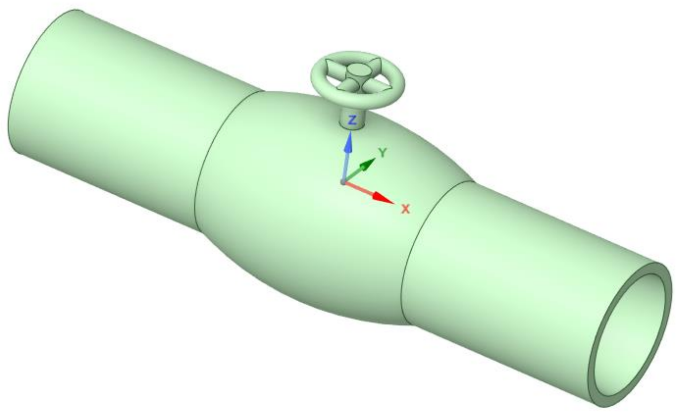
ANSYS Fluent Meshing Watertight Geometry Workflow

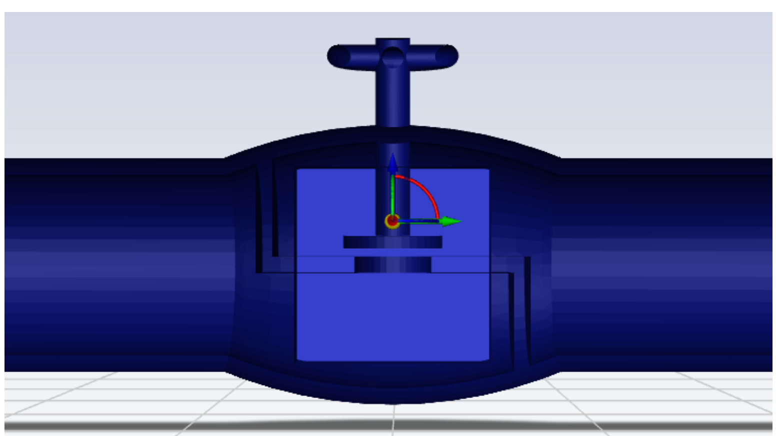
<u>Workshop 3: Stop Valve</u>

The objective is to generate a CFD-ready mesh for studying fluid flow through a Stop Valve. The learning objectives are adding BOI local sizing to refine the mesh at the valve section to capture complex flow dynamics, extracting the fluid regions by capping the openings of the solid geometry, and creating boundary layers in both fluid and solid regions.

Figure 1 shows the CAD geometry of the stop valve, whereas Fig. 2 show the cut-section of the imported CAD in ANSYS Meshing with BOI.



<u>Fig 1: CAD geometry of the Stop Valve</u>



<u>Fig 2: Cut section of imported geometry showing BOI in the valve region</u>

It is only possible to import BOI before the add local sizing task, hence a BOI is imported for refining the valve near regions. BOI is not a part of the body but just an entity that drives the local mesh refinement.

While generating the surface mesh, the “Separate Out Boundary Zones by Angle” option is changed to yes, as the imported geometry is solid, and we need to extract the fluid zone in the later stages, the fluid surfaces are then created based on the reference of the adjacent solid boundary zones. The separation angle is kept at 40 deg., its default value. After the surface mesh generation, the zones are defined independently, rather than the whole solid being defined as a single entity. Figure 3 shows the surface mesh generated, and Fig. 4 shows the extracted fluid region from the Stop Valve domain.

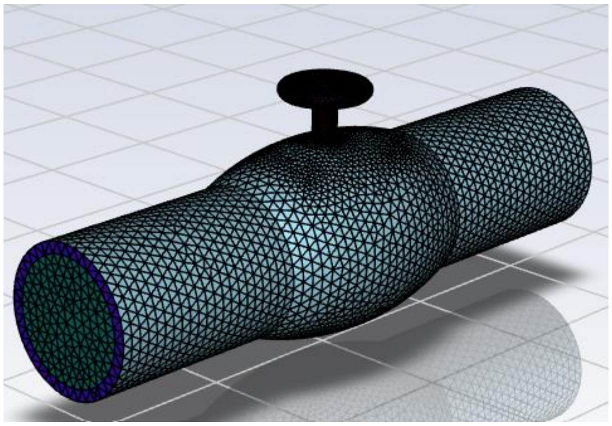


Fig 3: Surface mesh

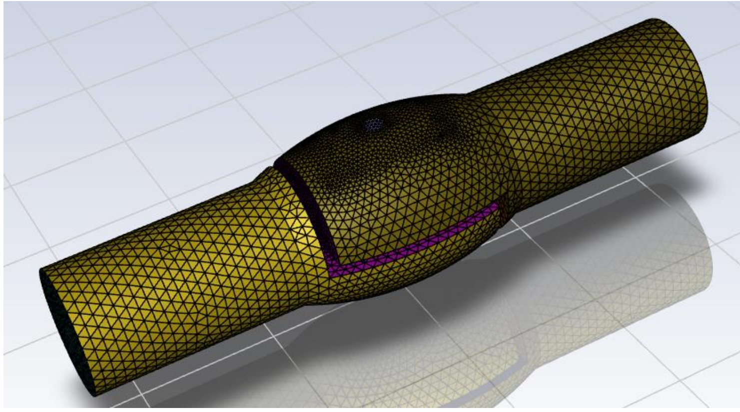


Fig 4: Extracted fluid region from the computational domain

In the boundary layers, 3 layers are added in the fluid region, and 1 layer is added in the solid region. Adding boundary layers in the solid region will help in accurately predicting the temperature gradients while doing the conjugate heat transfer analysis.

The polyhedral 'fill with method' is used to generate a good-quality conformal poly mesh. This is used as the orthogonal quality of mesh produced by this method is higher and the overall mesh count is less. In this case, the minimum orthogonal mesh quality is 0.21 and the mesh count is 117824. Fig. 5 shows a cut-section of polyhedra mesh generated in the core region.

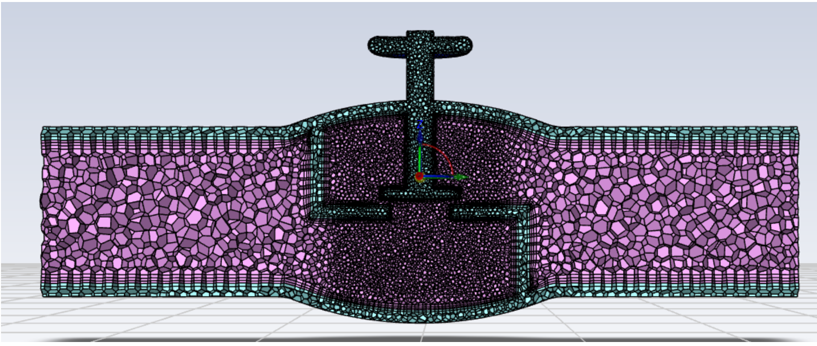


Fig 5: Polyhedra volume mesh in the domain

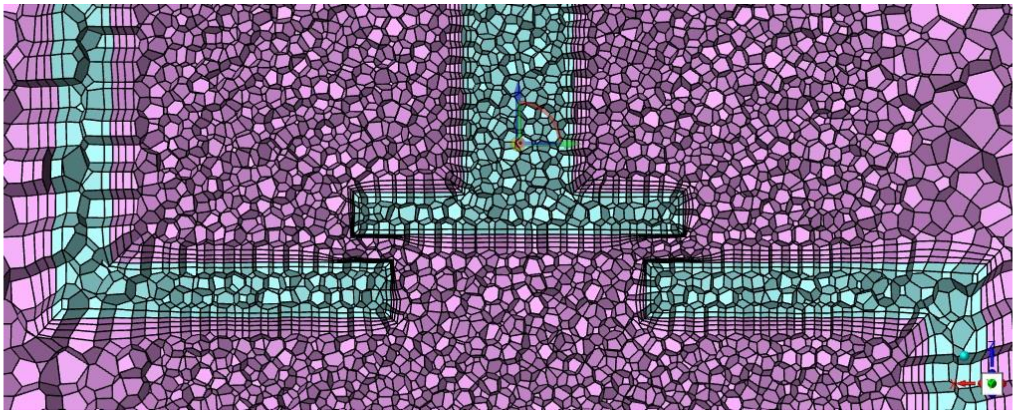


Fig 6: Boundary layer and refinement region the valve region

Figure 6 shows the boundary layers in both the fluid and solid regions. It also shows the refined mesh in the valve region obtained by BOI meshing.

For other methods, like hex-core – the minimum orthogonal mesh quality is very low, it is 0.05, and the overall mesh count is also very high compared to polyhedra - 280941. Even though for poly hex-core the mesh quality is - 0.21, and mesh count – 112227, similar to that of polyhedral, still polyhedra is a much better option as the flow in the value region will not be in a uniform direction. Hence, polyhedra provide a much better accuracy in flow gradient prediction in these regions.