STUDY OF SPLIT PUNCH AND DIE OF THE SHEET METAL BLANKING PROCESS FOR LENGTH COMPONENT

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Abstract

In This Paper we present a study of Split Punch and Die of Sheet Metal Blanking Process for Length Component. The Component with 740mm length is considered and Analysis of Punch and Die was carried out for study. The Split Punch and Die techniques introduced is being studied in this paper and it is the most applicable technique for the lengthy components. Sheet metal parts are widely used in products of high complexity and precision such as vehicles, aircraft and other automobile related products. Therefore, the press process has been identified as one of the most important manufacturing processes. During Blanking Process the force acting is more between the punch and die, failure or damage may occurs as reaches some production, so need to replace the punch and die as damages occurs. For small components punch and die can easily replaceable, easy maintenance, easy handling, less time consuming and low cost. As we consider lengthy components punch and die the manufacturing, heat treatment, maintenance, handlings need more time and cost is also very high. By integrating the split method of punch and die will be highly beneficial also helps to reduce the cost and time for heat treatment, easy replaceable of damaged parts, easy maintenance, easy handling, good life and durability can be achieved.

Keywords: *Split Punch, Split Die, Sheet Metal, Blanking Process etc…*

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1. INTRODUCTION

Sheet metal forming processes like blanking, stamping and bending are very commonly used in the manufacture of sheet metal parts and it takes a combination of different processes to manufacture sheet metal parts. Blanking and piercing are metal shearing processes in which the incoming sheet material is sheared to a desired shape. In blanking, the removed piece of material is the product and while in piercing, the material that is removed is scrap while the remaining part of the strip is the product. Blanking is one of the processes in which the sheet undergoes severe deformation since the sheet metal is sheared or separated to have the slug and part.

Sheet Metal blanking is an industrial process widely used in automotive, electronics and several other industrial applications. It consists in separating a blank from a sheet by means of high localised shear deformation due to the action of punch.

It should be general that amongst several existing sheet metal forming processes, the blanking process stands apart since it leads to plastic shearing followed by the creation and propagation of cracks.

The blanking process can be considered to include a series of phases in which the sheet metal undergoes deformation and separation, The Phases are Contact of the punch, shearing and crack formation, Breakthrough, Stripping.

The wear on punch and die is affected by the sheet material blanked, punch/die material and coating, geometry of the punch and die and punch/die corner radius to name a few.

Design considerations Include in the blanking process are

- Stability to Prevent deflection
- Adequate Screws to overcome Stripping and other forces
- Good doweling practice for accurate location
- Sectioning if required for proper heat treatment

2. DESCRIPTION OF THE STUDY

2.1 Brief Description of Solid and Split Punch and Die

Solid Punch and Die: The required shape of Part for blanking made on a single metal block for punch and die is known as solid Punch and Die

Split Punch and Die: Punch and Die contour built up from two or more pieces is known as the Split Punch and Die

The following factors influence the design of the punch and Die:

- Blanking part size
- Stock thickness
- Intricacy of piece part contour
- Type of tool
- Machinery available for manufacturing tool

2.2 Reasons for Designing the Split Punch and Die for the Length Components

1. Heat Treatment: Heat Treatment for the Punch and Die in the press tool operation plays an important role, to withstand the high cutting force and to have wear resistance, the punch and die is hardened and tempered.

   The Heat Treatment for the Punch and Die of the Length Components had some limitations as follows so need to go for Split type Punch and Die for the lengthy components
   - Time Consuming
   - Heavy care should be taken during the process
   - Result of the heat treatment is not 100%
   - Straight Components become destruction and shape changes to taper
   - We can go for precision heat treatment process to achieve 100% result but it also time consuming and high cost
2. Easy maintenance of the punch and die if any damage is occurred during the load application and failure
3. For easy Handling, removal and replace if any damage in the tool instead of changing whole tool
4. For Good Life and Durability
5. Reduced Time and Cost can be Achieved

3. DESIGN OF SPLIT PUNCH AND DIE FOR BLANKING PROCESS

3.1 Component Study

The component drawing is studied to know the important features, its geometry, Stages of operations, Special and important features of the component. The 3D views of the component as shown in Fig 1.

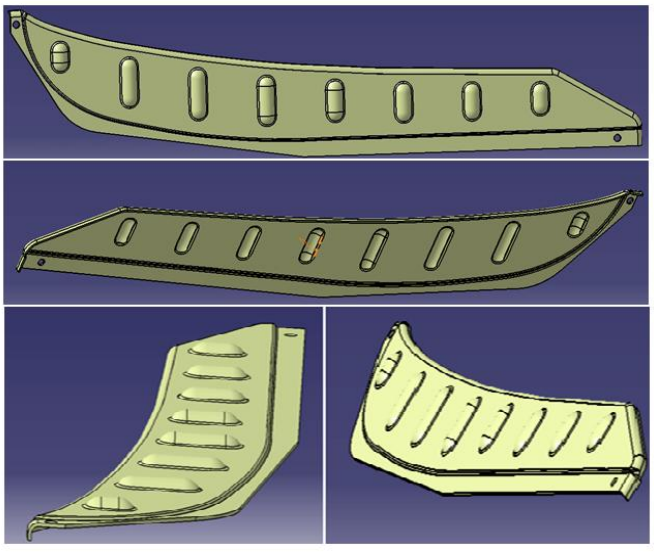

Fig -1: Component 3D Views

3.2 Component Details

The component details have given below:
Name of the component: a bumper external top panel
Material: Cold Rolled Carbon Steel Sheet
Designation: IS: 513 Grade ‘D’
Thickness: 2 mm
Component Length: 740 mm

3.3 Design Concept of Split Punch and Die

Designing press punch and die is a vital step in the development of press processes, The Conceptual Design was carried out using the AutoCAD and 3D Model was done using the CATIA Software for the Split Punch and Die.

Split Punch is assembled with Punch Holder. The Assembled and Explode view of Split Punch is as shown in Fig.2.

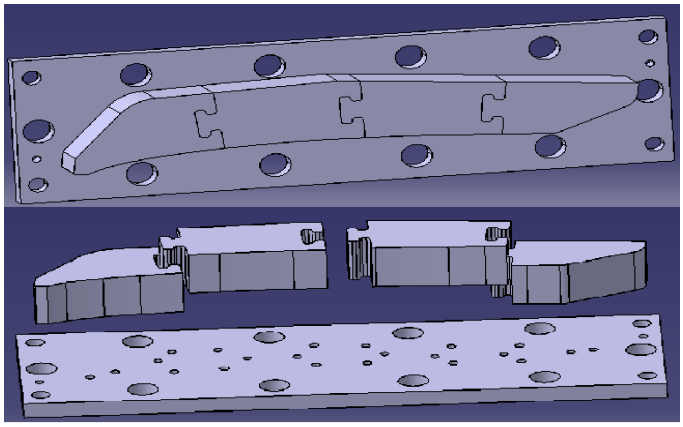

Fig -2: Assembled and Explode view of Split Punch

Split Die is assembled with Die Housing. The Assembled and Explode view of Split Die is as shown in Fig.3.

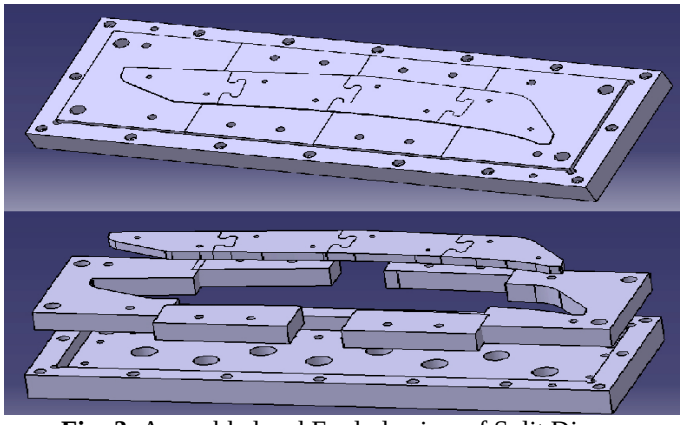

Fig -3: Assembled and Explode view of Split Die

3.4 Calculations

3.4.1 Shear Force

The force required to penetrate the stock material with the punch is the cutting force.

The formula for determining cutting forces takes into account the thickness of the work material, the perimeter of the cut edge, and the shear strength of the stock material.

The cutting force is calculated below
Cutting/Shear force = (L x t x f_s)
= (1642.9222x 2 x 260)
= 854319.54 N
= 854.31 KN

Where,
L= perimeter of the cut edge = 1642.9222mm
t = thickness of the work material = 2mm
f_s = shear strength of the stock material = 260 N/mm^2

3.4.2 Clearance

Clearance is defined as the intentional space between the punch cutting edge and die cutting edge. Clearance is expressed as the amount of clearance per side.

Cutting Clearance = c x t x ($\sqrt{f_s}$ /10)
= 0.01 x 2 x ($\sqrt{260}$/10)
= 0.10 mm/side

Where,
c = Constant = 0.005 for very accurate component
= 0.01 for normal component.
t = thickness of the work material = 2mm
f_s = shear strength of the stock material = 260 N/mm^2

3.5 Selection of the Tooling Material

The Work Material is IS: 513 Grade 'D'
Mechanical Properties: Yield Stress: 280 N/mm2
Tensile Stress: 380 N/mm2
Shear Strength: 260 N/mm2

Chemical Composition: C%: 0.12
Mn%: 0.5
P%: 0.04
S%:0.04

Punch Material: D2
Punch Holder Material: MS
Die Material: D2
Die Housing Material: MS
Die Ejector Material: D2

D2 material is used for punch, die and die ejector. AISI D2 tool steel is one of the carbon steels alloyed with Mo, Cr, and V, is widely used for various dies and cutters for its high strength and wear resistance due to formation of chrome carbide in heat treatment.

Mild Steel is used for punch holder and die housing. Mild steel is the most versatile, least expensive and widely used engineering material which has found extensive application in various industries.

4. ANALYSIS OF SPLIT PUNCH AND DIE

The analysis of Blanking Split Punch and Split die is carried out by the computer application engineering (CAE) software has been successfully executed for the evaluation of maximum transverse deflection and stresses. The stress analysis is mainly intended to estimate the load carrying capacity of the members.

Mechanics of materials and theory of elasticity approaches have been developed and successfully applied for the stress analysis of the members. The results reveal that by integrating CAD/CAE will be highly beneficial to Designer`s and thereby saving lot of expenditures by avoiding repeated costly tryouts, changing the die and punch designs and more over the development of the product / component lead time is greatly reduced.

4.1 Split Punch Analysis

4.1.1 Solid Mesh

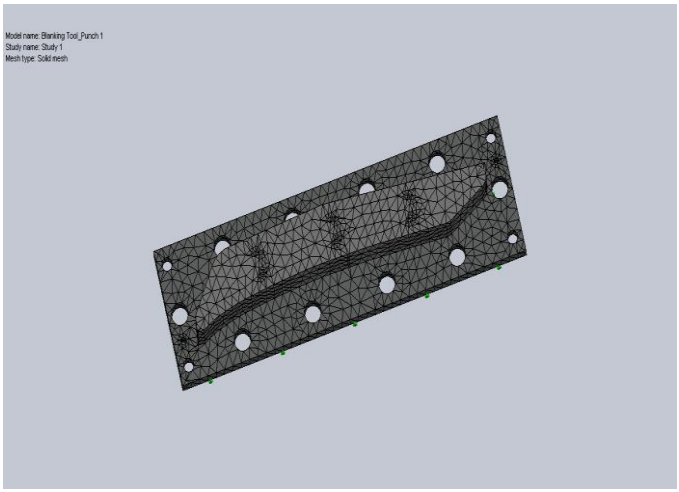

Fig -4: Solid Mesh of Split Punch

4.1.2 Static Nodal Stress:

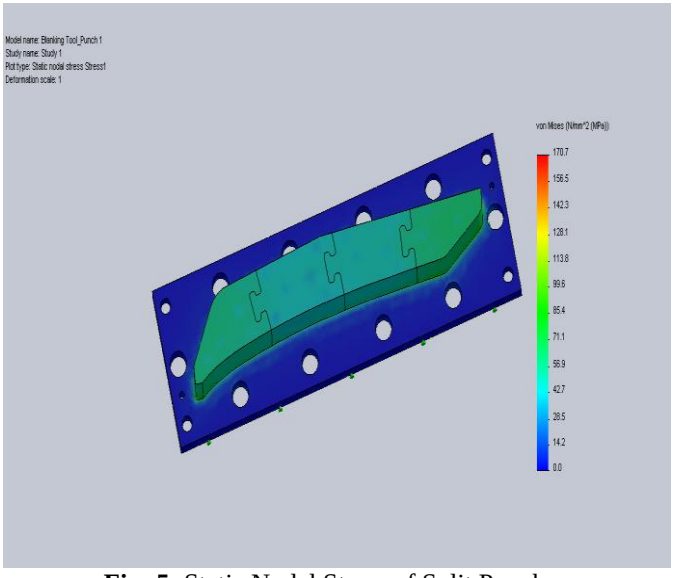

Fig -5: Static Nodal Stress of Split Punch

4.1.3 Static Displacement

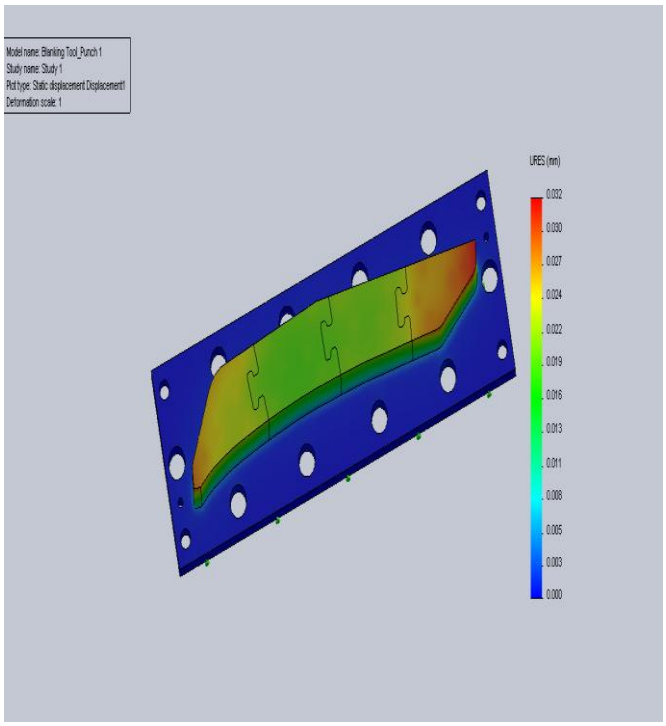

Fig -6: Static Displacement of Split Punch

4.1.4 Static Strain

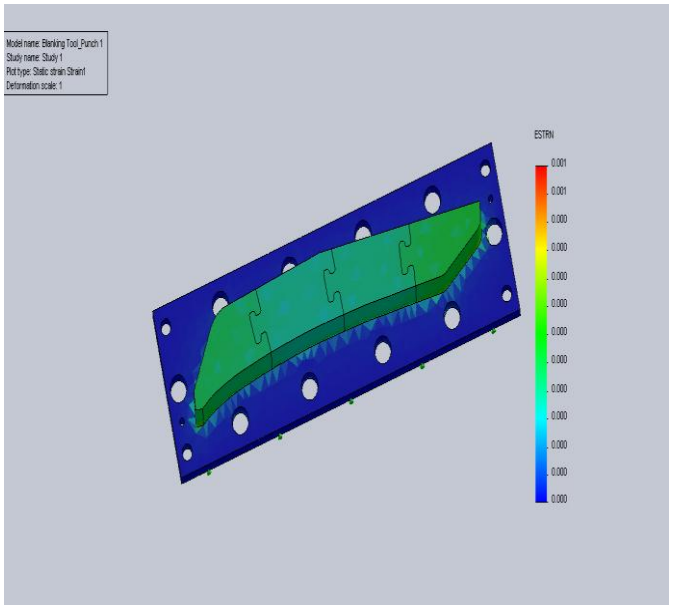

Fig -7: Static Strain of Split Punch

4.1.5 Analysis Results for Split Punch:

Table -1: Analysis Results for Split Punch

Type	Static Nodal Stress	Static Displacement	Static Strain
Minimum	0 N/mm^2	0 mm	0
Maximum	170.7 N/mm^2	0.032 mm	0.001

4.2 Split Die Analysis

4.2.1 Solid Mesh

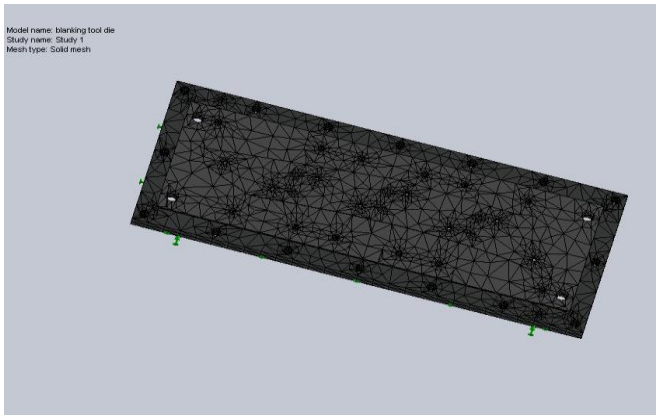

Fig -8: Solid Mesh of Split Die

4.2.2 Static Nodal Stress:

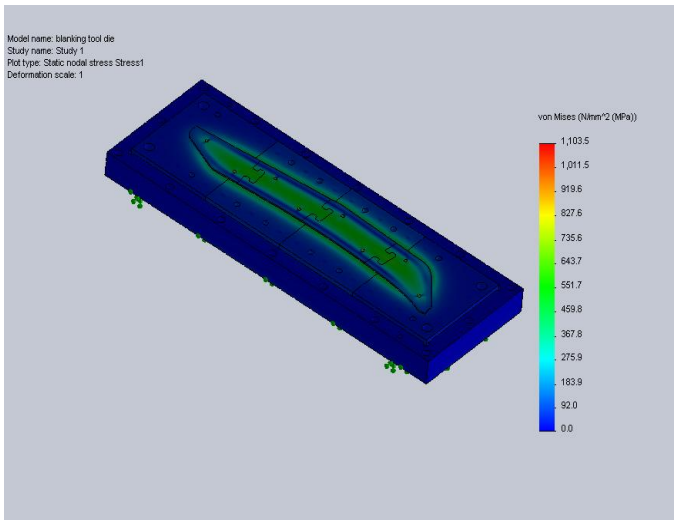

Fig -9: Static Nodal Stress of Split Die

4.2.3 Static Displacement:

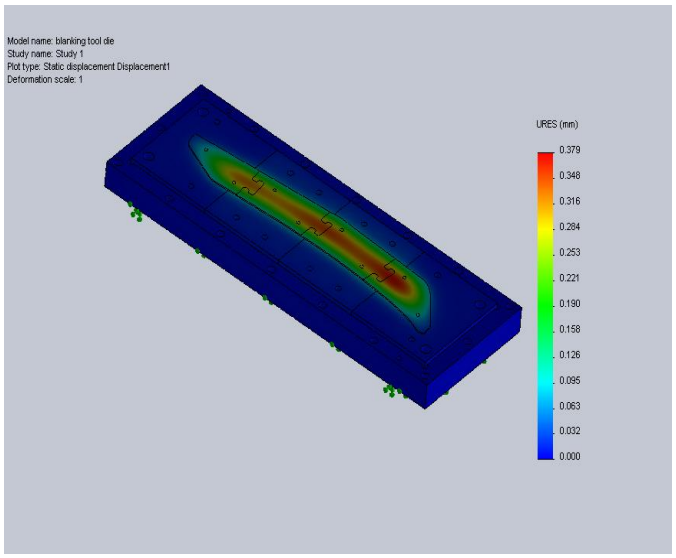

Fig -10: Static Displacement of Split Die

4.2.4 Static Strain:

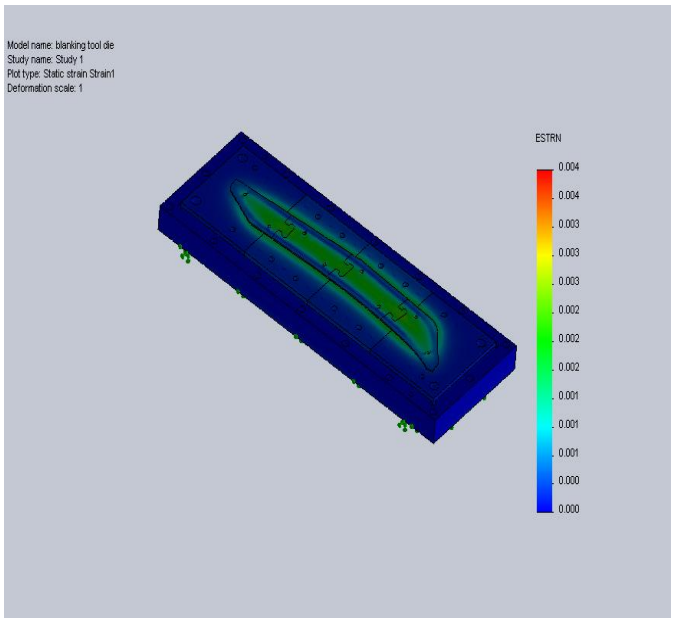

Fig -11: Static Strain of Split Die

4.2.5 Analysis Results for Split Die

Table -2: Analysis Results for Split Die

Type	Static Nodal Stress	Static Displacement	Static Strain
Minimum	0 N/mm^2	0 mm	0
Maximum	1103.5 N/mm^2	0.379 mm	0.004

5. CONCLUSIONS

1. In this Work, some significant aspects of split punch and die of sheet metal blanking process for lengthy component that is component length 740mm is discussed. Component Study and Analysis were made.

2. The Split Punch and Die Concept is well suitable and highly beneficial to reduce the time for heat treatment, maintenance, easy handling, replacement if any damages occur, good life and less cost Compared to the solid punch and dies.

3. Finally analyze the analysis result the design of split punch and die is safe for blanking operation.
If any damage occurs in feature, only that damage part can be replaceable.

4. Some Limitation of the split punch and die is that assembly- Uniform assembly with location using dowel is necessary for good operation. If Assembly is not uniform the final component is not accurate and some time it may damage the whole tool.

5. The results reveal that by integrating CAD/CAE will be highly beneficial and design is safe.

REFERENCES

[1]. N.B.Suresh, *A Lerner's guide to Press Tools*, published by Pannaga international academy, fourth edition [2010].
[2]. G.R.Nagpal, *Tool Engineering and Design*, Khanna Publishers
[3]. M.Rachik, J.M.Roelandt, A.Maillard, "*Some Phenomenological & Computational Aspects of Sheet Metal Blanking Process*", Journal of Material Processing Technology, Elsevier, Volume 128, 2012, Page 256-265
[4]. TOOL DESIGN DATA BOOK, directorate of technical education government of tamilnadu.
[5] GT&TC Standard Data Hand Book
[6]. Prakash H.Joshi, *Press Tool: Design & Construction*, Wheeler Publishing
[7]. Jutz-Scharkus, *Westermann Tables*, Revised second edition, new age international (P) limited, publisher [2006] [1996]
[8]. David A.Smith, *Die Design Handbook*, SME- Society of manufacturing engineers, Third Edition [1990]
[0]. COSMOS- Computer Aided Modelling and Analysis Manual

BIOGRAPHY

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