



Modelling and 3d Printing of Cylinder Fins of Two-Wheeler

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Abstract : The engine cylinder is one of the major automobile component that is subjected to high-temperature variations and thermal stresses. Cylinder fins in engines can face various issues, such as Heat Dissipation. In order to cool the cylinder, fins are provided on the cylinder for increase of the rate of heat transfer. By Increasing the number of fins and size of cylinder to enhance the surface area for improved heat transfer. Ensure proper air flow between cylinder fins. By Increasing fin parameters like length, pitch, thickness, fin number, wideness and materials are having great influence on heat transfer rates in Design. A CAD Model were built using Catia V5 in the form of CATPART format and that file is saved as STL file and send it to 3D printer for printing of the part by using 3D printing technology will convert digital design of object into physical part.

1. INTRODUCTION

1.1 Fins

A fin serves as an extended surface on an object, enhancing heat transfer to or from the surroundings by promoting convection. Heat transfer in an object is determined by conduction, convection, and radiation. To increase heat transfer, one can amplify the temperature difference between the object and the environment, boost the convection heat transfer coefficient, or enlarges the object's surface area. In some cases, modifying the first two options might not be practical or cost-effective. However, attaching fins to the object can effectively increase its surface area, offering an economical solution to heat transfer issues. Examples include circumferential fins around motorcycle engine cylinders and fins on refrigerator condenser tubes.

1.2 Engine Cylinder Fins

In internal combustion engines, the combustion of air and fuel occurs within the engine cylinder, generating hot gases with temperatures ranging from 2300-2500°C. This high temperature can lead to the burning of the oil film between moving parts, potentially causing seizing or welding. To maintain efficient engine operation, it's crucial to reduce this temperature to around 150-200°C. Excessive cooling, though, can diminish thermal efficiency. Therefore, the cooling system aims to maintain the engine at its optimal operating temperature. Notably, engines are inefficient when cold, so the cooling system is designed to delay cooling until the engine reaches its most efficient temperature range. Heat engines derive mechanical power by converting heat energy into mechanical work, akin to a water wheel harnessing power from a flowing mass. Since engines are inherently inefficient, they produce more waste heat than mechanical power. This waste heat is removed through various means, including cool intake air, hot exhaust gases, and active engine cooling mechanisms.



Fig:1 Cylinder Fins of Two-Wheeler

1.3 WORKING OF CYLINDER FINS:

The air-cooled system is typically employed in small automobile engines. This setup incorporates fins or extended surfaces on the cylinder walls and cylinder head. Heat generated during combustion within the engine cylinder is conducted to these fins. As air flows over the fins, the heat is dissipated into the surrounding air.

The dissipation of heat into the air is influenced by:

- (a) The volume of air passing through the fins.
- (b) The extent of the fin surface.
- (c) The thermal conductivity of the metal employed for the fins.

2. INTRODUCTION OF 3D PRINTING

WHAT IS 3D PRINTING?

3D printing, also known as additive manufacturing, utilizes computer-aided design to fabricate three-dimensional objects by layering materials such as plastics, composites, or bio-materials.

Significance of 3D Printers

The versatility, precision, and efficiency of 3D printers make them a promising asset in manufacturing. Rapid prototyping, enabled by 3D printers, significantly reduces both time and costs associated with traditional research and development processes.

Industries worldwide are leveraging 3D printing for prototyping as well as producing final products. From constructing entire homes to enhancing classroom learning experiences with printed educational materials, the adaptability of 3D printing transcends multiple sectors.

Methods of 3D printing

Different 3D printing technologies exist, each with unique characteristics affecting factors like material selection, surface finish, and production speed.

Examples include:

- > Stereolithography (SLA)
- > Selective Laser Sintering (SLS)
- > Fused Deposition Modelling (FDM)

The 3D Printing Process

Once a 3D model is prepared, the printer executes the printing process layer by layer, same as traditional inkjet printing but in three dimensions. This method adds multiple 2D prints to form a complete object.

History of 3D Printing

The origins of 3D printing date back to 1976 with the invention of the inkjet printer. In 1984, Subsequent advancements transformed printing technology from using ink to materials, leading to the emergence of 3D printing.

Problem statement:

The engine cylinder is one of the major automobile components that is subjected to high-temperature variations and thermal stresses. Cylinder fins in engines can face various issues, such as Heat Dissipation. Diagnosing the exact issue typically requires a combination of visual inspection, testing for thermal analysis, and possibly using diagnostic tools.

Solving the problem:

Cylinder fins in engines can face various issues, such as Heat Dissipation. To cool the cylinder, fins are provided on the cylinder to increase the rate of heat transfer. By Increasing fin parameters like length, pitch, thickness, fin number, wideness and materials having great effect on heat transfer rates in Design. A CAD Model were built using Catia V5 in the form of CATPART format and that file is saved as STL file and send it to 3D printer for printing of the part by using 3D printing technology will convert digital design of object into physical part

3. METHODOLOGY RESEARCH

- Designing
- Extruding
- Refining
- Exporting
- 3d Printing
- Printing
- Post processing
- Testing

3.1 MODELLING OF CYLINDER FINS

Part Modeling of Cylinder Fins

SKETCH: It gives the profile, like outer diameter of Cylinder Bore

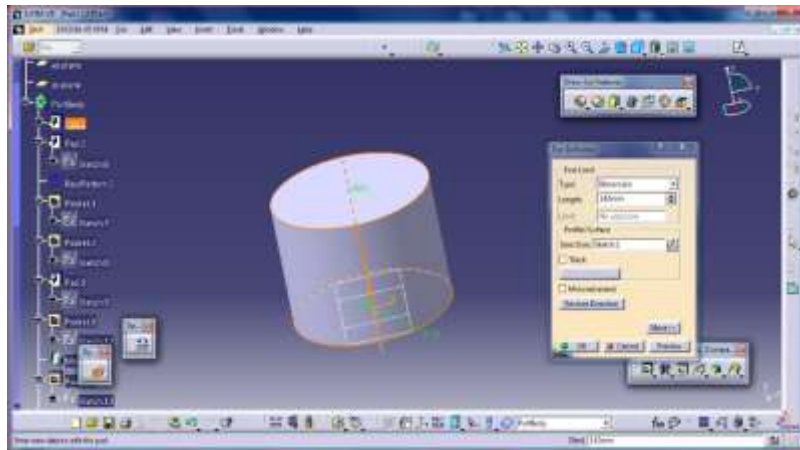


Fig:2 Pad Tool for Bore

USING RECTANGULAR PATTERN FOR FINS

During the part design process incorporate the transformation-based feature alongside the rectangular pattern tool. Select the pad tools as elements for patterning within the pattern options, and identify the required reference plane. Subsequently, specify the number of instances and the desired length.

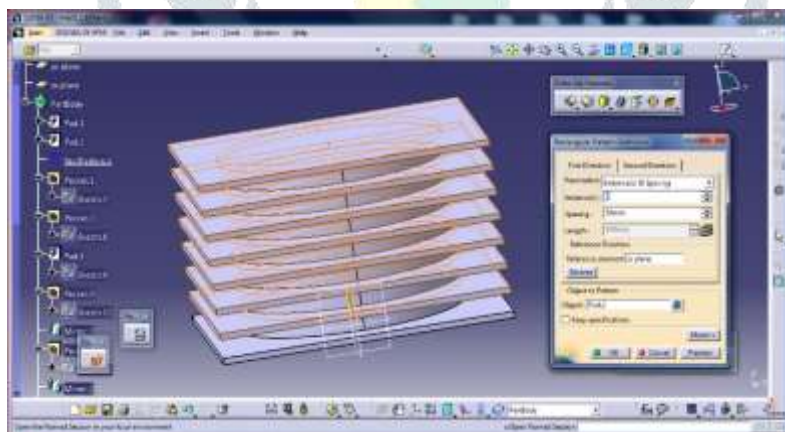


Fig:3 Rectangular Pattern for Fins

USING POCKET COMMAND FOR CYLINDER BORE

Now in part design. Locate the sketch-based feature and select the pocket tool. Within the pocket tool interface, employ the sketch tool to trace the shape depicted in the provided figure.

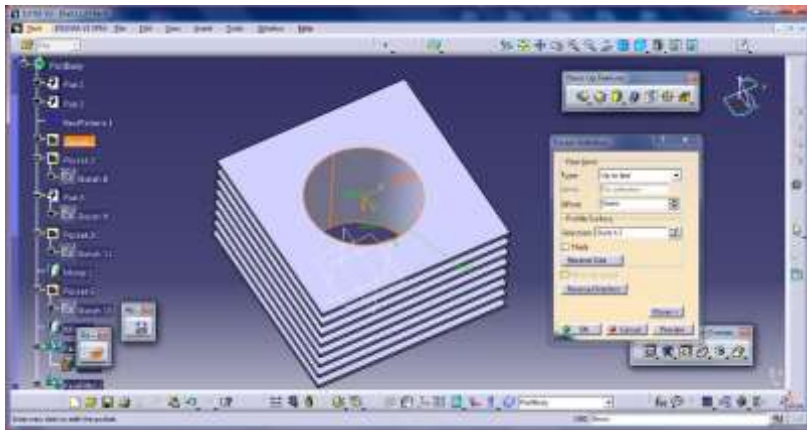


Fig:4 Cylinder Bore

Now in part design. Locate the sketch-based feature and select the pocket tool. Within the pocket tool interface, employ the sketch tool to trace the shape depicted in the provided figure.

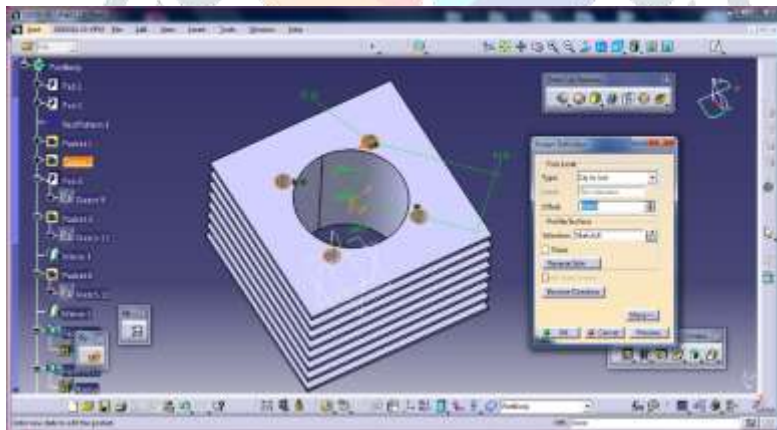


Fig:5 Nut Placement

In the part design section, go to the sketch-based feature and choose the pad tool. Within the pad tool, select the sketch tool and define the shape as shown in the figure.

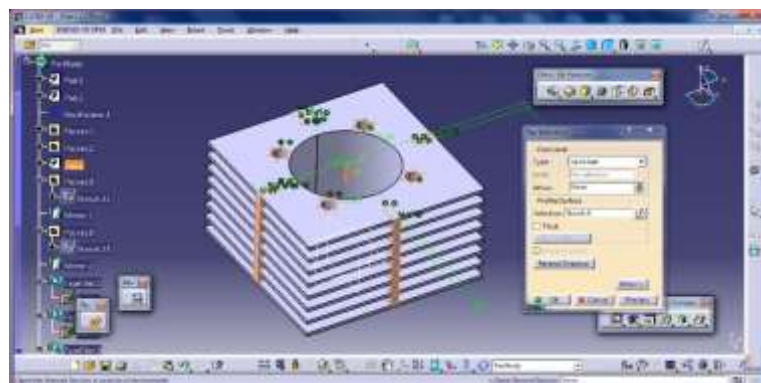


Fig:6 Pad Tool

USING POCKET COMMAND FOR REMOVING MATERIAL

Now in the part design navigate to the sketch-based tool and opt for the pocket tool. Within the pocket tool, utilize the sketch tool to outline the shape as demonstrated in the provided figure.

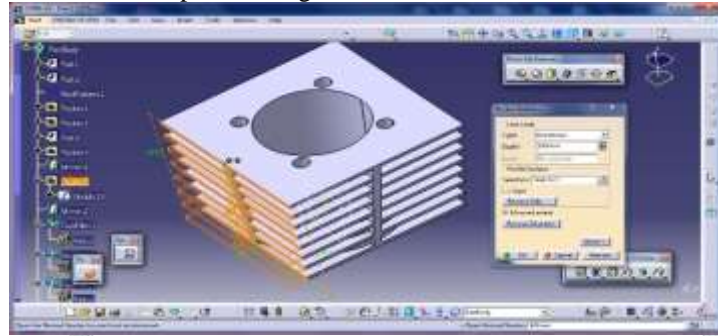


Fig:7 Pocket Tool

PAD TOOL FOR EXHAUST

In the part design section, go to the sketch-based feature and choose the pad tool. Within the pad tool, select the sketch tool and define the shape as shown in the figure.

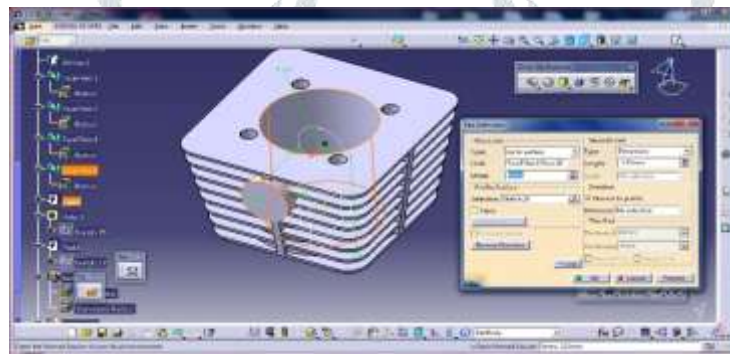


Fig:8 Pad Tool For Exhaust

USING MEASURE INERTIA MULTI VIEW: This command permits the simultaneous display of all component/model views on the screen, enabling editing directly within the workbench.

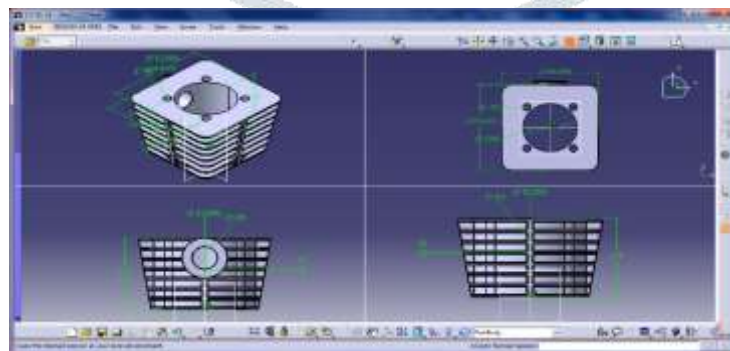


Fig:9 Final Design

4. PRINTING OF CYLINDER FINS OF TWO-WHEELER

Printing cylinder fins for a two-wheeler involves several steps.

First, the 3D model of the cylinder fins is created and saved in .stl format. Next, the file is opened in FLASHFORGE SOFTWARE where printing parameters such as scale and support structures are adjusted to strengthen weaker sections. Finally, the modified file is saved in .fdm format for FUSED DEPOSITION MODELLING. The 3D printer then executes the printing process as per the specified requirements.

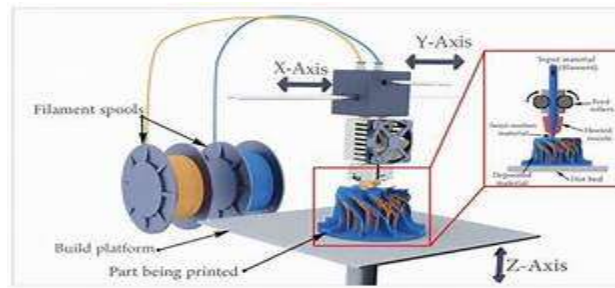


Fig:10 FDM



Fig:11 Overview of 3d printing software

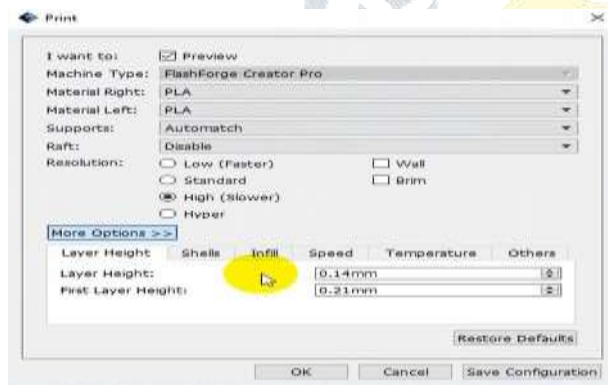


Fig:12 Selecting the material type and layer height

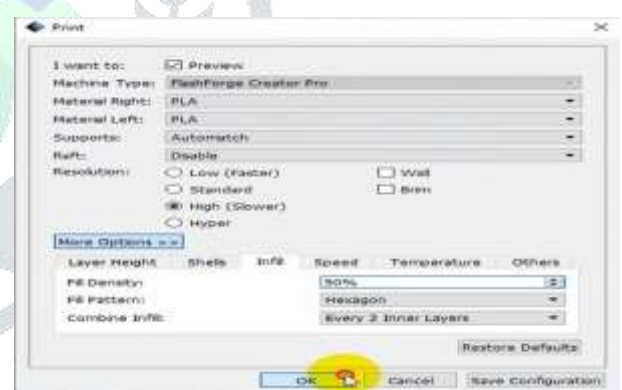


Fig:13 Selecting resolution and infill density

Saving the Sliced Model and Estimating Print Time

To save the sliced model and estimate print time:0, for the Cylinder Fins of Two-Wheeler in the Flash Forge software, follow these steps:

1. Adjust all necessary settings, then find the option to "Save" or "Export" within the software interface.
2. In the save window, choose *.svgx (Scalable Vector Graphics) as the file format for the sliced model.
3. Provide a suitable file name and select the destination folder. Click "Save."
4. After saving, the software will begin slicing the model into 2D layers understandable by the 3D printer.
5. During slicing, the software estimates print time based on factors like layer height, fill density and model complexity.
6. Once slicing is complete, the estimated print time is displayed, giving you an idea of the printing duration for the Cylinder Fins of Two-Wheeler.

IV. RESULTS

The design process involves using parametric software like Catia V5 to model a cylinder fin body for motorcycles. Modifications include adjusting fin thickness, increasing the number of fins, and resizing the cylinder to enhance heat transfer. These adjustments aim to improve the heat transfer rate. Once the model is properly designed, it is converted to the required file format and configured with suitable support structures for 3D printing. Necessary settings such as material selection, resolution, layer height, infill density, and fill pattern are adjusted, and the software provides an estimated printing time based on these settings. This ensures optimal print quality and accuracy for the final 3D model.



Figure 14 & 15 Final Component

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