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Design of Press Brakemachine Tool and Finding its Effectiveness using Data Analysis

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ABSTRACT

Press tool manufacturing is one of the widely emerging trends in production area. Basically sheet metal components are produced using press tools. In this work, Design and analysis procedure to develop bending press tool is discussed. The components manufactured using this process exhibits high dimensional accuracy therefore automobile and aircraft firm depend largely on press tools. The purpose of carrying out analysis is to prevent the costly tryouts and thus optimize the quality and rate of production.

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Introduction

Press Tool is the process which is used to produce the sheet metal components. Operations like Blanking, piercing, bending, forming etc. can be performed using press tool process. The basic operation that is performed using press tool is blanking and piercing. Both blanking and piercing process includes shearing of the sheet metal [1-5].

During bending operation the sheet metal is squeezed between a male and a female part which is called as punch and die. Hence the sheet metal takes the desired shape as that of punch and die.

Important considerations in Press Tool Design

Several points have to be taken into considerations during press tool design process.

- All the parts that are designed should have the capability to bear the heavy forces.
- There should be safety and ease of both operator and setter.

- Sufficient space should be provided to load the stock.

- Die set should be made of proper material.

Selection of Material

Along with the important design consideration one should also know about the proper material selection for components of a die set various types of tool steels with their suitability for components of die set. Material or selected tool steel should be very hard to resist wear and strong to bear load and at the same time die set components may have very complicated shape, design and need very accurate sizing. Most of them are manufactured by machining and then finishing operations [6-10]. Their manufacturing involves processing of tool steel to make these components, and then these are hardened by different hardening methods like water hardening, oil hardening, air hardening. So here we use D2 material for both Die and Punch because D2 steel is an air hardening, high-carbon, high- chromium tool steel. It has high wear and abrasion resistant properties. It is heat treatable and will offer hardness in the range 55-62 HRC, and is

machinable in the annealed condition. D2 steel shows little distortion on correct hardening. D2 steel's high chromium content gives it mild corrosion resisting properties in the hardened condition [11-15].

Results and Discussion

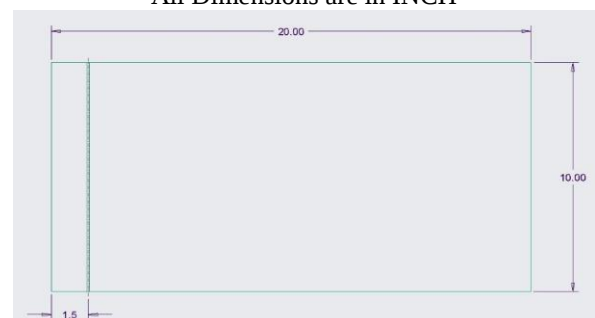
Analysis of V Tool Model

The selection of a V die greatly affects the bending process. It affects the radius, the pressure required, the minimum leg and the looks of the entire part. Keep in view, this work formulated a V tool for bending purpose. Thus, the dimensions of the proposed tool is tabulated in table 1 and its cross sectional view is depicted in figure 2

Table 1. Dimensions of the proposed parts

S.No	Part Name	Bend Depth	Length	Width
1	PRT0002	0.2	20	10
2	PRT0003	0.3		
3	PRT0004	0.4		
4	PRT0005	0.5		
5	PRT0006	0.6		
6	PRT0009	0.7		
7	PRT0010	0.8		
8	PRT0011	0.9		
9	PRT0012	1		
10	PRT0013	1.5		
11	PRT0014	1.6		

All Dimensions are in INCH



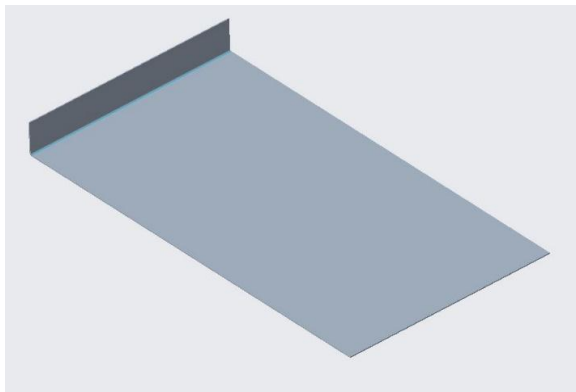


Figure 2. Procedure to select V-Block

V-Block	Bend Deep	
	1@40°	0.7
	1.5@75°	1.05
	3@75°	2.1

The performance of the proposed die under formulated 3 dimensions is described below

Evolution of the natural inside bending radius in a V die of 3 in.

In this die, with a 3 in V, the evolution of the bending radius is shown in Fig. 3. For 75° bending angle the inside bending radius approaches 1.5 in. It shows that evolution of the bending radius is almost independent of the material being bent.

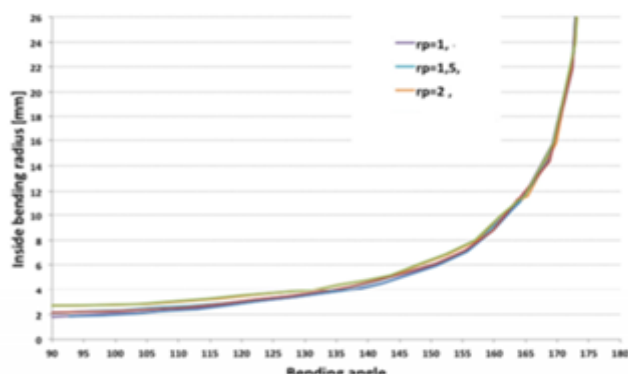


Figure 3. Evolution of the inside bending radius in a V die of 3 in

Here, we see that the evolution of the inside radius is similar for both punch noses with 1mm and 1.5 in radius. However for the 2 mm nose radius the evolution deflects from the free bending already for a wider bending angle. This confirms the validity of the recommendations.

Evolution of the natural inside bending radius in a V die of 1.5 in

In this die, with a 1.5 in V, being bent with a punch using different nose radii is shown in Fig. 4

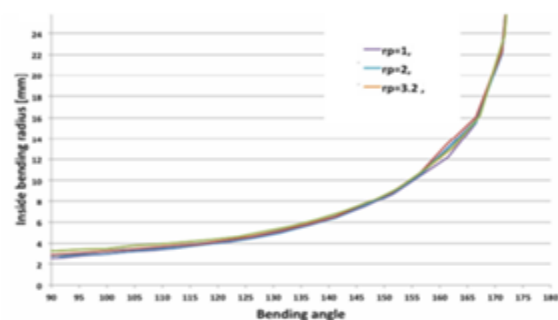


Figure 4. Evolution of the inside bending radius in a V die of 1.5 in.

Evolution of the natural inside bending radius in a V die of 1 in

In this die, with a 1 in V, 0.2, 0.3 and 0.4 mm thick, being bent with a punch in three different nose radius is shown in Fig. 5

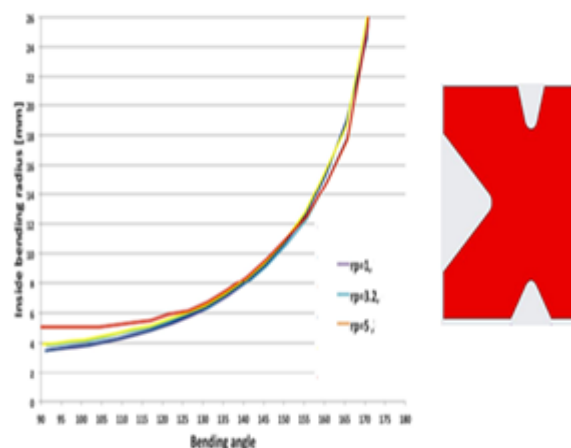


Figure 5. Evolution of the inside bending radius in a V die of 1 in.

Thus, from the above figures, it shows that evolution of the bending radius is almost independent of the material being bent.

From this bending, in different thicknesses, with different tooling sets, the following points are highlighted:

- Whenever we submit the plates to a bending process, respecting the traditional bending practice, the evolution of the inside bending radius is reasonable for all kind of materials, providing same V opening in the die.
- The radius on the punch only affect the evolution of inside bending radius if the inside bending radius is bigger than the usual rule.

Conclusion

Bending is one very common sheet metal forming operation used not only to form shapes like seams, corrugations, and flanges but also to provide stiffness to the part (by increasing its moment of inertia). The size of the die V-opening determines the inside radius of the bend. The metal forms to a natural radius based on the size of the die V-opening. From the previous study, it is found that three different types of tools can be combined together with slight modification in the machine which in turn helps to reduce the setting change over time from approx. 20 minutes to approx. 4 minutes. Thus, the formulated press brake includes three different V shapes in it. This in turn ensures the time saving process.

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