

AGRO AUGER

A PORTABLE SOIL DIGGING MACHINE

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Abstract: Planting Trees is major activity that involves digging holes using either a drilling machine mechanism or hand tools. AGRO AUGER is a soil digging machine which is used for plantation of sapling (rubber, coconut, banana, apple, pine, etc.). This machine uses the principle of auger drilling machine which is used in pile foundation during construction. The auger drill is made of required size by scaling down its original size as per the requirement. The machine is made automatic by employing a D.C motor which serves as a power source for digging the soil. This machine is designed for a preliminary aim of avoiding the use of shovels & levers in plantation of saplings thereby enhancing the plantation process by making it facile.

IndexTerms – DC-Direct Current, SS- Stainless Steel, LB-Linear Bearing.

The interest of people towards plantation of sapling is increasing due to global warming, rise in global temperature and many such factors, so plantation is being done at a faster rate through many of the N.G.O'S as well as people .In case of planting sapling in huge number it is difficult to use shovels & levers for the same it makes the process tiresome and takes very long time. This project focuses on reducing the time for plantation of saplings by employing a semi-automated machine. In the place of conventional shovels which will greatly reduce the planting time required. The machine uses the help of a mechanical drill which is primarily used in pile foundations in construction sites. A D.C motor/Engine can be fitted to the end of the auger shaft and which can be used both in clockwise and anti-clockwise direction thus enabling the shaft to go deep inside the soil as well as come back after the required size is being achieved. The machine can be transported easily since there are wheels which are provided at the bottom of the frame.

- To fabricate a soil digging machine which is used for digging holes in the soil for the plantation of short life span plants.
- To avoid the use of shovels & levers in plantation of saplings thereby enhancing the plantation process by making it facile.

Currently, hand held augers are used for drilling the holes for planting trees. The drilling of the holes typically involves cutting of the roots of the harvested stump with an implement such as an axe then using hand – held motorized auger to drill the hole to the desired depth. The use of the hand –held motorized auger has the following limitations:

1. It is difficult to control due to the weight of the device and the engagement of the roots of the harvested tree stump during operation.
2. It requires considerable muscular effort and difficult to maintain because of the difficult operative nature of the motorized auger. With the hand held motorized augers, the hole drilling process is labour intensive. It requires substantial effort getting up and down to chop roots, the hand-held motorized auger, drill the hole, lower the hand held motorized auger, get down on your knees to plant the seedling, pack dirt around the seedling, and then pick-up all the equipment to move on to the next site.
3. Some motorized auger devices tend to scatter dirt away from the holes being drilled by the auger, resulting in more difficult effort to pack soil around the seedling to finish the plant in process
4. The movement of machine around the farm is cumbersome.
5. The cost of machines involved is high

We first researched about the types of soils and their properties, specifically in Kerala. There are 9 types of soil found across the state. The 3 most common soils to be found are Coastal Alluvium, Laterite Soils and Hill Soils.

TYPE OF SOIL IN KERALA

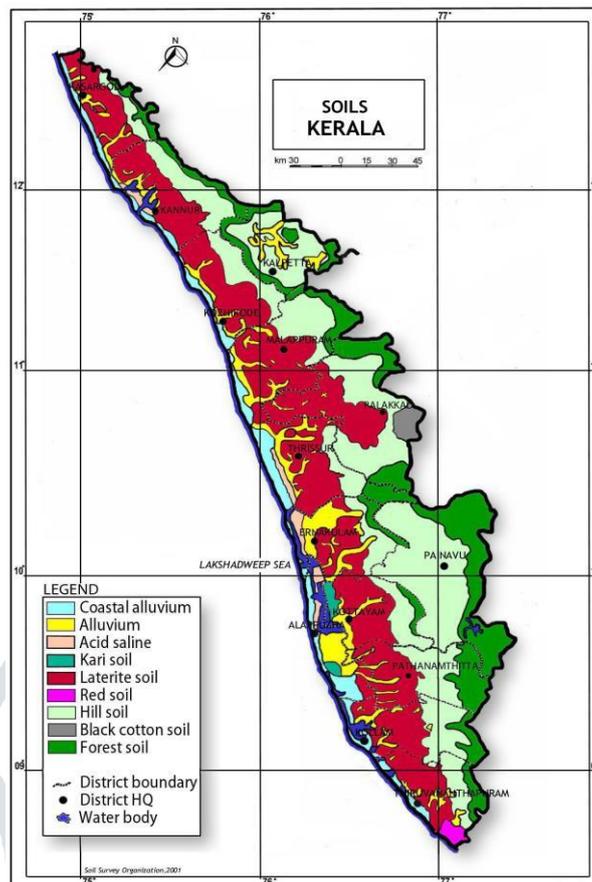


Fig. 3.1: Types of soil in Kerala

We then analysed different soil digging methods which are Displacement boring, Wash boring, Auger boring, Rotary drilling, Percussion drilling. Among these Auger boring was found to be fast and economical which uses simple, light, flexible and inexpensive instruments for large to small holes. It is very suitable for soft to stiff cohesive soils and also can be used to determine ground water table.

We then surveyed the limitations on the currently available auger drilling machines and following limitations were found.

- It is difficult to control due to the weight of the device
- It requires considerable muscular effort and difficult to maintain because of the difficult operative nature of the motorized auger. With the hand held motorized augers, the hole drilling process is labour intensive.
- The movement of machine around the farm is difficult.
- Use of Engine which makes it heavier and cause of pollution in small amounts

Working Parameters

- ❖ A direct AC source is used for operating the machine.
- ❖ By using a AC to DC converter the 230V AC is directly converted to 48V DC, which is the required specification for operating our DC Motor.
- ❖ BY adjusting the controller, we can regulate the RPM by using a rheostat.
- ❖ The entire equipment is fixed inside a framework.
- ❖ The linear downward motion is provided by using guideways by LB25UU.
- ❖ An expansion compression spring is also used for its reverse motion.
- ❖ While its downward motion, with the help of a bike throttle we can adjust the direction of rotation of motor.
- ❖ Since high torque is required for digging the soil, we used a axle helical gear engaged gearbox (gear ratio 2:1) which provide the rated torque for our purpose.
- ❖ After the digging process we can easily release the machine by applying little pressure on the handle by our hands.

IV. DESIGN AND MODELLING

The 3D model was designed in DS SolidWorks 2019. Each of the components were separately designed and was grouped together into an assembly. The components modelled consist of auger drill bit, frame and frame support, wire mesh, Interference study and clearance check was done in Solid works itself.

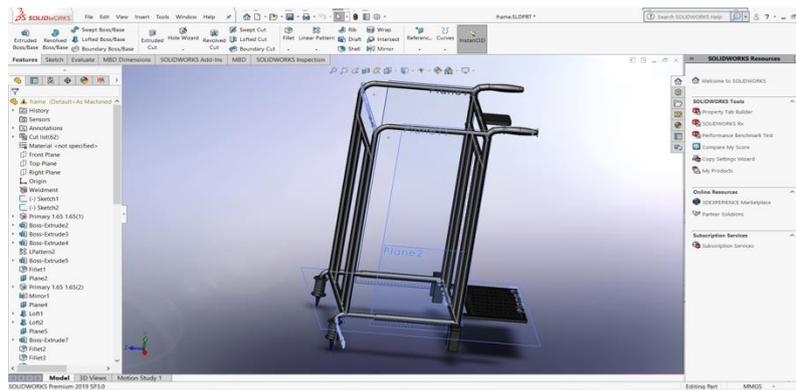


Fig. 4.1: Structural Frame Modelling

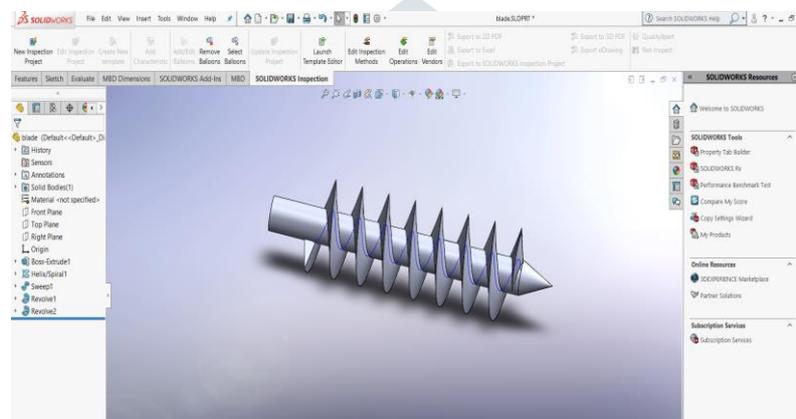


Fig. 4.2: Auger Drill Bit

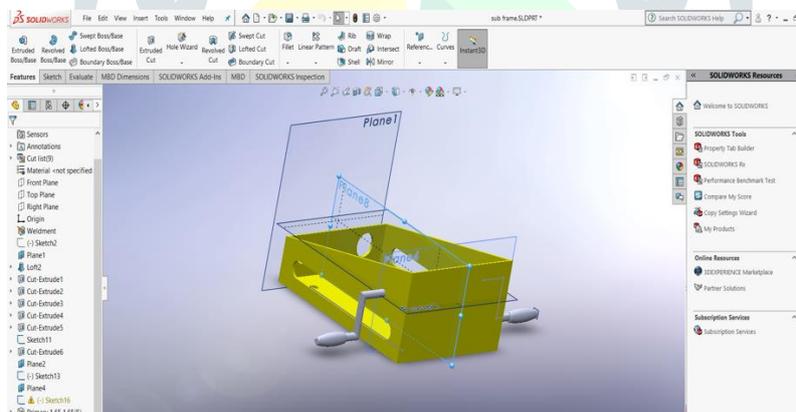


Fig. 4.3: Base Plate Modelling



Fig. 4.4: Rendered 3D Model

V . FRAME ANALYSIS

- Material is assigned/applied to the frame
- The 4 bases is fixed to the ground
- The weight of the motor is applied to the frame as shown in the figure by taking factor of safety as 2
- The weight of the guide rod is applied to the frame by using earth gravity

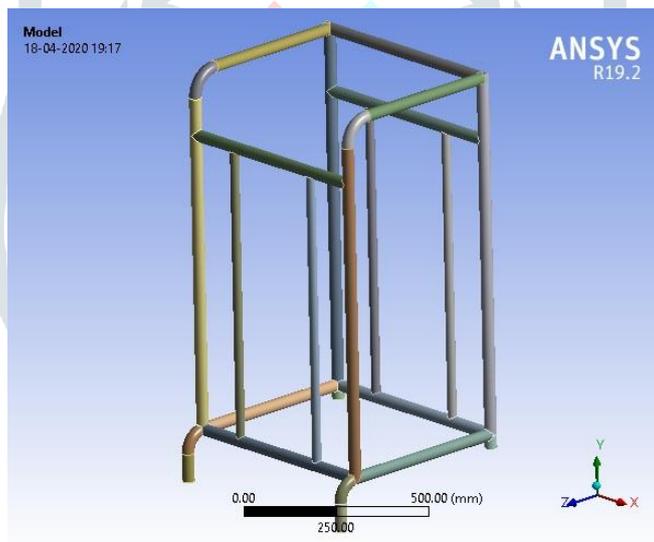


Fig. 4.5: ANSYS Frame model

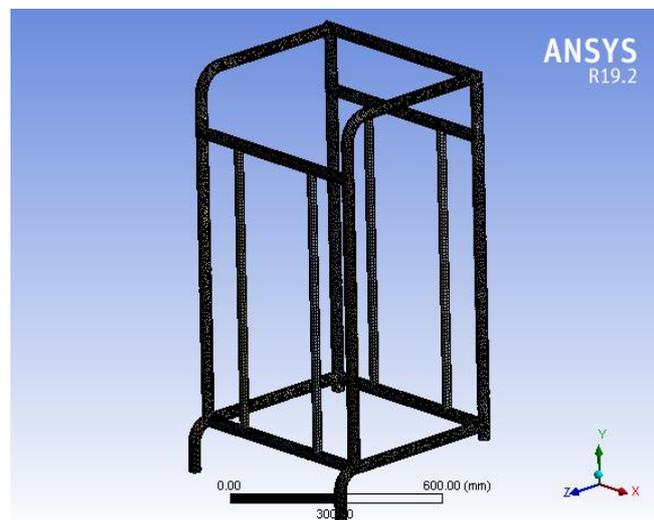


Fig. 4.6: Frame Meshing

- The body was then meshed with an element size of 10 mm and several analyses was done

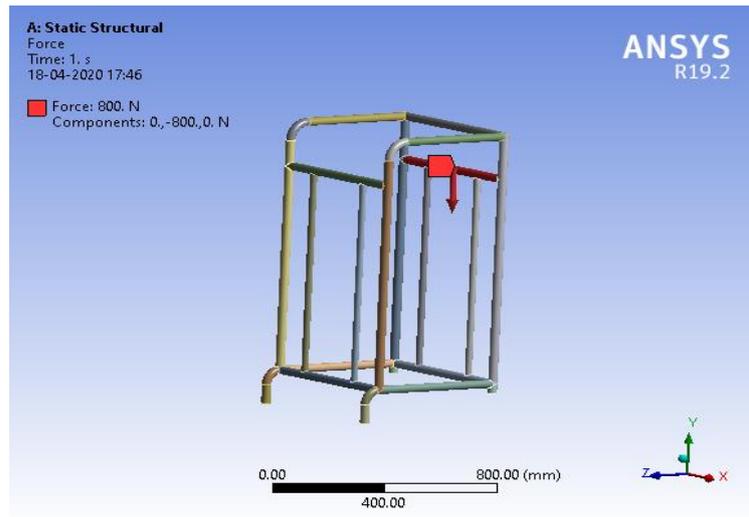


Fig. 4.7: Force Application

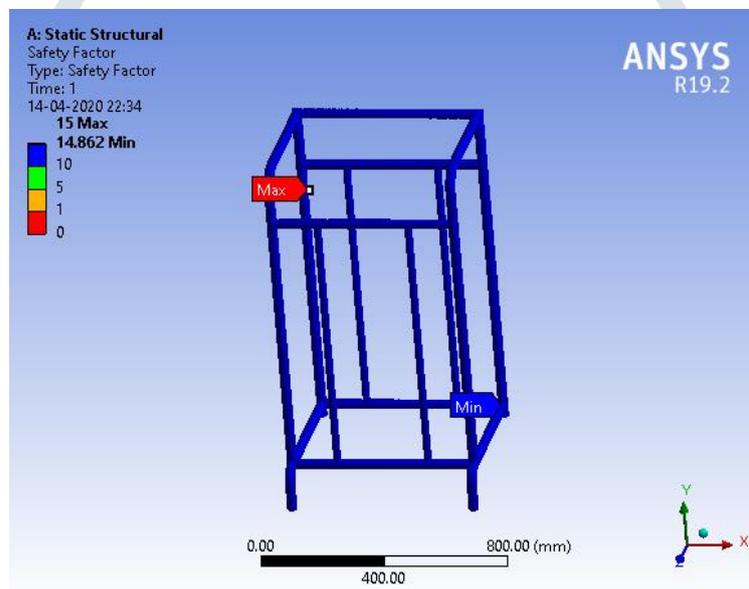


Fig. 4.8: Static Structural Analysis

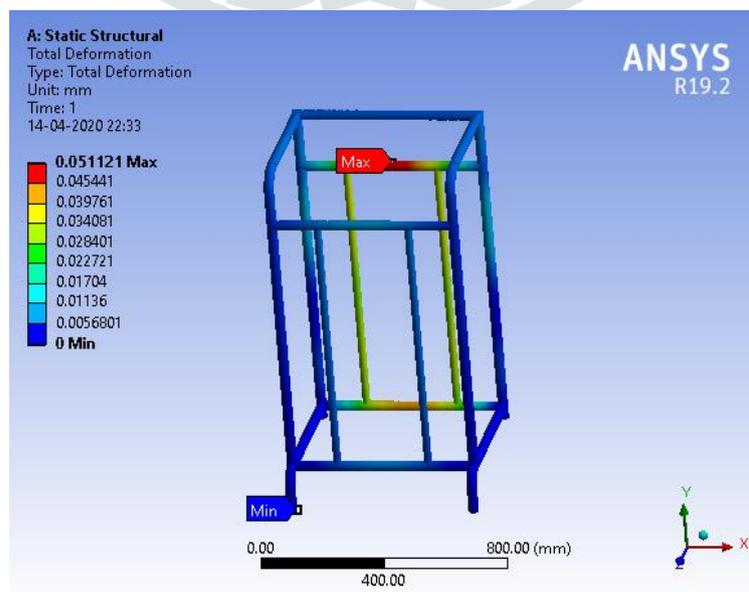


Fig. 4.9: Total Deformation

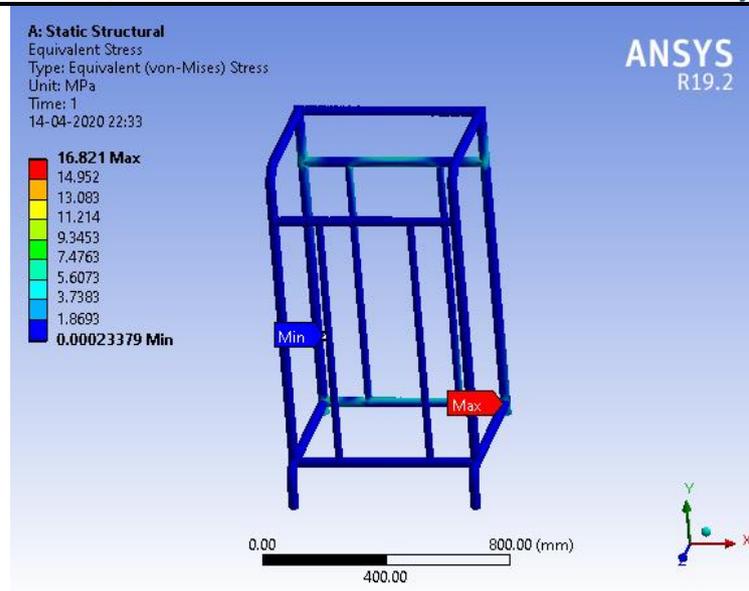


Fig. 4.10: Equivalent stress analysis

- The stress is found out to be 16.82 MPa
- The FOS is found out to be 15 max
- The max deformation is found out to be .05mm
- Hence the design of the frame is Safe and will not fail even in working condition.

VI . FABRICATION

Main elements of prototype were Galvanized iron (GI-Pipe) of 1-inch dia and we used Stainless Steel (SS-Rod) of 25mm dia for fabricating frame. We also used steel plates of 8mm thickness for creating base surface for holding our motor and gear components. Japan sheet of 18 gauge were used for covering the base plate. The main process done in fabrication are boring, cutting, grinding, surfacing, slotting, turning, threading, drilling, facing, knurling, taper turning, welding.



Fig. 5.1: Fabrication Process

VII . RESULTS AND DISCUSSION

The final prototype was tested in different soils like red soil, sandy loam, Rich dark brown loam and measure the depth of hole size and also the diameter of the hole formed as shown in figure 7.5 and figure 7.6. while testing in different soil it is found that some soil required more power and it is seen that while using DC Motor soil digging is made possible only then the motor reach high rpm. From this we understand that for gigning purpose along with high starting torques rpm is also needed for smooth operation.

The size of auger drill used in our project is having 30cm diameter and 90 cm length. The hole formed with this auger drill bit is having 35cm and we dig only up to 45cm depth due to hard stone present in that place. We also observed that at high rpm the machine is producing minute vibration and with some sound.



Fig. 6.1: Final Prototype

VIII . TESTING

We tested our prototype in red soil and in sandy loam, almost it take about 140s to make hole with a depth of about 450mm and width of about 340mm .we also found that augers cannot be used for soils in which the gravel particles or rock fragments are greater that approximately one-tenth of the diameter of the hole.



Fig.6.2: Testing



Fig. 6.3: Width Measurement



Fig. 6.2: Depth Measurement

SCOPE FOR FUTURE WORKS

- Automating the slides up and down movements by providing stepper motor and controllers.
- Solar power can be used as a source of power since we are using DC Motor.
- Using sensors like Ground penetration Radar, we can inspect the place we are going to dig.
- Using Weightless materials instead of SS, MS, we can reduce the weight of the equipment and hence easier to handle.
- Based on our experience in this project RPM is also an important factor in drilling process along with thigh torque.

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