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DESIGN OF SPM WITH ROLL TOOL FOR MUDGUARD HEMMING

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Abstract--- Hemming is a forming operation in which the edges of the sheet are folded or folded over another part in order to achieve a tight fit. This paper deals with the design of special purpose machine for hemming operation in mudguard. Present hemming process of mudguard by press forming are analyzed, tool improvement are made based on the results. Press forming operation has severe impact on cycle time, quality and aesthetics of the mudguard like wrinkling, line marking.

The objective is to design a special purpose machine for hemming operation in mudguard to improve productivity and quality. Roll forming tool is designed for hemming the edges of mudguard. In this process, the edges of mudguard are bent steadily as it passes between a set of rolling tools. This steady bending of rolling tool eliminates the stepping in press forming, which in turn reduces the cycle time. Gradual loading allows roll forming tool to take greater control over spring back, which in turn improves the quality and aesthetics of the mudguard. Special purpose machine is designed for developed tool by using CAD package.

Keywords-- Mudguard, Roll Tool Design, special purpose machine(SPM).

I. INTRODUCTION

Increase in demand on the motorcycle puts immense pressure for the people in auto industries. Mudguard an essential and aesthetic part in bikes. There will be two Mudguards for a bike, front mudguard prevent mud flaps to engine case while back mudguard prevent mud flaps to pillion rider. Increase in sales of two wheelers in India and abroad puts pressure on motorcycle manufacturers to concentrate on quality and production rate. The steel mudguard was processed by roll forming. The hemming of the longitudinal edges in the mudguard were done on line in the roll forming. But the edges along the lateral side cannot be hemmed online as the mudguard has to be cut according to the required length. Hemming an operation nothing but 180^0 bending. Hemming of the mudguard done actually for aesthetics, safety and to increase stiffness of the part. Currently the hemming of the edges in lateral direction was done using press tool. The press operation was noisy and the cycle time was more. Moreover the residual stresses on the part are more. As the mudguard section width was more the bending has to be done thrice.

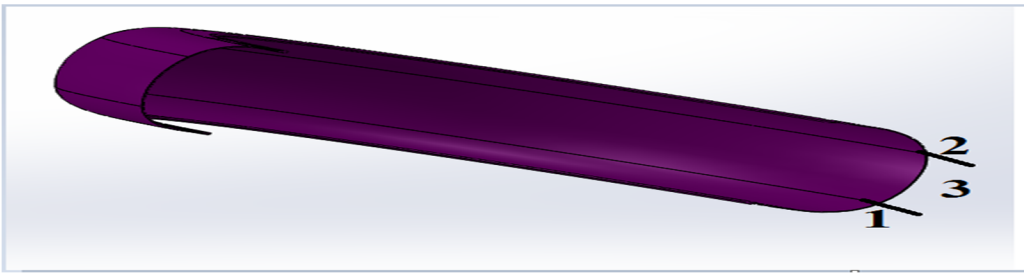

Fig 1: Mudguard

For single lateral edge to bend 90^0 the press operation has to be done thrice. For both the edges to bend 90^0 six operations has to be done. This increases the cycle time. The current tool was designed like to bend 90^0first then from 90^0 plus 45^0, then total 180^0.

This make the hemming process of lateral edges on in the mudguard too tedious. As the mudguard edge was bend thrice two line marks occur on the bulb formed after the hem. When bending a material the minimum inner radius to be maintained also should be taken into consideration [7]. The overall cycle time to do hemming on the both lateral edges was around 24 secs. As the other operations in processing the mudguard, cycle time per piece was less than the hemming operation. As a result before hemming operation the mudguards stagnate. After the hemming process other process were operating less. This affects the overall equipment efficiency. On conducting a study the part rejection was more due to this hemming operation due to the line marks and wrinkles formed. So a new tool design was needed to reduce part rejection and improve aesthetics.

Different methods were proposed, finally a change of tool was proposed i.e. roll as tool to do bending of 90^0 first. Forming using roll have worked. Roll forming is plastic deformation of metal strip by paired roll sets at room temperature without altering the thickness.

This method proves to be better in this case and the defects like line mark, wrinkles will not occur. So a pair of rolls were designed to do 90 degree bending of the mudguard edges. When we go for roll tool we cannot use the mechanical press machine. So a special purpose machine was developed.

Requirements of the SPM

In roll forming when the sheet was fed the gap between the rollers should be maintained. The gap will be same as that of the sheet thickness. The material will be having resistance to bend and this resistance will cause the rolls to separate. So first a clamping mechanism needed for positioning the rolls.

In order to old the work part and feed between rollers without slip a fixture to be designed.

Drive should be given to bottom roll. The top roll was driven using gear mechanism. The rolling speed usually be 2 rpm [8]. Ger to be designed accordingly.

So bearings suitable for the machine were also to be designed.

Many researchers have been published a paper on the Hemming process and press tool. A detailed description of research papers is presented.

Zamzuri Hamedon, Ken-ichiro Mori, Yohei Abe[1] to make the hollow sections for the structured body sheet metal is used. The hollow sections which are joined presently by resistance spot welding have insufficient energy absorption because the joins are not continuous. Thus, to overcome this issue, hemming process is adopted for joining hollow section. The hemming of the high strength steel sheet was successfully implemented using punch with stopper.

Subramanyam Pavuluri, B.Rajashekar, B.Damodhar [2] Press tools which are used to produce a particular component in large amount, out of sheet metals where particular component produced depends upon press tool construction and its configuration. Generally metals having thickness less than 6mm is considered as strip. The different types of press tool constructions leads to different process namely blanking, bending, piercing, forming, etc.

Rupali Chavan, Navneet Patil.[3] progressive die which performs a number of process like piercing, blanking, , etc in a single die at each workstation. Completed part is obtained at each stroke of press machine. This research deals with design of progressive tool having four workstations by using modelling software the parts and Quick press which is an add on software.

Sachin.G, Yathish.G, Amar[4]Tool design is one of the important trades, which requires a complete detailed study, structural analysis and process planning before implementing with any practical work. The performance of any press tool is largely depends on the process and design analysis. Design analysis and overview of a press tool which is need for large production of sheet metal component. A systematic approach in tool production is therefore very essential. This research mainly depends on the various aspects of press tool.

Nilesh N. Patil1, Wasim Shaikh[5] metal forming operations like Bending, Shearing, Blanking, etc. Any type of applications of the material selection is major parameter in sheet metal. Material which is used for sheet metal

manufacturing processes is the output of the rolling operation. Typically, sheets of metal are in the fort of flat, rectangular sheets of standard size. If the sheets are thin and very long, they may be in the form of rolls. So, by using various press tool designs and dies the designs of sheet metals are achieved.

Fissha Biruke ,Teshome Yonas ,Mitiku Degu[6] designing of combined press tool to be used in the manufacturing of the rice thresher blade, 2D and 3D modeling of the components, analyzing stress and displacement on the components are calculated. The design and selection of press tool components is carried out by following standard die design and analysis approach. The modeling and structural analysis of the components was carried out on SolidWorks software.

II. SPECIAL PURPOSE MACHINE DETAIL

Gear Box	16:1 double reduction gear box, TRANSTECH TH30-3-F80
Motor	Rated power = 0.37Kw, 7rpm, 496 Nm.
Hydraulic cylinder	80mm Bore Diameter, 50mm stroke length
Spur Gear	Module 2, 35 teeth, EN42B material
Bearings	Deep groove ball bearings,SKF-6006, SKF6005

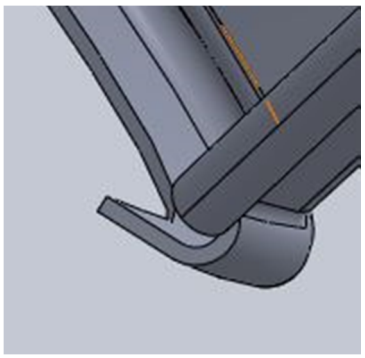

Fig 2:90 degree bending and rib forming

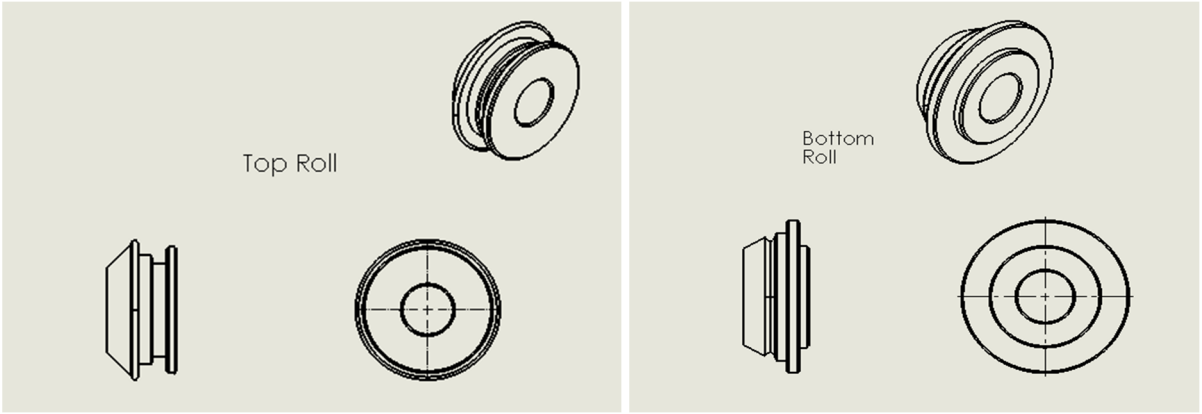

Fig 3: Roll Tool

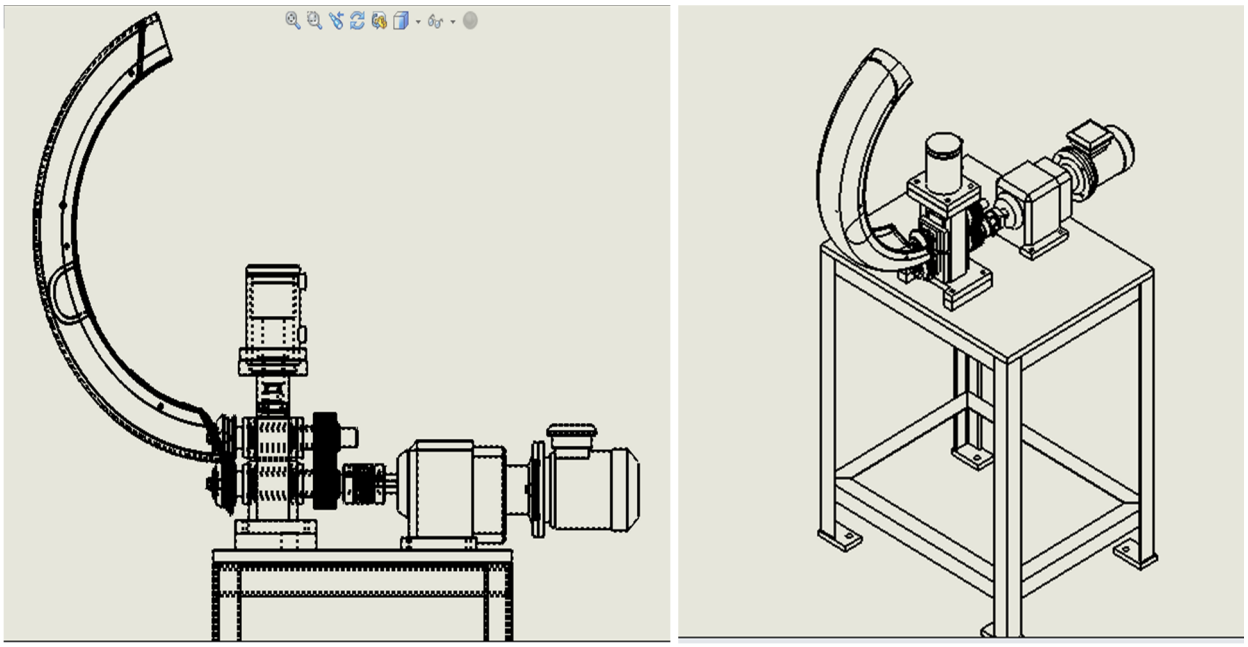

Fig 4:Special purpose design

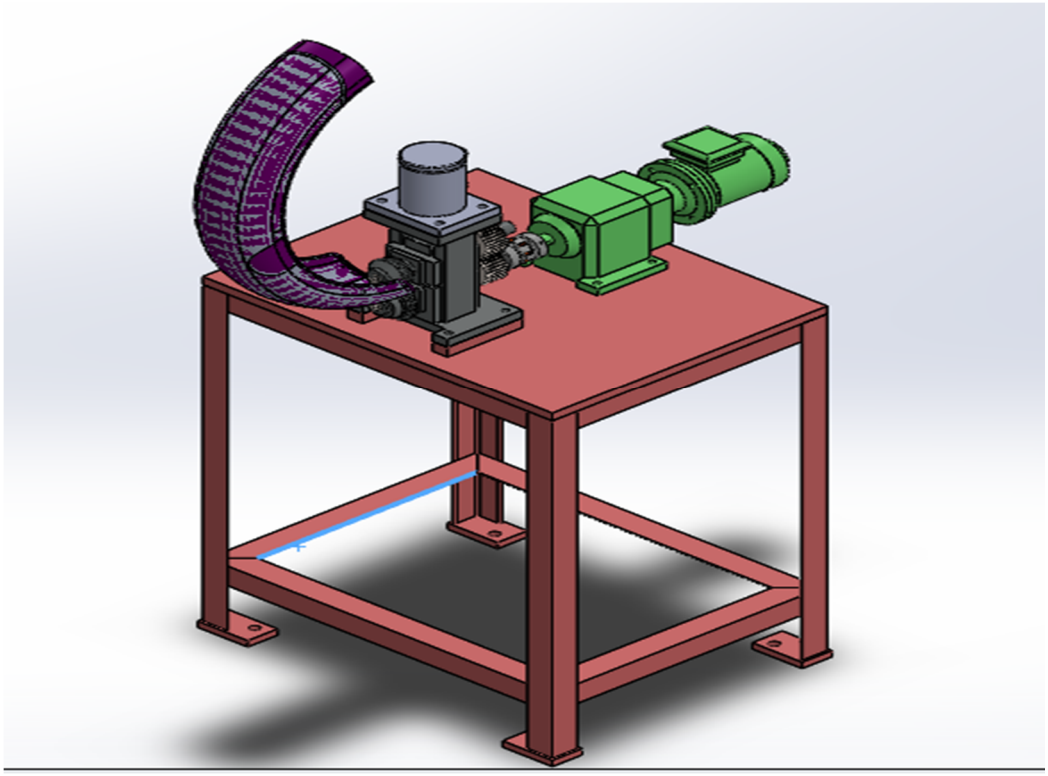

Fig 5: Special purpose machine Design

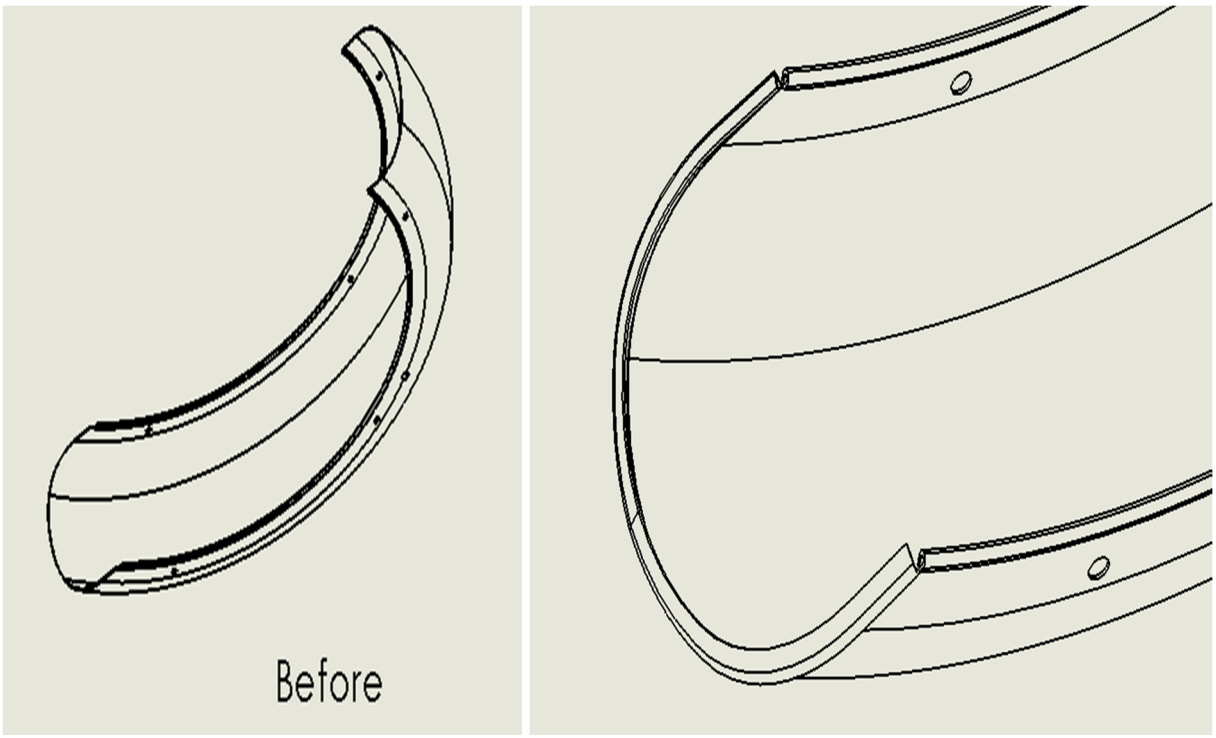

Fig 6: Before and after 90^0 bend

Gearbox and motor specifications- 0.37KW, 7rpm, Rated Torque= 496Nm, Gear unit ratio i= 129.23, output radial load in shaft. F_r = 15000, Service factor F_s = 2.6

The top and bottom gear ratio i= 1. The gear was calculated based on the PCD. The PCD derived from the top roll and bottom roll diameter. The gear OD = 74mm, Module 2. Therefore the number of teeth = 35.

Working of SPM:

Two sensors were placed at the centre top below the cylinder. When the mudguard initially touches the sensors the Hydraulic cylinder actuates and the top roll comes down and 1 mm gap will be maintained between the top roll and bottom roll. The sensors meanwhile will switch on the motors and the roller will start to rotate. The rotation mahe the mudguard to guide along the rollers and the material bends along the profile of the roller. Once the mudguard lateral edge travels throughout the rollers, the second sensors will activate and the motor switch off and the cylinder retracts. The hydraulic cylinder works with 1hp power pack. The cycle time of the operation for bending 90^0 was about 9 or 10 secs.

Advantages:

As the cycle time was reduced the production rate increases. Since the rollers do the forming the residual stress will less and also the line marks, wrinkles will not be occurring as the full width of mudguard was formed in one step. The cost of the SPM also was estimated to about 5 lakhs maximum, Which was less when compared to the press machine.

III. CONCLUSION AND FUTURE WORK

Thus the created SPM worked and the cycle time was reduced. Also improving quality as the line marks and wrinkles were not present. To complete the full hemming process we need to design another set of roll tool. The same hemming machine can be used for that tool. But to reduce the cycle time two machines with two roll sets have to be implemented. Implementing the two machine the cycle time will be around 15 secs. This helps increase production and helps the production line to run smoothly.

IV. REFERENCE

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