The Japanese Contribution to System Building

By Kikutake Kiyonori

Photo 1

Photo : Kikutake Kiyonori

The Cho no Ya treasure hall at Izumo Shrine

In my previous article, "A Vision for Japanese Style Development," I wrote that disassembling and reassembling features are the fundamental characteristics of traditional Japanese housing. I illustrated this with several examples, and introduced some of my designs incorporating these features such as the Tree Shaped Housing concept and the Ocean Cities concept.

In this article, I would like to discuss how modern buildings can contain this essential nature of traditional Japanese buildings to help ensure a sustainable environment.

Throughout my career, I have always been fascinated by the ingenious ways in which the ancient Japanese have continued to improve on their architecture to the point of realizing standardizations that have beauty and practicality, and I have always felt the need for similar standardizations in today's world. I believe environmentally friendly building practices can be realized with modern materials for modern buildings. What we need is a common system that is understood, welcomed and widely practiced so that the recycling of materials will become the norm and waste will be kept to a minimum.

Some 40 years ago, I had the opportunity to meet Professor Jean Prouvé (1901-1984), the French architect known as the father of architectural industrialization in France. His work was the beginning of mass production for architecture. Attracted by his work, I toured various production centers in Europe with Professor Prouvé. It was a source of wonder to me that this movement was re-creating modules in steel, aluminum and glass that Japanese wooden architecture took some 800 years to accomplish, and the method was being implemented extensively in France, Germany and Italy. This was the core of the "System Building" method that we know of today. As represented by the post-war Pirelli Building (Milano) and the Montecatini Edison Head Office Building (Milano), System Building had realized the performance specification contract, and strict cost controls, and even allowed for extensions and remodeling.

In recent years, I have observed factories and work sites with architect Josef Belmont, a prominent pupil of Professor Prouvé. Within the time span of a mere 50 years, the System Building method has been used in schools, hospitals, offices and apartments with a wide range of exteriors. This shows that System Building has achieved a high level of mass production in architecture. In my view, however, one agenda still remains to be taken on, and that is the development and advancement of the disassembling and reassembling technologies within System Building. If this was to be perfected, it could promote in modern architecture the merits of traditional Japanese wooden architecture such as, 1) recycling resources for environment sustainability, 2) production of universal modules to cut costs, 3) simplification of parts manufacturing and construction to reduce the time needed for construction, 4) enhancement of freedom due to ease in expansion and remodeling, and 5) formation of a framework for harmonization and coordination among buildings.

The movement towards System Building has already begun, and in time we shall see which country or region will become the leader in System Building. In Japan, although Japanese building industries have attained astonishing development, the use of System Building as an environmental system is extremely backward. In the language of apparel, we have been aiming to build haute couture buildings and have not been able to shift the gear toward a pret-à-porter range. This is the difficulty of a change in consciousness. However, in Japan, the demarcation between original creation and imitation, has long been widely recognized in

society as can be seen in the prevalent expressions of: *~ryu* (~style), *~fu* (~manner) and *~konomi* (~mode). Therefore, I feel that this recognition should be utilized in the development of mass production in architecture as the background to ensuring a sustainable environment. Though built by System Building, the exterior can be selected from various materials such as stone, glass, concrete panels and tiles of varying colors, leaving room for unlimited creativity.

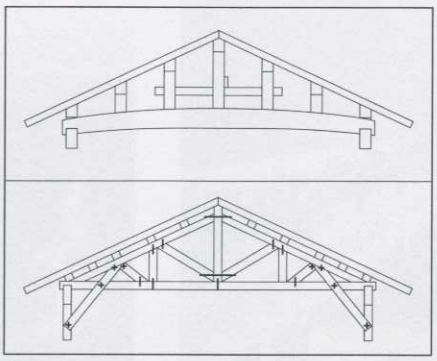
I would like to introduce some of my own attempts at System Building that are imbedded with disassembling and reassembling features.

Cho no Ya

As mentioned before, I believe that the essence of the Japanese building culture is found in disassembling and reassembling characteristics. Of course, wooden buildings allowed these features with ease, however, what really led to the development of traditional Japanese architecture was the thinking behind the use of space. The ideal was to maximize functionality for increasing the freedom of lifestyle. Striving to build a universal architecture that could be used by anyone allowed Japanese buildings to be extended, altered and relocated freely. Modules measuring 90cm x 180cm were developed for this purpose, and standardization was accomplished in the measurements of furnishings and fittings such as the *tatami* mats and the sliding doors. The development of standard modules was achieved even in clothing and tableware. By doing this, items could be used repeatedly, and they were developed to fit anyone and could be reused and recycled by anyone. This was the characteristic of the traditional Japanese architecture and the lifestyle that accompanied it.

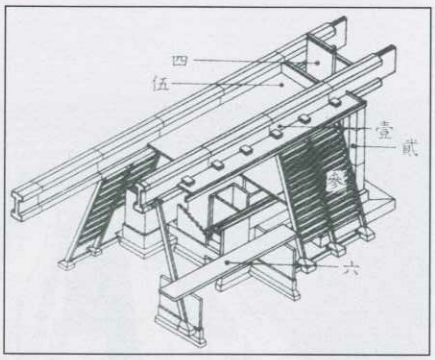
We can say that historically, the Japanese have been treading the path of System Building. A simple illustration can be shown in the roofing framework of a Japanese structure. In the West, trusses were erected for the roof framework, but in Japan the *wagoya* method was used. (Fig. 1) A comparison immediately shows that the wagoya took reuse through disassembling and reassembling into consideration.

Figure 1



Japanese wagoya roof framework (top) and Western roof framework

Figure 2



Cho no Ya framework

Now, I would like to give an example from modern architecture. In 1963, I designed the *Cho no Ya* treasure hall at the Izumo Shrine. (Photo 1) The reason why I conceived of a reinforced concrete building that could be disassembled and reassembled like a wooden building was that I was aiming for a sustainable building that would last a long time. Since the Izumo Shrine has existed for over a thousand years, I hoped its treasure hall would last just as long. The concrete parts were fitted around the pillars and beams to form the space within. (Fig. 2) When disassembling the building, the surrounding parts can be dismantled before removing the beams and pillars. With this system, damaged parts can be easily replaced so that renewal can take place. This project received the Architectural Institute of Japan Prize and also the American Institute of Architects Prize. This showed that the building was by no means an idiosyncratic solution, and I was grateful for the recognition.

Stratiform Structure System (artificial land)

Further extending the concept of Cho no Ya and applying it to urban infrastructure, I thought of creating multiple levels of artificial land that can be disassembled and reassembled easily. (Photo 2) I addressed the challenge

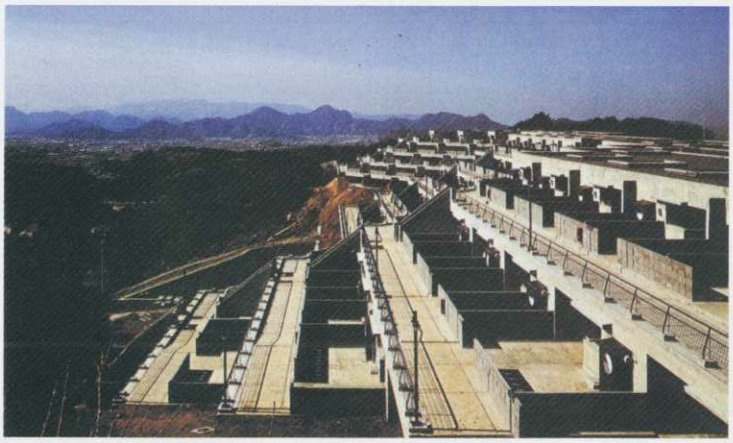
Photo 2

Photo : Kikutake Kiyonori

The Stratiform Structure System can be disassembled and reassembled with a triangular-shaped structure that can withstand earthquakes and typhoons

Photo 3

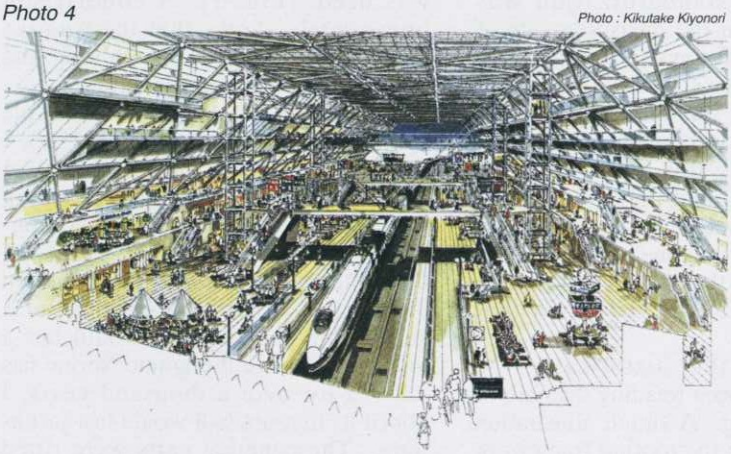
Photo : Osamu Murai



An application of the Stratiform Structure System to apartment housing in Shizuoka, Japan

Photo 4

Photo : Kikutake Kiyonori



A Stratiform Structure System over a train station

Photo 5

Photo : Kikutake Kiyonori

Proposal: research institute in the Amazon using the Stratiform Structure System

of how to solve the problem in the centers of major cities where there is not enough land and space. Consideration was given to building an urban infrastructure using machine industry technology and I came up with a stable, triangular-shaped structure that can withstand earthquakes and typhoons. The application of the Stratiform Structure System can integrate urban roads and buildings, and it excels in the use of space above railway stations for apartment houses, offices, shopping malls and other purposes. (Photos 3 and 4) The design scheme of the Stratiform Structure System allows it to be mechanically erected and dismantled. It can be expanded or contracted according to the needs of the time, creating artificial land in an innovative way.

The Stratiform Structure System is simple to use and blends in with nature as well. In 1992 a proposal was made with Professor Nakamura Keiko to use this technology for a tropical research institute in the Amazon. The Amazon is a severe natural environment. Trees must be cut down when creating a building in the jungle. With the artificial land method, however, it would be possible to protect much of the forest while simultaneously building laboratories, residences for researchers, recreational and sports facilities, and a health clinic. (Photo 5) The tropics are an important region for genetic research, and artificial land is a suitable infrastructure technology for the jungle habitat where the seasonal changes in water level can measure up to eight meters. Should this research station be needed elsewhere, it would be possible to relocate it.

Mega Domes

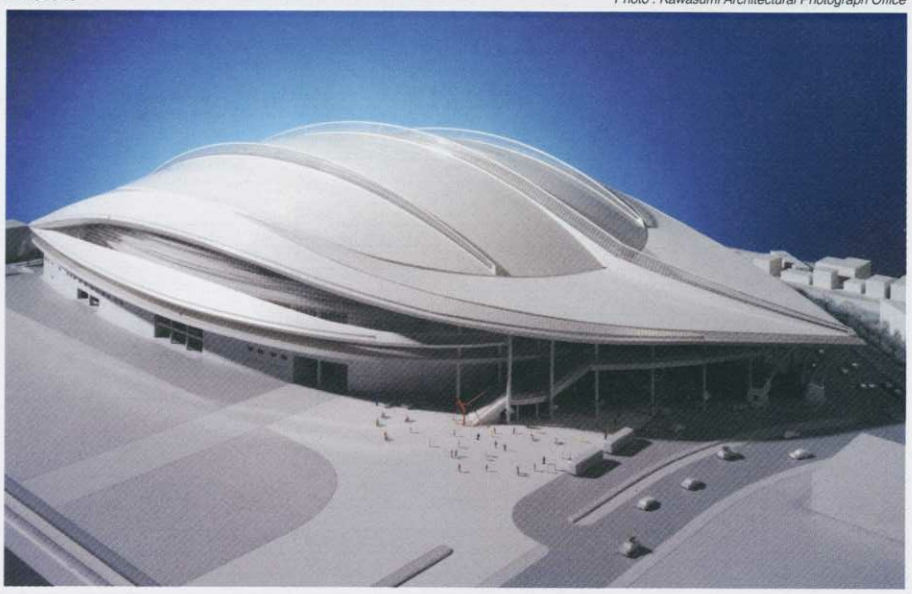
A large space without pillars is one of the environments that the 24-hour city requires in social and urban terms. This is because it can be used for many purposes, such as a plaza or *messe* for events and sports venues that are not affected by the weather. Historically, until the 19th century, domes were created mainly for religious buildings in stone and brick. From the 19th century onwards, concrete domes were produced, and the present day is an era of steel domes.

It appears impossible to make a dome that can be disassembled and reassembled. However, this can be overcome

with axial force dome technology. To achieve this, when the rise is kept within certain limits as against the span, the flexure almost disappears (patent pending). In this method, a dome can be created using unified members and joints, which signifies transferability and recycling capability. Assembly is simple and the dome can be disassembled with ease. Moreover, the shape of the dome's surface can be anything from oval to circular, square or even hexagonal. In terms of the construction work, it can be assembled starting from any point. This method cuts production costs and shortens the construction period. The Kawasaki Citizens' Museum (40m span) and the Kitakyushu Media Dome (190m span, Photo 6) are actual projects incorporating the axial force dome.

Photo 6

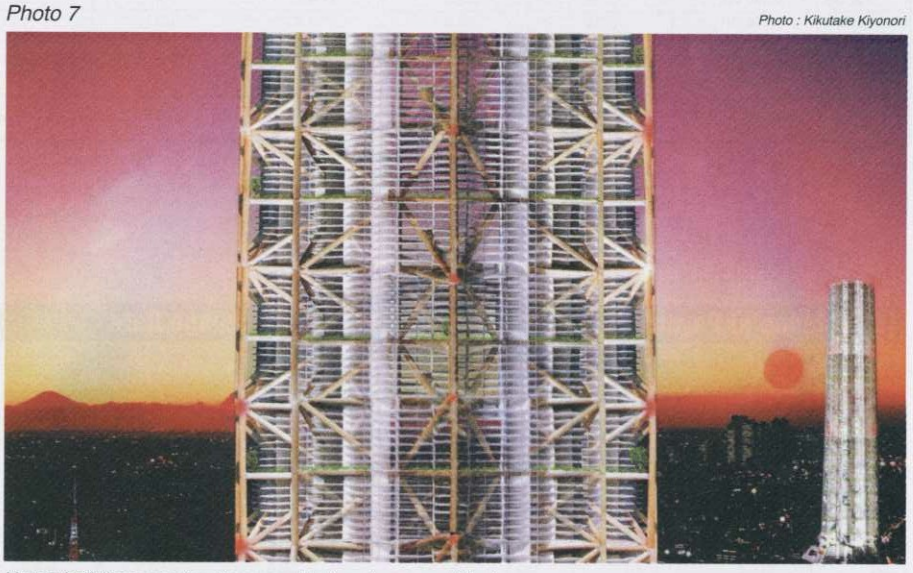
Photo : Kawasumi Architectural Photograph Office



Kitakyushu Media Dome is an example of the new axial force dome

Photo 7

Photo : Kikutake Kiyonori



Hyper buildings can be disassembled and reassembled

Hyper Buildings

For the past eight years, voluntary research on the skyscrapers known as "Hyper Buildings" has been carried out by about 50 private sector companies belonging to the Hyper Building Research Committee. The hyper building would range in height from several hundred meters to 1,000 meters. The Committee members who are architects, engineers, city planners are aiming for urban revival are discussing ways to produce abundant greenery in city centers, and working to devise cutting edge urban infrastructure at a higher level of performance. Through the concept of developing modules and assembling them to make a whole, entities such as escalators and elevators, evacuation and fire prevention floors at every 10th floor forming bamboo-like joints, water supply and sewage systems, and power and telecommunications are incorporated in the design to create a brand new multi-story urban infrastructure. (Photo 7) The hyper building would contain residences, offices, hotels, educational institutions, hospitals, shopping malls and cultural facilities. It represents a proposal for the city of the future by attempting to revive the space for urban activities in a modifiable, open form. The various modules are designed to allow fitting and removal, promoting freedom and optimum resourcefulness.

In conclusion, I would like to express my hope and belief in the expansion of a System Building industry in which the traditional Japanese way of building will be reflected. Ideally, more and more spaces, structures and facilities should be created with disassembling and reassembling factors in mind, for this is a very sensible way of effectively utilizing the limited resources. I hope to see more modern materials and parts becoming interchangeable and recyclable as we endeavor to achieve a free and open environment to which anyone can adapt. JJTI

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