

# Design Analysis and Modeling of Vertical Blades Table Fan

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**Abstract**— Change is necessary in every product to survive in competitive market, and customer needs are also very important. Product should be change according to customer needs. In villages mostly people uses table fan because of their roof's design, they can't use ceiling fan. And in buildings which have high roofs and workshops uses ceiling fan but during that there is probability of vibration. In usual table fan air circulation is not continuous. So to overcome that problem and for fulfillment of customer needs the change is necessary. So the VERTICAL BLADES FAN can be the optimal solution. It is totally new concept. In vertical blades table fan customer gets continuous air circulation at 360 degree.

**Key words:** Normal Table Fan, Vertical Axis Wind Mill, Blade Design

## I. INTRODUCTION

Fan is normally used for cooling, drying, air circulation, etc. Our research paper is related with the fan which is used for cooling purpose only. Now a days due to global warming the temperature remains comparatively high, so cooling is required to maintain it. Normally middle class families use fan for air circulation because they cannot afford AC, due to its high capital cost and high operating cost. So almost 80% of them uses fan.

There are mainly two types of fans are available:

- 1) Pedestal or Table fan
- 2) Ceiling fan

As per the rating of power consumption given by manufactures table fan consumes 50-55W, ceiling fan consumes 70-85W, Cooler uses 100-500W, AC uses 1500-2500W (1.5 TON). In rural areas as shown in fig (1) where the ceiling is not rigid and shape is not proper so, ceiling fan is not applicable.



Fig. 1: Ceiling fan is not applicable

Even the places as shown in fig (2) (House) & fig (3) (Workshop) where the ceiling is high, ceilingfan is not applicable. Even if we use it, it causes long shaft and thus due to improper balancing, vibrations take place and chances of failure is more.



Fig. 2: Snapshot



Fig. 3: Snapshot

So in that situation people uses table fan. It also has some limitations like, in which it can rotate up to 180 degree only, and for that extra rotating mechanism is required. Even it covers less area and also can't give continuous air flow and circulate the air only in the area which is in the plane of blades. The conventional table fan is as shown in fig (4).

Since 360degree fan is available but is like as shown in fig(5) which is not proper solution and even it can't give continuous air flow, and the plane of rotation of air flow is not convenient as it rotates 360 degree on horizontal axis.



Fig. 4: conventional table fan



Fig. 5: Fan

## II. LITERATURE

Main components in our fan are fan blade, shaft, bearing, motor etc. Though fan blades are the most important part. C. Sarraf, H. Nouri, F. Ravelet, F. Bakir (Elsevier Inc.) are the researchers who has researched on the effect of blade thickness on fan's overall performance. They had analyzed

an axial fan with two different thickness of blades and the conclusion is that the thick blade fan is preferable than thin blade fan because with thick blade wider range of flow can be achieved and fluctuations are less compare to thin blade.

So on that basis blade thickness can be decided as per the requirement of flow range.

Though blade shape and its thickness is important part so failure analysis of blade must be considered while designing. WANG Yan-qing, JI Zhe, CUI Yong-li, CUI Chun-zhi, SUN Zhi (Elsevier Inc.) are the researchers who has researched on the failure analysis of air fan blades.

The failure of all 12 blades of an air fan was investigated by metallurgical and mechanical experiments and an examination of the fracture surface. The experimental results show that the cast aluminum-silicon alloy without any modification had a number of material defects, such as coarse grains, a loose structure, a large number of shrinkage holes, a long and thin bold-pin shaped silicon-phase, poor material strength and serious brittleness. In addition, installed on the spindle without elastic conjunction, blade No.10 vibrated and inevitably Spun off due to the large centrifugal force. Therefore, blade No.10 first cracked at the locking handle then broke at the root, which caused all the other 11 blades to be broken by the crack of blade No.10. So the experimental result says that while casting of blade proper method should be used and selection of material is also very important.

### III. PROPOSED WORK

#### A. Design

The main work for our concept is to make the optimum design specially fan blade design and then analyze it that what amount of air flow particular design gives and how much area it covers. Till now we had made many design of blade and checked it on ANSYS 15.0 software for air flow and its direction, area covered and mass flow rate. All designs are made on CREO PARAMETRIC software first in 2D and then in 3D format.

The files of those designs are converted into “iges” format and entered in ANSYS 15.0 software for analysis. After analyzing different designs based upon our requirement we had selected this particular design. The reason behind selecting this particular design is that it fulfills the criteria which are required as direction of flow and plane of its working, mass flow rate etc.

Final design is as shown in fig 6. In which 4 aluminum blades are attached with a hollow mild steel shaft at 90degree. All four blades are given curve as shown in fig 6 because as the air strikes the blade and due to that curve the air tends to collect at center portion of blade. The blades are straight at initial some distance (7) and then bend at angle of 15degree. The reason behind giving that 15degree bend is to circulate the air outside and also to reduce air resistance and power consumption. Main components of the design are blades, shaft, bearing, coupling, motor and stand.

#### B. Blade and Shaft:

All four blades will be made from aluminum due to light weight and high resistance co-efficient. Shaft will be made from mild steel due to high ultimate tensile strength and ultimate shear strength. Shaft will be hollow because hollow shaft are more rigid than solid shaft.

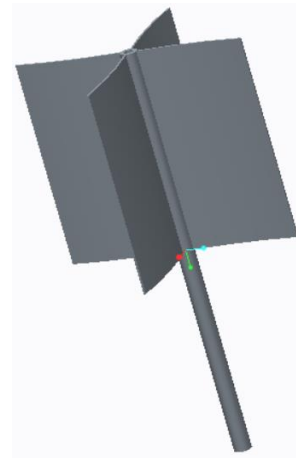


Fig. 6: Fan

#### C. Motor:

0.75 HP single phase induction motor having 1490 rpm, power consumption 60W will be used. Motor will be coupled to the shaft.

#### D. Bearing and coupling:

Two deep groove ball bearing will be used which can withstand the radial load of the shafts and blades. Bearing will be supported by casing. Hollow shaft will be coupled to motor with help of muff coupling which is best suited and easiest method for coupling.

#### E. Analysis

Ansys v15.0 this particular software is used to Analysis Design result for Real time Problem.

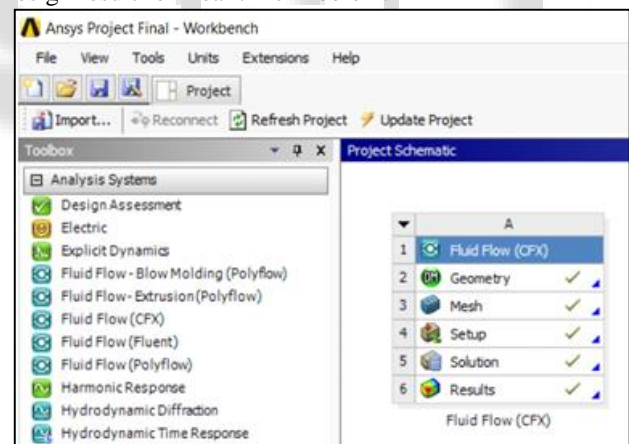


Fig. 7: Ansys v15.0

Here in our Design we have worked on Fluid Flow (CFX). This Process of Analysis is divided into 5 steps as below:

#### F. Geometry:

It includes the Importing or editing of any geometry design and if we don't have any design we can create one in it. Then we go to TOOLS<ENCLOSURE<BOX and UNIFORM.

#### G. Meshing:

In this step we divide the Whole Enclosure Including the Geometry in finite elements using the concept of FES. We have used here Tetrahedron Meshing. And refinement with value as 1.

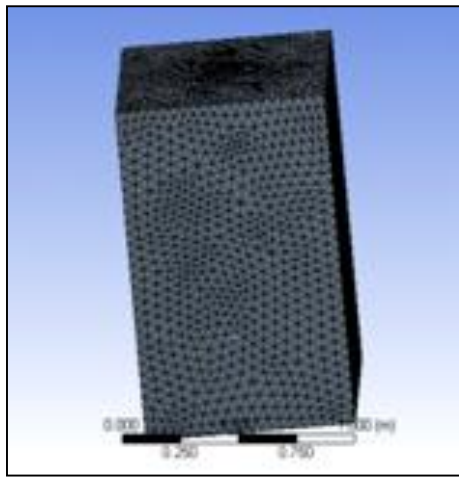


Fig. 8:

H. Setup:

This step includes setting up of the inlet and outlet of the boundary conditions. The parameters are all defined in this step and also the solver controls includes the Iteration Controls.

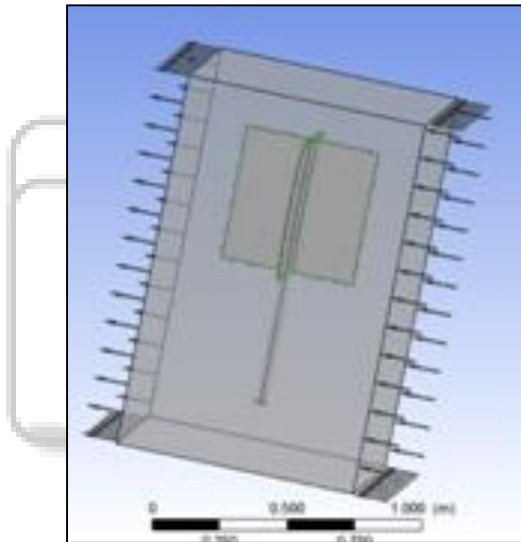


Fig. 9: Graph

I. Solution:

This step includes the solution done by the software itself we did not need to do anything in this process, once inputs are given.

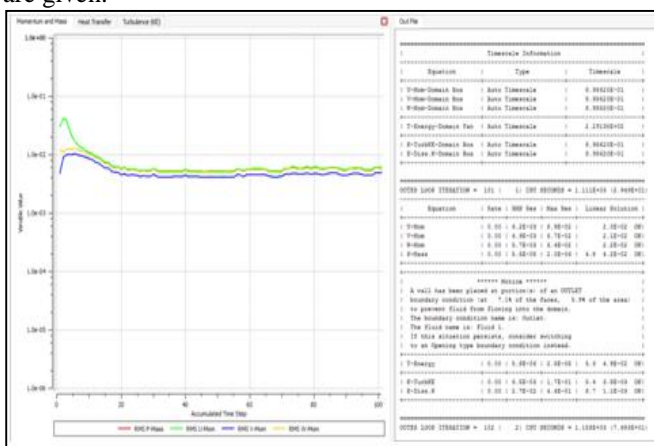


Fig. 10: Snapshot

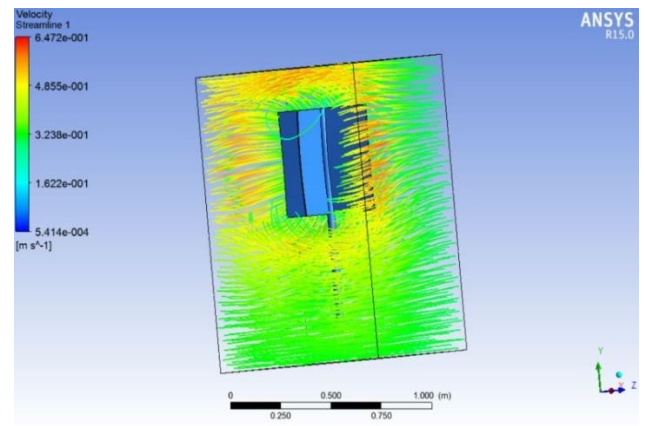


Fig. 11: Snapshot

IV. EXPECTED OUTCOMES

Cooling is necessary now days and with the help of different types of fans available it is quite easy. Using above all the techniques and procedure the ultimate goal is to obtain accurate result for fan which will give continuous air flow at 360degree.

V. CONCLUSION AND FUTURE WORK

This paper represents an efficient way for cooling using vertical axis fan which will give continuous air flow at 360degree at same power input which are given in table or ceiling fan.

Regarding the future work, it can be made more compact and lighter with the help of changing materials ex. Using composite material instead of aluminum, and designing of blade more efficiently, so it can provide more air flow at lower rpm also. We can also use variable speed motors to obtain air flow velocity as per the requirement. As we know fans are the important part for any industry and house hold purpose also, so with modification in design and with compactness it can be produced at larger scale.

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