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Design And Analysis of Fibre Reinforced Composite Ceiling Fan Blade

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ABSTRACT
With the increasing energy crisis in the present and future generations facing in the society, there is a need to reduce and optimize the energy. Though wide range of researches is being done in the areas of alternate energy sources, proper management of the available energy sources will contribute in controlling this energy crisis, particularly in populous countries. Because of enormous use of electric power, electricity storage is main problem throughout the world. Ceiling fan is one of the appliance that consumes electric power. This can be minimized by reducing the weight of the blade. In this work the design and analysis of composite fan blade made up of aramid fibre is carried out by determining the stresses and displacements induced in the composite fan blade.

Keywords: *Aramid fibre; Composite material; Displacements; Stresses; Weight.*

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I. INTRODUCTION

A ceiling fan is a device suspended from the ceiling of a room. Ceiling fan utilize hub-mounted rotating paddles in order to produce a cooling effect as a result of air circulation. A ceiling fan is a device that converts electrical energy into required rotational energy. Normally ceiling fan blades are made of up of steel, wood, etc., In existing ceiling fan blade consumes more power because of the more weight of the blade. The ceiling fan has become an important appliance in domestic as well as in industrial purposes.Though the power consumed by the fan is less, it is considered as that these fans run on continuous duty and this makes the power consumption more significant.

Less power consumption, less weight, effective utilization of natural resourses is main focus of the electrical appliances company in the present days. The above can be achieved by introducing better design concept, better material and better manufacturing process. Aluminium blades are widely used in ceiling fan blade manufacture. It has less density when compared to steel,high corrosion resistance and attractiveness. Despite of many advantages there are some limitations mainly less strength to weight ratio, paint coating problems etc., As a result composites have become a better replacement and mechanical adequate properties and their reduced weight compared to aluminium and other conventional materials.

Composite materials(also called as composites) aren materials made of two are more constituent materials with significantly different physical or chemical properties. The constituents may be identical or may not be identical. When the composites combine with each other (fibres when combine with resin)exhibit different properties. Due to their non-homogenity and non-isotropic behaviour they exhibit different characteristics. Composites are generally completely elastic up to failure exhibit no yield point or a region of plasticity.

Properties of aramid fibre:
Young'smodulus(12=13)=150Gpa
Young'smodulus(23)=4.2Gpa
shearmodulus(12=13)=2.9Gpa
shearmodulus(23)=1.5
Poissonratio(12)=0.35
Poissonratio(23)=0.35
Poissonratio(31)=0.35
volumeoffibre=60%
volumeofmatrix=40%
thickness of blade=0.1cm

II. EXPERIMENTAL TESTS AND DISCUSSION

Cost comparsion
1. Composite blade cost:
Cost of composite blade(1 unit): =Rs. 91/-
Cost of composite blade(3 units): =Rs. 273/-
2. Aluminium blade cost(1 unit): =RS.137/-
Aluminium blade cost(3 units): =Rs.410/-

3. Percentage saving in cost:

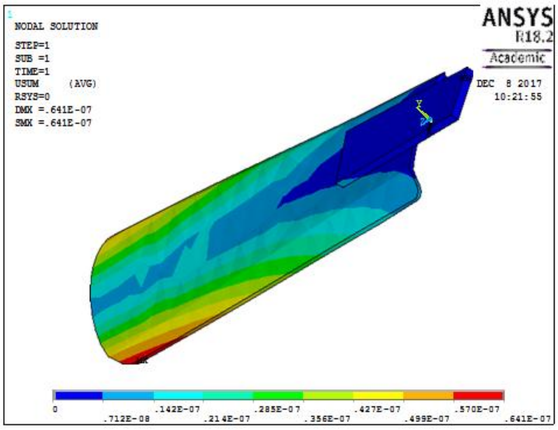
Total cost saved =Rs.137/-

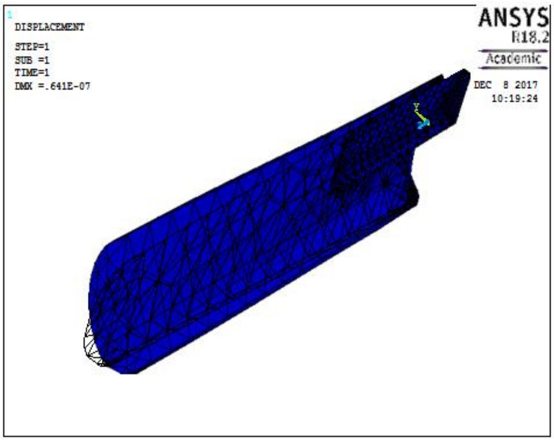
% saving in cost = 33.42 %

It is clear that by replacing aluminium blades with composite fan blades results in a total in a total reduction of 33.42 % in the cost incurred for the blades.

Displacements

The displacements produced in the composite blades are shown below.

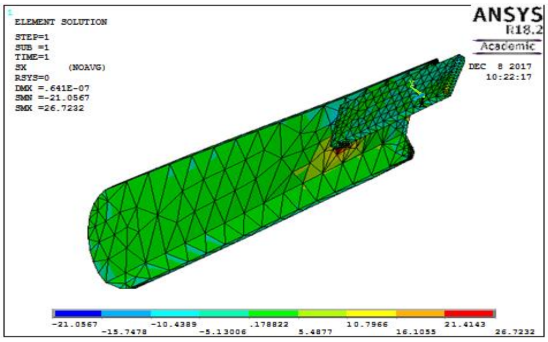




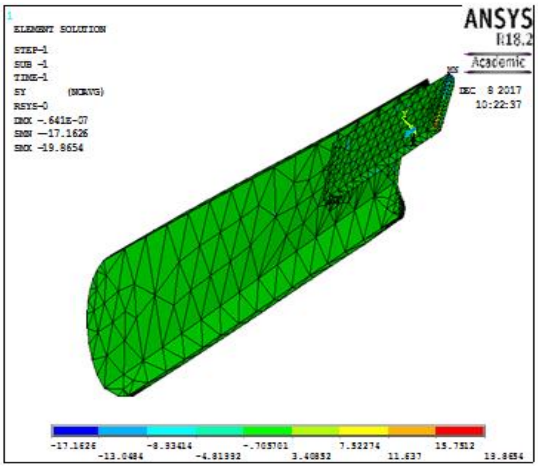
By the above results it is clear that the displacements produced in the ceiling fan blade are less when compared to oter conventional ceiling fan blades as it does not produce any deformation.

Stresses

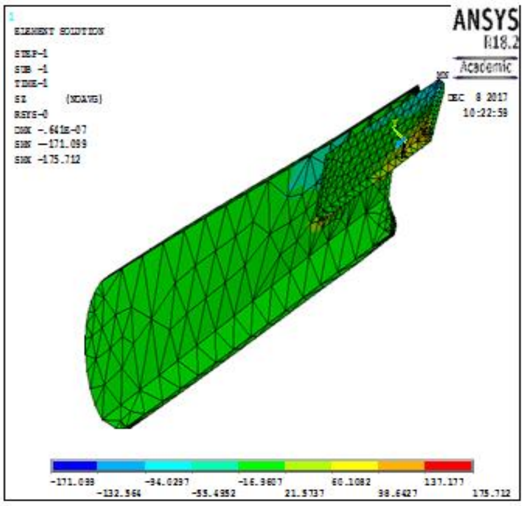
The stresses induced in the composite ceiling fan blade is given below:



Stress along X-direction:

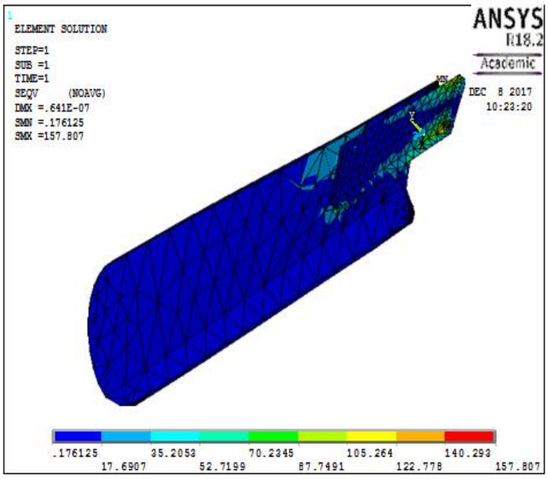


Stress along Y-direction

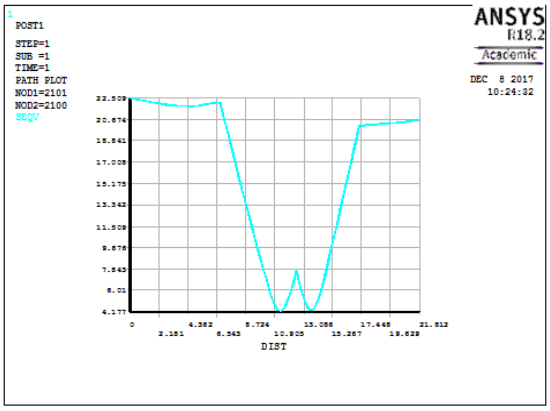


Stress along Z-direction

The resultant VONMISES stresses are given as:



From the above analysis results it is clear that the ceiling fan blade is safe and it does not produce any breaking or failure stresses in the blade.
The plot path of the given composite blade is given by:



III. RESULTS

1. Cost of the ceiling fan blade reduces by imparting fibre polymer in place of existing blades by 33.42 %
2. The displacements produced in the fibre composite is less than the other conventional fan blades.
3. The stresses induced in the in the blades results that the blade is safe.