



## (Modelling and 3d Printing of Dual Intake Manifold)

<sup>1</sup>Dr.M.Prakesh Babu, <sup>2</sup>S.Rohith, <sup>3</sup>V.Prasanna, <sup>4</sup>V.Nagaraju

<sup>1</sup>Professor, <sup>2</sup>Student of Mechanical Engineering, <sup>3</sup>Student of Mechanical Engineering, <sup>4</sup>Student of Mechanical Engineering

<sup>1</sup>Mechanical Engineering,

<sup>1</sup>Guru nanak institutions technical campus,hyderabad,Ibrahimpattanam

**Abstract :** The utilization of additive manufacturing technologies, particularly 3D printing, has revolutionized the prototyping and production processes across various industries. In this study, we present a comprehensive approach to the modelling and 3D printing of a double intake manifold for internal combustion engines. The project begins with the conceptualization and design phase, where Computer-Aided Design (CAD) software is employed to create a precise and optimized model of the manifold. Special attention is given to factors such as airflow dynamics, material selection, and structural integrity to ensure optimal performance under operational conditions. Following the design phase, the model is exported as an STL file and prepared for 3D printing. Various additive manufacturing techniques, including Fused Deposition Modeling (FDM) and Selective Laser Sintering (SLS), are evaluated for their suitability in producing the manifold. Material properties such as heat resistance, durability, and compatibility with automotive fluids are considered during the selection process.

### 1. INTRODUCTION

This paper presents a novel Dual Intake Manifold system where it precisely functions in diverting the charge through longer and shorter manifolds. Apart from conventional Dual Intake manifold system this system differs in the following

1. Valve less- no flow diverting valves are used, which reduces the complexity of system.
2. No external pneumatic or hydraulic actuation system is required.
3. No moving parts are present in the system thus increased reliability and reduced complexity in operation.
4. Highly compact and packaging is effective.
5. Functions based on Throttle position, partially open throttle condition (POT) and Wide open throttle condition (WOT)



FIG 1 Intake manifold

The proper entry of air to fuel mixture provides the greater swirl and increases in the efficiency of the engine.

1. Single Point Injection
2. Multi Point Injection
3. Direct Injection

### 1.1 WORKING OF INTAKE MANIFOLD:

Intake manifolds paintings with the aid of frivolously distributing both air and an air/fuel combination from the carburetor or throttle frame to the cylinders. This is done via careful engineering of each the design and orientation of the manifold. If a consumption manifold has too many changes in orientation or contour, the go with the flow of air may be impeded, which might bring about poor operation. With that during thoughts, aftermarket intake manifolds are regularly designed to be even greater green than OEM components. The engine's "L" head is attached to the block's side and the "I" head is to the cylinder head. The intake

manifold that is designed for high performance creates a high amount of vacuum. The vacuum helps to draw in fuel from the carburetor. In turn makes the flow of air and fuel efficient.

## 1.2 INTRODUCTION OF 3D PRINTING

### WHAT IS 3D PRINTING?

3D printing uses computer-aided design to create three-dimensional objects through a layering method. Sometimes referred to as additive manufacturing, 3D printing involves layering materials, like plastics, composites or bio-materials to create objects that range in shape, size, rigidity and color.

### Important of 3D Printers

The flexibility, accuracy and speed of 3D printers make them a promising tool for the future of manufacturing. Today, many 3D printers are used for what is called rapid prototyping.

Companies all over the world now employ 3D printers to create their prototypes in a matter of hours, instead of wasting months of time and potentially millions of dollars in research and development. In fact, some businesses claim that 3D printers make the prototyping process 10 times faster and five times cheaper than the normal R&D processes.

3D printers can fill a role in virtually almost every industry. They're not just being used for prototyping. Many 3D printers are being tasked with printing finished products. The construction industry is actually using this futuristic printing method to print complete homes. Schools all over the world are using 3D printers to bring hands-on learning to the classroom by printing off three-dimensional dinosaur bones and robotics pieces. The flexibility and adaptability of 3D printing technology makes it a game-changer for any industry.

### Methods of 3D printing

The term 3D printing encompasses several manufacturing technologies that build parts layer-by-layer. Each varies in the way they form plastic and metal parts and can differ in material selection, surface finish, durability, and manufacturing speed and cost. There are several types of 3D printing, which include:

- Stereolithography (SLA)
- Selective Laser Sintering (SLS)
- Fused Deposition Modelling (FDM)
- Digital Light Process (DLP)
- Multi Jet Fusion (MJF)
- Poly-Jet
- Direct Metal Laser Sintering (DMLS)

### The 3D Printing Process

When the modeling and slicing of a 3D object is completed, it's time for the 3D printer to finally take over. The printer acts generally the same as a traditional inkjet printer in the direct 3D printing process, where a nozzle moves back and forth while dispensing a wax or plastic-like polymer layer-by-layer, waiting for that layer to dry, then adding the next level. It essentially adds hundreds or thousands of 2D prints on top of one another to make a three-dimensional object.

### History of 3D Printing

Inception of 3D printing can be traced back to 1976, when the inkjet printer was invented. In 1984, adaptations and advances on the inkjet concept morphed the technology from printing with ink to printing with materials.

### Problem statement:

Dual intake manifold problems can vary depending on the specific issue you're experiencing. Some common problems include vacuum leaks, gasket failures, throttle body issues, and problems with the intake runners or valves. Diagnosing the exact issue typically requires a combination of visual inspection, testing for leaks, and possibly using diagnostic tools.

### Solving the problem:

Address Vacuum Leaks: Inspect all gaskets, intake manifold runners, and vacuum hoses for damage or leaks. Replace any faulty components and make all connections are secure.

Throttle Body Maintenance: Clean the throttle body to remove any carbon buildup on the throttle plate. Check for malfunctions in the throttle position sensor or idle air control valve and replace as needed.

Gasket Replacement: If gasket failures are detected, replace them with high-quality gaskets and ensure proper installation to prevent future leaks.

## 3. RESEARCH METHODOLOGY

- Designing
- Extruding
- Refining
- Exporting

- 3d Printing
- Printing
- Post processing
- Testing

### 3.1 MODELLING OF INTAKE MANIFOLD

Part Modeling of Intake Manifold

**Sketch:** It gives the profile, like outer diameter and inner diameter by intended means of line, rectangle command.

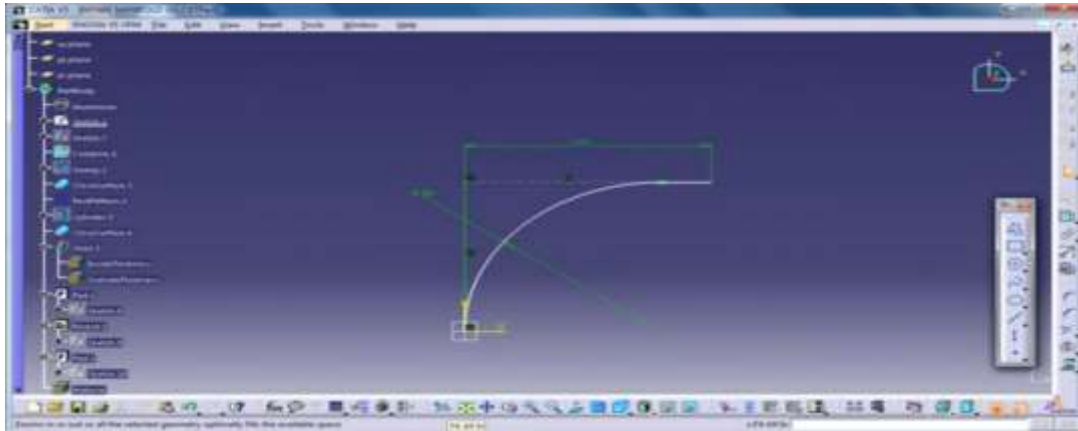
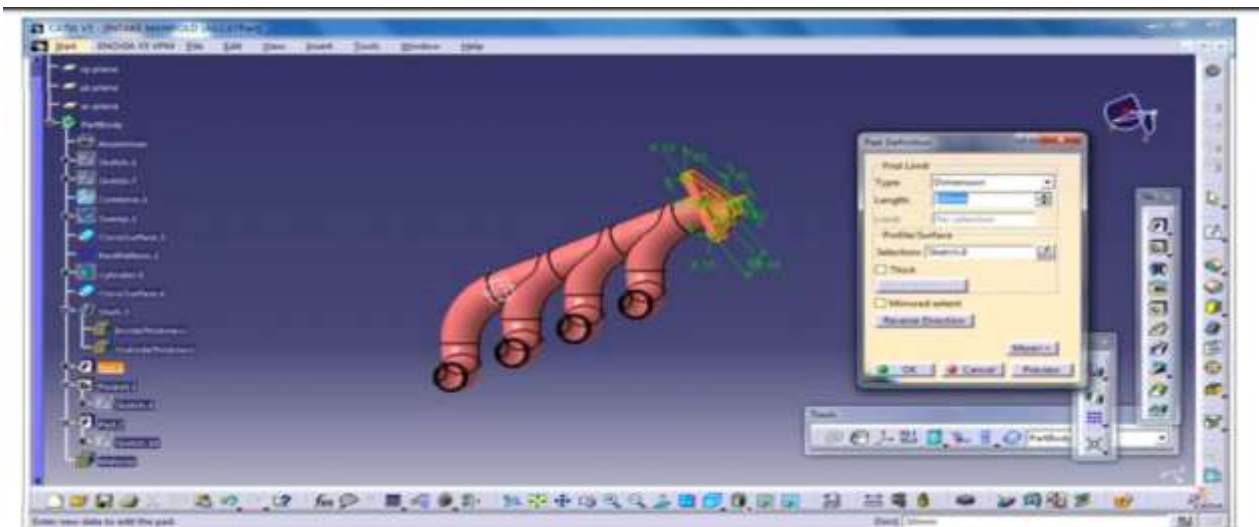


Fig.2 CATIA

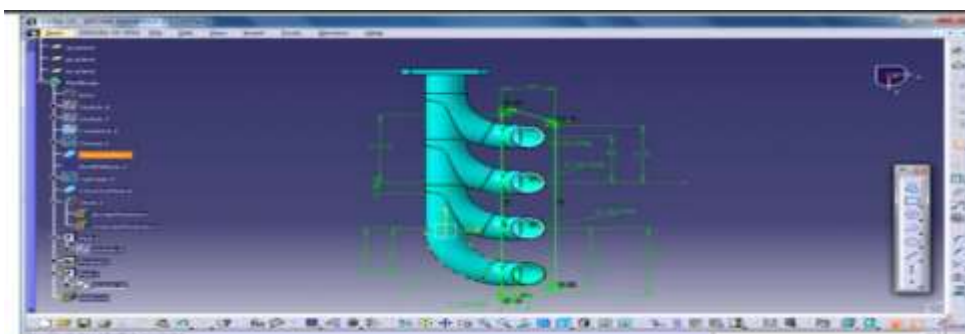
#### *USING SKETCH COMMAND FOR OUTER PROFILE PAD*

It gives the required thickness to the component .After the sketch, click on the close workbench icon and then the pad command appears, on clicking on it, the dialog box opens; the required value can be entered



*Fig 3 Command For Outer Profile Pad*

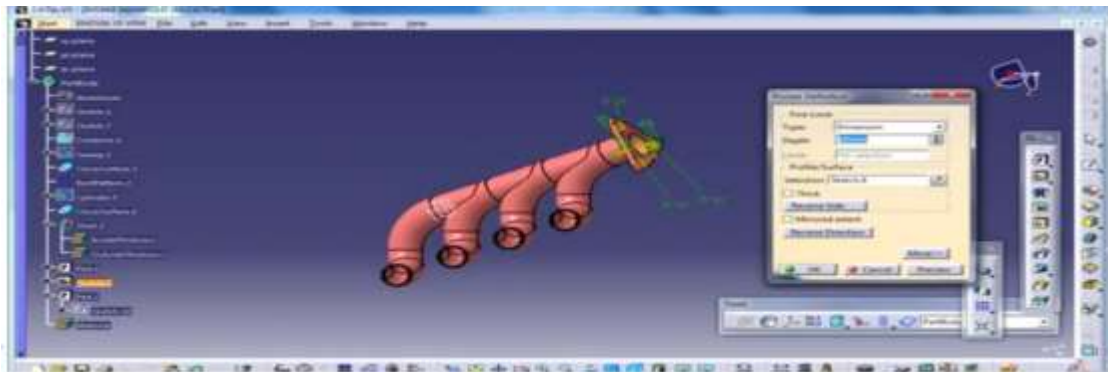
#### *USING PAD COMMAND FOR THICKNESS*



*Fig 4 Command For Thickness*

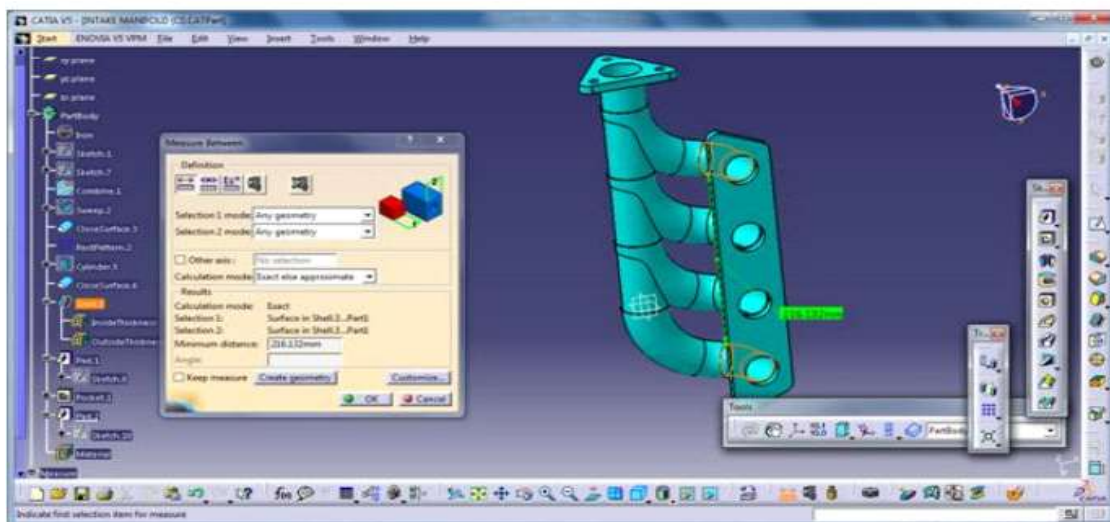
It gives the profile of the gear teeth, like a inner tooth or outer tooth gear by intended means of circle, arc, trim, reference line commands.

**WINDOW FOR HOOK/ CIRCLES PROFILE POCKET:** It gives the required pocket / groove / hole to the gear component .After the sketch, click on the close workbench icon and then the pocket command appears, on clicking on it, the dialog box opens; the required value can be entered.



*Fig 5 Circle Profile Pocket*

**4.5 USING POCKET COMMAND FOR REMOVING MATERIAL/ THICKNESS RECTR PATTERN:** This command is used to repeat the profile structure on the total selected workbench. This is the command need to enter the number of profiles are to be repeated on the workbench in the given dialog box.



#### 4.6 USING MEASURE LENGTH

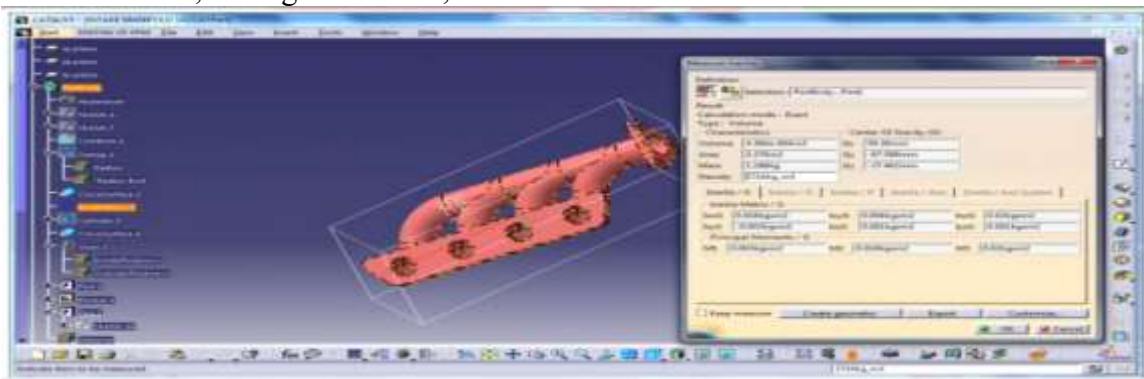
Applying Material properties: Selection of Component and type of material





**4.7 APPLYING MATERIAL PROPERTIES**

Measure Inertia: Here we get all the values of the material by which the properties were applied; like Mass, Area, Moment of Inertia, Young’s Modulus, etc



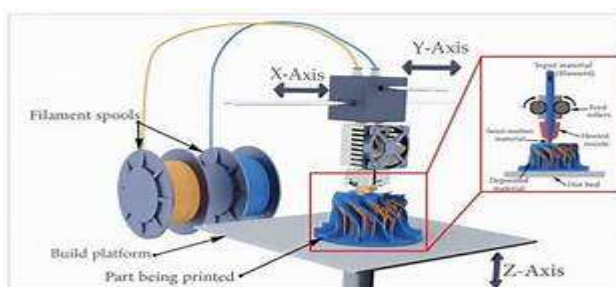
**4.8 USING MEASURE INERTIA MULTI VIEW:** This is the command in which all the views of the component / model can be displayed on the screen at a same time, they can be edited under the workbench.



**Fig 6 Discussion On Analysys Result**

**4. PRINTING OF INTAKE MANIFOLD**

After the completing the 3d modelling of intake manifold going to the 3d printing. Save as .stl file format. Open the FLASHFORGE SOFTWARE and import the intake manifold file.adjust and modify the printing parameters like scale and add support structure model at weaker sections.save the file in the FDM(Fused Deposition Modelling).fdm.format.Now the 3d printer comes to play and starts the printing according to our requirement.



**Figure 7FDM**



**Figure 8 Overview of 3d printing software**

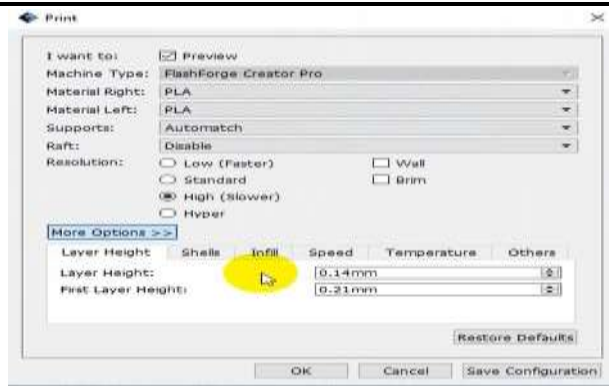


Figure 9 Selecting the material type and layer height

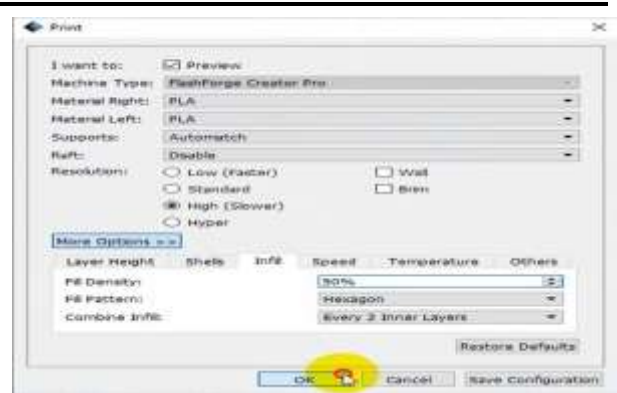


Figure 10 Selecting resolution and infill density

### Saving the Sliced Model and Estimating Print Time

Once you have configured the printing settings for the the Dual intake manifold in the FlashForge software, follow these steps to save the sliced model and estimate the print time:0.

1. After adjusting all the necessary settings, locate the "Save" or "Export" option within the software interface.
2. In the save window, choose the desired file format for the sliced model. In this case, select the format as \*.svgx (Scalable Vector Graphics).
3. Provide a suitable file name for the sliced model and choose the destination folder where you want to save it. Click "Save" to proceed.
4. Once the file is saved, the software will start slicing the model based on the configured settings. This process involves converting the 3D model into a series of 2D layers that the 3D printer can understand.
5. During the slicing process, the software will also estimate the time required to print the material based on factors such as layer height, fill density, and complexity of the model.
6. Once the slicing is completed, the estimated print time will be displayed within the software interface. This gives you an idea of how long it will take to print the the Dual intake manifold.

### IV. RESULTS

The result of following these steps is a properly designed and prepared 3D model of the intake manifold, converted to the required file format, configured with suitable support structures, and ready for 3D printing. The model is saved in the appropriate file format (\*.svgx or \*.fdp) with all the necessary settings adjusted, such as material selection, resolution, layer height, infill density, and fill pattern. The software provides an estimated printing time for the material based on the configured settings. By following these steps, we have successfully prepared the 3D model for printing, ensuring optimal print quality and accuracy.



### REFERENCES:

- [1] Ryan I., Christopher B. W., "Design and Manufacture of a Formula SAE Intake System Using Fused Deposition Modeling and FiberReinforced Composite Rapid Prototyping", Journal, Vol. 16 Is: 3, pp.174 – 179.
- [2] Heavy Duty Engines – MTZ 6/2005. 4. Jacobs, T., Chatterjee, S., Conway, R., Walker, A., Kramer, J. and K. Mueller-Haas, Development of a PartialFilter Technology for Hdd Retrofit, Sae Technical Paper 2006-01-0213. 56 K. S. Umesh, V. K. Pravin& K. Rajagopal
- [3] C. Lahousse, B. Kern, H. Hadrane and L. Faillon, "Backpressure Characteristics of Modern Three-way Catalysts",Benefit on Engine Performance, SAE Paper No. 2006011062,2006 SAE World Congress, Detroit, Michigan ,April 36, 2006
- [4] M.B. Beardsley et al.,Thermal Barrier Coatings for Low Emission, High Efficiency Diesel Engine Applications" SAE Technical Paper 1999-01-2255.
- [6] Rajesh Biniwale , N.K. Labhsetwar, R. Kumar and M. Z. Hasan, "A non-noble metal based catalytic converter fortwo-strokes, two-wheeler applications", SAE Paper No. 2001011303, 2001.
- [7] G. Muramatsu, A. Abe, M. Furuyama, "Catalytic Reduction of Nox in Diesel Exhaust",SAE 930135, 1993.
- [8] The scientific design of exhaust and intake systems by Philip Hubert Smith, John Cruickshank Morrison, R. Bentley, 1971
- [9] The Design and Tuning of Competition Engines by Philip Hubert Smith, BENTLEY ROBERT Incorporated, 1977
- [10] Automobile Engines - In Theory, Design, Construction, Operation, Testing and Maintenance by A.W. Judge