A Review Paper on Stress Analysis of sugar Mill Headstock

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Abstract:

Sugar is produced in sugar factory. Juice is extracted from the sugar cane with help of sugar mills. A lot of Pressure generates during the juice extraction process and to sustain this pressure mill should be strong, and should be verified. Headstock is a highly stressed part of mill. It carries rollers and trash plate assembly. They have to sustain forces experienced by rollers while exerting juice from the cane. It is observed that forces due to power transmission and dead weight have not been considered earlier, in order to calculate exerted forces on headstock during mill running closer to actual force Hydraulic force, force due to power transmission, & dead weight are considered. These forces are distributed on sugar mill headstock. So, in order to sustain the Headstocks against all these forces the static analysis is carried out by using ANSYS workbench software, and Weight optimized by changing the inner parameters of the headstock part for permissible stress value with the help of results of previous model. Comparison of both old and modified model of headstock has been done at the end to understand the changes occurred in Modified Headstock.

INTRODUCTION

Sugar cane is a class of carbohydrates that test sweet. We use sugar in our daily life like, in food to test it sweet, tea, and many more. To fulfill the people's sweets needs sugar is produced. Worldwide large amount of land brought under cultivation of sugarcane for sugar production.

All plants make sugar through the photosynthesis process but, sugar cane and beets have the highest percentage of sugar. Hence they use as raw material to produce sugar. Juice of sugar cane is extracted in sugar mill factory and by doing some process on juice sugar is made. For producing sugar, There is a number of the process are done on sugar cane, like cane receiving and unloading, cane preparation (cutting cane, shredding, and preparing for next process) juice extraction, juice clarification, juice evaporation, crystallization, centrifugation, sugar drying, etc.In the milling process, the juice is extracted by squeezing canes under rollers, with the help of high hydraulic pressure. Each mill has three to six rollers. There is some mills are used to extract juice as much as possible. When sugar cane comes out from one mill sugar, fiber absorbs some juice from extracted juice, because of its reabsorbing ability. To extract juice effectively from the cane, the cane layer is passed through a set of mills. Such set of mills is known as mill tandem. Rollers of the mill are arranged in such a way that mill will efficiently squeeze the cane bed. In three rollers mill rollers named as top roller, feed roller, and discharge roller. They are arraigned in a triangular pattern. Which remove sucrose 95-97%.

LITERATURE REVIEW

Yogini V. Deore et. Al.[1] She worked on FEA analysis and optimization of head stock used for Diameter 50"X 100" Sugarcane Mill. she has made the 3D model of headstock by referring the AutoCAD design. and analyzed it using ANSYS software for 50KN remote force. She found shear stress and total deformation of the head stock and on the basis of the maximum share stress i.e., 125Mpa. she reduced the thickness of the headstock by varying thickness values in order to sustain 50kN remote force at each roller center. She found 2.9628Mpa stress for original headstock and 92.545Mpa for modified headstock, which was less than Maximum share stress value. Hence, she concluded that the modified headstock is safe for 50"X 100" Sugarcane Mill.

Santosh Y Salunkhe et. Al.[2] Presented Design and Analysis of Ø40" x 80" Conventional Sugar mill headstock. The headstock is a highly stressed part, and hydraulic load acts on it. He has done the theoretical study by considering the bending moment and force polygon diagram to check the strength of it against the hydraulic load. Also, headstock has been studied using static structural anal 14Optimization of mill headstock analysis with the help of Ansys software. After that, both of the results have been compared. He found that the results of theoretical and Analytical are nearer. He checked the strength of the headstock against the hydraulic force and

calculated principal stresses, deformation of the mill headstock by using ANSYS workbench.

C. Adam, J Loughran.[3] Presented the effect of blanket Thickness on extraction energy in sugarcane rolling mills. They have done a FE investigation. In this paper explanation of how extraction performance of rolling mill improves by thin layer cane bed and at high counter Rolling speed of rollers have been done. Low speed and high speed of rollers performance has been shown with the help of graphs. Compression ratio verses roller load graphs are shown. They conclude that dissipation energy during rolling of cane can be characterized in bulk plasticity, friction sliding, juice flow. Until 2.5 nip compression ratio and 150 mm/s roller speed frictional sliding does not occur in FEA simulation of two roller mills. And thinner blanket of sugar cane, high milling speed will reduce sliding of can layer due to friction also juice extraction will slightly improve.

PROBLEM STATEMENT

Sugar mill is used to separate out the juice from the sugar cane. The top roller, feed roller, discharge roller and trash plate are mounted on the headstock of the sugar mill assembly. Hydraulic force is applied on the top roller when the cane layer is passes through the passage between rollers and trash plate. Power is given to the top roller to rotate the rollers and to push the cane bed forward direction with low speed and that power is distributed to other rollers by using spur gears. Hydraulic force, forces due to power transmission and dead weight forces are distributed on the headstock. In order to sustain the headstock against all this forces, the force analysis is required.

DESIGN OBJECTIVES

1. To study the force distribution on sugar mill headstock.

2. To Design the sugar mill headstock with given design inputs with use of basic design principles.

3. To Create a CAD model of Mill headstock and nut bolt using CATIA V5 software.

4. To Analyze the Mill headstock using ANSYS Software.

5. To optimize the mill headstock by changing inner parameters of the Mill headstock without affecting performance of mill headstock.

METHODOLOGY:

The proposed work is planned in following phases: -

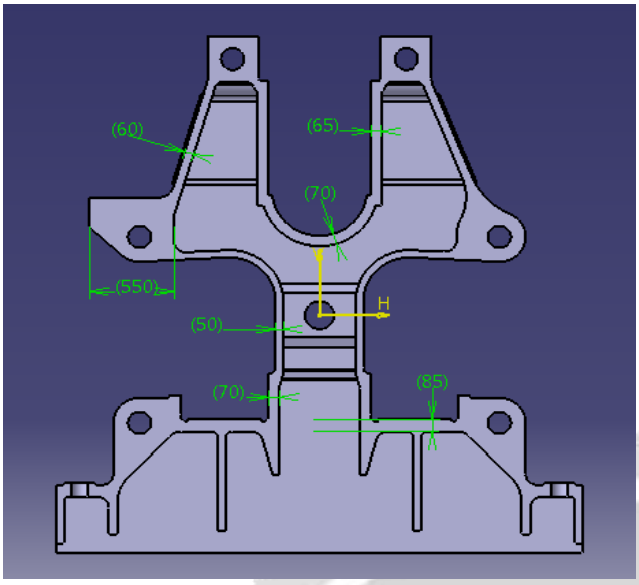
Methodology is a systematic way, in which theoretical analysis of the methods applied to almost every field of study, or it is the theoretical analysis of the body of methods associated with a branch of knowledge. A Methodology is not providing a solution but it is used to solve a problem theoretically.

Literature review.

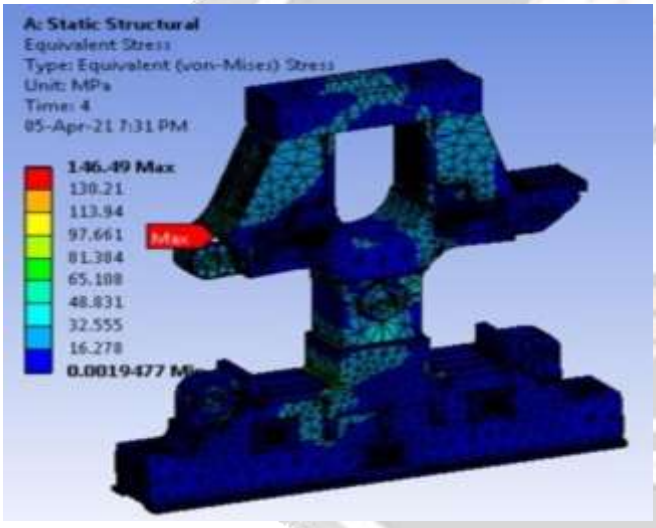
Study of power transmission and various load acting on headstock using various handbooks, United State Patent documents, Technical papers.

1. Development of theory.
    - This part includes the design and development of headstock geometrical profile and arrangement of components
    - Mechanical Design: This part includes the design and development of components of mount, selection of suitable materials.
    - Modeling is done using CATIA V5
    - Analysis of components has been done using ANSYS work bench.

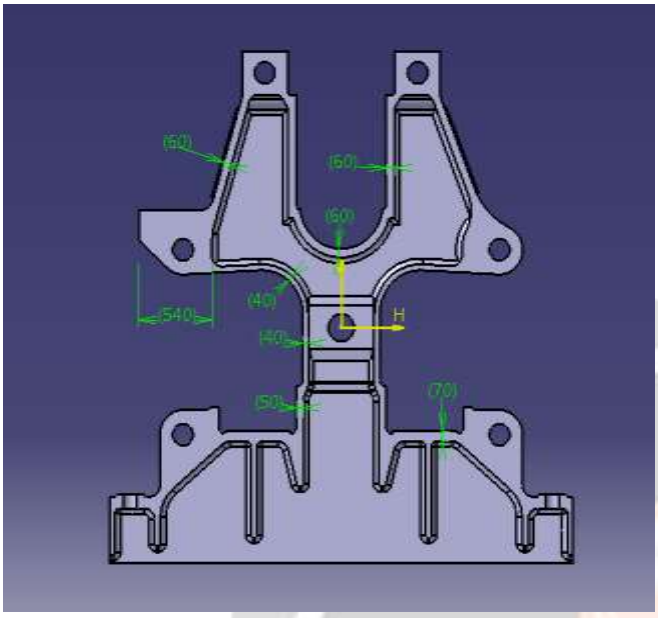
INITIAL MODEL



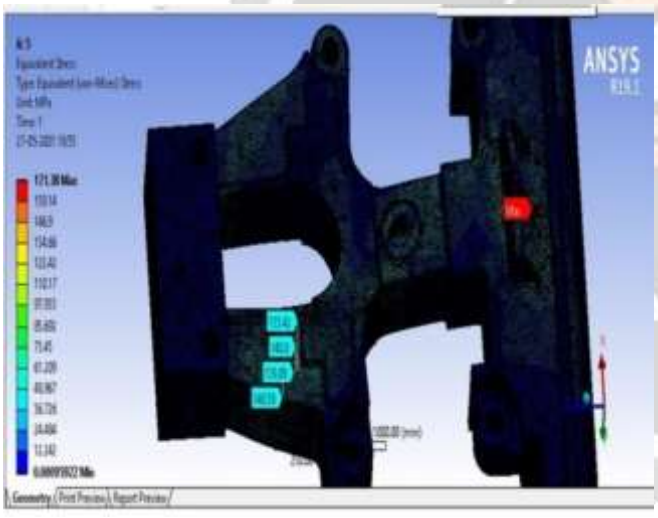
OLD HEADSTOCK MILL EQUIVALENT STRESS



OLD MODEL MODIFICATION



MODIFIED HEADSTOCK MILL EQUIVALENT STRESS



MODIFIED HEADSTOCK

Name	Type	Min. stress in MPa	Max. stress in MPa
stress	VON: von Mises Stress	9.5922e-4	171.38

Name	Type	Min. stress in MPa	Max. stress in MPa
stress	VON: von Mises Stress	0.0019	147

CONCLUSION

FEA analysis has been carried out for both old and modified sugar mill headstock model by using ansys workbench (static structure). And found stress, strain, and displacement results for both the models. According to this result following conclusions are found.

1. Maximum stress observed for original headstock is 147Mpa. Though for large element size, whereas 171Mpa. Is observed for modified headstock which is less than permissible stress 186.667Mpa. Hence optimized headstock is safe. (calculated force will be more than actual exerted forces but not less so, headstock will sustain at any condition)
2. It is observed that still most of area of headstock model is below 50Mpa. stress value so, it can be optimizing more by changing complete headstock design.

REFERENCE

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[2] "Santosh Y Salunkhe, "Design & Analysis of Ø40" x Ø 80" Conventional Sugar mill head stock"", International Journal of Scientifific Engineering and Technology, ISSN :2277- 1581,Volume No.4 Issue No.7, pp: 397- 400,01 July 2015.

[3] "C. Adam, J. Loughran, "The Effffect of Blanket Thickness on Extraction Energy in Sugarcane Rolling Mills: a Finite Element Investigation"",Science direct, Biosystems Engineering (2005) 92 (2), 255–263 doi:10.1016/j.biosystemseng.2005.07.0