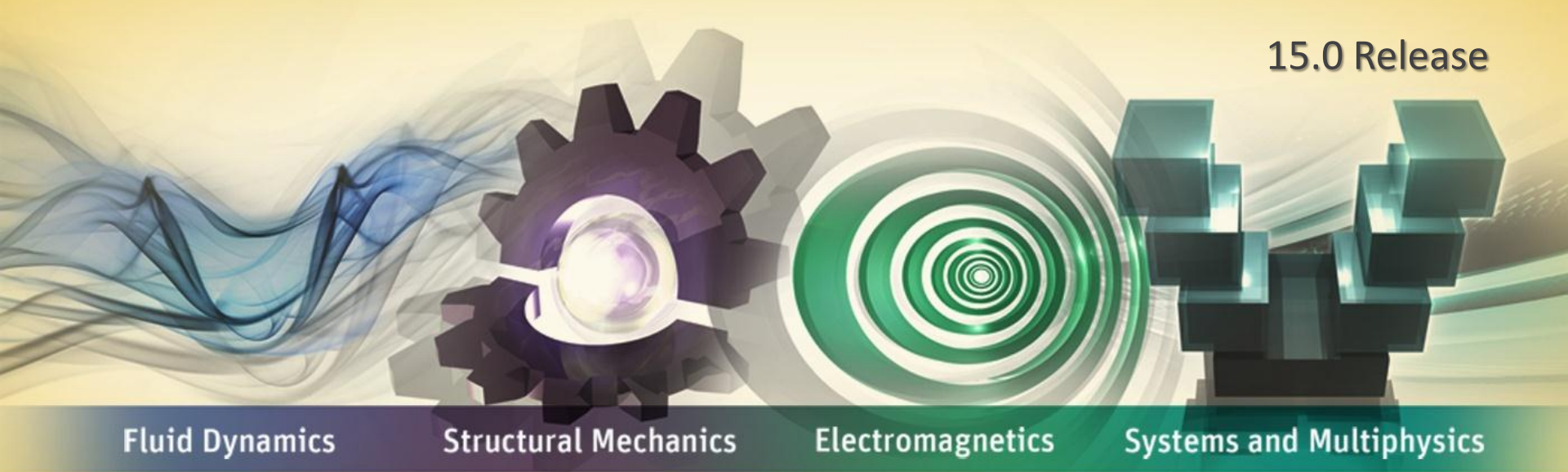


Appendix A

Hexa Basic Block Structures

15.0 Release

A horizontal banner with a yellow-to-orange gradient background. It features four distinct 3D visualizations: fluid flow streamlines on the left, a dark gear with a glowing center, a green concentric circle pattern, and a stack of blue and black cubes on the right. Below these images is a dark teal bar containing four white text labels.

Fluid Dynamics

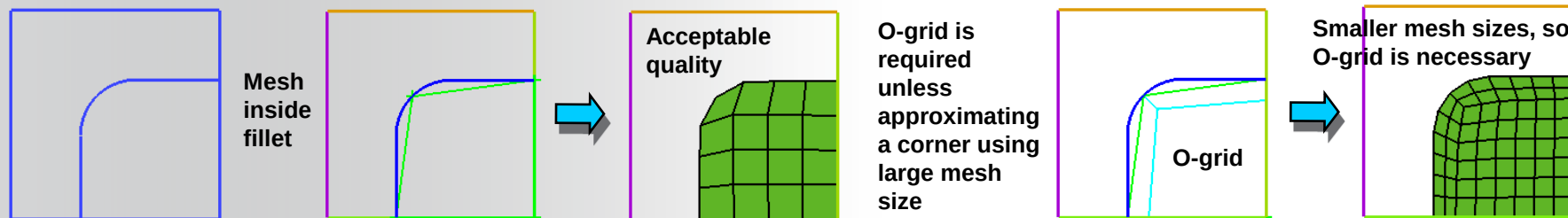
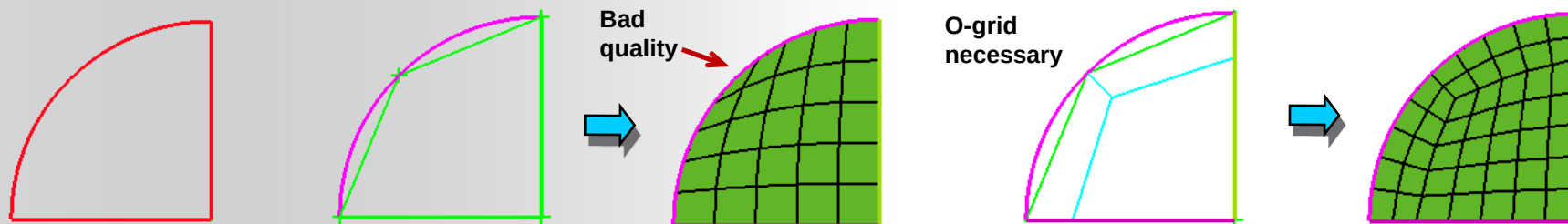
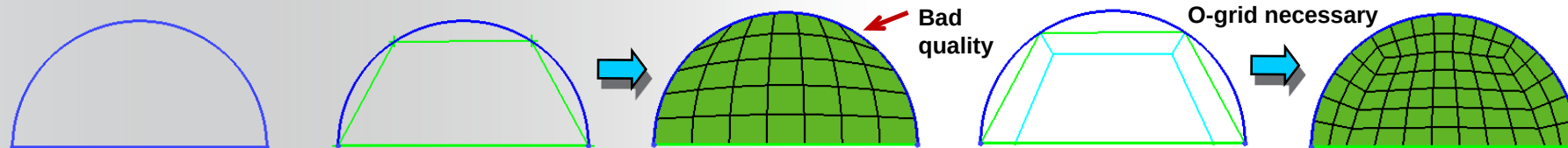
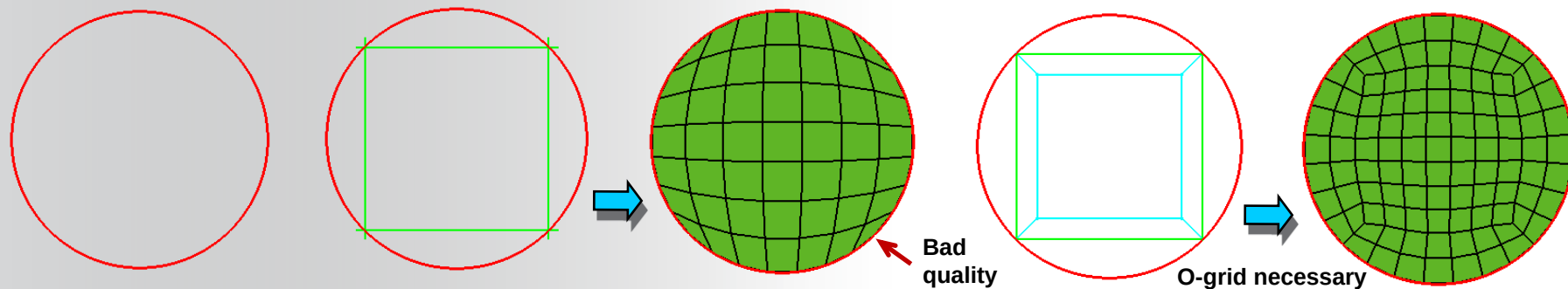
Structural Mechanics

Electromagnetics

Systems and Multiphysics

Introduction to ANSYS ICEM CFD

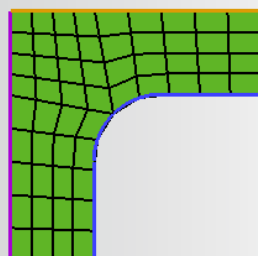
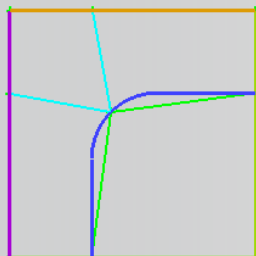
Appendix A – Basic Block Structures



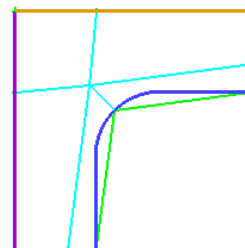
Appendix A – Basic Block Structures

In general, O-grids are required inside curvature but not outside curvature

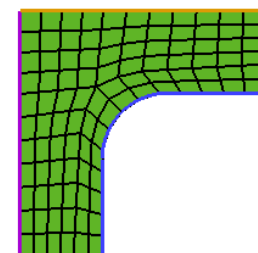
Mesh outside fillet



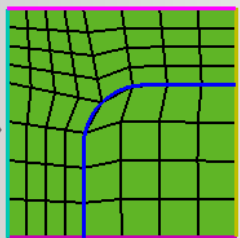
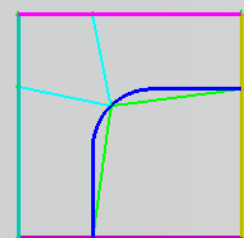
Quality is good without an O-grid



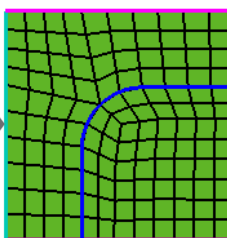
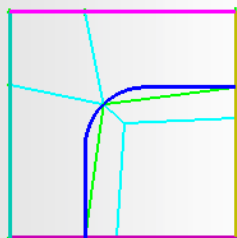
However, an O-grid makes normal grid lines for boundary layer resolution



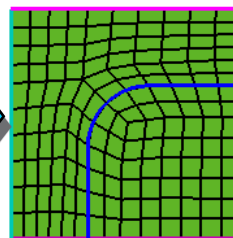
Mesh inside and outside fillet. Combine previous examples



— This method needs large mesh size —

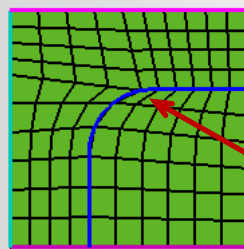
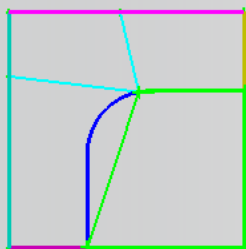


Add O-grid inside curvature



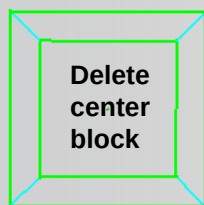
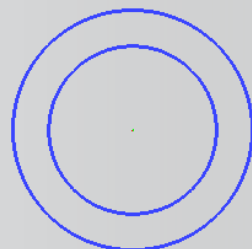
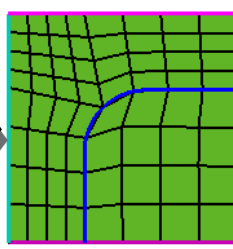
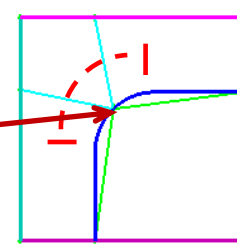
Add O-grid outside curvature

Vertex at end of fillet



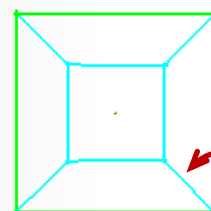
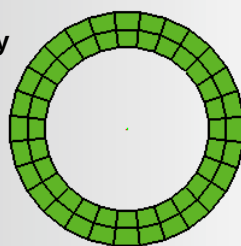
This is not preferable because quality is lower

There should be one vertex at the CENTER of every approximate 90 degree bend



Delete center block

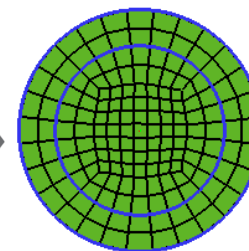
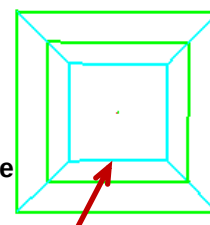
Mesh only in ring



Mesh in both

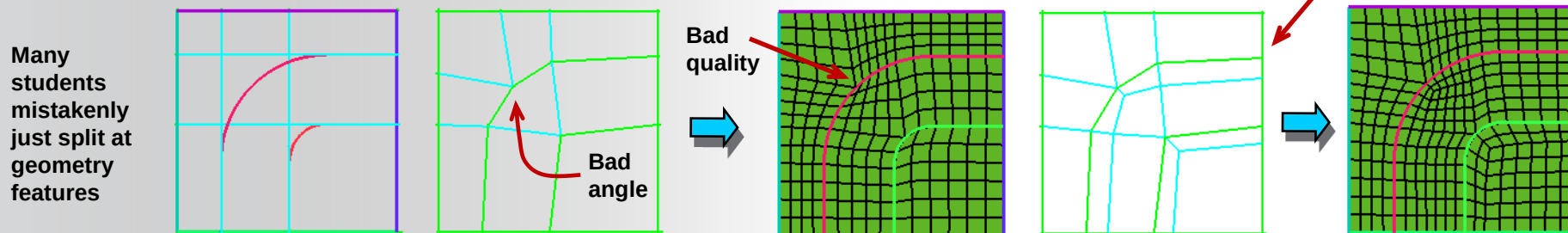
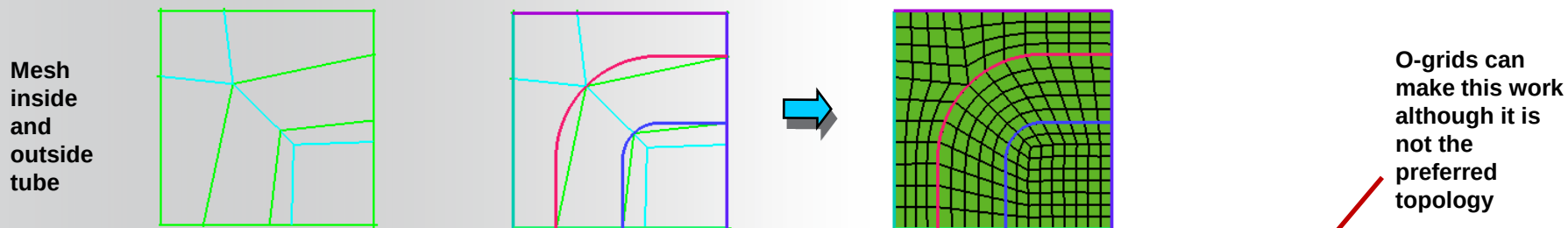
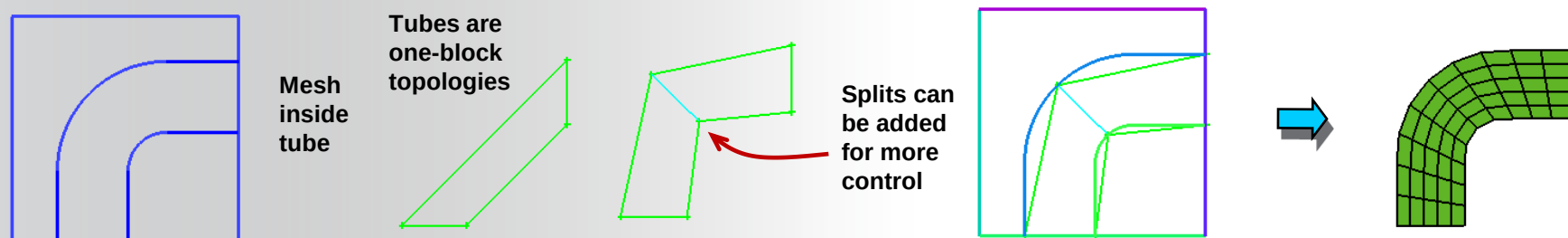
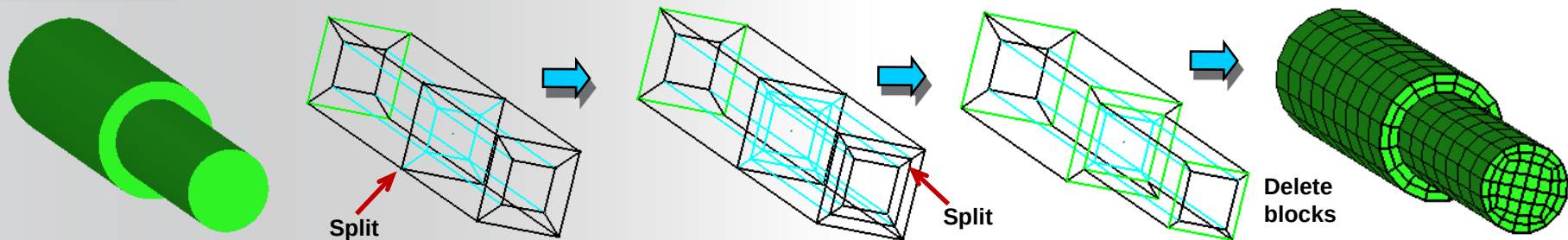


Split any radial edge

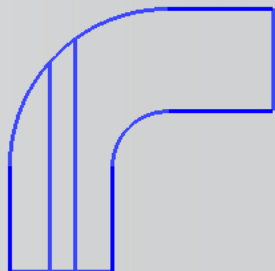


Inner O-grid block should be smaller than the smallest circle, NOT on the circle

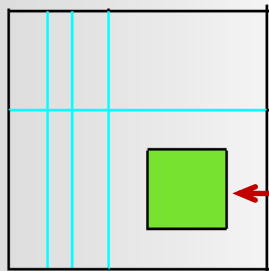
Appendix A – Basic Block Structures



Appendix A – Basic Block Structures

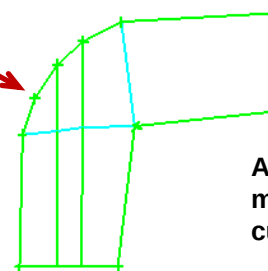


We must use the straight-through split strategy as in the previous example for grid lines to flow with the inner tube

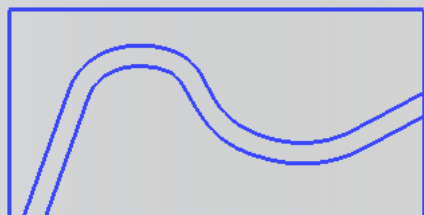
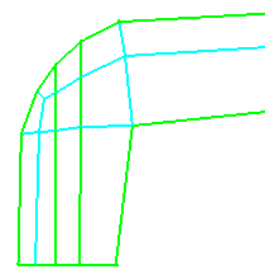


Bad angle

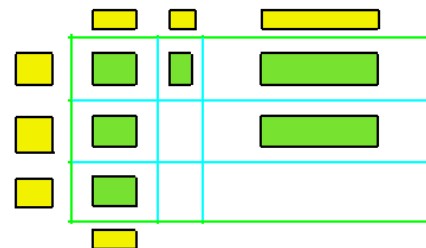
Delete block



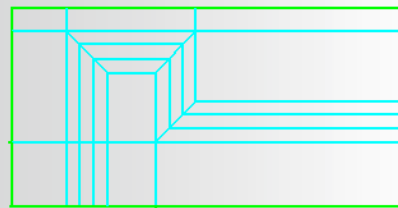
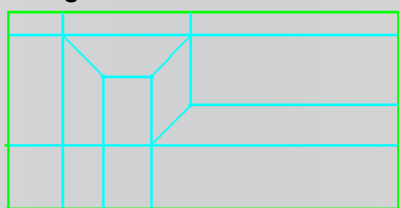
Add O-grid for meshing inside curvature



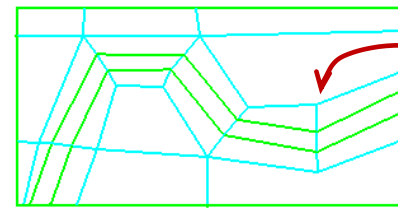
O-grids can be used to make complicated structures



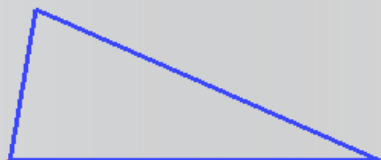
Blocks selected for creating O-grid



2 splits



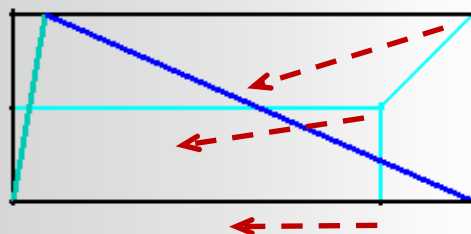
Split for better blocking control



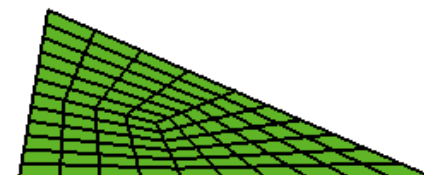
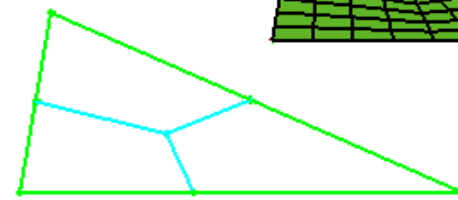
There are multiple methods of producing the Y-block structure

Method 1
Quarter O-grid

These may also be called wedge blocks. They can be used to effectively terminate mesh from continuing through the geometry

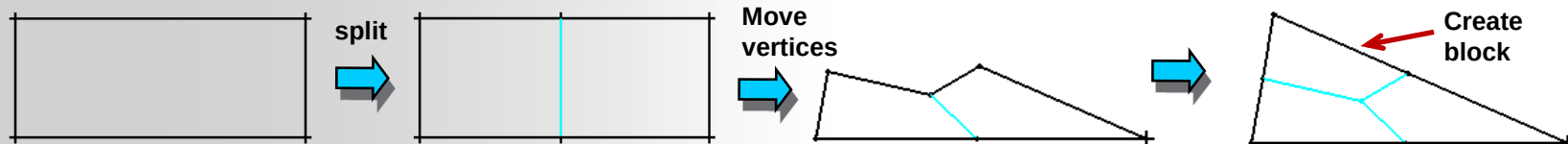


Move vertices

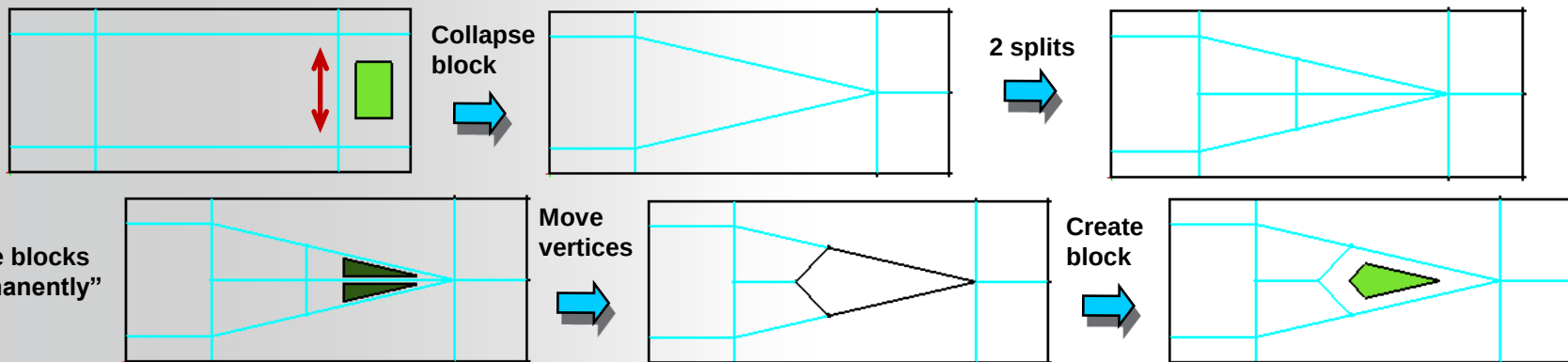


Appendix A – Basic Block Structures

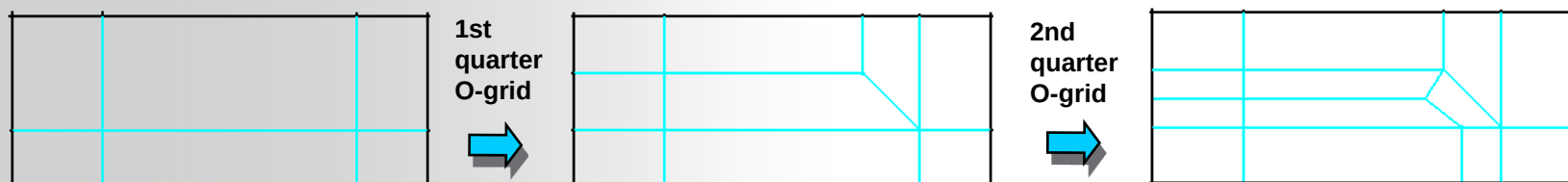
Method 2



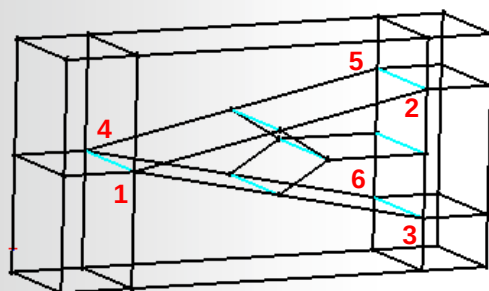
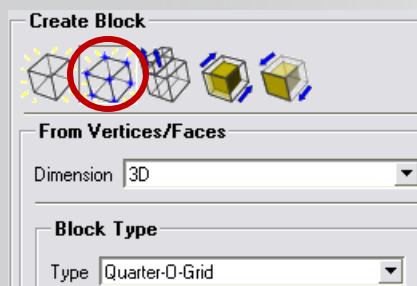
Method 3
Inside
H-grid
(bottom-up)



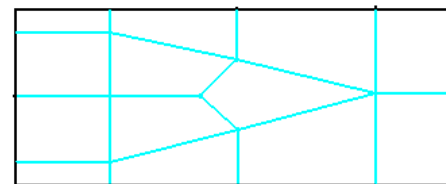
Method 4
Inside
H-grid
(top-down)



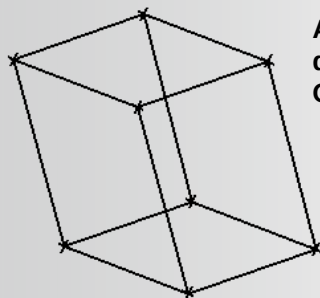
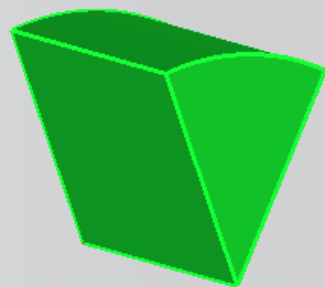
Method 5
Create
block
function
(quarter O-grid)



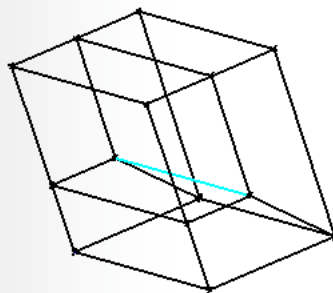
Move
vertices



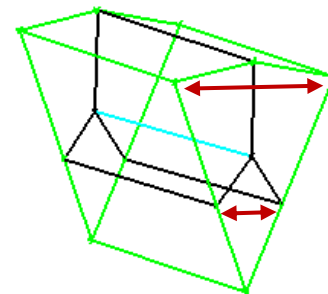
Appendix A – Basic Block Structures



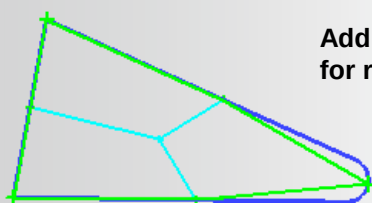
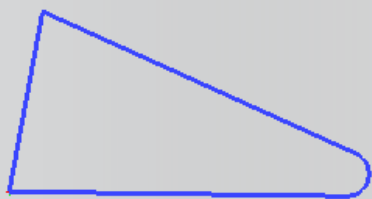
Add
quarter
O-grid



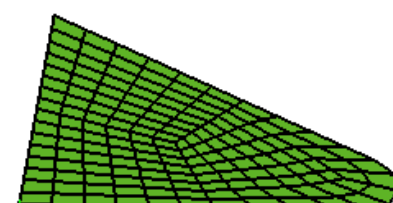
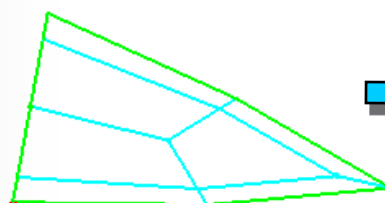
Move
vertices



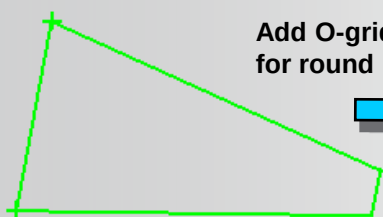
Used for
meshing
a periodic
wedge
domain
with
model
inside



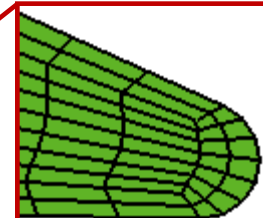
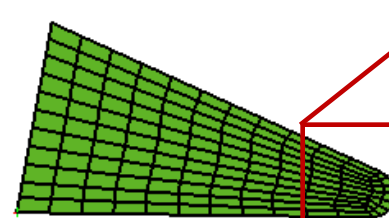
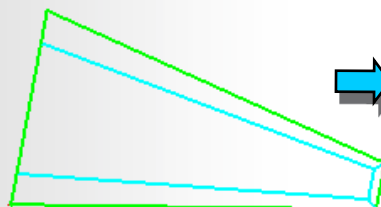
Add O-grid
for round



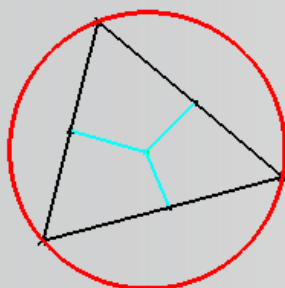
Since the round is
closer to 180
degrees than 90
degrees, having
two block corners
may be better (one
vertex corner for
every ~90 degrees)



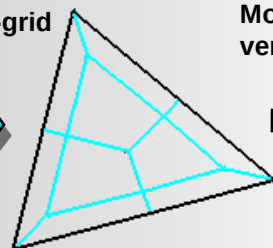
Add O-grid
for round



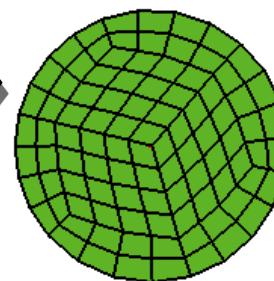
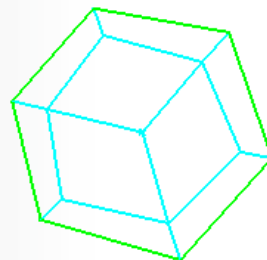
A Y-block
structure
can also be
used for a
circle



Add O-grid

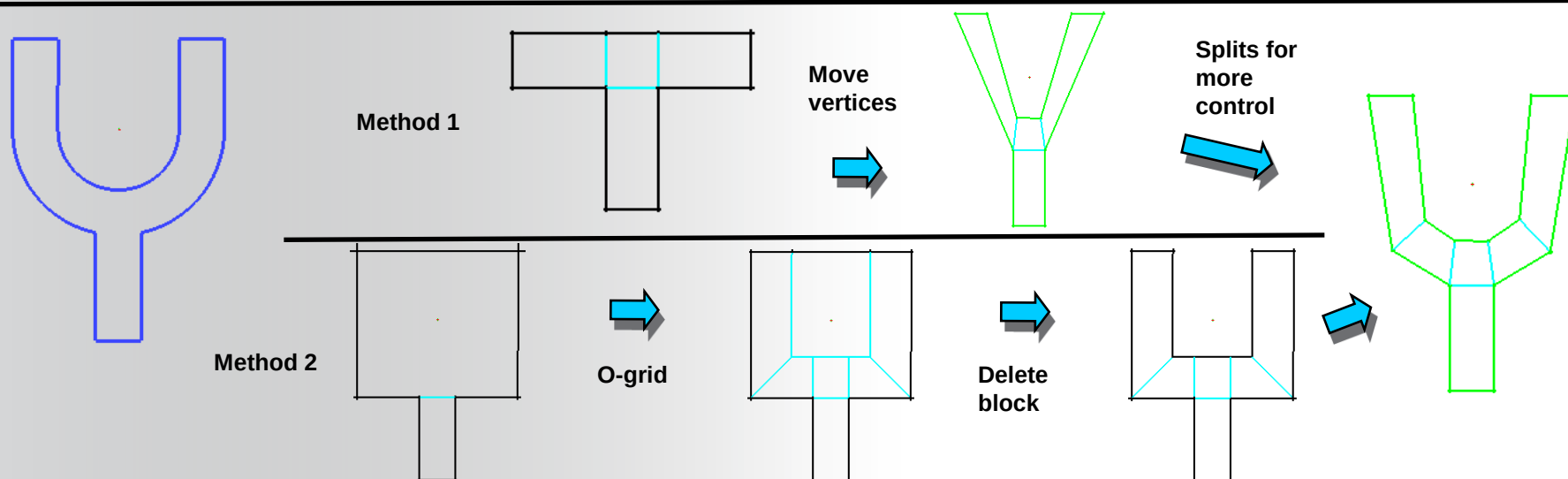
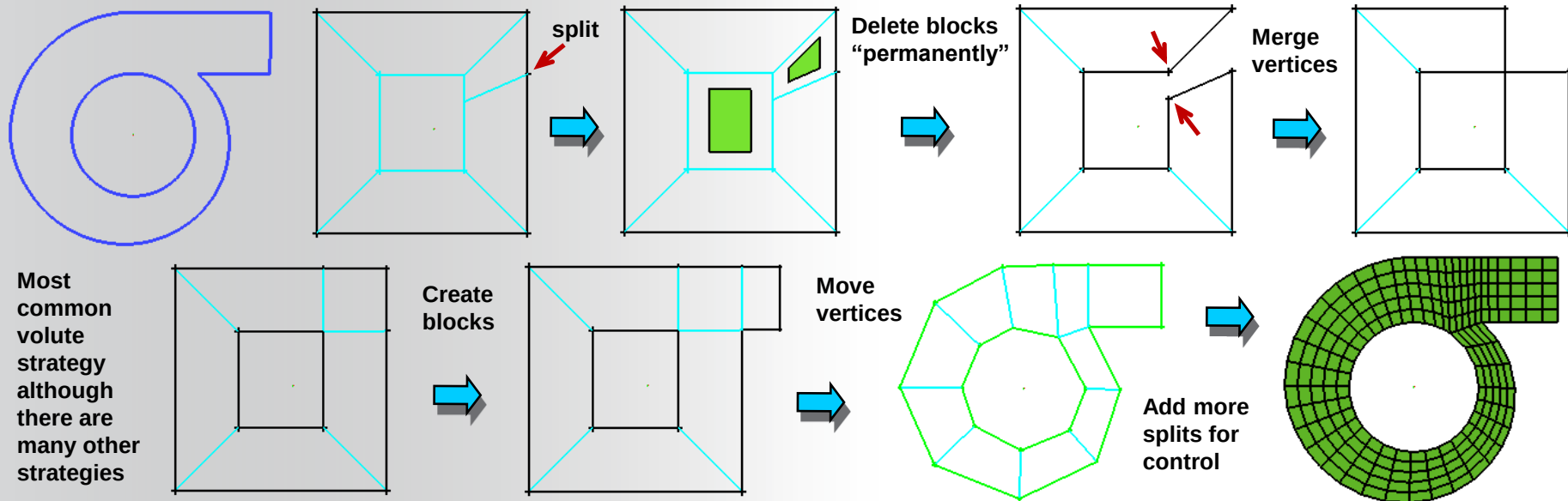


Move
vertices

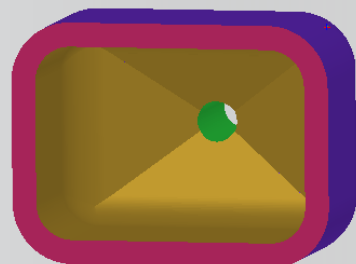


Useful for filling
the center of
geometry that is
periodic in
multiples of 3

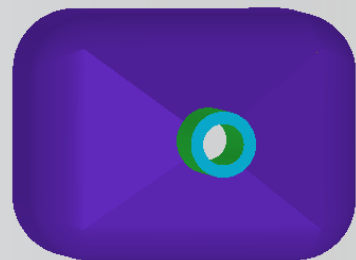
Appendix A – Basic Block Structures



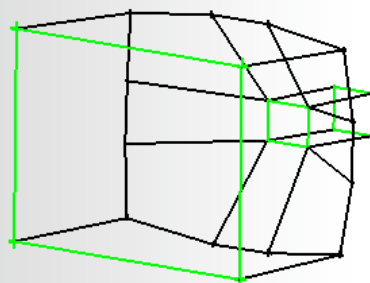
Appendix A – Basic Block Structures



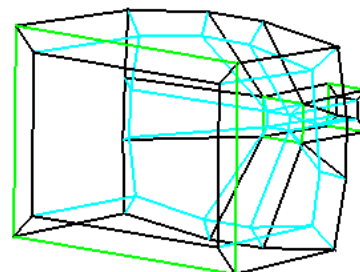
Thin thicknesses are easily done with an O-grid



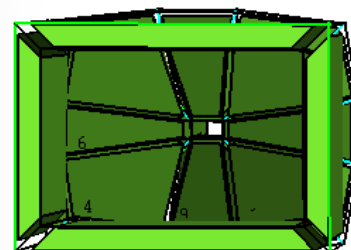
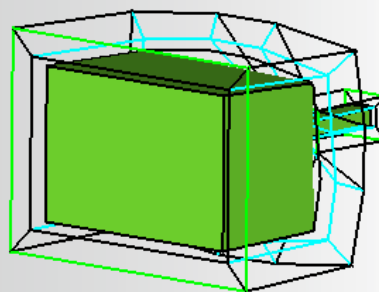
Delete the inside blocks



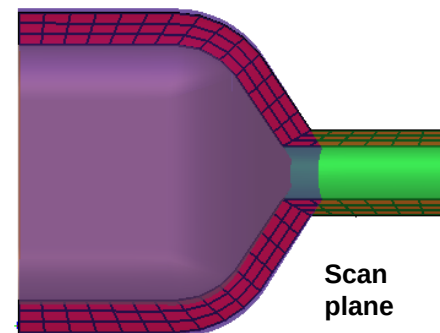
First block the outside



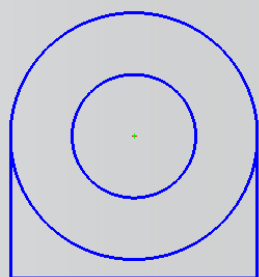
Then put an O-grid inside all blocks (add appropriate faces)



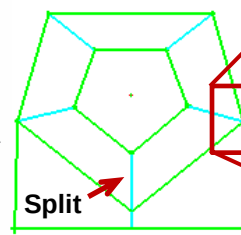
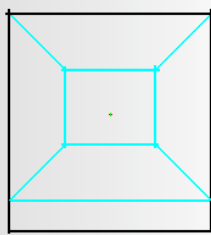
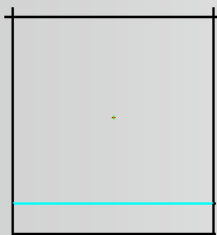
Resulting blocks



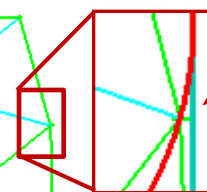
Scan plane



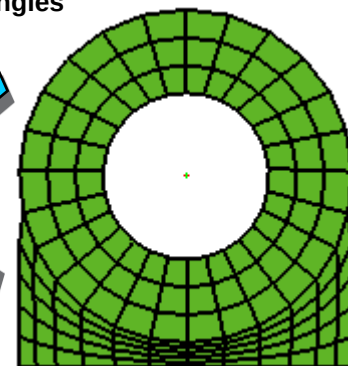
Method 1



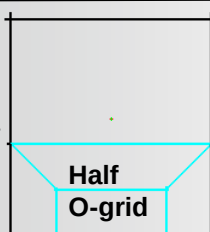
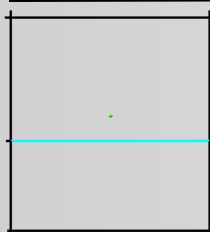
Split



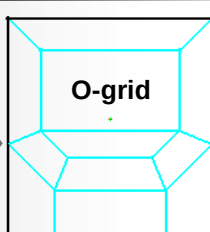
Vertex moved slightly off intersection for better angles



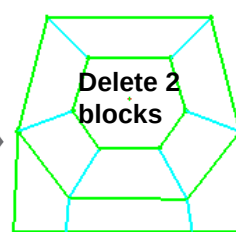
Method 2



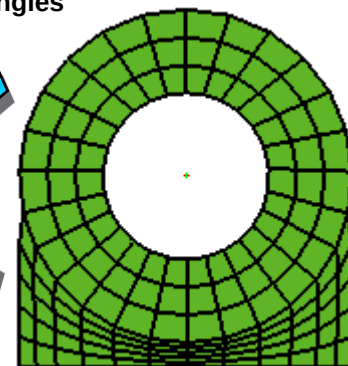
Half O-grid



O-grid

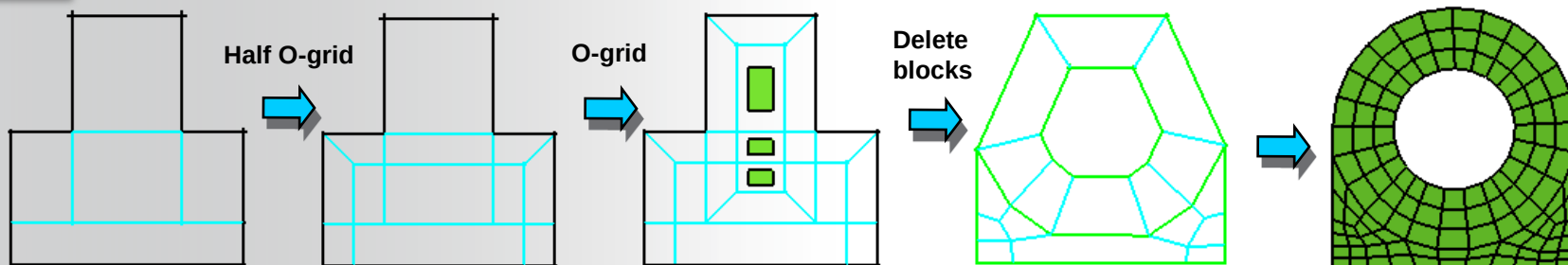


Delete 2 blocks

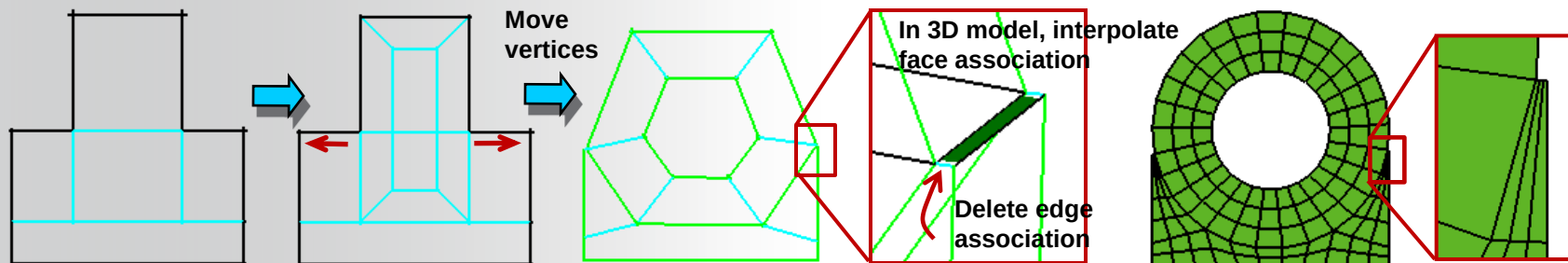


Appendix A – Basic Block Structures

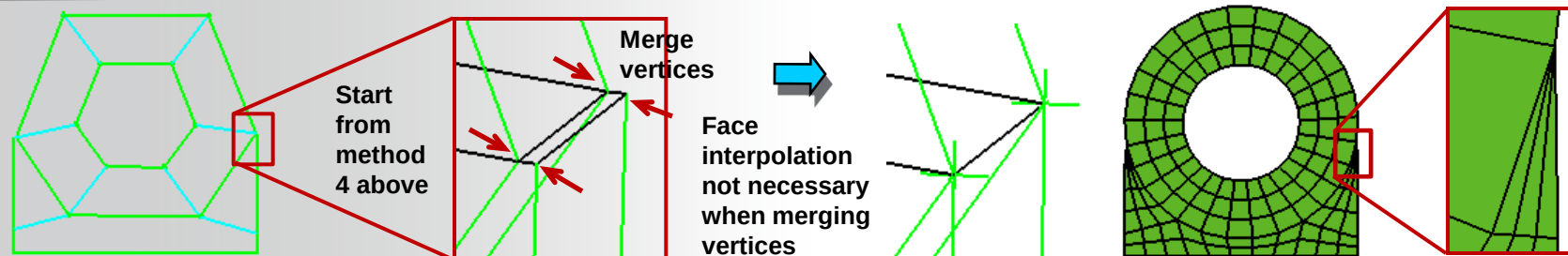
Method 3
Using Y-
blocks



Method 4
Leaving
small
ledge



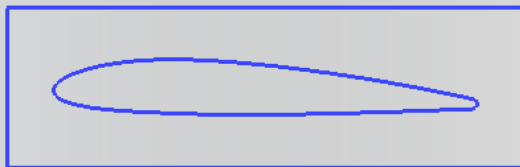
Method 5
Degenerate
blocks



Method 6
Convert
block

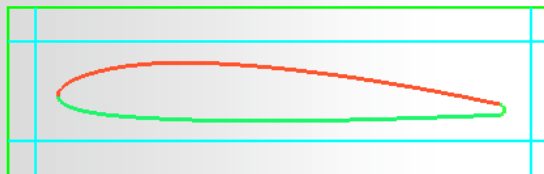


Appendix A – Basic Block Structures

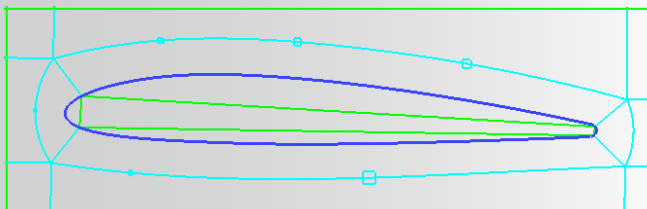
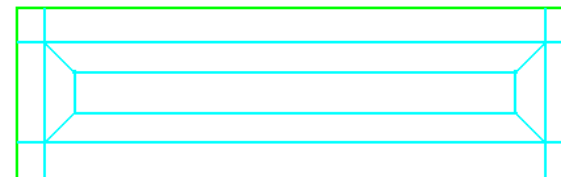


Filletted wings are easily done with a simple block. The block can be made larger than the wing and an O-grid made inside, or the block can be on the wing and the O-grid made around.

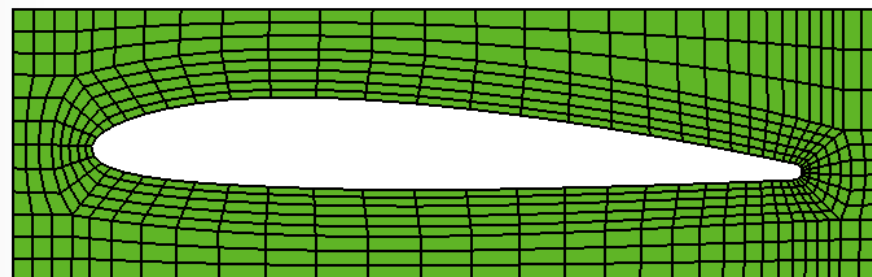
Split out a block larger than the wing



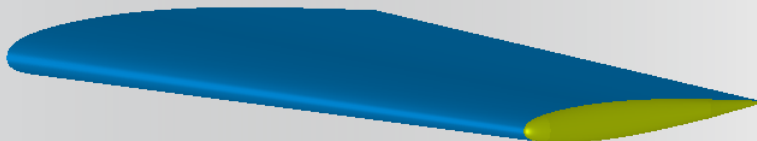
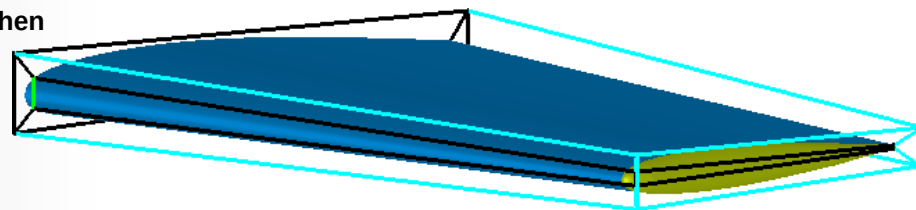
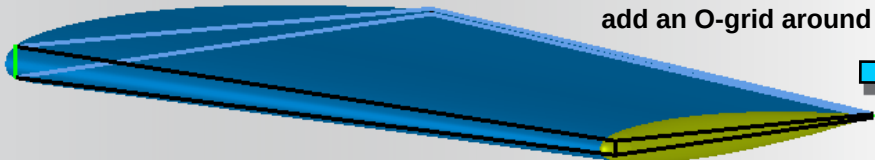
O-grid



Edge splits to shape edges



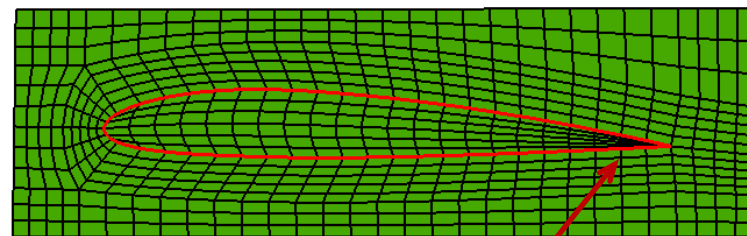
Filletted wings are easily done with a block on the wing then add an O-grid around



Knife-edge wings pose a problem if you collapse. The collapse behind the wing must propagate through the blocking, or invalid elements result in a corner.

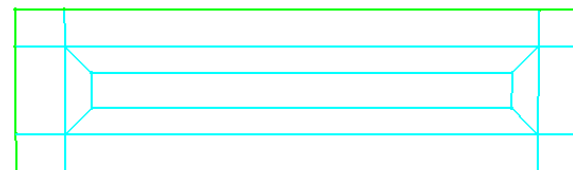
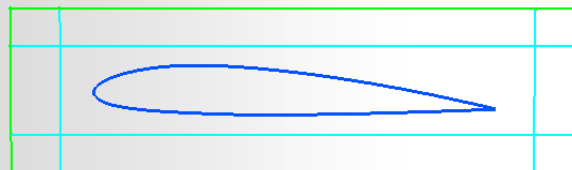
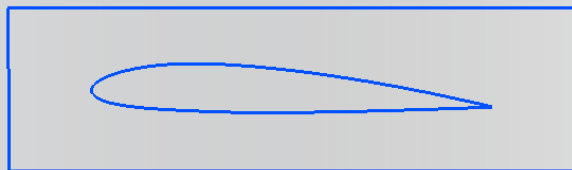
This means mesh beyond the blade tip will have the same mesh pattern as on the blade tip, as if the blade were meshed inside.

Mesh region beyond the blade-tip is bad quality

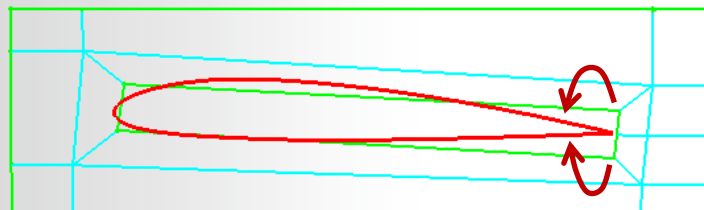


Very low angles and unnecessary mesh density result from a simple collapse

Appendix A – Basic Block Structures

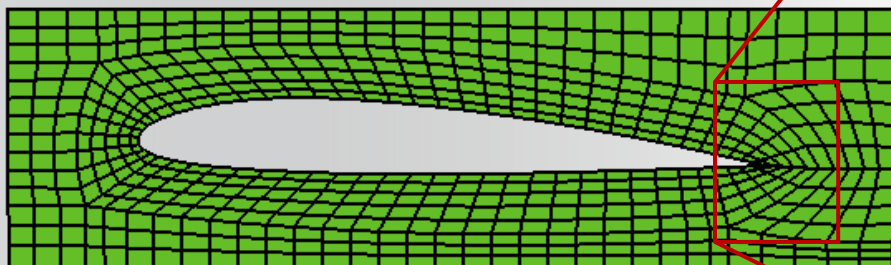
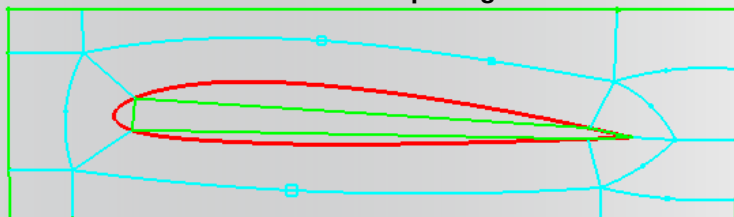


The easiest way to block sharp edge wings is to use the O-grid strategy shown previously and simply make a split down the middle for the sharp edge

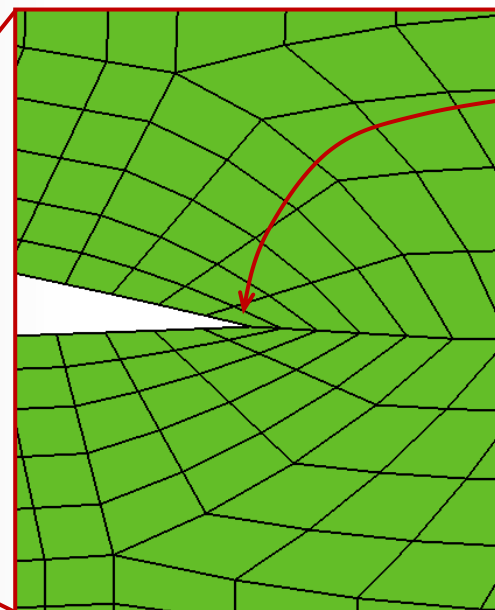


Make a split down the middle

Move vertices and shape edges



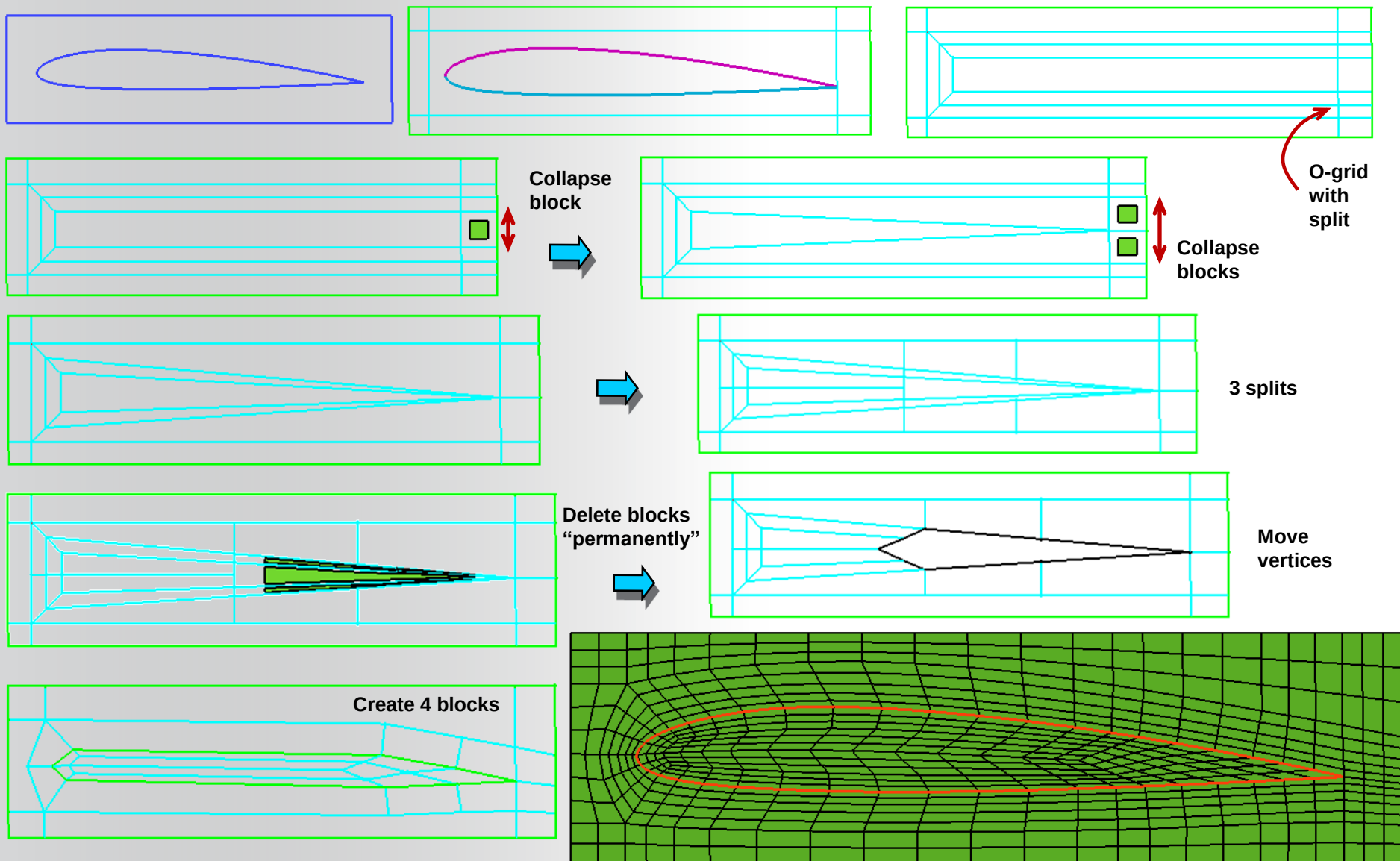
If the blade is very sharp, you will have to resort to collapsing beyond the trailing edge and use a more complicated strategy shown in the next slides to get good mesh beyond the blade tip. Or if a C-grid is desired, also use one of the strategies shown next.



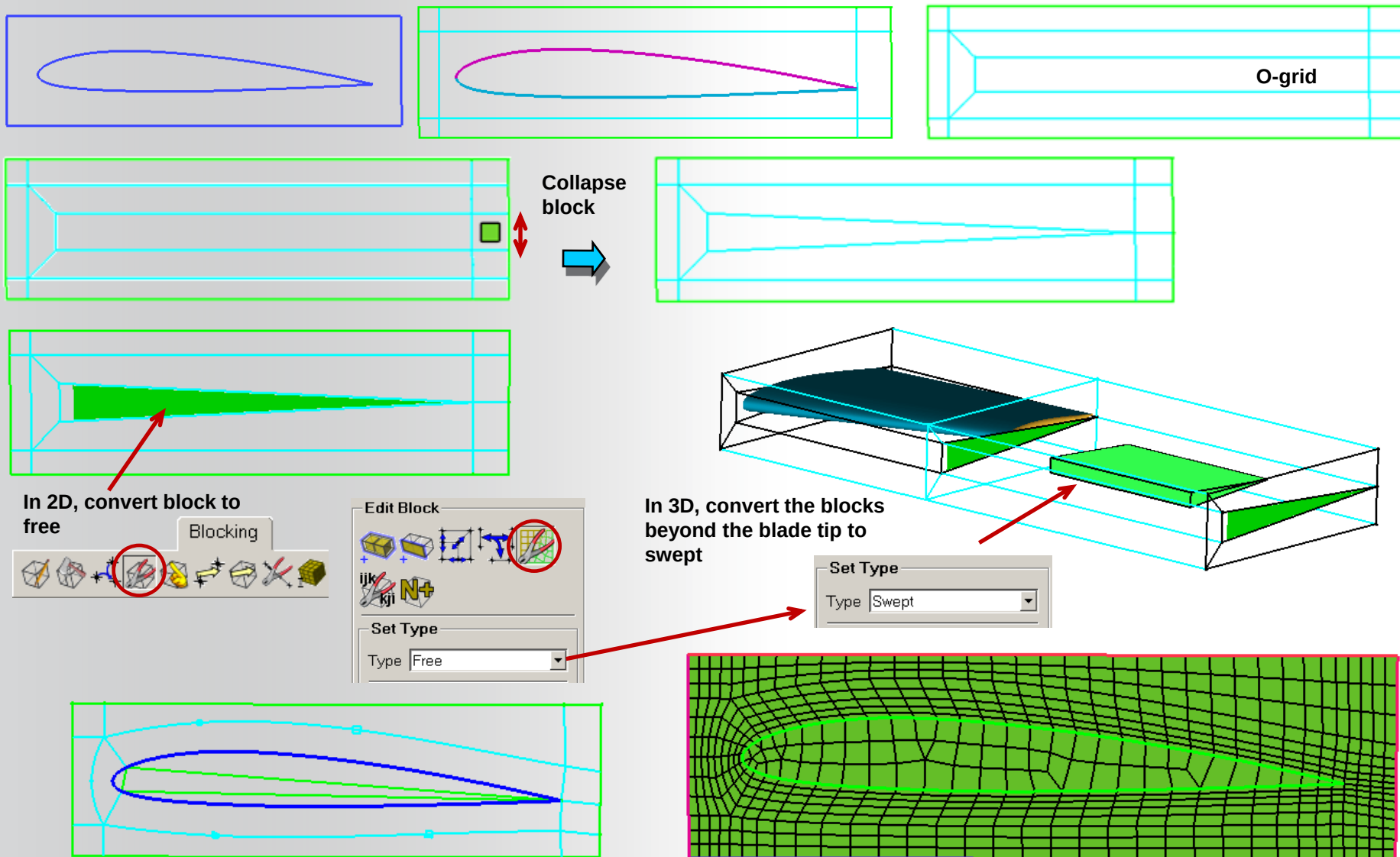
Element angles get worse as the blade angle gets sharper, so this strategy is only good for larger angled geometry. Best max angle possible = $180 - \frac{1}{2}$ the blade trailing edge angle

Since no collapsing is done, there is no problem with the mesh quality just beyond the blade tip. This strategy will work for rounded and flat tips (with an additional O-grid at the tip)

Appendix A – Basic Block Structures

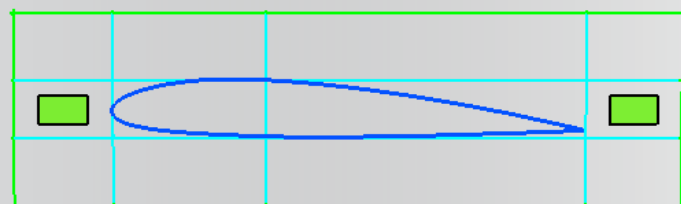


Appendix A – Basic Block Structures

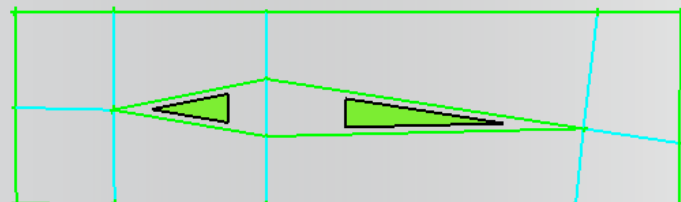
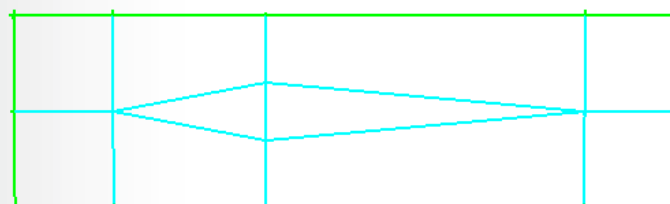


Appendix A – Basic Block Structures

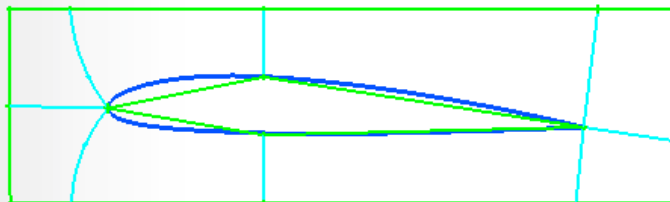
A knife-edge blade can also be handled by collapsing all around the blade if the complicated strategy of the previous examples are not wanted, or the blade is also sharp at the leading edge and tip.



Collapse blocks

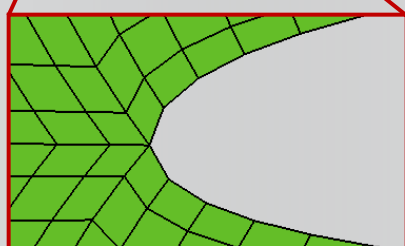
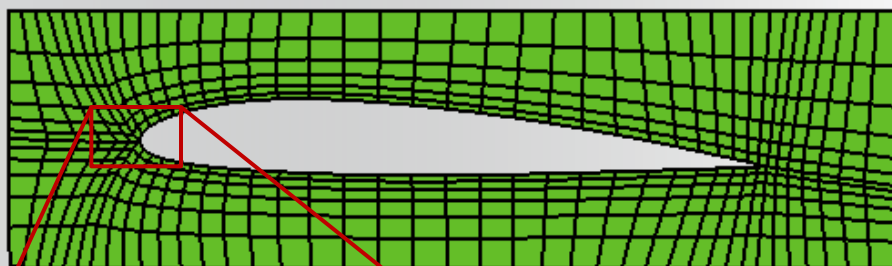


Delete blocks

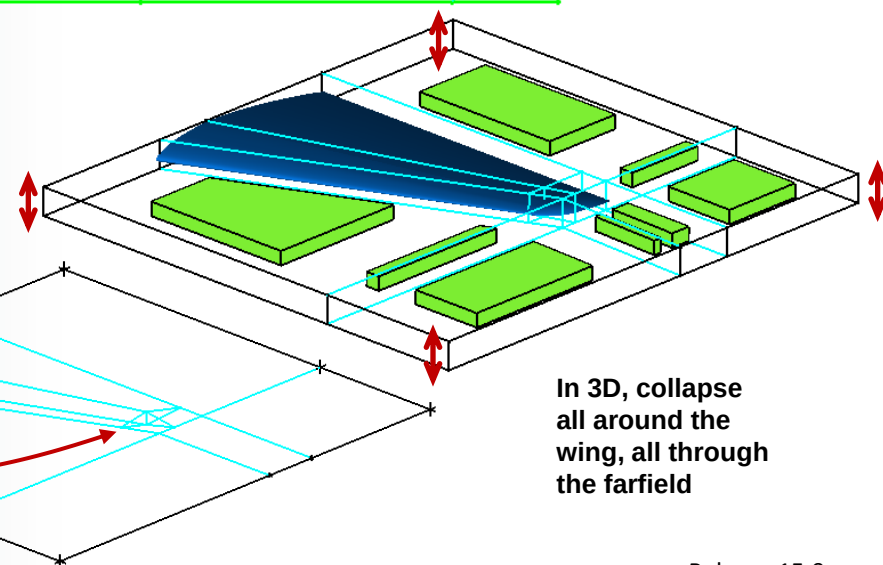


A split is needed somewhere in the middle, or else the next step of collapsing around the blade will also collapse the inner block to nothing.

Shape edges



Splits needed so wing is not collapsed



In 3D, collapse all around the wing, all through the farfield