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Design and Analysis of Land Leveller Suspension

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ABSTRACT

In The current year's traditional product technology of farming device have been leading to the deterioration of soil health and declining form profitability because of high enter of water and labor. Land levelling improves water coverage in the area, can improve irrigation performance. There might be lower in water intake and huge boom inside the crop yield and first-rate because of suitable field leveling, inside the latest generation the laser land leveler has been used, laser land levelling is one of the modern strategies which allows in the control of water and soil with the aid of decreasing the quantity and time required for irrigation. It is used only for professional character and hard setup. The primary troubles had been the effectiveness of laser land levelling as a water-saving tool in the new context of land use and possession, affordability of laser land levelling for farmers, and the economic viability of this area. So, over this affordability, the leveler becomes format and editing the existing device by means of using putting in suspension to it and have a look at to enhance the performance and reduce the price.. The suspension allows to degree the maximum and minimum land variation, that enables to set in the moderate stage, to perform the uniform pass the place of land. On this layout, sensors are used to reap the precision of component and similarly set the level automatically. This design normally requires to conquer professional men and women, i. e. Any person can set up the aspect and operate the device easily and used for distinctive tractors (2w & 4d).

I. INTRODUCTION

An unevenness of the soil surface has a chief effect at the germination, stand and yield of flowers thru nutrient water interaction and salt and soil moisture distribution sample. Land levelling is a precursor to acceptable agronomic, crop control practices and soil. Conserving technologies perform higher on well leveled and laid-out fields. Farmers apprehend this and therefore dedicate extensive attention and resources to levelling their fields properly [1]. However, traditional methods of levelling land are not best greater bulky and time-eating but greater steeply-priced as well. Very regularly most rice farmers level their fields beneath ponded water situations. The others dry level their fields and take a look at the stage with the aid of ponding water. Hence in the process of having true leveling in fields, a considerable amount of water is wasted. It's far a not unusual knowledge that most of the farmers follow irrigation water until all of the parcels are completely wetted and covered with a thin sheet of water[2]. Research has indicated that an extensive (20-25%) quantity of irrigation water is lost all through its utility at the farm because of terrible farm designing and unevenness of the fields. This problem is extra pronounced inside the case of rice fields. An unevenness of fields ends in inefficient use of

irrigation water and also delays tillage and crop establishment options. Fields that are not degree have choppy crop stands, elevated weed burdens, and choppy maturing of vegetation. A majority of these elements tend to contribute to decreased yield and grain first-rate which lessen the potential farmgate profits. Powerful land leveling is supposed to optimize water-use efficiency, improve crop establishment, lessen the irrigation time and effort required to manage the crop[3]. The manual for laser land leveling seeks to explain the advantages of land leveling in fields, especially rice fields, and assist increase the abilities of farmers and operators in using laser technology to gain a degree discipline surface. It is also meant to enable the customers to discover and understand the operating of the diverse components of a laser- managed land leveling system; undertake a topographic survey using a laser gadget; set up and use a laser-controlled levelling machine and troubleshoot a laser- managed levelling gadget. It's far hoped that the users (farmers and provider vendors) will discover this manual useful in adopting this crucial useful resource maintaining generation as a precursor to several different stepped forward agronomic, soil, and crop management practices[4].

A. Benefits of land leveling

Effective land levelling reduces the work in crop establishment and crop management and will increase the yield and excellent.

Degree land improves water coverage that l improves crop established order weed issues l improves the uniformity of crop adulthood l decreases the time to complete obligations l reduces the amount of water required for land preparation [6].

B. Yield

Studies have proven a massive boom in rice yield due to good discipline levelling. The following desk shows the results of land levelling experiments conducted in Cambodia between 1996 and 1999[8].

Table 1. Results of land levelling experiments conducted by CIAP in Cambodia, 1996-1999.

Year	Rice Yield (t ha^{-1})	
	Leveled fields	Unleveled fields
1996	3.40	2.67
1997	2.27	1.46
1998	2.72	2.36
1999 (CARDI)	2.34	2.00
Average	2.72	2.19

The above table shows that, for the same rice varieties and the same fertilizer input, the average increase in crop yield was 24% or 530 kg ha–1. In two experiments conducted at different localities, a strong correlation was found between the levelness of the land and crop yield. This correlation is shown in Fig. 1 [8].

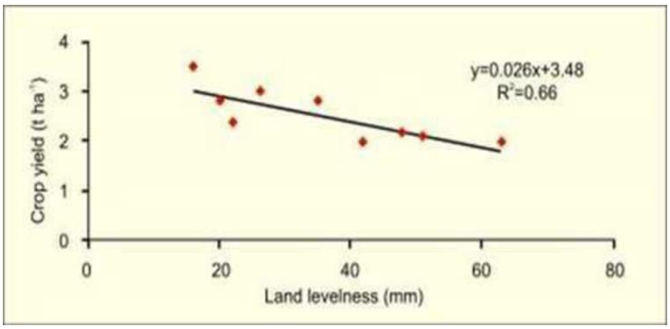


Fig 2. Graph showing a correlation between levelness of land and crop yield.

C. Weed Control

Land leveling increases yield. A massive part of this growth is due to advanced weed management. Advanced water insurance from better land leveling reduces weeds by up to 40%. This reduction in weeds results in much less time for crop weeding. A discount from 21 to 5 labor-days according to hectare is carried out. This represents a 75% decrease within the labor required for weeding[11].

Fig 1: Manual weeding operation.

D. Farm Operation

Land leveling makes possible the use of larger fields. Large fields grow the farming area (fig. 2) and enhance operational performance. Increasing area sizes from zero. 1 hectare to zero. Five hectare increases the farming region via among 5% and seven%. This boom in a farming place gives the farmer the option to reshape the farming place that may lessen working time with the aid of a discount of as much as 16 person-days per hectare 10% to 15% [6].

II. THEORY AND CONCEPTS

A. Options for Land Leveling

Draft animals, such as buffaloes and oxen, 2wheel tractors, or 4-wheel tractors can all be used as power sources to level a field. Different systems require different field conditions and operating time to complete the task.

Fig 3.

(a) conventional method of land levelling using animal- drawn timber log.

(b) mechanized land levelling using a tractor-drawn planter.

Draft animals and a pair of-wheel tractors the usage of harrows and leveling boards. These levelling strategies require overall water coverage of the sphere and require 7 to 8 days for a 2wheeled tractor and 12 days according to a hectare of land the usage of draft animals. Four-wheel tractor using rear-set up tractor blades or drag buckets. Four-wheel tractors are very effective for levelling each wet and dry fields. Moist fields are high-quality levelled with a rear-established tractor blade. Dry fields are first-rate levelled with the usage of hydraulically operated drag buckets. Tractor painting fees are dependent on the tractor's ability and the amount of soil to be moved. It takes approximately eight hours to level 1 hectare with a rear- mounted tractor blade. This reduces to approximately four hours when using a drag bucket[11].

B. Effects of Uneven Distribution of Land

The not unusual practices of irrigation in intensively cultivated irrigated regions are flood basin and check basin irrigation structures. These practices on traditionally levelled or unlevelled lands lead to waterlogging situations in low-lying areas (fig. 4a) and soil water deficit at higher spots (fig. 4b). Sizable

quantities (10-25%) of irrigation water are misplaced in the course of application on the farm because of negative control and uneven fields. Conservation agriculture practices coupled with precision land levelling facilitate uniform water utility and reduce deep percolation losses
of water[13].

Fig 4.

(a) Waterlogging in a wheat field.
(b) Uneven distribution of irrigation water under traditional land levelling.

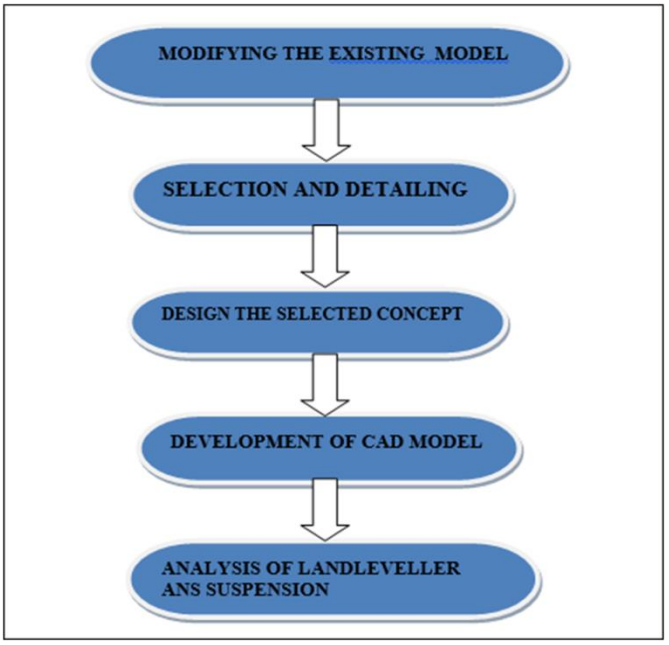
III. PROJECT OBJECTIVES AND PROJECT METHODOLOGY

A. Project Objectives

An exhaustive literature survey led to formulate the objectives for the present study of the model.
Objectives are as below

- Design & Modify the existing land leveller model by fitting free suspension to it.
- To conduct an analysis on suspension spring and leveller bucket in Ansys software.
- To conduct the levelling experiment for different soil conditions.

B. Project Methodology



Project Methodology Flow Chart

Fig shows a flowchart connected to Methodology followed during project execution. It consists of 5 steps

- Modifying the existing land levelling system.
- Selecting and detailing the selected concept.
- Designing the selected concept.
- Using CATIA V5 R20 software development of the CAD model.
- Analysis of Land Leveler & Suspension using Ansys Workbench software 17.2.

IV. MODIFICATION OF THE EXISTING MODEL

A. Existing land leveler

The leveling bucket may be either linkage set up or pulled with the aid of the tractor's drawbar. Pull kind structures are favored as it's miles less complicated to connect the tractor's hydraulic device to an outside

hydraulic ram than hook up with the internal manipulate device utilized by the linkage machine.

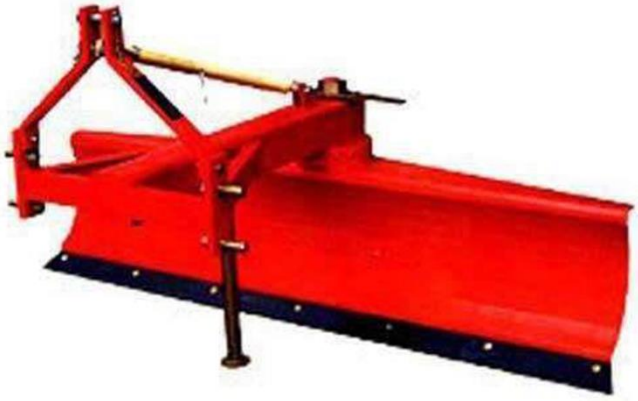


Fig 5: Existing land leveler

This fig 5 shows the present model of a land leveller, which can only mount in a particular level and drag pulled by the tractor's drawbar. This levelling method lags in the precision of land level irrigation.

B. Modified Model of Land Leveller

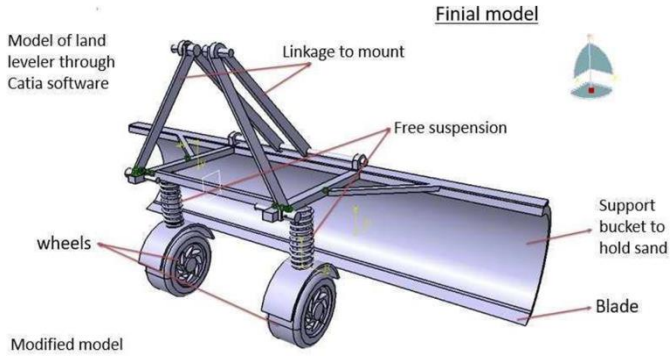


Fig 6: Modified Model of Land Leveller Using Catia V5 R20 Software

The Design of modifying the existing system by installing Suspension to it and analyze to improve the performance and decrease the cost. The Suspension helps to measure the maximum and minimum land variation, which helps to set in moderate level, to perform the uniform cross the area of land. In this design, sensors are used to achieve the precision of components and further set the level automatically. This design overall requires to overcome skilled persons, i.e., any person can set up the component and operate the system easily and used for different tractors (2W & 4D).

Table 2: properties of materials used for the land leveller

PARTS	MATERIAL	GRADES
Leveller Body	Iron	EN – GJS – 600-3 EN – GJS – 500-7
Blade	Carbon Steel	AISI 1065
Suspension	Steel Alloy	ASTM 1070
Wheel	Rubber	

C. Drafting

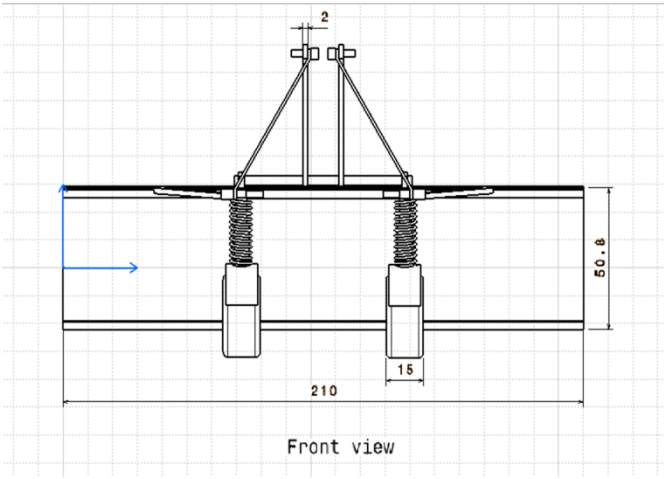


Fig 7: Front view

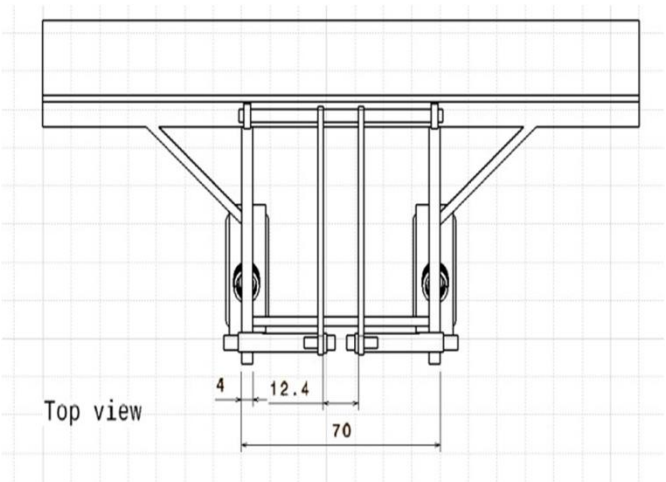


Fig 8: Top view

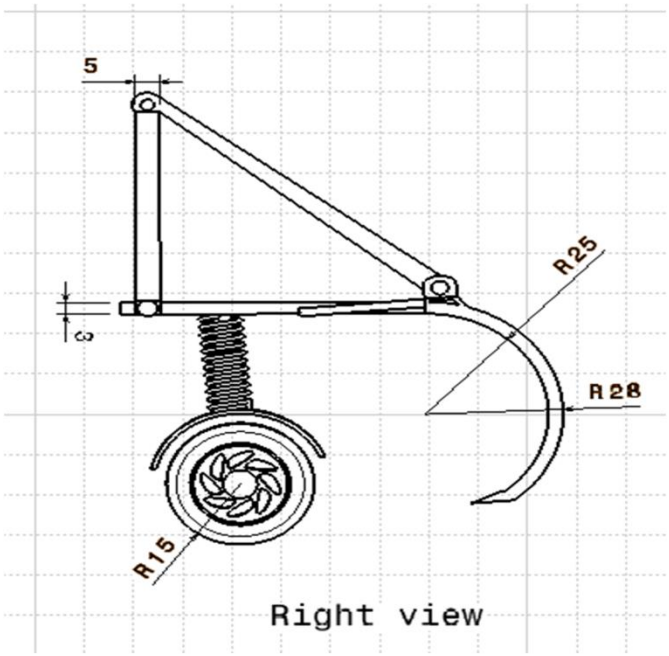
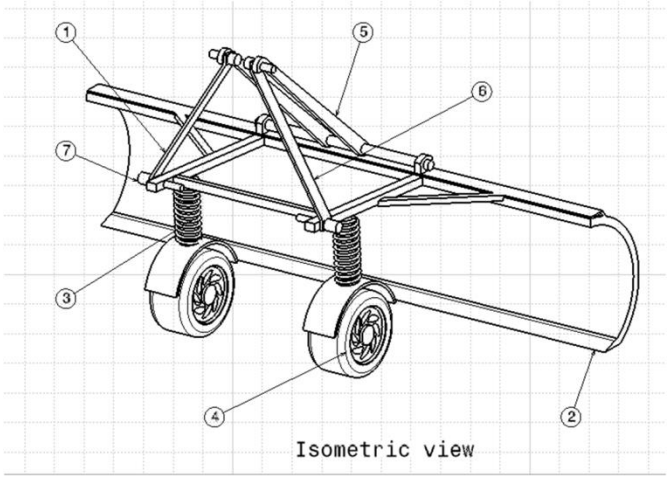


Fig 9: Side view



Sl no:	Part Number	Quantity
7	Bolt	4
6	Connecting strip to mount	2
5	Connecting strip	2
4	Wheel	2
3	Suspension	2
2	Blade	1
1	Leveller bucket	1

Bill of materials:

Fig 10: Iso view

V. RESULTS AND DISCUSSION

The static analysis is done in different loading conditions at assumptions of minimum and maximum load conditions for Suspension and Leveller blade to find max shear stress, max total deformation, and max stress analysis.

A. Analysis of A Suspension Spring at Different Load Conditions.

a. Shear stress analysis

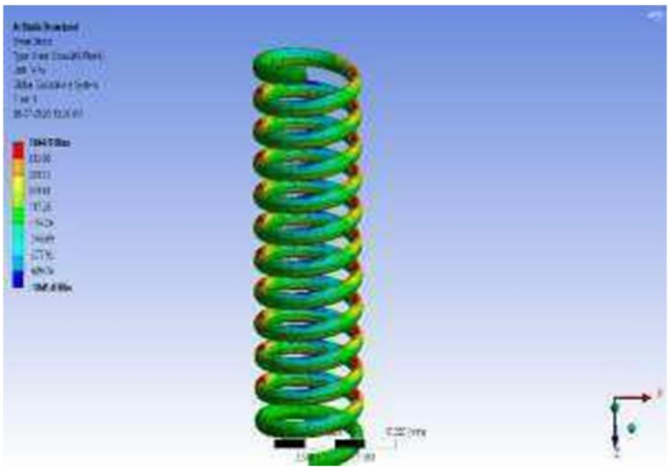


Fig 11. Shear stress analysis of a suspension spring at different load conditions.

b. Stress analysis.

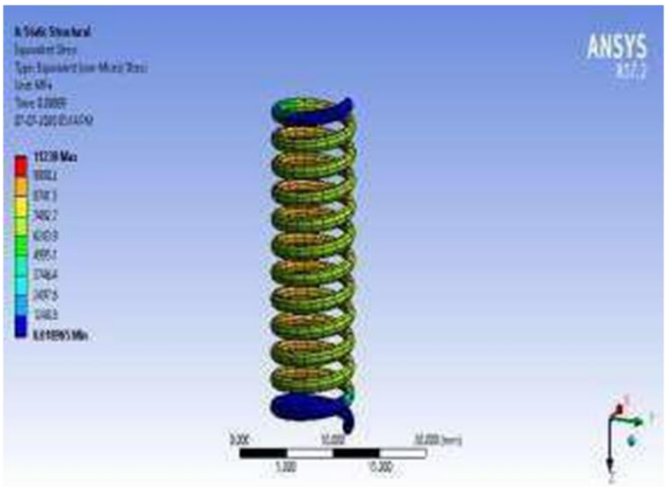


Fig 12. Stress analysis of a suspension spring at different load conditions

c. Total deformation

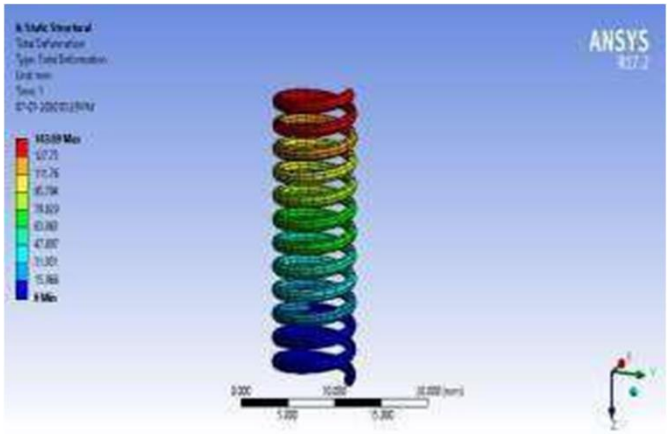


Fig 13. Total deformation of a suspension spring at different load conditions

Result for Suspension Spring at Different Load Conditions.

Table 3: Spring at Different Load Conditions

Sl no:	Load (N)	250	350	450
1	Von-mises stress (Mpa)	11239	15735	20230
2	Total Deformation (mm)	143.6	201.17	258.64
3	Shear Stress (Mpa)	749.61	1044.9	1340.2

B. Analysis of A Leveler Blade at Different Load Condition.

a. Stress analysis

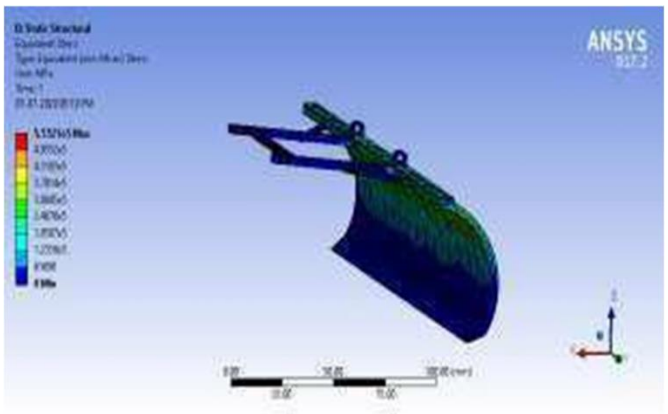


Fig 14: Stress analysis of a Leveller Blade at Different Load Condition.

b. Total deformation

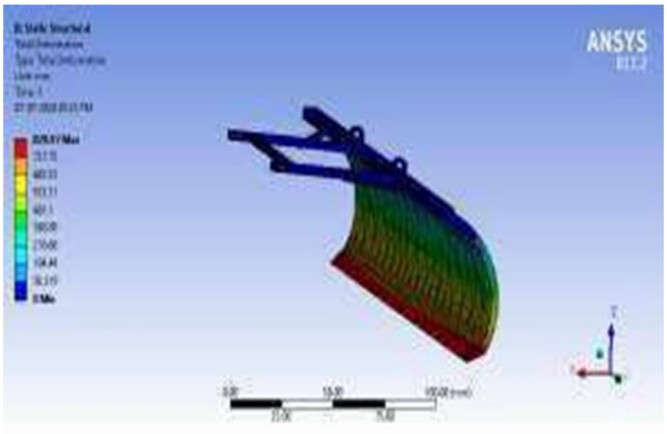


Fig 15: Total deformation of a Leveller Blade at Different Load Condition.

Result for Leveler Blade at Different Load Condition.

Table 4: Leveler Blade at Different Load Condition

Sl no:	Load (N)	500	1000	1500
1	Von-mises stress (MPa)	$2.776e^5$	$5.5521e^5$	$8.3281e^5$
2	Total Deformation (mm)	829.97	1659.9	2489.9

VI. CONCLUSION

The cost of the land Leveller is reduced up to 30%, it reduces the water requirement by 21% & For the proper Land level increase the yield of the crop by 20%. There will be less effect on Land laveller for different soil conditions & the designed Land Leveller can be used for different tractors (2W and. 4D). The static analysis of the suspension springs and leveling blade were performed. The analytical results were calculated and determined for three different loading condensation and are represented in tabular form under each load. By performing the static analysis, the max shear stress and the max total deformation under constant static load were determined and these results agreed well with the analytical results.

VII. FUTURE SCOPE

- Use of Hydraulic Suspension instead of Spring Suspension.
- Install the sensor to determine the Maximum and Minimum variation in Leveling and automatically set the Leveller blade to a moderate level.
- Check the Land Leveller for different speed conditions with different tractors.
- Conduct Levelling experiment for small and large areas of land.

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