



## Design and fabrication of an electric hacksaw

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### Abstract

Aimed at the design and fabrication of an electric hacksaw from locally sourced materials, the study commenced with a literature review of the past works on hacksaws, starting from historical perspective of electric hacksaws to their ergonomics features. The design which began with the slider crank calculation gave the following results: the acceleration of the slider,  $F_p$  of  $418.65\text{mm/sec}^2$ , the angular acceleration of the connecting rod,  $\alpha_{pc}$  of  $-40.93\text{mm/sec}^2$ , the cutting force required to cut a high speed steel of 1mm thickness and hardness of 60HRC as 10.67kN, as well as 5.42kWatts as the power required to drive the hacksaw blade. Due to its numerous advantages which include cost effectiveness, weldability, ductility, recyclability, etc., steel was mainly adopted in material selection during the fabrication of the electric hacksaw. Driven by 150watts and 100 rpm electric motor, the electric hacksaw with an incorporated blade was designed and fabricated to be robust, effective, and user-friendly. With a total pocket-friendly cost of two hundred Dollars, the electric hacksaw was later tested for safety and durability before painting. Recommendations were also made on the operation and parameters of the machine, before suggestions were offered on overall machine performance, optimization, as well as further improvements on the machine.

**Keywords:** electric hacksaw, design, fabrication, manufacturing, electric motor, overall machine performance, cutting speed, high speed steel

### Introduction

Manufacturing is derived from the Latin word *manufactus*, which means made by hand. In modern context, it involves manufacturing of products from raw material by using various processes such as hand tools, machinery, or even computers. It is therefore a study of the processes required to make parts and to assemble them in machines. Manufacturing is the backbone of any industrialized nation. It is a global business that was started during the industrial revolution in the late 19th century to cater for a large scale production of products (Jovane *et al.* 2008) [5]. Since then, manufacturing business has changed tremendously through the innovations of technology, processes, materials, communication, and transportation.

The major challenge of manufacturing is to produce more products with less material, less energy and less labour involvement (Nik 2023) [9]. Also, Okpala, Nwankwo and Onu (2020) [12], pointed out that the aim of today's manufacturing is to achieve waste reduction or possible elimination, as well as the development of a manufacturing system that is responsive to the market needs, by utilizing less resources to manufacture high quality products at reduced lead time, thus enhancing throughput and profitability. In order to address these challenges, manufacturing companies must have a strategy and competitive priority to enable them to compete in a dynamic market.

The complete understanding of basic manufacturing processes and workshop technology is highly difficult because the study deals with several aspects of workshop practices that is used to impart the basic working knowledge of the different engineering materials, tools, equipment, manufacturing processes, basic concepts of electro-mechanical controls of machine tools, production criteria, characteristics and uses of various manufacturing shops in

an industrial environment. It also describes and demonstrates the use of different hand tools, equipment, machinery and various methods of manufacturing that facilitate shaping or forming the different existing raw materials into suitable forms.

In large manufacturing industries, cutting operations are required for raw materials. However, manual hacksaw cutting is very strenuous and requires a lot of effort, as they are not feasible for large scale and accurate cutting. As automation is changing the world, the need for more automated systems to make human tasks faster and easier are required. For this purpose, the use of conventional hacksaw machine has become a common means for cutting operations in manufacturing industries. It is able to cut metal bars of different materials at the same time and will be helpful in many industries due its compatibility, reliability and efficiency. In present condition, electrically operated power hacksaw machines with different specifications are needed for use in the shop floor. These machines are so versatile that they can cut metal bars made up of different materials at considerably reduced time.

The economic importance of this research is to; increase productivity and profit making by reducing the time taken to cut metals, and to reduce the cost of production by saving the amount spent on man power in manufacturing industries. The intended design will be based on efficient and effective material cutting capacity, with minimum vibration and cost reduction by making use of locally-sourced cost effective materials.

### Literature Review

The sawing process is a method of cutting materials using a saw, which is a cutting tool with a blade consisting of a series of teeth that can cut through various materials such as

wood, metal, plastic, and others. The sawing process is used in a wide range of industries and applications, including woodwork, construction, metalwork, and manufacturing. According to Remmerswaal and Mathysen (1961)<sup>[13]</sup>, often times sawing is the first operation carried out on bar stock, therefore it is surprising that so little work has been done to understand the problems of this common operation. They explained that the fact remains that cutting-off operations can account for a significant part of the cost per piece.

The sawing process involves positioning the material to be cut, aligning the saw blade, and then making a series of back and forth, or circular motions with the saw to cut through the material. Depending on the type of saw being used and the material being cut, the sawing process can be performed manually or with the help of automated machinery. Hacksaws are classified under the category of hand saws. The hacksaw is one of the best and most widely used saw types when there is a need to cut metal or plastic precisely. Saif (2023)<sup>[14]</sup>, observed that the hacksaw's C-shaped frame is where the material-specific cutting blades are attached, and these blades' tooth counts of 18 to 32 per inch make it easy to cut through plastics.

Hacksaws are commonly used in construction, metalworking, and other industrial applications. When using a hacksaw, it is important to wear protective gloves and eyewear to prevent injury. It is also quite important to choose the right blade for the material being cut, and to keep the blade clean and sharp to ensure the best cutting performance. When a hacksaw is operated using machines, it is known as a power hacksaw. Power hacksaw is used when materials cannot be cut by hand or when the cutting

diameters of a material to be cut is large. They can cut large diameter work that requires a large amount of time and hard work to cut. According to Oberg *et al.* (2000)<sup>[10]</sup>, power hacksaw can be used to cut any type of material in workshops, as its blade is made of High Speed Steel (HSS). An electric hacksaw, also known as a power hacksaw is a type of saw that is powered by an electric motor to make cutting easier and more efficient. It is a mechanical cutting device that is used to cut metal. It is commonly used in construction, metalworking, and other industrial applications where a large volume of cutting is required. Gupta (2022)<sup>[4]</sup>, explained that power hacksaws are used to cut large diameter that require a lot of time and hard work to cut. He noted that since the hacksaw blade is made of HSS that it can be used to cut any type of material in the workshop.

Electric hacksaws have a similar design to hand-held hacksaws, with a replaceable blade that is held under tension by a frame which is usually made of cast iron, and can be adjusted to cut at different angles. However, instead of being powered by hand, the blade is powered by an electric motor that moves it back and forth to make the cutting motion. The saw's cutting speed can be adjusted to suit the material being cut, and the blade can be changed easily to accommodate different cutting tasks. Davim and Baptista (2001)<sup>[3]</sup>, stated that while increasing cutting speed is beneficial for surface quality, excessive cutting speed can accelerate tool wear by augmenting tooth temperature. Hence, while choosing the cutting parameters, there should be a trade-off between energy consumption, surface quality, and tool deterioration.

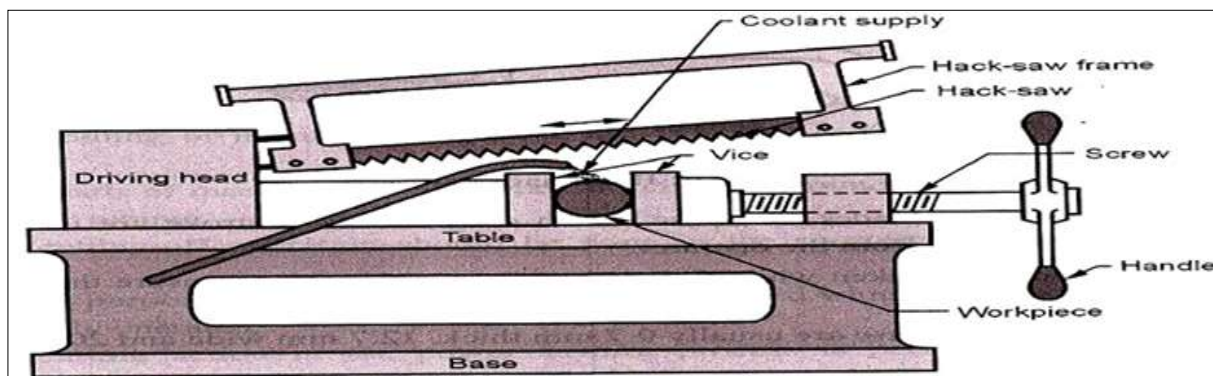


Fig 1: An electric hacksaw showing the different parts (source: mechtechguru.com)

### Ergonomic Features of an Electric Hacksaw

Ergonomics is the scientific study of human work, behavior, and well-being in relation to the design and use of products, equipment, and environments. Okpala and Ihueze (2017)<sup>[11]</sup>, explained that ergonomics encompasses other scientific disciplines like psychology, mechanical and industrial engineering, industrial and information designs, kinesiology, industrial safety, biomechanics, as well as anthropometry, and instead of physically compelling the worker to fit the job, it fits the job to the worker.

According to Bridger (1995)<sup>[2]</sup>, physical dimensions of furniture, equipment, clothing and workspaces are specified using anthropometric data to achieve proper ergonomic design. Ergonomics aims at optimizing the interaction between people and their work by improving the design of the workplace, tools, and equipment to make them more efficient, safe, and comfortable for the users.

The use of anthropometric data in design may constitute improvement in the health and comfort of the users (Barroso *et al.*, 2005)<sup>[1]</sup>. Similarly, Xiao *et al.* (2005)<sup>[16]</sup>, noted that anthropometric data is needed for ergonomically correct design of safe and efficient workplaces, equipment and tools. The ergonomic design of the electric hacksaw is intended to improve comfort and reduce strain on the user's hands and arms during extended use. Some common ergonomic features found in modern electric hacksaws include: soft-grip handles, balanced weight distribution, adjustable handles, vibration dampening, low noise levels, compact design, and trigger lock. These ergonomic features are intended to make electric hacksaws more comfortable and efficient for users, reducing the potential for hand and arm strain and improving the quality and accuracy of the cuts made with the saw.

**Materials and Method**

**1. Design Description**

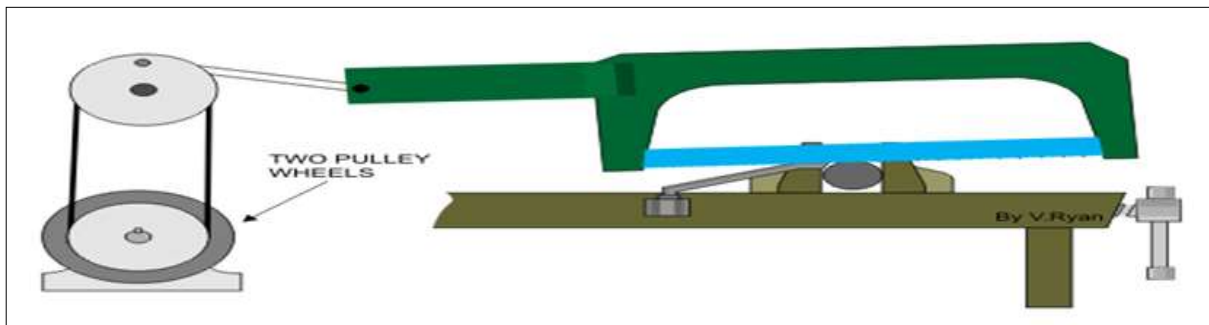
An electric hacksaw machine cuts through a variety of materials such as metal, wood, and plastic using an electric engine to drive a reciprocating blade. The concept of the design of the electric hacksaw machine is described here. The frame is made of heavy-duty steel which serves as the machine's support and structure to ensure stability. It is made to endure the vibrations that the reciprocating blade causes. The machine's heart is its motor, which is typically an electric motor with enough force to propel the blade at a fast speed. The motor sends electricity to the blade through the power transmission system.

The slider crank mechanism is used in the design to convert the rotary motion of an electric motor into the reciprocating motion of the hacksaw blade. The mechanism consists of a

crankshaft, connecting rod, and a slider. The hacksaw blade is attached to the slider, which moves back and forth in a straight line.

**2. Mechanical Assembly**

The base, the frame, the cutting blade, the motor, and the pulleys and belts are the common primary parts of an electric hacksaw machine. The base, which offers stability and support, is the machine's basis. The foundation mounts the frame, which acts as the framework for housing the other parts. The motor which is usually an electric motor powers the cutting blade, which is positioned on the frame. When the motor is activated, it spins the crankshaft, which in turn rotates the cutting blade. The cutting blade moves back and forth along a linear path, cutting through the material being worked on.



**Fig 2:** Mechanical assembly of an electric hacksaw (source: technologystudent.com)

**2.2 Electrical Assembly**

The battery, the motor, the switch, and the wiring are usually included in the electrical assembly of an electric hacksaw machine. The battery is in charge of giving it what it needs in terms of electricity. The motor is the element that drives the cutting blade by converting electrical energy into mechanical energy. A Direct Current (DC) motor is used in the design of the proposed machine. The machine can be turned on and off using the switch. The wiring links all the parts together and establishes the required electrical contacts. To avoid damage or interference with the machine's function, the wiring is routed and secured correctly.

**3. Design Calculations**

A slider-crank mechanism is a mechanical linkage that converts rotational motion into linear motion, or vice versa. It is frequently employed in internal combustion engines, where it is responsible for converting the pistons' linear motion into the crankshaft's rotational motion. Depending on how it is configured, the slider-crank mechanism can be used to provide either linear or rotational motion in a variety of various mechanical systems, including reciprocating pumps and compressors. The mechanism consists of the following:

- a. **Crankshaft (Rotating Component):** A crankshaft is an engine component that transforms the pistons' back-and-forth reciprocating action into rotating motion. Usually found in internal combustion engines, it drives the transmission, which in turn drives the wheels or pulley of a machine.
- b. **Connecting Rod:** A connecting rod is an engine component that connects the piston to the crankshaft in

an internal combustion engine. It is typically made of steel or aluminum and is responsible for transferring the force generated by the piston to the crankshaft, which converts it into rotational motion.

- c. **Slider:** A slider, also known as a wrist pin or gudgeon pin, is an engine component that joins the piston and connecting rod. The piston can swivel and transmit force to the connecting rod due to a cylindrical pin that is inserted between the tiny end of the connecting rod and the piston.

**3.1 Slider Crank Calculation**

The following information will be used in order to calculate the motion of a slider crank mechanism for an electric hacksaw:

1. Length of the crank,  $d = 88.9\text{mm}$
2. Length of the connecting rod,  $L = 254\text{mm}$
3. Angle of rotation of the crank,  $\theta = 92.5^\circ$

The position and speed of the slider can be calculated by assuming that the hacksaw blade goes back and forth in a straight line and that the connecting rod is fastened to the middle of the blade. The following formula were applied in the design.

- **Position of the slider at any given point in time is given as:**

$$X = L \cos\theta + \sqrt{L^2 \sin^2\theta - d^2}$$

$$X = 254 \cos(92.5) + \sqrt{(254)^2 \sin^2(92.5) - (88.9)^2}$$

$$X = -11.0793 + \sqrt{64516(0.9981) - 7903.21}$$

$$X = -11.0793 + \sqrt{64393.4196 - 7903.21}$$

$$X = -11.0793 + \sqrt{56490.2096}$$

$$X = -11.0793 + 237.6767$$

Position of Slider (X) = 226.5973 ≈ 227mm

**Linear velocity of the slider.**

To calculate the linear velocity of the slider, the position equation is differentiated with respect to time. The equation becomes:

$$V = -L \sin\theta + \frac{L^2 \sin\theta \cos\theta}{\sqrt{L^2 \sin^2\theta - d^2}}$$

Therefore,

$$V = -254 \sin(92.5) + \frac{254^2 \sin(92.5) \cos(92.5)}{\sqrt{254^2 \sin^2(92.5) - (88.9)^2}}$$

$$V = -254(0.9990) + 64516(0.9990) \frac{(-0.0436)}{\sqrt{64516(0.9981) - 7903.21}}$$

$$V = -253.746 + \frac{(-2810.085)}{\sqrt{64393.4196 - 7903.21}}$$

$$V = -253.746 + \frac{(-2810.085)}{\sqrt{56490.2096}}$$

$$V = -253.746 + \frac{(-2810.085)}{237.6767}$$

$$V = -253.746 + (-11.82314)$$

$$V = -265.57 \text{ mm/sec}$$

- To determine the velocity of the slider (Vp), it is given as:

$$V_p = \omega r (\sin\theta + \frac{\sin^2\theta}{2n}) \quad (\text{mm/sec})$$

Where;

$\omega$  = Constant angular velocity (rad/sec)

r = Crank radius = 88.9mm

Determining the constant angular velocity,  $\omega = 2\pi n/60$

n = speed of the crank = 100rpm

$\omega = 2\pi(100)/60$ , therefore  $\omega = 10.473 \text{ rad/sec}$

For Vp formula,  $n=L/r$ , ratio of length of connecting rod to crank radius = 254/88.9

$$n = 2.857$$

$$\text{Therefore, } V_p = \omega r (\sin\theta + \frac{\sin^2\theta}{2n})$$

$$V_p = 10.473 * 88.9 [\sin(92.5) + \frac{\sin^2(92.5)}{2 * 2.857}]$$

$$V_p = 931.0497(0.9990 + 0.9981/5.714)$$

Taking the LCM

$$= 931.0497(5.708 + 0.9981/5.714)$$

$$= 931.0497(1.1737)$$

$$= 1092.7509$$

Velocity of the slider,  $V_p = 1092.75 \text{ mm/sec}$

- To determine the acceleration of slider,  $F_p$  it is given as;

$$F_p = \omega^2 r (\cos\theta + \frac{\cos^2\theta}{n})$$

$$= (10.473)^2 (88.9) * [\cos(92.5) + \frac{\cos^2(92.5)}{2.357}]$$

$$= 9750.3835(-0.0436 + 6.6596 * 10^{-4})$$

$$= 9750.3835(-0.0429)$$

$$F_p = -418.645$$

The acceleration of the slider,  $F_p = 418.65 \text{ mm/sec}^2$

- To determine the angular velocity of the connecting rod, it is calculated using the following equation:

$$V = \omega \cos\theta / (n^2 - \sin^2\theta)^{1/2}$$

$$V = 10.473 \cos(92.5) / [(2.857)^2 - \sin^2(92.5)]^{1/2}$$

$$V = -0.4568 / (8.1624 - 0.9981)^{1/2}$$

$$V = -0.4568 / (7.1643)^{1/2}$$

$$V = -0.4568 / 2.6766$$

$$V = -0.1707$$

The angular velocity, V of the connecting rod = -0.171mm/sec

- To determine the angular acceleration of the connecting rod, it is calculated using the following equation:

$$\alpha_{pc} = -\omega^2 \sin\theta (n^2 - 1) / (n^2 - \sin^2\theta)^{3/2}$$

$$\alpha_{pc} = \frac{(-10.473)^2 \sin(92.5)}{[(2.857)^2 - \sin^2(92.5)]^{3/2}}$$

$$\alpha_{pc} = \frac{(-109.684)}{[(2.857)^2 - \sin^2(92.5)]^{3/2}} * 0.9990$$

$$* 7.162449 / (8.1624 - 0.9981)^{3/2}$$

$$\alpha_{pc} = -784.8205 / 19.1761$$

$$\alpha_{pc} = -40.9270$$

The angular acceleration of the connecting rod,  $\alpha_{pc} = -40.93 \text{ mm/sec}^2$

**3.2 Determination of Cutting Force**

The cutting force of an electric hacksaw depends on several factors such as the blade type, material being cut, blade speed, feed rate, and saw design. To determine the cutting force generated by the reciprocating motion of the saw blade, the following factors are considered: Blade speed, Blade pitch, Material properties, and Saw blade design.

The material properties include the material hardness and the material thickness. The cutting force required to cut a high speed steel can be calculated using the standard formula.

Cutting Force = Material hardness \* Material thickness \* Saw blade width \* Number of teeth per inch

Using the following parameters: Thickness = 1mm, Saw blade width = 0.5 inch = 12.7mm, Hardness of high speed steel = 60 to 70HRC, Number of teeth per inch = 14 teeth per inch.

$$\text{Therefore, Cutting force} = 60 * 1 * 12.7 * 14 = 10668 \text{ N}$$

Therefore, the cutting force required to cut a high speed steel of 1mm thickness and hardness of 60HRC = 10.67kN

**3.3 Power Calculation**

To determine the power required to drive the reciprocating parts of the electric hacksaw, the following factors are considered:

- Cutting Force: The cutting force required to cut the material will determine the power required to drive the saw. It is dependent on the type and thickness of the material being cut, the type and condition of the blade, as well as the feed rate.
- Blade speed: This is the speed at which the blade moves back and forth the cutting process. It is determined by stroke length and strokes per minute.
- Efficiency: The efficiency of the motor and the transmission system will affect the power required to drive the saw.

Power is calculated using the formula which were sourced from Khurmi and Gupta (2005) [6], Power = Cutting force (Newton) \* Blade speed (meter/min) / Efficiency

Where,

$$\text{Blade speed} = \text{stroke length} * \text{stroke per minutes} / 1000$$

Using the following parameters,  
 Stroke length= 10 to 12inches (254mm to 305.8mm) for a regular hacksaw blade, Stroke per minute= 150 to 300mins,  
 Blade speed=  $254 * 150/1000, = 38.1\text{m/min}$   
 Assuming the efficiency of the motor ranges from 75% to 78% and cutting force= 10668N

$\therefore \text{Power} = \text{cutting force} * \text{blade speed} / \text{Efficiency}$   
 $= 10668 * 38.1 / 75$   
 $= 5419.344\text{Watts}$   
 The power required to drive the hacksaw blade= 5.42kWatts

**3.4 Material Selection**

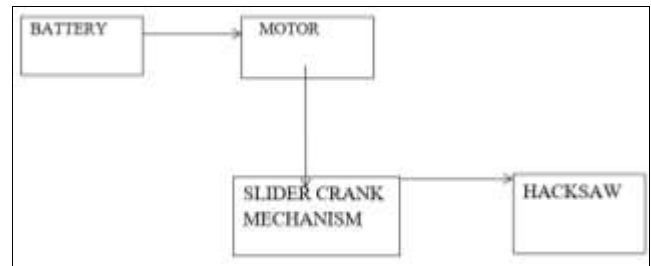
Material selection is the process of selecting the right material or materials for a particular application based on the application's needs, such as its mechanical qualities, corrosion resistance, cost, and environmental impact. The choice of materials is essential in engineering design since it has a direct impact on the functionality, dependability, and durability of the final product. According to Leonel, Venturini and Chateaneuf (2011) [7], to avoid structural failure, the stress in a component must not exceed the strength of the material, where the strength is simply the stress that causes a deformation or fracture failure. In the design, mild steel was mostly used due to its numerous advantages such as: cost effectiveness, weldability, ductility, recyclable, etc. The type of materials used in the fabrication is depicted in table 1.

**Table 1:** The selected materials and their specifications

S/N	Parts/Components	Material	Specification
1)	Frame	Mild Steel	2 inches by 1 inch
2)	Base	Mild steel	2mm
3)	Crankshaft	Mild steel	3mm
4)	Connecting rod	Mild steel	5mm
5)	Vice	Mild steel	4mm
6)	Motor		12V to 24V
7)	Hacksaw blade	High speed steel (HSS)	14 teeth per inch
8)	Battery		12V

**Working Principle**

The working principle of the electric hacksaw machine is based on the conversion of rotary motion into reciprocating motion using the slider crank mechanism, which is used to drive the cutting blade and cut through the material being worked on. The machine's vice has two teeth. Both jaws can move, with one being fixed. On one side, a threaded row is connected to the movable jaw, and on the other, there is a handle. The movable jaws of the machine vice travel forward and backward on the threaded rod of the machine vice when the handle is rotated. The machine's driving mechanism located inside the front and back columns, allows the hacksaw to move along the blade frame. When the switch is turned on and the hacksaw blade is brought close to the work piece, the driving mechanism starts followed by the cutting or material-removal process on the work piece. The forward stroke of the machine is a cutting stroke that involves the removal of material, whereas the reverse stroke is a passive stroke. Cutting only while the saw is moving forward prevents needless saw blade wear. Chips created by the forward stroke are removed from the work piece when it is on backward stroke.



**Fig 5:** The working principle of the electric hacksaw

**3.5 Methodology**

The main operations used in the fabrication process are as follows

- **Cutting operation**  
 Cutting operation is done on a mild steel metal sheet according to the required dimensions to fabricate the base. Two mild steel rods are cut according to the required dimensions to fabricate guide ways. Cutting operation is also done to fabricate the hacksaw frame and reciprocating frame.
- **Drilling operation**  
 This operation is performed to make holes on the slider so that rolling contact bearings and hacksaw frame can be fixed to the slider. Drilling operation is also done on the crank and connecting rod.
- **Welding operation**  
 Arc welding is performed at various places where permanent joints are required. The hacksaw frame is joined by arc welding. The base is also joined to the frame through welding operations; the crank is welded to the machine also.

**Fabrication and Analysis**

Firstly, in the construction of the frame and base of the machine, 2 inches by 1 inch mild steel was cut using the required dimensions of 22 inches length and then welded together, the frame was covered with a thick 2mm mild steel sheet by welding, in order to form the base of the machine where the motor and batteries will be mounted. To fabricate the vice, 4mm mild steel angle iron was welded on the base to construct a vice that will be used to hold the workpiece and a threaded rod was attached to the vice by welding for clamping the workpiece to the vice during a cutting operation. Three batteries of 12V and 4A per 10hrs each was mounted in parallel on the machine for supplying current and a direct current motor of voltage ranging from 12V to 24V was mounted on the machine with mounting bolts, while the motor is covered with a 2mm thick mild steel sheet folded around it. For the slider crank mechanism, a crank of 3mm thick mild steel of 3.5inches length was welded to the machine and a connecting rod of 5mm thick mild steel of 10inches length is joined to the crank by drilling a hole on it and using bolt and nut to join the two parts. The slider is attached to the machine and holes are drilled on it to attach the sliding bearings as well as the hacksaw frame on it. The other end of the connecting rod is attached to the hacksaw frame using bolt and nut to complete the mechanism.

### Mode of Operation

The mode of operation of the electric hacksaw is simple yet effective. It uses electricity generated from the batteries to power the motor that drives the blade back and forth to make cutting easier and more efficient than a manual saw.

The workpiece to be cut is clamped on the vice to prevent it from wobbling while cutting. The machine can be turned on using the ON/OFF switch, so that electricity is supplied from the batteries to the motor. The motor then drives the gear assembly, which in turn drives the blade. The blade moves back and forth rapidly, thereby cutting through the workpiece

### Analysis of Machine Performance

The electric hacksaw is powered using a DC electric motor wiper of 100Watts and three 12V batteries to send current to the motor. The machine was designed to cut a variety of materials with great performance and durability. In contrast to the manual process, more materials can be cut in a short period of time.

### Testing and Risk Analysis

The design calculations were employed in the fabrication of the machine. The machine was tested to ascertain its reliability and functionality. The test was carried out with a 12V to 24V DC motor wiper using a stop clock to determine the cutting time.

Risk analysis was performed to determine the machine's effectiveness. It entails methodically assessing the probability of unfavorable events happening and their potential effects on a variety of factors, including safety, reliability, performance, and operational effectiveness. It is an essential part in the design and fabrication process, and the first step of risk analysis is the identification of possible cause of risk. The possible risks associated with the use of this machine include the following:

- Contact with moving parts: The presence of sharp moving parts such as the saw blade or reciprocating mechanism can lead to cut.
- Noise exposure: Due to constant vibration initiated by the offset of rotating components, there is noise associated with the operation of the machine.
- Electrical hazards, such as electric shocks or short circuits.
- Potential for flying debris or workpiece ejection.

The risks associated with the machine can be grouped into two major categories;

- Risk of loading/unloading of the machine.
- Risk of machine operation.

Strategies to mitigate or control the identified risks include the following:

- a. Engineering controls: this can be achieved through the incorporation of safety features into the machine design such as guards, interlocks, and emergency stop buttons in order to prevent access to hazardous areas and minimize the likelihood of accidents.
- b. Administrative controls: establish safe work procedures, training programs, and maintenance schedules. Clearly communicate operating instructions, warnings, and limitations to machine operators.
- c. Personal Protective Equipment (PPE): identify and provide appropriate PPE, such as safety glasses, gloves,

and hearing protection, to minimize the potential for injury or exposure to hazards.

### Ergonomics and Cost of Production

The machine is designed to give operators comfort by dispensing with as much connecting mechanism as possible bringing the power switch closer to the operator. The presence of material handling equipment (the vice and the clamp) aids in keeping and holding the workpiece in place. The power supplied by the motor to the reciprocating mechanism which moves the hacksaw blade along the slider enables it to cut the workpiece which reduces the time and stress of the operator.

The total cost of the project is approximately two hundred Dollars which covers the cost of materials and sub-assemblies, transportation of materials and subassemblies, cost of machineries and equipment, fasteners, finishing equipment, fueling cost as well as other miscellaneous expenses.

### Conclusion

The aim of the study is to design and fabricate an electric hacksaw from locally-sourced materials. The body, frame and parts of the electric hacksaw were designed with the aid of solid works software and are made up of about 80% locally sourced materials and sub-assemblies. Also, necessary calculations were made based on the team's knowledge of design courses, strength of materials, and material selection.

Considering the problems associated with purchasing a brand new product, the various problem statements which include high cost, and over dependency on foreign materials, the project was designed and fabricated to solve such crucial problems. Also, the design and fabrication processes were carried out using available tools and machineries in the engineering workshop, with optimum functionality of the machine as the motivating factor.

Taking ergonomics suitability of the operator into consideration, the design and fabrication of the electric hacksaw not only answers the need for material cutting, but also ensures that operators comfort is guaranteed. Owing to the fact that all needed materials necessary for the functional and efficient running of the electric hacksaw was carefully selected, standard dimensions were taken where necessary to mitigate unwanted discrepancies of working parts that could lead to failure or under-performance.

The project enabled members of the team to develop their workshop operation skills such as welding, metal cutting, filing, etc., and also foster their experience with operating machine tools and equipment.

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