DESIGN AND ANALYSIS OF SINGLE PUNCHING DIE FOR AL -MG ALLOY COMPONENTS

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***Abstract*-In the current study attempt has been made to evaluate and compare the structural analysis of die under two materials namely aluminum 6061 and magnesium alloy. In this study a structural simulation was conducted on die materials such as aluminum 6061 and magnesium alloy, for single punching die application. Finite element analysis has been performed to obtain the variation of stress magnitude at critical location points. The structural analysis were done and verified by simulations in ANSYS software. Results were achieved from aforementioned analysis.**

Keyword: **Alloy, aluminum 6061, magnesium, Structural analysis**

1. INTRODUCTION

Punching is a one the best metal forming process that uses a punch press to force a tool, called a punch, through the work piece to create a hole in the means of shearing. The punch often passes through the work into a die. The new design creation especially for crankshaft to the forging would increase the stiffness of the press by 7.5 and decrees the weight 10% [1]. The die materials and provide criteria for selection of die materials , then application in the field for hot and warm forging of steel in mechanical press then finally concluded good life for die [2]. Originally the ANSYS analysis is carried out for temperature dependent properties for 100 0 for heat formingprocess.

At the time temperature is very low, yield stress is should be very high value and also axis symmetric boundary conditions for 2D problems discussed then stress raises in the plastic based region, The results shows punch load requirement of 218.416KN at 30mm to 256KN load for 45mm deep drawing process. So depth of drawing process enlarges the load requirements. Further investigation is carried out to find the effect of fillet radius on the punch load and stress generation [3].

A new logic should be created a single tool for multiple parts of bending, and then design a punch tool for various sheet metal parts then this paper describes synthesis of a single punch.Creatingparametric form of the tool then optimizing the punch forstrengthwhile inhibited by the interference formulations developed[4].

Thus principal problem and present attempt focus on single die punch material chosen based on the previous literature survey, finally two materials have been selected such as Al 6061 and magnesium alloy, in this two materials Analysis results were carried out by ANSYS software. The results reveals such as total deformation, equivalent elastic strain and equivalent stress for each material are determined.

2. EXPERIMENTALDESIGN

In the present work modeling of the die process many complex problems are encountered due to

non-linearity, the presence plastic transformations. Proper selection of element type, element size, and modelling variables is crucial to the validity of the 2D model for two different materials [5] like as aluminium 6061, magnesium alloy then experimental procedure depict shown in figure1.

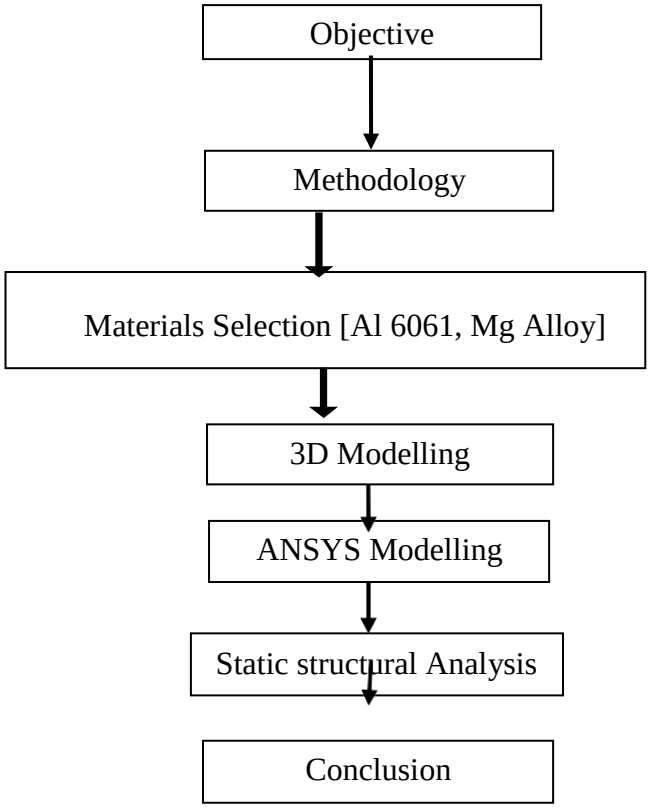

Figure 1. Experimental Process flow diagram

Punching process is one of the popular methods in metal forming. Many of the industrial parts are produced by this method because of its high strength and production rate of parts. The motorized forging has an advantage of working in low pressure, that is even a pressure of 6 bar is enough for operating the unit. The pressurized air passing through the tubes to the cylinder, forces the piston out whose power through the linkage is transmitted to the punch. The work piece thus got is for required dimensions and the piece can be collected through the land clearance provided in thedie.

The press is the forging machine tool designed to shape or cut metal by applying mechanical force or pressure. The metal is formed to the desired shape without removal of chips. The presses are exclusively intended for mass production and they represent the fastest and more efficient way to form a sheet metal into a finished product by using auto feed mechanism.

Press tools are used to form and cut thin metals. Press tools operation can be simplified to a few simple operations involving a punch a die

2.1 OBJECTIVE

The present investigation deals with the flow simulation of Aluminum forgings conforming to Aluminum and Magnesium henceforth studies the mechanical characteristics of the flow simulation results and experimental results.

Three-dimensional modeling of initial material and die are performed by CERO PARAMETRIC 2.0, while simulation and analysis of forging are performed by ANSYS Workbench

14.0. Parameters such as temperature, geometry of raw material and die are effective in reducing production cost and increasing part quality. Better quality and lower price caused the machining process to be replaced by hot forging process.

2.2 MATERIALS SELECTION [AL 6061, MGALLOY]

It is known that the presence of cast structure aluminium 6061 reduces the quality of aluminium strips. As a consequence, die set cast material needs to be processed subsequently by a combination of stress and deformation. During such processing the aluminium grains first obtain a stretched form. Subsequently, smaller grains form during recrystallization and the microstructure becomes more than ansys uniform[6].

Aluminium temperature has an effect on the mechanical properties of die cast aluminium metalmatrixcomposites.Theoretically,thelargestmeltstressandpunchingwould be achieved, if the pressure were applied when the melt temperature in the die was lower than its temperature, and just above the temperature required for the explosion of the material then aluminium alloy [7].In magnesium alloy systems, die metals that can be easily recycled must be used for the weight reduction of total deformation, energy load structures, As an example, magnesium alloys are used for parts of the steering wheel, instrument panel, and seat structure. In order to use punching process in transportation systems, we have studied methods that prevent cracking, buckling, and cross-sectional distortion under press bending in series aluminum and magnesium alloy extruded loading.[8].

Squeeze casting is one die materials the modern casting process developed to address the limitations of conventional punching processes such as stress or strain, use of runners and gates leads to material wastage, difficult to cast wrought aluminium alloys and to make die constructions hot die materials. The near net shape manufacturing capability of the die casting process need to produce the component that can be immediately used in services and would not add costly punching processes such as machining, polishing, shot blasting, plating and ballburnishing.[9].

2.3 3D MODELING

In the attempt present work focus on ANSYS 14.0 FEA software has been used for simulating the die set material for aluminium 6061, magnesium alloy process. ANSYS Parametric Design Language (APDL) is a scripting language that can be used to build the model in terms of variables. Shown in figure (2 &3).

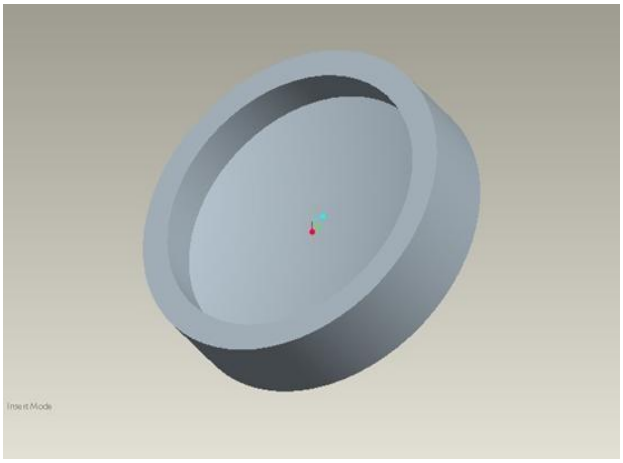

Figure 2. Revolving of 2D sketchMgalloy

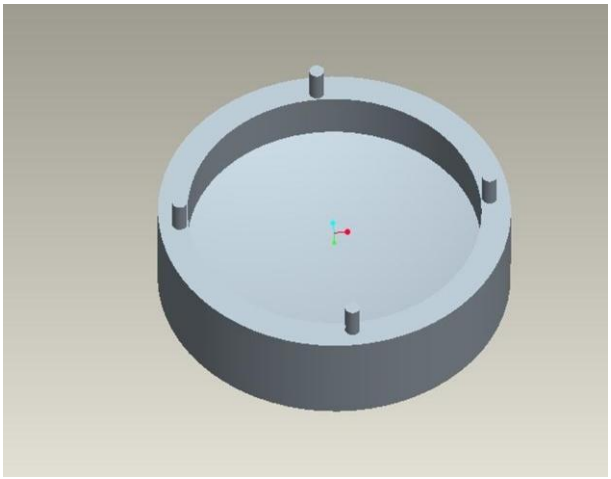

Figure 3. Create 2D sketch for pin (Mgalloy)

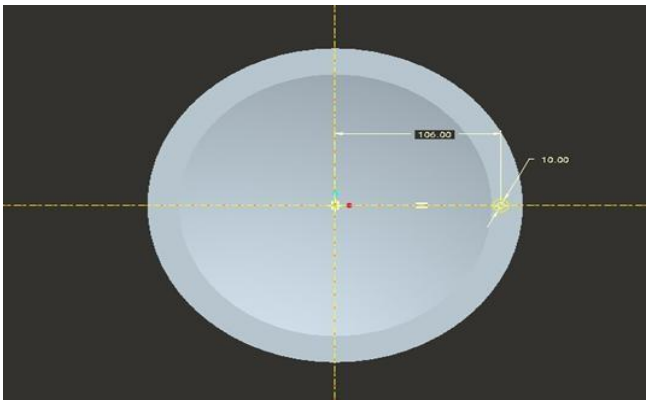

Figure 4. Make pattern for pin(Mgalloy)

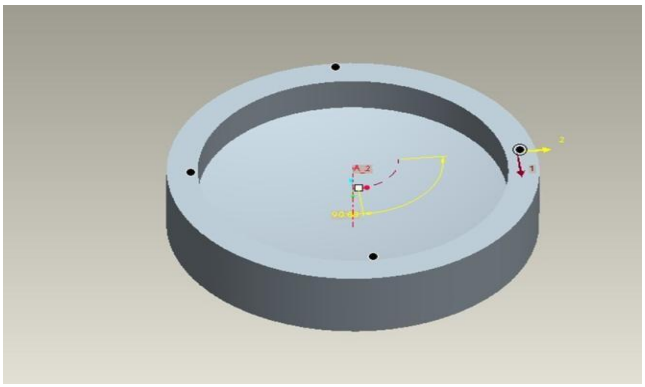

Figure 5. Final view of die in pro E (Mgalloy)

In this second step of simulation, the punch was analysed separately from the step 1 the punch PRO E model was generated in ansys and load into modelling punching layers to be consistent with the real one. The joining technique consists of two (Mg & Al) and five screws (Al & Mg), in addition to an epoxy adhesive. The finite element model involves materials elements with a mesh refinement in the vicinity of the screw holes [10]. Shown in figure (4 &5).

2.4 ANSYSMODELLING

The punching processes are largely composed of deep drawings and die set. An initial blank of 2.00 diameter is formed in five steps of deep drawing, and the dimensions of its corner Rare subsequently readjusted by holes and die set in four steps, and finally ironing process is performed in three steps to make the inner dieshape.

An FE simulation is conducted using DEFORM 3D, which is a commercial program, and with a die section of work piece and tools due to the symmetrical structure. A model of the work piece and tools (punch, die, and holder) [11].

2.5 STATIC STRUCTURALANALYSIS

Based on the deformation result presented in die set, the sheet inverse punching by magnetic force with discharge stress & strain. In comparison with the ansys stamping results, the values of the material flows from the sheet holders inward to die hole are increased if the coildischarge.

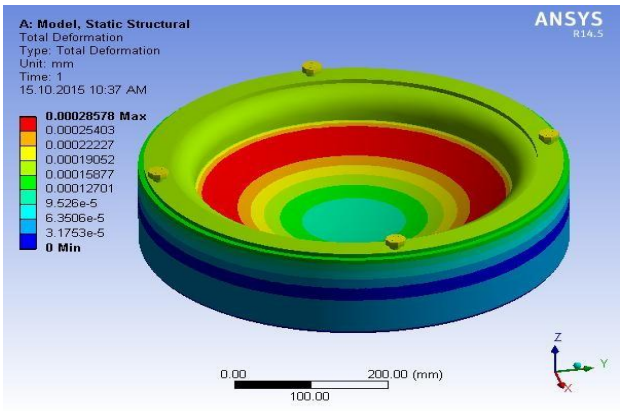

Figure 6. Total Deformation(Alalloy)

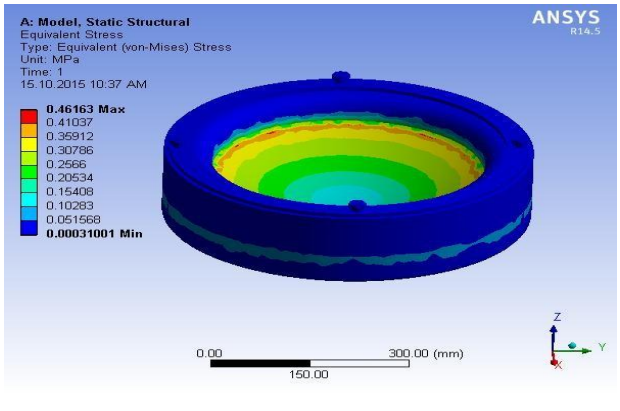

Figure 7. Stress (Alalloy)

The deflection of the inverse bulging height in axial direction in the condition of die set is larger than the 3 hole. Shown in figure 6 & 7.The process of the die set by punch in the condition of holes.

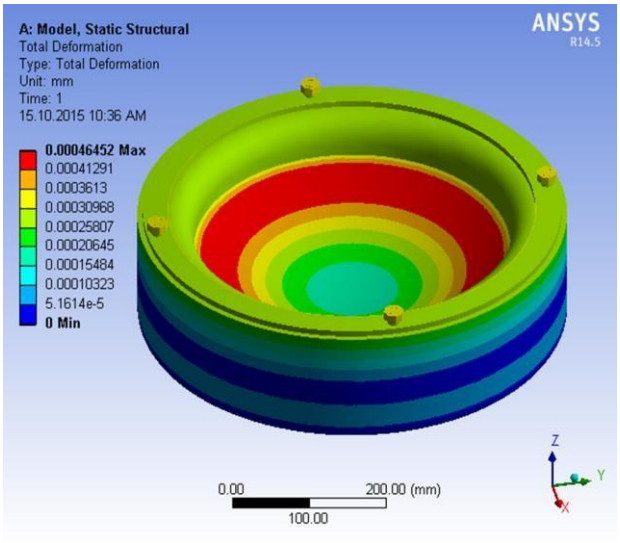

Figure 8. Strain(Mgalloy)

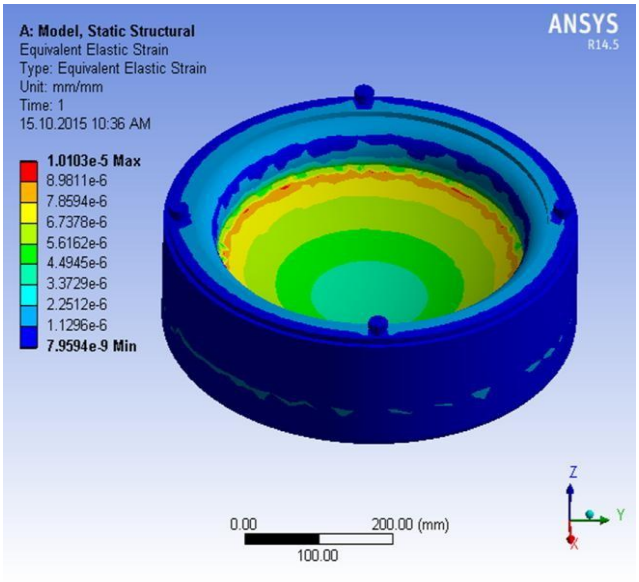

Figure 9. Total Deformation (Mgalloy)

The initial time of the inverse bulging punching to total deformation, the change of radial displacement with time at special points Mg alloy. Shown in figure 8 & 9 [12].

3. CONCLUSIONS

This paper describes for designing die for two different materials at the same time have strength to withstand the stress, strain and forces of bending. This paper makes contributions in thefollowingareas:Analysis has been carried out byaluminium6061 and magnesiumalloy.

The results such as total deformation, equivalent elastic strain and equivalent stress for each material are determined. Comparing these materials aluminium 6061 has the low values of total deformation, stress and strain. Hence it is concluded that aluminium 6061material can be used for thedie.

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