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AN APPROACH FOR PROGRAMMING FOOTWEAR PATTERNS CUTS

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Abstract: *The saving of leather, an extremely important objective in footwear manufacturing, requires following certains steps in the process of cutting the component parts of a footwear article in order to obtain better use of the leather surface. With this regard, the paper presents how to program the cuts of the outer parts of a shoe item in the cutting department, respectively a model of women shoes. For the chosen item, there were done single cuts for one number of size (10 options), as well as combined cuts of two distinct sizes (45 options).*
Programming uppers cuts consists in their practical realization, followed by choosing the optimal cuts in order to obtain the best global utilisation index.
The value of the global utilisation index depends on the values of the utilisation indices of the simple and combined cutting ways, the programming strategy and the iteration mode of the cutting options.
By using the simple and combined cuts, for the developed program resulted a 72.04% global utilization index versus 70.64%, obtained by scheduling only single cuts, requiring a quantity of 91 hides. In the case of cuts options with higher utilisation indices, a judicious programming strategy can lead to an efficient cutting, close to the best automatic data processing program.

Key words: *cuts, utilisation index, optimal nesting, programming, iteration*

1. INTRODUCTION

When using leather hides in the manufacture of footwear, an optimum nesting of the outerparts is required in the process of uppers cutting, in order to obtain the best utilisation index. The cutting of uppers is the process which cut out the patterns from specified leather hide for making shoes.

The value of the utilisation index depends on the patterns nesting option, so that a maximum utilisation of the leather surface results during cutting [1].

The nesting of the patterns on the leather surface is conditioned by the contour and the area of the hide, the topographical regions and the presence of flaws, the outline of the patterns and their positioning restrictions in the topographic areas of the leather, as well as the ways of combining the size numbers between them [1, 2].

Programming the cuts of the outer parts of the upper assembly for a shoe item implies two distinct stages [3, 5]:

a) making all possible options using both simple cut (single size number) and combined (two distinct size numbers of the same shoe);

b) choosing the optimized cutting options so that to cut the quantities of semi-finished products required for the manufacturing program in order to obtain the best global use index.

This paper presents the results of programming the cuts of the outer parts of a shoe item, respectively a women shoes model, in the cutting department of flexible footwear patterns.

2. CUTTING PATTERNS

For the chosen item, respectively a shoe model for women, of sizes in metric system 23, 23.5,…….., 27.5, there have been done both simple cuts of a single size (10 options), as well as combined cuts of two distinct size numbers (45 options), presented in table nr.1.

Table 1: *Different cuts*

N (cm)	Identification of simple and combined cutting									
23	C_1									
23.5	C_2	C_{11}								
24	C_3	C_{12}	C_{20}							
24.5	C_4	C_{13}	C_{21}	C_{28}						
25	C_5	C_{14}	C_{22}	C_{29}	C_{35}					
25.5	C_6	C_{15}	C_{23}	C_{30}	C_{36}	C_{41}				
26	C_7	C_{16}	C_{24}	C_{31}	C_{37}	C_{42}	C_{46}			
26.5	C_8	C_{17}	C_{25}	C_{32}	C_{38}	C_{43}	C_{47}	C_{50}		
27	C_9	C_{18}	C_{26}	C_{33}	C_{39}	C_{44}	C_{48}	C_{51}	C_{53}	
27.5	C_{10}	C_{19}	C_{27}	C_{34}	C_{40}	C_{45}	C_{49}	C_{52}	C_{54}	C_{55}

After nesting the patterns on the entire surface of the hide so that their number ensures a whole number of footwear pairs for the number of size considered, the utilisation index was evaluated with the foolowing equation [1] :

$$I_u = \frac{nA_S}{A_P}100, \ /\%/ \qquad \textbf{(1)}$$

where: Iu – utilisation index of the leather surface, /%/;

n – the number of entire products (pairs) arranged on the leather surface;

AS – set area (the area of the net surface of the patterns for one product), /dm2/;

AP – area of the leather hide, /dm2/.

The basic principles of programming is [4]:

- ✓ Prioritizing the quantities of semi-finished products for cutting at best utilisation indices;
- ✓ Distribution in decreasing order of utilisation indices until the quantities of the programmed semi-finished products are finished.

For this purpose, table 2 is created with lines corresponding to the size numbers and columns corresponding to the cuts options. Table 2 is completed with columns that include the pairs required by size numbers for a 1000-pairs program, order of lines iteration and programmed semi-finished goods, as well as lines for columns order iteration and the need of hides to be programmed.

Thus, table 2 shows the number of pairs in the cases at the intersection of the column lines, both for single cuts and for combined cuts, and in some cases the quantities to be programmed are also marked.

3. PROGRAMMING CUTS OPTIONS

The cutting option with the best utilisation index is Iu = 74.9%, which implies cutting 10 pairs of size N = 27 for the chosen article on a hide leather surface of 142 dm^2. The pairs needed for size number 27 is 55 pairs, 6 hides being programmed.

Table 2: *Types of cutting*

Number of pairs	Order of lines iteration	N [cm]	Simple and combined cuts									
			C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
50	III	23	12	6	6	6 48	5	5	5	5	5	3
70	-	23.5		6								
130	VII	24			6							
145	IX	24.5				6 48						
155	IV	25					6					
145	VIII	25.5						5				
115	II	26							5			
90	V	26.5								5		
55	I	27									5	
45	VI	27.5										6
U[%]			69.4	70.6	71.9	73.2	68.7	70.0	64.2	65.3	66.0	63.6
Order of columns iteration						III						
Number of leather hides, units						8						

Table 2 *(continuation)*

Number of pairs	Order of lines iteration	N [cm]	Simple and combined cuts								
			C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}
50	III	23									
70	-	23.5	12	5	5	5	5	4 69	5	3	3
130	VII	24		6							
145	IX	24.5			6						
155	IV	25				6					
145	VIII	25.5					6				
115	II	26						7 119			
90	V	26.5							5		
55	I	27								6	
45	VI	27.5									6

U[%]	71.09	67.2	68.5	69.7	71.3	73.4	66.3	62.9	64.3
Order of columns iteration						II			
Number of leather hides, units						17			

Table 2 *(continuation)*

Number of pairs	Order of lines iteration	N [cm]	Simple and combined cuts									
			C_{20}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}
50	III	23										
70	-	23.5										
130	VII	24	11	6	6	8 136	8	4	5	4		
145	IX	24.5		5							11 99	5
155	IV	25			5							5
145	VIII	25.5				3 51						
115	II	26					3					
90	V	26.5						6				
55	I	27							5			
45	VI	27.5								6		
U[%]			68.3	69.3	70.3	70.3	70.8	68.5	60.0	71.1	68.3	65.2
Order of columns iteration						VII					IX	
Number of leather hides, units						17					9	

Table 2 *(continuation)*

Number of pairs	Order of lines iteration	N [cm]	Simple and combined cuts								
			C_{30}	C_{31}	C_{32}	C_{33}	C_{34}	C_{35}	C_{36}	C_{37}	C_{38}
50	III	23									
70	-	23.5									
130	VII	24									
145	IX	24.5	5	6	4	4	5				
155	IV	25						11 154	5	4	5
145	VIII	25.5	5				5		5		
115	II	26		4						4	
90	V	26.5			6						5
55	I	27				6					
45	VI	27.5					5				
U[%]			65.2	66.5	66.7	71.4	70.6	70.6	72.9	67.6	68.9
Order of columns iteration								IV			
Number of leather hides, units								14			

Table 2 *(continuation)*

Number of pairs	Order of lines iteration	N [cm]		Simple and combined cuts									
			C_{39}	C_{40}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{46}	C_{47}	C_{48}
50	III	23										
70	-	23.5										
130	VII	24										
145	IX	24.5										
155	IV	25	4	4								
145	VIII	25.5			10 20	5	3	3	6 66			
115	II	26				5				10	4	4
90	V	26.5					7				6	
55	I	27	6					7				5
45	VI	27.5		6					4 44			
U[%]			71.5	72.6	69.7	69	71.6	73.1	72.1	70.6	71	65.7
Order of columns iteration									VI			
Number of leather hides, units									11			

Table 2 *(continuation)*

Number of pairs	Order of lines iteration	N [cm]	Simple and combined cuts							Programmed semi-finished goods [pairs]
			C_{49}	C_{50}	C_{51}	C_{52}	C_{53}	C54	C_{55}	
50	III	23								48
70	-	23.5								69
130	VII	24								136
145	IX	24.5								147
155	IV	25								154
145	VIII	25.5								137
115	II	26	4							119
90	V	26.5		10 90	5	5				90
55	I	27			5		10 60	5		56
45	VI	27.5	5			4		4	9	44
U[%]			66.8	65.7	73.8	67.4	74.9	65.5	59.4	Programmed hides, 91 units
Order of columns iteration				V			I			
Number of leather hides, units				9			6			

Thus, it is marked 60 in the case formed at the intersection between the line corresponding to N = 27 with the column 53.

Also, in column 53 it will be marked the amount of 6 corresponding to the need of the hides, the first step of t iteration being completed. In order to be able to identify later the steps of the iteration, I is marked in the column of line iteration.

Consistently this stated principle is followed by searching the cuts in the descending order of options with the best utilisation index, respectively the cutting option with Iu= 73.8%. This cutting

option can not be used because the size number N = 27 has been completely exhausted through programming from step I.

According to Table 2, the next cutting option in descending order of utilisation indices is the combined cutting between size numbers 23.5 and 26 with the Iu index = 73.4%. In this case from the hide surface a number of 4 pairs is obtained for N = 23.5 and 7 pairs for the size number N = 26. In the column 16 it is marked 69 at the intersection with the line corresponding to 23.5 and 119 at the intersection with the line corresponding to the size number N = 26. "II" is marked in the line iteration column and the quantity of 17 hides programmed at that step. This procedure is repeated till all the quantities of semi-finished products are completely programmed.

For this program the weighted average of the utilisation indices is calculated, obtaining the global utilisation index [4, 5]:

$$I_{ug}=\frac{\Sigma x_j \, I_{uj}}{\Sigma x_j} \qquad \textbf{(2)}$$

where : xj – the programmed quantities of hides ;
Iuj – utilisation indices for cutting options

By using simple and combined cuts options, 91 hides are needed in the developed cutting program, the global utilisation index being 72.04% compared to 70.64%, obtained by programming only simple cuts.

4. CONCLUSIONS

The value of the global utilisation index of the program depends obviously on the values of the utilisation indices of single and combined cuts.

Also, the value of this index depends on the programming strategy, the iteration mode of the cutting options, as shown in table 2.

Considering cuts with higher utilisation indices, a judicious programming strategy can lead to an efficient cutting program, close to the best automatic data processing program.

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