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MATERIAL OPTIMIZATIONAL ANALYSIS OF A CONVEYOR ROLLER

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ABSTRACT

In industries, it is very necessary to move the components from one area to the other in a regular basis. So, it is necessary to minimize the workers involved in it. So, here we have designed a conveyor which can be used in industries. It is capable of sending a material from one to place to other by manier means. So, it is necessary to found a way to transmit the materials from one place to another within the industry. So, here we have made a conveyor model which is used for the material transformation from one end to another. The main objective of this study is to explore the analysis of a roller. This has entailed performing a detailed static analysis. The study deals with static analysis.A proper Finite Element Model is developed using Cad software Pro/E Wildfire 4.0. In this project we are doing the material optimization of roller. This project we are designed the 3D model of the axle by using pro-e software and the analysis taken by different materials of the roller and the analysis taken by the ansys software. This project we are analyzing the rotational velocity and moment acting on the roller by the two materials. Presently the bearings are made by the material of stainless steel, this project we are testing the same load under another material.

1.INTRODUCTION

Conveyors are essential to productivity, from light-duty package-handling roller conveyors in distribution centers to overhead and towline chain conveyors carrying automobiles through assembly to massive ore-handling belt conveyors. To avert production stoppages due to conveyor failure, progressive companies use predictive condition monitoring technologies to monitor those assets. The objective is to detect impending failures before they occur, and take corrective action during scheduled production shutdowns. One of those technologies is thermograph, or IR Imaging. Thermal imagers capture two dimensional images representing the apparent surface temperatures of conveyor components, and are excellent tools for monitoring conveyors.

1.1 CONVEYOR PARTS

A conveyor belt (or belt conveyor) consists of two or more pulleys, with a continuous loop of material - the conveyor belt - that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport industrial and agricultural materials, such as grain, coal, ores, etc. generally in outdoor locations. Generally companies providing general material handling type belt conveyors do not provide the conveyors for bulk material handling. In addition there are a number of commercial applications of belt conveyors such as those in grocery stores. The belt consists of one or more layers of material they can be made out of rubber. Many belts in general material handling have two layers. An under layer of material to provide linear strength and shape called a carcass and an over layer called the cover. The carcass is often a cotton or plastic web or mesh. The cover is often various rubber or plastic compounds specified by use of the belt. Covers can be made from more exotic materials for unusual applications such as silicone for heat or gum rubber when traction is essential. Material flowing over the belt may be weighed in transit using a beltweigher. Belts with regularly spaced partitions, known as elevator belts, are used for transporting loose materials up steep inclines. Belt Conveyors are used in self-unloading bulk freighters and in live bottom trucks. Conveyor technology is also used in conveyor transport such as moving sidewalks or escalators, as well as on many manufacturing assembly lines. Stores often have conveyor belts at the check-out counter to move shopping items. Ski areas also use conveyor belts to transport skiers up the hill.A wide variety of related conveying machines are available, different as regards principle of operation, means and direction of conveyance, including screw conveyors, vibrating conveyors, pneumatic conveyors, the moving floor system, which uses reciprocating slats to move cargo, and roller conveyor system, which uses a series of powered rollers to convey boxes or pallets.

1.2 THE STRUCTURE AND LOADING OF THE CONVEYOR BELTS

There are often used conveyors with the belt with textile carcass to transport the material in mining industry. Such a belt consists of the following components The carcass provides the necessary strength and impact resistance for the conveyor belt, and it is also used to force transmission. It could be defined as a multi-element part of the conveyor belt connected with elastic material, which ensures the connection of the single components with one another and the dispersal of the energy atconveyor belt in operation. The top cover and protective edge enwind the carcass and protect it against the mechanical damage caused by transported material, against humidity impact and also against chemical and thermal influence affecting the conveyor belt. The bottom cover interacts with the rollers and with the drums of the conveyor and defends the carcass against their negative impact. Conveyor belt with the textile carcass The carcass provides the necessary strength and impact resistance for the conveyor belt, and it is also used to force transmission. It could be defined as a multi-element part of the conveyor belt connected with elastic material, which ensures the connection of the single components with one another and the dispersal of the energy at conveyor belt in operation. The top cover and protective edge enwind the carcass and protect it against the mechanical damage caused by transported material, against humidity impact and also against chemical and thermal influence affecting the conveyor belt. The bottom cover interacts with the rollers and with the drums of the conveyor and defends the carcass against their negative impact. The wearing of the conveyor belts depends on different factors, but mainly on operating conditions of the belt and on the type of transported material. The conveyors are continuous transport systems, which are able to transfer significant quantum of material. The downtime required for the repair or exchange of the broken belt always means huge economic costs. The wearing could have many causes. The belt is under wearing mostly at the input place where the conveyer is loaded. According to the experience from the operation of a belt, it is stated that up to 80 % of all damages of a conveyor belt are at the loading place of conveyor – at the input place. 3D mathematical model of conveyor belt...

The impact force, which is one of the basic reasons of conveyor belt wearing, rises at the input places. This point load is the consequence of the impact of the sharp-edged pieces of the transported material on the belt. If the impact energy is greater than the capability of the consoles, and of the conveyor belt to absorb this energy, then the conveyor belt damage occurs; first of all, the top cover in the form of transverse and longitudinal scratches, punctures and perforations. The impact resistance is related with the wearing, eventually with the damage of conveyor belts on the input places. This property is one of the most important properties, but it is not classified yet.

2. DESIGN AND ANALYSIS

2.1 DRAWING

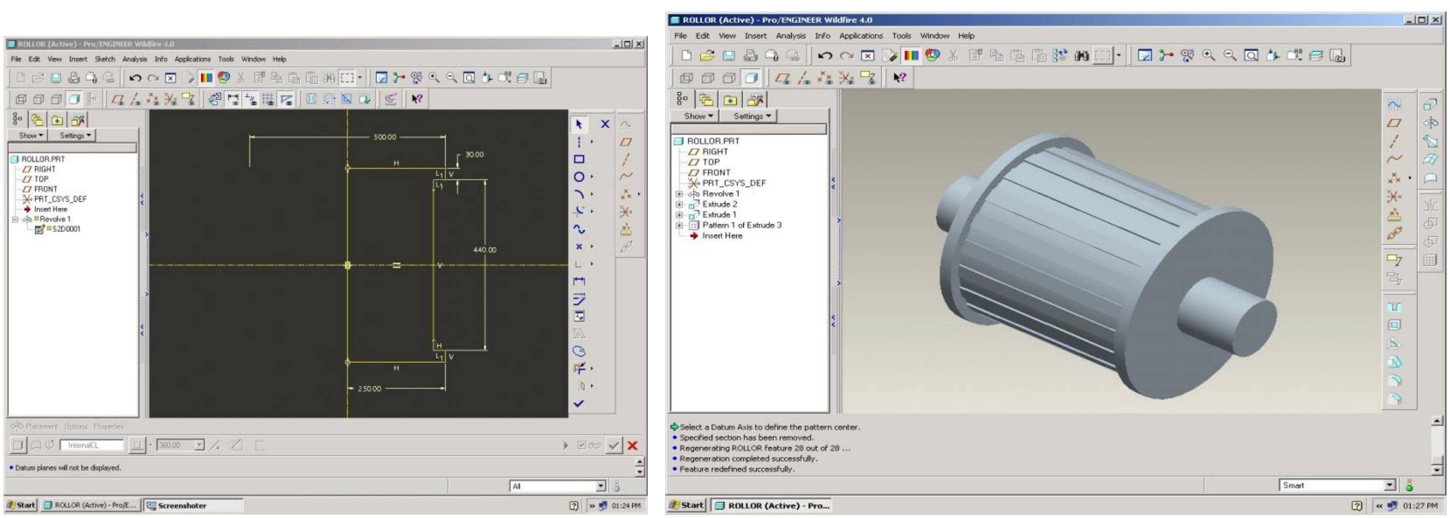

Figure 2.1 Roller Drawing

2.2 TRANSFORMATION OF MODEL

Then the model is converted in to the IGES format which is most suitable and easy access for any other software's.Using the IGES format we can import the conveyor roller model from PRO-ENGINEER to ANSYS. Now we can make any analysis like structural, thermal analysis etc

2.3INTRODUCTION TO ANSYS

ANSYS is an engineering simulation software provider founded by software engineer John Swanson. It develops general-purpose finite element analysis and computational fluid dynamics software. While ANSYS has developed a range of computer-aided engineering (CAE) products, it is perhaps best known for its ANSYS Mechanical and ANSYS Multiphysics products.ANSYS Mechanical and ANSYS Multiphysics software are non exportable analysis tools incorporating pre-processing (geometry creation, meshing), solver and post-processing modules in a graphical user interface. These are general-purpose finite element modeling packages for numerically solving mechanical problems, including static/dynamic structural analysis (both linear and non-linear), heat transfer and fluid problems, as well as acoustic and electro-magnetic problems.ANSYS Mechanical technology incorporates both structural and material non-linearities. ANSYS Multiphysics software includes solvers for thermal, structural, CFD, electromagnetics, and acoustics and can sometimes couple these separate physics together in order to address multidisciplinary applications. ANSYS software can also be used in civil engineering, electrical engineering, physics and chemistry.

ANSYS, Inc. acquired the CFX computational fluid dynamics code in 2003 and Fluent, Inc. in 2006. The CFD packages from ANSYS are used for engineering simulations. In 2008, ANSYS acquired Ansoft Corporation, a leading developer of high-performance electronic design automation (EDA) software, and added a suite of products designed to simulate high-performance electronics designs found in mobile communication and Internet devices, broadband networking components and systems, integrated circuits, printed circuit boards, and electromechanical systems. The acquisition allowed ANSYS to address the continuing convergence of the mechanical and electrical worlds across a whole range of industry sectors.

2.4 ANALYSIS PROCEDURE

ANALYZING THE CONVEYOR ROLLER – STEP BY STEP PROCEDURE

- The 3D model of the conveyor roller is designed by using pro-e software and it is converted as IGES format.
- The IGES (Initial Graphic Exchange Specification) format is suitable to import in the ANSYS Workbench for analyzing
- Open the ANSYS workbench
- Create new geometry
- File – import external geometry file – generate

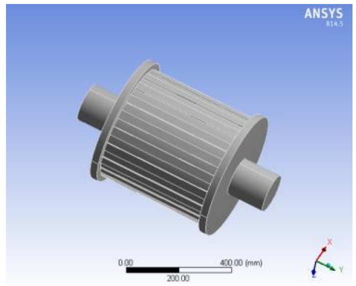

Figure2.1 Roller Drawing

- Project – new mesh
- Defaults – physical preference – mechanical
- Advanced – relevance center – fine
- Right click the mesh in tree view – generate mesh

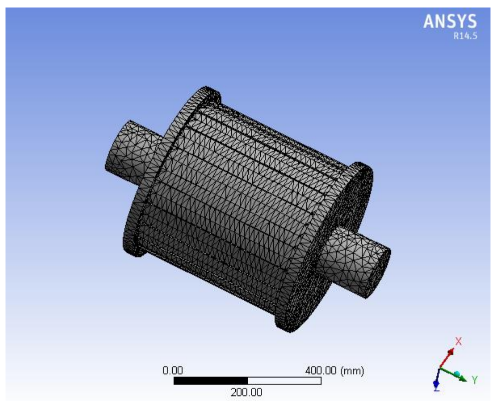

Figure2.2 RollerMeshing

- Project – convert to simulation – yes
- Select the all solid in geometry tree
- Definition – material – new material
- New material – right click – rename – Stainless steel.
- Enter the value of the young's modulus, poisons ratio, density and etc.
- New analysis – Static structural

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- Static structural – right click – insert – fixed support
- Select the end faces of the conveyor roller.
- Geometry – apply
- Static structural – right click - insert – rotational velocity – select the face to define the velocity direction
- Geometry – apply
- Provide the value of the force to 104.72 rad/s.
- Static structural – right click - insert – moment – select the face to define the moment direction
- Geometry – apply
- Provide the value of the force to 1500N/mm.
- Then define the solution
- Solution – right click - insert the total deformation, equivalent elastic strain, and equivalent stress.
- Right click the solution icon in the tree – solve
- Repeat the above steps for carbon fiber optimized material.
- To capture the figure use the option new figure in tool bar.
- The all results are taken in a picture – and save it to the required folder in the system
- The all readings are tabulated

VALUES APPLIED ON THE CONVEYOR ROLLER IN ANSYS WORKBENCH

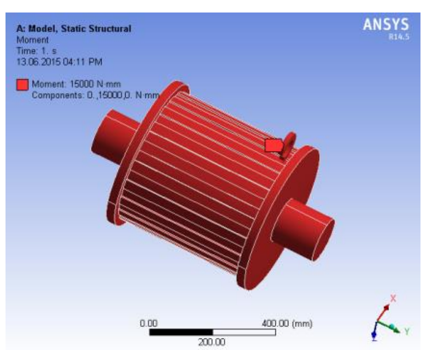

Figure2.3 Values Insert Method

2.5 RESULTS FOR EXISTING MATERIAL-STAINLESS STEEL

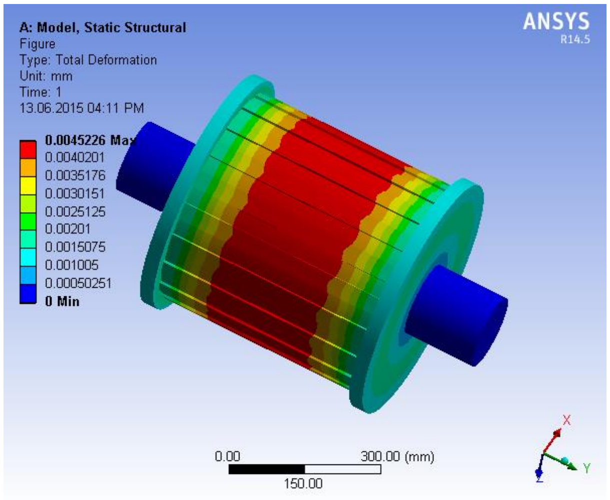

Figure2..3 Total Deformation

EQUIVALENT ELASTIC STRAIN

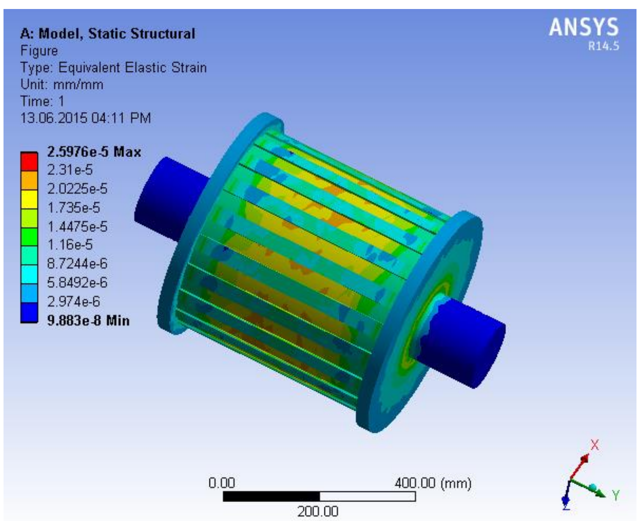

Figure 2.4 Equivalent Elastic Strain

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EQUIVALENT STRESS

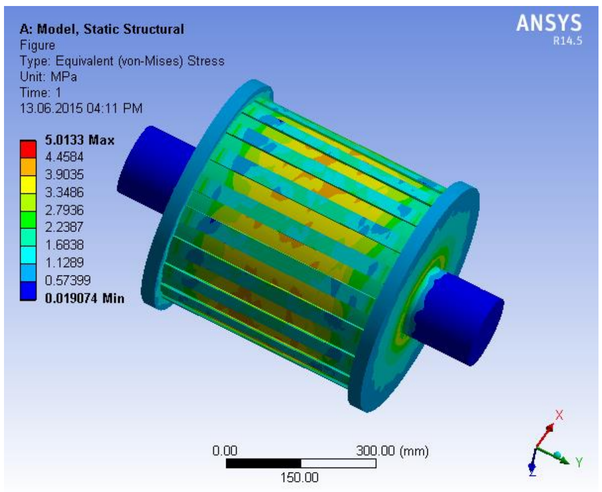

Figure2.5 Equivalent Stress

2.6 RESULTS FOR OPTIMIZED MATERIALS

CARBON FIBER (HIGH MODULUS)

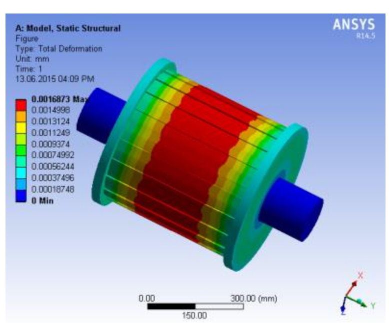

Figure 2.6 Total Deformation

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EQUIVALENT ELASTIC STRAIN

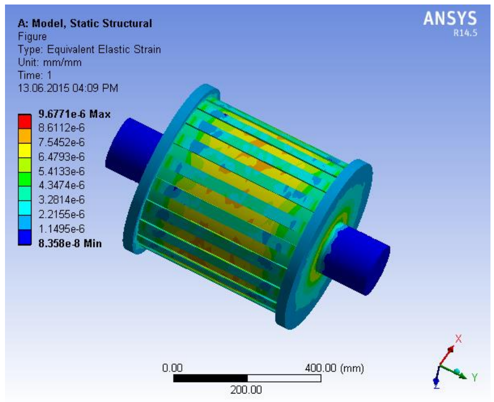

Figure 2.7 Equivalent Elastic Strain

EQUIVALENT STRESS

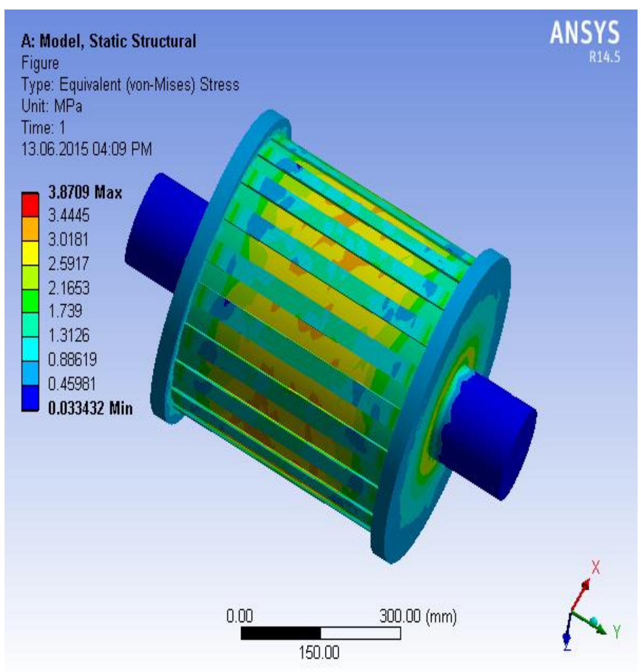

Figure 2.8 Equivalent Stress

2.7 COMPARISION OF RESULTS-RESULT FOR EXISTING MATERIAL

STAINLESS STEEL

	MINIMUM	MAXIMUM
Total deformation (mm)	0	4.522e-3
Equivalent elastic strain (mm/mm)	9.883e-8	2.597e-5
Equivalent stress MPa	1.907e-2	5.013

2.8 RESULTS FOR OPTIMIZED MATERIALS-CARBON FIBER (HIGH MODULUS)

	MINIMUM	MAXIMUM
Total deformation (mm)	0	1.687e-3
Equivalent elastic strain (mm/mm)	8.358e-8	9.677e-6
Equivalent stress MPa	3.34e-2	3.87

3. CONCLUSION

Analyzing results for conveyor roller under force are listed in the Table. Analysis has been carried out by stainless steel (conventional material) and carbon fiber composite (optimized material). The results such as total deformation, equivalent elastic strain and equivalent stress for each material are determined. Comparing the optimized materials and the conventional material, carbon fiber high modulus composite material has the low values of total deformation, stress and strain. While using carbon fiber weight of the conveyor roller is reduced by 22.58%. Hence it is concluded that carbon fiber material is suitable for the conveyor roller. While carrying out this project we are able to study about the 3Dmodelling software (PRO-E) and Study about the analyzing software (ansys) to develop our basic knowledge to know about the industrial design

REFERENCE

1. Suhas M. Shinde and R.B. Patil (2012), "Design and Analysis of a Roller Conveyor System for Weight Optimization and Material Saving", International Journal on Emerging Technologies.
2. S. M. Shinde and R.B. Patil (2012), " Optimization Technique Used for the Roller Conveyor System for Weight Reduction", International Journal of Engineering Research & Technology (IJERT).
3. Pawar Jyotsna, D.D.Date and Pratik Satav "Design And Optimization Of Roller In Belt Conveyor System For Weight Reduction".
4. Redesign Of An Underground Conveyor Using Composite Materials, University of New South Wales Mechanical and manufacturing engineering
5. Mallikarjuna Rao, G S V Suresh and Priyadarshini D (2012), **"**Alternate Design And Optimization Of Conveyor Pulley Using Finite Element Analysis", International Journal of Engineering Research & Technology.
6. Barnard Janse van Rensburg (2013), "The development of a Light Weight Composite Conveyor Belt Idler Roller", University of Southern Queensland Faculty of Health, Engineering and Sciences

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