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Design and making a 3D Printer using Solid works using FDM Technique

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ABSTRACT
With the help of CAD, rapid prototyping of physical objects can be achieved. In this method, objects are produced by stacking material in layers. This technology is also known as additive manufacture. There are five of the most common rapid prototyping such as visualization, appropriate forms, product testing, tools, and use of spare parts. 3D printer is an example of a machine that uses rapid prototyping. In this paper, we have discussed about designing and creating a 3D printer using the FDM method, FDM utilizes material extruded from a nozzle which is then driven by a motor. The material used here is a thread-shaped thermoplastic (coil) which is heated above the melting point by the heater. Then the material is extruded through the extruder nozzle hole. The heater maintains a constant temperature and then deforms the material from the solid to semi-solid (liquid) so that it will be easy to extrude. There is a heat transfer at the nozzle. Then, result analysis of the experiment done at 208°C is done. The nozzle type used is E2A57.
Keywords: *Rapid Prototyping, FDM, E2A57, Filament.*

I. INTRODUCTION

Rapid Prototyping is a technology related to physical objects that are obtained from the CAD. This method can produce objects by way of stacking the ingredients layers in layers. This technology is often also referred to as addictive manufacturing; there are five of the most common use of rapid prototyping: visualization, the appropriate forms, test products, tools, and the use of spare parts. One example of a machine that uses rapid prototyping is a 3D printer. 3D-Printing is a new breakthrough in the world of technology. 3D-Printing is a printer able to print 3-dimensional object. Advantages of 3D-Printing are very possible to make different shapes of patterns. This is due to the motion of the printer in 3coordinates. Associated with the definition 3D-Printing can function in the world of manufacturing. 3D printer is a method of making prototyping in a short time on the process of product development, rapid prototyping technology needed in competition the manufacturing industry especially in the era of products with a short life cycle such as currently. The existence of these problems then authors takes the theme of the thesis is to design, redesign and analyze the rapid prototyping: 3d printers type Fused with Deposition Modelling (FDM) using the type of raw material Polylactic Acid (PLA) filament diameter 1.75 mm. Therefore, the authors compiled a thesis with the title "Designing 3D Printer Rapid Prototyping Using Software Solid works 2016".

II. LITERATURE

Fused Deposition Modeling (FDM) is a Rapid Proto typing method that utilizes material extruded from a nozzle that is driven by the motor. The material is a thermoplastic shaped yarn (coil) that is heated above the melting point by the heater is then extruded through the vent extruder nozzle. Maintain the temperature of the heater and deformation material from a solid into a semi-solid (liquid) for easy extruded. Moving nozzle and dispense liquid extrusion forming layer. Plastic extrusion material will harden quickly once issued passes through the nozzle. After the first layer is formed, the platform moves down and then is the process of the formation of the next layer.

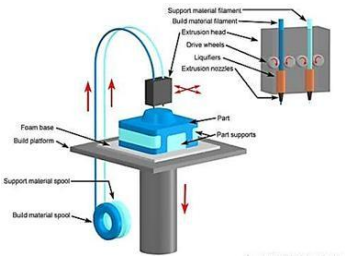

Figure1 Fused deposition modeling.

III. RESEARCHMETHODS

In the exercise of an activity of research, usually always starts with the determination of stages or steps of research. The following will be explained about the method of research conducted from beginning to end, research is shown through a flowchart.

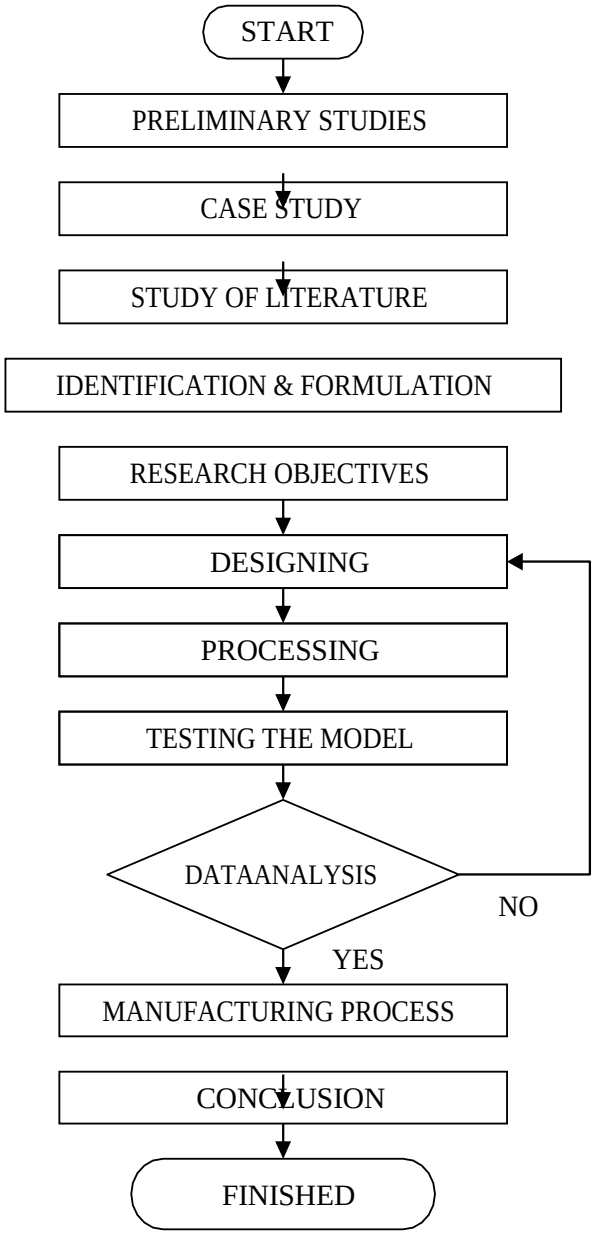

Figure2 Research flowchart.

Early stage does is study the literature thoroughly to get the initial data on the 3D printer will be created based on FDM method. Then determine the required design parameters such as length, width, height, weight, electric components and others.

3.1 Design of a3D Printer

The design of the model is used to create a model with a Hot Bed 214 x214 x3 mm and using a filament size diameter 1.75mm by the type of PLA.

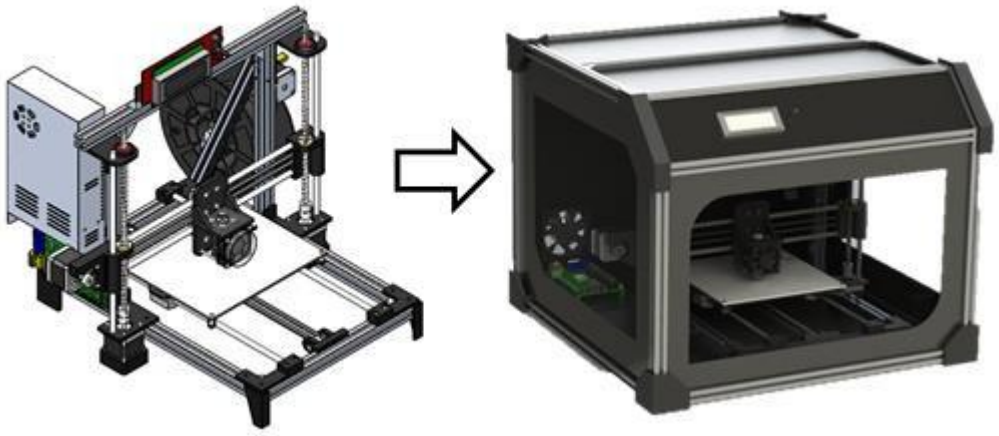

Figure3. Design printer 3D.

3.2 The selection of Model/Topology 3D Printer

Models used in 3D printer are using a model of Fused Deposition Modeling (FDM). Utilizing the material extruded from a nozzle that is then driven by the motor. The material is a thermoplastic shaped yarn (coil) that is heated above the melting point by the heater is then extruded through the vent extruder nozzle. Maintain the temperature of the heater and deformation material from a solid into a semi-solid (liquid) for easy extruded. Moving nozzle and dispense liquid extrusion forming layer.

3.3 Assembly of Electrical Components

The process of assembling electrical components between the mechanical components. Electric components Assembly can be seen in fig 4.

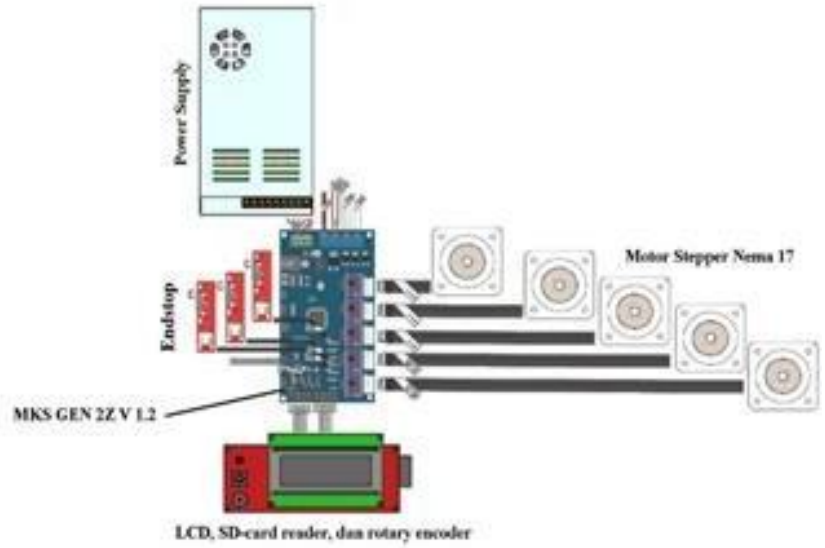

Figure4. Assembly of electrical components

Table1.3D Printer specifications.

No	Specifications	Description
1	Printer 3D Model	Fused Deposition Modelling (FDM)
	Nozzle	Diameter *Filament* 1.75mm
2		The diameter of the discharge at the tip of the nozzle 0.4mm
		The speed of discharge Filament in nozzle 25mm/s
3	Material melting point of filament	PLA190-210^{0}C
4	PCB Heat Bed PCB dimensions Work area	MK2b 214 mmx 214mm 200 mmx 200mm

IV. RESULTS AND DISCUSSIONS

In making the design of 3d printers using FDM model utilizing the material extruded from a nozzle that is then driven by the motor. The material is a thermoplastic shaped yarn (coil) that is heated above the melting point by the heater is then extruded through the vent extruder nozzle. Maintain the temperature of the heater and deformation material from a solid into a semi-solid (liquid) for easy extruded.

4.1 Analysis of Heat Transfer

Heat transfer that occurred on 3D printer namely the extruder which took place at the heater, where the heat energy generated by the cartridge heater (heating element) propagate through the heater filament towards a certain temperature, heat energy that propagates in the filament issued to convert the form of filament from solid to plastic melt. Temperature on the other components of the electric components.

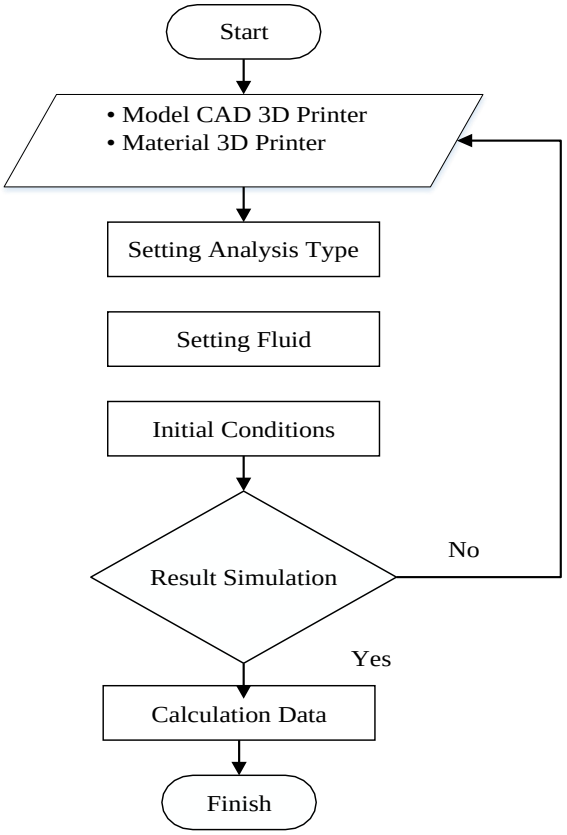

Figure5 Flow Chart Flow Simulation Thermal 3D Printing.

To analyze heat transfer that occurs in the heater has been designed, the author uses the CAE as a tool of analysis. The software used is the author of Solidworks Flow Simulation Thermal. Where this analysis aims to find heat transfer that occurs on each component part of the 3D printer. Process flow for analysis and simulation

of 3d printers can be viewed as process flow image below.

4.2 Thermal Analysis results on a Model 3D Printer

On this first model is a 3D printer prusa used as research material for the thermal analysis results knows it brings on a component and a component nozzle electric, after the material already exists then the next is the grant parameters to perform analysis of the flow temperature of the fluid, after completion of the analysis thus obtained analysis results can be seen in the picture below.

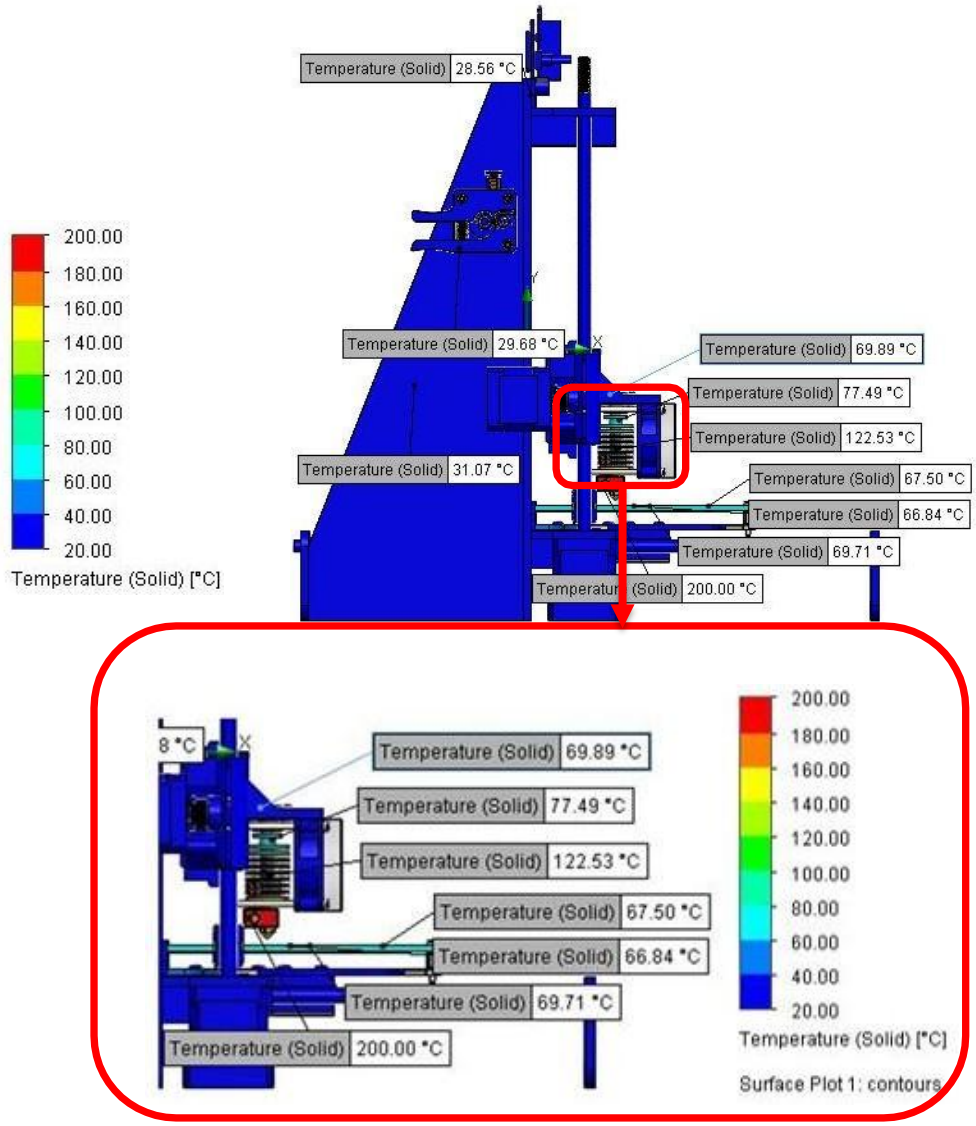

Figure 6 Heat transfer analysis results using the Software Solidworks 3D Printer Thermal Study PrusaI3

Based on the picture above the highest temperature distribution contours look there is the nozzle that is of 200^0C. Where that part is a part to melt the solid becomes liquid filament. Thermal loads received the distinction because of component temperature, then to prevent such things happening in the nozzle installed fan with a size of 5 mm and there is also a heat sink on the part of the nozzle so that the temperature can be reduced When the propagate to other components.

4.3 Thermal Analysis results on a Model 3D Printer Full Frame Almunium

This second model is a 3D Printer frame aluminium used as research material for knowing the thermal analysis results obtained on the components of the electrical components and nozzle, analysis results can be seen padagambar10.

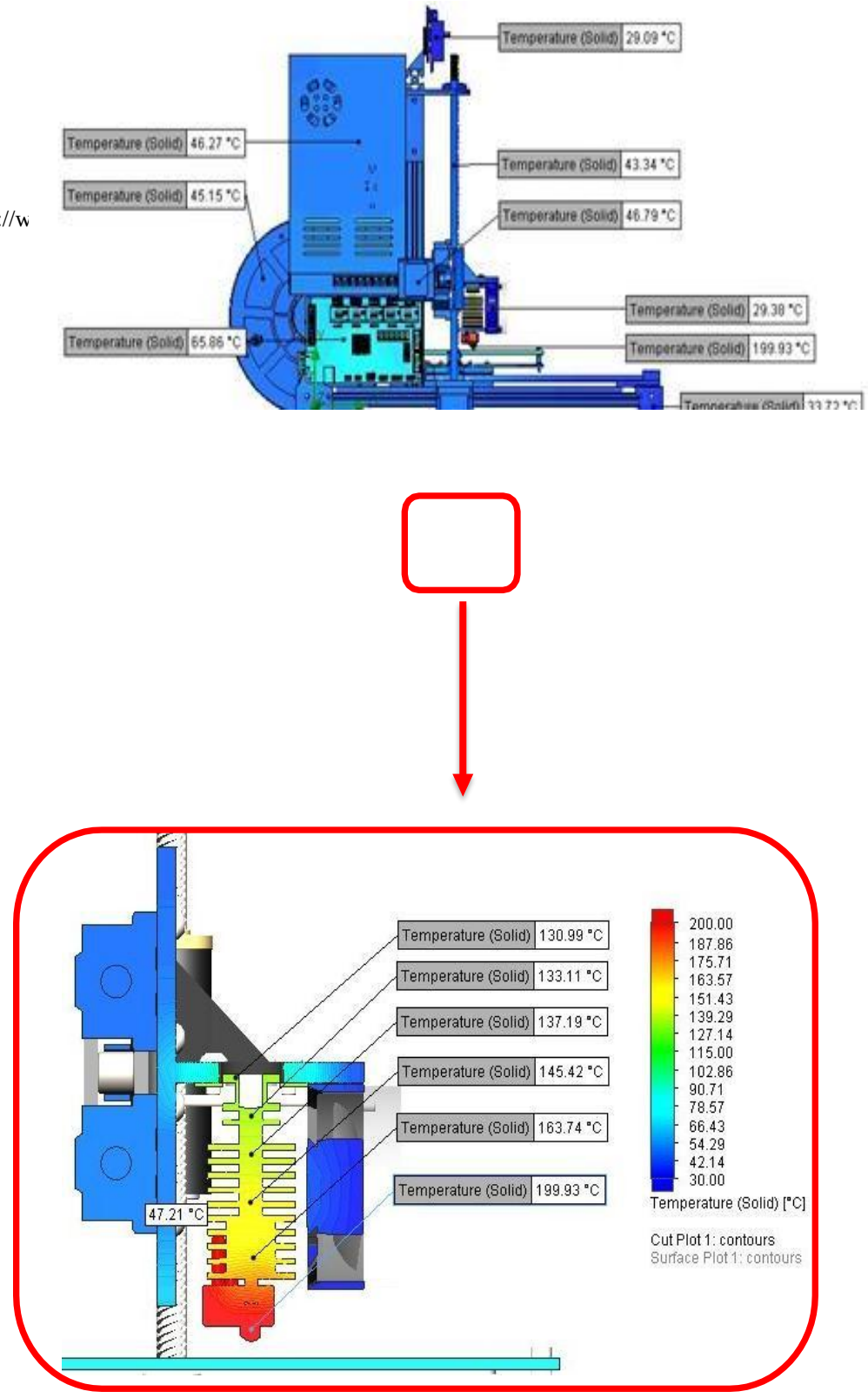

Figure 7 Analysis of heat transfer using Software Solidworks 3D Printer Thermal Study Frame Almunium

Based on the picture above the highest temperature distribution contours look there is the nozzle that is of 199.93° C. Where that part is a part to melt the solid becomes liquid filament.

4.4 Thermal Analysis results on a Model 3D Printer Full Frame Aluminum & Acrylic Body

The third model is a 3D Printer Full frame aluminum and acrylic body used as research material for the thermal

analysis results knows it brings on the components of the electrical components and the nozzle. The results of this analysis comprise flow trajections and thermal.

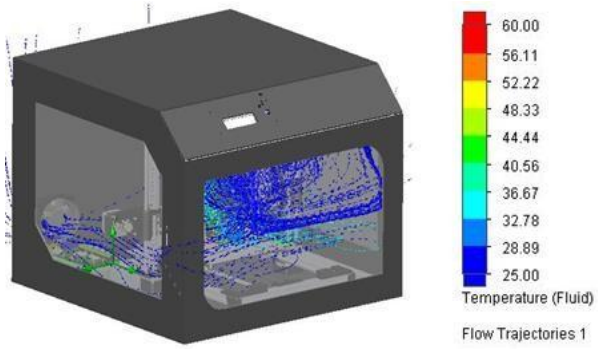

Figure8 Thermal Analysis results on a Model 3D Printer Full Frame Aluminum and Acrylic Body
In Figure 8 is the result of the analysis flow trajectories, where the result of its analysis in the form of simulations of fluid flow that occurs on a 3D printer full frame aluminum and acrylic body while Figure 9 is a point Probe.

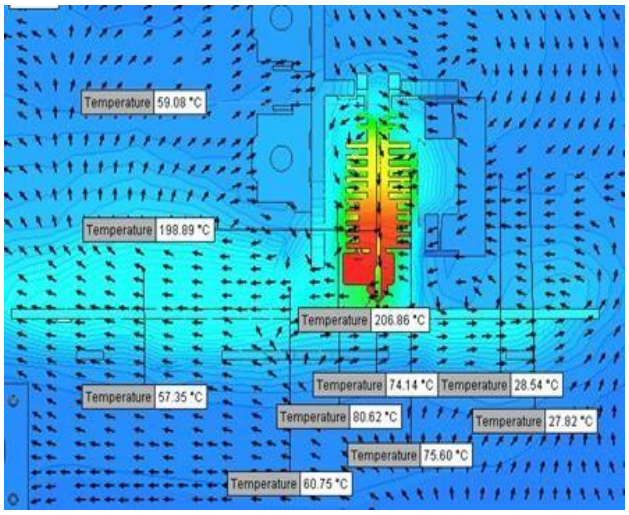

Figure9 The results Flow Trajectories and point the Probe the inside of the Printer

After knowing the flow trajectories then further discussion regarding thermal analysis that occurs at the printer. Based on the picture below the highest temperature distribution contours look there is the nozzle that is of 207.20°C.

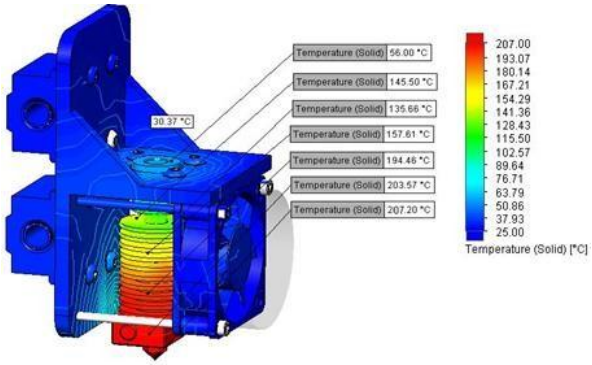

Figure10 The results Flow Trajectories and point the Probe the inside of the Printer

V. CONCLUSION

1. Based on the results of the analysis of the third 3D printer models on the components of the heater and nozzle can be the conclusion.
2. 3D printers are designed using FDM, where this method is utilizing the material extruded from a nozzle that is then driven by the motor. The material is a thermoplastic shaped yarn (coil) that is heated above the melting point by the heater is then extruded through the vent extruder nozzle. Maintain the temperature of the heater and deformation material from a solid into a semi-solid (liquid) for easy extruded.
3. The results of the analysis is of the subject of the flow temperature of the fluid and heat transfer by convection on three models, namely:

- The results of the analysis on the position of the 3D printer models prusa heater of 200 ˚C.
- Results of the analysis on the position of the 3D printer model heater full frame aluminum of 199.93 ˚C.
- Results of the analysis on the position of the 3d printer model heater full aluminum frame and the acrylic body of 207˚ C.

4. Based on the results obtained by E2A57 type heater, based on the catalogue of watt low firewood cartridge/insertion heater.
5. Analysis of thrust filament aims to find the magnitude of the force required for the driving rollers that the filament can flow(due to the urge) to the heater, the results obtained, namely 6,778 N.
6. The analysis of the speed of movement of the filament is needed to determine the speed of the shift of the filament (due to the driving style of roller) as well as the speed of rotation of the motor that is required in order for the resulting speed of the discharge that comes out of the nozzle fit that is 25mm/s, thus obtained the appropriate stepper motor IE NEMA17.

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