Mesh Quality Metrics

Access the metrics at *Mesh→Statistics→Mesh Metrics*.

Element Quality: area or volume over sum of square of edge lengths. EQ measures how far elements are from being perfect—*e.g.*, one indicates a perfect tetrahedron or cube, whereas near zero signifies a terrible element.

Aspect ratio: essentially ratio of longest edge to shortest edge; should not exceed 100.

Skewness: closeness to ideality of face or cell (*i.e.*, equilaterality or equiangularity)

Orthogonal quality: similar to skewness, but on reverse scale.

	Unacceptable	Bad	Acceptable	Good	Very good	Excellent
Skewness	0.98–1.00	0.95–0.97	0.80–0.94	0.50–0.80	0.25–0.50	0–0.25
Orthogonal quality	0–0.001	0.001–0.10	0.10–0.20	0.20–0.69	0.70–0.95	0.95–1.00

Practical Meshing

Create a 2D rectangle of dimensions 20 cm × 5 cm according to the procedure introduced in class. Apply a global sizing of 1 cm (*Mesh→Insert→Sizing, Face Meshing*) and mesh it.

Answer the following questions for the 2D rectangular geometry mesh.

1. What are the overall mesh metrics?
   a. Number: _____ elements
   b. Element quality: _____ (best) _____ (worst)
   c. Aspect ratio: _____ (best) _____ (worst)
   d. Skewness: _____ (best) _____ (worst)
   e. Orthogonal quality: _____ (best) _____ (worst)

Find the "lowest-quality" mesh element (by your own judgment, visually or mathematically).

2. What are the element mesh metrics? (Use the *Mesh Metrics* plot to help with this task.)
   a. Location _____
   b. Element quality: _____
   c. Aspect ratio: _____
   d. Skewness: _____
   e. Orthogonal quality: _____

Apply a local sizing of 0.25 cm on the edges to refine the boundary layer. (Select location; *Insert→Sizing*) Remesh.

3. How many mesh elements do you have now? _____ elements

4. Did the lowest-quality mesh element improve (and how), and what is now the worst feature of that element? (The "same" element doesn't exist—select one in the same region.)
   _____
   _____

5. Where did the limiting case "worst" element move to, and what are its characteristics?
   a. Location _____
   b. Element quality: _____
   c. Aspect ratio: _____
   d. Skewness: _____
   e. Orthogonal quality: _____

3D Cylinder

Create a 3D cylinder by extruding a ⌀10 cm circle along L = 20 cm. Generate a default mesh. *Answer the following questions for the 3D cylindrical geometry mesh.*

6. What are the overall mesh metrics?
   a. Number: _____ elements
   b. Element quality: _____ (best) _____ (worst)
   c. Aspect ratio: _____ (best) _____ (worst)
   d. Skewness: _____ (best) _____ (worst)
   e. Orthogonal quality: _____ (best) _____ (worst)

Right click on either end (face) of the cylinder. *Insert→Inflation*. Select the circumference of the face as *Boundary*. Generate the mesh again to see the effect of refinement along the boundary.

7. What are the new overall mesh metrics?
   a. Number: _____ elements
   b. Element quality: _____ (best) _____ (worst)
   c. Aspect ratio: _____ (best) _____ (worst)
   d. Skewness: _____ (best) _____ (worst)
   e. Orthogonal quality: _____ (best) _____ (worst)

Find the "lowest-quality" mesh element (by your own judgment, visual or formal).

8. What are the mesh metrics?
   a. Location _____
   b. Element quality: _____
   c. Aspect ratio: _____
   d. Skewness: _____
   e. Orthogonal quality: _____

Named Selections

Fluent uses named selections to designate parts of the mesh as simulation features, such as inflow boundaries, walls, outflow boundaries, axes of symmetry, etc.

Group-select the endmost nodes of the cylinder (only these—adjust your view accordingly and *Box Select*). Right-click and select *Create named selection...* to open a dialog box where you can collectively label these nodes as "inlet".