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Experimentation and Analysis of Gearless Transmission using 4 L-pins

Kunal C. SHIRAL[1], Vishal D. MAGAR[2], Sushma B. MURAR[3] Nikhil G. MORE[4],

[1,2,3,] B.E. Final Year Student, Department of Mechanical Engineering, S.S.G.M.C.E Shegaon, Maharashtra, India
[4]Assistant Professor, Department of Mechanical Engineering, S.S.G.M.C.E Shegaon, Maharashtra, India

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Abstract - *This paper represents the study of gearless transmission using elbow rod (L-pins). This project is based on experimentation and analysis of the new mechanism by replacing gears with 90º elbow rods to transmit the power. This mechanism consists of L-pins and hubs which are coupled together by placing the L-pins in the holes which are drilled in the hub. This paper also gives information about speed, strength, torque transmission of gearless transmission. This mechanism helps to reduce friction. In this project the power is transmitted with 4 L-pins radially connected at an angle of 90º with respect to center of axis. This mechanism is to be analyzed in Solid Works software to observe the responses of L-pins as well as the hub.*

Key Words: Elbow mechanism, Gearless Transmission, Hub, L-pins, Shaft.

1.INTRODUCTION

Nowadays time consuming and speed play's important role in day-to-day life. As well as saving of cost is necessary. The problem for gear transmission is that manufacturing of gear is complex process which require longer time as well as its manufacturing cost is additionally high. Another major problem is that the transmission having gear cause the jamming because of the backless error and produces more noise compared to other drives thanks to pitch mismatch. Therefore, we recommend Gearless mechanism which is additionally known as Elbow Mechanism. This mechanism saves the cost, time and space. It also reduces the losses. This mechanism consists equipment like L-pins, hub, and shaft. Gearless transmission works on the principle of slider and kinematic chain principle. [4]

2.SYSTEM STUDY AND COMPONENTS

In this mechanism numbers of L- pins are used between 3 to 8 which are inserted into the perforated holes in the hubs. If we used less than 3 L-pins then it will not work and will interfere.

This L-pins are inserted at an angle of 90º from the center on the hub.

The gearless transmission consists of following components: -

- L-Pins
- Hub
- Shaft
- Base Plates
- Bearings

[10]

3.WORKING

The Gearless transmission or elbow mechanism is one meanwhile equipment for power transmission at device for transmitting motion at any desired angle between drive shaft and driver shaft. This mechanism tells that it contains number of pins from 3 to 8. As the number of pins are more, smoother will be the operation. Its slides into the connection housing to creates a sliding and sliding pair. This mechanism has 4 of those sliding pairs. The power is supplied with the help of an electric motor.

We have modelled the 4 L-Pins gearless mechanism. The gearless mechanism is a portable and compact equipment. The system consists of 2 hubs, 4 L-pins, 2 shafts, motor (AC motor 1 HP), and belt drive. There is a motor and a belt drive assembled at the end of any one shaft. As electricity is supplied the shaft rotates from the motor and belt drive along with the hub. The L-pins placed in the holes of the hub moves in and out of both the hubs. Due to this the motion from one shaft is shifted to another.

4. DIAGRAM OF MODEL

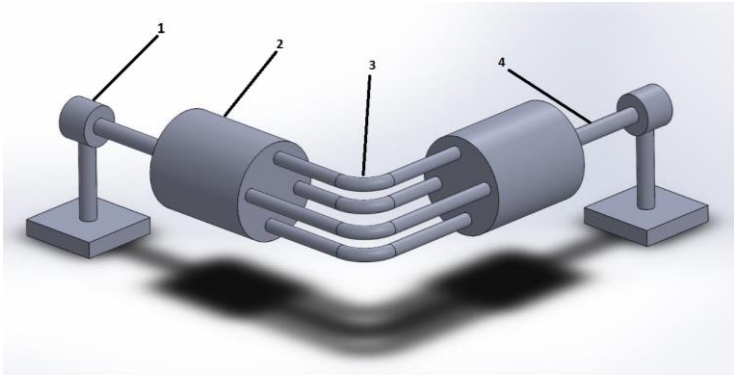

Fig -1: Model of gearless mechanism

1. Base plate (2)
2. Hub (2)
3. L-pin (4)

4. Shaft (2)

5.SIMULATION FOR FOUR L-PINS

In SOLIDWORKS software, all the parts of model are made and assembled on workbench. Each part of model is rigid and the concentric companion is used for relative motion. The lock mate feature is used for hub and shaft. The simulation introduced the system to watch the mechanism of L pins by von mises stress distribution. An alloy steel is used for this simulation. Fig. 2 shows the von mises stress distribution at speed of 100 rpm. Also fig. 3 shows the stimulation of equivalent strain, fig. 4 shows the deflection test and fig. 5 shows the factor of safety. It is necessary to check before manufacturing of model.

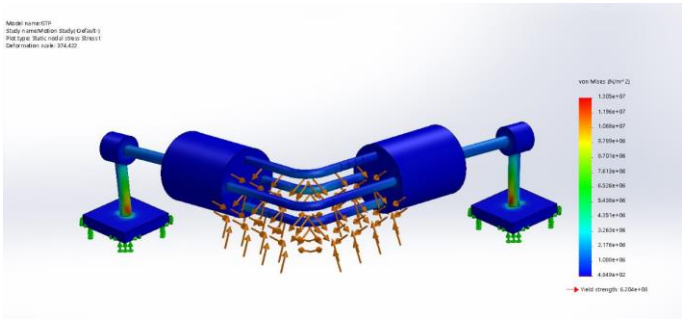

Fig -2: Von mises stress distribution.

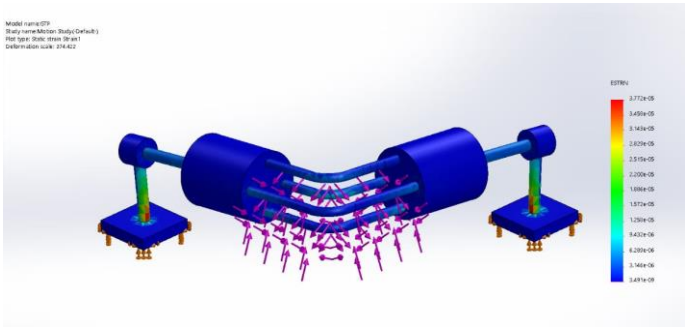

Fig -3: Stimulation of equivalent strain.

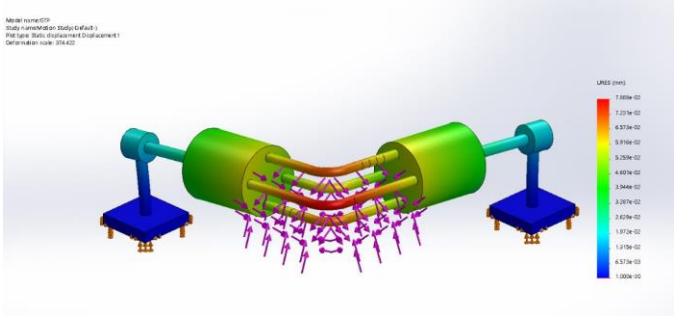

Fig -4: Deflection test.

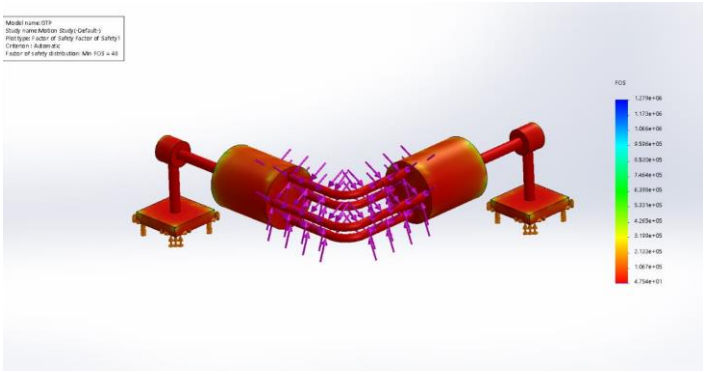

Fig -5: Factor of safety distribution.

On SOLIDWORKS software we have calculated the factor of safety. The factor of safety (FOS) plot shows the distribution of values over the model with a color chart.

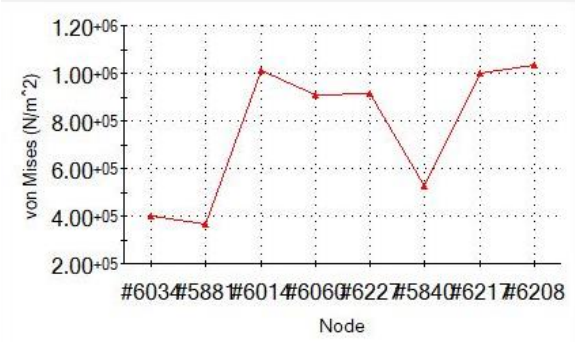

Fig -6: Maximum value of Von mises stress vs speed.

Von mises stress is used to determine the fracture or yield in a given material. From the graph it is clear that when the speed is increased.

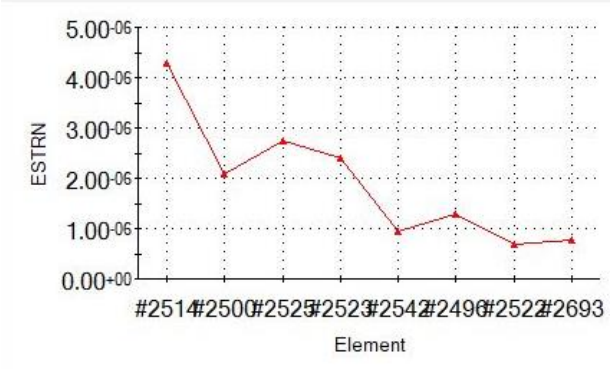

Fig -7: Equivalent strain graph.

From this graph, we come to know that relative distribution of deformative load on elements respect to their positions.

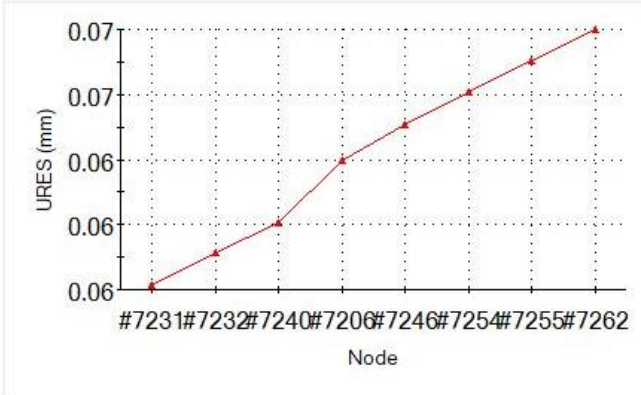

Fig -8: Displacement graph.

From this graph, it is found that continuing the increase in load, element tends to fail. It is also clear that stress is variable for the same nodal points. Strain is gradually decreasing according to selected nodal points, while displacement is increasing.

6.COMPARISON WITH GEARED MECHANISM

GEARED	GEARLESS
• **Manufacturing methods: -**	• **Manufacturing methods: -**
It is expensive and has complex calculations.	It is less expensive and has less calculations.
Special machines are required for manufacturing.	No need of special machines for manufacturing.
Cannot be interchange.	Can be interchanged.
• **Cause of failure:** -	• **Cause of failure: -**
Contains pitting, rust, incense and rust.	In this pitting, rust, erosion and fatigue are strictly reduced.
The entire gear set needs to be replaced.	Only the L-Pins are need to be replaced.
• **Lubrication and cooling: -**	• **Lubrication and cooling: -**
It is a complex system.	It is simple.
Cooling is a big issue.	Cooling is easy.

7.APPLICATIONS

- It can be used in tower clock.
- It can be used in wood cutting machine.
- It can be used in Go-cart vehicles.
- It can be used in robotics and artificial intelligence.
- It can be also used in pumping and compression devices.

8.ADVANTAGES

1. This mechanism is very simple due to value addition mechanism.
2. Mechanism is minimum.
3. No crank and crank shaft are required.
4. Slow and fast operations are easily achieved by setting the linkage.
5. Manufacturing cost is less.
6. More efficient than gears.
7. Easy to maintain and repairs.
8. Parts are easily portable.
9. Simple cooling system.
10. Continuous operation can be done without stopping.

9.LIMITATIONS

1. Does not work at very low starting torque.
2. Improper hole drilling could pose much problem.
3. Sudden load cause mechanism breakdown.
4. L-Pins are to be replaced after certain cycle time.

10.FUTURE SCOPE

1. It is recommended to work on stress concentration.
2. Flexible bent links may be used.
3. Torque bearing capacity can be improved.
4. Has bright future in automation and robotics.
5. Can be used in automobile industries.

11. CONCLUSIONS

Gearless Transmission has been analyzed on SOLIDWORKS software.

1) From efficiency we can say that load efficiency of mechanism is directly proportional to L-pins.
2) Efficiency of mechanism is also affected by nature material which is used to make elements.
3) This mechanism has a bright future in industries due to less manufacturing cost.
4) Some slowdown is found due friction and clearance in the system between the hub and L pins. This can be reduced giving proper surface finish and applying lubrication.
5) The main advantage of system is low cost and full of interchangeability.

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BIOGRAPHIES

K. Shiral,
Under graduation Student,
Studying Mechanical Engineering at Shri Sant Gajanan Maharaj College of engineering, Shegaon M.S. He has done the Go-kart designing and development program.

V. Magar,
Under graduation Student,
Studying Mechanical Engineering at Shri Sant Gajanan Maharaj College of engineering, Shegaon M.S. He completed the analysis on Catia software.

S. Murar,
Under graduation Student,
Studying Mechanical Engineering at Shri Sant Gajanan Maharaj College of engineering, Shegaon M.S. She has completed Master Certificate course in CAD/CAM at IGTR, Aurangabad in2018.

Prof. Nikhil G. More
He is working as an Assistant Professor, Department of Mechanical Engineering, SSGMCE, Shegaon M.S. He is completed his M.E. in Thermal Engineering from North Maharashtra University, Jalgaon and B. E. from S.G.B. Amaravati University, Amaravati. Recently he is completed his Diploma in Digital Fabrication from Fab Academy, MIT (USA). His field of research is solar thermal processes, solar energy, energy conversion. He is also published book on Energy Conversion by Das Ganu Publication, Nagpur