ANSYS Fluent Meshing Watertight Geometry Workflow

Workshop 4: Electronics enclosure

The geometry is of a Printed circuit board (PCB) placed in an enclosure as shown in fig. 1. The objective is to generate a CFD-ready mesh for conjugate heat transfer analysis, to explore the use of local sizing features like BOI and curvature, to improve the volume mesh features. This model consists of fan and heat sinks for the thermal management of the PCB.

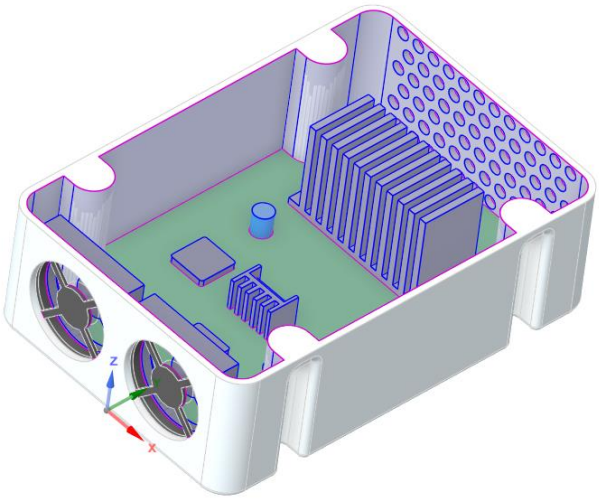

Fig 1: CAD geometry of the PCB and enclosure

For the local sizing, two BOIs were added for both the heat sinks to refine the mesh in that local region and accurately capture the flow physics. Fig. 2 shows the two BOI boxes covering the heat sinks.

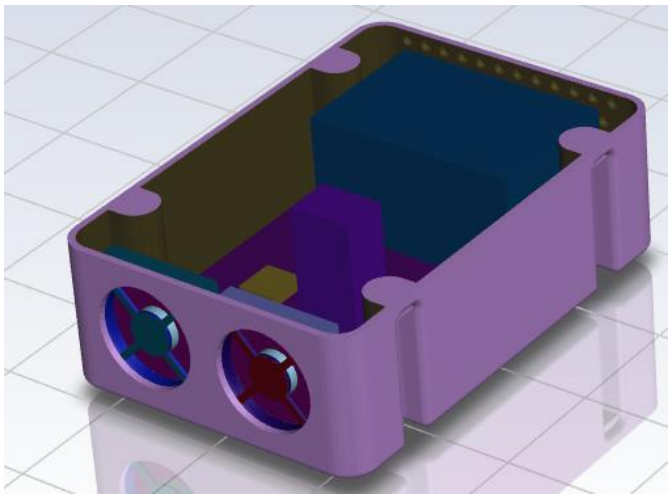

Fig 2: BOIs for the heat sinks

Curvature size controls were provided on the capacitor, hub walls, inlet, and outlet walls to accurately capture the curvature of these boundary. The curvature capture angle is set to 12. Fig. 3 shows the highlighted zones in green which are selected for curvature refining.

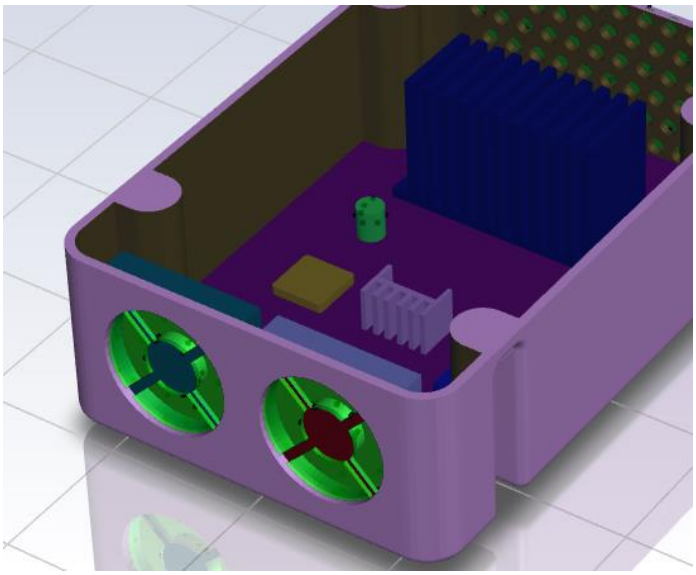

Fig 3: Zones selected for curvature refining

To generate the surface mesh, cells per gap were kept as 2. This ensures that a minimum of 2 cells are present across the thickness for the thinnest region of PCB to better capture the thermal gradients during conjugate heat transfer analysis (CHT). The proximity for generating the surface mesh was kept to the face and edges.

Fig. 4 shows the surface mesh generated on the heat sink surface and on the cooling fan surface.

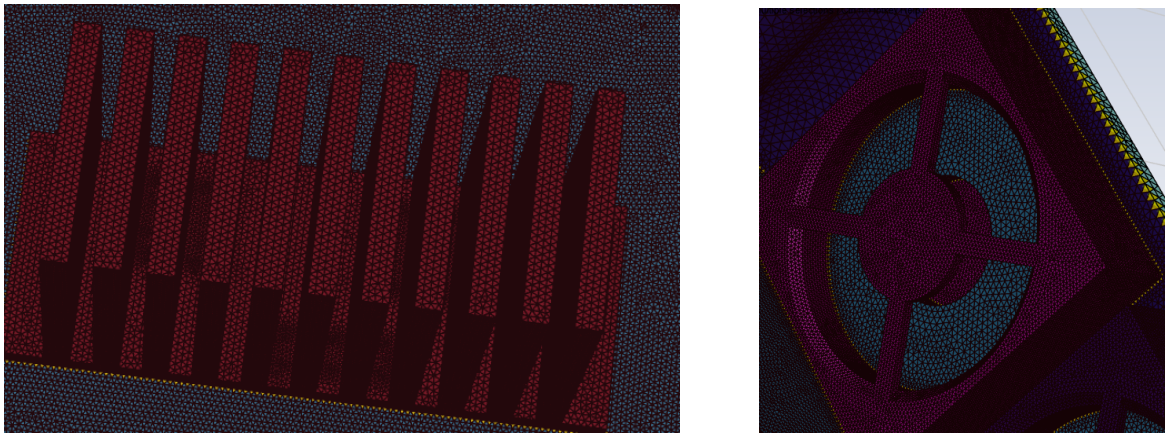

Fig 4: Surface mesh generated on the heat sink surface and on the cooling fan surface

Boundary layers were added in both the fluid and solid-fluid interface boundary in the solid regions. This allows to avoid large cell jumps across interfaces during CHT analysis. A total number of 10 boundary layers were added in the fluid region and 3 layers were added in the solid region. Fig. 4 on the next page shows the boundary layers in both the fluid and solid regions.

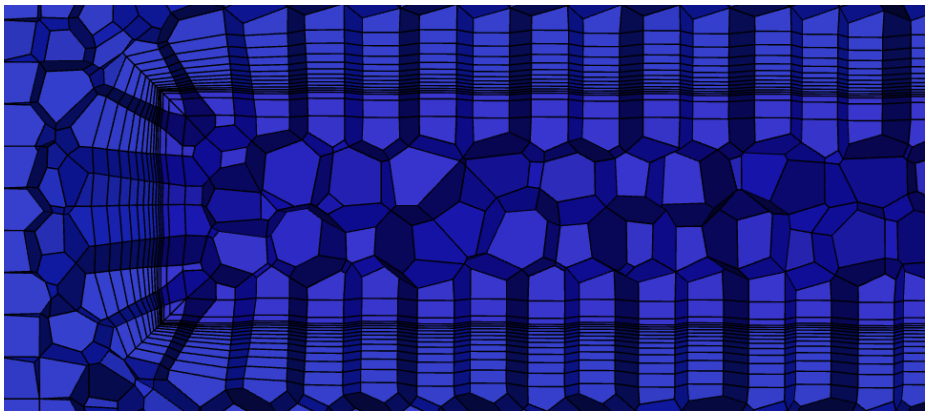

Fig 4: Boundary layer in the fluid and solid regions

Poly hexcore fill with method is used to fill the domain. This is mainly because geometry largely contains the quad shapes and flow direction is expected to be dominant in one direction.

The initial orthogonal quality was 0.05 and the mesh count was 4481367. Since the orthogonal quality is way below the minimum recommended quality of 0.1, another task was added to improve the mesh quality. After this operation, the minimum orthogonal mesh quality was improved to 0.13. Fig. 5 and 6 show the cut section of volume mesh in one direction and near the cooling fan, respectively.

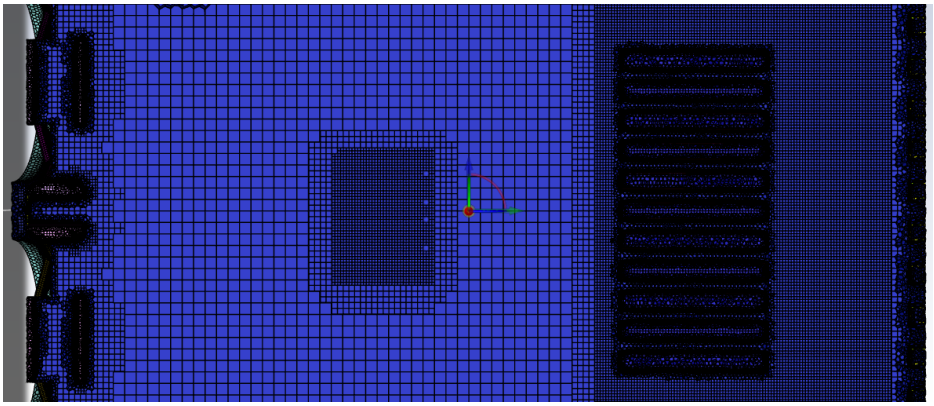

Fig 5: Planar section showing the mesh in one direction

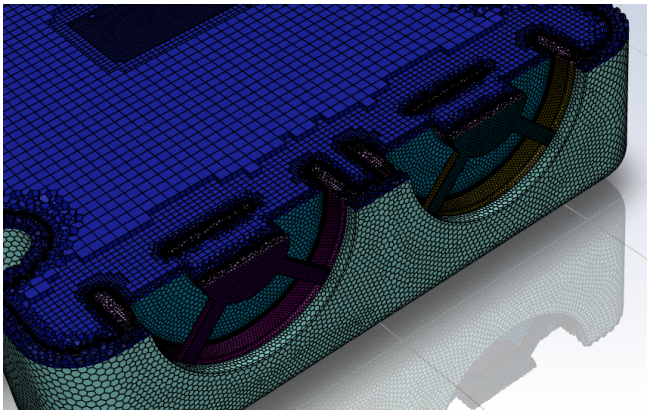

Fig 6: Volume mesh near the cooling fan