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DESIGN AND ANALYSIS OF EXHAUST MANIFOLD

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ABSTRACT

The Exhaust manifold is a standout amongst the most vital part to examine the related thermal stresses and deformations under reenacted operational conditions near the genuine circumstance on various materials. Examination completed by reference ecological testing conditions, in various surrounding temperatures on various materials i.e. solid metal, cast iron, aluminum, structural steel.

The finite element analysis software ANSYS Workbench 14.0 used to ascertain the direct unfaltering state temperature conveyance under the warm field and basic investigation. Warm examination computes the temperature dispersions and related warm amounts in a exhaust manifold.

Keywords: Exhaust Manifold, FEM, Heat Transfer Coefficient, Thermalstructural Analysis, Back Pressure, CATIA and ANSYS.

I. INTRODUCTION

1.1 Exhaust Manifold

The exhaust manifold of a vehicle motor is constantly presented to hot gasses. Cast iron has been being used for the generation of exhaust systems generally. The fundamental qualities required for the exhaust manifold material incorporate warm weariness quality required to withstand the high temperature deplete gasses, oxidation resistance , great manufacture properties and low warm ability to upgrade the reactant work. Ferritic stainless steel display every one of these properties and offers huge weight lessening too. The advancements in vacuum throwing process has helped in the manufacture of stainless steel complex with segment thickness of 2-5mm. Higher requests in contamination control will rise the fumes temperatures as well and in this manner, ferritic stainless steel will be in real use for fumes framework producing. Ferritic stainless steel displays enhances warm weariness attributes when prepared by strong arrangement reinforcing with molybdenum or niobium. This procedure likewise enhances the oxidation resistance and microstructural security. Ferritic stainless steel additionally has fetched points of interest due to the nonattendance of nickel in its creation. Another variation called the austenite stainless steel is utilized where ferritic stainless steel is unacceptable. Austenite stainless steel can improve its properties when enough carbon is added to it. Be that as it may, the higher cost constrains its use contrasted with the ferritic variation.

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1.2 Types of Manifolds

Motor exhaust manifold gather deplete gasses from every barrel and channel them into a fumes outlet. The complex is intended to give least backpressure and turbulence. Feline items use dry, water-cooled and air protected water-cooled (ASWC) complex plans, in view of use and outline prerequisites. Allude to

1.3 Dry Manifolds

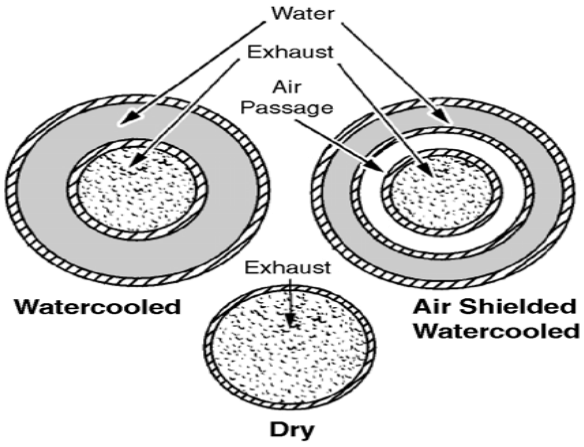
Dry manifolds are the favored manifold design. They are savvy and by giving the greatest conceivable fumes vitality to the turbocharger, they offer the most elevated general proficiency. Dry manifolds, in any case, likewise transmit the most warmth and achieve the most noteworthy surface temperatures. A few applications require low complex surface temperatures. For instance, the Mining Safety and Health .marine social orders require that engine surface temperatures stay beneath 200°C (400°F) for certain mines. Heat shields and covers are accessible for some Cat items to meet lower surface temperature necessities. A couple of marine items offer discretionary water-cooled manifolds. Gas

motors keep running with a higher fumes temperature contrasted with diesel motors. Because of these high fumes temperatures, a few models use water-cooled or air protected water-cooled manifolds.

1.3.1 Watercooled Manifolds

Entries inside water-cooled manifolds permit motor coat coolant to stream around the complex expelling heat generally conveyed by fumes gasses. Surface temperatures of water-cooled manifolds are impressively lower than those of dry manifolds, however warm dismissal to the coat water is expanded by 20 to 40 percent. This expansion requires a bigger limit cooling framework.

Water-cooled manifolds likewise diminish debilitate warm vitality conveyed to the turbocharger. This requires the utilization of a fittingly coordinated turbocharger for greatest effectiveness. The turbocharger utilized on dry complex applications may not be appropriate for use on water-cooled applications



1.3.2 Air Shielded Watercooled Manifolds

Air protected water-cooled manifolds (ASWC) make utilization of a protecting air depression between the ventilation system and the water shield. Motor water flows around the air shield however do not come into direct contact with the inward complex. This lessens the essential coat water cooling load and keeps up higher fumes vitality accessible to the turbocharger.

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1.3.3 Heat Shielding

Heat shielding might be utilized as a method for protecting hot surfaces and shielding segments or administrators from over the top warmth. The utilization of warmth shields relies on upon many variables including, however not restricted to, establishment sort, environment and administrative prerequisites. Gatekeepers may likewise be a powerful method for giving security. Shields that are composed and provided by Caterpillar are fit for this reason. Any client fitted shields must be deliberately outlined and connected to guarantee that harm to the motor does not come about. Wraps and shields, particularly those not gave by Caterpillar, must be wary of expanding segment skin temperature. Huge wind current around the shield can diminish increments in segment skin temperature

1.3.4 Blankets (Soft Manifold Shields)

Blankets are made of a protecting layer of material with a warm fabric external layer. Most covers will be held set up with stainless steel springs or wire which will be bound over the covers. Blanket will separate both warmth and commotion.

Caterpillar does not prescribe utilization of covers on ventilation systems, turbochargers or other motor segments. The utilization of complex covers regularly brings about untimely disappointment of ventilation system parts. Exemptions might be made if the protection is provided and affirmed for a specific application by Caterpillar; for these items, Caterpillar utilizes deplete and turbocharger parts that are produced using materials equipped for withstanding higher temperatures. Feline motors that utilization wraps and shields are created to a lower fumes gas temperature constrain.

1.3.5 Hard Wrap (Hard Manifold Shields)

Hard wrap is regularly utilized on the motor itself, for instance in the vee between cylinder banks. The hard wrap comprises of three layers; a warm sheet, a cover of fiberglass and sheet of bendable metal. It is introduced with the warm sheet confronting the hot surface yet not touching it. The air layer in the middle of functions as a cover. Openings for jolts can be penetrated in the metal sheet, making it simple to introduce or expel.

Guards and Shields

Guards and shields are usually made using perforated sheet metal. They are installed with an air gap between the shield and the hot surface. With adequate airflow around the engine, the heat transfer from iron to air will lower the temperature of the shield considerably.

1.4 Applications

1.4.1 Exhaust Systems for Specific Applications

Some engine applications confront more establishment difficulties than others. Marine establishments, for example, are managed almost no space and require impressive security from water entering the fumes framework. The data that takes after locations some of these challenges and can be relevant to marine based and in addition some land based establishments**.**

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1.4.2 Marine Dry Exhaust System

The marine dry fumes framework, as a rule, is like a run of the mill arrive based fumes framework and will be liable to a similar fumes framework plan contemplations as of now talked about in this area.

1.4.3 Marine Exhaust Ejector Automatic Ventilation System

A moderately basic framework using a motor's fumes for ventilating a motor room can be organized with most dry fumes frameworks. Ventilation work can be introduced around the motor fumes channeling in a manner that the fumes stream makes a vacuum that is used to draw the hot freshen up of the upper part of the motor room. This strategy has been utilized effectively in marine applications with little motor rooms and negligible ventilation prerequisites. A fumes ejector framework may draw out an amount of ventilating air around equivalent to the stream of fumes gas.

1.4.4 Marine Wet Exhaust System

Wet fumes frameworks blend the fumes gasses with the ocean water released from the ocean water side of the motor's coat water warm exchanger. Moisture of fumes gasses and seawater is released from the watercraft at or marginally beneath the vessels waterline. With a generally little height distinction between the motor's fumes release elbow and the vessels waterline, it is hard to outline a framework which will dependably keep water from entering the motor through the fumes framework. While various exclusive fumes parts are accessible to maintain a strategic distance from this issue, the most widely recognized non specific strategies are fumes risers and water lift silencers.

II. INTRODUCTION TO CATIA

CATIA is a completely mechanization programming which relates with the mechanical field. It is graphical UI which is anything but difficult to learn furthermore the product is highlight based and parametric strong demonstrating. We can draw 2D and 3D models of a section and in like manner the get together of the parts should be possible in it.

The shape or geometry of the model or gathering is needy upon the qualities which are alluded as imperatives. Modules, for example, sketcher module used to plan 2D drawings, part outline module is utilized to outline the 3D models of geometry, and Assembly work configuration is utilized to gather the diverse parts which are attracted the part outline module. Kinematics is utilized to give the recreation or movement to the part bodies which are planned and amassed to some degree and get together outline modules.

III. Different modules used in CATIA

- Sketcher
- Part Design
- Assembly Design
- Kinematics

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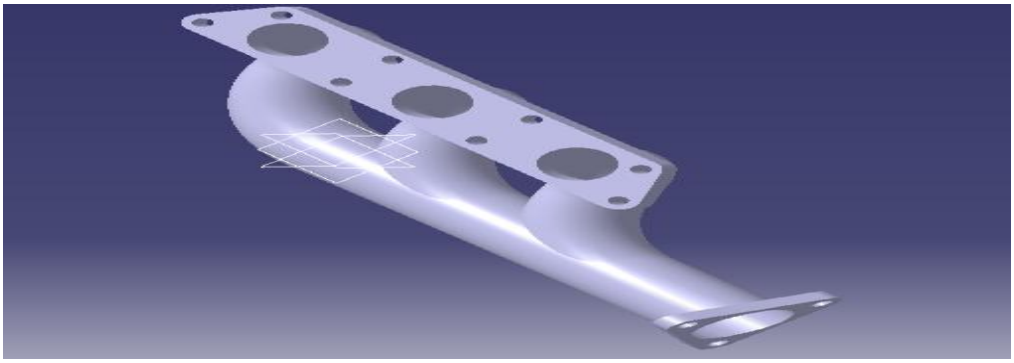
By Using the CATIA software the part designs were designed and assembly is made because compared to other software's CATIA is easy to design.

Exhaust manifold design in catia



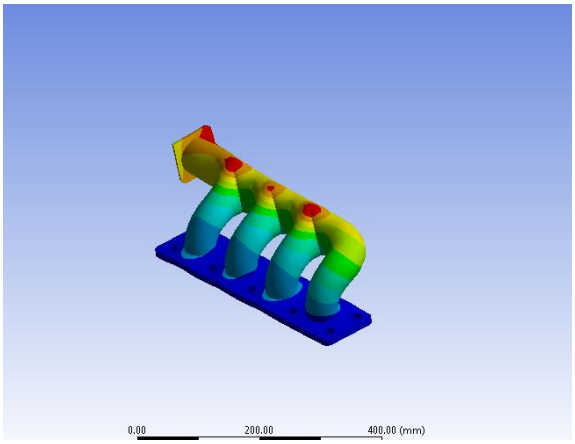
IV. FINITE ELEMENT ANALYSIS (FEA)

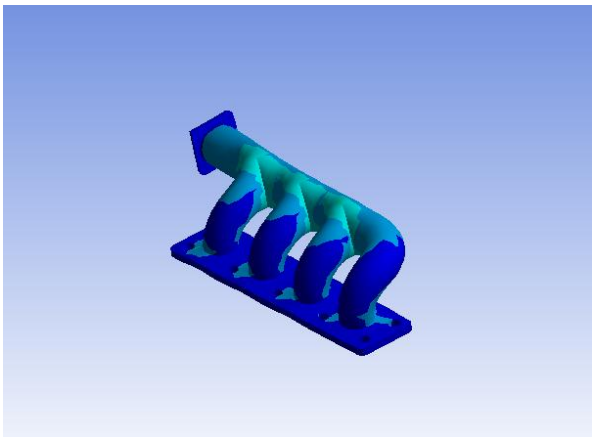
The major thought in FEA is that the body or structure might be isolated into more diminutive segments of limited estimations called "Limited Elements". The first body or the structure is then considered as a variety of these parts related at a set number of joints called "center points". Clear limits are approximated the evacuations over every constrained segment. Such acknowledged limits are called "shape limits". This will imply the development inside the segments similar to the movement at the centers of the segments.

The Finite Element technique is a logical device for settling customary and incomplete differential correlation in light of the reality it is a numerical device, it can deal with the unpredictable issue that can be meant in differential scientific proclamation from. The utilization of FEM is boundless as regards the course of action of rational plan issues. In light of high cost of handling force of years cruised by, FEM has a background marked by being used to deal with complex and cost basic troubles.

Ansys Result for Structural Steel

Total deformation andEquivalent stress





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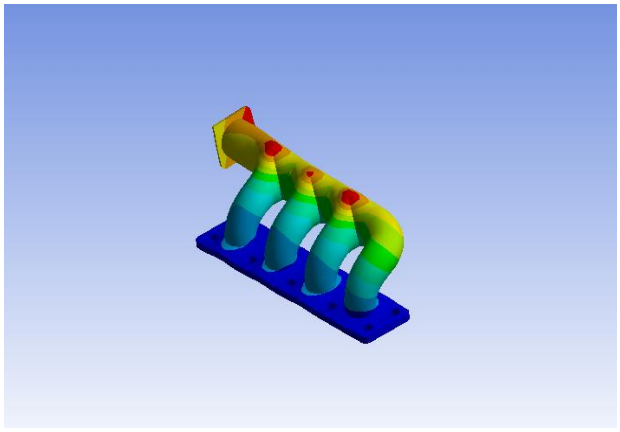
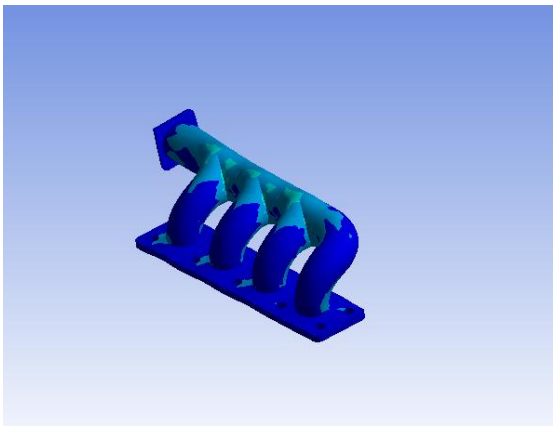
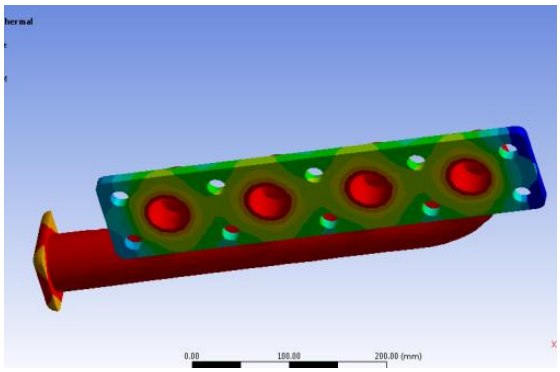
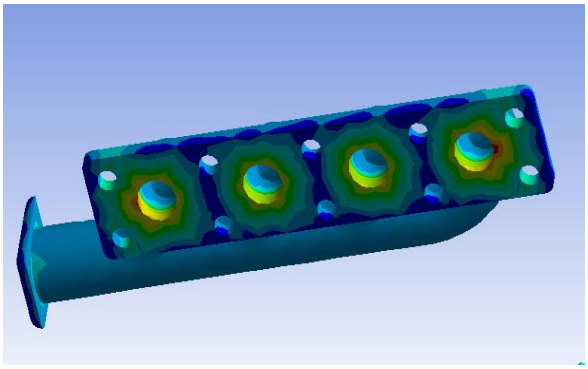
Ansys result for gray cast iron

Total deformation andEquivalent stress

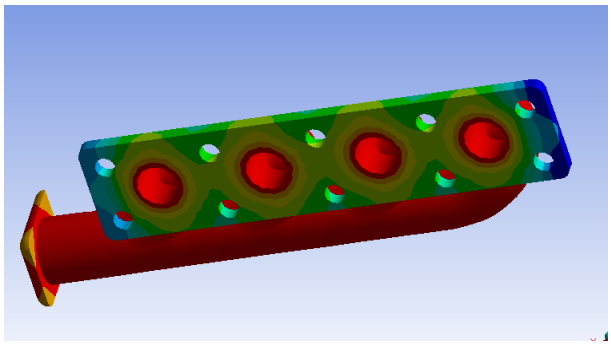
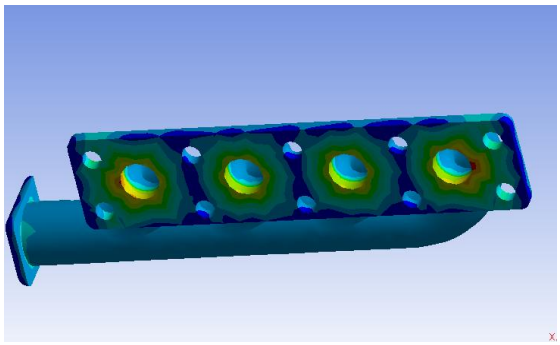
Thermal analysis Structural steel

Temperature distribution and Total heat flux

Thermal analysis for gray cast iron

Temperature distribution and Total heat flux

Structural analysis Result

Sl no	Material	Structural steel	Gray cast iron
1	Total deformation	0.0010116mm	0.0018464mm
2	Equivalent stress	1.8301e-5Mpa	3.5933Mpa

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Thermal analysis result

Sl no	Material	Structural steel	Gray cast iron
1	Temperature distribution	800.01◦c	800.01◦c
2	Heat flux	0.026119W/mm2	0.026079W/mm2

V. CONCLUSION

Basic examination and Thermal investigation has been performed on the ventilation system to discover the deformities in the arrangement of ventilation system. Examination was finished by considering the two uniquematerials structural steel and gray cast iron. gray cast ironhas observed to have more twisting while contrasted with others. structural steel is great material for this design.

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