# CONTRASTIVE THEORETICAL COMPARISON APPROACH UPON BLANKING-PUNCHING OPERATIONS ON CNC PRESSING CENTERS AND ON CLASSICAL PRESSES

### RIPANU Marius-Ionut<sup>1</sup>, NAGIT Gheorghe<sup>1</sup>, MERTICARU Vasile<sup>1</sup>, IACOB-STRUGARU Sorin-Claudiu<sup>1</sup> <sup>1</sup>Technical University "Gh. Asachi" of Iaşi

email: ripanumariusionut@yahoo.com, nagit@tuiasi.ro, v merticaru jr@yahoo.com, issc71@yahoo.com

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**Abstract:** The paper presents an approach on developing a contrastive theoretical comparison upon two technological methods in industrial applying of blanking-punching operations, respectively on CNC pressing centers and on classical presses. A principle strategy for developing the theoretical approach, some related considerations and the identification of comparison items are first of all included in the paper. A case study of comparative analysis between nesting for CNC pressing centers and for classical presses stamping, together with the related results and conclusions are also presented in the paper.

# 1. INTRODUCTION. PROBLEM STATEMENT AND STATE OF ART

Blanking-punching operations are one category of the oldest processes used in sheet metal parts manufacturing industry, showing also rapid development in short period of time in the domain which it serves. Blanking process was continuously improved, and we can find it in many areas today, some of its important aspect being the parts nesting and other important steps, together with the factors that influence the stamping process, hereby presented in this paper, [1]. Also, this steps are the base foundation of parts stamping processes, which make possible for the part to be fitted on as small as possible surface on the sheet metal, the resulting parts number to be the highest and the number of wastes as low as possible.

Thus, by research and rapid development in the stamping area, machine-tools were developed to ease the work. So, besides classical presses, seen through out metal sheet manufacturing industry, presses using CNC centers appeared, which helped in raising productivity and obtaining better quality. Two of the researches with many contributions in the area, helping to the general development, was those of Jackson and Mittal, [5], which focused on the blanking-punching operations based on an algorithm, this leading to automatic generation of the CNC program [5], [6]. Also, similar researches involved in the domain, were those of Raggenbass and Reissner [5], which looked into the connection between stamping and laser on the CNC centers, while at Twente University has been studied and developed the metal sheet manufacturing through good planning and management of factors involved in the workability in good conditions using CNC.

Some of the CNC centers used for manufacturing on sheet metal are: TRUMPF, AMADA ARIES, Finn-Power, Mazak, Bystronic and some of the CAD/CAM software used for design and automatic generation of the CNC code are: RADAN, WICAM, Nesting Software, EditCNC, CNCezPRO<sup>TM</sup>.

Looking from the development strategy point of view, due to the exceptional performances in sheet metal parts manufacturing industry, the requirements for obtaining superior economical and technical indicators can be accomplished by continuous improvement of research, design and execution, by improving manufacturing methods, and by using advanced technologies.

# 2. GENERAL APPROACH STRATEGY

Advanced technical research means a strict scientific step which can deliver a solution suitable to the research domain, starting with a clear strategy over the research aspects and its investigation methods.

That is why the present paper began by conception of a *primal vision over the general approach strategy*, particularly comparative study over parts stamping processes with classical presses or by CNC centers.

In Fig. 1, we can see the primal vision over the general approach strategy.



Fig.1. Primal vision over the general approach strategy

The main component is represented by the contrastive - compared research principle over the two methods of stamping, by classical presses or CNC centers, this being the central focus of the entire research strategy for the proposed theme. Knowing the actual industrial

context, allowed to determine the *purpose* of theme's making, which is providing designers, researchers and manufactures clear elements over the optimal conditions to apply such technologies, in order to produce parts by stamping.

These technologies, by precision and surface quality means, can be applied with relatively small costs, by use of the existing machine-tools and CNC centers used in the enterprises. So, they achieve some elements to be applied in upgrading manufacturing processes, of cold plastic deformation, especially blanking-punching parts in favorable economical conditions, the resulting parts being therefore competitive, [4].

To the mentioned purpose, we attached the investigation of existing information related to the theme, in order to establish clear objectives, then there was elaborated the research strategy by knowing the boundaries and research conditions which directly determine the validity and applicability area for the obtained results. The obtained results will be then analyzed and so, based on them, being able to formulate conclusions.

The purpose being comparative study over stamping with classical presses or CNC centers, there is intended to show advantages and disadvantages of each tools in blanking-punching sheet metal, and depending on design drawing requirements of quality, dimensional precision, we can choose between the two of them, considering also productivity and costs. In Fig. 2, there can be seen, schematically, the structuring mode in *applicability domain – performances – costs* triangle. Of course, the efficiency of each studied type can be guaranteed only if work conditions are obtained to ensure the quality of the manufactured part, meaning precision and surface quality imposed by design.



Fig. 2. Research objectives in applicability domain – performances – costs triangle

For accurate results, we have to not forget that blanking-punching process, as any other technological process, is a very complex one, depending on a multitude of interactions.

Related to this, in Fig. 3 we can see some aspects to be considered on comparative theoretical analysis of the two types of manufacturing.



Fig.3. Aspects to be considered on comparative theoretical analysis of the two types of manufacturing

# 3. PARTICULAR RESEARCH APPROACH SUBJECT

Related to above mentioned considerations, one direction of analysis of advantages and disadvantages of the two variants for blanking-punching operations, is to elaborate one comparative study, contrastive, between nesting with classical presses and nesting on CNC centers.

Nesting represents a very important aspect in blanking-punching operations, because it technologically determines material consumption, waste and material losses, as it is illustrated in Fig. 4, [1].



Fig.4. Sources of material losses at nesting

As it follows, there is presented a case study, together with results and conclusions, on nesting process of blanking-punching of a sheet metal part, on classical presses and CNC centers.

# 4. CASE STUDY

The case study focuses on one part, see Fig. 5, key shaped, made of steel, according to SR EN 1653:2003, 2 mm thickness.



### Fig.5. Part to be

manufactured

There is analyzed the possibility to obtain the part both on classical presses and CNC centers, considering nesting variants and the coefficient of use of the material.

There is mentioned that, in order to outline advantages and disadvantages of manufacturing on the two machine-tools, we considered that the part must be obtained of certain amount of material,  $2 m^2$ .

In Fig. 6 three nesting variants are presented, for blanking-punching on classical presses.





Fig. 6. Nesting variants

3.224

For these three nesting variants, emerged, by calculations with relation (1), [1]:

$$k_f = \frac{A \times n}{L \times B} \, [\%] \tag{1}$$

Values of the coefficient of use of material, resulted as it follows: for variant A, 42.61%; for variant B, 40.74%; for variant C, 35.9%. Related to the number of parts obtained for each nesting variant, there resulted: 1133 parts for variant A; 1119 parts for B; 531 parts for C.

In case of nesting on CNC centers, there has been used CAD/CAM software which can incorporate design, modeling, simulation, planning and creation of CNC code for manufacturing sheet metal, choosing the best nesting variants, with little waste. Thus, for nesting on 2 m<sup>2</sup> sheet metal, we chose RADAN software.

There is continued by showing images that describe sequences from the program which helped in calculations and nesting process for part from Fig.5. So, there can be seen graduating steps to the finishing part.

In Fig. 7 there can be seen the manufacturing centers on which the RADAN software can work. From those there has been chosen AMADA ARIES 245, with previously presented material and 2 mm thickness [7], [8].

New Part
Part name: PiesaAAA.RA1
Material: Staal
Thickness: 1 mm 💌 📖
Machine Tool
8 Behrens 8 (B8) 9 .
10 Behrens 5 auto (B5A)
12 Amada Pega 244 (RP1)
13 Amada Pega 358 (RP2) E 14 . 15
OK Cancel Attributes

Fig. 7. Choosing the center on which we are about to manufacture the part

Based on part's shape and dimensions, there are shown multiple dimensions of the sheet metal, standardized, on which the machine can work, and the coefficients of use of material with the exact number of parts resulted from the process and the number of metal sheets to cover  $2 \text{ m}^2$ .

There can be seen that the coefficient of use of material varies to sheet metal size, and the number of parts rises in proportion with the size of the sheet metal.

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2500.00 x	1000.00 mm	744	0	744	40.9%	5.5%	1	
2500.00 x	1250.00 mm	930	0	930	40.9%	4.4%	1	-
1780.00 x	1250.00 mm	660	0	660	40.8%	6.2%	1	
2020.00 x	1500.00 mm	900	0	900	40.8%	4.5%	1	
3000.00 x	1500.00 mm	1332	0	1332	40.7%	3.1%	1	=
2000.00 x	1000.00 mm	588	0	588	40.4%	6.9%	1	
2000.00 x	1500.00 mm	882	0	882	40.4%	4.6%	1	
1984.00 x	1135.00 mm	637	0	637	38.9%	6.1%	1	
* 300.00 x	300.00 mm	21	0	21	32.1%	30.6%	5	-
								-

Fig.8. Standardized values of sheet metal with coefficients of use of materials and the number of parts per metal sheet

In Fig.9. there is presented the positioning method of the part on the sheet metal with 300x300 dimensions and the number of parts previously shown.



Fig.9. Positioning the part on the sheet metal of 300×300 mm

After this step, there can be observed in Fig.10, the alignment of punchers which will cut the part and the starting point of the process. In the last figure, there can be seen one sequence of the program which the software generates.





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		N4X212.5								
		N5x172.5								
Auto Full		N6X132.5								
Autorui		N7x92.5								
Auto window:		N8x52.5								
		Program Output: Output Method								
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		N12X92.5								
		N13X132.5								
		N14X172.5								
Define group:		N15x212.5								
Begin End		N16X252.5								
Current State:	1	N17Y7.								
Speed%: 100		NIBX212.5								
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Fig.11. Program sequence by RADAN for cutting process

### 5. CONCLUSIONS.

1) Looking over the made researches, there has been observed that the efficiency of each machine-tool type used in cold plastic deformation area and especially in blanking-punching operations, depends on part's size and configuration.

2) The number of obtained parts on the classical presses is far bigger than the one from CNC centers, that being possible because of the part's configuration.

3) One major advantage of CNC centers is that of easiness to manipulate calculations, due to CAD/CAM system and to change one parameter which participates directly at manufacturing the semi-product.

4) All this advantages and the efficiency of each type of machine-tool are possible due to the nesting method of the part to be produced and the calculations that have to be made in order to achieve the proposed goal, the living proof being the number of obtained parts and the coefficient of use of material, which demonstrates that classical presses are still useful in industry and that they deserve a great deal of attention in the future, too.

5) An important advantage of the CNC pressing centres, unlike the classical presses, at the processing of simple configuration parts (like the one presented above) is the geometry and the manufacturing costs of the tools used in production.

6) Researches shall be developed further on the factors indicated as elements in the *applicability domain – performances – costs* triangle.

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