C I N T R A F O R

Working Paper

2

An Evaluation of Japanese Softwood Construction Lumber Grading Systems and Their Implications for North American Export Lumber Producers

1984

D. G. Briggs and N. Dickens

CENTER FOR INTERNATIONAL TRADE IN FOREST PRODUCTS
UNIVERSITY OF WASHINGTON
COLLEGE OF FOREST RESOURCES AR-10
SEATTLE, WASHINGTON 98195

An Evaluation of Japanese Softwood Construction Lumber Grading Systems and Their Implications for North American Export Lumber Producers

by

David G. Briggs
Assistant Professor

Nathan Dickens
Research Assistant

University of Washington
College of Forest Resources AR-10
Seattle, WA 98195

18 January 1984

Submitted to
Tom Snellgrove, Project Leader
Timber Quality Research
Pacific Northwest Forest & Range Experiment Station
U.S. Forest Service
Portland, OR

Preface

The acquisition of information for this report required the consultation of numerous individuals employed by lumber manufacturing firms, and export trading entities. Their information provided insight on the adaptations of North American lumber manufacturers to the Japanese lumber market. In addition, perspective on the historical background, and current status of lumber quality standardization in Japan was achieved with the assistance of private sources. Listed alphabetically, are the individuals who made significant contributions to the information base for this report.

T. Clary
Manke Lumber Co.
Tacoma, Washington

Gary Fowler
Weyerhaeuser Co.
Tacoma, Washington

Gene Heiser
Brazier Lumber Co.
Tacoma, Washington

Adolph Hertrich
Vanport Manufacturing Inc.
Boring, Oregon

Robert W. Hill
Seaboard Lumber Co.
Seattle, Washington

Ed Mason
Great Western Lumber Co.
Everson, Washington

Sumio Nikuni
Mitsubishi Co.
Seattle, Washington

Bob Noel
Cascade West Forest
Products Inc.
Steilacoom, Washington

Tom Spence
Pacific Lumber and Shipping
Seattle, Washington

Gary Takahashi
Portac Inc.
Tacoma, Washington

Table of Contents

List of Tables

List of Figures

Executive Summary

Purpose of Study

This study has developed information regarding the softwood construction lumber market in Japan and the major types of wood-based housing markets where this lumber is used. Since a large fraction of Japan's softwood supplies are imported from North America and as various factors influence Japan to import more finished softwood lumber as opposed to logs, it has become important for North American producers to become familiarized with Japanese softwood standards including sizes required, manufacturing tolerances, and grading rules. This report presents current detailed information on these factors, compares them with North American rules and provides approximate cross-references. In many cases, exact cross-references are impossible due to inherent differences between the Japanese and North American systems which are highlighted.

Japan's Softwood Imports

Japan, the largest importer of forest products in the world, averaged importing 22.3 million m^3 of softwood logs and lumber during 1978-82. Only 15.5% (3.5 million m^3) of these softwood imports were lumber; 5.9% from the United States and 9.6% from Canada. Softwood lumber imports have been slowly growing as roundwood supplies have become more restricted.

Japan's Housing Market

During the same period, Japan averaged 1321 thousand housing starts of which 60% were wood based. Construction, lumber product, and grade standards for western style platform frame (PF) or 2 x 4 construction were formally adopted by Japan in 1974 and have slowly grown to close to 19-20,000 units or about 2% of the wood-based housing. The remaining wood-based housing is traditional Japanese post-and-beam type construction.

Japanese Standards for Western Style Platform Framing Housing Lumber

The lumber grading system and product sizes for platform frame housing is very similar to North American grades (Figure 1). Although there is no Japanese counterpart for Economy and there are minor differences in nomenclature, there were some serious differences in the original 1974 Japanese interpretation of wane and narrow face knot displacements but these were subsequently altered and are now in close conformance with North American grades. One major remaining differences is the tighter manufacturing tolerance of the Japanese grades. Other differences relate to fissures or fiber separations. The Japanese grades of Select, No. 1 and Construction do not allow any through fissures at the ends of a piece while their North American counterparts have some degree of allowance. Thus, U.S. mills producing for the platform frame market in Japan will find little difference between their domestic and export procedures. The principal problem is that the platform frame market is too small to be a major market for U.S. exporters. Assuming 7500 BF of construction lumber per home (351,000 m^3/yr), this market currently uses 150 million BF/year or about 1% of the softwood lumber

imports and 0.2% of total softwood imports. It is unclear how rapidly this market will grow in the future as it involves trade-offs in cost, changes in the carpentry and construction professions, evidence that the tighter PF construction will adequately handle potential decay problems in Japan's high humidity, and acceptance of a different living style by Japanese consumers.

Japanese Standards for Traditional Housing Methods

Traditional Japanese housing (Figure 4, Table 6) uses a complex system of nomenclature and sizes. These products are graded for both appearance and structural performance characteristics since many structural members are exposed in the finished home and must satisfy aesthetic requirements as well as strength and support functions.

JAS Notification 1841 developed in 1967 presents a generalized grading system for logs, cants, and lumber but is inadequate in its failure to explicitly include critical factors affecting lumber strength, its omission of explicit wane allowances which are of great appearance concern, and in its omission of manufacturing tolerances.

Consequently, proprietary grading systems evolved between Japanese lumber producers, distributors, and users (Tables 7, 8). With incomplete knowledge of the details of Japanese building methods, grades, and specifications, North American mills have often used modified versions of North American grades to approximate the Japanese system. Table 9 presents the correspondences based on our interviews. There are numerous variations on this theme developed between a particular U.S. mill and its Japanese buyer. The U.S. mill may produce lumber in Japanese metric sizes, nearest English equivalents, or in the usual North American sizes.

The Japanese often remanufacture and regrade imported lumber to improve grades or sizing before it enters their distribution system.

Because of the proprietary system, Japan recently published a new Agricultural Standard (Notification 1892) that has been completely translated into English by the Japan External Trade Organization. This standard is based on the concepts underlying the proprietary system. It formally specifies the spectrum of product sizes (Appendix III, Table 1) defines defect measurement techniques including a knot diameter ratio method for visual strength classification and defines specific limits for various defects in each of three basic grades--Special, First, and Second. These basic grades essentially present minimum qualifications based on strength and appearance features. Included within each of the three basic grades are three additional appearance grades--Clear, Fine Small Knot, and Small Knot. The provisions of this system are presented in Appendix III. This grading system is correlated with the product nomenclature of the traditional house in Table 10 and with their closest North American counterparts in Table 11.

The availability of this new Japanese standard should facilitate greater understanding of their products and requirements by U.S. producers and lead to improved coordination of grades.

Based on our interviews, we estimate that only 100,000-300,000 m^3 or roughly 1% of the softwood lumber annually exported to Japan from North America is produced in Japanese sizes and graded according to Japanese rules by the producer. Most lumber exports to Japan are in either Japanese or North American sizes and graded according to North American grades, with modifications for wane and other features. The bulk of this

lumber is subsequently remanufactured and/or regraded in Japan before it enters the traditional housing market.

Impact on North American Producers

U.S. producers face a dilemma of whether to focus on long run promotion efforts to hopefully expand the PF market share or to attempt to produce for the immediate and large market for traditional housing. Unfortunately, information concerning the traditional building method, lumber products used and their grades have not been well known in North America. This study rectifies this problem based on recent translations from Japanese standards and our interviews with North American export mills as well as with representatives of Japanese softwood lumber buyers.

North American mills producing for export can expect some variation from their current recovery and grade yield levels when producing for export. Stricter Japanese wane allowances, particularly for lumber entering the traditional housing market can lead to a reduction in accustomed recovery from a given log size. Other grading differences such as treatment of fissures and knots will also lead to some degrade. This level of degrade is probably small for lumber entering the western style platform framing component of the Japanese housing market but could be more serious in lumber destined for the traditional market if the lumber is graded under North American rules. The Japanese also have stricter manufacturing tolerances than North America. Initially this may add to degrade but as mills learn to produce products within these close tolerances this degrade component will vanish and recovery may even be improved. No attempt was made to quantify these effects. It may be possible to get a general feeling for the nature of the net change due to

the interaction of these factors by modifying one of the several sawing pattern programs such as BOF to reflect Japanese requirements and compare the resulting theoretical recoveries with those obtained when the same size logs are sawn to North American standards. Such an analysis would be fairly complex and is beyond the scope of this investigation.

SECTION I

INTRODUCTION

Japan presently satisfies only 36% of its wood consumption from domestic supplies and is the world's largest wood importer with no hope of becoming self-sufficient (14). Demand is projected to continue to outstrip domestic supplies despite a policy of withholding current harvest to build up future inventories and the maturing of post-WWII plantations (13,15). Over the 1978-82 period, Japan imported an annual average of 41.6 million m^3 of logs and lumber (Table 1). If a reasonable assumption is made that the imports from non-Asian sources are primarily softwood species, it is apparent that imports from principal softwood sources averaged about 22.3 million cubic meters of logs and lumber per year. Approximately 15.5% of this was lumber; 5.9% from the U.S. and 9.6% from Canada.

Historically, the primary suppliers of softwood timber to Japan have been Canada, the United States, and the USSR. Log supplies have become limited, however, as the United States and Canada have placed restrictions on log exports. The potential availability of Siberian logs is huge but the extent to which this resource can affect future supplies is unknown. The combination of factors such as infrastructure problems, domestic and European block needs, growing internal processing capability, political decisions in a planned economy, and the dominance of larch growing stock, which is considered of inferior merchantability lead to historical and projected inconsistency of Siberian log supplies for export (8, 13, 15).

Table 1. Housing and timber import statistics for Japan, 1970-1982.

	Timber Imports of Japan (logs and lumber) 1000 m^3								Housing Thousands				
		Hardwoods	Softwoods							Wooden based		PF	
	Total	SE Asia Total	U.S. logs	U.S. lumber	Canada logs	Canada lumber	USSR	Others	Total	#	%	#	%[1]
1970	42,366	20,678	9,526	736	538	1,711	7,095	2,082	1,485	1,036	69.8	-	-
1971	40,325	21,689	7,110	661	648	913	7,071	2,243	1,464	967	66.0	-	-
1972	44,762	21,898	10,430	873	252	968	7,922	2,419	1,808	1,112	61.5	-	-
1973	52,280	26,969	10,525	1,353	93	1,341	9,155	2,843	1,905	1,120	58.8	-	-
1974	47,633	25,512	8,746	1,345	171	1,207	8,306	2,346	1,316	870	66.1	NA	-
1975	38,262	17,628	9,359	1,094	182	991	7,872	1,137	1,356	907	66.9	NA	-
1976	44,890	22,388	10,051	1,085	257	1,454	8,168	1,486	1,524	993	65.2	NA	-
1977	45,465	21,678	10,201	975	430	1,657	8,833	1,690	1,508	946	62.7	NA	-
1978	46,511	22,364	10,325	981	312	1,816	8,961	1,752	1,549	958	61.8	4.078	0.4
1979	49,902	23,078	12,400	1,536	340	2,089	8,013	2,446	1,493	910	61.0	11.079	1.2
1980	43,083	19,656	10,279	1,550	472	2,564	6,297	2,265	1,269	751	59.2	13.080	1.7
1981	33,118	15,493	7,402	1,130	323	1,823	5,770	1,177	1,152	654	56.2	14.581	2.2
1982	35,359	15,865	8,088	1,420	361	2,357	6,120	1,148	1,146	667	58.2	16.082	2.4

[1]Percent of wood based.

Source (14) except PF housing obtained from pesonal communication WWPA.

Table 1 also shows that recent levels of housing construction in Japan averaged 1321 thousand units during 1978-82, 60% of which were wood based. About 98% of the wood-based units were of traditional post-and-beam construction and 2% were of western style platform frame (PF) construction. Standards for the western PF, or 2 x 4, construction method, lumber product specifications, and grading provisions were adopted in 1974 by the Japanese Ministry of Construction and the Ministry of Agriculture and Forestry (6).

Constraints on the availability of domestic and imported softwood sawlogs are causing Japan to turn to finished and semi-finished softwood products, particularly construction lumber for housing. Since imported lumber frequently does not conform to Japanese sizes or grades, many Japanese mills specialize in remanufacturing, regrading, and machining to rework imported lumber into the grades, sizes, and notched connections used in customary construction. Western Canadian mills have been more inclined than their U.S. counterparts to produce Japanese sizes and qualities. However, a substantial portion of the softwood lumber industry in Canada and nearly all of that in the United States is uncompromisingly oriented toward production of products for North American platform frame housing. Tapping this source of supply was one factor that prompted the Japanese to consider and ultimately adopt North American framing construction lumber specifications, inspection methods, and building techniques.

A report (6) of studies conducted by the Ministry of International Trade and Industry revealed that western style PF construction is substantially more cost efficient than traditional Japanese methods. Labor requirements for residential house construction in the United

States are approximately 700 hours. A traditional Japanese home of equal size requires 2500 hours of labor. Japanese researchers estimate that the overall cost savings resulting from using western construction methods is in the range of 20 to 50% of the total construction costs. The initial cost advantage of western construction is offset to a large degree by the greater expenses for heating, plumbing, wiring, insulation, and furnishings.

The complexity of traditional Japanese housing construction has resulted in a chronic shortage of technical building tradesmen. The residential building regulations in Japan are relatively more complicated than in the United States and Canada. These factors hinder the building trades ability to respond effectively to the latent housing demand in Japan. PF construction was viewed as an opportunity to simplify the method of residential house construction and its associated regulations and it was anticipated that adoption PF construction would encourage an influx of technically trained professionals into the building trades.

Although rapid acceptance of PF housing was expected in Japan, almost ten years have gone by since adoption of PF standards and this construction has only gained a 2% share of the wood-based housing market. At least three factors seem to work against PF housing. First, while it is true that PF construction is cheaper than traditional construction, they require more in the way of finishing/furnishing so the cost differential by the time of occupancy is not as great as some have indicated. Second, the PF home requires a change in living style. Third, the Japanese have concerns that the PF system, with much tighter sealed-off spaces in walls and ceilings, will not ventilate adequately in

the very high humidity encountered in Japan and thus could lead to problems with decay (8).

These changes toward increased softwood lumber imports and the slow adoption of PF housing pose a dilemma for North American lumber producers. Certainly they would prefer to market lumber for PF housing since this would require no change from current practice with the exception of possible differences between the Japanese and North American standards for lumber used in PF housing. However, PF housing represents a small sector in Japan's housing market, hence producers wishing to capitalize on the larger traditional market must become familiar with the lumber grades and sizes used in the traditional post-and-beam home.

The purpose of this report is to clarify these issues by presenting the relationships between the Japanese Agricultural Standard for PF housing and their North American counterpart (Section II) and then describe the grades and specifications for the traditional post-and-beam home and the various means for accommodating these unique specifications by U.S. firms and their Japanese trading partners (Section III). In each of these sections we attempt to develop the closest possible correspondence between Japanese and North American grades. This is based on our interpretation of the grade specifications and our discussions with representatives of mills exporting lumber to Japan from the United States and Canada.

SECTION II

THE DEVELOPMENT AND IMPLICATIONS OF JAPANESE LUMBER GRADES FOR WESTERN FRAME CONSTRUCTION

A. Events Leading to the 1974 JAS Standard for Platform Frame Construction

PF construction is a technique using framed floor joists, nailed with structural plywood, and framed wall units with structural plywood or similar wall units attached to the platform to form a building. Prior to 1974, the use of PF construction was confined almost entirely to the United States, Canada, and the United Kingdom.

In order for the potential benefits of PF construction to be secured by the Japanese, a method for standardizing the quality of lumber intended for PF use had to be developed. This process began in March 1972 with an investigation of the PF construction method in Canada by members of the Japanese Ministry of Agriculture and Forestry, Building Research Institute, and Ministry of Construction. A draft proposal for a Japanese Agricultural Standard for PF lumber was developed by the Technological Association of Japanese Lumber Manufacturing during the period of June 1972-April 1973 (16). The draft proposal was essentially a translation of the North American National Grading Rule (NGR) which the American and Canadian lumber standards are based upon (4,5). The basis of the various elements of the NGR were carefully assessed by the Japanese authorities. Prior to the announcement of the Japanese Agricultural Standard (JAS) for PF lumber, the draft proposal was reviewed by members of the Ministry of Agriculture and Forestry and the Forest Products Standard Research Association.

On July 8, 1974, the Japanese Agricultural and Forestry Standard for Platform Framing Construction Lumber was announced by the Ministry of Agriculture and Forestry in the form of public notices Nos. 600, 756, 757 (1,2,3). The JAS specifies the spectrum of lumber products addressed grading (inspection) methods, labeling and the relation of sizes and grades of lumber products to the Japanese building standard for PF construction.

The JAS grading rules and subsequent revisions (7) have been translated by the Western Wood Products Association (WWPA) (16). Although the Japanese documents are the only officially recognized sources regarding the rules, the WWPA translation forms the basis for much of the information in this section.

Four features of the JAS grading rule provisions were inconsistent with the same provision categories in the NGR. These are more restrictive allowances for narrow face and spike-knots, wane, fissures, and manufacturing tolerances. These inconsistencies will be highlighted following a description of the structure of the 1974 JAS grading rule.

B. Provisions of the 1974 JAS Grading Rule

The JAS grading rule is designed to provide for the grading of lumber according to its predicted structural performance capability. The standard only applies to "surfaced" softwood framing construction lumber. Factory and shop lumber for manufacturing laminated beams are graded under other previously established JAS rules.

1) Species Groups

The JAS for framing construction lumber provides for the structural grading of softwood lumber derived from North American and New Zealand softwood species. Labeling of species according to the JAS is limited to two species groups: SI and SII which are presented in Table 1 of Appendix I. The classifications are based upon North American and Japanese research on the strength properties of the species included. The SI species group is intended to have higher basic stress values than the SII group.

2) Product Categories

The spectrum of softwood lumber products contained in the JAS is narrower than that provided for in the NGR. As shown in Figure 1, the JAS defines two product categories of platform framing construction lumber: Framing A lumber and Framing B lumber.

Framing A lumber is used in applications requiring a high degree of reliability in bending strength and corresponds in dimensions and grading rule structure to Structural Light Framing and Structural Joists and Planks in the NGR. JAS grades for Framing A lumber are Select, Grade 1, Grade 2, and Grade 3, which closely correspond to the NGR grades Select, No. 1, No. 2, and No. 3, respectively.

Framing B lumber is intended for end use as compressional structural members (vertical elements) and corresponds in dimension and grading rule structure to Light Framing in the NGR. JAS grades of Framing B lumber are Construction, Standard, and Utility which correspond closely in provisions to the Light Framing grades of Construction, Standard, and

Figure 1. Correspondence between JAS and North American Softwood Lumber Products and Grades.

	JAS	NORTH AMERICA
Name	Platform framing construction lumber	Dimension lumber
Classification and Gradings	Framing A Lumber	1. Structural light framing 2. Structural joist and planks
	Select ← →	Select structural (Sel Str)
	Grade 1 ← →	No. 1
	Grade 2 ← →	No. 2
	Grade 3 ← →	No. 3
		3. Studs
		STUD
	Framing B lumber	Light framing
	CONST	Construction (CONST)
	STAND	Standard (STAND)
	UTIL	Utility (UTIL)
	———	Economy
	———	Appearance framing
		Appearance (A)
	———	Joist and planks
		Economy

Source (16)

Utility, respectively. There are no provisions for "Economy" quality grades in either Framing A or Framing B lumber.

3) Dimensions

The JAS presents a three digit code for describing the nominal cross-sectional areas of Framing A or B lumber products. The first and last digits correspond to the nominal thickness and width of the piece respectively. The second digit of the code is always a zero. There are seven dimensional codes describing Framing A lumber and 3 codes describing Framing B lumber. The dimensional codes were devised to simplify transactions using Telex. For each dimensional code the JAS presents required dimensions for green and dry lumber. Nineteen percent moisture content is the upper limit for lumber considered as "dry." The required dimensions of dry and green lumber are obtained by converting the NGR required dimensions into metric units. Any lumber which does not meet the required dimensions including the allowable error is considered unacceptable.

The JAS permits a 1.5 mm (.0590 in.) deviation around the standard surfaced width or thickness of dry or green lumber. The narrow tolerance preserves the accuracy of design stress calculations using the required dimensions. The NGR addresses manufacturing tolerances for surfaced dimension lumber in two classifications, saw sized and sized dimension (Table 2). The NGR tolerances are less severe overall for saw sized lumber than the JAS tolerances while sized-dimension tolerances are compatible with the JAS tolerances. The NGR also specifies special tolerances for remanufactured lumber.

Table 2. NGR manufacturing tolerances for surfaced lumber.

Saw Sized:	Lumber uniformly sawn to the standard surfaced size but permitting in 20% of the pieces a manufacturing tolerance of 1/32" (.793 mm) under. An oversize tolerance of 1/8" (3.175 mm) is permitted.
Sized Dimension	Uniformly manufactured to the net surfaced sizes and may be rough, surfaced or partially surfaced on one or more faces. When opposing faces are rough a variation over size of 1/32" (.793 mm) is permitted in No. 2 and better, and Standard and better. A variation of 1/32" undersize is permitted. In stud utility and No. 3 a variation of 1/16" (1.587 mm) over or under is acceptable. The tolerances listed above apply to 20% of the pieces in a shipment.

Source: (4,5).

In North America, the length of softwood lumber generally starts at 6 feet with 1 foot increments to lengths as long as 24 feet. JAS expresses these lengths in metric units and requires that the length of lumber shall not be shorter than the specification length.

4) Defect Allowances

Table 2 of Appendix I presents the JAS grading rules for Framing A and Framing B lumber.

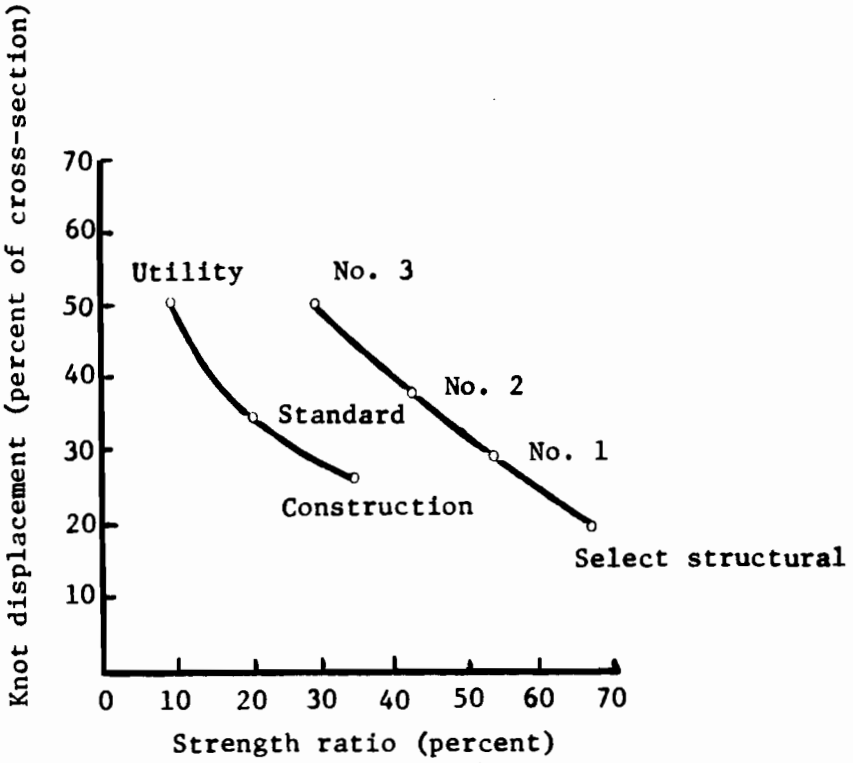
(a) Knots

Limitations on the surface dimensions and spacing requirements for sound, firm, and pith knots of a particular character and location on a piece are metric equivalents of values in the NGR for corresponding grades. Furthermore, the measurement techniques for assessing the magnitude of knots of various types and locations are generally consistent between the JAS and NGR grading systems. Narrow face and

spike knots are assessed in the JAS by utilizing the relative dimension ratio. The ratio involves the estimation of the cross-sectional fiber displacement by the knot as a proportion of the cross section in question (Appendix I Figure 1).

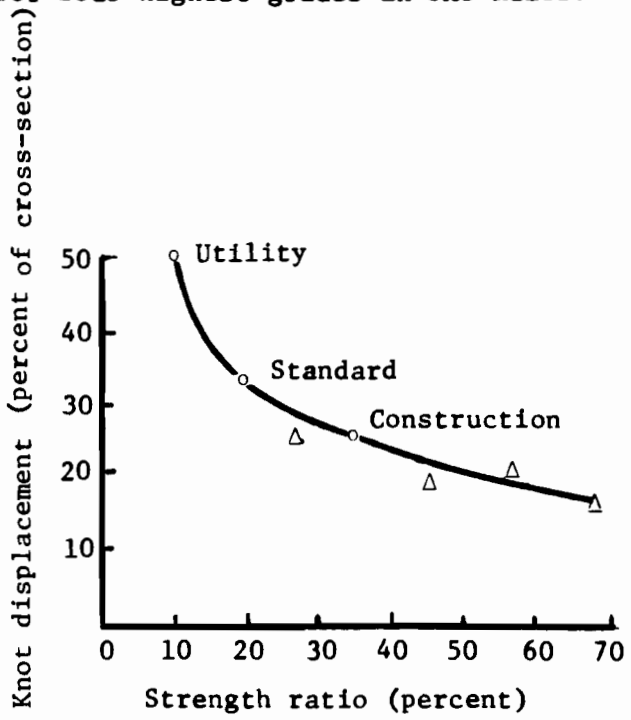
The narrow face knot displacement limitations published in the 1974 version of the JAS are more restrictive than those specified in the NGR for corresponding grades. This deviation is due to the adoption of a unique method for deriving narrow face knot displacement limitations by the Japanese. They generated the limitations from a graphical analysis of the relationship (Figure 2) between the NGR specified permissible displacement for narrow face knots spiked entirely across the wide face and the bending strength ratio. The line that represents the NGR displacements for Select through No. 3 was derived geometrically from the theory of strength ratios. The NGR displacement values for Construction through Utility were adopted from traditional yard lumber limitations which are more conservative than the values that mathematical modeling based on strength ratios would have generated. The Japanese decided to limit narrow face knot displacement to a value equal to that of knots spiked entirely across the wide face of the cross section and they extrapolated from the graphical relationship for the Light Framing grades Construction, Standard, and Utility to obtain displacements for their Framing A lumber grades Select, Grade 1, Grade 2, and Grade 3. Figure 3 shows the graphical relationship from Figure 2 and their extrapolation. The triangles represent the coordinates of the Framing A lumber grades. The displacement values obtained were rounded to simple fractions for convenience in application. Table 3 summarizes the differences between the JAS Framing A and B grades and the corresponding grades in the NGR

Figure 2. Permissible narrow face knot displacements versus bending strength ratios from the National Grading Rule.



Source (9)

Figure 3. Extrapolated and rounded knot displacements permitted for four highest grades in JAS Rules.



Source (9)

with respect to narrow face knot displacement. The impact of the discrepancies on the probability and magnitude of a percentage degrade of U.S. NGR graded shipments to Japan subject to reinspection under JAS provisions was a legitimate concern of U.S. producers, exporters, and Japanese importers.

Table 3. Maximum narrow face knot displacement allowed under the NGR and JAS grading rules.

Grade	Grading Rule NGR[1] (%)	JAS[2] (%)
Select	21	17
No. 1	29	20
No. 2	36	20
No. 3	43	25
Construction	43*	25
Standard	57*	33
Utility	71*	50

*When a narrow face knot is spiked entirely across the wide face of the cross section, the NGR and JAS displacement allowances are equal (i.e., Construction = 25, Standard = 33, and Utility = 50).

[1]Source (9).

[2]Source: (16)

(b) Wane

Differences in wane allowances (Table 4) between the JAS lumber grades and their NGR correspondents were another significant source of potential degrade of U.S. lumber shipments to Japan. The NGR wane allowances were not derived on a mathematical basis from strength ratio theory; instead they primarily address customer tolerance of wane. The JAS provisions for wane are stricter due to the lack of the extra wane allowance for 5% of the pieces in a shipment of Framing A or B lumber.

The extra allowance specified in the NGR applies over 25% of the length of the piece.

(c) Degrade effects of differences between JAS and NGR rules for a knots and wane

The JAS limitations on narrow face knot displacement and wane have the potential of causing degrade during Japanese reinspection of U.S. shipments. The Western Wood Products Association (6) estimated the degrade due to the stricter narrow face knot and wane limitations (Table 5). The more restrictive Japanese provisions resulted in an average degrade of 11% for Construction, Standard, and Utility. On a Standard and Better basis shown at the bottom of the table, the average degrade was 7.6%. These degrades all dropped from Standard or Construction to Utility or Economy under the Japanese rules. These tests did not incorporate possible additional degrade due to differences in treatment of fissures or differences in manufacturing tolerances.

(d) Fissures (checks, splits, shakes, etc.)

The differences between the NGR and JAS methods of fiber separation assessment can potentially cause product acceptance problems for North American shipments to Japan. The Select, Grade 1, and Construction grades of JAS Framing A and B lumber do not permit any through fissures at the ends of a piece while corresponding NGR grades permit through checks at the ends of a piece which are limited as splits. The NGR provisions for Select-No. 2 and Construction allow several heart shakes away from the ends of the piece, none of which are through the thickness. The JAS restricts all fissures away from the ends of the piece to half of the thickness.

Table 4. Maximum wane allowed under NGR and JAS grading rules.

Grade	NGR	JAS
SS, No. 1 Construction	25% of thickness, and width full length, or 50% of thickness and 33-1/3% of width for 25% of length	25% of thickness and width or less
No. 2, Standard	33-1/3% of thickness and width full length, or 66-2/3% of thickness and 50% of width for 25% of length	35% of thickness and width or less
No. 3, Utility	50% of thickness, and width full length, or 87-1/2% of thickness and 75% of the width for 25% of length	50% of thickness and width or less

Source: (9).

Table 5. Degrade of Douglas-fir and hemlock under JAS rules.

U.S. Grade	Volume BF	Degrade--Japanese Rules Knots (%)	Wane (%)	Total (%)
Construction	15,246	3.7	4.1	7.8
Standard	10,062	6.4	9.9	16.3
Utility	10,122	4.7	6.9	11.6
Totals	35,430	4.7	6.5	11.2
Std. and Btr.	25,308	2.8	4.8	7.6

Source: (6).

C. Recent Amendments to the 1974 JAS to Improve Harmony with the NGR

Closer harmonization of the NGR and JAS grading rules was the subject of several bilateral meetings between U.S. government and trade association officials and Japanese authorities. On July 18, 1978, the Japanese Agriculture and Forestry Standard for Platform Framing Construction Lumber was revised (7).

The most noteworthy revision are in the categories of wane allowances and spike knot displacement allowances. The extra provision for wane on 5% of the pieces in a parcel or shipment permitted under the NGR was adopted for Framing A and B lumber graded under JAS. The wane provisions are now consistent between the NGR and JAS.

The 1978 JAS revision included clarification of narrow face knot displacement allowances for Framing B lumber. The displacement limitations now apply to narrow face knots which are spiked across the wide face. Therefore, the spike knot restrictions for JAS Framing B lumber grades match their NGR correspondents.

The narrow face knot displacement allowances for Framing A lumber grades remain more severe than their counterparts in the NGR structural framing grade series. As mentioned previously, this discrepancy results from different methods of deriving displacement limitations. Producers grading to unmodified NGR provisions with respect to narrow face knot displacement should therefore expect some percentage degrade of the structural framing grades reinspected in Japan as Framing A lumber.

The discrepancy between the JAS and NGR with respect to the evaluation of fissures continues as well as the tolerance differences,

and may present an additional source of percentage degrade of lumber shipments.

D. Implications of Differences Between the JAS and NGR Rules

The pre-1978 differences between the North American and Japanese grading rules for platform framing lumber created complexities for North American producers that manufacture for Japanese as well as North American markets. Grading lumber destined for Japan under JAS rules required special production sorts. Logistical and inventory management problems were a consequence. Many North American producers have utilized NGR grading formats with adjustments for wane tolerance, and spike and narrow face knot displacement limitations to minimize the risk of reinspection degrade. The 1978 revision of the JAS eliminated the requirement of North American PF lumber exporters to Japan to modify NGR provisions for framing lumber wane allowances, and Light Framing spike knot allowances, to conform to the JAS. The probability of percentage degrade of U.S. PF shipments to Japan has been substantially reduced. However, the remaining stricter JAS provisions for product tolerances, fissures, and Structural Framing narrow face knot allowances suggests that the risk of JAS reinspection degrade may persist.

Another risk-minimizing measure instituted by exporters is the sales and invoice of lumber shipments on a Standard-and-Better basis using regular or modified NGR provisions. No specific footages by grade are guaranteed. Lumber that might normally drop from Construction to Standard would not be tallied as a degrade against a specific invoiced volume of Construction grade. This sales method does not protect against degrades from Construction to Utility, but some risk reduction to the

producer or exporter is afforded. A variation of the sales approach is the sale and invoice on a Standard-and-Better basis with a percentage limitation on the amount of Utility that can occur in a shipment due to degrade.

An alternative risk reduction procedure is the negotiation of an agreement with the purchaser to acknowledge and scrutinize the invoice on a North American rule basis. Claim settlements in cases of dispute are honored only on the provisions of the NGR. This sales method is the most difficult to establish. No such trading relationship was revealed during the information-gathering phase of this report. The Japanese Construction Standard law requires that all lumber and plywood imported from the United States and Canada for use in PF construction must be inspected under the JAS. For this reason, the majority of producers contacted either override NGR provisions or invoice on a Standard-and-Better basis in order to minimize reinspection degrades in Japan. The variety of tolerance provisions available to North American manufacturers producing for domestic and export markets can create confusion as to the proper tolerance to adhere to for production of dimension lumber destined for Japanese markets. The most efficient solution is the adoption of JAS tolerances for production runs destined for Japan.

E. Inspection Procedure

The inspection procedure for U.S. PF lumber shipments entering Japan is quite complex and has the ultimate effect of raising the cost of PF lumber to the end user. The key distinction between the Japanese and American lumber inspection systems is that JAS grading is done by lumber user groups whereas in North America grading is conducted almost entirely

by lumber producers. There are two registered grading institutions in Japan: Hokkaido Forest Products Inspection Association and the All Japan Federation of Lumber Association. Figure 2 of Appendix I highlights the inspection procedure for imported PF lumber shipments. The importer or distributor applies to the cost of the lumber, charges for breaking down incoming shipments, and procuring and applying labels. These charges have been estimated to escalate the cost of incoming shipments from $30 to $80/MBF (6).

On May 25, 1983, the Ministry of Agriculture, Forestry and Fisheries revised laws pertinent to the regulations on agricultural commodities. (12) With revision of the laws, those foreign overseas sawn lumber and plywood millers who come up to the Standard of the Ministry of Agriculture, Forestry and Fisheries, are allowed to indicate JAS certification on their products in the mill, and thereby bypass the reinspection system in Japan. The revised law pertaining to the JAS indication is to be enforced within 3 months after the notification date (May 25, 1983). Figure 3 of Appendix I outlines the revised law. The implementation procedure involves periodic travel of certified JAS inspectors to participating mills to conduct audits of the grading procedure and results. The revised law may promote foreign trade associations to secure JAS certification in order to harmonize its implementation by association members. A governmental organ or grading organ can apply for registration with the Japanese government for certification.

F. Summary

The decision to produce PF lumber for the Japanese market requires consideration of differences in product specifications, inspection procedure, and logistics, and the growth of the Japanese PF lumber market among other factors. The North American softwood lumber grades have clearly identifiable cross references in the Japanese Agricultural Standard. The latest WWPA translation (16) contains the most current provisions. The narrower product dimension spectrum in the JAS may potentially require special sorts to select material for the Japanese market. The non-acceptance of "Economy" grade material under the JAS provisions may create additional material routing/marketing problems. Differences in NGR and JAS provisions for narrow face knots, assessment of fiber separations, and manufacturing tolerances may cause a percentage degrade of North American shipments subject to reinspection in Japan under JAS. Table 3 presented the degrades attributed to narrow face knot specifications for Light Framing Grades Construction, Standard, and Utility prior to the 1978 JAS revision. Degrades of the structural framing grades Select, No. 1, No. 2, and No. 3 may also occur due to less severe narrow face knot displacement values than expressed for corresponding JAS grades; however, the distribution of percentage degrades have not been determined from trade association tests of these grades. In addition, the percentage degrade of NGR graded parcels due to less severe manufacturing tolerances, or fissure allowances have not been determined.

Internalizing the JAS certification/inspection process as provided by new Ministry regulations, can enable the North American producer to increase the suitability of the softwood dimension product for Japanese

markets, and generate a product that is more price competitive in the end user markets.

SECTION III

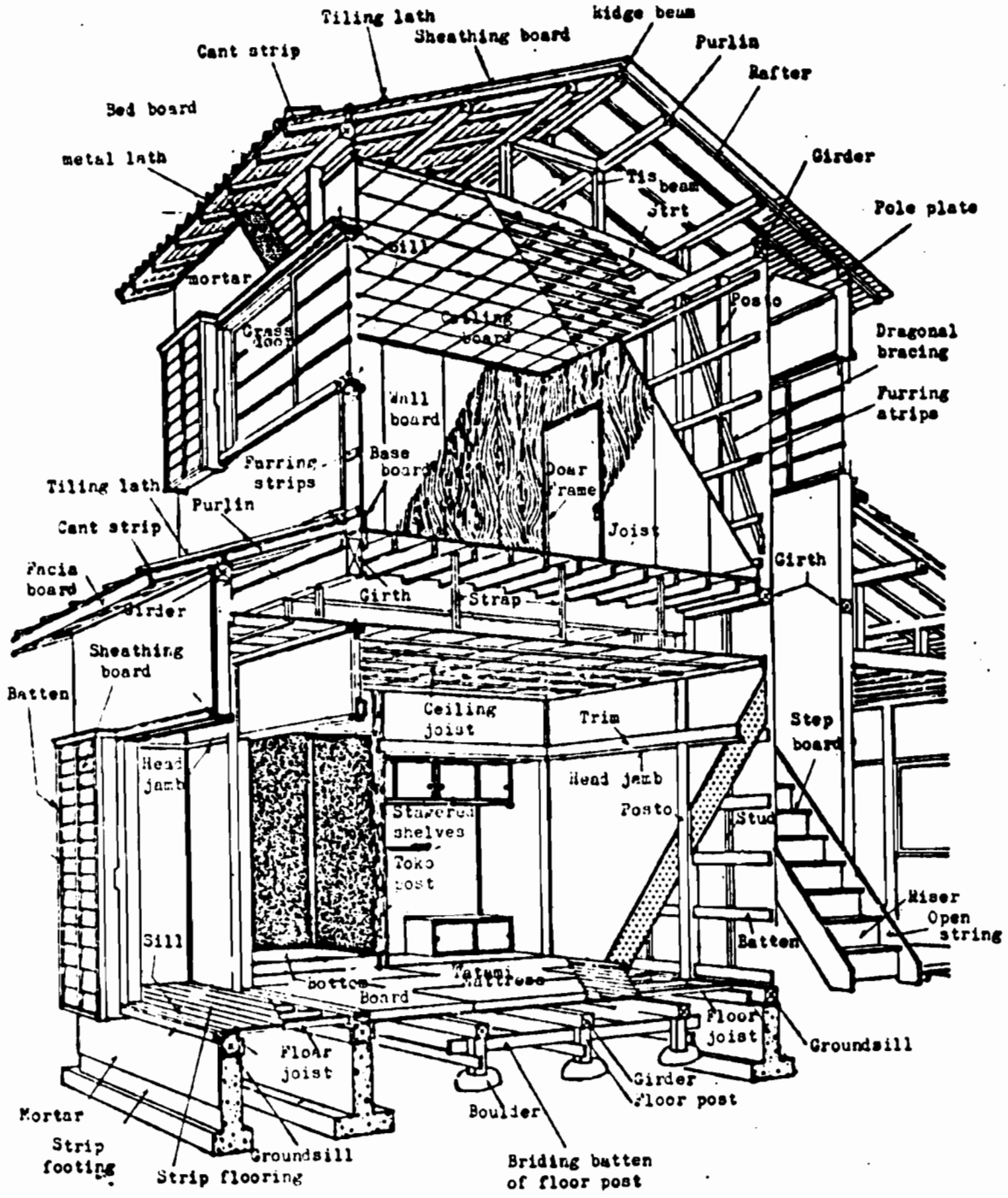
LUMBER PRODUCT SPECIFICATIONS AND GRADING SYSTEMS FOR JAPANESE TRADITIONAL POST-AND-BEAM CONSTRUCTION

A. Traditional Japanese Construction Technique and Lumber Product Spectrum

The traditional Japanese construction method involves the use of posts and beams as the principal structural framework. In contrast, the North American platform frame method utilizes framed wall units as principal structural units. Historically the architectural and engineering skills required for traditional housing construction in Japan have been embodied in the Japanese carpentry profession. The profession developed within a family guild system for shrine, temple, and domestic construction.

Figure 4 presents a common version of the Japanese traditional house. The design specifications for the traditional house are drawn on a grid which forms 910 mm (3 ft) squares; one half the size of the 910 mm x 1820 mm (3 x 6 ft) tatami mat which is used extensively in Japan as floor covering. The standard heights of the traditional Japanese house are 3 meters and 6 meters for one- and two-story houses, respectively. Lumber products are designated for specific construction applications through a nomenclature system which implicitly defines the product dimension range, quality, end use, and associated species (Table 6). The variance in lumber product dimensions corresponding to a given end use application can be attributed to unique design requirements due to builder/home buyer preference or environmental conditions such as snow loading, or earthquake hazard potential. The first of the corresponding

Figure 4. Construction components of a Japanese traditional house.



Source (17)

Table 6. Japanese traditional housing lumber categories.

Product	End use application	Length (m)	Cross section (mm)	Preferred species
Dodai	Ground sills along concrete foundation	4	102 x 102 103 x 103 105 x 105 118 x 118 120 x 120	Hemlock Yellow Cedar Larch Port Orford Cedar
Hashira	Vertical load supporting posts	3	102 x 102 103 x 103 105 x 105 118 x 118 120 x 120	Hemlock Port Orford Cedar
Keta	Horizontal crossbeams (girder) supporting roof joists or second floor joists	3 4 6	105 x 105 118 x 118 120 x 120	Hemlock Larch Douglas-fir Port Orford Cedar
Kamoi	Lintel, head jamb	2 3 3.65 4	45 x 105	Hemlock
Mabashira	Studs	3	27 x 105 30 x 105	Hemlock Larch
		4	27 x 90 33 x 105	Douglas-fir White spruce
Hirakaku	Crossbeams	3 4	105 x 120 and wider	Douglas-fir Pine

Table 6. (continued)

Product	End use application	Length (m)	Cross section (mm)	Preferred species
Moya	Ridge beams purlins sleepers	3 3.65 3.8 4 4.88 5.49 6	85 x 85 90 x 90 100 x 100	Douglas-fir Hemlock Larch Cedar
Neda	Floor joists rafters	2 3 3.65 3.8 4	45 x 105	Hemlock Douglas-fir
Kaku	Load supporting timbers	3 3.65 3.8 4	105 x 105	Douglas-fir
Shikii	Door sills, windowsills	2 3 3.65 4	45 x 105	Hemlock
Taruki	Rafters	3 3.65	36 x 36 42 x 42 45 x 45 45 x 60 45 x 90	Hemlock Douglas-fir

Table 6. (continued)

Product	End use application	Length (m)	Cross section (mm)	Preferred species
		3.8	51 x 51	
		4	36 x 45 33 x 72	
Sujikai	Diagonal bracing	3 3.65 4	45 x 105	Hemlock
Dobuchi	Horizontal bracing	3 3.65 4	15 x 85 18 x 85 20 x 90	Hemlock

species lists is the dominant species for the particular end use. The following discussion will relate these product categories to the construction sequence of a traditional Japanese house. Generally, these products are purchased in the rough green form and are passively air-dried.

The construction of a traditional Japanese house can be regarded as consisting of three phases. In phase one, the preservative-treated ground sills (Dodai) are installed on a concrete foundation. The function of Dodai is to distribute evenly the loads to be supported by the vertical posts (Hashira). The horizontally installed Dodai essentially ties the subsequently installed structural framework to the concrete foundation. Dodai is 4 meters in length and range from 105 to 120 mm square in cross section. Dodai are generally derived from hemlock, yellow cedar, or larch. The concern in Japan for minimizing earthquake damage underscores the importance of the structural performance capability of the wood composing the groundsill and the method of attachment to the foundation.

The next construction phase involves the erection and reinforcement of the basic structural skeleton which involves the attachment of posts to the groundsills and the attachment of beams to the posts. The critical points in the framework are the splicing and connecting joints utilized to join the structural members. Most splicing and connecting joints are reinforced with screws, bolts, iron fish plates or polymer resins. To further reinforce the framework, diagonal or cross bracing is added.

The vertical load supporting posts in the basic skeleton are called Hashira or Kaku. The standard dimensions of Hashira range from 102-120

mm square with a 3 meter length. The quality specifications for Hashira require clear faces and extremely accurate product geometry since Hashira posts are generally exposed to view in the finished home. Therefore both appearance and structural criteria are important. No wane is tolerated on Hashira and it must generally be free of heart center, and lack appreciable stain, pitch pockets, coarse or ripple grain. The Japanese carpenter often applies a hand planed finished to the Hashira posts. Hemlock is the primary species used for Hashira.

Kaku is another type of vertical load-supporting timber with a 105 mm square cross-section. It is generally not exposed to view in the final construction configuration, hence appearance quality requirements are subordinate to overall structural performance capability. Kaku is often produced from old-growth Douglas-fir which is widely recognized in Japan for its structural attributes, but it is not utilized where excellent appearance as well as strength are critical concerns due to its color and grain characteristics,

The beams incorporated in the skeletal framework are designated Keta, and Hirakaku. Keta ranges in cross section from 105-120 mm square, and in length from 3 to 6 meters and is generally derived from hemlock. The Hirakaku crossbeam is produced principally from Douglas-fir in cross-sectional sizes of 105 mm x 120 mm and wider, and lengths of 3 and 4 meters. Horizontal and diagonal bracing is accomplished by applying the Dobuchi and Sujikai products, respectively. Splicing and connecting joints are applied to the lumber for locations where the braces cross or connect with the other structural members. The Mabashira (stud) product is built into the structure in order to support the subsequently installed sheathing materials.

Joinery is also utilized to strengthen and stabilize the framework. Members joined to the framework both above and below the floor such as sills and lintels promote structural stability. Sills and lintels are designated as shikii and kamoi, respectively.

The wood floors of a traditional Japanese house are installed concurrently with the erection of the structural framework. The floor structure consists of sleepers, joists, and floor boarding. The joists are classified as Neda.

The roof truss installation is generally the final stage of the structural component construction. The structural products composing the roof truss include ridge beams, purlins, rafters, crossbeams, and posts. The Japanese style roof truss consists of a series of posts set on crossbeams, with the purlins which support the rafters and the roof set on top of the posts. The emphasis placed on the esthetic attributes of the roof truss depends on the design technique. Exposed rafter construction has long been favored in Japan, although Figure 4 presents a common design in which ceiling board is utilized which conceals the roof truss structure. The ridge beams and purlins in the roof truss are end use applications of the Moya product. The Taruki product is applied in the truss as rafters. The crossbeams in the roof truss are designated as Keta or Hirakaku. The product name designation for the short posts in the roof structure was not determined during the literature review or producer interview. These posts may be remanufactured from the larger post products (Hashira, Kaku). In Japanese architecture, there are various methods of assembling various roof truss components in order to achieve differing degrees of roof pitch. Metal reinforcement of the roof truss joint assemblies is common. Subsequent non-structural construction

phases involve the application of sheathing materials, and refinements of interior, and exterior design.

Knowledge of the relationships between the structural lumber products and their end use application, summarized in Table 6, promotes an understanding of the relative importance of appearance versus structural performance requirements for each product category. The Japanese softwood lumber grading system provides further insight on traditional lumber product specifications.

B. Japanese Grading Systems for Traditional Housing Lumber Products

Two pertinent quality standards of the Japanese Ministry of Agriculture and Forestry are: Notification 1841 "Grading and Measuring Regulations for Logs and Cut Lumber" adopted by the Ministry in 1967 and Notification (1892, 406) "Standards for Sawn Lumber, Balk Lumber, and Lumber with Edge" initially adopted on October 14, 1972, and most recently amended on March 19, 1981.

1) Notification 1841

There are a variety of unofficial English translations of Notification 1841 which either attempt to present the standard in its entirety, or extract selected provisions relating to softwood lumber.(18) Notification 1841 is a generalized grading rule which is intended to evaluate the quality of logs, hewn squares (cants) and lumber. The generalized grading provisions are extremely inefficient for evaluation of traditional lumber products.

In Notification 1841, lumber intended for use in architectural construction is designated as "basic cut lumber" which is further

classified as small, medium, or large depending on whether the lumber width is less than 14 cm, between 14 cm and 30 cm, or greater than 30 cm, respectively. Table 1 of Appendix II specifies the measurement techniques for volume determination. Thickness, width and length are expressed in centimeters and volume is expressed in cubic meters.

The lumber defects considered in JAS Notification 1841 include knots, bends (distortion), splits, loose heart, shakes, and holes. Defects present on lumber which are not addressed in the grading standards are limited depending on the impact of the defect on lumber utilization. Table 2 of Appendix II lists the measurement techniques for explicitly restricted defects. Explicit recognition of wane, slope of grain, and rate of growth is conspicuously absent. In addition, there are no manufacturing tolerances for softwood lumber products. Table 3 of Appendix II presents the grading standards for small, medium, and large basic lumber which will be briefly reviewed.

a) Small basic lumber

The standards for small basic lumber also apply to hewn squares with widths less than 14 cm or logs less than 14 cm in diameter. The imprecision of the generalized standards for lumber grading is evident. Small basic lumber is graded for conformity to one of two sets of provisions: class one or class two. Each set of provisions recognizes only two sets of defects: "bends" and "others." Bends are limited in terms of the maximum arc height of the piece distortion as a percentage of the piece width. All other lumber defects are limited qualitatively as either "not excessive" or "excessive."

b) Medium basic lumber

The grading of medium basic lumber requires the application of more explicit, quantitative defect limitations than small basic lumber grading. Medium basic lumber is classified in terms of its conformity to the provisions of one of three grades: First, Second, or Third. The restricted defects include knots, bends, splits, shakes and decay. The grading provisions are applicable to lumber or cants having widths between 14 cm and 30 cm, or logs with diameters between 14 and 30 cm.

c) Large basic lumber

The provisions for large basic lumber are designated for the grading of lumber or cants with widths greater than 30 cm or logs with diameters greater than 30 cm and is similar in scope to the provisions for medium basic lumber except that four lumber grades are classified. The "Fourth" grade has no specific defect limitations. It serves as a classification alternative for large logs, cants, or lumber which does not conform to the provisions of the upper three grades.

d) Critique of JAS Notification 1841

The grading system has two areas of major shortcomings: defect limitations and product dimensional requirements. The omission of critical factors affecting lumber strength such as rate of growth and slope of grain from the explicit limitations of the grading system is a major disadvantage. The absence of explicit wane allowances limits the scope of the grading system to address concerns for product appearance requirements. The absence of standard product dimensions for lumber or

manufacturing tolerances limits the effectiveness of the grading system as a quality assurance system.

These shortcomings can be attributed to the generalized nature of the application of the JAS grading rule. The standards published in Notification 1841 do not play a significant role in the grading of finished Japanese traditional lumber products. Notification 1841 has historical significance with respect to cant and lumber grading in Japan since the lumber and cant grading system evolved from the log grading system.

As a result of the deficiencies of the official Japanese lumber grading system, proprietary grading systems were developed in Japan for the standardization of the quality of traditional lumber products.

2) Proprietary Grading Systems

Proprietary grading systems for Japanese traditional housing lumber developed through agreements between Japanese lumber manufacturers, and distribution entities or product users. Although the specific details vary regionally, the general structure of the proprietary system is uniform. The lumber grades can be categorized into 3 types: clear face grades, premium construction grades, and general construction grades. Table 7 presents the grade spectrum. The Japanese clear face grades (Muji) were developed primarily for the grading of the Hashira product (Table 6). The grading of Hashira emphasizes clear faces and corners which can be exposed to view in the construction. The Japanese lumber purchaser selects Hashira graded 1, 2, 3, or 4 face clear depending on the angles at which the product will be exposed in the house. Generally no wane, stain, pitch pockets or heart center is permitted on the clear

Table 7. Proprietary grading system for Japanese traditional housing products.

Grade classification	Proprietary grade	
	English	Japanese
Clear Face Grades	4 Face Clear	
	3 Face Clear	Muji
	2 Face Clear	
	1 Face Clear	
Premium Construction	fine small knot	Jyoko
	small knot	Kobushi
	special first	Tokuichi
General Constrction	first	Itto
	second	Nitto

face grades. For appearance considerations, slope of grain is limited. With respect to the 1-3 clear face grades the appearance-related defects on the non-clear face are limited.

The premium construction grades "fine small knot," "small knot," and "special first" grades translate in Japanese to Jyoko, Kobushi, and Tokuichi, respectively. These grades provide high quality construction lumber for end use applications in traditional Japanese houses with less stringent appearance requirements than Hashira. A proportion of Hashira products is also graded for conformity to one of the premium construction grades rather than one of the clear face grades. The primary control variables distinguishing the grades are knot sizes, knot quantities, and wane allowances. Wane, where permitted, is strictly limited in each of the premium construction lumber grades.

The general construction grades First (Itto) and Second (Nitto) are similar to North American construction grades. However, the restrictions on wane, slope of grain and unsound wood are stricter than their closest North American counterparts (Standard and Utility, respectively).

Proprietary manufacturing tolerances for traditional Japanese lumber are stricter than North American standards. A width and thickness tolerance of ±1.0 mm with respect to the specified size is a generally accepted convention. Length tolerance is -0.

Table 8 lists the expected grades utilized to evaluate traditional lumber products under the proprietary system. The relationships are based on the product marketing emphasis of a U.S. lumber manufacturing firm.

The existence of a proprietary system for evaluating traditional Japanese lumber products has not directly benefited a significant number

Table 8. Acceptable Japanese grades for traditional lumber products categories.

Product category	Acceptable grades
Hashira	3 or 4 Faces Clear 2 Faces Clear Jyoko Tokuichi/Itto
Keta	Tokuichi/Itto Nitto
Mabashira	Tokuichi/Itto Nitto
Taruki	One or more faces clear Tokuichi/Itto Nitto
Shikii/Kamoi/Neda	One or more faces clear Jyoko Tokuichi/Itto Nitto
Moya	Itto
Kaku	Itto Nitto
Hirakaku	Itto Nitto

of exporting U.S. lumber manufacturers. The information flow network from Japanese lumber purchasers and distributors to North American exporters is limited with respect to details of the traditional lumber product specifications and grades. With incomplete knowledge of Japanese specifications North American exporters have utilized modified North American lumber grading systems to approximate the Japanese system. Table 9 presents a cross reference between the proprietary Japanese system, the appropriate correspondence in the National Grading Rule (NGR) and the areas of modification. This relationship was confirmed from lumber producer contacts during the information-gathering phase for this report.

The NGR select grades B and Better, and C select are frequently utilized as a 'proxy' for the 1-4 face clear grade series. Lumber is evaluated on all 4 surfaces for grade provision conformity. The NGR grades may be slightly modified by special restrictions on wane and slope of grain.

NGR grade proxies for the Jyoko, Kobushi, and Tokuichi grades were not determined from interviews with selected U.S. producers. A Canadian based lumber manufacturer utilizes the NGR Factory Select--No. 1 shop grade series as a proxy for the Japanese Jyoko grade which often is remanufactured in Japan as door and window parts. Special qualifiers to the NGR grades are implemented for slope of grain and unsound wood.

Based on the practical experience of U.S. and Canadian exporting lumber manufacturers, the closest NGR correspondents to the Japanese grades Itto and Nitto are Standard, and Utility respectively. Special revisions to the NGR grades with respect to wane, slope of grain, and unsound wood are implemented. A Canadian lumber manufacturer/exporter

Table 9. Cross reference of proprietary Japanese grading system and corresponding National Grading Rule grades.

Lumber Grade Cross Reference		Modified NGR Provisions
Japanese	National Grading Rule	
1-4 Face clear	B/C Select	Wane Manufacturing tolerances Slope of grain
Jyoko	Factory Select No. 1 Shop	Manufacturing tolerances Slope of grain Unsound wood
Tokuichi	Standard and Better	Wane Manufacturing tolerances Slope of grain Unsound wood
Itto	Standard	Wane Manufacturing tolerances Slope of grain Unsound wood
Nitto	Utility	Wane Manufacturing tolerances Slope of grain Unsound wood

considers to Japanese Tokuichi grade to be similar to the Itto grade with the distinction related to tighter restrictions on wane and non-strength impacting appearance defects.

North American lumber producers exporting to the Japanese traditional housing market generally manufacture the required metric sizes or the closest English equivalent. Under circumstances in which the underlying metric sizes required for the Japanese products are not considered at the stage of manufacture, the exported product is remanufactured in Japan before final distribution. The marketing advantage obtained from manufacturing to the required metric sizes must be reinforced by adhering to the strict required manufacturing tolerances of ±1.0 mm for thickness and width or the closest convenient English equivalent (±1/32 inch).

3) Notification 1892 (N 1892)

The drafting of the "Japanese Agricultural and Forestry Standard (JAS) for Sawn Lumber, Balk Lumber, and Lumber with Edge" (Notification 1892, 406) was significantly influenced by the existence of the proprietary system. Currently, there exists no official ministry sanctioned English translation of the standard. However, the Japan External Trade Organization (JETRO), a quasi-public organization has published an English translation. (19) The JETRO document authors emphasize that their translation is an unofficial preliminary document and recommend that the official Japanese language text be consulted when doubt arises concerning provisions of the standard.

The standard as translated by JETRO addresses three categories of lumber: sawn lumber, balk lumber, and unedged lumber. Virtually all of

the softwood lumber for traditional housing construction evaluated under the 1981 standard is classified as 'sawn lumber' and graded using the appropriate provisions corresponding to its product size classification. 'Sawn' lumber is derived from old- and second-growth raw material. 'Balk' lumber is derived primarily from thinning logs, and is directed to end uses such as concrete forming and bridge construction. 'Unedged' lumber is subsequently remanufactured into door and window parts or furniture components and has greater pertinence to hardwood lumber grading than softwood lumber grading in practice.

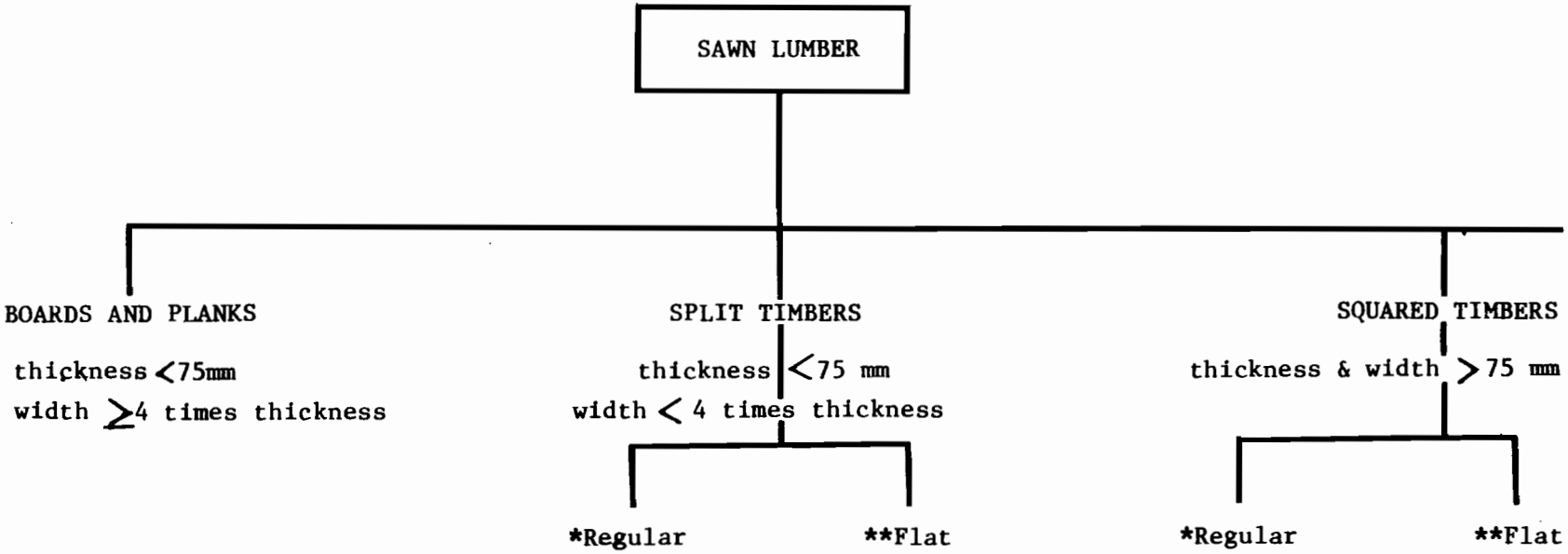
The sawn lumber standard will be emphasized here due to its particular relevance for the grading of Japanese traditional housing lumber products.

a) Sawn lumber

(i) Product classification structure--Sawn lumber is defined as lumber designated for construction or other general purposes. N 1892 classifies sawn lumber into three major categories based on thickness and width--Boards and Planks, Split Timbers, and Squared Timbers (Figure 5). Within the Split and Squared Timber cross-sectional size categories there are further subdivisions of lumber based on cross-section geometry. Appendix III Table 1 presents the standard dimensions of softwood lumber with the domain of the product classifications superimposed.

Articles 4 through 9 in the N 1892 specify measurement techniques for determining cross-sectional size, length, lumber tally and parcel volume of sawn lumber (Appendix III Table 2). Cross-sectional measurements are taken at the minimum cross-sectional area along the length of the piece. The quantity of lumber is expressed in leaf

Figure 5. Structure of sawn lumber product categories.



* square cross-section

**non-square rectangular cross-section

Note: Split and squared timber classifications refer only to a specific range of lumber cross sectional sizes and not to a state of manufacture.

(individual piece) or bundle (group of pieces) for Boards and Planks, and in piece or bundle for Squared or Split Timbers. The volume of individual lumber or bundles is required to be expressed in cubic meters.

(ii) Defect measurement techniques--Article 12 of N 1892 specifies the techniques for assessing the impact of softwood defects. Knots in softwood sawn lumber are measured in terms of their individual diameter and the contribution of knot diameters to the 'knot diameter ratio' (k.d.r.) of the piece. Knot diameter ratio is defined as the percentage of the diameter of a knot to the width of a lumber surface in which it exists. This measurement technique is an indirect measure of the impact of the presence of knots on the strength properties of lumber due to fiber displacement. Two-dimensional fiber displacement due to surface knots is estimated in visual stress grading by assuming that knots are cylindrical with their surface dimensions equal to the knot diameter and their length equal to the thickness of the piece. This two-dimensional displacement area as a fraction of the cross section of the piece of lumber in which it exists is proportional to the diameter of the knot as a fraction of the width of the lumber surface in which it exists (knot diameter ratio). The knot diameter ratio was related to the strength of a given cross-sectional area of a piece of lumber early in the development of visual stress grading in the United Kingdom and North America.

To measure the k.d.r. of a piece of lumber, the grader focuses on the most severely knot impacted cross section of the piece. At that locus the k.d.r. is calculated as the summation of the k.d.r.'s of all knots arranged laterally at the specific cross section. In effect, knots arranged laterally are considered as 'one' knot for the purposes of

k.d.r. calculation. The k.d.r. calculation is compared with the limitations specified for each grade in order to make a preliminary determination of piece grade. Appendix III Table 3 summarizes the procedure for measuring knot diameters and calculating the k.d.r. The manner in which the k.d.r. is implemented in the grading rules for sawn lumber depends on the product size. The variations will be discussed when the grading rule provisions are presented.

Appendix III Tables 4-6 present the techniques for assessing other strength and non-strength impacting defects. The measure of knot displacement (k.d.r.), slope of grain and rate of growth are evidence of the intention of the Japanese to develop a visual stress grading system. Additional lumber defects recognized in the sawn lumber standard include wane, end splits, ring shake, resin pockets, bark pockets, blemishes and holes.

Wane is one of the most critically evaluated lumber characteristics in the grading of traditional Japanese lumber products. Wane minimization or prohibition on lumber to be left exposed in the final construction configuration of the traditional Japanese home is a pervasive standard. For the lumber producer wane minimization in product output requires the underutilization of the cross section of a log as compared with products that allow wane and therefore has a negative impact upon lumber recovery. N 1892 specifies measurement techniques for assessing wane which have common and divergent elements to the North American method. In North American softwood visual stress grading wane is generally restricted in its thickness, width and length dimensions on boards and dimension sizes. N 1892 requires wane measurement on Boards and Planks in the thickness and width dimensions only. Wane restrictions

on Split and Squared Timbers are expressed as the proportion of the wane distance around the perimeter of the piece to the perimeter of the cross section if it were fully rectangular. The wane ratio of the most wane impacted cross section of the piece is measured for comparison with grade limits.

Manufacturing tolerances for each product category in the sawn lumber standard are stricter than the North American and Japanese tolerances for platform framing construction lumber, as well as Export R-list tolerances for clears and merchantable products.

(iii) Grading standard structure--Appendix III Tables 4-6 list the grading standards for sawn lumber. The standards have specific adaptations for the major categories of sawn lumber: Boards and Planks, Split Timbers, and Squared Timbers. A three grade system prevails for each product category with constant grade nomenclature.

The grades in each product category are denoted in hierarchical order as Special Grade, First Grade, and Second Grade, respectively. With respect to the actual phonetic representation of the Japanese language nomenclature, the grades are denoted as Toku-To, Itto and Nitto. The 3 basic grades constitute the foundation of the sawn softwood lumber grading system. In addition to the basic grades, 3 sets of special provisions stressing the appearance characteristics of lumber are standardized in the grading rules for each product category. The 3 special provision sets are designated Clear, Fine Small Knot, and Small Knot--Muji, Jyoko, and Kobushi, respectively, in Japanese. The defect types addressed in these special provisions are subsets of the defect types in the basic grades. The set of defects limited in the special provisions include knots, wane, end splits, decay, wormholes, and

blemishes. The special provision sets are designed to segregate lumber products having appearance attributes superior to the minimum requirements of the basic grades. Grading of lumber classified as sawn lumber is a two-stage process. First the basic grade of the piece is determined. Next the conformity of one or more surfaces of the piece to a special provision set is determined.

Boards and planks (Appendix III Table 4) which are candidates for special classification as Clear, Fine Small Knot, or Small Knot will have the special provision set applied to the best surface of the piece only. The defect limitations of the basic grade are supplanted by the corresponding limitations contained within the special provision set. The reverse surface of the piece is only required to conform to the complete set of standards specified in the predetermined basic grade (Special, First, or Second). Irrespective of the application of special provisions, the worst surface of the board must conform to the specifications of its basic grade. Due to the existence of 3 basic grades and 3 pairs of basic grade/special provision combinations, 12 potential grading outcomes exist for Boards and Planks.

Split Timbers (Appendix III Table 5) and Squared Timbers (Appendix III Table 6) are graded on all 4 surfaces of the piece. To conform to a particular grade, each surface must meet basic grade specifications. The standards for determining the basic grade, and conformity to special provision sets for Split Timbers are separate and distinct from those specified for Squared Timbers. The application of a special provision set to the basic grade of Split or Squared Timbers can focus on 1-4 surfaces of the piece. Therefore 39 grading outcomes can theoretically occur. In practice, the number of outcomes is somewhat less because

generally only Special and First grade lumber qualifies for special designation as Clear or Fine Small Knot on 1 to 4 surfaces.

The preceding discussion described the general structure of the JAS for sawn lumber. The next section presents the grading provisions in more detail.

(iv) Boards and Planks--Boards and Planks are defined as lumber products with thicknesses less than 75 mm and widths measuring at least four times the thickness dimension. The individual basic grades have distinct k.d.r. limitations which range from 20% for the Special (Toku-To) grade to 80% for the Second (Nitto) grade. The prohibition of wane in the Special grade suggests the intended visibility of special grade Boards and Planks in their end use application. The wane restrictions specified for the First and Second grades do not explicitly allow the projection of wane of a given thickness and width along an extensive portion of the length of a Board or Plank. The presence of wane is described as a 'chipped section' of a Board or Plank.

The Special Clear (Muji), Fine Small Knot (Jyoko), and Small Knot (Kobushi) provisions are applied to the best surface of each Board or Plank. The Clear grade prohibits knots, wane, end splits, decay and restricts blemishes. The Fine Small Knot and Small Knot provisions severely restrict the size and quantity of knots. Wane and end split ratios are limited to 3% of the width and length of lumber, respectively.

Manufacturing thickness tolerance is a strict ± 0.5 mm for pieces less than 15 mm in thickness and ± 1.0 mm for pieces greater than 15 mm in thickness. Width tolerance is ± 1.0 mm. The length tolerance is -0.

(v) Split Timbers--Split Timbers are defined as lumber having thicknesses less than 75 mm, and widths less than four times the thickness dimension and therefore are closer to being square in cross section than Boards and Planks. Pieces of square dimensions are designated as Regular Split Timbers and have a maximum cross-sectional size of 75 mm^2. The rectangular, non-square Flat Split Timbers range in thickness from 27 mm to 75 mm and in width from 60 mm to 300 mm. The lengths of Split Timbers range from 1.8 to 4.0 meters.

The Split Timber products are graded for strength as well as appearance. The knot diameter ratio limits for the Special, First, and Second basic grades are 30, 50, and 80%, respectively. The slope of grain requirements for the Special and First grades are 1:20 and 1:12 respectively. Wane restrictions for Split Timbers are strict. No wane is permitted on Special grade lumber unless it is marked "for edge stripping." The wane ratio is restricted to 20% total or 10% on each corner under First grade provisions.

The Clear (Muji), Fine Small Knot (Jyoko), and Small Knot (Kobushi) provisions segregate Split Timbers according to one of the special appearance criteria on one or more surfaces. Muji prohibits knots, wane, end splits and ring shakes. Jyoko and Kobushi restrict sound knot diameters to 10 mm (0.4") and 20 mm (0.8"), respectively. Jyoko and Kobushi also prohibit wane, end splits and ring shakes.

Manufacturing tolerances for Split Timbers are specified at ±1.0 mm for thickness and width while the length tolerance is -0.

(vi) Squared Timbers (Appendix III Table 6)--Squared Timbers are not less than 75 mm in thickness or width. The lumber product size spectrum

designated as Squared Timbers is subdivided into two categories: Regular Squared Timbers and Flat Squared Timbers. The distinction between Regular Squared Timbers and Regular Split Timbers relates to cross-sectional size, and not geometry or manufactured state. Both lumber types are sawn square lumber. The term "split" apparently refers to the relatively smaller cross-sectional sizes designated as Regular Split Timbers.

Regular Squared Timbers--Regular Squared Timbers are squared lumber which ranges in cross-sectional size from 75 mm^2 to 120 mm^2. The length range is 1.8 to 6 meters. Squared lumber with cross sections larger than the standard dimensions specified in Appendix III Table 1 would also be graded under the provisions for Regular Squared Timbers.

The standards for determining the basic grade of regular squared timbers emphasize structural property indicators to a greater degree than the standards for Regular Split Timbers. The greater emphasis is evident for two strength influencing factors: knot diameter ratios and specific gravity estimates. The grading standards require the measurement of two knot diameter ratios: basic k.d.r. and grouped k.d.r. Basic k.d.r. was defined previously. Grouped k.d.r. is defined as the sum of diameter ratios of knots existing in a 15-cm long lumber surface. The grader must scan to the most knot impacted 15 cm section of the piece to calculate grouped k.d.r. and compare the result with the grade limitation. This measurement has implications for the permitted spacing of knots, and ultimately the strength of the piece. The k.d.r. limitations effectively function as lead indicators of grade selection for lumber. If the requirements are satisfied, the remaining grade provisions function to

further justify the products for the construction end use application in light of the overall structural and appearance-related requirements.

The measurement of average growth ring width is required for the Special and First grades of regular squared timbers in order to estimate the specific gravity of the piece.

In order for Regular Squared Timber to be rated Clear or Fine Small Knot on one or more surfaces, the relevant defects existing more than 0.2 meters from either end of the piece must conform to the provisions. The relevant defects existing within 0.2 meters of the ends of the piece need only conform to Small Knot provisions for any surface rated Clear or Fine Small Knot. The defect limitations for the Clear, Fine Small Knot and Small Knot provisions for Regular Squared Timbers are equivalent to those specified for Flat Squared Timbers. Consistent with the special grading provisions for Regular Split Timbers, wane, end splits, and ring shakes are prohibited in all special grading provision categories for Regular Squared Timbers. The special limitations on decay, wormholes, and blemishes are also consistent between these product categories.

The manufacturing tolerances for Split Timbers are equivalent to the tolerances for Regular Squared Timbers.

Flat Squared Timbers--Flat Square Timbers normally range from 90 to 120 mm in thickness and from 120 to 300 mm in width. However, any lumber product having a rectangular, non-square cross section greater than 75 mm in thickness and width is also graded under the Flat Squared Timber provisions.

The knot diameter ratio assessment procedure for Flat Squared Timbers requires the application of different k.d.r. limits depending upon the zone of the piece in which a knot resides. Stricter single knot k.d.r. limits are applied to knots existing within the center one-third of the length of lumber relative to knots existing outside the center zone. The assessment zone is positioned equidistant from the ends of the piece. Grouped k.d.r. is limited in each grade specification.

The First Grade k.d.r. provisions are more complex than Special or Second Grade provisions. The First Grade k.d.r. limitations limit the k.d.r. of knots existing in specific zones of a cross section. The surface and edges of a single piece are divided into 3 equal zones which are oriented parallel to the arrises (corners) of the piece. On the surface region of any given cross section, the k.d.r. limitation for all knots existing within one-third of the piece width from the arrises is stricter than the k.d.r. limitation corresponding to knots located in the center one-third of the piece width. The same principle operates to limit the k.d.r. of edge knots located within one-third of the thickness from either arris to a greater extent than knots located within the center one-third of the edge. Furthermore, the surface and edge k.d.r. limitations are less severe for knots existing outside the center one-third of the length of lumber than for knots existing within the center one-third of the length of lumber. The First Grade k.d.r. provisions essentially subdivide a piece of lumber into 9 assessment zones on the surfaces, and 9 zones on the edges of the piece. The Special and Second grade k.d.r. provisions subdivide a piece into 3 assessment zones on the surfaces and edges of lumber. Figure 6 delineates the assessment zones for the JAS Flat Squared Timber grades.

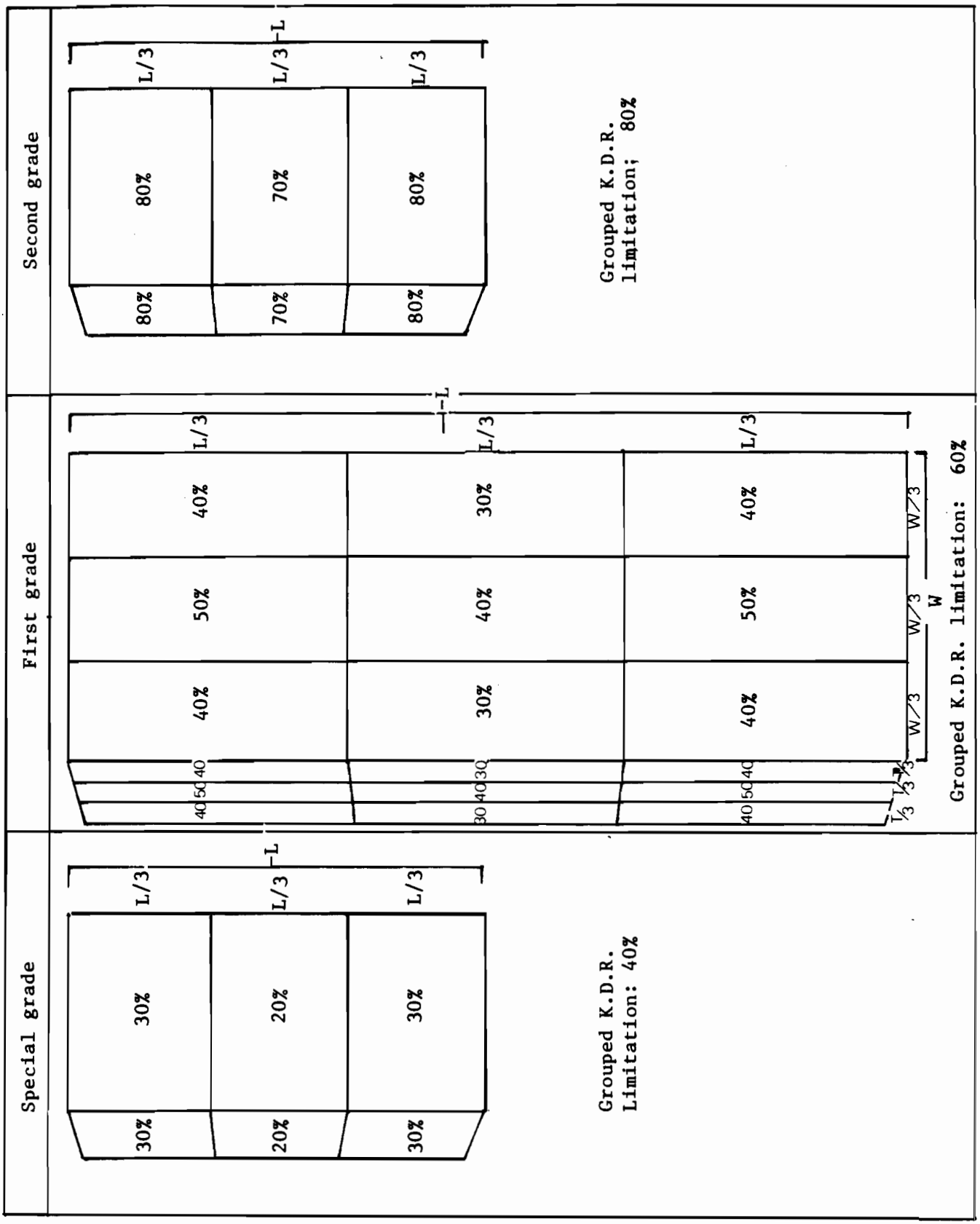


Figure 6. K.D.R. assessment zones for flat squared timbers.

The appropriate k.d.r. limitation corresponding to a particular zone is printed in the zone. The intent of the JAS k.d.r. provisions is clarified in the Figure. Flat Squared Timbers primarily serve as horizontal members in construction applications so bending stress impact is an important consideration. The relatively more severe k.d.r. limitations for the center 1/3 of the length is an apparent result of predicted higher in-service bending stresses in that region. The detailed k.d.r. limitations of the First Grade function to place stricter k.d.r. limits on knots located near the edges of the piece where the expected service bending stresses are highest, and relax the k.d.r. limits for knots located near the neutral axis of the piece.

The wane limitations for the Special Grade for Flat Squared Timbers is slightly less strict (wane ratio 10%) than the absolute prohibition expressed in the Special Grade of Regular Squared Timbers. The wane limitations expressed in the First and Second grades of Flat Squared and Regular Squared Timbers are equivalent.

Excluding k.d.r. limitations and Special Grade wane limitations there are no major distinctions between the grading standards for Regular Squared Timbers and Flat Squared Timbers. The standards of the latter product category, however, do not include provisions for limiting "chipped end." The manufacturing tolerances for Flat Squared Timbers are equivalent to that for Split Timbers.

The Clear Fine Small Knot, and Small Knot provisions for Regular Squared Timbers apply to the appearance grading of Flat Squared Timbers.

(vii) Marking--The N 1892 requirements for marking of graded lumber are uniform across all lumber product categories. Individual products are required to be marked to indicate common species name, standard grade name, thickness, width, length, and the product manufacturer. The type of preservative, insecticide, or kiln-drying process applied to the product must be indicated if applicable. A bundle of lumber is required to be marked to indicate the quantity which it is composed of in addition to individual product marking.

C. Summary of Sawn Lumber Grading System

The Japanese Agricultural Standards for Sawn softwood lumber are designed to standardize the quality of softwood lumber based on dual performance requirements: structural integrity and visual exposure in the construction configuration. The basic (standard) grades Special, First, and Second provide the foundation for estimating the structural performance capability of lumber. Appearance is also addressed in the basic grade provisions. The special quality classes (Clear, Fine Small Knot, and Small Knot) applicable to each basic grade enable the prospective purchaser to target lumber product specifications in light of the unique end use applications which they will serve.

The working stresses for lumber products graded to N 1892 and derived from particular species or species groups were not determined during the investigation for this report. The apparent lack of well-developed working stress tables for the JAS sawn lumber grades hinder the effectiveness for allocating softwood lumber on a specific structural requirements basis. In this regard, the North American and British stress grading systems have a considerable advantage.

Table 10 is an estimation of the grades under which the traditional Japanese lumber products would be evaluated under given their end use requirements.

The selection of North American lumber grades to approximate the Japanese grades is complicated by the existence of special provisions in the JAS which modify basic grades. Selection of the North American lumber grade series which corresponds closest to the JAS basic grade is the first step in approximation. The special provisions in the JAS would then be regarded as special amendments available to modify the North American grade series in order to meet the special requirements of the Japanese purchaser. Table 11 is a cross reference between the JAS grades and the North American National Grading Rule (4) and Export R List Grades (26) which are the closest correspondents to the JAS grades. The table is organized by the JAS product categories. The cross reference is based on the implicit and explicit intent of the JAS and North American grades with respect to the structural and appearance requirements for lumber. The key characteristics for which close correspondence between grades was sought included knot diameter limitations, wane allowances, slope of grain allowances and rate of growth requirements.

The utilization of domestic lumber grades to approximate foreign country lumber standards has been practiced historically for several reasons. Inadequate information sources relating to the details of foreign country lumber grading systems, and low domestic firm emphasis on foreign markets have hindered the assimilation of information on foreign lumber standards by production and marketing personnel in the U.S. forest products industry. Under circumstances in which foreign standard information is prevalent, and market opportunities promising, the

Table 10. N 1892 grading of traditional lumber products.

Product	N 1892 Product category	JAS Grade(s) basic	JAS Grade(s) modified
Dodai	I Squared Timber	*Special	**CL., FSN, SN
	A) Regular Squared Timber	First	CL., FSN, SN
		Second	
Hashira	I Squared Timber	Special	CL., FSN
	A) Regular Square Timber	First	CL., FSN
Keta	I Squared Timber	Special	FSN, SN
	A) Regular Squared Timber	First	FSN, SN
Kaku	I Squared Timber	Special	SN
	A) Regular Squared Timber	First	SN
Moya	I Split Timber	Special	
	A) Regular Squared Timber	First	SN
		Second	SN
Hirakaku	I Squared Timber	Special	
	A) Flat Squared Timber	First	SN
		Second	SN
Taruki	I Split Timber	Special	
	A) Regular Split Timber	First	
	B) Flat Split Timber	Second	
Mabashira	I Split Timber	Special	
	A) Flat Split Timber	First	
		Second	
Kamoi	I Split Timber	Special	CL., FSN
	A) Flat Split Timber	First	CL., FSN

Table 10. (continued)

Product	N 1892 Product category	JAS Grade(s) basic	JAS Grade(s) modified
Neda	I Split Timber	Special	
	A) Flat Split Timber	First	
		Second	
Shikii	I Split Timber	Special	CL., FSN
	A) Flat Split Timber	First	CL., FSN
Sujikai	I Split Timber	Special	
	A) Flat Split Timber	First	
		Second	
Dobuchi	I Boards and Planks	Special	
		First	
		Second	

*Basic grades: Special (Toku-To)
First (Itto)
Second (Nitto)

**Modifying provisions: CL = Clear (Muji)
FSN = Fine Small Knot (Jyoko)
SN = Small Knot (Kobushi)

Table 11. N 1892/North American grading rule cross reference.

JAS Product category	JAS Grade	North American Grades	
		NGR	Export R-list
Boards and Planks	Special	C and Better Select (waneless)	No. 2 Clear No. 3 Clear
	First	D Select No. 1 Common (wane minimized)	Selected merchantable
	Second	No. 2 Common Select merchantable	No. 1 merchantable
Split Timbers	Special	C and Better Select (waneless)	No. 2 Clear No. 3 Clear
	First	D Select (wane minimized) Appearance Framing	Selected merchantable
	Second	Construction Standard	No. 1 Merchantable No. 2 Merchantable
Squared Timbers I Regular Squared Timbers	Special	C and Better Select (waneless)	No. 2 Clear No. 3 Clear
	First	D Select (wane minimized) Appearance Framing	Selected merchantable
	Second	Construction Standard	No. 1 Merchantable No. 2 Merchantable
II Flat Squared Timbers	Special	C and Better Select (wane minimized)	No. 2 Clear No. 3 Clear
	First	Appearance Framing Select structural No. 1 structural	Selected merchantable
	Second	No. 2 structural Construction	No. 1 merchantable No. 2 merchantable

implementation of a foreign standard-oriented lumber production and grading operation in domestic firms may have further obstacles. The retraining of production and grading personnel is a cost burden which must be recovered from the revenues derived from foreign market penetration. There may be restrictions to the implementation of a foreign grading system in a domestic mill due to the job description specifications for unionized grading personnel.

If a producer desires to optimize the sales performance of lumber products in a foreign market, the export production/grading system should be oriented to address the foreign market requirements as closely as possible. However, the considerations discussed above will have significant bearing on the extent to which the producer will achieve the foreign market orientation.

Literature Cited

1. _____. 1974. Japanese agricultural and forestry standard for platform framing construction lumber. Public Notice No. 600, Ministry of Agriculture and Forestry, Japan, Aug. 7.
2. _____. 1974. Grading methods for lumber, timber, and cants. Public Notice No. 756, Ministry of Agriculture and Forestry, Japan, Aug. 7.
3. _____. 1974. Form and methods of labelling the grade of platform framing construction lumber. Public Notice No. 757, Ministry of Agriculture and Forestry, Japan, Aug. 7.
4. WWPA. 1981. Western Lumber Grading Rules 1981. Western Wood Products Association, Portland, Oregon.
5. _____. 1980. NLGA Standard Grading Rules for Canadian Lumber. Canadian Lumber Standards Administrative Board. American Lumber Standards Board of Review.
6. Roberts, H. A. 1976. Developing the Japanese Market for Framing Lumber Modern Plywood Techniques. Vol. 3, Miller Freeman, San Francisco, Calif.
7. _____. 1978. Revision of Japanese agricultural and forestry standard for platform framing construction lumber. Public Notice No. 726, Ministry of Agriculture and Forestry, Japan, June 8.
8. Bishoprick, S. 1976. Export Potential and the Japanese Lumber System. Modern Plywood Techniques, Vol. 3, Miller Freeman, San Francisco, Calif.
9. Ethington, R. L. 1977. Developments in foreign markets: The case for Japan. Forest Products Journal 27(10):54-61.

10. Moshofsky, G. S. 1976. Marketing Light Framing for Japanese. Construction Modern Plywood Techniques, Vol. 3, Miller Freeman, San Francisco, Calif.

11. Wallace, J. C. and M. Sasaki. 1976. Japanese Housing Trends and the 2 x 4 Framing System. Modern Plywood Techniques, Vol. 3, Miller Freeman, San Francisco, Calif.

12. _____. 1983. Indication of JAS mark permitted for overseas wood production mills. Japan Lumber Journal (June 30).

13. Sedjo, R. A. 1983. World Supply of Wood: Economic Resources. World Trade in Forest Products. J. S. Bethel (ed.), University of Washington Press, Seattle, Wash.

14. Utsuki, Y. 1983. The Japanese Timber Market is Open and Competitive: A View from a Consumer Nation, Japan. World Trade in Forest Products. J. S. Bethel (ed.), University of Washington Press, Seattle, Wash.

15. Whaley, R. S. and S. J. Branhain. 1983. Wood in the World's Materials Mix. World Trade in Forest Products. J. S. Bethel (ed.), University of Washington Press, Seattle, Wash.

16. WWPA. 1978. Japanese Grading Rules Translated. Western Wood Products Association, Portland, Oregon.

17. WWPA. 1981. U.S./Japan Lumber Trade Promotion Committee, Second Session, Tokyo, Japan, Proceedings. Western Wood Products Association, Portland, Oregon.

18. _____. Undated. Standards for cut lumber--exerpts from the Japanese Ministry of Agriculture Bulletin No. 1841.

19. JETRO. 1982. JAS sawn lumber, sawn balk lumber and sawn lumber with edge. Transl. Japan External Trade Organization, Tokyo.

20. PLIB. 1971. Export R list grading and dressing rules. Pacific Lumber Inspection Bureau, Seattle, Wash.

21. MacMillan Bloedel Co. 1976. Problems Associated with Cutting to Japans Specifications. MacMillian Bloedel Seminar Publication.

22. Seike, Kiyosi. 1977. The Art of Japanese Joinery. John Weatherhill Inc., New York.

Appendix I

Selected Provisions From Japanese Standards for PF Lumber

Table 1. Softwood species classification under JAS provisions.

Abbreviation for the species group	Abbreviation for the species type	Species
SI	DFir-L	Douglas-fir, western larch Japanese black pine, Japanese red pine, Dahuriaca larch (and other similar species), Southern Yellow Pine
	Hem-Tam	Pacific Coast Yellow cedar, Tamarack, jack pine, Eastern hemlock, Japanese larch, Thuja Japanese cypress, Taiwan cypress and other similar species, Port Orford Cedar
SII	Hem-Fir Amabilis Fir	Western hemlock, Amabilis fir, grand fir, Tsoga and similar species, Mountain Hemlock, White fir
	S-P-F or Spruce Pine-Fir	Balsam fir, lodgepole pine, Ponderosa pine, white spruce, Engelmann spruce, black spruce, red spruce, Coast-Sitka spruce, Alpine fir, Japanese silver fir, Yezo spruce, Japanese white fir, Scotch pine, Merkusii pine, Radiata pine and other similar species
	W. Cedar	Western redcedar, red pine, Western white pine, Eastern White pine, Japanese cedar, Agathis, Korean pine and other similar species

Source: (16).

Table 2

Japanese Standards for Framing A and B Lumber (16)

(3) ARTICLE 4. STANDARD FOR FRAMING A LUMBER
ARTICLE 5. STANDARD FOR FRAMING B LUMBER

Table of Japan Agriculture and Forestry Standard for Platform Framing Construction Lumber

Item		Framing A Lumber					
		Select			Grade 1		
Knots & Holes (Sizes not to exceed the following or equivalent displacement) (Unit: mm)		Sound, firm encased & pith knots (tight & well spaced)		Unsound & loose knots or holes	Sound, firm encased & pith knots (tight & well spaced)		Unsound & loose knots or holes
(Dimensional Code)		Edge	Center line		Edge	Center line	
On Wide Face	203	13 mm	13 mm	13 mm	19 mm	19 mm	19 mm
	204	19	22	19	25	38	25
	206	29	48	25	38	57	32
	208	38	57	32	51	70	38
	210	48	67	32	64	83	38
	212	57	76	32	76	95	38
	404	22	22	19	38	38	25
(Well spaced knots)		The sum of the sizes of all knots in any 15 cm of length of a piece must not exceed twice the size of the largest knot permitted (Upper Table)			Same as Select		
(Holes)		One hole or equivalent smaller per 120 linear cm			One hole or equivalent smaller per 90 linear cm		
On Narrow Face[9]		Displacement of 1/6 or less the cross section			Displacement of 1/5 or less the cross section		
Unsound Wood (Decay)		None			None		
Skin		Firm heart stain no more than 10% of piece Stained sapwood			Firm heart stain Stained sapwood		
Wane[10]		25% or less of the thickness and the width			Same as Select		
FISSURES Through	Away from ends	No longer than the width of the piece			Same as Select		
	At ends	None			None		
FISSURES Not Through	Away from ends	No more than 1/2 the thickness of the piece			Same as Select		
	At ends	No longer than 60 cm			Same as Select		
Manufacture		Not conspicuous			Not conspicuous		
Crook		No more than 0.2%			Same as Select		
Bow, Cup & Twist		Slight			Slight		
Average width of annual rings		No more than 6 mm			Same as Select		
Slope of Grain		No more than 60 mm			No more than 100 mm		
Other defects		Slight			Slight		
Treatment with Preservatives (indicated)		Treated with JIS 1550 Type 1, No. 1; Type 1, No. 2; JIS 1554, No. 1					

Dimensions (Unit: mm)	Dimensional Code	Green Lumber	Thickness	Width	Dry Lumber
Allowable Error: Thickness Width ± 1.5 gth — 0	203	203G	40	65	203D
	204	204G	40	90	204D
	206	206G	40	143	206D
	208	208G	40	190	208D
	Green lumber (G), MC above 19%; Dry lumber (D), MC below 19%				
Expression	1. Name of species; species group; species type (Common Name) (SI, SII) (S-P-F, DFlr-L) 3. Length 4. Manufacturer, Distributor (Importer)				

[9] & [10] see explanation pages I & II

Framing A Lumber						Grade					
Grade 2			Grade 3			Construction		Standard		Utility	
Knots		Holes	Knots		Holes	Sound, firm encased & pith knots (tight & well spaced)	Unsound & loose knots or holes	Knots	Holes	Knots	Holes
Edge	Center line		Edge	Center line							
22 mm	22 mm	22 mm	32 mm	32 mm	32 mm	32 mm	19 mm	38 mm	25 mm	51 mm	32 mm
32	51	32	44	64	44	38	25	51	32	64	38
48	73	38	70	95	51						
64	89	51	89	114	64						
83	108	64	114	140	76						
95	121	76	140	165	89						
51	51	32	64	64	64	38	25	51	32	64	38
Same			Same			The sum of the sizes of all knots in any 15 cm of length of a piece must not exceed twice the size of the largest knot permitted (Upper Table)		Same		Same	
One hole or equivalent smaller per 60 linear cm			One hole or equivalent smaller per 30 linear cm			One hole or equivalent smaller per 90 linear cm		One hole or equivalent smaller per 60 linear cm		One hole or equivalent smaller per 30 linear cm	
Same as Grade 1[11]			Displacement of 1/4 or less the cross section			Displacement of 1/4 or less the cross section[12]		Displacement of 1/3 or less the cross section		Displacement of 1/2 or less the cross section	
Slight			Not conspicuous			None		Slight		Not conspicuous	
Same as Grade 1			—			Firm heart stain Stained sapwood		Same as Construction		—	
35% or less of the thickness and the width[13]			50% or less of the thickness and the width			25% or less of the thickness and the width		35% or less of the thickness and the width		50% or less of the thickness and the width	
No longer than 1.5 times the width of the piece			No longer than twice the width of the piece[14]			No longer than the width of the piece		No longer than 1.5 times the width of the piece		No longer than 1/6 the length of the piece	
No longer than 60 cm			No longer than 1/3 the length of the piece			None		No longer than 60 cm		No longer than 1/3 the length of the piece	
Same as Select			—			No more than 1/2 the thickness of the piece		Same as Construction		—	
No longer than 90 cm (in the case where 1/4 the length of the piece is less than 90 cm, no longer than 1/4 the length of the piece)			—			No longer than 60 cm		No longer than 90 cm (in the case where 1/4 the length of the piece is less than 90 cm, no longer than 1/4 the length of the piece)		—	
Usable			Usable			Not conspicuous		Usable		Usable	
No more than 0.5%			Same as Grade 2			No more than 0.2%		No more than 0.5%		Same as Standard	
Not conspicuous			Usable			Slight		Not conspicuous		Usable	
Same as Select			—			—		—		—	
No more than 120 mm			No more than 250 mm			No more than 170 mm		No more than 250 mm		Same as Standard	
Not conspicuous			Usable			Slight		Not conspicuous		Usable	

or No. 2, and pass the test of preservative treatment.

Thickness	Width	Dimensional Code	Green Lumber	Thickness	Width	Dry Lumber	Thickness	Width
38	64	210	210G	40	241	210D	38	235
38	89	212	212G	40	292	212D	38	286
38	140	404	404G	90	90	404D	89	89
38	184							

aming B Lumber: contains 203, 204, and 404; Total of 3 types

2. Dimensional Code, letter expressing dry or green (Examples: 204G, 208D) (name or calling)

(11), (12), (13) & (14) see explanation pages I & II

Figure 1
Assessment of narrow face and spike knots
using the relative dimension ratio (16)

(g) Knot for 404

A knot on all four faces of 404 follows the rule of a knot at a wide face.

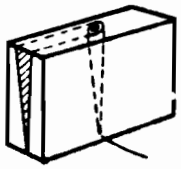
(B) Knot at narrow face

A knot at a narrow face is determined by the relative dimension ratio. The relative dimension ratio is the ratio between the area of the knot projected at the cross section of a piece of lumber and the area of the cross section.

Section of knots projected on cross section of board

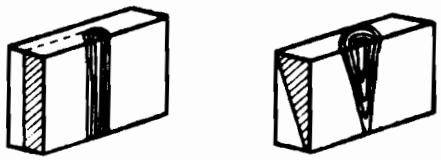
(a)

(b) Knot appears on one narrow face only

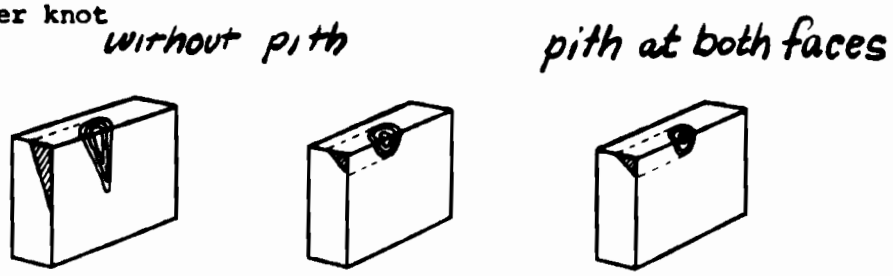


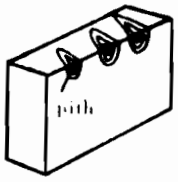
Assume that knot tapers toward the other edge

(c) Knot appears on three faces



(d) Corner knot

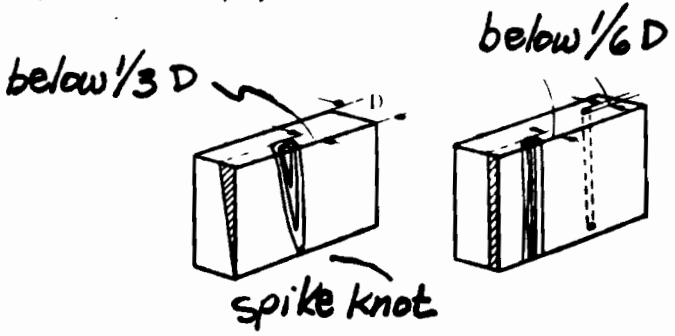




Note: When a knot is cut approximately lengthwise at a narrow face, it should be measured using the rule of a wide face.

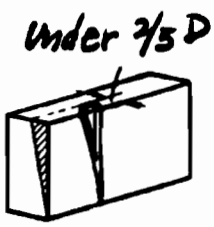
e. Example of Relative Diameter Ratio

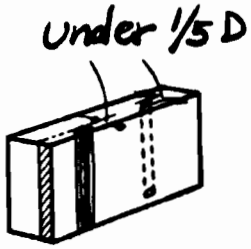
(15) (a) Below 1/6, Select



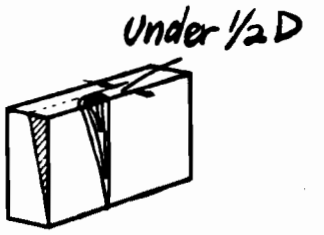
(15) See explanation on pages I and II.

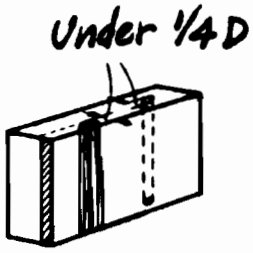
(15) (b) Below 1/5, (Grade 1 and Grade 2)



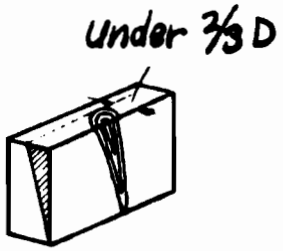


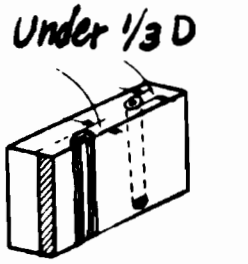
(c) Under 1/4 (Grade 3, Const)



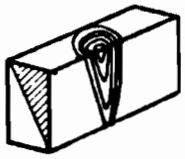


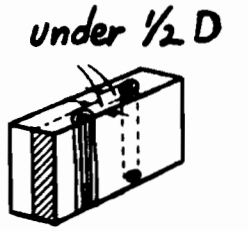
(d) Under 1/3 (Stand)





(e) Under 1/2 (Util)



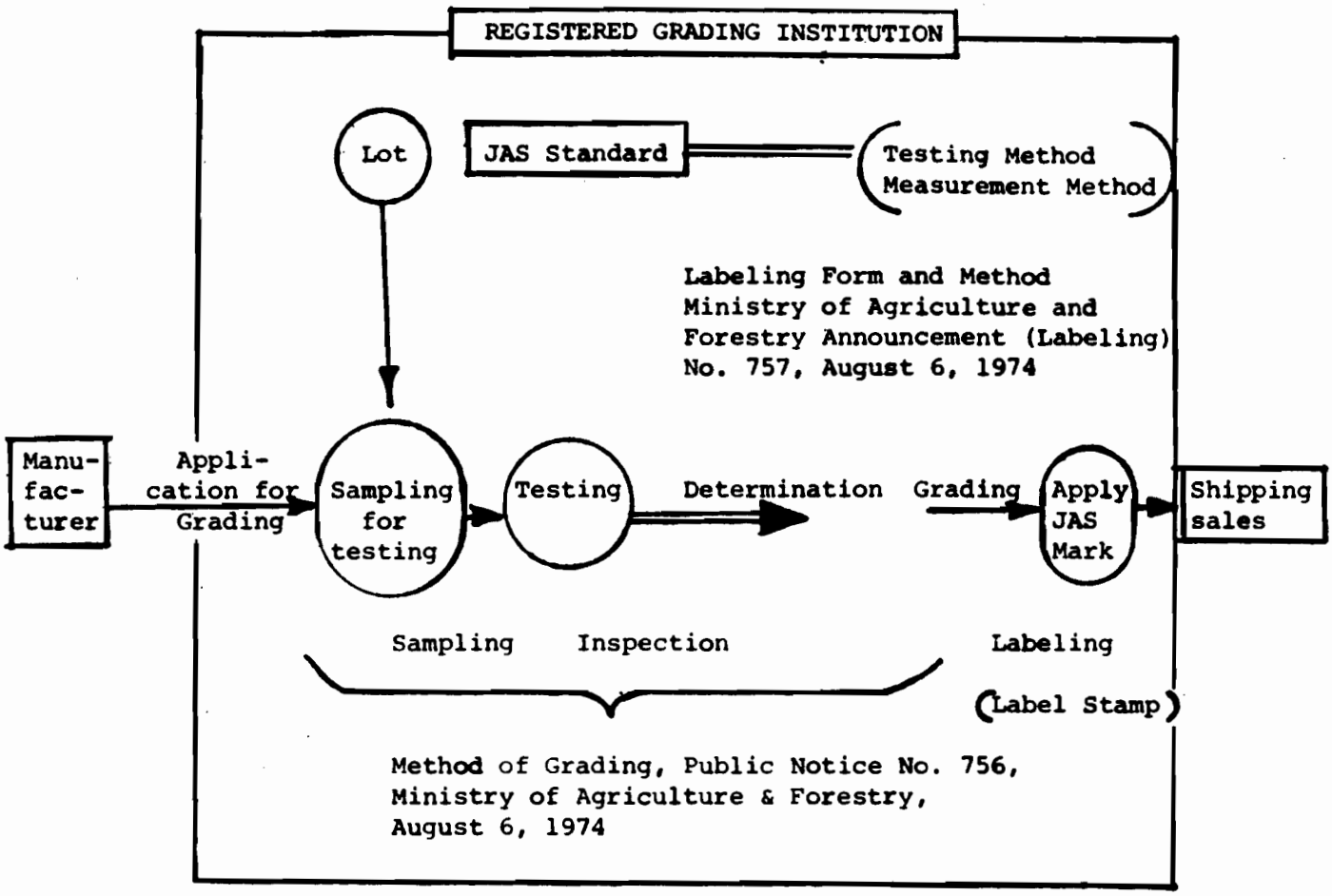


(15) See explanation on pages I and II.

Figure 2
JAS inspection procedure for PF lumber imports (16)

6 GRADING OF PLATFORM FRAMING CONSTRUCTION LUMBER

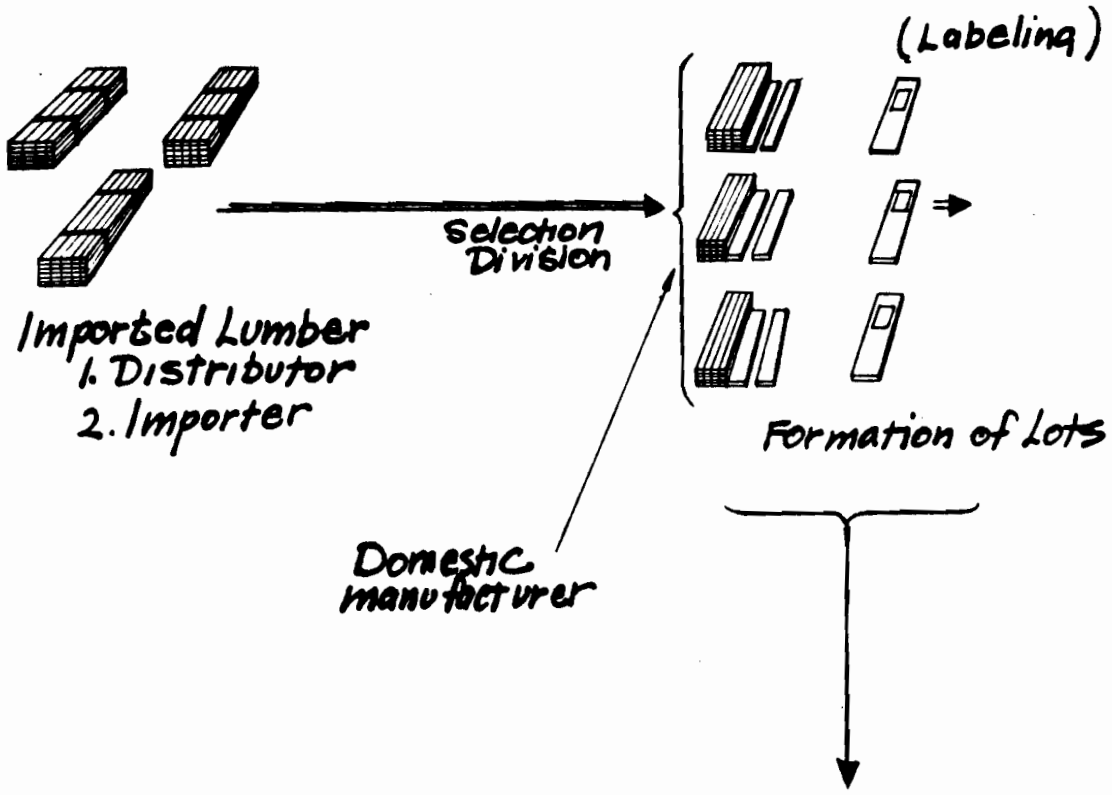
According to the Standardization of Agricultural and Forest Products and Fair Quality Labeling Act (JAS Act) (Act 175, 1950, Amended 1970), the process of grading of lumber according to the JAS Standard is as follows:



REGISTERED GRADING INSTITUTION

This is an institution registered with the Minister of Agriculture and Forestry to perform grading. Hokkaido Forest Products Inspection Association, an incorporated association (Hokkaido Linsan Kensa Kai (Hoku-Lin-Ken)) covers the district of Hokkaido, and All Japan Federation of Lumber Association, an incorporated association (Zenkoku Mokuzai Kumiai Lengokai (Zen-Moku-Len)), covers the entire nation except Hokkaido performs the inspection.

(1) PRACTICE OF TESTING FOR GRADING



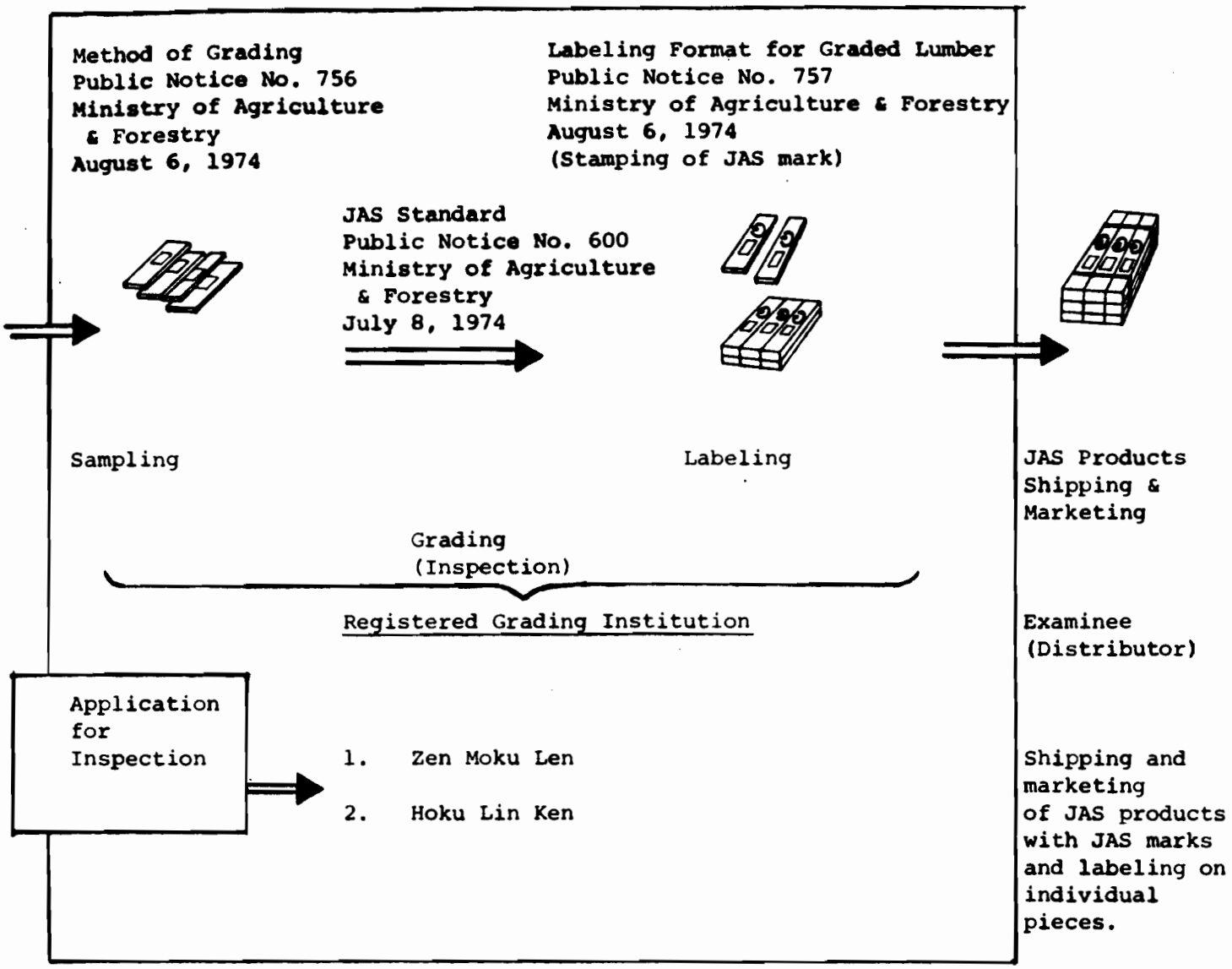
Applicants for inspection
(Examinee)

1. Manufacturer
2. Distributor
3. Importer

1 Form lots according to species, dimensional code, dry or green length, which are to be graded for the same grade.

2 Label all items on each piece according to the Labeling Standard.

3 Application for inspection to registered grading institute.



1 Samples are selected for testing and grading from each lot which has been regrouped and labeled (Method of Grading).

2 Grade the samples according to the JAS Standard.

3 Determination of grade of each lot according to whether the samples meet the specifications of the JAS Standard (Method of Grading).

4 Stamping of JAS mark on each piece in a lot which passes the JAS Standard (Labeling Format for Grading of Lumber).

Figure 3
Revision of JAS inspection procedures for foreign manufacturers

Outlines of Revised Law

A) JAS Approval and Approval System for Foreign Manufacturers

1) Approval for grading organ

A governmental organ or a grading organ registered with the government, under the approval of the Minister of Agriculture, Forestry & Fisheries, can let foreign wood manufacturers to grade agricultural & forestry commodities or to indicate graded result in order to enforce JAS grading without difficulty.

2) Approval of foreign manufacturers

Those manufacturers of wood products who are approved by the Minister of Agriculture, Forestry & Fisheries can indicate grading in advance on products before products are graded.

B) Approval and Cancellation of Approval for Foreign Manufacturers

1) In the case when foreign manufacturers, who are approved or qualified by the Minister of Agriculture, Forestry & Fisheries, does not comply a request by the Minister for improvement, report and inspection on grading;

2) Or in the case when manufacturers indicated grading without having a permission for grading;

3) Or in the case when manufacturers sold products in Japanese domestic markets as if they are graded products despite of ungraded ones.

In such cases, approval or qualification of the manufacturers shall be deprived.

C) Prohibitation of Delivery of Unqualified Graded Products (Imported Agricultural Commodities)

In domestic sales of graded products indicated by approved or approved foreign manufacturers, importers of agricultural & forestry commodities are not allowed to indicate any other graded mark or misleading mark than those marks indicated by the approved manufacturers.

Appendix II

Selected Provision from Notification No. 1841 (18)

Table 1
Measurement techniques for determining volume

Art. 7 (Length of basic lumber)

The length of basic lumber shall be the shortest distance between the two cut faces. However, when the above distance includes a small end part (less than 3 cm for the shortest diameter) or when it includes a protrusion or a hole, the part of the face included is not counted in the measurement.

Art. 8 (Unit dimensions for basic lumber)

8.1 The unit dimensions for measuring the diameter of logs or the width and thickness of rough hewn timber shall be 1 cm for small lumber other basic lumber shall be 2 cm. Fractions of the above units shall be disregarded.

10.2 Rough hewn squares

$$T \times W \times L \times \frac{1}{10,000}$$

where T is the thickness in cm whole numbers.
W is the width in cm whole numbers.
L is the length in cm whole numbers.

The volume of the basic lumber shall be in cubic meters (m^3), any fractions under the 3 places below the decimal point shall be treated by discarding 4 and under, and adding 5 and over as 1 to the third place. However, when the volume is less than three places below the decimal point, the fraction at the fifth place shall be treated by discarding 4 and under, and adding 5 and over as 1 to the fourth place.

Table 2
Defect measurement techniques of Notification 1841

Art. 14 (Method of measuring the defects)

The defects listed for the above two (2) Articles shall be measured according to the following table, where the defects are listed on the extreme left side column and the method of measuring is listed on the right side. Where the defect lies in the root-swelling or the uncounted end pieces of the logs or rough hewn squares, the above log parts shall be excluded from the measurements.

Knots	1. Dead or rotted knots (those less than 1 cm in longest diameter are precluded) shall be regarded as having a long diameter of the knot. 2. The longest diameter of 'hidden knots' shall be regarded as 1.5 times the actually measured largest unhidden knot's longest diameter (those knots less than 1 cm in longest diameter are precluded). 3. Where knots are hidden knots and knots less than 1 cm in longest diameter, the longest diameter of the hidden knot shall be regarded as 10 cm. However where the longest diameter of a swelling related to the hidden knot is over 10 cm, the longest diameter of the hidden knot is regarded as the same as that of the swelling.
Bends	1. The percentage (of bends), shall be the ratio between log diameter or the hewn square's width and the maximum arc height of the inner curvature of the bend. 2. Where 2 or more bends exist the percentage as per para. (1) for each shall be added and multiplied by 1.5.
Splits at ends, or loose heart	1. The percentage shall be the ratio between the length of the splits and the loose heart and the length of the log or hewn square. 2. Where there are 2 or more splits at one end, the length of the longest, where there are located at both ends, the total of the longest length of the splits for each end shall be the respective lengths. This applies also to the length of loose hearts. 3. When the depth of split exceeds 1/2 of the log diameter (or hewn log width) at the section with the split, the length of the split shall be regarded as 1.5 times the measured length. 4. The depth of splits, for splits running towards the log face's center the length of the split is regarded as the depth, for other splits the distance from the deepest point of the split on the log face to the log surface in the opposite direction to the log center is the depth of the split. (However, when a line connecting the log center with the deepest point of the split meets the split at an angle of 90° or larger, the deepest point is regarded as the depth of the split and where the angle is less than 90° the point where a line through the log center and perpendicular to the split meets the split is regarded as the depth of the split.

Cup shakes Heart shakes		1. Percentage, shall be the ratio of the length of arc of the defect to the circumference of the long (for the hewn square the total of the four sides with the corners filled) at the section (face) of the defect. 2. When 2 or more cup shakes exist at one end, the total of the two arcs to the circumference of the log (where the 2 cup shakes overlap, the ends of the arc on the outside are connected to the log center and the amount of overlap by the inside arc is subtracted from the total of the two). 3. When cup shakes exist at both ends the ratios calculated according to para. (1) and (2) above are added and the ratio for the total is calculated.
Rot and borer holes and hollows	Surface	The degree permissible depends on the what extent the defect affects the utilization of the basic material.
	Log face	1. Percentage, is the ratio of, the average diameter of rots, borer holes and hollows, to the diameter of the face of the log affected (for hewn squares its thickness). (Where 2 or over exist at one end the total of the average diameter) 2. Where defects are at both ends, the percentage is the total of that calculated according to para. (1) above.
Vertical surface cup shakes		1. Percentage, is the ratio of its length (where 2 or over, the added total length), to the length of the basic lumber. 2. Where 2 or more are parallel and exist on one surface, the defects are regarded as one and the length measured.
Other defects		The degree permissible depends on the what extent the defect affects the utilization of the basic material.

Table 3
Grade provisions of Notification No. 1841
for small, medium, and large basic coniferous lumber

Art. 12 (Standards for basic lumber from coniferous trees)

Basic lumber of coniferous trees shall conform to the following:

12.1 Small basic lumber (logs with diameters of 8 cm or less or hewn squares with widths of 8 cm or less are precluded)

Defects	Class 1	Class 2
Bends	less than 25%	over 25%
Others	not excessive	excessive

12.2 Medium basic lumber (Lumber from Japanese cypress over 150 years old is precluded)

Defects \ Grade	1	2	3
Knots (Those of 1 cm or less in longest diameter are precluded.)	Lumber conforming to at least one of the following. (1) No knots on at least 3 surfaces. (2) Knots on 2 neighboring surfaces with longest dia. less than 5 cm.	Lumber conforming to at least one of the following. (1) Knots on 2 surfaces only. (2) Knots on over 3 surfaces. Longest dia. less than 10 cm.	Defects exceeding those listed for Classes 1 and 2.
Bends	One hend of 10% or less.	Bends 30% or less.	Defects exceeding those listed.

Defects \ Grade	1	2	3
Splits and loose hearts	10% or less. Splits shall not be deeper than 1/3 of the log diameter of the face at the split (for hewn squares the width).	30% or less.	Defects exceeding those listed.
Cup shakes (Those located on the outside of a circle with a radius of 9/10 of the external radius of the log face where the defect is located.)	10% or less.	30% or less. However, those that overlap shall exist on one surface only when a line through the center bisects the log face at the defect.	Defects exceeding those listed.
Rot that exists in and is less than 20% at the ends are precluded. Borer holes or hollows.	Lumber surface — None exists	On only 2 surfaces and slight.	Defects exceeding those listed.
	Lumber face — None exists	30% or less.	Defects exceeding those listed.
Vertical surface cup shakes	None on surfaces without knots. 5% or less on other surfaces.	None on knot-free surfaces. 15% or less on other surfaces.	Defects exceeding those listed.
Other defects	Slight	Not excessive	Defects exceeding those listed.

12.3 Large size basic lumber (including medium size Japanese cypress over 150 years old)

Defects \ Grade	1st Grade	2nd Grade	3rd Grade	4th Grade
Knots (Those 1 cm or less for the longest diameter are precluded.) Knots (Those 15 cm or less for the longest diameter are precluded.)	Over three (3) surfaces shall be free of knots.	2 adjacent surfaces only shall contain knots (for any 2 surfaces).	Those conforming to one of the following: 1) 2 or 3 surfaces (for Japanese cedar 3 surfaces) contain knots.) 2) 4 surfaces contain knots with its longest diameter not more than 15 cm (for Japanese cypress not more than 10 cm). 3) 4 surfaces contain knots only 2 or 3 surfaces contain knots 10 cm or less in longest diameter (for Japanese cypress not more than 5 cm).	
Bends	One (1) bend, 5% or less (for Japanese cypress, 10% or less.)	One (1) bend, 10% or less (for Japanese cypress, 20% or less.)	Bends shall be, 20% or less (for Japanese cypress, 30% or less.)	Defects exceeding those listed, for up to 3rd grade
Splits and loose hearts	10% or less. Splits shall not be deeper than 1/3 of the log diameter of the face at the split (for hewn squares 1/3 of the thickness.)	20% or less. Splits shall not be deeper than 1/3 of the log diameter or the log face at the split (for hewn squares 1/3 of the thickness.)	40% or less.	Defects exceeding those listed, for up to 3rd grade
Cup shakes (Those located on the outside of a circle with a radius of 9/10 of the external radius of the log section where the defect exists shall be precluded.)	10% or less.	20% or less.	30% or less. However, those that overlap shall exist on one surface only when a line through the center bisects the section where the overlap exists.	

Defects \ Grade		1st Grade	2nd Grade	3rd Grade	4th Grade
Rot (whitewood, firwood, savara those located in the core of the log and 20% or less from the ends shall be precluded). Borer holes and hollows.	Surface	None	Exists on one surface only and is slight.	Slight	Defects exceeding those listed, for up to 3rd grade.
	Section	None	30% or less.	50% or less.	Defects exceeding those listed, for up to 3rd grade.
Vertical surface cup thakes.		None on knot-free surfaces, 50% or less on other surfaces.	None on knot-free surfaces, 15% or less on other surfaces.	30% or less.	Those with defects exceeding the degree listed up to 3rd
Other defects		Very slight.	Slight.	Not excessive.	Those with defects exceeding the degree listed up to 3rd grade.

Notes: (1) Those free of bends, rots or hollows, and other defects or below 2nd grade degree and are a minimum, grades under 1st grade shall be stepped up one grade.

(2) Those with over 4 kinds of defects and each defect is close to the maximum permissible in degree shall be down-graded 1 grade. However, this precludes 4th grade.

Appendix III

Selected Provisions from JAS N 1892 (19)

Table 1

N 1892 standard dimensions of Japanese softwood lumber

Standard Dimensions of Sawnwood Lumber

thickness (cm)	width (cm)																								length (m)							
0.5								3.6													15.0	18.0	21.0	24.0	27.0	30.0	1.8	1.9	2.0					
0.9								3.6			Narrow boards 7.5					9.0	10.0	10.5	12.0	15.0	18.0	21.0	Boards			1.8	1.9	2.0		3.65	3.8		
1.1															7.5	9.0	10.0	10.5	12.0	15.0	18.0	21.0	24.0	27.0	30.0	1.8	1.9	2.0	3.0	3.65	3.8	4.0	
1.3									4.5						7.5	9.0	10.0	10.5	12.0	15.0	18.0	21.0	24.0	27.0	30.0	1.8	1.9	2.0	3.0	3.65	3.8	4.0	
1.5	1.5								4.5						7.5	9.0	10.0	10.5	12.0	15.0	18.0	21.0	24.0	27.0	30.0	1.8	1.9	2.0	3.0	3.65	3.8	4.0	
1.8		1.8							4.5							9.0	10.0	10.5	12.0	15.0	18.0	21.0	24.0	27.0	30.0	1.8	1.9	2.0	3.0	3.65	3.8	4.0	
2.0					3.6				4.5							9.0	10.0	10.5	12.0	15.0	18.0	21.0	24.0	27.0	30.0	1.8	1.9	2.0	3.0	3.65	3.8	4.0	
2.4				3.6		3.6			4.5							9.0	10.0	10.5	12.0	15.0	18.0	21.0	24.0	27.0	30.0	1.8	1.9	2.0	3.0	3.65	3.8	4.0	
2.7					3.6			3.6			Flat split timbers			6.0	7.5	9.0	10.0	10.5	12.0	15.0	18.0	21.0	24.0	27.0	30.0	1.8	1.9	2.0	3.0	3.65	3.8	4.0	
3.0						3.6		3.6	4.5					6.0		9.0	10.0	10.5	12.0	15.0	18.0	21.0	24.0	27.0	30.0	1.8	1.9	2.0	3.0	3.65	3.8	4.0	
3.3							3.6	3.6							7.5	9.0	10.0	10.5	12.0	15.0	18.0	21.0	24.0	27.0	30.0	1.8	1.9	2.0	3.0	3.65	3.8	4.0	
3.6							3.6	6.0	4.5							9.0	10.0	10.5	12.0	15.0	18.0	21.0	24.0	27.0	30.0	1.8	1.9	2.0	3.0	3.65	3.8	4.0	
4.0								6.0	4.5			6.0				9.0	10.0	10.5	12.0	15.0	18.0	21.0	24.0	27.0	30.0	1.8	1.9	2.0	3.0	3.65	3.8	4.0	
4.5									4.5		9.5	6.0			8.5	9.0	10.0	10.5	12.0				Planks			1.8	1.9	2.0	3.0	3.65	3.8	4.0	
5.0															8.5	9.0	10.0	10.5	12.0							1.8	1.9	2.0	3.0	3.65	3.8	4.0	
5.5											5.5					9.0		10.5	12.0							1.8	1.9	2.0	3.0	3.65	3.8	4.0	
6.0												6.0				9.0		10.5	12.0							1.8	1.9	2.0	3.0	3.65	3.8	4.0	
7.0													7.0													1.8	1.9	2.0	3.0	3.65	3.8	4.0	

7.5											Regular split timbers				7.5												1.8	1.9	2.0	3.0	3.65	3.8	4.0	Regular squared timbers only
																8.5											1.8	1.9	2.0	3.0	3.65	3.8	4.0	
																	9.0						Flat squared timbers				1.8	1.9	2.0	3.0	3.65	3.8	4.0	↓
10.0												Regular squared timbers						10.0			15.0	18.0					1.8	1.9	2.0	3.0	3.65	3.8	4.0	6.0
10.5																			10.5		15.0	18.0	21.0	24.0		30.0	1.8	1.9	2.0	3.0	3.65	3.8	4.0	6.0
12.0																				12.0	15.0	18.0	21.0	24.0		30.0	1.8	1.9	2.0	3.0	3.65	3.8	4.0	6.0

Table 2
N 1892 measurement methods for lumber

(Dimensions of Lumber)

Article 4 The dimensions of lumber shall be expressed in thickness, width and length.

(Thickness and Width of Lumber)

Article 5 The thickness of any lumber shall be the dimension of one of the short sides of a rectangle made from its minimum cross section and its width shall be the dimension of one of the long sides of such a rectangle. With respect to small square and square, however, their thickness and width shall be the dimension of one of the four sides of a square made from their minimum cross section. As for trapezoid boards, their thickness shall be one half of the sum total of the upper and under sides of a trapezoid made from their minimum cross section and their width shall be the height of such a trapezoid.

(Length of Lumber)

Article 6 The length of any lumber shall be the shortest distance between both ends, which, however, shall not include an extra length.

(Standard Dimensions of Lumber)

Article 7

1. The standard dimensions of lumber of softwood and hardwood belonging to Dipterocarpaceae, Melastomataceae and other than families prescribed in Appendix No. 3 shall be as shown in Appendix No. 1.
2. The standard dimensions of hardwood lumber excluding those specified in the foregoing paragraph shall be as shown in Appendix No. 2.

(Unit for Reckoning the Quantity of Lumber)

Article 8 The quantity of lumber shall be expressed in leaf or bundle for boards and planks and in piece or bundle for small squared lumbers and squared lumbers.

(Procedure for Determining the Volume of Lumber and its Unit)

Article 9

1. The volume of one leaf or piece of lumber shall be found by the following formula:

$$T \times W \times L \times \frac{1}{10,000}$$

where,

T is the numerical value for the thickness of each lumber expressed in cm,
W is the numerical value for the width of each lumber expressed in cm, and
L is the numerical value for the length of each lumber expressed in m.

Table 3
N 1892 defect measurement techniques

(Measurement of Defects and others in Softwood Lumber)

Article 12 In applying the standards specified in Article 10 and Table (2) - b of the preceding article, failure, defects and others in softwood lumber shall be measured as prescribed below, except for those concerned with the extra length of such lumber:

Items	Methods of measurement
Knots	1. Largest diameter (1) The largest diameter of each knot except its skirt (hereinafter referred to as "the largest diameters") shall be measured. (2) With regard to the number of knots whose largest diameters is not more than one half of the limit, two or its fraction shall be regarded as one. (In case of one fourth of the limit, four knots shall be regarded as one.) 2. Knot diameter ratio (1) The knot diameter ratio shall be a percentage of the diameter of a knot to the width of a lumber surface in which it exists. (2) The diameter of a knot shall be a distance between the two tangential lines parallel to arrises of a lumber surface in which the knot exists. (In case a knot is divided by one or two arrises, however, the

	diameter of such a knot shall be the distance between, arris and the tangential line of the knot or the width of lumber surface in which the knot exists.) (3) If a knot lies across the two or three adjoining surfaces of split and squared timbers, the cross section of such a knot shall only be measured to determine its diameter ratio. (4) If a knot has a diameter not less than 2.5 times as much as its smallest diameter, it shall be considered to have one half of its actually measured diameter. 3. The grouped knot diameter ratio shall be the sum of diameter ratios of knots existing in a 15 cm-long lumber surface.
Chips, flaws, holes, bark pocket and resin-pocket in lumber surface	1. The diameter ratio and the diameter of these defects shall be measured in accordance with requirements for knots. 2. If chips or flaws in surface exist on the arris of a lumber, they shall be regarded as wanes.
Wane	1. The wane ratio for boards and planks shall be a percentage of the thickness or width of a wane to the maximum thickness or width of any section of a board or plank where such a wane exists.
	2. The wane ratio for trapezoid board shall be a percentage of wany parts to the height of a trapezoid in the minimum cross section where a wane exists. 3. The wane ratio for split and squared timbers shall be a percentage of many parts to the total length of four sides of a square or rectangle made up by filling lack in the minimum cross section where a wane exists. The wane ratio of one corner, however, shall be a percentage of maximum total wanting length of each corner to the total length of four sides of such square or rectangle. 4. With regard to regular squared timbers, any wane shall be measured by excluding the section of a timber in length of 0.2 m from both of its ends. 5. Those very insignificant wanes which can be cut away by processing shall not be measured.
End split	1. The end split ratio shall be a percentage of the length of an end split to that of a lumber. 2. If there exist two or more end splits in the same end, the length of the longest one shall be measured; if there exist two or more end splits in both ends, the sum of the length of the longest in each and shall be measured.

	3. If any split exists in a lumber surface, the length of such split shall be considered one third of its actually measured length. (If any split penetrates from one surface to the other, however, the length of such split shall be considered to be an actural length. 4. Those very insignificant and split and check shall not be measured.
Ring shake	1. The ring shake ratio shall be a percentage of the length of an arc of any ring shake to the total length of four sides of a square or rectangle in any end where such a ring shake exists. 2. If ther exist two or more ring shakes in the same end, the length of an arc of the longest one shall be measured; if there exist two or more ring shakes in both ends, the sum of the length of an arc of the longest one in each end shall be measured.
Spring	The spring ratio shall be a percentage of the maximum deviation from a straight line drawn from end to end of a lumber to the length of lumber.
Average width of annual rings	The average width of annual rings in and end shall be the mean value of all the widths of perfect annual rings on the same straight line almost rectangular to these annual rings.
Slope of grain	The height of slope of grain to the length of 1 m of a lumber shall be measured.

Table 4
N 1892 grading for boards and planks

(Standards for Softwood Lumber)

Article 10 The standards for softwood lumber shall be as prescribed below:

(1) Boards and planks

Taku-Te Itto Nitto

Classfacation	Standards		
	Special grade	First grade	Second grade
Knots including chips, flaws and holes in lumber surface (the same shall apply herein and Appendix 1) p38	The knot diameter ratio should be not more than 20 percent.	The knot diameter ratio should be not more than 00 percent.	The knot diameter ratio should be not more than 00 percent.
Wanes including chips and flaws in arris (the same shall apply hereinafter)	No wane should be observed.	The thickness and width of the chipped section of any board or plank shall be not more than 50 percent of its thickness and not more than 10 percent (20 percent for narrow board) of its width respectively.	The width of the chipped section of any board or plank shall be not more than 40 percent (50 percent for narrow board) of its width.
End splits (including checks in lumber surface the same shall apply hereinafter and to Article 12 and Appendix 1) or ring shake	End splits or ring shake should be not more than 10 percent.	End splits or ring shake should be not more than 20 percent.	End splits or ring shake should be not more than 40 percent.
Compression wood	Compression wood should be very insignificant.	Compression wood should be insignificant.	Compression word should not be conspicuous.
Decay or worm hole	Decay or worm hole should be very insignificant.	Decay or worm hole should be insignificant.	Decay or worm hole should not be conspicuous.
Other blemishes	Other blemishes should be very insignificant.	Other blemishes should be insignificant.	Other blemishes should not be conspicuous.
Incising	Incising may not be regarded as blemishes; provided, however, that it should not cause an about 10% or more decrease in the bending strength and Young's modulus of any board or plank as defined herein.		
Clear, fine small knot, or small knot	Those marked "CLEAR", "FINE SMALL KNOT", or "SMALL KNOT" should come up to the standards specified in the table (1) of Appendix 1.		
Preservative/ termite-control treatment or	Those marked to the effect that preservative/termite-control or preservative treatment was given should have been duly treated with such a preservative prepared in the mixture		

★ Fine small Knot = Sveka

Small Knot = Kokuchi

Clear 1 2 3 4 board = clear

preservative treatment		ratio as specified in the Japanese Industrial Standard K1550 Class 1 No. 1 (hereinafter referred to as "JIS K1550 Class 1 No. 1"), such a preservative prepared in the mixture ratio as specified in the JIS K1550 Class 1 No. 2 (hereinafter referred to as "JIS K1550 Class 1 No. 2"), such a preservative prepared in the mixture ratio as specified in the JIS K1554 No. 1 (hereinafter referred to as "JIS K1554 No. 1"), or such a preservative prepared in the mixture ratio as specified in the JIS K1554 No. 2 (hereinafter referred to as "JIS K1554 No. 2"). In addition, those marked to the effect that preservative/termite-control treatment was given should stand testing either for preservative/termite-control treatment Class 1 or Class 2 provided for in Paragraph 1. of Appendix 2, and those marked to the effect that preservative treatment was given should successfully bear testing for preservative treatment Class 3 stipulated in the same.
Insect control treatment		These marked to the effect that insect control treatment was given should stand a test relating to either insect control treatment Class 1, insect control treatment Class 2, or insect control surface treatment from among insect control treatment tests specified in Paragraph 2. of Appendix 2.
Kiln drying		These marked to the effect that they were kiln-dried should stand the moisture content test specified in Paragraph 3. of Appendix 2.
Dimensions		A difference between the dimensions marked and those measured should correspond with each one of the numerical values given below: 1. Thickness (1) Not more than 0.5 mm with respect to those whose thickness is less than 15 mm (2) Not more than 1.0 mm with respect to those which are 15 mm or more in thickness 2. Width - 1.0 mm or less 3. Length - 0
Marking	Details to be marked	1. Any board or plank should be marked with the following items: (1) Name of the species (2) Grade (3) Thickness, width and length (or width and length for trapezoid boards) (4) Name or corporate name of the manufacturer or a symbol of the manufacturer 2. Those marked to the effect that preservative/termite-control or preservative or insecticidal treatment was given should be marked with the type of preservatives or insecticides applied in addition to the items specified in the preceding section. 3. A bundle of lumber should be marked with the number of lumber making up such a bundle in addition to the items specified in Sections 1 and 2.
	Procedures for marking	1. Those details mentioned in (1), (2) and (3) of the above section 1 should be marked as prescribed below: (1) Name of the species. The most common name should be indicated.
		(2) Grade The standard grade should be indicated. If any board or plank which has been sawn from the heartwood of a species of Dipterocarpaceae is given the special grade, however, it may be marked "special grade (heartwood)." (3) Thickness, width and length The thickness, width and length of any board or plank should be expressed in millimeter, centimeter, or meter distinctively. 2. Marking on any board or plank to the effect that preservative/termite-control, preservative, or insect control treatment, or kiln drying was given should be done as prescribed below: (1) Those boards or planks which have been given preservative/termite-control treatment Class 1 should be marked with a "CLASS 1 PRESERVATIVE/TERMITE-CONTROL-TREATED" or "PRESERVATIVE/TERMITE-CONTROL TREATMENT CLASS 1" sign, those which have been given preservative/termite-control treatment Class 2 with a "CLASS 2 PRESERVATIVE/TERMITE-CONTROL-TREATED" or "PRESERVATIVE/TERMITE-CONTROL TREATMENT CLASS 2" sign, and those which have been given preservative treatment with a "CLASS 3 PRESERVATIVE-TREATED" or "PRESERVATIVE TREATMENT CLASS 3", along with the type of preservatives applied in accordance with the following procedure: a. If JIS K1550 Class 1 No. 1 was applied, mark down its symbol "PF 1-1" or "P 1-1." b. If JIS K1550 Class 1 No. 2 was applied, mark down its symbol "PF 1-2" or "P 1-2." c. If JIS K1550 No. 1 was applied, mark down its symbol "CCA-1" or "C-1." d. If JIS K1554 No. 2 was applied, mark down its symbol "CCA-2" or "C-2." (2) Those boards or planks which have been given insect control treatment should be marked with any one of the signs "CLASS 1 INSECT-CONTROL-TREATED" or "INSECT CONTROL TREATMENT CLASS 1", "CLASS 2 INSECT-CONTROL-TREATED" or "INSECT CONTROL TREATMENT CLASS 2", and "INSECTICIDALLY SURFACE-TREATED" or "SURFACE INSECT CONTROL TREATMENT" as well as with the type of insecticides applied in such a way as specified below: a. In case of a fluoric compound, mark down "FLUORIC COMPOUND" or its symbol "F." b. In case of a boron compound, mark down "BORON COMPOUND" or its symbol "B." c. In case of chlordane, mark down "CHLORDANE" or its symbol "C." d. In case of a mixture of chlordane and a tributylic tin compound, mark down "CHLORDANE TRIBUTYLIC TIN" or its symbol "C-T." (3) Those boards or planks which have been kiln-dried should be marked with a sign "KILN-DRIED" or "KD." 3. Those items specified in the above sections should be conspicuously and clearly marked on each piece of lumber, or each bundle of lumber.

(Note) The standards for measuring knots, and splits, compression wood, and decay or worm hole will be applied to the non-sloped surfaces for trapezoid board and to the worst surface, which contains the maximum degree of blemish, the same shall apply hereinafter, for other boards and planks.

Appendix 1 (to Article 10):

(1) Boards and planks

Classification	Standards		
	Clear	Fine small knot	Small knot
Knots	No knots should be observed.	Any "FINE SMALL KNOT" board or plank should not have more than three (or four for those boards or planks which are 24 cm or more in width) knots per 2 m or less in length and such knots should have a largest diameter of not more than 10 mm (or 5 mm for those loose and rotten knots or those knots which which are likely to come off).	Any "SMALL KNOT" board or plank should not have more than six (or eight for those boards or planks which are 24 cm or more in width) knots per 2 m or less in length and such knots should have a largest diameter of not more than 20 mm (or 10 mm for those loose and rotten knots or those knots which are likely to come off).
Wane	No wanes should be observed.	The wane ratio should be not more than 3 percent of the width of any board or plank.	Ditto
End split	No end split should be observed.	The end split ratio should be not more than 3 percent.	Ditto
Decay or worm hole	No decay or worm hole should be observed.	Decay or worm hole should be very insignificant.	Ditto
Other blemishes	Any other blemish should be very insignificant.	Ditto	Any other blemish should be insignificant.

(Note) The above standards will be applied to the best surface of each board or plank.

Table 5
N 1892 grading for split timbers

(3) Split timbers [illegible] those regular split timbers whose side is not less than 70 mm and those flat split timbers which are not less than 90 mm wide, marked "FOR CANAL SILL".

Classification	Standards		
	Special grade	First grade	Second grade
Knots	The knot diameter ratio should be not more than 30 percent.	The knot diameter ratio should be not more than 50 percent.	The knot diameter ratio should be not more than 80 percent.
Bark pocket or resin-pocket	Bark pocket or resin-pocket should be very insignificant.	Bark pocket or resin-pocket should be insignificant.	Bark pocket or resin-pocket should not be conspicuous.
Wane	No wane should be observed. With respect to those split timbers marked "FOR EDGE STRIP", however, the wane ratio should be not more than 40 percent.	The wane ratio should be less than 20 percent (40 percent for those marked "FOR EDGE STRIP") and that of each corner less than 10 percent (40 percent for those marked "FOR EDGE STRIP").	The wane ratio should be less than 60 percent (40 percent for those which are less than 90 mm wide) and that of each corner less than 40 percent (20 percent for those which are less than 90 mm wide).
Spring (bow)	The spring ratio should be not more than 0.2 percent. With regard to those which are less than 90 mm wide, however, spring should be very insignificant.	The spring ratio should be not more than 0.2 percent. With regard to those which are less than 90 mm wide, however, spring should be insignificant.	The spring ratio should be not more than 0.5 percent. With regard to those which are less than 90 mm wide, however, spring should not be conspicuous.
Cup or twist	Cup or twist should be very insignificant.	Cup or twist should be insignificant.	Cup or twist should not be conspicuous.
End split or ring shake	The end split or ring shake ratio should be not more than 5 percent.	The end split or ring shake ratio should be not more than 10 percent.	The end split or ring shake ratio should be not more than 20 percent.
Slope of grain (except for those lumbers which are less than 90 mm in width)	The greatest slope of grain to 1 m length of piece should be not more than 50 mm.	The largest slope of grain to 1 m length of piece should be not more than 80 mm.	—
Compression wood	Compression wood should be very insignificant.	Compression wood should be insignificant.	Compression wood should not be conspicuous.
Decay or worm hole	Decay or worm hole should be very insignificant.	Decay or worm hole should be insignificant.	Decay or worm hole should not be conspicuous.
Other blemishes	Any other blemish should be very insignificant.	Any other blemish should be insignificant.	Any other blemish should not be conspicuous.
Incising	Incising may not be regarded as blemishes; provided, however, that it should not cause an about 10% or more decrease in the bending strength and Young's modulus of any split timber as defined herein.		
Clear, fine small knot, or small knot	Those which are marked with signs "CLEAR 4 SIDES", "CLEAR 3 SIDES", "CLEAR 2 SIDES", or "CLEAR 1 SIDE", "FINE SMALL KNOT 4 SIDES", "FINE SMALL KNOT 3 SIDES", "FINE SMALL KNOT 2 SIDES", or "FINE SMALL KNOT 1 SIDE" or "SMALL KNOT" should come up to the standards specified in the table (2) of Appendix 1.		
Preservative/termite-control treatment or preservative treatment	Same as prescribed in the preceding table (1) (Preservative/termite-control treatment or preservative treatment).		
Insect control treatment	Same as prescribed in the preceding table (1) (Insect control treatment).		
Kiln drying	Same as prescribed in the preceding table (1) (Kiln drying).		
Dimensions	A difference between the dimensions marked and those measured should correspond with each one of the numerical values given below: 1. Thickness and width - 1.0 mm or less 2. Length - 0		
Marking	Same as prescribed in the preceding table (1) (Marking).		

(Note) The standards for measuring knots, bark pocket or resin-pocket, end split, slope of grain (excluding those of the split timbers which are less than 90 mm in width), compression wood, and decay or worm hole will be applied to the four surfaces of each timber.

	surface.	surface should be not more than 10 mm (or 5 mm with respect to those loose and rotten knots or those knots which are likely to come off).	cluding wider surface should be not more than 20 mm (or 10 mm with respect to those loose and rotten knots or those knots which are likely to come off).
Wane	No wanes should be observed.	Ditto	Ditto
End split or ring shake	No end splits or shakes should be observed.	Ditto	Ditto
Decay or worm hole	Decay or worm hole should be very insignificant.	Ditto	Ditto
Other blemishes	Any other blemish should be very insignificant.	Ditto	Ditto

(Notes) (1) The above standards will be applied to each one of the surfaces of any lumber.

(2) Those lumbers which have no knots in four surfaces, those which have knots in one surface but no knots in three surfaces, those which have knots in two surfaces but no knots in the other two surfaces, or those which have knots in three surfaces but no knots in the remaining one shall be regarded as qualified for the marks: "CLEAR 4 SIDES", "CLEAR 3 SIDES", "CLEAR 2 SIDES" or "CLEAR 1 SIDE" respectively.

(3) Those lumbers which have no knots exceeding such limits as specified in the standards for fine small knot in four surfaces, those which have such knots in one surface but no such knots in the other three surfaces, those which have such knots in two surfaces but no such knots in the other two, or those which have such knots in three surfaces but no such knots in the remaining one shall be regarded as qualified for the marks: "FINE SMALL KNOT 4 SIDES", "FINE SMALL KNOT 3 SIDES", "FINE SMALL KNOT 2 SIDES" or "FINE SMALL KNOT 1 SIDE" respectively.

(2) Split timbers

Classification	Standards		
	Clear	Fine small knot	Small knot
Knots	No knots should be observed in more than one surface including wider	The largest diameter of knots existing in more than 2 surface including wider	The largest diameter of knots existing in two or more surfaces in-

Table 6
N 1892 grading for squared timbers

(2) Squared timbers (including those regular squared timbers whose side length is not less than 70 mm and those flat squared timbers which are not less than 90 mm wide, marked "FOR GROUND SILL")

a. Regular squared timbers (including those regular split timbers whose side length is not less than 70 mm.)

Failure, defects and others	Standards		
	Special grade	First grade	Second grade
Knots	The knot diameter ratio should be not more than 30 percent and the grouped knots diameter ratio not more than 40 percent.	The knot diameter ratio should be not more than 40 percent and the grouped knots diameter ratio not more than 60 percent.	The knot diameter ratio should be not more than 70 percent and the grouped knots diameter ratio not more than 80 percent.
Bark pocket or resin-pocket	Bark pocket or resin-pocket should be very insignificant.	Bark pocket or resin-pocket should be insignificant.	Bark pocket or resin-pocket should not be conspicuous.
Wane	No wane should be observed.	The wane ratio should be not more than 20 percent and that of each corner not more than 10 percent.	The wane ratio should be not more than 60 percent and that of each corner not more than 30 percent.
Spring (bow)	The spring ratio should be not more than 0.2 percent. Concerning those marked "FOR GROUND SILL", however, the bow ratio should be not more than 0.5 percent.	Ditto	The spring ratio should be not more than 0.5 percent.
Twist	Twist should be very insignificant. Concerning those marked "FOR GROUND SILL", however, twist should not be conspicuous.	Ditto	Ditto
End split or ring shake	The end split or ring shake ratio should be not more than 5 percent.	The end split or ring shake ratio should be not more than 10 percent.	The end split or ring shake ratio should be not more than 20 percent.
Slope of grain	The greatest slope of grain to 1 m length of piece should be not more than 50 mm.	The greatest slope of grain to 1 m length of piece should be not more than 80 mm.	———
Average width of annual rings	The average width of annual rings should be not more than 6 mm.	Ditto	———
Compression wood	Compression wood should be very insignificant.	Compression wood should be insignificant.	Compression wood should not be conspicuous.
Decay or worm hole	Decay or worm hole should be very insignificant.	Decay or worm hole should be insignificant.	Decay or worm hole should not be conspicuous.
Chipped end	The ratio of a half of the sum of the maximum and minimum thickness-wise dimensions of the chipped section of an end of a lumber to the thickness of the lumber should be not more than 10 percent and the lengthwise dimension of the chipped section of such an end should be not more than 0.2 m.	Ditto	Ditto
Other blemishes	Any other blemish should be very insignificant.	Any other blemish should be insignificant.	Any other blemish should not be conspicuous.
Incising	Incising may not be regarded as blemishes; provided, however, that it should not cause an about 10% or more decrease in the bending strength and Young's modulus of any regular squared timber as defined herein.		
Clear, fine small knot, or small knot	Those which are marked with signs "CLEAR 4 SIDES", "CLEAR 3 SIDES", "CLEAR 2 SIDES", or "CLEAR 1 SIDE", "FINE SMALL KNOT 4 SIDES", "FINE SMALL KNOT 3 SIDES", "FINE SMALL KNOT 2 SIDES" or "FINE SMALL KNOT 1 SIDE" or "SMALL KNOT" should come up to the standards specified in the table (3) of Appendix 1.		
Preservative/termite-control treatment or preservative treatment	Same as prescribed in the preceding table (1) (Preservative/termite-control treatment or preservative treatment).		
Insect control treatment	Same as prescribed in the foregoing table (1) (Insect control treatment).		
Kiln drying	Same as prescribed in the foregoing table (1) (Kiln drying).		
Dimensions	Same as prescribed in the foregoing table (1) (Dimensions).		
Marking	Same as prescribed in the foregoing table (1) (Marking).		

(Note) The standards for measuring knots, bark pocket or resin-pocket, end split, slope of grain, compression wood, decay or worm hole, and chipped end will be applied to the four surfaces of each lumber.

b. Flat squared timbers (including those flat split timbers which are not less than 90 mm in width and marked "FOR GROUND SILL")

Failure, defects and others	Standards		
	Special grade	First grade	Second grade
Knots	The knot diameter ratio should be not more than 20 percent (30 percent for knots existing within one third of the length of a lumber when measured from both of its ends) and the grouped knots diameter ratio not more than 60 percent.	The knot diameter ratio existing within one third of the width or thickness of a lumber when measured from its arrises should be not more than 30 percent (40 percent for knots existing within one third of the length of a lumber when measured from both of its ends), that for knots other than those existing within one third of the width or thickness of a timber when measured from its arrises not more than 40 percent (50 percent for knots existing within one third of the length of a timber when measured from both of its ends), and the grouped knots diameter ratio not more than 60 percent.	The knot diameter ratio should be not more than 70 percent (80 percent for knots existing within one third of the length of a timber when measured from both of its ends) and the grouped knots diameter ratio not more than 80 percent.
Bark pocket or resin-pocket	Bark pocket or resin-pocket should be very insignificant.	Bark pocket or resin-pocket should be insignificant.	Bark pocket or resin-pocket should not be conspicuous.
Wane	The wane ratio should be not more than 10 percent.	The wane ratio should be not more than 20 percent and that of each corner not more than 10 percent.	The wane ratio should be not more than 60 percent and that of each corner not more than 30 percent.
Spring	The spring ratio should be not more than 0.5 percent.	Ditto	Ditto
Bow or twist	Bow or twist should not be conspicuous.	Ditto	Ditto
End split or ring shake	The end split or ring shake ratio should be not more than 5 percent.	The end split or ring shake ratio should be not more than 10 percent.	The end split or ring shake ratio should be not more than 20 percent.
Slope of grain	The greatest slope of grain to 1 m length of piece should be not more than 50 mm.	The greatest slope of grain to 1 m length of piece should be not more than 80 mm.	———
Average width of annual rings	The average width of annual rings should be not more than 6 mm.	Ditto	———
Compression wood	Compression wood should be very insignificant.	Compression wood should be insignificant.	Compression wood should not be conspicuous.
Decay or worm hole	Decay or worm hole should be very insignificant.	Decay or worm hole should be insignificant.	Decay or worm hole should not be conspicuous.
Other blemishes	Any other blemish should be very insignificant.	Any other blemish should be insignificant.	Any other blemish should not be conspicuous.
Incising	Incising may not be regarded as a failure or defect; provided, however, that it should not cause an about 10% or more decrease in the bending strength and Young's modulus of any flat squared timber as defined herein.		
Preservative/termite-control treatment or preservative treatment	Same as prescribed in the foregoing table (1) (Preservative/termite-control treatment or preservative treatment).		
Insect control treatment	Same as prescribed in the foregoing table (1) (Insect control treatment).		
Kiln drying	Same as prescribed in the preceding table (1) (Kiln drying).		
Clear, fine small knot, or small knot	Same as prescribed in the preceding table a. (Clear, fine small knot, or small knot).		
Dimensions	Same as prescribed in the preceding table (2) (Dimensions).		
Marking	Same as prescribed in the foregoing table (1) (Marking).		

(Note) The standards for measuring knots, bark pocket or resin-pocket, end split, slope of grain, compression wood, and decay or worm hole will be applied to the four surfaces of each lumber.

(3) Squared timbers

Failure and defects	Standards		
	Clear	Fine small knot	Small knot
Knots	No knots should be observed in more than one surface (or that including wider one with respect to those flat squared timbers).	The largest diameter of knots existing in more than one surface (or that including a wider one with respect to those flat squared timbers) should be not more than 10 mm (or 5 mm with respect to those loose and rotten knots or those knots which are likely to come off).	The largest diameter of knots existing in two more surfaces (or those including wider ones with respect to those flat squared timbers) shall be not more than 20 mm (or 10 mm with respect to those loose and rotten knots or those knots which are likely to come off).
Wane	No wanes should be observed.	Ditto	Ditto
End split	No end split should be observed.	Ditto	Ditto
Decay or worm hole	Decay or worm hole should be very insignificant.	Ditto	Ditto
Other blemishes	Any other blemish should be very insignificant.	Ditto	Any other blemish should be insignificant.

(Notes) (1) The above standards will be applied to each one of the surface of any lumber.

(2) Those lumbers which have no knots in four surfaces, those which have knots in one surface but no knots in the other three, those which have knots in two surfaces but no knots in the other two, or those which have knots in three surfaces but no knots in the remaining one shall be regarded as qualified for the marks: "CLEAR 4 SIDES", "CLEAR 3 SIDES", "CLEAR 2 SIDES" or "CLEAR 1 SIDE" respectively.

(3) Those lumbers which have no knots exceeding such limits as specified in the standards for fine small knot in four surfaces, those which have such knots in one surface but no such knots in the other three surfaces, those which have such knots in two surfaces but no such knots in the other two, or those which have such knots in three surfaces but no such knots in the remaining one shall be regarded as qualified for the marks: "FINE SMALL KNOT 4 SIDES", "FINE SMALL KNOT 3 SIDES", "FINE SMALL KNOT 2 SIDES" or "FINE SMALL KNOT 1 SIDE" respectively.

(4) The standards for small knot shall be correspondingly applied to those defects existing within 0.2 m from both ends of regular squared timbers rated as "Clear" or "Fine small knot".