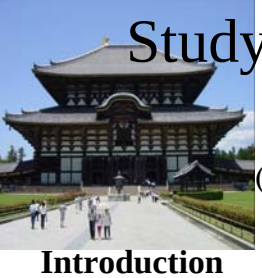

Study on repairing material for wooden cultural buildings

—Case study of natural Japanese cypress forest in Kiso—

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Introduction

Historical timber-frame buildings represent a very important part of the Japanese culture. It is important to maintain and manage them everlastingly in a good condition.

To maintain timber-frame buildings, it is necessary to ensure the long-term supply of large and high quality timber. It is necessary to conduct a study on the quantity and quality of large standing trees in natural forests. We have conducted a survey in order to estimate available quantity of naturally grown Japanese cypress trees being the source of a repairing material for the timber-frame buildings.

Material and Method

Our study site was in the Kiso area, which is located in Nagano Prefecture. The Kiso area supplies the most part of the lumber necessary to repair timber-frame buildings. For this purpose, we have conducted a measurement of 75 sample tree. Trees were selected applying the systematical sampling procedure. We have measured the diameter of the each tree at several heights (1/10 of tree height, breast height, 3m, 5m, 7m and so on) and the total tree height. Each sample trees was evaluated by the means of the timber quality such as the number of knots and presence of wounds or twists.

Result

We have calculated the relative taper-curve of 75 sample trees. The relative taper curve fitted well into a third-order equation (R^2 = 0.777) (Fig.1). We calculated each diameter at 11.5 m height using taper curve individually. There are 60 trees with a diameter at 11.5 m larger than 45 cm. In our definition, the large size timber is longer than 10 m and larger than 45 cm at the top end diameter. There are 25 high quality trees without knots, wounds and twists under 11.5 m, besides larger than 45 cm diameter at 11.5 m height.(Fig.2) They are 32% of the whole research trees. We divided research trees into 2 groups according to the relative crown height, and the mean relative crown height was 0.38.(Table.1) However there were no evident differences of timber quality between 2 groups.

80% of sample trees satisfied the standard of “large size timber”, although 32% of sample trees satisfied both standard of the size and the quality. Some kinds of faults were observed in other 48% of sample trees (35 sample trees). In details, faults were as follows: 13 twisted trees, 23 knotted trees and 9 wounded trees. These faults can be also distinguished by intensity of twists (photo.1), pattern of knots appearance (photo.2) and the type of wounds like the thunder damage, wind damage, animal damage or other physical damage(photo.3,4,5).

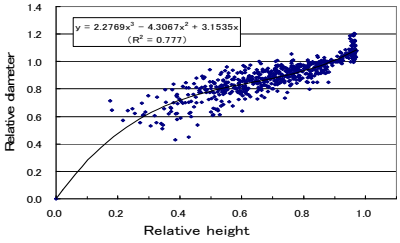

Fig.1 Relative Taper curve of 75 sample trees

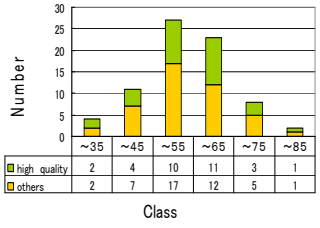

Fig.2 Diameter classification

Table.1 Classification of relative crown height

Relative Crown Height	Quality	N
＞0.38	high quality	16
	others	24
＜0.38	high quality	15
	others	20

Table.2 Classification of the faults

Type	Items
stem shape	bend
	twist
	elliptic
knots	symptom
	few
	many
wounds	hitting damaged by stone or branches
	thunder damage
	bark involved inside the stem
	depression (damaged by wind)
	animal damage

Conclusion and Discussion

To maintain historical timber-frame buildings, it is necessary to conduct a research on the available stock by visually observing the wood quality of standing trees. It is likely that visually observing standing trees can serve to predict the quality of the wood being requested for the repairing of timber-frame buildings. Determining the quality of standing trees by the visual approach is not an easy task since it is necessary to involve the expertise of an experienced person. Furthermore, different standards concerning the tree quality being used by foresters and conservationists impose more problems.

Conservationists are seeking for a large amount of the best quality trees and its supply is not feasible in present. Too high standards set by conservationists may have negative impact to the forest resources. There is need to reconcile standards concerning the tree quality and those new indices should be able to promote a more efficient and the sustainable use of forest resources.

Twisted

Photo.1

Knotted

Photo.2

Hitting damaged by stone or branches

Photo.3

Depression（damaged by wind）

Photo.5

Bark involved inside the stem

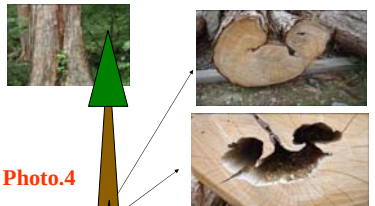

Photo.4