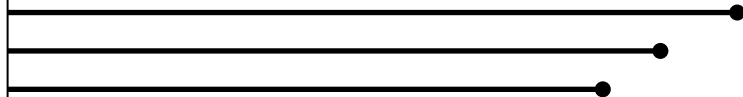




SCM ENGINEERING SERVICES

Technical Report on

TRIMMED CELL HEXA MESHING OF A AIR DUCT



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1. Introduction

The present work involves, the cad model cleaning and surface preparation for an air duct consisting a two air flowing channels, a holed separation ring and a combination air inlet.

The study was carried out in the procedure given below,

1. CAD cleaning
2. Surface preparation and surface meshing
3. Volume Meshing

2. Software and Hardware used

2.1 Software

CAD geometry preparation was done using CATIA V5 modeling software whereas surface and volume meshing were done using STAR CD modules, Pro-surf and Pro-am respectively.

2.2 Hardware

The hardware used for CAD model preparation and mesh generation was Intel based windows platform. The work was carried out on P4 processor, with 2 GB RAM.

3. Geometry and Mesh generation

3.1 CAD Clean Up

The four wall surfaces perpendicular to the Z-axis were moved as requested. The other surfaces were trimmed with the new wall surface.

In order to simplify and making the geometry ready for meshing, a CAD clean up procedure was done using CATIA and steps indicated below,

- Removing the unwanted surfaces and holes from the original IGS file supplied.
- Surface trimming and using other techniques to get a closed surface
- Splitting the geometry into four parts for logical meshing
- Leaving a small gap at the interface of blade edge surface
- Closing edges of all the surfaces

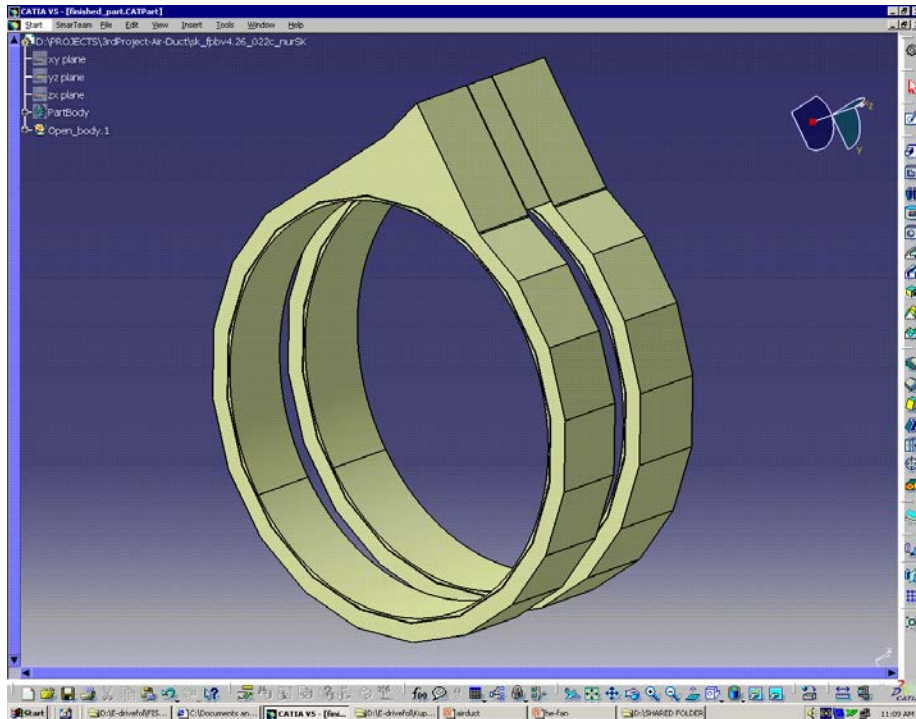


Fig 1. Three-Dimensional View of Cleaned CAD Model

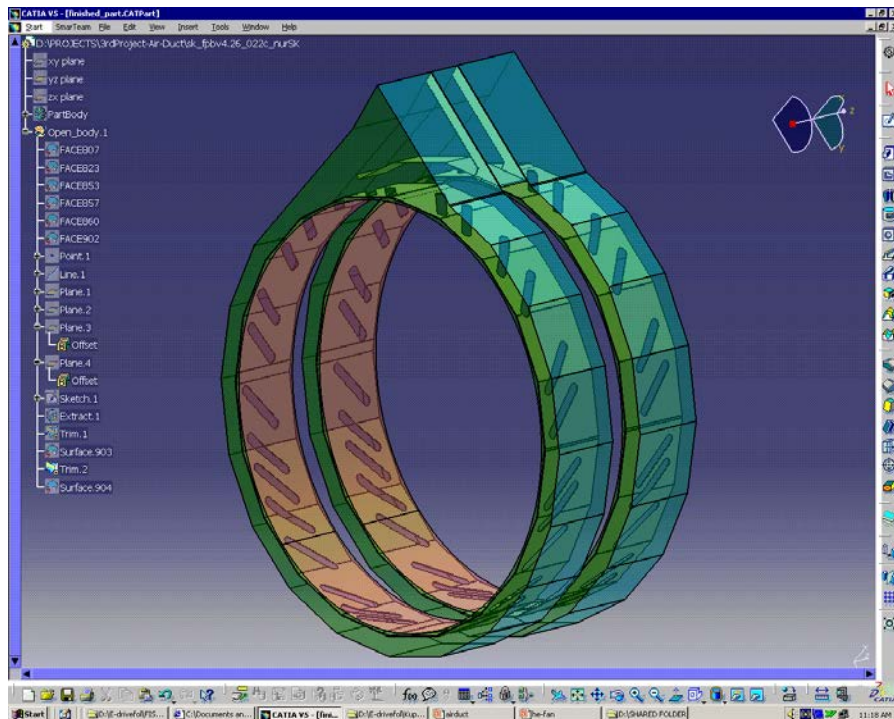


Fig 2. An Inside View of the Model Showing Perforated Ring Plate

3.2 Mesh generation

3.2.1 Surface Mesh Generation

The finished CAD geometry was imported to surface meshing tool of Star CD, Pro-surf. The very smaller curves, having a curve length less than tolerance value were removed and near curves were joined together. The overlapping surface-edges were merged and corner points were created.

Using perfect curves, points and surfaces the geometry surface is meshed. The whole geometry surface was meshed using triangular cells having side length between maximum specified and minimum tolerance length to capture curvature.

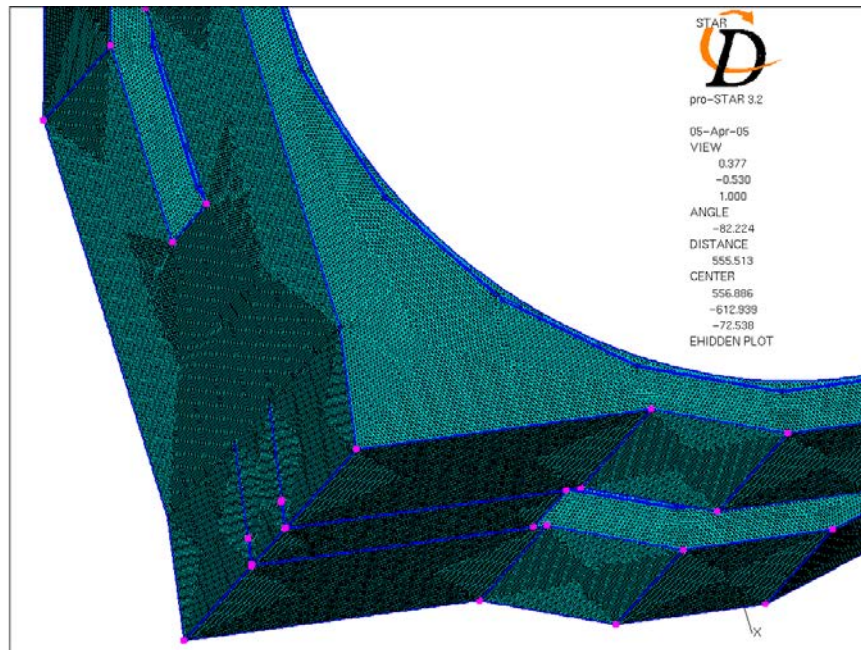


Fig 3. Finished surface mesh with edge lines and corner points

3.2.2 Meshing criteria

Meshing requirements were

The maximum number of cell 1.7 million

Cell length parameters:

Radial Direction

When Radius $R = 827.5 - 853.5$, Radial Cell Length $L_r = 2$ mm

When $R = 853.5 - 925.0$, $L_r = 2.2$ mm increasing to 9mm

Circumferential Direction

Circumferential cell length $L_\theta = 8 - 8.5$ mm at $R = 827.5$ mm

Z - Direction

Cell Length $L_z = 9$ mm, constant

3.2.3 Volume Mesh Generation

The following strategy was adopted to get required mesh

- Shrinking the surface mesh by 1mm thick to make extrusion layer at final stage
- Making a custom mesh with required dimensions
- Classifying the custom mesh with surface mesh and refining the surface cells
- Mesh generation using this refined mesh
- Creation of surface layer from finished volume mesh
- Surface Layer Extrusion and assembling it with the volume mesh

The following figures show the different stages of mesh generation:

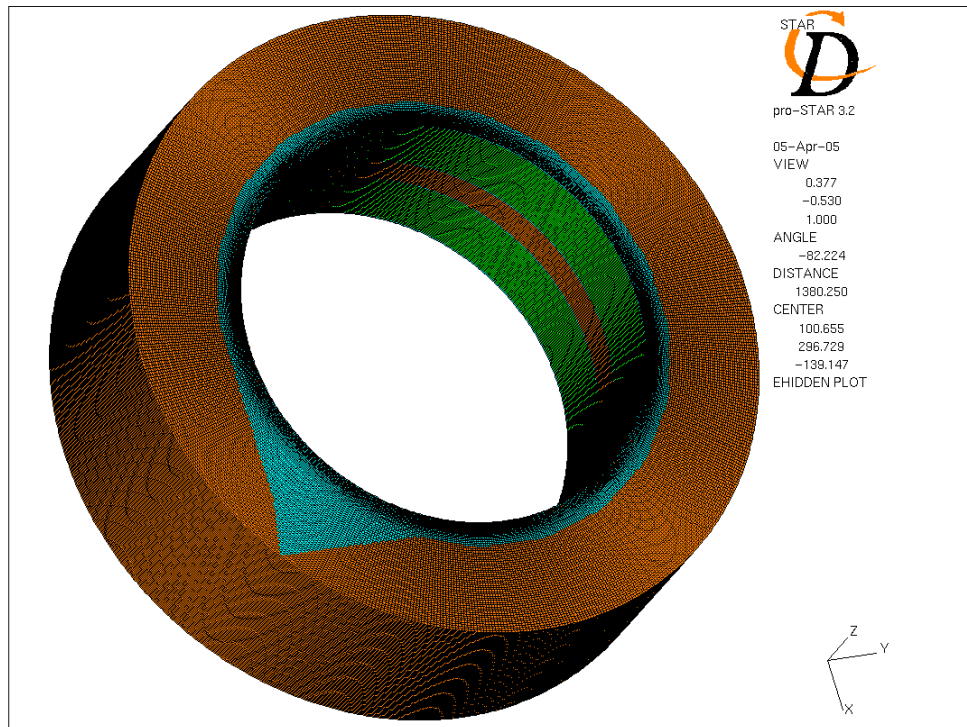


Fig 4. Custom Mesh after Classification

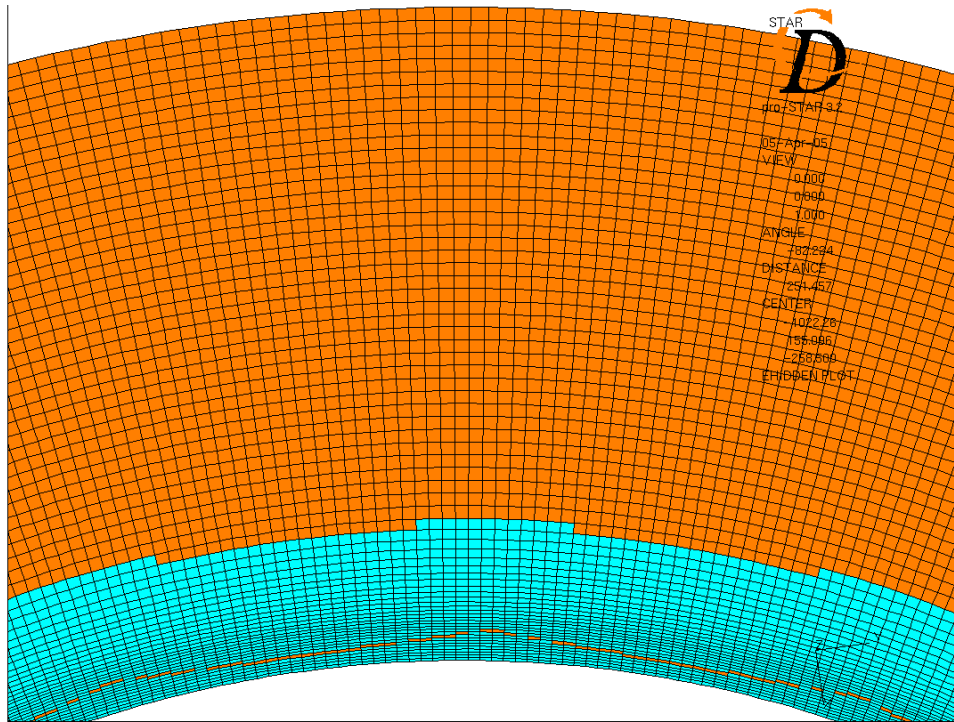


Fig 5. Closer View of the Custom Mesh

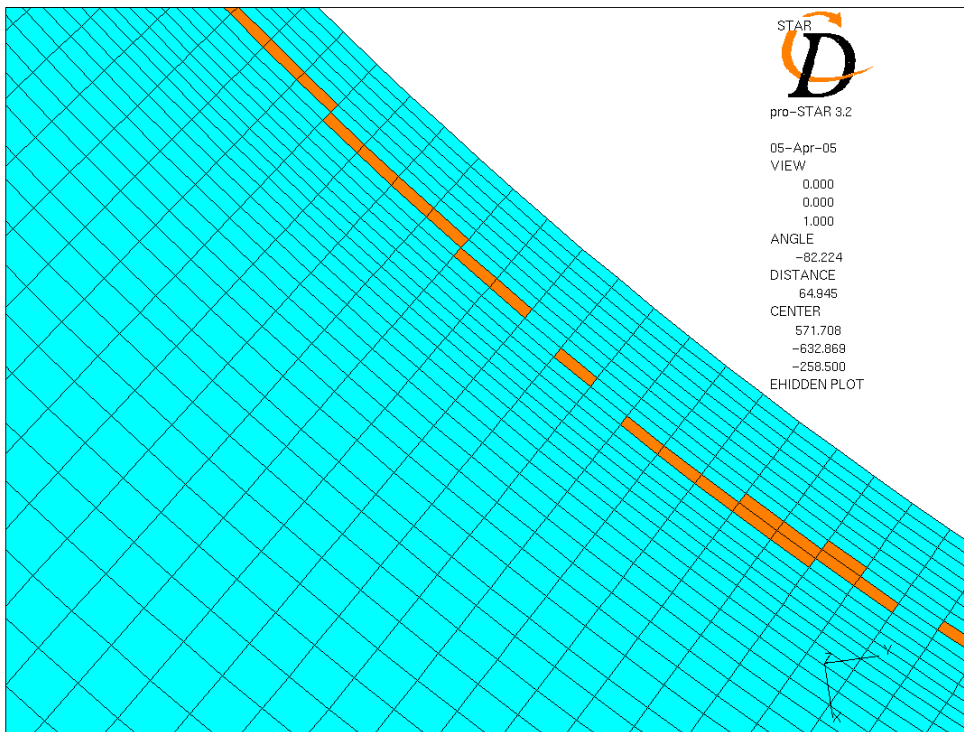


Fig 6. Variation of Radial Cell Length in Custom Mesh



Fig 7. Completed Volume Mesh in Pro-am

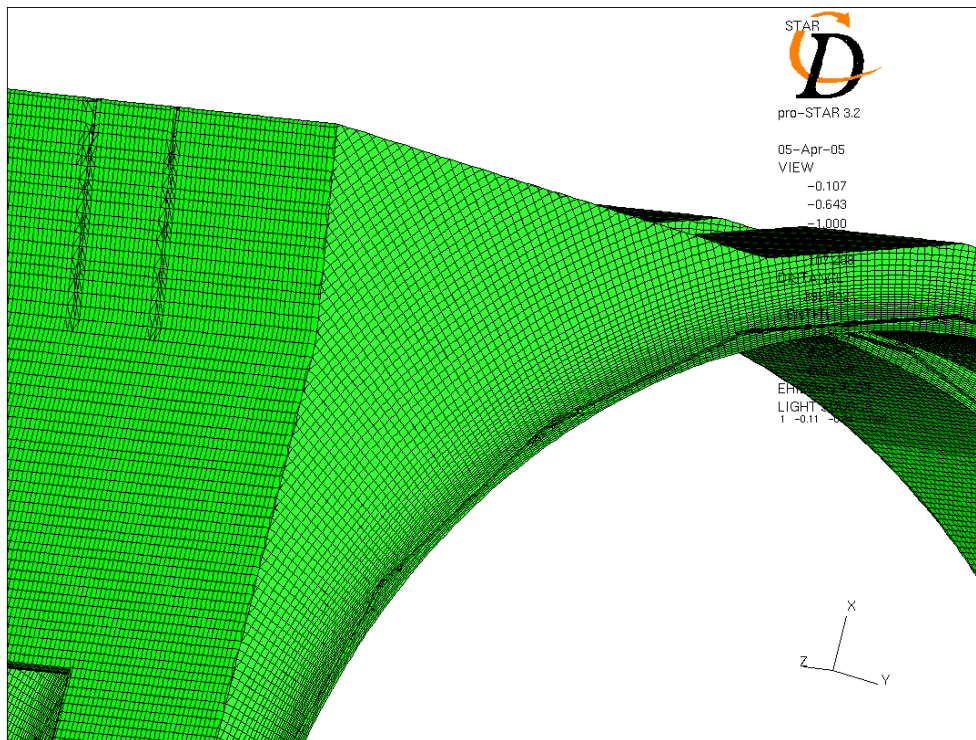


Fig 8. Air Inlet portion of Completed Volume Mesh in Pro-am

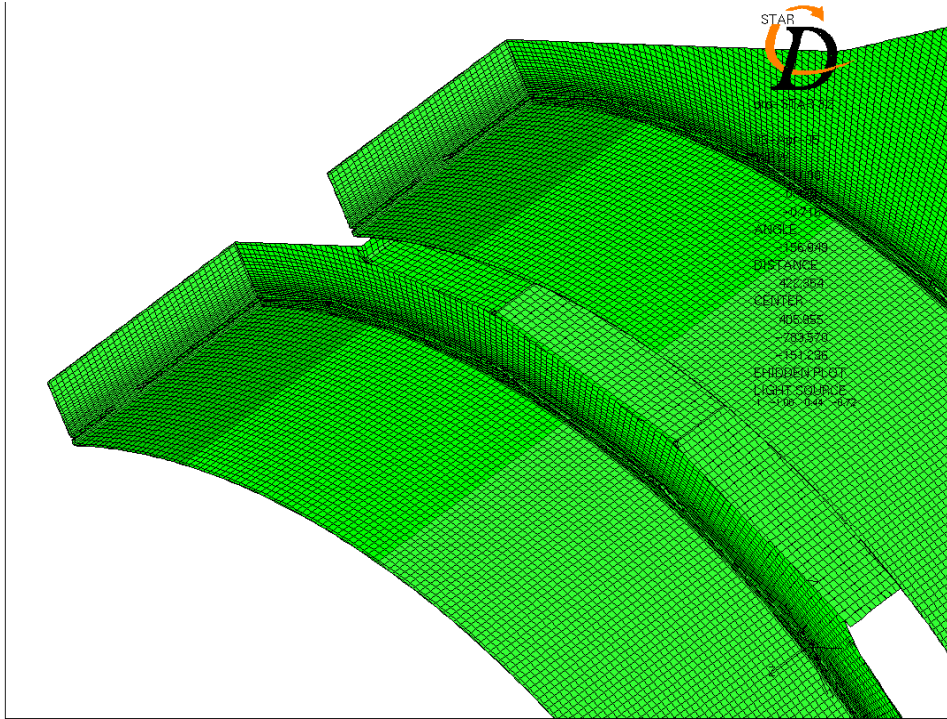


Fig 8. Sectional View of the Mesh

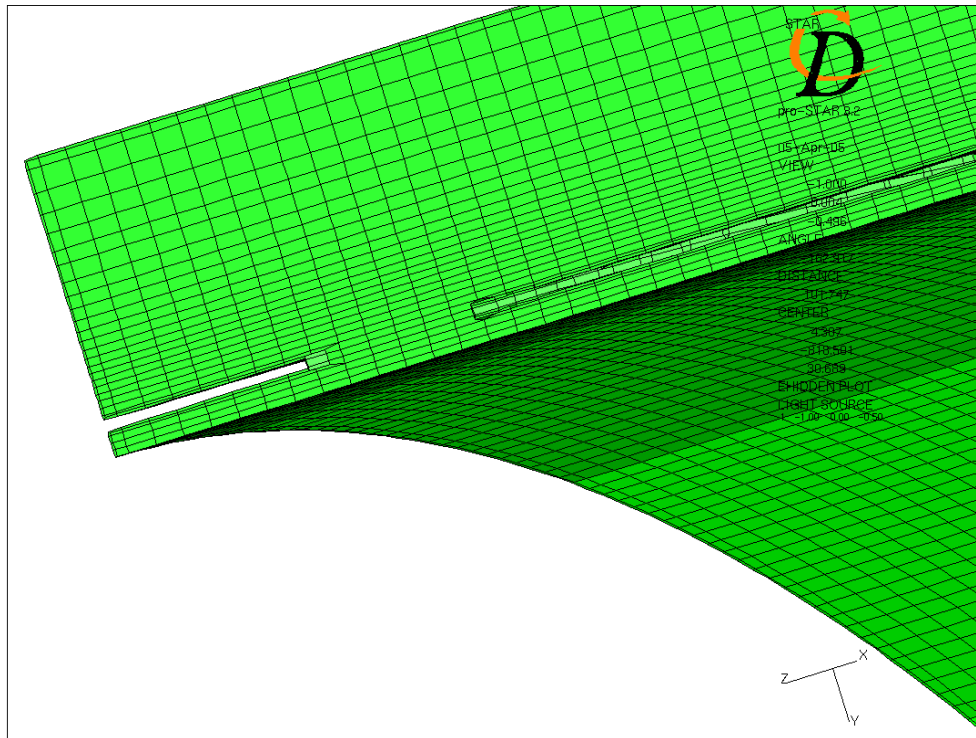


Fig 9. Sectional View of the Mesh showing extrusion layer

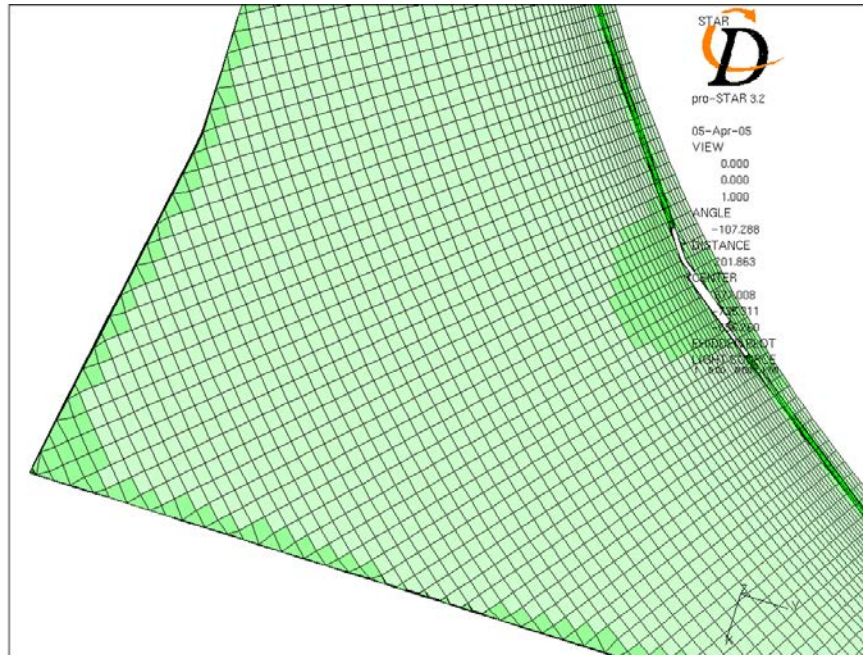


Fig 10. A part of the Mesh showing gap between cell layers implying the perforated separation plate

3.2 Quality checking for the final mesh

The final mesh has a total of 1683057 cells, perfectly meeting other dimensional requirements

- The final surface is extruded to get wall layer
- The finished mesh is checked for quality
- Left handedness
- Negative volume
- Crack and cell connectivity
- Aspect ratio
- Internal angle
- Face warp angle
- Couple

Corrective steps were made for the cells below quality limit by using various fixing tools available in Star CD.

