iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** V **Month of publication:** May 2020

DOI: http://doi.org/10.22214/ijraset.2020.5100

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

Development of Bamboo Cutter Prototype

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Abstract: ***Bamboo is harvested almost all over the world. In the various Asian region, bamboo is almost available in every part. Its harvesting provides job opportunities to many people, due to the properties of its various species have demand in construction, technology has increased a lot. In modern trend demand for handcrafted art and natural artefact increased. To fulfil the increased demand for bamboo, cutting the operation of bamboo must be paced up. In traditional harvesting processes which are carried out manually take more time, labour work and also provide damage to surrounding undergrown bamboos.***
To overcome this and to minimize stresses on workers, an attempt has been made to design a bamboo cluster cutting machine, which is simple in design and can be handled by the common man. The demand for a bamboo cutting machine is higher and it is time to respond to the problem aroused. Designing and fabricating such types of functional machines is important to save money instead of investing money and time buying labour and conventional tool. Since wood resources are declining and their products are very expensive as compared to bamboo, it's preferable to use bamboo furniture rather than using wood and timber. As per the studies, it is easier and economical to harvest bamboo and it is good for the future without disturbing the ecosystem.
Our main concern is to avoid the cutting of surrounding undergrown bamboo to reach the cluster for cutting and also to save the time, labour work, lead time, and move towards the partial automation.
Keywords*: Slider-Crank Mechanism, Cad Design, Spiral Bevel Gear, Linear Bearing, Knuckle Joint, Needle -Type Roller Bearing.*

I. INTRODUCTION

Study shows that after every 3-4 years bamboo reaches to its full maturity, if not harvested the starch content is accumulated in bamboo which causes borer (Infection on bamboo due to excess starch content.) due to which bamboo strength and its other properties will be affected, and it will start to deteriorate, so it is important to harvest bamboo at its peak time. The undergrown bamboo has less strength as compared to the mature bamboo, so it is very essential to cut bamboo at the proper time without damaging the under-grown bamboo. For this purpose, we have to develop the bamboo cutting machine which has a compact size, easy to handle, which will be capable of cutting the mature bamboo only. The machine has been designed and developed to minimize the damage to undergrown bamboo. To avoid unnecessary wastage of bamboo, proper harvesting tools must be used which does not deal with unnecessary damage to under-grown (immature) bamboos. The conventional available tools are- chainsaw, hacksaw, sickle, knives, etc. In conventional method the whole bamboo cluster is harvested after 4-5 years considering the whole cluster is grown. Some of these tools are expensive and difficult to operate with greater risk for accidents. These tools don't provide proper cutting action and give a bad bottom finish which can lead to infect the whole bamboo cluster. Hence to overcome these difficulties, a proper bamboo cutting tool prototype is designed and developed. The designed cutting tool is based on the slider-crank mechanism. With this tool, the cutting rate is increased, good bottom finish and the number of labours is reduced. The tool is available at a low cost. Because of its compact size, it does not damage the surrounding immature bamboos and is also easy to use. Its compact size provides the reachability and accuracy of the main mature bamboo cluster.

Figure 1: Harvesting peripheral bamboos

Figure 2: Harvesting whole bamboos cluster

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II. LITERATURE STUDY

A. Harvesting of Bamboo by Kenya Forest Research Institute.

This study states that systematic and selective cutting of mature culms assures the growth of young bamboo shoots increasing its yield strength. Every culm is considered mature after 3-4 years after planting.

The harvesting of mature culms begins after 3-4 years, after which harvesting can be done annually.

1) Harvesting can be done during the dry season as the starch content is less, which makes them less prone to get infected.
2) In clump, new culms are produced outwards towards the periphery of older culms. Plan the cutting operation so that it avoids the cutting of young culms that are grown outwards.
3) Do not cut young culms unless and until required.
4) Process the harvested bamboo to prevent it from borer attack.

B. DC Motor by Ahmed M. T. Ibraheem, Northern Technical University.

This study states that the speed of DC motors can be controlled finely, it can also develop rated torque at variable speed. Advantages of DC motors are

1) High initial torque.
2) Variable acceleration and deceleration.
3) Controllable speed.
4) Available in wide ranges.

C. Deep Groove Ball Bearing by John

Deep Groove Ball Bearing is the most widely used type of Bearings in the world. They can operate a high speed and can carry radial and (limited) axial loads.

They are commonly used in Electric Motors, Compressors, Fans & Conveyors. As they can carry axial and radial loads, this type of bearings has great versatility or have a wider range of applications for many industries. Deep groove ball bearings create very less friction torque which in turn lowers the operating temperature, due to which the life of the bearing increases, and thus reduced the energy cost of running equipment.

Lubrication system is not required after the installation, which means it has low maintenance. Design is very simple and can have high running accuracy and high-speed operation and longer service life.

D. Needle Roller Bearing by Hiroshi Yamagata

Hiroshi Yamagata, in The Science and Technology of Materials in Automotive Engines, 2005. The needle roller bearing works under high bearing loads in a limited space in the big end.

The rollers implement planetary motion between the crankpin and the big end, and the smaller diameter makes the big end light, thus lowering weight but at the same time increasing contact stress. Soft silver-plating protects the side surface of the retainer holding the rollers from side thrust.

E. LM Bearing by Thomson India

LM Bearing assures self-alignment and prevents shaft deflection. Optimal distribution of load between ball tracks lower coefficients of friction. Seals present on each side keep dirt out while keeping lubrication which eventually maximizes the bearing life.

F. Spiral Bevel Gear by Lampin Co.

Spiral bevel gears have helical teeth positioned at 90°. The teeth are designed with a curve to achieve optimal traction and flexibility. As the pinion and gear mesh at 90 °, they will not slip during the operation. It ensures smooth and reliable transmission for high-speed and high torque applications.

The curve in the tooth creates dependable, tooth to tooth meshing that reduces backlash and prevents it from slipping. The meshing is done in a particular manner which allows lubricants to be spread evenly. Curved teeth cuts ensure improvement in performance and it extends the life of the equipment due to low vibration.

III. OBJECTIVE OF PROJECT

The specific objectives of the study can be summarised as follows.

A. To engineer the machine for cutting mature bamboo of a cluster.
B. To improve the cutting rate so that lead time will reduce.
C. To design a machine that is economical, safe and convenient.

IV. COMPONENTS

Sr No.	Resource used	Specification	Material used
1.	Spiral bevel gear (Spur)	Outer Diameter: 60mm Right-Handed 40 teeths	Mild steel
2.	Spiral bevel gear (Pinion)	Outer Diameter: 19mm Left-Handed 11 teeths	Mild steel
3.	L. M. bearing (Model Number: LM 10UU)	29 x 19 x 10 mm (length x Outer diameter x Inner diameter)	Stainless steel
4.	Roller Bearing (Model Number: HK 0810)	12 x 10 x 8 mm (length x Outer diameter x Inner diameter)	Stainless steel
5.	Ball bearing (Model Number: 696z)	6x15x5 mm (Width x Outer diameter x Inner diameter)	Mild steel
6.	Motor casing	5 mm thick	3d printed ABS
7.	Connecting rod	77 mm CTC	Cast iron
8.	Bearing casing	5mm thick	3d printed ABS
9.	Cutting blade	6.5 x 1 x 0.1 inches (l x b x t)	Stainless steel
10.	Roller bearing	12mm / 7mm	Stainless steel
11.	Motor Rs-775	24 V, 5 amp, no load 10,000 rpm	Aluminium
12.	Bolts	-	Aluminium
13.	Nuts	-	Aluminium
14.	Battery	24 V, 2200 mAh	Li-Po
15.	Switch	-	Plastic
16.	Connecting wires	6amp	Copper
17.	Adapter	24 V, 5 amp	-

Table I: Specification of components.

V. WORKING

The machine works on the principle of the reciprocating mechanism. The main component of a bamboo cutter is as follow:

A. Motor

D.C Motor (Rs-775 24V) is mounted on the base plate with help of motor casing. The motor is attached to the spiral left-handed pinion. This motor will rotate the crank. It uses the principle of electromagnetic flux which converts electrical energy into mechanical energy to give the desired output. This motor can also be called as the actuator of the whole mechanism.

Figure 3: RS-775 D.C Motor

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B. Spiral Bevel Gear

Spiral Bevel gear is acting like the crank of the mechanism. The spiral bevel gear is having an offset pin which will connect to the connecting rod and create the reciprocating motion for the mechanism. This gear is fixed with the help of the gear pin on the base plate and aligned 90° to the pinion to achieve efficient meshing. This gear has helical teeth which can be both right-handed as well as left-handed, but the gear used is right-handed spiral gear. The gear assembly of spiral bevel gear and its pinion is called hypoid. Hypoid gears are used for power transmission as this assembly is more efficient than conventional worm gearing because of multiple tooth meshing at the instant.

Figure 4: Spiral Bevel Gear Spur and Pinion

Figure 5: Spiral Bevel Spur Gear With offset pin

C. Connecting Rod

This device uses the slider-crank mechanism for cutting. The slider-crank mechanism is a 4-bar mechanism in which the coupler link is called a connecting rod. The connecting rod which is used is the MT 810 series, made of cast iron. This rod acts as a link between crank and slider.

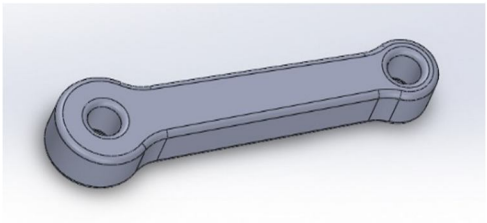

Figure 6: Connecting Rod

D. Blade

The slider is a part which reciprocates to and fro in the mechanism. The slider has constrained motion. A slider is connected to a connecting rod. Here, the blade acts as a slider which is made up of stainless steel. This material is widely used on an industrial level. This material has high corrosion resistance along with high mechanical strength due to its carbon content.

Figure 7: Blade

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VI. CAD DESINGS

A. All The Dimensions Are In MM

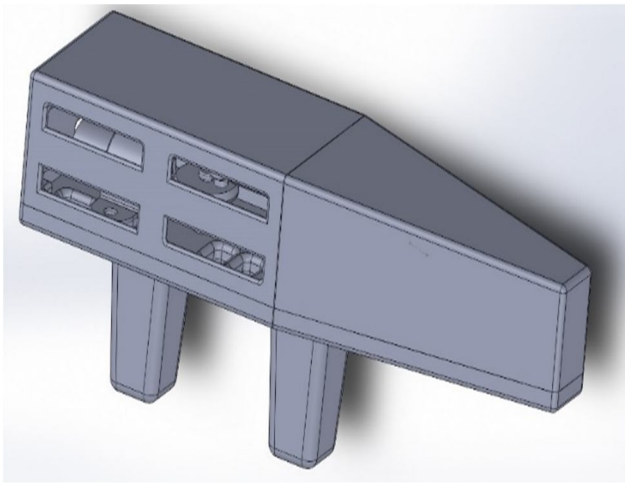


Figure 8: Complete assembly with covering

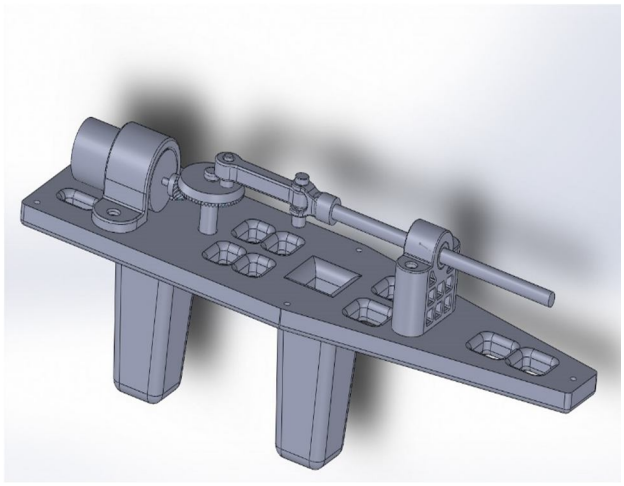


Figure 9: Complete assembly without cover

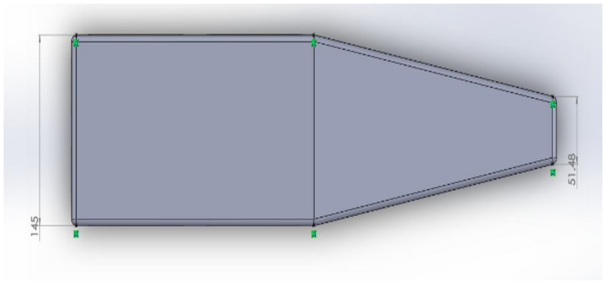


Figure 10: Top Cover Top View

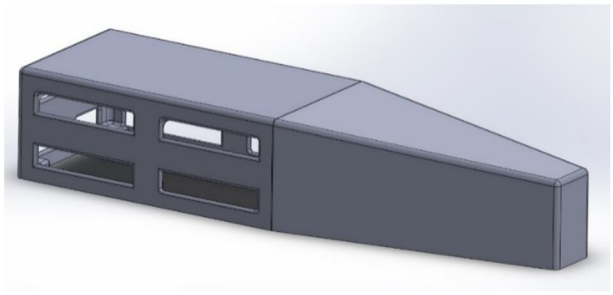


Figure 11: Top Cover Side View with Height 95mm

VII. RESULTS AND DISCUSSION

The results of the study are presented and discussed regarding the aim of the study, which is to harvest the fully grown bamboo without harming the young peripheral grown bamboo. As stated in the previous chapters to know the physical properties of bamboo, we have collected some samples of the bamboo of different ages from the agro-field.

A. LAB TEST

Sample from Agro-Forestry Research Farm, Nagpur of Bambusa tulda was selected, the selected samples are known to be of 2yr, 3yr, 4yr and 5yr old. The selected bamboo was of 2ft each, we performed some tests on each sample to know its mechanical properties over the period on the UTM machine.

Age of Bamboo in years	Shear Strength τ (GPa)
2	7.2
3	7.4
4	7.5
5	6.6

Table II: Shear Strength of Bambusa tulda

Age of Bamboo in years	Bending Strength	
	Modulus of Elasticity (MOE) in GPa	Modulus of Rupture (MOR) in GPa
2	16900	93.6
3	16700	88.8
4	17000	86.9
5	18000	86.3

Table III: Bending Strength of Bambusa tulda

Age of Bamboo in years	Compressive Strength (GPa)
2	39.9
3	38.1
4	37.6
5	32.1

Table IV: Compressive Strength of Bambusa tulda

The average tensile strength of bamboo is situated roughly around *160 N/mm2*
According to this calculation, we further calculate the required cutting force which was found out to be 345N. The prime components of the mechanism are designed considering this force with the factor of safety 2.

B. Performance test

1) *Test with no Load:* The bamboo cutter was run on two different amperes to find the best results with no load the applied current was 6amp and 12 amp and voltage were 24V DC. The cutter was operated for 1 hr and was attached to energy meter for measurement of power consumption.

Sr. No.	Parameter	Observations
1	Time of operation	1 hour
2	Speed of cutting Unit, RPM	6 amp – 5495 RPM 12 amp – 11812 RPM
3	Power Required, W	6 amp – 45W 12 amp – 90W

Table V: Result of no-load test

2) *Test with load:* The performance test of the bamboo cutter was conducted at the farm and we found out that the bamboo cutter was able to cut a single bamboo at a time when 12amp current at 24V is supplied, at this particular input we achieved the max output. It took almost 45 sec to cut a bamboo whose wall thickness was 10mm, usually, with conventional methods, it takes 1.5 mins.

C. Interpretation Of Data

The above CAD figures are photos of the actual prototype and screen-captured images from the proponents' simulation, using Solidworks Simulation 2013. The proponents did it to determine the problem, and data will also provide a sufficient result that leads the proponents to decide upon the appropriate material to be used.

VIII. CONCLUSION AND FUTURE SCOPE

A. Conclusion

The Bamboo cutting machine is successfully fabricated and tested. The various cross-sectional shapes and quality of sticks that can be produced by this machine cannot be achieved by traditional manual methods. The machine can cut bamboo with minimum human effort with high productivity. The machine can be easily operated by unskilled labour with negligible maintenance costs. For different shapes and sizes of bamboo strips, blades can be placed at different angles with the help of adjustable slides. Automation of this machine by incorporating motor instead of manual operation can be a boon in large scale industries.

Based on the results obtained and discussions made in the previous chapter the following conclusion were drawn:

1) The bamboo cutter is suitable for small and larger farmers.
2) The output of this device is more than conventional methods.
3) The power can be increased with an increase in current input.
4) The overall output was close to the desired output.

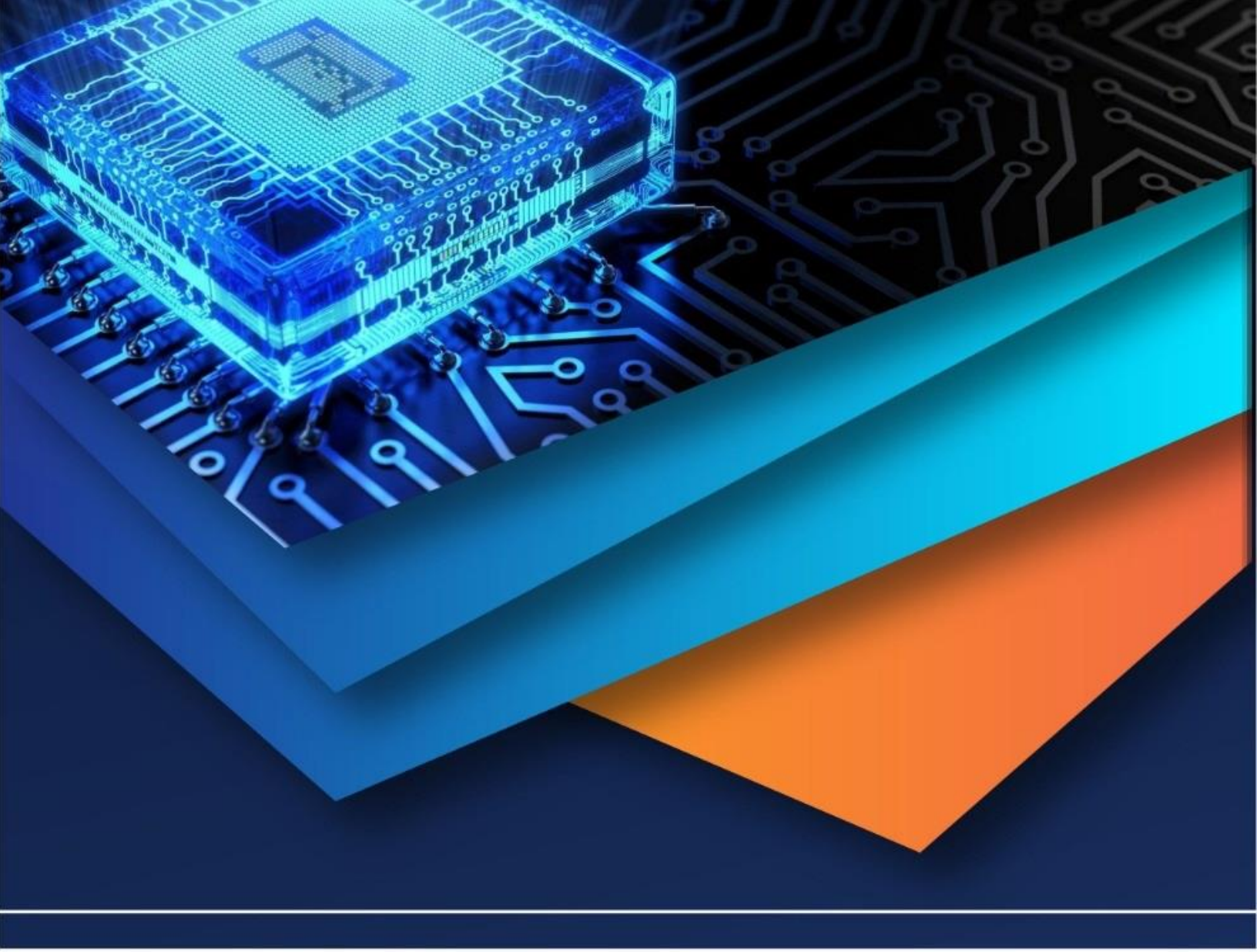
B. Future Scope

The bamboo cutter was developed to cut the fully grown bamboo, the maturity of the bamboo can also be determined with the percentage of moisture in the bamboo. To make this bamboo cutter more versatile and better for commercialization the following suggestions are made for future work.

1) We suggest developing the moisture sensor which can sense the moisture and can determine the maturity of the bamboo this can be very useful for the uneducated farmer to know which bamboo they have to harvest.
2) The more powerful motor can be used to get better performance which will be able to cut multiple bamboos at a time.

REFRENCES

[1] Harvesting of Bamboo by Kenya Forest Research Institute-“Guidelines for cultivating Ethiopian lowland bamboo”
[2] Literature review on “DC MOTOR” by Ahmed M. T. Ibraheem Alnaib
[3] Michael Kearney. “Kinematics of a slider-crank mechanism”
[4] Alexander Slocum 2008. “Fundamentals of Designs” Topic 10 Bearings
[5] Colin H. Simmons, Neil Phelps and The Late Dennis E. Maguire. “Manual of Engineering Drawing 4th Edition (2012)”
[6] Thomson Bearing Manufacture Bearing Standards Book Available Online https://www.thomsonlinear.com/en/products/linear-bearings-literature
[7] Lapmin Co. What Are the Benefits of Choosing Spiral Bevel Gears? Available Online https://www.lampin.com/2017/07/25/importance-of-spiral-bevel-gear/
[8] J. K. GUPTA & R. S. KHURMI (1976) . Theory of Machines. S. Chand.
[9] S. S. RATTAN (2009) .Theory of Machine. McGraw-Hill India. Pvt. Ltd.
[10] D. SHIWALKAR (2013). Design Data for Machine Elements. Denett & Co.
[11] https://www.researchgate.net/scientific-contributions/2089894335_Hiroshi_Yamagata



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