Available online www.ejaet.com

European Journal of Advances in Engineering and Technology, 2020, 7(8):17-20

Research Article ISSN: 2394 - 658X

Improving the Productivity of D-Brackets Manufacturing Process

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ABSTRACT

Manufacturing of goods in large quantities by using machines and techniques such as the assembly line and division of labour is known as Mass production. D-Brackets manufacturing can be identified as mass production process. D-Bracket is a part of low tension insulator and hardware component. It produces using mild steel. It is used for connecting shackle/Spool insulator to poles and for link fitting applications in 11/33 kv overhead lines.

This project was focused on introducing a press machine combining two processes for the manufacturing process of D-Brackets. The press performs double lancing operations, which are shearing and punching on a single stroke of the press. Designing and fabrication of a press machine by combining shearing and punching processes were done.

Designing was done using three-dimensional modeling of the components, analyzing stress and displacement on the components. The modeling and structural analysis of the components were carried out on Solid works 2012 and it was found to be acceptable. The design and selection of materials were carried out by following standards of press machine design approach and analysis method. This new machine can replace shearing machine and low capacity punching machine from the manufacturing process.

By introducing this double acting machine to the D-Bracket manufacturing process, it was reduced number of labours, manufacturing lead time and cost per D-Bracket. Thereby, considerable improvement of productivity per day of D-bracket manufacturing was achieved.

Key words: Improvement of Productivity, D-Bracket, Manufacturing process, shearing and punching

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INTRODUCTION

Manufacturing of goods in large quantities using machinery and techniques such as the assembly line and division of labour is known as Mass production. Mass production has some special characteristics such as standardization of products and process sequence, dedicated special purpose machines having higher production capacities and output rates, large volume of products, short cycle time of production, lower in process inventory, perfectly balanced production line, flow of materials, continuous components and parts without any back tracking, easy production planning and controlling.

D-Brackets manufacturing can be identified as mass production because some of the characteristics are represented as mentioned above.

D-Bracket is a part of low-tension insulator and hardware component. It produces using mild steel. They are used for connecting shackle/spool insulator to poles and link fitting applications in 11/33 kv overhead lines. There are six steps to manufacture a D-bracket as follows.

1. Cutting 300 mm length pieces from 30mm x 6mm x 5.8m Flat iron using shearing machine. (Shearing process)
2. Grinding bars of both cutting ends of the cut pieces by using pedestral grinding machine. (Grinding process)
3. Punching three holes of 19mm diameter in three attempts using multi purpose press maching. (Punching process)
4. Hammering to prepare straight flat iron piece after hole punching. (Hammering process)
5. Bending shape of D-Bracket using press machine.(Bending process)
6. Storing or stack in boxes for transportion. (Storing Process)

RATIONALE FOR STUDY

The annual requirement of D-Brackets in Ceylon Electricity Board (CEB) is over 600,000 Nos. but at present manufacturing capacity is 200,000 Nos. Therefore, large portion of D-Brackets requirement was offered to the private suppliers.

Productivity of the manufacturing process is not enough to achieve the annual demand. Production cost of D-Bracket is increasing year by year due to the increasing material cost and labour cost. However, price of D-Bracket should be maintained lower than the price mentioned in CEB price list.Price list value decreases due to government policies but cost of D-Bracket is increasing.Present machineries and their capacities and productivity are not enough to achieve the demand.Cost of new machines is also very high and cost recovery time will be many more years.At present only 6.5 labour hours per day is only allocated to the D-Bracket production from total working hours of 12 hours and rest of 5.5 labour hours per day is idling time.

Therefore, there was a need to find a mechanism to improve the productivity of the D-bracket manufacturing process.
It was decided to design a mechanism combining Shearing and Punching processes.

METHODOLOGY

Work study was carried out to identify the total labour hour requirement per day. It was revealed the following information.

Time per D-Bracket from manufacturing process	97.74	s ..(1)
Time per D-Bracket from turning die set	6.95	s ..(2)
Time per D-Bracket from unloading flat iron lengths	4.74	s ..(3)
Time per D-Bracket from machine set up	1.64	s ..(4)
Time per D-Bracket from stack in boxes	1.44	s ..(5)
Total time required per D-Bracket (1)+(2)+(3)+(4)+(5)	112.50	s
D-Bracket manufacturing per day	1100	Nos
Total time per 1100 nos	123,753.63	s
Total labourhrs required per day for 1100 nos of D Brackets	34.38	Hrs

Present time allocation for 1100 Nos. of D-Brackets manufacturing process is as follows.

Men	5	
Days	1	
Labour hours per day	12	Hrs
Total allocated time per day	60	Hrs
Actual time consumed to the process from work study	34.38	Hrs
Extra time consumed to the process per day	25.62	Hrs

It was clear that 25.62 Hrs were consumed by five workersper day as extra time for the D-Brackets manufacturing process. This time was allocated to another job or assign to idling time cost code which was increased overhead cost of the product. Sketch of a D-bracket with insulator is shown in Fig.1 below.

Fig. 1 D-Bracket with insulator

A preliminary data collection from similar works and analysis was carried out to improve D - Bracket manufacturing process. Using information gathered from literature survey, features of the proposed mechanism and suggestions were made. Suitable mechanism was selected considering surveyed limitations. All design calculations [3-7] and components selection were done using theoretical and practical knowledge gathered from academic and working experience in industry. Proposed designed mechanism was developed by assembling parts as shown in Fig. 2, Fig. 3 & Fig. 4 of the following sketches.

Sketch of proposed punching and shearing press machine is as given in Fig. 2 below.

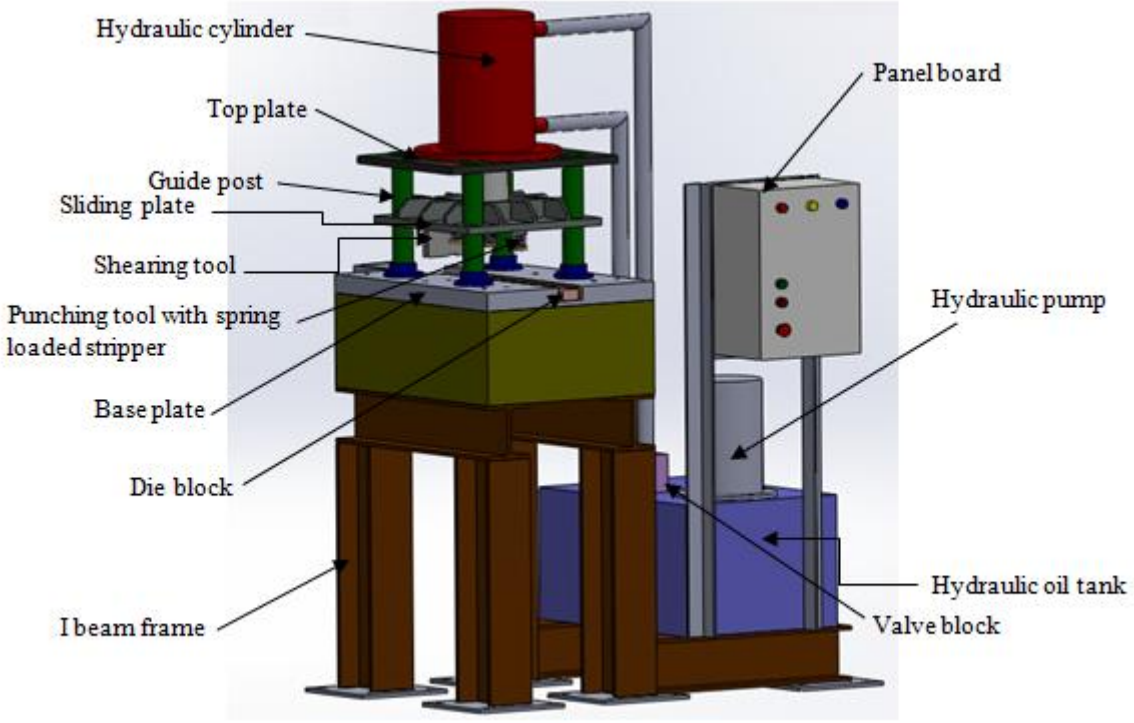

Fig. 2 Sketch of proposed punching and shearing press machine

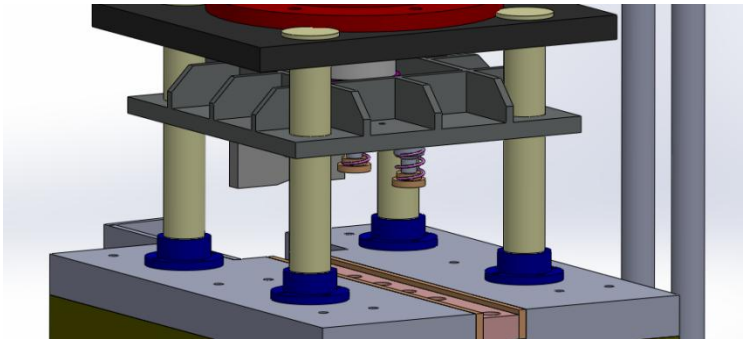

Fig. 3 Sketch of Stripper plate assembly

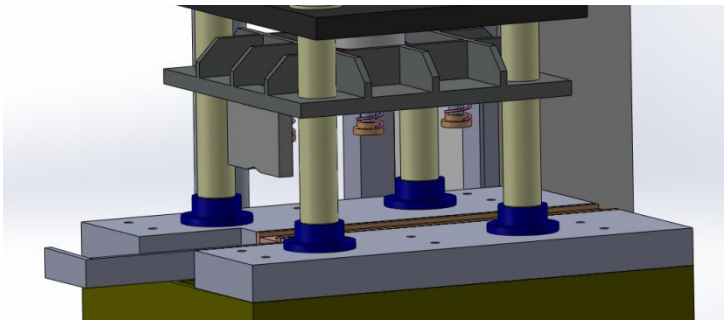

Fig. 4 Sketch of Stopper and Shearing tool assembly

Fabricate Punching and Shearing press machine is shown in Fig. 5 below.

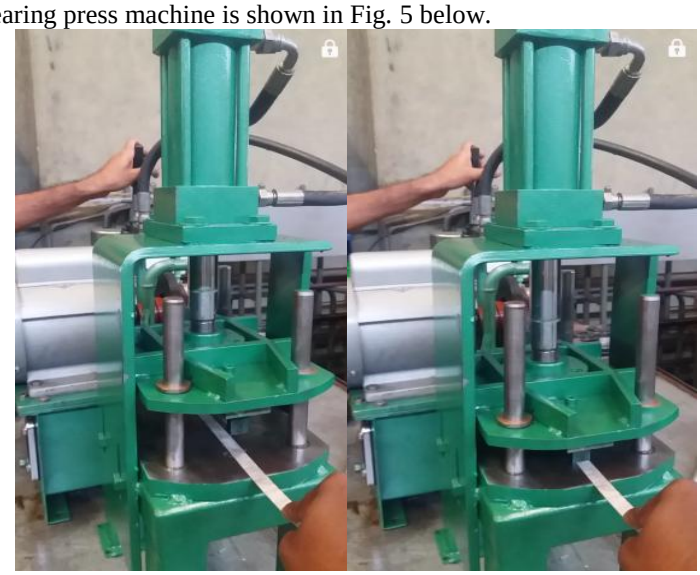

Fig. 5 Fabricated proto type machine

DISCUSSION AND CONCLUSION

It was decided to fabricate the press machine as a proto type model due to high cost of manufacturing and also to check the concept is working properly [3, 5].

Worked with proto type fabricated machine, following results were obtained.

Labour hrs saving per bracket in **Work station 1 (Shearing)**	15	Sec
Labour hrs saving per bracket in **Work station 2 (Punching)**	14	Sec
Total labour hrs savings per bracket	29	Sec
Total labour hrs savings per 1100 bracket per day	31,900	Sec
Total labourhrs saving in hours per day	8.86	Hrs …..(1)
Forecasted labourhrs saving was 9.17 hrs		
Total labour hours by using old machines	34.38	Hrs …..(2)
Total labour hours by using new press machine (2)-(1)	25.52	Hrs

Acording to above results,it can be concluded that proposed concept was worked successfully and time saving was accepted acording to the forcasted time saving.Most suitable steel to fabricate press die tool is A2 die steel [1, 4]. But this material is not available in Sri Lankan market. Therefore , proto type design was done by using D2 Die steel.Calculated value of the power of the pump is very much high. Physical arrangement and the structure of the pump is large. Therefore, the flow rate was divided in to two values and selected double pumps for the system, by reducing cost than single high capacity pump. Flow rate was divided according to match the market availability flow rate.Double pump is a single unit, but it has high pressure and low pressure pumps driven in single shaft. Minimum pump capacity is required to the high pressure stage. High pressure pump is used to shear and punch operations. Low pressure pump is used to move piston before shear and punch.

Acknowledgement

Authors are thankful to Department of Mechanical Engineering, The Open University of Sri Lanka for supporting to this work.

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