Design, Analysis and Fabrication of Gearless Transmission by Elbow Mechanism

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Abstract— this paper represent real time study of gearless transmission mechanism. This transmission system is to be analysed in solid works software to study reaction of elbow rods and hub and then the fabrication of mechanism is carried out. The real time study is carried out by applying a motor to one of the shafts which drives the output shaft. The analysis is performed by applying the force on hub according to given Revolution per minute. Similar analysis carried out at different higher revolutions per minute and forces are applied. As a result response of elbow rod and hub investigated to find permissible speed of mechanism. Key words: solid work, autodesk inventor(2016) elbow rods, gearless transmission mechanism, hub, workbench

I. INTRODUCTION

Today’s world requires speed on each and every engineer's field are confronted to the challenges of efficient transmission of power. Gears are costly to manufacture. It’s 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.

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.

II. SYSTEM STUDY

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 120° 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 by the Fig.1.

Fig. 1: View Of Gearless Transmission Mechanism

III. METHODOLOGY

1) study of research papers.
2) design of shaft, rod and elbo.
3) SolidWorks simulation feature is used to find out stress
4) Fabrication of shaft, rod and elbo.
5) Mounting of shaft on wood board/iron board.
6) Assemble the all part.
7) Evaluating design moment and force and calculation.
8) Compare the actual result with model
9) And suitable application.

IV. MATERIAL PROPERTIES AND CALCULATIONS & POST PROCESSING

A. Material Properties

1) Mild Steel 45C8

<table>
<thead>
<tr>
<th>Material</th>
<th>Tensile strength</th>
<th>Yield strength</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild steel 45C8</td>
<td>630MPa</td>
<td>380MPa</td>
<td>229 BHN</td>
</tr>
</tbody>
</table>

Table 1. Properties of Material Mild Steel 45C8

2) Stainless Steel X6Cr17

<table>
<thead>
<tr>
<th>Material</th>
<th>Tensile strength</th>
<th>Yield strength</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless steel X6Cr17</td>
<td>750MPa</td>
<td>430MPa</td>
<td>230 BHN</td>
</tr>
</tbody>
</table>

Table 2. Properties of Material Stainless Steel X6Cr17

<table>
<thead>
<tr>
<th>Component</th>
<th>Material</th>
<th>Diameter(mm)</th>
<th>Length(mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hub</td>
<td>Mild steel 45C8</td>
<td>92</td>
<td>82</td>
</tr>
<tr>
<td>Shaft</td>
<td>Mild steel 45C8</td>
<td>30</td>
<td>230</td>
</tr>
<tr>
<td>L-bow rod</td>
<td>Stainless steel X6Cr17</td>
<td>12.7</td>
<td>600</td>
</tr>
</tbody>
</table>

Table 3. The Descriptions of Component Constituting Mechanism and Material of Each Component

By applying material it becomes possible to establish mass of each component in the mechanism

Rod is modeled on 90° in assemble create all 3D part in solid work.

Fig. 2: View Of Assemble In Solid Work
V. CALCULATIONS & POST PROCESSING

A. Design Stresses Of Rod

<table>
<thead>
<tr>
<th>Dimeter of rod is 12.6mm and length is 600mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Z = 0.78R^3 )</td>
</tr>
<tr>
<td>( Z = 0.78 \times 6.3^3 )</td>
</tr>
<tr>
<td>= 199.71kg/mm²</td>
</tr>
</tbody>
</table>

Bending stress of rod

\[
\sigma = \frac{PL}{2Z} = \frac{4 \times 199.7}{294.3 \times 600} = 0.221 \text{N/mm}^2
\]

B. Design Stress Of Hub

<table>
<thead>
<tr>
<th>A hub internal dimeter is 32mm and outer dimeter is 92mm,length is 82mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>( p = 100 \times 9.81 = 981 )</td>
</tr>
</tbody>
</table>

\[
\sigma_b = \frac{p(D_i - 0.5D_0)^2}{D_i^2 - D_0^2} = \frac{981 \times (32 - 0.5 \times 92)^2}{32^2 - 92^2} = 135.01 \text{N/mm}^2
\]

C. Design Stresses of Shaft

<table>
<thead>
<tr>
<th>A shaft dimeter is 30mm and length is 230mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>( M = 2151.11N \times 230mm = 494755.3Nmm )</td>
</tr>
</tbody>
</table>

Bending stress for shaft

\[
\sigma = \frac{32M}{\pi d^3} = \frac{32 \times 494755.3}{\pi \times 30^3} = 186.649 \text{N/mm}^2
\]

Tensile shear stress of shaft

\[
M_t = 60 \times 10^6 \times kw \left( \frac{2m}{kw} \right) = 596831.03Nmm
\]

\[
\tau = \frac{16M_t}{\pi d^3} = \frac{16 \times 596831.03}{\pi \times 30^3} = 112.57N/mm^2
\]

VI. ANALYSIS

In fig3 show a stress distribution over the elbow rod at 120rpm and calculate stress on the following table:

<table>
<thead>
<tr>
<th>RPM</th>
<th>Direct stress(N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>4.43</td>
</tr>
<tr>
<td>100</td>
<td>2.58</td>
</tr>
<tr>
<td>120</td>
<td>4.43</td>
</tr>
<tr>
<td>140</td>
<td>4.64</td>
</tr>
<tr>
<td>160</td>
<td>4.82</td>
</tr>
</tbody>
</table>

Table 3. Direct Stress of Elbow Rods at Different Rpm

Fig. 3: Stress Distribution Over the Elbow Rod

VII. RESULT

There is clear in analysis and Fabrication 140rpm to 160rpm is safe for gearless transmission system. Thus simulation results satisfy motion analysis results.

VIII. CONCLUSION

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.

REFERENCES


