Chapter 4: Solids and Hexas

Creating a Hexahedral Mesh using the Solid Map Function
Solid Map: What is it?

- **Location:**
  - **3D** (page) > **solid map** (panel)
  - OR -
  - **Mesh** > **Create** > **Solid Map Mesh**

- **What it does:**
  - Creates hexa-penta mesh in 1 or more volumes
    - Each volume is defined by selecting a solid geometry entity
    - Easy to define shape for the mesh since only one entity is selected
  - Each volume must be a “**mappable shape**”
Solid Map Volume: Mappable Shapes

- **Solid Map** requires solid geometry of mappable shapes
- Mappable shapes are defined as:
  - 2 opposing faces (called “source” and “destination” faces)
  - 1 or more faces that directly connect the source and destination
    - These enclose the volume between the source and destination
    - Called “along faces”
  - “Drag direction”: the vector from the source face to the destination face
    - A volume might be mappable in more than 1 direction
Solid Map One Volume: Process

- Basic process of using solid map: one volume is:

  1. Create solid geometry
  2. Split the solid geometry into mappable regions
  3. Use solid map to create hex mesh on each solid entity
Solid Map Volume: Tips and Requirements

- Source and destination faces
  - Source face can be made of multiple surfaces
    - Edges can be suppressed to make a single surface (if possible)
    - Destination face must be a single surface

- Solid map will mesh the rectangular region
  - Only 1 side has multiple surfaces (connection to the meshed cylindrical region)

- Solid map will fail
  - Both sides have multiple surfaces (connection to the cylindrical regions)
Solid Map Volume: Tips and Requirements

- Edges and fixed points on along faces
  - Hexa mesh will follow shared edges parallel to the drag direction
  - Shared edges perpendicular to the drag direction cause solid map : volume to fail
    - Suppress these edges
  - Hexa meshes will ‘ignore’ fixed points along drag direction

Edges perpendicular to drag direction  Suppress the edges  Solid map can now mesh the part
Solid Map Volume: Tips and Requirements

- Splitting solid geometry
  - Try to divide the part into the fewest regions possible
  - Less divisions = less work = less time
  - Less divisions = larger regions
    - More control over mesh size
    - Not forced to use smaller mesh size due to small regions
Solid Map Volume: Tips and Requirements

- Fillet control
  - If needed, split the fillet surface along its length
  - Suppress the original fillet edges

Split the fillet lengthwise

Suppress the original edges

Create the solid mesh
Solid Map Volume: Tips and Requirements

- Controlling mesh pattern with shell mesh
  - *Solid map : volume* will use mesh pattern of shell mesh on the source face
  - Use *automesh* panel (recommended but not required)
    - Automatically associated with the surface
    - Ensures connectivity with adjacent elements
  - Can use other shell meshing panels (*drag*, *spin*, *spline*, etc.)
    - Need to associate the elements to the surface before solid meshing
      - Use *node edit : associate* panel to do this

![Diagram]

- Default
- Create shell mesh
- *Solid map* uses the shell mesh pattern
Solid Map Volume: Tips and Requirements

- Meshing adjacent volumes
  - Mesh volumes that are immediately adjacent to volumes that have already been meshed
    - Ensures proper mesh connectivity if possible
    - 2 start points will probably not result in matching mesh patterns
  - Start with smaller volumes
    - Mesh pattern of small volumes will be used on an larger, adjacent volume
      - Must be connected to the source face of the larger, adjacent volume

Start with the smaller region
Mesh pattern from the smaller region is carried through the larger
Solid Map Meshing – Multi Solids

“Solid Map” Panel ➔ 3D – solid map - multisols

- What it does:
  - Creates hexa-penta mesh in multiple volumes simultaneously
  - Each volume is defined by selecting a solid geometry entity
    - Each volume must be a “mappable shape”
    - Control over node density, mesh method and other mesh controls such as mesh flow are all now possible BEFORE creating the solid mesh.
Solid Map Volume: Tips and Requirements

- Meshing adjacent volumes, continued
  - Drag perpendicular to adjacent volumes
    - Along faces are always rows/columns of quads
    - Allows adjacent volumes connected by their along faces to be easily connected & equivalenced
      - Avoids discontinuities
    - Manually specify the source & destination faces in *solid map : volumes*