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STATIC STIFFNESS OF CIRCULAR SAW BLADES

The article outlines the technique of strain estimating of a band saw blade. The quality of processing depends on the strain character of a band saw rim, improved quality of processing being provided by the saws where the rim is not displaced in opposite directions over the saw perimeter under axial loading.

Introduction. The performance of circular saws is described by many parameters, including static and dynamic rigidity of the blades. Static rigidity is known as a ratio of the rim axial load to the strain rate. This parameter makes it possible to assess technological capabilities of the tool and is rather simple to define.

Main part. *Technique for estimation of circular saw static rigidity*.

To estimate static rigidity of circular saws it should be considered that the saw disc is deformed not only by radius vector of the lateral force application but over the whole disc area as well.

To identify the relation of the power load to the strain rate, an apparatus has been built on the 1K62 lathe spindle base. This unit is built with maximum precision to avoid random inaccuracies of measurements. The cylindrical shank of the unit is fixed in the cams of the turning jaws. The saw blade is then mounted on the shank between flanges using the thread joint. Axial load is applied to one of the saw teeth and the shift rate is measured to the 0.5 division value of the flat-disk scale of top slide. Indicating gages (ИЧ 10МН model, division value 0.01 mm, scale measuring limit 0-10 mm, maximum permissible error max. 4μ) are set around the rim periphery. They help to register the rim strain in checkpoints of the rim semiperiphery.

The experiments were carried out in comparative terms. Working woodcutting saws were analyzed, their technological performance being very familiar, i.e. commercial saws, cutting saws, ripping saws made by Leitz company and experimental saws. The checkpoints for estimating the rim strain were selected so as to embrace the saw semiperiphery and to take into consideration specific features of the saw rim design. The checkpoints layout is given for all measurements. For saws with slots in the rim, the strain rate was defined by tooth tops before and after the slots to assess their effect on the rim strain.

Specifications of a commercial saw. To estimate the rim strain rate a commercial saw produced at Minsk machine-tool plant was selected. The saw can be used for ripping the logs of 360 mm diameter, it has 2.2 mm blade thickness and 48 saw teeth and is to be employed at furniture factories, e.g. "Minskproektmebel".

The strain was registered in checkpoints 0.25CP, 0.5CP, 1CP. The resulting curve is shown in Fig. 1.

The vertical axis shows the values of the prescribed axial deflection of the rim on the following scale: 0.25; 0.5; 0.75, 1.5 mm. The horizontal axis presents the resulting axial displacement in the checkpoints: 0.25 CP (45°), 0.5 CP (90°), 1 CP (180°).

Checkpoint 0.25 CP (45°) being moved off the application point of the prescribed deflection, the value of the rim axial displacement decreases as much as 4 times. Zero displacement, i.e. "dead" point "H" is located off ≈0.45 CP at all values of the deflection ranging 0.25–1.5 mm. Further over the periphery the deflection of the rim was registered in reverse direction what is shown in the negative range of y axis (see graph). Further on, as the deflection value approaches the opposite checkpoint (1CP) of the saw periphery, it tends to decrease and approach zero value.

Rim strain in ground saws. The ground saw has 310 mm diameter, blade thickness t = 3.2 mm and 64 saw teeth.

The nature of strain of a circular saw rim is shown in Fig. 2. Being moved 0.25CP off the point of the forced displacement, the ground saw reveals the axial displacement of teeth which is three times less compared to the strain of the saw produced by Minsk machine-tool plant. Being moved off over 0.5CP, the teeth displacement is insignificant and unidirectional looking similar to the typeface of the Cyrillic "С". The strain of commercial saw rim differs from the one described above and its curve moves to the negative values of y axis resembling the typeface of the Latin "S". The results obtained are consistent with alternative strain diagrams of circular saw blades cited in the reference [1]. The nature of the strain of a circular saw blade determines the abilities of cutting process along with the value and indication of the strain in the saw blade [2]. Blade tapering of a circular saw ensures high quality of wood machining operations. *Blade strain of the Leitz circular rip saw*. Specifications of the Leitz circular saw are as follows: HW – kreissageblat, WK 850-2 058311, 300 x 3.2/2.2, Z = 96/9.82, σ = 25 791, n_{max} = 7,600.

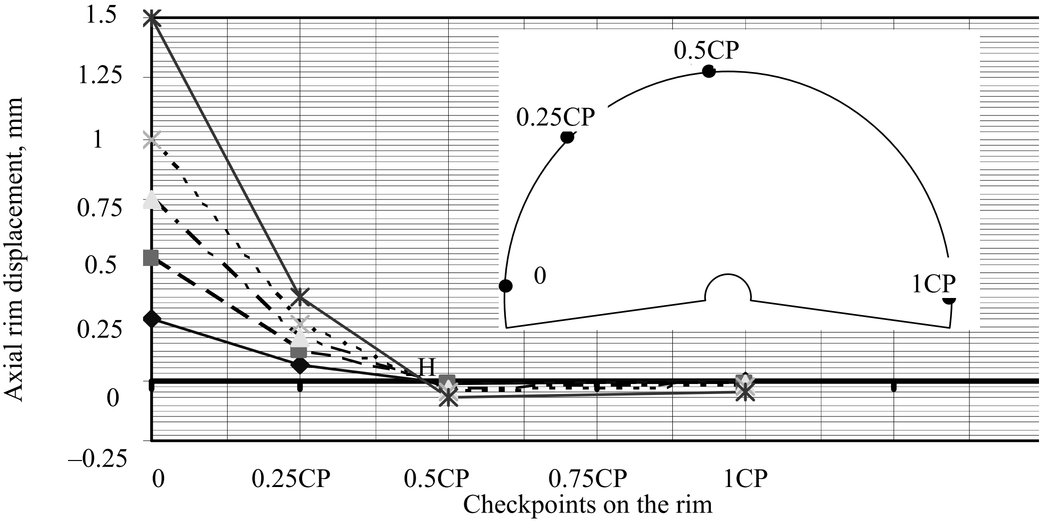

Fig. 1. Relation of the prescribed axial displacement of the rim to the teeth displacement in checkpoints on the semiperiphery of commercial saw (D = 360 mm, t = 2.2 mm, z = 48)

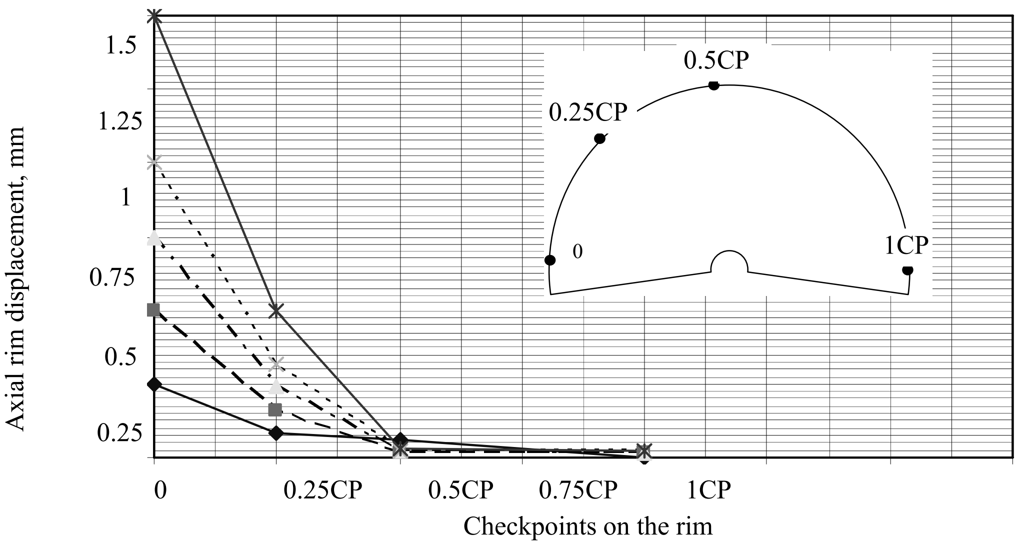

Fig. 2. Relation of the prescribed axial displacement of the rim to the teeth displacement in checkpoints on the semiperiphery of ground saw (D = 310 mm, t = 3.2 mm, z = 64)

The saw blade has 4 radial compensatory 40 mm deep plots in the rim. The specific character of the rim strain of this saw type is that the strain rate of the tooth top was registered before and after the compensatory slots.

The resulting curve of the rim strain of the Leitz saw is shown in Fig. 3.

The dotted lines show displacements before the compensatory slots, the full ones show those after the slots. The curve analysis reveals that the slots do not have any significant effect on the nature of rim displacement under static shear load. The strain of the rim resembles that of the ground saw presenting C curve with only minor differences. Zero displacement (H point) however differs considerably from that of the commercial saw (Fig. 1) and is located off ≈0.85CP at all displacement values. The teeth following 0.85CP and the point of applied load tend to displace slightly in the reverse direction, therefore the displacement values are in the negative range of y axis.

Rim strain of experimental saw with variable radial section. Specifications of experimental saw with variable radial section are as follows: saw diameter is 370 mm, rim thickness is 2 mm, groove thickness is 1.3 mm, the number of teeth clusters z_6 is 20.

The resulting curve of the rim strain of the experimental saw is shown in Fig. 4.

The curve analysis (Fig. 4) shows that the rim displacement of experimental saw under static axial load resembles that of the ground saw (Fig. 2).

The decreasing rim displacement as it moves off the forced axial displacement point proves to ve more gradual compared to that of the ground saw. It has its maximum value in 0.75CP point and approaches its zero value following the C-curve.

This fact makes it possible to expect improved saw kerf surface by using experimental saws with variable radial section. Their performance can be similar to that of the ground saw due to the shaping of circular saw blade section from the flanges to the rim.

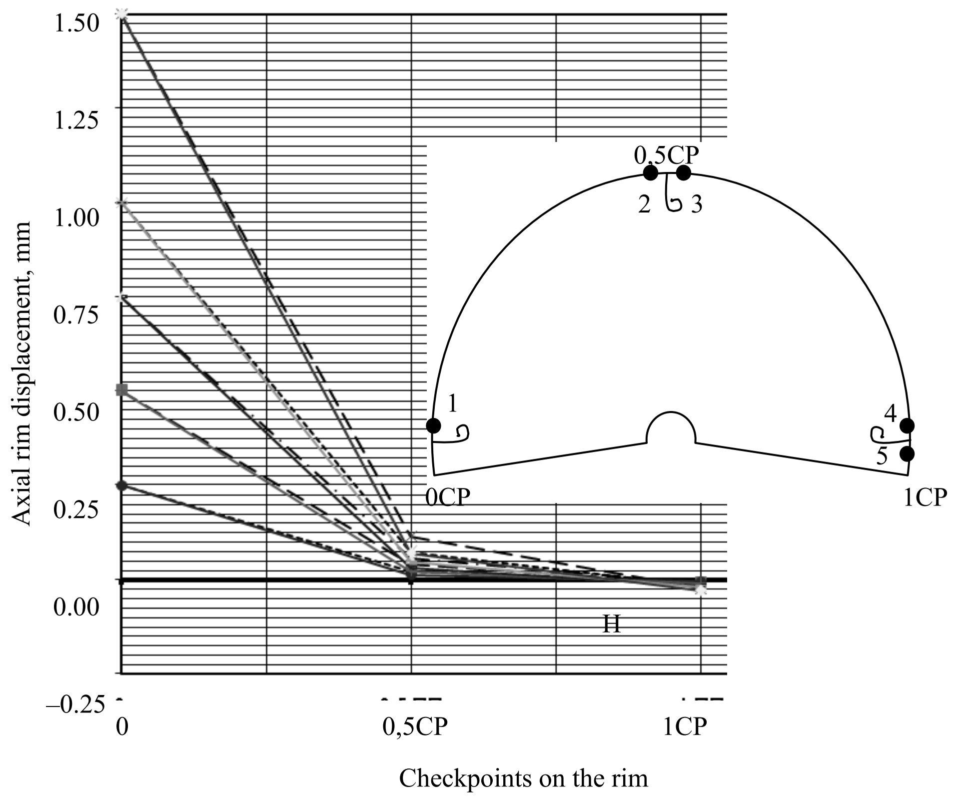

Fig. 3. Relation of the prescribed axial displacement of the rim to the teeth displacement in checkpoints on the semiperiphery of Leitz saw (HW – kreissageblat, WK 850-2 058311, 300 x 3.2/2.2, Z = 96/9.82, σ = 25 791, n_{max} = 7600)

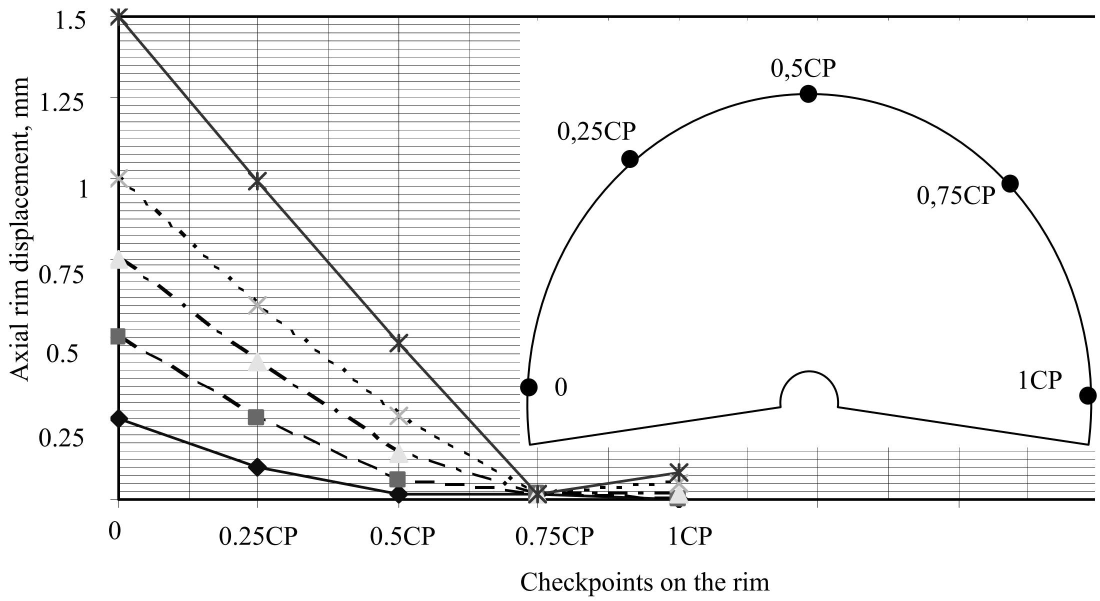

Fig. 4. Relation of the prescribed axial displacement of the rim to the teeth displacement in checkpoints on the semiperiphery of experimental saw (D = 370 mm, t = 1.3 mm, z_6 = 20)

Conclusion. The analyzed technique for estimation of circular saw blade strain is simple and applicable in the production process.

The research has shown that there are differences in the rim strain of various circular saws and they can be registered very precisely. The comparative analysis reveals that the circular saw blade strain is of individual nature. Saws from one batch differ in axial teeth displacement over the periphery, the applied load being equal. The research results allow us to assume that this is related not only to the inaccuracy of saws geometrical parameters but to the residual stress of the saw blade metal caused by the preceding technological operations (technological strain).

So far the research arrives at the conclusion that the highest quality of machining operations can be obtained by using saws where the rim does not displace reversely over the periphery under static axial load and the saw blade has a C-curve shape.

References

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