NEK5000 – ICEM-CFD Mesh Tutorial

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Mesh for Nek5000 by using ICEM-CFD with Boundary Conditions

In this tutorial, a T-junction geometry is meshed by using ICEM-CFD and applied boundary conditions.

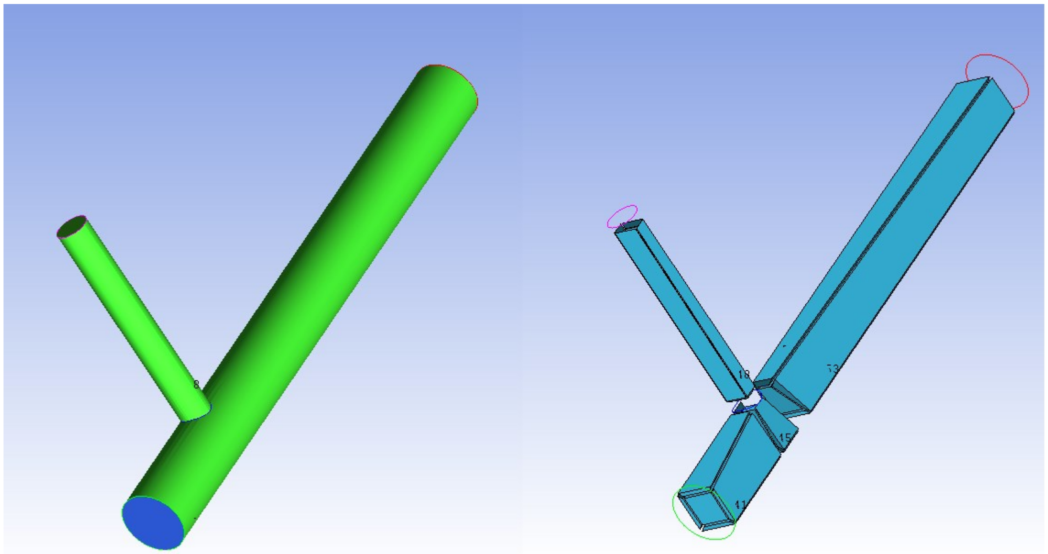

Figure 1: T-Junction Geometry blocking

Step 1

In this step, it is assumed the user is already familiar with ICEM-CFD. The mesh is created by using a blocking strategy to obtain fully hexahedral cells. Once the mesh creation has been done with blocking method, the mesh needs to be converted to unstructured mesh as shown in Figure 2 due to the Exodus-II format requirement discussed further in Step 4.

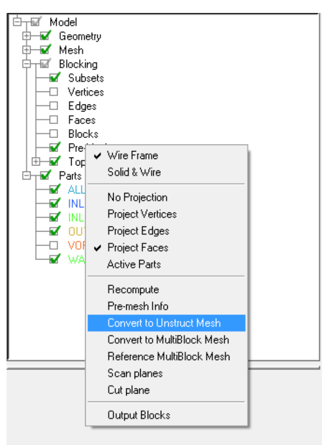

Figure 2: Conversion to Unstructured mesh

Step 2

In this step, the created mesh in step 1 needs middle nodes between each node. Hexa8 can be converted to Hexa27 in ICEM CFD's Edit Mesh tab as shown in Figure 3.

Edit mesh -> Convert Mesh ->

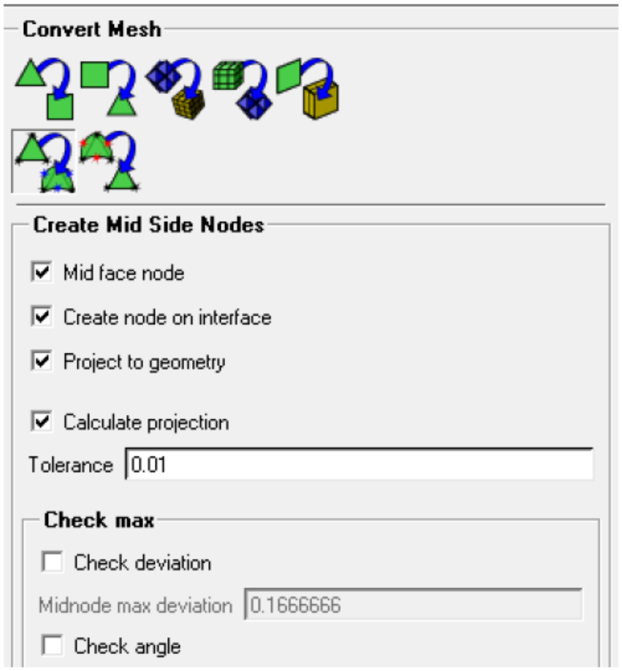

Figure 3: Hexa8 to Hexa27

Step 3

Due to a problem with importing the mesh into Cubit/Trelis importing problem, there should be at least one Hexa8 element in the mesh. To create a trivial Hexa8 element, the following steps can be followed:

Geometry -> Create/Modify Surface (Create a small cubit far away from your target mesh)

Edit Mesh -> Create Element->Hex :

Method: From Points (Select the points you created above to create a hex 8 element.)

Step 4

This step is the most important part of the process. All the elements should be under a part, which may be called "ALL", except surfaces that define boundary conditions. This can be seen in Figure 4

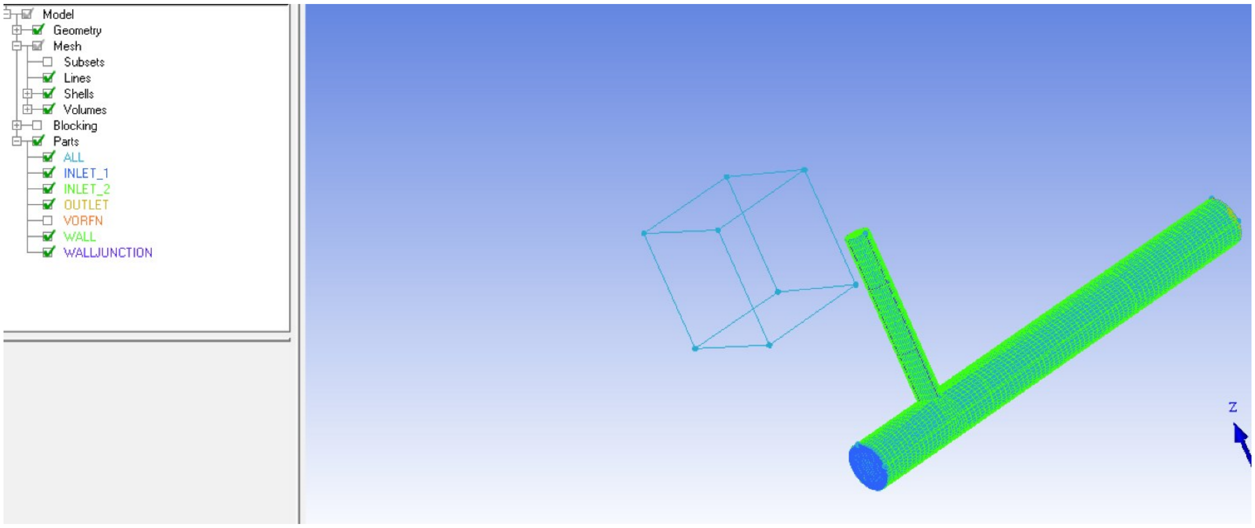

Figure 4: Mesh with Hexa27 and Hexa8

The rest of the step involves selecting a solver, defining sideset IDs for boundary conditions, and writing an input file.

Output -> Select Solver -> EXODUS-II

Output -> Part Boundary Conditions as in Figure 5

Output -> Write Input (Name the .exo file to be created)

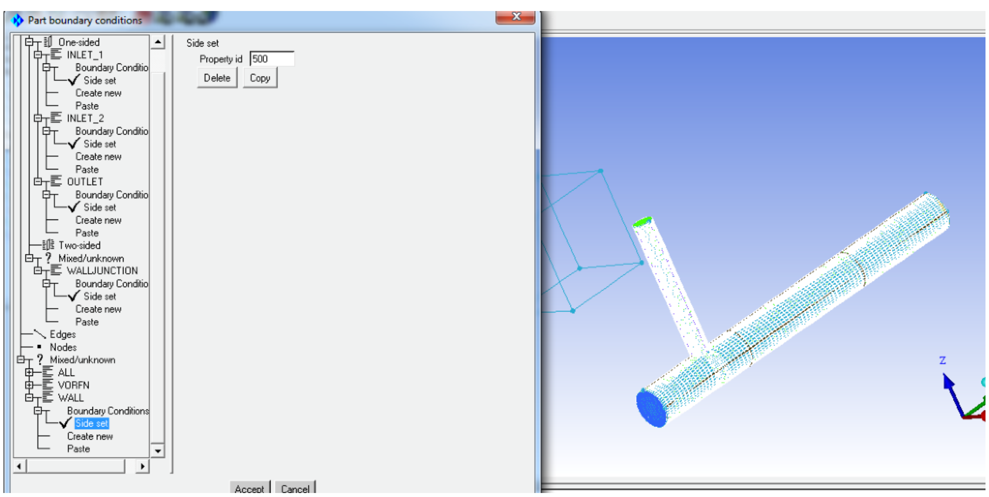

Figure 5: Boundary conditions (Sideset ID)

CUBIT/TRELIS

In this step, the Exodus mesh file created with ICEM-CFD will be imported to CUBIT and in order to identify sideset IDs with their corresponding surfaces.

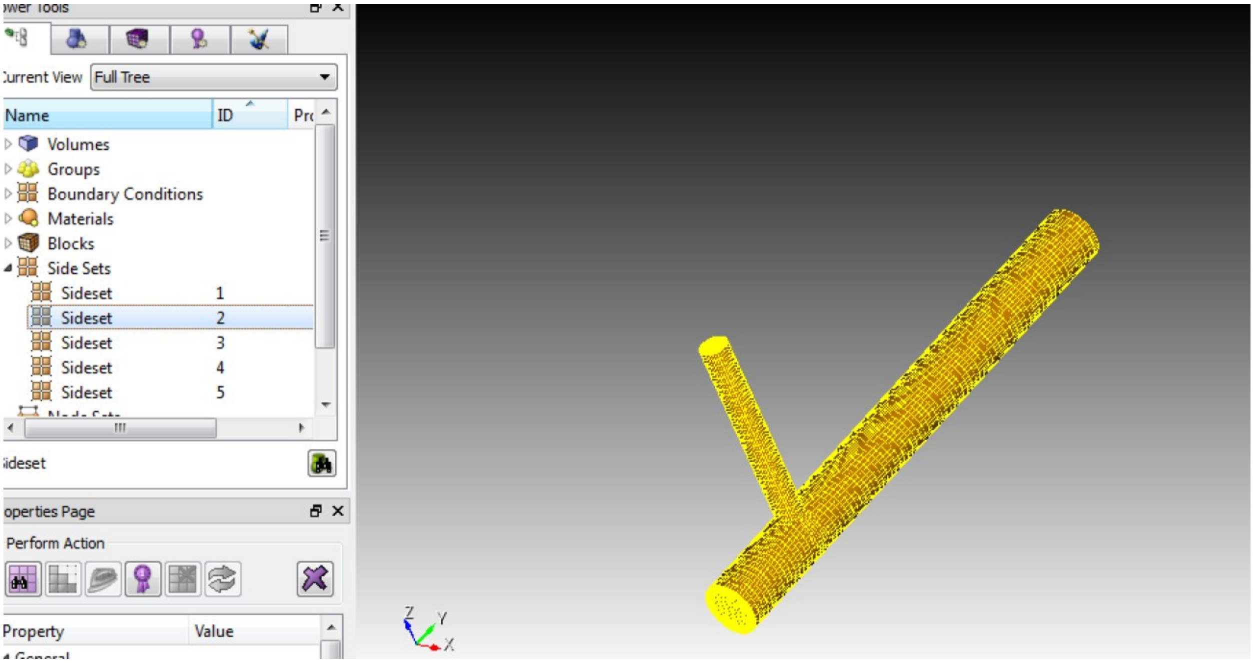

Figure 6: Cubit Mesh

Commands for example case

- import mesh geometry "C:\Users\YOURUSERNAME\Desktop\exodus.exo" block 2 use nodeset sideset linear no_merge
- sideset 1 surface 1
- sideset 2 surface 2
- sideset 3 surface 3
- sideset 4 surface 4
- sideset 5 surface 5
- export mesh "exporta.exo"

At this step all boundaries can be confirmed and identified visually by clicking on sideset's as shown in Figure 6

MOAB

This is the last step before the file can be read by Nek to create a mesh file with boundary conditions.

- mbconvert export a.exo tjunca.h5m //conversion
- mbpart 64 tjunca.h5m tjuncb.h5m // partioning

NEK5000

In this step, the partitioned file from MOAB will be read by NEK5000, and a mesh file will be created.

For this case, the MOAB example in the NEK5000/Example folder can be used by modifying parameters in the box area of Figure

.Usr file also needs following lines as given below

- call gen_rea(2)
- call exitt()

Once run is done newrea.out file will be created with boundary conditions.

```
      0.0000000E+00
      0.0000000E+00
       4.000000         p99    dealiasing:if <0 disable
      0.0000000E+00     p100 reserved
      0.0000000E+00     p101   No. of additional filter modes
      0.0000000E+00
      5.0000001E-02     p103   weight of stabilizing filter (.01)
      0  Lines of passive scalar data follows2 CONDUCT; 2RHOCP
      5  LOGICAL SWITCHES FOLLOW
  T     IFFLOW
  T     IFTRAN
  T     IFADVC (for each field)
  T     IFMOAB
  T     IFSCHCLOB
   5.00000       5.10000      -1.00000      -1.00000     XFAC,YFAC,XZERO,YZERO
 **MESH DATA** 6 lines are X,Y,Z;X,Y,Z. Columns corners 1-4;5-8
tjuncb.h5m
1 0      1 fluid set, 0 other/solid sets
2       fluid set #10
1        Material properties -fluid set #10: MATINDX of 1, All elements: IMATIE = 1
5         no. bc sets; bc set id, bc type: (f=flux, c=convective, t=dirichlet, I=adiabatic)
1    1    v
2    1    W
3    1    W
4    1    v
5    1    O
            0 PRESOLVE/RESTART OPTIONS  *****
            7         INITIAL CONDITIONS *****
C Default
C Default
C Default
C Default
C Default
C Default
C Default
  ***** DRIVE FORCE DATA ***** BODY FORCE, FLOW, Q
            4                 Lines of Drive force data follow
C
C
C
C
  ***** Variable Property Data ***** Overrrides Parameter data.
            1 Lines follow.
            0 PACKETS OF DATA FOLLOW
  ***** HISTORY AND INTEGRAL DATA *****
            0   POINTS.  Hcode, I,J,H,IEL
  ***** OUTPUT FIELD SPECIFICATION *****
            7 SPECIFICATIONS FOLLOW
  T      COORDINATES
  T      VELOCITY
```

Figure 7: Modifications to Nek5000 MOAB example script

Acknowledgement

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