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Computer simulation of aluminum stamping process with the use of the Finite Element Method

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Abstract. The purpose of the paper is analyse the influence of the falling stamp speed on the material in the aluminum stamping process. The simulation was accomplished on a few samples and the time of the falling stamp was changing. The article shows using of the finite elements method for simulation of aluminum stamping process in dependence of the time of falling stamp. The simulation of stresses and deformation received, as the result of stamping process, was carried out with the assistance of the finite elements method in ANSYS. It is worth to underline the fact that one of the major factor that has an influence on the quality of a draw piece is speed of the falling stamp. It was observed that, too fast falling of the stamp causes huge stresses, which leads to destruction of the material. FEM application meaningful cuts down the time of design cycle in many industrial applications what increases productivity and revenue. The application of FEM is very useful for the sake of selection of methodological process of designing and an accuracy of solution.

Keywords: Tool Materials computer simulation; finite element method, process of stamping, aluminum.

1. Introduction

Nowadays aluminum is the second metal used in the word in regard of application frequency and systematically gaining popularity. It is worth to underline that density of this silvery white and light metal is three times lower than the density of iron. Moreover aluminum's valuable properties are: oxidation resistance, water resistance, nitric compound action resistance and many organic acids action resistance. More and more aluminum products are demanded, which find an application as a raw material, semi-finished product and ready product in different fields of economy and in industries such as: automotive, building, chemical, electronic, metallurgical and packaging. Without a doubt one of many connected elements made with aluminum are sections, which are used with clean aluminum. They are currently used very frequently in building industry , for example to suspension ceiling framing or walls made with gypsum cardboard. Moreover these sections are applied in: interior equipment, electronic, sport, household equipment, mechanical devices, armaments industry, automotive industry and also in many others fields (Mondolfo 1976).

Stamping process comprises plastic processing ways of sheet metal plates, tapes and foils (mainly in cold) what consists in processing them in spatial products such as: tin coatings, flexible steel sections-open or with a joint and other. During the process of design of such a type of plastic processing it is desirable to know both press-formability and properties of sheet metal plates. Sheet- metal forming includes a wide gamut of treatments and activities in the sheet- metal forming in the range of technological processes, which vary in way of strengths activities, types of shape changes and also in applied equipments and tools. It is technology which develops especially fast in the world and shows

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considerable technological progress (Marciniak *at al.* 2002). Figure 1 shows stamping process.

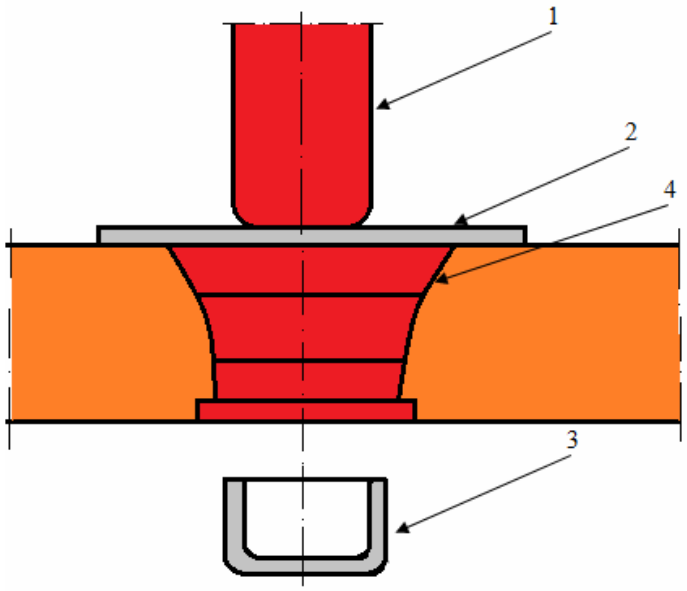

Fig. 1 Stamping process diagram: 1- a punch, 2- a material, 3- a drawpiece 4- a die

Depending on coherence conditions the sheet- metal forming processes can divide in two groups:

- processes of cutting and die shearing, in which occurs purposefully coherence assertion
- processes of plastic formation are additionally divided in:
  - bending, tin and tape formation without change of its thickness
  - drawing, which consists in redrawing a charge through a die hole, in order to obtain an object in a shape of vessel
  - spinning, which consists in processing of plate sections in vessels which have circular sectional view (Boljanovic 2004).

Stamping process applies in many branches of productions for example in automotive , aviation, arms, and food industry.

The Finite Elements Method is applied in many fields of contemporary industry and also in modern technologies which are supported by computers (Dobrzański *at al.* 2005, 2010, 2012). Nowadays this method is the most popular and the fastest developing numerical methods which are used in aircraft, ballistic rocket, automotive, shipbuilding, machine and electrotechnics industry and also is included in such fields of science as biomechanical, medicine, mechatronic, and in materials technology. Computer methods using in design processes serve mainly to optimization of these processes (Żukowska at al. 2016).

The finite elements method is also used in plastic forming and thanks to its application it is possible to perform simulation of aluminum press forming by selection of appropriate forming parameters for given material such as pressure force and falling speed of punch on (Botelho at al. 2007).

During drawing occurs conversion of flat product into a drawpiece, which is unable to change into a plane. As the result of punch action the material undergoes plastified and gradually relocates into interior of a die block. During the process of press forming the dimension of flange and unbounded surface decrease, whereas increase the area of contact zone between a material and a stamp.

The purpose of this thesis is studying the influence of falling speed of punch on material during the process of aluminum press forming.

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