International Journal for Research in Engineering Application & Management (IJREAM)
ISSN : 2454-9150 Special Issue - AMET-2019

Analysis and fabrication of Automatic Four-way Hacksaw Machine

[1]Aditya Shinde, [2]Mokshay Jain, [3]Prathamesh Sahastrabuddhe, [4]Prof. Shrikant Yadav, [5]Sidharth Ahire
[1,2,3,4,5]Department of Mechanical Engineering, MIT College of Engineering, Pune, India.
[1]adityasshinde@yahoo.com, [2]mokshayjain@gmail.com, [3]iprathamesh@icloud.com,
[4]shrikant.yadav@mitcoe.edu.in, [5]sidahire1998@gmail.com

***Abstract*— The objective of this paper is to perform analysis on Four-Way Hacksaw Machine and its base frame. This model implies conversion of rotary motion of crank to reciprocating motion of hacksaw blades, which is done by using Double Slider crank Mechanism. This motion is used for hacksaw machine. In this model four hacksaws are operated at the same time. This model will overcome the Traditional Hacksaw Machine which does material cutting of single piece at particular time interval and also fulfills the needs of more material cutting accounts to Mass Production. This machine works significantly well with minimum vibrations and jerks. This machine will also do cutting of different kind of materials. Hence the proposed model of Hacksaw Machine will be welcomed by many industries due to its compactness, safe operation and improved efficiency.**

Keywords—Analysis, Double slider crank, Four hacksaws, Mass production, Safe operation.

I. INTRODUCTION

The four way hacksaw is a cutting machine designed to cut multiple wooden blocks simultaneously by applying Double slider crank mechanism. Objective is to analyse the effect of cutting force on the base frame of Four Way Hacksaw machine. The main function of this hacksaw machine is to cut wood by motor power. The hacksaw is placed on opposite sides and as the crank moves, cutting operation is performed. The Double slider crank mechanism is used to convert the rotary motion into the reciprocating motion. Hence when the motor is switched on, the power from the motor is delivered to the crank wheel. The crank wheel rotates such that the hack saw blades reciprocate. The work pieces are mounted on the machine vice firmly and the entire system is switched on. Thus the four work pieces are cut simultaneously using the motor and the mechanism. Further, in order to increase the cutting force, the frame sides and the slider are connected using a hinge joint and the symmetric weight of the slider is increased.

Figure 1 – CAD model of Four Way Hacksaw Machine

II. LIST OF COMPONENTS

SR. NO.	Component	Material detail
1	Frame	MS
2	Four Hacksaw Blades	Bi-metallic
3	Four Guide-ways	MS
4	Disc	MS
5	Crank Pin	MS
6	Vices	MS
7	Electric Motor	0.5HP
8	Connecting Rods	MS
9	Hacksaw Frames	MS

Table 1-List of Components

III. REVIEW OF LITERATURE

The vast review of literature will help to understand the

Concept, theorems and different factors affecting the performance of machine.

In this paper presents the concept of four-way hacksaw blade machine mainly carried out for production based industries. Industries are basically meant for production of useful goods and services at low production cost, machinery cost and low inventory cost. Knowledge about developed a model of a machine reach would be capable of performing different operation simultaneously, and it should be economically efficient. These machines can be used in remote places where electricity is regular. It is designed as a portable one which can be used for cutting in various places. It can be used for operating on materials like thin metals, wood etc.[1]

This research paper stated that it consist of single phase vertical electric motor rigidly placed at the center of metallic foundation provided. The shaft of motor rotates at 90-100 rpm with the power 2HP. The circular disc is mounted on the shaft of motor with the help of key and key slot arrangement .[2]

It is known that conventional power hacksaw machine can be replaced with automated power Hacksaw machine. Automated power hacksaw machine gives high productivity in short time period in comparison with the conventional power hacksaw machines. The major advantage of this machine is intervention of labour is reduced to maximum level. In this rapid emerging industrial section the use of power Hacksaw machine is wide, time and labor plays a major role in production process.[3]

This research paper provided with information of cutting forces required to cut various types of woods. It has a detailed analysis of wood porperties, cutting forces and cutting power in accordance to various tools used to cut wood.[4]

IV. MATHEMATICAL CALCULATIONS

5.1 Cutting force

For wooden block of dimensions 50.8 mm x 38.1 mm x L mm, A block of dimensions 50.8 mm×38.1 mm has been taken and the stroke length is 0.3 mm/stroke.

From, Properties of wood (Encyclopedia of Materials: Science and Technology, ISBN:0-08-0431526,pp. 9732-9736)

For teak wood we take τ_{shear}= 8.8 MPa

Depth of Cut (d) = 0.3 mm/ stroke

Cutting Force Required (F) = τ_{shear} x CS area of cut= 8.8 x 0.3 x 50.8 = 134.112 N

V. SOLUTION METHODOLOGY

Here, static analysis of the base frame has been done on Ansys. By using that the stress developed at different points and the deformation at different points has been shown. This has been done in order to ensure the safety of the base frame. Since the frame has to bear the stresses generated due to different conditions, the design must be safe.

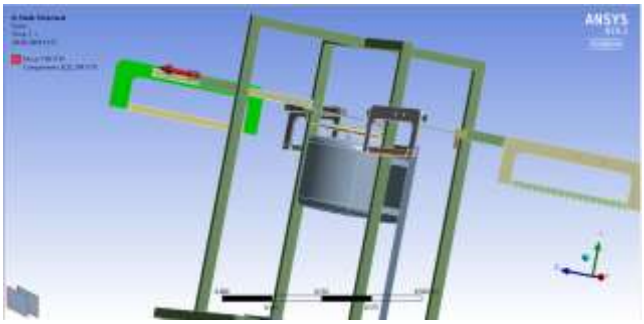

Figure 1- Direction of force

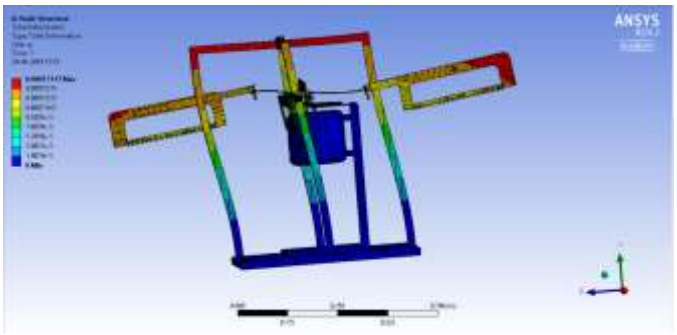

Figure 2- Total Deformation

Here, we have done analysis for the stress acting on the frame. The stress acting at different points is indicated in the bar at the side of the figure.

Since, the values are in permissible range, hence, the design is safe.

The Boundary Conditions applied for the analysis are-

1. The base of the frame is fixed. 2. Horizontal force of the hacksaw frame.

Details about Meshing-

Meshing type is linear rectangular mesh.

Mesh size (resolution) is of 2 mm.

Here the deformation produced in the frame due to different forces is shown. Since the deformation is in safe range hence the design is safe.

VI. WORKING

The experimental setup of our project consists of a frame on which the hacksaw blades are mounted. The hacksaw blades are mounted on the four sides of the frame. The circular crank plate is mounted in the centre of the frame which is operated by a motor. Connecting rods are used to connect the crank wheel and the hacksaw blades. The

Scotch Yoke mechanism is used to convert the rotary motion into the reciprocating motion. Hence when the motor is switched on, the power from the motor is delivered to the crank wheel. The crank wheel rotates such that the hack saw blades reciprocate. The work pieces are mounted on the machine vice firmly and the entire system is switched on. Thus the four workpieces are cut simultaneously using the motor and the mechanism.

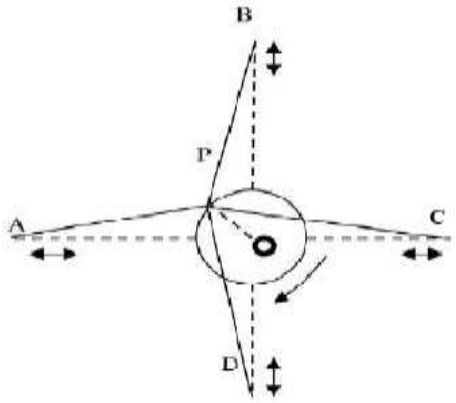

Figure 3- Working of Mechanism

Parts are fabricated according to the dimensions proposed safe by calculations and design analysis.

1) Firstly the base frame is constructed.
2) Then the slider and hacksaw arrangement is mounted on the frame.
3) After that vice is attached to end supports according to the height of hacksaw.
4) Then motor is mounted in the middle.
5) Then the reducing gear arrangement is fixed to the motor.
6) Crank disk is mounted on the reducing gear.
7) Then the connecting rods are attached to the clamp on the hacksaw.
8) When electricity is provided, the set up becomes operational.

VII. FABRICATION CHALLENGES

Sr.	Operations	Challenges
1.	Calculation of cutting speed and force	Assumptions and standard values
2.	Motor Selection	Based on Cutting force of 4 blades
3.	Selection of motor with required torque	Torque sufficient but need to lower the speed
4.	Procuring a dimmer circuit to regulate RPM	High rpm to calculated(assumed) rpm
5.	Construction of frame	Establishing required vertical distance between the disc and reciprocating member
6.	Assembly of Motor	Making an arrangement to withstand the weight of the motor
7.	Assembly of reciprocating member	To restrict degree of freedom of the member
8.	Assembly of Connecting rods of equal lengths	Proper Pin joints should be used.
9.	Assembly of hacksaw and vice	The stroke length should be sufficient to cut the specimen on the vice. Vertical Force application can be done using compression spring

Table 2- Fabrication challenges

VIII. CONCLUSIONS

From above discussion it is concluded that the model of four way hacksaw is helpful to overcome the problems of conventional hacksaw with high efficient, it's easy to operate and simple in construction. The static analysis performed on the model gave safe results and concluded safe working of the machine under normal conditions. Various fabrication challenges were identified and can be overcome using suitable solutions. Future scope includes increasing the motor power and dimensions of eccentric cam by which the size of material to be cut can be increased and by using limit switches or sensors, automatic feeding mechanism for material can be introduced.

REFERENCES

[1] Theoretical Analysis of Four Way Hacksaw Blade Machine by asst. Prof. Sachin Mate ,April 2016

[2] Theoretical Analysis of Multi-way Power Hacksaw Machine Kshirsagar Prashant R, Rathod Nayan,Rahate Prashant P,Halaye Prashant P, April 2015

[3] Design and Fabrication of Automated Hacksaw Machine, D. V. Sabarianand, V. Siddhartha, B. Sushil Krishnana,T.Mohanraj, April 2014

[4] Comparison of measured and calculated values of cutting forces in oak wood by Marija Durkovic,

[5] O.Cakir, A. Yardimen, T. Ozben, ―Selection of cutting fluids in machining processes‖, Journal of Achievements in Materials and Manufacturing Engineering, volume 25, Issue 2, December 2007.

[6] R. Subhash, C.M. Meenakshi, K. Samuel Jayakaran, C. Venkateswaran, R. Sasidharan, ―Fabrication pedal powered hacksaw using dual chain drive‖, International Journal of Engineering and Technology, ISSN: 220- 223, volume 3, Issue 2,2014.

[7] R. Ambade, A. Sartabe, M. Arekar, V. Khachane, P. Gawali (April 2015) ,‖ Design & Fabrication of Human Powered Multi-Purpose Machine‖, International Journal of Advanced Technology in Engineering and Science,ISSN(Online):2348-7550,Volume No 03,Special Issue No.01, Page Number 293-297.

[8] R. Anand, Khomesh, S. Kumar, A. Verma (April2016),‖ Theoretical Analysis Of Four Way Hacksaw Blade Machine‖, International Journal of Advance Research and Innovative Ideas in Education, ISSN(O)-2395-4396, Vol-2 ,Issue-2..

[9] Six types of service scotch-Yoke mechanism and rack and pinion mechanism (Chaseand Stewart, 1994). [10]S.S Rattan, Theory of Machines,ThirdEdition,McgrawHill