# Title: Design and Analysis of Gearless Transmission System

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## ABSTRACT

***Introduced gearless power transmission arrangement used for skew shafts. In this transmission system no. of pins or links used must be odd..3,5,7,9…..& centers of any two pins or links hole must not be on that line which represent the diameter of the shaft. If more pins or links used motion will be smoother, but increase in no. of pins or links not at the cost of strength of the shaft. Pins or links are fixed (may be permanent or temporary) in the drilled holes at the both shaft ends due to which motion is transferred. The dimensions of the pins or links and angle for the pins are all given very precisely, holes drilled very accurately.The modern gear drives are widely used due to their reliability and accuracy.However the major drawback is backlash and vibration .Due to vibration ,noisy operation introduce wear and tear and we get less span of life for gears.The system is to be analysed in SolidWorks package software to watch the response of the elbow rods and the also the hub (coupled with shaft). The real time 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.***

**Keywords:***Gearless transmission ,pins, hub ,solid works, stress analysis, displacement analysis.*

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## 1. INTRODUCTION

Motion transmission is relaying the same type of motion from the one part of object to another (rotational to translation ,translation to rotation).multiple angular gearless drive is motion transmitting device used for transmitting motion at various angle between driving and driven shaft. The scrutiny of this mechanism reveal that it comprises of pins ranging from 3-8 pins per assembly and with increase in pins operation becomes smoother. These pins slide inside symmetrical spaced holes machined on solid cylindrical disc. Thus the sliding pair help the shaft to revolve the shaft at desired angle

### 1.1Objectives

The main objectives of this project is to design for shaft,c-section,welded joints ,selection of motor,sliding pins.we have also done research for selection of materials for various parts,calculated cost estimation and done analysis for stress,factor of safety,displacement etc.

### 1.2 Scope

- Torque bearing capacity can be improved.
- Efficiency can be improved.
- Flexible bent links can be used.
- Has a bright future in automation and robotics

### 1.3Working Principle

The Gearless transmission or El-bow mechanism is a device for transmitting Motions at any fixed angle between the driving and driven shaft.The synthesis of this mechanism would reveal that it comprises of a number of pins would be between 3 to 8 the more the pins the smoother the operation.These pins slide inside hollow cylinders thus formatting a sliding pair. Our mechanism has 3 such sliding pairs. These cylinders are placed in a Hollow pipe and are fastened at 120* to each other. This whole assembly is mountedon brackets wooden table. Power is supplied by an electric motor.The working of the mechanism is understood by the diagram. An unused form of transmission of power on shaft located at an angle.Motion is transmitted from driving to the driven shaft through the roads which are bent to conform to the angles between the shafts. These roads are located at in the holes equally spaced around a circle and they are free to slide in & out as the shaft revolves. This type of drive is especially suitable where quite operation at high speed is essential but only recommended for high duty.The operation of this transmission will be apparent by the action of one rod.During a revolution. If we assume that driving shaft "A" is revolving as indicated by arrow the driven shaft B will rotate counter clockwise. As shaft A turns through half revolution C shown in the inner and most effective driving position slides out of both shafts A & B.The first half revolution and rod "C" then will be at the top then during The remaining half this rod "C" slide in wards until it again reaches to inner most position shown in Fig. in the meanwhile the other roads have of course passed through the same cycle of movements all rods are successively sliding inwards and outwards.

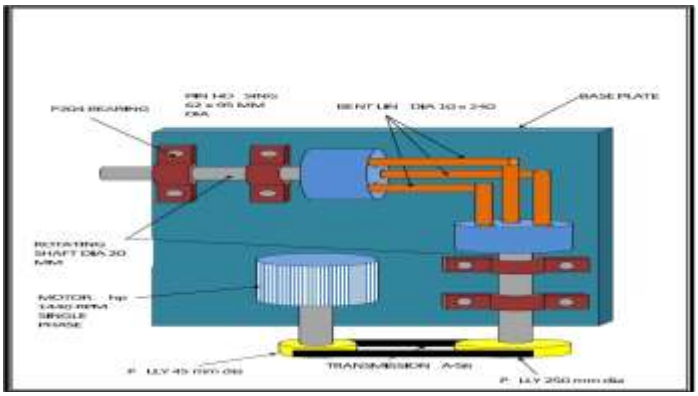



**Fig no 1:working principle of gearless mechansim**

**2. Literature Review :** The Gearless transmission or El-bow mechanism is a device for transmitting motions at any fixed angle between the driving and driven shaft. The synthesis of this mechanism would reveal that it comprises ofa number of rod would between 3 and more the rods the smoother the operation. Our mechanism has 3 such sliding pairs.

The rod are placed in a hub at 120o angle to each other. The whole assembly is mounted on chanal. Power is supplied by an electric motor. An used form of transmission of power on shaft located at an angle. The working of the mechanism is understood

This project is the equipment useful to improve the quality of gear being manufactured and can be made in very less time. this project uses El-bow mechanism which is an ingenious link mechanism of kinematic chain principle and slide. This is also called as "Gearless transmission mechanism" and very useful for transmitting motion at right angles. Transmits power at any angle without utilising gears. Skew Shaft The term "shaft" , used in this standards has a wide meaning and serves for specifications of all outer elements of the part , including those elements , which do not have cylindrical shapes And "skew" means non-parallel and non-intersecting so the shafts which are non-parallel and non-intersecting are known as skew shafts.

Crossed helical gears - Helical or "dry fixed" gears offer a refinement over spur gears. The leading edges of the teeth are not parallel to the axis of rotation, but are set at an angle. Since the gear is curved, this angling causes the tooth shape to be a segment of a helix. Helical gears can be meshed in parallel or crossed orientations. The former refers to when the shafts are parallel to each other; this is the most common orientation. In the latter, the shafts are non-parallel, and in this configuration the gears are sometimes known as "skew gears". For a 'crossed' or 'skew' configuration, the gears must have the same pressure angle and normal pitch; however, the helix angle and handedness can be different. The relationship between the two shafts is actually defined by the helix angle(s) of the two shafts and the handedness, Where is the helix angle for the gear & E is the angle between two shaft. The crossed

configuration is less mechanically sound because there is only a point contact between the gears, whereas in the parallel configuration there is a line contact.

A worm drive is a gear arrangement in which a worm (which is a gear in the form of a screw) meshes with a worm gear (which is similar in appearance to a spur gear, and is also called a worm wheel). The terminology is often confused by imprecise use of the term worm gear to refer to the worm, the worm gear, or the worm drive as a unit. To overcome all these difficulties we have a mechanism which transmits motion between the two non – parallel (intersecting) and coplanar shafts. As it replaces gears and transmits motion without the aid of gears it is also called as ―Gearless Power Transmission Mechanism‖. As a reference we have designed the mechanism for transmitting motion at right angle. However it can also be employed for transmitting motion at any angle to the driven shaft by using the pin bent to conform to the angle between the shaft (acute, obtuse or right angle). The motion study and simulation of various mechanisms has been frequently studied for several years. Elaheh Hassanzadeh Toreh, Mehdi Shahmohammadi and Nasim Khamseh performed Kinematic and Kinetic Study of Rescue Robot . Gadhia Utsav D. given the Quarter model of Wagon-R car's rear suspension by making analysis on ADAMS software . Assad Anis carried out analysis of Slider Crank Mechanism on ADAMS Software package . A. A. Yazdani performed Multibody Dynamics Simulation of an Integrated Landing Gear System using MSC.ADAMS Mohammad Ranjbarkohan made use of ADAMS software package and Newton's laws for analyzing the behavior of slider crank mechanism and investigated the effect of engine rpm on connecting rod and crankshaft However, therehasn't been performed any study to sort out problems on gearless transmission mechanism. Hence, this analysis is performed.

## 2.1Materials Used

| SR NO | PART NAME | MAT | QTY | DECREPTION |
|---|---|---|---|---|
| 1 | Frame | Ms | 1 | C Section 75x 40x 4 Mm |
| 2 | Moter | Std | 1 | 0.25 Hp 1440 Rpm |
| 3 | Shaft | Ms | 2 | Dia20mm X350m |
| 4 | HOUSING | Ms | 2 | Dia 95 Mm X 62 Mm |
| 5 | BENT LINK | Ms | 3 | Dia 10 Mm X 240 Mm |
| 6 | Pulley | Ci | 2 | Dia 45 & 250 Mm |
| 7 | PEDESTAL BEARING | CI | 4 | P204 |
| 8 | Belt | Leather | 1 | A-56 |
| 9 | ANGEL | MS | 1 | 35 X 35 X 5 Mm |
| 10 | NUT BOLT WASHER | MS | 10 | M10 |
| 11 | Welding Rod | - | | |
| 12 | Colour | - | | |

**Table-1: Specification Of Materials**

### 2.2Design Calculation For Shaft And Bent Links

Max tensile stress = 60 N/mm2 Maxm shear stress = 40 N/mm2 Shaft design on basic of study Considering 25 % overload

Tmax= 1238 x 1.25= 1.525 x 10 3N-mm

The shaft is subject to pure torsional stress

We know T= 3. 14/16 x fs x d3

15250 = 3. 14/ 16 x 70x d3

D =10.20mm

Taking factor of safety = 2

D = 10 x 2 = 20mm Same torque is transmitted to bent link shaft

So torque on each shaft = T /3 = 15250 /3 = 5083 N mm

T= 3. 14/16x fs xd3

5083 = 3. 14/ 16 x 70x d3

D = 7.17 mm

Taking factor of safety =1.4

D = 7 x 1 .4 = 9.8 =10mm

### 2.3 Design Of C-Section

Material: - M.S.

The vertical column channel is subjected to bending stress

Stress given by => M/I = f b / y

In above equation first we will find the moment of inertia about x and yAxis and take the minimum moment of inertia considering the channel of ISLC 75 x 40 size.

We know the channel is subject to axial compressive loadIn column section the maximum bending moment occurs at channel of section

M = Ra x L/2

M = 750 x 1500/2

M = 562500 N-mm

We know

F b = M/Z

Z = t (l x b + (b2/6))

Z = 5 (40x 65 + (652/6))

Z = 3304 mm3

Now check bending stress induced in C Section

F b induced = M/Z

F b induced = 562500 /3304 = 170.25 N / mm2

As induced stress value is less than allowable stress value design is safe.

F b = Permissble bending stress = 320 N / mm²

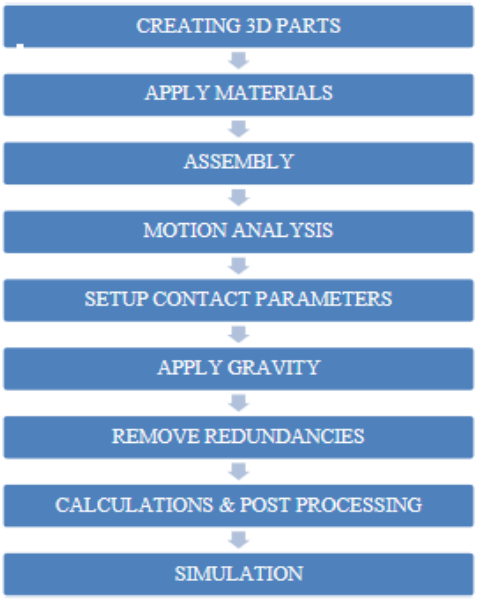
F b induced < f b allowable

Hence our design is safe.

ISSN: 2321-8169
1253 – 1258

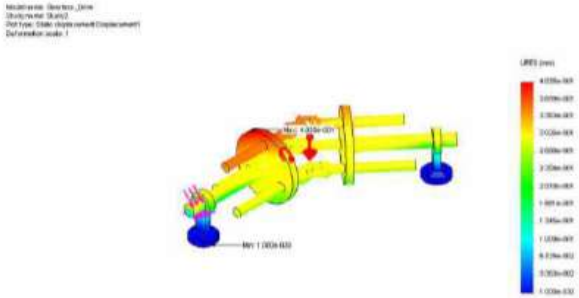
## 3Analysis part

### 3.1)Methodology




### 3.2)Von-Misses Stress Plot

### 3.3)Displacement Plot



### 3.3)Factor Of Safety Plot

## 4 Conclusion

Designing of Multi-angular gearless drive instigated with assumptions and random dimensions because no significant development has been done before in this unchartered territory. With software support and assiduous endeavour the final optimal design has been obtained. The final design thus obtained is capable of transmitting torque and power at varied angles depending on the angular limitation of the hooks joint. With further research and advanced analysis in the design wide-ranging applications of the drive can be discovered.

## 5 Acknowledgement

It is a genuine pleasure to express my deep sense of thanks and gratitude to my mentor and guide Prof.S.B.TELI. His dedication and keen interest, above all, his overwhelming attitude to help students has been mainly responsible for completion of our work. His timely advice, meticulous scrutiny, scholarly advice and approach have helped us to a great extent to accomplish this task.
I thank profusely to all the staff of Mechanical Engineering Department, Smt. Kashibai Navale College of Engineeringfor their kind help and cooperation throughout my study period.
This acknowledgement would be incomplete without expressing my special thanks to Prof. Dr. A. P. Pandhare, Head of the Department (Mechanical Engineering) for their support during the work. I would also like to extend my heartfelt gratitude to the Principal, Dr. A.V. Deshpande who provided a lot of valuable support, mostly being behind the veils of college bureaucracy
Finally it is our privilege to thank our mentors at “U B Tech Solution” for letting use their workshop for manufacturing and assembling. It surely has increased our knowledge about the design and manufacturing various components

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