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Preliminary results of the visual assessment of boards made from low-quality oak logs

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ABSTRACT

The subject of this paper is the quantitative analysis of defect-free Class I lamellae extracted from low-quality logs. From the sessile oak and pedunculate oak logs included in the study, 50 boards were produced, of which 18% of the surface area could be used to make standard size lamellae. The remaining surface area of the boards either contained some wood defects or the defect-free part was not of a size suitable for lamella production. While the length of the majority of the lamellae was between 0.25 and 0.50 m, the width of most of the lamellae was in the middle category (50 mm). Our conclusion suggests that it may be worthwhile to use low-quality logs for the production of lamellae for glued-laminated wood supports, if lamellae with smaller wood defects could also be used. This would increase the amount of wood that can be used in industrial production and would allow to make high added value wooden parts from an actually unused assortment.

INTRODUCTION

In recent decades, the share of firewood among forest products has increased as the demand for low-quality sawlogs, previously processed by the sawmill industry, has disappeared. In developed societies, however, there is now an increasing demand for only logs suitable for industrial use (mainly by sawmills) should be removed from the forests. The remaining woody biomass in the forests should increase the humus supply and the amount of wood degrading organisms and the amount of organisms that feed on them. The amount of firewood within the harvested forestry assortment exceeds 50% (Lett et al. 2018). In order to increase the currently low processing ratio of forest products for both veneer and sawmill industry, it is necessary to investigate how much of the approximately 80% of logs that are not adequate for these purposes as a result of visual assessment may still be suitable for further use in the sawmill industry. In this way, the products with the highest added value could be made from them - still economically.

The continuously increasing market price of oak logs justifies an even greater increase in sawmill yield compared to other species. This can be achieved by producing as little waste as possible and by recovering the maximum fraction of the waste that has been uneconomically processed so far. On the other hand, the processing of low-quality logs and sawn timber, which have been neglected up to now, must also be re-developed. Small parquet lamellae have played an important role in the past and could be used again, for example, in glued-laminated wood structures. Accordingly, our aim is to review and analyse some properties of low-quality oak logs. This includes the quantification of the high quality lamellae that can be extracted from the timber.

EXPERIMENTAL METHODS

The quality of the oak logs used for the test (*Quercus robur* L. and *Quercus petraea* (Matt.) L.), processed on a band sawmill, did not reach the quality of category II according to the Hungarian standard MSZ 45 (2022), which is currently widely used in Hungary. The minimum width of the resulting boards after cutting of the slabs was 120 mm, followed by board thicknesses of 30 mm. The stacking was not preceded by timber grading. After five months of outdoor storage (natural drying), a stack of 50 timbers was selected. These were further analysed. For the analysis, digital photographs were taken of each board (Canon Powershot SX50 HS; Canon Inc, Japan). The resulting images were analysed using Adobe Photoshop software (Adobe Inc, CA, USA) to determine the number and size of defect-free lamellae extractable from the boards. Both sides of the boards were considered. The lamella sizes correspond to the most common sizes of parquet and furniture component dimensions used in production nowadays (30-80 mm width and 250-1100 mm length). The results were tabulated for further analysis. Table 1 shows an outstanding example of the quantity of lamellae that can be obtained from one board.

Table 1: Example of the quantity of lamellae that can be obtained from boards: dimensions and summary of the lamellae that can be extracted from board No. 208. Board length 3 m; width 0.38 m

Board	**Lamella width [m]**						**Altogether**	
No. 208	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**[m^2]**	**[%]**
Lamella length [m]	0.35	0.25	0.25			0.40		
	0.25	0.40	0.40			0.25		
	0.25	0.40	0.30			0.40		
	0.30	0.30				0.35		
	0.25					0.35		
	0.25							
	0.25							
	0.25							
	0.30							
	0.35							
	0.25							
	0.25							
Altogether	3.30	1.35	0.95	0.00	0.00	1.75	**0.34**	**29.9%**

RESULTS AND DISCUSSION

The timber shown in Fig. 1 contains a number of typical wood defects that are typically found after processing low-quality oak logs. Typical wood defects are large knots, dead knots, slope of grain due to inclined growth, significant local slope of grain around large (or grouped) knots, pith and radial fissures, large fissures due to growth stresses, a higher proportion of sapwood in smaller diameter logs, and occasional biotic damages, mainly in sapwood, in addition to dead knots.

Figure 1: Sample No. 208 used for visual classification, with several typical wood defects

The total surface area of the 50 boards included in the test was 60 m^2. The dimensions of the lamellae that could be extracted from the boards and the total quantities corresponding to the dimensions are given in Table 2.

Table 2: Summary for high quality lamellae yield

	50 pcs. boards	Lamella width [mm]						Altogether
		30	40	50	60	70	80	
Surface [m^2]	59.79	1.90	0.17	6.70	0.51	0.00	1.65	10.93

Table 2 shows that the surface area of the 50 boards derived from low quality oak logs is about 60 m^2 and the surface area corresponding to defect-free Class I lamellae is less than 11 m^2. This represents a yield of only 18.3%. The distribution by width shows that 17% of the lamellae fall into the narrowest category (30 mm width), with a similar amount (15%) falling into the widest category of 80 mm. Surprisingly, the largest proportion belongs to the 50 mm wide lamellae, which is above 60%. The proportion of the remaining width categories is negligible, totalling 6%. Of course, we have tried to get the widest possible lamellae from the boards, because it makes most sense from a value-added point of view. The same applies to the length of the lamellae. As a result, no size was found to dominate the lengths. All of the length categories between 0.25 and 0.50 m received a proportion of 10% or more. Thus, mainly shorter sizes were extracted during the lamella selection, as expected; the largest proportion (18%) was for length 0.3 m and 14% for length 0.4 m. In contrast, the overall proportion of length sizes between 0.55 and 1.1 metres was 24%. An illustrative summary is shown in Table 3.

***Table 3:** Size distribution of the lamellae. The colour transition from blue to white gives a visual indication of the quantities*

		Lamella width [m]					
		0.03	0.04	0.05	0.06	0.07	0.08
Lamella length [m]	0.25	43	1	55	7	0	8
	0.3	55	2	72	6	0	9
	0.35	15	2	41	2	0	6
	0.4	17	4	45	1	0	11
	0.45	9	0	27	1	0	9
	0.5	11	1	39	4	0	3
	0.55	7	0	12	1	0	1
	0.6	6	1	9	0	0	0
	0.65	3	0	10	0	0	0
	0.7	1	0	12	0	0	2
	0.75	2	0	1	0	0	0
	0.8	1	0	5	0	0	0
	0.85	0	0	1	1	0	0
	0.9	0	0	0	0	0	1
	0.95	0	0	0	0	0	0
	1	1	0	1	0	0	1
	1.05	0	0	0	0	0	0
	1.1	1	0	1	0	0	0
Total amount [pcs]		172	11	331	23	0	51

It can be concluded that the extractable lamellae widths are not limited to the narrowest range, which is certainly positive for the value yield. However, a total surface yield of 18% is very low, because it means that approximately 80% of the raw material cannot be used for the intended purpose if the lamellae are produced in a continuous industrial production of unsorted and ungraded boards. In the future, it may be worth considering not only defect-free lamellae but also those with minor defects, which can still be used to produce high quality and high strength glued-laminated wood supports.

CONCLUSIONS

In this study, we tested the quality of timber derived from low-quality oak logs. Our main objective was to determine the amount of defect-free lamellae that can be obtained from logs that do not reach category II of the current Hungarian standard (MSZ 45 2022).
Out of 50 boards with a surface area of approximately 60 m^2, 11 m^2 of lamella surface could be extracted, which represents an extraction rate of 18%. The survey was carried out with the lamellae widths and lengths in use today, with the largest proportion of lamellae being the middle size, 50 mm wide. This is definitely advantageous from a value-added point of view. In terms of lengths, three quarters of the assortment was

between 0.25 and 0.5 metres, i.e. belonging to the short lamella section. All these results were due to the presence of a significant number of wood defects which limited the extraction of first grade lamellae: mainly sound and dead knots, slope of grain, sapwood, fissures and biotic damages. Given that the subsequent use of these small-sized lamellae seems possible mainly in glued-laminated wood supports, it is likely that lower quality lamellae (contain small knots, sapwood, etc.) could be used as well, which would highly increase the yield. This requires further research, analysis and related mechanical testing.

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