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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 Studded 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

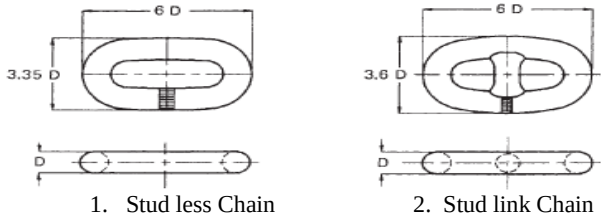
2. Types of Mooring chain

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 perment 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.



1. Stud less Chain 2. Stud link Chain

Figure 1. Types of Chain

Almost all the mooring system elements are designed by the DNV (Det Norske Veritas) .Which is an autonomous and independent foundation with the objectives of safeguarding life and the environment. DNV undertakes classification, certification, and other verification and consultancy services relating to quality of ships, offshore units and installations, and onshore industries worldwide, and carries out research in relation to these functions.

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.

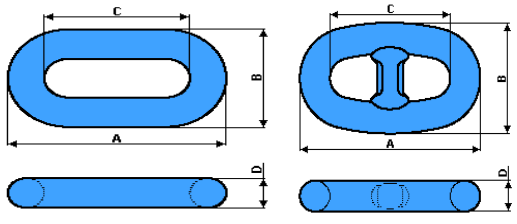


FIg.2. Selected model for FEA analysis.

Parameter	Studless link	Studded link
Weight of one full link	142.2 Kg	159.3kg
D	122 mm	122 mm
A	732 mm	732 mm
B	408.7 mm	439.2 mm
C	488 mm	488 mm

Table no.1 Defined parameter for selected model

ANSYS 12..0 Software is used for analysis the above model . Solid 185 mesh is used for descritization of model . It is defined by 8 nodes having three degrees of freedom at each node. Convergence study was done on the studless chain model at the different mesh size i.e. 30 ,25,20,15,and 10mm and plotted the convergence graph (Stress vs No. of element).

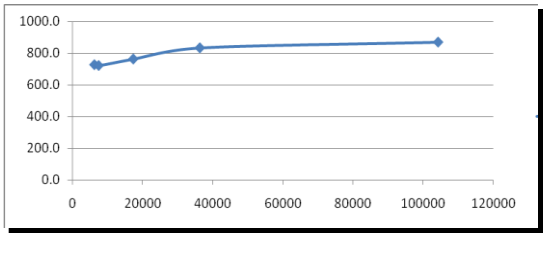


Fig.3. Convergence Study Graph

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

Description	Type / values
Type of Analysis	Structural Non linear Analysis
Material Used	Structural Steel
Young's Modulus	2e11 Pa
Poisson's Ratio	0.3
Isotropic Hardening	Bilinear isotropic hardening
Yield Strength	850MPa
Tangent Modulus	2e10Pa
Proof Load	5504KN

Table no.2 Material Details

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 simulated to capture the accurate results. Here the 2 boundary condition are used show in fig 3 (a) and (b)

(a) (b)

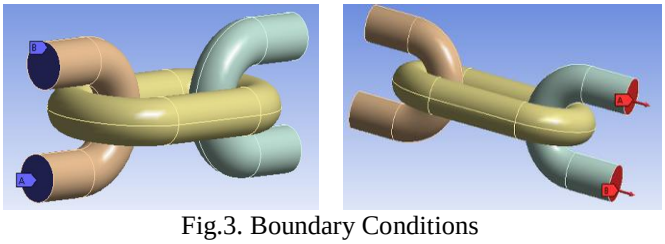


Fig.3. Boundary Conditions

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

links is rotated to achieve the required position of angles.Multi point constraining are consider for this analysis .

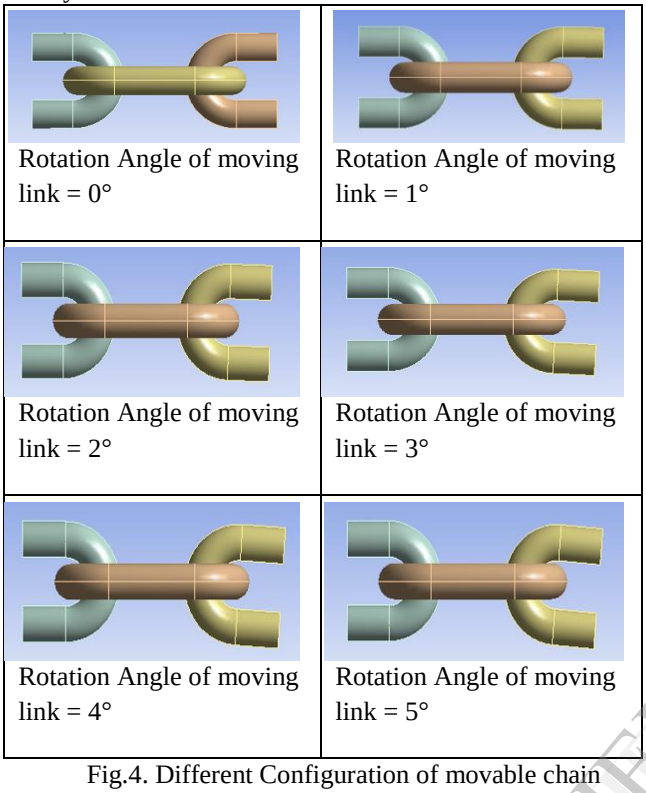


Fig.4. Different Configuration of movable chain

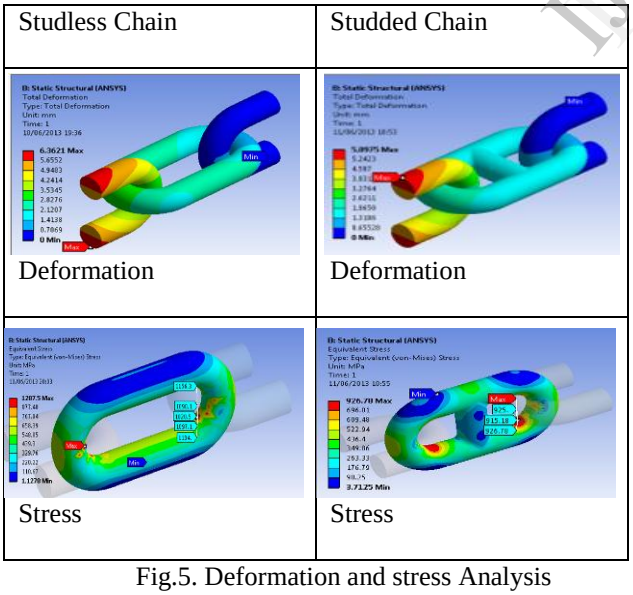


Fig.5. Deformation and stress Analysis

Fig. 5 shows the zero degree (0°) studless and studded chain analysis carried out in the ANSYS 12.0 Software.

4. Result And Discussion:-

Sr. No.	Rotation of Angle (deg)	Studless Chain		Studded Chain	
		Deformation (mm)	Stress (MPa)	Deformation (mm)	Stress (MPa)
1	0	4.6	1156.3	5.9	926.8
2	1	9.8	833.1	6.5	918.2
3	2	14.1	836.1	7.3	880.2
4	3	17.6	842.7	8.1	887.5
5	4	21.9	856.3	8.6	893.4
6	5	25.9	889	8.8	918.4

Table no.3 Analysis Result

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 .

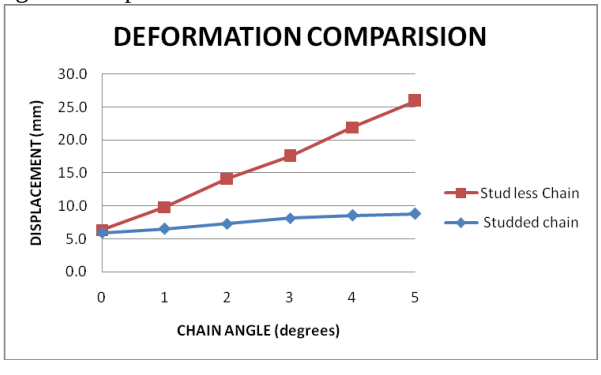


Fig.6. Deformation Comparison

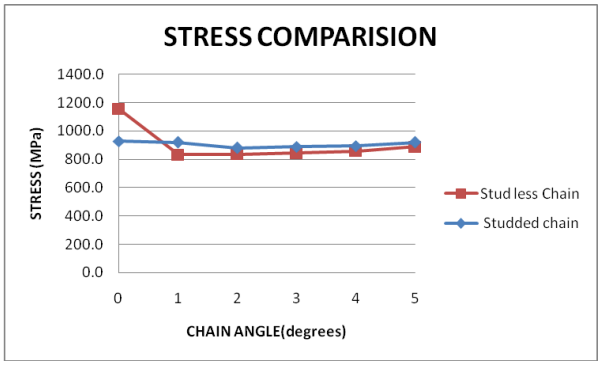


Fig.7. Stress Comparison

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

[1] R E Hobbs1* and I M L Ridge2 -Torque in mooring chain. Part 1: background and theory. J. Strain Analysis Vol. 40 No. 7

[2] I M L Ridge2 and R E Hobbs1* - Torque in mooring chain. Part 2: experimental investigation.

[3] Offshore Standard - DNV-OS-C201- Structural Design for Offshore unit (WSD Method) April 2011.

[4] Hiroshima, T. and Sawa, T. Three-dimensional elastoplastic finite-element analysis of link chains in chain hoist subjected to combined loads of torsion and impact tension. Trans. Japan Soc. Mech. Engrs, Part A, November 1995, 61(591), 2442–2449.

[5] Offshore Standard - DNV-OS-C201- Structural Design for Offshore unit (WSD Method) April 2011.

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