DETERMINATION OF THE PUNCHING FORCES BY LABVIEW SOFTWARE APPLICATIONS

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Abstract: *Knowing more precisely the amount of forces required in the plastic deformation process by punching is particularly important for proper sizing of components used in the processing tools (moulds or dies). Also, the correct value of total deformation force is absolutely necessary to determine the center of pressure and to choose the equipment. In this paper, by using an application made in LabView, graphical programming language can measure strain values for each punch forces and the total force of deformation, for any item, regardless of material of which it is achieved, in a very short time. The users of application presented in this paper must follow only steps for determine the total force in the plastic deformation, without using laborious mathematical calculus.*
Key words: *forces, stamping, LabView, e-learning*

1. INTRODUCTION

The calculations to determine the punching strength (for every punch) and the total deformation force without the use of specialized software, could lead to erroneous values. Taking into account the fact that according to these values of forces, the working parts of die-sized mould plates such as punches and assets will be dimensioned, any calculation error could have catastrophic consequences on the deformation process. Also, if from the estimation will result inadequate values of the total deformation force and according to this value will be adopted a mould that can develop a certain strain, and in fact much larger forces are needed, the plastic deformation process will not be achieved.

Using LabView graphical programming environment was developed an application which supports designers in the computer aided design field, no matter they do not have knowledge of programming. In addition, the computer aided design instrument developed in Labview is available for the students, engineers and teachers on e-learning platforms courses of Engineering and Management of Technological Systems Faculty in the form of executable files without the need for users to have software LabView installed on their personal computer.

2. PUNCHING FORCE CALCULATION

Punching is a process of cold plastic deformation achieved with the aim to separate the waste from the part by penetrating punches in active plate material placed on the mould die (Dobrescu & Popescu, 2002).

In the punching process the total force deformation is determined by the relation 1 (Sindilă, 2007):

$$F = Fs + Fsc + Fimp + Fel \qquad (1)$$

were:
F – represents the total deformation force, in N;

Fs – the force actually used for total separation of the part of waste (drilling, cutting, shearing, etc.) or partial one and is given by relation 2 (Sindilă, 2001):

$$Fs = k \times l \times g \times \tau \qquad (2)$$

were:
k – the coefficient that takes account of the physical-mechanical anisotropy of the material, k = 1,1 ….1,3;
l – the perimeter shearing, in mm;
g – the material thickness, in mm;
t – the shear strength of work piece material, in N/mm^2.
Fsc – the force to remove material on the working parts of die mold. The literature from this field of activity calls for the removal force, values 10% of punching force.
Fimp – thrust force through the hole in the plate material assets. The values recommended by the literature for thrust force are 7% of stamping.
Fel – force required to compress the elastic elements.

3. LABVIEW APPLICATION FOR THE DETERMINATION OF THE PUNCHING TOTAL FORCE

A LabVIEW application contains two main windows. The panel is the graphical user interface window, i.e. the user will see when will access the application made (figure 1). Through panel elements, the application receives input data and then displays the output data that have resulted from the software.

The diagram is the window that describes the algorithm after the application programmer will perform the calculations necessary for processing information and reasoning (figure 2).
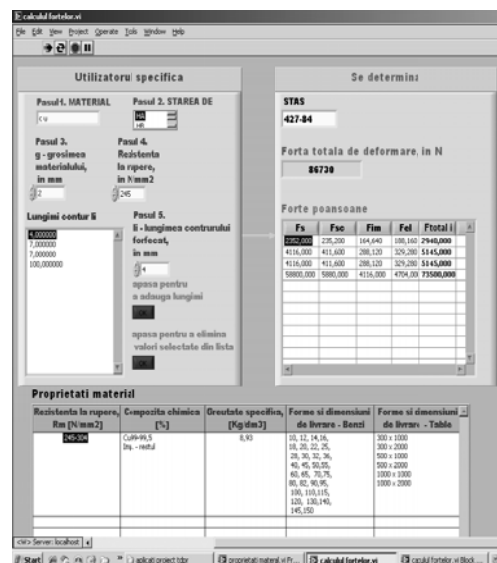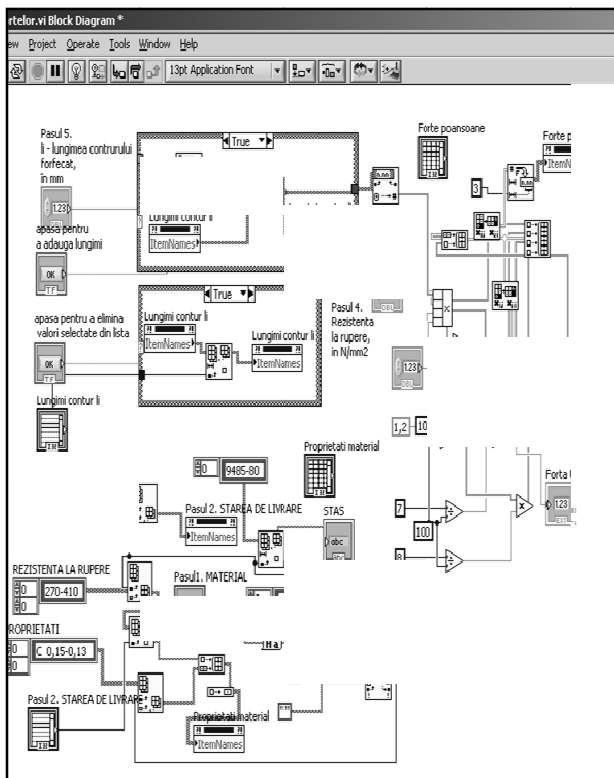

Fig. 1. Frontal panel

Fig. 2. Application diagram

After the programmer has made an application and delivered it to the user as an executable file, the user will have no longer access to the chart.

To determine the total force in the plastic deformation the user must follow these steps:

- **Step 1.** The user will specify the material used to make the part, through a String control element. Even if the user enters empty spaces in the specified text, they will be removed using Search and Replace String function. Also, regardless if the entered text characters are written with capital or small letters, they will be converted into corresponding characters by using To Lower Case. At the running of the application the String indicator element called STAS will show the specified standard material. In the item type indicator Table will appear listed the material properties used to determine the forces.
- **Step 2.** Through the element type List box will select the material delivery status.
- **Step 3.** Through the numerical control element is established the material thickness.
- **Step 4.** Through the numerical control element will specify the material tensile strength values as shown in the table properties.
- **Step 5.** Each contour processing will specify its length by a numerical control element. Given the multitude of components which can be obtained by plastic cold deformation justified by many fields of application, the user is provided an element of type List box. Here can be added by pressing a Boolean control, infinity of numerical values representing cut lengths. Even if improper values were inserted in the list, the user is provided a control element to remove the wrong input selected values.

In the running application, the element type indicator Multicolumn List Box named "Punching forces" will display values punching force Fs, the force of material removal Fsc, the material thrust force Fimp, the force required to compress the elastic elements and the total force for each punch. All these forces numerical values will be used by the designer for the sizing of die active elements of the mould used in the plastic cold deformation.

The numeric indicator element called "Total force of deformation" will show the total amount of the deformation force to fit the work piece, the value of which will take into consideration to the adoption of equipment used in the deformation process. To determine all this force, the chart was used the following types of functions, repetitive structures and constant values:

- constant values string type with one and two dimensions;
- constant values numerical type;
- constant values Boolean type;
- structures type Case and type For;
- property nodes for elements of type Listbox and Multicolumn List box, with attribute Itame Names ;
- the data type functions Array like: Build Array, Delete from Array, Index Array, Search 1D Array, Transpose 2D Array, Add Array Elements;
- specifically functions to arithmetical operations like: Compound Arithmetic, Multiply, Substract etc,
- data type specific functions such as string like Search and Replace String Function.

The LabView file was turned in an executable file taking into account the following steps:

- form of the File menu we choose the option New Project to create a new project;
- After adding the new project from its own menu, we add to the option Build Specification a new application with exe. extension. To save the executable application we define the name and the path;
- for the defined executable application we add in the provided list of the new project by selecting Source File, the LabView file in the forces determination;
- the command Build will create an executable file that can run on any computer without the need for LabView software.

The created file is available for the users of the courses platform from the Engineering and Management of Technological Systems Faculty.

Such design tools created by developing modern techniques and technology processes support and enhance the activity of all design engineers.

4. CONCLUSION

Plastic deformation processes used to obtain semi finished parts from sheet or strip of relatively small thickness provides numerous advantages compared to cutting or molding processes, with high productivity and precision and a coefficient of material utilization particularly high. Obviously that the product design and manufacturing technology it requires high skilled engineers. To significantly reduce the design time and to increase the calculations accuracy, the design tools were made in different design languages. LabView graphical programming environment addresses these requirements and is usable by anyone even if they do not have knowledge of programming.

5. REFERENCES

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