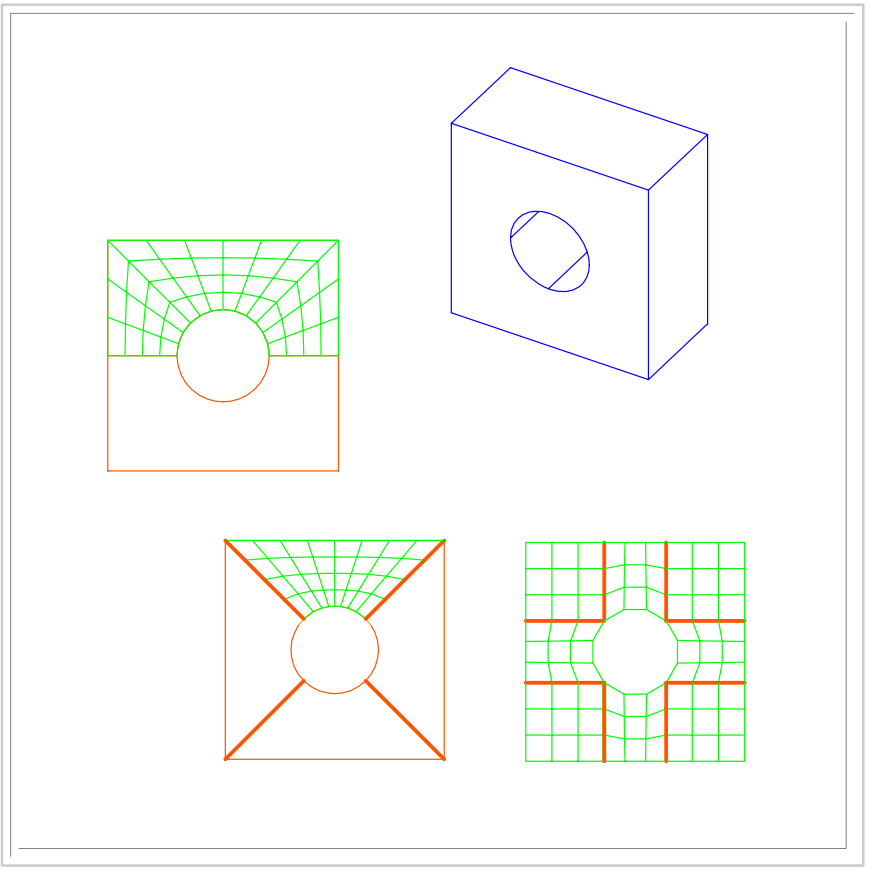


Mapped Meshing on Surfaces

I-DEAS™ Tutorials: Fundamental Skills

This tutorial covers mapped meshing techniques on surfaces.

Learn how to:

- split surfaces
- mesh surfaces
- use biasing
- use unequal number of elements

Before you begin...

Prerequisite tutorials:

- Getting Started (I-DEAS™ Multimedia Training)

  –or–

  Quick Tips to Using I-DEAS
  –and–
  Creating Parts
- Introduction to Simulation
- Managing Parts in Model Files
- Free Meshing

This tutorial on mapped meshing builds on the concepts introduced in the Free Meshing tutorial: defining mesh parameters and generating free meshes on surfaces.

If you didn't start I-DEAS with a new (empty) model file, open a new one now and give it a unique name.

File
Open

Open Model File form

Model File name: any unique name
OK

Make sure you're in the following application and task:

Simulation
Master Modeler

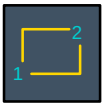
Set your units to mm.

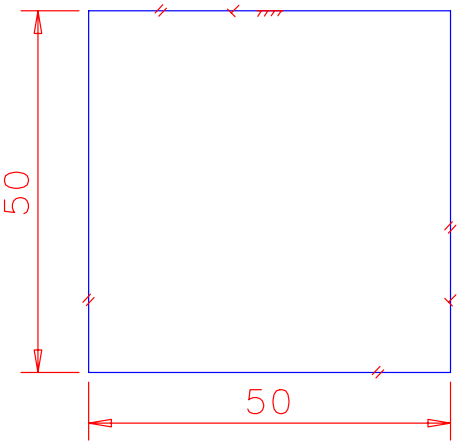
Options
Units

mm (*milli newton*)

What: Sketch this square to the dimensions shown.

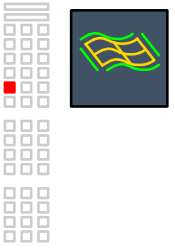
Hint





What: Create a surface bounded by the square.

How:



Options...

Surface by Boundaries Options form

Stitch/Join Edges

Autochain Wireframe

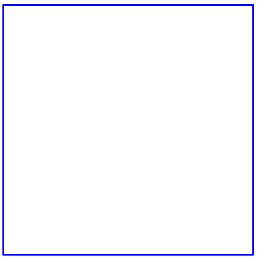
OK

---

pick square

Done

Yes

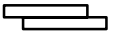


What: Name this part.

Hint

 *Name*: Mapped Surface

Save your model file.

 *File*
Save

Warning!
If you are prompted by I-DEAS to save your model file, respond:

 *No*

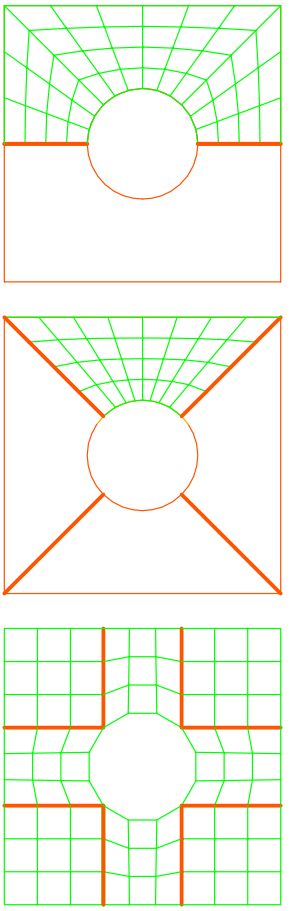
Save only when the tutorial instructions tell you to—not when I-DEAS prompts for a save.

Why:
If you make a mistake at any time between saves and can't recover, you can reopen your model file to the last save and start over from that point.

Hint
To reopen your model file to the previous save, press Control-Z.

Unlike free meshing, mapped meshing doesn't allow holes in the interior of a mesh. Because of this, surfaces have to be split or trimmed to create 3- or 4-sided areas without interior holes.

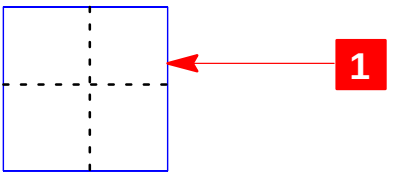
Here are 3 different ways a square plate with a hole can be split, along with the resulting mesh patterns.



What: Sketch in place on the surface and draw a circle.

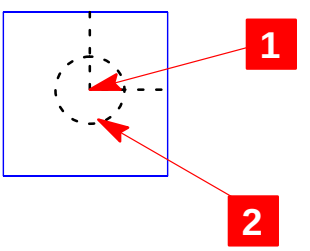
How:

1 pick plane to sketch on



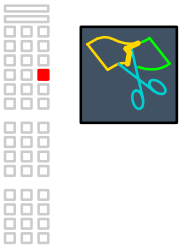
1 locate center

2 locate point on edge

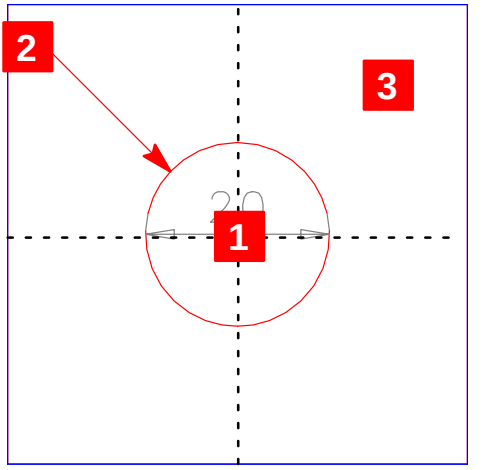


What: Trim a hole in the surface. Keep the area outside the hole.

How:



1. pick surface
2. pick trimming curve
3. *Done*
4. indicate region of surface to keep
5. *Done*



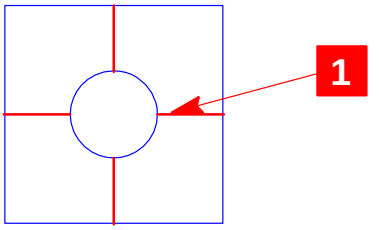
Things to notice

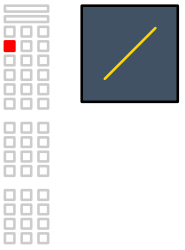
If you display the part in shaded mode, you'll see that there is now a hole in the center.

What: Sketch in place on the surface and sketch a line from the center of one side to the other.

How:

1

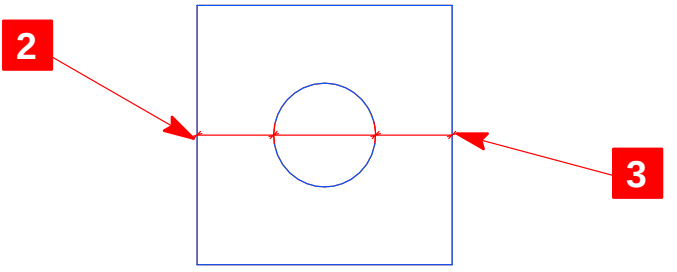




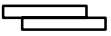
2 locate start

3 locate end

Done



Recovery Point



File
Save

The circle and the line were sketched with *Sketch in place* on the surface – a good practice. You can associatively dimension and constrain trimming geometry to existing edges. This makes it easier to modify, and to use techniques like optimization, which uses part dimensions as variables to change the mesh.

What: Divide the surface with the line. In one step, you can extrude the line into a plane and split surfaces intersected by the plane.

How:

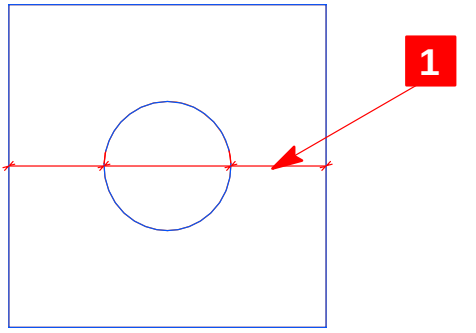
 *Section Options...*

 *Stop at intersections* (off)

 *OK*

 *Split Surface*

1



 *Done*

Extrude Section form

OK

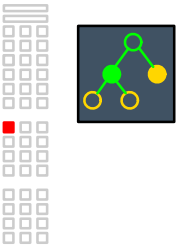
All

Done

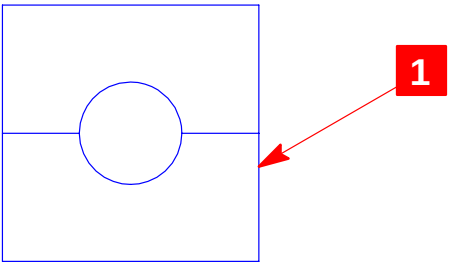
Recovery Point

File
Save

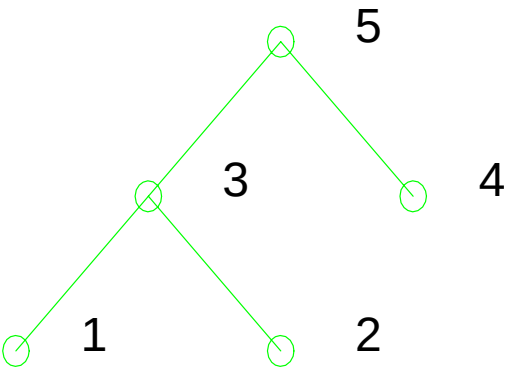
What: Display the part history tree to review the steps.



1



History Access form



1. Surface by boundary
2. Trim information
3. Trim operation
4. Extrude
5. Split operation

Dismiss

Things to notice

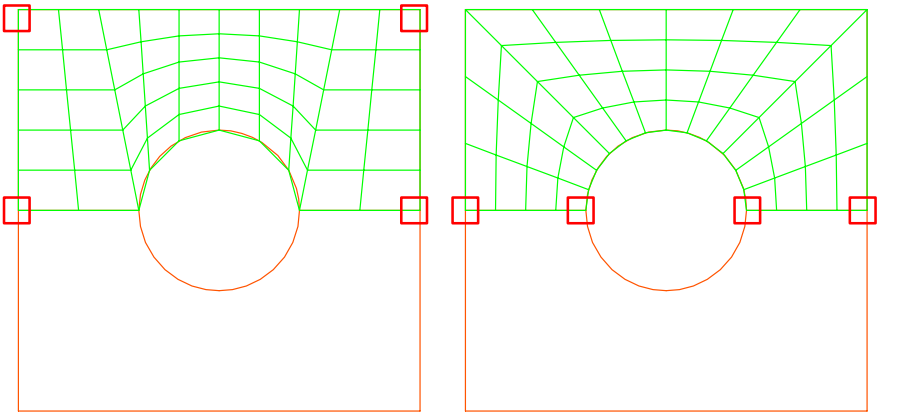
Since each step is a separate node of the history tree, each one can be modified or deleted.

With mapped meshing, element size and local element densities are not defined, as they are in free meshing.

The mapped mesh is controlled by:

- defining corners of the mesh (3 or 4)
- defining the number of elements per side
- optionally defining edge biasing – making the elements smaller at the ends or the center of an edge

The first decision is how to define the mesh corners.



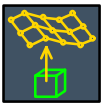
Picking the physical corners may seem logical, but picking the corners as shown on the right above minimizes the distortion. This is especially true around the hole, where stresses may be important.

This tutorial follows the example mesh on the right.

What: Create an FE model to reference this part.

How:

Meshing



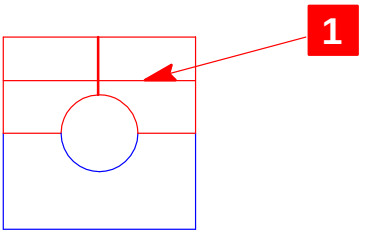
FE Model Create form

OK

What: Define thin-shell mapped mesh parameters on the top region. Then, define the corners.

1

Done



Define Mesh form

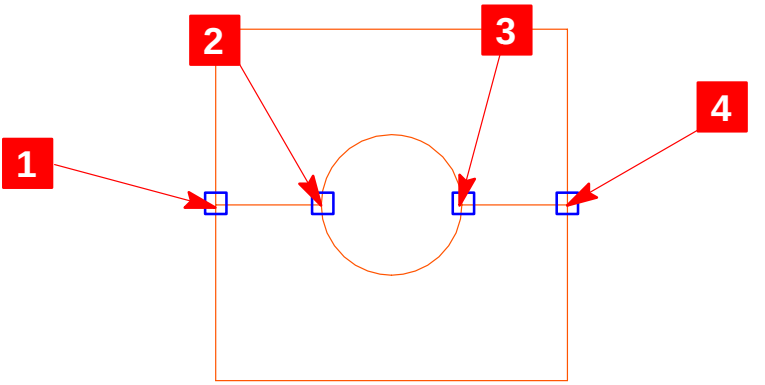
Mapped

Mapped Options...

Mapped Meshing Options form

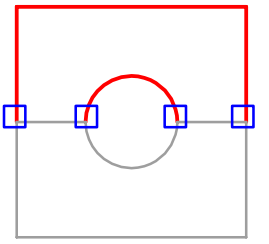
Define Corners

(shift–pick 1–4)



Mapped Meshing Options form

Define Elements/Side

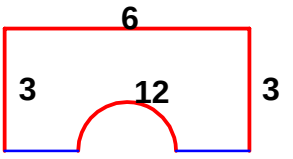


What: Define the number of elements per side.

How:

Check *I-DEAS Prompt*.

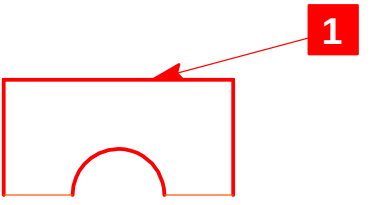
number of elements for highlighted sides: 12



The software determines the distribution of elements per side based on the length of the edges. If you used different dimensions to create your part, your default distribution may differ.

Change distribution

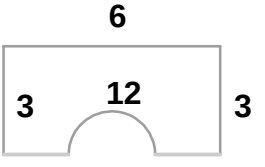
1

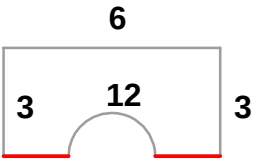


number of elements on the edge: 3

number of elements of edge: 6

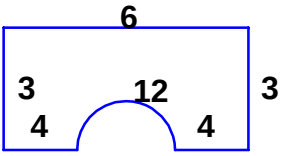
Done






number of elements for highlighted sides: 4


Done

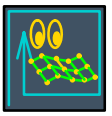



Dismiss

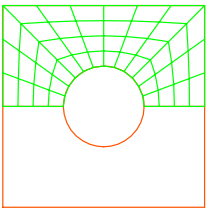
What: Generate the mesh.

How:

Define Mesh form

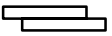


Modify Mesh Preview form




Keep Mesh

Recovery Point

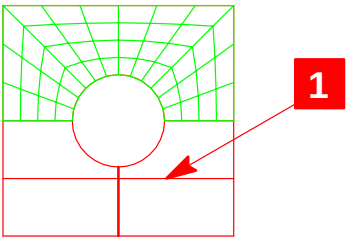

File
Save

What: Define and generate a mesh on the other surface.

How:

1 pick surface

Done



Define Mesh form

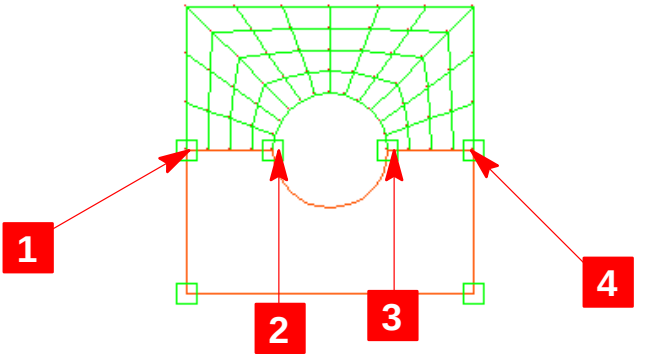
Mapped

Mapped Options

Mapped Meshing Options form

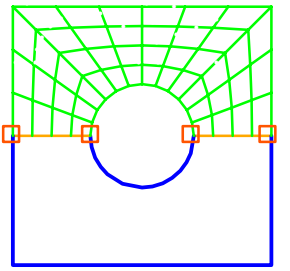
Define Corners

(shift–pick 1–4)



Mapped Meshing Options form

Define Elements/Side

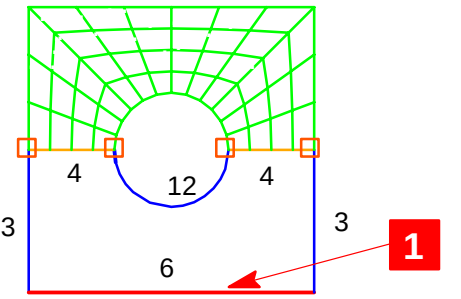


Check *I-DEAS Prompt*.

number of elements for highlighted sides: 12

Change distribution

1



number of elements on the edge: 3

number of elements of edge: 6

Done

Things to notice

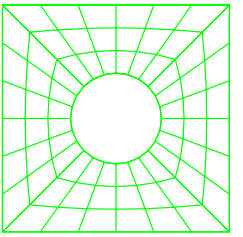
There are no prompts for the elements per side on edges that are shared with the first mesh.

Mapped Meshing Options form

Dismiss

Define Mesh form

Modify Mesh Preview form



Keep Mesh

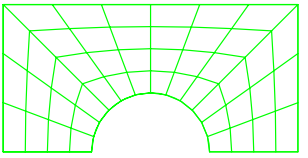
Recovery Point

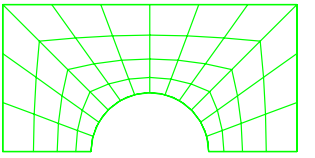
File
Save

Use biasing 1 of 4

With a radial mesh pattern like this (shown on the left), element lines get closer together in the center toward the hole, causing the elements to become stretched.

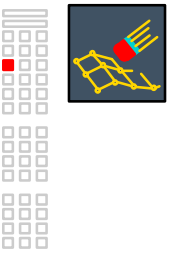
One solution to this is to bias the mesh (shown on the right).





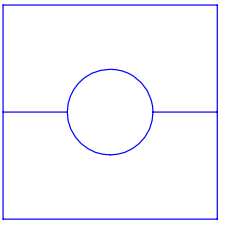
What: Delete the mesh on all surfaces. (Don't delete the mesh definition.)

How:

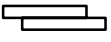


All

Done



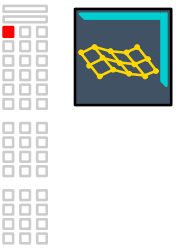
Recovery Point

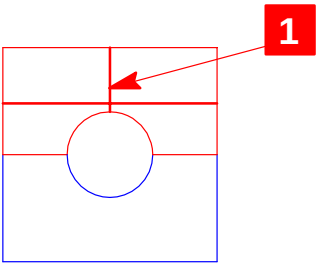


File
Save

What: Define edge biasing near the hole so the elements are smaller by a factor of 2.

How:





1 pick surface

Done

Define Mesh form

Mapped Options

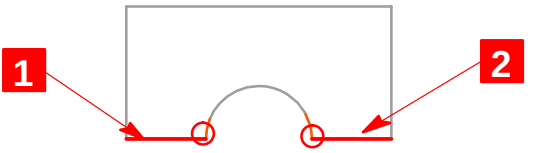
Mapped Meshing Options form

Define Biasing: End

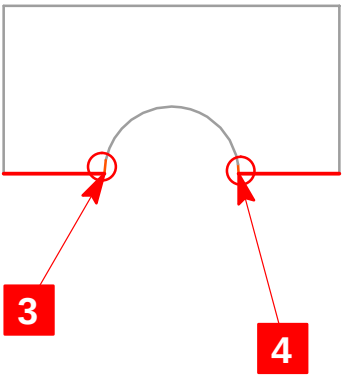
---

1 pick

2 shift-pick



Done



3

bias: 2

Yes

4

2

Yes

Mapped Meshing Options form

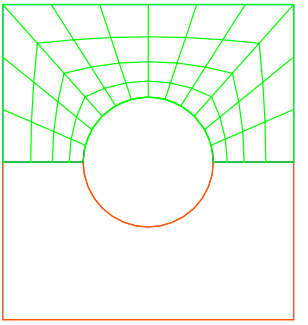
Dismiss

Define Mesh form

OK

What: Generate the mesh.

Hint



Recovery Point

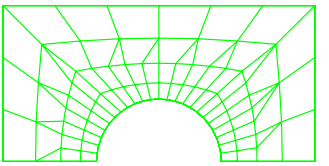
File
Save

Things to notice

Now element lengths are shorter in the radial direction near the hole, which keeps element aspect ratios more constant.

Use unequal number of elements 1 of 3

Another method is to set an unequal number of elements on opposite sides.



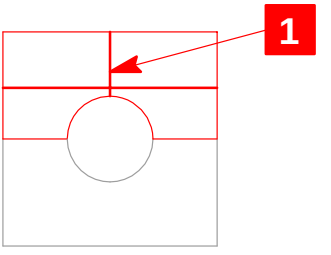
First, delete the mesh on all surfaces. (Don't delete the mesh definition.)

 *All*

 *Done*

What: Define the elements per side, using an unequal numbers of elements.

1 pick surface



 *Done*

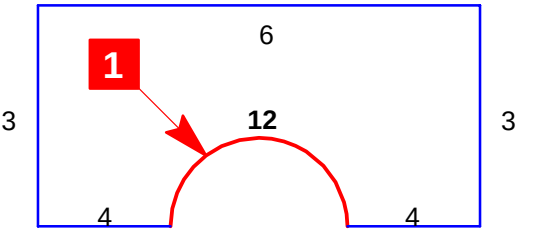
Define Mesh form

Mapped Options...

Mapped Meshing Options form

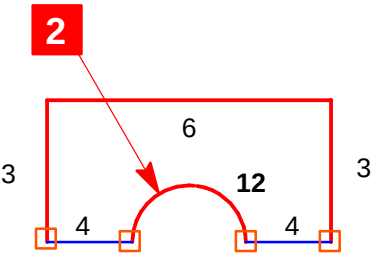
Define Elements/Side

1



Set unequal elements

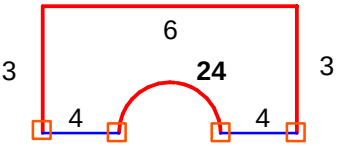
2



Done

number of elements for highlighted sides: 24

Done

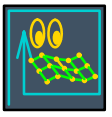


Done

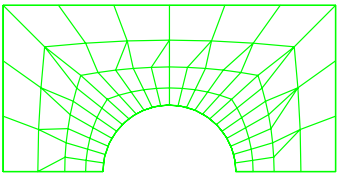
Mapped Meshing Options form

Dismiss

Define Mesh form



Modify Mesh Preview form



Keep Mesh

Things to notice

Triangular elements are added to the mesh to transition between the unequal number of elements on opposite sides.

For more information on meshing surfaces, see the tips on the next page.

There are both surface and solid methods to create a part that can be used for meshing surfaces. However, it may be easier to extrude to create a solid part rather than to create a single surface.

When working with individual surfaces for meshing, create the outer boundary first, then trim or split the surface into regions.

Remember to use *Sketch in Place*.

When using *Trim*, remember to pick all the regions to keep.

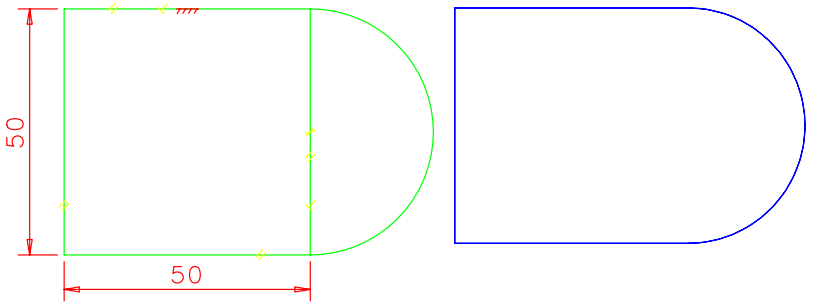
Use the *Split* option of *Extrude* to divide surfaces. The *Split* icon is not as useful for finite element modeling, because it requires you to create a splitting part first.

On your own...

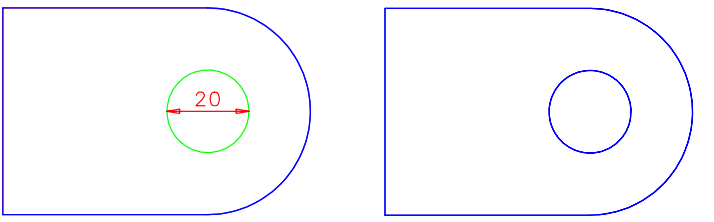
Here is a typical 2D meshing example to try as a review of the techniques in this tutorial.

Hint

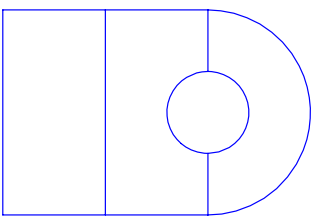
Surface by Boundary.



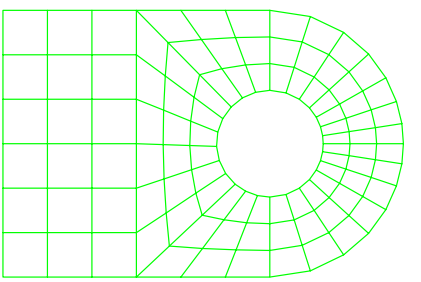
Sketch in Place, *Trim*



Sketch in Place, *Extrude–> Split Surface*



Define Shell Mesh, *Shell Mesh*



You've completed the Mapped Meshing on Surfaces tutorial.

Delete the FE model, then delete the part. This part is not used in any other tutorial.

Hint

See also...

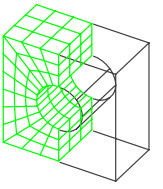
For additional information on the concepts covered in this tutorial, see the following:

Help, Manuals, Table of Contents

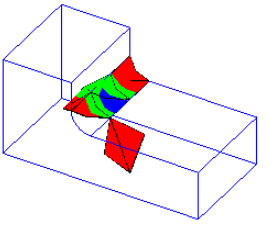
Simulation: Finite Element Modeling User's Guide
- Simulation Techniques and Examples
  - Meshing; Creating Nodes and Elements
- Meshing a Model
  - Icon Overview for Meshing
  - Creating a Mesh

What's next?

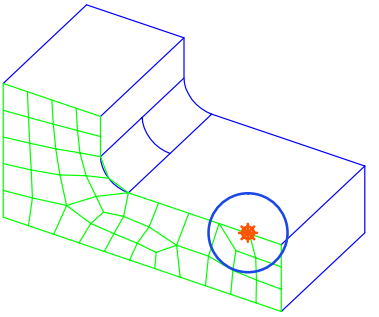
The tutorial "Mapped Meshing of Volumes" expands on the surface techniques just completed.



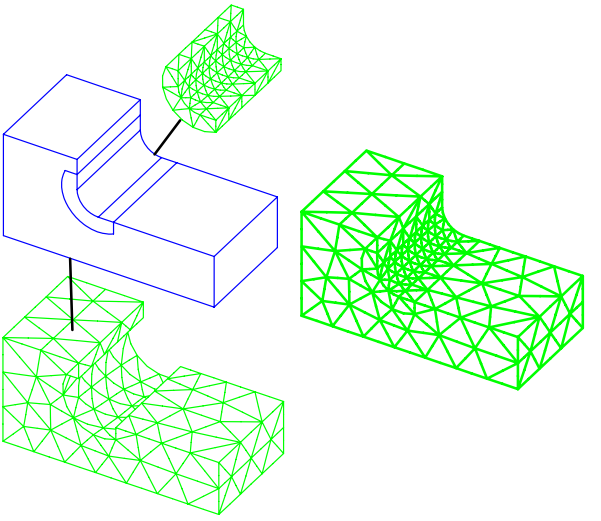
The tutorial on checking element quality shows how to compute element quality checks.



The Boundary Condition Sets tutorial covers information on ways to control node locations.



The Preparing a Part for Analysis tutorial covers partitioning a part into multiple volumes to control meshing.



To exit this tutorial, select:

File
Exit

Warning!
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Structural Dynamics Research Corporation
2000 Eastman Drive
Milford, Ohio 45150
(513) 576−2400