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Static and Dynamic Analysis of Centrifugal Blower Using Composite Material

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Abstract

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. Rotating impellers increase the speed of the air blowing from other end. They use the kinetic energy of the rotating blade or impeller to increase the pressure and tends to slightly decrease velocity of the air/gas stream which in turn moves them against, dampers and other components which causes the resistance. This project is static and dynamic analysis of centrifugal blowers using composite materials Centrifugal blowers are used in naval applications and motors which have high noise levels. The noise generated by a rotating component is mainly due to random loading force on the blades and periodic iteration of incoming air with the blades of the rotor. The Contemporary blades in naval applications are made up of Aluminum or Steel and generate noise that causes disturbance to the people working near the blower. The present work aims at observing the choice of HM Carbon as an alternative to metal for better vibration control. HM Carbon, known for their superior damping characteristics are more promising in vibration reduction compared to metals. The modeling of the blower was done by Unigraphics. It is proposed to design blower with HM Carbon, analyze its strength and deformation using FEM technique. In order to evaluate the effectiveness of HM Carbon and metal blower using FEA packaged (ANSYS). Modal analysis is performed on both Aluminium and HM Carbon blower to find out first five natural frequencies.

Keywords: ANSYS 14.5, Mesh

Introduction

Centrifugal Bower

Centrifugal blowers look more like centrifugal pumps than fans. The impeller is typically gear-driven and rotates as fast as 15,000 rpm. In multi-stage blowers, air is accelerated as it passes through each impeller. In single-stage blower, air does not take many turns, and hence it is more efficient. Centrifugal blowers typically operate against pressures of 0.35 to 0.70 kg/cm2, but can achieve higher pressures. One characteristic is that airflow tends to drop drastically as system pressure increases, which can be a disadvantage in material conveying systems that depend on a steady air volume. Because of this, they are most often used in applications that are not prone to clogging.

Most manufacturing plants use fans and blowers for ventilation and for industrial processes that need an air flow. Fan systems are essential to keep manufacturing processes working, and consist of a fan, an electric motor, a drive system, ducts or piping, flow control devices, and air conditioning equipment (filters, cooling coils, heat exchangers, etc.). An example system is illustrated in Figure 1. The US Department of Energy estimates that 15 percent of electricity in the US manufacturing industry is used by motors. Similarly, in the commercial sector, electricity needed to operate fan motors composes a large portion of the energy costs for space conditioning (US DOE, 1989). Fans, blowers and compressors are differentiated by the method used to move the air, and by the system pressure they must operate against. The American Society of Mechanical Engineers (ASME) uses the specific ratio, which is the ratio of the discharge pressure over the suction pressure, to define fans, blowers and compressors

Centrifugal pumps are very common equipment used in residence, agriculture and industrial applications. It is essential for a pump manufactured at low cost and consuming less power with high efficiency. The overall performance is based on the impeller parameters and it is essential to identify the optimized design parameter of the impeller. R. Ragoth Singh, and M. Nataraj[1] study the performance of centrifugal pump impeller by developing the vane profile by circular arc method and point by point method and perform CFD analysis of the impeller vane profile for forward and backward curved vane . Adgale Tushar Balkrishna, G.R.Gogate and R.V. Bajaj[2] work on pump reducing vibration levels below permissible levels in Centrifugal blower. Karthik Matta, Kode Srividya and Inturi Prakash[3] are change the material of centrifugal pump impeller and study the effect on the performance of pump by static and modal analysis of same. Energy Efficiency Guide for Industry in Asia[4] study the performance of pump and suggest the energy saving parameter for pump design and design overall pump. C. Kundera and V.A. Martsinkovsky [5] are done static analysis and deriving relationships between the impeller geometry and the basic performance parameters of the pump. A numerical example was used to show the calculation procedure of static characteristics for the predetermined parameters of an impeller for a single-stage pump. Shardul Sunil Kulkarni[6] CFD analysis is currently being used in the design and construction stage of various pump types, the use of which reduces significantly the new pump development time and costs. The scope of present work is to investigate the performance of impeller by developing the vane profile by changing vane outlet angle from standard range 16 to 35 and inlet angle calculate as per design of given data of pump. After designing the pump, pump design check by reverse Designing method for pump mathematically validation method then after check same by using software result and then manufacturing model of same design data and check the same data by experimental method.

Design Of Centrifugal Blower
Solidworks Introduction
Overview of Solid Modeling

The Solidworks Modeling application gives a strong demonstrating framework to empower quick calculated outline. Specialists can join their necessities and outline confinements by characterizing numerical connections between various parts of the plan. Configuration architects can rapidly perform theoretical and point by point plans utilizing the Modeling highlight and requirement based strong modeler. They can make and alter mind

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boggling, reasonable, strong models intuitively, and with far less exertion than more conventional wire edge and strong based frameworks. Highlight Based strong demonstrating and altering capacities enable fashioners to change and refresh strong bodies by specifically altering the measurements of a strong component as well as by utilizing other geometric altering and development systems.

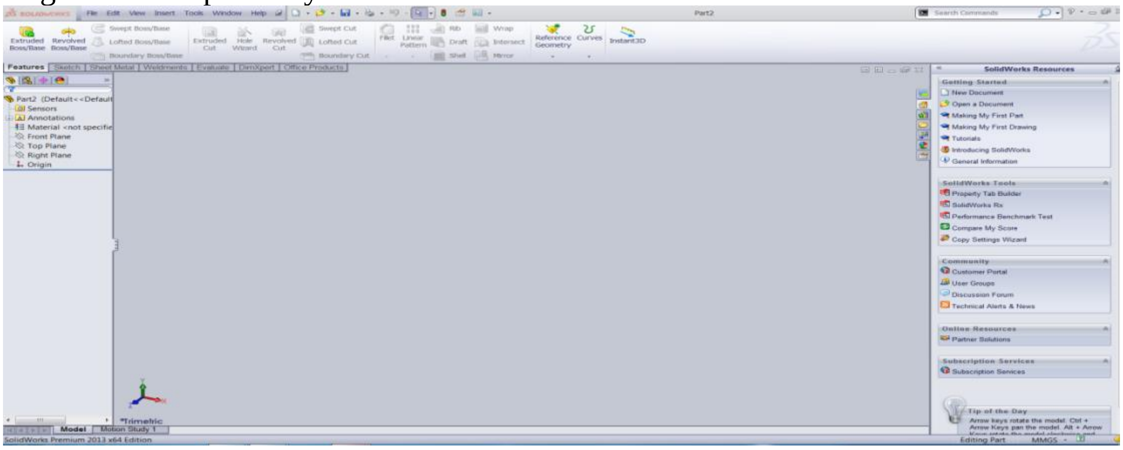


Fig: 1.1 shows the interface of the solidworks

Blending and Chamfering

- zero radius
- Ability to chamfer any edge
- Cliff-edge blends for designs that cannot accommodate complete blend radius but still require blend

General Operation

Start with a Sketch Utilize the Sketcher to freehand a portray, and measurement a "framework" of Curves. Now would then be able to clear the draw utilizing Extruded Body or Revolved Body to make a strong or sheet body. Can later refine the outline to correctly speak to the question of enthusiasm by altering the measurements and by making connections between geometric items. Altering a measurement of the outline adjusts the geometry of the draw, as well as the body made from the portray.

- **Creating and Editing Features**
  Highlight Modeling gives a chance to make highlights, for example, openings, spaces and sections on a model. Now engineer would then be able to specifically alter the measurements of the component and find the element by measurements. For instance, a Hole is characterized by its measurement and length. Engineer can straightforwardly alter these parameters by entering new qualities. Engineer can make strong collections of any coveted plan that can later be characterized as a frame includes utilizing User Defined Features. This gives Engineer a chance to make Engineer own particular custom library of shape highlights.
- **Associativity**
  Cooperatively is a term that is utilized to show geometric connections between singular parts of a model. These connections are built up as the originator utilizes different capacities for display creation. In an affiliated model, limitations and connections are caught naturally as the model is produced. For instance, in an acquainted model, a through opening is related with the appearances that the gap enters. In the event that the model is later changed so either of those faces moves, the gap refreshes consequently because of its relationship with the countenances. See Introduction to Feature Modeling for extra points of interest.

- **Positioning a Feature**

Inside Modeling, Engineer can position an element in respect to the geometry on Engineer model utilizing Positioning Methods, where Engineer position measurements. The element is then connected with that geometry and will keep up those affiliations at whatever point Engineer alter the model. Engineer can likewise alter the situation of the element by changing the estimations of the situating measurements.

- **Reference Features**

Engineer can make reference highlights, for example, Datum Planes, Datum Axes and Datum CSYS, which Engineer can use as reference geometry when required, or as development gadgets for different highlights. Any component made utilizing a reference highlight is related to that reference include and holds that relationship amid alters to the model. Engineer can utilize a datum plane as a source of perspective plane in building outlines, making highlights, and situating highlights. Engineer can utilize a datum hub to make datum planes, to put things concentrically, or to make spiral examples.

- **Expressions**

The Expressions apparatus gives Engineer a chance to fuse Engineer prerequisites and plan limitations by characterizing numerical connections between various parts of the outline. For instance, Engineer can characterize the tallness of a supervisor as three times its distance across, so when the breadth changes, the stature changes too.

- **Boolean Operations**

Displaying gives the accompanying Boolean Operations: Unite, Subtract, and Intersect. Join consolidates bodies, for instance, joining two rectangular squares to frame a T-molded strong body. Subtract expels one body from another, for instance, expelling a barrel from a square to shape a gap. Meet makes a strong body from material shared by two strong bodies. These activities can likewise be utilized with free frame highlights called sheets.

- **Undo**

Engineer can restore a plan to a past express any number of times utilizing the Undo work. Engineer don't need to take a lot of time ensuring every activity is completely right, in light of the fact that a slip-up can be effortlessly fixed. This flexibility to effortlessly change the model gives Engineer a chance to stop stressing over missing the point, and liberates Engineer to investigate more conceivable outcomes to take care of business.

- **Additional Capabilities**

Different UNIGRAPHICS NX applications can work straightforwardly on strong articles made inside Modeling with no interpretation of the strong body. For instance, Engineer can perform drafting, designing investigation, and NC machining capacities by getting to the suitable application. Utilizing Modeling, Engineer can plan an entire, unambiguous, three dimensional models to depict a question. Engineer can extricate an extensive variety of physical properties from the strong bodies, including mass properties. Shading and concealed line abilities enable Engineer to picture complex gatherings. Engineer can distinguish obstructions consequently, wiping out the need to endeavor to do as such physically. Concealed edge perspectives can later be created and put on illustrations. Completely cooperative dimensioned illustrations can be made from strong models utilizing the proper choices of the Drafting application. In the event that the strong model is altered later, the illustration and measurements are refreshed consequently.

- **Parent/Child Relationships**

  On the off chance that a component relies upon another question for its reality, it is a tyke or ward of that protest. The question, thusly, is a parent of its youngster include. For instance, if a HOLLOW (1) is made in a BLOCK (0), the square is the parent and the empty is its child. A parent can have in excess of one youngster, and a kid can have in excess of one parent. A component that is a kid can likewise be a parent of different highlights. To see the majority of the parent-youngster connections between the highlights in work part, open the Part Navigator.

Creating a Solid Model

Displaying furnishes the plan build with instinctive and happy with demonstrating systems, for example, drawing, include based displaying, and measurement driven altering. A magnificent method to start a plan idea is with a draw. When Engineer utilize an outline, an unpleasant thought of the part ends up spoke to and compelled, in view of the fit and capacity necessities of Engineer plan. Along these lines, Engineer plan aim is caught. This guarantees when the plan is passed down to the following level of building, the essential necessities are not lost when the outline is altered.

The technique Engineer use to make and alter Engineer model to frame the coveted protest relies upon the shape and many-sided quality of the question. Engineer will probably utilize a few unique strategies amid a work session. The following a few figures outline one case of the plan procedure, beginning with a portray and closure with a completed model. To begin with, Engineer can make a draw "diagram" of bends. At that point Engineer can clear or pivot these bends to make a perplexing bit of Engineer plan.

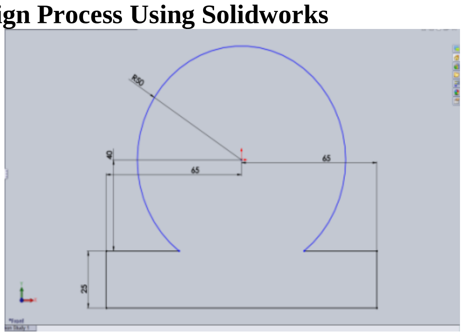
Introduction to Drafting

The Drafting application is intended to enable Engineer to make and keep up an assortment of illustrations produced using models created from inside the Modeling application. Illustrations made in the Drafting application are completely affiliated to the model. Any progressions made to the model are consequently reflected in the illustration. This associativity enables Engineer to roll out the same number of model improvements as Engineer wish. Other than the ground-breaking associativity usefulness, Drafting contains numerous other helpful highlights including the accompanying:

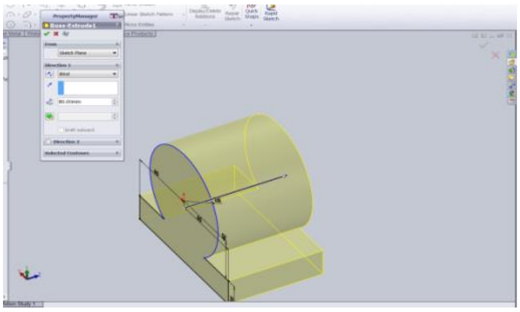
- An intuitive, easy to use, graphical user interface. This allows Engineer to create drawings quickly and easily.
- A drawing board paradigm in which Engineer work "on a drawing." This approach is similar to the way a drafter would work on a drawing board. This method greatly increases productivity.
- Support of new assembly architecture and concurrent engineering. This allows the drafter to make drawings at the same time as the designer works on the model.
- The capability to create fully associative cross-sectional views with automatic hidden line rendering and crosshatching.
- Automatic orthographic view alignment. This allows Engineer to quickly place views on a drawing, without having to consider their alignment.
- Automatic hidden line rendering of drawing views.
- The ability to edit most drafting objects (e.g., dimensions, symbols, etc.) from the graphics window. This allows Engineer to create drafting objects and make changes to them immediately.
- On-screen feedback during the drafting process to reduce rework and editing.
- User controls for drawing updates, which enhance user productivity.

Finally, Engineer can add form features, such as chamfers, holes, slots, or even user defined features to complete the object.

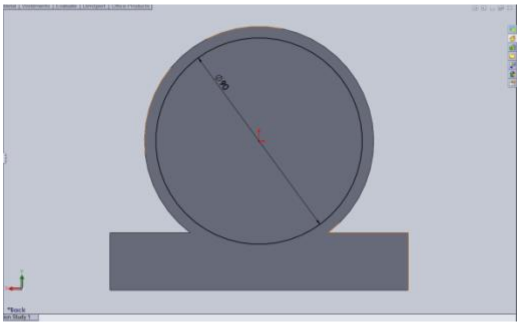
Design Process Using Solidworks



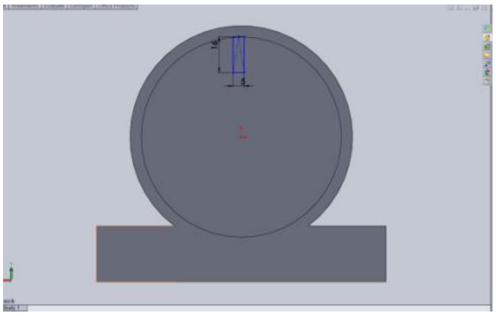
3.1 2D Sketch of blower



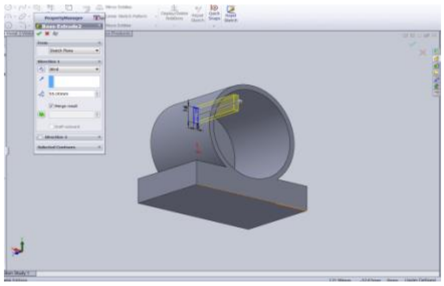
3.2 Extrude of 2D Sketch of blower



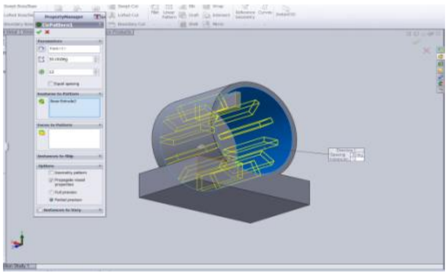
3.3 2D Sketch of blower



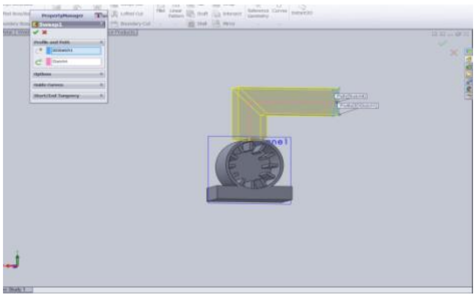
3.4 2D Sketch of blower



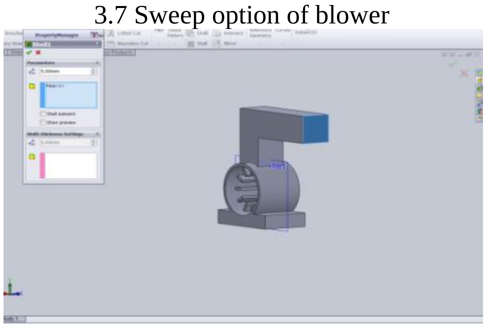
3.5 Extrude of 2D Sketch of blower



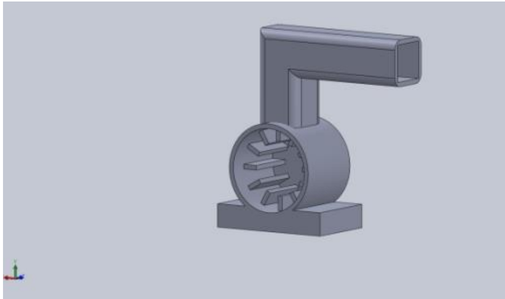
3.6 Circular pattern of blower



3.7 Sweep option of blower



3.8 Shell of blower



3.9 Final model of blower

Materials For Centrifugal Blower
Composite Material:

A composite is a material that is formed by combining two or more materials to achieve some superior properties. Almost all the materials which we see around us are composites. Some of them like woods, bones, stones, etc. are natural composites, as they are either grown in nature or developed by natural processes. Wood is a fibrous material consisting of thread-like hollow elongated organic cellulose that normally constitutes about 60-70% of wood of which approximately 30-40% is crystalline, insoluble in water, and the rest is amorphous and soluble in water. Cellulose fibres are flexible but possess high strength. The more closely packed cellulose provides higher density and higher strength. The walls of these hollow elongated cells are the primary load-bearing components of trees and plants. When the trees and plants are live, the load acting on a particular portion (e.g., a branch) directly influences the growth of cellulose in the cell walls located there and thereby reinforces that part of the branch, which experiences more forces. This self-strengthening mechanism is something unique that can also be observed in the case of live bones. Bones contain short and soft collagen fibres i.e., inorganic calcium carbonate fibres dispersed in a mineral matrix called apatite. The fibres usually grow and get oriented in the direction of load. Human and animal skeletons are the basic structural frameworks that support various types of static and dynamic loads. Tooth is a special type of bone consisting of a flexible core and the hard enamel surface. The compressive strength of tooth varies through the thickness. The outer enamel is the strongest with ultimate compressive strength as high as 700MPa. Tooth seems to have piezoelectric properties i.e., reinforcing cells are formed with the application of pressure. The most remarkable features of woods and bones are that the low density, strong and stiff fibres are embedded in a low density matrix resulting in a strong, stiff and lightweight composite (Table 1.1). It is therefore no wonder that early development of aero-planes should make use of woods as one of the primary structural materials, and about two hundred million years ago, huge flying amphibians, pterendons and pterosaurs, with wing spans of 8-15 m , could soar from the mountains like the present day hang-gliders. Woods and bones in many respect, may be considered to be predecessors to modern man-made composites.

Early men used rocks, woods and bones effectively in their struggle for existence against natural and various kinds of other forces. The primitive people utilized these materials to make weapons, tools and many utility-articles and also to build shelters. In the early stages they mainly utilized these materials in their original form. They gradually learnt to use them in a more efficient way by cutting and shaping them to more useful forms. Later on they

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utilized several other materials such as vegetable fibres, shells, clays as well as horns, teeth, skins and sinews of animals.

performance and absence of strong need for mass reduction. Researches in the area of automobile components have been receiving considerable attention now. Particularly the automobile manufacturers and parts makers have been attempting to reduce the weight of the vehicles in recent years. Emphasis of vehicles weight reduction in 1978 justified taking a new look at composite springs. Studies are made to demonstrate viability and potential of FRP in automotive structural application. The development of a lit flex suspension leaf spring is first achieved. Based on consideration of chipping resistance base part resistance and fatigue resistance, a carbon glass fiber hybrid laminated spring is constructed. A general discussion on analysis and design of constant width, variable thickness, and composite leaf spring is presented. The fundamental characteristics of the double tapered FRP beam are evaluated for leaf spring application. Recent developments have been achieved in the field of materials improvement and quality assured for composite leaf springs based on microstructure mechanism. All these literature report that the cost of composite; leaf spring is higher than that of steel leaf spring. Hence an attempt has been made to fabricate the composite leaf spring with the same cost as that of steel leaf spring.

Miravete.A, Castejon. L, Bielsa.J, Bernal.E - Analysisand Prediction of large composite Structures, 1990. Material properties and design of composite structures are reported in many literatures. Very little information is available in connection with finite element analysis of leaf spring in the literature, than too in 2D analysis of leaf spring. At the same time, the literature available regarding experimental stress analysis more.The experimental procedures are described in national and international standards. Recent emphasis on mass reduction and developments in materials synthesis and processing technology has led to proven production worthy vehicle equipment..

For automobiles: 50Cr 1, 50 Cr 1 V 23, and 55 Si 2 Mn 90 all used in hardened and tempered state. For rail road springs: C 55 (water - hardened), C 75 (oil-hardened), 40 Si 2 Mn 90 (water-hardened) and 55 Si 2 M N90 (oil-hardened).

Selection of Composite Material

The ability to absorb and store more amount of energy ensures the comfortable operation of a suspension system. However, the problem of heavy weight of spring is still persistent when using steel leaf spring. This can be remedied by introducing composite material instead of steel which is normally used in the conventional leaf spring. It is well known that springs are designed to absorb and store energy and then release it. Hence, the strain energy of the material becomes a major factor in designing the springs. The relationship of the specific strain energy can be expressed as

$$U = \sigma^2 / \rho E$$

where σ^2 is the strength, ρ
the density and E is the Young's modulus of the spring material. It can be easily observed that material having lower modulus and density will have a greater specific strain energy

capacity. Research has indicated that E-Glass/Epoxy has good characteristics for storing specific strain energy. Hence, E Glass/ Epoxy is selected as the composite material

Applications:
Commercial and industrial applications of composite s are so varied that it is impossible to list them all. The major structural application areas, which include aircraft, space, automotive, sporting goods, and marine engineering. A potential for weight saving with composites exists in many engineering field. The first major structural application of composite is the corvette rear leaf spring in 1981. A uni- leaf E-glass – reinforced epoxy has been used to replace a ten-leaf steel spring with nearly an 80 % weight savings.Other structural chassis components, such as drive shafts and road wheels, have been successfully tested in the laboratories and are currently being developed for future cars and vans. The metal matrix composites containing either continuous or discontinuous fiber reinforcements, the latter being in the form of whiskers that are approximately 0.1- 0.5 μm in diameter and have a length to diameter ratio up to 200.Particulate-reinforced metal matrix composites containing either particles or platelet that ranges in size from 0.5 to 100 μm. Dispersion-strengthened metal matrix composites containing particles that are less than 0.1 μm in diameter. And metal matrix composites are such as directionally solidified eutectic alloys. Benefits: i. Weight reduction, ii. High strength, iii. Corrosiveness, iv. Low specific gravity.

Materials for leaf spring
Analysis of HM Carbon/Epoxy Composite FEM Model details
Mechanical properties:
Metallic blower and
Composite blower
ii) Material properties of composite blower : (HM Carbon/Epoxy)

property	Value	
Young's modulus E	EX	14000 MPa
	EY	
	EZ	8800 MPa
Poisson's ratio	NUXY	0.13
	NUYZ	0.39
	NUZX	
Mass density	1750 $kg/m3$	
Damping co-efficient	0.02	

Failure Analysis of Centrifugal Blower
Static analysis
Procedure for Static analysis in ANSYS14.5 Build the FE model as shown fig Define the material properties such as young’s modulus and density etc., Apply boundary condition and pressures as given. Solve the problem using current LS command from the tool bar.
Procedure for modal analysis in ANSYS14.5 Build the FE model explained in fig Define the material properties such as young’s modulus and density etc., Apply boundary condition as given. Enter the ANSYS14.5 solution processor in which analysis type is taken as modal analysis, and „by taking mode extraction method, by defining number of modes to be

extracted. Solution method is chosen as Block lanczos method. Solve the problem using LS command tool bar.
Procedure for harmonic analysis in ANSYS Build the FE model explained in fig. Material properties such as Young's modulus and density are defined. Apply the constraints and pressure as explained as given. Enter the ANSYS solution processor in which new analysis is chosen as harmonic response and solution method. For this analysis the solution technique used is frontal solver. By defining the frequency range as 0-500 HZ with 150 sub-steps. Solve the problem using current LS command tool bar and obtain the results.

Dynamic Analysis vs. Static Analysis

Dynamic analysis is the testing and evaluation of an application during runtime.

Static analysis is the testing and evaluation of an application by examining the code without executing the application.

Many software defects that cause memory and threading errors can be detected both dynamically and statically. The two approaches are complementary because no single approach can find every error. The primary advantage of dynamic analysis: It reveals subtle defects or vulnerabilities whose cause is too complex to be discovered by static analysis. Dynamic analysis can play a role in security assurance, but its primary goal is finding and debugging errors. The primary advantage of static analysis: It examines all possible execution paths and variable values, not just those invoked during execution. Thus static analysis can reveal errors that may not manifest themselves until weeks, months or years after release. This aspect of static analysis is especially valuable in security assurance, because security attacks often exercise an application in unforeseen and untested ways. Intel® Inspector generates dynamic analysis results to help you find and fix memory and threading errors. You can also use the Intel Inspector to visualize and manage static analysis results created by Intel® compilers in various Intel studio products.

Dynamic Analysis Is Critical to Application Security
Dynamic analysis is the testing and evaluation of a program by executing data in real-time. The objective is to find security errors in a program while it is running. Veracode's dynamic analysis testing empowers companies to identify and remediate security issues in their running web applications before hackers can exploit them. By dynamically testing web applications in a run-time environment, Veracode inspects applications the same way a hacker would attack them – providing the most accurate and actionable vulnerability detection available.

Dynamic Analysis Testing
A Dynamic analysis test communicates with a web application through the web front-end in order to identify potential security vulnerabilities and architectural weaknesses in the web application. Unlike source code scanners, a dynamic analysis program doesn't have access to the source code and therefore detects vulnerabilities by actually performing attacks.

A dynamic analysis security scanner can facilitate the automated detection of security vulnerabilities within a web application. A dynamic analysis test is often required to comply with various regulatory requirements. Dynamic analysis scanners can look for a wide variety of vulnerabilities, including:

- Input/output validation: (Cross-Site Scripting, SQL Injection, etc.)
- Specific application problems
- Server configuration mistakes/errors

Dynamic Analysis Benefits Using Veracode

- A dynamic analysis tool can detect vulnerabilities of the finalized release candidate before shipping.
- A dynamic analysis tool simulates a malicious user by attacking and probing, and seeing what results are not part of the expected result set.
- As a dynamic testing tool, it is not language dependent. A web application scanner is able to scan JAVA/JSP, PHP or any other engine-driven web application.
- Report of critical vulnerabilities discovered is delivered, complete with accompanying information to enable development and QA teams to recreate flaws.
- Detailed remediation information on how to fix the flaws is provided.
- Guidance is provided on proactive steps to drive longer-term strategies that organizations can adopt to improve overall application security across their software portfolio.

Advanced Dynamic Analysis to Find Hidden Issues

Veracode's dynamic analysis security scanning analyzes the data and content of information presented by the application in order to find hidden security issues that are missed by other products. Veracode dynamic analysis looks "inside" of directories, debug code, leftover source code and resource files to find hidden username/passwords, SQL strings, ODBC connectors and other sensitive information that hackers can exploit to gain unauthorized access to your application.

Full Integration With Static Analysis

Unlike "stand-alone" web scanners, Veracode is the only dynamic analysis provider to incorporate both static and dynamic testing as a single offering. Veracode's dynamic web application testing is integrated with our patented static binary analysis, which enables enterprises to fully test their applications using multiple assessment methods to provide a single set of convergent results, ratings and reports.

Dynamic analysis using SOLIDWORKS Simulation enables designers and engineers to quickly and efficiently determine the impact of time varying loads on the structural response of their product design to ensure performance, quality, and safety.

Tightly integrated with SOLIDWORKS CAD, dynamic analysis using SOLIDWORKS Simulation can be a regular part of your design process, reducing the need for costly prototypes, eliminating rework and delays, and saving time and development costs.

Dynamic Analysis Overview

Dynamic analysis can incorporate frequency, impact, and drop tests. The primary unknown in a dynamic analysis is component displacement over time, but with this calculated, stresses, velocities, and accelerations can also be determined together with the natural modes of vibration.

SOLIDWORKS Simulation uses one of two methods for dynamic analysis:

- Linear modal analysis determines the natural modes of vibration and then the displacements, stresses, strains, velocities, and accelerations.
- Nonlinear dynamic analysis calculates the displacement field at every time step, given the applied loads and initial component velocities. From this field, the nonlinear stresses, strains, velocities, and accelerations are calculated.

Element Selection and Material Behavior
J-Integral or stress-intensity evaluation (accessed via the **CINT** command) supports the following elements:
• PLANE182
• PLANE183
• SOLID185 13 • SOLID186
• SOLID187

J-Integral or stress-intensity evaluation supports the following material behavior:
• Linear isotropic elasticity
• Isotropic Plasticity

FEA Modeling of Composite centrifugal Blower:
i) Project Description:
The assembly model consists of all parts.
The element type used is solid 186. Hexahedral mesh has been used.
Static and dynamic loads are applied on the blower
The load has applied in the different cases.
➢ Modeling 2-D Linear Elastic Fracture Problems
➢ Modeling 3-D Linear Elastic Fracture Problems

i) Modeling 2-D Linear Elastic Fracture Problems

The recommended element type for a 2-D fracture model is PLANE183, the 8-node quadratic solid. The first row of elements around the crack tip should be singular, as illustrated in. The PREP7 preprocessor's **KSCON** command (**Main Menu> Preprocessor>Meshing> Size Cntrls>Concentrat KPs> Create**), which assigns element division sizes around a keypoint, is particularly useful in a fracture model. It automatically generates singular elements around the specified keypoint. Other fields on the command allow you to control the radius of the first row of elements, the number of elements in the circumferential direction, and more.
Software Used: ANSYS 14.5
STATIC ANALYSIS OF CENTRIFUUGAL BOWER USING HM CARBON/EPOXY
Material properties
Longitudinal Modulus (E_Z): **14 GPa**
Transverse Modulus (EY): **8.8 GPa**

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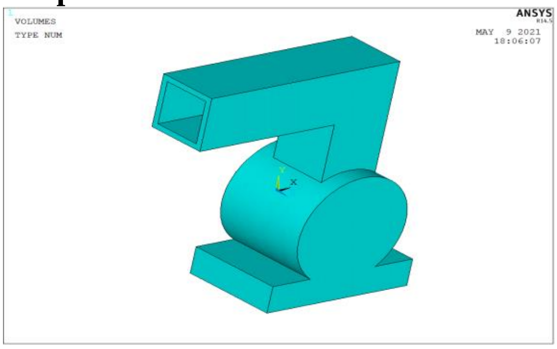
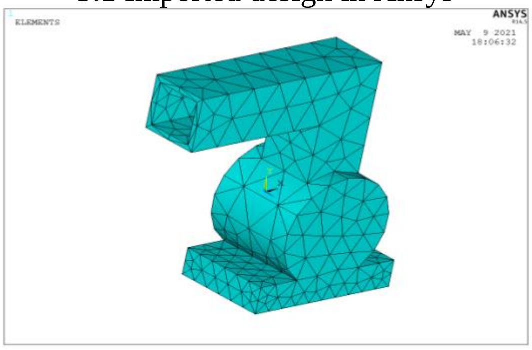
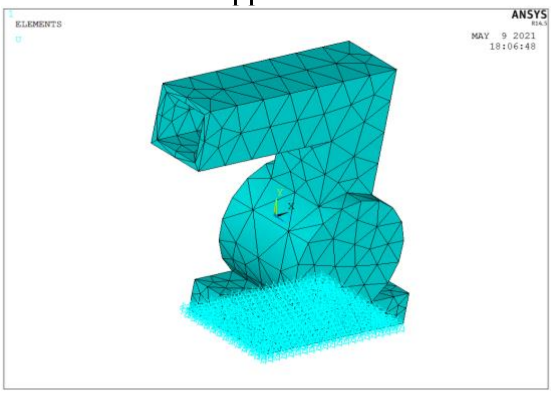
Shear modulus (G_{xy}): **4.2 GPa**
Shear modulus (G_{yz}): **4.2 GPa**
Shear modulus (G_{xz}): **4.2 GPa**
Poisson's Ratio: **0.3**
Density: **1750 Kg/m3**
Ply orientation: **-45º, 0º, 0º, 45º**
Yield strength: **800 Mpa**



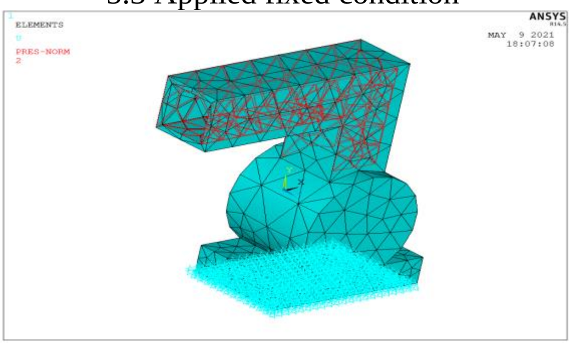
5.1 Imported design in Ansys



5.2 Applied mesh



5.3 Applied fixed condition



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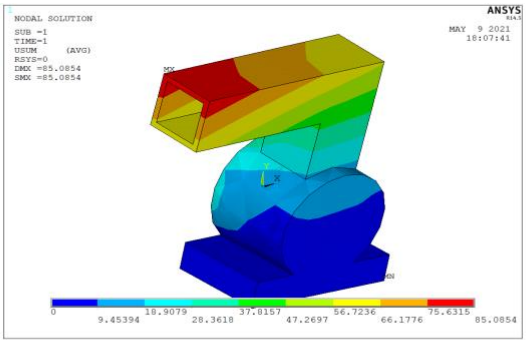
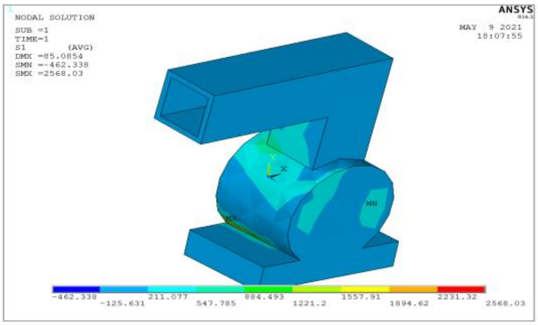
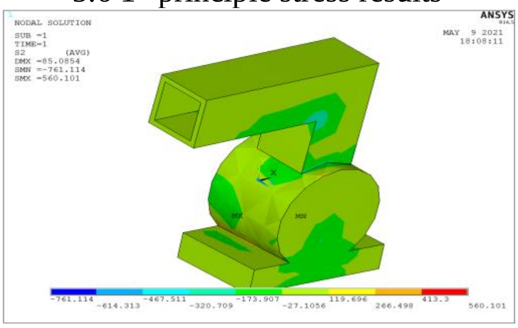
5.4 Applied pressure 2MP



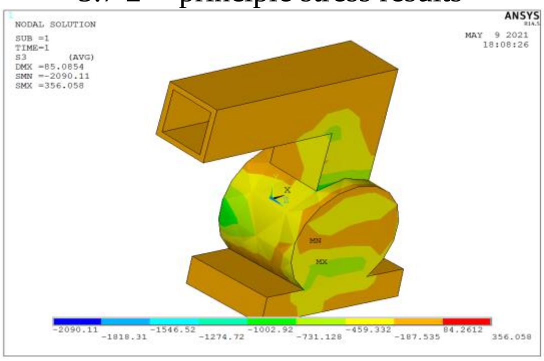
5.5 Deformation results



5.6 1st principle stress results



5.7 2nd principle stress results



5.8 3rd principle stress results

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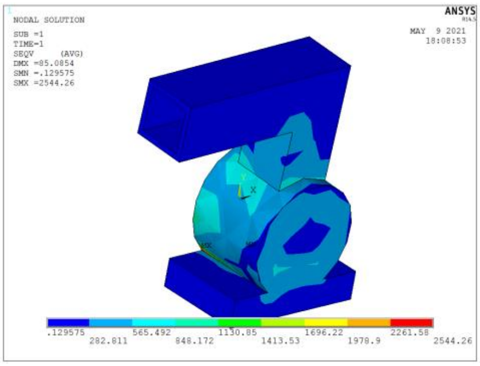

5.9 Vonmises stress results

Modal Analysis Of Centrifugal Blower

<u>Model Analysis Introduction:</u>

A modular examination decides the vibration attributes (common frequencies and mode shapes) of a structure or a machine segment. It can likewise fill in as a beginning stage for another, more definite, unique examination, for example, a transient powerful investigation, a consonant investigation, or a range examination. The common frequencies and mode shapes are essential parameters in the outline of a structure for dynamic stacking conditions. Now can likewise play out a modular investigation on a pre-focused on structure, for example, a turning turbine sharp edge. On the off chance that there is damping in the structure or machine segment, the framework turns into a damped modular investigation. For a damped modular framework, the characteristic frequencies and mode shapes end up complex. For a pivoting structure or machine segment, the gyroscopic impacts coming about because of rotational speeds are brought into the modular framework. These impacts change the framework's damping. The damping can likewise be changed when a Bearing is available, which is a typical help utilized for pivoting structure or machine part. The development of the normal frequencies with the rotational speed can be examined with the guide of Campbell Diagram Chart Results. A Model investigation can be performed utilizing the ANSYS, Samcef, or ABAQUS solver. Any distinctions are noted in the areas underneath. Rotor dynamic investigation isn't accessible with the Samcef or ABAQUS solver**.**

POINTS TO PERFORM:

The Rotational Velocity stack isn't accessible in Model investigation when the examination is connected to a Static Structural examination.

Pre-focused on Model investigation requires playing out a Static Structural examination first. In the modular investigation can utilize the Initial Condition question point to the Static Structural examination to incorporate pre-push impacts**Material properties**

Longitudinal Modulus (E_Z): **14 GPa**
Transverse Modulus (EY): **8.8 GPa**
Shear modulus (G_{xy}): **4.2 GPa**
Shear modulus (G_{yz}): **4.2 GPa**
Shear modulus (G_{xz}): **4.2 GPa**
Poisson's Ratio: **0.3**
Density: **1750 Kg/m3**
Ply orientation: **-45^o, 0^o, 0^o, 45^o**
Yield strength: **800 Mpa**

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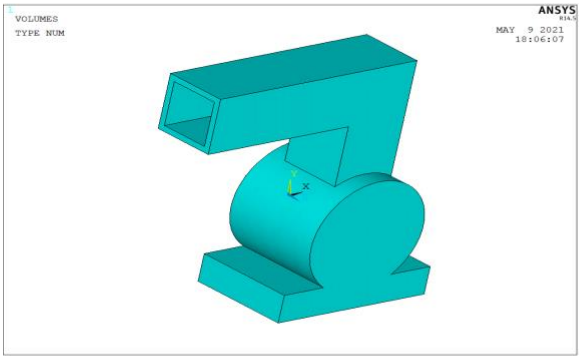
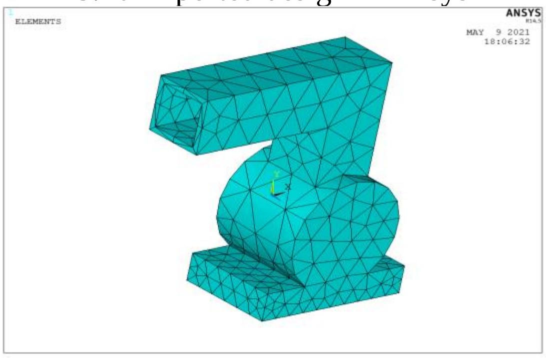
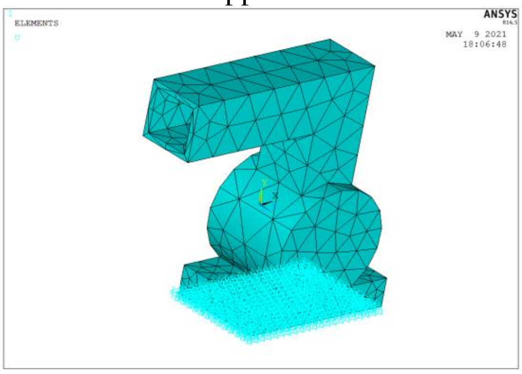


5.10 Imported design in Ansys

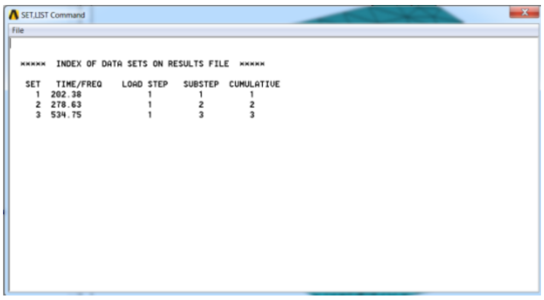


5.11 Applied mesh



5.12 Applied fixed condition

Frequency results



SET,LIST Command

File

***** INDEX OF DATA SETS ON RESULTS FILE *****

SET	TIME/FREQ	LOAD STEP	SUBSTEP	CUMULATIVE
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2	278.63	1	2	2
3	534.75	1	3	3

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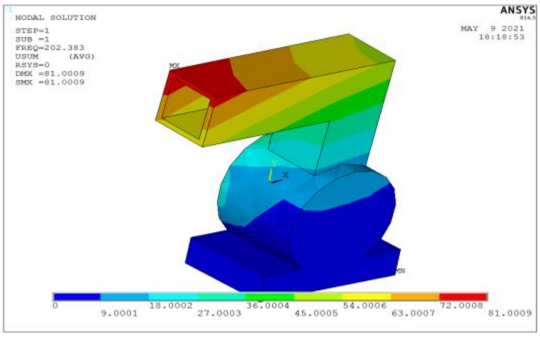
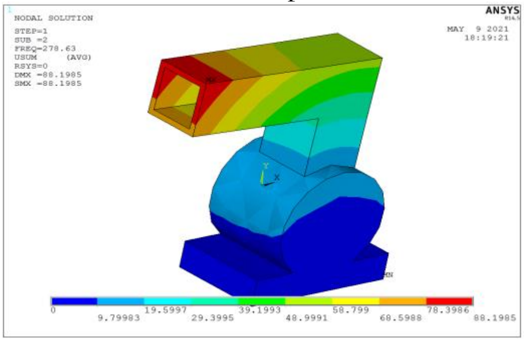
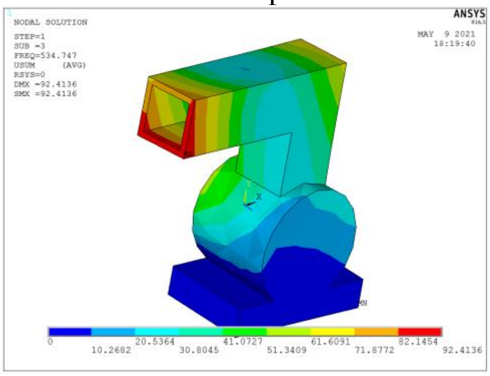


5.13 Mode shape1 results



5.14 Mode shape2 results



5.15 Mode shape3 results

Results And Conclusion

In this project mainly focused on improving Centrifugal blower with composite material using Ansys software. In this project modal analysis of blower was studied briefly to finding natural frequencies (vibration characters).

Results

Results of static and modal analysis of blower is given below. And also related graphs are plotted below

MATERIAL	DEFORMATION(mm)	VONMISESS STRESS(MPa)
HM CARBON/EPOXY	85	565

Table: 01 Static analysis results

MODEL ANALYSIS RESULTS

Initial Freq   Max Freq

MATERIAL	INITIAL FREQUENCY(Hz)	MAXIMUM FREQUENCY(Hz)
HM CARBON/EPOXY	202 HZ	535 HZ

Table: 02 Modal analysis results

CONCLUSION

The Stresses of HM Carbon/Epoxy blower obtained in static analysis are within the allowable stress limits. From analysis results concluded that blower with composite HMCarbon/Epoxy material produced less stress (which is less than ultimate stress) and less frequency range (less noise) in operating conditions. Hence considered material is safe for development of blower.

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