MODELLING AND ANALYSIS OF MACHINING FIXTURE FOR ROTOR BLADE ON FOUR AXIS VERTICAL MACHINING CENTRE

A.SHIRISHA
14R31D0407, M.Tech, Nova College Of Engoneering And Technology, Jafferguda, Hayatnagar, Hyderabad

Dr. D.RAMESH
Principal, Nova College Of Engoneering And Technology, Jafferguda, Hayatnagar, Hyderabad

ABSTRACT

This Project presents the Modelling and Analysis of Machining Fixture for Rotor Blade on 4 Axis Vertical Machining Centre (VMC) machine. Fixture is necessary to hold parts for manufacturing, assembly and inspection. Fixtures should ideally be simple, inexpensive, lightweight and modular. The fixture was designed on the lines of low cost and high durability. It was also designed on the lines of easy pick and place of the components. Vent holes were also provided for allowing a smooth and noise free operation by allowing the air to escape to the surroundings. Locating accuracy and machined part quality tested and found that the fixture is as good as any dedicated fixture in production.

After a study of input data like Part drawing, Assembly drawing, tolerances and critical dimensions the fixture modelling is done. For this purpose, CAD software Pro-Engineer is utilized. Solid models of individual components are created and assembled, for analysis

The component namely the rotor blade is to be located and fixed in the assembly. The forces applied on the rotor blade are due to machining and are applied on the Fixture plate. The resulting displacements and stresses are determined by using Solid works software.

Another important aspect in designing the fixture is to reduce non production time i.e. setup time. In the designed fixture there is 50% reduction in setup time than previous fixture setup and also reducing operator fatigue to minimum.

INTRODUCTION:

This project is intended to design and develop a machining fixture for rotor blade. Machining fixture requires systematic design to clamp, hold and guide the tool during machining process. Using the design data and geometry of the component fixture is designed to hold the part with less time for loading and unloading the part.

Machining Fixtures:

The obvious place for Fixtures is in mass production, where large quantity of output offers ample opportunity for recovery of the necessary investment. It is a special tool used for locating and firmly holding a workspace in the proper position during a manufacturing operation. As a general rule it is provided with devices for supporting and clamping the work piece. It is fixed to the machine bed by clamping in such a position that the work in the correct relationship to the machine tool elements.

These are the devices, which accelerate the production particularly with 100% interchangeable parts.

Purpose of Machining Fixtures:

The main purpose of the fixture is to locate the work quickly and accurately, Support it properly and hold it securely, thereby ensuring that all parts produced in the fixture will come out alike within the specified limits. In this way accuracy and interchange ability of the parts are provided.

By maintaining or even improving the interchange ability of the parts, a jig or fixture contributes to a considerable reduction in the cost of assembly, maintenance and the subsequent the potential of standard machines and the quality of the parts are produced. One important goal, to design a fixture in such a way as to make it foolproof, and there by contribute to added safety for the operator as well as for the machine tools and other parts being used.

OBJECTIVE:

The high competition in the automobile industries leads to the ones survival. With this the company plans for more innovation and increase in production.

When the productivity increases, the work should be more with a greater speed i.e., all the assemblies, sub-assemblies should be done with in the stipulated amount of time allotted to the operator. Fixturing reduces the chances of mistake and in the same manner increases the productivity of manufacturing of the item

- To locate & hold part accurately while operation is being done.
- To increase the productivity of manufacturing
- To avoid the mistakes
- To ensure the safety of operator & making operation easier.
- To ensure the consistency of quality i.e. precise manufacturing.

BASICS OF THE FIXTURE DESIGN:

Orientation of the part:

Fixture design should be such as to maintain the required orientation of the part. Final assembly of the part will be only ensured after the proper orientation during subassembly itself.

A. Support:

Fixture should give all supports necessary for the part, which is to be processed. Fixture support consists of pillar, riser, and profile block.

B. Location:

Processing of any part as per the engineering specifications is only possible if the part is located to the required location. Improper location will cause variation in the dimensions or tolerances.

C.Clamping:

Once the part is supported and located, it is the clamping, which ensures the stability of the component. Most of the times, toggle clamps are used to clamp the component.

D.Equipment Access:

Next necessity is that the equipment that is used for the component processing should reach to the desired location of the component.

Skill Reduction: Jigs & Fixtures simplify locating and clamping of the work pieces. Tool guiding elements ensure correct positioning of the tools with respect to the work pieces. There is no need of skill ful setting of the work piece or tool. Any average person can be trained to use Jigs & Fixtures. The replacement of a skilled workman with unskilled labour can effect substantial saving in labour cost.

Cost Reduction: Higher production, reduction in scrap, easy assembly and savings in labour costs results in substantial reduction in the cost of work pieces produced with Jigs & Fixtures.

2. LITERATURE REVIEW:

B John J. et al have focused on the design of fixtures for turbine blades is a difficult problem even for experienced toolmakers. Turbine blades are characterized by complex three-dimensional surfaces, high performance materials that are difficult to manufacture, close tolerance finish requirements, and high precision machining accuracy. **A Al-Habaibeh.et al have made an attempt** to an experimental design and evaluation of a pin-type universal clamping system. The clamping system is designed for holding complex-shaped aerospace components, such as turbine blades, during machining processes. **S. Keith Hargrove et al** has addressed many of the micro issues of automating the fixture design process using computers. Most of this research has concentrated on the geometric and kinematic factors that determine the configuration of a computer-aided fixture design (CAFXD) system **Kailing Li Ran Liu et al** discussed about the research and development of the CAD/CAPP/CAM and the wide application of CNC technique in the manufacturing, the traditional method for the jig and fixture design has not adapted to the demands of complexity and variety in the practical production with update of products more and more rapid. **Y. Zheng et al** has presented a systematic finite element model to predict the fixture unit stiffness by introducing nonlinear contact elements on the contact surface between fixture components. The contact element includes three independent springs: two in tangential directions and one in the normal direction of the contact surface. Strong nonlinearity is caused by possible separation and sliding between two fixture components. **G. Padilla at el** have focused on the organization of the different stages of the production cycle in order to shorten the time to market. Within this context, fixture design is crucial: the fixture is the major link between the machined part and the machine tool with a strong influence on the part quality, manufacturing.delays and costs. Production process difficulties are focused on the fixture design.

It has been an evident case that the Design of Machining Fixture for Rotor Blade on VMC machine is a research topic of vitality. A thorough study of literature suggests the usage of machining fixture for rotary blades. Fixture Design consists of High product rate, low manufacturing cost operation.

FIXTURE DESIGN FOR ROTOR BLADE:

For making the machining fixture design it is required to study in detail about the component for which fixture is designed and customer requirements.

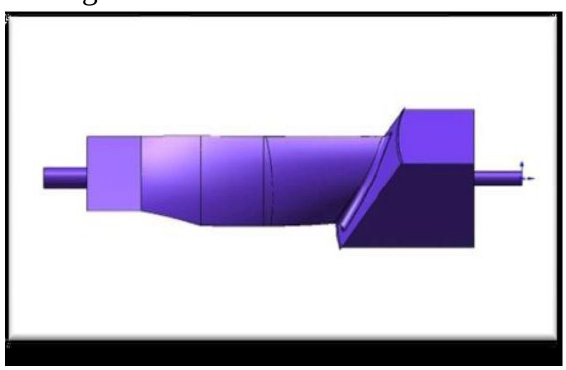
Component & Machine Details:

Component : ROTOR BLADE

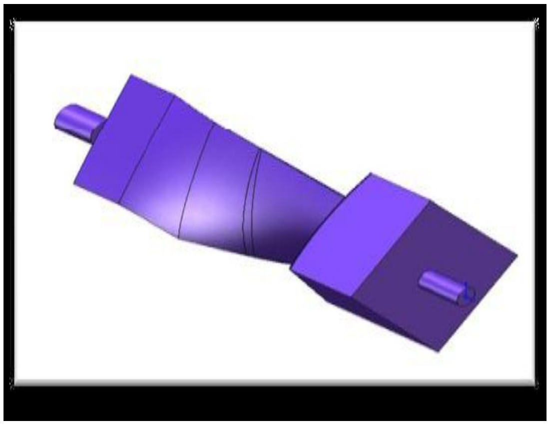
Material : ALUMINIUM ALLOY

Input Condition : Base Machined Machine Used : VMC-4AXISTool Taper :BALL NOSE TOOL

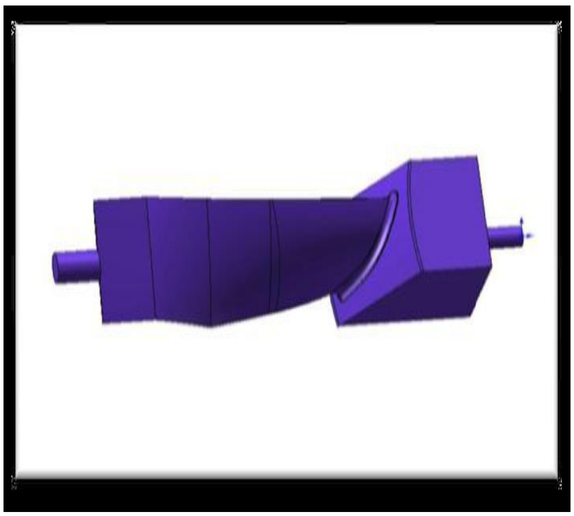
Operation: Face milling, drilling, slot milling.



ROTOR BLADE (A)



ROTOR BLADE (B)



ROTOR BLADE (C)

Conceptual Layout:

Fixture is to be designed for face milling, drilling and taping. The holes are to be drilled on the machined face. Hole sizes and lengths are given in details in operation sheet. So from the nature of the operations to be carried out. **By taking all above factors into considerations, we have generated a conceptual layout of fixture as follows:**

1) Part to be loaded on cylindrical pin and Diamond pin with the help of Rough Guide pins.
2) Part to be butted against rest pads.
3) Hydraulic swing clamps to be used for clamping.
4) Orientation to be kept always on pre machined hole.
5) Part seat check to be accommodated on rest pads.

INTRODUCTION ABOUT ANALYSIS:

ANSYS is an Engineering Simulation Software (computer aided Engineering). Its tools cover Thermal, Static, Dynamic, and Fatigue finite element analysis along with other tools all designed

The company was founded in 1970 by Dr. John A. Swanson as Swanson Analysis Systems, Inc. SASI. Its primary purpose was to develop and market finite element analysis software for structural physics that could simulate static (stationary), dynamic (moving) and heat transfer (thermal) problems. SASI developed its business in parallel with the growth in computer technology and engineering needs. The company grew by 10 percent to 20 percent each year, and in 1994 it was sold. The new owners took SASI's leading software, called ANSYS®, as their flagship product and designated ANSYS, Inc. as the new company name.

BENEFITS OF ANSYS:

The ANSYS advantage and benefits of using a modular simulation system in the design process are well documented. According to studies performed by the Aberdeen Group, best-in-class companies perform more simulations earlier. As a leader in virtual prototyping, ANSYS is unmatched in terms of functionality and power necessary to optimize components and systems.

The ANSYS advantage is well-documented.

ANSYS is a virtual prototyping and modular simulation system that is easy to use and extends to meet customer needs, making it a low-risk investment that can expand as value is demonstrated within a company. It is scalable to all levels of the organization, degrees of analysis complexity, and stages of product development.

Finite Element Method:

The limitations of the mind are such that it cannot grasp the behavior of its complex surrounding and creation in one operation. Thus the purpose of sub dividing all systems into their individual components or elements whose behavior is readily understood and the re building the original system from such components to study its behavior is natural way in which a engineer, the scientist or even the economist proceeds. Finite element method, which is a powerful tool for analyzing various engineering problems, owes is origin to the above mentioned way in which a human mind works.

The basic idea in the FEM is to find the solution of complicated problems by replacing it by a simpler one. Since the actual problem is replaced by a simpler one in finding solution , be will be able to find only an approximate solution rather than the exact solution. The existing mathematical tools will not be sufficient to find the exact solutions (and some times, even an approximate solutions) of most of the practical problems. Thus in the absence of any other covenant method to find even the approximate solution of given problem, we have to prefer the FEM. the FEM basically consists of thus following procedure. First, a given physical or mathematical problems is modeled by dividing it into small inter connecting fundamental parts called **"Finite element"**. Next, an analysis of the physical or mathematics of the problem is made on these elements: Finally, the elements are re-assembled into the whole with the solution to the original problem obtain through this assembly procedure.

The finite element method has developed simultaneously with the increasing use of high speed electronic digital computers and with the growing emphasis on numerical method for engineering analysis. Although the method was original developed for structural analysis the general nature of the theory on which it is based has also made possible us successful application for so of problem in other fields of engineering.

Structural Analysis:

Structural analysis is probably the most common application of the finite element method. The term structural (or structure) implies not only civil engineering structures such as ship hulls, aircraft bodies, and machine housings, as well as mechanical components such as pistons, machine parts, and tools.

Static Analysis:

A static analysis calculates the effects of steady loading conditions on a structure, while ignoring inertia and damping effects, such as those caused by time varying loads. A static analysis can, however, include steady inertia loads (such as gravity and rotational velocity), and time-varying loads that can be approximated as static equivalent loads (such as the static equivalent wind arid seismic loads commonly defined in many building codes).

Static analysis is used to determine the displacements, stresses, strains, and forces in structural components caused by loads that do not induce significant inertia and damping effects. Steady loading and response are assumed to vary slowly with respect to time.

The kinds of loading that can be applied in a static analysis include**:**

- Externally applied forces and pressures
- Steady-state inertial forces (such as gravity or rotational velocity)
- Imposed (non-zero) displacements
- Temperatures (for thermal stain)
- Fluences (for nuclear swelling)

A static analysis can be either linear or non-linear. All types of non-linearities are allowed-large deformations, plasticity, creep, stress, stiffening, contact (gap) elements, hyper elastic elements, and so on.

BASIC STEPS IN ANSYS (Finite Element Software):

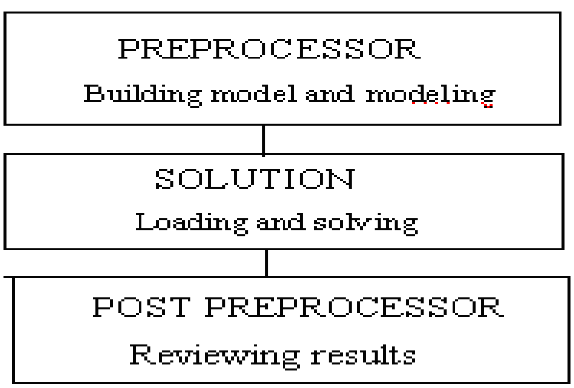


Fig STEPS IN ANSYS

Pre-Processing (Defining the Problem):

The major steps in pre-processing are given below

- Define key points/lines/ areas/volumes.
- Define element type and material/geometric properties
- Mesh lines/ areas/volumes as required.

The amount of detail required will depend on the dimensionality of the analysis (i.e., 1D, 2D, axi-symmetric, 3D).

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ANSYS

For all engineers and students coming to finite element analysis or to ANSYS software for the first time, this powerful hands-on guide develops a detailed and confident understanding of using ANSYS's powerful engineering analysis tools. The best way to learn complex systems is by means of hands-on experience. With an innovative and clear tutorial based approach, this powerful book provides readers with a comprehensive introduction to all of the fundamental areas of engineering analysis they are likely to require either as part of their studies or in getting up to speed fast with the use of ANSYS software in working life. Opening with an introduction to the principles of the finite element method, the book then presents an overview of ANSYS technologies before moving on to cover key applications areas in detail. Key topics covered: Introduction to the finite element method Getting started with ANSYS software stress analysis dynamics of machines fluid dynamics problems thermo mechanics contact and surface mechanics exercises, tutorials, worked examples With its detailed step-by-step explanations, extensive worked examples and sample problems, this book will develop the reader's understanding of FEA and their ability to use ANSYS's software tools to solve their own particular analysis problems, not just the ones set in the book.

At ANSYS, we bring clarity and insight to customers' most complex design challenges through fast, accurate and reliable simulation. Our technology enables organizations to predict with confidence that their products will thrive in the real world. They trust our software to help ensure product integrity and drive business success through innovation.

Every product is a promise to live up to and surpass expectations. By simulating early and often with ANSYS software, our customers become faster, more cost-effective and more innovative, realizing their own product promises.

ANSYS Mechanical software offers a comprehensive product solution for structural linear/nonlinear and dynamics analysis. The product offers a complete set of elements behavior, material models and equation solvers for a wide range of engineering problems. In addition, ANSYS Mechanical offers thermal analysis and coupled-physics capabilities involving acoustic, piezoelectric, thermal-structural and thermal-electric analysis.

ANSYS Structural software addresses the unique concerns of pure structural simulations without the need for extra tools. The product offers all the power of nonlinear structural capabilities - as well as all linear capabilities - in order to deliver the highest-quality, most reliable structural simulation results available. ANSYS Structural easily simulates even the largest and most intricate structures.

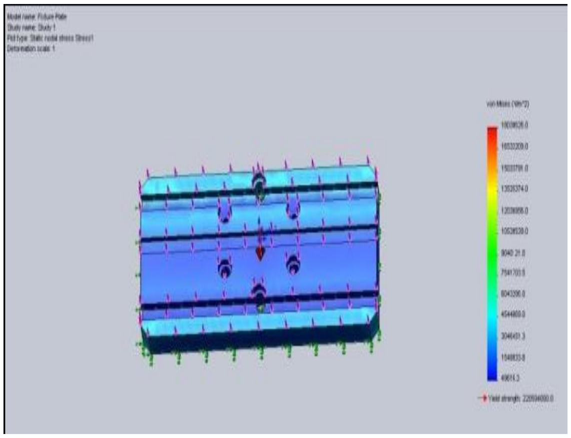
ANSYS Professional software offers a first step into advanced linear dynamics and nonlinear capabilities. Containing the power of leading simulation technology in an easy-to-use package, ANSYS Professional tools provide users with high-level simulation capabilities without the need for high-level expertise. The package comes complete with a full contingent of linear elements, significant nonlinearities, the ability to solve complex assemblies, and the most requested set of solvers.

ANSYS Design Space software is an easy-to-use simulation software package that provides tools to conceptualize design and validate ideas on the desktop. A subset of the ANSYS Professional product, ANSYS design space allows users to easily perform real-world, static structural and thermal, dynamic, weight optimization, vibration mode, and safety factor simulations on all designs without the need for advanced analysis knowledge.

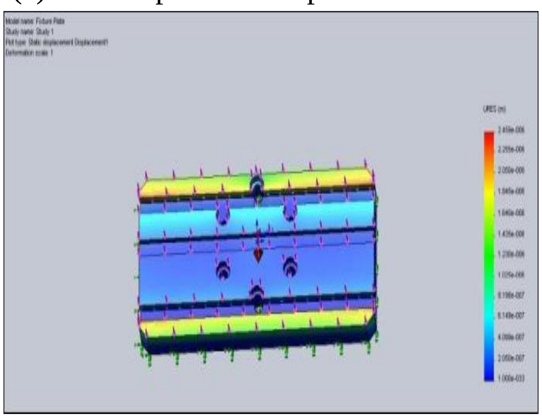
Dynamics software provides incredibly short solution times for even the most complex multi-part assemblies undergoing dramatic translations and rotations. It is an ANSYS Workbench add-on module that works directly with ANSYS Structural, ANSYS Mechanical, and ANSYS Multiphysics.

Selection of Fixture Body:

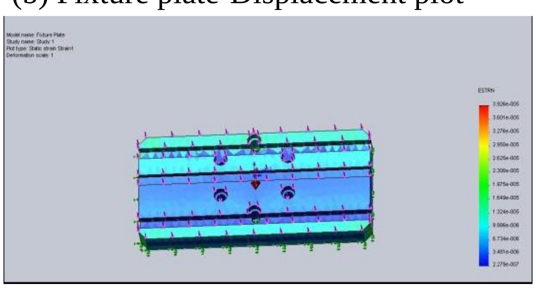
The customer is used vertical machining center for the machining of component. So that my concept is to keep the component horizontal to the machine bed. For this purpose, I select Tombstone structure. This structure should withstand the cutting forces applied. This Tombstone dimensions should fall under the work envelope of specific machine and it could accommodate the component and fixture elements. Therefore the dimensions of Tombstone (X, Y) 600 X 400. The width of Tombstone will be decided by the analysis, used as Solid works COSMOS as below. By this analysis, the deflection is came 2 microns at maximum force of drilling (5.18 Kgf) at the centre hole point. This value is within the safe tolerance of customer requirement.



(a) Fixture plate-stress plot



(b) Fixture plate-Displacement plot



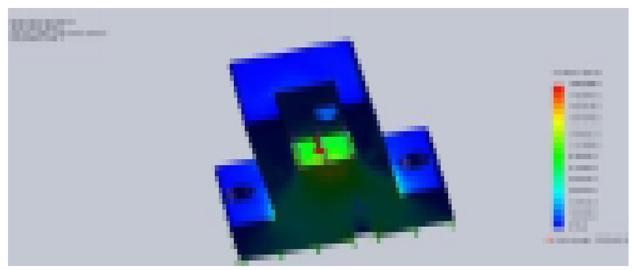
(c) Fixture plate-strain plot

Figure (a) shows the variation of von mises stress. The max value of von mises stress is (1.80306e+007) and is developed where there is maximum load. The value of von mises stress is less, where there is minimum load.

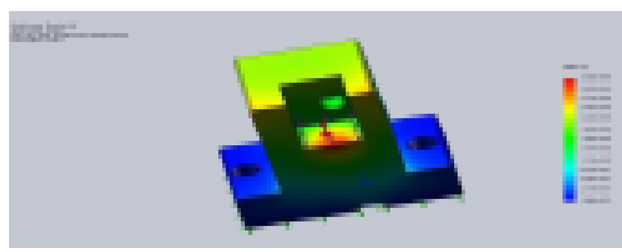
Figure (b) shows the variation of resultant displacement. The max value of resultant displacement is2.45948e-006m and is developed where there is maximum load.

Figure (c) shows the variation of equivalent strain. The max value of equivalent strain is3.92623e-005 and is developed where there is maximum load. The value of equivalent strain is less, where there is minimum load.

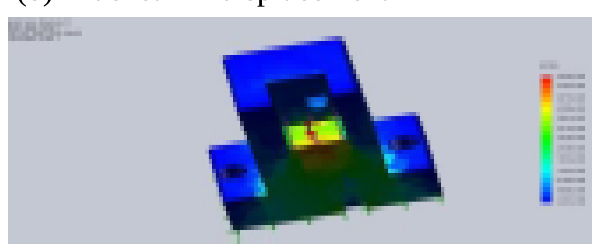
SELECTION OF BRACKET LH-STUDY:



(a) Bracket LH stress



(b) Bracket LH displacement

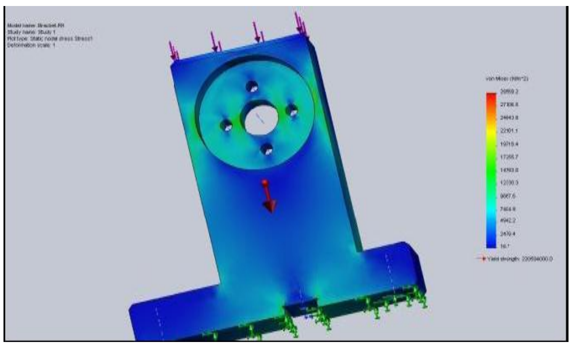


(c) Bracket-LH strain

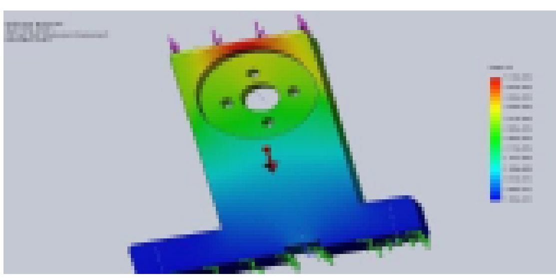
fig(a) shows the variation of von mises stress. The max value of von mises stress is1.95621e+007 and is developed where there is maximum load. The value of von mises stress is less, where there is minimum load. The maximum load developed at the bottom of the bracket-LH.

Fig (b) shows the variation of resultant displacement. The max value of resultant displacement is3.32987e-006 and is developed where there is maximum load.

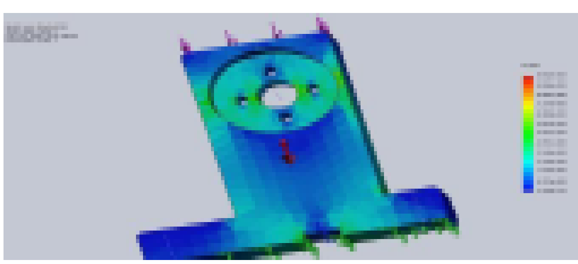
Fig. (c) shows the variation of equivalent strain. The max value of equivalent strain is5.8501e-005 and is developed where there is maximum load. The value of equivalent strain is less, where there is minimum load.



(a) Bracket-RH –Stress plot



(b) Bracket RH displacement



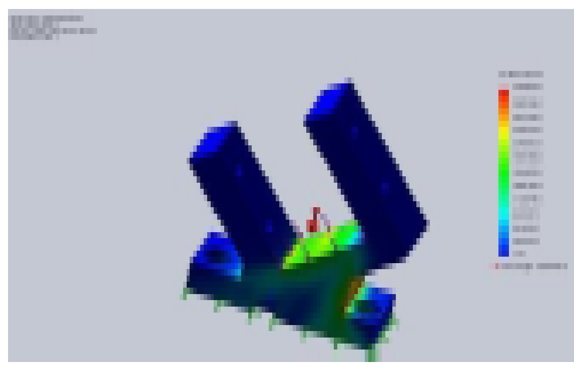
(c) Bracket-RH strain

Fig. (a) shows the variation of von mises stress. The max value of von mises stress is29569.2 and is developed where there is maximum load. The value of von mises stress is less, where there is minimum load.

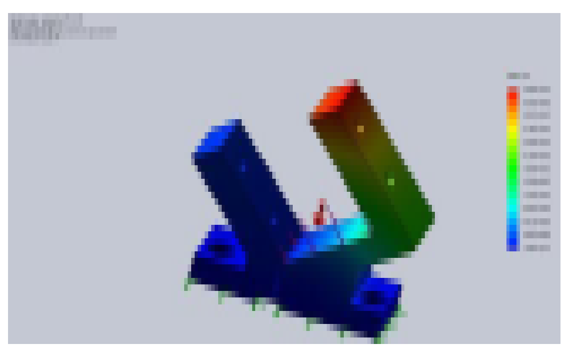
Fig. (b) shows the variation of resultant displacement. The max value of resultant displacement is5.11953e-009 m and is developed where there is maximum load.

Fig (c) shows the variation of equivalent strain. The max value of equivalent strain is9.69231e-008 and is developed where there is maximum load. The value of equivalent strain is less, where there is minimum load.

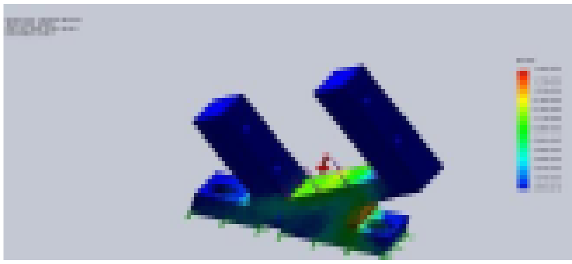
SELECTION OF CLAMPING BRACKET STUDY:



(a) clamping bracket stress



. (b) clamping bracket displacement



. (c) clamping bracket strain

Fig. (a) shows the variation of von mises stress. The max value of von mises stress is3.3689e+007 and is developed where there is maximum load. The value of von mises stress is less, where there is minimum load. The blade right side is clamped using clamping bracket. The maximum load developed in downward direction.

Fig. (b) shows the variation of resultant displacement. The max value of resultant displacement is 3.60786e-005 m and is developed where there is maximum load.

Fig (c) shows the variation of equivalent strain. The max value of equivalent strain is 0.00012195 and is developed where there is maximum load. The value of equivalent strain is less, where there is minimum load.

SELECTION OF LOCATING PLUG STUDY:

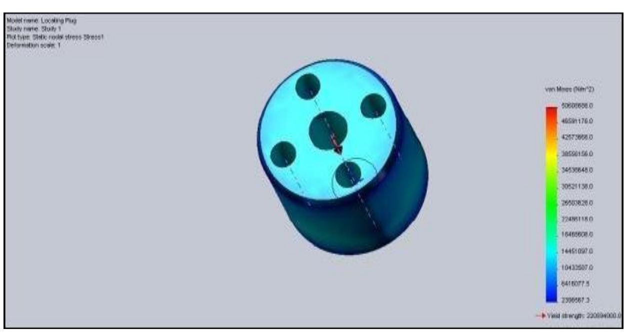


Fig (a) Locating Plug-Stress plot

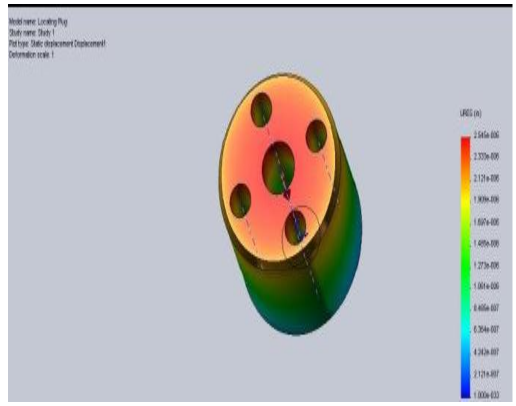


Fig (b) Locating Plug-Displacement plot

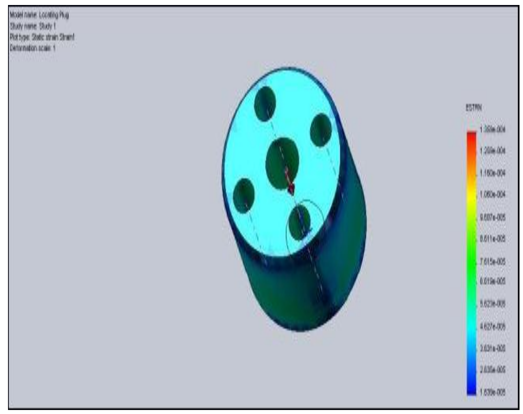


Fig (c) Locating Plug Strain plot

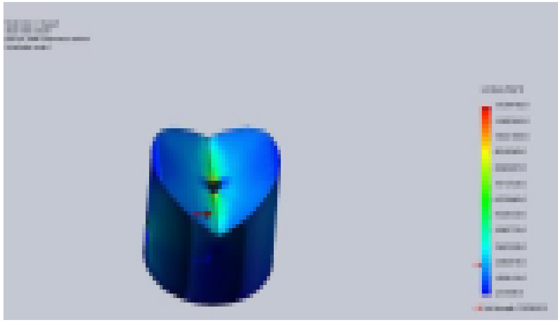
The total stresses depend on locating plug. Because the chuck is holding the clamping plug.

Fig.(a) shows the variation of von mises stress. The max value of von mises stress is5.06087e+007 and is developed where there is maximum load. The value of von mises stress is less, where there is minimum load.

Fig.(b) shows the variation of resultant displacement. The max value of resultant displacement is 2.54541e-006 m and is developed where there is maximum load.

Fig.(c) shows the variation of equivalent strain. The max value of equivalent strain is 0.000135903 and is developed where there is maximum load. The value of equivalent strain is less, where there is minimum load.

SELECTION OF BLOCK STUDY:



Fig(a) V-support block strain

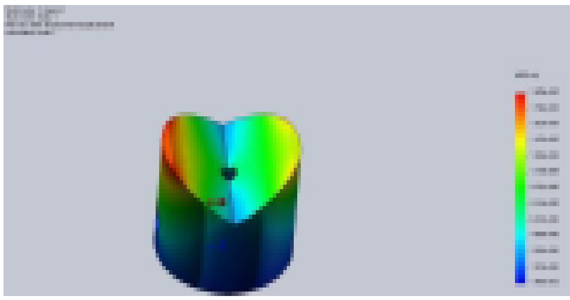


Fig (b) V-support block displacement

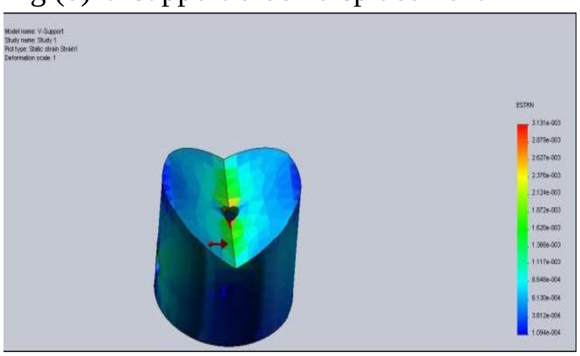


Fig (c) V-Support-Strain plot

Fig.(a) shows the variation of von mises stress. The max value of von mises stress is1.27286e+009 and is developed where there is maximum load. The value of von mises stress is less, where there is minimum load. The load developed from left to right of the V-Block.

Fig. (b) shows the variation of resultant displacement. The max value of resultant displacement is 1.95946e-005 m and is developed where there is maximum load.

Fig. (c) shows the variation of equivalent strain. The max value of equivalent strain is 0.00313094 and is developed where there is maximum load. The value of equivalent strain is less, where there is minimum load. The above results show the Design of Machining fixture for Rotor blade on VMC machine. The main aim of the fixture is to reduce the lead time, High product rate and low manufacturing cost.

Features of Fixture Assembly:

1) Machining fixture:

Machining fixture are used for quick operations to perform actions such as butting the component against pads, clamping and orientation of the part. It saves loading time since many actions are performed simultaneously.It ensures proper clamping and butting against locating pads due to use of hydraulic supports and clamps.

2) Repeatability and accuracy of loading and hence operations to be performed

3) Fool proofing Ensures the part is always loaded in correct position

4) Reduction in cycle time Due to use of hydraulic elements, automatic loading tackles, and HMC the cycle time is reduced to a large extent.

5) Longer life of fixture assembly Long life of the fixture is ensured due to the use of changeable parts in case of wear and strength of the parts is also ensured by the use of rigid plates and castings.

6) Cost Effectiveness Since the cycle time is reduced, the cost per piece is also reduced.

7) Manufacturing feasibility The parts are designed by considering the manufacturing possibilities and also form the point of mfg costs of the parts.

8) Use of Standard parts Standard parts are used wherever possible and hence lead time is reduced.

RESULTS AND DISCUSSION

In the present work, the analysis of fixture is carried out using Solid works. The geometric model of the Fixture elements is drawn by using AutoCAD. The fixture is loaded with the help of clamping plug with 0-1800 in rotor axis on the machine.First operation is roughing operation, is done on vmc -4axis machine with 10diameter ball nose tool on both sides cv and cx profiles. For the component convex operation is done with 0-180 degrees, after convex operation fixture is rotated 0-200 degrees for the concave operation.Semi finishing operation is done after heat treatment on VMC -4axis machine with 8 diameter ball nose tool on both sides cv and cx profiles for the component.Finishing operation is done after semi finishing operation on vmc -4axis machine with 8diameter ball nose tool on both sides cv and cx profilesSo, all the operations are carried out by using same fixture at different control conditions. At ought milling operation the material removal rate is high. so at that time max stress is developed on fixture. In finishing operation material removal rate is less so stress developed at that time less The fixture is developed at max load condition and min load condition. The values are calculated to design the fixture using Solid works COSMOS analysis tool, to find out the stress, strain and displacement for each and every component of the fixture assembly. These results are

Case 1:

Figure (a) shows the variation of von mises stress. The max value of von mises stress is (1.80306e+007) and is developed where there is maximum load. The value of von mises stress is less, where there is minimum load.

Figure (b) shows the variation of resultant displaement.The max value of resultant displacement is2.45948e-006m and is developed where there is maximum load.

Figure (c) shows the variation of equivalent strain. The max value of equivalent strain is3.92623e-005 and is developed where there is maximum load. The value of equivalent strain is less, where there is minimum load.

Case 2:

Figure (a) shows the variation of von mises stress. The max value of von mises stress is1.95621e+007 and is developed where there is maximum load. The value of von mises stress is less, where there is minimum load. The maximum load developed at the bottom of the bracket-LH.

Figure (b) shows the variation of resultant displaement.The max value of resultant displacement is3.32987e-006 and is developed where there is maximum load.

Figure (c) shows the variation of equivalent strain. The max value of equivalent strain is5.8501e-005 and is developed where there is maximum load. The value of equivalent strain is less, where there is minimum load.

Case 3:

Figure (a) shows the variation of von mises stress. The max value of von mises stress is29569.2 and is developed where there is maximum load. The value of von mises stress is less, where there is minimum load.

Figure (b) shows the variation of resultant displaement.The max value of resultant displacement is5.11953e-009 m and is developed where there is maximum load.

Figure (c) shows the variation of equivalent strain. The max value of equivalent strain is9.69231e-008 and is developed where there is maximum load. The value of equivalent strain is less, where there is minimum load.

Case4:

Figure (a) shows the variation of von mises stress. The max value of von mises stress is3.3689e+007 and is developed where there is maximum load. The value of von mises stress is less, where there is minimum load. The blade right side is clamped using clamping bracket. The maximum load developed in downward direction.

Figure (b) shows the variation of resultant displaement.The max value of resultant displacement is 3.60786e-005 m and is developed where there is maximum load.

Figure (c) shows the variation of equivalent strain. The max value of equivalent strain is 0.00012195 and is developed where there is maximum load. The value of equivalent strain is less, where there is minimum load.

Case5:

The total stresses depend on locating plug. Because the chuck is holding the clamping plug.

Figure (a) shows the variation of von mises stress. The max value of von mises stress is5.06087e+007 and is developed where there is maximum load. The value of von mises stress is less, where there is minimum load.

Figure (b) shows the variation of resultant displaement.The max value of resultant displacement is 2.54541e-006 m and is developed where there is maximum load.

Figure (c) shows the variation of equivalent strain. The max value of equivalent strain is 0.000135903 and is developed where there is maximum load. The value of equivalent strain is less, where there is minimum load.

Case6:

Figure (a) shows the variation of von mises stress. The max value of von mises stress is1.27286e+009 and is developed where there is maximum load. The value of von mises stress is less, where there is minimum load. The load developed from left to right of the V-Block.

Figure (b) shows the variation of resultant displacement. The max value of resultant displacement is 1.95946e-005 m and is developed where there is maximum load.

Figure (c) shows the variation of equivalent strain. The max value of equivalent strain is 0.00313094 and is developed where there is maximum load. The value of equivalent strain is less, where there is minimum load. The above results show the Design of Machining fixture for Rotor blade on VMC machine. The main aim of the fixture is to reduce the lead time, High product rate and low manufacturing cost.

CONCLUSIONS

The fixture is successfully designed and analyzed at SRI VENKATESWARA MECHANICAL AND ELECTRICAL ENGINEERING INDUSTRIES, private limited, leading manufacturers of earth moving equipment. The following are the results obtained while designing and from tryout of the fixture. The main purpose of fixture is to locate the work quickly and accurately, support it properly and hold it securely, thereby ensuring the all parts produced in same fixture will come within specified limits.

Another important aspect in designing the fixture is to reduce non production time i.e. setup time. In the designed fixture there is

50% reduction in setup time than previous fixture setup.

Operator conformability has prime consideration in fixture design. In this fixture design ergonomic aspects have studied carefully reducing operator fatigue to minimum.

Rigid clamping and proper loading sequence has achieved the total assembly accuracy within prescribed limit. The self alignment of components has achieved by designed loading sequence. Unloading of finished component has achieved successfully without any hindrance of designed groups.

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