IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018 ISSN: 2320-1363

DESIGN AND ANALYSIS OF GEARLESS TRANSMISSION

MAKANA LATHA SRI [1], DOKIBURRA .SHAKEENA [2]

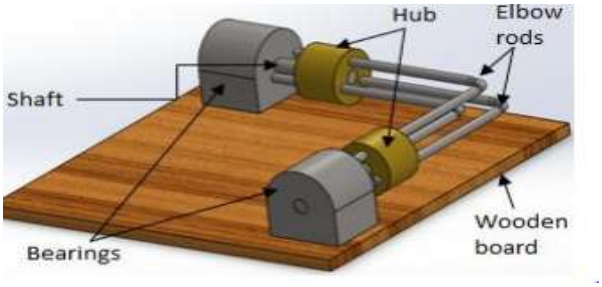
1 Dept., of Mechanical Engg. M-Tech Student (Machine Design), KIET Engineering College

2 Dept., of Mechanical Engg. Assistant Professor (Machine Design), KIET Engineering College

ABSTRACT: This project "EL-BOW TRANSMISSION" being compact and portable equipment, which is skillful and is having practice in transmitting power at right angle without any gears being manufactured. The El-bow Mechanism transmits the input power towards the output side such a way that the angular forces produced in the slacks are transmitted with the help of rods which takes up the input power and the right angle drive is transferred towards the output slack and rod assembly. Therefore, it is appreciated that efficiency as high as 90-92% are possible in gear less transmission mechanism.

Here is a wonderful mechanism that carries force through a 90ºbent rod. Transmitting rotational motion around an axis usually involves gears, which can quickly become complicated, inflexible and clumsy-looking, often ugly. So, instead of using gears, this technology elegantly converts rotational motion using a set of cylindrical bars, bent to 90º, in a clever, simple and smooth process that translates strong rotational force even in restricted spaces. A gearless transmission is provided for transmitting rotational velocity from an input connected to three bent links. Both the input shaft and the housing have rotational axes. The rotational axis of the input shaft is disposed at an angle of 90 degree with respect to the rotational axis of the housing. As a result, rotation of the input shaft results in a processional motion of the axis of the bent link. The rotary and reciprocating motion of bent link transmit rotation of prime mover to 90 degree without any gear system to an output shaft. Modeling is done in PTC CREO software and analysis is done in ANSYS.

INTRODUCTION: An essential requirement of the present world is to achieve the objectives with maximum efficiency at minimum cost. This requires least manufacturing cost of replacement when any instrument fails. And also that it performs the intended function at a higher efficiency. For transmitting motion and power from one shaft to another which are non-parallel or intersecting and coplanar, bevel gearing are generally employed. But there are some inherent disadvantages associated with bevel and worm gearing stated as complexity in manufacturing, High cost of replacement.



1.1Gearless transmission mechanism

Figure 1 shows the trimetric view of system under study. As the figure suggest that this mechanism is formed with 9 links and one board by assembling them together. Contact friction between bearings and shaft as well as between elbow rods and hubs are considered. Whole mechanism is developed for analysis with taking gravity into account. System is designed with factor of safety taken as 2.

WORKING

Here is a wonderful mechanism that carries force through a 90ºbend.Translating rotational motion around an axis usually involves gears, which can quickly become complicated, inflexible and clumsy-looking, often ugly. So, instead of using gears, this technology elegantly converts rotational motion using a set of cylindrical bars, bent to 90º, in a clever, simple and smooth process that translates strong rotational force even in restricted spaces. A gearless transmission is provided for transmitting rotational velocity from an input connected to three bent links. Both the input shaft and the housing have rotational axes. The rotational axis of the input shaft is disposed at an angle of 90 degree with respect to the rotational axis of the housing. As a result, rotation of the input shaft results in a processional motion of the axis of the bent link. The rotary and reciprocating motion of bent link transmit rotation of prime mover to 90 degree without any gear system to an output shaft without gears. The transmission includes an input shaft.

MECHANISM

1. As a wood cutting machine, the cutter is attached on the output shaft.

IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018 ISSN: 2320-1363

When motion is transmitted through mechanism to output shaft the shaft will start to rotate at adjusted speed. The speed is adjusted by means of pulley (i.e…RPM).

The cutters will also start to rotate along with the shaft the because of cutter is 250mm.the through slot introduces in the table for free rotation of cutter edges in table. Now the feed given to wooden rods or plywood to cut in desire shape and size. The speed is adjusted by means of pulley (i.e.RPM). The cutters will also start to rotate along with the shaft the because of cutter is 250mm. the through slot is introduced in the table. Now feed given to wooden rods or plywood to cut in desired shape and size.

APPLICATION

The featured product has its widest application as an extension for a socket wrench. Here the design makes it easy to reach fasteners in the automotive and other mechanical industries, where direct access to bolts and screws is often limited. However, the possible applications for this technology extend into numerous fields. Just think of the possibilities for power transmission in push bikes, toys and hand cranked equipment, or for movement transmission in store and outdoor signage

1) Driving for all kinds four faced tower clocks. The elbow mechanism was first use in the year 1685 for the famous London tower clock named big been.

2) The mechanism is invariable used for multiple spindle drilling operation called the gang drilling.

Used for angular drilling between 0 to 90 degree position.

- Lubrication pump for C.N.C. lathe machines.
- The mechanism is very useful for a reaching a drive at a clumsy location.
- Air blower for electronic and computer machine.
- The mechanism has found a very usefully use in electronic and computer

Technology for multiple.

The elbow mechanism is used for movement of periscope in submarines,

The year 1685 for the famous London tower clock.

SELECTION OF MATERIAL

The proper selection of material for the different part of a machine is the main objective in the fabrication of machine. For a design engineer it is must that he be familiar with the effect, which the manufacturing process and heat treatment have on the properties of materials. The Choice of material for engineering purposes depends upon the following factors:

- Availability of the materials.
- Suitability of materials for the working condition in service.
- The cost of materials.
- Physical and chemical properties of material.
- Mechanical properties of material.

The mechanical properties of the metals are those, which are associated with the

ability of the material to resist mechanical forces and load. **MATERIALS USED**

1.5.1 Mild steel

Reasons:

1. Mild steel is readily available in market
2. It is economical to use
3. It is available in standard sizes
4. It has good mechanical properties i.e. it is easily machinable.
5. It has moderate factor of safety, because factor of safety results in unnecessary wastage of material and heavy selection. Low factor of safety results in unnecessary risk of failure
6. It has high tensile strength
7. Low co-efficient of thermal expansion

1.5.2 Properties of Mild Steel:

M.S. has carbon content from 0.15 % to 0.30%. They are easily wieldable thus can be hardened only. They are similar to wrought iron in properties. Both ultimate tensile and compressive strength of these steel increases with increasing carbon content. They can be easily gas welded or electric or arc welded. With increase in the carbon percentage weld ability decreases.

Mild steel serve the purpose and was hence was selected because of the above purpose.

1.5.3 Bright Material:

It is a machine dawned. The main basic difference between mild steel and bright metal is that mild steel plates and bars are forged in the forging machinery means is not forged. But the materials are drawn from the dies in the plastic state. Therefore the material has good surface finish than mild steel and has no carbon deposits on its surface for extrusion and formation of engineering materials thus giving them a good surface finish and though retaining their metallic properties.

LITERATURE REVIEW

2.1 Analysis and Simulation of Gearless Transmission Mechanism

1. International Journal of Core Engineering & Management (IJCEM) Volume 1, Issue 6, September 2014 Analysis and Simulation of Gearless Transmission Mechanism.

This paper presents the real time study of mechanism. The system is to be analyzed in Solid Works package software to watch the response of the elbow rods and the also the hub (coupled with shaft). The real time

IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018 ISSN: 2320-1363

study is carried out by applying a motor to one of the shafts supported on bearings. Motion analysis is performed by running the mechanism at 15 revolutions per minute reaction forces and reaction moment are plotted against clock run of 5 seconds by using post processor. Similar motion analysis is carried out at different higher revolutions per minute and peak values of forces and moments are taken from the plot and compared with allowable stress. Theoretical calculations are made to obtain allowable stress by making use of design data values. As a result, response of elbow rod and hub is investigated to find the permissible speed of mechanism. Further simulation is performed to verify the motion analysis results.

MODELLING ANALYSIS

3.1 INTRODUCTION TO CAD

Computer-aided design (**CAD**) is the use of computer systems (or workstations) to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. The term **CADD** (for Computer Aided Design and Drafting) is also used.

INTRODUCTION TO PTC CREO

PTC CREO, formerly known as Pro/ENGINEER, is 3D modeling software used in mechanical engineering, design, manufacturing, and in CAD drafting service firms. It was one of the first 3D CAD modeling applications that used a rule-based parametric system. Using parameters, dimensions and features to capture the behavior of the product, it can optimize the development product as well as the design itself.

ADVANTAGES OF CREO PARAMETRIC SOFTWARE

1. Optimized for model-based enterprises
2. Increased engineer productivity
3. Better enabled concept design
4. Increased engineering capabilities
5. Increased manufacturing capabilities
6. Better simulation
7. Design capabilities for additive manufacturing

3.4 CREO parametric modules:

- Sketcher
- Part modelling
- Assembly
- Drafting

3D MODEL

Fig 3.1 3D module of gearless transmission

2D MODEL

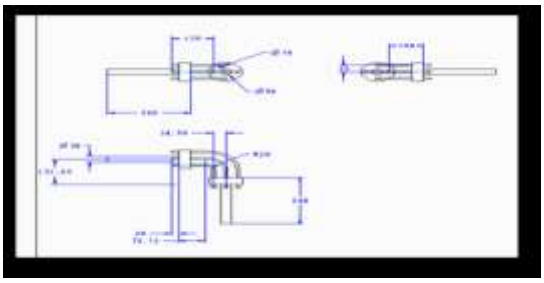


Fig 3.2 2D module of gearless transmission

3.5 INTRODUCTION TO FEA

Finite element analysis is a method of solving, usually approximately, certain problems in engineering and science. It is used mainly for problems for which no exact solution, expressible in some mathematical form, is available. As such, it is a numerical rather than an analytical method. For example, engineering strength of materials or the mathematical theory of elasticity can be used to calculate analytically the stresses and strains in a bent beam, but neither will be very successful in finding out what is happening in part of a car suspension system during cornering.

MODELLING AND SIMULATION

4.1 INTRODUCTION TO ANSYS

ANSYS is general-purpose finite element analysis (FEA) software package. Finite Element Analysis is a numerical method of deconstructing a complex system into very small pieces (of user-designated size) called elements. The software implements equations that govern the behaviour of these elements and solves them

IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018 ISSN: 2320-1363

all; creating a comprehensive explanation of how the system acts as a whole. These results then can be presented in tabulated, or graphical forms. This type of analysis is typically used for the design and optimization of a system far too complex to analyze by hand. Systems that may fit into this category are too complex due to their geometry, scale, or governing equations.

STATIC ANALYSIS OF ELBOW MECHANISM

Used software for this project work bench

Open work bench in Annoys 14.5

Select static structural>select geometry>import IGES model>OK

Fig 4.1 Static analysis of elbow mechanism

Click on model>select EDIT

Select model >apply materials to all the objects (different materials also)

Mesh> generate mesh>ok

Fig 4.2 mesh generation

Static structural A5>insert>select .displacement>select fixed areas>ok

>Select pressure>select pressure areas> enter pressure value

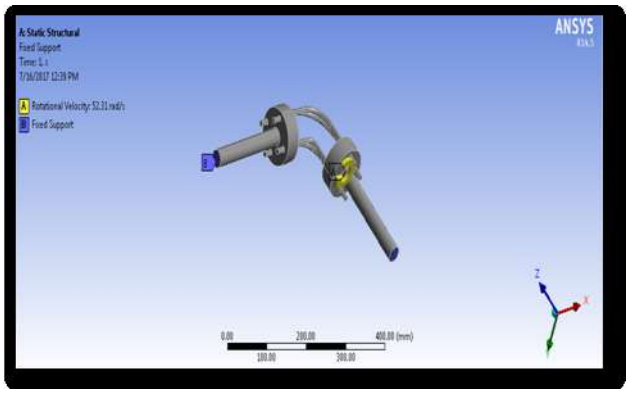


Fig 4.3 pressure values

Solution A6>insert>total deformation>right click on total deformation>select evaluate all results

Insert>stress>equivalent (von misses)>right click on equivalent >select evaluate all results
Insert>strain>equivalent (von misses)>right click on equivalent >select evaluate all results

MATERIAL- MILDSTEEL

AT SPEED-500 RPM

DEFORMATION

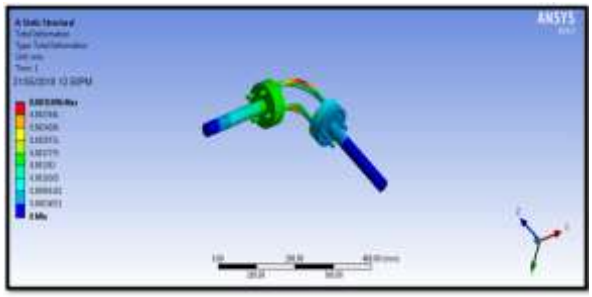


Fig 4.4 Static analysis of gearless mechanism deformation

STRESS

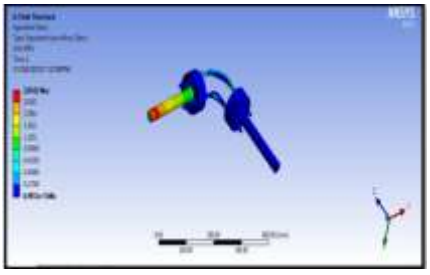


Fig 4.5 Static analysis of gearless mechanism stress

IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018 ISSN: 2320-1363

STRAIN

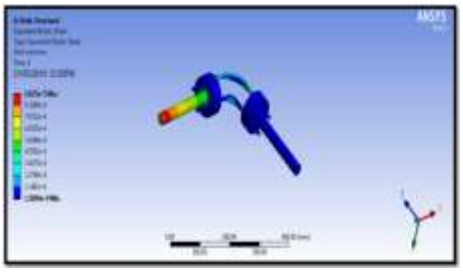


Fig 4.6 Static analysis of gearless mechanism strain

AT SPEED-1000 RPM

DEFORMATION

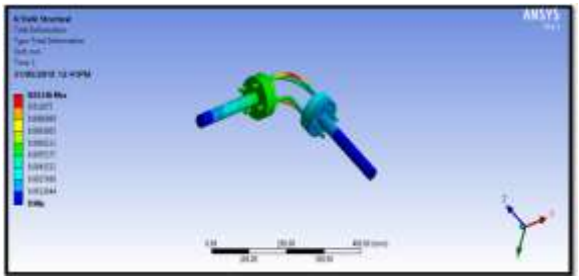


Fig 4.7 Static analysis of gearless mechanism deformation

STRESS

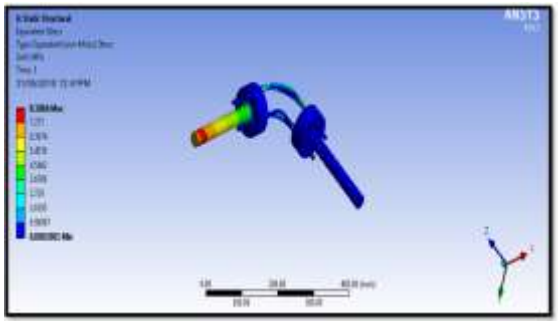


Fig 4.8 Static analysis of gearless mechanism stress

STRAIN

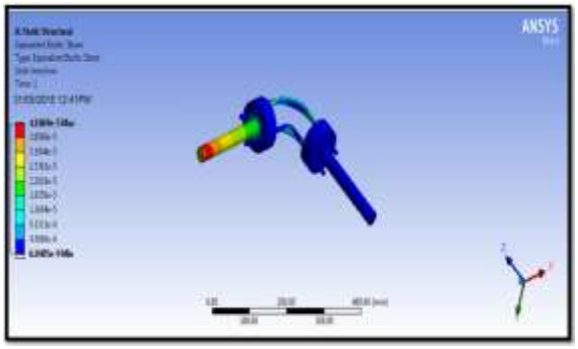


Fig 4.9 Static analysis of gearless mechanism strain

RESULT & DISCUSSIONS

5.1 STATIC ANALYSIS RESULT TABLE

Table 1 Static analysis result

MATERIAL	SPEED(RPM)	DEFORMATION (mm)	STRESS (N/mm^2)	STRAIN
MILD STEEL	500	0.0031096	2.0471	1.025E-5
	1000	0.01246	8.1866	4.016E-5
	1500	0.028037	18.421	9.24E-5
STAINLESS STEEL	500	0.0031834	2.0245	1.05227E-5
	1000	0.012736	8.0993	4.2114E-5
	1500	0.028893	18.375	9.5543E-5
CAST IRON	500	0.0052019	1.8698	1.7047E-5
	1000	0.020811	7.4804	6.8199E-5
	1500	0.047212	16.971	0.00015472

MODAL ANALYSIS RESULT TABLE

Table 2 .Model analysis result

MATERIAL	FRQUNCEY	TOTAL DEFORMATION-1	FRQUNCEY	TOTAL DEFORMATION-2	FRQUN-CEY	TOTAL DEFORMATION -3
STEEL	150.48	24.334	266.96	16.442	278.82	18.555
STAINLESS STEEL	148.83	24.503	264.14	16.552	275.67	18.691
CAST IRON	25.382	25.382	206.44	17.162	215.93	19.34

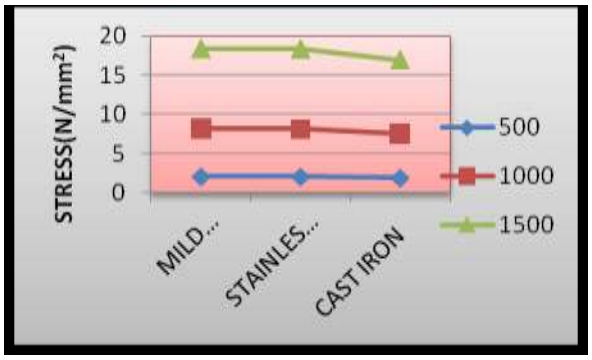
5.3 GRAPHS

IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018 ISSN: 2320-1363

5.3.1 DEFORMATION PLOT

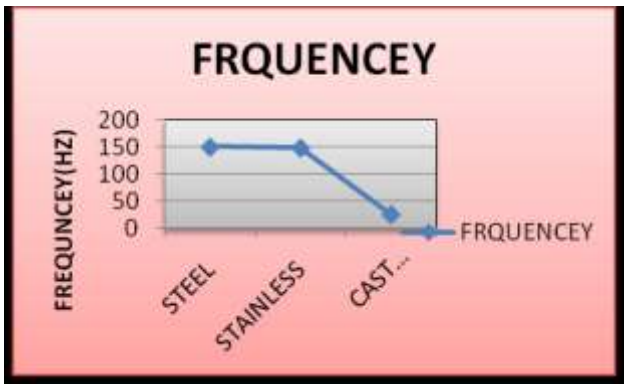
Plot 5.1 Deformation plot for all three materials

5.3.2 STRESS PLOT



Plot 5.2 Stress plot for all three materials

5.3.3 FREQUENCY PLOT



Plot 5.3 Frequency plot for all three materials

CONCLUSION & FUTURE SCOPE

Gearless elbow mechanism is a compact and portable equipment that is skillful and transmitted power at right angle without gears which has been analyzed on Ansys software. The transmission of rotational motion around an axis by gears both input and output shafts has been connected to bent links.

The rotary and reciprocating motion of bent link has been transmitted rotation of prime mover without any gear system to an output shaft. The response of the elbow rods and hub was analyzed for different materials like (mild steel, stainless steel and cast iron) and for different speeds (500, 1000 and 1500 rpm).

It is been concluded from the analysis that mechanism with 4 elbow rods made up of CAST IRON material is works perfectly. The mechanism runs smoothly when it is kept at 500 R.P.M. And the efficiency obtained is nearly 90-92%. Also it can be concluded that as the number of elbow rods increases smoother the operation would be.

FUTURE SCOPE

1) Working on stress concentration is recommended.

2) Working on aluminum as a prime material is recommended.

3) Fatigue analysis is recommended.

4) Analysis of the mechanism with higher no of elbow rods is recommended.

REFERENCES

DESIGN AND ANALYSIS OF GEARLESS TRANSMISSION

MAKANA LATHA SRI

DOKIBURRA .SHAKEENA

IJMTARC – VOLUME – V – ISSUE – 23, JULY-SEP, 2018 ISSN: 2320-1363

1. International Journal of Core Engineering & Management (IJCEM) Volume 1, Issue 6, September 2014Analysis and Simulation of Gearless Transmission Mechanism.

2. International Journal of Ethics in Engineering & Management Educationist: 2348-4748, Volume 1, Issue 5, May2014Gearless Power Transmission- L Pin Coupling.

3. International Journal of Scientific & Engineering Research, Volume 6, Issue 7, July-2015 Multi-Angular Gearless Drive.

4. IJSRD - International Journal for Scientific Research & Development| Vol. 4, Issue 02, 2016 Design, Analysis and Fabrication of Gearless Transmission by Elbow Mechanism.

5. International Journal of Engineering Research & Technology (IJERT)ISSN: 2278-0181Vol. 3 Issue 3, March – 2014Gearless Power Transmission-Offset Parallel Shaft Coupling.

6. Book s. s. rattan MC Grew Hill Education (India private limited), new Delhi.

7. A Kumar and S. Das, "An arrangement for power transmission between co-axial shafts of different diameter", International journal of engineering research technology.

8. https:// www.youtube.com/watch?v= School of Mechanical and Building Sciences.

9. Gearless transmission for speed reduction through rolling motion induced by rubbing motion, US patent no. 6,113,511, September 5, 2000.

10. PSG Design data book.

11. Justin Madsen, High Fidelity Modeling and Simulation of Tracked Element by using MSC ADAMS, ME 491, Independent Study.

12. Mate J., Tracked Mechanism Simulation of Mobile Machine in MSC ADAMS/View Res. Agar. Eng., 56: 1-7, 2010.