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# Design of Portablehelical Disc Power Tiller for Coconut Tree Bed Preparation

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**ABSTRACT:** In agricultural practices, soil cultivation plays a crucial role in preparing the land for planting crops. The objective of this study was to design and fabricate a **helical disc power tiller** that efficiently breaks up soil, mixes organic matter, and prepares the field for planting. The helical discs are arranged in a circular pattern and are attached to a rotating shaft. The helical discs have a spiral shape, resembling a corkscrew. The dimensions of the power tiller depend on the specific model and manufacturer.

**KEYWORDS:** SOIL CULTIVATION, HELICAL DISCS, FIELD PREPARATION, ORGANIC MATTER, AGRICULTURE.

## I. INTRODUCTION

The helical disc power tiller marks a significant advancement in agricultural machinery, revolutionizing soil cultivation practices. By integrating traditional disc harrow principles with contemporary engineering, this equipment delivers superior efficiency and performance in tillage operations. Research conducted by Reddy et al. (2019) underscores the efficacy of helical disc power tillers in soil cultivation, emphasizing their ability to penetrate diverse soil types while minimizing soil disturbance. This study highlights how helical discs contribute to improved seedbed preparation and crop establishment compared to conventional tillage implements.[1] Moreover, Gupta and Singh (2020) demonstrated the economic advantages of helical disc power tillers through their research on fuel consumption. Their findings illustrate the fuel-saving potential of these tillers, making them a cost-effective choice for farmers.[2]

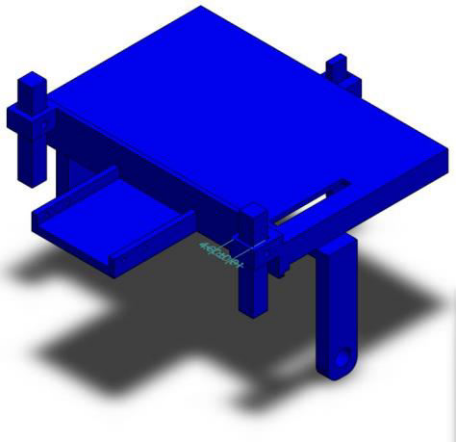

Fig.1.Layout diagram of tiller chase

Helical disc power tillers offer versatility in depth and speed adjustments, allowing farmers to tailor tillage operations to specific crop and soil requirements. Kumar et al. (2021) highlighted the adaptability of helical disc power tillers across various agroecosystems, resulting in enhanced crop productivity and profitability.[3] In summary, helical disc

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power tillers represent a cutting-edge solution in modern agriculture, optimizing soil cultivation practices and offering tangible benefits for farmers.

The design of a helical disc power tiller typically consists of multiple sets of rotating helical discs attached to a central shaft powered by an engine. The discs are arranged in a staggered or offset configuration to ensure thorough soil tillage and minimize soil compaction. The rotating action of the discs cuts through the soil, mixes it, and creates a fine seedbed suitable for planting.
Helical disc power tillers offer several advantages over traditional tillage methods. They are efficient in breaking up hard or compacted soil, improving soil aeration and drainage, and incorporating crop residues into the soil.

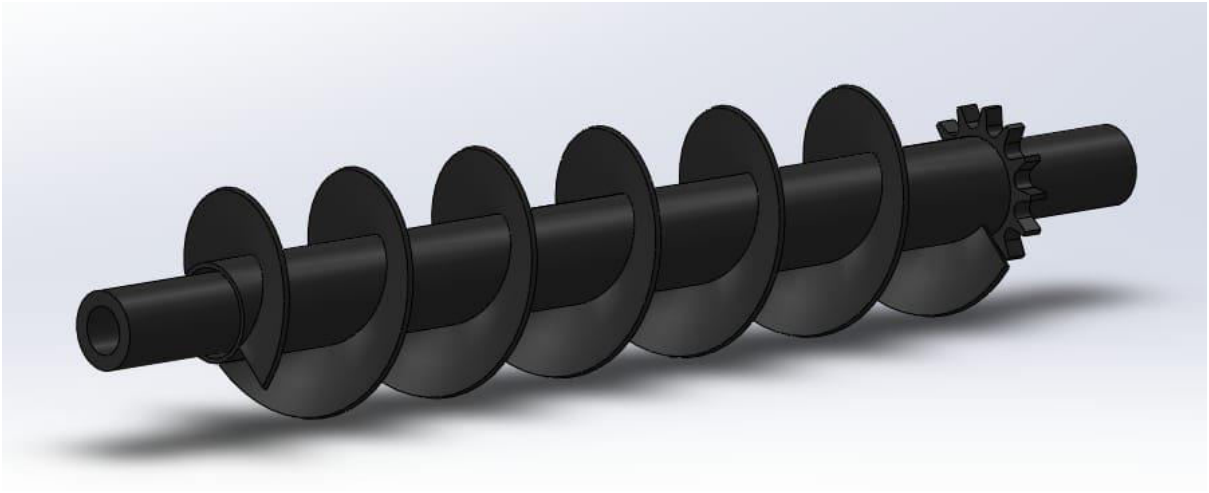

Fig.2.Helical Disc

Overall, helical disc power tillers play a crucial role in modern agriculture by enhancing soil health, increasing crop yields, and reducing labor and time required for soil preparation. Their efficient soil tillage capabilities make them indispensable tools for farmers around the world.

## II. WORKS OF POWER TILLER

A power tiller is a versatile agricultural implement that performs various works related to soil cultivation and preparation. Here are some of the primary works carried out by a power tiller:

1. Primary Tillage: Power tillers are commonly used for primary tillage tasks, which involve breaking up and loosening the soil to prepare it for planting. This includes initial soil turning to bury crop residues, remove weeds, and create a suitable seedbed for crops.

2. Secondary Tillage: After primary tillage, power tillers can perform secondary tillage operations to further refine the seedbed and prepare it for seeding or planting. This may include leveling the soil surface, breaking up clods, and incorporating soil amendments such as fertilizers or organic matter.

3. Seedbed Preparation: Power tillers are essential for preparing well-prepared seedbeds where seeds or seedlings can be planted effectively. They create a fine and crumbly soil texture, ensuring proper seed-to-soil contact for optimal germination and root growth.

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4. Weed Control: Power tillers help control weeds by uprooting and burying weed seeds, cutting off weed roots, and disrupting weed growth cycles. This reduces competition for nutrients, water, and sunlight, promoting healthier crop growth.

5. Mixing and Incorporation: Power tillers are used to mix soil amendments such as compost, manure, or lime into the soil, ensuring even distribution and incorporation for improved soil fertility and structure.

6. Cultivation Between Rows: In row-cropped fields, power tillers equipped with narrow tines or attachments can be used for inter-row cultivation. This helps control weeds between crop rows, aerates the soil, and promotes better nutrient uptake by crops.

7. Mulching: Some power tillers come with mulching attachments or capabilities. They can chop and incorporate crop residues or cover crops into the soil as mulch, providing organic matter, improving soil moisture retention, and reducing erosion.

8. Land Preparation for Horticulture: Power tillers are also used in horticulture for preparing land for orchards, vineyards, and garden beds. They help break up compacted soil, create planting rows, and establish suitable growing conditions for fruit trees, vines, or vegetables.

9. Ridge and Furrow Formation: In certain farming systems like raised bed cultivation or furrow irrigation, power tillers can create ridges or furrows for planting crops or managing water flow in fields.

## III. WORKING PRINCIPAL

The working principle of a power tiller involves several key components and processes that work together to perform soil cultivation and preparation tasks efficiently. Here is an overview of the working principle of a typical power tiller:

1. Engine: A power tiller is equipped with an internal combustion engine, usually fueled by gasoline or diesel. The engine provides the necessary power to drive the tiller's components and perform various soil tillage operations.
2. Transmission: Power from the engine is transmitted to the tiller's working parts through a transmission system, which may include gears, belts, chains, or a combination of these. The transmission system controls the speed and torque delivered to the tiller's components based on the operator's input.
3. Tines or Blades: Power tillers are equipped with rotating tines or blades that penetrate the soil and perform the actual tillage operations. These tines or blades can vary in number, size, and configuration depending on the specific tillage tasks and soil conditions.
4. Depth and Width Adjustment: Most power tillers allow operators to adjust the depth and width of tilling according to their requirements. Depth adjustment is typically achieved by raising or lowering the tines or adjusting the depth control mechanism, while width adjustment may involve changing the spacing between tines or using multiple tine sets.
5. Operation: To operate a power tiller, the engine is started, and the operator guides the machine over the soil surface. The rotating tines or blades dig into the soil, breaking it up, loosening compacted areas, and creating a suitable seedbed for planting. The tiller may also incorporate organic matter, mix soil layers, and help control weeds by uprooting and burying them.
6. Safety Features: Power tillers are equipped with safety features such as operator presence controls, engine shut-off switches, and protective shields to ensure safe operation and prevent accidents.
7. Maintenance: Regular maintenance, including cleaning, lubrication, blade sharpening, and inspection of mechanical components, is essential to keep the power tiller in optimal working condition and extend its lifespan.

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## IV. CONSTRUCTION AND WORKING OF HELICAL DISC

## POWER TILLER

A helical disc power tiller is a type of agricultural machinery used for soil cultivation, seedbed preparation, weeding, and other farming activities. It consists of several key components that work together to perform these tasks efficiently. Here is an overview of the construction and working of a helical disc power tiller:

**Construction:**

1. Frame: The frame of a helical disc power tiller is typically made of sturdy steel or aluminum to provide structural support and durability.

2. Engine: A gasoline or diesel engine powers the tiller, providing the necessary energy for the operation.

3. Transmission system: The transmission system transfers power from the engine to the rotating components of the tiller.

4. Helical discs: The helical discs are the main working components of the power tiller. They are mounted on a shaft and rotate to cut through the soil and break up clods.

5. Depth control mechanism: A depth control mechanism allows the operator to adjust the depth at which the helical discs penetrate the soil.

6. Handlebars: The handlebars provide the operator with control over the direction and speed of the tiller.

**Working:**

1. Start the engine: The operator starts the engine of the power tiller using a pull cord or electric starter.

2. Adjust depth: The operator adjusts the depth control mechanism to set the desired depth at which the helical discs will work.

3. Engage transmission: The operator engages the transmission system to transfer power from the engine to the helical discs.

4. Drive the tiller: The operator guides the power tiller by holding onto the handlebars and walking behind it as it moves forward.

5. Soil cultivation: As the helical discs rotate, they cut through the soil, breaking up clods and preparing the seedbed for planting.

6. Steering: The operator steers the power tiller by adjusting the direction of the handlebars to navigate around obstacles and turn at the end of rows.

7. Stop the engine: Once the job is complete, the operator stops the engine by turning off the ignition switch or using a kill switch.

Overall, a helical disc power tiller is a versatile and efficient agricultural machine that helps farmers prepare their fields for planting and maintain healthy soil for optimal crop growth.

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## V. SIMULATION RESULTS

**Stress Analysis:**

Stress is a measure of the internal forces acting within a material, typically expressed as force per unit area. It represents the intensity of the internal forces that resist deformation in a material subjected to external forces.

There are several types of stress:

**Normal Stress:** Normal stress acts perpendicular to the plane of the material. It can be tensile (pulling apart) or compressive (pushing together).

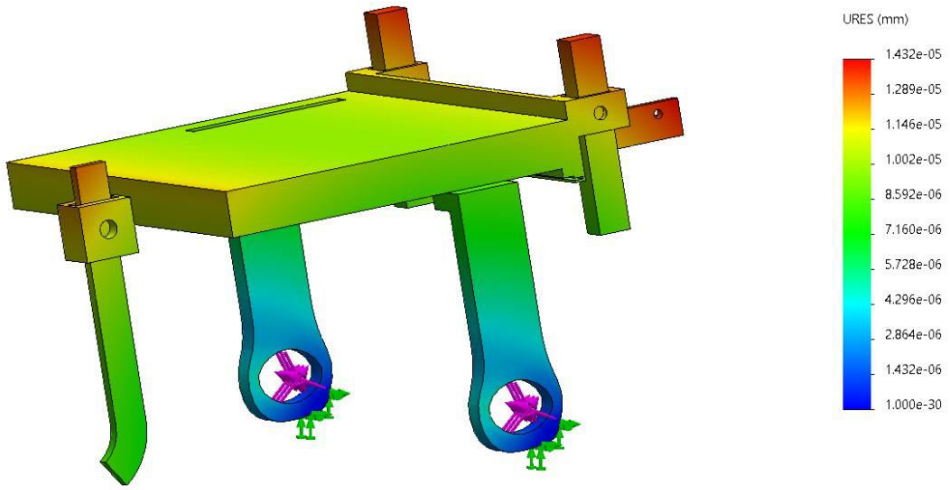


Fig.1.3.Stress Analysis for Chase

Shear Stress: Shear stress acts parallel to the plane of the material and tends to deform the material by sliding one part of the material over another part.

Torsional Stress: Torsional stress occurs in a material subjected to twisting forces.

Bearing Stress: Bearing stress occurs between two surfaces in contact, such as a bolt and a nut, and is perpendicular to the contact area.

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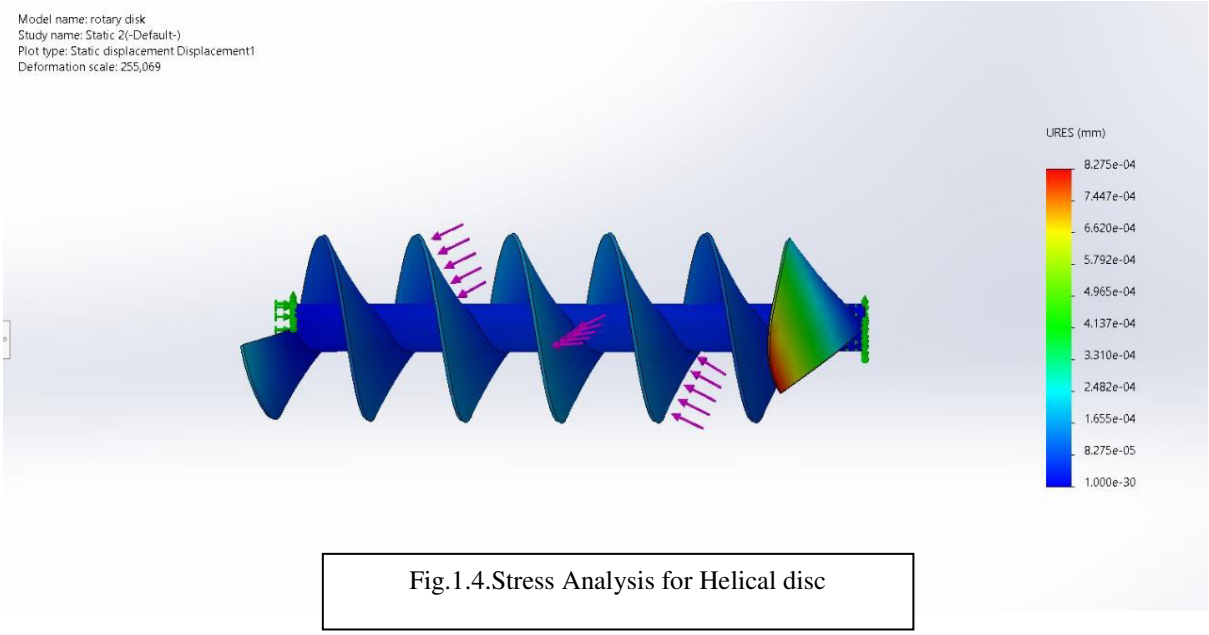


Fig.1.4.Stress Analysis for Helical disc

Stress is an important factor in engineering design, as it determines whether a material will deform or fail under a given set of loading conditions. Stress analysis is used to calculate and analyze these internal forces to ensure that a material can withstand the applied loads without failure.

Strain Analysis:

Strain is a measure of the deformation of a material relative to its original size or shape. It quantifies how much a material has stretched, compressed, or twisted under an applied load. Strain is typically expressed as a dimensionless quantity or as a percentage.

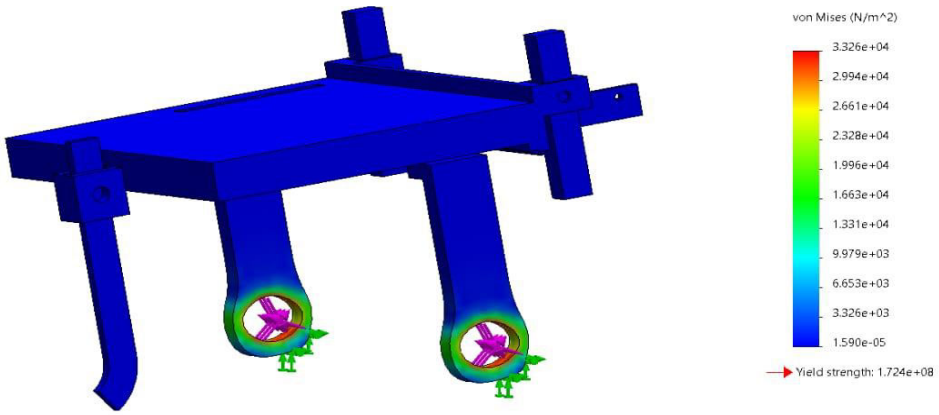


Fig.1.5.Strain Analysis for chase

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There are several types of strain:
Normal Strain: Normal strain measures the change in length of a material per unit length in the direction of the applied force. It can be tensile (positive strain, lengthening) or compressive (negative strain, shortening).
**Shear Strain**: Shear strain measures the change in shape of a material due to shear stress. It is the change in angle between two lines originally perpendicular in the material.

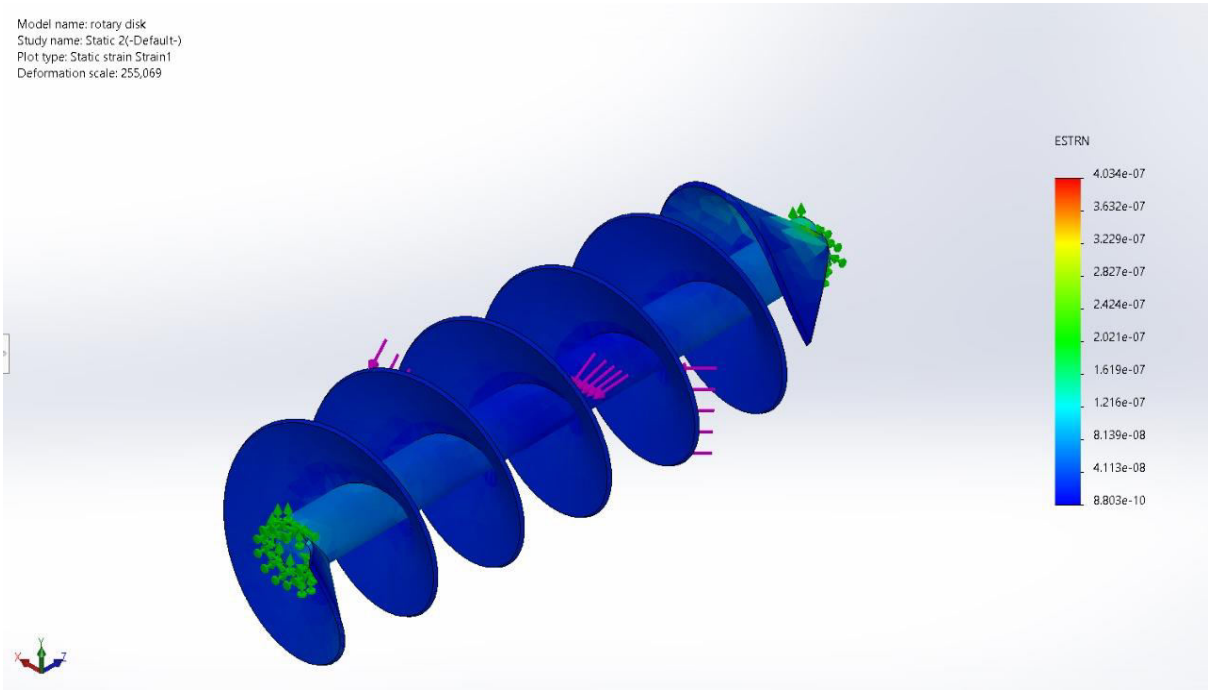


Fig.1.6.Strain Analysis for Helical Disc

Strain is an important parameter in material behavior analysis, as it helps determine how materials respond to external forces. The relationship between stress and strain is described by the material's elastic modulus, which relates the two quantities in linear elastic materials.

## VI. APPLICATIONS OF HELICAL DISC POWER TILLER

Helical disc power tillers are commonly used in agriculture for a variety of applications, including:

1. Seedbed preparation: Helical disc power tillers are used to break up soil clods, mix in organic matter, and create a fine, level seedbed for planting seeds or transplants.

2. Weed control: The rotating helical discs of the power tiller can help cut and uproot weeds, making it easier to manage weed populations in the field.

3. Soil aeration: By breaking up compacted soil and creating channels for air and water to penetrate, helical disc power tillers help improve soil aeration and promote healthy root growth.

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4. Mixing in fertilizers: Farmers can use power tillers to incorporate fertilizers or soil amendments into the soil, ensuring even distribution and maximizing nutrient uptake by plants.

5. Residue management: After harvesting a crop, power tillers can be used to incorporate crop residues back into the soil, promoting decomposition and improving soil health.

6. Land reclamation: In areas with degraded or compacted soil, helical disc power tillers can help loosen the soil, break up hardpans, and improve soil structure for better crop growth.

7. Ridge formation: Power tillers equipped with adjustable depth control mechanisms can be used to create ridges or furrows for planting crops like potatoes or other row crops.

Overall, helical disc power tillers are versatile tools that play a crucial role in modern agriculture by facilitating various soil preparation and cultivation tasks to enhance crop productivity and sustainability.

## VII. CONCLUSION

Helical disc power tillers are essential tools in modern agriculture for various soil preparation and cultivation tasks. From seedbed preparation to weed control, soil aeration, fertilization, residue management, land reclamation, and ridge formation, these versatile machines play a crucial role in enhancing crop productivity and sustainability. Farmers rely on helical disc power tillers to efficiently and effectively manage their fields, ensuring optimal conditions for healthy plant growth and successful harvests.

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