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Comparative Analysis of Press Tool Design for Seat Lock Patch of Mobilio Car with AutoForm Technology

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***Abstract*—Users of four-wheeled vehicles or cars in Indonesia are increasing every year. Therefore, the production of manufacturing companies in the automotive sector is increasing. This relates to companies providing vehicle components that are formed from sheet metal material to be mass-produced with the same shape and tolerance. To achieve this, an effective and efficient press tool design is required. The seat lock patch is one of the many components of sheet metal material found in four-wheeled vehicles or cars. Its function is to lock the third-row seats on the Mobilio car. Products are made in three processes are, drawing, redrawing, trimming-piercing. This study aims to determine the efficiency and effectiveness of the press tool design that best accommodates the process for manufacturing these components in one stamping process. The method used is the method of analysis and comparison of the press tool design, between the group tool and the combination tool with the help of AutoForm Engineering software technology. Based on the results of the analysis with AutoForm technology, were found that the most optimal press tool process for making the third-row seat locking patch on a Mobilio Car is the group tool. The better, optimal, time-efficient selection of third-row seat locking patches on a Mobilio Car is the group tool. Also, this method is easier in terms of the setting process in the press machine.**

Keywords—press tool, group tool, combination tool, AutoForm

I. INTRODUCTION

The dies or tool or what is commonly called the press tool is a printing tool for making a component / pressed part that is made according to the desired design and processed on a press machine [1]. Dies are usually used for forming or working thin plates. Making dies requires a long process, including the machining process. Machining is a manufacturing process in which the geometric shape of the workpiece is changed by removing excess material, by controlling the work of the tool on the workpiece of the desired geometric shape [2]. Progressives tools are a method of printing aids used to manufacture a wide range of products, which vary from high-precision components in electrical equipment to car bodies. Progressives tool design is a design with a complex and highly specialized procedure.

A Study of Fereshteh-Saniee and Montazeran in Hendrawan [3] states that the deep-drawing process is one of the important processes in plate formation. The method used in the numerical simulation is the Finite Element Method, in the simulation of the effect of the element type on the forming loading, the variation of the plate sheet thickness, and the friction coefficient on the loading step curve. The results of the research method were compared with the numerical results with the experimental results, the basis of the comparisons using Siebel's formulation for the accuracy of the results compared to the related analysis.

However, the important process before the manufacturing process is the design or design process. In the design process, all form planning and manufacturing processes must be completed properly. The calculation includes, the design stage and cost analysis to obtain profit. Profit or profit is the difference between total revenue or income and the total cost [4], while the cost is a sacrifice of resources to achieve a goal [5]. In manufacturing companies, profit optimization is the main goal of each production process. To achieve this, precise calculations and analyses are needed to support the achievement of maximum profits, one of which is to make

efficiency in the production process to reduce production costs so that productivity can be increased.

Accurate sheet metal forming simulations are indispensable for developing cost-effective production processes for automotive components. Increased effectiveness and development of the stamping process allow for shorter development times, increased material utilization, less material waste, thereby making a significant contribution to the current automotive industry's efforts to reduce the environmental burden of industrial processes. Significant accuracy improvements with finite element simulations to form sheet metal can be obtained by combining advanced friction models and advanced material models as demonstrated by Volvo Cars' research in collaboration with Tata Steel, TriboForm Engineering, AutoForm Engineering, the University of Twente [6].

Among the many components of four-wheeled vehicles, one of which is Patch, Seat Locks on Mobilio Car where can be seen in Figure 1. This component is a component found in the third-row seats which function as locks for the third-row seats on Mobilio Car. The position of the components when installed can be seen in Fig. 2. This component is made from plates with common steel materials, namely JSC270C. Before being installed on a car, this product will be connected first by welding it with a rod. The process of making this product consists of three processes, namely Drawing, Re-Drawing, and Trimming-Piercing. To accommodate these three processes, a printing tool is needed in one process..

Based on the description of the above problems, an analysis of the selection of a better process between the group tool and the combination tool was carried out using AutoForm technology. The analysis data will be validated with real punch and dies trials.

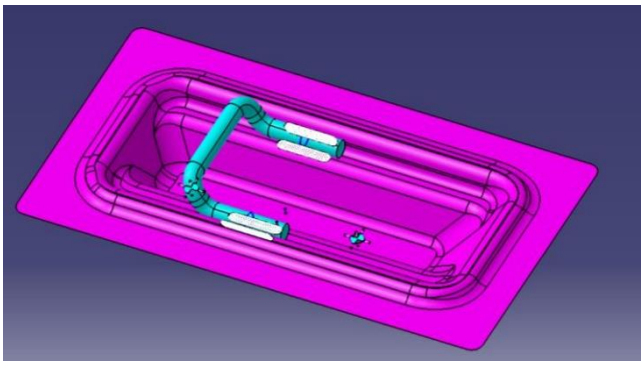

Fig. 1. Third patch lock of Mobilio car.

Fig. 2. Product position in the Mobilio car.

II. METHODS

A. *Design Method*

The stages of designing the Group Tool and Combination Tool for Seat Lock Patch of Honda Mobilio, use the design method according to VDI 2222 (Verien Deutsche Ingenieuer) which can be seen in Fig. 3. In this design, there is no analysis and product design in the planning section because the product is already undefined.

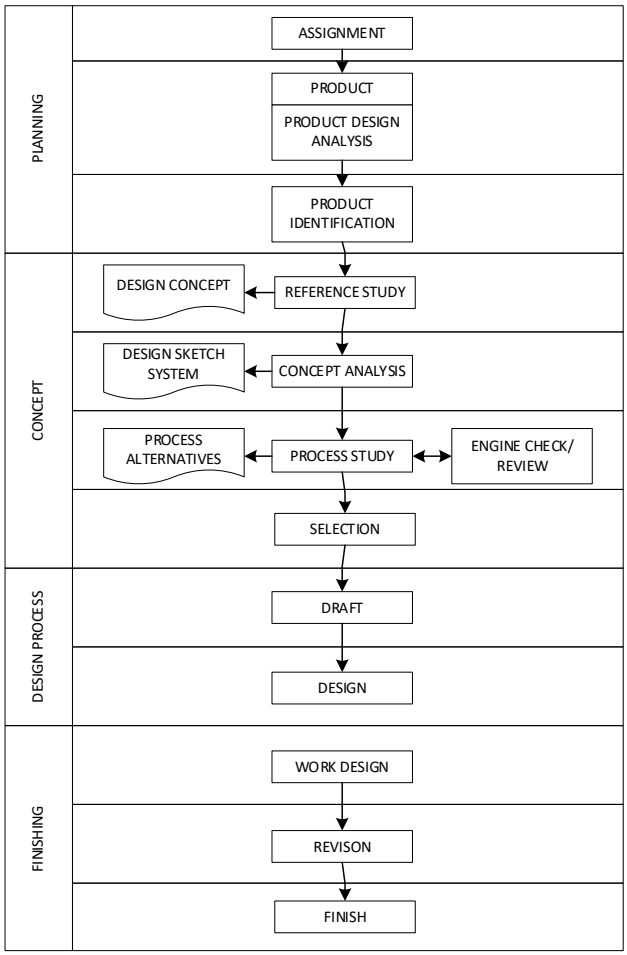

Fig. 3. Stages of VDI planning 2222.

B. Product Analysis and Identification

The product to be made of the press tool is one of the many sheet metal components of the Honda Mobilio. The product used is on the back, which is in the third row of Mobilio Car seats with the following specifications:

Material	: JSC270C
Thickness	: 1,6 mm
Ductile Resistance (Re)	: 140-240 N/mm2
Maximum Resistance (Rm)	: 270 N/mm2

The shape and dimensions of the product are shown in Fig. 4.

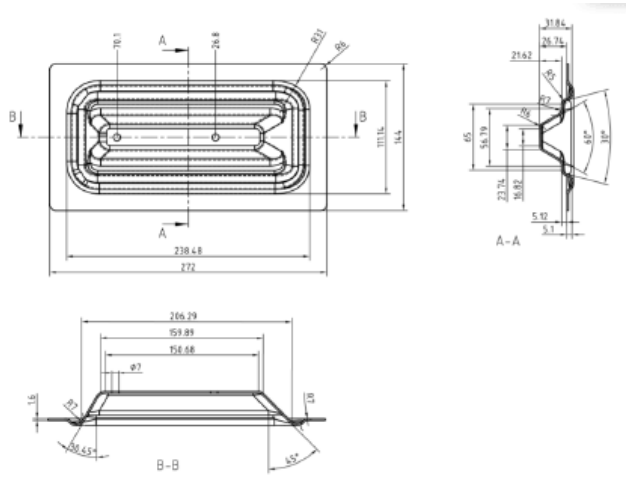

Fig. 4. Seat lock patch product.

III. Results and Discussion

The product range is needed to get the outer side of the blank. To find out the product range, the writer uses two methods, namely manual and Forming Suite software. The calculation of strain is divided into three stages of calculation of strain. Based on the above calculations the stretch to the X and Y axis is Lx=180,32 mm and Ly = 308,81mm. It is can be seen in Fig. 5.

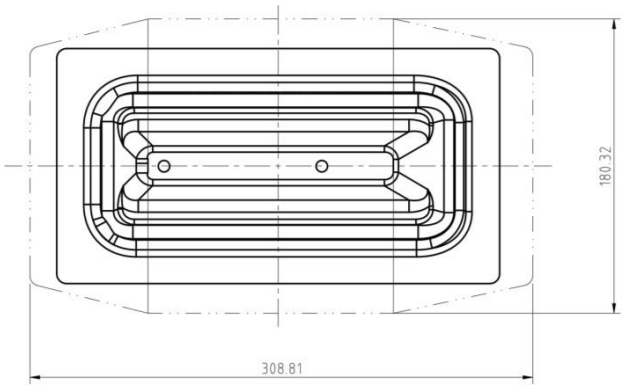

Fig. 5. Manual calculation result range.

Based on the simulation using the Forming Suites software, the results of the stretch calculation have a not too significant difference. The manual calculation is the result of the L bending approach. Based on the above calculations the stretch to the X and Y axis is Lx=202.76 mm and Ly = 177.08 mm The resulting shape of the stretch using the software can be seen in Fig. 6.

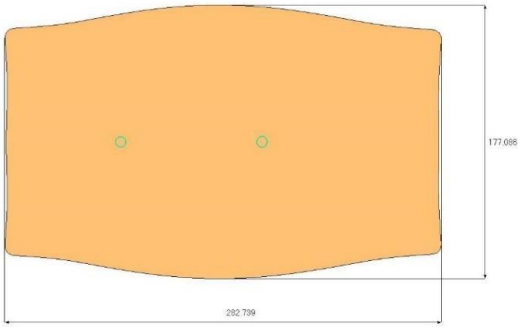

Fig. 6. Forming suite result.

The press tool design that will be compared is the group tool and combination tool. Calculation of the design used in making the tool group includes the calculation of the cutting process, forming process, clearance in the cutting process, penetration in the cutting process, total processing force, and tool force. The following calculation data can be seen in Table 1. While the results of the combination tool calculation can be seen in Table 2.

TABLE I. RESULT OF GROUP TOOL DESIGN CALCULATION

Parameter		
Process	***Result***	***Unit***
Trimming	300,586	N
Forming	328,117	N
Stripper Cutting	30.058,6	N
Blank Holder	137.507,33	N
Pad Restrike	26.249,4	N
Tonnage	628.685	N
Penetration	2	mm
Clearance	0,05	mm
Engine Capacity	76	Ton

TABLE II. RESULT OF COMBINATION TOOL DESIGN CALCULATION

Parameter		
Process	***Result***	***Unit***
Trimming	300 586,32	N
Stripper Cutting	30058,32	N
Stripper Spring	5009,77	N
Spring	K=980	N/mm
Cushion	Ø34	mm
Engine Capacity	76	Ton

The press machine that can be used is the FUKUI MDE-350 (the machine used in the construction of the tool group) because it meets the minimum requirements for process tonnage, bolster size, ram, and DH. In addition, the AIDA DSF-C1100a press machine with a press force of 110 tons.

Based on the calculation results between the group tool and the combination tool, the better process is the group tool, although it requires a greater cutting force the machine used is still the same, namely 110 tons. The results of the combination tool design can be seen in Fig. 7 and Fig. 8. And the results of the group tool design can be seen in Fig. 9 until Fig. 11.

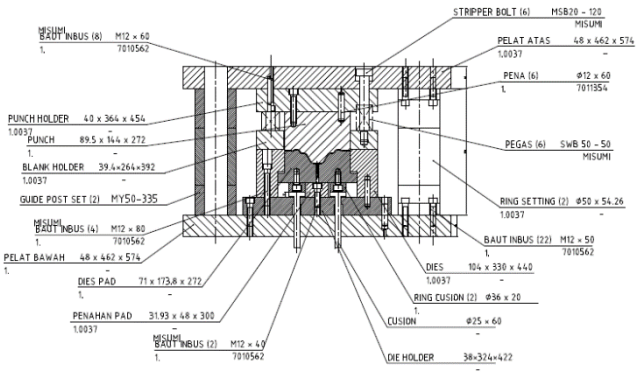

Fig. 7. Front view combination tool assy.

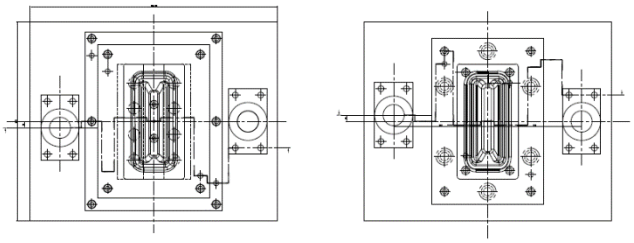

Fig. 8. Open top and bottom combination tool assy.

Based on the results of the calculation between the group tool and the combination tool, the better process is the combination tool, even though it requires a greater cutting force, but the machine used is still the same, namely 110 tons.

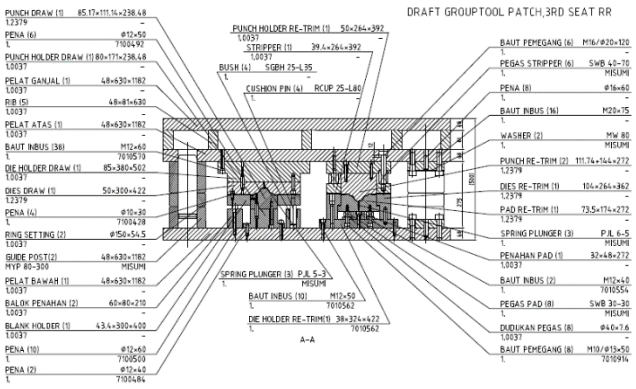

Fig. 9. Front view group tool assy.

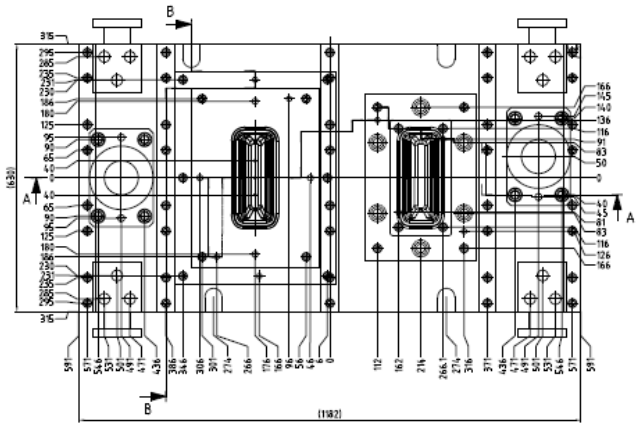

Fig. 10. Top view group tool assy.

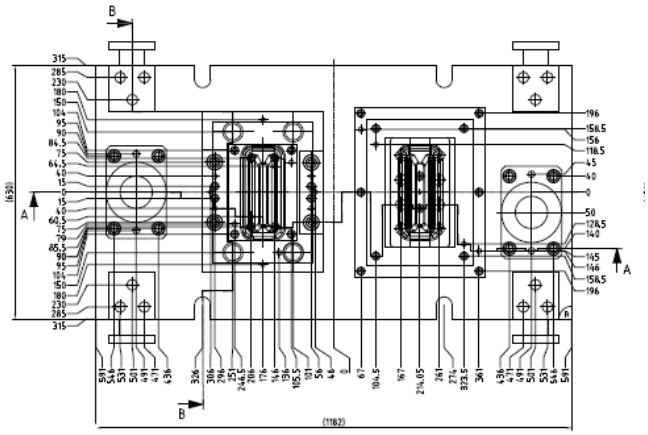

Fig. 11. Bottom view group tool assy.

IV. CONCLUSION

The result of designing a press tool for effective and efficient locking patches. In the group tool and combination tool, there is not a significant difference. In the group tool process, the forming process is easier in the process of setting settings on a press machine with a press capability of 110 tons. Besides, based on the results of the analysis using the AutoForm software, it also shows that the group tool method is better than the combination tool. This can be seen in the value of the forming process value on the combination tool which is 15% higher than the group tool. However, this still needs further research to compare in terms of costs. Thus, the method selection for third-row seat locking patches on a Mobilio Car is more precise and accurate. Besides, testing the main part of the press tool, namely dies and punch, also needs to be done on a press machine to see product results and be measured visually with a measuring instrument.

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