DESIGN AND DEVELOPMENT OF A GRAIN COLLECTING MACHINE

A PROJECT REPORT

SUDHARSAN	**M**	**(927622BME091)**
SUDHAKAR	**G**	**(927622BME092)**
SUGAN	**C**	**(927622BME093)**

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

M. KUMARASAMY COLLEGE OF ENGINEERING, KARUR

ANNAUNIVERSITY: CHENNAI 600025

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BONAFIDE CERTIFICATE

Certified that this project report "**DESIGN AND DEVELOPMENT OF A GRAIN COLLECTING MACHINE**" is the bonafide work of **"SUDHARSAN M (927622BME091), SUDHAKAR G (927622BME092), SUGAN C (927622BME093)"** who carried out the project work during the academic year 2023 – 2024 under my supervision. Certified further, that to the best of my knowledge the work reported here in does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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INTERNAL EXAMINER EXTERNAL EXAMINER

DECLARATION

We affirm that the Project titled **"DESIGN AND DEVELOPMENT OF A GRAIN COLLECTING MACHINE"** being submitted in partial fulfillment off or the End Semester Examination of **B.E. MECHANICAL ENGINEERING**, is the original work carried out by us. It has not formed the part of any other project or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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INSTITUTION VISION&MISSION

Vision

- To emerge as a leader among the top institutions in the field of technical education.

Mission

- Produce smart technocrats with empirical knowledge who can surmount the global challenges.
- Create a diverse, fully engaged, learner-centric campus environment to provide quality education to the students.
- Maintain mutually beneficial partnerships with our alumni, industry and professional associations.

DEPARTMENT VISION, MISSION, PEO, PO & PSO

Vision

- To create globally recognized competent Mechanical engineers to work in multi-cultural environment.

Mission

- To impart quality education in the field of mechanical engineering and to enhance their skills, to pursue careers or enter higher education in their area-of-interest.
- To establish a learner-centric atmosphere along with state-of-the-art research facility.
- To make collaboration with industries, distinguished research institution and to become a center of excellence.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

The graduates of Mechanical Engineering will be able to

- PEO1: Graduates of the program will accommodate insightful information of engineering principles necessary for the applications of engineering.
- PEO2: Graduates of the program will acquire knowledge of recent trends in technology and solve problem in industry.
- PEO3: Graduates of the program will have practical experience and interpersonal skills to work both in local and international environments.
- PEO4: Graduates of the program will possess creative professionalism, understand their ethical responsibility and commit towards society.

PROGRAM OUTCOMES

The following are the Program Outcomes of Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / Development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life - long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life -long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

The following are the Program Specific Outcomes of Engineering Graduates:

The students will demonstrate the abilities

1. **Real world application:** To comprehend, analyze, design and develop innovative products and provide solutions for the real-life problems.
2. **Multi-disciplinary areas:** To work collaboratively on multi-disciplinary areas and make quality projects.
3. **Research oriented innovative ideas and methods:** To adopt modern tools, mathematical, scientific and engineering fundamentals required to solve industrial and societal problems.

Course Outcomes	At the end of this course, learners will be able to:	**Knowledge Level**
CO - 1	Identify the issues and challenges related to industry, society and environment.	Apply
CO - 2	Describe the identified problem and formulate the possible solutions.	Apply
CO -3	Design / Fabricate new experimental set up/devices to provide solutions for the identified problems	Analyze
CO -4	Prepare a detailed report describing the project outcome	Apply
CO - 5	Communicate outcome of the project and defend by making an effective oral presentation.	Apply

MAPPING OF PO & PSO WITH THE PROJECT OUTCOME

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO - 1	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3
CO - 2	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3
CO - 3	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3
CO - 4	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3
CO - 5	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3

CONTENTS

ABSTRACT

The design and development of efficient grain collecting machinery is crucial in enhancing agricultural productivity and minimizing post-harvest losses. This project focuses on creating a versatile, cost-effective, and energy-efficient grain collecting machine tailored to small and medium-scale farming operations. The machine is designed to streamline the collection of grains directly from fields post-harvest, reducing the need for manual labor and addressing labor shortages often faced by farmers. The development process involves integrating a series of components, including a hopper for grain intake, a conveyor system, and a sorting mechanism to separate unwanted materials, such as stones and debris, from the grains. To optimize energy consumption, the design incorporates lightweight materials and a power-efficient motor system. Field tests are conducted to evaluate the machine's performance in terms of collection speed, grain purity, and adaptability across different terrains and crop types. This project's outcome is expected to offer an affordable solution to smallholder farmers, enhancing their grain collection processes and contributing to the overall efficiency and profitability of the agricultural sector.

CHAPTER 1
INTRODUCTION

The design and development of a grain-collecting machine is a vital advancement in agricultural mechanization, aimed at improving efficiency in grain harvesting and post-harvest handling. Traditional methods of collecting grain are labor-intensive, time-consuming, and often result in significant losses due to spillage, improper handling, and weather exposure. A dedicated grain-collecting machine addresses these challenges by automating the collection process, minimizing wastage, and ensuring grains are gathered quickly and stored safely.

The development process involves a careful examination of the agricultural field conditions, types of grain to be collected, and the desired machine specifications. Key design considerations include the machine's mobility across various terrains, its adaptability to different grain types, the durability of materials used, and energy efficiency. Additionally, ergonomics and ease of use are essential to ensure that farmers and operators can utilize the machine with minimal training. This project integrates mechanical, electrical, and agricultural engineering principles to create a practical, reliable, and cost-effective solution that meets the needs of modern agriculture, ultimately contributing to food security and sustainable farming practices.

CHAPTER- 2

LITERATURE REVIEW

Grain collecting machines play an essential role in post-harvest agricultural processes, as they streamline grain gathering, reduce labor costs, and minimize crop losses.

1. Historical Development of Grain Collecting Machines:

Early grain collection was labor-intensive, relying on manual tools like sickles and baskets. Mechanized grain collection began with the advent of threshers and reapers in the 19th century. Over time, innovations like combine harvesters emerged, integrating cutting, threshing, and collecting functions. Recent efforts aim to make smaller, affordable grain collectors for developing regions, addressing needs that large combines cannot meet

2. Design Parameters and Mechanisms:

Modern grain collectors typically use rotating paddles, conveyors, or pneumatic systems to guide grains into collection bins. Studies on optimized paddle shapes and rotation speeds have led to significant efficiency improvements. The orientation of feed conveyors also plays a role in reducing grain damage.

3. Challenges in Design and Development:

One of the main barriers to widespread adoption of grain collecting machines is their high cost. Researchers have worked on reducing production costs by using locally available materials and modular designs that are easier to repair and maintain.

A significant challenge is designing machines that can handle various types of grains, which vary in size, shape, and harvesting requirements. Mechanisms

need to be adjustable or modular to accommodate different grains without compromising performance.

4. Advances in Automation and IoT Integration:

Recent grain collecting machines incorporate automation for more precise control over collection speed, feeding rates, and sorting functions. Sensors for grain quality, moisture, and impurity levels provide real-time feedback, enabling farmers to make informed adjustments.

IOT Integrations technology is gaining traction in agricultural machinery, including grain collectors. Studies show that IoT-enabled grain collectors can report operational data, monitor fuel and power consumption, and alert users to maintenance needs. Such features reduce downtime and enhance machine life.

5. Energy Efficiency and Sustainability Considerations:

With the rising emphasis on sustainable agriculture, energy-efficient designs and the use of eco-friendly materials have become significant research areas. Solar-powered grain collectors, for instance, offer an eco-friendly alternative, especially in sunny regions. Reducing emissions and using biodegradable materials where possible are also ongoing areas of research.

CHAPTER 3

DESIGN AND DEVELOPMENT

The design and development of a grain collecting machine focuses on creating an efficient, user-friendly device to assist farmers in harvesting and collecting grain with minimal labor. The process begins with conceptualizing the machine's purpose and gathering requirements, followed by designing components that streamline collection, cleaning, and transportation of grains. Engineers prioritize a durable frame and materials that withstand harsh agricultural environments. The machine is often designed to have an adjustable collection mechanism that accommodates different grain types and field conditions. An essential aspect of development includes integrating an efficient power source, such as a small engine or an electric motor, which can optimize fuel or energy consumption while providing sufficient torque for varied terrains.

Key steps in the design process include CAD modeling for visualizing and refining the structure, followed by simulation tests to ensure reliability under real-world conditions. Developers focus on making the machine easy to operate, often incorporating automated or semi-automated features to reduce the labor intensity for users. Special attention is given to ergonomics, ensuring the machine’s controls are accessible and manageable even for extended periods of operation. Prototyping and field testing are critical, as they allow the team to gather user feedback and adjust the design to better meet farmers' needs. The final stage involves production-ready adjustments that ensure the machine is economically feasible for large-scale manufacturing and easy maintenance, reducing downtime and long-term operating costs.

In developing a grain collecting machine, specific attention is given to the machine's efficiency in collecting, sorting, and minimizing grain loss. Modern designs incorporate sensors to monitor the quantity and flow of grain being collected, which helps to optimize performance and avoid spillage. Many models

include adjustable collection mechanisms, such as height and angle modifications, to adapt to various crop types and harvesting conditions. This adaptability is crucial for farmers working across different terrains and grain types, allowing a single machine to serve multiple purposes and reduce the need for separate equipment.

Safety is also a primary consideration. Designers work to include protective guards around moving parts and intuitive safety features to protect users from potential hazards. For instance, automatic shut-off functions in cases of clogging or overheating can prevent damage and extend the machine’s operational life. Noise reduction measures, such as adding mufflers or insulation, are sometimes incorporated to improve the operator's comfort and reduce noise pollution.

CHAPTER 4

CONSTRUCTION

The construction of a grain collecting machine involves assembling various components with a focus on durability, efficiency, and ease of operation. The frame, often made from high-strength steel or aluminium alloy, serves as the foundation, providing structural support to withstand heavy loads and rough field conditions. The frame design is crucial, as it must balance robustness with a lightweight form to allow for easy manoeuvring. Welded joints and reinforced sections add extra strength, particularly in areas that experience higher levels of stress. A key part of the construction is the grain collection mechanism, which may include adjustable intake heads, rotating brushes, or augers that guide the grain into the machine. These components are usually made of corrosion-resistant materials such as stainless steel to ensure longevity, especially when working in moist or dusty environments. The intake heads are designed to be easily adjustable, allowing for different grain sizes and varying field heights to be accommodated with minimal setup time.

CHAPTER 5

COMPONENTS AND DESCRIPTION

MAJOR COMPONENTS

1. Wheels
2. Frame
3. Grain Collection Plate
4. Grain Storage Compartment
5. Shaft
6. Handle
7. Base Frame
8. Supporting Frame
9. Mounts and Joints
10. Screws and Bolts

WHEELS

Road cleaning machines play a crucial role in maintaining the cleanliness and safety of our roadways. Among the various components that contribute to the efficiency of these machines, wheels stand out as a fundamental element. This essay explores the significance of wheels in road cleaning machines, focusing on their design, functionality, and impact on the overall performance of these essential vehicles.

Wheels in road cleaning machines come in various designs, each tailored to meet specific requirements. Common types include solid rubber wheels, pneumatic wheels, and dual wheels.

Solid rubber wheels provide stability and durability, making them suitable for heavy-duty road cleaning tasks. Pneumatic wheels, on the other hand, offer a smoother ride and enhanced shock absorption.

FRAME

- Begin by introducing the importance of road cleaning machines in maintaining cleanliness and safety on roads. Highlight the role of the frame as a critical component in the overall structure of these machines. Discuss the typical design of frames in road cleaning machines. Are they rigid or flexible? How are they shaped to accommodate different cleaning components?
- Explain the importance of a well-designed frame in supporting the weight of various components and ensuring stability during operation.
- Detail how the frame contributes to the overall functionality of the road cleaning machine. For example, how does it support the brushes, suction systems, and other cleaning mechanisms?
- Explain how the frame affects the maneuverability of the machine and its ability to reach different areas on the road.
- Explore how the frame is designed to distribute the load evenly across the machine. This is crucial for preventing premature wear and tear on specific components.
- Discuss stress factors that the frame must withstand during operation, such as vibrations, impacts, and continuous movement. Are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel. In a two-pulley system, the belt can either drive the pulleys normally in one direction (the same if on parallel shafts), or the belt may be crossed, so that the direction of the driven shaft is reversed (the opposite direction to the driver if on parallel shafts). As a source of motion, a conveyor belt is one application where the belt is adapted to carry a load continuously between two points.

GRAIN COLLECTION PLATE

The grain collection plate is a critical component of a grain-collecting machine, designed to efficiently gather harvested grains as they are separated from the stalks. Typically located at the front or underside of the machine, the collection plate is engineered to capture and direct the grains into the intake system, ensuring minimal spillage and loss. It is often equipped with a series of adjustable brushes or paddles that help channel the grains into a hopper or conveyor belt, preventing blockages or buildup. The plate is made from durable, wear-resistant materials such as stainless steel or heavy-duty plastic to withstand the abrasive nature of grains and the rough field conditions. Additionally, it may feature a curved or sloped design to facilitate smooth grain flow, optimizing the collection process. The grain collection plate is also designed to be easily adjustable, allowing operators to fine-tune its height or angle based on the crop type and terrain, ensuring maximum efficiency across different harvesting conditions.

GRAIN STORAGE COMPARTMENT

The grain storage compartment is a vital part of a grain-collecting machine, responsible for safely holding the harvested grains once they have been separated and collected. Typically positioned at the rear or side of the machine, the compartment is designed with a large capacity to accommodate large volumes of grain, reducing the need for frequent unloading during harvest operations. The walls of the storage compartment are usually angled or curved to ensure that grains flow smoothly and efficiently towards the exit, preventing clogging or buildup. To protect the stored grains from external elements, the compartment is often constructed from durable, weather-resistant materials such as galvanized steel or coated aluminum, ensuring longevity and resistance to rust or corrosion. Additionally, the grain storage area is equipped with a discharge system, which may include augers or conveyor belts, for easy unloading into trucks or storage

bins. Some models also incorporate sensors to monitor the grain levels, alerting the operator when the compartment is full and preventing overloading. The design of the grain storage compartment emphasizes efficiency, ease of use, and minimal grain loss, ultimately contributing to the overall productivity of the machine.

SHAFT

Shaft is a common and important machine element. It is a rotating member, in general, has a circular cross-section and is used to transmit power. The shaft may be hollow or solid. The shaft is supported on bearings, and it rotates a set qof gears or pulleys for the purpose of power transmission. The shaft is generally acted upon by bending moment, torsion, and axial force. Design of shaft primarily involves in determining stresses at critical point in the shaft that is arising due to loading. Other two similar forms of a shaft are axle and spindle. Axle is a non-rotating member used for supporting rotating wheels etc. and do not transmit any torque. Spindle is simply defined as a short shaft. However, design method remains the same for axle and spindle as that for a shaft. 8.1.2 Standard sizes of Shafts Typical sizes of solid shaft that are available in the market are, Up to 25 mm 0.5 mm increments 25 to 50 mm 1.0 mm increments 50 to 100 mm 2.0 mm increments 100 to 200 mm 5.0 mm increments 8.1.3 Material for Shafts The ferrous, non-ferrous materials and non-metals are used as shaft material depending on the application. Some of the common ferrous materia l for shaft are discussed below. Hot-rolled plain carbon steel. These materials are least expensive.

HANDLE

Road cleaning machines play a pivotal role in maintaining clean and safe urban environments. These machines are equipped with various components and features to efficiently tackle the task of removing dirt, debris, and other pollutants from roads and public spaces. One crucial element that often goes unnoticed but plays a significant role in the operation of these machines is the handle. The handle serves as the interface between the operator and the machine, providing control and maneuverability.

Functionality of Handles:

Handles in road cleaning machines serve multiple functions, contributing to the overall efficiency and ease of operation. One primary function is control. Operators use handles to guide the machine along the desired path, ensuring precise and effective cleaning. The design of the handle is crucial in providing a comfortable grip, reducing operator fatigue during prolonged use.

MOUNTS AND JOINTS

Mounts in Road Cleaning Machines:

Mounts are structural elements that connect various components of a road cleaning machine, providing stability and support. They serve as the foundation for other essential parts, such as brushes, vacuum systems, and water tanks. The design and quality of mounts significantly influence the machine's durability and overall effectiveness. Properly engineered mounts contribute to reduced vibrations, noise, and wear and tear, ensuring a smoother operation and a longer lifespan for the machine. The mounts in road cleaning machines are subjected to diverse conditions, including rough terrains, varying temperatures, and exposure to water and chemicals. As such, the materials used in constructing mounts must

be durable, corrosion-resistant, and capable of withstanding environmental challenges. Common materials include high-strength alloys and polymers designed to endure the demanding conditions encountered during road cleaning operations.

Joints in Road Cleaning Machines:

Joints play a pivotal role in facilitating movement and flexibility within road cleaning machines. These articulating points enable the machine to navigate different contours of the road surface, ensuring thorough cleaning even in challenging terrains. The design of joints is critical for achieving optimal maneuverability while maintaining structural integrity.

SCREWS AND BOLTS

Road cleaning machines play a pivotal role in maintaining clean and safe roadways. These machines are intricate systems comprised of various components, and among them, joints and bolts are crucial elements that contribute to their overall efficiency and reliability. This essay explores the significance of joints and bolts in road cleaning machines, highlighting their role in ensuring optimal performance and longevity.

The Importance of Joints:

Joints in road cleaning machines facilitate movement and articulation, allowing the equipment to adapt to different terrains and angles. These joints are pivotal in ensuring that the cleaning apparatus can navigate through curves, bends, and uneven surfaces with ease. Properly designed joints enhance the flexibility of the machine, enabling it to cover a wide range of areas effectively.

The Role of Bolts:

Bolts act as the backbone, holding various components together in road cleaning machines. These fasteners are responsible for securing critical parts such as brushes, suction systems, and chassis. The reliability of bolts directly impacts the structural integrity of the machine, making them a vital consideration in the design and manufacturing process. Choosing the right type of bolts is crucial for withstanding the harsh conditions road cleaning machines face daily. Corrosion-resistant bolts, for instance, are essential to combat exposure to water, chemicals, and other environmental factors. Regular inspection and tightening of bolts are necessary maintenance practices to prevent loosening, which can lead to malfunctions and accidents.

CHAPTER 6

WORKING

The working of a grain-collecting machine involves a coordinated sequence of steps designed to efficiently gather, process, and store grains during harvesting. As the machine moves across a field, its intake head and collection mechanism (such as rotating brushes or adjustable paddles) sweep through the crops, guiding the grains onto a collection plate. This plate channels the grains into the threshing unit, where the grains are separated from the stalks through controlled impact and vibration.

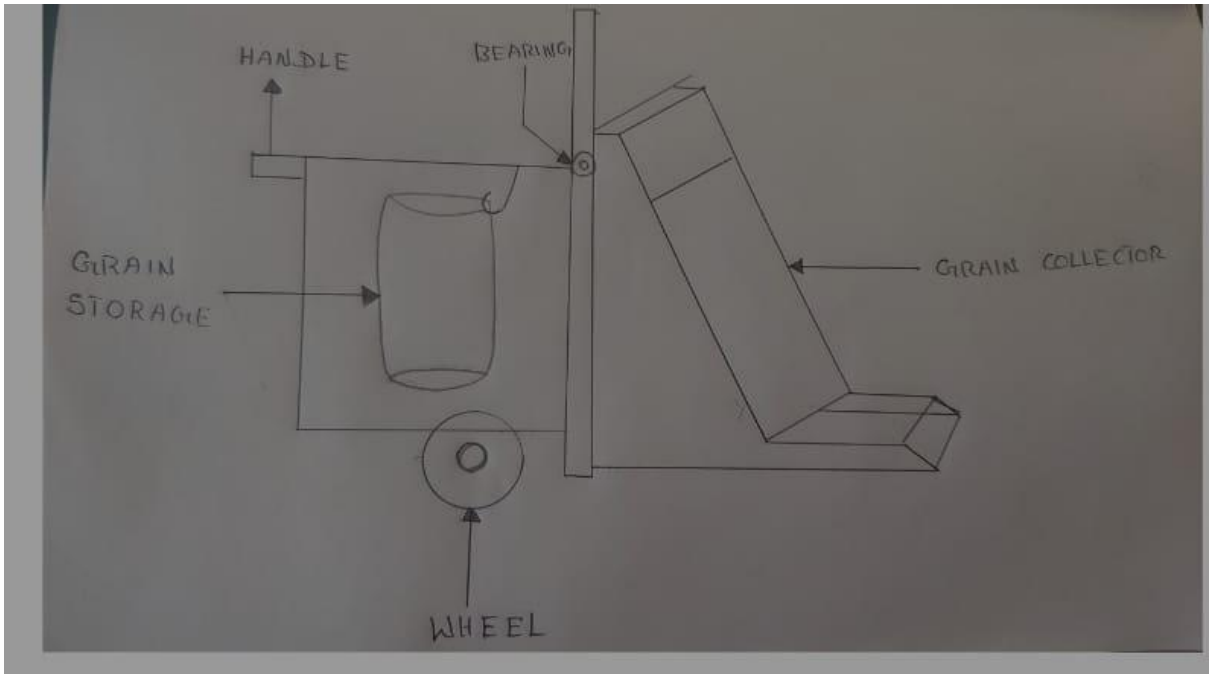
Once separated, the grains move into a cleaning system, often comprising sieves and airflow fans that remove unwanted debris like chaff, stones, or stems. This process ensures that only clean grains proceed to the next stage, while the leftover material is either expelled onto the field as mulch or collected for other uses.

The cleaned grains are then conveyed to a storage compartment via a conveyor belt or auger system. Here, they accumulate until the compartment reaches capacity. Sensors in some machines can detect when the storage is full and alert the operator, preventing overloading. The operator can then easily offload the grains into a truck or storage bin using an integrated discharge system.

Throughout the process, power is transmitted from the engine to various components via a series of belts, gears, and hydraulic systems, ensuring each part operates at the right speed and intensity for optimal grain collection. Modern grain-collecting machines may also feature automation technology, such as GPS navigation, moisture detection, and speed controls, enabling more precise and efficient operation across diverse field conditions. This coordinated working mechanism makes the machine highly effective in reducing manual labor and maximizing yield.

CHAPTER 7

3D MODELING



CHAPTER 8

MATERIALS USED

S.NO	DESCRIPTION	QUANTITY	MATERIALS
1	GRAIN COLLECTING MACHICE	1	MILD STEEL
2	WHEELS	4	STEEL WITH RUBBER
3	HANDLE	1	STAINLESS STEEL
4	FRAME	AS PER REWUIRMENT	MILD STEEL
5	SHAFT	AS PER REWUIRMENT	MILD STEEL
6	SCREWS AND BOLTS	AS PER REWUIRMENT	STEEL
7	GRAIN STORAGE	1	STEEL
8	COLLECTOR BIN	1	NYLON

CHAPTER 9

CONCLUSION

In conclusion, the design and development of a grain-collecting machine represent a significant advancement in agricultural technology, addressing the need for efficient, high-capacity grain harvesting. By incorporating robust structural elements, efficient grain collection mechanisms, and smart storage and unloading systems, these machines streamline the entire harvesting process, from field to storage. The design emphasizes durability, ease of use, and adaptability, ensuring reliable operation across varied field conditions and crop types. Innovations in automation, sensor technology, and eco-friendly power options further enhance the machine's performance, minimizing grain loss, reducing fuel consumption, and supporting sustainable farming practices.

CHAPTER 10

COST AND ESTIMATION

S..NO	DISCRIPTION	COST Rs:
1	GRAIN COLLECTING MACHINE	2000
2	WHEELS	600
3	SHAFT	200
4	FRAME	300
5	COLLECTOR BIN	200
6	SCREWS AND BOLTS	200
7	GRAIN STORAGE	300
8	HANDLE	140
9	TOTAL	1940

CHAPTER 11
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