

Design and Finite Element Analysis of Shearing Machine – A Case Study at Daulat Industries, Nagpur

Ahtesham Khan¹ Atul P. Ganorkar²

¹M.Tech Students ²Assistant Professor

^{1,2}Department of Mechanical Engineering

^{1,2}Anjuman College of Engineering and Technology Nagpur, Maharashtra, India

Abstract— Shearing machines are based on the principle of metal cutting by shearing action of a moving blade in relation to a fixed blade. It is a simple process which involves the cutting of metal sheet by two knives which are posed at an angle relative to each other. This project is based on the requirement of Daulat Industries, Nagpur. To design a shearing machine which is capable of cutting 5mm thick stainless steel sheets of 8ft wide and 4 ft length in size. In this research we will develop a CAD model of shearing machine and optimization of machine using FEA.

Key words: Shearing machine, design and optimization of machine

I. Introduction

Shearing is a general name for most sheet metal cutting, but in a specific sense, designates a cut in a straight line across a strip, sheet or bar. This procedure leaves a clean edge on the piece of the metal that is sheared or cut. Shearing machines are used to cut or shear metal sheets in many ways. The particular method chosen depends on several factors such as the size and shape of the parts required and the numbers needed. The moving cutting member of a shearing machine may be actuated by:

- 1) Hand lever in bench shearing machines
- 2) Foot treadle in treadle guillotines
- 3) Electric motor or hydraulic system in power guillotines

It is also known as die cutting. It is a process which cuts stock without the formation of chips or the use of burning or melting the metal. In strict technical terms, the process of shearing involves the use of straight cutting blades or sheet metal or plates, however rods can also be sheared. Shearing type operations include: blanking, piercing, roll slitting, and trimming.

In shearing, a punch is used to push a work piece against the die, which is fixed. Usually the clearance between the two is 5 to 40% of the thickness of the material, but dependent on the material

There are various types of metal cutting operations, each is defined by the relationship of the end tool position to the thickness of the material. These three are: Alligator shear, Bench shear, Guillotine, Power Shear, Throatless shear.

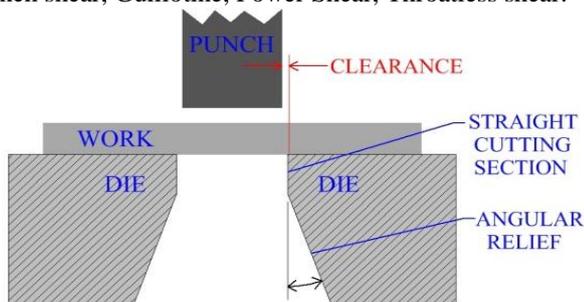


Fig. 1: Simple diagram of shearing machine

II. LITERATURE REVIEW

Nexhat Qehaja Hakif Zeqiri [1] The reliability of the metal cutting tools is a relatively new scientific field. This field includes study, analysis and development of the cutting edge characteristics in the definite conditions and time interval of exploitation that will not change the used parameters of the allowed limits. The aim of the paper is to research, identify and analysis the factors which bring to the failure of the instrument during the cutting process. If we are limited on the investigation of the reliability of the metal cutting tools, within the processing system one can conclude that its depend the several factors and presents very complex phenomena because the tool could fail during the work. These failures mostly happen cause of consumption, crack and fracture of the cutting instrument. The cutting process characterized by; material of working piece, the material of instrument and the conditions of the realized processing (cutting regime, geometry of instrument, cooling equipment and lubricators and the dynamic state of system: machine–instrument–equipment–working piece). The current researches indicate that the probability functions of the cutting instruments failure will relied on the Weibulls disperse.

Pawan Kumar Rai, Dr. Aas Mohammad, Hasan Zakir Jafri [2] Sheet metal parts play an important role in automotive industry. Different types of reinforcement, body parts, and door parts are manufactured in sheet metal scope. With every manufacturing process there are some defects associated with the same. In same manner in sheet metal components there are also many types of defects arises in different processes. But out of these defects the most common and prominent defect is “burr”.

Application of sheet metal components includes Aircraft industry, Automobiles, Construction work and many other applications such as appliances, food and beverage containers, boilers, kitchen equipment, office equipment etc.

Vishal Tambat, Nilkanth Rane, Omkar Savant, Pankaj Yadav [3] The shearing machine and bending machine is most important in sheet metal industry. This machine should be used for straight cutting machine with wide application. But in some industry hand sheet cutter and hand bender are used. For that machine to operate the human effort are required. The machine should be simple to operate and easy to maintain, hence we tried out to develop the Pneumatic Shearing and Bending Machine. In shearing operation as the punch descends upon the metal, the pressure exerted by the punch first cause the plastic deformation of the metal. Since the clearance between the punch and the die is very small, the plastic deformation takes place in a localized area and the metal adjacent to the cutting edges.

In bending operation the bend has been made with the help of punch which exerts large force on the work

clamped on the die. The bending machine is designed in such a way that, it works automatically. The machine is designed by observing the factors to improve the efficiency and to reduce the cycle time by producing quality output. Automation of machine is achieved with the help of pneumatic system. This paper involves the design of an efficient system which reduces the human effort and help to increase production output. It also includes pneumatic system, pneumatic component and shearing die and bending die.

Cheng Hua Wang Carnegie, David A. Bourne Carnegie [4] This paper describes an integrated system for the design and production of sheet metal parts. We have identified some important features for the sheet metal bending process. These features are automatically generated as the design progresses. After the designs are complete, our automatic process planning system uses the features and generates new ones to aid the production of plans with near-minimum manufacturing costs. Finally, these plans are used to produce parts on an automatic bending system. Once a plan is generated, it can be used to manufacture the part, and to provide feedback to design and other factory systems. The application of features and the potential feature interaction problems are discussed. Several key manufacturing problems are also considered and the result of planning is used to resolve these problems. By solving these feature interaction problems and often practical manufacturing issues, we are able to plan and manufacture the majority of the parts we have tested under one hour after the flat patterns are prepared.

K.Krantikumar, K.V.S.S.Saikiran, Jakkoju Sathish [5] We are using scissors for simple sheet metal cutting. It is a manual method so that sheet metals are to be wasted sometime because of mistakes happened such as wrong dimensions etc., and also even a simple cutting may take long time. Hydraulic machines are also available for sheet metal cutting. But this method is used for only heavy metal cutting and its cost is very high. We are using a pneumatic system for sheet metal cutting in a easy way. It is operated by a pneumatic hand lever of two ways control valve. Control valve is operated by a compressor.

III. NEED OF DESIGNING THE SHEARING MACHINE

- During a visit to the DAULAT INDSUTRIES, it was revealed that there is a requirement for shearing machine to cut 5mm thick sheets of stainless steel (ss).
- There are various shearing machine available in the market to perform this task. But the general manager at Daulat Industries is insisting to design and fabricate the machine in house.
- After a detailed conversation with the general manger it was decided that the designing and optimizing part of the shearing machine would be executed in this project.
- In this project, the design and optimization of a shearing machine which is capable of cutting 5mm thick stainless steel sheets will be designed and optimized with the help of CAD and FEA software's.
- With this project the company will be benefited from the advancements of computer technologies and thus will be able to reduce cost of procuring a shearing machine.

IV. RESEARCH METHODOLOGY

In present study, we create the CAD model of shearing machine. Then analysis of the design will be performed. If required the optimization and analysis of optimized design will be performed after that results will be discussed and design will be finalized.

V. CONCLUSIONS

With this project the company DAULAT INDUSTRIES Nagpur, will be benefited from the advancements of computer technologies and thus will be able to reduce the fabrication cost of shearing machine without compromising on the performance parameters.

REFERENCES

- [1] Merrill L. Ridgeway, Kenneth E. Olding "Mechanical Press, Especially A Cupping Press", United States Patent, 3902347, (1975).
- [2] E. Paul. Degarmo, "Shearing in Metal Cutting", Pages 518-528, Materials and Processes in Manufacturing, Eighth edition, 2003, Prentice Hall of India Pvt Ltd.
- [3] "Experiments on sheet metal shearing" Emil Gustafsson - Division of Mechanics of Solid Materials Department of Engineering Sciences and Mathematics Luleå University of Technology SE-971 87 Luleå, Sweden
- [4] Z. Klim, E. Ennajimi, M. Balazinski and C. Fortin, Cutting tool reliability analysis for variable feed milling of 17-4PH stainless steel.
- [5] Qehaja, N.; Bunjaku, A.; Salihu A. & Zeqiri, H., The reliability of the metal cutting tools on the bases Of the technological criteria of consumption method.
- [6] R. Hambli, A. Potiron, and A. Kobi, "Application of design of experiment technique for metal blanking processes optimization," *Mécanique & Industries*, vol. 4, no. 3, pp. 175 – 180, 2003.