

ClothWorks

v1.7.4

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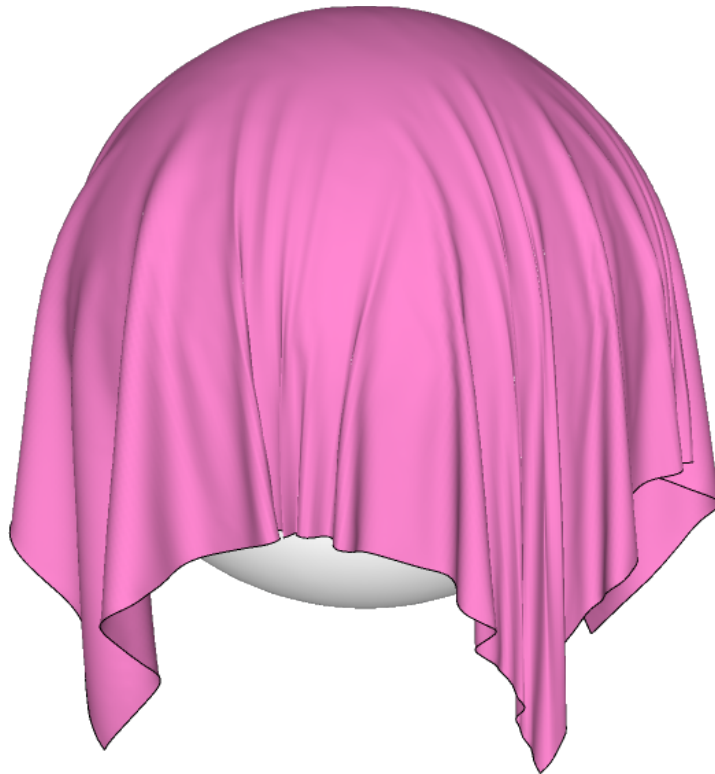
Introduction

ClothWorks is a general purpose cloth and string simulator for SketchUp, for interior and exterior design. With ClothWorks you can simulate flags, curtains, table cloth, pillows, and wires.

This manual guides you through a set of tutorials for using ClothWorks. The tutorials are ordered in a way that the first tutorial is the most detailed and contains clear instructions and guidelines for achieving a task. The consequent tutorials are less detailed and may require an understanding obtained from a previous tutorial. Following this guide in chronological order will allow you to get the most out of this guide.

About this Manual

This manual covers the newer versions of ClothWorks, specifically version 1.7 and later. If you are at a previous version of ClothWorks, it is recommended that you update to the newer release. Newer releases are available at the SketchUcation Plugin Store.



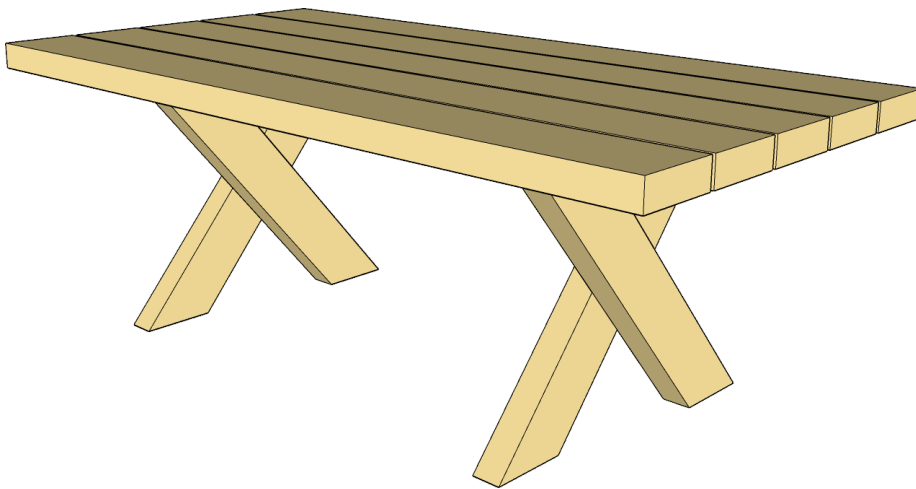
Draping Rectangular Table

This tutorial walks you through the steps for draping cloth over a rectangular surface. If you are a beginner, this is a great place to start.

1. Draw a table with a rectangular surface or find an existing model of a table. The table that you draw must be a group or a component.

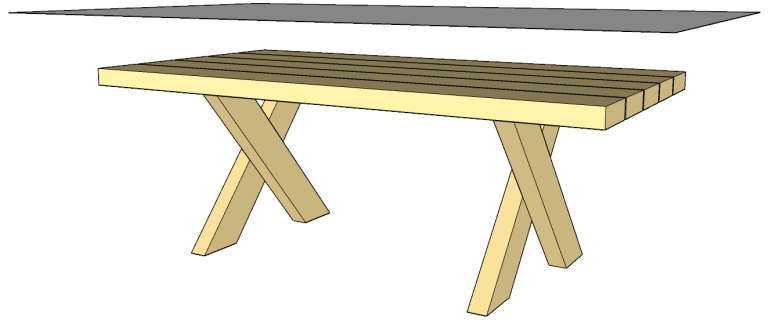
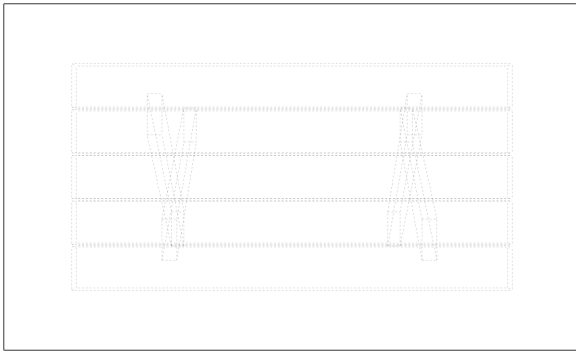
For drawing a table, or any other stationary object, ClothWorks does not have guidelines or prerequisites for the structure of the geometry. A stationary object can consist of as many internal components and groups as needed. A stationary object is compatible with ClothWorks for as long as all of its content is wrapped in a top-level group or a top-level component. Wrapping faces and edges into a group allows you to assign ClothWorks properties. In ClothWorks, a top level group/component is an only object assignable simulation properties. Properties of internal groups and components are inherited from their top-level group.

A rectangular table can look something like in the figure below. Note that all of the table's geometry is contained within a top-level group.



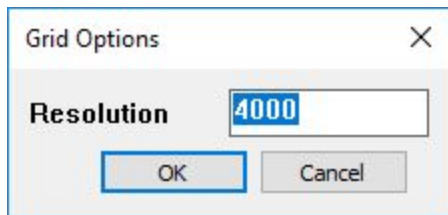
2. Assign a *Collider* state to the table: Right-click on the table's top-level group and select:
(Context Menu) *ClothWorks* → *Make Collider*
3. Having created a stationary object, that is the collider, we now focus on creating a cloth object. Cloth objects are usually represented by a rectangle. To cover this table with a tablecloth, we need a rectangle slightly greater than the surface of the table. Draw a rectangle over the top surface of the table:
 - a. Make use of the *Rectangle* tool to stretch a rectangle from one corner of the tabletop to the other.
 - b. Offset each edge of the rectangle outward an equal, desired length.
4. Group the geometry of the rectangle, so that the rectangle is a top-level group and geometry is accessible one level deep within the group. For a group or a component to be a valid cloth object, it must be a top-level instance. Additionally, cloth objects are not hierarchical; faces and edges one level deep within the cloth object is the only geometry considered for simulation. Geometry within internal groups and components is ignored.

5. Move the rectangle a vertical distance over the table to allow for a drop effect.



6. Assign a *Cloth* state to the rectangular group: right-click on the rectangular group and select:
(Context Menu) *ClothWorks* → *Make Cloth*
7. Now that we have a rectangle, we need to apply a grid to the cloth object. There are three kinds of grids in ClothWorks: Adaptive, Equilateral, Quadrilateral, and Cross-Quadrilateral. Quadrilateral grid usually gives the best results in all types of simulations, except for curtains. When simulating curtains suspended by gravity, the quadrilateral grid stretches unevenly along the corners. For curtains it's better to use a cross-quadrilateral grid, which rotates the quads 45 degrees allowing the cloth stretch evenly along the corners. Adaptive grid is used for applying grids to shapes that are not rectangular. The equilateral grid consists of equilateral triangles, allowing for balanced stretch along any direction. The only problem with equilateral grid is that the results are not as promising compared to using other grid types. We will familiarize with some of the grid types in the next tutorials. For this table, we use a quadrilateral grid. Right-click on the cloth and access:
(Context Menu) *ClothWorks* → *1 Cloth* → *Apply Quadrilateral Grid*

An input box will appear, prompting for grid resolution:



Grid resolution denotes the number of squares to divide the cloth into. For example, if a rectangular cloth is $222\text{ cm} \times 134\text{ cm} = 29748\text{ cm}^2$ and the grid resolution is 4000 squares, the rectangular cloth is divided into 4000 squares that are $29748 / 4000 = 7.437\text{ cm}^2$ each.

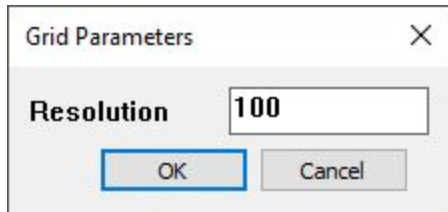
Higher resolution grid provides a better quality simulation result over a lower resolution grid. Consequently, a lower resolution grid affects performance less significantly compared to a higher resolution grid. Setting grid resolution is about finding a quality and performance balance most suitable to you.

A grid resolution between 4000 and 6000 squares provides a reasonable balance between performance and quality. A grid resolution below 4000 squares or above 6000 squares has a minor or a significant effect on performance, respectively. Computer processing power, of course, affects these ranges.

There is also a feature, called *Adaptive Remeshing*, which dynamically increases the grid resolution of cloth where

curvature is high and maintains the original resolution of cloth where the curvature is low. Adaptive Remeshing is an additional factor that must be considered when balancing between quality and performance. If simulating with adaptive remeshing, starting out with a low resolution grid, like 100 squares, provides a good balance between quality and performance. *Adaptive Remeshing* is utilized in the next step of this tutorial.

For this particular tutorial, we go with a grid resolution of 100 units and make use of *Adaptive Remeshing*:

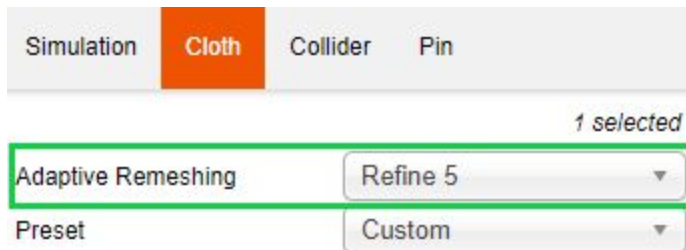


Press *OK*.

8. Set cloth adaptive remeshing quality to 5. This can be done with the following steps:
 - a. Select the cloth rectangle.
 - b. Open ClothWorks UI.



- c. Select the *Cloth* tab and change *Adaptive Remeshing* dropdown to *Refine 5*.



9. With the UI open and the cloth selected, also adjust the following properties:
- Set *Thickness* to 1 mm
 - Set *Stretch* stiffness to 0.5.
 - Turn on *Self-Collide*.

Adaptive Remeshing: Refine 5
Preset: Custom
Density: 200
Thickness: 1
Friction: 0.05
Stretch: 0.5
Bend: 0.001
Damper: 0.25
Cloth Scale: 1
String Scale: 1
Drag: ☒
Self-collide: ☒
Preserve Shape: ☒
Cross Springs: ☐

10. Now select the table, and set its thickness property to 3 mm.

Simulation: Cloth Collider Pin
1 selected
Thickness: 3
Friction: 0.7

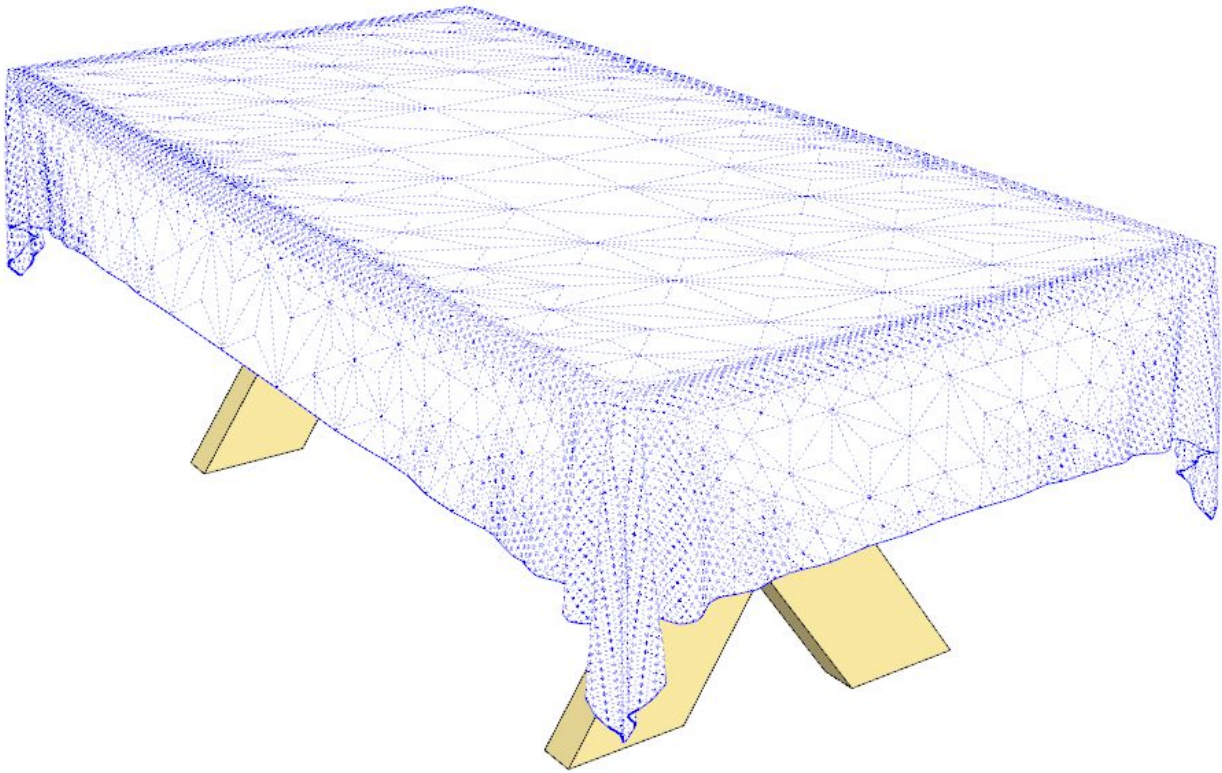
11. With the properties for the cloth and collider adjusted, we are almost ready to simulate. Activate the simulation tab and ensure the *Draw with GL* option is checked. This allows you to visualize the dynamically changing geometry of the cloth, while simulation is running.

Simulation		Cloth	Collider	Pin
Timestep	1/420			
Rate	4			
Animate Scenes	Off			
Gravity	10			
Wind X	0			
Wind Y	0			
Wind Z	0			
Drag	0.25			
Viscosity	0.002			
Update Textures	<input type="checkbox"/>			
Outline Pins	<input type="checkbox"/>			
Record	<input type="checkbox"/>			
Multi-Threaded	<input checked="" type="checkbox"/>			
Draw with GL	<input checked="" type="checkbox"/>			
Help Box	<input type="checkbox"/>			

12. We are ready to simulate. Press the *Toggle Play* button:



You should observe cloth draping over the table:

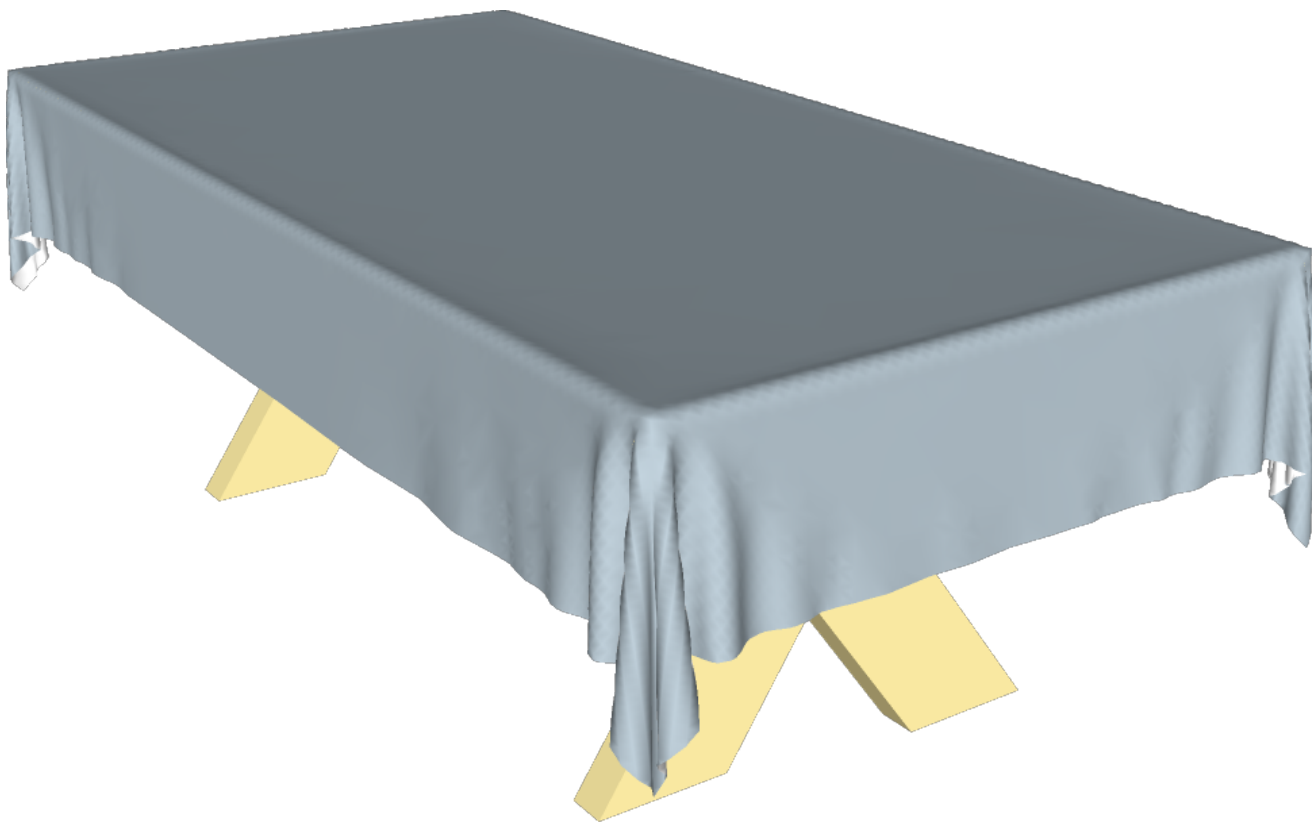


13. Once the cloth settles, press the *Stop* button to end the simulation.



If you stopped the simulation too early, you can press play again to resume simulation; and then, stop the simulation at the desired moment.

A newly generated mesh should replace the temporary mesh. Once stopped, your scene should contain a cloth object fully draped over the table:

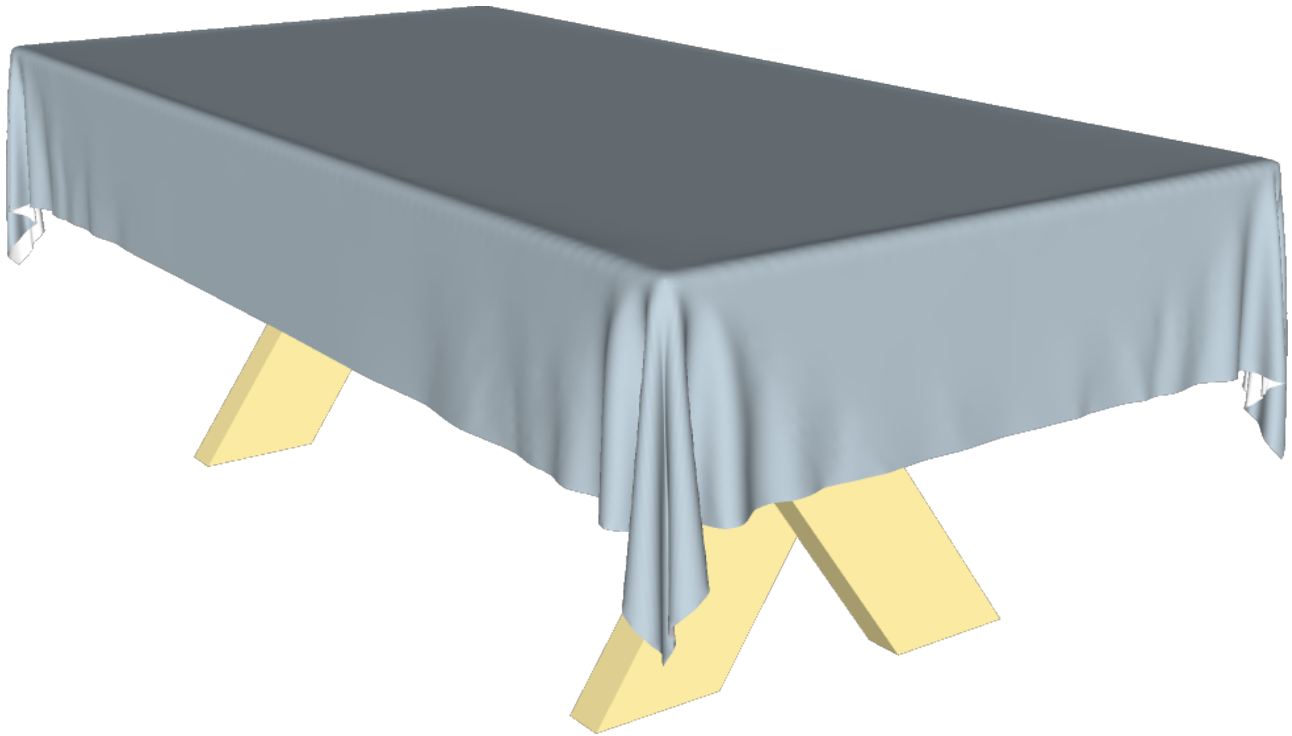


14. If your ClothWorks is licensed, you can utilize the Loop subdivision feature to smoothen the cloth; if not, feel free to skip this step.

To smoothen the tablecloth, right-click on the tablecloth and select:

(Context Menu) ClothWorks → 1 Cloth → Apply Loop Subdivision

It may take some time for the operation to complete. Once completed, the tablecloth should be smoother:



Loop subdivision notes:


- a. It is not recommended to simulate cloth after applying Loop subdivision. If you do intend to simulate cloth, ensure that adaptive remeshing is turned off and stretch stiffness is slightly increased.
- b. To undo Loop subdivision, perform an Undo operation (CTRL-Z) **two** times.
- c. Loop subdivision shrinks the cloth. Shrinking can cause cloth to intersect the edges of the collider. Do the following in case that happens:
 - i. Undo the Loop subdivision
 - ii. Undrape the cloth
 - iii. Increase the thickness property of the collider
 - iv. And simulate again
- d. If you apply Loop subdivision with a texture already applied to the faces of the cloth, you may have to re-apply the texture, following the steps in #15 (undrape, apply material directly to faces, and drape). In the current version, when you apply Loop subdivision or Laplacian smoothing, the UVQ coordinates of the textures are not recalculated.

15. (Optional) Having a resulting cloth model, apply a texture to the cloth, described in the steps below:

- a. Undrape the cloth via ClothWorks toolbar or context menu:
 - i. If doing through ClothWorks toolbar, select the cloth and click *Toggle Drape* icon:



- ii. If doing through context menu, right-click the cloth and access:
(Context Menu) ClothWorks → 1 Cloth → Undrape
- b. Apply a desired material/texture directly to the faces of the cloth:
 - i. Double-left-click the cloth group to enter the context.

- ii. Select a desired material from the *Materials* panel.
- iii. Left-click on the front face and/or back face to color the cloth.
- iv. Exit the context of the group, either by left-clicking the background or using the context menu.
- c. Drape the cloth:
 - i. If doing through ClothWorks toolbar, select the cloth and click *Toggle Drape* icon:
The screenshot shows a software toolbar titled "ClothWorks" with a red close button in the top right corner. The toolbar contains several icons: a document with a cloth, a play button, a square, a left arrow, a right arrow, a cloth with a pin (highlighted with a green box), and a pin icon. The highlighted icon represents the "Toggle Drape" function.
 - ii. If doing through context menu, right-click the cloth and access:
(Context Menu) *ClothWorks* → 1 *Cloth* → *Drape*

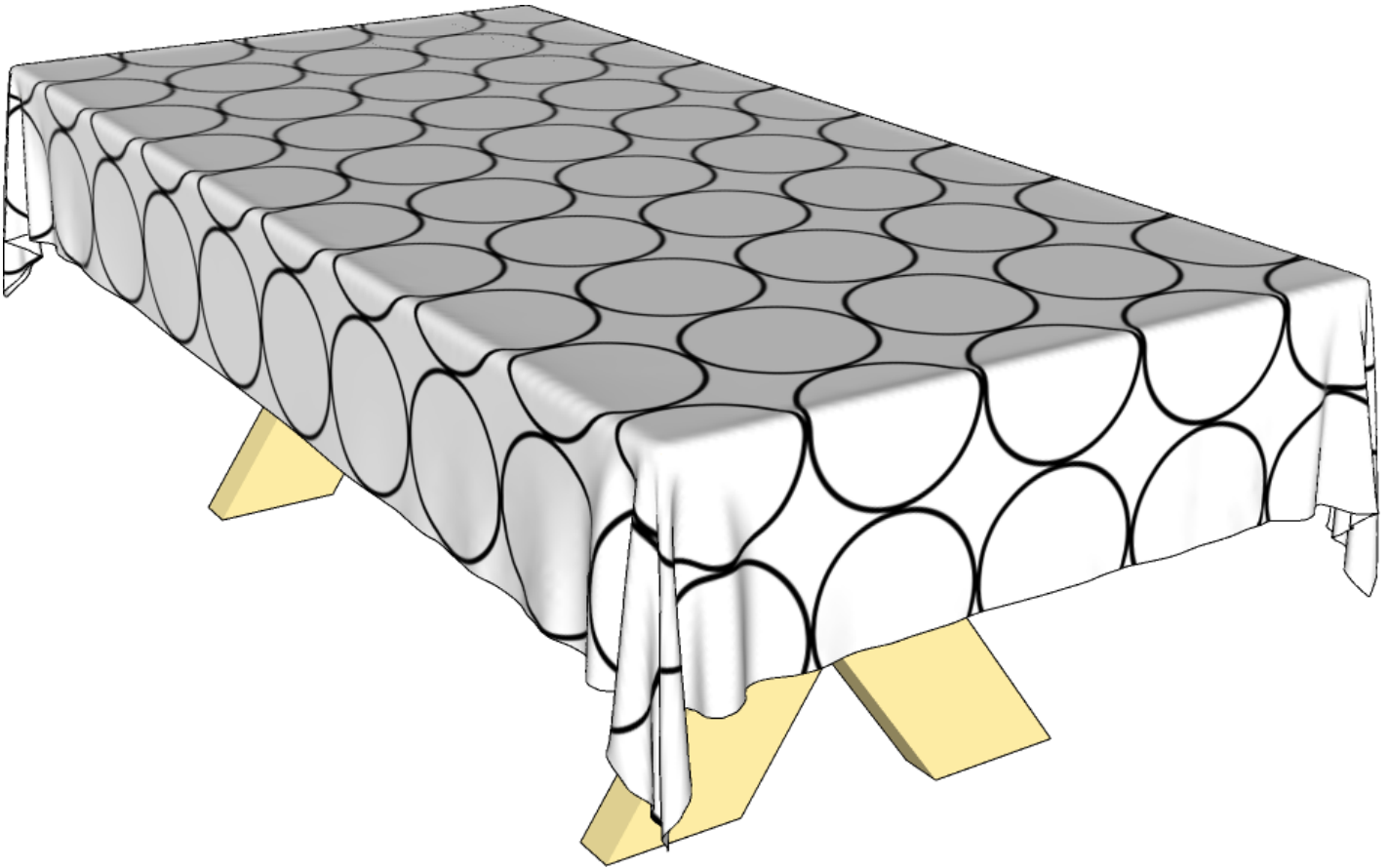
If you are not satisfied with the texture/material applied, repeat the step using a different material.

16. (Optional) Now that you have a resulting cloth model, you can eliminate drape data from your model. This step is optional and is only there if you are interested in reducing the size of your SKP file.

To eliminate drape data, access:

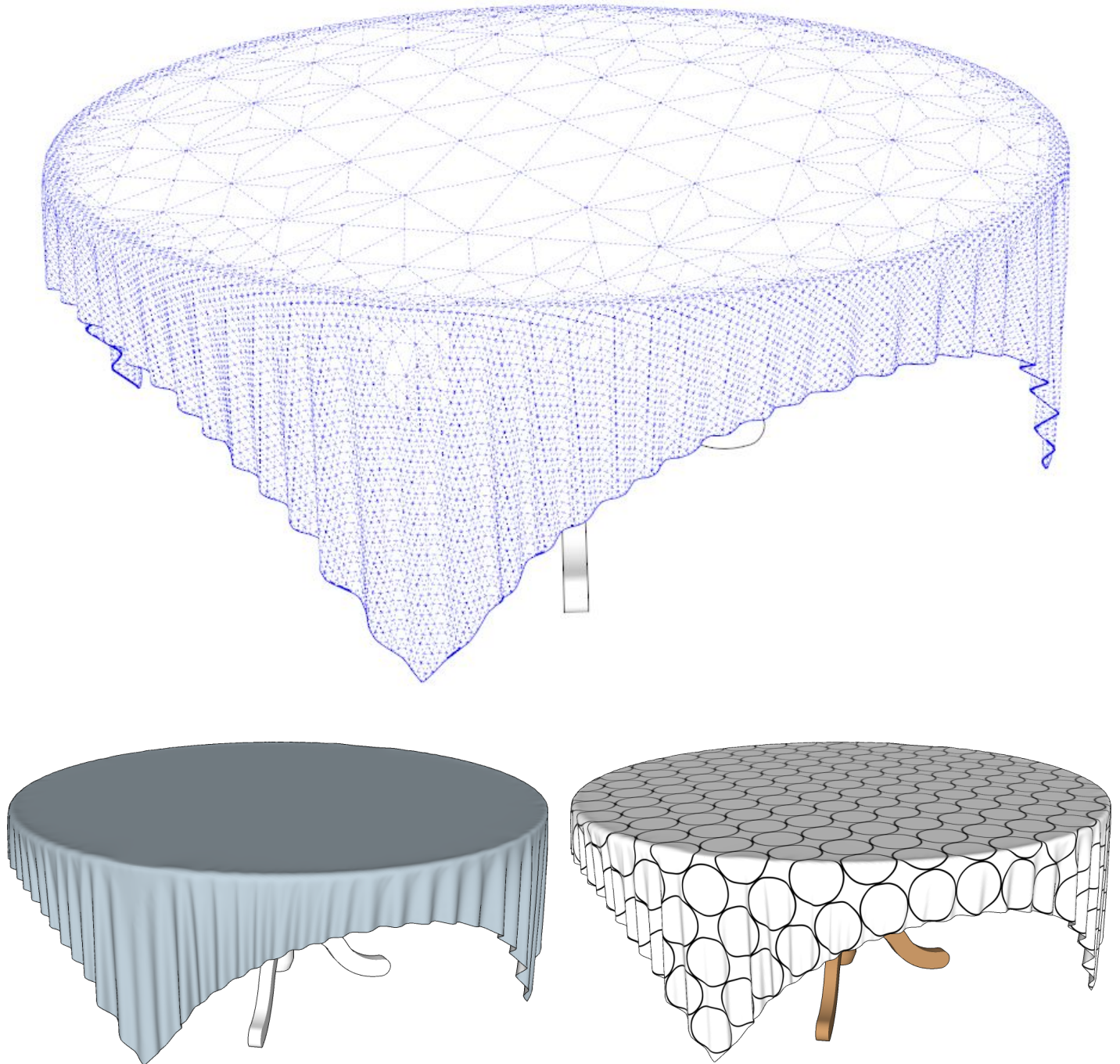
(Menu) → Extensions → ClothWorks → Clear Draped and Purge

This deletes the saved vertex positions from the cloth, which prevents the Toggle Drape command from working but also reduces the file size by a few megabytes.



Draping Circular Table

To drape a circular table, you follow the exact same steps as you drape a rectangular table, described in the previous tutorial.



Curtains

The following tutorial focuses on creating a curtain with strips. This tutorial requires that your ClothWorks is licensed to use the movable pin tool. The movable pin tool is required to complete the tutorial:

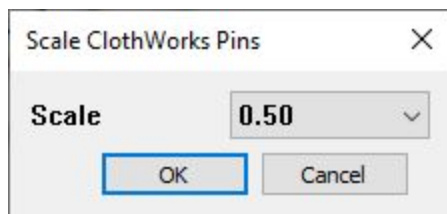
1. Open SketchUp and set model length units to centimeters.
2. Draw a rectangle on XZ-plane or YZ-plane, with dimensions of 136 cm X 180 cm.
3. Group the rectangle (along with the outer edges).
4. Assign a Cloth property to the group; select the group and access:
(Context Menu) ClothWorks → Make Cloth
5. Create 6 pins across the top edge of the cloth, an equal distance from each other. To achieve that, you can create one pin at the upper-left side, copy it to the upper-right side and then type **/6**. To create a pin:

- a. Select the *Add Pin* tool:

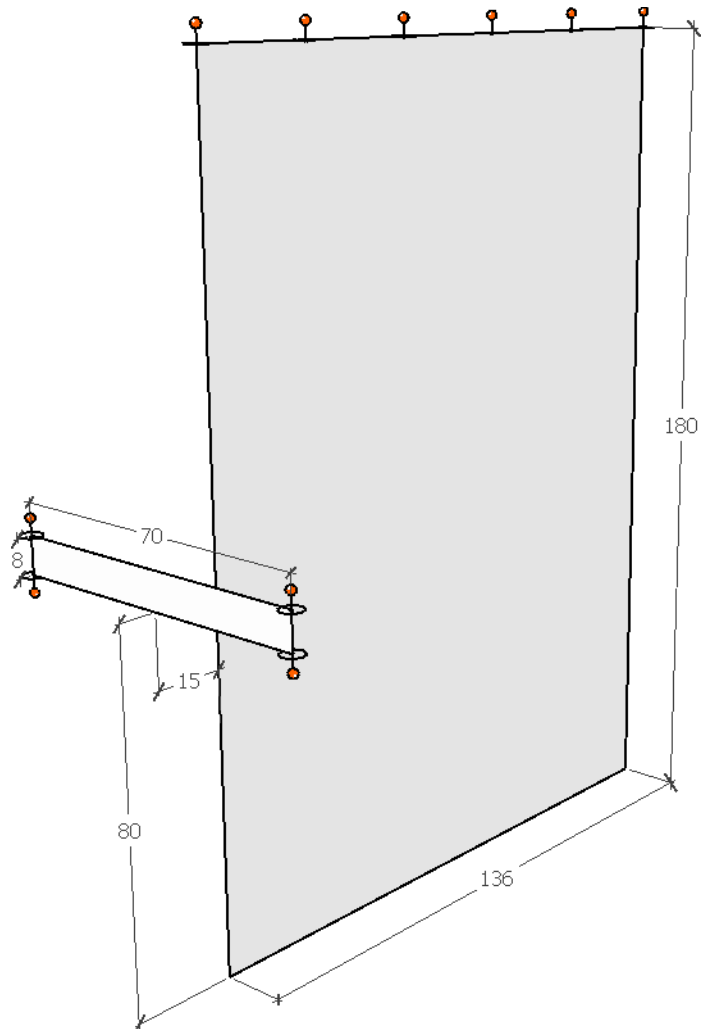


- b. Left-click at a corner of the cloth.
- c. Left-click directly above the first point to indicate the direction.

6. Set pin scales to 0.5, to reduce the amount of vertices locked by the pins.
 - a. Select all pins and access:
(Context Menu) ClothWorks → 2 Pins → Edit Scale
 - b. Set scale to 0.5 and press OK:



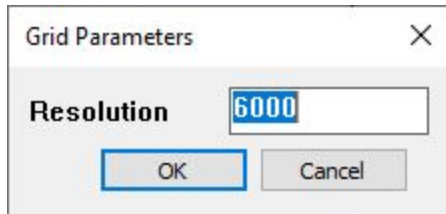
7. Draw a 70 cm x 8 cm rectangular strip at the side of the cloth and position it 80 cm above the lower, horizontal edge of the curtain and 15 cm away from the left, vertical edge of the curtain.
8. Group the strip and assign it a cloth property.
9. Attach 4 pins at the corners of the strip.



Note: For visual purposes, the pin scales is 1.0 in the figure.

10. Apply a quadrilateral grid to the curtain, with resolution of 6000 squares. You can also try the cross-quadrilateral grid if the cloth stretches unevenly along the corners, but with a slightly lower resolution, like 5000 squares:

- a. Right-click the curtain group and access:
(Context Menu) ClothWorks → 1 Cloth → Apply Quadrilateral Grid
- b. When prompted, set resolution to 6000 squares and click OK:

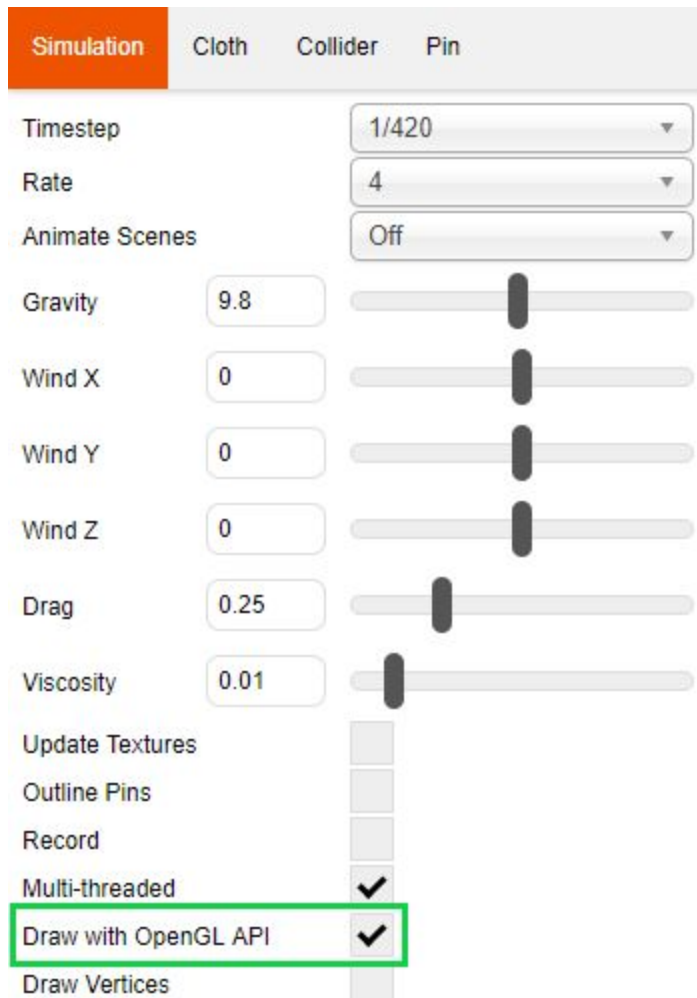


11. Apply a quadrilateral grid to the strip, with resolution of 80 squares.

12. Open ClothWorks UI.

13. Set simulation properties as follows:

- a. Check *Draw with OpenGL API*.
- b. Leave everything else as is.



14. Select the curtain and adjust properties as follows:

- a. Ensure *Adaptive Remeshing* is off.
- b. Set *Thickness* to 3.
- c. Set *Friction* to 0.
- d. Set *Stretch* to 1.
- e. Set *Bend* to 0.001.
- f. Check *Self-collide*.
- g. Ensure *Cross Springs* is not checked.

Simulation

Cloth

Collider

Pin

1 selected

Adaptive Remeshing

Off

Preset

Custom

Density

200

Thickness

3

Friction

0

Stretch

1

Bend

0.001

Damper

0.25

Cloth Scale

1

String Scale

1

Drag

✓

Self-collide

✓

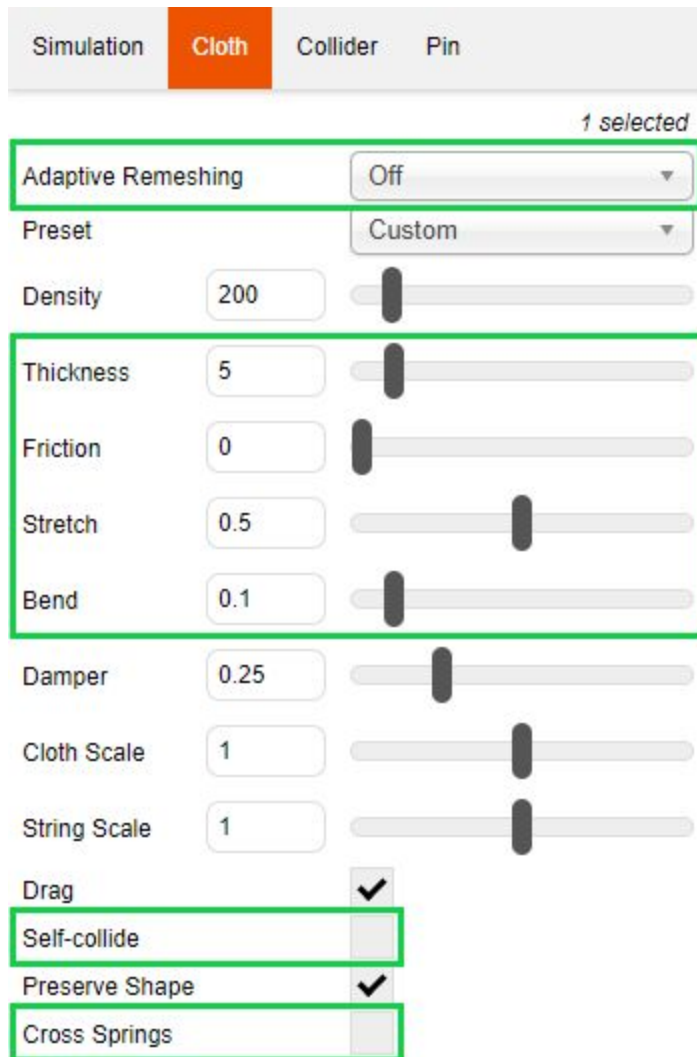
Preserve Shape

✓

Cross Springs

15. Select the strip and adjust properties as follows:

- Ensure *Adaptive Remeshing* is off.
- Set *Thickness* to 5.
- Set *Friction* to 0.
- Set *Stretch* to 0.5.
- Set *Bend* to 0.01.
- Uncheck *Self-collide*.
- Ensure *Cross Springs* is not checked.



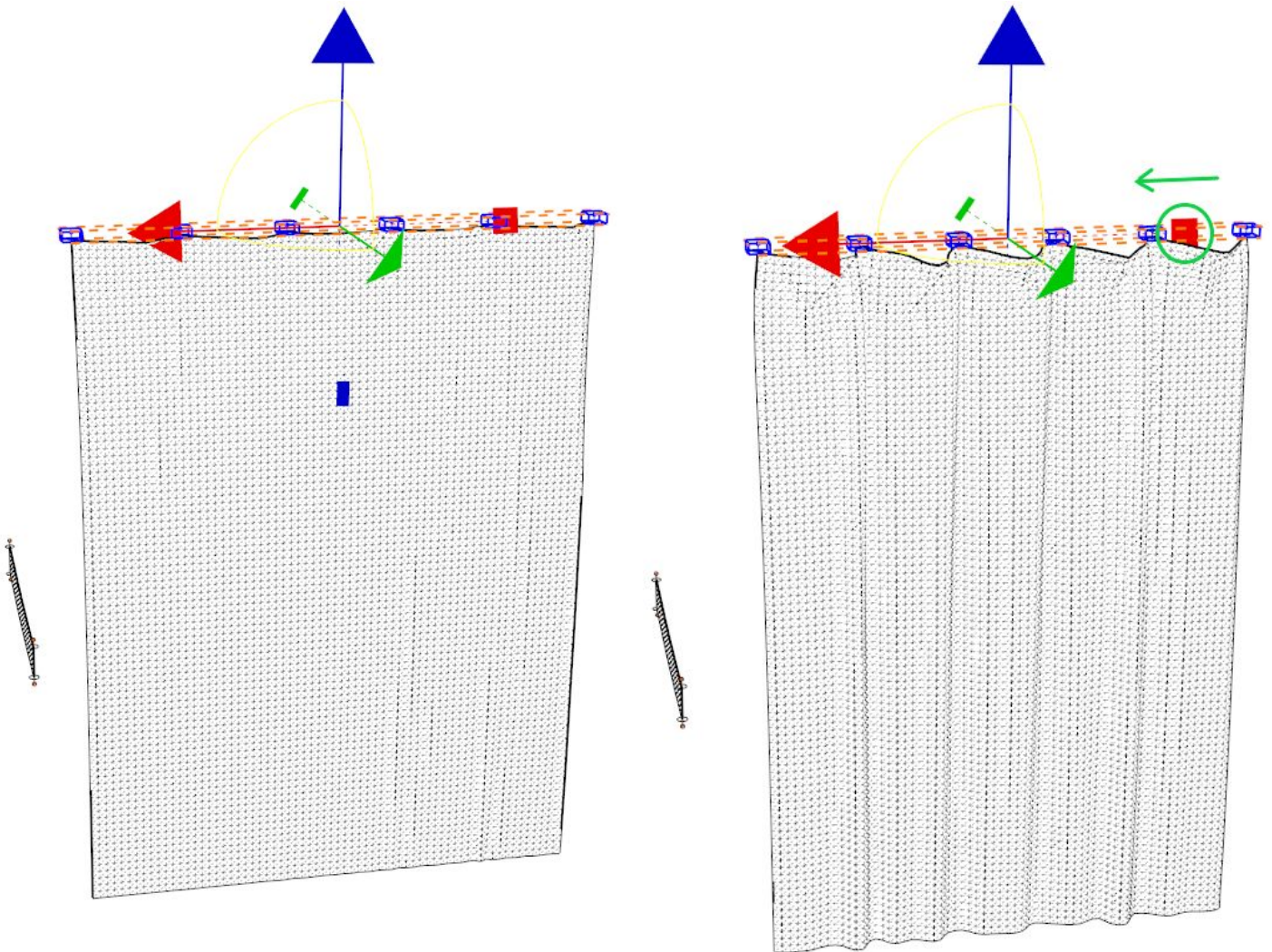
16. Start simulation:



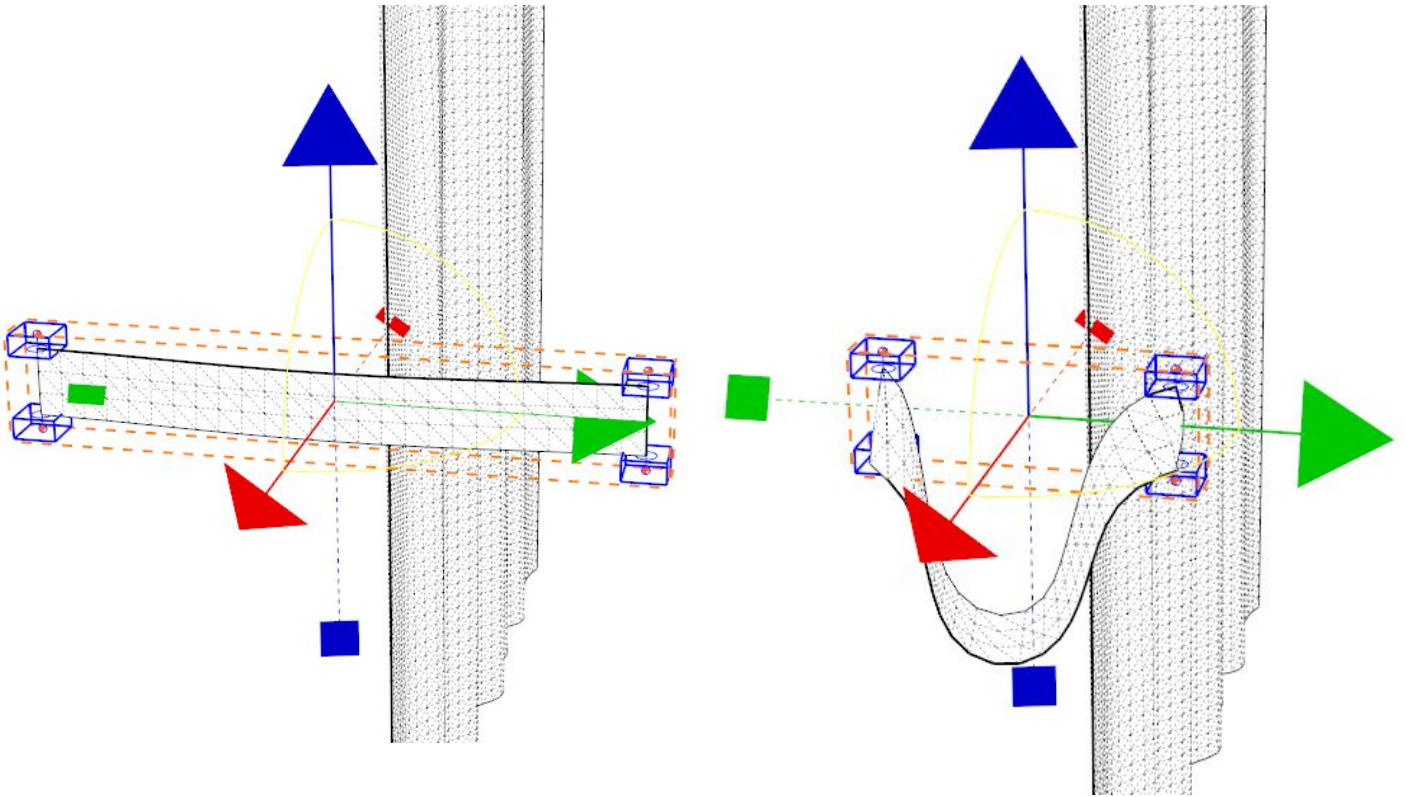
You can pause/resume or stop/start simulation in between the next steps to help you navigate between the working screen and the tutorial.

17. Converge curtain pins toward the center:

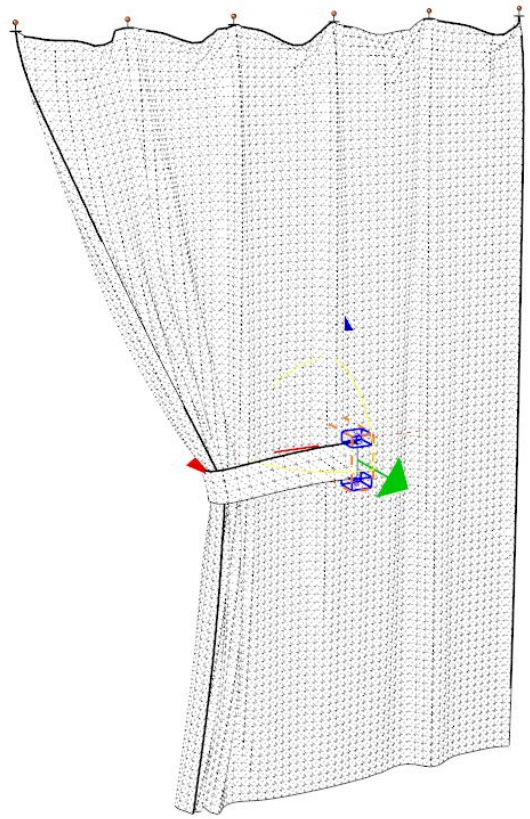
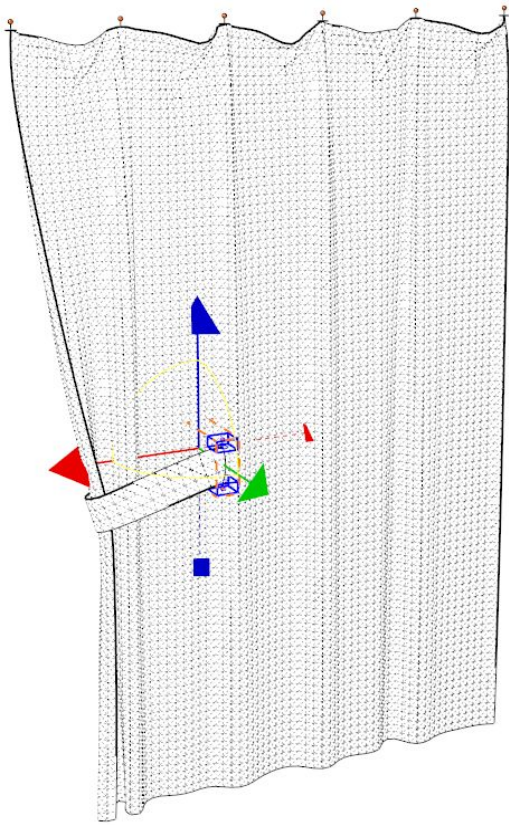
- a. Use the ClothWorks rectangular select tool to select all the pins over the upper edge of the curtain:
 - i. Press and hold down the left mouse button at the upper-left corner of the rectangle.
 - ii. While holding down the left mouse button, move the cursor toward the lower-right corner of the select rectangle, until you accommodate all the curtain pins.
 - iii. Release the left mouse button.
- b. Converge curtain pins, such that the new distance between the outer pins is roughly 80 to 90 percent of the original distance:
 - i. Press and hold down the left mouse over the red or green square of the gizmo.
 - ii. Move the selected square toward the center until the new length between the outer pins is roughly 80 to 90 percent of the original length; release the mouse button.



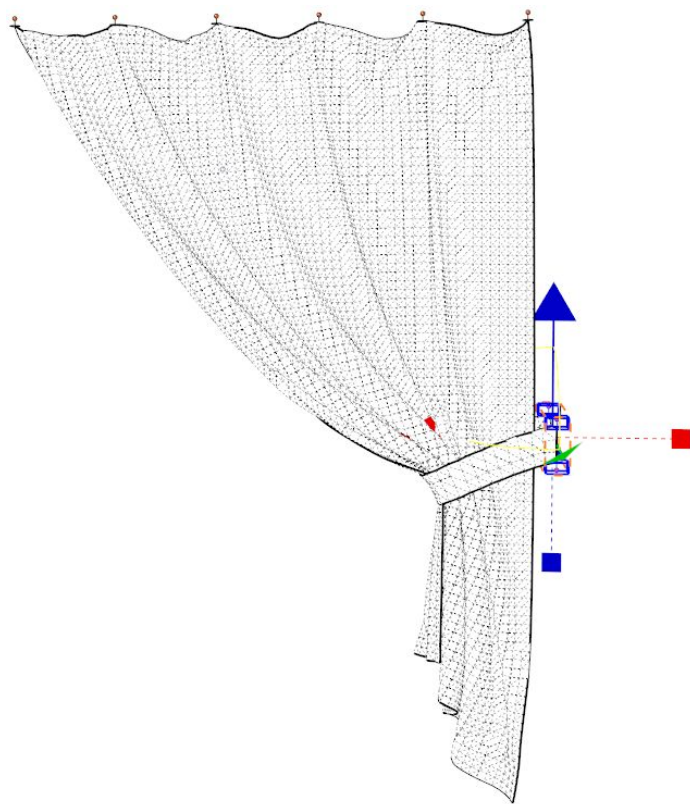
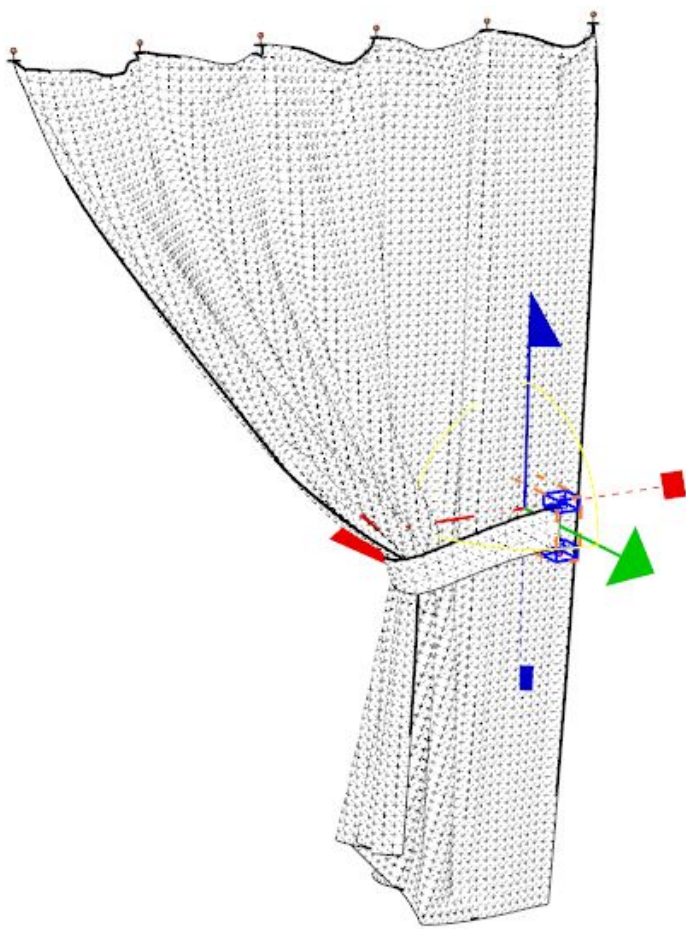
18. Select the four pins of the strip and converge them as well, until the new length is roughly 50 percent of the original length:



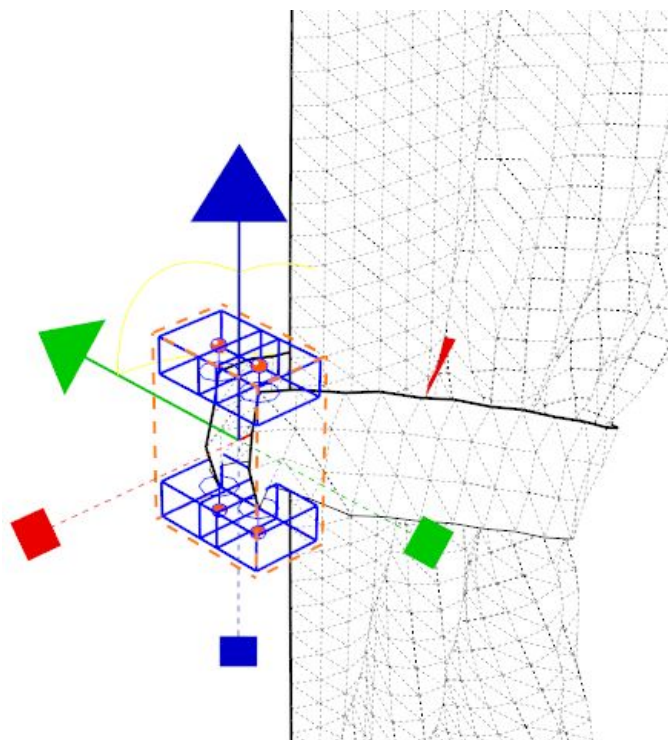
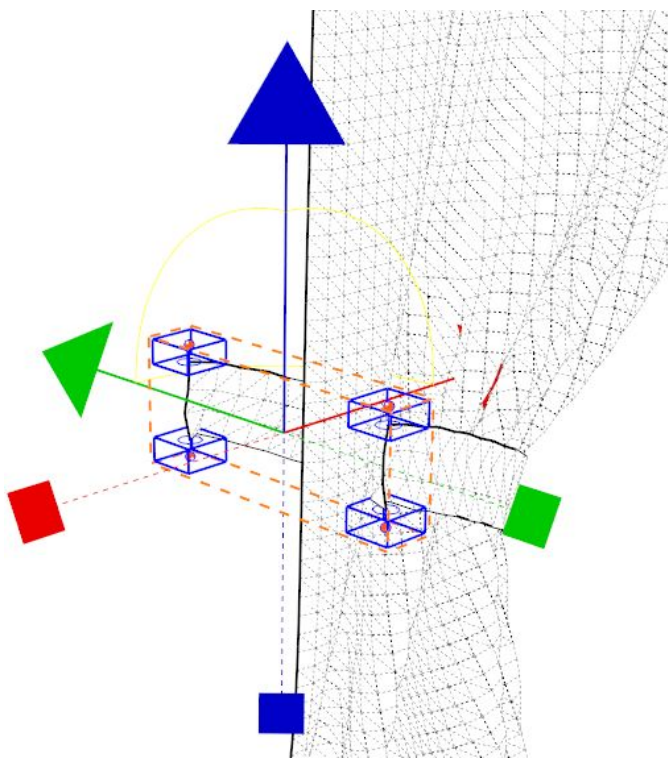
19. Drag the strip, slowly toward the opposite, vertical edge of the curtain; pause/stop simulation along the way to ease the process. To move the gizmo, click and drag the red or green arrow of the pin.



Move the pins until you are slightly beyond the opposite edge of the curtain.



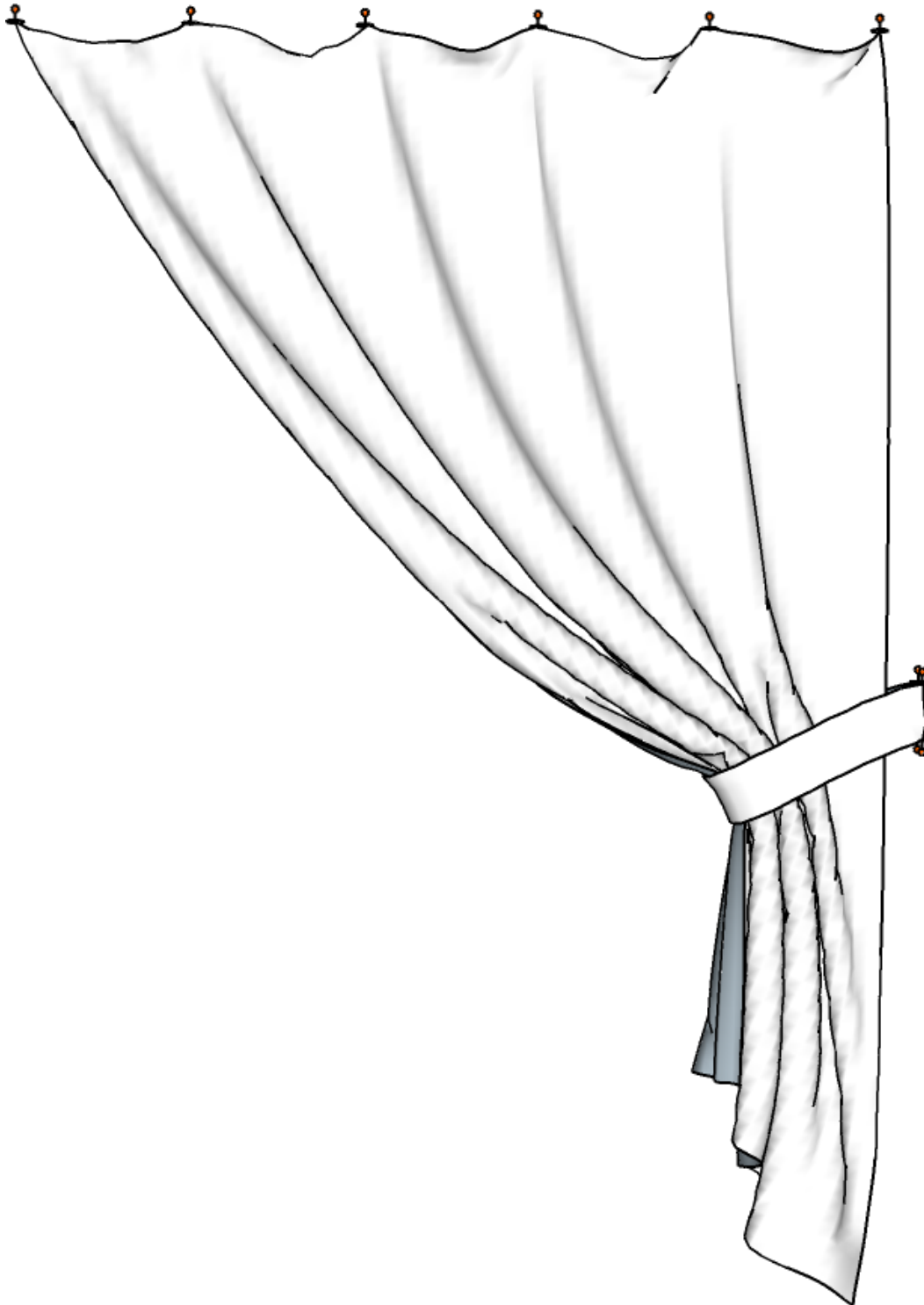
20. Converge the pins horizontally to close the loop of the strip:



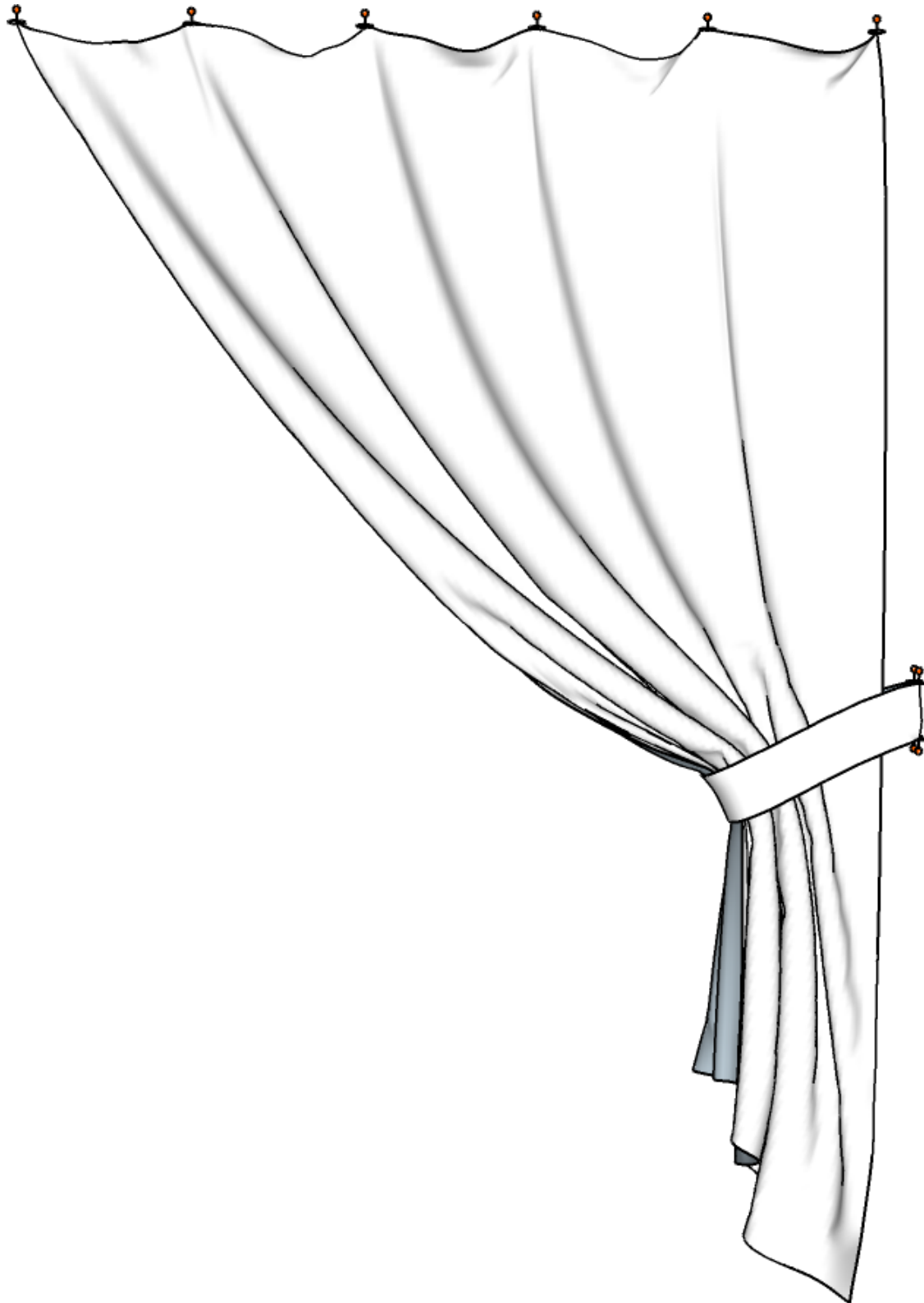
21. Stop simulation:



Upon stopping, permanent mesh should replace the temporary, simulation mesh:



22. Apply loop subdivision to both the strip and the curtain; select both and access:
(Context Menu) *ClothWorks* → 2 *Cloths* → *Apply Loop Subdivision*



23. (Optional) Apply a texture to the curtain and/or the strip, as described in the following steps:

a. Undrape the cloth via ClothWorks toolbar or context menu:

i. If doing through ClothWorks toolbar, select the cloth and click *Toggle Drape* icon:



ii. If doing through context menu, right-click the cloth and access:

(Context Menu) *ClothWorks* → 1 *Cloth* → *Undrape*

b. Apply a desired material/texture directly to the faces of the cloth:

i. Double-left-click the cloth group to enter the context.

ii. Select a desired material from the *Materials* panel.

iii. Left-click on all the visible faces of the cloth. You can use a third-party tool to position the materials.

iv. Exit the context of the group, either by left-clicking the background or using the context menu.

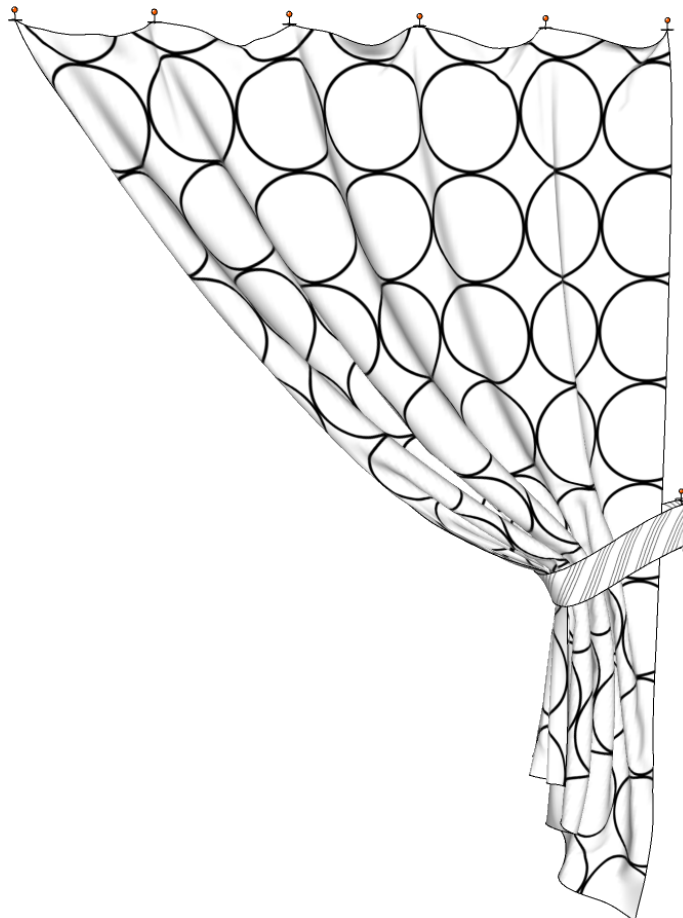
c. Drape the cloth:

i. If doing through ClothWorks toolbar, select the cloth and click *Toggle Drape* icon:



ii. If doing through context menu, right-click the cloth and access:

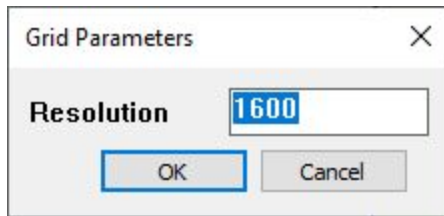
(Context Menu) *ClothWorks* → 1 *Cloth* → *Drape*



Quadrilateral Flag

This tutorial covers how to simulate a rectangular cover.

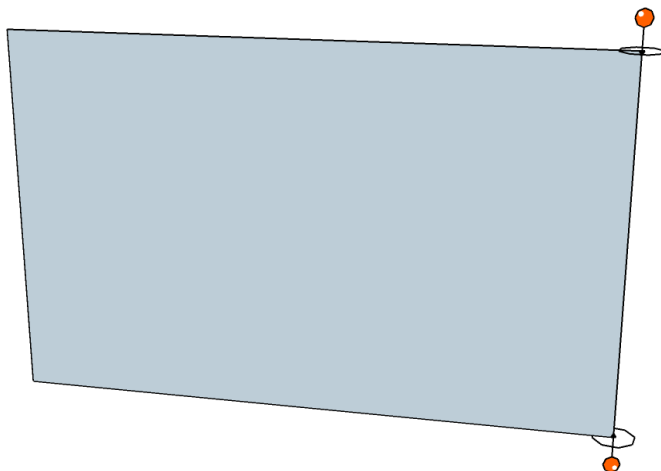
1. Draw a vertical rectangle for the flag, of a desired size, and make it a group.
2. Assign a cloth property to the group; right-click the group and access:
(Context Menu) *ClothWorks* → *Make Cloth*
3. Apply a quadrilateral grid to the flag:
 - a. Right-click the group and access:
(Context Menu) *ClothWorks* → *1 Cloth* → *Apply Quadrilateral Grid*
 - b. When prompted, set resolution to 1600 squares and click *OK*:



4. Create two pins at the upper-right and lower-right corners of the flag:
 - a. Select the *Add Pin* tool:

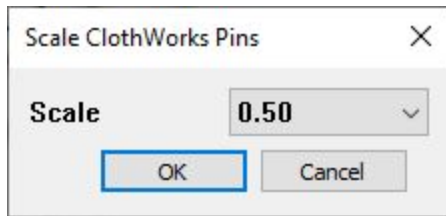


- b. Create an up-looking pin at the upper-right corner of the flag:
 - i. Left-click at the upper-right corner of the flag.
 - ii. Left-click again at a point directly above the first point.
 - c. Create an down-looking pin at the lower-right corner of the flag:
 - i. Left-click at the lower-right corner of the flag.
 - ii. Left-click again at a point directly below the first point.



5. (Optional) Edit pins scale as necessary. The whole point of adjusting pin scale is to increase/reduce the amount of vertices locked by the pins.

- a. Select the two pins and access:
(Context Menu) *ClothWorks* → 2 Pins → *Edit Scale*
- b. Set scale to a desired value and press *OK*:



6. Open the ClothWorks UI:



7. Select the flag and adjust properties as follows:

- a. Ensure *Adaptive Remeshing* is off.
- b. Set *Density* to 80.
- c. Set *Thickness* to 2. Only applies if *Self-Collide* is checked. This value is in millimeters and should be based on grid spacing. A rule to keep in mind is to have thickness no more than 1/3 of the grid padding.
- d. Set *Friction* to 0. Only applies if *Self-Collide* is checked.
- e. Set *Stretch* to 1.0.
- f. Set *Bend* to 0.01.
- g. Check *Drag*.
- h. Uncheck *Cross Springs*.
- i. Uncheck *Self-Collide*. For now we simulate without self-collision as it is not perfect.

Simulation **Cloth** Collider Pin

1 selected

Adaptive Remeshing Off

Preset Custom

Density 80

Thickness 2

Friction 0

Stretch 1

Bend 0.01

Damper 0.25

Cloth Scale 1

String Scale 1

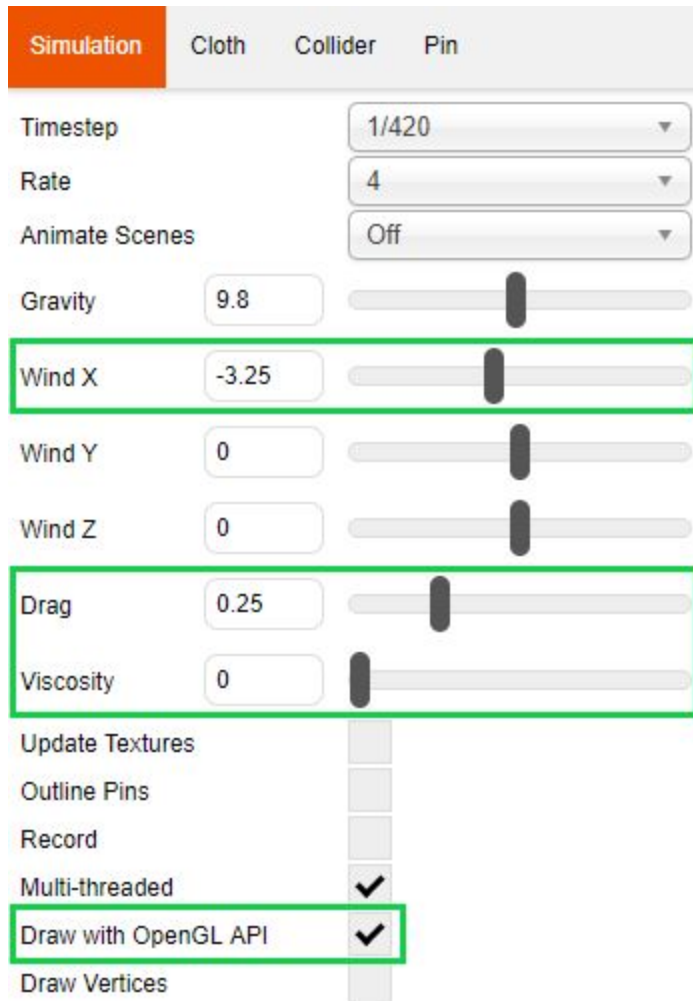
Drag ☒

Self-collide ☐

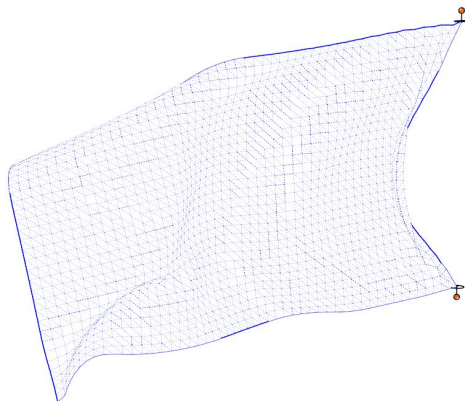
Preserve Shape ☐

Cross Springs ☐

8. Adjust simulation properties as follows:
- Set *Wind X* to -3.25.
 - Set *Drag* to 0.25.
 - Set *Viscosity* to 0.00.
 - Check *Drag with OpenGL API*.



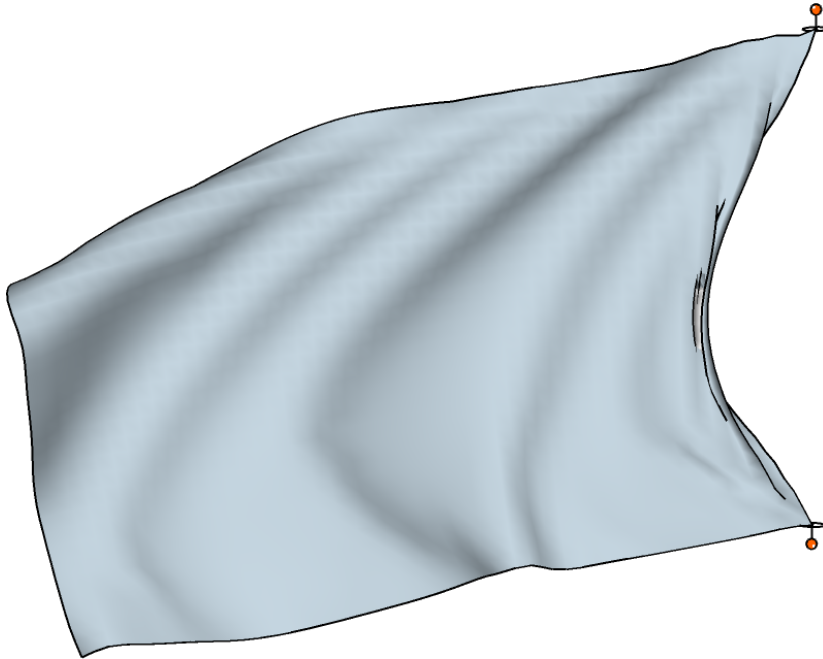
9. Simulate:



10. Stop the simulation at a desired point:



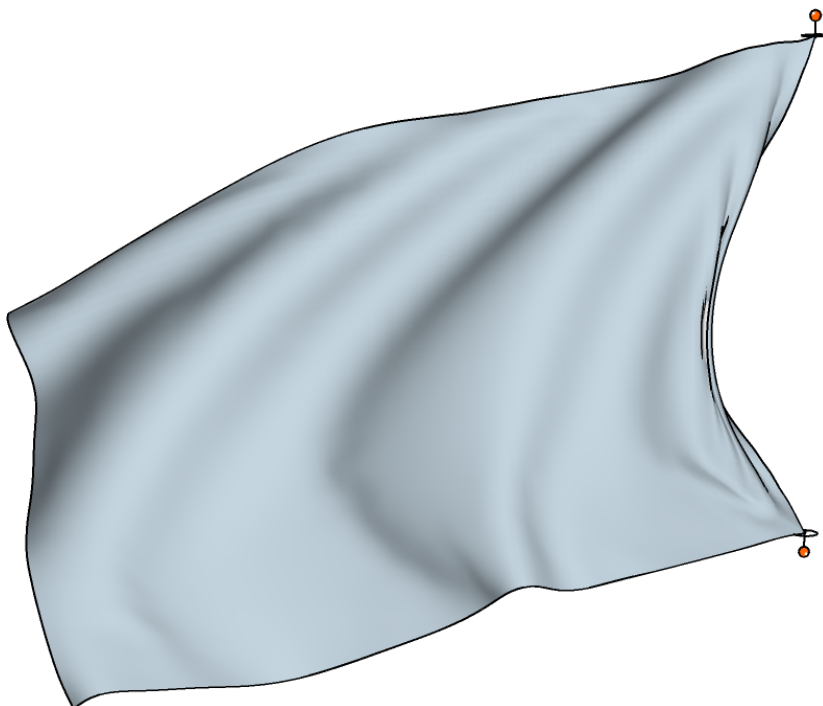
Once stopped, the original mesh will replace the temporary mesh:



If you stopped the simulation at a point where there is too much self-overlapping geometry, or the view is not appealing, try simulating again, as described in step 9; otherwise, continue to step 11.

11. Apply loop subdivision (if your ClothWorks is licensed):

(Context Menu) ClothWorks → 1 Cloth → Apply Loop Subdivision



12. (Optional) Apply a texture:

a. Undrape the cloth via ClothWorks toolbar or context menu:

- i. If doing through ClothWorks toolbar, select the cloth and click *Toggle Drape* icon:



- ii. If doing through context menu, right-click the cloth and access:

(Context Menu) *ClothWorks* → 1 *Cloth* → *Undrape*

b. Apply a desired material/texture directly to the faces of the cloth:

- i. Double-left-click the cloth group to enter the context.
- ii. Select a desired material from the *Materials* panel.
- iii. Left-click on the front face and/or back face to color the cloth.
- iv. Exit the context of the group, either by left-clicking the background or using the context menu.

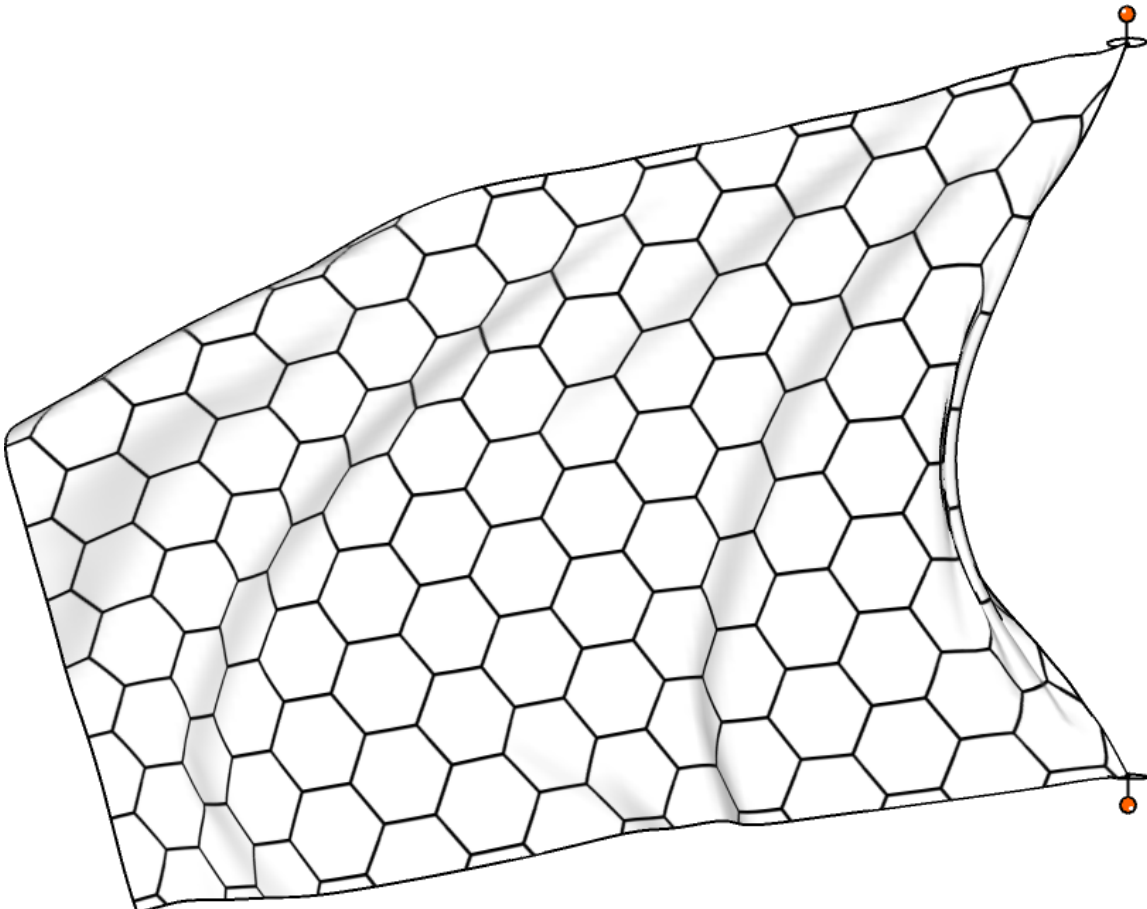
c. Drape the cloth:

- i. If doing through ClothWorks toolbar, select the cloth and click *Toggle Drape* icon:



- ii. If doing through context menu, right-click the cloth and access:

(Context Menu) *ClothWorks* → 1 *Cloth* → *Drape*

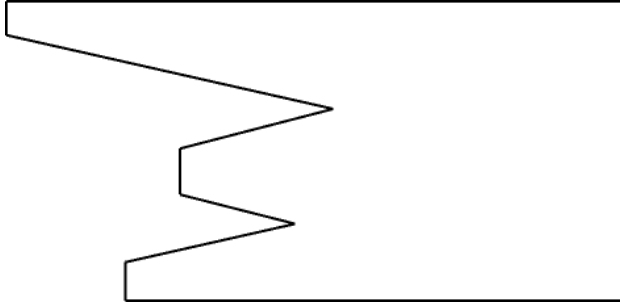


Next tutorial focuses on simulating a flag that is not necessarily rectangular.

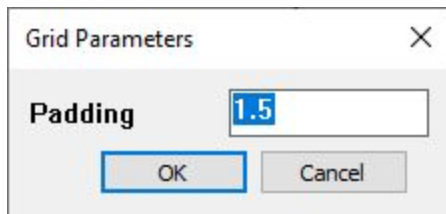
Irregular Flag

At this point we have simulated a rectangular flag. For an irregular flag, which is a polygon with cut-outs, we cannot use the quadrilateral grid option. The quadrilateral grid option is only compatible with faces that consist of four outer edges. For the irregular polygon, we use the adaptive grid option. Aside from the grid option, all steps for simulating an irregular flag are similar to simulating a quadrilateral flag. Applying adaptive grid requires that your ClothWorks is licensed.

1. Open SketchUp and set model units to centimeters.
2. Draw an irregular face, similar to the one shown in the figure below, with outer dimensions of 80 cm X 40 cm:



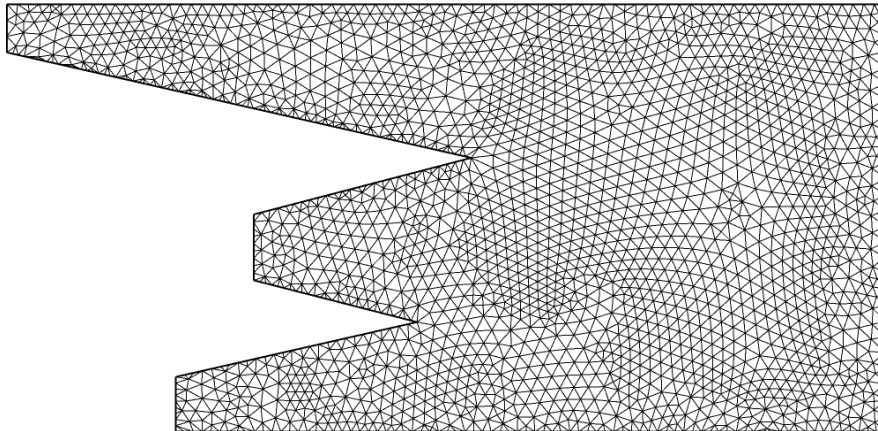
3. Group the face.
4. Assign a cloth property to the flag group:
(Context Menu) ClothWorks → Make Cloth
5. Apply an adaptive grid, with spacing set to 1.5 cm:
 - a. Select the flag and access:
(Context Menu) ClothWorks → 1 Cloth → Apply Adaptive Grid
 - b. When prompted, set padding to 1.5 cm and click OK:



Note: If your model units are not in centimeters, you can pass **1.5 cm** or **1.5cm**.

If the flag dimensions are different from 80 X 40 cm, use the tape measure tool to estimate a desired grid padding on the flag.

If you unsoften all edges, the grid should be similar to the grid in the figure below:



6. Attach pins at the upper-right and lower-right corners of the flag.

a. Select the *Add Pin* tool:



b. Create an up-looking pin at the upper-right corner of the flag:

- i. Left-click at the upper-right corner of the flag.
- ii. Left-click again at a point directly above the first point.

c. Create a down-looking pin at the lower-right corner of the flag:

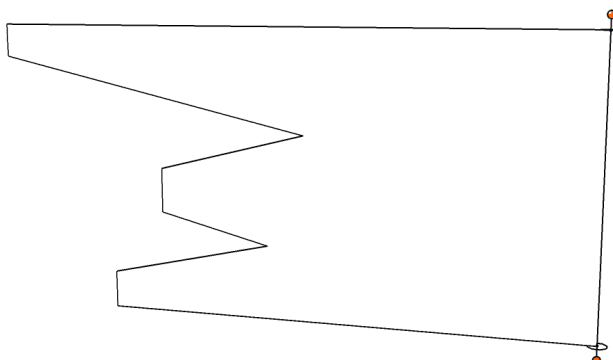
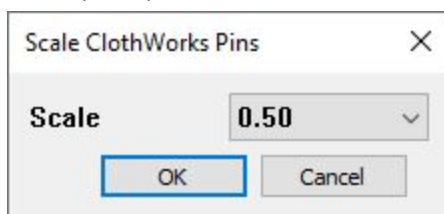
- i. Left-click at the lower-right corner of the flag.
- d. Left-click again at a point directly below the first point.

7. (Optional) Edit pins scale as necessary. The whole point of adjusting pin scale is to increase/reduce the amount of vertices locked by the pins.

a. Select both of the pins and access:

(Context Menu) *ClothWorks* → 2 Pins → *Edit Scale*

b. When prompted, set scale to a desired value. For this particular flag, a pin scale to 0.5 is ideal; press *OK*:



8. Open ClothWorks UI:



9. Select the flag and adjust properties as follows:
- Ensure *Adaptive Remeshing* is off.
 - Set *Density* to 10.
 - Set *Thickness* to 2. This property is only used with self-collision.
 - Set *Friction* to 0. This property is only used with self-collision.
 - Set *Stretch* to 0.5
 - Set *Bend* to 0.05.
 - Check *Drag*.
 - Uncheck *Self-Collide*. Self-collision does not work well with flags. For now, we simulate without self-collision.
 - Ensure *Cross Springs* is unchecked.

Simulation **Cloth** Collider Pin

1 selected

Adaptive Remeshing Off

Preset Custom

Density 10

Thickness 2

Friction 0.05

Stretch 0.5

Bend 0.05

Damper 0.25

Cloth Scale 1

String Scale 1

Drag ☒

Self-collide ☐

Preserve Shape ☒

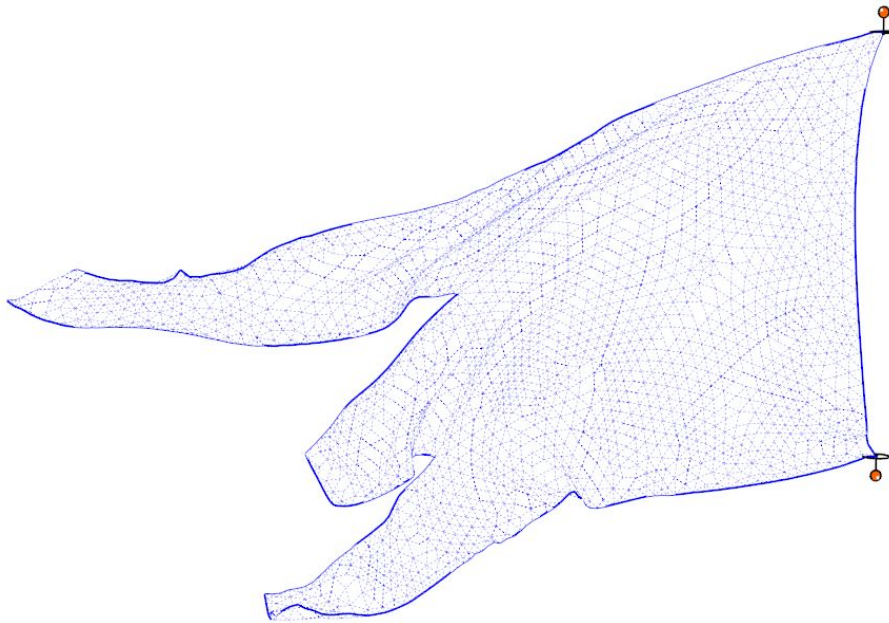
Cross Springs ☐

10. Adjust simulation properties as follows:

- a. Set *Wind X* to -2.
- b. Ensure *Drag* is 0.25.
- c. Set *Viscosity* to 0.
- d. Check *Draw with OpenGL API*.

Simulation	Cloth	Collider	Pin
Timestep	1/420		
Rate	4		
Animate Scenes	Off		
Gravity	9.8	<input type="range"/>	
Wind X	-3.5	<input type="range"/>	
Wind Y	0	<input type="range"/>	
Wind Z	0	<input type="range"/>	
Drag	0.25	<input type="range"/>	
Viscosity	0	<input type="range"/>	
Update Textures	<input type="checkbox"/>		
Outline Pins	<input type="checkbox"/>		
Record	<input type="checkbox"/>		
Multi-threaded	<input checked="" type="checkbox"/>		
Draw with OpenGL API	<input checked="" type="checkbox"/>		
Draw Vertices	<input type="checkbox"/>		

11. Simulate:



12. Stop simulation at a desired point:



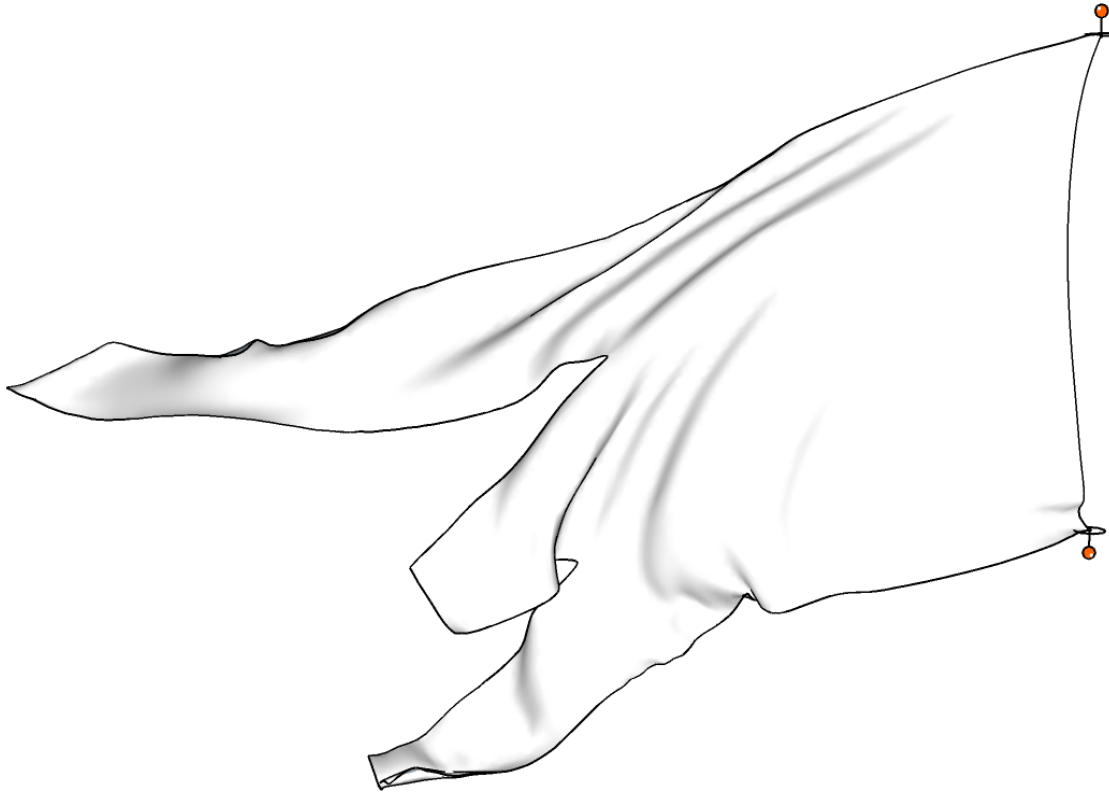
Upon stopping, the actual model should replace the temporary drawing:



If your flag has self-overlap or the view is not desirable, resume simulation (repeat step 11).

13. Apply loop subdivision (if your ClothWorks is licensed):

(Context Menu) ClothWorks → 1 Cloth → Apply Loop Subdivision



14. (Optional) Apply a texture, utilizing the drape/undrape functionality:

a. Undrape the cloth via ClothWorks toolbar or context menu.

i. If doing through ClothWorks toolbar, select the cloth and click *Toggle Drape* icon:



ii. If doing through context menu, right-click the cloth and access:

(Context Menu) ClothWorks → 1 Cloth → Undrape

b. Apply a desired material/texture directly to the faces of the cloth:

i. Double-left-click the cloth group to enter the context.

ii. Select a desired material from the *Materials* panel.

iii. Left-click on the front face and/or back face to color the cloth.

iv. Exit the context of the group, either by left-clicking the background or using the context menu.

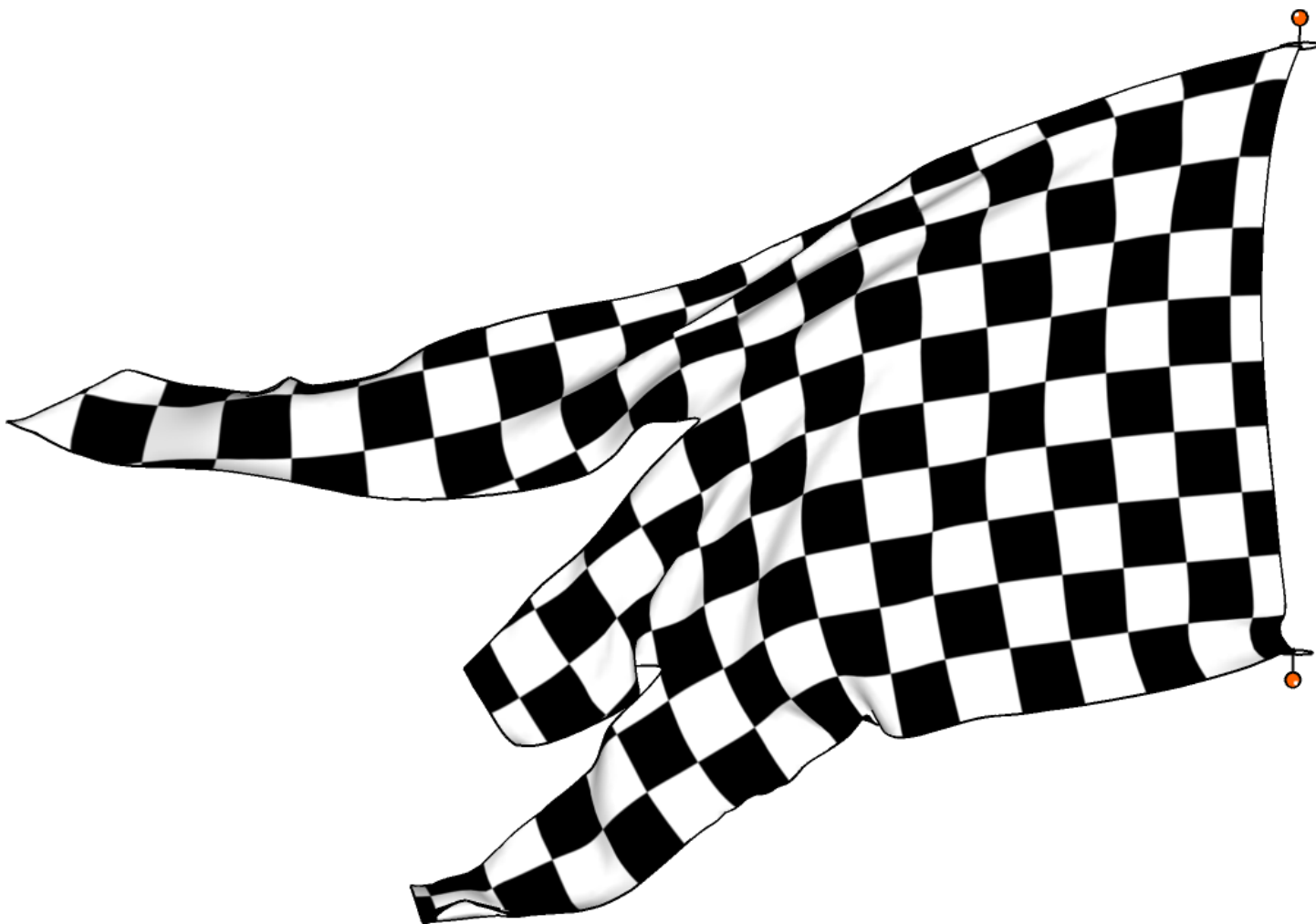
c. Drape the cloth.

i. If doing through ClothWorks toolbar, select the cloth and click *Toggle Drape* icon:



ii. If doing through context menu, right-click the cloth and access:

(Context Menu) ClothWorks → 1 Cloth → Drape



This covers the techniques for simulating flags. Although self-collision was not used, you are still able to obtain realistic results.

Pillow

In this tutorial, we create a pillow. Although ClothWorks does not support simulation of soft solids, you can still achieve an end-result that resembles a realistic, deformable solid. The following steps guide you for creating a pillow:

1. Before we begin, set your model length units to centimeters. This can be done by accessing:

(Menu) Window → Model Info

2. Draw a rectangle, 70 cm x 40 cm.

3. Group the rectangle.

4. Right-click the group, and assign it a cloth property:

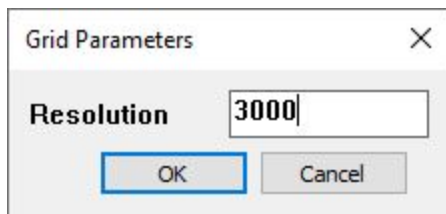
(Context Menu) ClothWorks → Make Cloth

5. Apply a quadrilateral grid with resolution of 3000 squares:

- a. Right-click the cloth group and access:

(Context Menu) ClothWorks → 1 Cloth → Apply Quadrilateral Grid

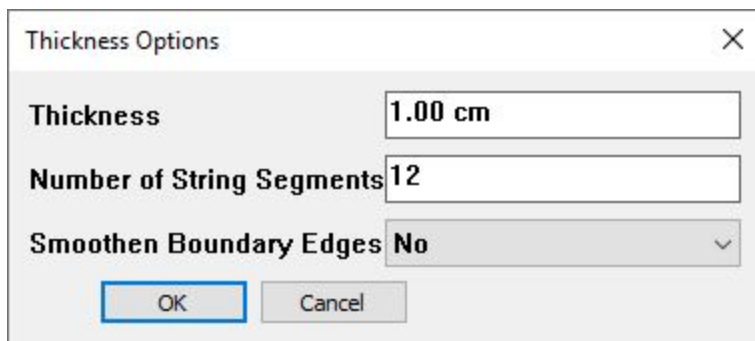
- b. When prompted, set resolution to 3000 squares and click **OK**.



6. Generate a one centimeter thickness for the cloth:

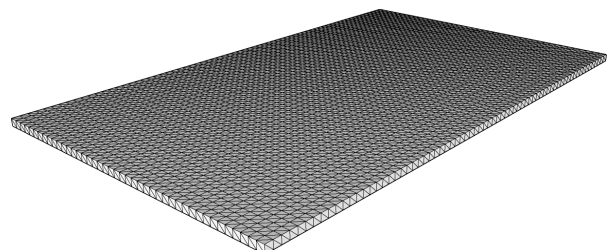
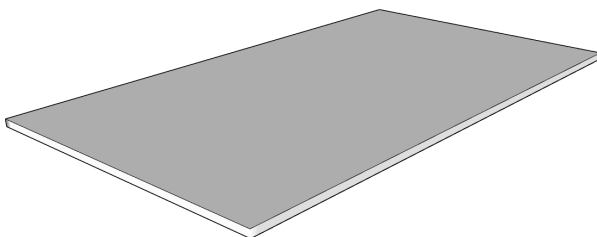
- a. Right-click the cloth group and access:

- b. When prompted, set **Thickness** to **1 cm** or just **1** if your model units are set to centimeters. Also, ensure that **Smoothen Boundary Edges** is set to **No**.



Do not worry about the *Number of String Segments* for now. This is used for generating thickness for lonely edges; press **OK**.

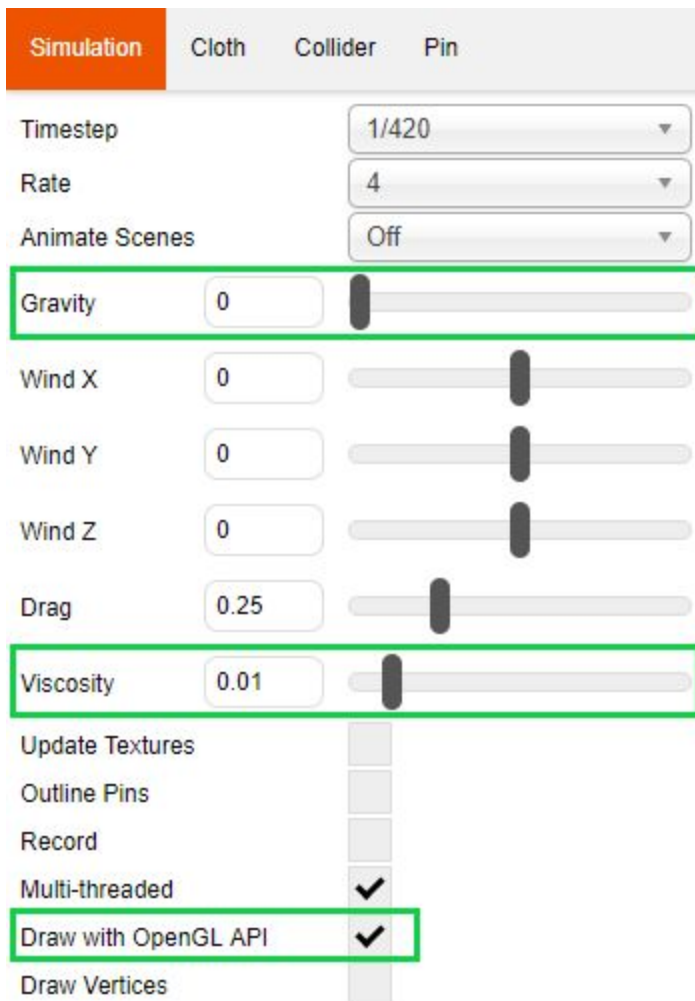
- c. Once generated, your model should look like a rectangular prism. If you unsoften all edges you should see a 3d grid:



7. Now, we are ready to tweak simulation properties. Open ClothWorks UI:



8. Activate *Simulation* tab and adjust properties as follows:
- Set *Gravity* to 0.
 - Ensure *Viscosity* is set to 0.01.
 - Check *Draw with OpenGL API*. This will make it easier for us to see the pillow.



9. Select the pillow and adjust properties as follows:
- Ensure *Adaptive Remeshing* is off.
 - Set *Thickness* to 2.
 - Set *Stretch* to 0.5.
 - Set *Bend* to 1.0.
 - Uncheck *Preserve Shape*. This will force the bend springs to unwrap the solid.
 - Check *Self-Collide*.

Simulation **Cloth** Collider Pin

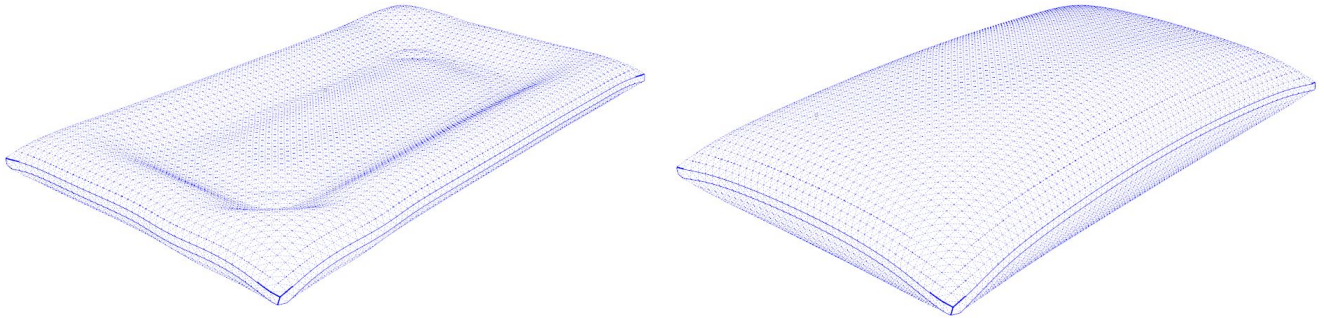
1 selected

Adaptive Remeshing	Off	
Preset	Custom	
Density	200	
Thickness	2	
Friction	0.05	
Stretch	0.5	
Bend	1	
Damper	0.25	
Cloth Scale	1	
String Scale	1	
Drag	<input checked="" type="checkbox"/>	
Self-collide	<input checked="" type="checkbox"/>	
Preserve Shape	<input type="checkbox"/>	
Cross Springs		

10. Now, we are ready to simulate. Press *Toggle Play*:



You should observe the pillow inflating:



11. Once the pillow inflates, increase simulation viscosity and reduce pillow bend stiffness:

- a. Set simulation viscosity to 0.1:
 - i. Unless already, open ClothWorks UI and *Simulation* tab.
 - ii. Set *Viscosity* to 0.1:



- b. Set pillow bend stiffness to 0.003:
 - i. Select the pillow.
 - ii. Unless already, open ClothWorks UI and activate the *Cloth* tab.
 - iii. Set *Bend* to 0.003:

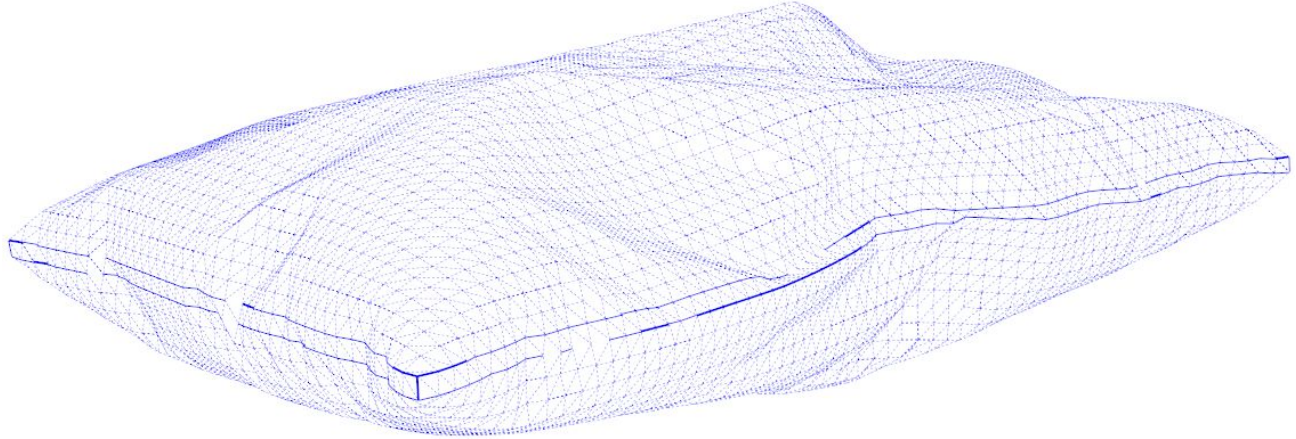


The pillow should start forming wrinkles. If not, decrease the simulation viscosity, wait for the wrinkles to form, and then increase the simulation viscosity again. Note that grid resolution applied to the cloth plays a significant role on the wrinkle formation.

12. Use *Pick and Drag* tool to deform the pillow at desired places:

- a. Click and hold down the left mouse button over a desired point on the cloth.
- b. While holding down the left mouse button, slowly drag the cloth to form a desired deformation.
- c. Release the left mouse button.

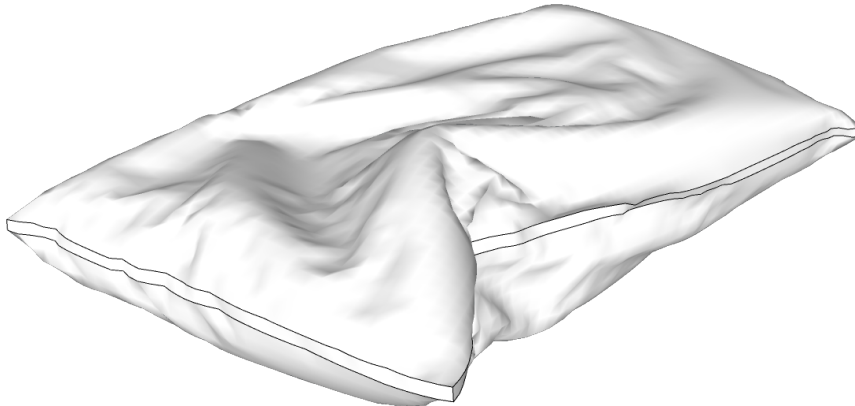
Repeat steps A-C at different points on the pillow. If you crumpled the pillow too much, increase the bending stiffness, wait for the pillow to unwrap, decrease the bending stiffness, and try deforming the pillow again.



13. Stop the simulation:



At this point, your pillow may look something like this:

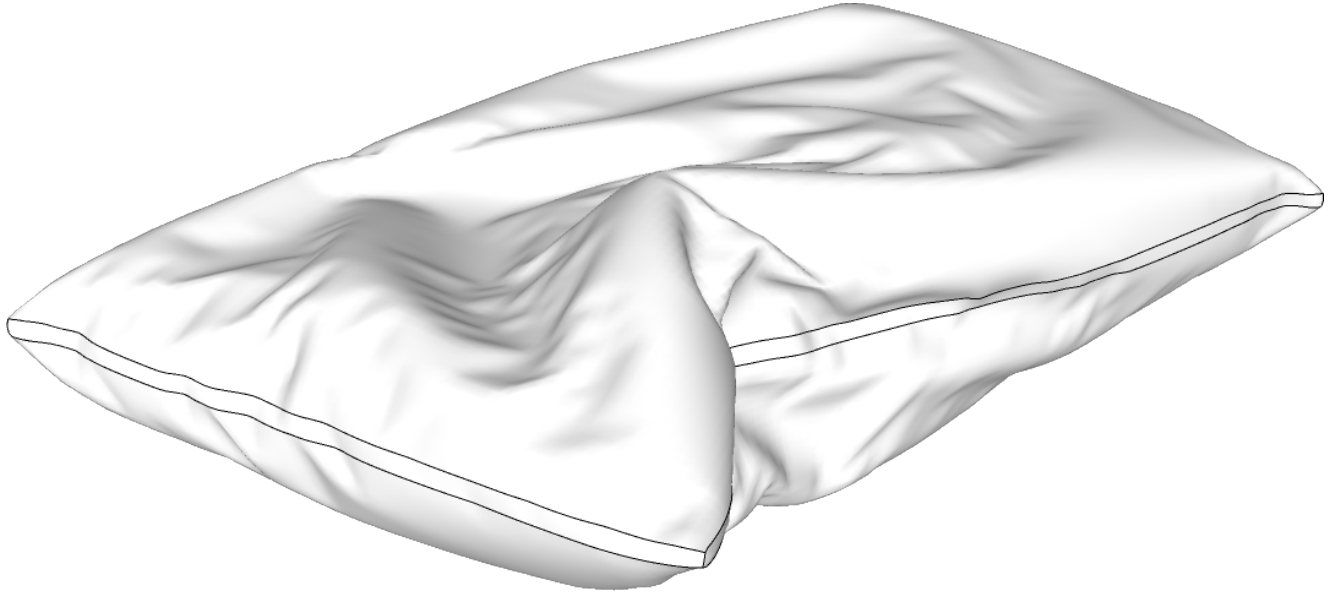


14. Eliminate collision overlaps if any. A pillow can have collision overlaps, especially at the corners. Do the following to eliminate the overlaps:

- a. Uncheck *Self-Collide* property for the pillow.
- b. Start the simulation.
- c. Use *Pick and Drag* tool to eliminate the overlaps; increase bending stiffness if desired.
- d. Stop the simulation.
- e. (Optional) Re-check *Self-Collide* property for the pillow.

15. If you are not satisfied with the results, start the simulation again and repeat steps 11 through 13.

16. Apply Loop subdivision (if licensed). To subdivide the cloth, right-click on the cloth and access:
(Context Menu) *ClothWorks* → 1 *Cloth* → *Apply Loop Subdivision*



17. (Optional) Apply a texture to the pillow, as described in the following steps:

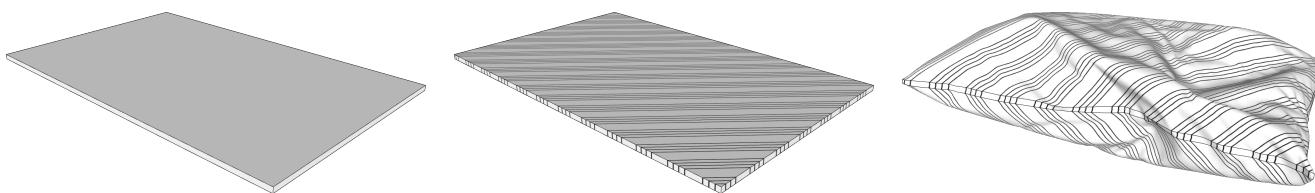
- a. Undrape the cloth via ClothWorks toolbar or context menu:
 - i. If doing through ClothWorks toolbar, select the cloth and click *Toggle Drape* icon:



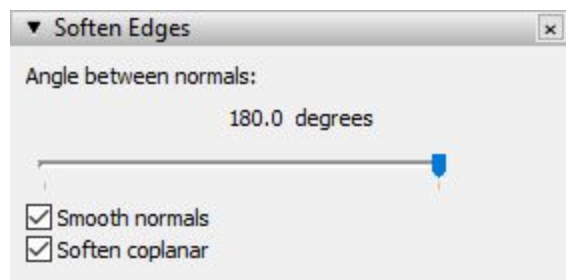
- ii. If doing through context menu, right-click the cloth and access:
(Context Menu) *ClothWorks* → 1 *Cloth* → *Undrape*
- b. Apply a desired material/texture directly to the faces of the cloth:
 - i. Double-left-click the cloth group to enter the context.
 - ii. Select a desired material from the *Materials* panel.
 - iii. Left-click on all the visible faces of the pillow. You can use a third-party tool to position the materials.
 - iv. Exit the context of the group, either by left-clicking the background or using the context menu.
- c. Drape the cloth:
 - i. If doing through ClothWorks toolbar, select the cloth and click *Toggle Drape* icon:



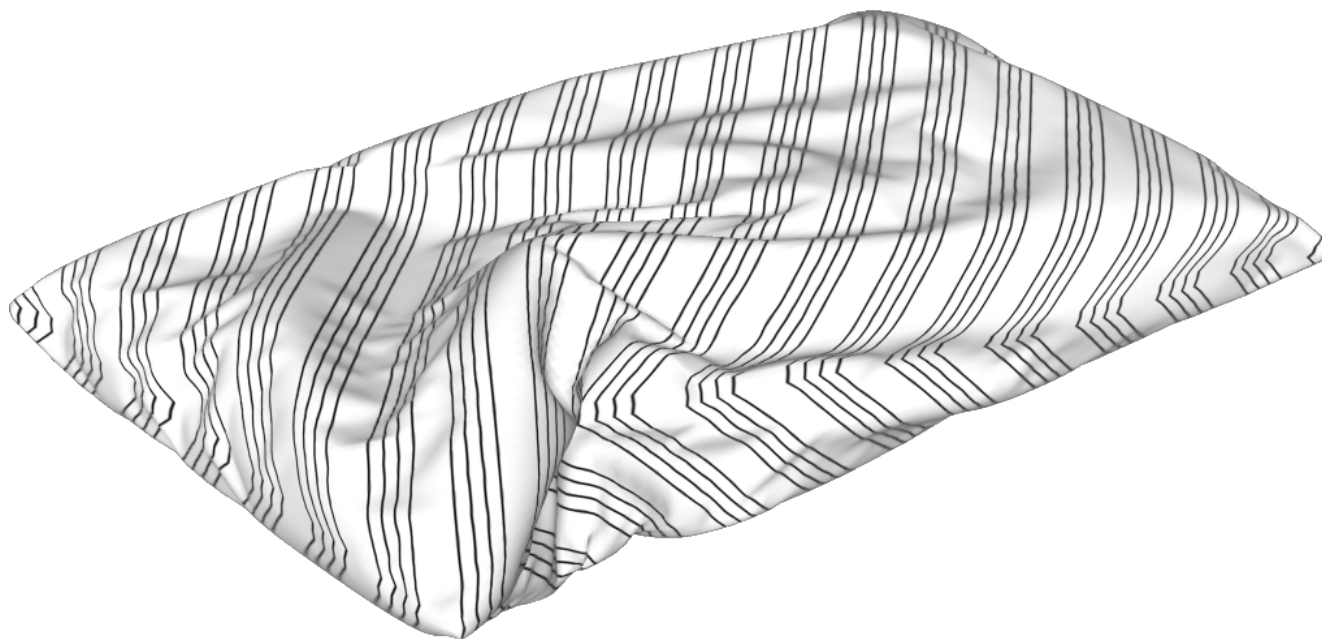
- ii. If doing through context menu, right-click the cloth and access:
(Context Menu) *ClothWorks* → 1 *Cloth* → *Drape*



18. Soften and smooth all edges:



With all the steps completed, you should have a realistic looking pillow.



To create an additional pillow within the same model, set the original pillow to ignore and repeat all the steps for creating a new pillow. To ease the task, you can also create multiple copies of the pillow once you reach step 9, or even step 14, and simulate each pillow with desired deformations.

To simulate one pillow at a time, either:

- Set all other pillows to ignore by selecting the pillows and accessing:
(Context Menu) *ClothWorks* → *Ignore*
- Hide all other pillows
- Or simulate from selection