IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 7.047 ⁜ Vol. 10, Issue 5, May 2022

DOI: 10.17148/IJIREEICE.2022.10509

DESIGN AND DEVELOPMENT OF METAL BENDING MACHINE

GAURAV RAJESH CHORDIYA[1], ANIKET GANESH THOPTE[2],

PROF. DHANASHREE WARE[3]

Student, Dept. of Mechanical Engineering, Anantrao Pawar Collage Of Engineering & Research,

Pune Maharashtra, India[1,2]

Assistant Professor, Dept. of Mechanical Engineering, Anantrao Pawar Collage Of Engineering & Research,

Pune Maharashtra, India[3]

Abstract*:* In the Dual roller bending machine, the both rollers rotate. Bending can be done in sheet metal For designing a two stage roller bending machine, it is required to calculate the exact force for bending. Based on this force, the machine parameters and motor power are decided. Various factors that should be considered while calculating this force are material properties, width, and thickness, number of passes, bending radius, force developing mechanism and link. To analyses the force and power for motor the designer takes the help of analysis software. The cost of software for analysis is high. So there is requirement to find simple formula. In this paper the various theories regarding bending are reviewed, formulae for force and power calculation are collected and finally a case study is taken where we have put together all the results of these formulae. This machine works on simple kinematic system instead of complicated design. This machine can bend up-to 8 mm thick sheet and up-to 2cm diameter of pipe. Bending machine is a common machine in machine shop that is used to bend a metal. Thereare 3 roller used in bending machine. The common product of metal bending machine are pipe (square and circular) bending if separate attachment of die is provided, sheet bending. During the roll bending process the sheet or plate or pipe is passed through consecutive rollers that gradually apply pressure on pipe. Because of this pressure the change in radius of pipe or sheet occur.

I. INTRODUCTION

Main focus of this project is to design the manual roller bending machine. This machine helps bend the different sheets according to the requirement. This machine does not involve any external force or electricity; instead, it involved only a man force, i.e., a person can run the machine with the help of a hand. The design of this machine is so that it requires a little force to perform the task. This machine helps usin doing the bending tasks that required little effort. Different components that are used in this machine and its mechanism will also be discussed in this project. This project is to vogue and constructs a negotiable roller bending machine. This machine uses to bend steel pipes and metal strips into a curve, so the choicecurvature shapes. This machine is very convenient for movable work and is created of steel and easy to run. Moreover, it is easy to carry and use at anytime and anywhere. It reduces human effort and, in addition, required low less talent to figure this machine. We incline to face live arising with operated by hand roller bending machine using block, motors, gears, and support (frame). Power is that the machine for pipe bending, and everyone works manually. Therefore, our objective is to extend preciseness at low costs while not moving the pipe bending's productivity. This machine works on the simple kinematic system instead of subtle vogue. Because of its mobility, it is usually utilized by a tiny workshop or fabrication search. A bending machine is also a standard tool in the workshop that is accustomed bend a metal.

Project Specifications

- The specifications of this project mainly involve the use of different types of mechanisms, in a manual roller bending machine, the gear mechanism, power transmission, speed controller.

- In simple words, most specifications are linked with the theory of machines. Since the project's objective is to design a manual roller bending machine, the concepts of mechanisms must be clear. Mostly, the engineering standards involved in this design are taken from ASME codes. First of all, all the parts are separately designed, and then they are assembled. The machine design standards were used for designing the gears and mechanism of power transmission.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 7.047 ⁜ Vol. 10, Issue 5, May 2022

DOI: 10.17148/IJIREEICE.2022.10509

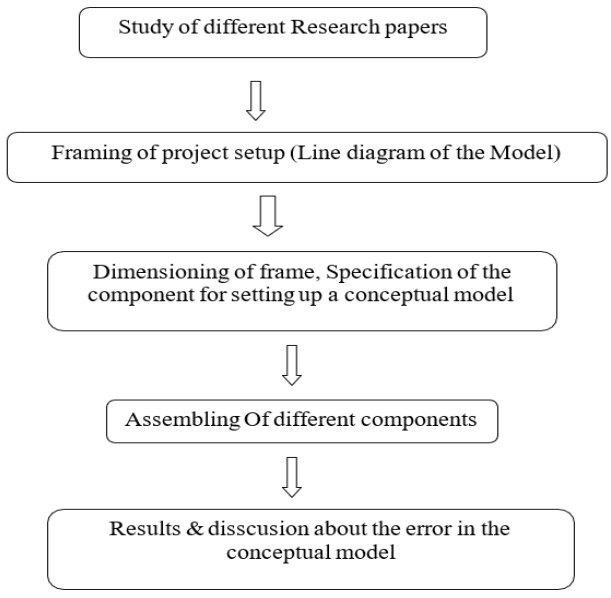
II. LITERATURE SERVEY

Roller bending machines are very much utilized worldwide in the industries to performthe different types of functions on metal sheets. The size of these machines isvery much significant as compared to the other machines. These machines are involved many components that help bend the metal sheets. Bending of the metal sheets is necessary for different industries to make the different parts according to thegiven requirements. Metal structures are made up of different types of metal sheets and strips. These strips are made over the roller bending machines. The metal sheet is placed between the roller, and through the rolling force of the rollers, it bends in the forward direction. The thickness of the sheet is also reduced through this machine. These machines required much effort in bending the metal strips. In construction and metallic projects, different bending metal strips are used. Also, These machines consume a lot of energy and effort, for example, fuel or electricity, to bend the sheets. The primary purpose of this project is to reduce the operating cost and maintenance costs of the roller bending machine. Moreover, this manual machine is required less maintenance and easy to handle. Also, the manual roller bending machines required no electricity to operate. So, the design of these projects is helpful for the industries to minimize the cost of a specific project.

The onset of the industrial revolution took place from the 17th century until the mid-18th. This revolution was the reason for the existence of functioning machines today. The main branch of this revolution is manufacturing since it allowed the use of machines that significantly made daily human tasks much more accessible. Cold bending has been around since 1800B.C; it slowly developed until the industrial revolution in the 1760s'. Many types of bending are available nowadays. A pyramidal type was chosen with a three-roller bending setup because of its various capabilities with just two degrees of freedom. The goal is to improve this type of process using analytical geometry and empirical techniques to achieve anameliorated design. There are many types of bending techniques present now, but every type has its advantages and disadvantages. The two rollers on the bottom are used to fix the workpiece in a horizontal direction, and the upper roller will apply a downward force. The upper roller is adjusted using a hydraulic jack; thus, the roller only moves in the vertical direction. When defining the current bend angle, this clamp is locked. The bottom rollers start to rotate, thus making a bending force.

Figure 1 on the workpiece, which will result in deforming the workpiece hence achieving plastic deformation. The main advantages of this process are that this mechanism is straightforward and straightforward. It can remedy the workpiece that has been deformed in a wrong way, such as skew (Bending Error), accurate, consistent, and convenient. However, the disadvantages of such a process are unusable scrap parts. It occurs mainly in vertical three roller bending [2], which means if the pipe is long, due to its weight (workpiece weight) while being rolled, it will bend to a side and cause torsion. Moreover, it is a type of manufacturing inaccuracy of unwanted deformation or deflection.

III. METHODOLOGY



IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 7.047 ⁜ Vol. 10, Issue 5, May 2022

DOI: 10.17148/IJIREEICE.2022.10509

Methodology of Design & Analysis:

A parameter study is done to evaluate the most crucial parameters for FE analysis of axial ball bearings. The parameters that are evaluated are mesh density, contactstiffness, osculation, load level, geometrical nonlinearity and material nonlinearity. The studies are performed by means of the FE software Ansys. condition and how the loads are applied etc. Therefore the FE model is nothing else but anapproximate realization of the reality. The parameter study can be done by physical tests. However it will increase the cost, time and resources consumedand therefore FE analysis is more suitable choice, at least for parameter evaluation.

Theoretical aspects of the work

In this study the finite element method is adopted using Pro Engineer and Ansys as a commercial CAD and FE program. The following chapter contains some fundamentals ofthe applied theories provided that the reader has an initial knowledge of basic structural mechanics, machine components, and fundamentals of the finite element method.

Finite element method

Finite element method (FEM) is a method for approximate solutions of partial differentialequations. The domain of interest is divided into finite elements on which the solution is approximated by piecewise-polynomials. The finer the partition (Mesh)is, the more accurate the solution.

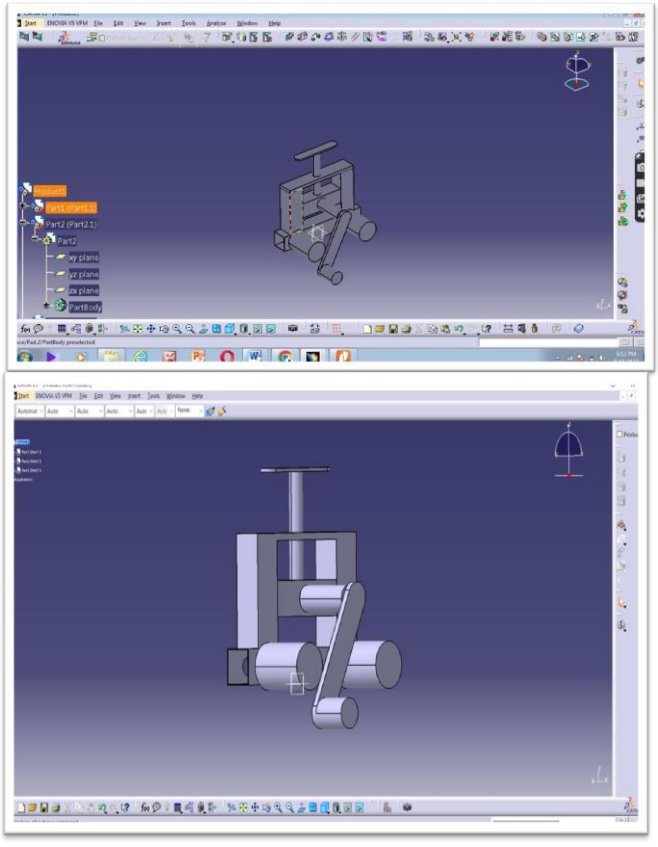
Nonlinear Analysis

Nonlinear analysis is used when a structure behaves nonlinear when loaded i.e. the deformation and the stress state does not have a linear relation to the applied load. Thethreemain sources to nonlinear behaviors are: contact, geometric nonlinearities and material nonlinearities. In order to manage such calculations with a linear process the Newton Raphson method can be used.

Newton-Raphson method

Newton-Raphson is an iterative method for finding solution to nonlinear equationsand equation systems . In FE calculations the method is used for non-linear problems and the relations between force and displacement is shown in Figure 2.1 for one degree of freedom. The procedure for Newton-Raphson method is as follows

SYSTEM DESIGN :



IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
Impact Factor 7.047 ⁜ Vol. 10, Issue 5, May 2022
DOI: 10.17148/IJIREEICE.2022.10509

1) Material nonlinearities

A nonlinear stress-strain relationship results in a nonlinear behavior. Plasticity is a nonlinear stress-strain relationship as shown in Figure 2.4. Definition of Plasticity according Ansys (2007) is: "When a ductile material experiences stresses beyond theelastic limit, it will yield, acquiring large permanent deformations."

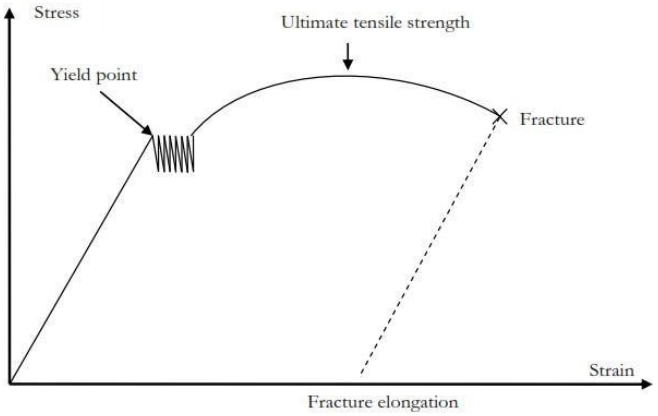


Fig.7 Relationship Between Stress & Strain

Ansys
Ansys is a commercial, general purpose FE software which has been on the market since 1971. It can be used in several applications for example to study the thermal heat flow, fluid flow, magnetic fields, acoustics/vibrations and last but not leaststructural mechanicalproblems.

Contact in Ansys
A handful of ways to handle contact are available in Ansys. However, the onedescribed here is penalty based contact since it provides short calculation times and therefore is used.

When a penalty-based contact is used, Ansys adds a spring coefficient (k factor) whentwo surfaces come in contact with each other, in order to prevent penetration and to transfer load. (Figure 2.7) However penetration will occur in order to transfer force, which is not the case in reality. Therefore the penalty-based methods are sensitive to the choice of the spring coefficient. The spring coefficient Ansys uses during calculations is the product between the "normal stiffness factor" specified by the user and a reference factor calculated by the program. An additional aspect (apart from the accuracy) to consider whenselecting the "normal stiffness factor" is the convergence behaviour. A stiffer contact will result in more calculation iterations, since bouncing might occur.

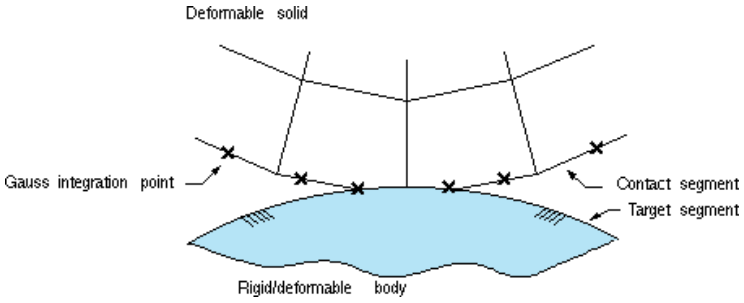


Fig. Contact StiffnessAsymmetric Behaviour

A contact condition can be either symmetric or asymmetric. When the contact condition issymmetric none of the surfaces can penetrate each other, while when the contact is specified as being asymmetric only one of the surfaces is prevented from penetrating the other i.e. the contact surface can not penetrate the target surface butthe opposite is possible. Figure 2.8 illustrates the importance of selecting the correct contact pair.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 7.047 ⁜ Vol. 10, Issue 5, May 2022

DOI: 10.17148/IJIREEICE.2022.10509

IV. CONCLUSION

Nowadays, pipe bending is a common occurrence. Various automatic and semi- automatic bending systems are used in mass manufacturing. However, automated and semi- automatic pipe bending machines are expensive for limited manufacturing. They still cannot be used in areas where electricity is scarce and expensive. Manual pipe bending, onthe other hand, is less costly and simple to build and run. The plans, development, and performance tests are all depicted in this article. Also, below is a summary of the successful test results:

1) With two fixed rollers, the bent diameter is solely determined by the mid roller'sdeflection
2) The deviation in outcomes is decreased as thedeflectionincreases.

V. FUTURE SCOPE

- To bend metal sheet and pipe in one system.
- To operate the system hydraulically.
- To ease the operation in small scale industries.

VI. REFERENCE

1. P. S. Thakare, P. G. Mehar, Dr. A. V. Vanalkar and Dr. C. C. Handa, “Productivity Analysis of Manually Operated And Power Operated Sheet Bending Machine: A Comparative Study”,International Journal of Engineering Research and Applications (IJERA), ISSN: 2248-9622, Vol. 2, Issue 2, Mar-Apr 2012, PP.111-114.
2. V. Senthil Raja, R.Maguteeswaran, C. Karthik, S.Rajarajan and D. Shanmuga Vadivel, “ANew Model in Design and Manufacturing of Mobile Hydraulic Pipe Bending Machine in Industry”, International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 3 Issue 1, January – 2014 PP 2706-2713.
3. H. A. Hussain, M. Sohail Pervez, Md. Naushad Alam and Atul. P. Ganorkar, “Design and Development of Bicycle Integrated Pipe Bending Machine”, IOSR Journal of Mechanical and Civil Engineering (IOSRJMCE), e-ISSN: 2278-1684, p-ISSN: 2320-334X, 2014, PP 24-28.
4. Mohan Krishna S. A., “Experimental Design and Fabrication of a Portable Hydraulic Pipe Bending Machine”, International Journal of Development Research, ISSN: 2230-9926, Vol.4, Issue, 12, pp. 2681- 2684, December, 2014, PP 2681-2684. APCOER, B.E. (Mechanical)
5. Prashant P. Khandare, Dhiral N. Patel, Mayur K. Aher, Ravi S. Parbat and Prof. Swapnil S. Patil, “Study of Portable 3 Roller Pipe Bending Machine”, International Conference on Emerging Trends in Engineering and Management Research, ISBN 978-81- 932074-7-5, 23March 2016, 624-630.
6. Mahesh Gadekar and Mr. Amol, “Design & Development of Three Roller Sheet BendingMachine”, International Journal on Recent and Innovation Trends in Computing and Communication, ISSN: 2321-8169, Volume: 3, Issue: 8, August 2015, PP 5132 – 5135