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Basic board problem in „nesting”

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Abstract: *Basic board problem in „nesting”*. Work in nesting technology is possible because of usage of cutter as cutting tool. Thereby one can obtain cutting precision with minimal fillet radius of edge depending on cutter diameter. The machining technology is realized via cutting off by so called shank cutter; parts from the whole large dimensions board. During this process shank cutter penetrates the basic board only for under one millimeter. Before nesting the machined board is placed on basic board on screen table which enables damage of screen table. Unfortunately after each operation the basic board has cutting traces which are differential and depend on stability of thickness dimension on the whole board surface. The above dependence enforces so called facing of the whole surface to level the board so that it has equal thickness on the whole surface(regeneration of basic board). In nesting technology very important problem is depth value of tool in basic board. Milling of chip laminated board and measurement of depth value of shank cutter in the basic board was performed in CNC PRATIX Z2 produced by SCM.

Keywords: nesting, optimization, cutting of boards, board basic

INTRODUCTION

„Nesting” means optimal planning and cutting pieces from flat boards of plywood or boards for example lingo-cellulosic. Optimization means maximal utilization of board/sheet keeping optimal operation process for a given cutting-in pass in one machining centre. Cutting optimization is also innovative technology called Nested Based Manufacturing – NBM.

In wood industry CNC machining of board elements, eliminates saw mills from technological process. It means that full range of machining like profiling, vertical drilling, cutting wholes as well as cutting of rectilinear and curvilinear elements according to cutting optimization are performed by one machine from the whole board. The above characteristic that this type of machines are extremely versatile and are widely used [2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13].

Work in nesting technology is possible because of usage of cutter as cutting tool. Thereby one can obtain higher cutting precision with minimal fillet radius of edge depending on cutter diameter (Fig.1). Versatility of this technology is a result of large working table (most often not smaller than 3.000 x 2.100) which enables loading the whole particle or MDF board. Overall nesting technology occurs usually more effective and cheaper than classical technologies realized on typical woodworking machinery [10, 14] (Fig.2).

Fig. 1 Milling mortises in a board

Fig. 2 Cutting board with nesting technology

THE PROBLEM OF BASIC BOARD IN NESTING

The technology of nesting depends on cutting off elements with so called shank cutter from the whole large dimensions board. During cutting shank cutter penetrates base board for less than one millimeter. The larger the board the better optimization of cutting. The machined board is placed on base board (Fig.3) on the screen table (Fig.4). The recommended basic boards

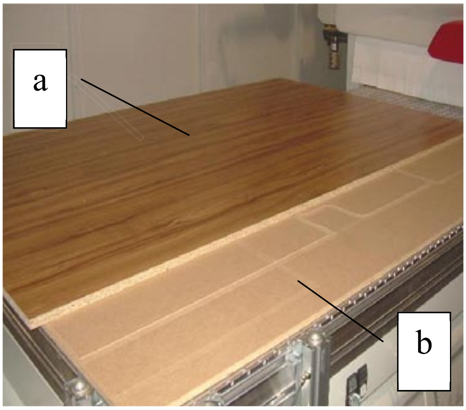

Fig. 3 Boards on CNC working table
a) for cat, b) basic board

Fig. 4 The raster vacuum table used by "nesting"

should have low density (are cheap), so that they are able to provide high transpiration vacuum like for example very light chip boards or MDF which are characterized by high penetrability (density around 500kg/m^3) [1,3].

Via base board pumps of capacity 600-900 m3/h suck the machined board. Diamond shank cutter of diameter 12-20 mm mills wanted elements penetrating base board from 0,3 to 0,5 mm. Earlier milling profiles are cut on the surface of elements. After cutting profiles on narrow surfaces of elements might be milled.

Unfortunately after each operation the base board has cutting traces which are differential and depend on stability of thickness dimension on the whole board surface [6]. The above dependence enforces so called facing of the whole surface to level the board so that it has equal thickness on the whole surface (regeneration of basic board). The base boards partly used up must be periodically regenerated and after having reached minimal thickness must be exchanged for new ones.

BASE BOARD REQUIREMENTS

Requirements concerning base boards (according to Rodolfo Bardelli [6] CNC producer):

- dimensions of base board must fit the screen table,
- average thickness 8-16 mm (minimum thickness 5 mm),
- penetration of shank cutter in base board during milling 0,15 – 0,2 mm,
- average number of milling process before base board regeneration 20-25,
- average thickness of material removed during regeneration of base board and leveling 0,3mm,
- speed of levelling tool for base board v_c = 50m/min (tool diameter 100mm),
- average the average working time: 3 minutes.

Average number of regenerations up to exchange for a new base board depends on its thickness and shank cutter penetration.

RESEARCH OF SHANK CUTTER PENETRATION DEPTH IN BASE BOARD

In machining process a very essential problem is value of penetration of tool in base board. As so far there are no reliable data concerning this problem some research has been undertaken. Milling of chip laminated board and measurement of depth value of shank cutter in the basic board was performed in CNC PRATIX Z2 produced by SCM (Fig.5).
Nesting technology was tested in Suchy Las near Poznań in headquarters SCM. An MDF board

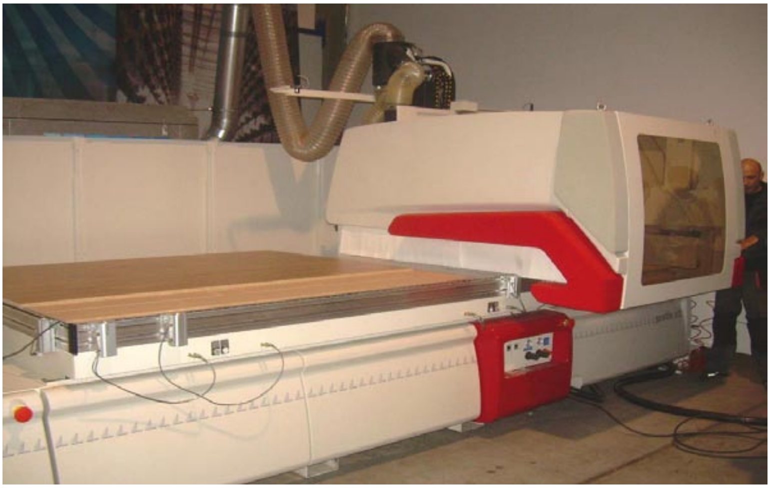

Fig.5 Machining center SCM typ PRATIX z2

was used as a base board with density around 530 kg/m^3. Cutting process took place on a screen table with underpressure fixing of a board (4250 x 2200 mm). Cutting was performed with arrangement resulting tool penetration in base board of 0,15 – 0,2 mm. The thickness of machined particle board was 18 mm ±0,32.

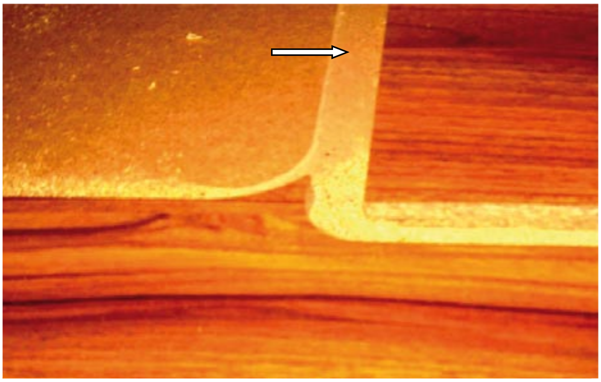

Fig. 6 Top plate after cutting and underlay with traces of milling cutter

Fig. 7 The measurement method recess

Diamond shank cutter (diameter 12 mm) cut particle board for required elements penetrating base board from 0,3 to 0,5 mm (Fig.6). After this operation the depth of penetration was measured in base board. The measurement was performed with digital slide caliper with accuracy up to 0,01 mm (Fig.7). The data obtained concerning SHANK cutter penetration range from 0,4 to 0,5 mm.

They are much bigger than assumed before tests. One can assume that these differences might be a result of different features of particle boards like for example mineral inclusions or other contamination; Uneven pour of particles in a board or other influencing their thickness and tolerance. Protrusion of shank cutter below machined board advised by machines producers (0,15 – 0,2 mm) seems unrealistic because it does not comply the accuracy of base board performance and which can be different. Practically boards according to producers (e.g. Krono Żary) have tolerance ±0,3 mm, which can result in lack of penetration in base board and not cutting machined board till the end at assumed shank cutter penetration in base board from 0,15 to 0,2 mm. The above presented tests a minimal penetration in base board was obtained. On the other hand too deep penetration in base board has negative economical results because it accelerates expenditures on regeneration and more often exchange.

CONCLUSION

Machining with nesting technology lets eliminate circular saw from production process and limit costs of production contributing to limitation of production area. Each nesting process leaves traces on base board which differs on whole board surface.

Deeper penetration of shank cutter in base board result in worse underpressure fixing especially when cutting smaller elements. That is why there is necessity of more frequent leveling of base board. Because penetration of shank cutter is deeper from assumed the boards have to be regenerated more often. It also needs higher work input.

When a base board reaches minimal thickness it has to be exchanged which influences average number of cutting processes.

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Streszczenie: *Problem płyty bazowej w „nestingu”.* Operacje w technologii „nestingu” są możliwe przez zastosowanie freza jako narzędzia rozcinającego. Dzięki temu uzyskuje się precyzję cięć z minimalnym promieniem zaokrąglenia krawędzi zależnym od średnicy narzędzia. Technika obróbki polega na wycinaniu tzw. frezem trzpieniowym formatek z całego arkusza płyty o dużym formacie, podczas którego frez jedynie na kilka dziesiątych milimetra wcina się w płytę podkładową tzw. bazową. Płyta do rozkroju jest układana na podkładzie z płyty bazowej na stole maszyny, który zabezpiecza stół rastrowy przed przefrezowaniem. Niestety po każdej operacji pozostaje ślad na płycie bazowej po tzw. ścieżkach obróbkowych, który jest różny i zależy od stabilności wymiaru grubości na całej powierzchni rozkrawanej płyty. Zmusza to do tzw. ”operacji planowania” całej powierzchni płyty bazowej, aż do uzyskania jednakowej grubości (operacja regeneracji płyty bazowej). W procesie obróbki istotnym problemem jest wartość zagłębienia narzędzia w płytę bazową. Próby rozkroju płyty wiórowej laminowanej i pomiary wielkości zagłębienia się freza w płytę bazową przeprowadzono na centrum obróbczym PRATIX Z2 produkcji włoskiej firmy SCM.

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