MINI PROJECT REPORT
On
GEARLESS POWER TRANSMISSION

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1602-18-736-086

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Under the guidance of

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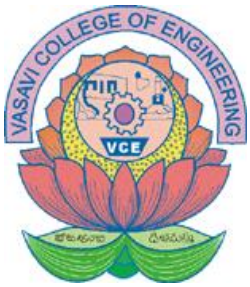
Assistant Professor



DEPARTMENT OF MECHANICAL ENGINEERING

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)

AFFILIATED TO OSMANIA UNIVERSITY
HYDERABAD

April 2020

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Submitted by:

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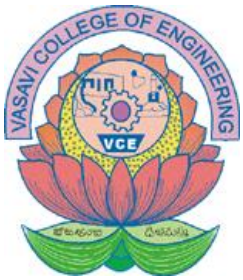

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IBRAHIMBAGH, HYDERABAD

CERTIFICATE

This is to certify that the Mini project report entitled "***GEAR LESS POWER TRANSMISSION*** " is a bonafide record of a mini project carried out by

RAHUL MOGILI 1602-18-736-086
SAI SARTHAK MANUSANI 1602-18-736-098

in the Department of Mechanical Engineering, Vasavi College of Engineering (Autonomous) (Affiliated to Osmania University), Hyderabad during the academic year 2019-20.

Mr. M. Venu Gopal Reddy
Project Guide

Dr.T.Ramamohan Rao
Professor & HOD
Dept. of Mechanical Engg.

ACKNOWLEDGEMENT

We would like to express deep sense of gratitude to our guide Mr.**M.VENU GOPAL REDDY**, for his valuable suggestions and directions towards the execution of this project.We sincerely express our thanks to him.

We are fortunate and very thankful to Mr**.M.SUDHAKAR** for helping us to carry the project.

We are thankful to Mr.**M. VENU GOPAL REDDY,** for helping us to carry the work.

We are thankful to **Dr. T. RAMAMOHAN RAO, PROFESSOR & H.O.D.** , who has extended positive support for executing the project.

Finally I am thankful to all those who have either directly or indirectly contributed towards the execution of the project.
Sincerely,

RAHUL MOGILI 1602-18-736-086

SAI SARTHAK 1602-18-736-098

Contents

ABSTRACT

Power transmission for skew shafts is with the help of either crossed helical gear or worm gear or hypoid gears in a machine, but the manufacturing of these gear is very complex, power loss in gears due to sliding motion and the shaft orientations is very limited, so need arises for a better system. In Gearless power transmission for skew shafts which reduce the losses, cost & save the time and space. This system allows the changing in the orientation of shafts during motion which is very interesting and fascinating about this mechanism. In this transmission system no. of pins or links used must be odd 3,5,7,9... Pins or links are fixed in the drilled holes at the both shaft ends due to which motion is transferred. The Working of this arrangement is very smooth & work effectively with a very minimum amount of power losses, which is skillful and is having something precise in transmitting power at right angle without any gears being manufactured

INTRODUCTION

Today's world requires speed on each and every field. Hence rapidness and quick working is the most important. Now days for achieving rapidness, various machines and equipment's are manufactured. Gears are costly to manufacture. Its need to increase the efficiency of transmission which cannot be done using geared transmission. Gearless transmission mechanism is capable of transmitting power at any angle without any gears being manufactured.

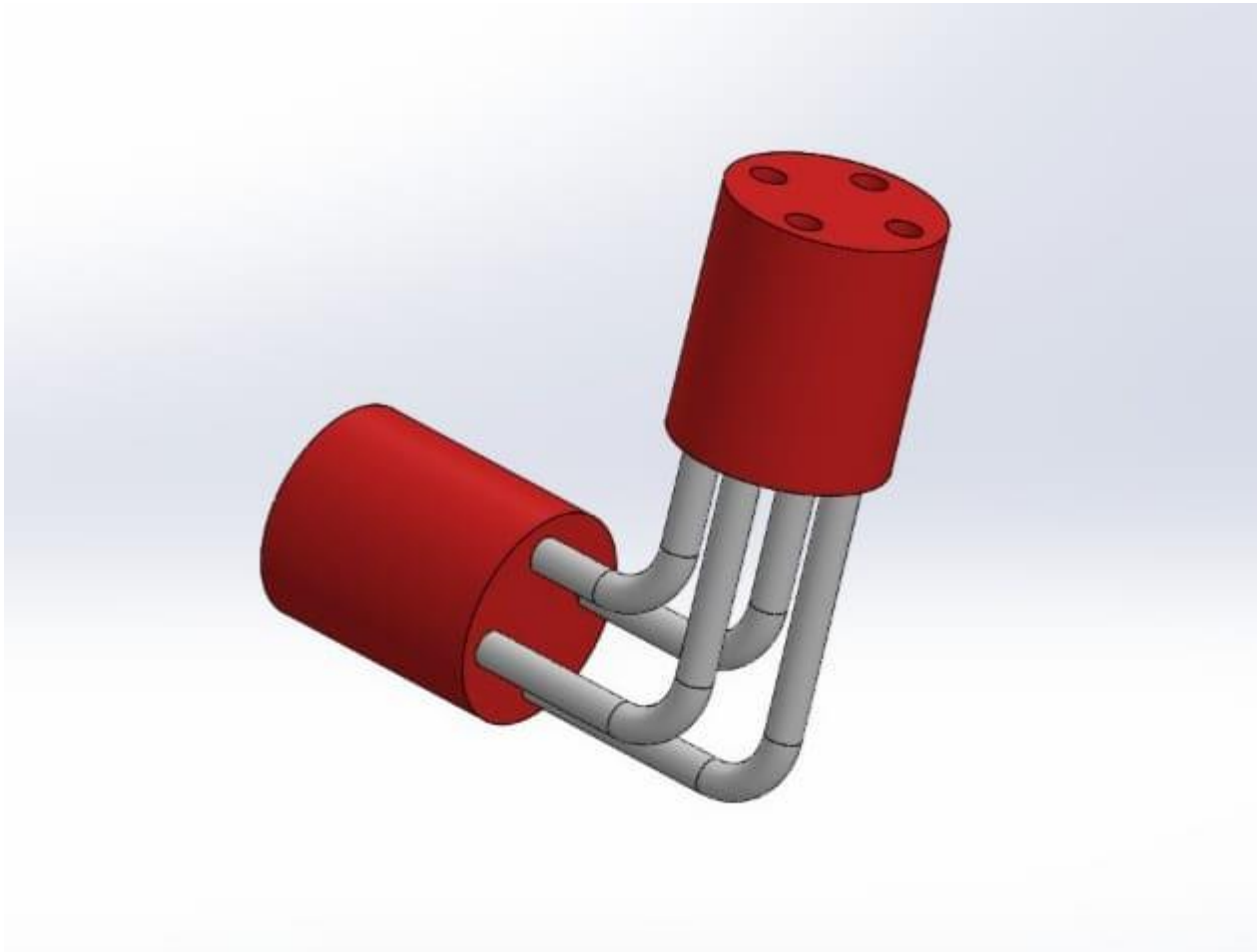
So here I introduced a gearless power transmission system for skew shafts which reduce the losses, cost & save the time and space. This system allows the changing in the orientation of shafts during motion which is very interesting and fascinating about this mechanism.

Also during analysis of mechanism and working it is seen that this gearless transmission can be used for both intersecting shafts and skew shafts but here we introduced a solution for skew shafts so main attention is towards the skew shafts.

ELBOW MECHANISM:

The elbow mechanism is a efficient design of gearless transmission technique and the kinematic system that allows for efficient power/motion transmission at any required angle. This mechanism allows for motion transmission from 90 degree to 180 degree angles between the driver and the driven shafts...,

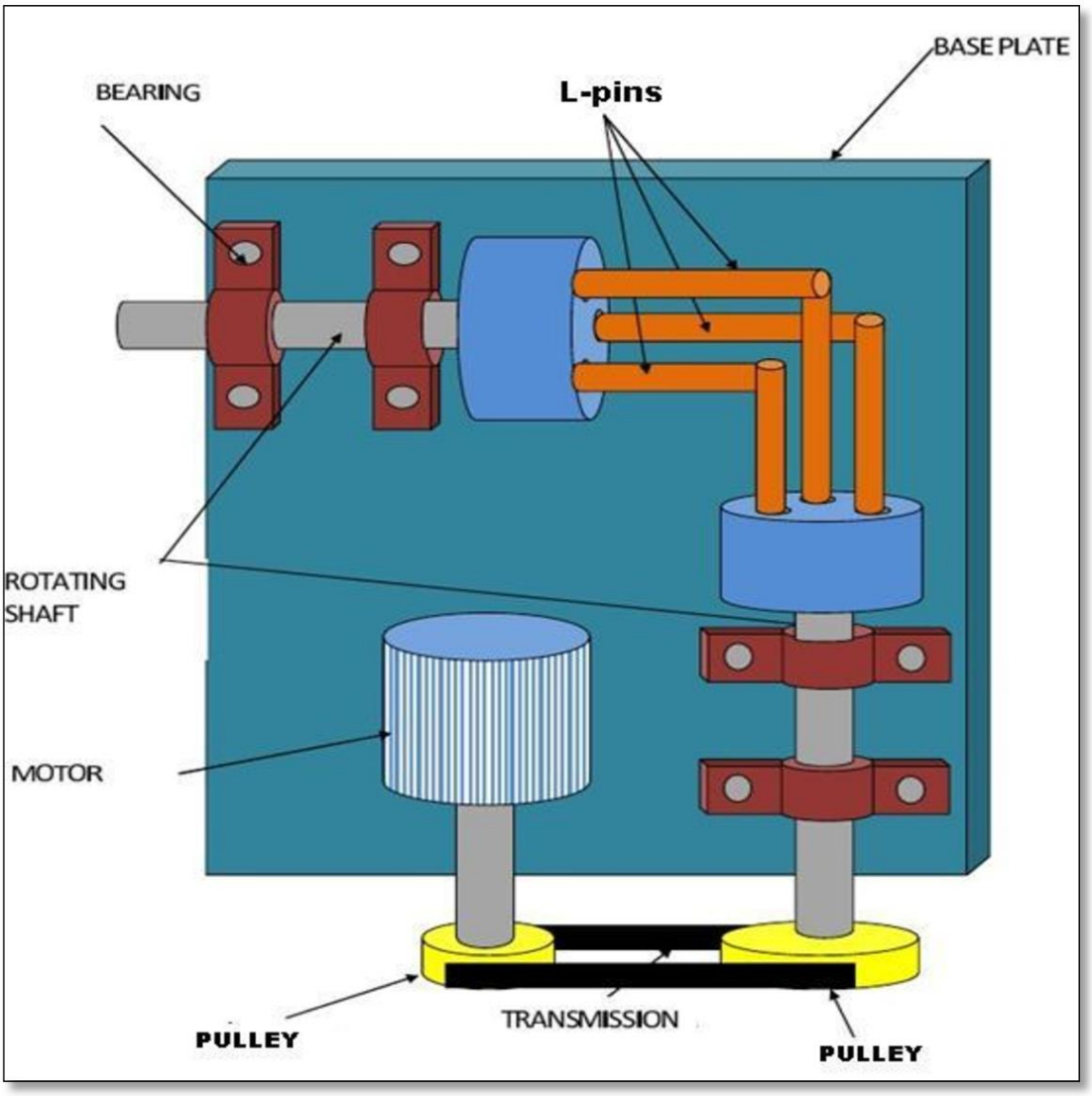
ELBOW MECHANISM:



GEARLESS POWER TRANSMISSION
GENERAL LAYOUT

In this section different views of the arrangement and the components used for arrangement are shown, which is necessary for understanding the proper working and setup of the arrangement.

Here in the diagram, planes are shown which helps us in the understanding of the mechanism and movement of shafts and link used.



DESCRIPTION OF PARTS

- **SHAFT:**

It is a rotating part which is used to transmit the torque. One end of shaft is connected to handle bar and at the other end it is connected to circular disc.

- **FRAME:**

It is a rigid body that supports the entire mechanism.

- **HUB:**

A hub is a physical layer networking device which is used to connect multiple devices in a network. A hub has many ports in it.

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 of a 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.

- REFERENCE:

International research journal of engineering and technology (IRJET)
WEBSITE:www.jret.net-issue 04/04/2017.

We referred the above journal for our mini project. It discuss about the gear less power transmission using elbow mechanism. Based on this we designed a gearless power transmission machine. We referred all the theory and design calculations from this journal. This journal helped us in completing work in an easier way.

PROBLEM DEFINITION:

This arrangement gives the coverage of a wide range of shaft diameter, which may be standard or non-standard which is not possible in the existing gear arrangement because the manufacturing of gears for skew shafts very complex and because of standardization its only use of shafts of standard diameter.

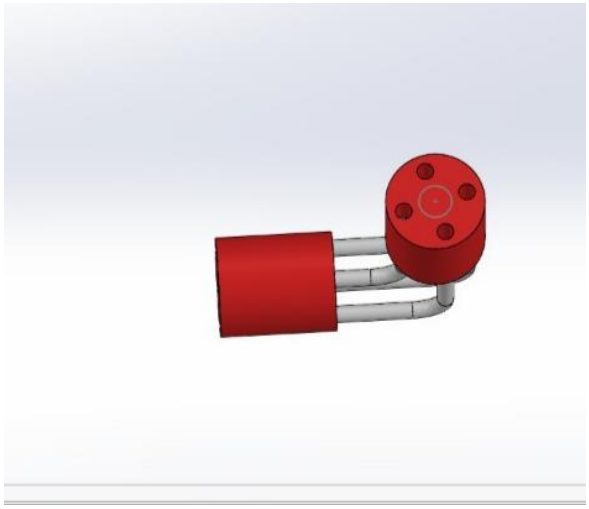
· Proposed gear less transmission with pins can be used for very high speeds and for high loads which is comparable to the worm gear and not possible for crossed helical gears.

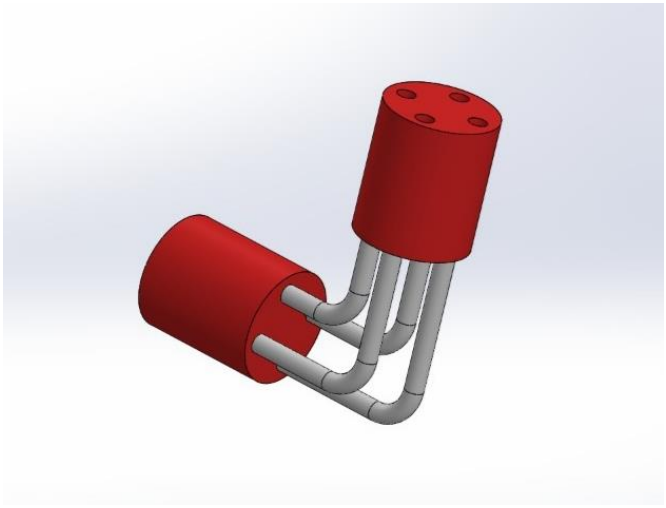
· This system not having any possibility of like sliding and point contact as in crossed helical gears so power loss is very low in introduced arrangement and used for high loads with proper rigidity of shafts and pins.

· The main and very interesting advantage of this proposed system is that we can changes the position of shafts during motion or during intermittent position according to need by using given type of links at the place of pins which is not possible in any existing system till now.

VIEWS OF SETUP

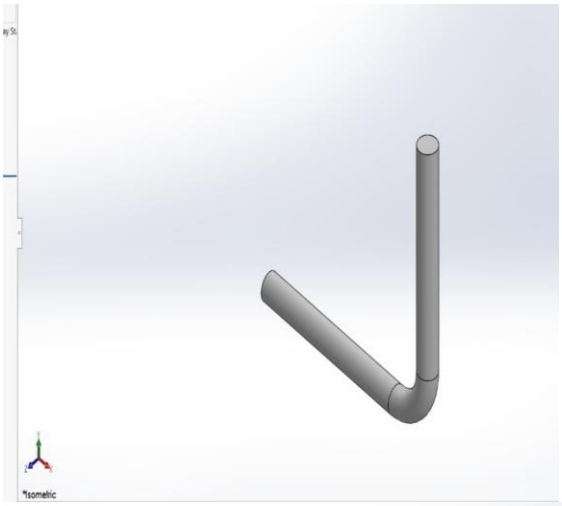
- **Different views of the elbow setups are shown in figure**

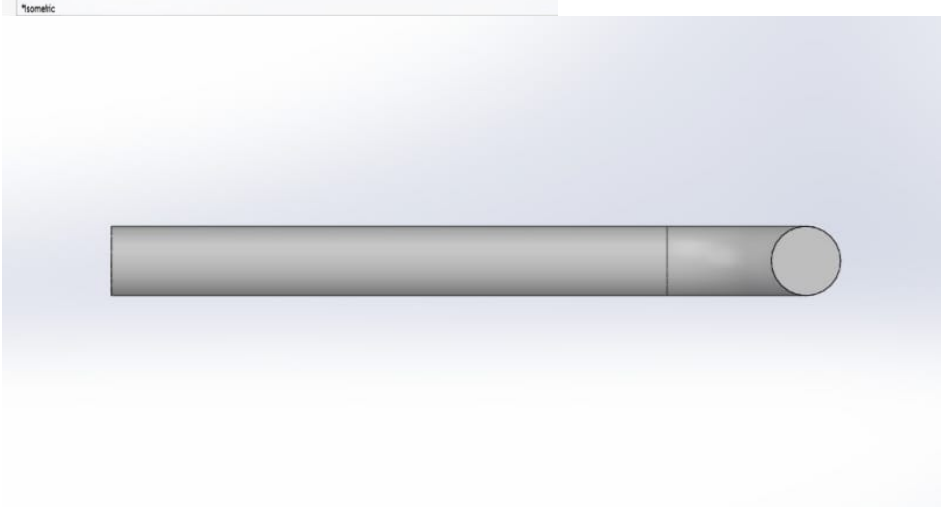




VIEWS OF THE PINS:

- Here different views of the pins according to the setup are shown.





ARRANGEMENT OF PINS IN SHAFT

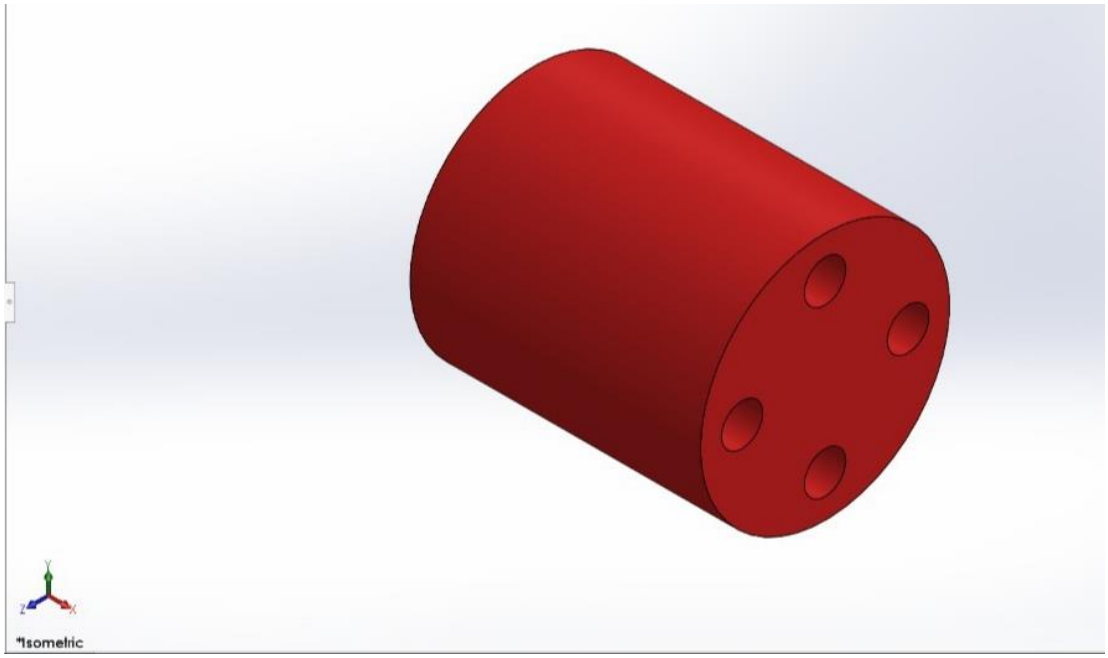
In the below diagram for basic arrangement of pins in the shaft holes are shown. The diagram clearly shows that pins used are in odd no.3, 5, 7, 9… and centers of any two pin holes must not be on that line which represent the diameter of the shaft and angle between all consecutive holes should be equal for smoother power transmission. Value of angle such that it's multiple with any integral not equal to 180 degrees.

Let the Value of angle = x degree, then n*x ≠ 180 degree. Where n is an integral value.

As mentioned, Angle between the centers of any two pin holes must not be on that line which represent the diameter of the shaft because if this happen angle between them is 180 degrees and during motion pins or links use are trying to overlap each other because of this motion interrupted. Also, as we mentioned that pins no. should be odd and angle between consecutive holes are equal so it can be easily understood by below table that why it is necessary.

NO. OF PINS	**ANGLE BETWEEN CONSECUTIVE HOLE(DEGREE)**	**ANGLE BETWEEN CONSECUTIVE HOLE(DEGREE)**	**VALUE OF INTEGRAL**
2(even)	180	Yes	1
3(odd)	120	No	No integral
4(even)	90	Yes	2
5(odd)	72	No	No integral
6(even)	60	Yes	3
7(odd)	51.43	No	No integral
8(even)	45	Yes	4
9(odd)	40	No	No integral

In upper table it is seen that with any no. of pins other than odd there must be an integral whose multiplication with angle gives the value 180 degrees so only odd no. of pins used.



VIEW OF SHAFT WITH HOLES

FORMULATION, MODELLING AND ANALYSIS

DESIGN CALCULATIONS

Testing of the machine and for functioning

Power of motor = ¼ H.P = 746 x 0.25 = 186.5 N- m /s

Rpm of motor N= 1440 rpm

Power of motor P =186.5 watt.

$$P = 2 \pi N TP /60 \text{ --------- (Eq.1)}$$

Where, N = Rpm of motor = 1440

T = Torque transmitted

From eq.1 we get,

$$186.5 = 2\pi \times 140 \times T/60$$

T = 1.23 N-m

T = 1238 N-mm.

DESIGNING OF SHAFT

Following stresses are normally adopted in shaft design

Max tensile stress = 60 N/mm2

Max shear stress = 40 N/mm2

Considering 25 % overload

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

A shaft diameter is 20mm and length is 230mm

$$M = 2151.11N \times 230mm$$

$$= 494755.3Nmm$$

Bending stress for shaft

$$\sigma = 32M\pi \times d3$$

$$= 186.649 \text{N/mm}^2$$

Tensional shear stress of shaft

$$Mt = 60 \times 106kw2\pi n$$

Where, Kw=7.5, n=120

$$Mt = 596831.03 \text{Nmm}$$

$$\tau = 16Mt/\pi d^3$$

$$= 16 \times 596831.03/\pi \times 203$$

$$= 112.57 \text{N/mm}^2$$

DESIGNING OF HUB

Considering a hub of internal diameter is 32mm and outer diameter is 92mm, length is 82mm.

p $= 100 \times 9.81 = 981$

σb $= pDi2\ /D02 - Di2$

$= 980 \times 322\ /922 - 322$

$= 135.01 \text{N/mm}$

DESIGNING OF EL-BOW ROD

We know that,

Same torque is transmitted to bent link shaft

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

$$T = 3.14/16 \times fs \times d3$$

$$5083 = 3.14/16 \times 70 \times d3$$

$$D = 7.17 \text{ mm.}$$

Take approximately D=8mm.

Diameter of rod is 8mm and length is 300mm

$$Z = 0.78R3$$

$$= 0.78 \times 43$$

$$= 49.92 \text{ kg/mm}^2$$

Bending stress of rod

$$\sigma = PL/4Z$$

$$= 186.5 \times 300/4 \times 49.92$$

$$= 280.19 \text{ N/mm}^2$$

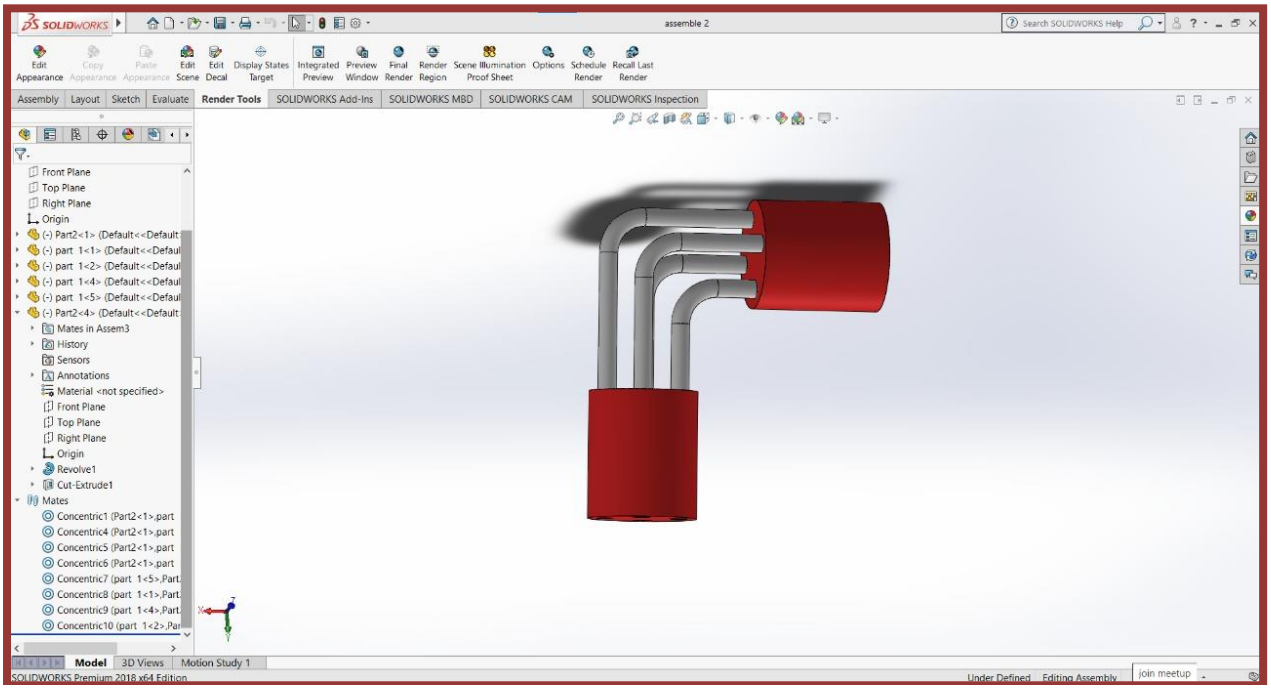
METHODOLOGY:

We used Solid works Software to Design The parts.

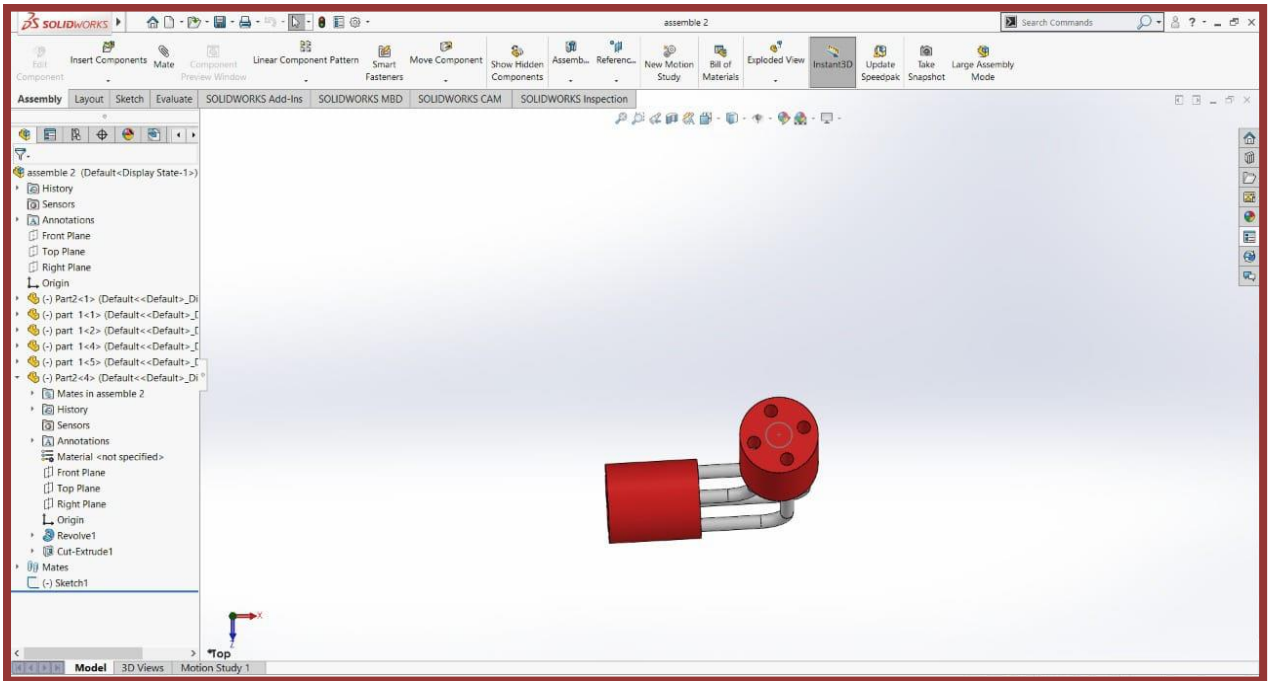
Hub of Internal Diameter=32mm.

Hub of External Diameter=92mm.

Hub Length=82mm.

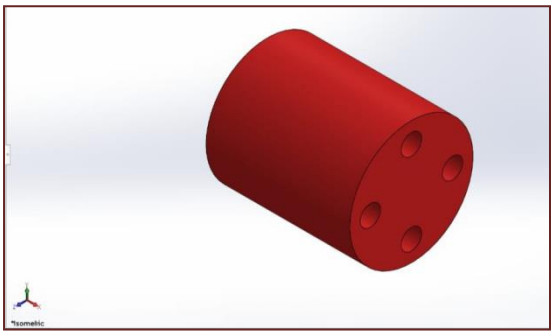


TOP VIEW



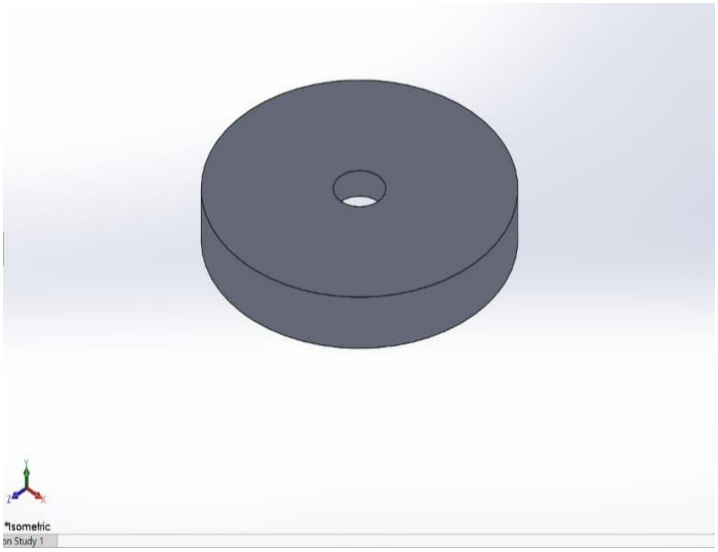
FRONT VIEW

HUB: A hub is a physical Layer networking device which is Used to connect multiple devices in a net work. a hub has many ports in it.

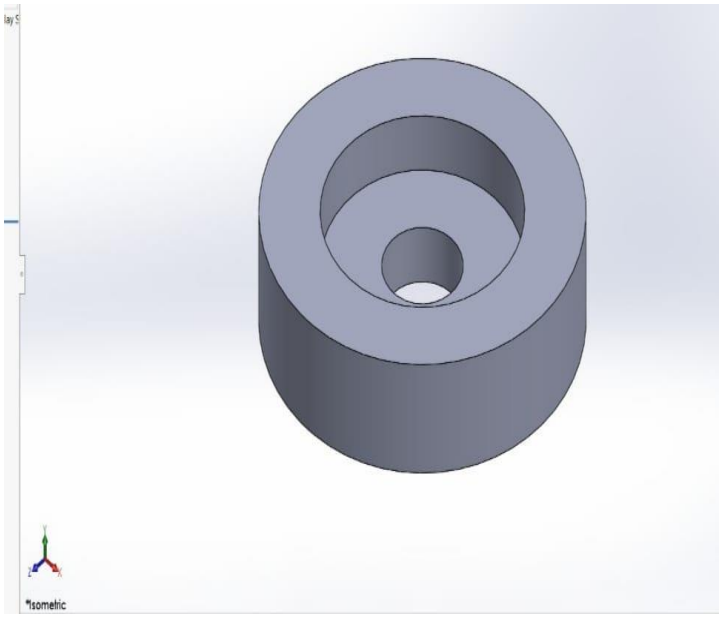


HUB

PULLEYS: A pulley is a wheel on axle (or) shaft that is designed to support movement and change of direction of taut cable (or) belt (or) transfer of power between the shaft and cable (or) belt.



LARGE PULLEY

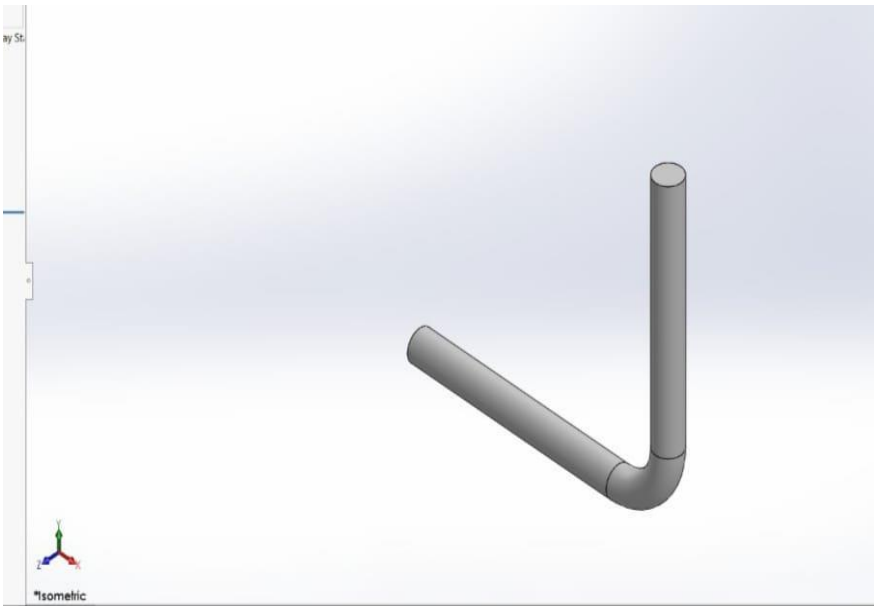


SMALL PULLEY

L-PIN ROD:

DIAMETER OF L-PIN ROD =8mm

LENGTH OF L-PIN ROD =300mm

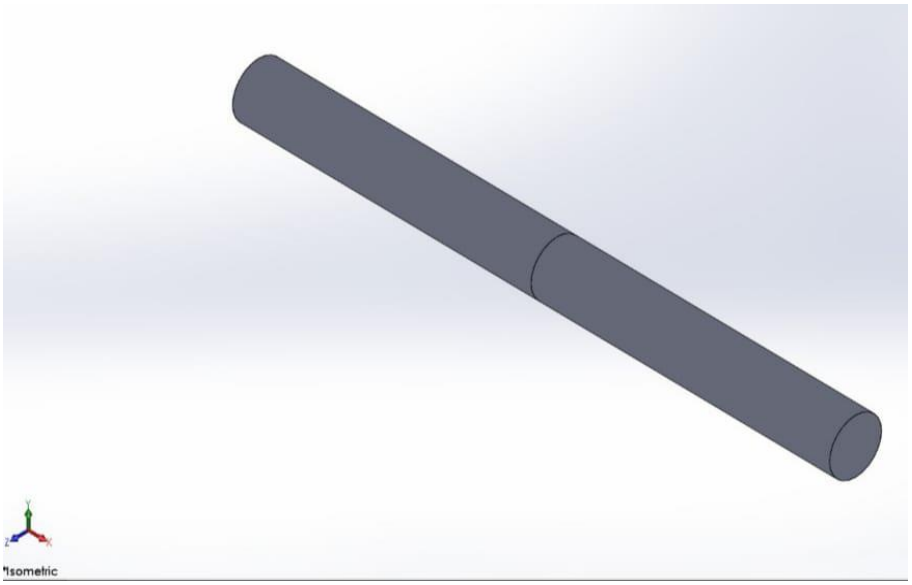


SHAFT:

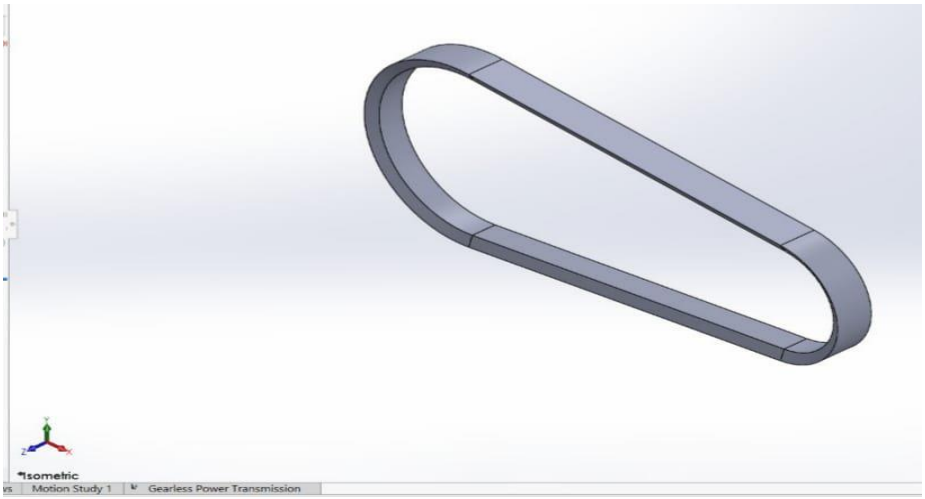
It is a rotating part which is used to transmit The torque one end of the shaft is connected to handle bar and at the other end it is connected to circular disc

Shaft diameter is = 20mm.

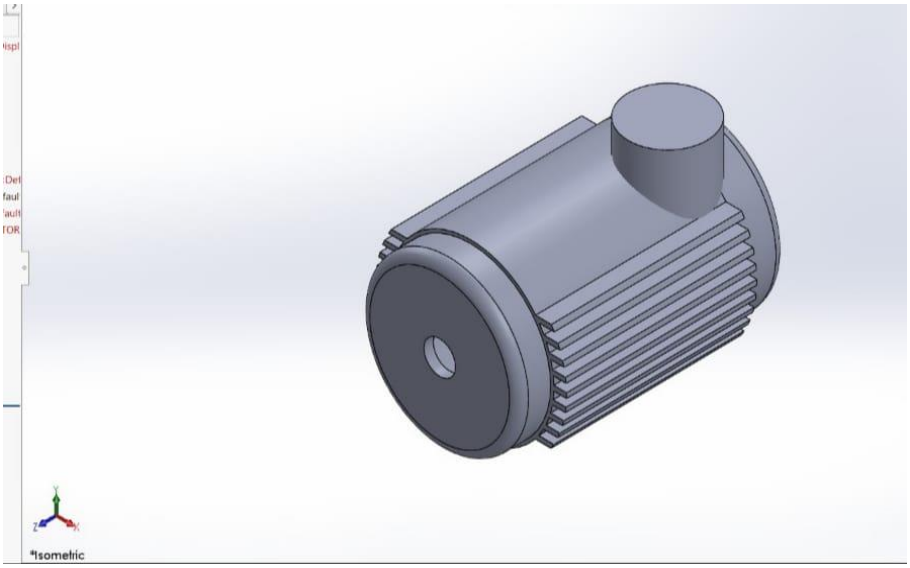
Length of the shaft = 230mm.



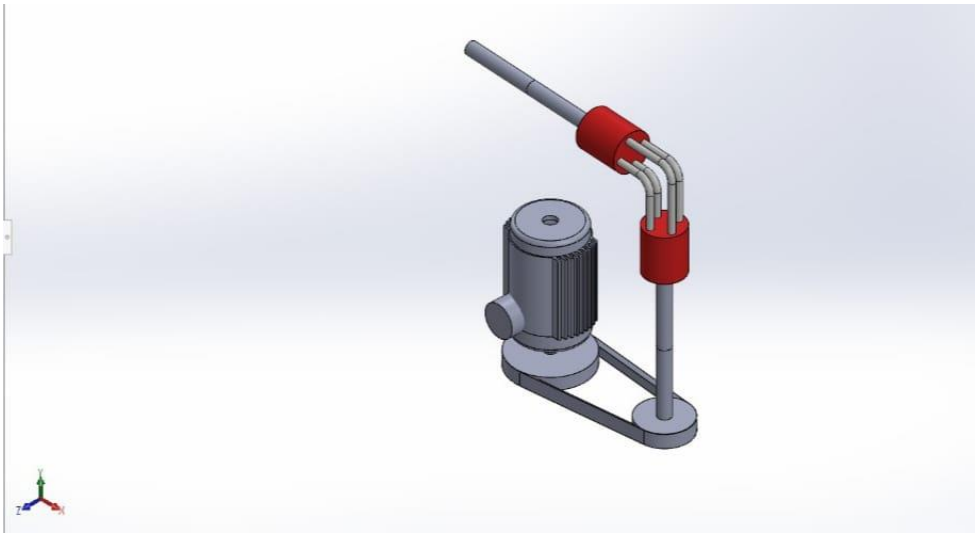
BELT:

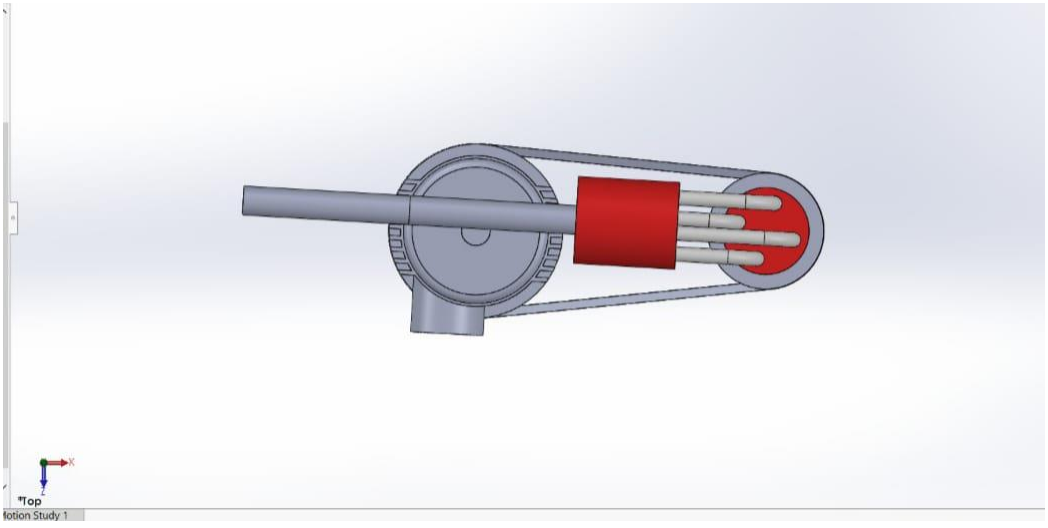


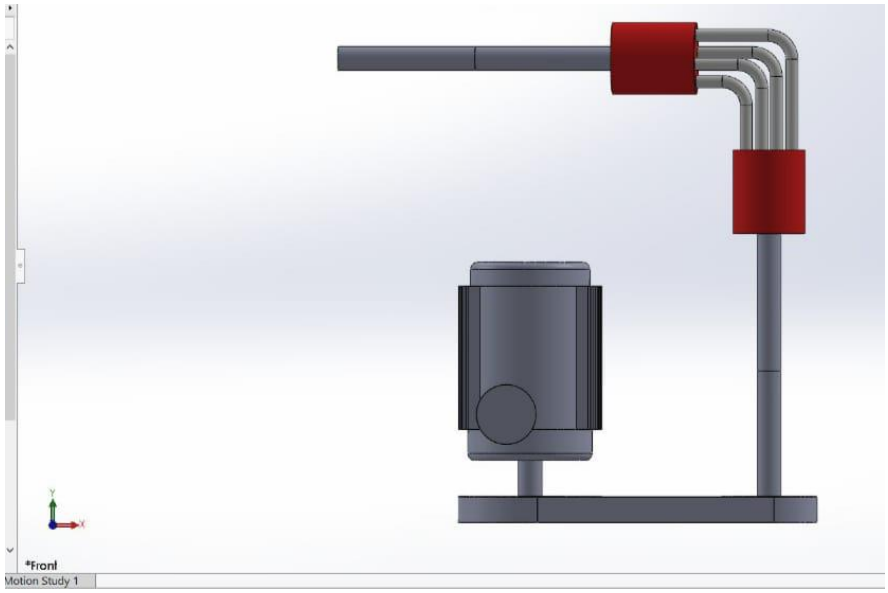
MOTOR:



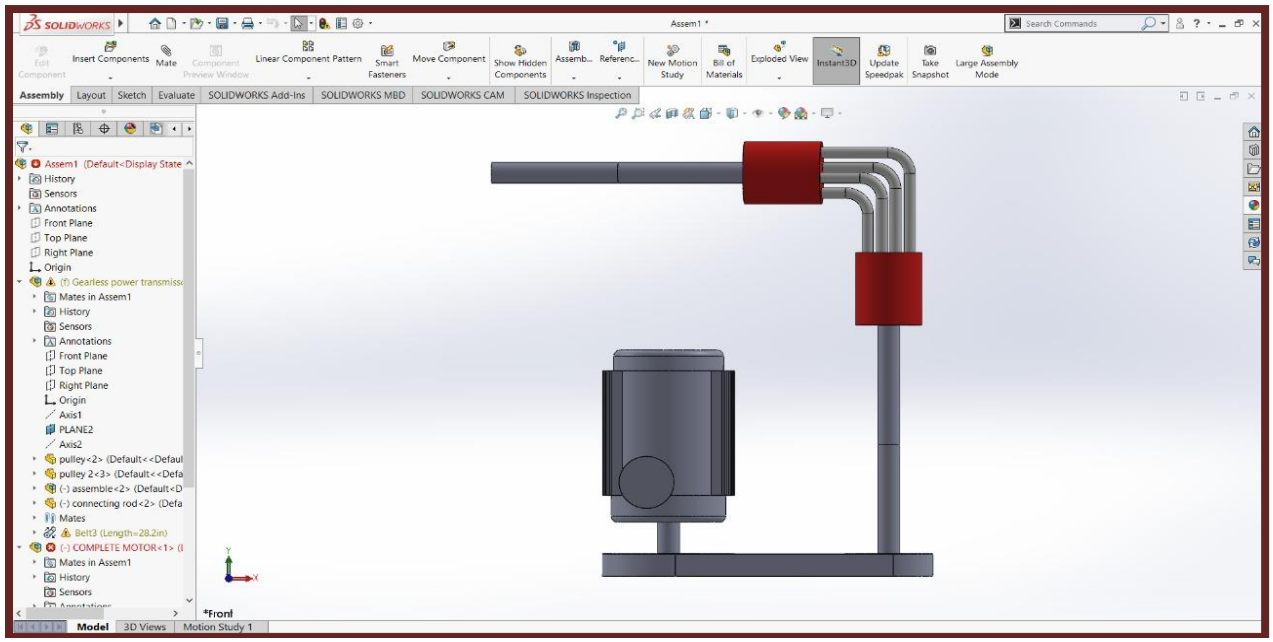
VARIOUS VIEWS OF ASSEMBLY:




*Top
Motion Study 1



ASSEMBLY OF GEARLESS POWER TRANSMISSION



DIMENSIONS:

- **DIAMETER OF THE SHAFT = 20mm.**
- **LENGTH OF THE SHAFT = 230mm.**
- **INTERNAL DIAMETER OF THE HUB = 32mm.**
- **OUTER DIAMETER OF THE HUB = 92mm.**
- **LENGHTH OF THE HUB = 82mm.**
- **DIAMETER OF THE ROD = 8mm.**
- **LENGHTH OF ROD = 300mm.**

DESIGNED PARTS OF MODEL WITH THE ABOVE DIMENSIONS.

MODELLING AND ANALYSIS

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 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:

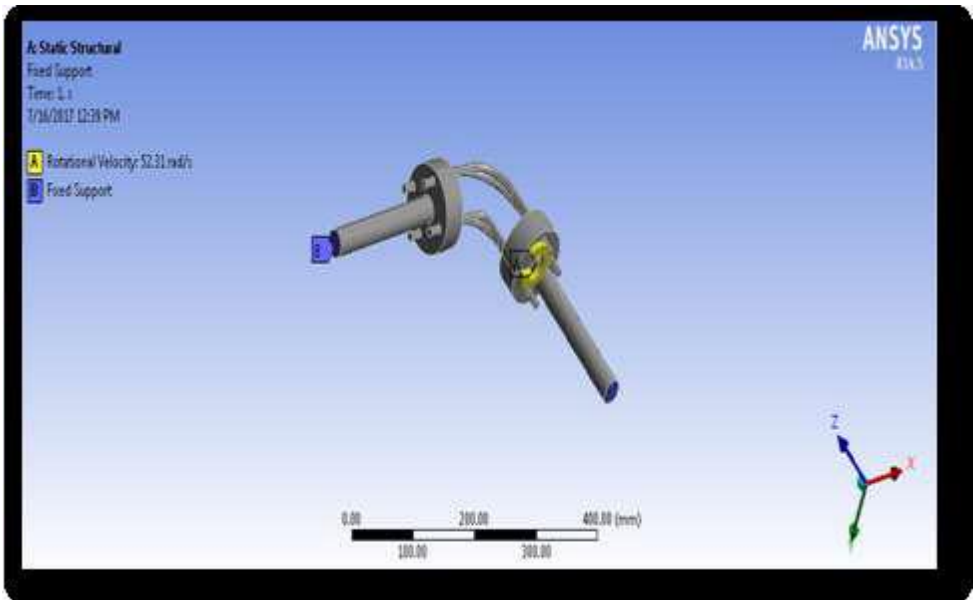
STATIC ANALYSIS OF ELBOW MECHANISM

apply materials to all the objects

(different materials also)

MESH GENERATION

Static structural

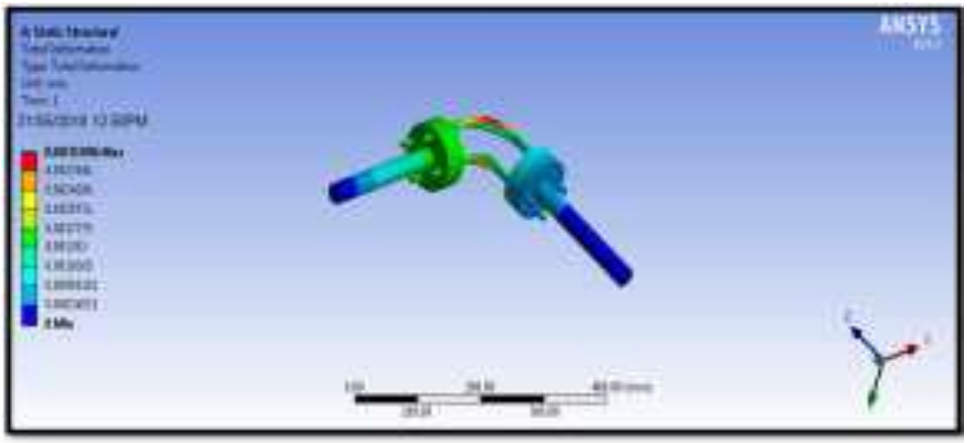


PRESSURE VALUES

MATERIAL- MILDSTEEL

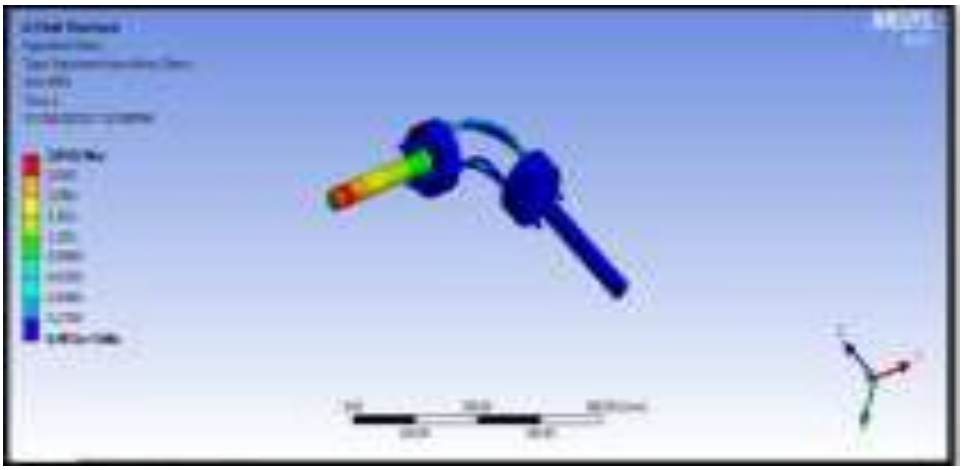
AT SPEED-500 RPM

DEFORMATION



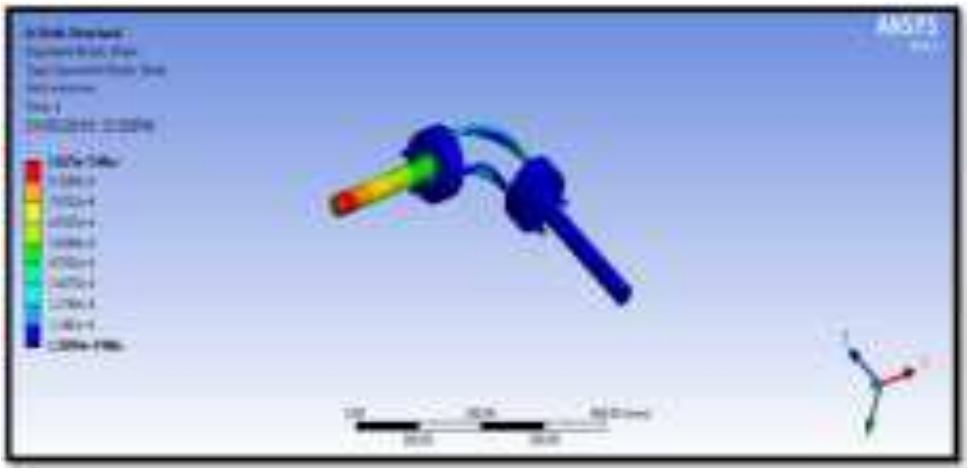
STATIC ANALYSIS OF GEARLESS MECHANISM DEFORMATION

STRESS



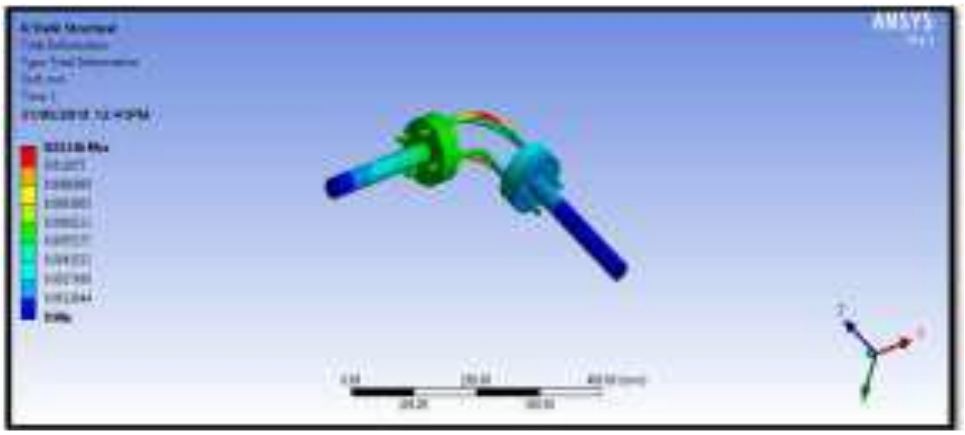
STATIC ANALYSIS OF GEARLESS MECHANISM STRESS

STRAIN



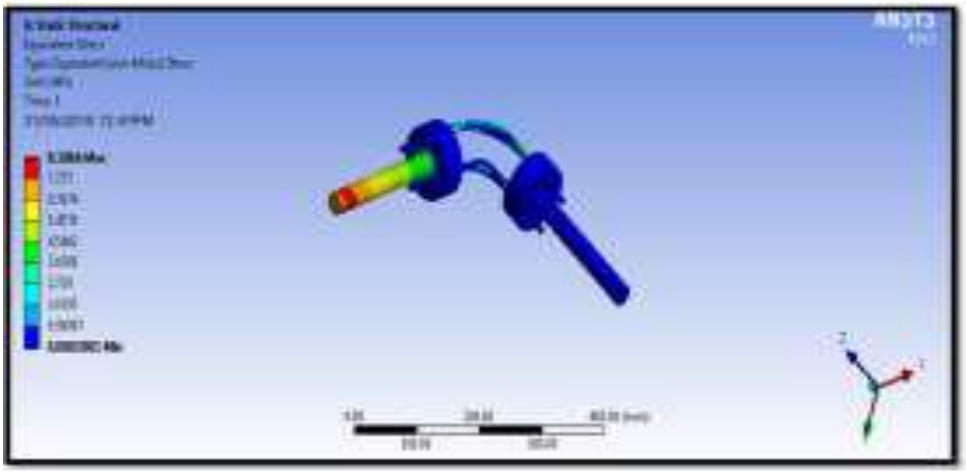
STATIC ANALYSIS OF GEARLESS MECHANISM STRAIN

AT SPEED-1000 RPM
DEFORMATION



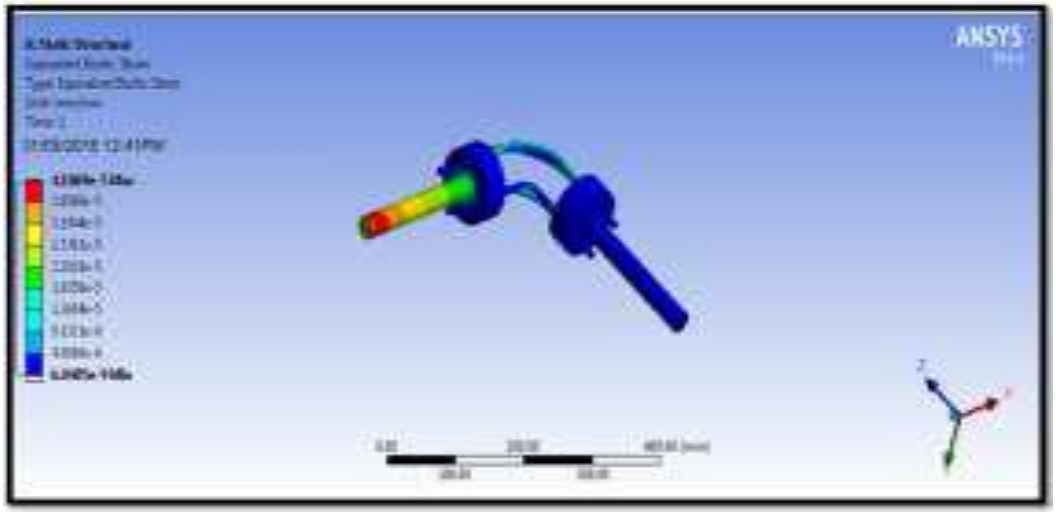
STATIC ANALYSIS OF GEARLESS MECHANISM DEFORMATION

STRESS



STATIC ANALYSIS OF GEARLESS MECHANISM STRESS

STRAIN



STATIC ANALYSIS OF GEARLESS MECHANISM STRAIN

RESULT & DISCUSSIONS

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	148.85	24.503	264.14	16.552	275.67	18.691
CAST IRON	25.382	25.382	206.44	17.162	215.93	19.34

MATERIALS USED:

S.NO	PART NAME	MATERIAL	QUANTITY
1	SHAFT	MS	2
2	BENT LINKS	MS	3
3	PULLEY	CI	1
4	FRAME	MS	1
5	L-PINS	MS	4

EXPERIMENT TEST SET UP DESCRIPTION WHENEVER APPLICABLE

- Driving for all kinds four faced tower clocks. The elbow mechanism was made use of the “Big Ben Clock” having four dials on the tower of London. This clock was installed on 1630 AD and still it is functioning in good condition.
- 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.

CONCLUSION

During working on experimental setup and after a long discussion it is observed that proposed arrangement used for any set of diameters with any profile of shafts for skew shafts of any angle but the shaft's must be having the rotational motion about his own axis, transmission of motion is very smooth and desirable and used only for the equal R.P.M. of driving shaft and driven shaft by employing links or given type of links for appropriate joints for revolute pair.

Some successful mechanical devices function smoothly however poor fly they are made while other does this only by virtue of an accurate construction & fitting of their moving parts.

This projects which looks very simple & easy to construct was actually very difficult to conceive & imagine without seeing an actual one in practice. Motions demands to be studied first & we have done that very thing. We find that while acceptable analysis for existing mechanism can often be Made quite easily we cannot without insight & imagination make effective synthesis of new mechanism hence we are mould to present this our project gear less transmission at 90 degree (El-bow mechanism) which we have managed to successfully device after long & hard input in conceiving its working principle.

SUGGESTIONS FOR FUTURE WORK

1) Working on stress concentration is recommended

2) Working on aluminium as a prime material is recommended

3) Fatigue analysis is recommended

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

APPLICATIONS

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, toy sand hand-cranked equipment, or for movement transmission in store and Outdoor signage.

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RESULTS & DISCUSSION

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.

The model works correctly as per the design. With the help of this system, we can efficiently reduce the cost in power transmission and further advancement in this technology can be made.

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COURSE – PO CORRELATION MATRIX

Course: Mini Project	Course code:**PW619ME**	Class: BE 3/4	Sem.: **VI**

Course Outcomes: On completion of the course, the student will be able to

CO1	Chose appropriate field of interest and define the problem.
CO2	Plan the activities for carrying out the work in teams to solve the problem
CO3	Develop the capability to conduct investigations on the chosen problem and obtain results.

CO	PO 1	PO2	PO 3	PO4	PO5	PO 6	PO7	PO8	PO9	PO 10	PO 11	PO 12
1	2	3	2	3	-	3	3	3	-	-	1	2
2	2	-	-	-	2	-	-	-	-	3	3	2
3	-	2	3	3	3	-	-	-	-	2	-	-
Avg.	2	2.5	2.5	3	2.5	3	3		2.5	2.5	2	2

CO	PSO1	PSO 2	PSO3
1	2	-	3
2	-	2	
3	-	3	2
Avg.	2	2.5	2.5

PROGRAM SPECIFIC OUTCOMES (PSOS)	
1	apply principles of Basic
2	model, analyze, design, and realize Mechanical components and processes.
3	be prepared to work professionally and ethically in thermal, design and manufacturing areas of mechanical engineering.

PROGRAM OUTCOMES (POS)	
1	Graduates demonstrate knowledge of basic sciences and mechanical engineering.
2	Graduates demonstrate an ability to identify, formulate and solve engineering problems
3	Graduates demonstrate an ability to design and conduct experiments, analyze and interpret
4	Graduates demonstrate an ability to design a system, component or process as per needs and specifications
5	Graduates demonstrate skills to use modern engineering tools, software and equipment to
6	Graduates demonstrate an ability to visualize and work on laboratory and multi disciplinary tasks.
7	Graduate shows the understanding of impact of environment and society of engineering solutions and aim to provide sustainable solutions.
8	Graduates demonstrate knowledge of professional and ethical responsibilities.
10	Graduates are able to communicate effectively in both verbal and written form.
11	Graduates will demonstrate the ability to handle the projects through appropriate project
12	Graduates develop confidence for self education and ability for life-long learning