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One Step Formability Analysis of LSV link bracket Using Siemens NX

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ABSTRACT

This project concerns the methodologies to be used to simulate complete formability of aerospace sheet metal components and the study of how different mechanical properties propagate and influence the component fabrication. Most of the Automobile and Aerospace components are manufactured using Press tool with sheet metal operations. These increasing requirements necessities a design and manufacturing procedure based on Finite element method Sheet metal formability results predictions. With the assistance of Sheet metal one step formability analysis, the problem regions, causes and solutions can be found using the Computer aided Engineering techniques and productivity can be achieved by reducing expensive shop floor Press tool tryouts and eliminating reworking of tools. This paper describes the methodology by which, influence of product design, metal properties and manufacturing boundary conditions on deformation of sheet metal component. The outcome results on the components can be analysed and post processed results can be used to redesign the Punch, Die, Component and determining the Manufacturing parameters like Pressure pad load, spring back constraints etc. The virtual Finite element analysis can detect spring back, splitting, thinning defects, Stress and strain limits at the component design stage. The study is carried out using Siemens NX software One step formability.

Keywords *- Finite Element Analysis, Bending, Forming, NX one step Formability*.

1. INTRODUCTION

Press tool device is used to convert sheet metal into essential shape by various cutting, non-cutting and hybrid press operations. Majority of Automobile and Aerospace products are manufactured using Sheet metal forming technology. The formability analysis can be used in design feasibilities of component, Punch and Die design. Forming and Bending are important sheet metal operations in producing components. In sheet metal forming and bending operations, a sheet metal is subjected to plastic deformations using press tool to confirm to a planned shape. During the process, the optimization of process parameters, Punch, Die and component design has to be done correctly to eliminate defects.

Bending is shaping the metal around a straight axis. Forming is shaping the metal to the desired contour around nonlinear axis. During bending of a strip, the material outward of the neutral axis is subjected to tensile stress and material inside is subjected to compressive stress. The variation in stress parameters causes thickness reduction and fracture at the bend section.

Spring back is the elastic recovery of sheet metal after the load is removed in sheet metal operation. Spring back will be greater for materials having lower elastic modulus and higher yield strength. Springback increases for a sheet with higher width to thickness ratio as the stress state is biaxial or plane stress.

Formability of sheet metal is the capacity of the sheet metal to undergo forming to the desired shape and dimensions, without failure. Finite Element analysis software is regularly used in the design assessment of component, forming punch

And dies. The process analysis method has been established as a practical methodology in the part formability to access failure. With this methodology process tooling and die tryout

Phases may be removed or can be decreased in the virtual environment and productivity can be increased by reducing tooling costs and lead-times.

2. ONE STEP FORMABILITY

One step formability is used in development of sheet metal parts using FEM analysis and to find out the defects like thinning, necking, resulting stress, strain and spring back effects to predict the risk in forming. One step formability analysis is done considering material properties, binder tonnage, draw-beads, friction. This is used to fine tune the blank holder force, draw beads position, material selection, product design. One step formability command directly gives the final component output results after manufacturing with a given manufacturing constraints in a quick time compared to Incremental formability analysis.

3. PROCESS METHODOLOGY

The formability of blank sheet depends on the process parameters such as part material, part overall size and shape, part thickness, pressure, friction coefficient and blank holder force and spring back match points boundary conditions.

Fracture and Part thinning are the major modes of failure in sheet metal parts while manufacturing. One of the quality criterions in sheet metal formed parts is thickness distribution which decides the strength of component. In this study, a Fuel filter bracket with Cold rolled low carbon mild steel and blank thickness of 4.5 mm is analyzed by using Siemens NX software to study the effect of these parameters on failure modes, thickness distribution and springback effects. The development of complex sheet metal can be easily found using one step formability command. The parameters for analysis are shown in Table 1. The geometry of LSV link bracket is shown in Fig. 1. In this paper the usage of applying sheet metal parameters in forming operation and analysis procedure and results are shown with the help of Siemens NX software.

Sl. No.	Parameters	Values
01	Young's Modulus	206000 Mpa
02	Ultimate Tensile Strength	340 Mpa
03	Yield Strength	235 Mpa
04	Strain hardening exponent	0.2
05	Poisson's ratio	0.3
06	Shear strength	400 Mpa
07	Mass Density	7850kg/m^3

Table 1: Material Properties.

Fig 1: Fuel Filter Bracket.

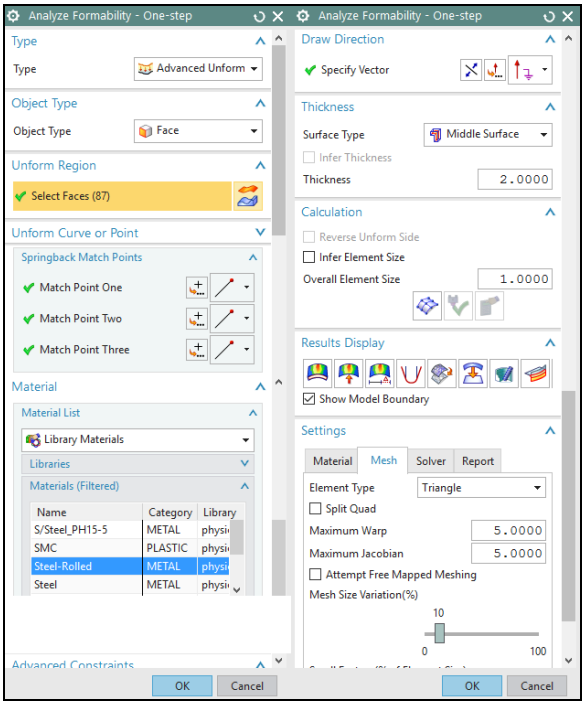

Fig 2: Siemens NX Analyze Formability.

4. RESULTS AND DISCUSSION

The Mechanical parameters and constraints values are entered after selecting geometry using One Step formability command of Siemens NX software.

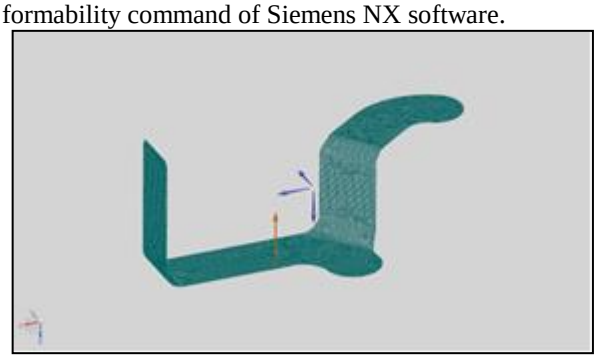

Fig 3: Model Mesh.

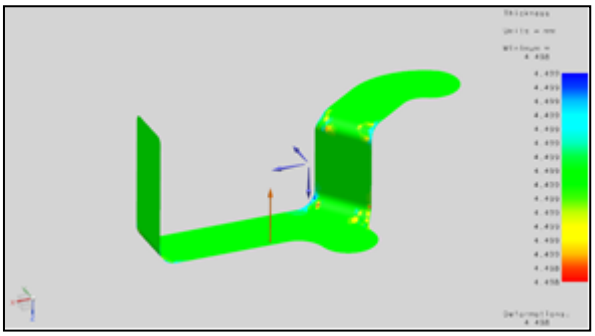

Fig 4: Thinning.

The model is meshed using Triangle and Quad mesh by defining maximum warp, Jacobian values and the wall thickness distribution is generated using display thickness.

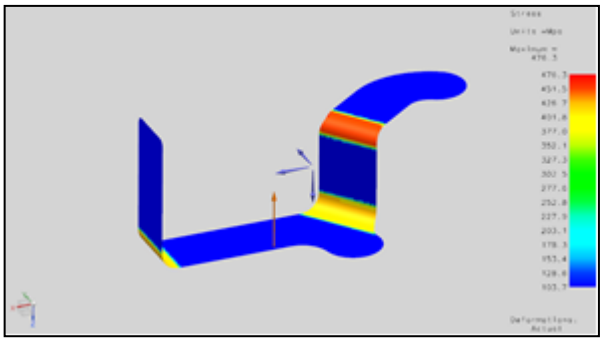

Fig 5: Equivalent Stress.

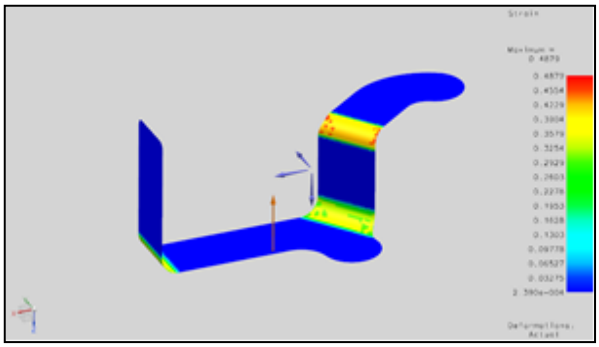

Fig 6: Equivalent Strain.

The stress distribution is generated using display stress to know the failure or crack regions and the strain distribution is generated using display strain.

The spring back effects is predicted using display spring back and output spring back faceted body.

Fig 7: Progressive Press Tool for Stage 01.

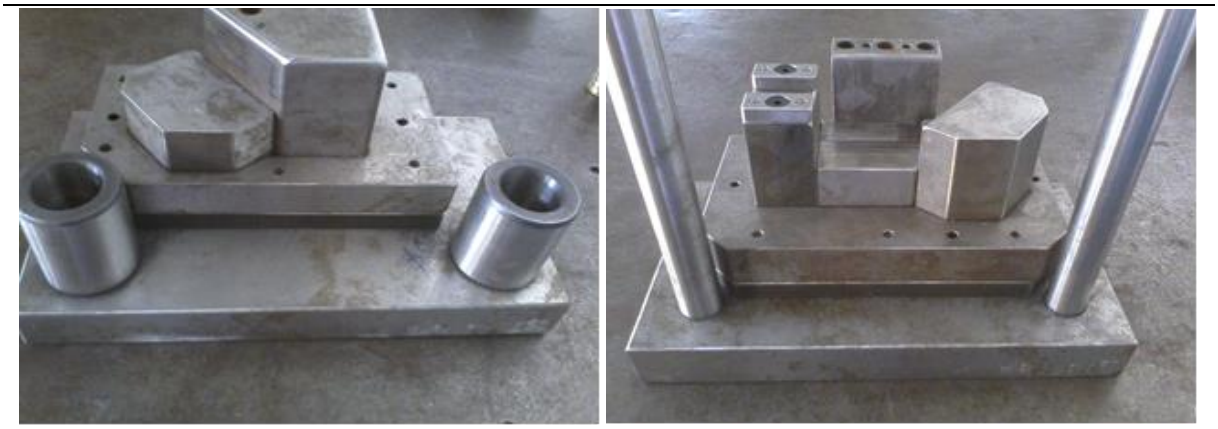

Fig 8: Forming Press Tool for Stage 02.

The analysis is carried out by selecting The Sheet metal component material by assigning Springback match constraints, draw direction, surface thickness and triangular element type using the Analyze formability one step command. The component is manufactured using blanking stage 01, forming stage 02 and forming stage 03 press tools. The analysis results of forming tools stage 02 and stage 03 are found nearest to manufactured component.

5. CONCLUSION

The analysis is carried out by selecting the Sheet metal component material, by assigning Springback match constraints, draw direction, surface thickness and appropriate element type using the Analyze formability one step command. All the component actual dimensions after manufacturing are complemented and found nearest to dimensions of NX formability analysis results and all the dimensions were found acceptable within the drawing tolerance.

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