STUDY AND MODIFICATION OF SOOT BLOWER IN SUGAR INDUSTRY

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ABSTRACT
Due to the unbalancing of the impeller of soot blower the vibrations are generated which causes the damage to the soot blower and get breakdown after some time period of working.

KEYWORDS: 3-D Modelling, Impeller, Vibration, Catia, Soot blower,ANSYS, Fan etc.

INTRODUCTION
1.1 PROBLEM STATEMENT
Vibration is an important indication of system performance in centrifugal fan. Vibration of the centrifugal fan and its dynamic behavior has become a key technology of some corporations, which concerns the safe and normal operation of the machine. The impeller forming principal part of the fan, its performance has an outsized effect on the efficiency of the fan. As the main source of vibration and noise in fan operation, the research on their vibration characters is very necessary. Centrifugal fan impeller is the core component of fan for energy conversion; it directly affects the coefficient of safety of the fan. The centrifugal force caused by the unbalance value of the impeller is one of the important reasons which cause the fan vibration. Fans are subject to vibration because they have a high ratio of rotating mass to total mass and operate at relatively high speeds. Unlike most mechanical equipment, there are two major causes for vibration in fan equipment. First is aerodynamic which relates to airflow, second is mechanical which concerns with rotating components, fasteners and structural support. The result of excess vibration can vary from nuisance disturbance to a catastrophic failure. By identifying symptoms at an early stage repairs can be scheduled, reducing the risk of catastrophic failure. The present case study was carried out on a centrifugal fan used for the purpose of supplying air for combustion of fuel in furnace of boiler. The existing centrifugal fan is subject to vibrations exceeding permissible limits by margin, it has following specifications:

Flow rate = 3000 m^3/hr
Static head = 650 mmWC
Motor power = 12.5 HP, 2900 rpm.
The impeller has following dimensions OD 660 mm, ID 200 mm, blade width at leading and trailing edge as 45 mm and 30 mm respectively. Hence, the project aims to carry out vibration analysis using FEA tools and rebuilt modified model to resolve and bring vibration levels within permissible range.

1.2 OBJECTIVE
All fans must generate some vibration. They continuously rotate and since nothing is perfect, cyclic forces must be generated. It's only when vibration reaches a certain amplitude that we call it bad. Vibration may just be an indicator of some problem with a mechanism, or it may be a cause of other problems. Excessive vibration can cause fasteners to loosen or can cause fatigue failure of structurally loaded components. Finally, vibration can transmit into adjacent areas and interfere with precision processes, or create an annoyance for people. Hence the objective of this case study is to resolve vibration problem of existing fan and bring vibration levels within permissible range.

1.3 SCOPE
The operation of any mechanical system will always produce some vibration. Our goal is to minimize the effect of these vibrations, because while it is undesirable, vibration is unavoidable. The result of excess vibration can vary from nuisance disturbance to a catastrophic failure. The cause of vibration is either due to a rotational part being out of balance, i.e. the fan wheel or motor pulley, or a mechanical fault such as misaligned drives, bent shafts, or aerodynamic forces. Keeping in mind that all vibrations occur at regular frequencies, determining that frequency will help to diagnose the source of the vibration. At last, an optimum design proposed, such that to resolve vibration problem and bring vibration levels within permissible range.

1.4 METHODOLOGY
1) Creation of 3D geometry.
2) Importing the geometry for meshing.
3) Solving for the meshed model with constraints and boundary conditions.
4) Viewing the results during post-processing.
5) Interpretation over the results.

LITERATURE REVIEW
2.1 FAN BASICS
According to engineering data, twin city fan companies [1]fans and blowers are turbomachines which deliver air at a desired high velocity (and accordingly at a high mass flow rate) but at a relatively low static pressure. The pressure rise across a fan is extremely low and is of the order of a few millimeters of water gauge. The rise in static pressure across a blower is relatively higher and is more than 1000 mm of water gauge that is required to overcome the pressure losses of the gas during its flow through various passages. A blower may be constructed in multistage for still higher discharge pressure.

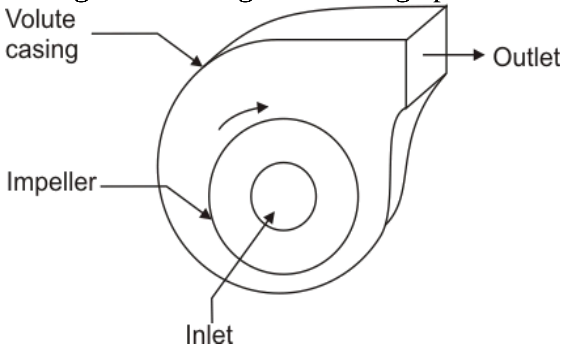

Fig.2.1 A centrifugal fan or blower

A large number fans and blowers for relatively high pressure applications are of centrifugal type. A blower consists of an impeller which has blades fixed between the inner and outer diameters. The impeller can be mounted either directly on the shaft extension of the prime mover or separately on a shaft supported between two additional bearings. Air or gas enters the impeller axially through the inlet nozzle which provides slight acceleration to the air before its entry to the impeller. The action of the impeller swings the gas from a smaller to a larger radius and delivers the gas at a high pressure and velocity to the casing. The flow from the impeller blades is collected by a spiral-shaped casing known as volute casing or spiralcasing. The casing can further increase the static pressure of the air and it finally delivers the air to the exit of the blower.

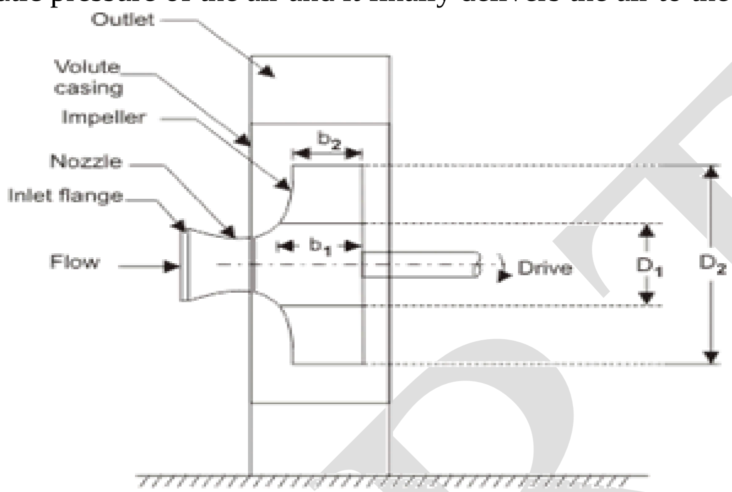

Fig.2.2 Main components of a centrifugal blower

The centrifugal fan impeller can be fabricated by welding curved or almost straight metal blades to the two side walls (shrouds) of the rotor. The casings are made of sheet metal of different thickness and steel reinforcing ribs on the outside. Suitable sealing devices are used between the shaft and the casing.

CAUSES OF FAN VIBRATION:

The forces which result in vibration in fans are primarily due to minor imperfections in the rotating components. The most common of these imperfections is that the center of mass does not coincide with the center of rotation. We call this “unbalance.” Unbalance is corrected by adding (or removing) weight so as to make the two centers coincide. Some fan rotor systems may have multiple planes along the axis of the shaft where unbalance exists. A fan that has a fan wheel on one end and a large sheave on the other may have to be balanced by adding weights to both the fan wheel and the sheave. This is called “two-plane balancing.” A wide fan wheel should be balanced in two planes that are on the fan wheel itself. This is also called “dynamic balancing.” The term dynamic balancing is often confused with a rotating balance. Balancing machines that are commonly used on fan wheels may be capable of either static (single plane) or dynamic (two plane) balancing.

CONCLUSION

Vibration characteristics can be improved by checking the right combination for various thicknesses of material to be used for different components i.e. back plate, blade and shroud. In existing impeller its first modal frequency i.e. 99 Hz is closer to 2X frequency of fan i.e. 96 Hz. After modifying the impeller the first modal frequency was shifted to 122 Hz. There was overall vibration improvement leading the modified impeller vibration to go below boundary limits. There is n-number of reasons for vibration, though they cannot be completely eliminated, but can be reduced by applying suitable method. In future scope for work, the fan can be simultaneously designed by simulation checking for both flow and structural performance. Also now-a-days materials like aluminum and GRPF (composite materials) are replacing structural steel these can be thought of as alternative materials to steel for improving performance.

SPONSORED BY

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