TD Mesher Tutorial

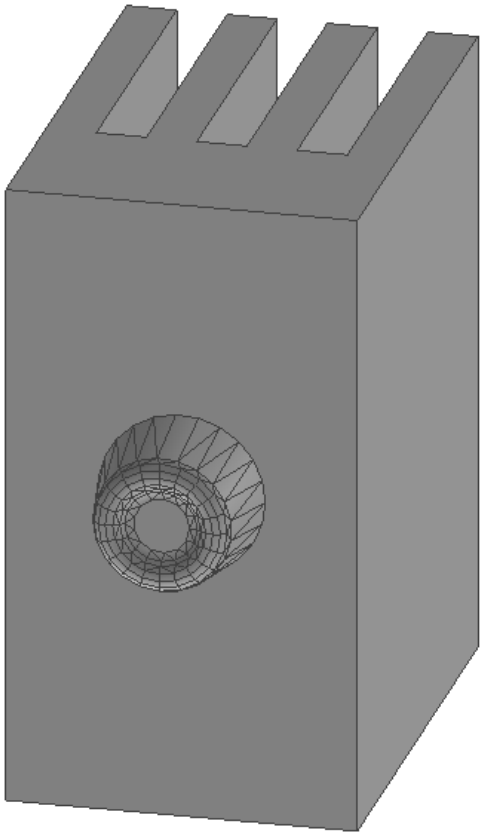
This tutorial will give the user an opportunity to create simple meshes using TD Mesher. TD Mesher is a simple part mesher that fills the gap between building geometry with primitives and using a full-featured mesher, such as TD Direct.

Objectives

- Create a free mesh
- Extract surfaces from solid geometry for extruded and revolved meshes
- Create an extruded mesh
- Create a revolved mesh

Model Description

The geometry is a simple diode and heat sink. The geometry is duplicated and on two layers (initially, one layer is frozen). The first layer will be used to create a free mesh: tetrahedral solid elements and triangular surface elements. The second layer will be used to extract surfaces from the solid geometry to be used for extruded and revolved meshes.



Open Tutorial File

1. Browse to and open ../Tutorials/Thermal Desktop/TD Mesher Tutorial/TDMesher – Start.dwg

Create Free Mesh on Heat Sink

A free mesh is composed of tetrahedral solid elements and triangular surface elements. A free mesh can be created on a solid body or a non-manifold surface. When meshing a solid body, the users can choose to create a solid mesh, a surface mesh or both. A solid-only mesh will only participate in conduction through the solid body and cannot have surface heat loads, radiation exchange, or face contact. A surface-only mesh will only conduct along the faces of the solid, allow radiation exchange, and allow surface heat loads and contact.

If you accidentally exit the TD FEM Mesh Controller Dialog after creating the preview, simply select the mesh preview and then Thermal > Edit.

Generate the mesh preview

1. Select **TD Mesher > Mesh Part**
2. Select the heat sink
3. On the **TD FEM Mesh Controller** dialog, select **Generate Preview**
4. On the **Mesh Generation Parameters** dialog, set **Fraction of Max Dimension** to 0.2
5. Leave other settings at default values and select **Generate Preview**
6. Move the **TD FEM Mesh Controller** dialog to view the mesh preview

Create a label for the mesh

7. Select **Set Label**, type **HeatSink1**, and select **OK**

Edit the node properties

8. Select **Edit Node Properties**
9. Type **HEATSINK1** into **Submodel** field of the **TD FEM Mesh Node Properties** dialog
10. Select **OK** and respond to any dialog boxes

Edit the surface mesh properties

11. Select **Edit Surface Properties**
12. On the **Cond/Cap** tab, select **Generate Cond/Cap**
13. Type 0 into the **Expression** and select **OK**
14. Select **OK** to close the **Thin Shell Data** form

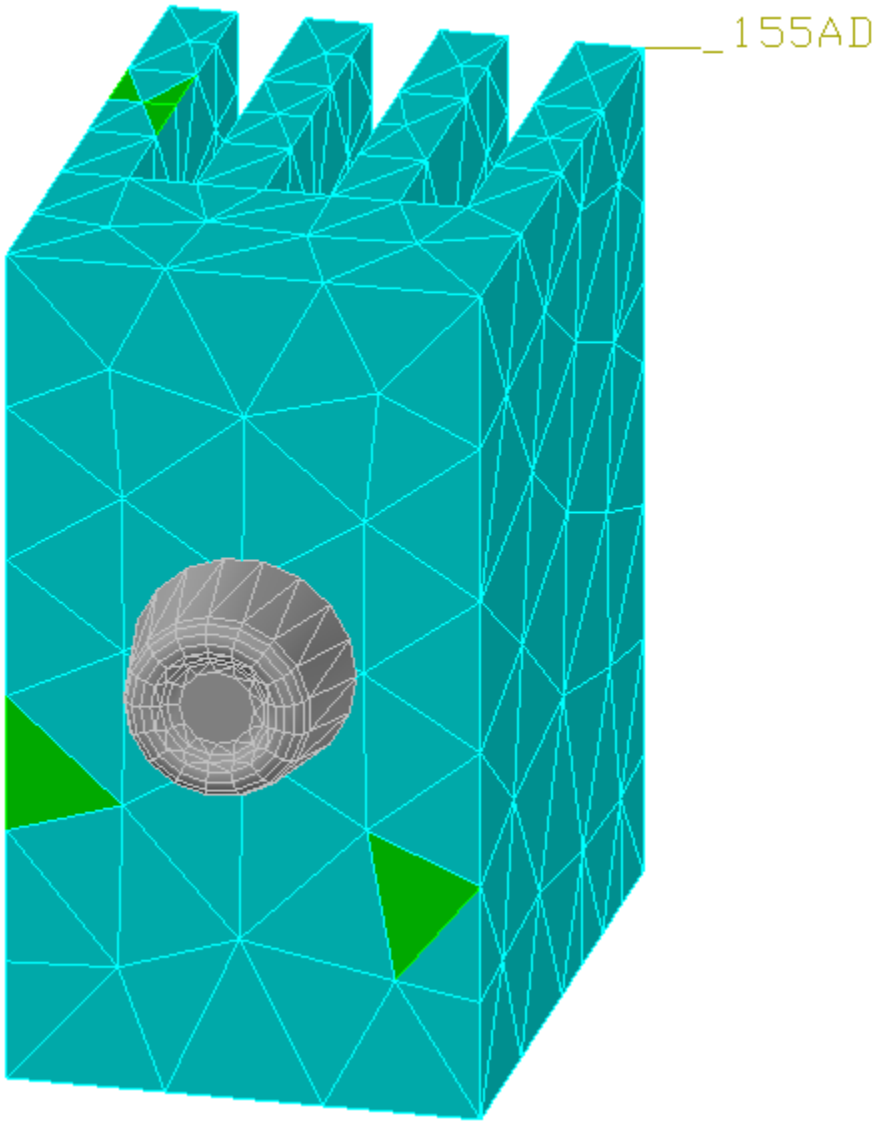
Since the surface mesh will only be used for radiation and/or contact, then the conductance of the surface mesh should not be generated. The solid elements will generate conductance and capacitance for the part.

Edit the solid mesh properties

15. Select **Edit Solid Properties**
16. Choose **Aluminum** from the **Material** drop-down list and select **OK**
17. Select **Generate TD FEM Mesh from Preview**.

18. Select **OK** to exit the **TD FEM Mesh Controller** dialog

The mesh will look something like the following image. The mesh may have multiple colors. That is a result of the layers used for the different types of elements.



Mesh Layers and Visibility

TD Mesher creates up to four layers:

- TDFEM_2D* - contains any surface elements and the associated nodes
- TDFEM_3D* - contains any solid elements and the associated node that are not shared with surface elements
- TDFEM_MC* - contains the mesh preview or controller

- TDFEM_PRT* - contains the part that was meshed; if the mesh controller is deleted, the part returns to its original layer

Turn off visibility of the solid mesh that was just created

1. Select **Format > Layer**
2. Click the Sun beside the **TDFEM_3D*** layer in the **Freeze** column to change to a snow flake
3. Close the **Layer Properties Manager**

Create Free Mesh on the Diode

Repeat the steps above, selecting the diode as the object to be meshed. Make the following changes:

- Mesh Generation Parameters
  - Fraction of Max Dimension: 0.1
  - Max Turning Angle: 30
- Mesher Label
  - Label: Diode1
- TD FEM Mesh Node Properties
  - Submodel: DIODE1
- Solid Element Atributes
  - Material: Diode

As time permits, open the Model Browser, list by Meshers, edit the Diode1 mesher and try different values for Fraction of Max Dimension and Max Turning Angle

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Extract Face from Solid Geometry for Extruded Mesh

The TD Mesher can extrude meshes from a source face. To mesh the source face, it must be separated from a solid body.

1. Use the **Layer Properties Manager** or the Layer drop-down to thaw the **Extruded mesh** layer
2. Type **EXPLODE** and select the heat sink body

The Explode command breaks an object into more basic objects. In this case a body is broken down into faces.

Extract Profile from Solid Geometry for Revolved Mesh

To revolve the diode, half of the profile must be extracted. This is done by creating a solid box that overlaps a quarter of the diode. The intersection of the box and the diode provide a solid that, when exploded provides the required profile.

Move the UCS to the base of the heat sink

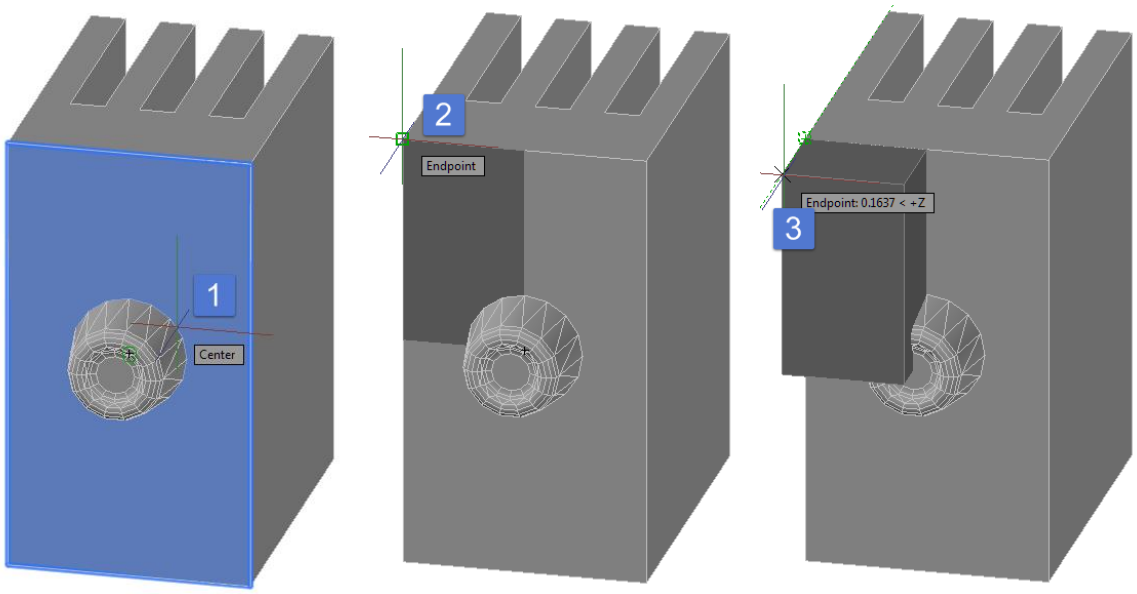
The XY plane of the UCS is the drawing plane in AutoCAD.

1. Select **Tools > New UCS > Face**
2. Select the base of the unmeshed heat sink and choose **Accept**

The view cube will turn to show Top in the same direction as the base of the heat sink.

Draw the solid box

3. Select **Draw > Modeling > Box** (command BOX)
4. Hold **SHIFT** and Right Click and select **Center** from the options
5. Click near the base of the diode when the word **Center** appears
6. Click the top-left corner of the heat sink base
7. Move the mouse so the box hides the top of the diode and click



Take the intersection of the box and the diode

8. Select **Modify > Solid Editing > Intersect**
9. Select the new box and the diode and hit **ENTER**

The diode is quartered.

Explode the diode

10. Select the partial diode
11. Type **EXPLODE**

Create an Extruded Mesh

An extruded mesh meshes the selected face and then extrudes that mesh in the desired direction.

Generate mesh preview

1. Select **TD Mesher > Extrude part**
2. Select the end of the heat sink (with the channels)
3. On the **TD FEM Extrude/Revolve Controller** dialog, select **Generate Preview**
4. Enter **0.2** for **Fraction of Dimension**
5. Enter **0.75** for **Extrusion Distance**
6. Enter **10** for **Equal Size Layers**
7. Leave all four **Meshed Faces/Interior** boxes checked

8. Select **Generate Preview**

Note that the extrusion is in the wrong direction.

Reverse direction of extrusion

9. Select **Generate Preview**
10. Enter **-0.75** for **Extrusion Distance**
11. Select **Generate Preview**

Create a label for the mesh

12. Select **Set Label**, type **HeatSink2**, and select **OK**

Edit the node properties

13. Select **Edit Node Properties**
14. Type **HEATSINK2** into **Submodel** field of the **TD FEM Mesh Node Properties** dialog
15. Select **OK** and respond to any dialog boxes

Edit the surface mesh properties

The extruded mesh has surfaces at the base (the selected surface), end, and side surfaces. Each set can be edited separately. As before, the surface conductance will not be generated.

16. Select **Edit Base Surfaces**
17. On the **Cond/Cap** tab, select **Generate Cond/Cap**
18. Type 0 into the **Expression** and select **OK**
19. Select **OK** to close the **Thin Shell Data** form
20. Repeat steps 16 – 19 for the End and Side surfaces

Edit the solid mesh properties

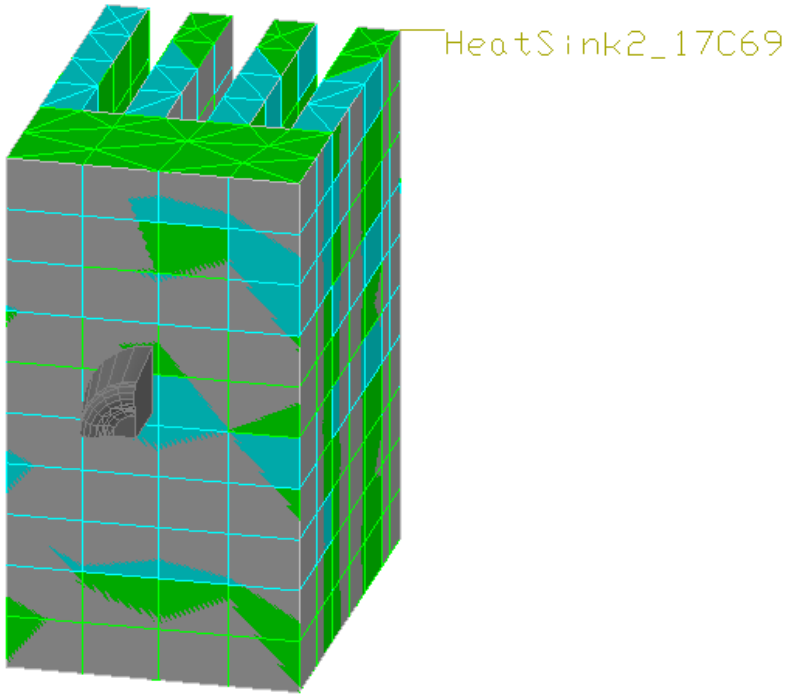
21. Select **Edit Solids**
22. Choose **Aluminum** from the **Material** drop-down list and select **OK**
23. Select **Generate TD FEM Mesh from Preview**.
24. Select **OK** to exit the **TD FEM Extrude/Revolve Controller** dialog

The mesh will look something like the following image. The mesh can make selection difficult for the revolved mesh.

Turn off all mesh items

25. Select **TD Mesher > Mesher All Off**

Only the unmeshed geometry remains visible.



Create a Revolved Mesh

A revolved mesh, like an extruded mesh, starts from a surface and revolves around a selected axis. The axis must be created before creating the mesh

Return to the WCS

1. Type **UCS**
2. Type **World**

The view cube returns to its original position.

Create the axis of revolution

3. Select **Draw > Line**
4. Click at the center base of the diode and then at the center top of the diode.

Create the revolved mesh preview

5. Select **TD Mesher > Revolve Part**
6. Select a cross-section face of the diode for the **Surface for Meshing**
7. Select the line created above for **axis of revolution**
8. On the **TD FEM Extrude/Revolve Controller** dialog, select **Generate Preview**
9. Enter **0.1** for **Fraction of Dimension**
10. Enter **30** for **Max Turning Angle**
11. Enter **360** for **Angular Sweep**
12. Enter **16** for **Equal Size Layers**
13. Uncheck **Generate Surface Mesh Preview at Base** and **Generate Surface Mesh Preview at End of Extrusion**
14. Select **Generate Preview**

Create a label for the mesh

15. Select **Set Label**, type **Diode2**, and select **OK**

Edit the node properties

16. Select **Edit Node Properties**
17. Type **Diode2** into **Submodel** field of the **TD FEM Mesh Node Properties** dialog
18. Select **OK** and respond to any dialog boxes

Edit the surface mesh properties

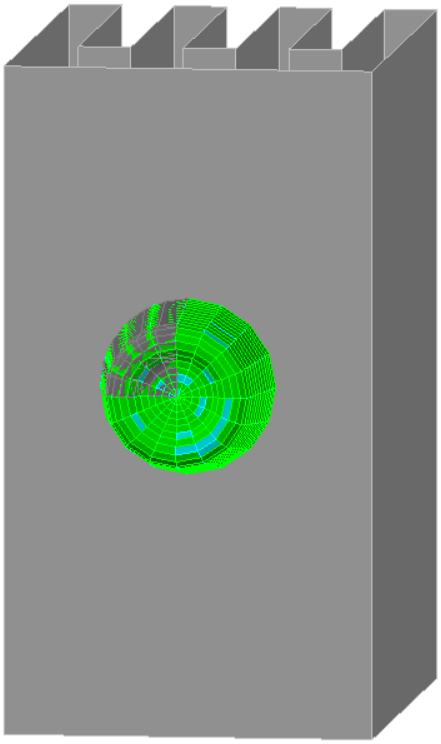
The extruded mesh has surfaces at the base (the selected surface), end, and side surfaces. Each set can be edited separately. As before, the surface conductance will not be generated.

19. Select **Edit Side Surfaces**
20. On the **Cond/Cap** tab, select **Generate Cond/Cap**
21. Type **0** into the **Expression** and select **OK**
22. Select **OK** to close the **Thin Shell Data** form

Edit the solid mesh properties

23. Select **Edit Solids**
24. Choose **Diode** from the **Material** drop-down list and select **OK**
25. Select **Generate TD FEM Mesh from Preview**.
26. Select **OK** to exit the **TD FEM Extrude/Revolve Controller** dialog

The mesh will look similar to the image below.



Turn the meshes on and all geometry off

1. Select TD Mesher > Mesher All Off
2. Select the remaining faces of the diode
3. Using the Layer drop-down list, select the Extruded Mesh layer
4. Freeze the Extruded Mesh layer and the Solid Mesh layer
5. Select TD Mesher > Mesher Preview Only
6. Select TD Mesher > Mesher Surface On