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Design, Analysis and Optimization of Centrifugal Blower

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ABSTRACT: Centrifugal blowers play an important role in many industries. This project presents a design methodology to examine various parameters of the centrifugal blower using computational fluid dynamics approach and Finite Element Analysis concept. The effects of blower geometry, blower speed, impeller geometry, and blade design and fillet radius have been assessed. Total discharge and blower total efficiency are the output parameters calculated. The blower is modeled using SOIDWORKS and after simplification the modeled blower is meshed in SOIDWORKS. The solution is obtained. The post processing is carried out using ANSYS and the results are presented and discussed in detail. Based upon the ANSYS results once again blower parameters are changed and examined. Finally, the optimum values of the parameters are obtained. These obtained values need to be implemented into the design for better performance of the blower.

Keywords: Centrifugal Blower, Blower Blade, Blower Efficiency.

1. INTRODUCTION:

A centrifugal blower is a mechanical device for moving air or other gases. The terms "blower" and "squirrel cage fan" (because it looks like a hamster wheel) are frequently used as synonyms. These fans increase the speed of air stream with the rotating impellers. They use the kinetic energy of the impellers or the rotating blade to increase the pressure of the air/gas stream which in turn moves them against the resistance caused by ducts, dampers and other components. Centrifugal blowers accelerate air radially, changing the direction (typically by 90o) of the airflow. They are sturdy, quiet, reliable, and capable of operating over a wide range of conditions. Centrifugal blowers are constant CFM devices or constant volume devices, meaning that, at a constant fan speed, a centrifugal fan will pump a constant volume of air rather than a constant mass. This means that the air velocity in a system is fixed even though mass flow rate through the fan is not. The centrifugal blower is one of the most widely used Fans. Centrifugal blowers are by far the most prevalent type of fan used in the HVAC industry today. They are usually cheaper than axial fans and simpler in construction. It is used in transporting gas or materials and in ventilation system for buildings. They are also used commonly in central heating/cooling systems. They are also well-suited for industrial processes and air pollution control systems. It has a blower wheel composed of a number of blower blades, or ribs, mounted around a hub. The hub turns on a driveshaft that passes through the blower housing. The gas enters from the side of the fan wheel, turns 90 degrees and accelerates due to centrifugal force as it flows over the fan blades and exits the blower housing.

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2. LITERATURE REVIEW:

To improve the operating stability of a centrifugal blower, discrete cavities are introduced just upstream of the impeller and optimized for further improve the operating stability we referred Optimization of vibrations in a centrifugal blower to enhance operating stability by Sang Bum MaKwang YongKim [1]. They did experimental study on noise reduction and performance of an industrial centrifugal blower .they compare noise characteristic of FC blades and BC blades. And then, some different volute geometric configurations were carried out and the performance and noise of the FC blades centrifugal blower increases we referred Experimental study on the noise reduction of an industrial forward-curved blades centrifugal blower by Qi Datong MaoYijun LiuXiaoliang Yuan Minjian [2].

The process reveals that optimization of the original geometry of blower, at 1.5 times width of impeller, 24° tongue angle and 10% reduction in volute outer radial locations, pressure head and flow uniformity increases compared to other cases we referred optimization of centrifugal blower volute by Beena D.Baloni ,Yogesh Pathak and S.A.Channiwala [3].

3. METHODOLOGY:

1. Getting parameters of old blower
2. Calculation of optimized parameters
3. Modelling parts of blower
4. Selection of material
5. Fabrication drawing
6. Finite Element Analysis (FEA)
7. Bill of material
8. Costing

4. PROBLEM DEFINATION:

Concern industry manufactures blowers and supplies it to food industry, it is found that they are facing many problems regarding centrifugal blower. They are using centrifugal blower for ventilation purpose, also they are using blower to maintain the temperature of food storages. The present centrifugal blower is made up of from AISI 4340 steel (M.S) material here corrosion is a major problem. The ingredients of the same are mixing with fruit pulps, which is harmful, also weight of the present blower is high, and strength of impeller is less.

4. RESULTS:

MATERIAL SELECTION: For basic parts of blower we have used material AISI 4340 Steel (MS). Thus for shaft we have used IS 2062 Steel (MS) due to which corrosion does reduces.
For chassis we have used Plain Carbon Steel.

Finite Element Analysis (FEA):

1. **SHAFT:**

After doing FEA for AISI 4340 Steel (MS) material we found out that maximum stress is 13.491 N/mm^2 (MPa).

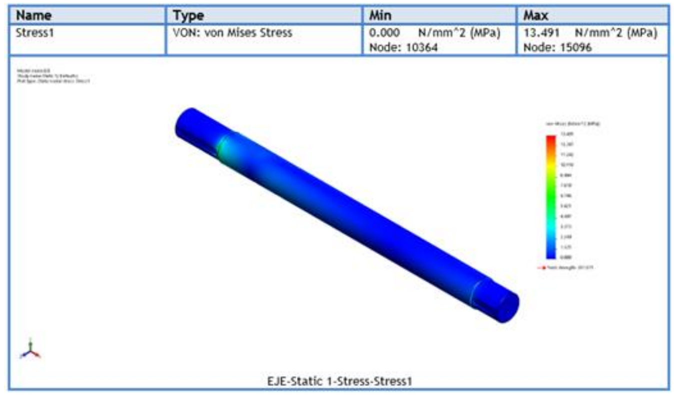

Fig.1: FEA for AISI 4340 steel

After doing FEA for IS 2062 Steel material we found out that maximum stress is 30.792 N/mm^2 (MPa).

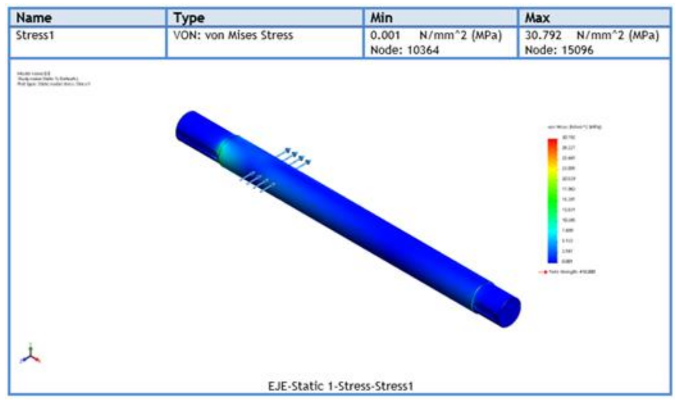

Fig.2: FEA for IS 2062 steel

After doing FEA for Mild Steel the stress was 77.791 N/mm^2 (MPa).

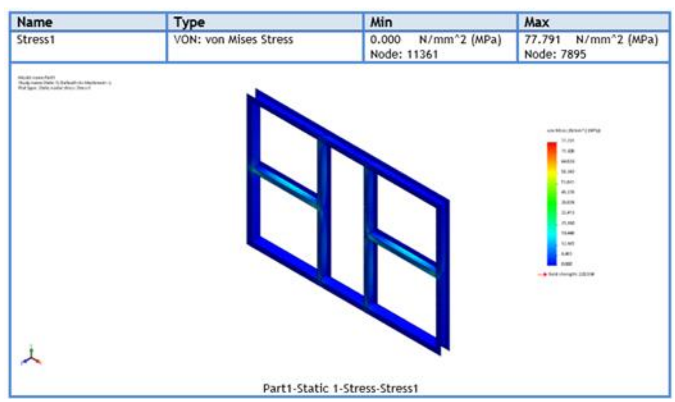

Fig.3: FEA for Chassis before

After doing FEA for Plain Carbon Steel the stress is 1,153.119 N/mm^2 (MPa).

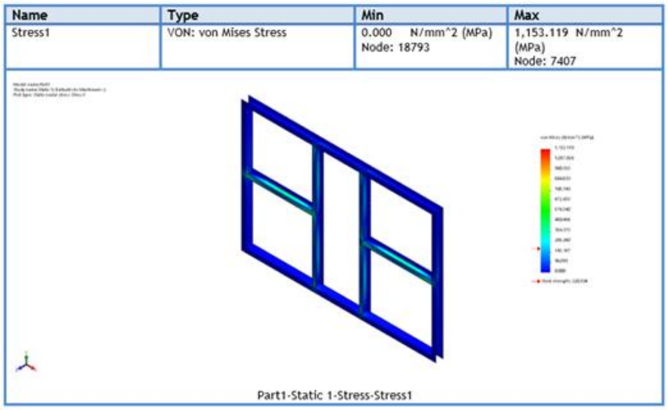

Fig.4: FEA for Chassis after

5. CONCLUSIONS:

NUMBER OF FATIGUE CYCLES INCREASE:

Number of cycles previously are 3350x10^7 cycles for material AISI 1020.The cycles increases to 5730x10^7 cycles by using a material IS 2062

REDUCTION IN CHASSIS VIBRATIONS:

Material of Chassis before is Mild steel. By using ASHBY Chart, plain carbon steel is used to minimize the vibration and increase stability of Chassis of Centrifugal Blower

6. REFERENCES:

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