A Plan to Improve the Merchandising of
Number 2 and 3 Common Dimension Lumber

by

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INTRODUCTION:

I. The purpose of this thesis is to improve the merchandising possibilities of No. 2 and 3 common dimension lumber.

II. This problem is important in as much as the market for the lower grades of lumber has been and is at the present time very poor. Lumber mills, retail and wholesale lumber dealers find that their number 2 and 3 grades move very slowly in comparison with the clears. Since about 45% of all the lumber cut falls into the classification of No. 2 and 3 common, the problem of disposing of this lumber is very important to one in the lumber business.

III. The method used to devise a means of aiding the merchandising of this lumber is derived as follows:

A. The basis for grade of dimension lumber is that of strength and appearance; my topic will deal with the problem on a strength basis entirely.

B. This problem will be dealt with on the premise that the mechanical properties of No. 2 and 3 common in many cases will prove these grades comparable to No. 1 common for many uses.

C. The data used in the experiment which made this topic possible was collected from actual flexural tests performed in the engineering laboratory.

IV. Specifications of the material to be tested:

A. Size: 2" x 6" - 10' were used as the basis for the test.
B. **Surfacing:** All pieces to be surfaced clean to 1 5/8" x 5 5/8".

C. **Moisture content:** All material to be as nearly 15% moisture content as possible. If not at 15%, strength values to be adjusted to correspond with 15% m.c. by means of standard procedure used by the Forest Products Laboratory (formula for adjustment in U.S.D.A. Tech. Bulletin #479).

D. **Slope of grain:** No sample to have a slope of grain of more than 1 : 20.

E. **Rings per inch:** All pieces to have from 8 to 12 annual rings per inch.

F. **Density:** All pieces to have from 25 - 30% late wood.

G. **Grain:** All pieces to be flat grain.

H. **Species:** All pieces to be of Douglas fir.

V. **Selection of samples:**

Pieces of 2" x 6" - 10' were selected as nearly as possible as outlined above with knots or knot holes located within the middle fourth of the piece and at, or within, 1/4" of the wide face. The knot classification falls into three main groups with four knot sizes for each group. The groups and knot sizes are as follows:

- **Group I:** Intergrown knots of 1", 1 1/2", 2", 2 1/2" diameters. Total of 12 samples.
- **Group II:** Encased knots of 1", 1 1/2", 2", 2 1/2" diameters. Total of 12 samples.
Group III: Knot holes of 1", 1 1/2", 2", 2 1/2" diameters. Total of 12 samples.

The accuracy of the experiment is hampered by comparatively few number of samples tested, however, the supply of 2" x 6" dimension lumber in this locality limited the total number of samples tested to 48. The samples were taken from the Corvallis Lumber Company yard and were carefully taken with due regard to specifications as set up by C. E. Thomas, Associate Professor of Engineering Materials, and Glenn Voorhies, Assistant Professor of Wood Products, Oregon State College.

VI. Testing Procedure:

Type of test: A standard static bending test with third point loading was conducted on all samples. The load was applied at the rate of .1 inches per minute by means of a movable head on the 150,000# Riehle Universal Testing Machine in the engineering laboratory. Loads were recorded at #100 intervals with the corresponding deflection at each interval obtained by means of an attached deflectometer. Two samples of each knot size in each group were tested for both tension and compression.

VII. Calculations:

A. The modulus of rupture was computed for each test by means of the formula \( \frac{3 \times F \times L}{2 \times b \times h^2} \)

B. The results of the above calculations were averaged for the compression and tension side of the member in each of the knot classes in each of the three groups.
C. The modulus of rupture was then plotted over knot size for each of the three knot groups. (Shown on accompanying graph.)

VIII. Results:

According to the results obtained by the tests, and shown in Fig. 1, a knot hole from 1 1/4" - 2 1/4" near the center of the piece and placed near or on the outside face, has a greater modulus of rupture and is correspondingly stronger than an intergrown or sound tight knot of the same size placed similarly. Encased knots likewise have a higher modulus of rupture than intergrown knots up to 2" in diameter.

Figures 2, 3, 4 and 5 show samples of the lumber after the modulus of rupture had been reached. Figure 6 shows the type of testing machine used for the tests. Figure 1 shows the average modulus of rupture of both tension and compression perpendicular to the grain plotted over knot size for each knot classification.

IX. Explanation of results of tests:

It is hard to believe that a knot hole is stronger than an intergrown knot. An intergrown knot, however, is surrounded by more highly distorted grain than a knot hole and is considerably weakened from the grain distortion.

A knot hole is formed by the sapwood growing around a dead limb on the bole of the tree. An intergrown knot is formed from a live branch growing from the bole of the tree. As the branch grows, the grain near the point of exit from the trunk of the
tree becomes more and more distorted. This distorted grain, when surrounding a knot in a piece of sawed lumber, has a definite weakening effect on the tensile and compressive strength of the piece.

MERCHANDISING PLAN:

The grading rule specifications of the West Coast Lumbermen's Association allow the following knot defects in Douglas fir dimension lumber:

No. 1 Dimension:

Intergrown knots:

- 1" in 2" widths
- 1 1/4" in 3" widths
- 1 1/2" in 4" widths
- 1 3/4" in 6" widths
- 2" in 8" widths

Encased Knots:

- 2/3 the diameter of the above allowable knots

Knot Holes:

- 3/4" in 4" and 6" widths
- 1" in 8" and wider widths, 3 to each 16' of length

No. 2 Dimension:

Knots—sound and unsound, loose, approximately:

- 1 1/2" in 3" widths
- 2" in 4" widths
- 3" in 8" widths
3 1/2" in 10" widths
4" in 12" and wider

Knot Holes:
1 1/4" in 4" and 6" widths
2" in 8" and wider widths

No. 3 Dimension:

Will allow any type of knot with a diameter greater than specified in No. 2 Dimension up to 2 1/2" per 4" of width.

According to the results obtained by the aforementioned tests, many pieces of No. 2 dimension will qualify for No. 1, and likewise, many pieces of No. 3 dimension will qualify for No. 2 as far as strength is concerned.

The manufacturing problem of No. 3 dimension is largely that of salvaging some value out of material that already has a cost attached to it, and generally does not pay the cost of production.

Under adverse market conditions No. 2 will not meet the cost of production and is often hard to move at a profit.

Douglas Fir dimension stock is used for load bearing members such as joists, rafters, plates, studding, bridging, headers, decking, and scaffolding. In any of the above uses, strength is the prime requisite and appearance is a minor factor as most of the lumber is concealed when used for one of the uses listed above.

Provided this plan was submitted to the West Coast Lumbermen's Association and approved, sufficient literature could easily be compiled and distributed to all association dealers explaining
the facts about the case which are:

1. Approximately 6 to 8% of No. 2 Dimension lumber will compare equally with No. 1 Dimension on a strength basis. The 6 - 8% depending on the type, size, and placement of knots contained within the piece, could be sorted on the green chain.

2. Approximately 8 to 10% of No. 3 Dimension lumber will compare equally with No. 2 Dimension on a strength basis and could be sorted in the above manner.

3. The dealers could dispose of this No. 2 and 3 dimension more easily to contractors and the like if they could present evidence sanctioned by the West Coast Lumbermen's Association as to the basis for such conclusions.

4. With literature bearing the approval or stamp of the West Coast Lumbermen's Association, the facts could easily and quickly be presented to certain shopper-buyers and a better market could be created for about 8% of the lower grade Dimension lumber.

SUMMARY:

I. Conclusions:

Although the results obtained from this experiment may not be absolutely accurate due to the limited number of samples tested, the results obtained show a distinct trend toward the basis of assuming that the experiment was accurate.
There are several possibilities of aiding the merchandising of dimension lumber provided the tests performed were of reasonable accuracy, at least accurate enough to establish a definite trend.

II. Recommendations:

I believe that if enough samples were tested to allow for a sound average, that this experiment could be turned into an actual benefit to the lumber industry.

If this data were submitted to the Forest Products Laboratory for further research, and the findings held true, it would increase the marketability of the lower grade dimension lumber considerably.
Fig. 2

A 2" knot hole in a piece of 2" x 6" Dimension lumber showing compression failure.
Fig. 3

A 2" intergrown knot in a piece of 2" x 6"
Dimension lumber showing compression failure.
A 1" encased knot in a piece of 2" x 6" dimension lumber showing compression failure.
A 1 1/2" encased knot in a piece of 2" x 6" dimension lumber showing tension failure.
Type of testing machine used to test Douglas Fir samples of 2" x 6" dimension lumber for tensile and compressive strength.
BIBLIOGRAPHY


2. West Coast Lumbermen's Grading Rule Book No. 10


4. Wood Handbook, prepared by Forest Products Laboratory