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Timber cross-cutting accuracy obtained with an automatic saw

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Abstract: *Timber cross-cutting accuracy obtained with an automatic saw*. The aim of this study was to verify the accuracy of cross-cutting of Scots Pine timber with use of optimization cross-cut saw Salvador Supercut 500. An influence of nominal element length and thru-feed speed was examined and analyzed with statistical methods.

Keywords: sawing, cross-cutting accuracy, wood machining

INTRODUCTION

Timber cross-cutting is a very frequently performed technological operation in wood industry. Mostly high-performance cross-cut optimizers entirely replace manual work on circular saws, decreasing labor costs and augmenting production yield. Numerous literature available concerns rip-sawing accuracy in sawmills (Eklund 2000, St. Laurent 1970), since, in most cases, it influences more the material yield, than cross-cutting.

Cross-cutting optimization issue was described by Ronnqvist M. and Astrand E. (1998) for fixed-length products as well as for continuous-length products. For the second solution, defects of wooden boards are cut out on the basis of automatic scanning and image analysis or by worker visual assessment and cutting lines marking. This is mainly a part of a longitudinal wood joining lines, which do not require specific lengths of elements. On the other hand automatic optimizing cross-cut saws may also be utilized as a stand-alone machines for production of elements of strictly defined length with or without taking into consideration the defects and quality classes. In such case a compliance between demanded and real dimension (length) arises to a crucial issue.

For simple cross-cutting mode the roughness of created surfaces were examined by Kminiak and Gaff (2015) and depending on: wood species, saw blade type and feed force. The length accuracy relies mostly on infeed (board positioning) system, which requires dynamic accelerations and decelerations.

The aim of present work was to examine the length accuracy of pine boards after timber cross-cutting on automatic optimizing saw Salvador Supercut 500, depending on boards' nominal length and thru-feed speed.

MATERIALS AND METHODS

The boards of Scots Pine with moisture contents of 10-14% have been planed with use of four-side moulder before the experimental work. The boards after planing with dimensions: 15 mm thick, 65 mm wide and 2600 mm long were subjected to cross-cutting with three cutting lengths ordered: 384 mm, 850 mm and 1500 mm. In current experiment wood defects cut-out was not involved; the mode used was simple cutting list order. In this mode the cycle on Salvador Supercut 500 saw included: length scanning, in-feed timber movement, stopping the board to cut-off its termination, accelerating to a maximal travel speed allowed (if element is long enough to achieve it) and length cutting. In such cycle it is impossible to set up the travel speed of the board since it is variable and changes from zero to maximal and back to zero. Therefore the producer allows regulations of percentage of maximal material traveling speed (150 m/min – Anonymus (2013)) as well as acceleration and deceleration. For purposes of present work 40%, 70% and 100% speeds were chosen.

For each of 9 cases considered: three nominal length by three speed levels, 50 specimens were produced and measured, giving total 450 boards. The measurements were performed with use of the caliper with 1540 mm measurement range and 0,05 mm of precision.

Next a discrepancy of stock length was calculated as a difference between the measured and nominal lengths. Additionally an error (e) of cut length was evaluated according to the following formula:

$$e = \frac{L_R - L_N}{L_N} \cdot 100\%$$

where:
L_R – length measured
L_N – nominal length

RESULTS

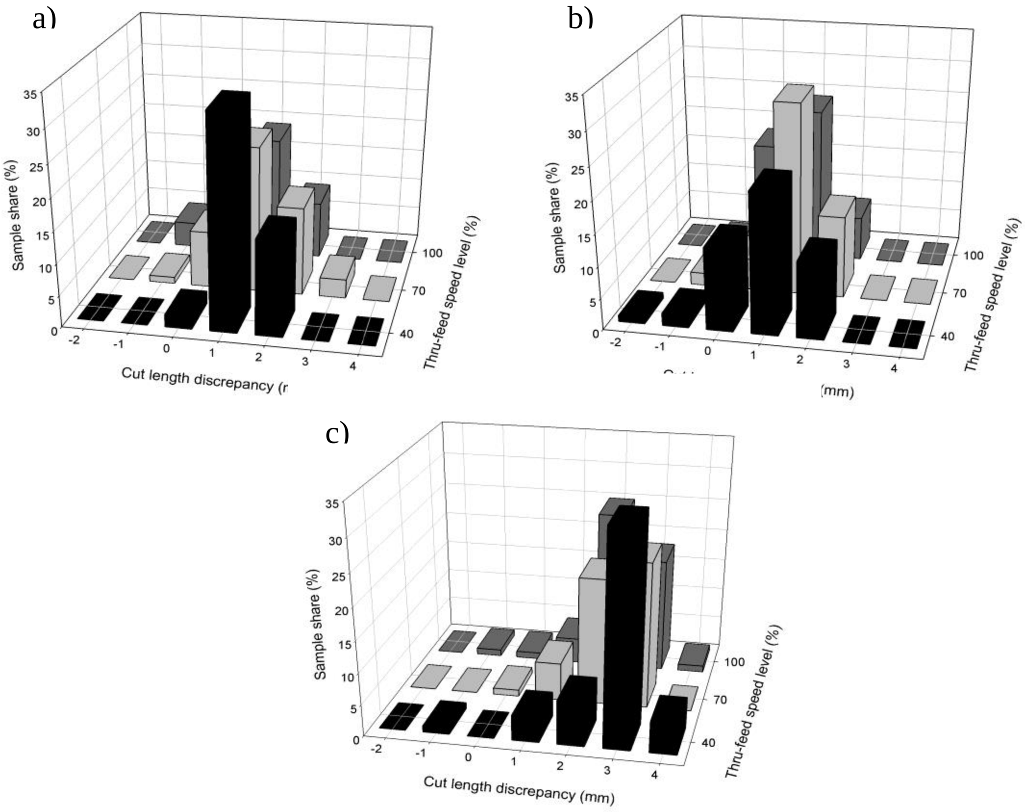

Figure 1. Histograms of cut length discrepancy for nominal lengths: a) 384 mm, b) 850 mm, c) 1500 mm

Histograms of cut length discrepancy are shown in the figure 1. The scatter of length dimension discrepancy covers values from -2 mm up to 4 mm. Relatively to the nominal length the errors of cut length start at –0.469% and reach +0.664%. It is evident, since discrepancies are mainly positive, that the saw oversizes the boards for all nominal lengths and speed levels. Population peaks for 384 mm and 850 mm, located around 1 mm, visibly shift with increasing nominal length toward 1500 mm and reach values 2 and 3 mm, depending on thru-feed speed. A tendency for the thru-feed speed level is not clearly visible.

Figure 2. One-way analysis of variance for saw work speed and cut length error. Vertical lines denote 0,95 level of confidence

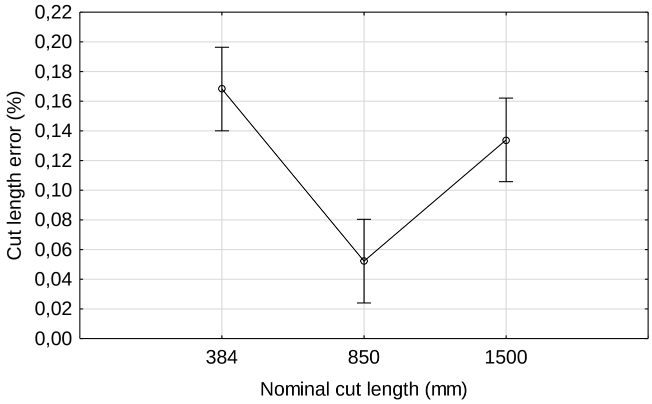

Figure 3. One-way analysis of variance of nominal cut length on cut length error. Vertical lines denote 0,95 level of confidence

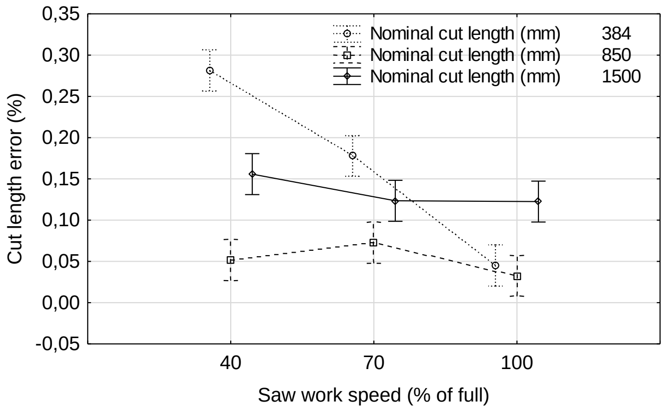

Figure 4. Two-way analysis of variance of nominal cut length on cut length error

To verify and validate tendencies, a one- and two-way analysis of variance (ANOVA) has been utilized with use of Statistica software. Firstly one–way ANOVA was performed for saw work speed and cut length error (*e*). Figure 2 presents that increasing the work speed leads to reduction of cut length error. In considered length range this relation (reduction from 0,16% to 0,07%) monotonic, however discrimination power of work speed (independent variable) is rather poor since Wilks' Lambda = 0,9438.

Second independent variable – nominal cut length, in opposition, has a strong contribution to the variance model (Wilks' Lambda = 0,2557). Its relation to the cut length error is not monotonic though (fig. 3). The average error of cut length is the smallest for medium timber length (850 mm) and equals 0,052% and increases both for shorter and longer boards.

Two-way ANOVA model presented in figure 4 does not bring any better determination that above discussed. The mixed variable model has Wilks' Lambda value on the not satisfying level of 0,889.

CONCLUSIONS

Experiment preformed on cross-cutting accuracy of automatic optimizing cross-cut saw allows to form the following conclusions:

- The discrepancy of cut length was from -2 mm up to 4 mm
- The saw work speed rather does not influence the sawing accuracy.
- The cut length error strongly depends on the nominal cut length, but this dependency is not monotonic

REFERENCES

1. Anonymus 2013: Salvador Supercut 500 Manuals, version 10.02. Salvador woodworking machinery
2. Eklund U. 2000: Influencing factors on sawing accuracy in a bandsawmill, Holz als Roh- und Werkstoff 58: 102-106
3. Kminiak R., Gaff M. 2015: Roughness of surface created by transversal sawing of spruce, beech, and oak wood. BioResources, 10(2): 2873-2887
4. Ronnqvist M., Astrand E. 1998: Integrated defect detection and optimization for cross cutting of wooden boards, European Journal of Operational Research 108 (3): 490-508
5. St. Laurent A. 1970: Effect of sawtooth edge defects on cutting forces and sawing accuracy, Forest Products Journal 20 (5): 33-40

Streszczenie: *Dokładność cięcia poprzecznego drewna na pilarce automatycznej.* Celem niniejszej pracy była weryfikacja dokładności cięcia poprzecznego drewna sosny zwyczajnej za pomocą optymalizerki Salvador Supercut 500. Zbadano wpływ nominalnej długości elementów i prędkości przesuwu oraz przeanalizowano uzyskane wyniki metodami statystycznymi.

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