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Design and Thermal Analysis of Fixture Assembly and Base plate For Crank Case in Machining Center

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ABSTRACT:- *There is a need for better methods of determining reliability and more accurately assessing the life span of machines and production in systems. The project presents unique Hydraulic Fixture for Machining Crank Case. The fixtures are work holding device used to hold, supports and locate the position of work pieces for machining operation. A Fixture Assembly consists of a clamps The present trends in industry are mostly applying applications of the Hydraulic and Pneumatic techniques, because it helpful to save time and precipitate the accuracy and also it had some flexibility*

Designer for create a model of designed fixture in ***SOLIDWORKS*** *software and carried out finite element analysis on fixture model in view of given boundary condition before for manufacture and can see inadequacy and we can make abatement accordingly without getting it manufacture, which saves a great amount of money and time.*

Mainly the dimensional accuracy depends upon the relative position of the workpiece and machine tool. In this research the design of fixture on this the work piece deformation based on different load applications. Finite element analysis of fixture and crank case is carried out using ANSYS workbench software. Clamping forces are calculated for 3,-5 Mpa hydraulic pressure and are taken into consideration in analysis. It is conducted in various toolbars to calculate the steady state thermal, static structural analysis transpire and they can make reworking in fixture assembly model as per which creates ideal fixture assembly design to get manufactured. Theoretical and numerical method is used to calculate the maximum stress and deformation for the clamping forces of 10.5KN with hydraulic pressure 30, 40 and 50 bar.

***Key Words: Hydraulic fixture, Mounting Pads, Clamp, and Toggle clamp**, CAFD, FEA.*

1. INTRODUCTION:

There is an expanding requirement for improved strategies for deciding the dependability and foreseeing the lifetime of machines and generation frameworks all the more precisely. The paper presents one of a kind Design and Analysis of chamber water powered installation for HMC.

A Fixture is a gadget for holding a work piece during machining tasks. The name is gotten from certainty that an installation is constantly attached to a machine or seat in a fixed position. It doesn't contain extraordinary plan for managing the cutting apparatus, as drill dances do in a set up utilizing installation the duty regarding exactness relies on the administrator and the development of the machine device. Different sorts of tooling utilized for situating parts with respect to one another for creating reason for existing are likewise usually alluded to as installation get together apparatus and weld apparatus are instances of this sort. Many machining tasks can be performed by clamping the work piece to the machine table without utilizing an installation particularly when a couple of parts are to be machined. Be that as it may, when the quantity of parts are enormous enough to legitimize its cost an installation is commonly utilized for holding and finding work piece.

In this examination the structure of installation amalgamation by methods for various apparatus area plans was created and furthermore inspects the work piece twisting dependent on various burden applications.The most significant criteria's for fixturing are work piece strength,

Position exactness and work piece distortion. A decent installation configuration is one that limits work piece geometric mistake. Work piece area standards are characterized as far as 3-2-1 fixturing which is generally utilized work piece area technique for kaleidoscopic parts. Power investigation is worried about checking whether the powers connected by the installation and cinching are adequate to keep up static harmony.

Apparatus is generally utilized in the business functional generation as a result of highlight and points of interest. To find and immobilize work pieces for machining, examination, get together and different tasks installations are utilized. An installation comprises of a lot of locators and clamps. Locators are utilized to decide the direction and position of a work piece, though cinches apply clipping powers on the work piece with the goal that the work piece is squeezed solidly against locators.

Objective:

Thermal Analysis of Hydraulic Fixture Design and Mechanical Engine Crank Case Right on HMC. Limiting aggressiveness and work bits of questions due to clipping powers in machining for keeping up given machining exactness and resistances. Decreasing the dislodging to build up the perfect installation plan that expands the finding precision and workpiece dependability.

By executing FEA in a PC helped apparatus structure (CAFD) condition, uneconomical and superfluous "experimentation" try in the machine store is wiped out.

Fixture planning is to conceptualize a basic fixture configuration through analyzing all the available information regarding the material and geometry of the work piece, operations required, processing equipment for the operations, and the operator.

1.1 General Requirements of a Fixture

In order to maintain the workpiece stability during a machining process, an operational installation needs to fulfill a few prerequisites to completely play out its capacities as a work holding gadget. The accompanying requirements must be watched while planning a feasible installation:

- Deterministic location

A workpiece is said to be kinematically controlled when it can't move without losing contact within any event one locator. The workpiece is obliged by a lot of fittingly put locators so it is respectable for the machining task. Finding blunders because of locators and finding surfaces of the workpiece ought to be minimized to precisely and interestingly position the workpiece inside the machine organize an outline.

- Total constraint

A workpiece should be fully constrained at all times to prevent any movement. Clamps should provide locking forces to hold the workpiece in place -once it is located. A totally restrained part should be able to remain in static equilibrium to withstand all possible processing forces or disturbance. A necessary and sufficient condition to warrant workpiece stability is to satisfy the condition of force closure.

- Contained deflection

Workpiece disfigurement is unavoidable because of its flexible/plastic nature, and the outside powers affected by the clasping activation and machining tasks. Twisting must be restricted to an adequate extent so as to accomplish the resistance determinations.

- Geometric constraint

Geometric limitation ensures that all fixturing components have an entrance to the datum surface. They additionally guarantee that the installation segments don't meddle with cutting apparatuses during a machining task. Notwithstanding these prerequisites, an apparatus configuration should have attractive attributes, for example, fast stacking and emptying, least number of segments, availability, and plan for various cutting tasks, movability, and low Cost, and so forth.

1.2 Fixture Design considerations:

Installation arranging is to conceptualize an essential apparatus arrangement through breaking down all the accessible data with respect to the material and geometry of the workpiece, activities required, handling hardware for the tasks, and the administrator.

The accompanying yields are incorporated into the apparatus plan:

- Fixture type and complexity
- Number of work pieces per fixture
- Orientation of work piece within fixture
- Locating datum faces

Clamping surfaces Support surfaces, if any

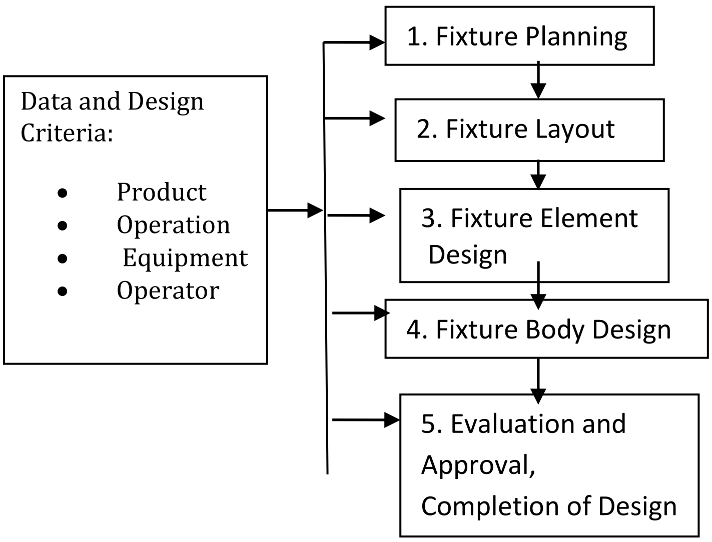


Figure 1.4 various aspects of fixture design

Generation of fixture layout is to represent the fixture concepts in a physical form.

The following outputs are included in the fixture layout:

- Positions of locators
- Positions of clamps

- Positions of supports, if any
- Type of locators
- Type of clamps
- Type of supports
- Clamping forces and sequence

Installation component configuration is either to detail the structure illustrations submitted on paper or to make the strong models in a CAD arrangement of the down to earth exemplification of the applied locators, clips and supports. It is conceivable to utilize standard structures or exclusive parts. The accompanying yields are incorporated into the apparatus component structure:

- Detailed plan of locators
- Detailed structure of braces
- Detailed structure of backings, assuming any Device body configuration is to deliver an unbending structure conveying all the person installation components in their appropriate spots.

(**Automotive engineering**: Vehicle components, Engine, transmission, and exhaust)

Crankcase compression is the method of starting some

smaller two-stroke engines, where the mixture charge is compressed in a sealed crankcase by the descending piston before passing to the combustion chamber.

In two-stroke cycle engines using **crankcase compression**, lubricating oil must be added to the inlet air.

The two-stroke cycle uses **crankcase compression** to pump the fresh charge into the cylinder.

In almost all two-stroke cycle engines, **crankcase compression** is used to force air into and scavenge the cylinders.

Crankcase, compression.

Types of crank cases:

Crankcase is the technique for beginning some littler two-stroke or four stroke motors, where the Rigging box of Crankcase for interfacing apparatus of first apparatus second apparatus to fifth rigging associating through apparatus shaft within crankcase in this wrench case it is comprised of aluminum (al) and it is separated 2 types

For example crankcase right, crankcase left this is necessity sort of vehicle Crankcase, pressure,

Car designing: Vehicle parts, Engine, transmission, Crankcase and fumes

Besides protecting the crankshaft and connecting rods from foreign objects, the crankcase serves other functions, depending on engine type. These include keeping the motor oil contained, usually hermetically or nearly hermetically .

Crank Case Assembly Drawing:

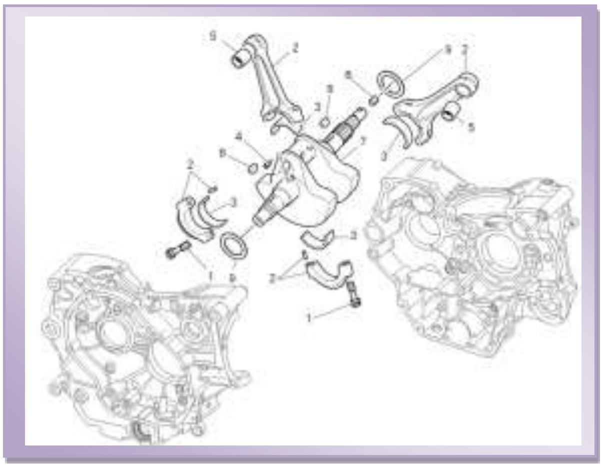


Fig:2 Crank Case Assembly Drawing

Brief explanation about crankcase components:

A crankcase is the lodging for the crankshaft in a responding inward burning motor. The walled in area shapes the biggest hole in the motor and is situated underneath the cylinder(s), which in a multicylinder motor is generally coordinated into one or a few chamber squares. Crankcases have frequently been discrete parts, yet more regularly they are vital with the chamber bank(s), framing a motor square. In any case, the territory around the crankshaft is still as a rule called the crankcase. Crankcases and other essential motor auxiliary segments (e.g., chambers, chamber squares, chamber heads, and incorporated mixes thereof) are regularly made of solid metal or cast aluminum through sand throwing. Today the foundry procedures are generally exceedingly robotized, with a couple of gifted specialists to deal with the throwing of thousands of parts.

2. Hydraulic Fixture:

A clamping framework that utilizations high-weight fluids to power cinches and hold a work piece set up. Using pressurized water clasped apparatuses have numerous favorable circumstances over physically clipped installations. As a rule, these advantages diminish costs for makers enabling them to legitimize the underlying venture for a water powered clasping framework. Pressure driven cinching empowers makers to put more knowledge into the installation taking out human blunder and delivering a progressively steady, unsurprising procedures regardless of who the administrator is or what generation move your machine runs.

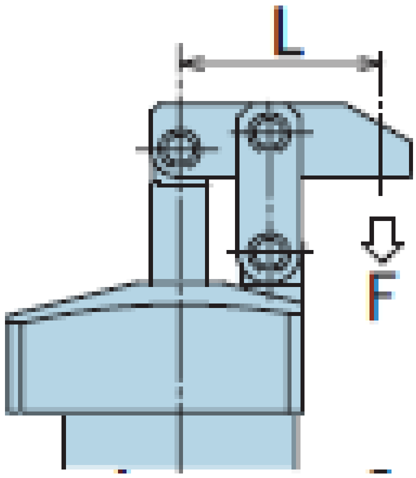


Fig: 3.Hydraulic cylinder

Clamping Forces by Analytical Method:

To ascertain cinching powers by Analytical strategies we considered cylinder and brace switch linkage association in that first we have determined resultant cylinder power following up on clip switch when water powered weight is connected to cylinder head and after that we accepted clasp switch as an inflexible component with immaterial mass. Here we have 2 unique lengths of switches are appeared in beneath figures.

Also from above fig, forces acting on piston by hydraulic pressure are as follows:

1. Force acting on piston head by hydraulic pressure: F1

F1 = (π/4) × (D max)2 × (P)

2. Force acting on piston head by cylinder head (opposing piston force): F2

F2 = (π/4) × (Dmean2 – Dmin2) × (P)

3. Net force acting on piston rod: FR

FR = F1 – F2

For Fig a:

For Fig a:

Given Data;

Dmax = Maximum piston diameter = 45mm; Dmean = Mean diameter of piston = 22 mm;

Dmin = Minimum piston diameter = 15mm;

Hydraulic Pressure = P = 30, 40&50 bar;

P = 3, 4 and 5MP;

So, For 3 MPa hydraulic pressure;

1. Force acting on piston head by hydraulic pressure: F1
F1 = (π/4) × (Dmax) 2 × (P)

F1 = (π/4) × (45)2 × 3 = 4.77 KN

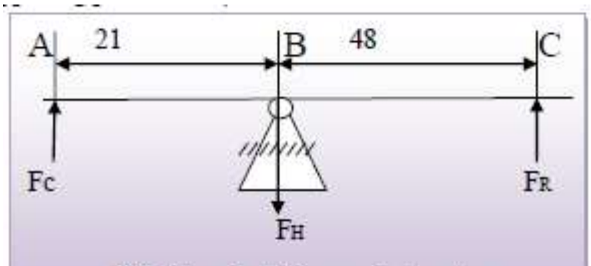


Fig. 4 Free Body Diagram of clamp lever

2. Force acting on piston head by cylinder head (opposing piston force): F2

F2 = (π/4) × (Dmean2 – Dmin2) × (P)

F2 = (π/4) × [(22)2 – (15)2] × 3 = 0. 777 KN

3. Net force acting on piston rod: FR

Fig: 3.Hydraulic cylinder

FR = F1 – F2

FR = F1 – F2 = 4.768 – 0.777 = 3.99 K

Where,

C is the point where lever is hinged.

FH is reaction force at hinge.

B is point where net piston force (FR) applied.

A is point where clamping force (FC) applied.

So from Free Body Diagram;

By Newton's first law of equilibrium;

Σ Vertical Force = 0

FC + FR - FH = 0;

Also, by taking moment at point C equal to zero;

ΣMC = 0 (clockwise +);

FC × 48 – FR × 21 = 0

FC = (3.99 × 21) / 48

For Fig b:

Given Data;

D max = Maximum piston diameter = 35 mm ;

D mean = Mean diameter of piston = 22 mm ;

D min = Minimum piston diameter = 16 mm ;

Hydraulic Pressure = P = 30,40 & 50 bar;

P = 3,4 and 5 MPa;

So, For 3 MPa hydraulic pressure;

Similarly, clamping Forces for 4 and 5 MPa

Hydraulic pressure are also calculated

i.e. For4 MPa pressure clamping force is Fc =1.713KN and

For 5 MPa pressure clamping force is Fc = Fc =1.64KN.respectively.

1. For 3 Bar1.745 + 2.031 = 3.76 KN

   (*Forever cylinder using 2 times so we are calculating double)

   i.e., 3.76 X 2 = 7.552 KN

2. For 4 Bar 1.716 + 2.66 = 4.373

   i.e., 4.373 X 2 = 8.746 KN

3. For 5 Bar 1.641 + 3.38 = 5.021

   i.e., 5.021 X 2 = 10.04 KN.

   As per these values I done experiment.

3. DESIGN OF FIXTURE:

Fig 5. Crank Case right 3D model

3.1 Component Details

A **crankcase** is the connected to the reciprocating IC engine. The segment is a Crank Case directly For Diesel motor, made up of material Aluminum amalgam (2014-T6), weighing 2.34 kg and the part to be created by weight bite the dust throwing process. The tasks to be performed on segment, utilizing planned apparatus set up, are boring and exhausting. Figure 1. Wrench Case right which is to be cinched. This is the part to be machined and braced in the installation.

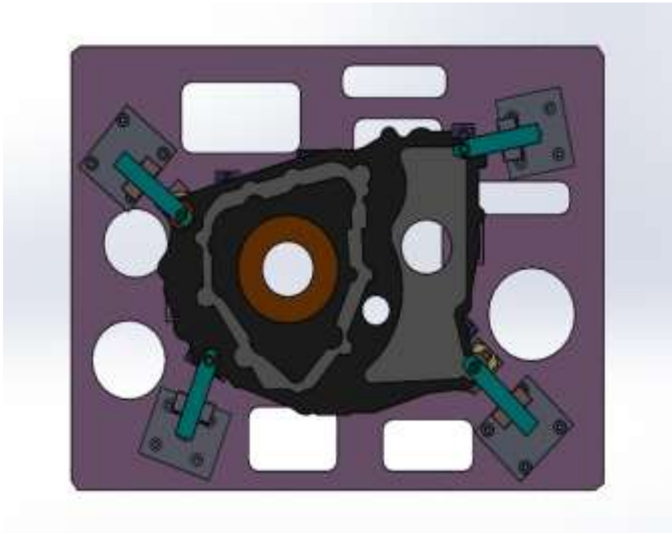


Fig 6. Shows 3D CAD model of Fixture Assembly of Crank Case right

Above fig shows boring surface completion and exhausting tasks are performed on the two sides individually that is from top view side and base view side .In this 3D model view all parts are gathered. The sub get together with segment which utilizing sub parts areRest Pad Plain

1. Rest Pad Air seat
2. Clamp Pad
3. Rest Pad Air seat
4. Hydraulic Cylinders
5. Spacers for Rest Pad Plain and Air seat.
6. Hydraulic Cylinders Spacers
7. Round Rough guide
8. Anti-Fall
9. Diamond Pin Locator
10. Coolant Flusher
11. Round Pin Locator
12. Linear Bush
13. Clamp Lever
14. Bush extractor

LOCATING PINS:

These exactness finding pins are particularly valuable for workpiece area due to the wide determination of head distances across accessible to fit machined openings in the part. Notwithstanding standard measurements, these pins are additionally rapidly specially made in any exceptional head width from .1150" to 1.0400" in .0001" increases. One Round Locating Pin and one Diamond Locating Pin are frequently utilized together to situate from two openings without official, in light of the fact that the Diamond Locating Pin is diminished to situate in just 1 pivot. The sort appeared here, with a slip-fit shank and lock screw space, is intended for inexhaustible establishment. Additionally accessible in a press-fit sort, for perpetual establishment.

Round & Diamond pin:

Round and Diamond Locating Pins are accessible in four standard shank measurements, each with a scope of standard head widths in 1/32" increases (2mm augmentations in metric), each accessible in either standard or undersize fit. Head and shank widths are concentric to inside .0005" TIR. Made in USA. Utilizing 3, 4& 5 MP. In this utilizing 4 Plain Rest Pads,3 Rest Pad Air seats,5 Rough aides.2 Hydraulic vertical chambers with chamber spacer for cinching and clasp switches and cushions for direction Diamond and Round Pin locators.

Static Structural Analysis Result:

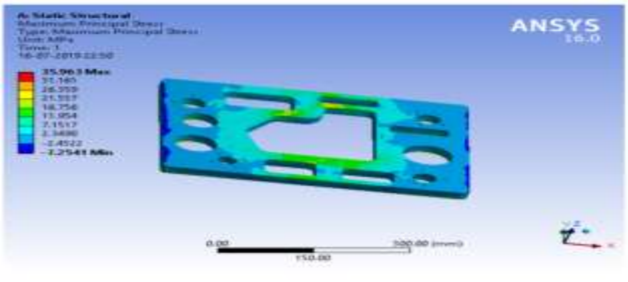


Fig: 7. Equivalance Stress 1000N .

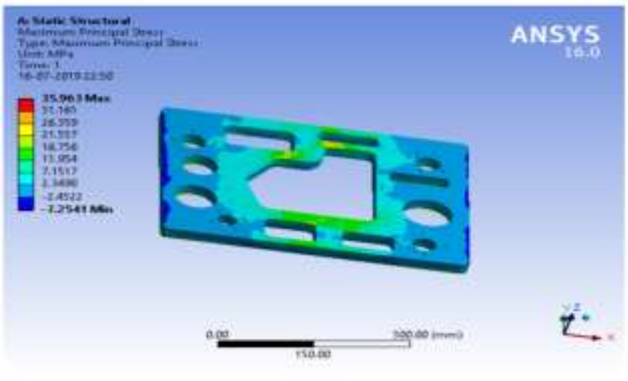


Fig: 8. Max.Principal Stress 1000N

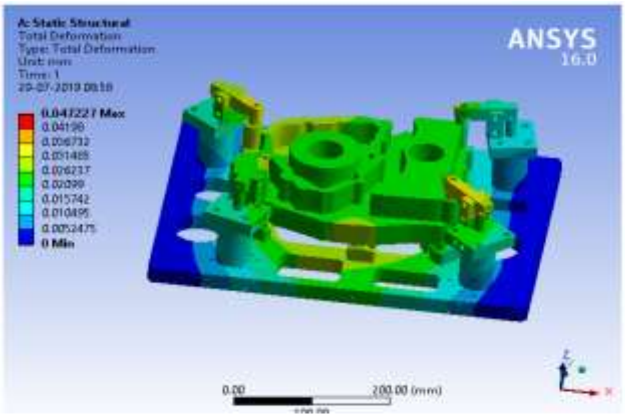


Fig: 9. Static Structural Total Deformation for 5bar

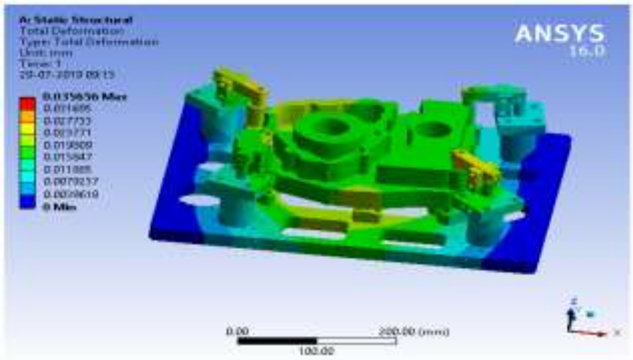


Fig: 10.Static Structural Total Deformation for 3bar

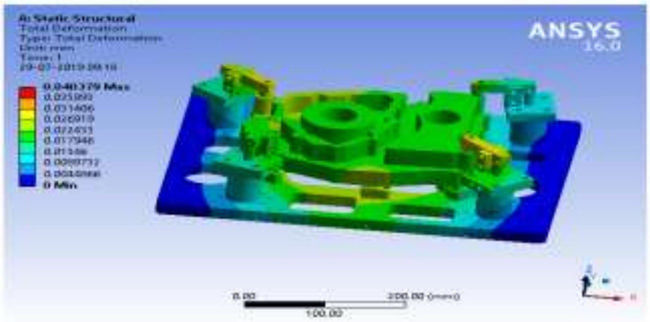


Fig: 11.Static Structural Total Deformation for 4bar

Fig: Static Structural Total Deformation for 4bar

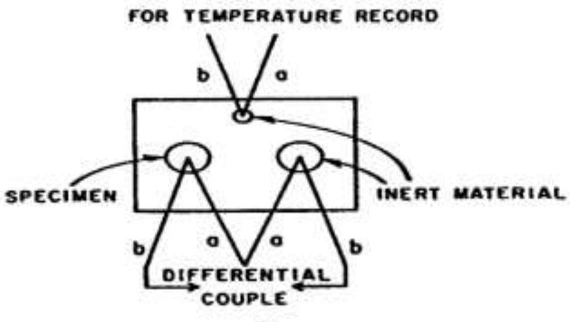
- 3 Bar – 3.53 e-002
- 4 Bar - 4.03e-002
- 5 Bar – 4.72e-002

4. Thermal analysis:

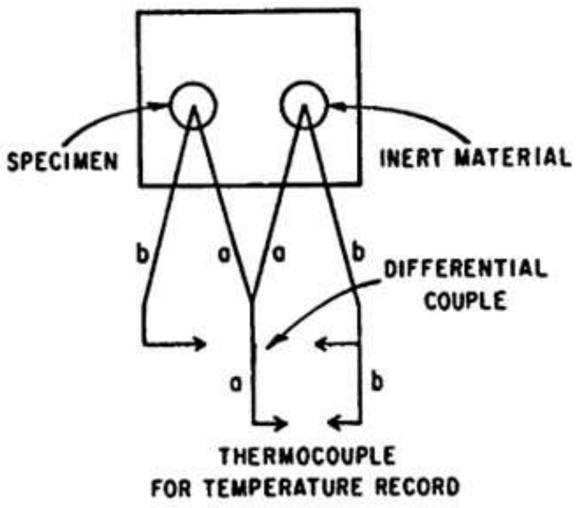
1.0 INTRODUCTION

A comprehension of the complex physicochemical marvels related with the development and conduct of cementations mixes is encouraged through the utilization of a wide range of sorts of analytical strategies. Systems, for example, NMR, XRD, neutron enactment investigation, nuclear retention spectroscopy, IR/UV spectroscopy, electron microscopy, surface region methods, pore portrayal, zeta potential, viscometer, warm examination, and so forth., have been utilized with some achievement. Of the warm investigation systems, the Differential Thermal Analysis (DTA) and somewhat, Thermo gravimetric Analysis (TG) techniques are more famously utilized than others. They are progressively versatile, simpler to utilize, and yield significant outcomes in a limited ability to focus time. In this section the utilization of DTA will be featured and some work announced using TG, conduction calorimetric, and other related strategies will likewise be referenced, with regular models.

A substance exposed to warm treatment may experience physical or concoction changes as in measurement, attractive powerlessness, weight, crystalline progress, mechanical property, acoustic property, heat impacts, and so on. In warm examination, these progressions are pursued as an element of temperature. It has been recommended that warm investigation ought to likewise be reached out to take into consideration fast warming of the example to some temperature pursued by an estimation of the property with time under an isothermal condition.[1] In the semi static warm examination technique, a substance is warmed at known interims of temperature for a couple of hours and a specific property is estimated. In the dynamic strategy, for example, DTA or TG, the property of a material is trailed by constant warming at a uniform rate.



(a)



(b)

- For the most part, the temperature (x-hub) is plotted against the ΔT on the y-pivot. The exothermal impacts are demonstrated upward and the end warm impacts descending as for the standard. In the DTA writing, warm impacts are accounted for as far as the trademark temperature, top temperature, temperature scope of the pinnacle, crest width, crest sufficiency or stature, and pinnacle territory. By deciding the idea of the pinnacle (endothermic or exothermic), the temperature of the trademark pinnacle, and other general attributes, it is conceivable to use DTA for both subjective and quantitative purposes. By warming the double or ternary blends in the DTA contraption, the grouping of responses during warming may likewise be pursued. Numerous variables, for example, the sort and size of test holder, heater, thermocouple, rate of warming, affectability of the account framework, level of dryness of the example, the measure of test, molecule size and crystallinity, pressing thickness, warm conductivity, and shrinkage or swelling of the example, will influence the outcomes. The convenience of DTA is additionally improved with the advancement of multipurpose kinds of hardware which join at least one sorts of aide procedures to DTA. Models are: DTA-Effluent Gas Analyzer, DTA-Mass Spectrometer, DTA-DTG-TG, DTA-TG-Radioactive Emission, DTA-TG-Dilatometer, DTA-XRD, and so forth.
- valuable data to the structure of a designing item:
- Temperature conveyances.

- Heat motion ways – significant data in assessing protections.
- As a limit condition for the examination of warm pressure
- Warm examinations give valuable data in the accompanying applications:
- Chemical plants
- Burners and combustors.
- Heat exchangers.
- Undersea protection frameworks.
- Warm investigation can be performed utilizing FEA or CFD. FEA technique is regularly favored when assessing warm pressure is the fundamental motivation behind the investigation or the limit conditions are all around characterized. CFD is a superior strategy in assessing stream limit conditions (heat move coefficient and liquid temperature) when the stream or structure geometry is mind boggling. Liquid Structure Interaction (FSI) can be utilized for stream reenactment first to give precise warm limit condition at that point pursued with pressure investigation. FSI will be all the more requesting on figuring assets.

The figuers allshows the result of thermal analysis of Transient thermal analysis in that we are showing 2 types

1. Total Heat Flux.

2. Directional Heat Flux.

In this we are applying 3 parameters

1. Temperature.(Room Temperature)
2. Convection. (Film coefficient Temperature).

We are given values based on standard temperature of Ambient Temperature is 22 degree Celsius. Film coefficient temperature are also produced it depends on cutting parameters

i.e., carbide drill tool cuts structural steel that produces 120-200 degree temperature.

Based on this we are applied a temperature, convection and internal heat generation.

Total operation was done after it was 60-70 degree temperature produced, but these component has cooling the temperature fastly. But it has certain temperature after completing total operation. For that we based on we are applied the values whatever we have taken for this component.

5. Thermal Analysis Result:

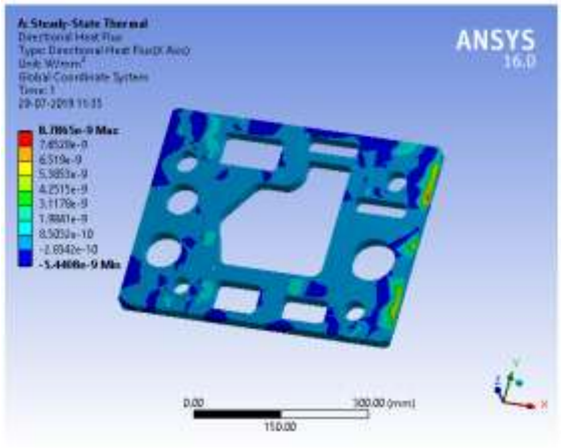


Fig:12. Directional Heat Flux (Steady State Thermal

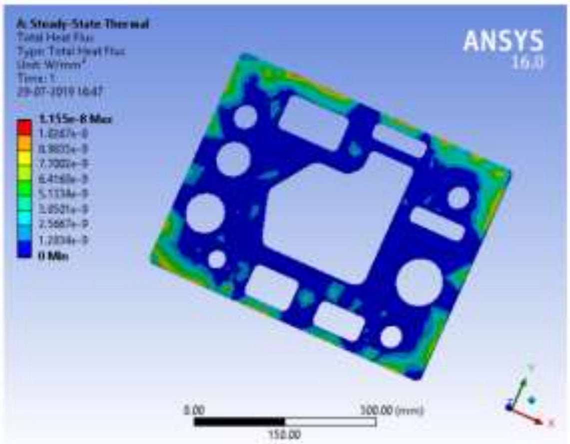


Fig: 13. Total Heat Flux (Steady State Thermal)

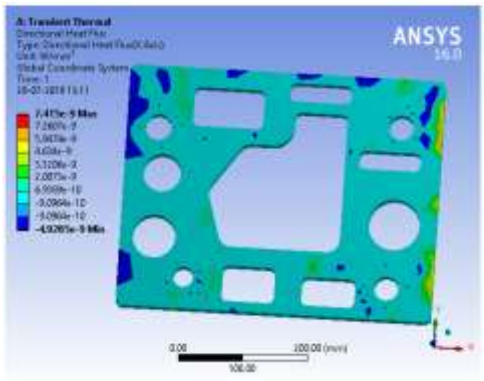


Fig: 14.Transient Thermal Directional Heat Flux.

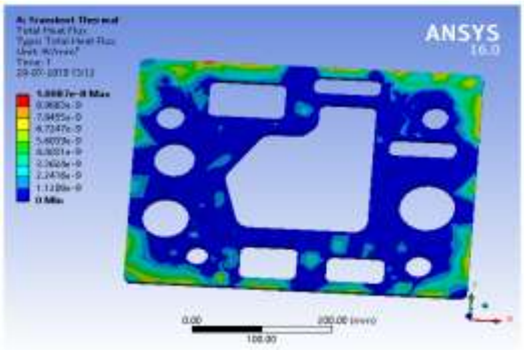


Fig: 15. Transient Thermal Total Heat Flux.

Graph:

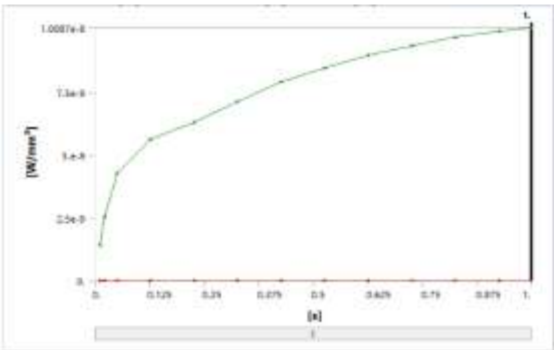


Fig: 16.Transient Thermal Directional Heat Flux

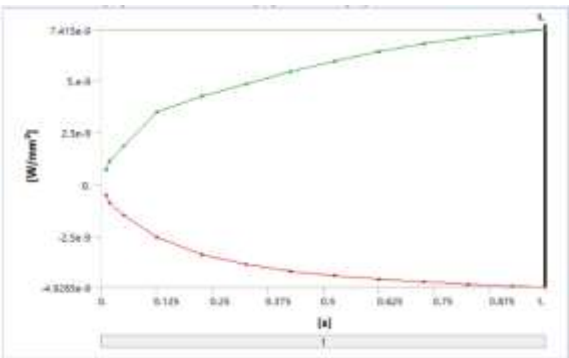


Fig: 17. Transient Thermal Total Heat Flux.

Time [s]	Minimum [W/mm²]	Maximum [W/mm²]
1.e-002	-26.752	28.835
2.e-002	-44.588	46.922
5.e-002	-81.189	86.824
0.14	-157.97	169.88
0.24	-236.28	245.01
0.34	-305.87	310.84
0.44	-369.45	370.38
0.54	-428.31	425.06
0.64	-483.21	475.68
0.74	-534.7	522.76
0.84	-583.17	566.65
0.94	-628.94	607.66
1.	-655.5	631.3

Structural Steel > Constants

Density	7.85e-006 kg mm^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	4.34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6.05e-002 W mm^-1 C^-1
Resistivity	1.7e-004 ohm mm

Directional Heat Flux

6. Conclusions:

By doing thermal analysis on crank case machining it sis observed that

- In this project as per result the 3D requirements of fixture assembly are studied and data and results are presented in SolidWorks. Confirmation of assembly design is done using the ANSYS Workbench. These clamping forces are calculated at 30, 40 and 50 bar hydraulic pressure using analytical and numerical methods, which are accepted and taken into a count during the static structural analysis of the fixture assembly and the crank case., so from Finet Element Analysis result the 1st type of Fixture Assembly design is to be consider as for manufacturing the final fixture assembly system.
- In this paper, the 3D requirements of fixture assembly are studied and data and results are presented in SolidWorks. Confirmation of assembly design is done using the ANSYS Workbench. These clamping forces are calculated at 30, 40 and 50 bar hydraulic pressure using analytical and numerical methods, which are accepted and taken into a count during the static structural analysis of the fixture assembly and the crank case.
- Also the Finet Element Analysis results of total deformations for the1st fixture design model is validated by comparing the results of the experiment tests on Analysis conducted in the case of fixture Crankcase, so that the validity for the total deformation by the Finet Element Analysis and the experimental tests is nearly equal. We therefore conclude that the resulting values from the deformations and von-misses stresses from the Finet Element Analysis are true, i.e. Fixture precisely designed, analysed and made.
- Also for the 1st type fixture assembly design model are finding of the work can be illustrated as follows;
- i). CAFD reduces the time for designing the fixture which is hard manually.
- ii) The use of Finet Element Analysis for CAFD's environment, eliminating unnecessary and uneconomical trial and error experiments on machine shop floor.
- iii) As well as tightening the Crankcase at 30 bar Hydraulic pressure and maintaining its position and stability against cutting forces lower than tolerance limit with low stress and deformation values.
- iv) Therefore a 30 bar hydraulic pressure for the clamp is preferred over 40 and 50 bar
- v) 0.0356 mm maximum deformation is observed at 30 bar pressure with respect to machining tolerance allowance.

- In this I done steady state and transient thermal analysis in this temperature values of thermal expansion co efficient values is
  For Stead State Thermal Analysis
  - Total heat flux: 1.0087e-8 Max
  - Directional Heat flux: 7.415e-9Max

  For Transient Thermal Analysis

  - Total heat flux: 1.0087e-8 Max
  - Directional Heat flux: 7.415e-9Max

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