

DESIGN AND DEVELOPMENT OF MESH MAKING MACHINE

Submitted in partial fulfillment of the requirements for the award
of

Bachelor of Engineering degree in
Mechanical Engineering

By

J. JOEL BERGLIN (Reg. 40150702)

J.JOYSON (Reg. No. 40150019)



DEPARTMENT OF MECHANICAL ENGINEERING

SCHOOL OF MECHANICAL ENGINEERING

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with grade “A++” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI – 600119

APRIL - 2024



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited "A++" Grade by NAAC | 12B Status by UGC | Approved by AICTE
www.sathyabama.ac.in

DEPARTMENT OF MECHANICAL ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of J. JOEL BERGLIN (Reg.no 40150702) and J. JOYSON (Reg. No. 40150019) who carried out the project entitled "**DESIGN AND DEVELOPMENT OF MESH MAKING MACHINE**" under our supervision from December 2023 to April 2024.

Internal Guide
Dr.G. ARUN KUMAR, M.E., Ph.D.

Head of the Department
Dr. GANESAN S., M.E., Ph.D.,

Submitted for Viva voce Examination held on 06-04-2024

Internal Examiner
External Examiner

DECLARATION

We, J. JOEL BERGLIN (Reg.no 40150702) and J. JOYSON (Reg. No. 40150019) hereby declare that the Project Report entitled "**DESIGN AND DEVELOPMENT OF MESH MAKING MACHINE**" done by us under the guidance of **Dr.G.ARUN KUMAR, M.E., Ph.D.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.

1.



2.



DATE: 02-04-2024

SIGNATURE OF THE CANDIDATES

PLACE: CHENNAI

ACKNOWLEDGEMENT

We are pleased to acknowledge our sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

We convey our sincere thanks to **Dr. S. GANESAN., M.E., Ph.D.**, Head of the Department, Department of Mechanical Engineering for providing us necessary support and details at the right time during the progressive reviews.

We would like to express our sincere and deep sense of gratitude to our Project Guide **Dr.G. ARUN KUMAR, M.E., Ph.D.** for his valuable guidance, suggestions, and constant encouragement paved way for the successful completion of our project work.

We also express our thanks to all Teaching and Non-teaching staff members of the Department of Mechanical Engineering who were helpful in many ways for the completion of the project.

ABSTRACT

The project aim is to design and develop mesh making machine, which is also called specifically the Chain Link Fence Machine. The main objective is to improve wear resistance of fence. The authors are also discussed techniques used to enhance material surface properties. It provides a comprehensive description of the structure, manufacturing, and operation of the wire meshing machine (Chain-link fence). It is made by flattening a mesh of interconnected wire coils to an overall thickness perpendicular to the mesh equal to two to five times the diameter of the wire. The flattened mesh is then wrapped into tight coils or put in a container in a meandering way. A pattern or rollers can be used in this technique. In this work, the detailed design process, including the selection of materials, mechanical components, and control systems are discussed. The integration of safety mechanisms to protect operators and prevent machine malfunctions are discussed. Additionally, the paper highlights the economic feasibility of this machine through a cost-benefit analysis, demonstrating its potential for reducing production costs and increasing the competitiveness of chain link mesh manufacturers. The development of a mesh-making machine, specifically targeting the enhancement of wear resistance in chain-link fences, represents a significant advancement in the realm of fencing technology. This project aims to address the challenges associated with traditional wire meshing techniques by introducing a novel approach that not only improves durability but also streamlines the manufacturing process. At the core of this endeavor lies a meticulous design process, wherein careful consideration is given to various factors such as material selection, mechanical component specifications, and control system integration. The development of a mesh-making machine, specifically targeting the enhancement of wear resistance in chain-link fences, represents a significant advancement in the realm of fencing technology.

TABLE OF CONTENTS

CHAPTER No.	TITLE	PAGE No.
	ABSTRACT	v
	LIST OF FIGURES	viii
	LIST OF TABLES	ix
	LIST OF SYMBOLS AND ABBREVIATIONS	x
1	INTRODUCTION	1
	1.1 INTRODUCTION	1
	1.2 CHAIN LINK FENCE MACHINE	3
	1.3 COMMERCIALIZATION	3
2	LITERATURE SURVEY	4
3	AIM AND SCOPE	10
	3.1 INTRODUCTION	10
	3.2 ENHANCED PRODUCTIVITY	10
	3.3 PRODUCT QUALITY	11
	3.4 COST REDUCTION	11
	3.4.1 STANDARDIZING THE MACHINE	12
	3.4.2 IMPROVING MECHANICAL PROPERTIES	12
	3.5 REINFORCING MESH	12
4	MATERIALS AND EXPERIMENTAL METHOD	
	4.1 METHODOLOGY	13
	4.2 MATERIALS USED	15
	4.2.1 WIPER MOTOR	15
	4.2.2 MESHING MOLD	17
	4.2.3 G-WIRE	19
	4.2.4 STRAP IRON	21
	4.2.5 CHAIN SPROCKET	23

CHAPTER No.	TITLE	PAGE No.
5	RESULTS AND DISCUSSION	25
5.1	RESULT	25
5.2	DISCUSSION	28
	5.2.1 DESIGN SPECIFICATION	29
	5.2.2 DESIGN CALCULATION	30
	5.2.2.1 DESIGNING OF STRAP IRON	29
	5.2.2.2 DESIGNING OF MOLD	31
	5.2.2.3 DEVELOPMENT OF MATHEMATICAL MODEL	32
	5.2.3 2D MODEL OF MESH MAKING MACHINE	33
	5.2.4 3D MODEL OF MESH MAKING MACHINE	34
	5.2.5 OUTCOME OF PRODUCT MESH DEVELOPMENT	36
	5.2.6 TESTING OF MESH MAKING MACHINE	37
6	SUMMARY AND CONCLUSION	39
6.1	SUMMARY	39
6.2	CONCLUSION	40
	REFERENCES	41

LIST OF FIGURES

FIGURE No	TITLE	PAGE No.
4.1	METHODOLOGY	14
4.2	WIPER MOTOR	17
4.3	MESHING MOLD	19
4.4	G-WIRE	21
4.5	STRAP IRON	23
4.6	CHAIN SPROCKET	24
5.1	PITCH AND DIAGONAL DISTANCE	26
5.2	PITCH AND DIAGONAL DISTANCE	27
5.3	2D MODEL OF MESH MAKING MACHINE	33
5.4	OVER ALL VIEW OF MESH MAKING MACHINE	34
5.5	SIDE VIEW OF MESH MAKING MACHINE	34
5.6	FRONT VIEW OF MESH MAKING MACHINE	35
5.7	TOP VIEW OF MESH MAKING MACHINE	35
5.8	OUTCOME OF THE PRODUCT	36
5.9	TESTING OF MESH MAKING MACHINE	38

LIST OF TABLES

TABLE No	TITLE	PAGE No.
5.1	DATA OF INDUSTRIAL SAMPLES	26
5.2	DATA OF MOLD SAMPLES	27
5.3	COMPARISON OF PREDICTED AND OBTAINED VALUES	28

LIST OF SYMBOLS AND ABBREVIATIONS

V_c	Cutting speed (mm/sec)
N	Spindle speed (rpm)
V_c	Penetration rate (mm/sec)
F_n	Feed per revolution (mm/rev)
MRR	Metal Removal Rate (Q)
M_c	Torque (N/m)
T_c	Machining Time (sec)
A_e	Axial depth of cut (mm)
A_p	Radial depth of cut (mm)
R_a	surface roughness factor
L	length of cut (mm)
D	diameter (mm)
F_x	Tangential Force (N)
F_t	Thrust Force (N)

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The design and development of a mesh-making machine represent a remarkable intersection of engineering innovation and industrial necessity. In an era characterized by rapid urbanization, infrastructure expansion, and an ever-growing demand for construction materials, the importance of efficient and precise mesh production cannot be overstated. This machine, carefully conceived and meticulously engineered, serves as the backbone of various industries, including construction, manufacturing, agriculture, and more.

The primary objective behind the creation of this mesh-making machine is to revolutionize the way mesh products are manufactured. It addresses key challenges such as improving productivity, enhancing the quality and consistency of mesh, reducing labor costs, and ensuring safety in the production process.

This is a cutting-edge technology, including motorized components, computerized control systems, and advanced materials, to create a robust, reliable, and versatile machine capable of meeting the evolving needs of various industries. The ability to adjust mesh sizes, patterns, and production speeds ensures adaptability to a wide range of applications, making it a versatile asset for manufacturers.

Furthermore, the development reflects a commitment to sustainability. By streamlining the mesh-making process, it minimizes material waste and energy consumption, contributing to a more environmentally conscious manufacturing approach.

In this exploration of the design and development of the motorized mesh-making machine, we will develop into its key components, the innovative technologies employed, the engineering principles governing its operation, and the potential impact on the industries worldwide. Through this journey, we aim to shed

light on the transformative potential of this machine and its role in shaping the future of mesh production.

The design and development of a mesh making machine represents a significant leap in the field of industrial automation and construction technology. This innovative machine is poised to revolutionize the manufacturing process of chain link fences and meshes, offering increased efficiency, precision, and cost-effectiveness. In this introduction, we will develop the fascinating world of this groundbreaking machine, exploring its purpose, significance, and the exciting potential it holds for various industries.

Chain link mesh, widely used in applications such as fencing, security barriers, and construction, has traditionally been produced through labor-intensive manual processes. These processes are not only time-consuming but also prone to errors and inconsistencies, resulting in a less-than optimal final product. The need for a solution that can automate and streamline this production has never been more apparent.

The design and development of a chain link mesh making machine aim to address these challenges by harnessing cutting-edge technology, robotics, and advanced materials. This machine promises to deliver precise and uniform mesh products at a pace that surpasses human capabilities, while also reducing the need for manual labor and associated costs.

Moreover, the chain link mesh making machine's potential extends beyond just manufacturing efficiency. It can enhance the overall quality of chain link products, ensuring they meet or exceed industry standards. This, in turn, translates into stronger and more durable fences and meshes, with applications ranging from securing properties to supporting infrastructure projects.

In this exploration of the design and development of the chain link mesh making machine, we will delve into its inner workings, the technology driving it, the benefits it offers, and its potential impact on various sectors. By understanding the ingenuity behind this innovation, we can appreciate its role in shaping a more efficient and reliable future for the manufacturing and construction industries.

In conclusion, the design and development of a chain link mesh making machine is a significant engineering challenge with far-reaching implications. Its ability to produce high-quality chain link mesh efficiently impacts industries ranging from construction and agriculture to security and infrastructure. By embracing innovation and employing cutting-edge technology, engineers are working tirelessly to create machines that meet the growing demand for this essential product. This journey towards excellence in manufacturing showcases the power of human ingenuity and engineering prowess.

1.2 CHAIN LINK FENCE MACHINE

A chain link fence is a highly popular fencing option renowned for its utilitarian design and practical applications. It is constructed using a series of interconnected metal wires, traditionally fabricated from steel or aluminum, which are meticulously woven to form a distinctive diamond-shaped mesh pattern.

One of the standout features of a chain link fence is its exceptional durability. The materials used in its construction are specifically chosen for their resistance to rust, corrosion, and weathering, ensuring that the fence retains its structural integrity even in challenging outdoor environments. This longevity is further enhanced by the option of galvanizing the metal wires, a process that involves coating them with a protective layer of zinc to bolster their resilience against the elements.

1.3 COMMERCIALIZATION

We also aim to commercialize to replace the locally made machine with the one that is based on perfect calculations. This would enable our local market to produce precise and high-quality fence. Thus, instead of importing it we can save enough money by generating good quality product locally.

CHAPTER 2

LITERATURE SURVEY

Renton, D., and Elbestawi, M.A. (2000): In the research paper titled as “Enhancement in the wear resistance by hard facing” the authors have given a broader view of increasing the wear resistance abilities of materials using the technique of hard facing. In today’s Industrial Era the problem of wear has become a headache for the owners of different industries. According to economical point of view, this is becoming a very costly service for the industrialists as they have to repeatedly check the condition of the equipment and in case of the failure, they have to replace it causing more money and ultimately affecting the production of the industry. The technique which is being discussed in this research paper is surfacing in which the properties (like corrosion resistance, wear resistance) of the material are improved by the addition of some superior material having good wear properties over the surface of the base metal. The other objective that is obtained through surfacing is shaping the material in the required dimensions. However, the criteria of success solely depend upon the objective for which the material is to be used and, on the structure.

Krishnan, R. et al (2001): In the research paper titled as “Improving the wear resistance of coating surface by magnetron sputtering”, the author has discussed the ways of increasing the wear resistance of the material by sputtering the Magnetron particles. The mentioned research paper effectively discusses the ways of improving the wear resistance and reducing the friction losses on the surfaces of the coating surfaces (mostly epoxy resins) by using the method of Magnetron sputtering (metallic or non-metallic). The mentioned method of increasing the wear resistance is also used to decrease and ultimately diminish the abrasion losses. It also comprehensively demonstrates the ways of decreasing the friction losses and enhancing the wear resistance ability of the surfaces. This research paper

discusses the use of Ti/C on the surfaces of coatings (epoxy resins), ultimately increasing the wear resistance ability of the coated surface and enhancing the surface properties to a new level with the help of calculations and data obtained from the experimental analysis. The research paper further explains the process of sputtering and how it increases the surfaces properties of the materials. According to the mentioned research paper the Magnetron sputtering acts as the lubricating film ultimately enhancing the wear and surface properties of the material and it opens many new possibilities of enhancing the surface properties of the coating materials using the Magnetron sputtering.

Singh, R., and Vinayak, H. (1998): A frame of metal screen has numerous types but the most commonly used is a wire mesh. A wire mesh is a network of wires usually galvanized that consists of parallel rows and also the columns that intersect. Most of the times metal sheets that are either expanded or perforated are considered to be the wire meshes due to resemblance in the physical appearance and uses in the daily life. But they are not the wire meshes. There exists a huge variety in the types of wire meshes depending upon the manufacturing material and the required dimensions and shape of the mesh. In the wire meshes the network of the wires (mostly galvanized) is made by the welding the wires at different points giving the mesh its shape. In the manufacturing of the wire mesh welding or weaving are the most commonly used joining methods. The specific wire that is used in making the meshes is made in a very specific manner.

Norton, J., and Arraez, C. (2000): Welded wire meshes are made in a very specific way in which the required shape of the mesh is obtained by joining the metal wires with the help of different welding techniques. The metal wires are arranged in such a way that there are parallel rows and parallel columns and then they are welded at the intersection points that are equidistant. Before introducing the metal wire into the machine, the wire is machined down to the required dimensions. After feeding it into the machine, the wire makes the mesh of the required shape and size. When the wire is in the machine and the machine is being made the welding is done simultaneously in parallel series meeting the perpendicular lines. After machining

the previous mesh, the next batch of the mesh is introduced into the machine where the welded joints are made, and this process goes on and on. The heat source of the metal wires that are being used in the manufacturing of the welded meshes is the electrical resistance. At the end of the process, the length of the mesh is checked and if required length is obtained then it is cut with the help of different techniques giving a continuous strong and rigid frame of meshes. A wire meshing machine is basically a transforming machine changing the metallic wires into the meshes of the required shape and sizes. Different types of wires depending upon the composition and the size are used in the manufacturing process.

Voll, B.A., B.M. Richard, and A.D. Gabrysch. (1998): The woven wire mesh resembles a lot with a woven cloth and its principle is quite similar to a cloth weaving machine. Unlike the welded mesh the woven mesh consists of arrays of lines that intersect. The main goal or purpose of manufacturing a stable sheet of meshes is obtained by weaving the wires over and under the perpendicular wires and the produced pattern of the meshes is known as the “Plain Weave Mesh”. Another pattern can be made by using this technique known as the “Twill Weave Mesh”, but they are required in the fields where more flexibility is required. And to elaborate further in this method a single wire is woven over two perpendicular wires and then under and the process goes on until the required length of the mesh frame is obtained. As in this method no welding or other joining process is required, the required pattern of the mesh is obtained by introducing the wire into a machine having different pattern of meshes according to the requirement. After passing through the chosen pattern of the mesh the wires are given curls and after that the next wire is introduced into the machine.

Chondros, T.G. et al (2009): A chain link fence is made up of chain link wire meshes. The chain link wire meshes are basically a type of woven wire mesh in which usually galvanized steel wire is used although other types of wires for example aluminum wires, PVC wires can also be used. In a chain link wire mesh, the galvanized steel wires are interlinked with each other in a zig zag pattern in such a way that they form a diamond shaped box when they are fully in the form of

mesh. The manufacturing of chain-link fencing is called weaving. A metal wire, often galvanized to reduce corrosion, is pulled along a rotating long and flat blade, thus creating a somewhat flattened spiral. The spiral continues to rotate past the blade and winds its way through the previous spiral that is already part of the fence. When the spiral reaches the far end of the fence, the spiral is cut near the blade. Next, the spiral is pressed flat and the entire fence is moved up, ready for the next cycle. The end of every second spiral overlaps the end of every first spiral.

Owens, W.A. and E.A. Otto (1939): The main task of the mold is to shape the mesh according to the requirements. The size of the diagonal of the mesh is determined by the pitch and the internal diameter of the die. Greater the pitch and diameter of the die, greater will be the diagonal of the mesh. Mold is the most important part of the whole machine as it gives the mesh the required shape. As the mold is under constant forces, temperature changes it is subjected to a wear. In order to make the mold so that it can sustain for a longer period requires a selection of the material that have good material properties. Molds are crucial in mesh making machines as they determine the final pattern and structure of the mesh. They ensure precision and consistency, improving product quality. Molds are essential for creating mesh products that meet industry standards and customer expectations.

Menon, K., and Krishnamurthy, K (1999): The chain-linked fences with motorized components reveals a burgeoning interest in the integration of automation and security within perimeter fencing systems. Researchers have delved into the utilization of motorized gates and barriers as integral parts of chain-linked fences, aiming to significantly enhance access control and safety measures. This has become particularly relevant in our modern, security-conscious world. Numerous studies have explored a diverse range of motorization technologies, such as electric actuators and automated gate openers, which offer the advantages of convenience and remote-controlled access. This technological diversification allows for adaptable solutions that cater to specific user requirements and situational demands. Moreover, research has increasingly focused on the synergistic integration of sensors and surveillance systems with motorized chain-

linked fences. This fusion of technologies not only reinforces perimeter security but also augments monitoring capabilities, providing real-time insights and early threat detect.

Smith, R.V. and A.M. Shannon (1990): The wire mesh filters used in mesh making machines reveals a critical component that significantly influences the quality and efficiency of wire mesh production. Researchers have explored various aspects of wire mesh filters to optimize their performance and ensure the production of high- quality mesh. Studies in this field have delved into the materials used for wire mesh filters, focusing on their durability, corrosion resistance, and heat resistance, as these factors are crucial for maintaining filter integrity and longevity during the mesh- making process. Additionally, researchers have investigated the design and mesh size of these filters to achieve specific filtration goals, ensuring that the final wire mesh product meets the desired specifications. Efforts to enhance wire mesh filter manufacturing have included the development of advanced production techniques and quality control processes. These advancements contribute to consistent filter quality and reduce variability in mesh production. Moreover, research in this area has explored the impact of wire mesh filters on the overall efficiency of mesh making machines, aiming to minimize downtime and maintenance while maximizing output and product quality.

Tabor, D.et al (2000): The hardness of metal used in mesh making machines is a critical factor that significantly influences the performance, durability, and longevity of wire mesh products. The selection of the appropriate metal hardness is vital to ensure that the resulting mesh can withstand the intended applications and environmental conditions. Metals used in mesh making machines are typically characterized by their hardness, which is the material's ability to resist deformation, scratching, or penetration. In wire mesh production, commonly used metals include stainless steel, carbon steel, and various alloys, each with its own hardness properties. Stainless steel, known for its corrosion resistance and durability, often features different levels of hardness depending on the specific alloy. This makes it suitable for a wide range of applications, from fine filtration to heavy-duty industrial use. Carbon steel, which is less corrosion-resistant but exceptionally strong, offers

high hardness, making it ideal for heavy-duty mesh applications like concrete reinforcement. Alloy metals, such as brass or bronze, can be used in decorative or architectural wire mesh and have varying hardness levels based on their composition.

McLoughlin, T.P. et al (1985): The fence assembly for a mesh making machine is a fundamental component that plays a crucial role in guiding and securing the wire during the mesh production process. It is typically a structured framework that surrounds the working area of the machine, ensuring that the wire maintains its alignment and spacing during weaving or welding. The fence assembly consists of sturdy frames, rollers, tensioning devices, and guides to facilitate the precise movement of the wire mesh as it is formed. These components work together to maintain proper tension, alignment, and spacing of the wires, resulting in a uniform and high-quality mesh product. In weaving machines, the fence assembly guides the wires over and under each other to create the desired mesh pattern.

Mischke, C.R. and J.E. Shigley (1996): The machine design for a mesh making machine is a critical aspect of ensuring the efficiency and functionality of this industrial equipment. Typically, the design includes a robust frame or chassis that provides structural stability to support the entire system. The frame is often made from durable materials like steel to withstand the stresses of the wire mesh production process. Key components in the machine design include wire feed mechanisms that facilitate the continuous supply of wire to the weaving or welding area. These mechanisms are often equipped with tensioning systems to ensure consistent wire tension, which is essential for creating uniform mesh. The weaving or welding mechanism is at the core of the design.

Juvinall, R.C. et al (2007): Machine component design for a mesh making machine encompasses several fundamental considerations that are essential for the equipment's functionality and efficiency. Firstly, material selection is crucial. Components must be made from durable and corrosion-resistant materials, such as steel or specific alloys, to withstand the mechanical stresses and potential exposure to harsh environmental conditions.

CHAPTER 3

AIM AND SCOPE

3.1 INTRODUCTION

The aim and scope of mesh making machine in modern manufacturing is of paramount significance. These specialized machines are designed with the primary goal of enhancing productivity, improving product quality, and reducing production costs. Their scope is broad, encompassing the production of various types of mesh, including chain link fences, reinforcing mesh, and wire grids, which find application across industries such as construction, agriculture, and manufacturing. Moreover, these machines have an international reach, serving global markets and catering to diverse industrial requirements. As technology advances and industries evolve, the aim and scope of mesh making machines continue to play a pivotal role in shaping the landscape of efficient, high-quality mesh production.

3.2 ENHANCED PRODUCTIVITY

A primary objective of mesh making machines is the substantial enhancement of manufacturing productivity. These specialized machines are meticulously designed to automate and streamline the production of a wide array of mesh products, encompassing chain link fences, reinforcing mesh, and wire grids. They achieve this by mechanizing tasks that were traditionally labor-intensive, a transformation that leads to a remarkable increase in production rates.

The impact of these machines extends beyond productivity gains, as they play a vital role in various industries, including construction, agriculture, and manufacturing. By automating mesh production, they enable manufacturers to meet growing demands while maintaining product consistency, ultimately contributing to cost-effectiveness and competitiveness in the market. In essence, mesh making machines are instrumental in revolutionizing the manufacturing landscape, offering a combination of efficiency and quality that was previously unattainable through manual labor.

3.3 PRODUCT QUALITY

The product quality achieved by mesh making machines is a testament to their precision and reliability. These machines are engineered to consistently produce mesh products of exceptional quality, meeting stringent industry standards. The mechanized processes, guided by advanced technology and precise control systems, ensure uniformity in mesh dimensions and integrity. This not only enhances the aesthetic appeal of the mesh but also improves its functional characteristics, such as strength and durability. Whether it's chain link fences, reinforcing mesh, or wire grids, mesh making machines deliver products that exhibit minimal variations and defects. This commitment to quality has a profound impact on the industries they serve, underlining the crucial role of these machines in delivering reliable and superior mesh products

3.4 COST REDUCTION

A core objective of mesh making machines is the reduction of production costs. These machines primarily achieve this aim by automating intricate processes and minimizing the reliance on manual labor. By streamlining and mechanizing various production stages, mesh making machines contribute significantly to cost efficiency. This cost-effective approach results in competitive pricing for the mesh products they manufacture. Consequently, manufacturers can offer their products in the market at more appealing price points while maintaining profitability. The ability to achieve cost reduction through automation positions mesh making machines as valuable assets in manufacturing operations, benefiting both producers and consumers through improved affordability and economic viability.

It is a paramount objective in the development and implementation of mesh making machines. These machines aim to streamline the manufacturing process and optimize resource utilization, ultimately leading to significant cost savings. By automating labor-intensive tasks and minimizing human involvement, mesh making machines decrease the need for manual labor, which is often a substantial part of

the overall production expenses. Additionally, they contribute to reducing material waste and enhancing operational efficiency.

3.4.1 STANDARDIZING THE MACHINE

The main aim on which we are working on this machine is to standardize this machine. As described above that local machine is all based on rough calculations, so our output is of low quality and not precise. For this reason, our first aim is to precise this machine by standardizing the calculations and measurements of all the parts and instruments used in it for example standardizing the scaling of die, including its inner and outer diameter, its pitch and separation between grooves so that fence of perfect alignment is produced.

3.4.2 IMPROVING MECHANICAL PROPERTIES

Another important step is improving the material of various parts used in this machine. This includes the material testing of the material used in it and also of different materials to obtain a material with maximum yielding and ultimate strength. This is very important to choose a right material with maximum possible material strength because as it is a continuously working machine, so material becomes wear very quickly if it has less material strength or if wearing of material used is not properly studied. This will cause less life of machine parts specially mold and thus extra cost which make this operation less economical.

3.5 REINFORCING MESH

Reinforcing mesh, a vital product of mesh making machines, is a grid-like structure composed of interconnected steel wires. It serves as a critical component in reinforcing concrete structures, such as walls, floors, and foundations. Reinforcing mesh enhances the structural integrity of these constructions by providing tensile strength, preventing cracks, and increasing load-bearing capacity. Its use significantly improves the durability and longevity of concrete elements. Mesh making machines are designed to produce reinforcing mesh with precision, ensuring uniformity and high-quality products.

CHAPTER 4

MATERIALS AND EXPERIMENTAL METHOD

4.1 METHODOLOGY

Creating a mesh-making machine involves a systematic methodology that encompasses several key steps, each crucial to the successful development of this specialized manufacturing equipment.

The first step in this process is concept development and design. Engineers and designers collaborate to outline the machine's specifications, capabilities, and intended applications. This phase involves determining the type of mesh to be produced, the materials to be used, and the desired mesh size and configuration. Next, detailed engineering and prototyping become essential. Engineers create a comprehensive design, including the machine's mechanical and electrical components, ensuring that it can efficiently and accurately produce the specified mesh. Prototypes are built and tested to identify any design flaws and make necessary improvements.

Following successful prototyping, the manufacturing process begins. This stage involves sourcing high-quality materials, fabricating the machine's components, and assembling the final product. Quality control procedures are implemented throughout to ensure precision and consistency in mesh production.

Software development and automation are also pivotal components of mesh-making machines. Developing custom software to control the machine's operations, such as adjusting mesh dimensions, monitoring production, and troubleshooting errors, is integral to its functionality and efficiency.

Once the machine is complete, rigorous testing and calibration are performed to fine-tune its performance and ensure it meets industry standards and specifications. In conclusion, designing and building a mesh-making machine is a complex and multifaceted process that combines engineering, design, manufacturing, software development, and quality control. This methodology results in a reliable and efficient machine capable of producing high-quality mesh for various applications.

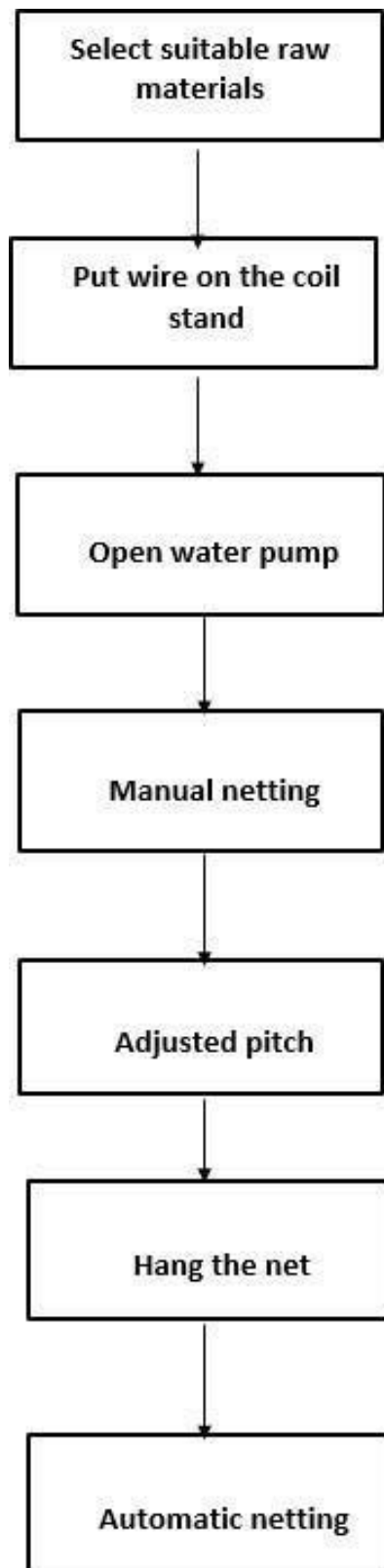


Figure 4.1 Methodology

4.2 MATERIAL USED

In the manufacturing of an industrial processes, experimentation plays a pivotal role in optimizing machinery and techniques. In this context, we introduce an experimental setup designed to demonstrate the functionality of a mesh making machine, employing common components such as a wiper motor, galvanized wire, strap iron, chain sprocket and a mesh mold. This experimental arrangement allows us to gain practical insights into the process of mesh production, emphasizing the adaptability and versatility of mesh making machinery for various applications, from chain link fencing to reinforcing mesh for construction. Through this setup, we can explore the dynamics of wire manipulation, mold utilization, and the role of the wiper motor in automating the mesh production process, shedding light on the key elements that make mesh making machines an indispensable asset in modern manufacturing.

4.2.1 WIPER MOTOR

A wiper motor, as depicted in Figure 4.2, serves as a specialized and indispensable component within the context of a mesh-making machine. This mechanical or electrical device is meticulously engineered to perform repetitive and controlled motions or sweeps, ultimately aimed at facilitating the precise and consistent creation of mesh structures.

The primary function of a wiper motor in the realm of mesh production is to orchestrate the systematic and synchronized movement of critical components or mechanisms involved in the mesh-making process. This orchestration of movement is integral to ensuring the uniformity, accuracy, and quality of the resulting mesh products.

At the heart of its operation, the wiper motor acts as the driving force that powers and controls essential elements within the mesh-making machine. These elements can encompass cutting blades responsible for shaping the mesh, wire feeders that provide the raw material for mesh production, or alignment mechanisms crucial for maintaining the correct positioning of wires or threads.

The controlled and coordinated movement enabled by the wiper motor is fundamental to achieving the desired mesh pattern, thickness, and dimensions. This precision ensures that the mesh product adheres to stringent specifications, meeting the specific requirements of various industries and applications.

In practical terms, the wiper motor's role extends beyond mere motion generation. It operates in a manner that guarantees that each element involved in the mesh-making process operates in harmony, preventing inconsistencies or irregularities in the final product. This meticulous control results in a mesh structure that not only exhibits visual uniformity but also possesses the necessary structural integrity and reliability demanded by industries such as construction, agriculture, and fencing.

Furthermore, the reliability and durability of wiper motors are key attributes that contribute to their suitability for mesh-making applications. These motors are engineered to endure continuous and repetitive operations, ensuring their longevity and consistent performance over extended periods. Their robust design makes them well-equipped to withstand the demands of the mesh production environment.



Figure 4.2 Wiper Motor

In essence, a wiper motor serves as the driving force behind the intricate and repetitive motions required during mesh production, contributing to the

machine's overall efficiency and the quality of the final mesh product. It ensures that each cycle of the mesh-making process is executed with precision, leading to consistent and high-quality mesh products suitable for a wide range of industrial applications.

4.2.2 MESHING MOLD

Meshing mold: as shown in fig 4.3 serve as fundamental tools in various industries, revolutionizing the production of mesh structures. These molds are ingeniously designed with openings, slots, or channels, meticulously crafted to accommodate the specific material of choice. The result is a versatile framework that allows for the precise shaping and configuration of the mesh according to the mold's exact specifications. This intricate process, often requiring additional manufacturing steps like welding, weaving, or bonding, depends on the material selected and the technique employed for mesh creation. The utilization of a mesh mold not only streamlines the production process but also significantly contributes to the overall quality and reliability of the finished mesh, rendering it suitable for a diverse range of applications, thereby enhancing the efficacy of numerous industries.

In the field of engineering, meshing molds are invaluable tools for finite element analysis (FEA). To simulate the behavior of structures under different conditions, and meshing molds play a pivotal role in accurately representing complex geometries. To create custom meshes tailored to the specific application is indispensable for optimizing structural designs, whether in aerospace, civil engineering, or automotive industries. The meshing process, facilitated by these molds, allows engineers to analyze stress distribution, thermal properties, and fluid flow, ensuring the structural integrity and safety of critical components.

The application of mesh molds extends to the realm of computer graphics, where they are instrumental in shaping the virtual world. In video games, animations, and simulations, artists and developers rely on meshes to define the 3D objects that populate these virtual environments. Mesh molds provide a

foundation for modeling characters, vehicles, buildings, and landscapes, enhancing the visual fidelity and immersion of digital experiences.

Scientific simulations also heavily depend on mesh molds for numerical solutions to complex physical problems. Whether it involves modeling fluid dynamics, heat transfer, or electromagnetism, researchers require accurate meshing to approximate real-world phenomena. By using mesh molds, scientists can perform simulations that inform critical decisions in fields as diverse as environmental science, materials science, and biomedical research.

It is an essential component responsible for shaping and defining the specific pattern, size, and structure of the mesh product being manufactured. The meshing mold's design can be customized to produce various types of mesh, such as chain link fences or reinforcing mesh for concrete. Its role is pivotal in achieving the desired product specifications and quality. The adaptability of meshing molds underscores their importance in accommodating diverse industrial applications and enhancing the efficiency and versatility of mesh making machines.



Figure 4.3 Meshing Mold

4.2.3 G WIRE

G-wire: as shown in fig 4.4 assumes a pivotal role across various applications and is typically identified by a gauge number, such as "G wire 10" or "G wire 16". These gauge numbers are of paramount significance as they precisely convey the wire's thickness or diameter. In this standardized system, lower gauge numbers indicate thicker wires, while higher gauge numbers signify thinner wires.

The choice of G-wire gauge assumes critical importance in shaping the performance and attributes of the mesh, necessitating a meticulous evaluation of factors such as strength, flexibility, and the desired mesh opening size. The gauge number assigned to G-wire conforms to an established measurement system, ensuring consistency and precision in industries where G-wire plays a fundamental role. For instance, in domains like construction and architecture, the gauge of G-wire becomes a pivotal parameter in the design and fabrication of mesh structures tailored to a wide array of applications.

In scenarios where structural robustness is of primary concern, opting for a lower gauge G-wire, indicating a thicker diameter, is the preferred course of action. Thicker wires inherently possess superior strength and durability, rendering them ideal for applications demanding structural reinforcement, the creation of resilient security fences, or the construction of heavy-duty industrial partitions. These meshes are engineered to withstand the rigors of challenging environments, providing the essential support and longevity required.

Conversely, higher gauge G-wires, denoting thinner diameters, offer distinct advantages in applications where flexibility and the attainment of finer mesh openings are imperative. The heightened flexibility of thinner G-wires facilitates ease of handling and installation, rendering them apt for applications necessitating intricate shapes or contours. In conclusion, G-wire, demarcated by its gauge number, serves as a versatile component across a spectrum of applications. The gauge system, with lower numbers representing thicker wires and higher numbers denoting thinner wires, affords precise control over wire dimensions, enabling tailored solutions for specific use cases. Be it the assurance

of structural integrity in construction or the fulfillment of flexibility and finer mesh requirements in filtration, the judicious selection of the appropriate G-wire gauge is instrumental in meeting in each application.

The G wire serves as the fundamental building block for creating the mesh structure, as it is woven or interconnected to form the desired pattern. Its strength and longevity ensure that the final mesh product can withstand various applications, from chain link fencing to reinforcing concrete structures. G wire's versatility and resilience make it an indispensable component in mesh making machines, contributing to the creation of robust and long-lasting mesh products.



Figure 4.4 G-Wire

4.2.4 STRAP IRON

Strap iron, as depicted in Figure 4.5, plays a crucial role in the realm of mesh making. This versatile material consists of elongated strips or bars, typically crafted from metals like steel or iron. What sets strap iron apart is its distinctive flat and elongated shape, making it an ideal choice for a wide range of applications within the mesh-making process.

The use of strap iron in mesh fabrication offers a multitude of advantages. Its flat profile ensures a smooth and consistent surface, which is paramount when creating mesh structures. The uniformity of strap iron strips contributes to the precision of the mesh, resulting in a final product that meets stringent quality standards.

One of the primary applications of strap iron in mesh making is as a framework or support structure. These elongated strips are strategically positioned to create a sturdy foundation for the mesh. This reinforcement enhances the mesh's stability and durability, allowing it to withstand various external forces and environmental conditions. Whether used in fencing, industrial sieving, or architectural mesh designs, strap iron provides the necessary structural integrity.

The flat nature of strap iron also simplifies the mesh assembly process. Its ease of handling and manipulation makes it convenient for mesh manufacturers to customize the mesh according to specific requirements. This adaptability ensures that mesh structures can be tailored to fit a myriad of applications, from security barriers to filtration systems.

Additionally, strap iron's compatibility with various metalworking techniques, such as welding and bending, makes it an invaluable resource in mesh fabrication. This allows for the creation of intricate mesh designs with precise dimensions and specifications. It also facilitates the integration of strap iron into larger mesh assemblies, offering versatility mesh design and configuration.

In the context of mesh making, strap iron's contributions are substantial and wide-reaching. Its flat, elongated form provides a solid foundation for mesh structures, ensuring stability and reliability. Whether as a reinforcing framework or a component of intricate mesh designs, strap iron's adaptability and compatibility with metalworking processes make it an indispensable material in the world of mesh fabrication. Its enduring presence continues to shape and enhance the quality and versatility of mesh products across various industries.

In conclusion, strap iron is an indispensable component in the realm of mesh making machines, contributing significantly to the precision and reliability of chain link mesh production. Its robust construction, corrosion-resistant materials, and ease of installation make it a fundamental element that ensures the quality and efficiency of the entire manufacturing process. Strap iron exemplifies the fusion of

engineering expertise and durable materials, facilitating the creation of high-quality chain link mesh for various industrial and commercial applications.

It is employed as a support element in the machine, ensuring that the mesh pattern and dimensions are accurately maintained as the manufacturing process progresses. Strap iron's rigidity and durability make it an ideal choice for this purpose, as it can withstand the mechanical stresses and pressures involved in mesh production. Its role is pivotal in guaranteeing the final mesh product's integrity and consistency, contributing to the quality and reliability of the mesh created by the machine.



Figure 4.5 Strap Iron

4.2.5 CHAIN SPROCKET

Chain sprocket, as depicted in Figure 4.6. A chain sprocket plays a fundamental role in driving and controlling the intricate machinery that transforms raw materials into precise and structured mesh products. It serves as a crucial mechanical component, typically connected to the machine's power source, often an electric motor. The chain sprocket is responsible for transmitting motion to the machine's various moving parts, such as rollers, feed mechanisms, and wire manipulation components, facilitating the entire production process.

One of the key features of a chain sprocket is its ability to provide consistent and synchronized motion. This is particularly vital in mesh making machines where precision and uniformity are paramount. The sprocket's design, including the size and the number of teeth, is carefully calibrated to achieve specific mesh patterns and dimensions. As the sprocket rotates, it engages with a chain, ensuring that the different elements of the machine move in harmony, resulting in a well-defined and structured mesh product.



Figure 4.6 Chain Sprocket

The adaptability of chain sprockets is another noteworthy aspect. Mesh making machines often require adjustments to accommodate various mesh patterns and sizes. Chain sprockets can be readily swapped out to modify the machine's operation, enabling manufacturers to produce different types of mesh with minimal downtime. This versatility is essential in meeting the diverse needs of the market, where mesh products vary widely in terms of size, shape, and application.

Furthermore, chain sprockets contribute to the reliability and durability of mesh making machines. The engagement between the sprocket and chain is

designed to withstand considerable mechanical stress, ensuring the machine's longevity and consistent performance over time. This reliability is essential in high-production environments where continuous operation is crucial for meeting demand and maintaining quality standards.

In summary, the chain sprocket in a mesh making machine is an integral component that drives the machinery, ensuring precise and synchronized motion. Its adaptability and ability to withstand mechanical stress make it a cornerstone of the manufacturing process, allowing for efficient production of various mesh types while maintaining machine longevity and reliability. The role of the chain sprocket underscores its significance in the manufacturing industry, where the production of structured mesh products is integral to numerous applications and sectors.

CHAPTER 5

RESULT AND DISCUSSION

5.1 RESULT

The Chain Link Wire Meshing Machine can generate meshes of different sizes defined by the diagonal distance of the meshes. The design of the mold is very important in the functioning of the wire meshing machine. The buyers mostly require the fences depending upon the size of meshes. The size of the mesh is defined by the diagonal distance of the mesh. In order to develop a mathematical relation for the designing of the mold, it was necessary to obtain observations from the samples available in the local market. So, for that purpose around nine samples were taken from the local industry in the form of diameter of mold and corresponding mesh sizes.

With the help of developed mathematical equations, now it is possible to produce any mesh size according to the requirements of the buyer. The mesh size defines the designing of the mold. The design of the mold available in the local market was totally based on hit and trial method, that's why it was necessary to obtain different samples of the mesh sizes and molds and with the help of obtained data develop some mathematical relations for mold designing.

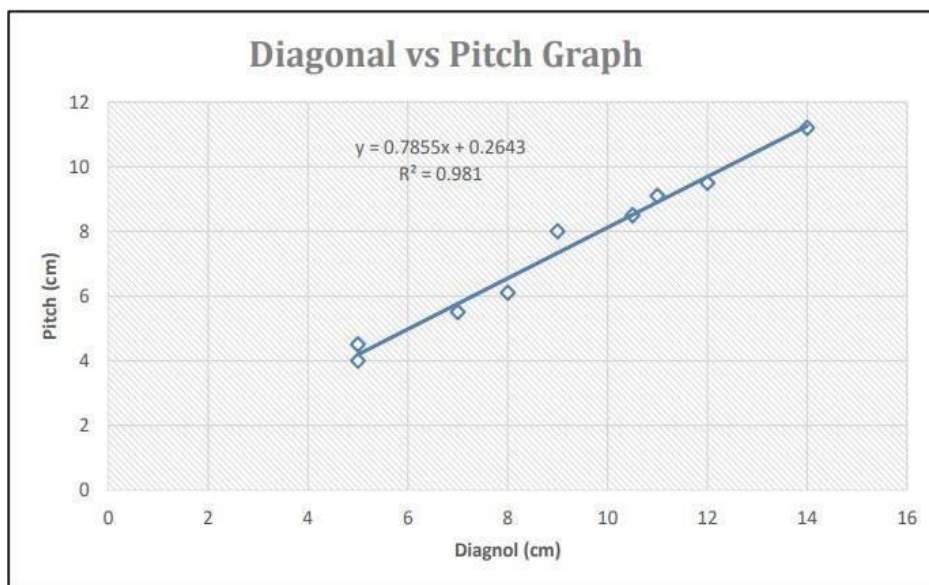
In the first part of analysis, a graph was obtained between the pitch and the diagonal distance. With the help of regression analysis, a mathematical equation was developed for finding out the pitch of the mold. Now, after obtaining the pitch a graph was obtained between pitch and internal diameter of mold.

The Table 5.1 shows measurements of pitch and diagonal distance taken from nine different samples and Figure 5.1 plots the data for statistical analysis

Table 5.1: Data of industrial samples

Sr. No	Pitch(cm)	Diagonal Distance(cm)
1.	4	5
2.	4.5	5
3.	5.5	7
4.	6.1	8
5.	8	9
6.	8.5	10.5
7.	9.1	11
8.	9.5	12
9.	11.2	14

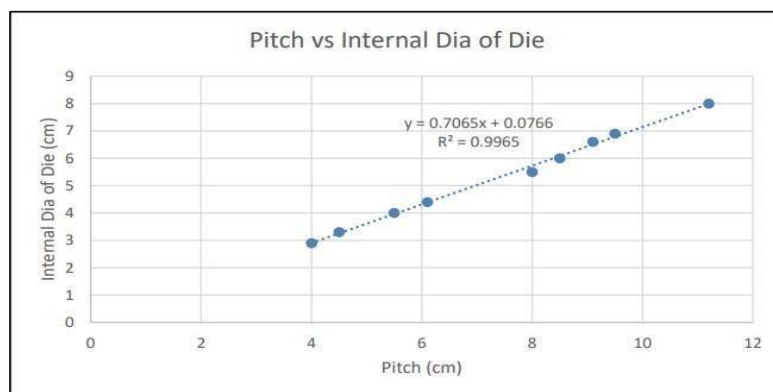
The following figure shows the relation between pitch and diagonal distance



The figure 5.1 shows the measurement of pitch and diagonal distance Table 5.2 Data of mold samples

Sr. No	Pitch(cm)	Internal Diameter(cm)
1	4	2.9
2	4.5	3.3
3	5.5	4
4	6.1	4.4
5	8	5.5
6	8.5	6
7	9.1	6.6
8	9.5	6.9
9	11.2	8

After regression analysis of the second graph a mathematical relationship was developed between pitch and internal diameter of the mold.



The figure 5.2 shows the relation between pitch and diagonal distance

5.2 DISCUSSION

Now, the above data and its analysis gives the mathematical relations required to design a mold according to defined requirements. The first relation gives the values of the pitch of the mold, so if the size of the mesh is known the pitch can be easily found out.

$$\text{Pitch} = (0.7855 \times \text{Diagonal of required mesh}) + 0.2643 \quad (5.1)$$

With the help of above equation, the pitch can be found which will be used further. Now, the second graph is drawn between pitch and internal diameter of the mold of different samples. Thus, developing equation for the internal diameter of mold which is required for its design.

$$\text{Internal Diameter} = (0.7065 \times \text{Pitch}) + 0.0766 \quad (5.2)$$

The above equations fulfill the requirements for the designing of mold which is the single most important thing in determining the product type. The meshes of 12, 14- and 16-gauge wires have been produced from the developed Chain Link Fence Machine by using above developed equations. The Table 5.3 shows a comparison between predicted values and obtained results using a mesh size of 7.7 cm.

Table 5.3: Comparison of predicted and obtained values

Parameter	Predicted value(cm)	Obtained Results(cm)	%Error
Diagonal	7.7	7.7	0%
Pitch	6.31	7.1	12.51%
Internal Dia. Of Die	4.5	3.7	17.7%

5.2.1 DESIGN SPECIFICATION

Base Frame:

Length of the frame = 16 Inches

Width of the frame = 8 Inches

Thickness of the frame = 1.2 Inches (3 cm)

MESH MOLD:

Length of the mold = 8.5 Inches

Width of the mold = 1.40 Inches

Depth of the spiral (for 1 depth) = 3.5 mm

Thickness of the mold = 3 mm

Strap Iron:

Length of the strap = 25 Inches

Width = 3 cm

Chain Sprocket:

For Big Sprocket:

Length of the sprocket = 7.30 Inches

Width = 0.5 mm

For Small sprocket:

Length of the sprocket = 3.10 mm

Width = 0.3 mm

Wheel Chain size of each teeth = 1cm

5.2.2 DESIGN CALCULATION

5.2.2.1 Designing of strap iron

For finding the shear stress τ on the strap iron, we have to find the J and T.

The polar moment of inertia J can be found out using the equation (1.1)

$$J = \frac{\pi}{32} \times D^4 \quad (1.1)$$

Where;

J = Polar Moment of Inertia

D = Dia. Of Strap iron As
measured,

D = 0.03m

$$J = 7.938 \times 10^{-8} \text{ m}^4$$

Now, to find out the required Torque of the strap iron, equation 1.2 can be used

$$T = \frac{P \times 60}{2\pi N} \quad (1.2)$$

Where;

T = Torque in the strap iron

P = Power of motor in W

N = Speed of motor

As, measured $P = 1\text{hp} = 746\text{ watts}$, $N = 1425\text{ RPM}$

$T = 14.8\text{ N.m}$

Now, with the help of equation 1.3 shear stress can be evaluated[46].

$$T / J = \tau / r \quad (1.3)$$

Where;

τ = Shear Stress

r = Radius of iron As

measured,

$r = 0.015\text{m}$

$$\tau = 2.79\text{ MPa}$$

The deflection in the strap iron can be found out by using the equation 4.4

$$\delta = 32LT/ \quad (1.4)$$

Where;

L = Length of strap iron

G = Modulus of rigidity

As in case if steel $G = 77\text{ G Pa}$, Length of rod = 0.55m

$$\delta = 4.22 \times 10^{-3}\text{ m}$$

Where;

δ = Deflection in strap iron

L = Length of strap iron

G= Modulus of rigidity

5.2.2.2 Designing of mold:

While designing the mold there are two important factors that are considered. First one is the diagonal ratio which can be found out using the equation.

$$\text{Pitch of Helical Diagonal Ratio} = \quad (1.5) \\ \text{Diagonal Ratio} = 0.8101$$

The other factor that is considered is the pitch ratio which can be found using the following equation.

$$\text{Pitch Ratio} = \frac{\text{Internal Dia of mold}}{\text{Pitch of Helical}} \quad (1.6)$$

$$\text{Pitch Ratio} = 0.72$$

5.2.2.3 Development of Mathematical Model

Samples of meshed wire of different sizes from different machines were taken and then

measured their dimensions with respect to the mold from which they were produced. A mathematical relation was established between the dimensions of the mold and the wire mesh produced by it. It was found that there exists almost a constant ratio between the pitch of the grooves of the mold and the size of the mesh produces by it. Similarly the relation between pitch of grooves of the mold and internal diameter of the mold. The graphs were plotted from measurements of different samples taken from local industry. Both graphs show a linear direct relation of Diagonal ratio and Internal diameter with the pitch of the grooves of mold.

. However, there is slight difference in their linearity with respect to each other and their respective ratios are shown in equation 1.7 and 1.8.

$$\text{Diagonal Ratio} = \frac{\text{Pitch of helical}}{\text{Diagonal distance}} = 0.8101 \quad (1.7)$$

$$\text{Pitch ratio} = \frac{\text{Internal Dia of Mold}}{\text{Pitch of Helical}} = 0.72 \quad (1.8)$$

5.2.3 2D MODEL OF MESH MAKING MACHINE

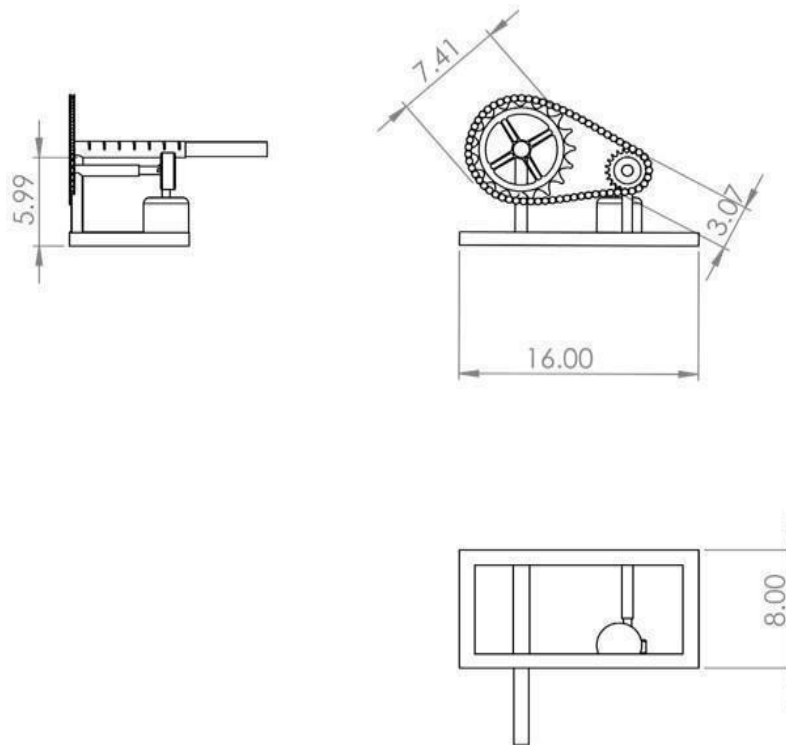


Figure 5.3 2D model of mesh making machine

5.2.4 3D Model Of Mesh Making Machine

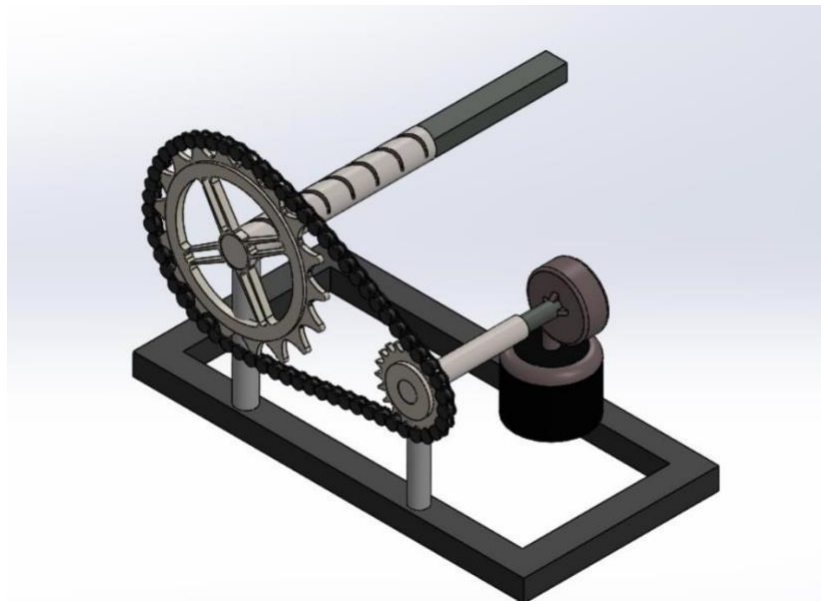


Figure 5.4 Overall view of Mesh Making Machine

- The Mesh Making Machine (MMM) is a specialized device for creating mesh patterns or grids.
- It is used in applications such as fencing, construction, and agriculture.
- The machine relies on a wiper motor as its primary power source and driving mechanism.

The wiper motor enables a seamless and efficient mesh production process

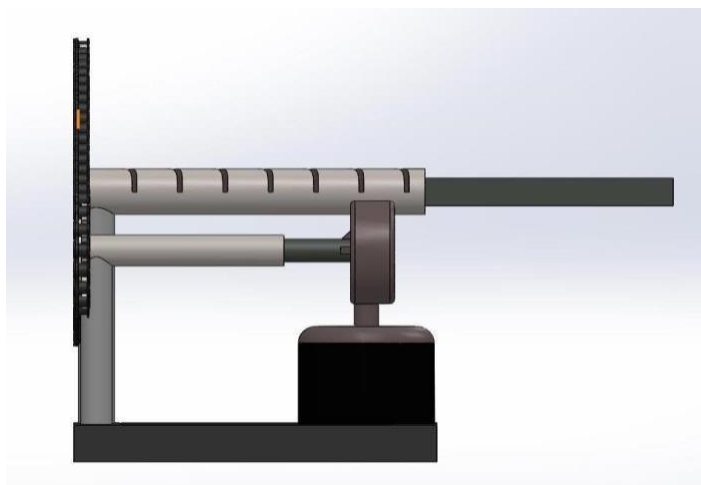


Figure 5.5 Side view of Mesh Making Machine

- The machine operates by interweaving or connecting individual wires or threads to construct a mesh structure.
- The wiper motor imparts rotational motion to control the precise movement and spacing of the wires.

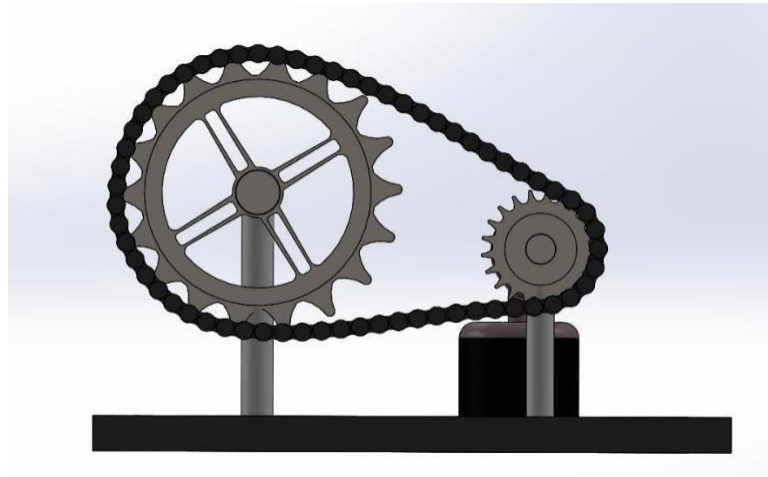


Figure 5.6 Front view of Mesh Making Machine

- The utilization of a wiper motor offers advantages such as reliability, durability, and precise control over wire spacing.
- The motor's controlled movement minimizes variations in wire spacing and alignment, resulting in visually appealing and functionally reliable mesh.

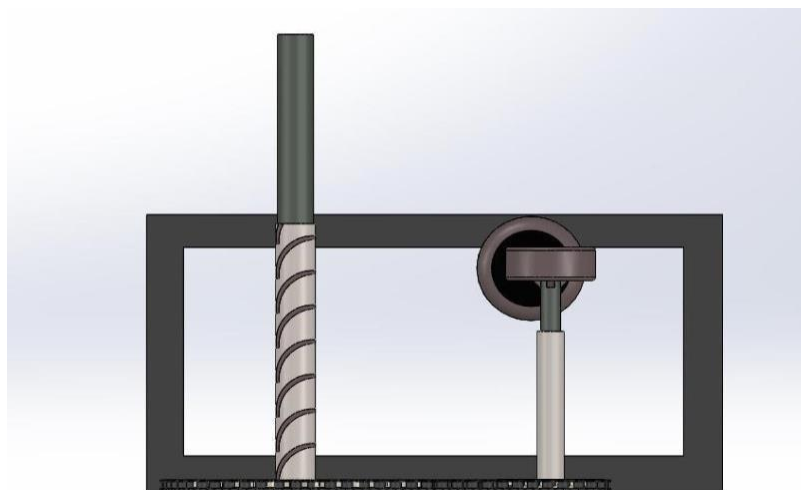


Figure 5.7 Top view of Mesh Making Machine

- The wiper motor's rotational motion can be finely tuned and synchronized to achieve the desired wire spacing and mesh configuration.
- This level of control is instrumental in tailoring the mesh to meet specific requirements, whether for security fencing or agricultural applications.

5.2.5 OUTCOME OF PRODUCT MESH DEVELOPMENT

A chain link fence is a highly popular fencing option renowned for its utilitarian design and practical applications. It is constructed using a series of interconnected metal wires, traditionally fabricated from steel or aluminum, which are meticulously woven to form a distinctive diamond-shaped mesh pattern.

This lattice-like configuration imparts a unique combination of transparency and security to the fence, making it a preferred choice for various residential, commercial, and industrial settings.



Figure 5.8 Chain Link Fence

One of the standout features of a chain link fence is its exceptional durability. The materials used in its construction are specifically chosen for their resistance to rust, corrosion, and weathering, ensuring that the fence retains its structural integrity even in challenging outdoor environments. This longevity is further enhanced by the

option of galvanizing the metal wires, a process that involves coating them with a protective layer of zinc to bolster their resilience against the elements.

In addition to their security benefits, chain link fences are highly versatile. They come in various heights, gauges, and mesh sizes to cater to different needs, from residential boundaries to sports facilities and industrial compounds.

5.2.6 TESTING OF MESH MAKING MACHINE

After the designing and fabrication of the mold, according to the new modifications. All the remaining parts including two bearing, a Strap iron and a feeding mechanism were mounted on the base frame. All these components are already being discussed. To hold the mold, a specially designed clamp is being used. A 1Hp wiper motor is being used to drive the machine. The final assembly is shown in Figure 3.1.

1. Base frame
2. Wiper motor
3. Mesh mold
4. Mild steel strap iron
5. Wire feed mechanism
6. Chain sprocket
7. G-Wire

Twelve tests were conducted using the design and development of mesh making machine. In Mesh mold, the depth of the spiral was 6mm and the result of this level of depth, the G-wire got stuck in the same place and there is a repeated of motion. From the result we found that the 6mm depth was not applicable thus we used 3mm level of depth in the spiral. In the beginning of testing, number of curves in the spiral of mesh mold was 6 thus the load was high and hard, in the secondary testing there is a reduce in the number of curve which is 4 thus the results, the machine running successfully but there is a need of effective additional support. The final number of curve in the spiral of mesh mold was reduced as 3, by the reduction the machining run successfully. In Strap iron, there was 3 number of test had been took place, at

first the strap iron was much more longer than the mesh mold and result was failed. in the secondary trial the strap iron was cut by the same length of the mesh mold and as the output we didn't got the expected shape of output which is three edged corner shape but instead we got a oval shaped output. By taking in account, we took a adequate length which was a bit longer than the mesh mold and as the results we got the expected three edged shape(zigzag).

In G-wire, there was 3 set of trails were made, in the first trail, 0.5mm fitness wire was used to passing through the strap iron but it was running in the exact location repeatedly , then the second attempt, 1.5mm fitness wire were used thus there is a rupture where the wire was under direct load. In the final attempt , we took the wire of fitness 1mm which resulted in success.

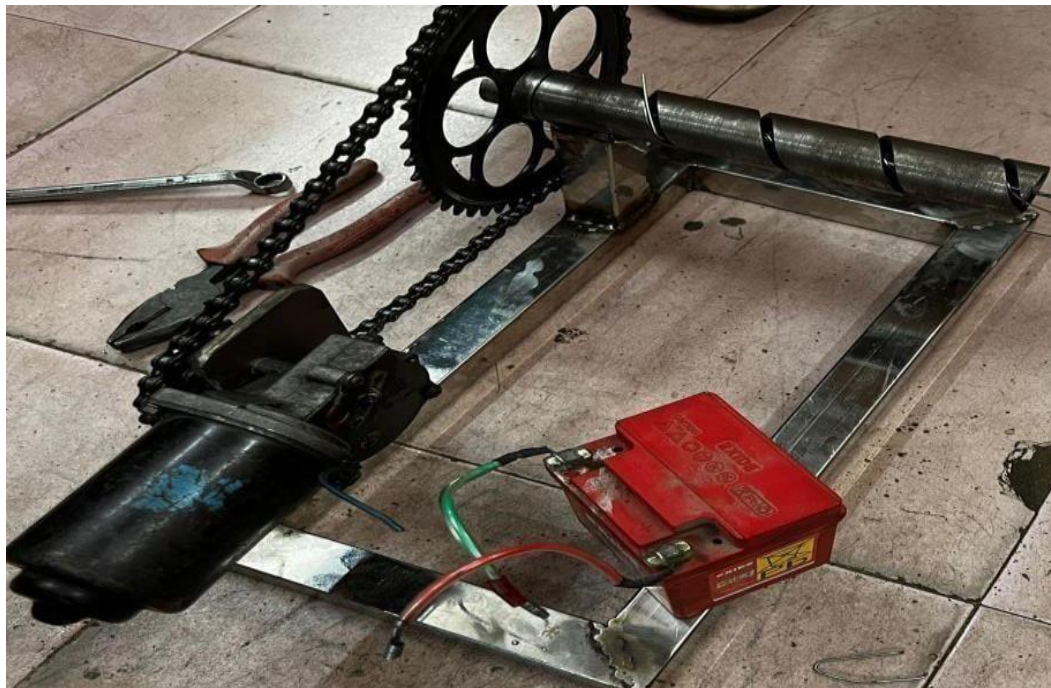


Figure 5.9 Testing Mesh Machine

CHAPTER 6

SUMMARY AND CONCLUSIONS

6.1 SUMMARY

A mesh making machine is a versatile industrial device designed for the automated production of wire mesh products. This equipment is crucial in various industries, including construction, agriculture, and manufacturing. In essence, a mesh making machine streamlines the process of creating wire mesh by weaving or welding wires together, resulting in a grid-like pattern suitable for diverse applications.

Wire mesh is a fundamental component used in a wide range of sectors, from reinforcing concrete in construction to fencing in agriculture. Mesh making machines come in various types, with two primary methods: weaving and welding.

Wire mesh weaving machines intricately interlace wires, typically in a crisscross pattern, to create various sizes and designs of mesh. These machines can adjust wire tension, spacing, and patterns to produce custom meshes for specific applications. The process is highly versatile, allowing for different wire thicknesses and materials.

Welding mesh machines, on the other hand, use electric resistance welding to fuse wires at their intersections. This method results in a sturdy and uniform mesh grid. Welding machines are faster and well-suited for high-volume production, making them common in industries requiring large quantities of mesh.

Mesh making machines offer several advantages. They enhance productivity by automating what would be a labor-intensive and time-consuming process by hand. They also ensure uniform quality and accuracy in mesh production, reducing waste and the risk of errors. Moreover, they can adapt to various wire materials, making them suitable for different applications, from light-duty fencing to heavy-duty reinforcement.

In conclusion, mesh making machines play a pivotal role in modern industry, offering efficient and precise methods for producing wire mesh. Whether through weaving or welding, these machines provide essential building blocks for countless products, making them a critical asset in various sectors worldwide.

Two primary methods are used by mesh making machines: weaving and welding. Weaving machines intricately interlace wires to create diverse mesh sizes and designs, offering great flexibility for different applications. These machines can adjust wire tension, spacing, and patterns to meet specific requirements, making them ideal for producing custom meshes.

On the other hand, welding mesh machines employ electric resistance welding to fuse wires at their intersections, resulting in a durable and uniform mesh grid. Welding machines are particularly well-suited for high-volume production, as they are faster and can produce a significant quantity of mesh in a short amount of time.

6.2 CONCLUSIONS

- The machine was successfully built with available resources. The machine has a competitive advantage over its counter parts in terms of performance, product quality and it is more economical.
- It satisfies all the parameters from an engineering point of view. By using the observations obtained from data samples of different mesh sizes and dies, the machine has been redesigned to achieve more accurate and better results.
- The newly designed adjustable stand makes it possible to operate the machine in confined spaces and thus making it more user friendly.
- Also, the life expectancy and quality of the mold has been considerably increased with the use of high carbon steel as a substitute material.
- Thus, this newly designed machine opens up new horizons for startups and business setups. This project is a small step towards betterment of the local industry.

REFERENCES

1. Allegaert, M., & Wostyn, S. (1996), Fence with mesh panels, Google Patents.
2. Buchely, M., et al. (2005), The effect of microstructure on abrasive wear of hardfacing alloys, *Wear*, 259(1-6), 52-61.
3. Shibe, V. and V.J.M.C. Chawla, (2013) Enhancement in wear resistance by hardfacing: a review.
4. Burlachenko, O., & Klochkov, D. J. P. E. (2016), Increase of the Wear Resistance of Metal Details on the Basis of a Simultaneous Application of the High-Test Cover and Ultrasonic Vibrations, 150, 442-447.
5. Chondros, T.G. (2009), The development of machine design as a science from classical times to the modern era, In *International Symposium on History of Machines and Mechanisms*, Springer.
6. Foerster, G.J.S.P., (1972). *Designing Die-Casting Alloys*. (9372).
7. Holmberg, K., and Mathews, A. J. T. S. F. (1994), Coatings tribology: A concept, critical aspects, and future directions. *Surface and Coatings Technology*, 253(1-2), 173-178.
8. Meletis, E., et al., (1995) Tribological characteristics of DLC films and duplex plasma nitriding /DLC coating treatments.
9. Hyman, B., (2003). *Fundamentals of engineering design, product design*:
10. Kao, K., et al. (2010), Effect of mesh patterning with UV pulsed-laser on optical and electrical properties of ZnO/Ag-Ti thin films, *Journal of Applied Physics*, 256(24), 7446-7450.
11. Kotecki, D., and Ogborn, J. J. W. J.-I. W. R. S. (1995), Abrasion resistance of iron- based hardfacing alloys. *Wear*, 74(8), 269-278.
12. Meneve, J., et al., (1997) *Thin tribological coatings: magic or design*.
13. Krishnan, R. (2001), *Electric motor drives: modeling, analysis, and control*. Prentice Hall.

14. Lee, B.-S., et al. (1999). Design of a linear switched reluctance machine. in Conference Record of the 1999 IEEE Industry Applications Conference. Thirtyfourth IAS Annual Meeting.
15. Malyshev, V, A. Volkhin, and B.J.O.C. Gantimirov, (2013), Tribological characteristic improvement of wear resistance MAO-coating.
16. McLoughlin, T.P. (1985), Fence assembly, Google Patents.
17. Menon, K., and Krishnamurthy, K. (1999), Control of low-velocity friction and gear backlash in a machine tool feed drive system, Mechatronics, 1999.
18. Norton, J., and Arraez, C. (2000), Machine Design.
19. Owens, W.A. and E.A. Otto. (1939), Machine for continuously forming curved wire forms, Google Patents.
20. Pall, D.B. and R. Richard. (1967), Woven wire mesh, Google Patents.
21. Patrick, B.J. (1988), Welded wire fence panel, Google Patents.
22. Renton, D., and Elbestawi, M.A. (2000), High-speed servo control of multi-axis machine tools, International Journal of Machine Tools & Manufacture.
23. Ritter, K., et al. (1972), Process for manufacturing welded mesh, Google Patents.
24. Roemer, G.R. (1945), Continuous manufacture of welded wire mesh, Google Patents.
25. Simioni, L. (2000), Fence system, Google Patents.
26. Singh, R., and Vinayak, H. (1998), Multibody dynamics and model analysis of compliant gear bodies, Journal of Sound and Vibration.
27. Smith, R.V. and A.M. Shannon. (1990), Method and apparatus for forming wire mesh cages, Google Patents.
28. Sodre, J. and J.J.J.o.f.e. Parise. (1997), Friction factor determination for flow through finite wire mesh woven-screen matrices, Journal of Fluids Engineering, 119(4), 847-851.
29. Sotillos, J.J.S. and J.A.S. Sotillos. (2003), Modular fence, Google Patents.
30. Tabor, D. (2000), The Hardness of Metals, Oxford University Press.

31. Tu, Y.-P. (1998), Wire mesh fence structure, Google Patents.
32. Verstraete, M. (1969), Roll of compacted mesh chain link fencing, Google Patents.
33. Verstraete, M. (1970), Method for winding chain link fencing, Google Patents.
34. Voll, B.A., B.M. Richard, and A.D. Gabrysch. (1998), Wire mesh filter, Google Patents.
35. Wang, X., et al. (2008), Microstructure and wear properties of the Fe-Ti-V-Mo-C hardfacing alloy, *Wear*, 265(5-6), 583.
36. Mischke, C.R. and J.E. Shigley, (1996) *Standard handbook of machine design*. McGraw-Hill.
37. Wener, K., et al. (1977), Chain-link fencing package and method of making same, Google Patents.
38. Wenlong, S., et al. (2010), Study on cutting forces and experiment of MoS₂/Zr-coated cemented carbide tool, *International Journal of Machine Tools & Manufacture*, 49(9-12), 903-909.
39. Goldstein, J.I., et al., (2017) *Scanning electron microscopy and X-ray microanalysis*. Springer
40. Yerokhin, A, et al., (1999). *Plasma electrolysis for surface engineering*.