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Design Analysis and Simulation of Elbow-pin Mechanism

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Abstract— Gears are used where exact velocity ratio and high precision is needed . Therefore they are used in higher end applications and manufacturing is a complex and tedious process resulting in huge costs . The elbow pin mechanism replaces gears and can be used for small scale and high speed applications . The mechanism effectively checks the limitations of gears . This paper presents a real time study and is aimed at design , analysis and simulation of elbow pin mechanism. I have used Parametric creo for design,analysis and simulation purposes.

Index Terms—. Parametric creo, Gear replacement, Elbow pins , Design and Analysis **.**

1.INTRODUCTION

For most occasions , gears are used to transmit power between two shafts/areas. Various gears are used depending upon the angle between the shafts . For transmission of power between the intersecting shafts mostly straight and spiral bevel gears are used. Though the usage of gears produces accurate results and efficiency in a large scale applications, when viewed on small scale , there are many limitations such as complexity in manufacturing due to complicated profile, increased manufacturing costs due to need of high precision .

In elbow-pin mechanism the gears are completely replaced . The source power , which is to be transmitted , is given to the input shaft . Then the input shaft is welded to the hub/drum . Odd number of holes(say-3,5,7…..) are drilled in the hub/drum . L-pins (same number as number of drilled holes) is inserted into the holes . The other end of the L-pin is connected to the hub-2 which is at 90 degree to the input shaft and hub-1 . The output shaft is welded to the second hub, in this way the power is transmitted through 90 degrees.

2 .OBJECTIVE

The main objective of the project is to design the components and analyse the stresses and to check whether they are within the same limits .The secondary objective is to find the ways in which the mechanism overcomes the limitations of gears.

3.DESIGN

The mechanism uses elbow pins , more the number of pins more would be the effectiveness of power transmission . These links slide inside hollow cylinders thus formatting a sliding pair. This mechanism has 3 sliding pairs. These cylinders are placed in a hollow pipe and are fastened at 120 degree to each other. The entire setup is mounted on a frame . Power is supplied by an electric motor. The working of the mechanism is understood by the diagram [1]. Besides 90 degrees power can be transmitted at any angles between zero degree to 90 degree . Motion is transmitted from driving to the driven shaft through the rods which are bent to conform to the angles between the shafts. These rods are located at in the holes equally spaced to slide in & out as the shaft revolves.

3.1 DIMENSIONS

TABLE 1
DIMENSIONS OF COMPONENTS

COMPONENT	DIAMETER	LENGTH
SHAFT	80	80
HUB	36	200
ELBOW PIN	15	500

4. A VIEW OF THE MECHANISM

Fig 1 Trimetric View Of The Mechanism

5.WORKING

Power is supplied to the input shaft through a D.C.Motor.Then the

input shaft transmits power to the hub which is welded . As the hub rotates the pins starts sliding outward and away from the hub . This inturn causes the rotation of output hub in the same direction . Then the output shaft receives power from the output hub.

5.1 **Power flow diagram**

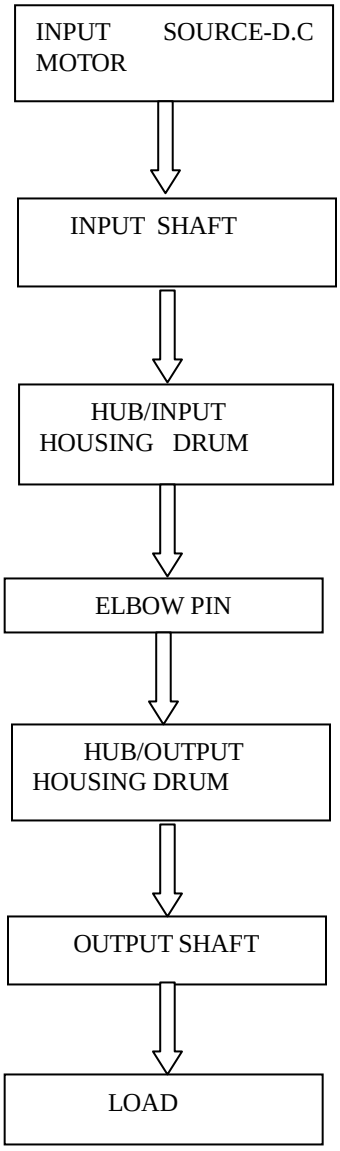

Fig 2 Flow Chart Indicating Power Flow

6 .MATERIALS USED

TABLE 2
LIST OF COMPONENTS AND MATERIALS

COMPONENTS	MATERIALS USED
Elbow pin	Stainless steel
Hub/drum	Mild steel
Shaft	Mild steel

7.STRESS CALCULATIONS FOR ELBOW PINS

7.1 BENDING STRESS

Bending stress equation for solid circular object is given by

$$\sigma = 32M/\Pi D\text{^}3$$

where ,

M- Bending moment in N-mm.

D- Diameter of the pin in mm.

Allowable bending stress = 60 N/mm^2

From analysis Max bending moment= 15 N-m

$$\sigma = (32*15)/(3.14*15^3)$$

$$=45.29\ N/mm^2$$

ACTUAL STRESS<ALLOWABLE STRESS.
DESIGN IS SAFE.

7.2 SHEAR STRESS

Shear stress equation for solid circular object is given by

$$\tau=16T/\Pi d\text{^}3$$

Where,

T is torque transmitted in N-m,

D is the diameter of the shaft in m.

Torque=Reaction force * Radius of the shaft.

Allowable shear stress = 18.5 N/mm^2

Reaction force = 52 N

$$\tau= (16*52*15)/(3.14*15^3)$$

$$= 1.17\ N/mm^2.$$

ACTUAL STRESS<ALLOWABLE STRESS.
DESIGN IS SAFE.

8.SIMULATION AND EVALUATION FOR HUB AND SHAFT

The analysis were performed by considering the hub and the shaft as a single part

8.1 STRAIN ANALYSIS

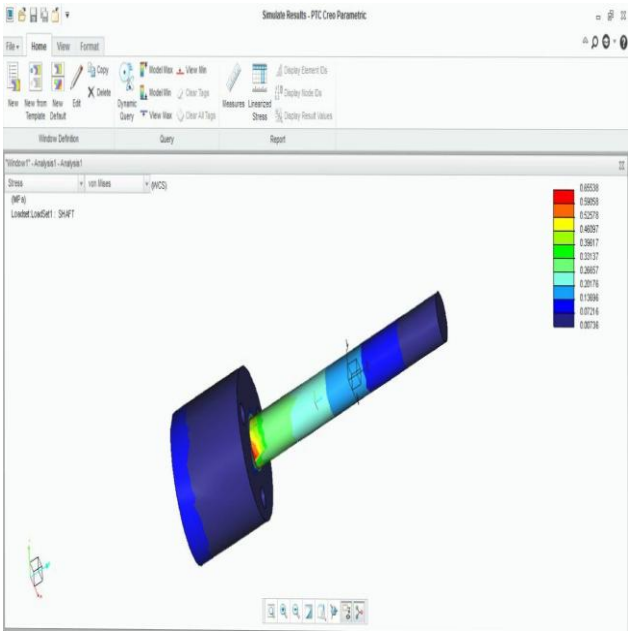

Fig 3 Strain Analysis Of Hub And Shaft

8.2 STRESS ANALYSIS

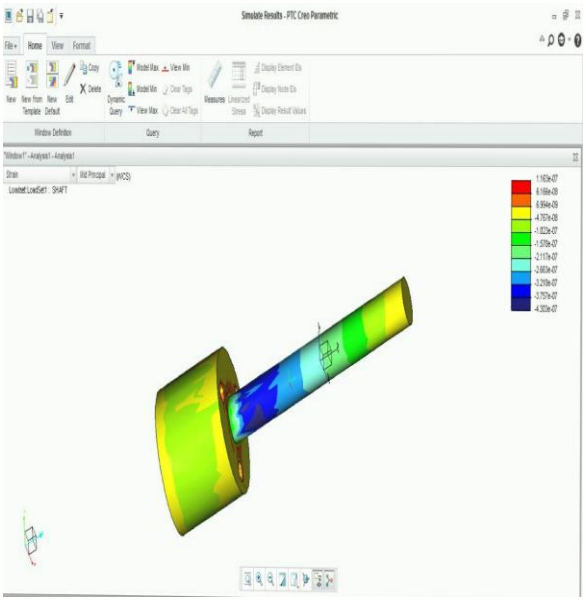

Fig 4 Stress Analysis Of Hub And Shaft

GRAPH

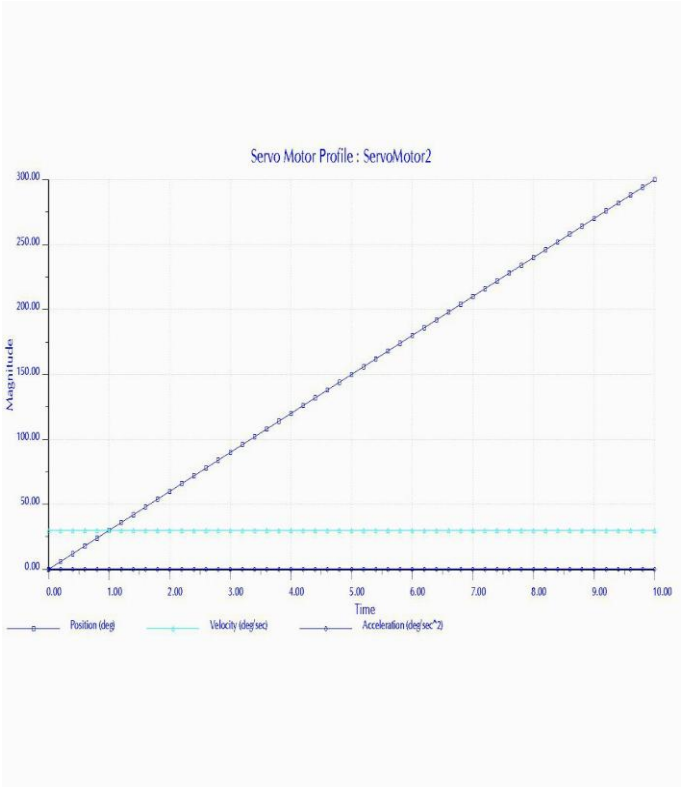

Fig 3 velocity and acceleration as a function of time.

9.MERITS

1) This mechanism allows shafts of any diameter , thereby providing freeness to manufacturing of shafts as well as it reduces cost.

2) The position of the shaft can be varied at anytime provided that the length of the pin also increased.

3) In case of breaking up of any particular pin , the pin alone can be replaced , while the other components of the system need not to be replaced.

4) There is no intricate or complex shapes , so it can be manufactured at ease , lowering the production and labour costs.

5) It can be also used for high speed applications**.**

6) Very low set up cost.

7) The set up is quite compact.

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