

# Design And CFD Analysis of Antenna Cold Plates

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**Abstract-** The cold plates are widely used in active phased array radars; these are mainly intended to take away the heat generated by the electronics. As rise in temperature completely degrades the performance of electronics there by effecting the radar functionality. The cold plate construction is a high end production technique, where the fluid passage groove is made in one plate and a cover plate is vacuum brazed on the top to make a leak proof high strength joint. [1]Vacuum aluminum brazing is a careful balance of time, temperature, and vacuum level. These parameters are controlled to maintain the fundamental brazing success parameters. The major heat exchange is through conduction and convection mechanisms. In this paper modeling and CFD analysis is carried out using Solid Works and Solid Works flow simulation to visualize the flow pattern in the fluid passage groove of cold plate and also to determine the pressure drop. [2]The application of cold plates also widely applicable on areas of thin profile section antenna arrays.

**Keywords-** Cold plate antenna, CFD, Solid Works flow simulation, Pressure drop

## I. INTRODUCTION

[3]The cold plate are majorly for cooling a plurality of electronic components, including: a cooling fluid manifold for mounting over the plurality of electronic components; a main fluid inflow duct within the manifold for supplying pumped cooling fluid; a main fluid outflow duct within the manifold for removing pumped cooling fluid. The heat removal is due to the conduction of heat from electronics to the aluminium base frame and then the conducted heat is convected through the water flowing in the passage groove as a pump is employed to force the water more mass flow of water through the passage groove removes more amount of heat. In this study a Cold Plate is considered for CFD analysis in order to find out the Pressure Drop and to visualize the flow Pattern and the thermal behavior is considered in this study.

## II. MODELING

Cold plate modeling is done through user friendly CAD tool solid works and is shown in the figure 1a and 1b

Table 1:Parts of Cold Plate

S.No	Component	Material
1	Base plate having fluid Groove	Aluminium
2	Cover plate	Aluminium

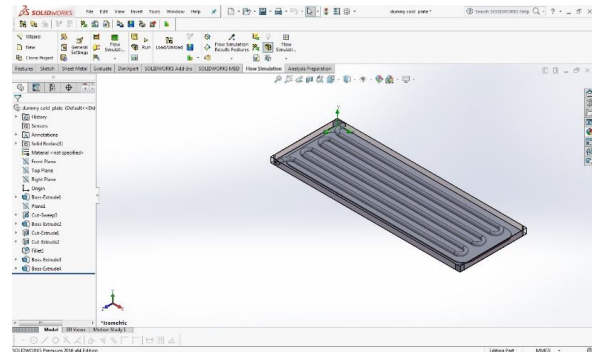


Fig. 1a-Cold Plate Model

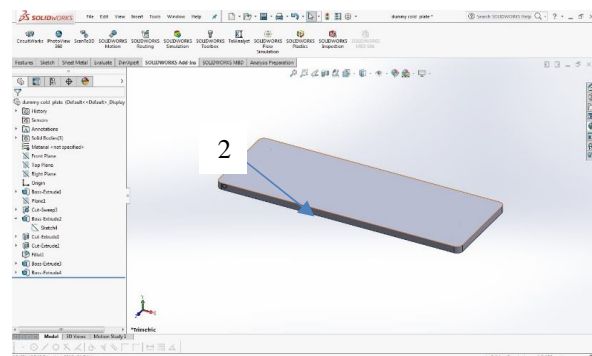


Fig.1b-Cold Plate Model

## III. COMPUTATIONAL FLUID FLOW ANALYSIS

Modelling of Cold plate is followed by CFD analysis, to understand the flow characteristics and to visualize the flow pattern. The following steps are followed in CFD analysis: CFD Solid Works initial settings and methodology:

- The project name is Cold plate Dummy with SI units, Water is selected as fluid for internal flow analysis.
- The fluid domain is a rectangular area surrounding the plate and the fluid sub domain is the fluid passage region(groove)
- The boundary conditions are taken on one side as mass flow rate 0.017Kg/s(equivalent to 1 lit/min) while on the other side a pressure opening equivalent to 1 atm is defined.

- The analysis is further carried out with Automatic medium size mesh (optimum for this study as fine mesh consumes huge time)

Now the results plots (goal plots) obtained from the CFD software are detailed below in the following figures :

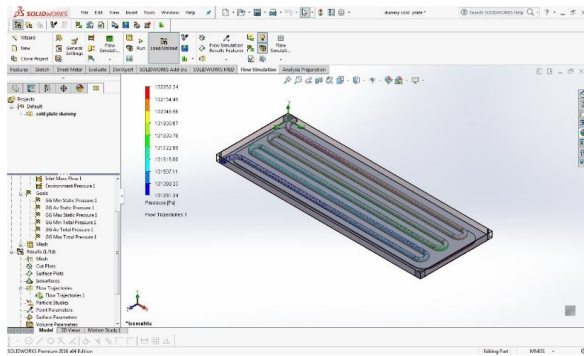


Fig 2 a : Internal Flow Visualization

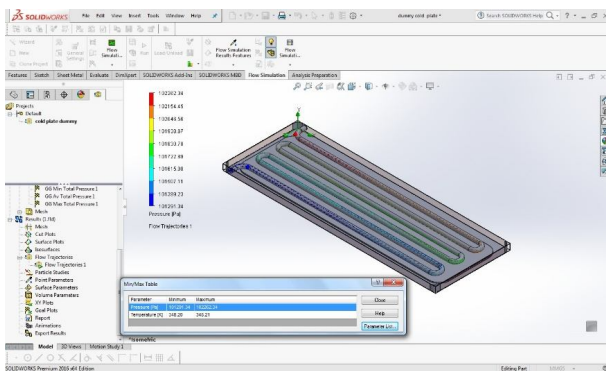


Fig 2 b : Internal Flow Visualization and Pressure Variation Table

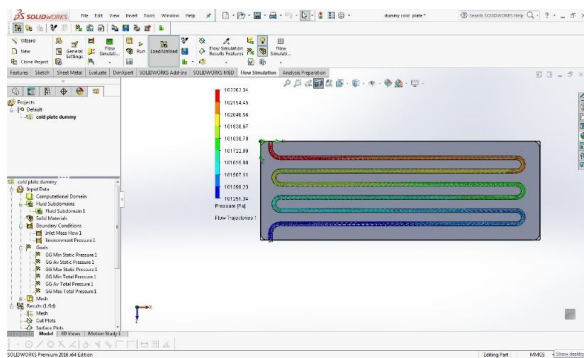


Fig 2 c : Internal Flow Visualization

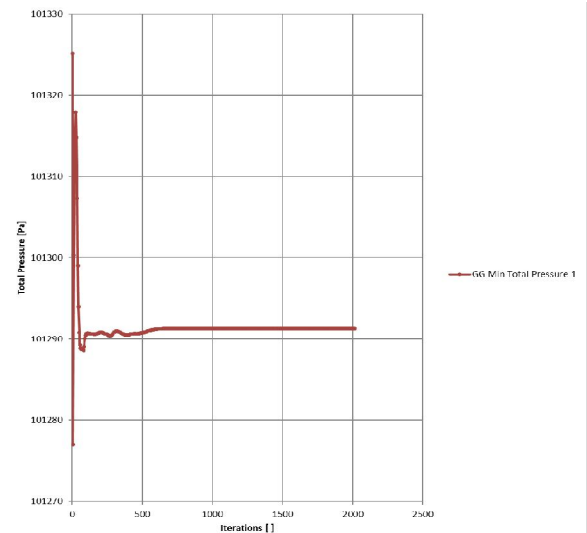


Fig 3 :Variation of Total Pressure Vs iteration

#### IV. CONCLUSION

- The modeling of cold plate is done using solid works followed by CFD analysis using solid works flow simulation.
- Pressure drop is calculated as the difference between the pressures on inlet side and out let side and its value is 971 Pa
- The flow pattern of the water along the flow passage is visualized with boundary conditions as atmospheric pressure outlet and 1 lt/min flow rate and are shown in Fig 2a,2b and 2c.
- The Convergence of CFD simulation can be assured by Fig-3, the total pressure vs iterations

#### REFERENCES

- [1] Vacuum Aluminum Brazing - What Matters Most-Craig Moller and Jim Grann,Ipsen Incorporated, Cherry Valley, Illinois USA
- [2] ANALYSIS AND DESIGN OF INTEGRATIVE ANTENNA COLD PLAT BASED ON TILE MODULES-C. Qin, S.L. Jiang, R. Xiao, Nanjing Research Institute of Electronics and Technology, Nanjing 210039, China.
- [3] Integral cooling system for electric components-Messina; Gaetano P. (Hopewell Junction, NY)