METLA

FINNISH FOREST RESEARCH INSTITUTE

VISUAL AND MACHINING PROPERTIES OF NORDIC SCOTS PINE WOOD FOR JOINERY AND FURNITURE INDUSTRY

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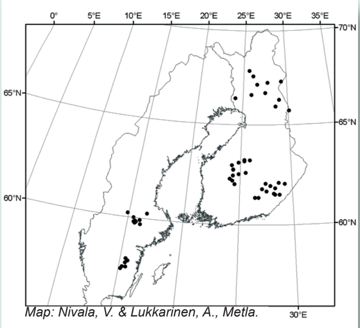

Fig. 1. Location of the sample of 60 stands selected to obtain a variation in geographical origin, climate, site index, and tree age representative of mature clear-felling stands of Scots pine in Finland and Sweden.

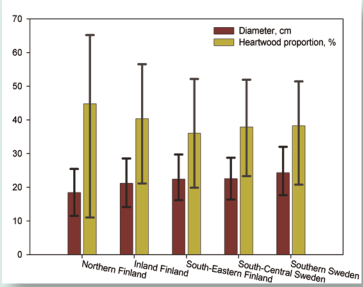

Fig. 3. Median log diameter (without bark) and area proportion of heartwood in different regions. Combined data for all heights are shown. Bars represent median values and whiskers the 10th and 90th percentile, respectively.

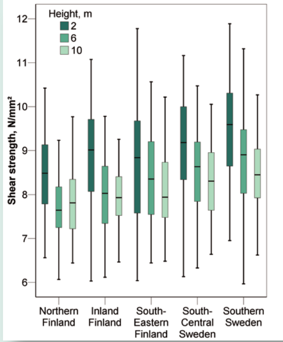

Fig. 5. Box-and-whiskers plot of static shear strength in different regions by sampling height.

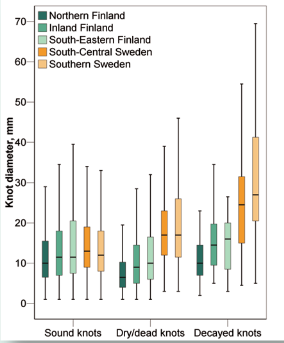

Fig. 2. Box-and-whiskers plot of knot diameters in different regions by knot type. Combined data for all heights and boards are shown.

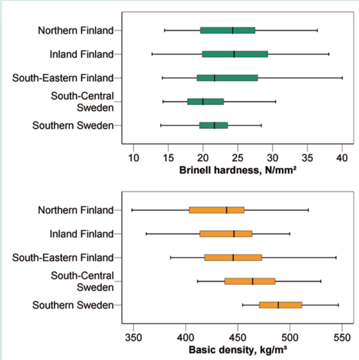

Fig. 4. Box-and-whiskers plot of Brinell hardness (top) and basic density (down) of wood in different regions. Data for 2m height and 2-board are shown.

Introduction

The specific wood properties of Nordic Scots pine (*Pinus sylvestris* L.) applicable for further processed end-use products, as well as their variation and the affecting factors are neither well known, demonstrated, nor fully utilized in the marketing argumentation. Pine wood tends to have large variations in material properties related to silviculture and growth region. Additionally, the level and variation in those properties are most probably different compared to other competing species and non-wood materials in the main market segments.

Visual properties may affect customers' choices, e.g., when buying interior materials or furniture. In addition, some of these properties, such as heartwood proportion and knottiness, affect the wood machining properties. Therefore they play a great role in producing homogeneous wood products free from defects, and also in finger jointing industry and in billet production for joinery and furniture products. In addition, knottiness affects also the mechanical properties of wood, whereas shear strength and Brinell hardness have some influence for instance on ability of mechanical connecting of wood.

In this study the knottiness properties, heartwood proportion, Brinell hardness and static shear strength of Nordic Scots pine wood were studied.

Material and methods

Sixty mature Scots pine-dominated stands were selected in three regions in Finland and two regions in Sweden, 12 stands from each region (Fig. 1). In each stand, eight Scots pine trees covering the diameter range of conventional saw log and small-diameter log trees (DBH>14cm) were felled for sampling. In each tree, 70-cm sample bolts were cut from 2m, 6m, and 10m heights, and bolts were further sawn through-and-through into approx. 30-mm thick boards. Boards were numbered ascending from pith outwards, starting from 0-board (pith enclosed). Smaller sub-samples were prepared for wood property studies. In total, material consisted of 60 stands, 180 trees, and 540 bolts.

Knottiness properties were measured from boards with approx. length of 70cm (N=2263). Heartwood proportion (N=537) was determined as a ratio between heartwood area on a cross-section and total cross-sectional area, assuming both areas circular. Resistance to indentation, i.e. Brinell hardness (N=908), was measured perpendicular to grain according to the European standard EN 1534 with FMT-MEC 100 kN material testing apparatus. Due to major occurrence of "sinking in" (elliptical indentations) the results were calculated based on depths, not diameters, of residual indentations. Ultimate shear strength parallel to grain in tangential direction (N=1087) was determined according to Skanorm 11.

Results

- Knottiness properties (internal)
  - By region, in all boards the average whorl interval (length of defect-free wood zone between two adjacent whorls) ranged between 156mm and 276mm;
  - at all heights, median diameter of sound knots had no significant differences between regions, contrary to larger differences in the diameter of dry/dead knots and decayed knots (Fig. 2);
  - variation in knot diameters within regions increased with increasing height;
  - median values and within-region variation of diameter of dry/dead knots and decayed knots increased from the north to the south (Fig. 2);
  - from the north to the south, average internal knot angle (0°=vertical, 90°=horizontal) decreased from 77° to 59°.
- Heartwood proportion
  - Area proportion of heartwood increased with increasing latitude despite of simultaneous decrease in stem diameter (Fig.3); there were no significant differences in heartwood proportion between sampling heights;
  - in stems with similar age the heartwood proportion was largest in the south; in stems with similar diameter the heartwood proportion was largest in the north due to lower growth rate.
- Brinell hardness
  - By region, correlation coefficient between Brinell hardness and basic density ranged between 0.63 and 0.78;
  - mainly due to basic density variations the hardness values decreased with increasing sampling height, but increase in hardness from pith outwards was not so clear despite of increasing basic density;
  - hardness increased with increasing latitude despite the lower basic density in the north (Fig. 4).
- Shear strength
  - Relatively high correlations between basic density and shear strength were found in all regions (from 0.61 to 0.85), similar relationship at all sampling heights;
  - as basic density increased with increasing distance from pith also shear strength increased from pith outwards;
  - moderate differences in shear strengths between sampling heights and regions (Fig. 5).

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