ARES Workshop - Ansys FEA

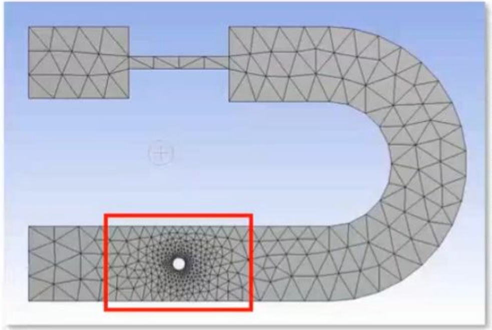
Cas Kent & Ann Phan

Curvature and Proximity

Curvature sizing limits the angle between adjacent elements

Best used for curved surfaces

Growth rate determines transition to larger mesh away from curvature



Curvature and Proximity

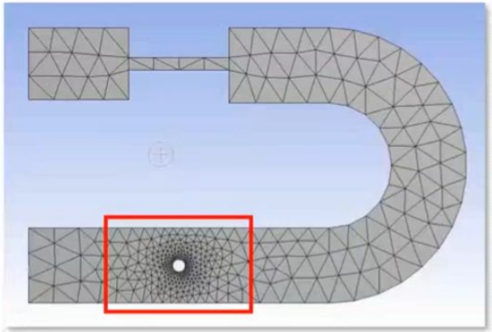
Curvature sizing limits the angle between adjacent elements

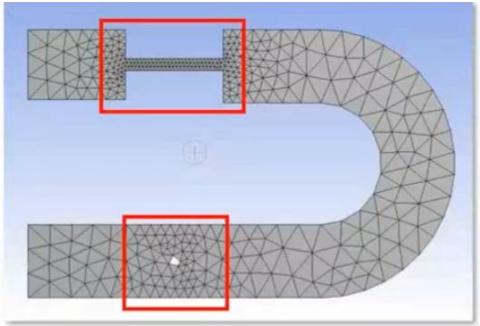
Best used for curved surfaces

Growth rate determines transition to larger mesh away from curvature

Proximity sizing ensures a minimum number of elements across thin faces/narrow gaps

Note this does not apply to the curved surface





Defeaturing

Defeaturing ignores features below a certain size

Default feature size is half the minimum **local** element size

In areas of fine local mesh, features are kept

In areas of coarse local mesh, features are omitted

Midsurfacing (Shell Meshes)

https://info.simuleon.com/blog/5-reasons-why-your-fea-simulations-should-be-setup-with-a-mid-surface-shell-mesh-for-thin-walled-parts

Beam Extraction

Beams FEA Guide

Trying to model long, thin beams as a solid 3D mesh is undesirable:

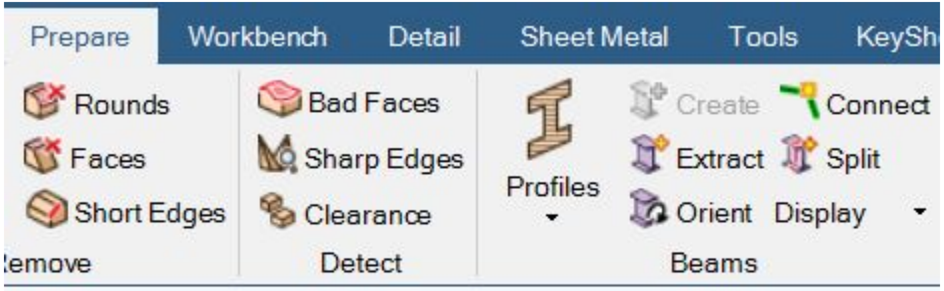
- Requires a tiny mesh with many elements. This means **huge solving time**
- Solid mesh gives **massive FEA error** for very long and thin beams

Much more efficient to model beams as **1D objects** which include profile and thickness as internal **parameters**

- More **accurate**
- **Faster** solving, meshing and post-processing

Beam Extraction

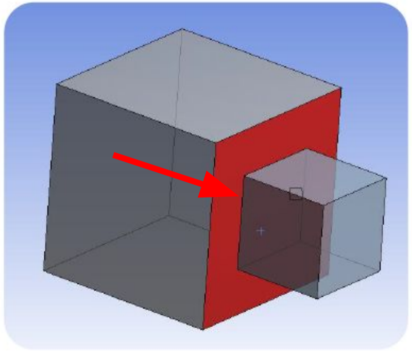
Ansys provides **Beam Extraction** tools



Sharing Topology

For designs with multiple parts, it's best to **share** any contacting surfaces

When two parts don't share the contacting faces, the mesh will be **discontinuous**



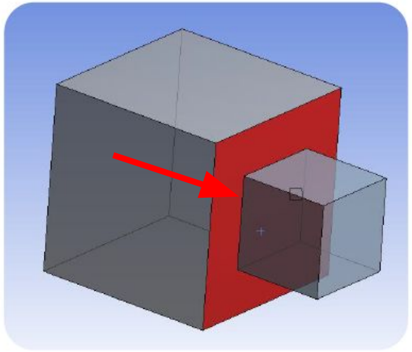
Sharing Topology

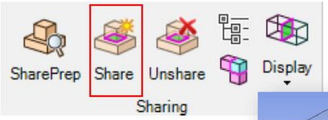
For designs with multiple parts, it's best to **share** any contacting surfaces

When two parts don't share the contacting faces, the **mesh will be discontinuous**

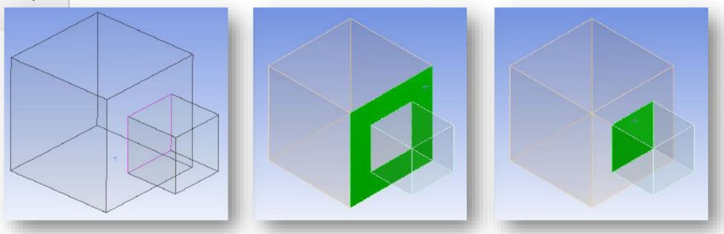
When the parts share surfaces, the **mesh will be continuous** and the shared surface will be an **internal** surface

This is called "conformally meshed"





Bodies that share topology



Meshing Advice

Mesh **should match the physics of the problem**

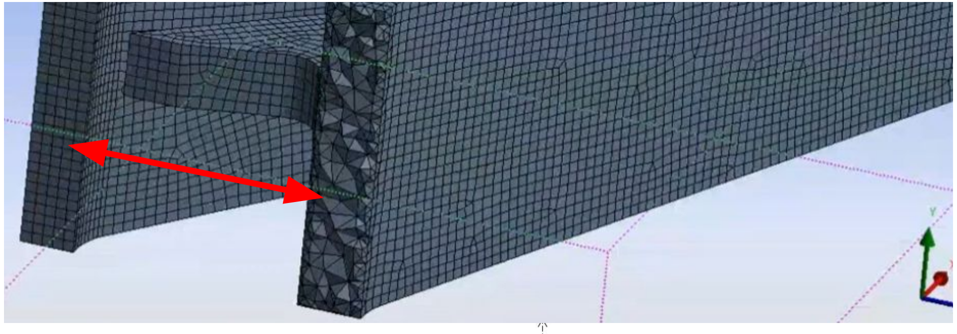
Check the **internal mesh** quality (sections)

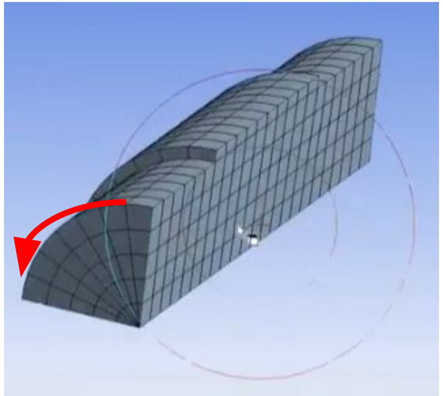
Convert long parts into **1D beam elements** and thin-walled parts into **surface elements**

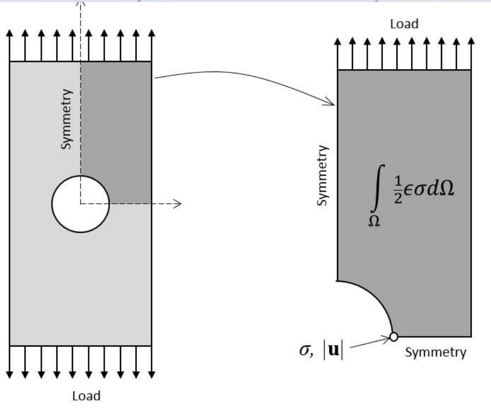
Huge mesh with lots of elements isn't necessarily good

Look for symmetrical and **sweepable** surfaces

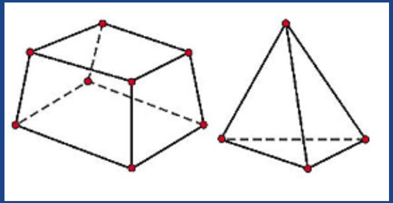
Remember **symmetry**, and consider **2D solution** for symmetrical problems







Hex vs. Tet Mesh



Hex can be **structured** (uniform), tet is unstructured.

Hex is generally **more accurate** than tet for the same cell count.

For complex geometry, hex mesh is **more difficult** to achieve than tet.

Hex mesh can be **quicker** to make.

Harder to get high quality hex mesh than tet.

Can also make hybrid meshes with both hex and tet.

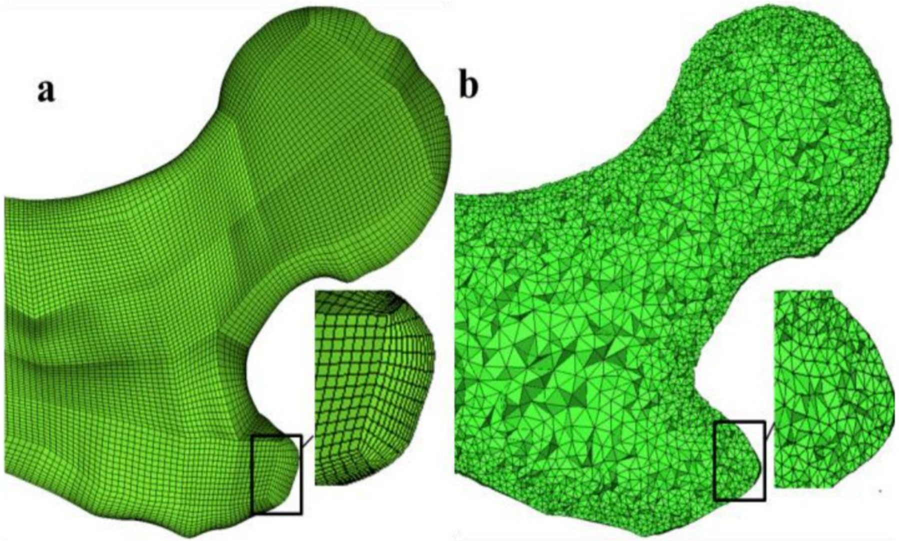
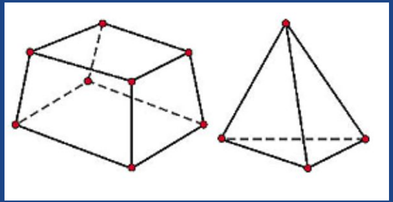


Figure 1: a) Hex, and b) Tet meshes for a femur.

Hex vs. Tet Mesh



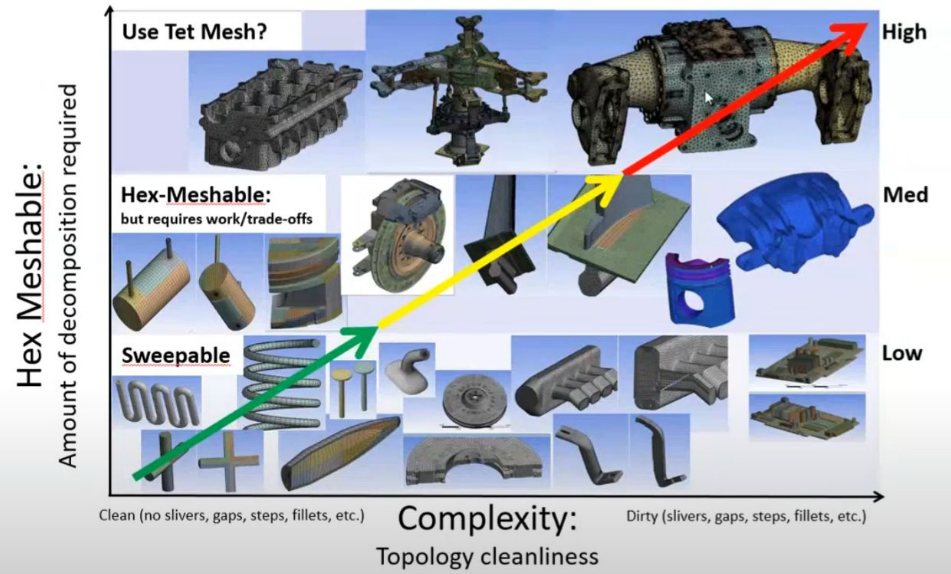
Hex can be **structured** (uniform), tet is unstructured.

Hex is generally **more accurate** than tet for the same cell count.

For complex geometry, hex mesh is **more difficult** to achieve than tet.

Hex mesh can be **quicker** to make.

Can also make hybrid meshes with both hex and tet.



Contact Types

Next week - topic

See you next week! :)