

AGNIESZKA WDOWIAK\*

## USING THE VISUAL METHOD TO SORT POLISH PINE STRUCTURAL SAWN TIMBER WITH RESPECT TO STRENGTH

### WYTRZYMAŁOŚCIOWE SORTOWANIE POLSKIEJ SOSNOWEJ TARCICY KONSTRUKCYJNEJ METODĄ WIZUALNĄ

#### Abstract

The conducted investigation focused on sorting Polish pine sawn timber with regard to strength, using the visual method in accordance with the PN-D-94021 standard [4]. The sawn timber was obtained from four selected Poland's nature and forest lands: Land A – Mazovian-Podlasiian Nature and Forest Land (Forest District Garwolin), Land B – Little Poland Nature and Forest Land (Forest District Przedbórz), Land C – Silesian Nature and Forest Land (Forest District Kędzierzyn Koźle), Land D – Carpathian Nature and Forest Land (Forest District Piwniczna).

*Keywords: structural sawn timber, sawn timber quality classes, sorting with regard to strength, visual method, Poland's nature and forest lands*

#### Streszczenie

Przeprowadzono badania obejmujące wytrzymałościowe sortowanie polskiej sosnowej tarcicy metodą wizualną zgodnie z PN-D-94021 [4], pochodzącej z czterech wybranych krain przyrodniczo-leśnych Polski: Kraina A – Mazowiecko-Podlaska Kraina Przyrodniczo-Leśna (Nadleśnictwo Garwolin), Kraina B – Małopolska Kraina Przyrodniczo-Leśna (Nadleśnictwo Przedbórz), Kraina C – Śląska Kraina Przyrodniczo-Leśna (Nadleśnictwo Kędzierzyn Koźle), Kraina D – Karpacka Kraina Przyrodniczo-Leśna (Nadleśnictwo Piwniczna).

*Słowa kluczowe: tarcica konstrukcyjna, klasy jakości tarcicy, sortowanie wytrzymałościowe, metoda wizualna, krainy przyrodniczo-leśne Polski*

## 1. Introduction

Recently, there has been a growing demand for structural sawn timber. Sawn timber has been increasingly applied in the construction industry, owing to modern manufacturing technology and appropriate preservative protection. At present, it is used to construct not only single family houses, but also multi-storey buildings. In Poland, structural sawn timber is used in the production of roof rafters and the construction of walls in frame structure houses. Houses made from solid logs of varying thickness are very popular. The production of structural elements glued in layers from sawn timber is increasing, too. Since the structure must be safe, the structural sawn timber needs a guarantee of strength, so it must be sorted in terms of strength. Such sorting allows defining the modulus of the sawn timber's elasticity using a machine or the visual method. When the sawn timber modulus of elasticity and the density are known, it is possible to predict its strength. In different European states, the visual sorting of structural sawn timber is based on national standards. They have been developed based on the results of the examination of timber obtained in particular regions. Timber from the same wood species, but from different regions of Europe, designed to be used in construction, reveals different properties and structural features. Therefore, sorting standards developed in different countries differ from each other [3].

When the visual method is applied to sort the sawn timber in terms of strength, each piece of timber is thoroughly analysed and classified into the appropriate sorting class on the account of the encountered structural, shape or processing defects. Softwood structural sawn timber is divided into three quality classes. These classes are coded in the following way: KW – high quality, KS – medium quality, KG – lower quality. The following features are regarded as timber defects: knots, twisted fibres, cracks, resin pockets, bark pockets, rind galls, rot and insect galleries. The standard takes into account the following shape and processing defects: waness, lengthwise curvature, crosswise curvature, warpedness and other processing defects (non-perpendicularity of timber heads). The criterion that most often determines the class of sawn timber quality is the presence of knots, primarily their size and location in the cross section of the sorted piece of the sawn timber. The PN-D-94021 standard defines the knottiness of a sawn timber piece with two parameters:  $U_{\text{knot}}$  and  $U_{\text{m knot}}$ . An authorised sorter examines the whole length of the plank and looks for the weakest cross section with the biggest knot or the largest cluster of knots. After establishing the weakest cross section, the sorter determines the value of the  $U_{\text{knot}}$  i.e. the ratio of the area of the knot (knots) to the area of the whole cross section as well as the value of the  $U_{\text{m knot}}$  coefficient – the ratio of the knot area in the so-called worse margin to the area of that margin. Margins are the edge zones of each sawn timber piece with the width of  $\frac{1}{4}$  width of the plank. The worse margin, i.e. the one whose knots occupy a larger area, is always selected. Another very important timber defect, which must be taken into account during the sorting in terms of strength, are the twisted fibres. They may be acceptable in the structural sawn timber to a different extent. Cracks, resin pockets, bark pockets and rind galls are treated in the same manner and they are acceptable to a different extent, depending on the location and intensity of their appearance. Rot is practically unacceptable, empty insect galleries are sporadically acceptable in the worst class. The standard defines the acceptable, maximum width of annual growth rings in each class [2–4].

## 2. Sorting the structural sawn timber in terms of strength by the visual method

### 2.1. Research material characteristics

In Poland, there are eight distinguished areas called nature and forest lands with varied geographical-climatic conditions. These are: Baltic, Mazurian-Podlasiian, Great Poland-Pomeranian, Mazovian-Podlasiian, Silesian, Little Poland, Sudetian and Carpathian. Dziewanowski suggested the division of Poland into four belts: I Pomeranian Pine Belt, II Lowland Pine Belt, III Upland Pine Belt, IV Mountain Belt [1, 3].

The following lands were selected for the research:

- Mazovian-Podlasiian Nature and Forest Land, code A, timber was obtained from the Forest District Garwolin;
- Little Poland Nature and Forest Land, code B, timber was obtained from the Forest District Przedbórz;
- Silesian Nature and Forest Land, code C, timber was obtained from the Forest District Kędzierzyn Koźle;
- Carpathian Nature and Forest Land, code D, timber was obtained from the Forest District Piwniczna.

Five batches of sawn timber with differently sized cross-sections and with 40 pieces each were selected from each land, with the exception of the cross section of 40×82 mm. The length of the sawn timber was app. 4.0 m. 240 pieces of the sawn timber were examined in total [3, 5]. The dimensions of the sawn timber from different lands are presented in Table 1.

Table 1

#### Cross section dimensions of the sawn timber from different Poland's nature and forest lands [3]

Dimensions [mm]	LANDS				Total
	A	B	C	D	
	Number of pieces				
37×48×4050	10	10	10	10	40
40×82×3650	20	25	25	10	80
50×100×4000	10	10	10	10	40
50×125×4000	10	10	10	10	40
50×200×4000	10	10	10	10	40
Total	60	65	65	50	<b>240</b>

## 2.2. Sorting polish pine structural sawn timber with respect to strength

During sorting, which was performed in the company Tartak OLCZYK in Świdno, the sawn timber was measured with respect to the thickness, width and length. Each piece was analysed and all the sawn timber features were measured, including knottiness, twisted fibres, surface and head cracks, lengthwise curvature of sides and planes, crosswise curvature, warpedness, waness, bark pockets, resin pockets and fibre waviness. In most cases, the pieces contained a feature determining the quality class of the sawn timber, primarily knots. Once the weakest cross section was selected, along the length of each piece of the sawn timber, the knots therein were projected on the auxiliary checked paper sheets with the dimensions of the cross section of the sorted piece. The obtained drawings provided the base for determining the knottiness coefficient. When determining the knottiness coefficients, attention was paid to the location of the knots throughout the cross section and in the marginal zones. For an accurate classification, in many cases, auxiliary drawings were made for two or three cross sections. The final stage involved the comparison of the drawings with each other and the selection of the one, which projected the knots from the weakest cross section [3, 4, 6, 7].

Sorting the sawn timber from Mazovian-Podlasiian Nature and Forest land yielded the highest number of pieces in the KW class (6 pieces) and the KS class (13 pieces) in comparison with other lands (Fig. 1). For the whole batch from this land, the rejection rate was 41.7%.

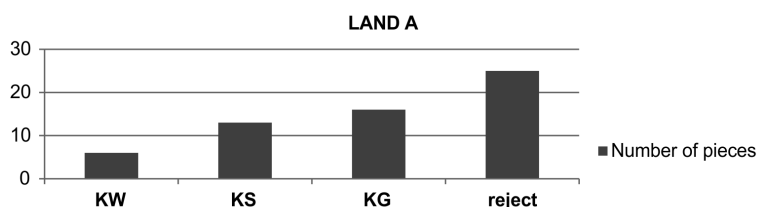


Fig. 1. Number of pieces in different sorting classes according to visual sorting (Mazovian-Podlasiian Nature and Forest Land – Land A – Forest District Garwolin)

Little Poland Nature and Forest Land (Fig. 2) had 4 of the sawn timber pieces classified as the KW class and 10 pieces as the KS class. The most numerous group includes the sawn timber classified as the reject – 29 pieces. This number is higher than the KG class by 7 pieces.

Silesian Nature and Forest Land had 3 pieces of the sawn timber classified as the KW class and 8 pieces classified as the KS class. These results are not much worse than those of Little Poland Nature and Forest Land. The number of the rejected pieces is also high – 28 pieces, which amounts to 43.1% of the whole sawn timber batch from that land. 26 pieces were classified as KG (Fig. 3).

The sawn timber from Carpathian Nature and Forest Land (Fig. 4) was the worst of all the examined batches. Only one piece was classified as the KW class and only three pieces as the KS class. This batch of sawn timber yielded the largest number of rejects – as many

as 29 pieces, which amounts to 58% of the whole sawn timber from this land. Such a high rejection rate was mostly determined by knots (15 pieces). In other cases, it was due to waness (5 pieces), cracks (2 pieces), twisted fibres (one piece) and other defects (2 pieces). In the case of a few rejected pieces, there were two or three defects in one piece.

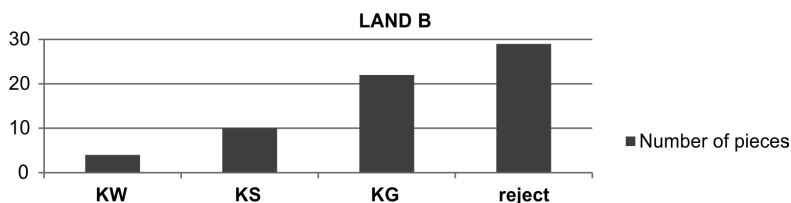


Fig. 2. Number of pieces in different sorting classes according to visual sorting (Little Poland Nature and Forest Land – Land B – Forest District Przedbórz)

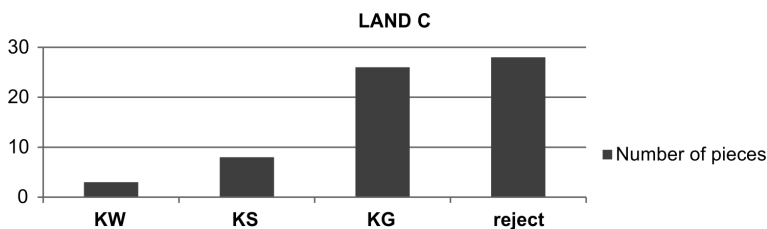


Fig. 3. Number of pieces in different sorting classes according to visual sorting (Silesian Nature and Forest Land – Land C – Forest District Kędzierzyn Koźle)

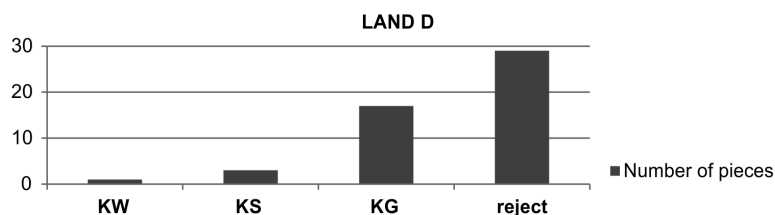


Fig. 4. Number of pieces in different sorting classes according to visual sorting (Carpathian Nature and Forest Land – Land D – Forest District Piwniczna)

### 3. Conclusions

The conducted examination yielded the sawn timber sorting results for different Poland's nature and forest lands (Table 2).

Table 2

**The grading results obtained by sorting the sawn timber in terms of strength by the visual method, according to the PN-D-94021 standard [3, 4]**

LAND	KW		KS		KG		reject	
Mazovian-Podlasiian Nature and Forest Land	6 pcs	10 %	13 pcs	21.67%	16 pcs	26.67%	25 pcs	41.67%
Little Poland Nature and Forest Land	4 pcs	6.15 %	10 pcs	15.38%	22 pcs	33.85%	29 pcs	44.60%
Silesian Nature and Forest Land	3 pcs	4.62 %	8 pcs	12.31%	26 pcs	40.00%	28 pcs	43.08%
Carpathian Nature and Forest Land	1 pcs	2.00 %	3 pcs	6.00%	17 pcs	34.00%	29 pcs	58.00%
<b>TOTAL</b>	<b>14 pcs</b>	<b>5.83 %</b>	<b>34 pcs</b>	<b>14.17 %</b>	<b>81 pcs</b>	<b>33.75 %</b>	<b>111 pcs</b>	<b>46.25 %</b>

The table shows that 46.25% of the analysed sawn timber was classified as a reject, 33.75% was classified as the KG sorting class, 14.17% was classified as KS, whereas 5.83% was graded as the best class (KW). The sawn timber from Carpathian Nature and Forest Land was distinctly the worst of all the analysed batches, because only one piece was classified as corresponding to the KW class and only three pieces as belonging to the KS class [3].

### References

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