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Stress Anlysis And Weight Reduction Of Roller Of Roller Conveyor

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ABSTRACT-

Yet most people had worked on save material of roller and ease of design of roller for manufacturing and assemble it. The aim of this paper is to study existing conveyor system and new weight optimize roller conveyor system (like wt. of roller, shaft etc.) The current trend is to provide weight/cost effective products which can give less effort to user.

In general, for convey parts from one place to another we can use different types of devices and among them one is roller conveyor. It is designed for ease for assembly, manufacturing safely convey part and reduce cost. The assembly of roller has different stresses issue in contact region between any matching parts .

Roller conveyor is subjected to easy state of loading therefore we designed it with higher factor of safety.

Keywords-*Roller conveyor, Automation Component Design, Analysis of Roller Assembly, Manufacturing of Roller Conveyor.*

I. INTRODUCTION

A. Introduction -

Roller conveyor is subjected to easy state of loading therefore we designed it with higherfactor of safety. (for ex. Like want to design one roller conveyor for convey engine block whose wt. is 30 kg. and 10 piece travel at a time in whole length of conveyor. That time the total weight of conveying is ((convey block wt. + roller assembly wt.) x factor of safety). Therefore ((300kg + 350kg) x 1.4) = 910 kg with factor of safety. For that region the material saving idea is found to analyze new point for project. In design roller one also point to check stress issues at the contact regions between any two elements; like roller and bearing, bearing and shaft etc. also in whole assembly in roller conveyor.

So we can achieve considerable amount of material saving if we ll' design shaft in two piece and save inner material of roller assembly by 'Finite Element Method' is a mathematical technique used analysis stresses and analyis. For that design part model in catia software as individual part's like, roller, shaft and two standard model of bearing which contact with shaft and roller. Then Constraints and loads are applied to the model at specified locations. Also apply properties to the roller like material, length, thickness, etc. The roller design is analyzed in FEA .The stresses and deformations are shows on scalar plot.

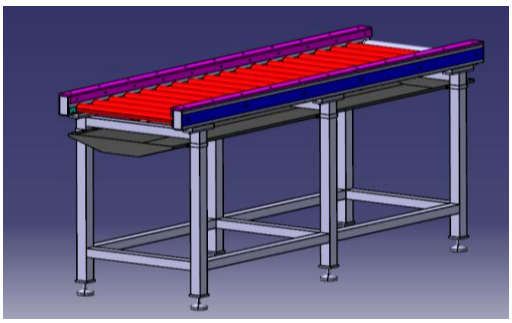

Fig. I.1- 3-d design of roller conveyor

B.Type's of Conveyor-

1. Gravity Conveyor systems
2. Powered Belt Conveyor systems
3. Pneumatic conveyor systems
4. Vibrating conveyor systems
5. Flexible conveyor systems
6. Vertical conveyor systems and spiral conveyors
7. Live Roller Conveyor systems.

II. LITERATURE REVIEW

S.S. Gaikwad& E.N. Aitawade[3]is the paper has to weight optimization of roller of existing roller conveyor by critical part's. The existing roller conveyor design with modification. The static analysis we did of roller conveyor to find out stress analysis and deflection. And optimize the roller weight as per modification.

Suhas M. Shinde and R.B. Patil [2]PawarJyotsna ,D.D. Date, Pratik Satav [1] S.S. Gaikwad, E.N. Aitavade [5] are work and design on existing system for wt. reduction. This design concluded them that to critical design like shaft, roller, structure are redesign. And the parameter generate in ANSYS software.

RajratnaA.Bhalerao, Dr. R.J. Patil [6]is considering structure of gravity roller conveyor for wt. Reduction by static load and Save material within limit of result consideration undergoes within given loading condition's. The natural Frequency carried out by structure whose force apply vertical direction.

III. ROLLER DESIGN & ASSEMBLY DETAIL

As per the Fig.I.1- 3-d design of roller conveyor, the existing roller was designed. And for optimization we modify the design of shaft in roller assembly. The modelling like following –

SR. NO.	COMPONENT	MATERIAL	QTY. (NOS.)
01	ROLLER	SCHEDULE 40	01
02	SHAFT	EN 8	01
03	BEARING	STANDERD	02

Table – III.1 – List of part's in Roller assembly

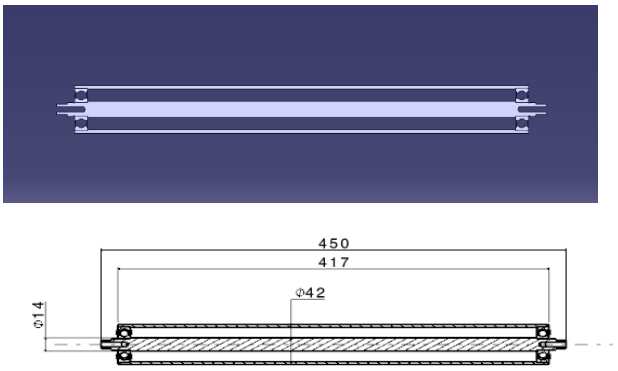

Fig.III.1.-Existing roller modelling & drafting

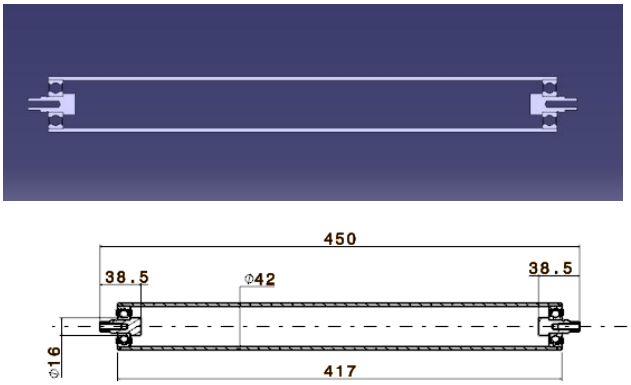

Fig.III.2.- Optimized roller modelling & drafting

The modeling of roller assembly consist of Roller 1 no, Shaft 1 no., and Bearing (6301) 2 nos. in existing conveyor and same in optimized roller consist roller no., Bearing (6301), & optimized shaft 2 nos. as redesign. The above fig. shows both existing and optimized roller design.

IV. CALCULATION'S

A.Expression for Von Mises Stress –

- The condition For failure is as follow-

$$\left[\frac{(\sigma_1-\sigma_2)^2+(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2}{2}\right]^{1/2} \geq \sigma_y$$

- The expression denotes Von Mises Stress-

$$\left[\frac{(\sigma_1-\sigma_2)^2+(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2}{2}\right]^{1/2} = \sigma_v$$

Mathematically, the maximum distortion energy theory (Von Mises Stress) for yielding is expressed as,

$$(\sigma_{t1})^2+(\sigma_{t2})^2-2\sigma_{t1}\times\sigma_{t2}=\left(\frac{\sigma_{yt}}{F.S.}\right)^2$$

B. Deflection Formula-

The deflection 'Y' will be,

$$Y=\frac{F\mathcal{L}^3}{3EI}$$

'I' describe the moment of inertia, And then rewrite the formula is,

$$Y=\frac{F\mathcal{L}^3}{\frac{3\times E\times \pi\times D^4}{64}}$$

C. The Practical Comparisons with Optimized Roller-

The Result of Roller assembly (like Deformation & Von mises stresses) are calculated by Hyper-mesh software and it compares with the practical calculation on UTM machine. The result of Hyper-mesh software and result of UTM is going to close as we get existing factor of safety 1.4 now it will get in 1.3. The result are match.

The UTM machine which is at our college premises I using it and the actual condition of UTM is as following.

V.ANALYSIS OF ROLLER ASSEMBLY -

The roller design is completed in catia software and use Hyper-mesh for analysis. When modeling of existing roller and optimized roller assembly is completed then both assemblies are uploaded in Hyper-mesh one by one. And 30 Kg wt.(UDL) Universal Distributed load apply on each roller. And the result found are as follow –

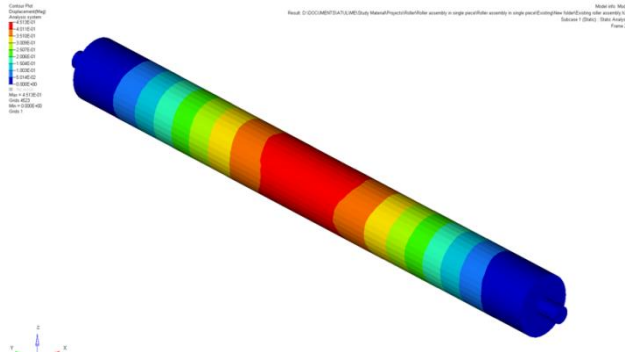

Fig.V.1. -Existing roller deflection

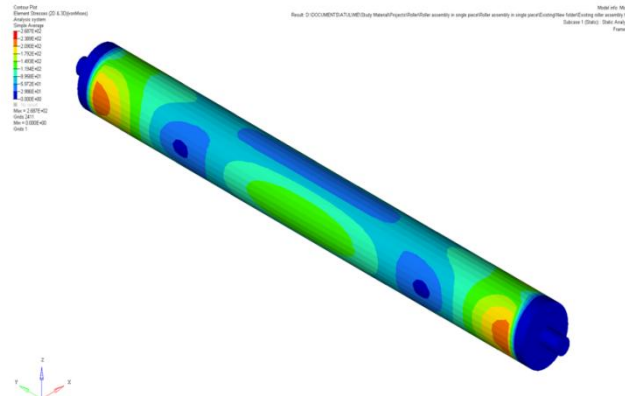

Fig.V.2. -Existing roller von mises stresses

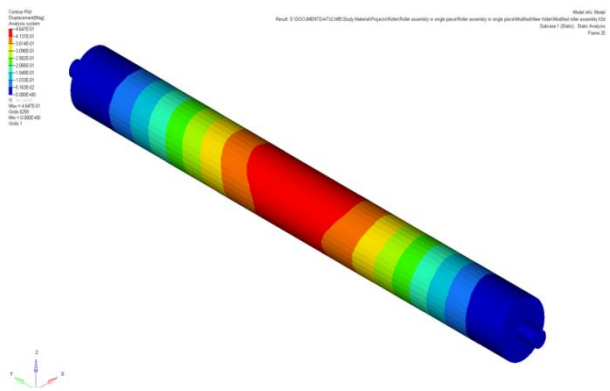

Fig.V.3. -Optimized roller deflection

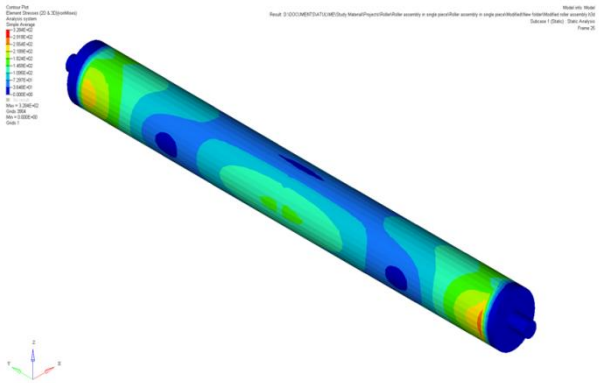

Fig.V.4. Optimized roller von mises stresses

Parameters	Von Mises Stress (N/M^2)	Deformation (Mag.) (mm)
Existing	2.687×10^{02}	4.513×10^{-01}
Optimized	3.284×10^{02}	4.647×10^{-01}

VI. RESULT COMPARISON

A) Effect of Optimized Design Compared with existing design

NAME OF COMPONANT	WT.(KG.) EXISTING DESIGN	WT.(KG.) OPTIMIZE DESIGN
ROLLER	1.192	1.192
SHAFT	0.515	0.144
BEARING	0.2	0.2
TOTAL WT. OF ROLLER ASSEMBLY	1.907	1.536

B) Weight reduction due to Optimization

DESIGN	WT. (KG.)	% MATERIAL REQUIRED COMPAIRE TO EXISTING DESING	% MATERIAL SAVE COMPAIRE TO EXISTING DESING
EXISTING	1.907	100	---
OPTIMIZED	1.536	80.54	19.46

C) Stress analysis before optimization & after Optimization

DESIGN	MAX. DEF. (MM)	MAX. VON MISES STRESS (N/M^2)
EXISTING	4.513×10^{-01}	2.687×10^{02}
OPTIMIZED	4.647×10^{-01}	3.284×10^{02}

VII. CONCLUSIONS

1. The Factor of Safety of Existing Conveyor is too high than required and therefore the weight reduction scope in roller assembly is increased.
2. Due to optimization the reduced weight is 19.46 %.
3. 0.371 Kg. Wt. Optimize per roller like that whole conveyor optimize wt. Is 3.71 Kg. Therefore the power required to move roller required also reduce.
4. Also the model manufactured as a physically and it work safely as observed.

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