An Investigation of The Effects of Increasing the Number of Fins on a Plate Fin Heat Exchanger to Point of Failure under Conditions of Forced Convection

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Aim of the Project

The aim of the dissertation was to complete simulations and manual calculations to test the effects of adding fins to heat sinks, until a negative effect was achieved.

The project objectives were:

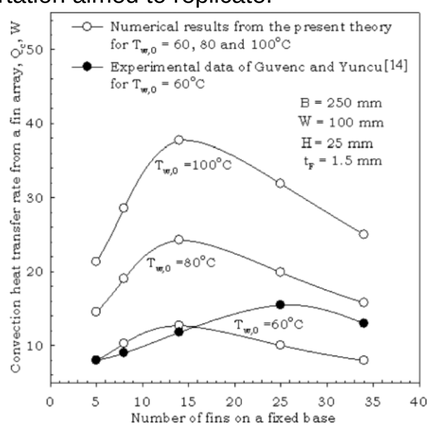
- ⊡ Model the heat sink in SolidWorks
- ⊡ Import SolidWorks file to ANSYS
- ⊡ Complete ANSYS Simulations
- ⊡ Extract and analyse results of the simulations

Background

Heat sinks are used to cool electronic components and other components that experience high operating temperatures. The most common of these heat sinks is the plate-fin type, and this was the type selected for analysis in this dissertation.

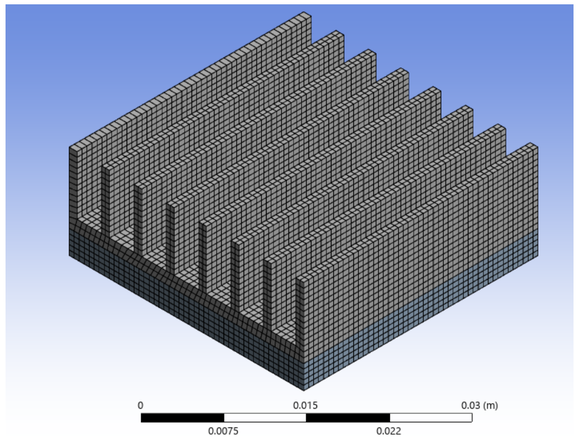
Previous research had shown that under conditions of natural convection, the rate of heat transfer from the heat sink improved with the addition of fins up to a point before being negatively impacted. This research then aimed to test whether this still was the case under conditions of forced convection, which is the condition that heat sinks for PC chips are under during normal operation.

Seen below is a graph of the results from the previous research mentioned above, that this dissertation aimed to replicate.

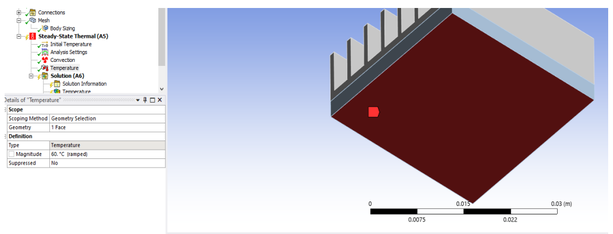


Setup of Analyses

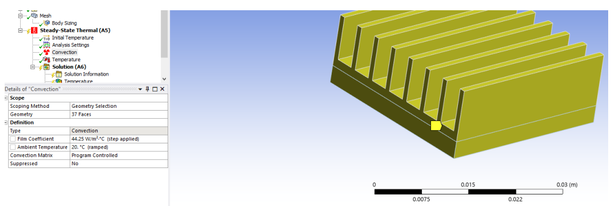
Seen below is the setup of the analyses within ANSYS steady state thermal. The images show the creation of the mesh and the setting of the various initial surface conditions for the analyses.



Seen below is the menu for setting the temperature of the base surface of the heat sink for analysis. This was set as 60° C for all of the analyses that were carried out.



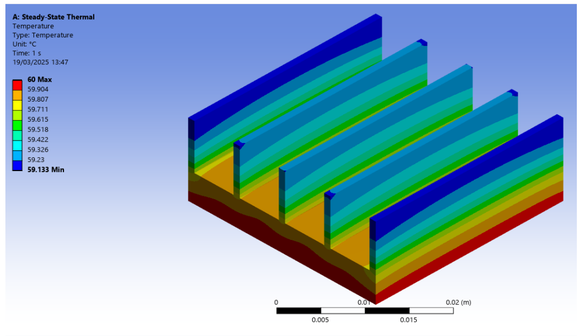
Seen below is the menu for setting the convection film coefficient of the surfaces of the heat sink that would interact with the airflow under operating conditions. This was set at 44.5 W/m2 for all analyses

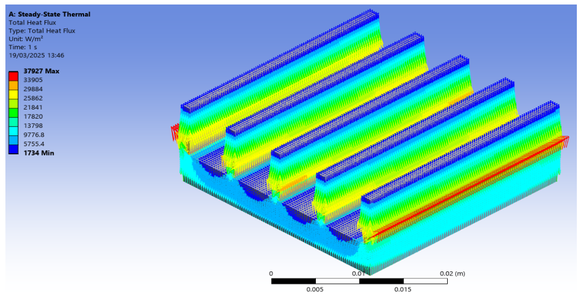


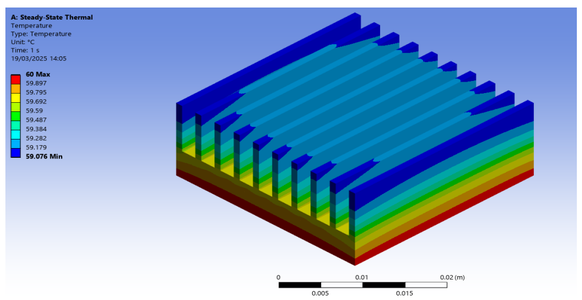
Steady State Thermal results

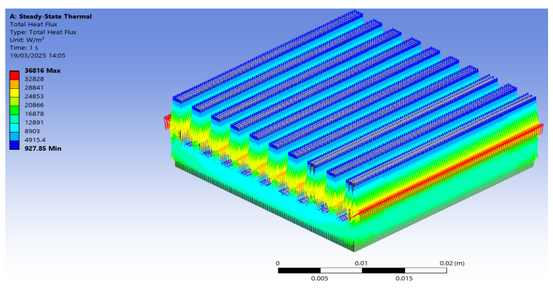
Steady Sate Thermal Analysis Results

Below are the results from the steady state thermal analyses conducted on the heat sinks. The below graphics show the heat flux and temperature profiles of the 5-fin and 10 fin heat sinks.



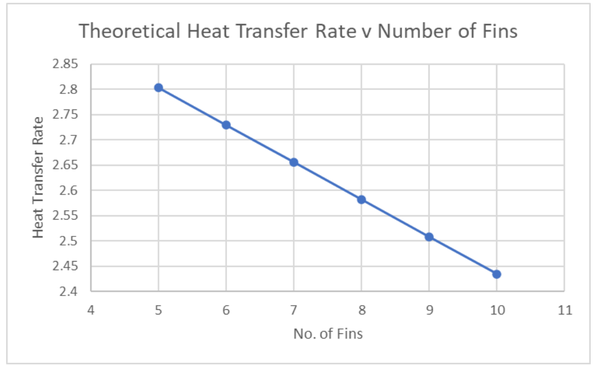


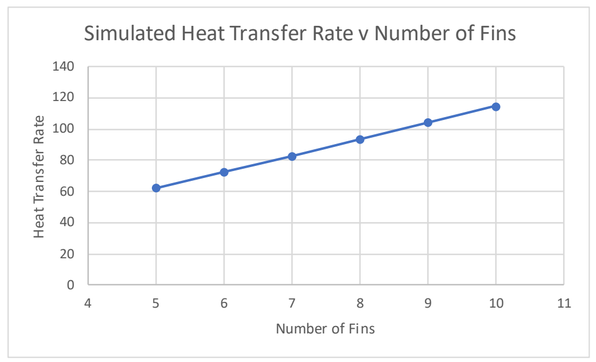




Conclusions

- ⊡ The theory calculations returned a result of a negative linear relationship between the number of fins and the heat transfer rate
- ⊡ The simulations returned a result of a positive linear relationship between the number of fins and the heat transfer rate
- ⊡ The temperature graphics showed a reduction in effectiveness from the 8-fin model onwards
- ⊡ Both sets of results showed opposing trends and neither match with the previous research indicating further study is required.





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