Annals of Warsaw University of Life Sciences – SGGW
Forestry and Wood Technology No 74, 2011: 139-142
(Ann. WULS-SGGW, Forestry and Wood Technology 74, 2011

The performance analysis of spade bit during drilling of beech

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Abstract: *The performance analysis of spade bit during drilling of beech.* Drilling with spiral bits is common and typical technology in metal cutting. More special shapes of bits are used in wood drilling. This article offers part of results received from drilling of beech with spade bits, and offers original values received by authors.

Keywords: spade bit, drilling, beech, feed force (thrust).

INTRODUCTION

For drilling in wooden structures so as wooden houses, timber of a roof are flat bits used very often. Generally these bits are available for rough drilling in wood and wood-composite materials. Partially are used in home application for electrical installation (in this case is design a little different from here described bits, mainly from diameter and teeth geometry point of view.)
A typical spade bit, the basic design of which has not changed for decades, is shown in Fig. 1 along with its major topological features.

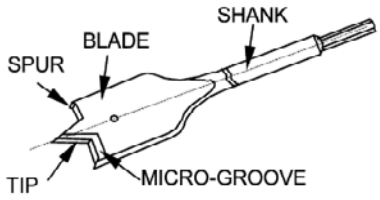


Fig.1 Spade bit and basic terminology (ZHAO, A., EHMANN, F.)

Information about this samples of bits are very rare, it means that the most knowledge is waiting for research. These drills are used for hand-held drilling or for drilling with low revolutions by portable drilling machine, is very important to design so shape of cutting part, that will reduce power consumption, thrust force and eliminate or minimize cratering on the opposite side of board.
Design if geometry part was in focus of [EHMANN and ZHAO], like drilled material MDF was used. Force and power consumption was published by [JAVOREK and BALKO] and beech was used as sample of wood.

EXPERIMENTAL METHODOLOGY

In this article are published results from beech drilling focused for analysing of thrust. As experimental machine was used radial pillar drill with parameters mentioned in table 1.
Table 1: Technical parameters of drill machine

Machine dimensions (length x with x height)	2970 mm x 1130mm x 3400 mm
Cutting speed	19 revpm –1900 revpm
Feed speed	0,047 mmprev – 2 mmprev
Max. bit diameter	75 mm

Diameter of tool spindle	50 mm
Total power	15 kW

Technological parameters are marked very clean in scheme in fig.2.

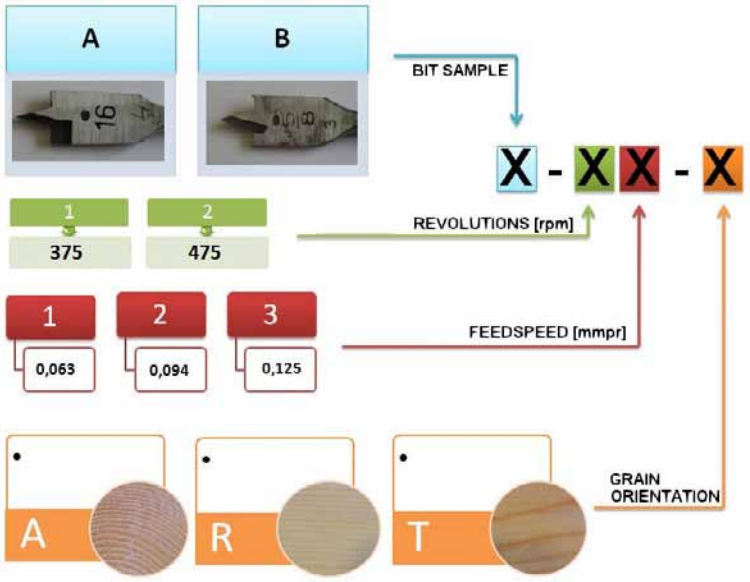
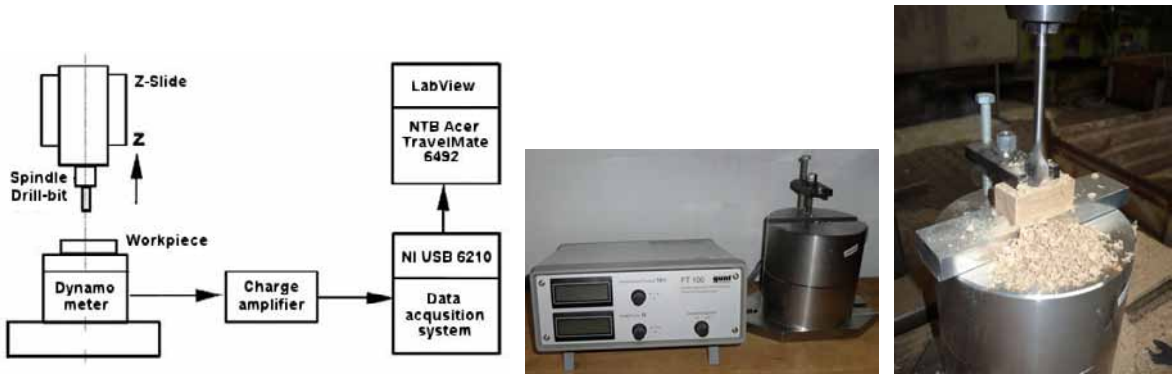


Fig.2 Technological parameters of experiment (Balko)

The beech was used like experimental sample. Samples were carved out of log so, that grain orientation against bit feed was in longitudinal, radial and tangential direction (Fig. 3).

Fig.3 Experimental samples (Balko)

For data measuring was used equipment that consisted from dynamometer GUNT 100 with data range for feed force 0 N – 10 kN, for torque moment 0 Nm – 50 Nm. (Fig.4). Registered analog signal was transported via data amplifier, A/D changer NI USB 6210 to computer and was processed by LabView 8.6 software.



Principal scheme (ZHAO, A., EHMANN, F.) – Amplifier (Javorek) – Detail of drilling (Javorek)

Fig.4 Experimental device

RESULTS

The graphs in bottom mentioned figures reflect influence of grain orientation, type of drill, cutting speed and feed speed to thrust force.

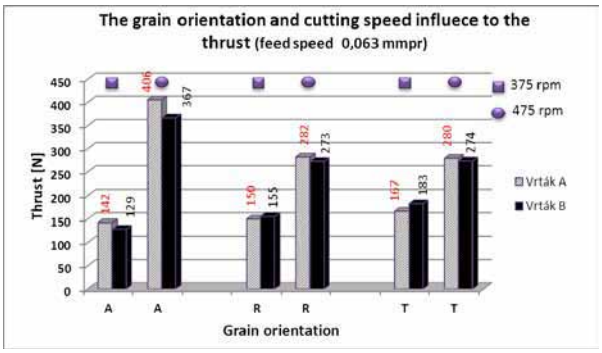


Fig.5 Influence of grain orientation and cutting speed to thrust

For feed speed 0.063 mmprev and for cutting speed 375 rpm the maximum values of thrust were measured for tangential drilling by bit B (Fig.5) – 183 N. In this case was the maximum difference between bit marked A (without spurs) and market B (with spurs) – 16 N, i.e. 8.8 %. The minimum thrust was for drilling in axial direction by bit market B – 129 N. For cutting speed 475 rpm the maximum thrust was for bit A and longitudinal grain orientation – 406 N, and maximum differences between thrusts were 126 N.
Graph in Fig.6 shows values of thrust for feed speed 0.094 mmprev. The extreme force was for drilling in axial (longitudinal) direction, 502 N. It was for cutting speed 475 rpm and for bit A. In this experiment the values of force for bit B and for 375 rpm were very similar, in range from 270 N to 289 N.
In graph (Fig.7) are results from drilling with feed speed 0.125 mmprev. The total thrusts are the biggest in this case – it this case the feed speed was 46.8 mmpmin for 375 rpm, and 46.8 mmpmin for 475 rpm. The max. thrust was 680 N (375 rpm, bit A, axial grain orientation), i.e. 4.7 times more than for feed speed 0.063 mmpm and the same other technological parameters.

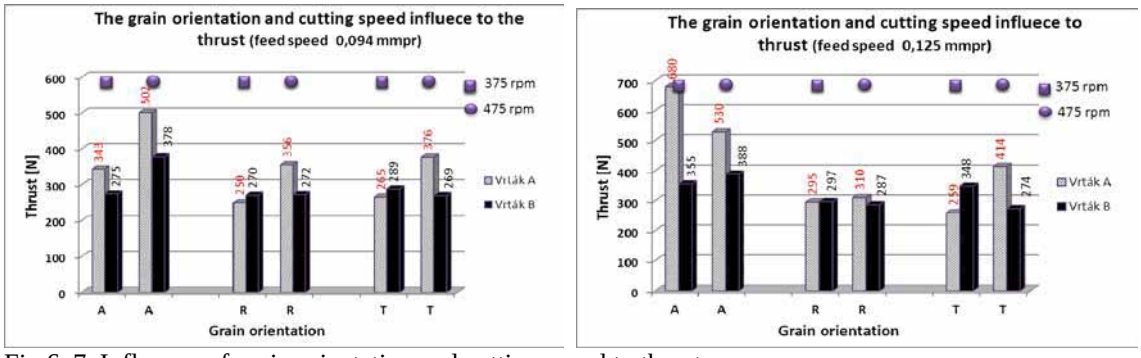


Fig.6, 7 Influence of grain orientation and cutting speed to thrust

CONCLUSION

1. The using of these types of bits require delicate using, small feed speed and back plate for increasing good edge quality.
2. Bits wits spurs need smaller feed force, better keep cylindrical shape oh hole, but wearing intensity depends very intensely from cutting speed.

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Streszczenie*: Analiza wiercenia drewna bukowego środkowcem płaskim.* Wiercenie wiertłami śrubowymi jest powszechnym i znanym typem obróbki metalu. W przypadku obróbki drewna powszechnie używa się wielu innych typów wierteł. Artykuł prezentuje część wyników uzyskanych przy wierceniu drewna bukowego środkowcem płaskim.

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