Parametric Analysis & Design Structure of Hydraulic Seed System

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Abstract
This paper is bases on the design and manufacturing of the sowing machine based on hydraulic principlenamed as 'Hydraulic Seed Sowing Machine'. The machine is very efficient in working and will be able to easily sow the seeds like (bajra, rice, Val, gram, groundnut, pea, maize, groundnut, etc.). The machineis following the conditions such as – It operates on a permanent raised bed of 100 cm width which can sow seeds with fertilizer in 5 rows at 25 cm approximately apart. Seeds - bajra, rice, Val, gram, groundnut, pea, maize, groundnut, etc. Mechanism is preferably impact dibber and it make very thin slit of max depth of 30-40 cm. It covers the seeds after sowing and be operated by 1-2 people either 1 hp power motor or manually and sow 0.6 to 1 ha in approximately 6 hours. Hydraulic Seed SowingMachine is Potential of being self-driven to get higher speed.

1. INTRODUCTION

In our country, farming is done by the traditional way. Traditionally the seeds were sown by hands which was very time consuming. So, to save the time and efforts of farmers, the use of machines has been started. The agriculture field means seed sowing. The performance of agriculture is measured by cost and yield of agriculture products. But the efficiency is more important factor to be considered. Here invention of the model is to improve prior art machines and to provide seed sowing machine which works on hydraulic power which increases the efficiency of planting the seeds of large variety of sizes
i.e. seeds like *bajra, rice, Val, gram, groundnut, pea, maize, groundnut, etc.*
Till now, hydraulic system in that manner is not used in any raised bed seed sowing machine. Generally hydraulic equipment is operated by any external electrical or fuel consuming equipment. In our machine we used I in such a way that it is operated by pedalling so that there is no consumption of any fuel or electrical energy. We used it in an eco-friendly manner to generate constant force / torque.

1.1. Materials and Components

Here the materials and components which are used in inventing the model are following:

Table 1 Components

Sr. no	Components	Specification	Quantity	Uses
1	Hydraulic gearmotor	101-2504-009 MAKE EATON HSN/SSC 8412	1	Conversion of hydraulic energy to mechanicalenergy
2	Hydraulic gear	Speed op-5015 flow rate-	1	Conversion of mechanical
	pump	6.4 Lpm		energy to hydraulic energy
3	Pillow block bearings	P204 and P205	4-4 each	To reduce friction
4	Hollow square pipe	3.5×3.5 cm thickness = 2mm	13 m	To make chassis
5	Bicycle frames	With pedals without tyres 22 inches(standard)	2	To get input power
6	Bicycle sprockets	80 mm dia and 200 mmdia	5 of 80 mm dia 4 of 200 mmdia	Power transmission
7	Bicycle chain		Length = 6 m	Power transmission
8	Hexagonal nuts and bolts with washers	Length =80 mm Diameter=12 mm	40	Temporary fastening
9	Hexagonal nuts and bolts with washers	Length = 80 mm Diameter = 8 mm	40	Temporary fastening
10	Mild steel shafts	1) 25 mm dia, length = 3meter 2) 15 mm dia,	1-1 each	As an axle

		Length = 1.5 meter		
11	G.I. Sheet	0.5 mm thickness	1 sq. m	Temporary fastening
12	Ball bearings	6202 or 6002	2	As an axle
13	Rubber or plastic plate	12 mm thickness	1 sq. ft.	To make seeder box
14	Rubber pipe	25.4 mm dia	4 m	To reduce friction of seeder shaft
15	Hydraulic oil	68 AWS	5 l	To make seed distribution mechanism
16	Fiber sheet	2 mm thickness (opaque)	3×1.5 m	To distribute seeds in respective lane
17	Bike tyres	2.5/R18	4	For hydraulic system
18	Oil tank	5 litres	1	To store hydraulic oil
19	PVC braided hose pipe	0.5-inch dia	2 m	To make hydraulic circuit
20	Hose clamp	0.5 inch	8	To connect hose pipe with motor
21	Rode ends	10 mm dia	4	To make steering mechanism
22	MS pipe	Thickness=1.5mm Dia = 20 mm	Length=12m	To make structure for roof

1.2. Experimental Set-Up

In our working model, we use a ladder frame chassis of wheel base 2 meter and track width of 1.3 meter.Our machine is rear wheel drive which is driven manually. As different seeds require different depth of digging, we have used depth adjustment system in front wheels. Here a 7 LPM hydraulic gear pump and OMP25 hydraulic gear motor is used. So, it is named as '**HYDRAULIC SEED SOWING MACHINE'**. We use anti-wear, anti- rust hydraulic oil which has excellent oxidation stability. Dribblers are designed in such a way so that minimum stress will develop in them. Height adjustment system is also involved in the sowing machine so that the height of the dribblers will be adjusted.

1.3. Working Principle

In our model, the mechanism used here is hydraulic mechanism. It consists of main components which namely, hydraulic gear motor and hydraulic gear pump. These components hydraulic gear motor and hydraulic pump makes the machine very efficient and saves the time for working.

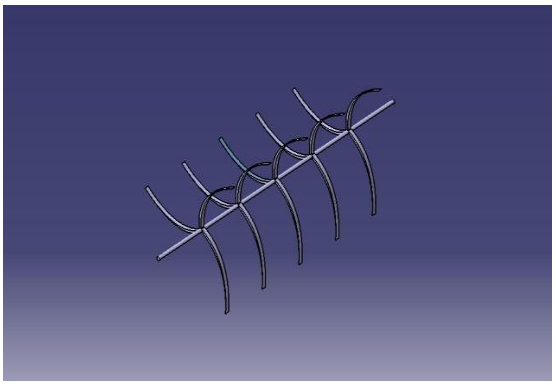
1.3.1. Chassis design: -

Chassis design is made as like for carrying the support of whole cycle chassis. The chassis consists of mainly two cycle frames in which one is attached to the rear wheels to move the machine forward after pedalling and other cycle frame is attached to the hydraulic gear pump which will work to convert mechanical energy to hydraulic energy i.e. to generate pressure in oil when pedalling is done.

- Hydraulic gear pump: Gear pumps use meshing gears to pump fluid through displacement. These areone of the most common types of pumps for hydraulic fluid applications.
- Gear pumps are also widely used in chemical equipment's for pumping high viscosity fluids. There are two main variations. An external gear pump that uses two external spur gears and an internal gearpump that uses external and internal spur gears. Gear pumps are positive displacement (or fixed displacement) and deliver a fixed amount of fluid with each revolution. Some gear pumps are designed to act as a motor or pump. The oil used in the hydraulic seed sowing machine is hydraulic oil or fluid. Here, internal spur gears are used.
- Hydraulic gear motor: Hydraulic motors are mechanical actuators that convert hydraulic pressure and flow into torque and angular displacement (rotation). A hydraulic motor is a rotating counterpart of a hydraulic cylinder as a linear actuator. Most broadly, a category of devices called hydraulic motors can include devices that operate on hydroelectric power (that is, water engines and water motors).

1.3.2. Dribbler mechanism: -

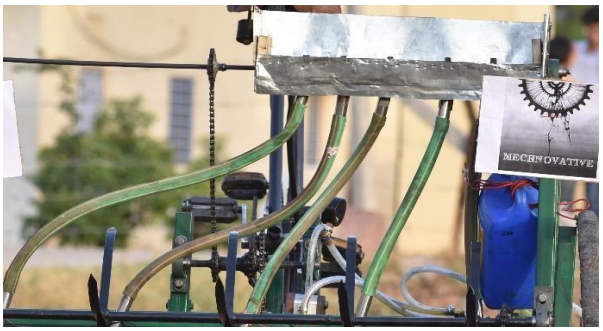
The hydraulic energy is converted into mechanical energy with the help of the hydraulic gear motor i.e. pressurised oil will be used in hydraulic gear motor to rotate the dribblers for digging the soil. The dribblers are mounted on the shaft at 25 cm distance apart in 5 rows.



***Blades** (Figure 1)*

1.3.3. Seeder Mechanism:

Another gear is mounted on the Hydraulic gear pump which will transmit the power to another gear mounted on the seeder box shaft. Moreover, the seeder box consists of rubber rollers on which 4 slots have been cut. These slots will allow the seed to comes through the slot while rotation of the shaft. This will allow the seed to pass through the hole in the seeder box simultaneously through the pipe placed at 25 cm apart.



Seeder mechanism *(Figure 2)*

1.3.4. Height adjustment system: Height adjustment system is involved in the hydraulic seed sowing machine for adjusting the height of the dribblers. 8-10 holes are made in square pipe and accordingly thedribblers are fit to maintain the height.

1.3.5.

Height adjustment *(Figure 3)*

1.4. Material Specification List

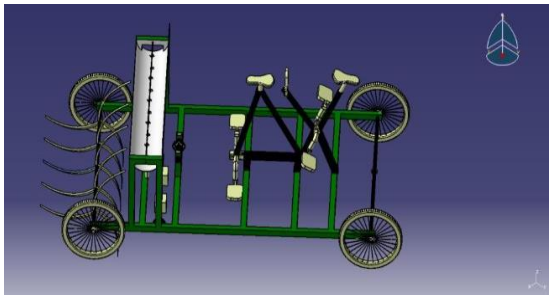
Table 2 Amount List

Sr. no.	Components	specifications	Qty.
1.	Hydraulic motor	101-2504-009	1
2.	Hydraulic pump	Speed op 5015,LPM 6.4	1
3.	frame	MS	1
4.	Wheels with tyres	2.5/R18	4
5.	Sprocket and chain set	68AWS	2
6.	oil		5 lit
7.	Layout cost		
8.	Assembly cost		
9.	Paint		1lit
10.	Bi cycle frame		2

2. METHODOLOGY:

The machine design is first made in 3d modelling software i.e. Catia V5 before the actual manufacturingand then analysed in Ansys software.

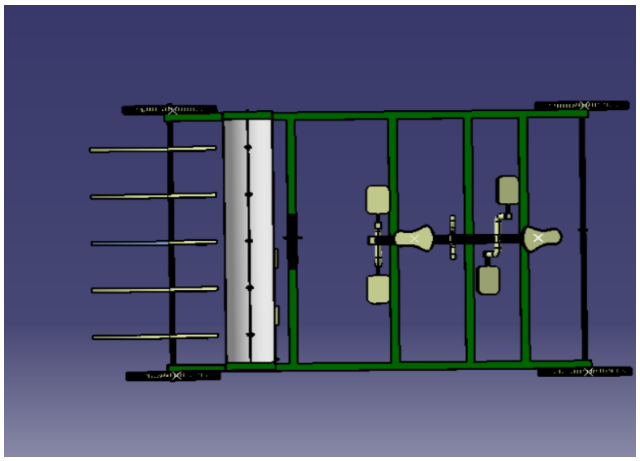
The following conditions are given:



Machine design *(Figure 4)*

Table 3 Speeds

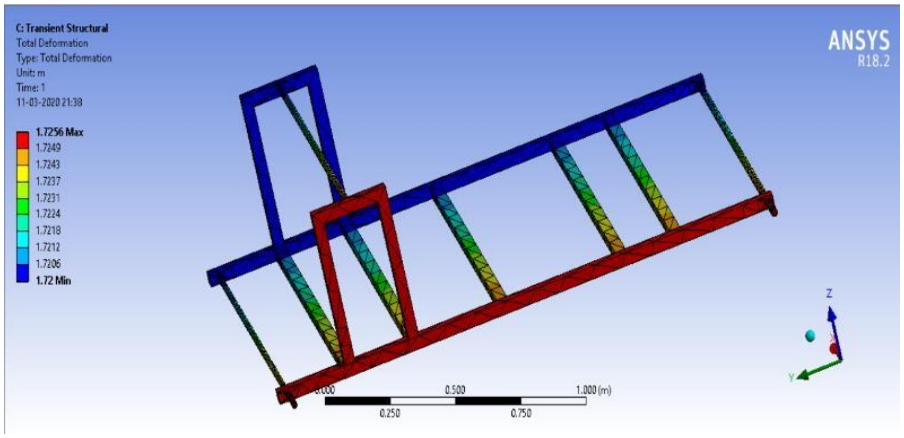
S. no.	Component	Speed
1.	Wheel	15.7 rpm
2.	Pedal	7 rpm
3.	Pump	15.7 rpm
4.	Motor	24 rpm
5.	Dribblers	60 rpm



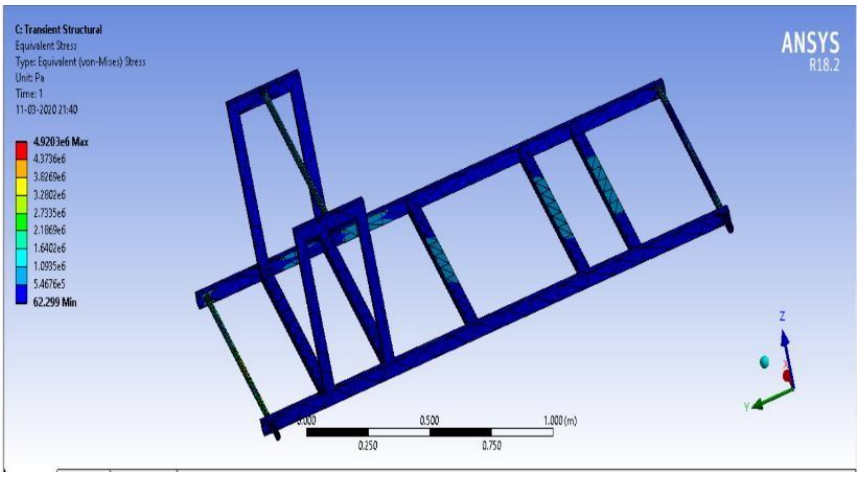
Top view *(Figure 5)*

The following properties are analysed:

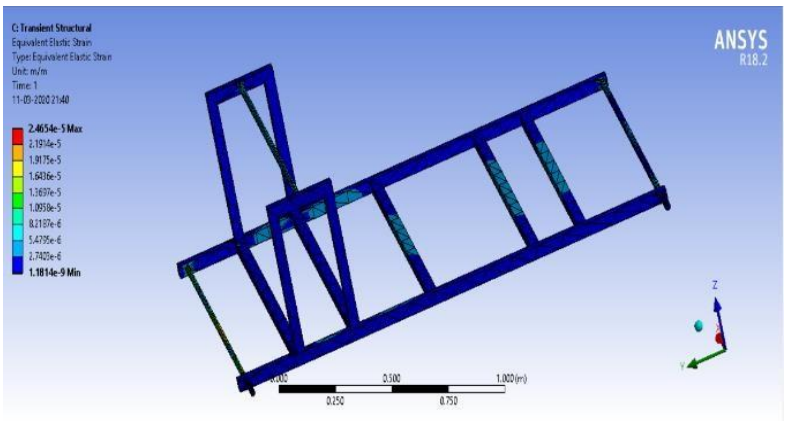
1. Total deformation
2. Total equivalent stress (von-misses stress)
3. Total equivalent strain (von-misses strain)4.



Total deformation *(Figure 6)*



Equivalent stress *(Figure 7)*



Equivalent strain *(Figure 8)*

2.1. Calculation:

Total area covered by the machine per travel = 125 m^2Total rounds taken by machine = 40
Total time taken by the machine = 360 min.Total time taken per rounds = 9 min./round
Speed of the machine = 200 m/9 min.= 22.22 m/min.
Radius of wheel = 0.225 m
v=ωr
m = 22.22/0.225 = 98.76 rad/min.
Wheel rpm = m/2Π = 98.76/2Π = 15.7 rpm or 0.26 rps
i.e. 1 rotation in 4 secs

3. RESULT AND CONCLUSION:

The hydraulic seed sowing machine is designed and analysed with the software. After that the machineis manufactured which operates on a permanent raised bed of approx. 100 cm width which can sow seeds with fertiliser in 5 rows at 25 cm apart distance.
The following results are obtained from the analysis:

Table 4 Results

S.no.	Property	Max. value	Min.value
1.	Total deformation	1.7256 m	1.72 m
2.	Equivalent stress	4.920*106	62.299pa
3.	Equivalent strain	2.465*10-5	1.18*10-9 pa

REFERENCES:

1. Ryszard Daniel, Tim Paulus, 2019, Lock Gates And Other Closures In Hydraulic Projects Paul Michael, Hassan Khalid, and Tom Wanke, An Investigation of External Gear Pump Efficiencyand Stribeck Value, 2012,SAE RS Khurmi, machine design, pp 204-303
2. Wikipedia, Hydraulic Motor, 2009, JSTOR