Utilization of Sugi (Japanese cedar) in light flame construction

Keiko Hosogaya
Dr. course student
Graduate School of Agriculture and Life Science, The University of Tokyo
Tokyo, Japan

Tomoaki SOMA
Assistant Prof., Dr.Agr.
Graduate School of Agriculture and Life Sciences, The University of Tokyo
Tokyo, Japan

Kenji KOBAYASHI
Dr. course student
Graduate School of Agriculture and Life Sciences, The University of Tokyo
Tokyo, Japan

Naoto ANDO
Prof., Dr.Agr.
Graduate School of Agriculture and Life Sciences, The University of Tokyo
Tokyo, Japan

Summary

Sugi (Japanese cedar) trees are mostly grown up enough to use as building materials in Japan. Now, these are limited to use for conventional post and beam construction. The number of light flame constructions has been increasing, and it reached to 100,000 in 2006. If Sugi lumbers can be used in light flame constructions, the demand for Sugi lumber will be expanded significantly.

We tested the quality of sawn Sugi lumbers for light flame constructions. It was verified that sawn Sugi lumbers mostly have enough quality to use for light flame constructions without lumbers cut from juvenile Sugi trees.

The economical problems of Sugi lumber for light flame constructions were also dealt with in this report. Commercial distribution routes of lumbers consist of producers, consumers and circulators. Hearing investigations to those members were conducted in order to clear up the issue involved in distributing Sugi lumber. The results showed that insecurity for Sugi lumbers’ strength and cost among those members would pose obstacles to the distribution of Sugi lumbers. To spread Sugi lumber utilization for light flame construction, the correct data for Sugi lumber would be needed to present widely.

1. Purpose

The purpose of this paper is to clarify if Japanese cedar can be used as lumbers for the platform method construction, and on the assumption that it can be used, to analyse the reasons why it has not been utilized until now, neither distributed in the market of lumbers.

It has passed more than 30 years since the platform method construction was introduced and recognized as the authorized one by which the houses could be made under the Construction Standard Act in Japan in 1974. Until now the studies and experiments have been preceded for the purpose of application of domestic wood for the platform method construction. As a result the lumber of Japanese cedar is categorized in the species group S.II.W.Cedar and certified to clear its standards of strength.

In spite of national acceleration to utilize the domestic wood, especially Japanese cedar, the lumbers of Japanese domestic wood for platform method construction have not gained general acceptance.
2. Market Research

2.1. Market Research to the Suppliers

The object of fact-finding and field study on the suppliers, that is to say, owners of forest, sawmills, or the factories of the wooden products, is to investigate the possibility of produce of Japanese cedar lumber, and prerequisite conditions for it. As a result the factories of the columns for conventional constructions do not have equipment facilities for producing lumbers; neither have motivations for tapping new markets open. While the factories of laminated wood columns have all the plant and equipment to be able to be developed for producing Japanese cedar lumber, and also are looking for the new market for the sake of utilization of Japanese cedar that was planted after the Second World War and has reached at time to be cut.

2.2. Market Research to the Demanders

The house builders, construction companies, companies of component and pre-cutting, wholesale dealers and firm business companies are taken as an object of the field study. Prerequisite conditions of adapting Japanese cedar lumber are the followings;

1. Confirmation of the performance of Japanese cedar lumber for platform method constructions
2. Prices
3. Security of delivery

The significances of utilization of Japanese cedar lumber are the followings,

1. Social Responsibility of company for the environmental problem
2. Preventive measures against the decrease of J-grade SPF lumber imported from North America
3. Preventive measures against the Problem 2013 when the shipment of Canadian pine lumber will be suspended for the reasons of insect damage
4. Appeal for grant of local government to construct houses of domestic wood
3. Technical Verification of Japanese cedar Lumber

The object of the technical test is to verify the shear load factor of wall studded of Japanese cedar lumber. The test sheathed walls consist of three types: one of them is made of only S.P.F. lumbers, another is made of flames of S.P.F. and whole studs of Japanese cedar, and the third is made of flames of S.P.F. and finger-jointed studs of Japanese cedar.

The results of the tests are the followings: the shear load factor of the walls studded of Japanese cedar is stronger than the first type walls made of only S.P.F. lumbers. The application of Japanese cedar lumber as stud of the Platform method construction does not have any problem, rather it gains the ascendancy over the walls made of only S.P.F.

4. Investigation on the Probability of Distribution of Japanese cedar Lumber

4.1. The Demand of 204 Studs

The total floor area per house of platform method construction is 90m$^3$ on average. The lumber consumption volume per 1m$^2$ floor area is 0.173m$^3$. The ratio of 204 studs on the total lumber consumption volume of a house is about 40%. Considering the above the annual demand of the volume of 204 studs is 450,000m$^3$

The demand of Japanese cedar studs can be a third of the total demand, that is, 150,000m$^3$, the maximum could be 300,000m$^3$. The annual consumption of Japanese cedar log for the platform method construction will amount to 600,000m$^3$. 

Table 1. List of Results of Experiments

<table>
<thead>
<tr>
<th></th>
<th>Py (kN)</th>
<th>K (deg/10$^{-4}$)</th>
<th>P$_{1/120}$ (kN)</th>
<th>P$_{max}$ (kN)</th>
<th>P$_u$ (kN)</th>
<th>u</th>
<th>Ds</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS1</td>
<td>14.52</td>
<td>1.65</td>
<td>13.42</td>
<td>28.30</td>
<td>24.73</td>
<td>3.98</td>
<td>0.38</td>
</tr>
<tr>
<td>YS2</td>
<td>16.20</td>
<td>1.39</td>
<td>13.02</td>
<td>27.94</td>
<td>25.16</td>
<td>3.51</td>
<td>0.41</td>
</tr>
<tr>
<td>FJ1</td>
<td>14.73</td>
<td>1.71</td>
<td>13.97</td>
<td>26.74</td>
<td>24.67</td>
<td>4.27</td>
<td>0.36</td>
</tr>
<tr>
<td>FJ2</td>
<td>15.26</td>
<td>1.66</td>
<td>14.17</td>
<td>26.99</td>
<td>24.42</td>
<td>4.50</td>
<td>0.35</td>
</tr>
<tr>
<td>SPF</td>
<td>15.47</td>
<td>1.80</td>
<td>14.89</td>
<td>23.53</td>
<td>23.52</td>
<td>4.00</td>
<td>0.38</td>
</tr>
</tbody>
</table>

Table 2. List of Shear Load Factor

<table>
<thead>
<tr>
<th></th>
<th>Py (kN)</th>
<th>(a) Py</th>
<th>(b) Pu × (0.2/Ds)</th>
<th>(c) P$_{max}$ × 2/3</th>
<th>(d) P$_{1/120}$</th>
<th>选用倍率</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS1</td>
<td>16.20</td>
<td>12.35</td>
<td>18.63</td>
<td>13.02</td>
<td>3.46</td>
<td>3.66</td>
</tr>
<tr>
<td>YS2</td>
<td>14.52</td>
<td>13.04</td>
<td>18.86</td>
<td>13.42</td>
<td>3.66</td>
<td>3.80</td>
</tr>
<tr>
<td>FJ1</td>
<td>14.73</td>
<td>13.55</td>
<td>17.83</td>
<td>13.97</td>
<td>3.87</td>
<td>3.87</td>
</tr>
<tr>
<td>FJ2</td>
<td>15.26</td>
<td>13.81</td>
<td>18.00</td>
<td>14.17</td>
<td>3.67</td>
<td>3.67</td>
</tr>
<tr>
<td>SPF</td>
<td>15.47</td>
<td>12.45</td>
<td>18.22</td>
<td>14.89</td>
<td>3.49</td>
<td>3.49</td>
</tr>
</tbody>
</table>
4.2. The Stability and Security of the Supply

It will be necessary to line up the suppliers that have a capacity to produce Japanese cedar lumber from 300,000m³ to 500,000m³ in a year for the stability of supply of the 204 studs for the platform method construction. The sum of the production of Japanese cedar of the suppliers which are investigated here accounts for probably from 200,000m³ to 300,000m³. The rest can be fulfilled by some large-scale saw-mill producers.

4.3. The price

The wood products of Japanese cedar become to be able to offer a nice price relatively in comparison with North American lumbers under the world-wide economic situations. In December, 2006, S.P.F.204 lumbers of J-grade are 42,150 yen/m³ in the market, and Japanese cedar 204 lumbers are calculated as 41,560 yen/m³.

<table>
<thead>
<tr>
<th>Raw material cost</th>
<th>Japanese cedar standard-type logs</th>
<th>Log price: ¥12,000/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Recovery factor: about 55%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>→Raw material cost per sawn lumber m³: ¥21,800/m³</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Saw milling cost per log m³: ¥5,000/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovery factor: about 55%</td>
</tr>
<tr>
<td>→Saw milling cost per sawn lumber m³: ¥9,100/m³</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Kiln drying cost per lumber m³: ¥6,000/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovery factor: about 80%</td>
</tr>
<tr>
<td>→Kiln drying cost per lumber m³: ¥7,500/m³</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Surfacing cost per lumber m³: ¥3,000/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovery factor about 95%</td>
</tr>
<tr>
<td>→Surfacing cost per finished lumber m³: ¥3,160/m³</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total cost: ¥41,560/m³</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Delivery cost to the user’s factory: ¥6,000/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total ¥47,560/m³</td>
</tr>
</tbody>
</table>

* Recovery factor numbers are based on Japan Housing and Wood Technology Centre, The Report on Construction of Model Houses of Platform method Build, 1994

* Saw milling cost can be reduced to ¥3,000/m³ level at a big size saw mill which consume about 100,000m³/year logs magnitude.
5. Necessary Requirements for the Utilization of Japanese cedar Lumbers

5.1. Key Buying Factor

The necessary requirements for the utilization of Japanese cedar lumbers are three,

(1) Quality
(2) Price
(3) Stable and Secure Supply. Japanese cedar lumber is able to fulfill these requirements as above mentioned.

![Fig.4: Diagram of requirements of Merchandising Japanese cedar lumber]

5.2. Predominant Factors of Japanese cedar Lumber

It will be necessary for the market of Japanese cedar lumbers to present predominant factors to gain a general acceptance in the existent market of North American lumbers.

5.2.1. Operational advantages

(1) Supply of the quantity and sizes of lumbers in necessity
(2) No stocks in hand by the speedy order and delivery
(3) Cost down of physical distribution
(4) Short waiting time until delivery after order
(5) Not subject to movement of exchange

5.2.2. Sales advantages

(1) Appeal to the public or clients to be a company considering the natural environment or the conservation of the Japanese forest
(2) Positive image of the domestic wood to be healthy and secure
(3) Sales merit for clients to be able to gain municipal aid

5.2.3. Advantages of processing

(1) High efficiency of operating for the reasons that Japanese cedar is light and soft
(2) High efficiency of operating for the reasons that Japanese cedar is easy to be nailed and effective

5.3. Administrative Management

It is necessary to reform the present conditions in which Japanese cedar is excluded in reality from the market of lumbers for the reason of lack of reference of the Regulations of Construction of Platform method construction.
5.4. Necessity of Strategy and Marketing of Japanese cedar Lumber

The suppliers themselves do not recognize Japanese cedar to be applicable for the Platform method construction, neither for the solid constructions. It is one of the challenges to correct the wrong perception that “Japanese cedar is weak material” for the construction. It will be necessary to make the information of technical data known to everyone and to make the strategic promotion of Japanese cedar lumber by an organization of promoting and marketing as like as COFI (Council of Forest Industries Canada).

![Diagram of Necessity of Sales Promotion of Japanese cedar lumber](image)

**Fig. 5 Diagram of Necessity of Sales Promotion of Japanese cedar lumber**

6. References

