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DESIGNING AND MANUFACTURING THE PRESS TOOL OF AIR BENDING V BRAKE

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Abstract. Nowadays, the metal forming process in the welding machinery and machinery industry is developing very rapidly, especially in the bending process. The buckling process is a metal formation which generally uses sheet plates or rods from both ferrous and non-ferrous metals by bending, which in the bending process will cause a stretching or stretching on the neutral axis of the field along the bending area and producing a straight bending line. Appropriate technology machines have been widely used to increase productivity, efficiency, and effectiveness in the production process for community efforts. One of the appropriate technologies that can be applied in buckling is a tool equipped with a press tool. Press tool is one type of tool for the formation, cutting and bending of products from the base material of sheet plates whose operation uses a press machine. This paper have several stages, such as: designing consept, manufacturing product, assembling, and testing the press tool. In this study, a V brake bending tool has been produced which has a capacity that is bending line length 300 mm, bending width 33 mm, spring height 110 mm, free step distance 19 mm, spring load received 263,820 N and material capacity that can be bent is a thickness of 3 mm, the punch angle used is 85º with a punch radius used which is 1.5 mm while the die angle is 85º

Keywords : press tool, air bending, design and manufacture.

1. INTRODUCTION

The metal forming industry has developed very rapidly, especially in the bending process especially in the machinery and welding workshop industry. The buckling process is a metal formation that generally uses sheet plates or rods from both ferrous and non-ferrous metals by bending, which in the bending process will cause a stretching or stretching on the neutral axis of the field along the bending area and producing a straight bending line [1][2]. The phenomenon of the development of metal formation through buckling processes occurs in the manufacturing industry in large cities in large-scale and small-scale welding machinery and workshops in rural areas. This was triggered by the increasing use of various kinds of mechanization technology, especially in the field of food security and security in everyday people's lives such as post-harvest process technology and other agricultural mechanization technologies. [3][4].

Several buckling processes are often carried out in the manufacturing process for the manufacture and repair of products in machinery and welding manufacturing workshops such as electronic panel components, automobile vehicle panels, toolboxes, fish combustion, agricultural machinery, and mechanization tools and so on. However, there are still many small-scale workshops that bend the plates manually, namely using a hammer and iron base as a base so that the time used is not efficient and the resulting product is not guaranteed quality. Equipment owned by industry is usually a large-capacity engine where operational costs will be large while producing small-sized objects does not have to use large-capacity machines. Because of that, small plate bending tools are needed.

Thus, the application of appropriate technology is needed to increase the effectiveness of metal formation through this bending process. The use of appropriate technology machines has been widely used to increase

productivity, efficiency, and effectiveness in the production process for community businesses, especially those in the area. One of the appropriate technologies that allow it to be applied in buckling is a press machine equipped with a press tool.

Press tool is one type of tool for the formation, cutting and bending of products from the base material of sheet plates whose operation uses a press machine. Based on its formation process the Press tool is clarified into three, namely coining, bottoming and water bending. Formation using coining and bottoming is more accurate but to require different bending angles, it must use a different punch and die. Unlike the case with metal formation using water bending, to produce different bending angles only need to use one punch and die and different emphasis steps [5] [6].

2. METHODS

This research was carried out in the mechanical workshop and mechanical laboratory of Ujung Pandang State Polytechnic. The materials used in this study included iron shaft St 42, US box St 42, and steel plates. While the equipment used is milling machines, lathes, drilling machines, grinding machines, cutting saw machines and various dimensional measuring instruments. Several stages are carried out in this design so that it can run well, namely:

Firstly, the design stage begins by designing the press concept V bending tool that will be created. The concept of this design is continued by making image design in accordance with ISO standards. This image design includes the overall design drawing design and image design for all components both components made and standard components.

Secondly, in manufacturing and assembly stage, the nonstandard components are made by referring to the working drawings of the design. while standard components are purchased. After all the components that have been made and purchased are finished, a press tool assembly is carried out based on the results of the design.

Lastly, the press tools that have been assembled are then tested by bending the plates of low carbon steel. The trial process is carried out using 85o angle V-shaped dies. While the punch used is an 85º angle and a 1.5 mm radius. After the trial is completed, the resulting product is then measured by its bending angle to obtain. The sheet base material used is the St 37 carbon steel plate with a thickness of 3 mm.

3. RESULTS AND DISCUSSION

3.1 Result of Designing Press Tool

The press tool component consists of die sets, punch and dies themselves. Die set is a stand for assembling all components of the press tool. Die sets designed to be used as a tool to bend the plate material from carbon steel. This die set is specifically designed so that the punch and dies can be changed according to needs.

A. Designing the Construction of Press Tool

The design of the die set auxiliary construction along with the punch and die that will be used is as follows:

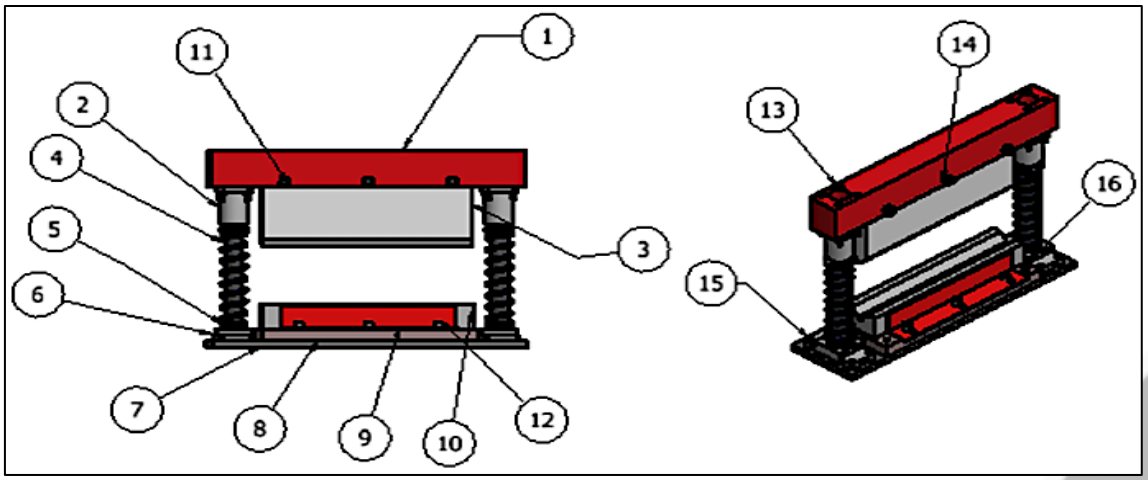

Figure 1. Design construction of press tool

Based on Figure 1, the press tool consists of several components, namely: 1) Top Plate; 2) Bearing; 3) Punch; 4) Spring; 5) Shaft; 6) Axle Stand; 7) Bottom Plate; 8) Coating plates; 9) die locking plate; 10) die; 11) Punch and Top Plate Binder Bolts; 12) Die locking bolt; 13) Bolt Bearings; 14) Punch and Top Plate Binding Nuts; 15) Holder bolt; 16) Die Coating Bolts.

B. Calculating the Construction of Press Tool

Some components play an important role in the V Brake bending process. Therefore, it is necessary to do some calculations to get the right design results as follows:

1. Loading for Load Spring. Die set components to provide spring load, namely top plate, punch, ring, and bearing. The determination of the mass of the die set auxiliary tool which is spring-loaded is used the equation as follows [7]:

$$W = V.\rho \quad (1)$$

Where W is component mass (kg), V is component volume (mm^3), ρ is density (kg/mm^3). Making components was using medium carbon steel density of 7860 Kg / m3. The following is a calculation of the mass of components that overload the spring:

a. Mass of Top plate (W_{tp}) = (Vtot . ρ)
= (V_I - V_{II} - V_{III} - V_{IV}) . ρ
= 11,407 kg

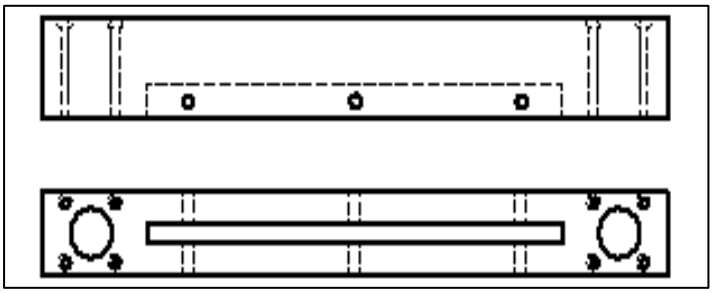

Figure 2. Top plate

b. Mass of Punch (Wp) = (Vtot . ρ)
= (V_I - V_{II} + V_{III} + V_{IV}) . ρ
= 15,339 kg

c. Mass of Bearing (Wb) = 2,377 kg (stainless steel)

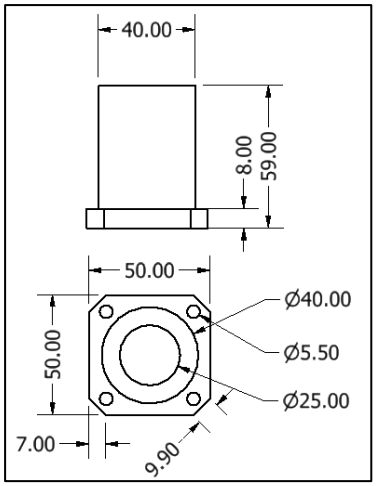

Figure 3. Bearing

d. Mass of Ring (Wr) = 0.046 kg (brass)

Thus, the total load received by the spring is:

$W_{total} = W_{top\ plate} + W_{punch} + W_{bearing} + W_{ring} = 29{,}17kg$

2. Strength of spring. Calculation of spring strength needs to be done to find out the selected spring can return the top plate, punch, and bearing at its original position after loading the bending process is

carried out. It is known that the spring diameter and wire diameter are 40 mm and 5 mm respectively, and the shear modulus (G) = 83x103 N / mm. Then the equation used is as follows [8]:

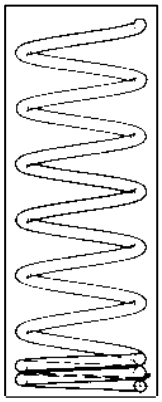

Figure 3. Spring

$$W = \frac{\delta.G.d^4}{8.D^3.n} \quad (2)$$

$$W = \frac{(Lo-Li).G.d^4}{8.D^3.n}$$

$$W = \frac{(110-100).83x10^3.5^4}{8.40^3.2} = 506{,}592 \text{ N}$$

There are 2 pieces of springs on the die set, the load that is able to be retained by the spring theoretically is 1,013,184 N. Based on the calculation of the total load of the upper component of the die set received by the spring (Wtot) of 29.17 kg or 263,820 N, then springs used are safe because the spring load is greater than the total load received

C. Result of manufacturing Press Tool

In this study, the design and manufacture of press tools produced one die set which was equipped with one punch with an angle of 85^0 1.5 mm radius and or V-shaped fruit dies at an angle of 85^0. This press tool is capable of bending product components and machining of various metal sheet materials precisely. Bendable components have a maximum width of 300 mm. The press tool that is produced can be seen in Figure 4.

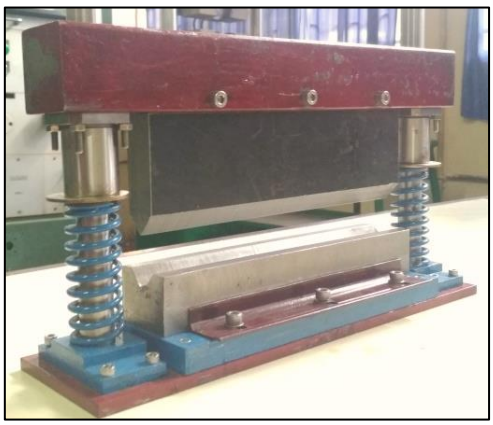

Figure 4. Press tool die set

3.2 Result of Testing Press Tool

After the assembly process is complete, the next step is to test the press tool to find out whether the tool is functioning properly or not. The trial process can be seen in Figure 5.

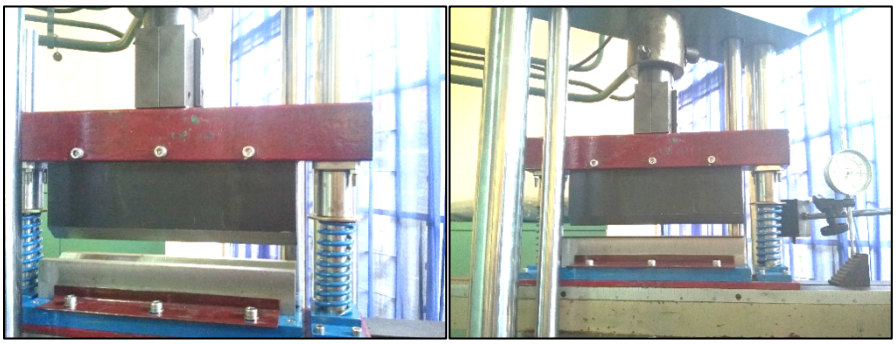

Figure 5. Press tool die set on UTM (Universal Testing Machine)

In this testing process, 10 test samples were carried out with the punch angle used, namely 85º radius 1.5 mm, dies with the angle used 85º and the material to be tested was St 37 carbon steel thickness of 3 mm. The results of testing the press tool measuring 300 x 60 x 3 mm from St 37 steel thickness 3 mm can be seen in Figure 11 as follows:

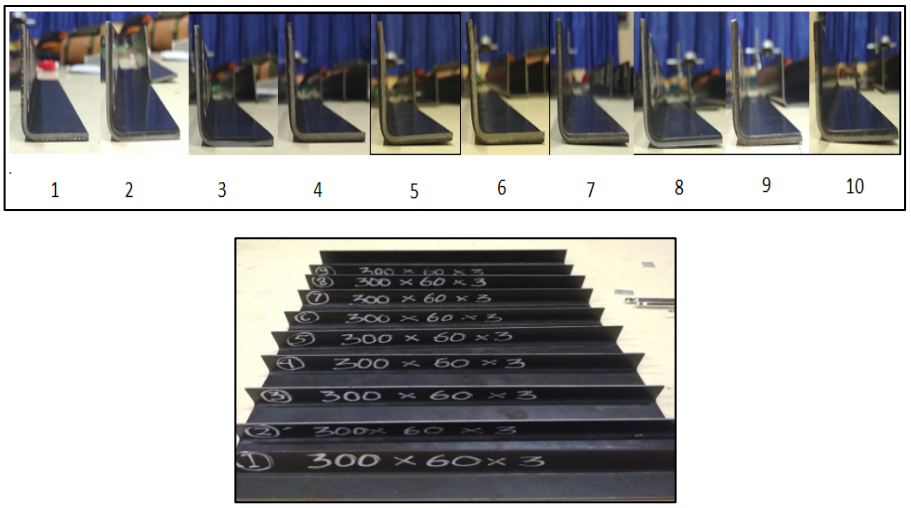

Figure 6. Product of testing press tool

The data on the measurement of bending angle from the press brake tool V brake can be seen in Table 1 below.

Table 1. Test Results Data Press Tool V Brake Bending tool

No.	Load (N)	Bending Angle			Springback
		(º)	(")	(º)	(º)
1	395	90	15	90,25	5,25
2	349	90	25	90,42	5,42
3	345	90	30	90,5	5,5
4	349	91	0	91	6
5	342	89	30	89,5	4,5
6	342	91	0	91	6
7	349	90	45	90,75	5,75
8	355	90	0	90	5
9	343	90	5	90,08	5,08
10	345	90	15	90,15	5,15

Based on the table above shows that all bending angles produced are close to 90º and 90º, and springback is close to 5º and 5º. The bending angle produced is equal to 90º and springback is equal to 5º located at test

number 8. While the bending and springback angle deviations are greatest with the bending angle 91, and the same springback 6 value is in the test numbers 4 and 6.

3.3 Discussion

The results of the design and manufacture of press tool has been done well. This press tool has also been tested with bending of sheet metal. The design and manufacturing model has also been done by Suyuti et al who made a simple press tool for V-bending bottoming [9], as well as designing the prototype of a press tool for making an O-ring with pneumatic System [10].

4. CONCLUSION

Based on the results of the study, it can be concluded that the results of designing and manufacturing the Air Bending V Brake Press Tool can be used as a tool for bending production V. The specifications of this V Brake Air Bending Press Tool are bending line length 300 mm, bending width 33 mm, spring height 110 mm, free step distance of 19 mm, spring load received 263,820 N and capacity of material that can be bent is ST 37 thickness 3 mm.

5. ACKNOWLEDGEMENT

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