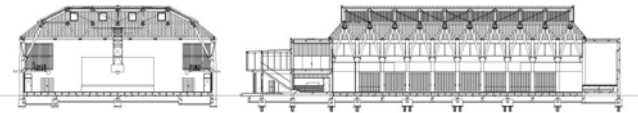


Figure 26: Gujohachiman sports center, Hachiman town, Gifu 2001

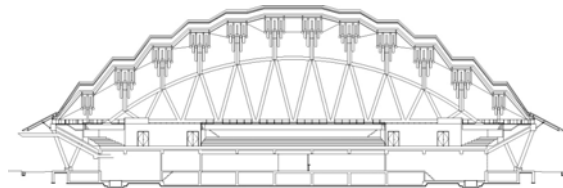


Figure 27: Taio sports center clubhouse, Nakatsue village, Oita 2001



Figure 28: Yamakuni municipal Misato primary school gymnasium, Oita 2002

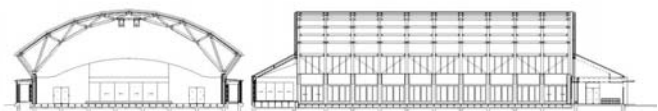


Figure 29: Joetsu municipal Arima River fishing park resting place, Niigata 2002

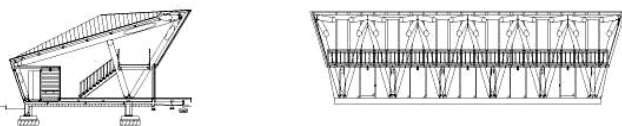


Figure 30: K&I's residence, Tokyo 2002

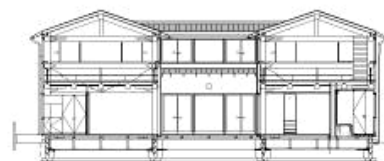




Figure 31: Yabe village community hall, Fukuoka 2003



Figure 32: Mikuni municipal boathouse, Fukui 2002

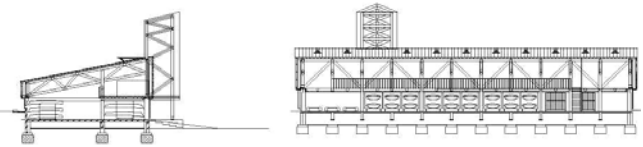


Figure 33: Oyabe municipal Mizushima dome, Toyama 2003

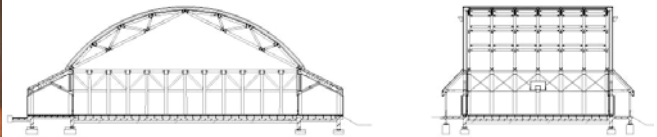


Figure 34: Oita Skelton&Infill house, Oita 2005



Figure 35: Takeda municipal farm products store, Oita 2004



Figure 36: Mukawa village covered croquet ground, Yamanashi 2004

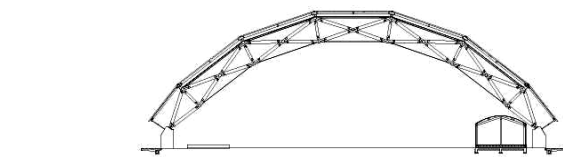


Figure 37: Nishiiyayama village communication center, Tokushima 2004







Figure 38: Nishiiyayama village monorail station, Tokushima 2004

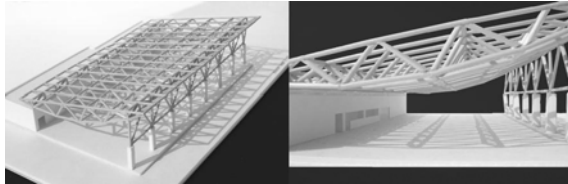
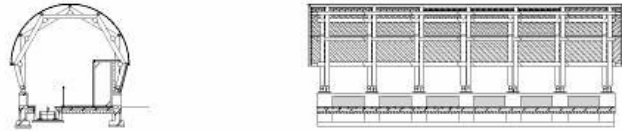


Figure 39: Nishiiyayama village principal products store, Tokushima 2005

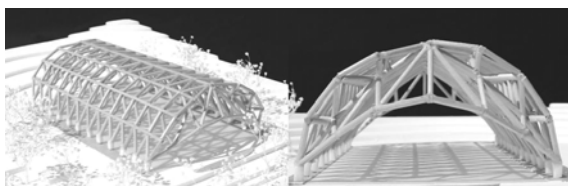
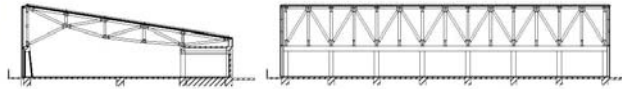
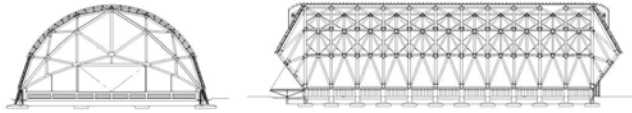


Figure 40: Mikamo village Mikamo dome, Okayama 2005



S = 1 : 1000

## 6 Efficient use for the large stock of wood resource and a new construction method for forestry from now on

The forests in Japan are rapidly going to be useless properties. To recover them as useful properties, it will need a new practical method for healthy, safe and long-life buildings and houses as most of Japanese people's demand. In the 80's, I was designing several houses with the idea of skeleton and infill as Semi-rigid timber framed structure, in which imported laminar were used for laminated timber. Then thirteen years ago I started developing "the skeleton and infill construction-method, that is profitable for both forestry and architecture using barked and seasoned (air dried) cedar and cypress log". This is named as "Skeleton log construction method" that brings safety to architecture by: to arrange low-strength and variation of qualities of cedar and cypress using logs that has higher-strength at 13% to 20% than lumber, and to manipulate a diametrical difference as capacity between top and bottom of the log considering comparative strength. This capacity also enhances a fire-resisting performance as a fireproofing, and makes less thermal change in rooms by its large specific heat, moreover it decreases condensation preventing mold and ticks, also it makes a healthy space free from allergy trouble. A combination of skeleton with no diagonal braces and flexible infill creates a durable house or building. In Japan, a durable wooden architecture lasts longer than a reinforced concrete structure which is regarded as quite durable in general.

“Skeleton log construction method” consists of two parts: Long-span structure with bold log (large diameter and short length) , and Semi-rigid joint timber framed structure. With the combination of lumber and laminated material, using local wood products and local carpentry techniques, thirty cases has been realized for last twelve years. Tadashi Hamauzu, a structural engineer and I were received an award from the Architectural Institute of Japan in 2004, for our achievements as “Improvement and realization of wooden construction method for public architecture with local materials and techniques”.



Figure 41: Nakatsue village covered futsal ground, Oita 2001



Figure 42: Nishiiyama village communication center, Tokushima 2004



Figure 43: Nishiiyama village monorail station, Tokushima 2004