JOURNAL INDUSTRIAL ENGINEERING & MANAGEMENT RESEARCH (JIEMAR)
Vol. 1 No. 2 : JULI 2020 ISSN ONLINE : 2722 – 8878
http://www.jiemar.org DOI : https://doi.org/10.7777/jiemar.v1i2

Mini Press Tool as Learning Practical: Designing, Manufacturing, and Analysis

Rusdi Nur[#*1], Muhammad Arsyad Suyuti[#2]

[#]*Mechanical Engineering Department, Politeknik Negeri Ujung Pandang*
Jalan Perintis Kemerdekaan Km 10 Tamalanrea Makassar, Indonesia

[*]*Center for Materials and Manufacturing, Politeknik Negeri Ujung Pandang*
Jalan Perintis Kemerdekaan Km 10 Tamalanrea Makassar, Indonesia

[1]rusdinur@poliupg.ac.id

[2]muhammadarsyadsuyuti@poliupg.ac.id

Abstract *— Metal forming is often found in several industries making household appliances, automotive, manufacturing electronic components and others ranging from small or medium-sized industries. The mini press tool was produced as a learning medium to help improve students' knowledge and skills. The mini press tool was performed in mechanic laboratory of mechanical engineering department, which is divided some stage, such as designing stage using Autodesk software, manufacturing the components, assembling the parts, and analysing the performance. Based on all stage, it concluded that the mini press tool have specifications i.e.: frame height is 360 mm, frame length is 180 mm, frame width is 150 mm, electric motor with speed of 1400 rpm, maximum load capacity is 372,04 kg. The mini press tool can be used as a learning media tool for students to provide an overview and understanding the press tool of parts and components. It can bending some products with a maximum forming force of 372 kgf with a bending time of about 3 seconds per product or 1,200 products/hour.*

Keywords — *Mini press tool, learning practical, metal forming.*

I. INTRODUCTION

The metal forming is growing rapidly both in the large-scale manufacturing industry and small to remote villages. This is due to the development of technological advancements in people's daily lives in the automotive, electronic equipment, agricultural equipment, machine tool tools and household appliances such as making pans, cake mould, car chassis and others [1].

The metal forming process can be carried out using punch and dies tools, where one of the applications for using punch and dies is applying into the press tool. Punch and dies installed on the press tool can be used not only for the forming process but also for the cutting process, and the bending process of sheet-shaped material [2]. Metal forming is often found in several industries making household appliances, automotive, manufacturing electronic components and others ranging from small to medium-sized industries [3]. Metal working through the process of metal forming in bulk can be done one of them by using a press tool. Mass product manufacturing is very profitable because it can save production costs in the metal manufacturing industries. It also can speed up the production process in greater numbers with the same size and in a short time. Besides the press tool machine can also produce various products or components by replacing punch and dies in accordance with the desired product shape. The mastery of metal forming using a press tool is theoretically taught to students. Especially, in the mechanical engineering department of the D4 Manufacturing Engineering study program as well as the D3 Mechanical Engineering study program student specializing in production through engineering design tools and production aids. However, students' knowledge and understanding of this subject have not been achieved maximally. This is because students will easily understand this subject more clearly if it is taught theoretically and demonstrated through practical media tools.

The process of metal forming through a press tool machine should be introduced to students through direct practicum using a press tool machine, or through other learning media tools to further enhance student skills. The problem is that the press is damaged so it cannot be used as a practical tool, and also the unavailability of other learning media tools that can be used to practice or demonstrate this metal forming process. The press tool should be introduced comprehensively to students in order to facilitate the maximum knowledge and understanding of the metal forming process. Based on the things explained above, we took the initiative to produce a mini press tool as a learning medium to help improve students' knowledge and skills. It also can provide accurate data on how the application of the metal forming process by using a mini press tool.

II. MINI PRESS TOOL

The definition of a press tool is a tool to produce a process of forming material on both sides, here the material is pressed with a certain amount of force on both sides [4]. Other definition press tool is tools that support a foundation and a pounder, a power source and a mechanism that causes the pounder to move straight and upright to its foundation [5]. Reference [6] defines the press tool that press tool is a tool for forming products from sheet-based materials whose operations use a press machine. It different stated that press tool is a tool which is used for cutting and forming plates into desired products based on the principle of emphasis [7]. The mini definition is stated by the Indonesian Dictionary is related to a small amount or small size [8].

The press tool has in common that basically the press tool is used for cutting and forming work in terms of forming the product. It can be concluded that the press tool machine is a tool used for cutting and forming work driven by a driving motor with a certain mechanism in terms of producing a uniform product based on the principle of emphasis. From the definition above, the term of mini press machine design as a learning media can be interpreted, that is, the process of designing and building a small-sized tool to produce something. In the process of forming the material, it is driven by a motor to carry out the process of cutting and forming the plate into the desired product based on the principle of emphasis.

III.METHOD

The design of mini press tool machines as learning media is implemented and carried out at the Mechanical and Laboratory Workshop, Mechanical Engineering Department, Ujung Pandang State Polytechnic in Makassar.

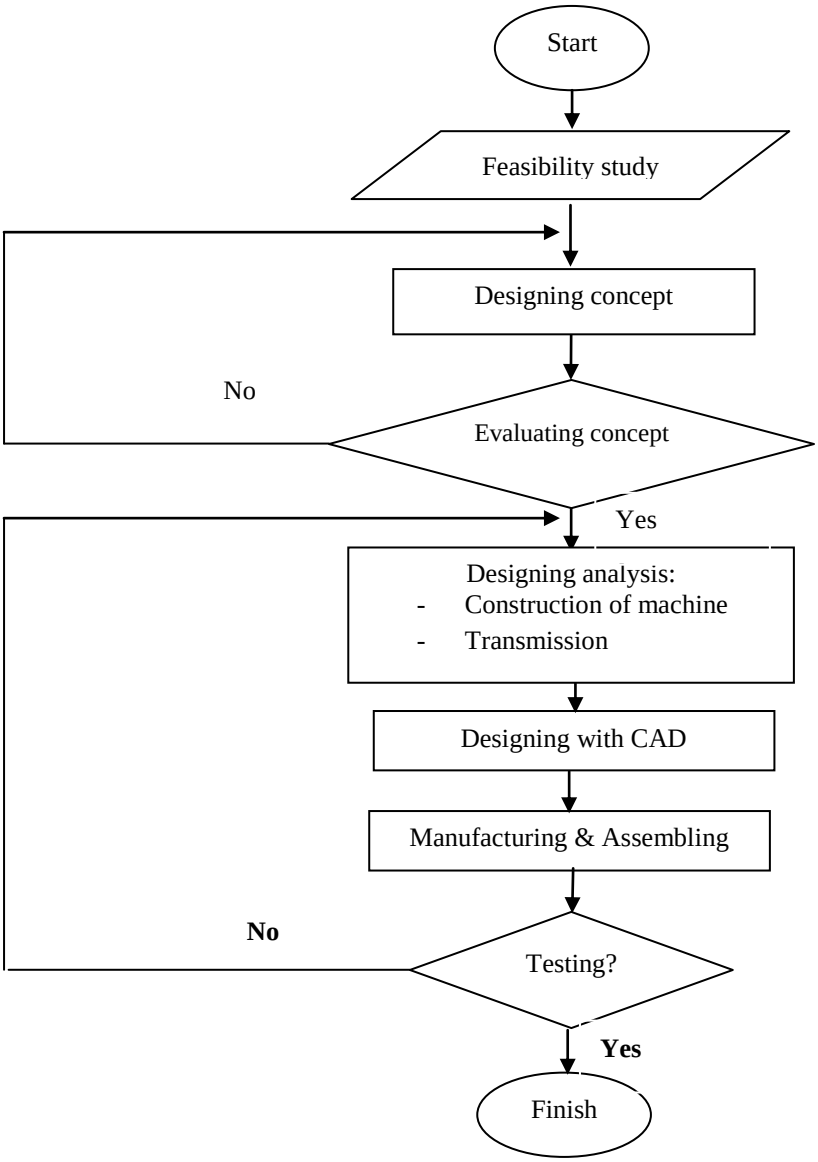


Fig. 1 Flow chart of designing and manufacturing mini press tool

The process of designing and manufacturing mini-press tool will be starting from feasibility studies that discuss the use of press tool, then proceed with the design concept in making press tool and evaluated the concept with some assessment of the design concept. If the concept is no change then carried back the design concept. If nothing changes then followed by an analysis of the construction process of designing the engine and transmission used, with CAD design, make and assemble each component mini-press tool.

Mini-press tool have already made and assembled complete performance can be tested according to the desired shape and considered complete if there is no problem in testing.

A. Tools

A mini press tool machine design is able to produce in working optimally with appropriating tools and materials are needed. The tools and materials used are as follows:

- Lathe machine and tools
- Cutting machine and tools
- Boring machine and tools
- Milling machine and tools
- Welding machine and tools
- Grinding machine and tools
- Hand tools
- Vernier caliper
- Measurement tools

B. Materials

There are some materials used to produce a mini press tool as follows:

- Plate, box and cylindrical steel of St42
- Assab steel HQ 75
- Aluminum
- Bushing
- L profile with thickness of 2 mm and 3 mm
- Shaft
- Bolt and Nut of M6, M8 and M12

IV. RESULT AND DISCUSSION

The method of designing and manufacturing a mini press tool machine consists of several stages, as follows:

A. Designing Stage

In this stage, it was carried out with some actives as follow:

a. Designing components will be created by drawing on a computer using Autodesk software.
b. Calculating the components designed.
c. Designing engine design drawings.

B. Manufacturing Stage

After the design stage is complete, the next stage is the manufacturing stage. The process of making components is carried out at the Mechanical Laboratory and Mechanical Workshop Department of Mechanical Engineering, Ujung Pandang State Polytechnic. In the process of designing a mini press tool machine as a learning medium, it is necessary to consider sequences or procedures, both from the design to be made and the procedure for making a mini press tool as a learning medium. The components of the mini press tool machine that are made in the manufacturing process are: Frame, Machine Table, Steering, Crankshaft, Crank Arm, Shaft, Machine Stand, Machine Table Binder, Machine Binding and Machine Stand, Punch, Steering Pins, Dies, Die Shoe and pressure pad.

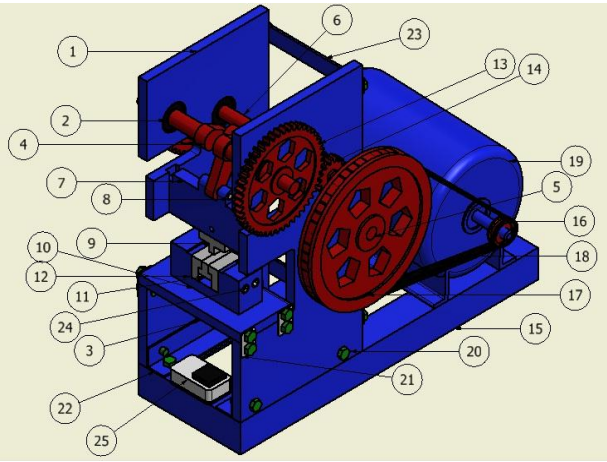
The operation of the mini press tool can be done with the following steps:

- Turn on the equipment by connecting the power cable to a 220 V electrical source,
- Prepare and mount the aluminium plate material on the dies.
- If the specimen material is ready, you can press the ON/OFF button to forming the plate.

In order to maintenance, it can be performed to provide lubrication for each moving components (i.e. gear used, the connecting shaft and the V belt), to clean the punch and dies that can be form the plate smoothly.

The mini press too can be assembled the cover body in order to close the moving components for safety consideration, and make sure the tool is secure for users.

JOURNAL INDUSTRIAL ENGINEERING & MANAGEMENT RESEARCH (JIEMAR)
Vol. 1 No. 2 : JULI 2020 ISSN ONLINE : 2722 – 8878
http://www.jiemar.org DOI : https://doi.org/10.7777/jiemar.v1i2



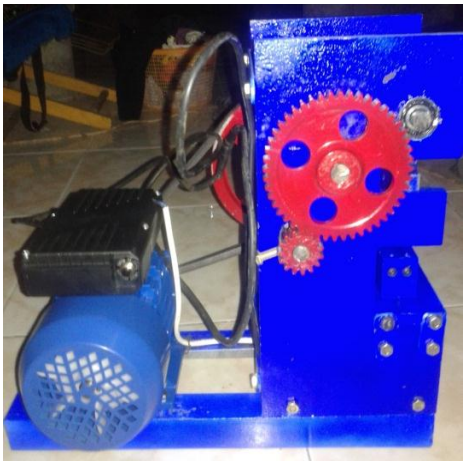


Fig. 2 Result of designing and manufacturing of mini press tool

Description:

1. Frame
2. Bearing
3. Table
4. Eccentric shaft
5. Pulley shaft
6. Gear Shaft
7. Guidance
8. Pin
9. Punch
10. Die Shoe
11. Pressure Pad
12. Dies
13. Big Gear
14. Small Gear
15. Bed Machine
16. Small Pulley
17. Big Pulley
18. V-Belt
19. Electric Motor
20. Bolt
21. Table fastener
22. Motor fastener
23. Frame fastener
24. Bolt of L type
25. ON/OFF Switch

C. Discussion

Mini press tool machine is a series of tools that are used to make metal formation. In this paper, it produces one type of product namely bending U with flanges. It needs to test the materials before determining one type of product was formed. This is done to determine the tensile strength of the material to be formed. In material testing two material samples are used as a comparison.

V. TABLE I
BENDING TEST RESULT

Materials	t (mm)	l (mm)	F(N)	$\tau_{t\,Max}$
Plat A	0,25	25	4000	640 N/mm^2
Plat B	0,25	26,8	5760	859 N/mm^2

In table I, the data of maximum tensile strength was obtained at 859 N/mm^2 for B material. This data can be used to determine the bending force with its value is 261,44 kg.mm. The mini press tool use a motor with a pulley and gear transmission system to move the punch up and down to form the workpiece on the dies with the eccentric shaft. The electric motor rotation used is 1400 rpm with a power of 0,5 HP, and then reduced by gear transmission on the crankshaft becomes 39,06 rpm and produces a torque of 9301,12 kg.mm. These parameters can used to forming products is 372,04 kg.f as the maximum load capacity. The mini press tool was carried out using a U bending product with a flange of zinc material in order to determine the time after produced. The experimental results can be shown in table follows:

VI. TABLE III
RESULT DATA OF PRODUCT FORMING TIME

No.	Product	Production Process Time (s)		
		Setting Time	Processing Time	Total Time
1.	Plat B	1,26	1,35	2,61
2.	Plat B	2,52	1,57	4,09

3.	Plat B	1,84	1,71	3,55
4.	Plat B	1,48	1,30	2,78
5.	Plat B	1,26	1,44	2,7
6.	Plat B	1,35	1,30	2,65
7.	Plat B	1,17	1,30	2,47
8.	Plat B	1,39	1,35	2,74
9.	Plat B	1,66	1,39	3,05
10.	Plat B	0,99	1,53	2,52
Total		14,92	14,24	29,16
Average		1,49	1,42	2,91

In table II, It shows that the production time in each product consists of setting time and processing time. It was obtained some values, i.e. the setting time is 1.49 sec, the processing time is 1.42 sec, and the total production time for each product is 2.91 sec. The specimen was formed with dimensions of 52 mm x 15 mm, and tested using the mini press tool. The product after testing can resulted with the following dimensions:

VII. TABLE IIIII
DIMENSION DATA OF PRODUCT

No	Materials	X_1	X_2	X_3	X_4	X_5
1.	Plat B	15 mm	7 mm	7 mm	8 mm	15 mm
2.	Plat B	15 mm	7 mm	7 mm	8 mm	15 mm
3.	Plat B	15 mm	7 mm	7 mm	8 mm	15 mm
4.	Plat B	15 mm	7 mm	7 mm	8 mm	15 mm
5.	Plat B	15 mm	7 mm	7 mm	8 mm	15 mm
6.	Plat B	15 mm	7 mm	7 mm	8 mm	15 mm
7.	Plat B	15 mm	7 mm	7 mm	8 mm	15 mm
8.	Plat B	15 mm	7 mm	7 mm	8 mm	15 mm
9.	Plat B	15 mm	7 mm	7 mm	8 mm	15 mm
10.	Plat B	15 mm	7 mm	7 mm	8 mm	15 mm

In Table III, it can be seen that the dimensions of the product have the same size of all the material produced. this experimental design had been adopted to analysed the effect of punch angle (80^o, 85^o and 90^o) on the spring back behavior of the medium carbon steel under V-bending through experimental and analytical studies [9]. Likewise, the experiments of a V-shape bending to investigate the influence of springback of ASTM A-36 mild carbon steel based on the punch parameters variation (i.e. various punch radius of 2, 4, and 6 mm, and punch angle of 80^o, 85^o, and 90^o) [10].

VI. CONCLUSIONS

Based on the results of the designing and manufacturing a mini press tool as a learning medium, it can be conclusion as follow:

- The mini press tool have specifications i.e.: frame height is 360 mm, frame length is 180 mm, frame width is 150 mm, electric motor with speed of 1400 rpm, maximum load capacity is 372,04 Kg.
- The mini press tool can be used as a learning media tool for students to provide an overview and understanding the press tool of parts and components.
- It can bending some products with a maximum forming force of 372 kgf with a bending time of about 3 seconds per product or 1,200 products/hour.
- In the operation of mini press tool machines, punch and dies can be replaced according to the desired product shape.

ACKNOWLEDGMENT

This work would not have been possible without the financial support of the Centre for Research and Community Service of Politeknik Negeri Ujung Pandang. We are grateful to all of those with whom I have had the pleasure to work during this and other related projects.

REFERENCES

[1] T. Altan, G. Ngaile, and G. Shen, “Cold and Hot Forging: Fundamentals and Applications, Volume 1,” *AMS international*. 2005.

[2] "Sheet metal forming and blanking," in *Metal Forming Handbook*, 1998.

[3] *Metal Forming Handbook*. 1998.

[4] W. A. Knight and G. Boothroyd, *Fundamentals of Metal Machining and Machine Tools*. 2019.

[5] M. C. Shaw, "Manufacturing processes for engineering materials," *Int. J. Mach. Tool Des. Res.*, 1985.

[6] M. A. Suyuti, M. Iswar, R. Nur, and E. Erniyanti, "Desain Konstruksi Press Tool Sebagai Alat Bending Bentuk V Dengan Garis Bending Max. 300mm," *J. Sinergi Jur. Tek. Mesin*, 2019.

[7] W. Dufraine, J. W. Evans, and M. Hill, *Fundamentals of tool design*. Society of Manufacturing Engineers, 2010.

[8] KBBI, "Kamus Besar Bahasa Indonesia (KBBI)," *Kementerian Pendidikan dan Budaya*. 2016.

[9] M. A. Suyuti and R. Nur, "The Influence of Punch Angle on the Spring Back during V-Bending of Medium Carbon Steel," in *Advanced Materials Research*, 2015, vol. 1125, pp. 157–160.

[10] M. A. Suyuti, M. Iswar, and R. Nur, "Effect of Punch Parameters on Springback for Mild Carbon Steel in A V-Shape Bending Process," in *IOP Conference Series: Materials Science and Engineering*, 2019.