Design for Reuse- Case study of World Exposition 2005 Aichi Japan

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Abstract
In the 156 years history of World Expositions every EXPO has developed and exhibited new possibilities offered by the technology, architecture and urban design of the age the EXPO was held. In this way the World Expositions have furnished us with a glimpse of the future, a quality that has become a hallmark of the EXPO. Sometimes this glimpse has been of the immediate future, sometimes of a more distant one. Contemporary EXPOs are of a 6 months’ duration, and therefore every facility at the site is basically conceived as temporary structure. The aim of this paper is to analyze the history of conversion of some EXPOs of the past and to show which ones have been successful in this field. Secondly, we shall examine which facilities were reused and converted at the EXPO 2005 in Aichi. In this respect we shall focus on two examples of government and official participants’ pavilions and see how successful planning can lead to a systematic reuse and recycling system. In this connection we shall also see, how an auctioning system can support the whole of the conversion process. Thirdly we will examine the challenges encountered during the actual conversion that took place at the “Aichi Prefecture Pavilion” converting this into the “Kaisho Forest Center”.
At the same time, we shall examine how the materials that were used in the construction of this pavilion also were reused to build the “Shimoyama Elementary School”. Lastly we suggest to the EXPO 2010 Shanghai, China how the system of reuse and conversion can be put into practice during both the planning and construction phases and then later during the deconstruction phase. These suggestions will be of use both for EXPO 2010 and other future EXPOs.

1. Introduction – Problematics, methodology and structure of the study:
EXPO 2005 Aichi was the first World Exposition of the 21st century. Therefore, it was important to address the pressing global problems of the environment as well as to reconsider the relation between humankind and nature. Sustainable development is not only sustainability of natural resources, but also of finding a means to do with what we already have and to use these resources to their utmost. Therefore actual conversion and the idea that conversion is a do-able practice in future EXPOs is of utmost importance.
One of the main themes of EXPO 2005 was to minimize building waste. The use of modules offered by the organizers, instead of constructing individual pavilions was to reduce impact on the environment by not
having to use transportation costs for building materials sent from distant areas of the world. The 3R’s system, (reduce, reuse and recycle) was considered in all the stages of planning, construction and operation. From 1994 when BIE (Bureau of International Exposition) recognized the main theme “Nature’s Wisdom” to be the focal point for solution to global issues, the search to find a new paradigm for symbiosis of humankind and nature started. This was the main theme of EXPO 2005 Aichi.

One of EXPO 2005’s greatest strengths was its’ environmental friendliness. In order to implement this theme, a research committee for 3R’s in Expo was organized in the BCJ (Building Center of Japan) in 2002. The chair was Prof. K. Kimura and other members were Prof. S. Fukao, J. Shiino, T. Nobe, S. Matsumura, M. Yamaha and H. Watanabe.

It was deemed important to conduct a self imposed environmental assessment. It was to eventually consist of some 217 items, including topics such as rare animals and plant-life, land quality and waste materials. The opinion of local citizens toward the environment was reflected through a variety of related organizations. The 3r’s were also put into effect. For example, if a tree absolutely had to be removed, it was transplanted to another location or given to local citizens who planted it in their own yards.

To compensate for the loss of felled trees, many more were planted in other areas, such as Mongolia, the foot of Mt. Fuji, as well as nearby towns.

The EXPO site was separated into 2 areas. The largest was Nagakute and the smaller area was Seto. The 2.6km Global Loop in the Nagakute area was a symbolic structure in EXPO 2005 that stated “we will not tread on the terrain in order to protect life on earth”. The Global Loop was a “floating” corridor that linked all the “Commons” of the EXPO at the same level. By traveling this “loop”, visitors could literally, travel to all corners of the world, on foot or by using the electric trams and pedi cabs. It was barrier free for wheelchairs and baby buggies and it embodied the principles of universal design. A short portion of the Global Loop remains as a memorial of EXPO 2005. During the deconstruction of the loop, there were requests from the public to have it converted into a multi-purpose skating or skateboarding track as well as a bicycle or running track.

The Seto area was the point of origin for EXPO 2005 and was designated by the city of Seto and Aichi Prefecture to become a commemorative zone after the EXPO finished, therefore the Aichi Prefecture Pavilion was planned from the beginning with conversion in mind.

2. Building, site and infrastructure activation in past international expositions:

Before delving into the main analysis on the Aichi exposition, let us briefly examine how facilities built for international expositions were activated in the past. First of all, expositions facilities were built under the following concepts:

① Build for temporary use and demolish after exposition without reusing; this seems apart from our interest but the site exists even after the demolishment of the pavilions; it is thus the situation of this former site that we should examine from the point of view of activation.

② Build as urban stock for permanent use; this is seen in expositions of past in developing cities or countries; for example, the Paris expositions in the 1800’s left not only future architectural heritages such as the Grand Palais and the Petit Palais used even today as an art museum, but also infrastructures, in the forms of the Lyon Station and the Alexandre III bridge.

③ Build under concept of sustainable development after making a reuse programme for a whole body or his parts; this is as we will show later in this paper, the concept proposed and practiced in the Aichi exposition. It is an indispensable concept for future expositions in any country.

We conducted a field study, from the point of view of ③, on expositions after the Rio’s declaration on sustainable development in 1992 in the United Nations Conference on Environment and Development (UNCED). Except for horticultural exhibitions and the Taehon exposition in Korea, we investigated four
expositions: Seville, Genoa, Lisbon and Hannover. The Table 1 below summarizes the acquired results of this field work:

<table>
<thead>
<tr>
<th>City</th>
<th>Year</th>
<th>Pavilion activation</th>
<th>site infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seville</td>
<td>1992</td>
<td>Activation of 3 pavilions (ex: from the Italia Pavilion to an Incubation centre for young venture enterprises)</td>
<td>Failure of activation of the rope way (now closed) Failure of activation of the park (now ruined)</td>
</tr>
<tr>
<td>Spain</td>
<td></td>
<td>Several pavilions left in ruins</td>
<td></td>
</tr>
<tr>
<td>Genoa</td>
<td>1992</td>
<td>Activation to the Cotone Congressi Genova of the main pavilion converted for the exposition from a cotton warehouse by Renzo Piano</td>
<td>High quality urban design proposed by Renzo Piano (ex: reconnection of the exposition area to the old city centre by burying a current traffic road)</td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lisbon</td>
<td>1998</td>
<td>Activation of several pavilions into a theatre etc. (but problem of low function rate)</td>
<td>Construction of an underground Construction of a new town Construction of a business district</td>
</tr>
<tr>
<td>Portugal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hannover</td>
<td>2000</td>
<td>Appropriation of many existing fair pavilions Activation of 4 pavilions (ex: from the EU pavilion to three Art schools and a multi-level parking structure)</td>
<td>Construction of a tramway</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td>Activation of 5 pavilions (ex: from the Vatican pavilion to the Kloster Volkenroda Monastery) Paper recycle of the Japan pavilion</td>
<td>Central area: Maintaining of the original fair site East area: activation of several pavilions to form a business district West area: demolition of all the pavilions to form a lawn park</td>
</tr>
</tbody>
</table>

Among these cases, we give high evaluation to the Genoa exposition and the Hannover exposition from the point of view of sustainable development.

The Genoa exposition seems to be a failure because of its low visiting performance, but thanks to Renzo Piano, being invited as a master architect of this event, a well considered master plan was elaborated by taking into account the sustainability of this city. Indeed, Piano met the challenge by planning with the following concept:

“The Genovese dislike waste. I interpret this temperament in my project so that I make works show a permanent value for Genoa with following its development plan whose perspective contains also the reuse after the session.”

The exposition’s heritage, constructed according to this philosophy, accommodates today 3.5 million visitors, produces 48.5 million euros of income, employs 900 employees, and raises 50 million euros of far-reaching economic effect per year.

Because the city of Hannover has had a long tradition of international trade fairs since 1946, the site program ordered a maximum use of the existing pavilions having 2 million m². Further more, our field study made clear the activations which are shown in Table 2, and Figure 1.

On the other hand, most of the pavilions left after the Seville exposition became ruined and the technology park built on the site is only accessible by car; it is not equipped with a sustainable public transport system except a poor bus network. Concerning the Lisbon exposition, we can appreciate the rehabilitation of a polluted area along the River Tejo and its activation to a waterfront park; but the function rate of the conserved pavilions seems poor and we saw several pavilions in ruin.
Table 2: Architectural activations after the Hannover expositions
(*Zero Emissions Research & Initiatives)

<table>
<thead>
<tr>
<th>Pavilions</th>
<th>Activation [Conversion (C) or Remove and Reassembly (RR)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU</td>
<td>(C) 3 Art schools and a multi-level parking</td>
</tr>
<tr>
<td>Christ</td>
<td>(RR) Kloster Volkenroda [monastery] [Figure 1]</td>
</tr>
<tr>
<td>France</td>
<td>(C) Sports shop of French capital</td>
</tr>
<tr>
<td>Netherlands</td>
<td>(RR) RR in Netherlands (new occupation unknown)</td>
</tr>
<tr>
<td>Sweden</td>
<td>(C) Business centre of Swedish capital</td>
</tr>
<tr>
<td>Lithuania</td>
<td>(RR) RR in Lithuania as an exhibition centre</td>
</tr>
<tr>
<td>Latvia</td>
<td>(RR) RR in Latvia (new occupation unknown)</td>
</tr>
<tr>
<td>China</td>
<td>(C) Germany-China clinic</td>
</tr>
<tr>
<td>Norway</td>
<td>(RR) RR in Norway (new occupation unknown)</td>
</tr>
<tr>
<td>Vatican Pope</td>
<td>(RR) Community centre of Liepaja city in Latvia</td>
</tr>
<tr>
<td>Nepal</td>
<td>(RR) Nepal promotion centre in Germany</td>
</tr>
<tr>
<td>Singapore</td>
<td>(RR) Partial RR in Singapore (new occupation unknown)</td>
</tr>
<tr>
<td>Japan</td>
<td>(Recycle) Recycle of so-called Paper Pavilion</td>
</tr>
<tr>
<td>ZERI*</td>
<td>(RR) RR in Tokyo and Paris to be exhibited (not realized?)</td>
</tr>
</tbody>
</table>

The detailed investigation on these expositions gave us the following conclusions:
① Draw a clear vision from the initial stages of facility planning and on stock activation after the conclusion of use of the facilities, the site and the infrastructure;
② Conduct a strict cost-benefit analysis if the equipment is to be conserved;
③ Prepare a transport program if the site is reused; from the point of sustainable development, the program must reduce car use and encourage the use of public transport system.

With these perspectives, now let us enter into the analysis on stock activation in the Aichi exposition.

3. Examples of material conversion in Aichi Expo 2005

Expo 2005 was a 6 month event and basically every facility was planned and built as temporary structure. In accordance to the main theme of the Expo, The 3R system, (reduce, reuse and recycle) was considered from the initial stages of the planning, construction and operation.

Examples of adopting the 3R’s are as follow:
- Official participants’ pavilion/module system, 18mx18mx9m (height);
- Japan government pavilion/internet auction for reuse of most of the materials;
- Gas pavilion/reuse of gas facilities;
- Kaleidoscope Tower/moved to another place in Aichi pref.;
- Expo-vision screen/moved to the Mizuo track field;
- Bench/reuse in parks in Aichi and Kanagawa pref.;
- AED/reuse in 26 cities and towns;
- Dry mist/reuse in Anjo city and Toyota city;
- Wind & solar generation/reuse in Toyota city and Anjo city;
- Global Tram/reuse in amusement facility;
- Bicycle taxi/reuse in Aichi, Gifu and Shiga pref.

Among the examples of reuse in Expo 2005 shown above, this paper will explain the following three cases in details.

Case 1: Government Pavilion of Japan in Nagakute area [Figure 2].

The pavilion was designed as temporary architecture and the reconstruction of whole building in another location was not considered. The pavilion was thought as an experimental model of new businesses of the concept of reuse and recycle of architecture in the near future. In general, the building is composed of thousands of elements, frame members, units, pieces and materials.

In the case of reuse of elements, the decision of the optimum unit or element is most important. And keeping the material value of the element and setting of the optimum price is also important.
The information system to match the supply and needs is required.

Figure 2: Japan Government Pavilion.

As the result of reuse of Nagakute pavilion, the following information is obtained:

1) As the result of the first auction: average successful bid was 47.4%:
High percentage of what acquired successful bids was as follows:
- Elevator 100%;
- Exhibition material 63.9%;
- Environmental material 60.4% (these two materials seemed to get the premium value for memory of the Expo);
- Interior electrical wiring, air conditioning ducts and etc. 50.6%;
- The infrastructural materials were thought that the reduction in value was small.

Low percentage of obtaining successful bids was «doors and fixtures» 1.8%

2) At the second auction, 100% of woods, kitchen facilities, equipment unit, and electric facilities were successfully auctioned.

Through the experience of bids for reuse, the following flow is required to be maintained:
1. Data-base of reuse materials (kinds, quality, quantity, location);
2. Obtain reuse materials (and keep and stock the materials);
3. Establish the optimum market system;
4. Establish the optimum management system.

Case 2: Official participants’ pavilion:

In this Expo, every official participant’s pavilion was designed using the module system. The basic module size was 18mx18mx9m (ceiling height) and five modules were provided at maximum. Exterior finishing and interior exhibition were completed by each country. The reason why the module system was applied was to reduce the waste of building materials after the Expo and to increase the possibility of reuse of the module.

The following two examples are conversion of pavilions to factories:
Case 2-1: Qatar Pavilion was converted to the factory building of Nippon Denshi Kogyo Co., Ltd. in Toyoake City [Figure.3].

Figure 3: Left: Qatar pavilion after EXPO 2005
Right: Nippon Denshi Kogyo

Case 2-2: Austria pavilion was converted to the factory building of Jin-no Company Ltd., in Toyoake City. In this case the conventional 3 storied building was constructed connected to the reused building [Figure.4].
4. The reuse program of timber at Aichi Kaisho Forest Center (Aichi Pavilion Seto at the Expo 2005 Aichi, Japan)

The Aichi Pavilion Seto, in the Seto area, is one of two pavilions that were constructed by the host prefecture Aichi. The 3,000m² pavilion used during the expo was scheduled to be reduced to half the size after the EXPO, and become the Satoyama Visitor Center, located in the 'Kaisho Forest' construction zone. It is possible to say 1,500m² of the permanent section, which included furniture, was reused. The other 1,500m² temporary sections, will now be discussed in some detail keeping in mind the concept of 3R’s.

The temporary section of the exterior walls of the Aichi Pavilion Seto was constructed using pure, unrefined timber. Excluding the theatre part, the same timber was used for the interior walls and floorboard. Approximately 100m³ of temporary housing materials were nearly 100% reused in the reconstruction work. This reuse initiative was planned in detail right through from the design phase. A search was conducted for a site that was still under construction when the exposition ended in order to identify and examine whether materials could be used from the Aichi Pavilion Seto. An elementary school based relatively close to the EXPO site in Shimoyama Village expressed a willingness to be involved in the reuse plan and therefore timber was used from this region.

Due to the timber being public property, this complicated ownership details and therefore a clearance valuation was required to complete the transfer of ownership. However, within the half year period of the EXPO, the depreciation on the materials was minimal and hence it was possible for these second hand materials could be purchased at price higher than their actual cost. To avoid this problem the following steps were taken. Firstly, Aichi Prefecture borrowed timber on lease and upon termination of the Expo, the materials were returned to the Shimoyama Forest Association. Secondly, the materials were bought by Shimoyama Village and supplied to the elementary school construction group [Figure. 5].

This above process also assisted with the handover of materials between Aichi Prefecture and contractor. Such building materials are often managed by the contractor through the construction phase and are handed
over upon completion as usual. However, if the contractor were to sublet the contract it would infringe the law. Therefore, during construction, the materials were borrowed by Aichi prefecture, which bore the construction insurance cost for the material and the contractor bore the installation and processing costs. Thus, by using this arrangement it made the lease plan possible.

Some ideas were required for the design and construction of the sites, not only for the module and details but also as part of the reuse plan. Using the unit system could restrict both the buildings and incur losses, and would also have increased the costs at the same time. Therefore a refined process was adopted where the timber used for construction was assembled gradually piece by piece, thus minimizing the risk of over expenditure. Furthermore, to facilitate the drying process of the timber, gaps were left between the timber beams during the running of the Expo.

Advantages:

① Aichi Prefecture and Shimoyama Village were able to reduce costs working together, by having the recycle plan in place.

② Positive forest management effects by using local materials along with reduction of CO2 (carbon footprints) by increasing efficiency of transportation.

③ Children and citizens of the area were enlightened by the fact that local timber was used at the Expo and reused at their local elementary school.

Future Points to Consider:

① In construction of the exhibition building and in reconstruction, it was necessary to forecast the rate of potential loss;

② The construction process did not go as smoothly as planned, due to extension of materials depot, resulting in lost production time.

In conclusion, Shimoyama Village, Shimoyama Forest Association, members from Aichi Prefecture Municipality, designers and contractors met and comprehensively reviewed the entire project, right back to the initial stages. In addition, there are currently similar lease projects in progress where the entire building is to be leased. The objective now is to promote the idea of public ownership, review legislative reform, and make construction methods with recycled materials more common place. Looking to the future the process of maintenance and recycling requires further examination into the durability of buildings and materials used in construction.

5. Conclusion and Advice for Shanghai Expo

The next registered World Exposition will take place in Shanghai in 2010. The theme is “Better Cities-Better Life”. The construction on the site has already started and the EXPO promises to become a very important milestone in the history of World Expositions, with a very large number of participating nations and probably of a record number of visitors. We understand that the Shanghai EXPO intends to use the concept of sustainability that was so successfully launched at the 2005 EXPO, a concept important to have present in
almost all the areas of EXPO.

The question of waste will be one of the major challenges at this EXPO and will affect almost all areas of the event. Waste is not only material waste but also waste of resources, knowledge etc.

In order for this major event to get the best possible results in cost efficiency, learning from the recent EXPO in Aichi can prove to be crucial.

Therefore the 2010 EXPO in Shanghai can no doubt use the well-documented experience of EXPO 2005 Aichi to its own advantage and to the advantage in general of the EXPO movement. Building upon the experience of the past, is also a kind of “conversion” and “reuse”, like when Shanghai EXPO plans to use old factory buildings in their “Best city practice zone”, they actually adhere to the principle of conversion, this shows how sustainability and conversion are matters of the greatest importance to this EXPO - just as it was to EXPO 2005.

The experience of EXPO 2005 Aichi in reuse and conversion can be useful, relevant and of great benefit for the organizers of the next EXPO in Shanghai in 2010.

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Basic websites:

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- Renzo Piano Building Workshop: http://www.rpbw.com/

Notes:

1. It is interesting to remark that there are some cases in which a certain number of Expos equipments were left behind without previous program. For example, the Eiffel Tower was programmed to be demolished at the end of 20 years after the Expo of 1889 but she was conserved to be an important cultural urban stock today.
2. For the detail of this field study, refer to the following articles (in Japanese): TORIUMI Motoki and TSUNODA Mari Christine, « A basic fieldwork for the research on World Expositions heritage», in Proceedings for the 2005 AIJ meeting F-1, September 2005, pp.377-378; idem, « Building Stock Activation after Seville and Genoa Expositions - A basic fieldwork for the research on World Expositions heritage II», in Proceedings for the 2007 AIJ meeting F-1, September 2007;
4. This village is now a part of Toyota City by merger.