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Analysis of Roller in V-Belt Base Cutting for Material Optimization

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Abstract: Along with the fourth industrial revolution different tools coming from optimization are creating new opportunities in production management. While manufacturing processes are stochastic and rescheduling decisions need to be made under certainty, it is complicated task to decide whether rescheduling is worthwhile, which is often addressed in practice on a greedy basis. To find a trade-off between rescheduling frequency and the growing accumulation of delays, we propose a rescheduling framework, which integrates optimization algorithms. To prove the effectiveness, we first model work scheduling problem with dependent setup and limited resources inspired by an industrial application. Then we solve the scheduling problem through a hybrid approach and train the model for rescheduling patterns. Finally, we compare its rescheduling performance with periodical approaches. Through observing the simultaneous results, we find the integration of these techniques can provide a good compromise between rescheduling frequency and delays. The main contribution of the work is the formalization of the problem, the development, solution methods and the optimization-based framework for supporting rescheduling decisions.
Keywords: Optimization, Analysis, Production, Framework, Simulation.

I. INTRODUCTION

The main contribution in the view of improving the rescheduling strategy, our paper proposes a new rescheduling framework by combining optimization and analysis algorithms. The proposed approach provides empirical substantiation of effectiveness and effectiveness in the product problems. A project aimed at the fourth industrial revolution. It is essential to highlight that the paper goal is to describe the integration between Optimization and Analysis to show a comprehensively proof of work methodology, but not necessarily to exploit its full potential which can achieved only by tailoring the method of studied setting. For this reason, both the chosen algorithms are not the most advanced ones but selected among mature and popular methods, which have shown excellent performance in the past. This choice shows the potential of getting better performance by adopting more advanced and tailored algorithms. The purpose of this machine to apply multiple rubber bases of on a single wide sleeve and separate individual belt at the same time. V-Belt Base cutting uses a component called as roller on which the sleeve is loaded. The HSS cutter are placed at the bottom of the Roller which penetrates the base and sleeve in order to separate the individual belt. This penetration creates grooves on the roller as well and as the grooves gets deeper than 2mm the roller becomes useless and doesn't separate the belts efficiently.[2]

II. PROBLEM STATEMENT

V-Belt Base cutting machine is special purpose machine. The purpose of this machine to apply multiple rubber bases of on a single wide sleeve and separate individual belt at the same time. V-Belt Base cutting uses a component called as roller on which the sleeve is loaded. The HSS cutter are placed at the bottom of the Roller which penetrates the base and sleeve in order to separate the individual belt. This penetration creates grooves on the roller as well and as the grooves gets deeper than 2mm the roller becomes useless and doesn't separate the belts efficiently. During the Designing and production of the Base Cutting machine material selected roller Nylon as the default material of the roller. In continuous production Nylon roller only last for 8 hours after that the production needs to be stopped in order to replace the Nylon roller. This was hampering the production of the Belts in in belt manufacturing industries. So, they replaced the Nylon material with more superior and expensive material called as Teflon. The Teflon roller last about 12 hours in continuous use.

Using teak wood for an alternative material in term of hardness Teflon is expensive material. Each Teflon Roller needs to be replaced after 12 Hours of use. So, it is not feasible for any belt manufacturing company. To use Teflon as their default material for Roller of the Base Cutting Material for long period of time and hence they are in search of new material which is cheaper in price and last as same as Teflon and works efficiently.

III. METHODOLOGY

The primary methodology for the research involved a review of policy context for skills development in professional Industry as well as strategy context for export development. Secondary research involved a review of relevant literature concerning the needs of companies with regards to skills, market specific needs and studies of best practice. To solve the problem first import the Para solid model to the ANSYS which is analysis software by using which we have to solve the problem. In the next step we have to do the meshing on roller. Next step is to apply loads i.e., force and torque which are mentioned in the loading case then the next step is to apply the boundary conditions by seeing the actual model i.e., where it is fixed. Next is to solve the problem by using software. After completion of the solution by using software, we have to do the physical testing of roller. The efficiency of roller is very low in v belt base cutting machine to solve the problem to analyse the material Ansys software is used. the primary step is to import the Para solid model to the ANSYS which is analysis software by using which analysis is completed. subsequent and thus the foremost vital step is meshing on roller and parts. Next is applying loads i.e., pressure, displacement and rotational velocity which are mentioned within the load case then after the boundary conditions were applied by seeing the particular machine i.e., where it's fixed. Then the matter is solved by the Ansys software. After completion of the answer by using software next step is to undertake to the physical testing of roller material

IV. MATERIAL PROPERTIES

According to industry roller was made up of Teflon having properties. Teflon properties are shown below

TABLE 1. Properties of Teflon

Young’s modules	4E+08 pa
Bulk modules	1.6667E+09
Poisson’s ratio	0.4
Ultimate tensile stress	4.6E+08

Using teak wood as a substituted to the Teflon material having properties shown below

TABLE 2. Properties of Teak Wood

Young’s modules	9.3165+09 pa
Bulk modules	2.2182e+10
Poisson’s ratio	0.43
Ultimate tensile stress	4.6e+08

V. MESHING GENERATION

Meshing of a given model are going to be done counting on geometry of the model, it's better to possess more degrees of freedom hence a greater number of elements in order that results obtained are going to be closure to analytical results. In two bay panel analyses, crack region is meshed with a greater number of elements in comparison with other parts of fuselage, for obtaining a converged solution which successively a far better solution. the elemental premise of FEM is that as number of elements (mesh density) is increased, the answer gets closer and closure, however solution time and compute resources required also increases dramatically as we increase the number of elements to truth solution. [3]

TABLE 3 Details Of Mesh

Element Order	Program Control
Element Size	Default
Nodes	121500
Elements	45815

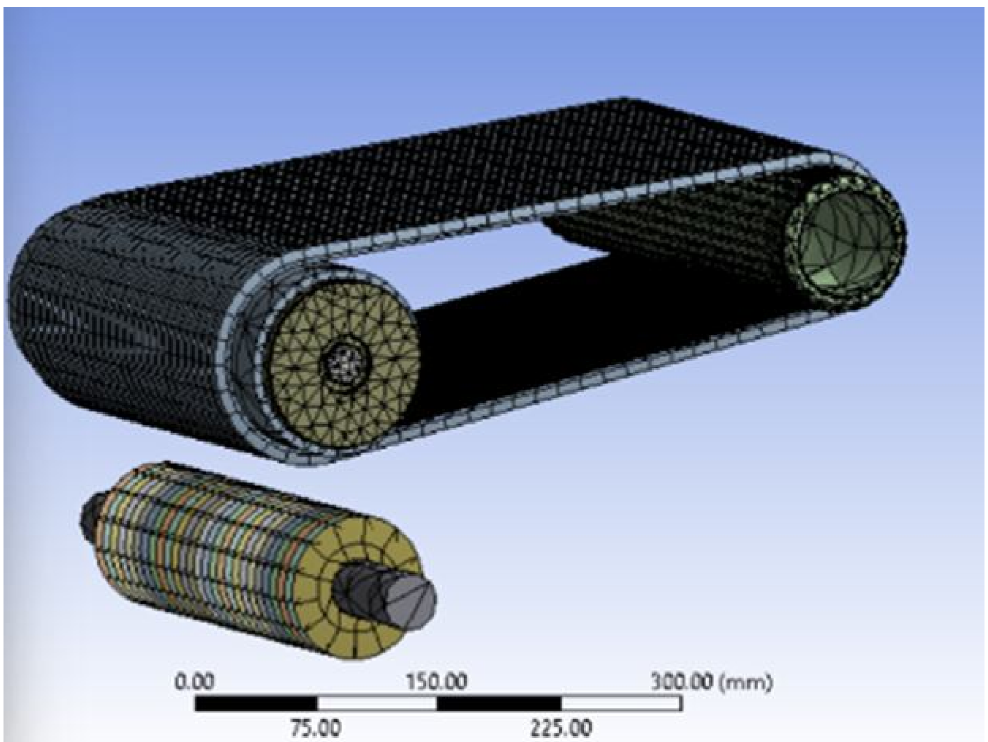

Fig 1. Meshing Generation

VI. LOADING AND BOUNDARY

A. Fixed support

Fixed support was applied on the rotational member such has roller and support roller shaft which was connected to the motor so that the shaft should not produce any variation during the process.

B. Pressure

Pressure out on the cutter rod was according to co-ordinate system given:
X component-0.pa
Y component-0, pa
Z component-75000 pa
Pressure applied on direction was normal to the surface of the cutter rod. The force apply was exact equal to the force applied by the pneumatic machine om the surface of cutter rod.

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C. Rotational velocity

Velocity was provided to the roller. Which was rotating by means of shaft at certain velocity. The rotational velocity given to the roller was along the components of the by coordinate system:

X component- 0 rad/sec
Y component-9.4248 rad/ sec
Z component-0 rad/sec
The velocity of the component was measured tachometer.

D. Displacement

There are two displacement condition acting. First is on the roller in which the coordinates given to the roller are:

X component- free
Y component- ramped
Z component – ramped
Second displacement is given on the cutter rod to move upward and downward movement to cutter to cut the belt placed on the roller. The displacement was provided by means of coordinate system given below:

X component- 0 m (ramped)
Y component- 0m (ramped)
Z component – 0.05m (ramped)
Displacement given to the rod was to restrict the movement above certain height and direction. The boundary conditions are as shown below:

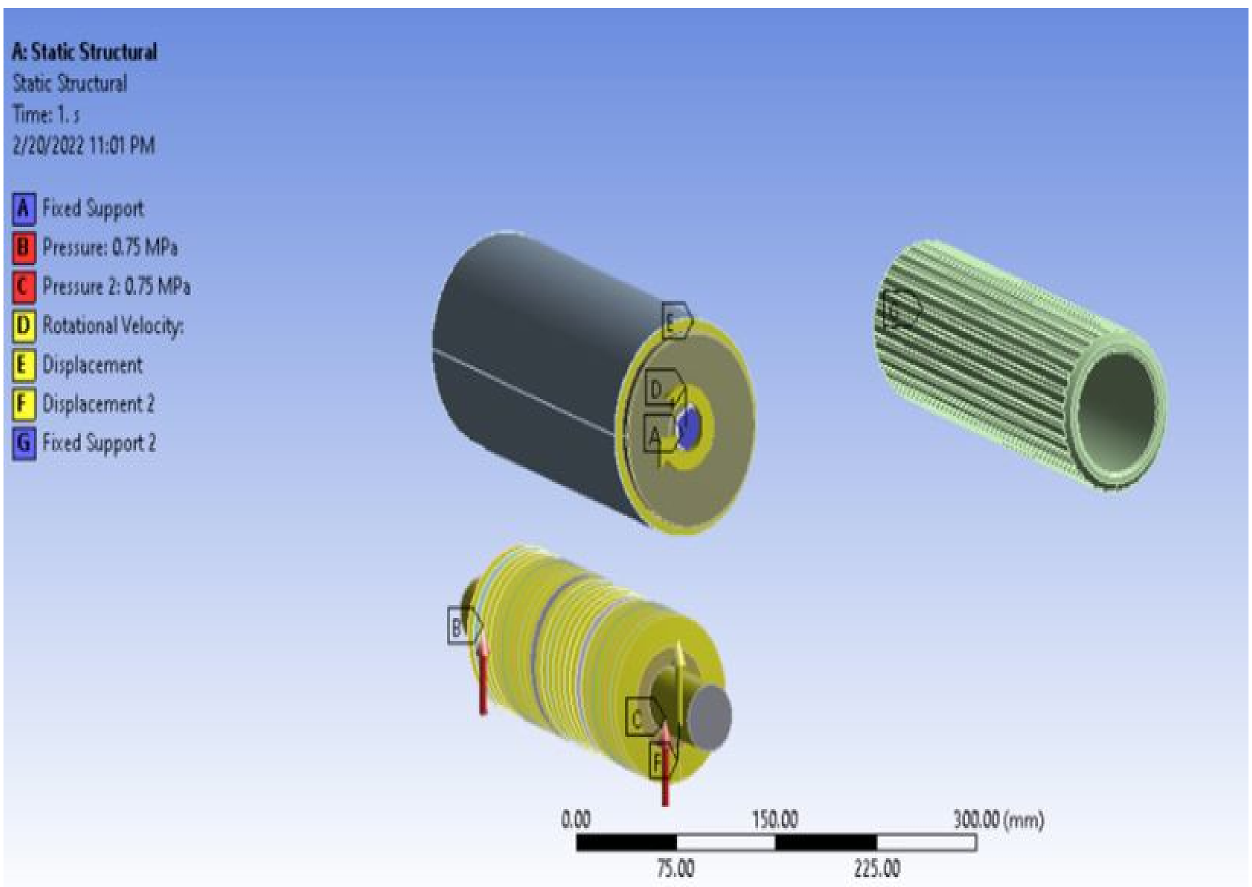

Fig 2. Boundary Condition On 3d Model

VII. RESULT OF MATERIAL TEFLON

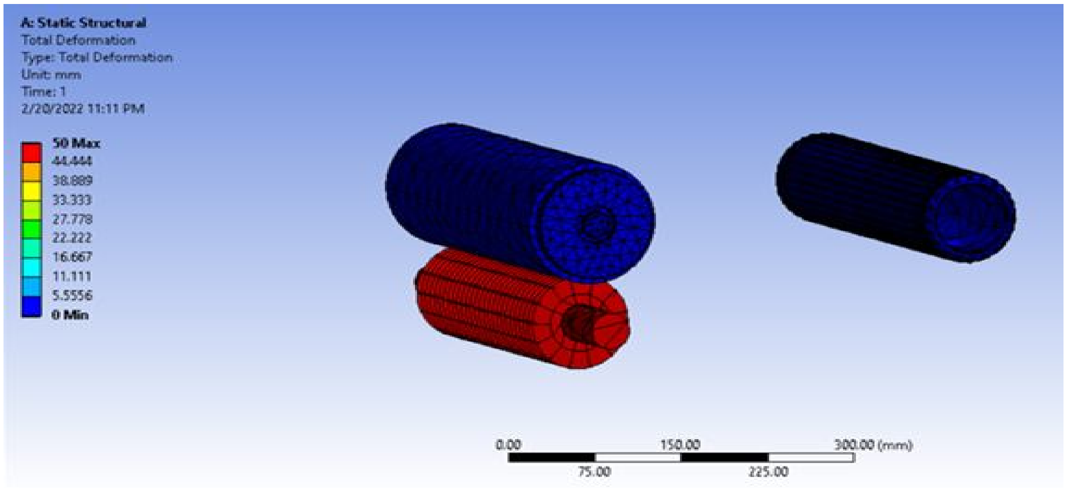

Fig 3. Total Deformation For Teflon

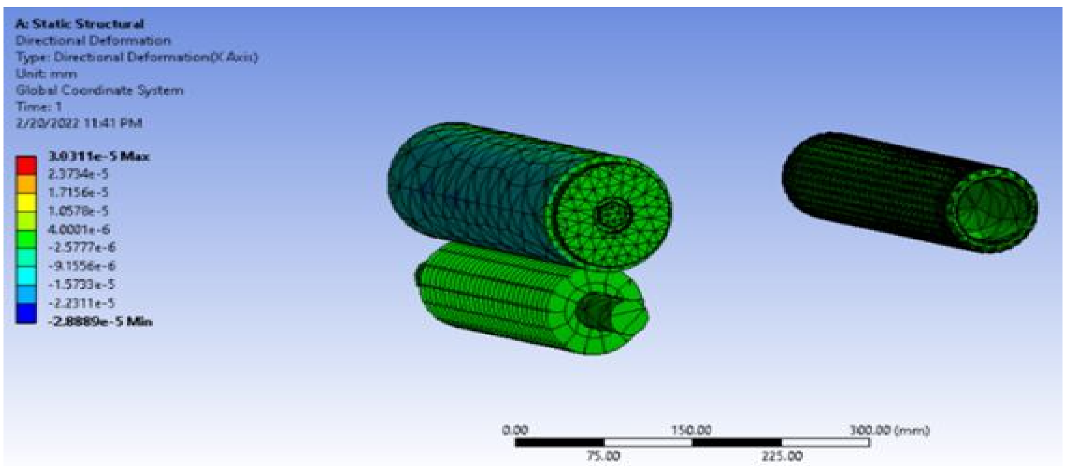

Fig 4. DIRECTIONAL Deformation For Teflon

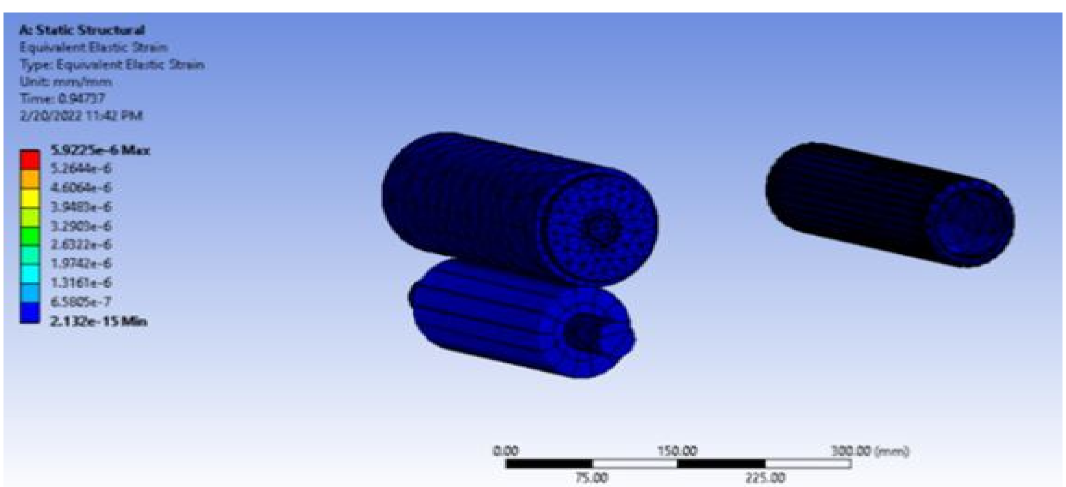

Fig 5. Equivalent Elastic Strain

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VIII. RESULT OF MATERIAL TEAK WOOD

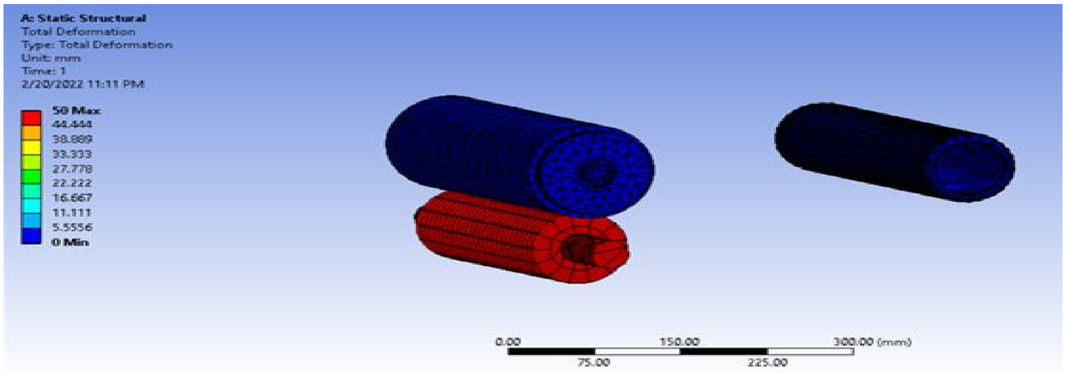

Fig 6. Total Deformation

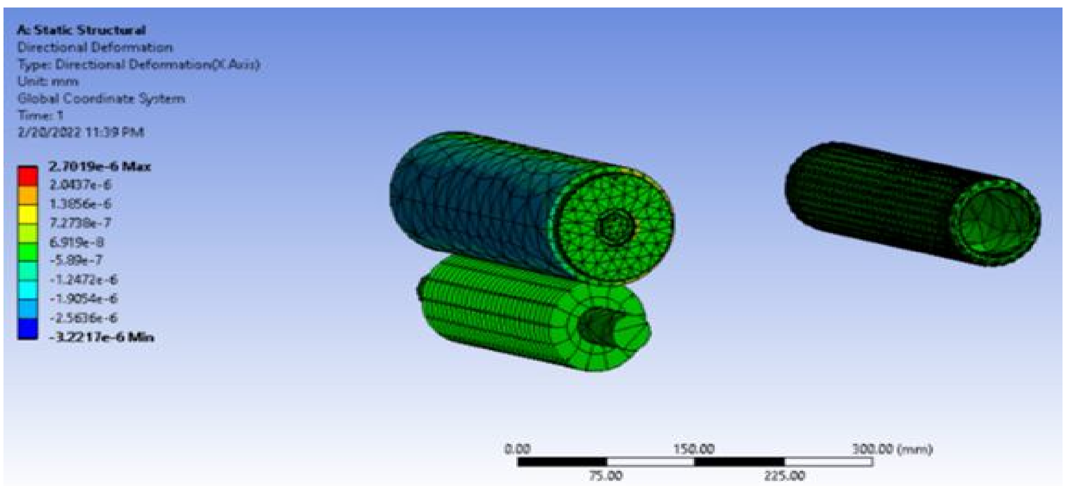

Fig7. Directional Deformation

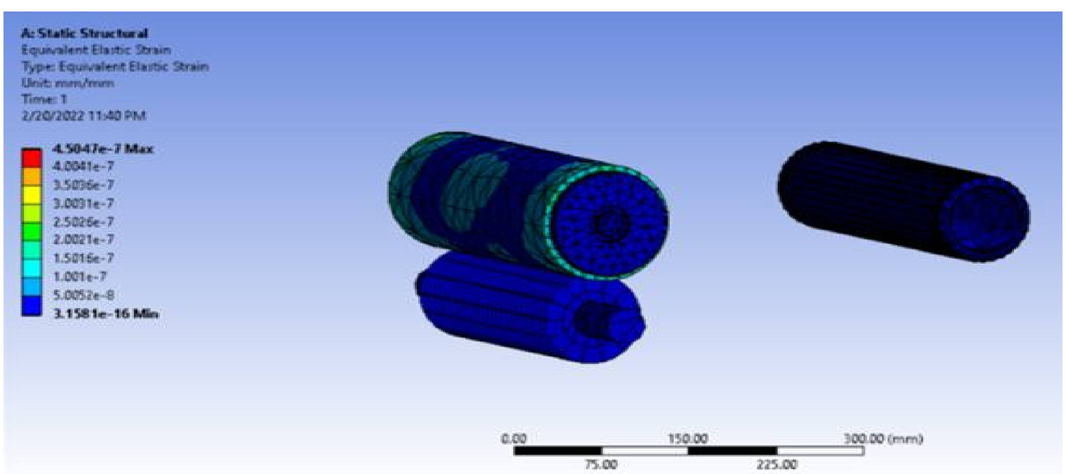

Fig 8. Equivalent Elastic Strain

Hence it is observed that teak wood does not shows any major difference along with the results of Teflon which is majority use in industry as roller it can be replace by teakwood which shows similar property as shown in above result. Teak wood roller can be use as substitute for Teflon roller.

IX. RESULTS

TABLE 4
Comparison of Teak wood and Teflon

Material	Teflon	Teak wood
Total deformation	10.471 mm	10.471 mm
Directional deformation	-1.4263e-006 mm	-4.4321e-008
Equivalent elastic strain	1.6317e-008 mm	6.0186e-010mm

After analysing both material it is found that the total deformation of Teflon and the teak wood is same that is i.e., 10.471 mm. there is slight difference in directional deformation between these two materials. the directional deformation of Teflon is -1.4263e-006mm and teak wood -4.4321e-008mm. The value of equivalent elastic strain of the Teflon is 1.6317e-008 mm and Teak wood is 6.0186e-010mm.

X. CONCLUSION

In this paper we have proposed a new material i.e., teakwood coping with working environment, this work represents the preliminary approach to use optimization and analysis together in the field by assuming the availability of real time data analysis we proved the potential of this technique by conducting practical on base cutting machine it is essential to notice that despite the simplicity of this technique we have been able to achieve good result. as compared to original material

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