FORESTRY MANAGEMENT TO ENHANCE THE ADDITIONAL VALUE OF WOOD

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1. RADIATA PINE TIMBER GRADING

1) Wood is one of the basic materials available to the engineer, and its strength qualities compare favourably with those of other building materials. However, the single most important disadvantage of wood is that even when a species has been selected on the basis of its general characteristics, a high degree of variation can be a common feature among individual pieces. This is due to:

   (a) Variations in the strength of clearwood related to site influences. This can be clarified by providing data for specific regions as has happened with Douglas fir.

   (b) Variation in the strength of clear timber due to location within the tree. This is important in radiata pine which has a distinct corewood zone.

   (c) Variation due to the presence, size, and location of defects such as knots. This is important in species which have discrete whorls of branches as do the pines.

2) The high degree of variability necessitates the formulation of timber grading rules to allocate sawn timber to categories of defined properties suitable for specific end uses.

   In New Zealand grades for radiata pine first appeared in 1938 and the current grades became national standards in 1978. The New Zealand Forest Service conducts regular courses to instruct industry personnel in the interpretation of the grading rules covering a range of native and exotic species.

3) The National Timber Grading Rules establish visual grades for the selection of wood suitable for boards, framing, engineering, and utility.

4) *Boards* (up to 40 mm thick): Used in long lengths for high quality furniture, panelling, weatherboards, etc., or in short clear lengths for manufacture into furniture components or finger-jointed lengths.

   Board grades are determined from the better face and edge and the reverse face is normally permitted to be one grade below. Strength is not normally a consideration with board grades and grading is based purely on the effects of defects on visual appearance. The order of board grades in the 1978 rules is: Finishing, Dressing, Factory and Merchantable.

   Currently revisions are under way which are intended to cater for expected changes in new crop radiata pine, specifically the creation of long clear lengths. It is expected that Premium (clear) and Select (high proportion of clear lengths) grades will be introduced in the near future.

5) *Framing and engineering grades*: Timber for structural uses is selected for stiffness and strength, and defects are considered in relation to their effect on stiffness and strength. The rules describe the defects allowed in the poorest pieces admissable to each grade—maximum sizes.

   In radiata pine the main properties influencing mechanical properties are branching characteristics and wood density. These are catered for in the grading rules through limitations on the knot area ratio which is dependent on the type of knot (spike or other) and on the size of the pitch. The order of selection is: Engineering, No. 1 Framing, No. 2 Framing.

   Recent changes to building codes permit wooden structures up to four storeys high and open up exciting possibilities for extending wood uses.

6) *Utility grades*: In all timber sizes, grades recognize utility material and assign it to Box grades. These can be used for a range of both low grade products such as packaging, or up-graded by defecting and finger-jointing and used for furniture, moulding, etc.

7) *Stress grading*: New Zealand sawmills produce stress grades in 40 mm sizes for the Australian market. The majority of this is visually stress graded. A stress grade is one having an assigned allowable stress in bending (strength) and modulus of elasticity (stiffness).

   It is normally designated by its allowable stress in bending, e.g., 5 MPa or F5. Both visual and mechanical stress grading procedures are intended to achieve the same result, but experience has shown that the visual method is less efficient.

Machine grading is more expensive but generally gives higher recoveries of the better grades and is more reliable because wood density is accounted for in addition to knot characteristics.

In visual stress grading the permissable defects are calculated on the basis of the basic stresses of the species (clear timber values), the range of required allowable stresses, e.g., F4, F5, F8, F11 as for the Australian market and tables giving the strength-reducing effects of recognisable defects.

Machine stress grading is superior to visual grading because the timber is flexed in the machine and the effects of combined defects such as knots, grain deviation, and wood density are taken into account. The commonest type of machine uses the close correlation between the stiffness of wood measured as a plank and the stiffness and strength measured as a joist. Plank stiffness is measured directly by applying a constant load and assessing deflection and a grade mark is automatically applied.

8) Present uses for stress graded timber include roof trusses, glue lamination, scaffold planks, ladder styles, long span beams, and joists.

Interest in the use of stress grades is likely to increase in many countries. In particular, the advantages of machine stress grading offer an efficient means of segregating timber into guaranteed strength groups and overcome much of the variability inherent in visual grading methods. In the case of radiata pine, machine methods will enable high grades to be recovered from all combinations of site and age, although clearly the best recoveries will occur in high density areas and older rotations.

表1 ラディアタ・パイン材の規格
（Radiata Timber Grades）

(1) Radiata Board Grades

規格	主な用途
Board（40㎜まで）	
Finishing	家具、パネリング（＝羽目板）
Dressing	フローリング、インテリア用材、ウェザボード
Factory	家具、建具
Merchantable	Sarking、フェンス板
Box	工業用の用途（例えば 箱、木わくなど）

(2) Radiata Framing Grades

規格	主な用途
Framing（40㎜以上）	
Engineering（F11+）	はり、けた、設計計算による構造物
No.1 Framing（F5, 8）	構造物（高い強度を必要とするもの）
No.2 Framing（4）	構造物（強度を必要としないもの）
Factory	家具、フィンガー・ジョイントされる材
Box	工業用の用途（例えば パレットなど）

2. USE OF SOLID WOOD AND WOOD PRODUCTS

1) The forests of New Zealand are currently producing some 10 million m³ of roundwood per year, to supply 350 sawmills, 10 plywood and veneer plants, 3 particleboard mills, 8 pulp and paper mills, and 2 fibreboard plants (with 2 more planned for 1985-86). Ninety-five percent of roundwood is exotic species.

表2 ラディアタ・パインの丸太材の消費内訳
（1984年）

最終用途など	材積（百万m³）	百分率
丸太の輸出	0.543	6 %
国内で消費される製材品	1.651	18
輸出される製材品	0.445	5
製材工場の燃料材と廃材	1.398	15
輸出されるチップ	0.372	4
単板用、合板用	0.068	0.5
パーティクル・ボード	0.158	2
ファイバー・ボード（繊維板）	0.142	1.5
メカニカル・パルプ（機械パルプ）	1.208	13
ケミカル・パルプ（化学パルプ）	2.815	30
ポスト、ポール（つか、円柱、電柱など）	0.534	6
	9.334	100

丸太が供給されるニュー・ジーランド内の工場数（概数）

製材	350
単板、合板	10
パーティクル・ボード	3
パルプ、紙	8
ファイバー・ボード	2（1985－1986：さらに2工場）

2) *Posts and Poles*: Treated posts and poles from radiata pine are widely used:

表3 ラディアタ・パイン小径丸太の消費割合（1984年）

用途	割合（%）
フェンス用	56
果樹園芸用など（例えば 果樹園の支柱など）	34
建築用の丸太	3
農業用の小屋（畜舎、納屋など）	2
電柱、電信柱など	2
海事用（ヨットハーバの係留柱など）など	1
基礎ぐい	1
輸出される円柱とくい	1
	100

3) *Sawn timber*: Of the 2 million m³ sawn, 75% is used domestically in a wide range of uses:

表4 ラディアタ・パイン製材品の消費量（1984年）

用途	使用の割合（%）
住宅用の建築用材	41
非住宅用の建築用材	21
コンテナー、パレット用材	10
家具用材	5
農業用（農業用の建物など）材	3
その他	20

Radiata pine is the predominant building material —most dwellings are wood framed and many have wooden weatherboards. Some of the reasons for this popularity are:

(a) Range of grades available.
(b) Long lengths available.
(c) Easily preservative treated.
(d) Nails easily.
(e) Dries rapidly when installed wet and distortion is minimal.
(f) Clear finger-jointed lengths can be used for high quality uses.
(g) Paints and stains well.

Recent changes to building codes permit wooden buildings up to four storeys high. They often make use of engineering grade and laminated beams.

4) *Veneer and plywood*: Radiata pine has replaced natives in veneer production and accounts for 96 % of the wood used. A wide range of plywood thickness (3–9 ply) and treatments are available for use in residential (decking, flooring, sarking), construction (box beams, form work, sheds, stress skin panels), industrial and commercial (pallets, containers, caravans, storage bins), and agricultural (gates, silos, fences, doors) environments.

Decorative pine veneers are becoming more popular.

5) *Fibreboard*: Several types of fibreboard are made from radiata fibres (pulp).

	Softboard	Medium	Hardboard
Density	350	350–750	800

The traditional softboard (insulating board) and high density hardboard have been supplemented since 1976 by medium density fibreboard (MDF). This new product competes directly with particleboard. It can be machined to give a high quality surface and edges can be moulded. Recent developments include embossed MDF for furniture and exterior MDF. Seventy percent of New Zealand production is used in furniture.

6) *Particleboard*: This product is made in a range of medium and high density types and is used for furniture, flooring and wall linings. Veneers of wood or paper extend the possible uses.

7) *Furniture and joinery*: The scarcity of native woods and the cost of imports has resulted in the wisespread use of clear radiata for furniture manufacture. Advantages are:

(a) Light colour —can give light or dark finish.
(b) Even texture —machines and stains well.
(c) Good strength-to-weight ratio.
(d) Excellent screw holding.

One potential problem is the poor surface hardness of wood from near the pith.

The ease of preservative treatment makes radiata ideal for outdoor furniture.

Solid wood doors and clear or finger-jointed components are becoming more popular both domestically and on export markets.

（附 表）

Grades of construction plywood (from NZS 3614)

(Note that other grades may be agreed between purchaser and manufacturer.)

Grade of plywood	Description of common uses	Grade of veneers		
		Face	Back	Inner plies
N-N	Both sides suitable natural finish.	N	N	Cp and C veneer adjacent to faces – Cp
A-A	Both sides smooth, suitable for painting; for use where appearance of both sides is important — screens, signs.	A	A	C
A-C	Uses similar to A-A, but where one side is less important.	A	C	C
B-B	Solid face both sides — concrete form work.	B	B	C
B-C	Solid face one side, containers, farm buildings, engineered components, concrete form work.	B	C	C
Cp-D	A reasonably solid surface with minor opend defects — flooring, decking, and similar uses. *Note*: As regards flooring there are two cases to be considered: 1. Single-skin flooring in which the upper surface must be reasonably solid (Cp-D grade or better); and 2. A two-skin floor comprising primary flooring (D-D grade or better) covered with some further layer to provide a reasonably solid surface.	Cp	D	Cp and C veneer adjacent to faces – Cp
C-C	For sarking, primary wall sheathing, primary flooring, pallets, bins, crates, boxes.	C	C	D
C-D	For sarking, primary wall sheathing, primary flooring, pallets, bins, crates, boxes.	C	D	D
D-D	For sarking, primary wall sheathing, primary flooring, pallets, bins, crates, boxes.	D	D	D

木材の付加価値を高める林業のあり方

〔解説／文責：九州大学農学部・堤 壽一〕

昭和60年10月5日の『品質懇話会』で講演いただいたDr D. J. Cownは、New Zealandの国立林試、つまりForest Research InstituteのWood Quality and Conversionで、Research Field Leaderを務める研究者です。

Dr Cownは、日本学術振興会の外国人招へい研究者として、九州大学農学部木材理学教室に、1985年8月から10月中旬終りまで滞在しました。この研究者は、スコットランド（イギリス）のアバディーン大学林学部を卒業し、N.Z. 林試に入ったあとは木材の比重の研究で世界的に著名になった方です。学位はカナダのブリティッシュ・コロンビア大学で得ております。最近は、木材材質と丸太品質、製材の木取りパターン、製材の歩留りと収益性、その他を勘案させ、林業サイドとを密接に連携づけた新しい研究を行なっています。

この講演の中で話題提供されたのは、

(1) ラディアタ・パイン材に適用される木材規格

(2) ラディアタ・パイン材を利用した製材品、および木材製品

についてであります。

私たち九州の林業関係者にとって大切なのはスギ材などです。話題の中で使われたのがラディアタ・パインが主であるために、われわれ日本人にとってはヨソゴトというような考えかたでなく、『木材生産と木材利用とをどのように連携しているか』に関心を持って理解されるよう、皆さまにお願いします。日本の林業が、将来の木材利用や木材工業に受け入れられる木材生産を期するにはどうしたらよいのか、ラディアタ・パイン材で払われた努力のあとを見るのも、意味があることのように思えます。

1950年代の前半に、ニュー・ジーランドの木材事情は一変しました。すなわち、在来の樹種（Indigenous species）と外来の樹種（Exotic species）の需要供給が同量になり、その後はラディアタ・パインを主体とする木材供給に変わっています。

他方で、ラディアタ・パイン林業は、牧畜業や農業との土地生産性の競合、林地の生産性や林業の収益性、木材工業の発展のために必要な木材の供給などを課題として、極めて集約的に進められねばなりません。さらに、自然保護、環境保全、防災などを目的とする森林事情はわが国と同じであるうえに、経済林の施業には極めて高度で総括的な研究が期待されています。このように厳しくて困難な課題を克服しながら、ラディアタ・パイン林業が進められてきたのです。

〔この講演で用いられた用語の解説〕

Board（板）・・・厚さ40㎜までで、強さよりも美観を期待する。

Framing（主に構造材）・・・厚さ 40㎜以上の板で、強さを期待する場面で主に使われる。

New crop と Old crop ・・・後者は1960年代以後に植栽されたもので、すべての林分が『枝打ち』と『間伐』を受けていると見てよい。ただし、今までの伐出材は前者がラディアタ・パインの主流であるが、すでに後者に移り変わる時点にさしかかっている。

New cropの典型的な施業例・・・① 750～1250本／ha植栽、②400～600本の2.2mに枝打ちを行なって、あとの立木は捨て伐り間伐（ほぼ5年生）、③200～250本の2.2～4.0mに枝打ち（ほぼ7年生）、④200～250本の4.0～6.0mに枝打ちを行ない、その他を捨て伐り間伐（ほぼ9年生）、⑤ 30年生で皆伐。