Comparision Of Studless And Studed Chain Using Finie Element Analysis
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Abstract

The objective of this work was to analyze Studless and Studed link chain through the Finite Element Analysis and compare the FEA result and practical result on the basis of deformation while applying the proof load.

The Chain is a most simple constructional and useful mechanical device. It is mostly used in hoisting and transmission and for attaching secure movable bodies e.g. anchoring ship.

Keywords:-Mooring Chain, Types of chain, Analysis of chain.

1. Introduction

Chain is the one of the most useful element in the mooring system. Mooring is a system which holds a ship in a certain position to accomplish a specific work. It should restrain a vessel against the act of wind, wave and current forces. So the mooring is safely holding the vessel to protect the ship, life, and public interest and to preserve the capabilities of vessel and surrounding facilities

Because of following reasons the chain is widely used in the mooring application for the offshore platform.

- Rugged and less damage prone than the wire rope or fibre rope.
- Less prone to corrosion than wire rope.
- Chain weight is intrinsically torque balanced in that an axial load does not generate twist or torsional moment in the chain.
- It Provide catenary effect

2. Types of Mooring chain

Basically there are two types of mooring chains. Selection of the type of chain will be influenced by the application.

1. Studless mooring chain
2. Studded or stud link mooring chain

Studless mooring chain :- It is commonly used for permanent mooring e.g. those for floating, production, storage and offloading, floating production system.

Studded or Stud link chain: - It is commonly used for moorings that have to be reset often during their service life. e.g. those for a semisubmersible drilling platform, as it are less prone to knotting during handling. It tends to be stronger for a given size and grade of steel. Its weight is more (about 9% than the stud less chain) and it is more expensive to produce.

3. Research Methodology

Chain is design by DNV standard and it is totally depend upon the diameter of the rod used to manufacture the chain. For this thesis work chosen...
diameter of the rod is 122 mm, below fig. 2 and Table no. 1 shows the studless and studded chain with its parameter. Initially built the model of the Studless and studded chain with the help of modelling tool such as CATIA V5 R19 and assemble all three part by using the axis coincidence of each other. The right and left side half link is exact half in dimension of middle link.

From above graph the 15 mm mesh size is shown the accurate result so hence forth 15 mm mesh size is selected for further analysis. And for this analysis the material details are listed as in the below tabulated form.

<table>
<thead>
<tr>
<th>Description</th>
<th>Type / values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Analysis</td>
<td>Structural Non linear Analysis</td>
</tr>
<tr>
<td>Material Used</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Young's Modulus</td>
<td>2e11 Pa</td>
</tr>
<tr>
<td>Poisson's Ratio</td>
<td>0.3</td>
</tr>
<tr>
<td>Isotropic Hardening</td>
<td>Bilinear isotropic hardening</td>
</tr>
<tr>
<td>Yield Strength</td>
<td>850 MPa</td>
</tr>
<tr>
<td>Tangent Modulus</td>
<td>2e10 Pa</td>
</tr>
<tr>
<td>Proof Load</td>
<td>5504 KN</td>
</tr>
</tbody>
</table>

The real life scenario occurring on the chain link has to be simulated in analysis software for which accurate resemblance of loads and boundary conditions needs to be simulated to capture the accurate results. Here the 2 boundary condition are used shown in fig 3 (a) and (b).

This analysis covered the six set of iteration of studless and studded link for an angle 0° to 5° with an incremental by 1° (i.e. 0°, 1°, 2°, 3°, 4°, 5°). Movement of the angle 0° to 5° is taken on the movable link at which the force is applied. Below fig. 4 shows the different configuration of the chain, how movable...
Multi point constrainting are considered for this analysis.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Rotation of Angle (deg)</th>
<th>Studless Chain</th>
<th>Studded Chain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rotation of Angle (deg)</td>
<td>Deformation (mm)</td>
<td>Stress (MPa)</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>4.6</td>
<td>1156.3</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>9.8</td>
<td>833.1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>14.1</td>
<td>836.1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>17.6</td>
<td>842.7</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>21.9</td>
<td>856.3</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>25.9</td>
<td>889</td>
</tr>
</tbody>
</table>

Above tabulated data gives the deformation and stress induced in the studless as well as studded link while applying the proof load of 5504KN.

Fig 6 shows the graphical representation of the deformation induced in the studless (shown in red colour) and studded (shown in blue colour) chain with respect to the different angles. It is clearly explained that as the angle increased the deformation induced in the studless chain increases proportionally, But in studded chain when the angle is increased deformation is increased slowly it mean due to stud addition the studded chain can have more capacity to withstand against the proof load.

Fig. 5 shows the zero degree (0°) studless and studded chain analysis carried out in the ANSYS 12.0 Software.
Stress comparison graph clearly explained that there is not much more difference between the stress induced in the studless and studded chain but the stress consistency is much better than the studless chain.

5. Conclusion

Mass of stud less chain was 142.2kg and for studded chain the mass is 159.3kg. There is mass increase of 12% is observed, but at the same displacements have reduced by 200%.

As these chains are to be implemented for high reliability systems, the performance in terms of strength and stiffness needs to be given more importance than the mass increase or production cost.

The stress developed in the stud less chain is less than studded chain. It is almost 3 to 5 % more stress developed in the studded chain. But from graph stress line show the stability in nature as the rotation of angle increase

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7. Reference

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