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SHAPE OPTIMIZATION OF BLOCK CHAIN LINK

Ms. Sana Shaikh[1],

[1]Asst. Professor in Mechanical Engineering Department , Sanjay Ghodawat Institute, Atigre,Kolhapur

***Abstract*—. Block chain is more suitable to long term continuous running and conveying the sugar cane with limited torque fluctuation in sugar factory. it must have great tensile strength against shearing and be resistant to dynamic and shock wear. Stress concentration near to hole in the chain link plate has been observed therefore breaking takes place at the location of minimum area. In this work Finite Element Analysis results have been found in accordance with the theoretical results. It has been found from experimental work carried out that designed chain is safe under the maximum working load. There is scope for reduce the weight of chain link. Hence scope to reduce the power required to drive the chain**

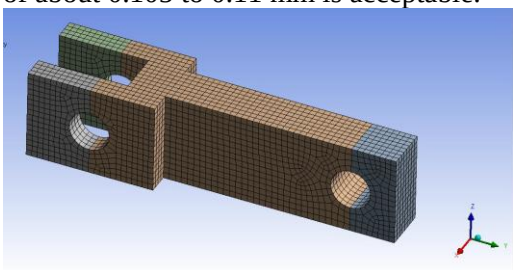
Keywords: **Block conveyor chain, weight reduction, Finite element analysis, experimentation.**

I. INTRODUCTION

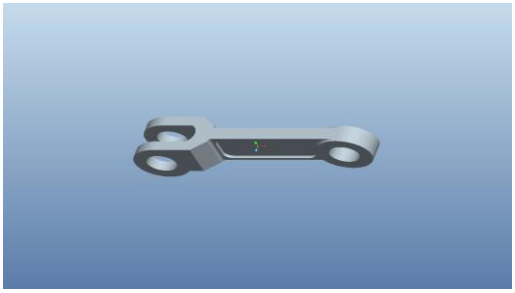
The block chain is very important component in automotive process industry. So there is need of replace the old design of block chain with new optimized design. Which is better in case of weight, strength, cost and power consumption to drive the chain. Block forged chains are the critical component in sugar mills, food processing, fertilizer industry, pharmaceutical industry, cement industry, foundry industry, coal mines etc. This study will help in reducing weight of chain link by using stress analysis. In turn it will help in reducing weight of chain and consume power required to drive chain in various above said industries. ANSYS Parametric Design Language (APDL) program to carry out linear static, modal, transient and optimization analysis of existing roller conveyor is done by Suhas M. Shinde et. al.[1] to find new shape of conveyor. The analytical, experimental and numerical behavior of chain strip under tensile loading is studied by Jagtap et. al.[2] . Failure of engineering components due to presence of defects in the material are studied by M. Sujata et. al.[3]. Different failures of roller conveyor chain links under different loading conditions using Mild Steel are studied by S. R. Kale et. al.[4]

II.FINITE ELEMENT ANALYSIS OF BLOCK FORGED CHAIN

Material selected for simulation work is EN9 with Modulus of Elasticity 2.06 x 105 MPa, Poisson Ratio 0.3, Density 7800 Kg/m3. The load applied is 600000 N tensile loading. Meshed model of forged chain link is shown .the chain has been meshed by using rectangular grid. A material property for EN9 has been entered as an input. The size of mesh is taken as 5 mm after studying the mesh sensitivity on the results of the analysis. To start the optimum material reduction and the changes in the stress plot and deformation plot are analyzed. For this, several models are made and analyzed for the same load. As per the forged material EN9, the stress of around 410 Mpa and deformation of about 0.105 to 0.11 mm is acceptable.



different shapes of forged chain link are prepared and analysed for the von Mises Stress and Total Deformation plots. Following model is the optimum one as per the Simulation work carried out.

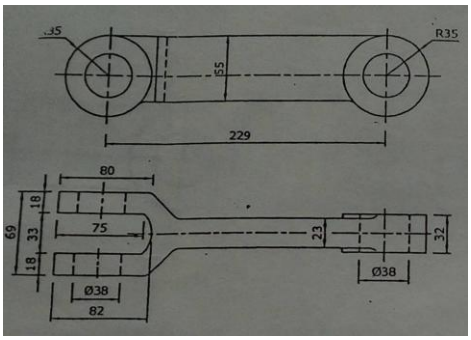


Weight reduction of previous chain as per simulation Work is as follows.

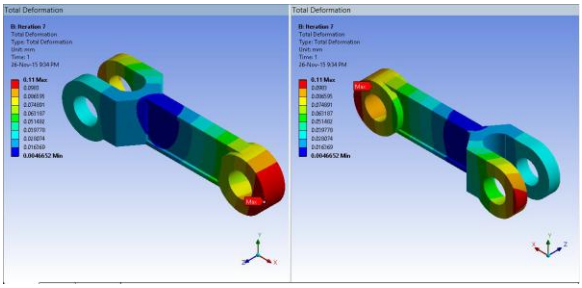
Parameter	Value	Unit
Basic Chain link Weight	3.8440	Kg
Final Chain link's expected weight	3.0213	Kg
Percentage Weight reduction	20.09	%

III.EXPERIMENTAL WORK

Experimental testing of chain link plates is carried out to study the effect of material and heat treatment uncertainty on stress-strain plot. The Experimental test setup for this experiment is Computerized Universal Testing Machine of 1000kN capacity available at Urja Metalurgical Lab, Bhosari, Pune.



CAD (2D) Model of chain link



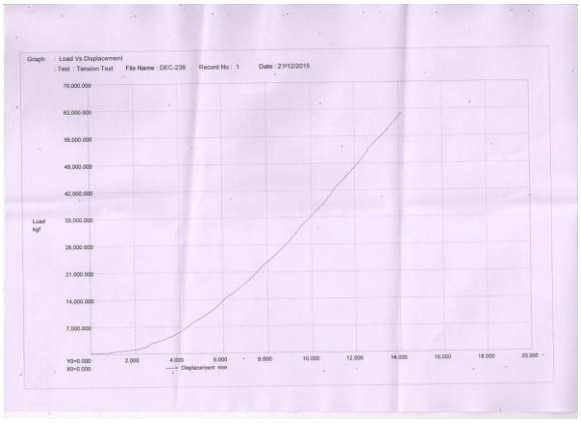
The maximum deformation of the shape of forged chain link is 0.11 mm. The stress and total deformation plots denote that the shape 7 of the link of chain will bear the required load and sustain the stress developed under the given conditions. Thus the optimum shape of the chain has been achieved successfully with considerable amount of material removal from the forged chain link.

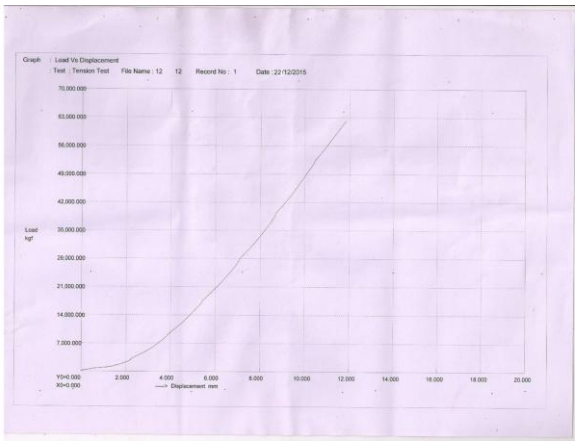
Fixture is prepared to hold the chain link in UTM rigidly.teh male part of fixture fits in upper jaw of UTM and female part fits in lower jaw of UTM and helps to hold the link.

Then assembly gets loaded and displacement of link starts gradually. At 608.9kN assembly breaks.

IV. RESULTS AND DISCUSSION

Load-displacement plot for present cane carrier block conveyor chain which gives us breaking load is 608.9kN and elongation of 14.2 mm. Here it is observed that breaking happens at Fork of conveyor.





load-displacement plot for optimized cane carrier block conveyor chain which gives us breaking load is 609.65 kN and elongation of 11.8 mm. Here it is observed that breaking happens at fork of the link. Weight of conveyor plate is reduced by 805gm for each link plate

Type	**Experimental Result**		**Finite Element Analysis Result**		**Remark**
Property	**Original Chain**		**Optimized Chain**	**Original Chain**	**Optimized Chain**
Chain pull (KN)	–	–	–	–	**Less on optimized chain**
Breaking Load (KN)	608.86	609.61	–	600	**Almost same**
Displacement (mm)	14.2	11.8	–	0.11	**Less on optimized chain**
Stresses (N/mm2)	595.32	594.59	–	406.9	**Almost same**
Power reduced (W)	–	166.93	–	179.5	**0.7% power is reduced**
Weight reduced/link (gm.)	–	805	–	822.7	20% weight is

V. CONCLUSION

Existing, weight/link has been reduced up to 805gm at the same time breaking load of the chain has been increased by 1Tonnes.
stress concentration near to elliptical hole in the chain link therefore breaking takes place at the location of minimum area.
The fatigue initially nucleated at the external cracks of the chain link, and later propagated to the inside of the links until sudden fracture occurred.
The weight saving is 20% thus achieved will have a significant impact on cost of the chain, and more importantly with a lighter chain, the cost savings during operation will also be significant.

VI. REFERENCES

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