VERIFYING THE VALIDITY OF STUDYING AND ARCHIVING DESIGN LANGUAGE BASED ON TIMBER STRUCTURES FROM THE PERSPECTIVE OF ADAPTATION TO ACTUAL CONSTRUCTION

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ABSTRACT: As preparation for future urgent projects, we studied construction design language, which forms the core of the design process, through 5 years wood-workshops and archived the results. At the great earthquake in 2011, we selected a design language prepared previously and students attempted to self-build a temporary gathering place.

KEYWORDS: Design language, Design process, Timber structure, Wood – workshop, Studying and archiving

1 INTRODUCTION

During the design process, architects always analyse and then consider the proposed shape for consideration in order to arrive at the most desirable shape for the conditions. They then further explore the new proposed shape for consideration by consolidating the analysis results. As the medium for determining conditions and shape, design language evaluates the suitability of shape and conditions. The role fulfilled by design language is significant.

Within the architectural design process, the spiral model in which this cycle of analysis, consolidation and evaluation is repeated while ideas are output and in which the design process is progressed from the abstract stage to the concrete stage is widely known. In addition, there also exists a mapping model in the form of chart that is comprised of an abstract-concrete axis and a whole-part axis. This model allows for individual differences in thought entry points. In other words, the design process is not regarded as a predetermined route or stage, but as a free route or stage and is ultimately portrayed as a map that encompasses all points.

From a practical project perspective, construction has a wide variety of condition levels and in some cases it is difficult to apply a modelling design process.

2 BACKGROUND AND OBJECT

On the 11th of March, 2011, Japan was hit by the greatest earthquake on record. In disaster-stricken areas, people are forced to live in so-called “temporary” regions, homes and communities for a number of years. Japan is a country with an abundant supply of forests and by nature has many wooden houses. Also, because of the ease of processing timber, the majority of this “temporary” housing is made up of timber structures, which are constructed quickly. It is certain that further large-scale earthquakes will occur in Japan in the near future.

2.1 PROBLEMS AND PAST STUDIES

It is not possible to apply a modelling design process to the construction required immediately after an earthquake, such as “temporary” housing. It is necessary to take shortcuts, by using the spiral model or the mapping model, to lead to an appropriate response to people’s needs. In other words, our first problem is to determine whether or not preparations can be put in place in advance for urgent projects.

In our previous study [1], we demonstrated the effect of wood-workshops on the systematisation of learning. We clarified the main challenges for understanding structural mechanics. However, we approached this from an educational perspective and we did not touch upon the social significance.

2.2 OBJECT OF STUDY

(1) As preparation for future urgent projects, study construction design language, which forms the core of the
design process and requires considerable time to put together, through wood-workshops and archive the results. 

(2) Through projects that actual utilise design language from the archives, verify the validity of the archives and their significance for the university.

3 METHODOLOGY

At our university, wood-workshops have been carried out continuously for 5 years, from 2008 to 2012. Members of the workshops are student volunteers, teaching staff and practicing architects. The consistent rules of the workshops are that (a) Structures are timber structures, (b) Every effort is made not to use special hardware and (c) Every effort is made not to use anything other than handheld tools. Seizing the opportunity presented by the great earthquake in 2011, we selected a design language prepared previously and students attempted to self-build a temporary gathering place. In addition to temporary housing, a gathering place is a facility required in a disaster-stricken area in an emergency to maintain a sense of community among local residents. Therefore, we selected the 2009 “Soccer-ball Dome” from the archive.

4 CONCLUSIONS

4.1 STUDYING AND ARCHIVING OF DESIGN LANGUAGE

Table 1: 5 years Wood-workshops

<table>
<thead>
<tr>
<th>Year</th>
<th>Design Language</th>
<th>Description</th>
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<tr>
<td>2008</td>
<td>“The Arbour”</td>
<td>The framework assembled from small members contributes to the ease of transporting the parts and the interesting combination of face elements and three-dimensional elements. It uses traditional Japanese timber structure interlocking joints. Engagement of the wooden pieces is used for the interlocking joints and these are strengthened using embedment as the resistance element.</td>
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<tr>
<td>2009</td>
<td>“The Soccer-ball Dome”</td>
<td>Using only a single stable and easy to produce geometric unit called a hexagon, a sphere with a hexagonal or octagonal geometric pattern is created. ARARE, which is so-called box joints, are used to join the hexagonal panels. By forming polyhedrons from the panels it’s possible to reinforce the strength of the panels and increase the stability of the dome.</td>
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<tr>
<td>2010</td>
<td>“The Helix”</td>
<td>The Helix is an attempt at a dynamic form using straight line members. A tunnel-shaped space and biotic form is created using only single L-shaped units. Interlocking joints were adopted for the members as the resistance element against the flat planes. The L-shaped units were created using tenon-mortise joints and each unit was joined by interlocking.</td>
</tr>
<tr>
<td>2011</td>
<td>“The Object”</td>
<td>This motif can be seen often. This design is characterised by the unpredictability of timber structures. Nobody can predict the spectacle of square timber floating and the aim is to dispel the sense of weight. With ten isometry it is easy to recognise tension-bearing members and compression bearing members.</td>
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<tr>
<td>2012</td>
<td>“The Arbour 2”</td>
<td>A shelter with a wonderful form is created by joining together five HP shells. HP shells consist of a combination of straight frame members around the perimeter and internal curved surfaces. Plywood is used to produce the curved lines and therefore it is necessary to deal with compaction direction buckling.</td>
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4.2 ADAPTATION TO ACTUAL CONSTRUCTION IN DISASTER-STRICKEN AREAS

In Omoe in Miyako City, which was stricken by the tsunami following the Great East Japan Earthquake, there is a gathering place for people forced to live in temporary housing. The gathering place was self-built by architects and 30 students. The structure is a dome (diameter 10.3m) in the shape of a truncated icosahedron soccer-ball cut in half and is comprised of regular hexagons and regular pentagons. The faces of the hexagons are wood panel structures and the faces of the octagons are openings to which film has been attached. It is vital that the construction is simple and low-cost and therefore the structural panels are comprised of ribs of dimension lumber and structural plywood and film was used for the openings instead of glass.

Figure 1: Actual construction of “Soccer-ball Dome”

4.3 SUMMARY

We obtained the following results from a series of design studies, archiving and actual construction. 

(1) The study and archiving of design languages as a means of preparation was extremely useful because we were able to put the archives to direct use following an actual earthquake. However, we clarified that it is necessary to study creating an expansive space that is not too rigidly fixed in relation to purpose. 

(2) We found that it was easy to carry out the study on timber structures and that timber structures were also easy to construct by volunteers at actual construction. 

(3) The fact that we were able to illustrate the development flow of study into actual construction through wood-workshops and that we were able to demonstrate the social significance of this through construction in disaster-stricken areas by volunteers may be considered one element of forging links with society, which is one challenge for university education.

REFERENCES