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Design & Simulation of Drawbead Profile in Sheet Metal Forming of Components

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Abstract— The quality of sheet metal component is secured by the material flow into the die cavity. Draw beads are usually used in sheet metal forming to restrain the sheet from flowing freely into die cavity. In this project, finite element method is used to improve the location of a draw bead and analyzed the strain and thickness variations during the panel header drawing process. In proposed project draw bead is added to the blank holder to reduce the thinning effect of blank caused due to forming process. Altair's HYPERFORM and Radios solver commercially available for simulation and analyzing the forming process. By using draw bead and forming parameter such as blank holding force, coefficient of friction therefore tendency of wrinkling and thinning reduced. The sheet metal forming is a key manufacturing technology of automotive component because of its process flexibility for a quick realization of design shift sat a possible cost. The main objective of stamping die-makers is to design and manufacture a set of forming tools that can be used dependably for a defect-free sheet metal product within the desired dimensional tolerances and the required surface quality. By above Solution Method we reduce the component thinning by 10%.

Index Terms—(Draw beads, Die Cavity,Thickness,thinning Hyperform,simulation)

I.INTRODUCTION

The sheet metal forming is a key manufacturing technology of automotive component because of its process flexibility for a quick realization of design shifts at a possible cost. Despite of the geometric construction and therefore the assembly function of a sheet metal part, the main objective of stamping die-makers is to design and manufacture a set of forming tools that can be used dependably for a defect-free sheet metal product within the desired dimensional tolerances and the required surface quality.

In forming of sheet metal component the forming errors like wrinkling, thinning etc. are commonly observed at the very first tool tryout. In single-stage drawing of sheet metal blank the metal is drawn over various surfaces and varying radii, this makes the prediction of defects complicated. The Finite element simulation of sheet metal forming is increasingly applied to el iminate forming defects, predict and optimize process parameters and to predict stresses / strains in sheet metal blank to prevent blank failure.

To determine the result of the process parameters on the final forming quality is very difficult in sheet metal forming process because forming process experience very complicated deformation. These process parameters got to be determined for the optimum forming condition before the process design. Throughout the years, the sheet metal forming industry experiences technological advances that allowed the production of complex parts. However, it still lies heavily on trial-error and the expertise of skilled workers. The quality of the final product shape is determined by the tools design, process parameters, shape and material of the blank. It is important to care fully consider all these factors prior to manufacturing otherwise a defective product could result.

II. PROBLEM DEFINITION

Thinning and wrinkling are predominant defects in Sheet metal forming process which are occurred due to non-uniformity in geometry of sheet metal.

1. Thinning:- Thinning is defect in which the metal is flow into the die less than required value

FIG-1:-Thinning Sheet metal

2. Wrinkling:- wrinkling is defect in which the metal is flow into the die more than required value

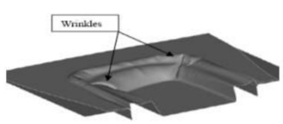

FIG-2:-Wrinkling in Sheet metal

The existence of these defects may damage surface quality, reduce dimensional precision, cause local crack of component and leads to failure of the forming process. In order to improve product quality and reduce cost, optimization of various process parameters to be applied to sheet metal forming process. So in this thesis reducing %thinning and wrinkling of sheet metal component by introducing variable dimension draw bead is studied.

III. METHODOLOGY

The thinning error in Panel header is eliminated by means of FEM simulations and Taguchi methods. For FEM simulations we require, CAD model of Panel lower plenum, specification of Panel lower plenum, and specification of existing press tool setup. The CAD modelling of Panel header is done, then from theoretical calculations the required number of draws and press tonnages are calculated. Further the forming tools are modelled in CATIA V5R21 and this collection of data is used for virtual simulation experimentation. Complete sheet metal forming process

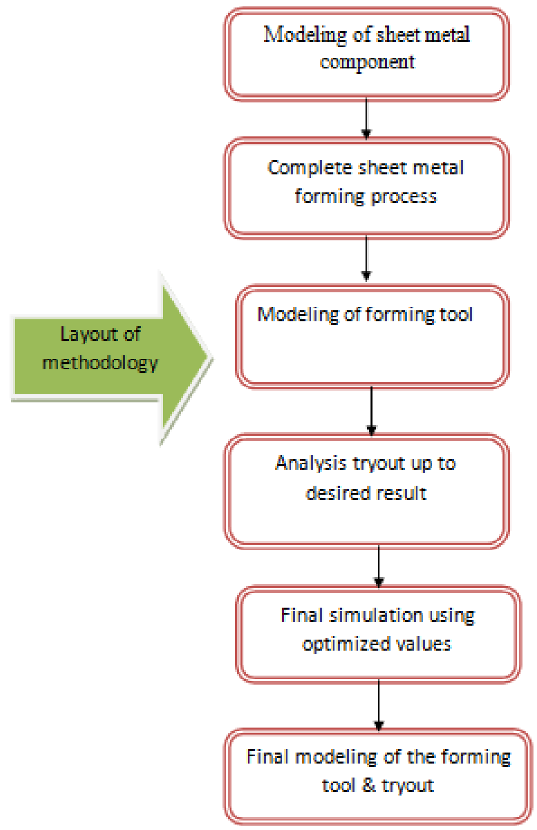

FIG-3:-Flowchart

IV. NUMERICAL SIMULATION

Numerical simulations were carried out for the given conditions and results were obtained. Simulation is carried out using incremental Radioss platform in Altairs HyperForm software package. To achieve the less than 20% thinning several iterations are carried out with variable draw bead dimensions. The basic steps for conducting a representative FE simulation of a sheet metal forming process including formability are given schematically in fig. 4 and outlined as follows.

In numerical simulation, contact is necessary between the sliding bodies for the metal forming process, the die was treated as master surface and others were treated as slave surfaces.

The component to be formed is taken into HyperForm as an IGES data then using the available commends in HyperForm a mesh was created for blank and die, for creating the mesh for other parts like punch, binder automatic tool build option was used.

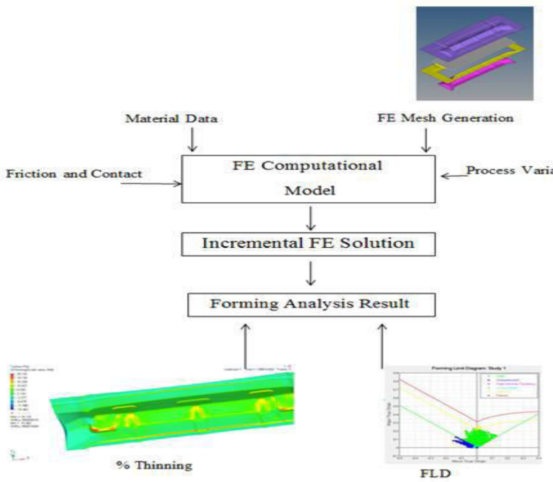

FIG-5:- FE simulation of sheet metal forming process

V. DRAW BEAD DESIGN

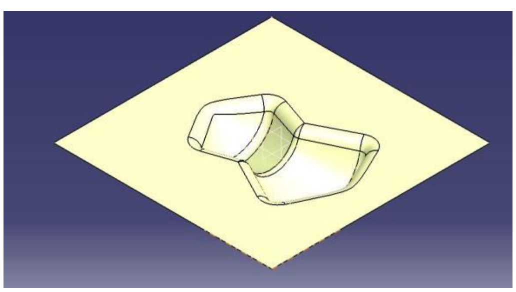

FIG.6 :-Draw bead Profile

The positioning of the draw beads is crucial to their effectiveness. They should be close to the area requiring restraint and perpendicular to the flow of material. The draw bead is positioned at various locations over the binder surface from the die cavity. The various draw bead radius which used in simulation..This radius varied according to previous iteration results. To obtain desired results various draw bead design and iterations carried out before finalizing die design.

VI. IMPROVEMENT BY SIMULATION

For simulation first of all, tool setup generation is required, the exact tool setup used for simulation. Blank holder also known as binder incorporated for holing the edges of sheet metal blank in place against the top of the die while punch forces the sheet metal into the die cavity. In trials, various draw bead design are changed and radius R1 approximately define height of bead varied from 3mm to 6mm for material flow control. Radius R2 increased if there is more thinning takes place similarly while in case of wrinkling one of the radius keep on decreasing upto material thickness. Prediction of fracture, wrinkling is studied from results obtained from solver and viewed in Altair's Hyperview,

CONCLUSIONS

- This paper presents finite element based simulation techniques for optimize the position of a draw bead and investigated the strain and thickness variations during the panel header drawing process.
- A number of iterations were performed in CAE world before concluding the final design. This significantly replaced the proto part making and testing cost and time.
- This study shows that if thinning occurred at particular area of component increasing entry side radius of draw bead will result into reducing thinning effect, similarly wrinkling tendency avoid by decreasing entry side radius.

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