SUBDIVISION MODELING IN PRACTICE

by YVES PAUWELS

BASIC SHAPE FIRST: DETAIL LATER

Basic shape

Start with a box with a number of segments; just enough (of course, this is weighing it up somewhat) to determine your basic shape. Do not worry if your shape is an edge short, just cut an additional one via the connect tool.

Certainly do not add too much segments to the box, since then you would have too many vertices, which you would have to drag. Then it is hell from the beginning to get everything beautifully flowing.

Low poly mesh = Control mesh

Throughout the course, I will use the term “control mesh” for the low poly mesh you make, on which the TurboSmooth modifier is placed.

0,0,0

When you start modeling your object, it is best to place it in the 0, 0, 0 vertex of your 3D world. After all, nowadays many products are symmetrical or at least symmetrical to a certain extent.

Symmetry

When your object is symmetrical, it is best to remove one half of your mesh (make sure you have an edge running in the middle when you set the number of segments of your box).

Possibly, the top and bottom part are also identical, which allows you to only model one fourth. Then you can even remove the bottom half.

Placing TurboSmooth modifier on it

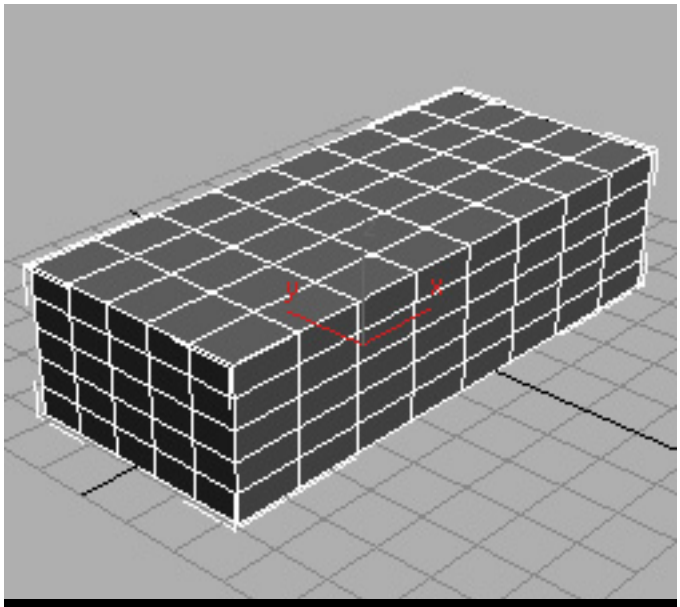
First, make an editable poly of your box and place the TurboSmooth modifier on it to see what the temporary result is. If necessary, you can set “show end result” in your modifier stack to see the end result while you are working in your editable poly. The orange mesh you see is the control mesh.

Cutting detail

Once the basic shape is determined, you will cut edges where necessary (sounds easy, doesn’t it?). This part will extensively be discussed later on in the course when we look at some projects of students and remodel them.

Cutting into loose parts if necessary

An object does not have to consist out of one single mesh. You can feel free to detach parts from your basic mesh and continue to work on those. This makes it easier to divert edges to certain places; then sometimes, you do not have to cut them throughout your entire mesh. On page 4, you can see how this Microsoft mouse finally is built up as for mesh objects.



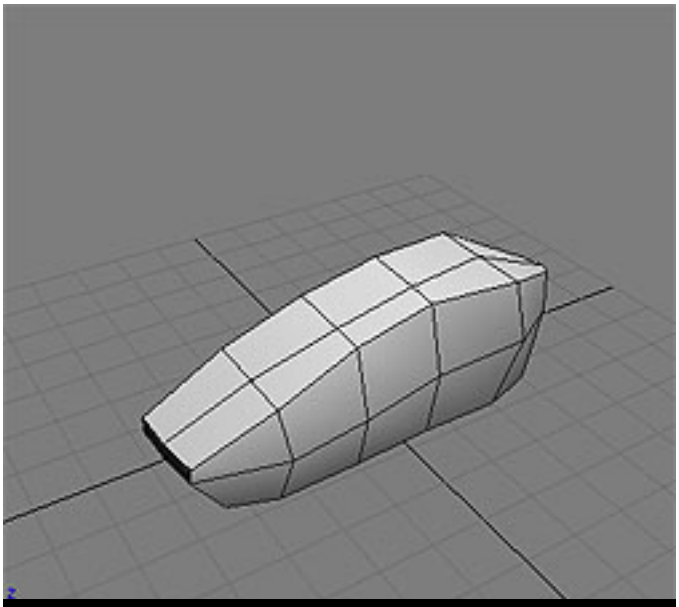
This is NOT RIGHT as a basic shape. You need to drag way to many vertices to get the shape right.

Collapse TurboSmooth: BEWARE!

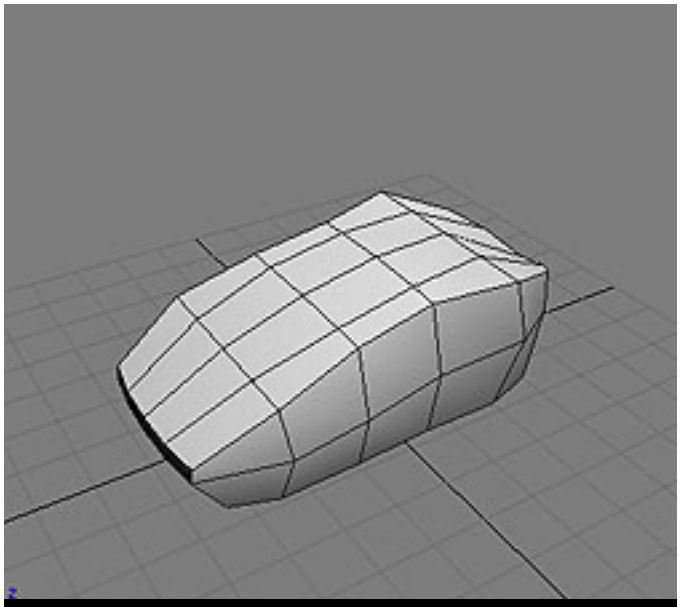
Beware if you want to convert a mesh on which a TurboSmooth modifier is placed back into an editable poly.

If you have a very low poly object (e.g. a cube without segments), and you want to start with a spherical mesh, you can indeed first place a TurboSmooth with an iteration of 1 or perhaps even 2, and then collapse your mesh back into an editable mesh.

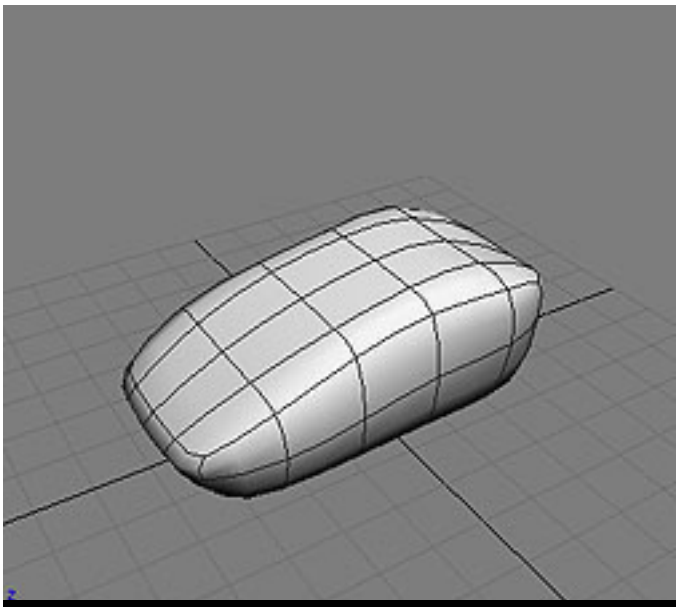
However, do certainly not collapse a control mesh – which already has many details – with a TurboSmooth, because then you can never return (unless you still have a couple of undo’s) to your control mesh and that is pretty annoying. So once more: a call to save incrementally.



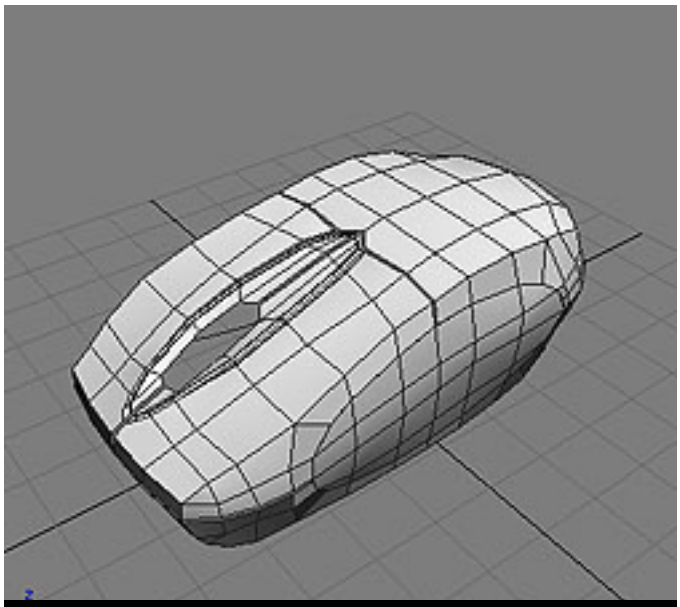
The basic shape: started from a half box with a number of segments. Then, the vertices were moved.



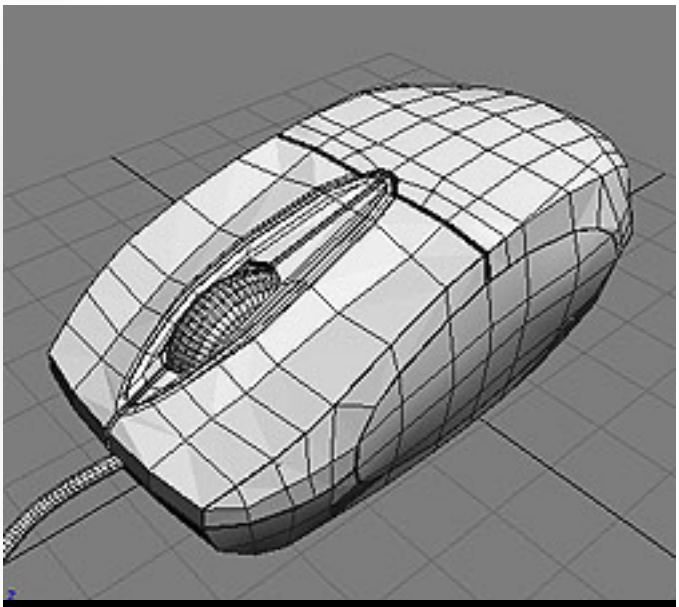
The Symmetry modifier was placed on it so we only need to model one half.



The TurboSmooth modifier was added to see the rounded object. Vertices were adjusted.

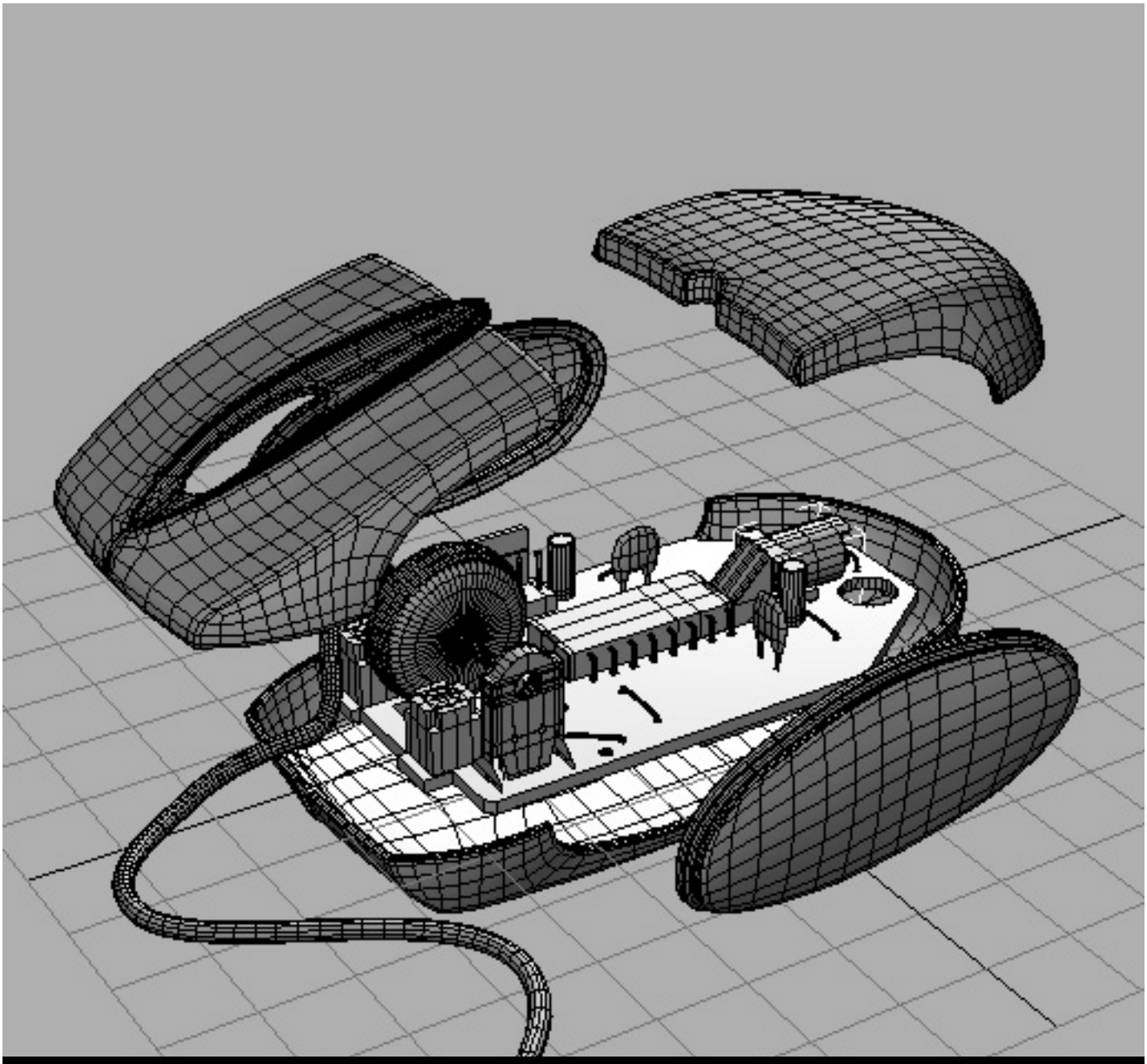


Perhaps a large step, however, edges were cut or via inset, details were added.



Corners were further beveled. The scroll wheel was added, so was extra detail.

Tris and Ngons were removed, which leads us to our result. In the next step, we will add lighting and material, however, first, the model has to be finished.



In this figure, all the separate meshes are moved somewhat, so you can see how it is actually built. Not much is left from the original basic shape, however, we needed the latter to determine the shape and to – from that starting point – keep on adding details. The inside was also modeled, because you can see through the red side.

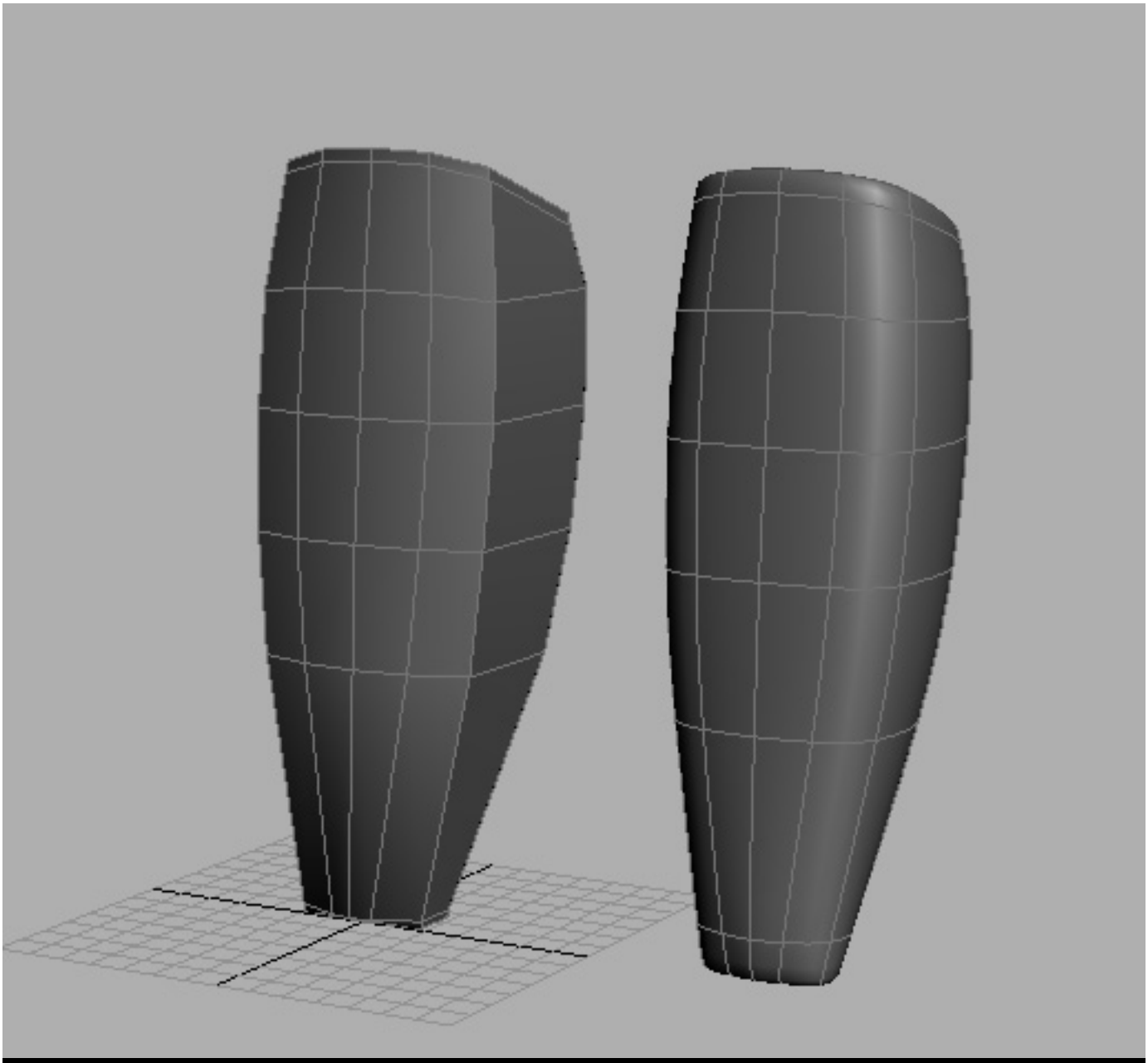
EACH PROJECT IS DIFFERENT

We cannot discuss all possible problems that can occur when SubD modeling. Chamfers, holes, cuts, strange shapes, shapes crossing or overlapping each other, detail on a double bent surface, from convex to concave, from rectangular to oval, bumps, buttons… These are all problems you can encounter.

It is the intention that you, by a number of techniques, can solve such problems and most of all, that you do not make a mess. At all times, you need to try to keep the overview.

Just sketch it out.

A tip; and I will keep repeating it: try to sketch the mesh on paper.



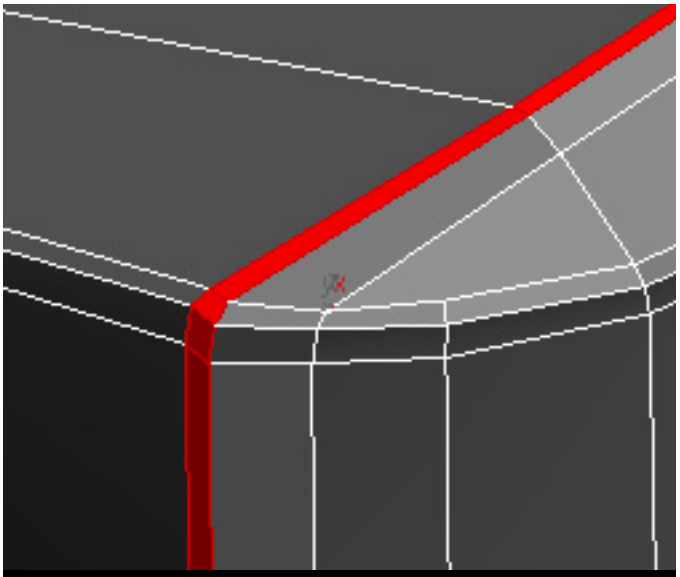
The basic shape: trying to approach the general shape with as little vertices as possible. The fewer vertices you have, the easier it is to obtain a flowing line. If you have more vertices, it is much more difficult and it also is more work to adjust the shape. At the top and at the bottom, an additional edge has been added.

EXAMPLE: COMPUTER SPEAKER

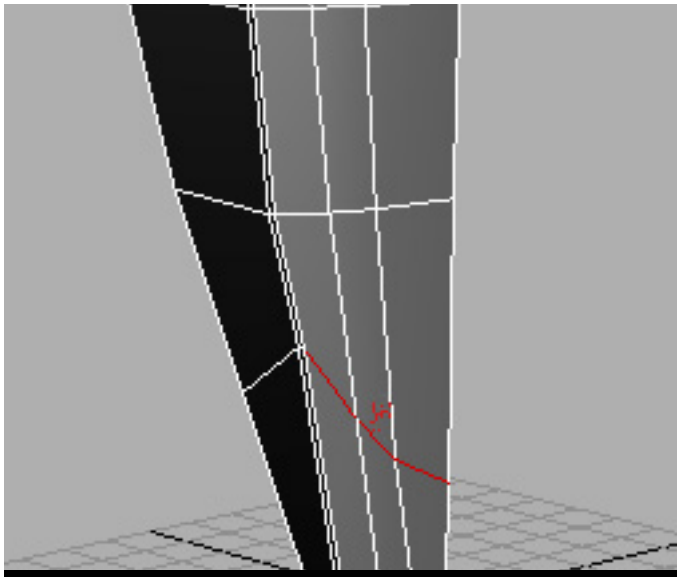
What now follows is a step by step tutorial on how these computer speakers were modeled. Almost every step is illustrated. Especially the preparation is important; making sure that the edges are right before moving on to the details. If the basis is right, then the details can rather quickly be added. We also model just one half and thus use the symmetry modifier.

Reference

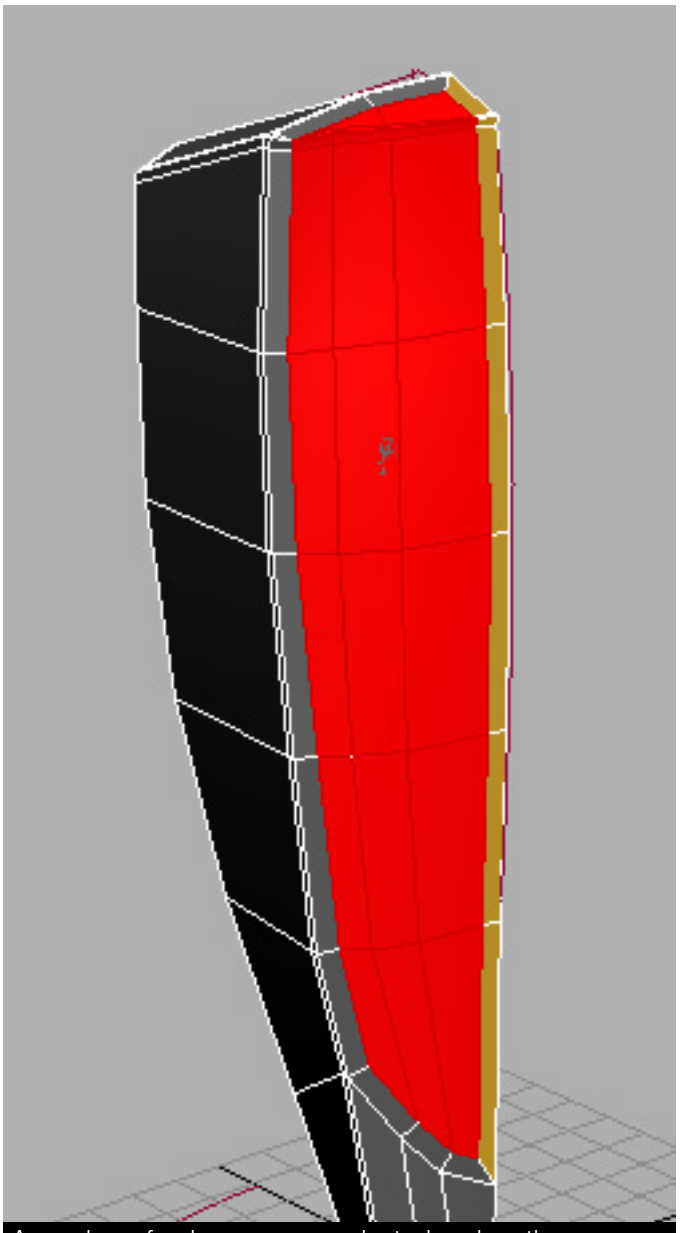
This speaker is made “at sight”, and rather servers as an exercise than as a usable end result. If you want to be sure of the proportions and dimensions, you better take a number of high resolution photos of the object and insert this as a reference in your scene. Make sure you have a perfect photo of the front, side, and back of your object. If possible, use a tripod and turn the product in relation to the camera.



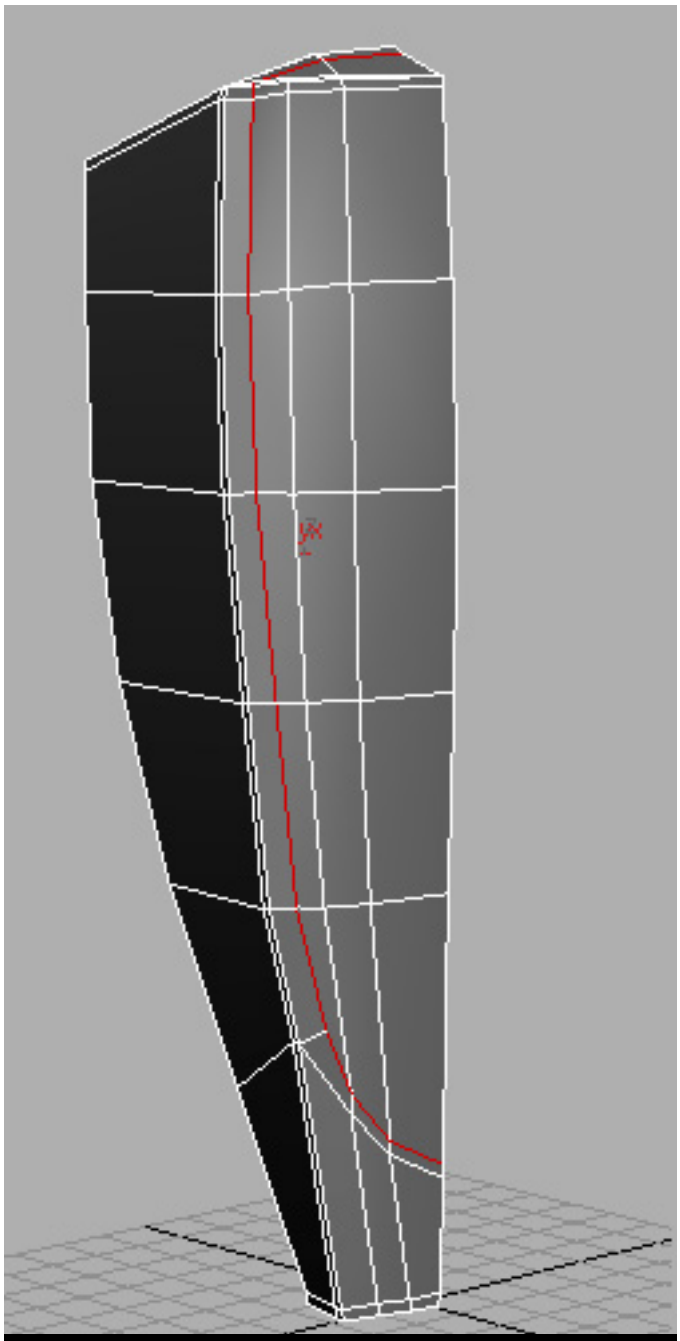
This is how the top angle looks for now. Throughout the mesh, a double edge was added, which will serve as a chamfer.



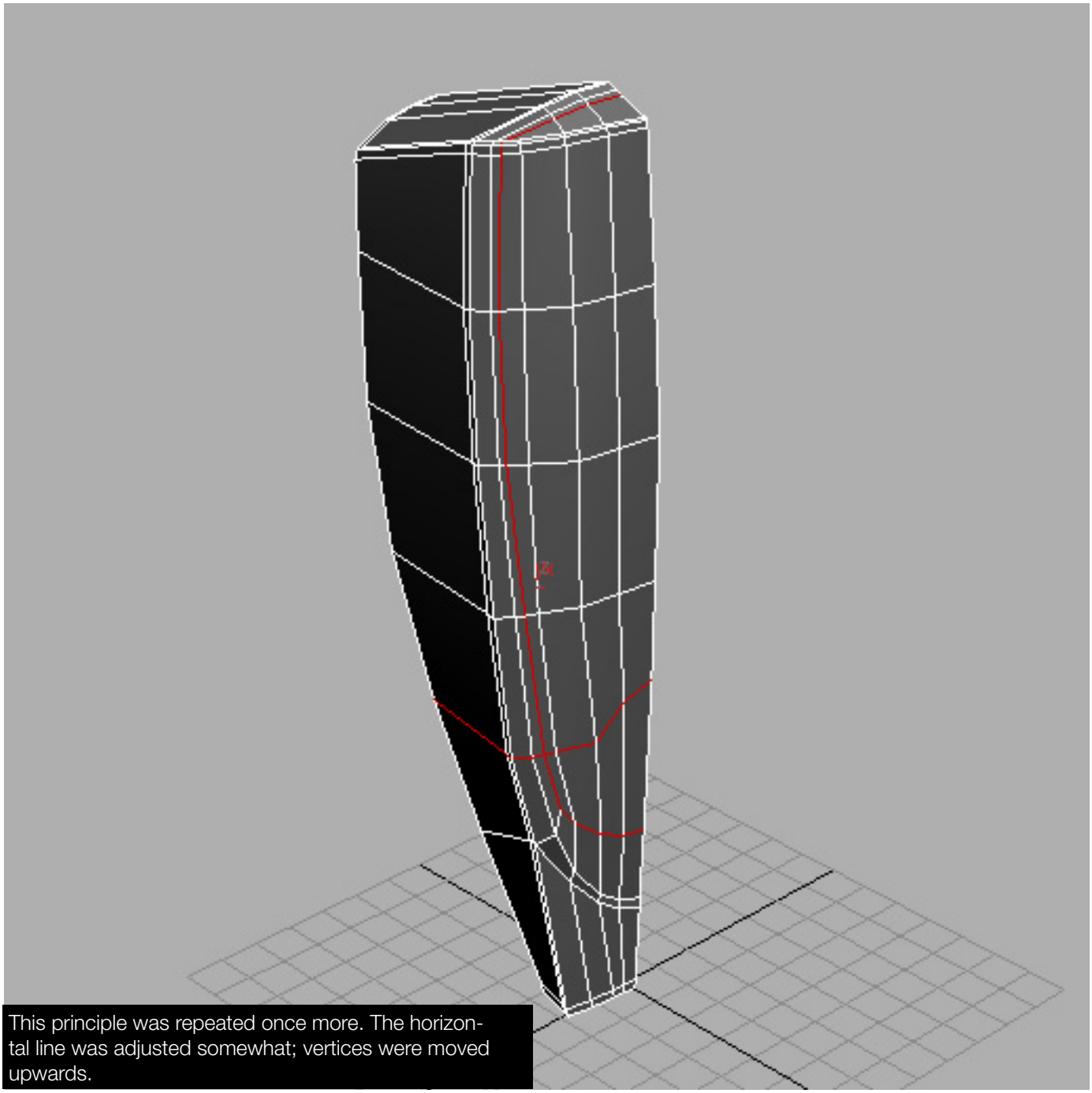
At the bottom, an edge was added, of which the vertices were somewhat rearranged to obtain the curve that is so characteristic of this speaker.



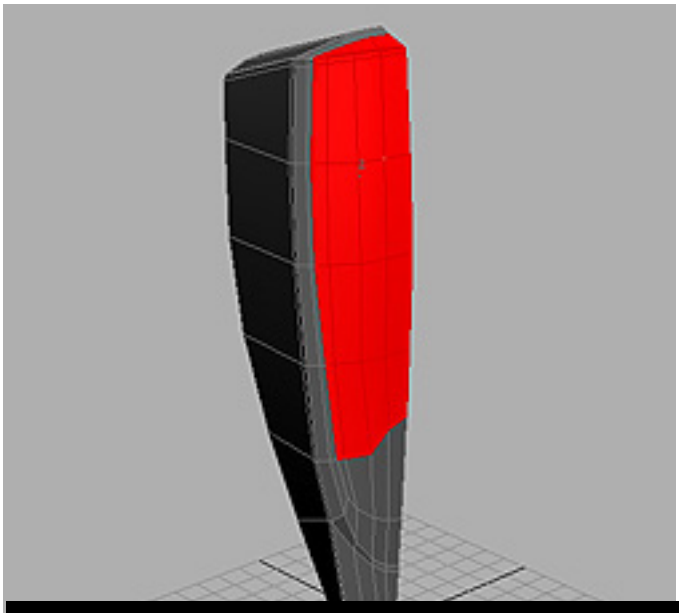
A number of polygons were selected and on these, an inset was executed. The goal is to obtain the edge you can see at the right. The polygons against the center edge (indicated in yellow) are removed. The vertices were put back on the center edge.



This is the edge we finally obtain.



This principle was repeated once more. The horizontal line was adjusted somewhat; vertices were moved upwards.

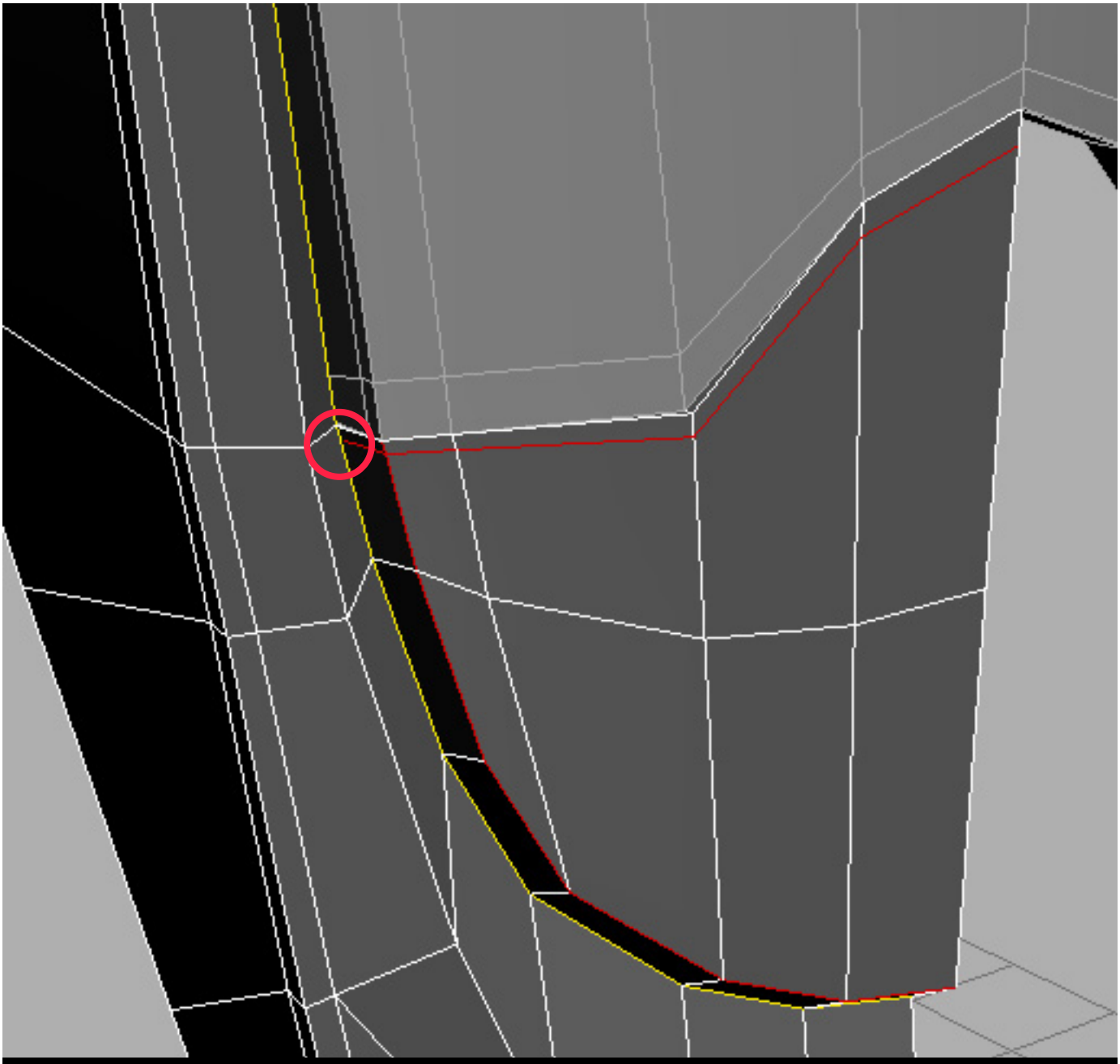


These polygons were selected and detached. We now have two objects.

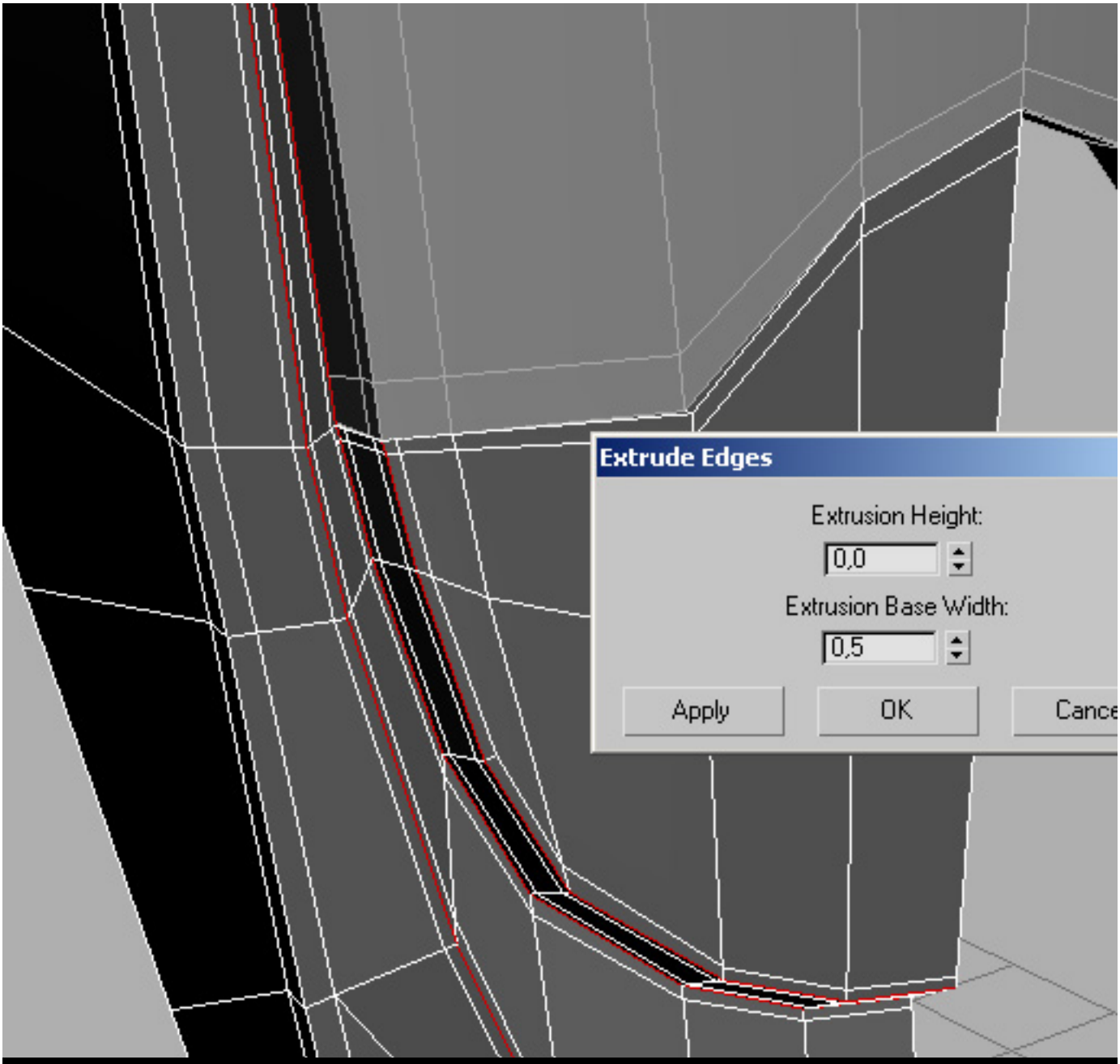
Up till now, we only have dealt with the general shape and putting edge loops in the mesh. At times, look at the shape with the TurboSmooth and adjust where necessary.

We also have two separate objects. This allows us to deal with specific problems per object, and so we do not have to cut edges throughout the entire mesh.

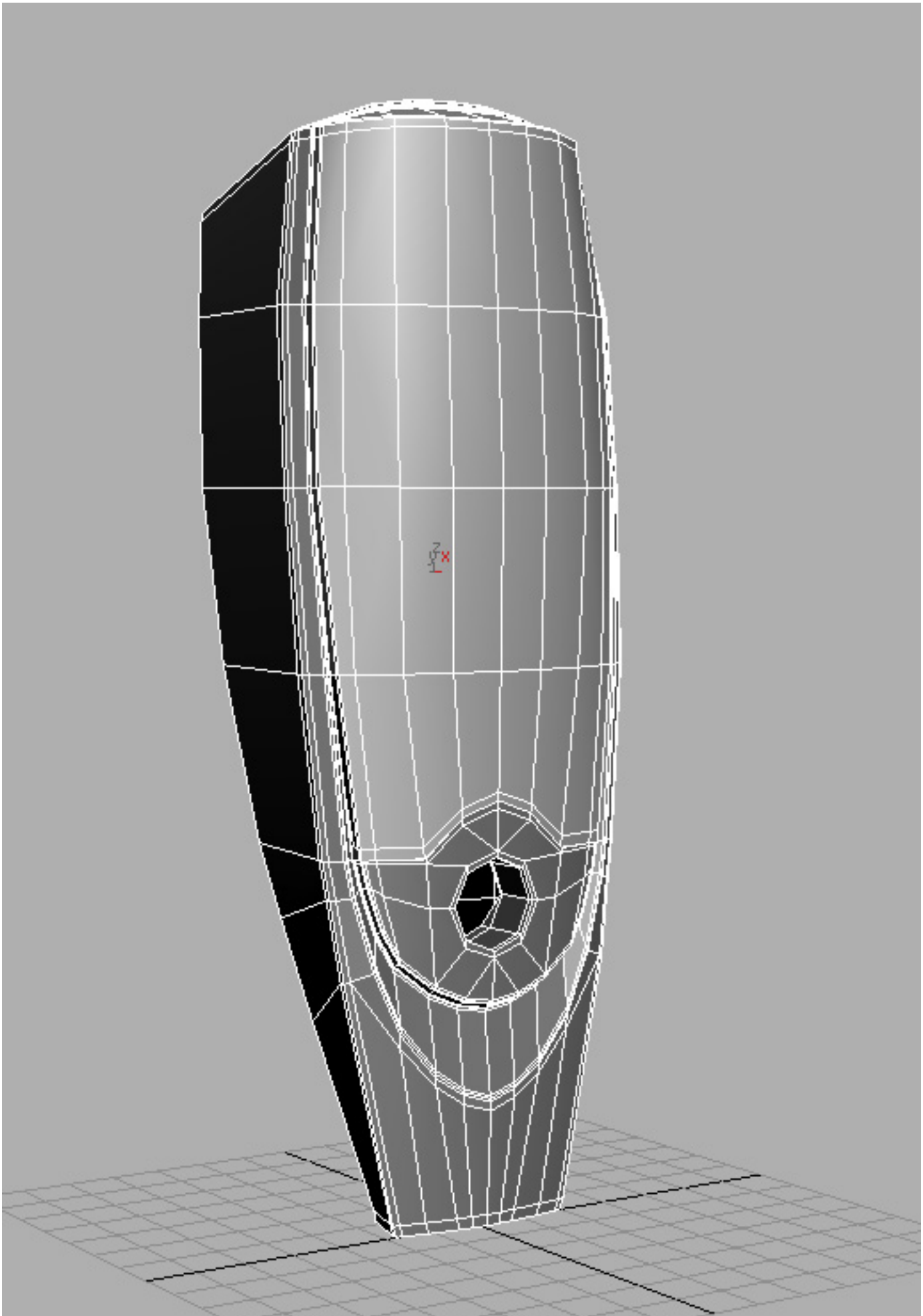
As from now, we will add roundings and details.



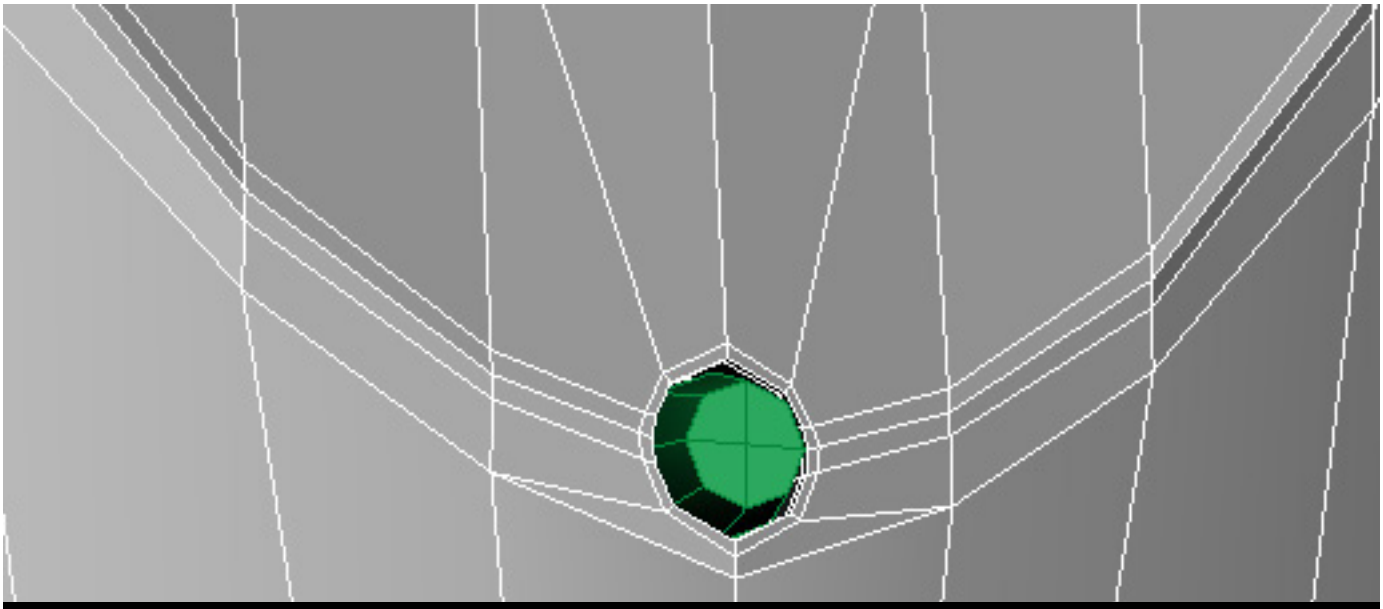
These edges were added. The yellow edge was moved backwards to obtain the depth.
Note that we still have a non quad (in the small circle), however, I did not want to draw this edge throughout the mesh.



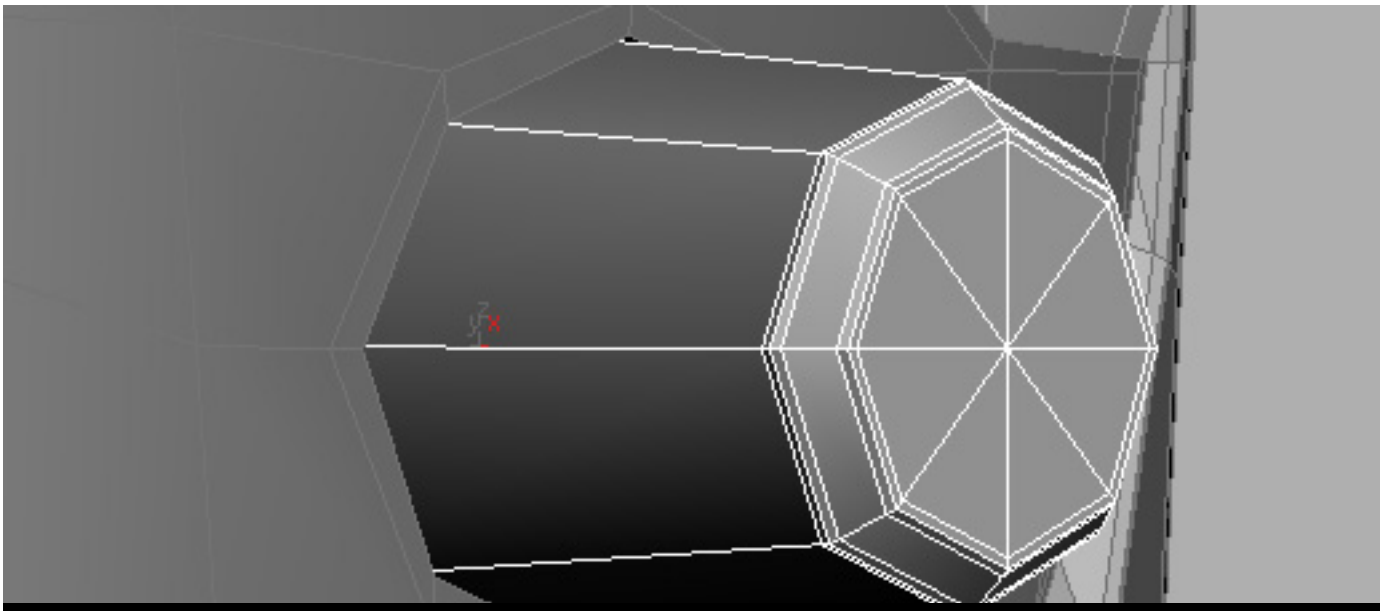
Subsequently, the edges were provided with an edge left and right to create a sharper edge. This was possible with the mode extrude without height.



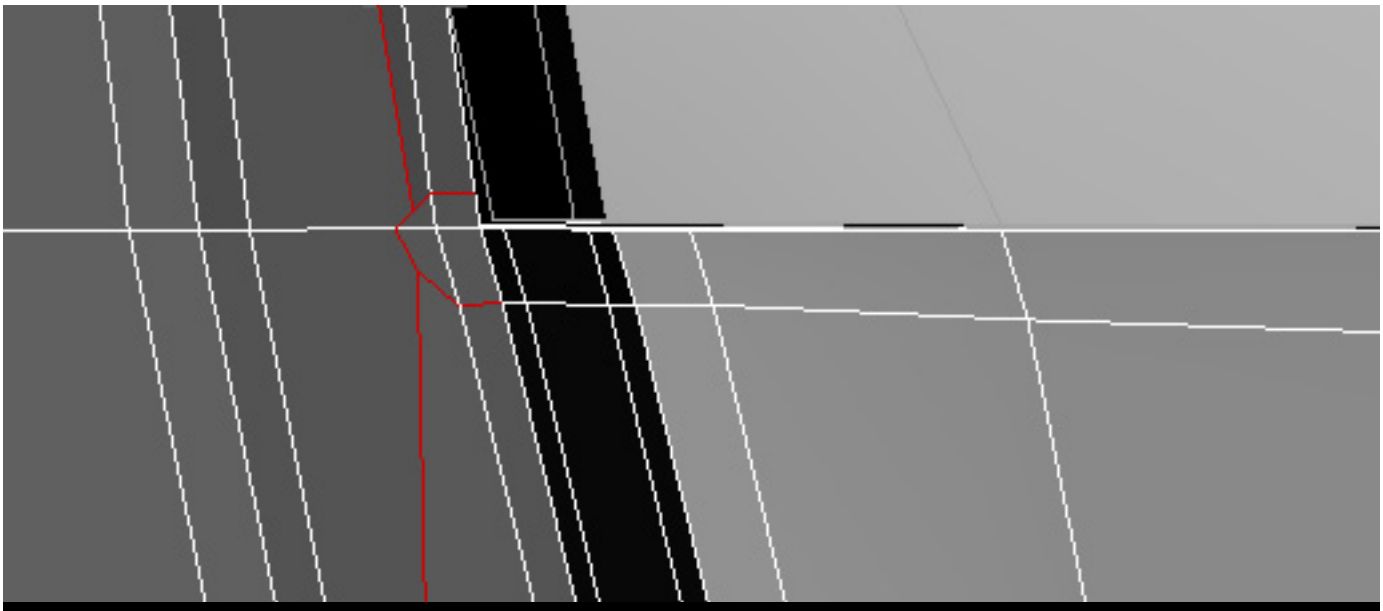
The opening for the volume button was cut in. A circle with interpolation steps 1 was used as reference and via the cut tool, the shape was cut. Non quads were solved and the opening was extruded inwards. Edges were added to obtain sharper roundings.



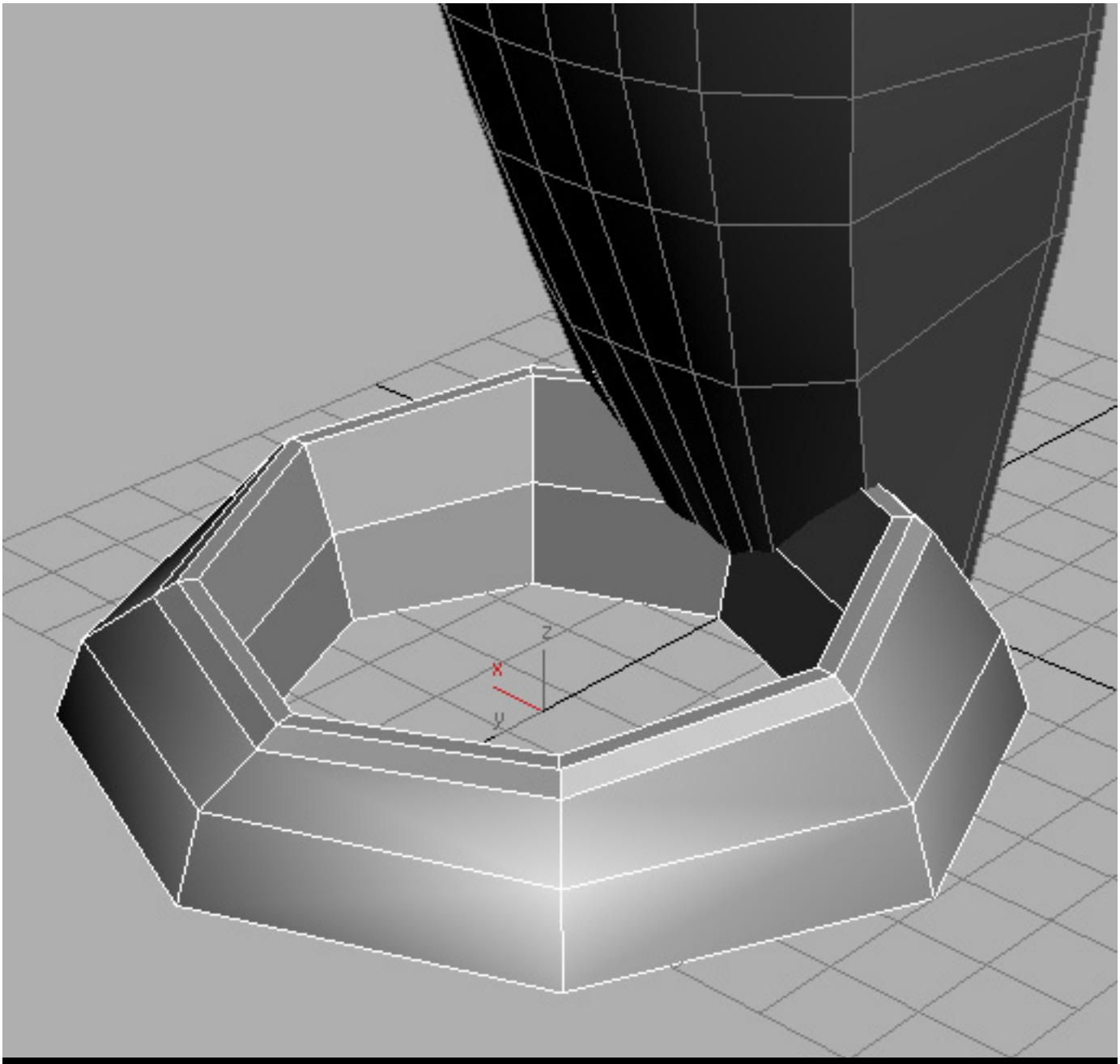
The opening for the LED light was cut in the mesh in the same way as the opening for the volume button, and everything was made quad. The LED light itself is a separate object.



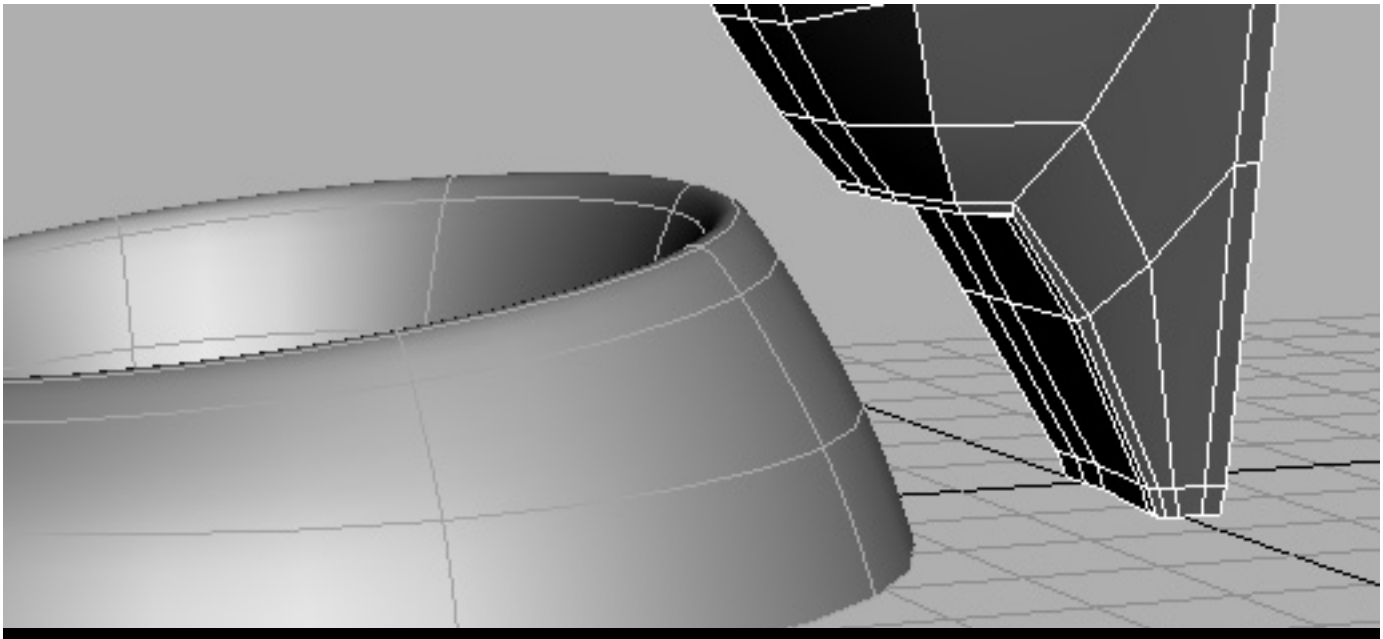
The volume button too is a separate object, which was put into place. Here, extra edges are needed.



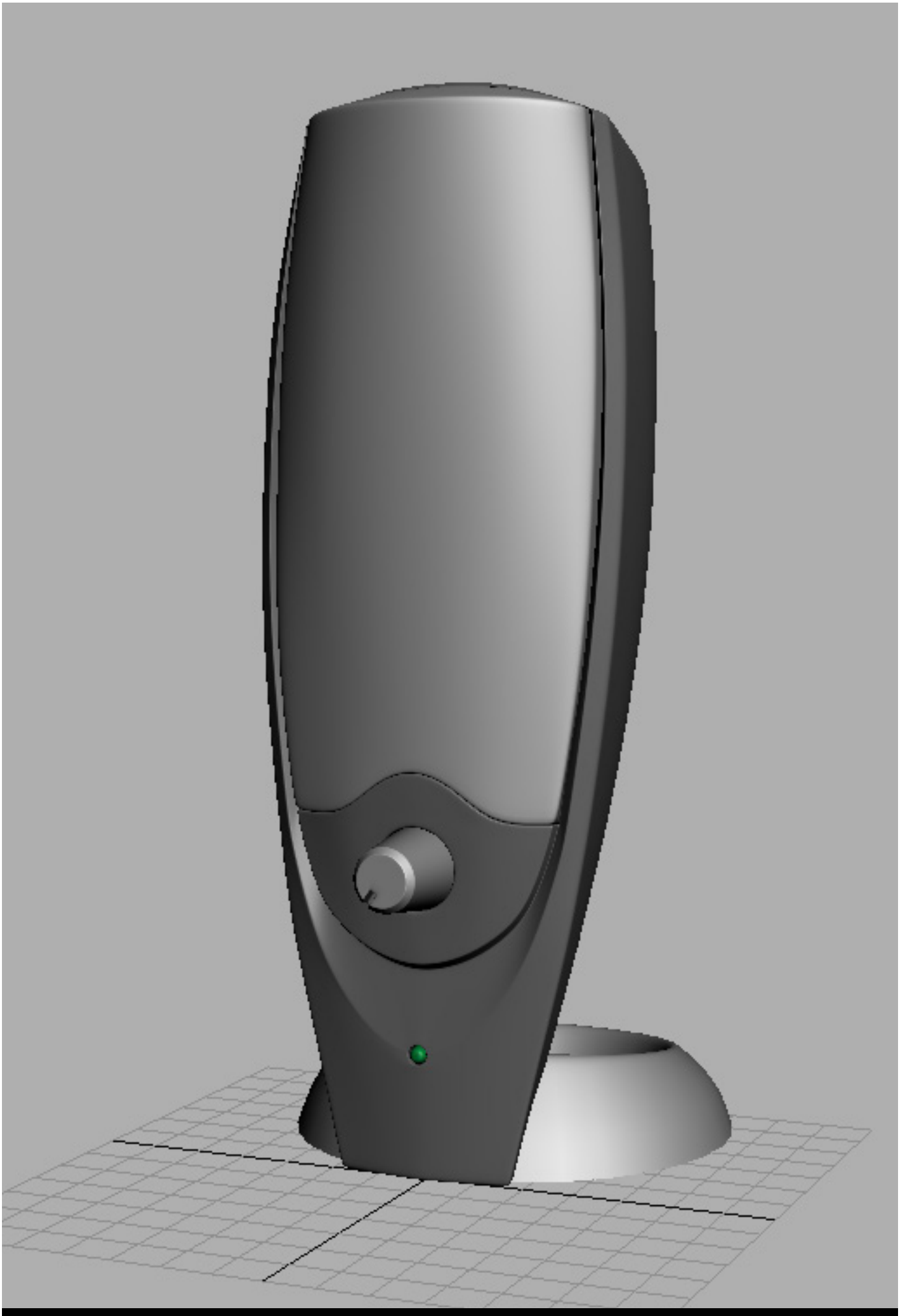
On page 8, we still had a non quad. This is now solved.



The base was regarded as a separate object. Started from an 8-sided cylinder, which was built outwards with some extrudes and then back inwards. The polygons at the inside were removed.



The shape at the back of the speaker was also modeled and should follow the curve of the base.



The end result in the viewport. Look again at your mesh from all sides and check if the edges are flowing perfectly. Now all that remains is adding lighting and providing the right materials.

ADD A RECTANGULAR DETAIL LOCALLY

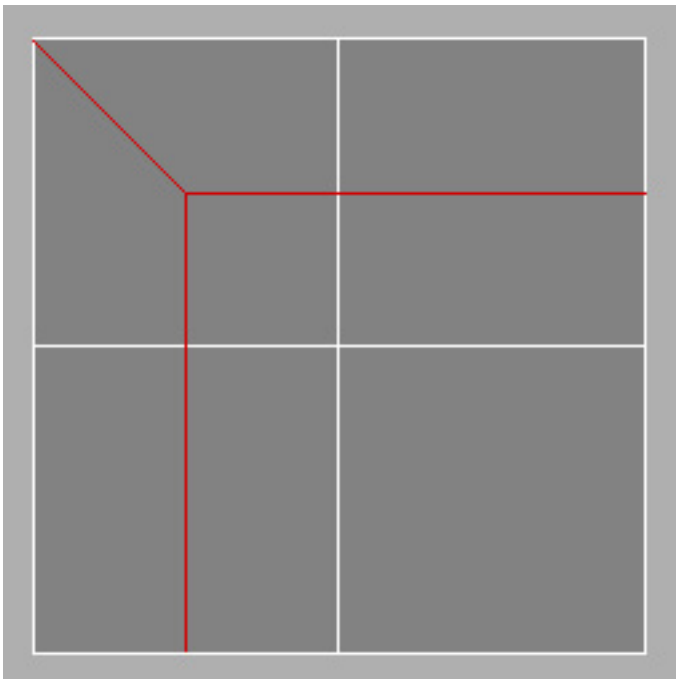
In the previous part of the course, we have already seen how you need to cut a hole in your mesh, and thus locally adding more detail without the entire mesh.

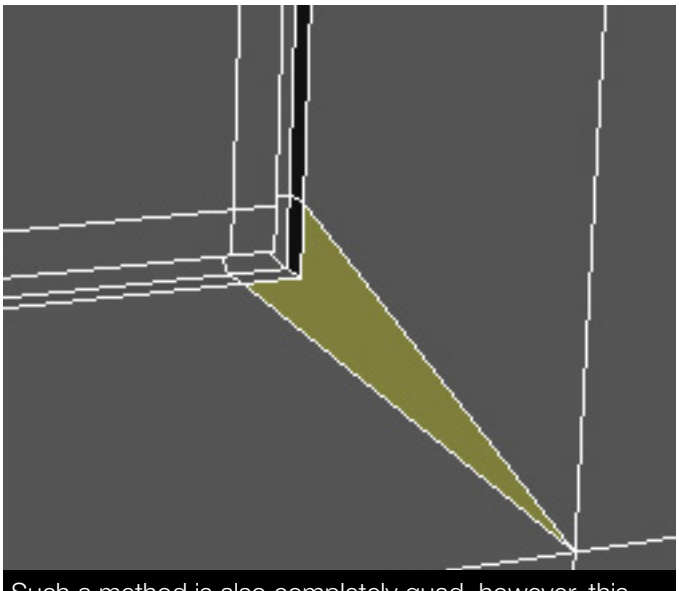
However, what about a rectangular shape of which the corners are slightly rounded?

The best way to do it is based on the technique described hereunder. It does require that you cut through the entire mesh; however, you can avoid this by locally placing EVEN MORE edges.

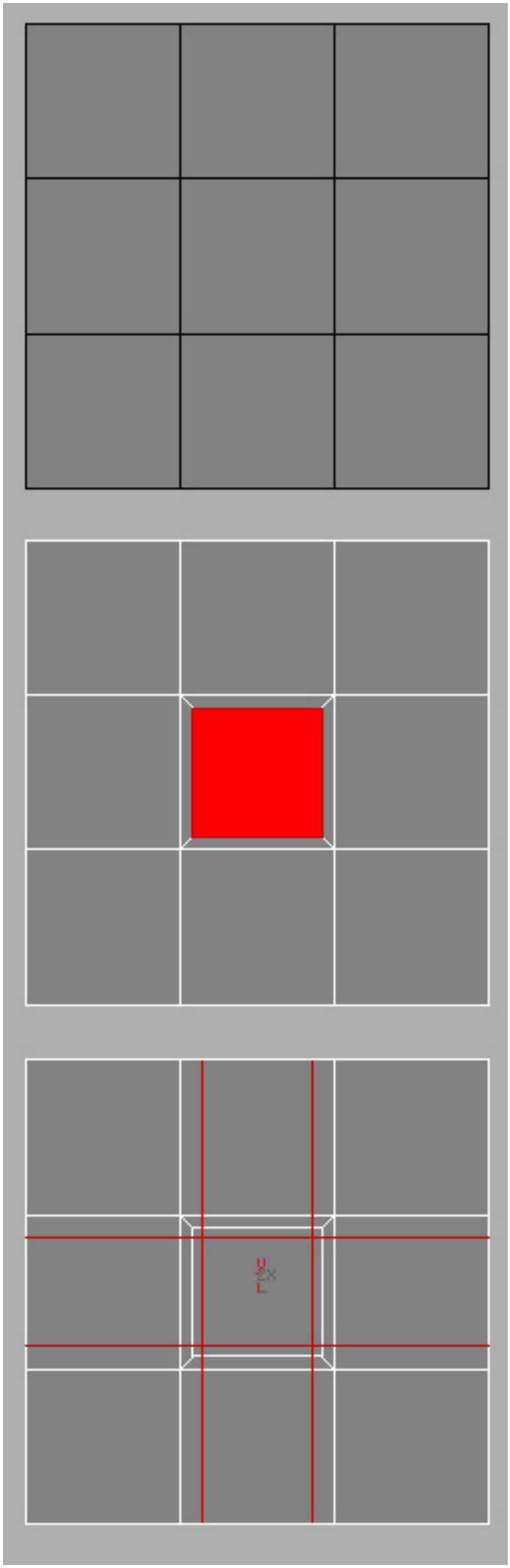
Then, you can weld vertices together and collect them in one pole. By removing the middle one of the three edges, you obtain a “false triangle”.

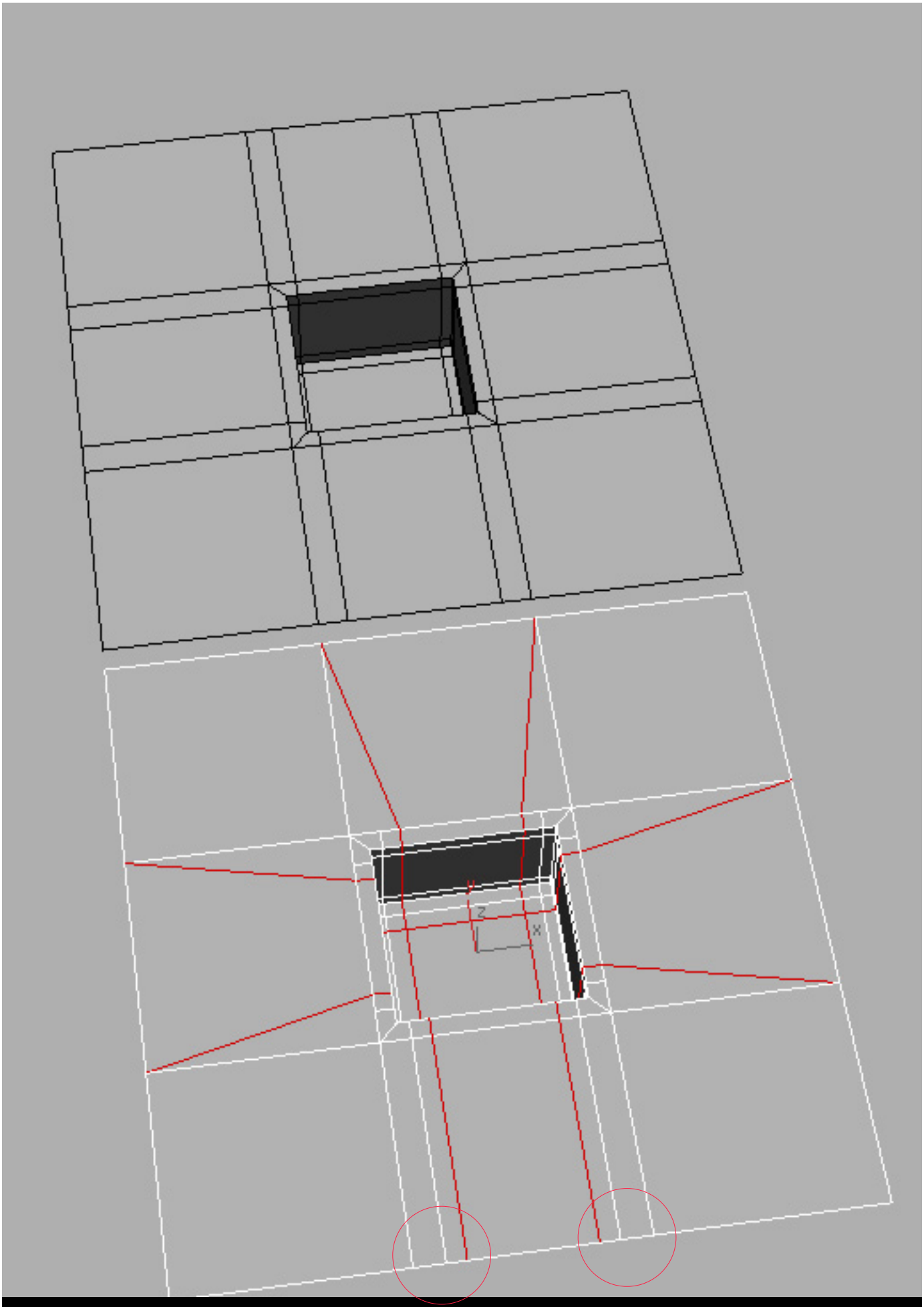
Adjoining, you see a theoretical approach of the problem.





Such a method is also completely quad, however, this is no well-shaped quad (“arrow quad”) and causes bad smoothing.





Top: the loops, which go throughout the entire mesh.
Bottom: additional loops are cut so you get 3 edges next to each other. You can take 3 obtained vertices together and remove the middle edge. In that way, you get a “false triangle” and the detail has been kept locally. We need to mention, though, that the bottom solution is not that ideal when the starting surface is bent. The poles cause pinches.

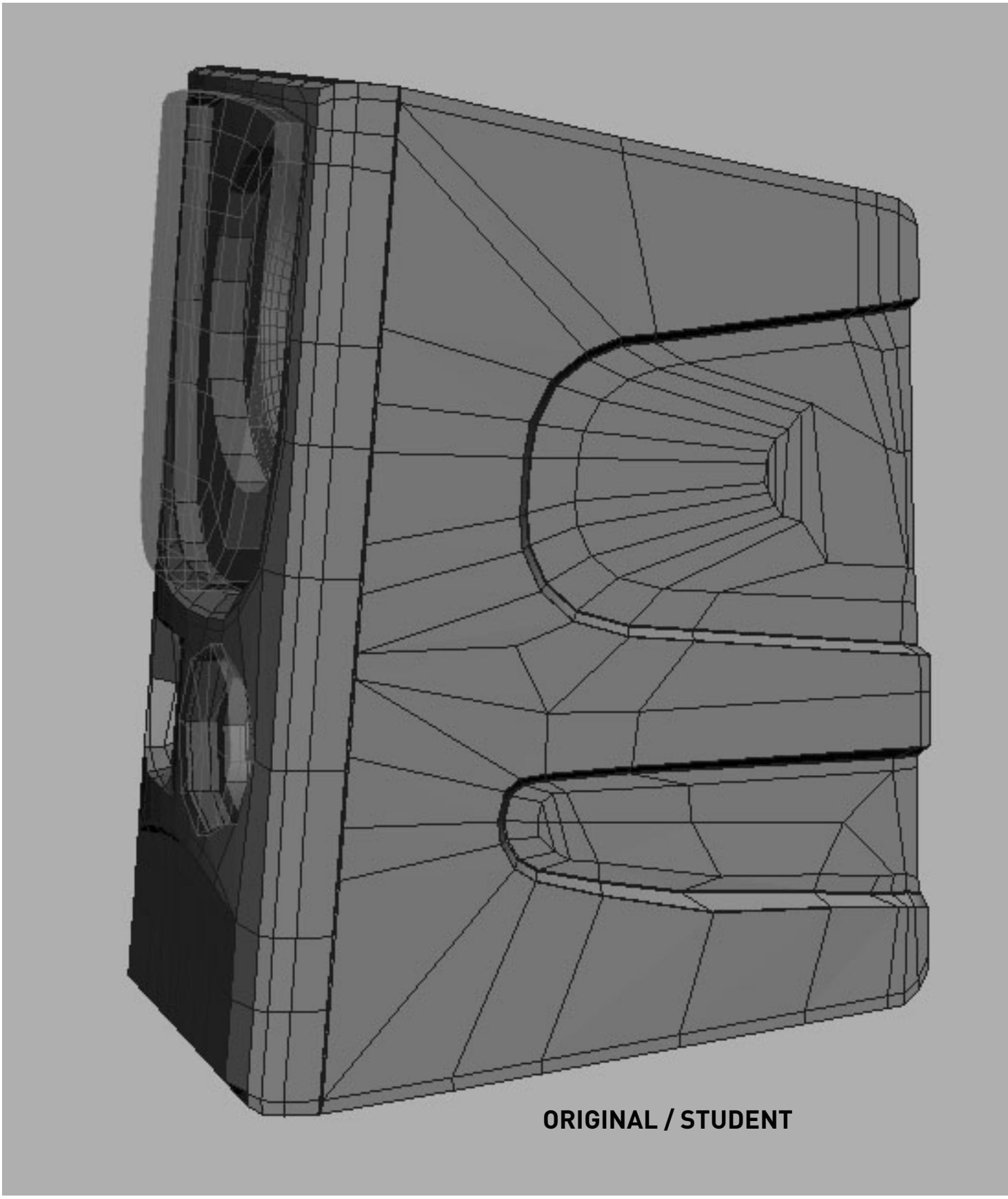
STUDENT PROJECT 1 REVISED

This is the project of Robin Haudenhuyse. Obviously a great render since he was able to persuade the viewer that it is “real”.

On the pretext of “everything can be better”, we are going to scrutinize his mesh to see what can possibly be improved.

We will only look at the structure of the mesh; the materials, the lighting and the render are beyond reproach. For your information: it took me just under an hour to adjust the mesh; thus it has not been remodeled.


SURROUND
ON/OFF
POWER
VOLUME
BASS
TREBLE



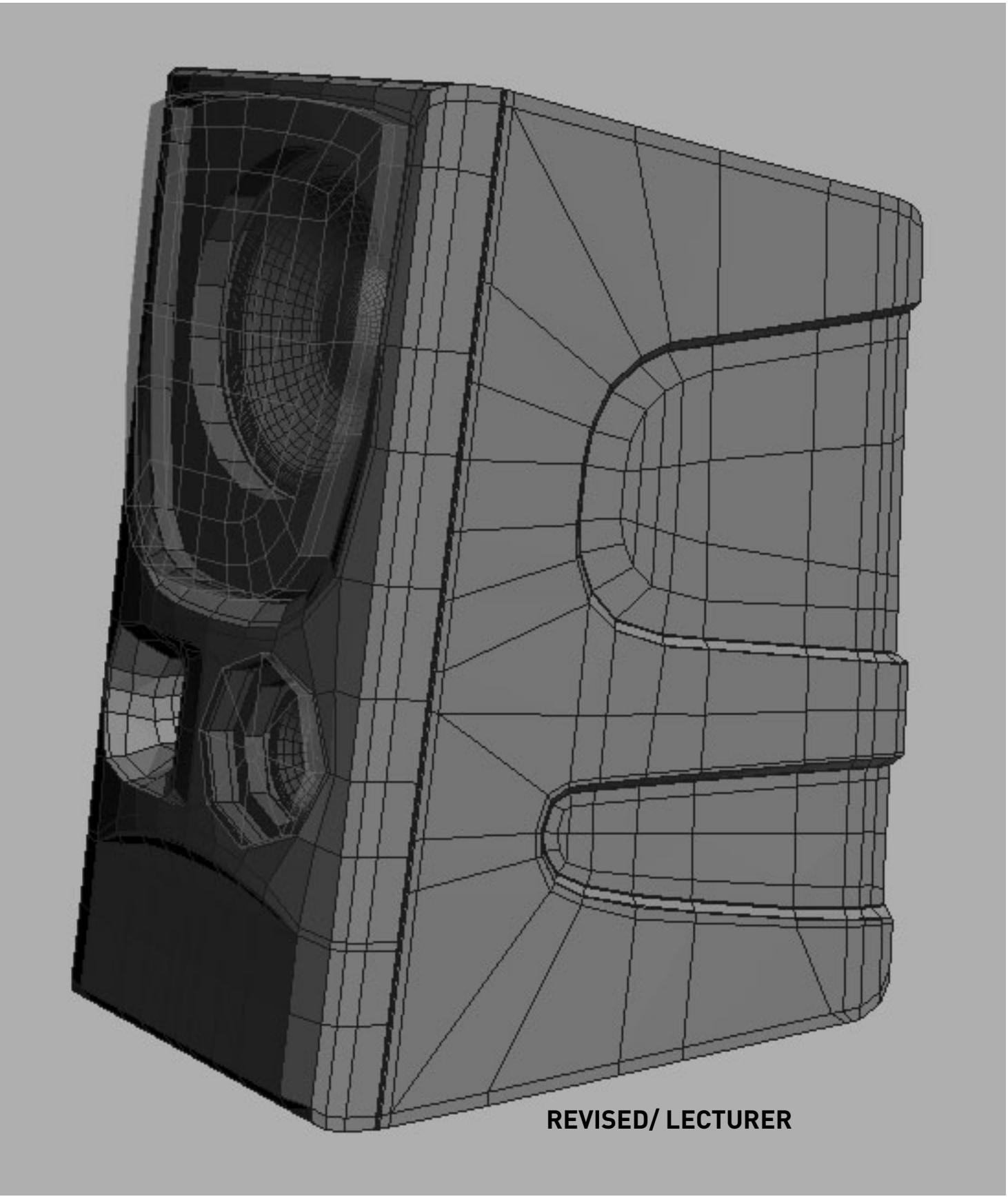
GOAL: HAVING CONTROL

In the figure above, you see both meshes next to each other. At the left hand side the original of Robin, and at the right hand side the mesh that was adjusted by me. What immediately catches the eye is that the side of the original model looks somewhat messy, notwithstanding that it does not show in the render.

What we are really after, is that as a modeler, you need to control your mesh, so you can quickly adjust something (by means of edge loops for instance); so that roundings of specific parts in the model are uniform, so that the TurboSmooth will not "pull" more in a certain place than in another.

Maintain overview

Of course, knowing what you are doing is also important. Why are you adding a certain edge to your mesh, what is its function and what effect has adding that edge on the



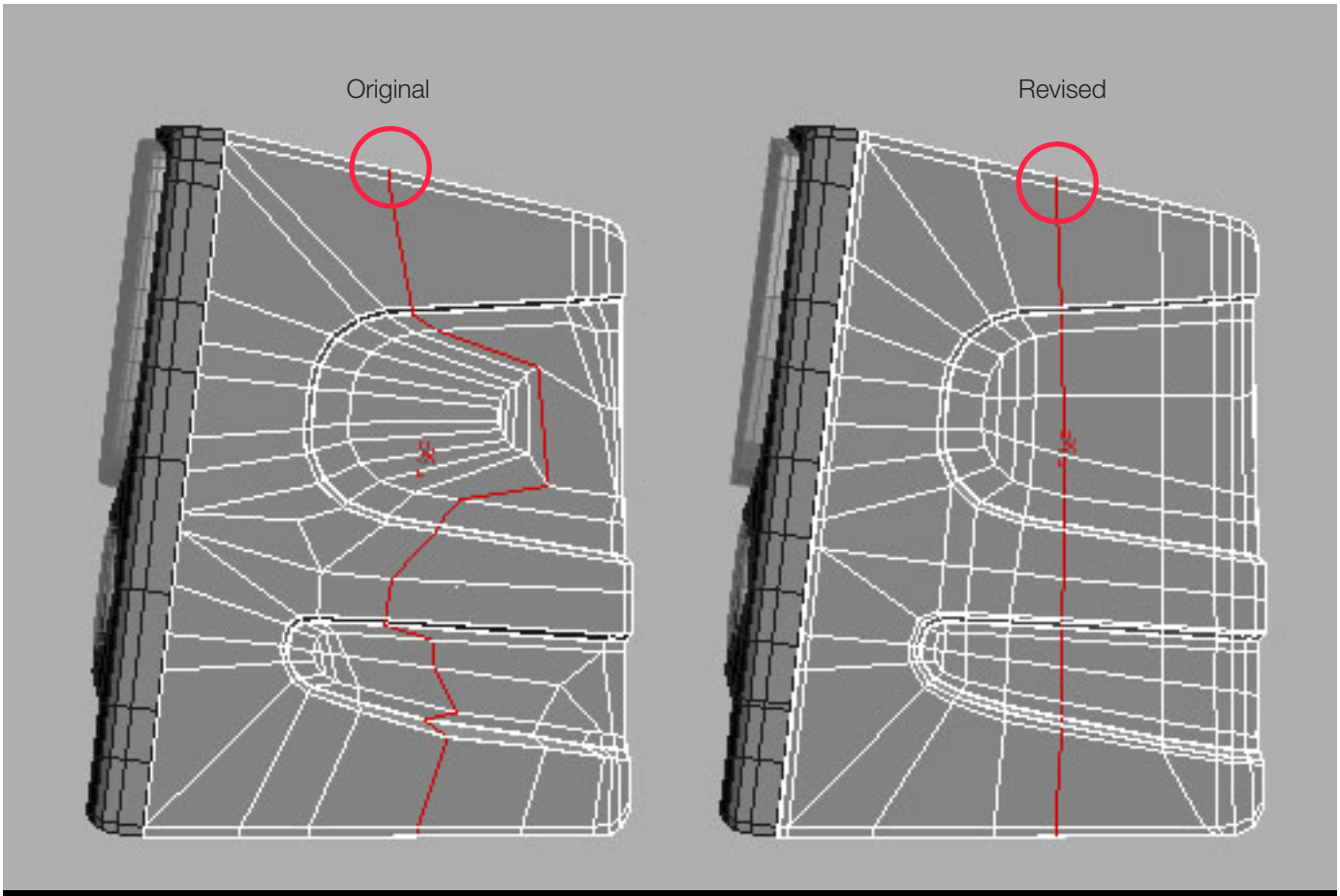
adjacent polygons?

It is very likely that the edge will not be placed correctly right away, thus you want to be able to quickly move, adjust or remove it.

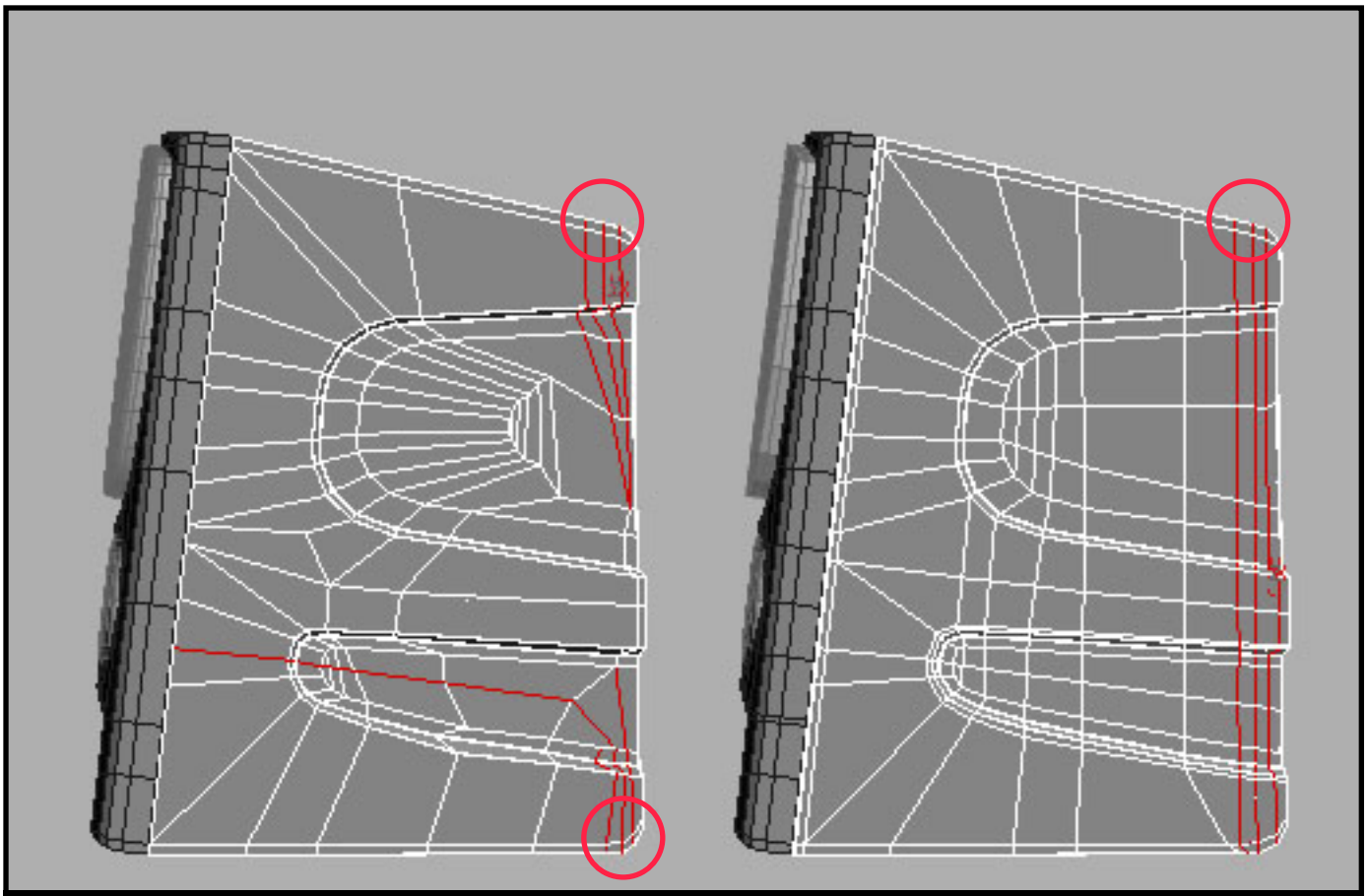
Try to maintain an overview of what you are doing. First of all, you do this by working really structured and neat. When you want to have more detail at a specific place, bear in mind the adjacent polygons and look where the added edges can run to. Sometimes, you can connect an edge with a vertex, sometimes you will have to draw an edge completely through to the edge or a hole of your mesh, or you can divert it to the symmetry line.

Legibility

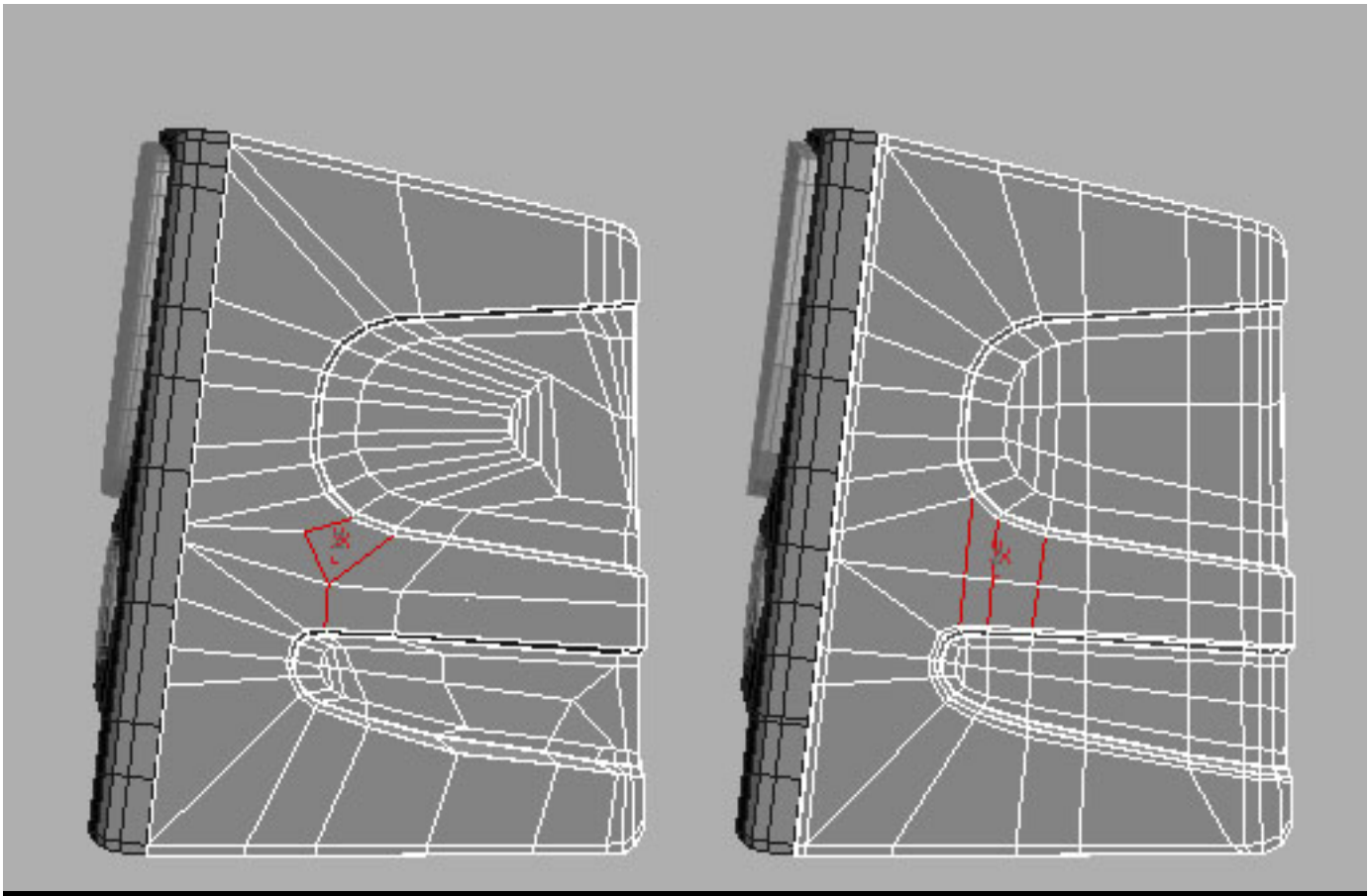
When you keep your mesh clean, it will also be more legible and it will be easier to see what is going on. You will get frustrated less quickly than if you have to work in a mess.



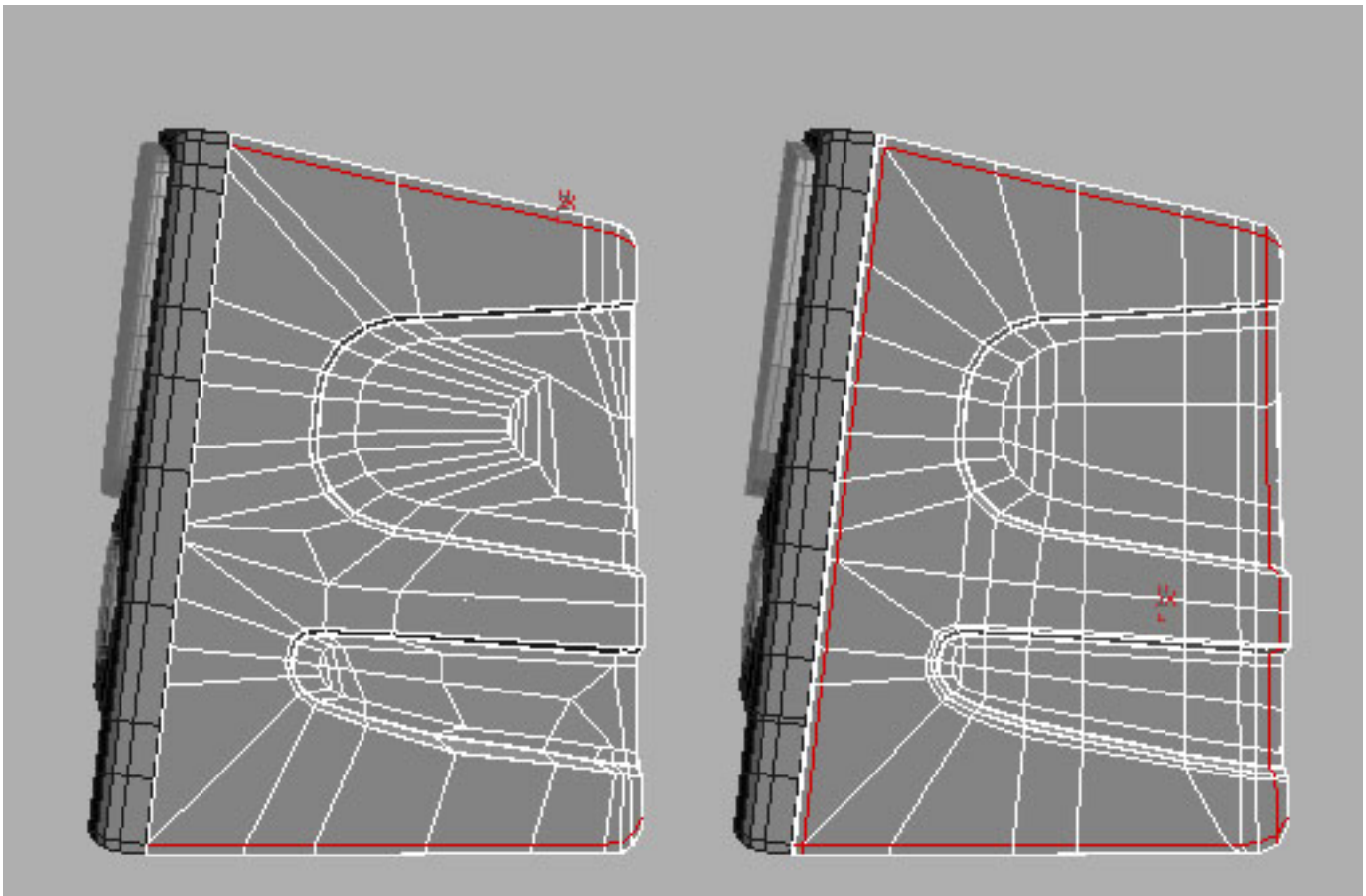
On both meshes, we have selected the same edge on top (where the small circle is) and made a “loop” selection. You clearly see that the edge on the left runs zigzag through the mesh; this makes it difficult to move it if necessary. The legibility of your mesh also deteriorates.



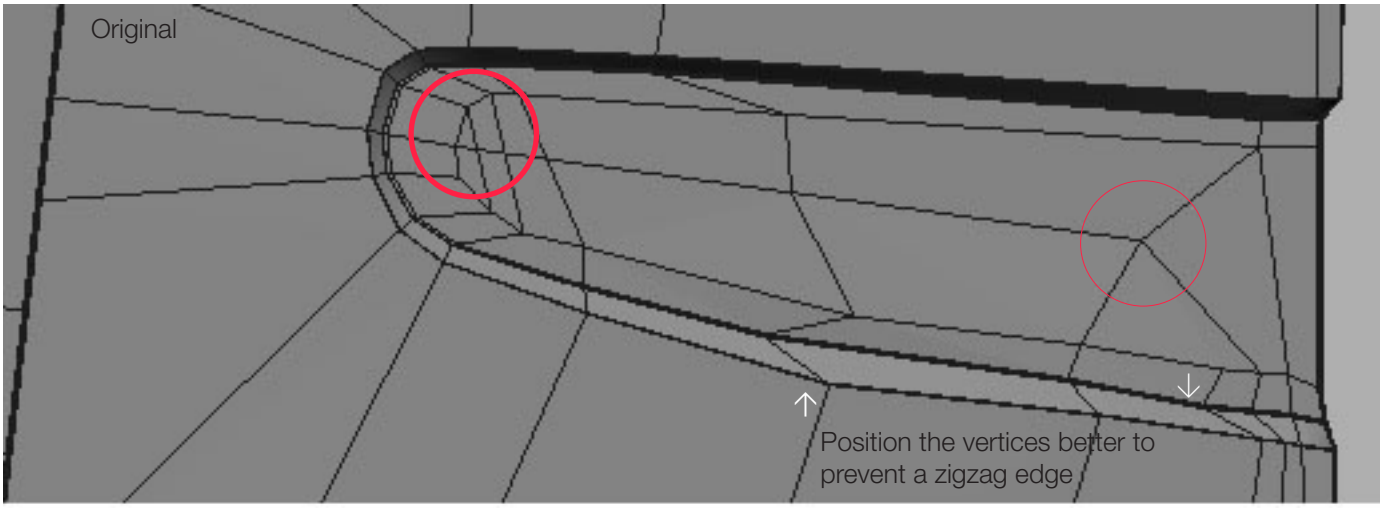
Again we have made a loop selection, however, now at the back side. On the original, we see that the loop at the top suddenly stops and snarls up in a vector. Therefore, we also take a look at the bottom; and here too, the loop bears off completely or stops. At the right, the loop flows through the mesh and we can quickly select or move separate edges.

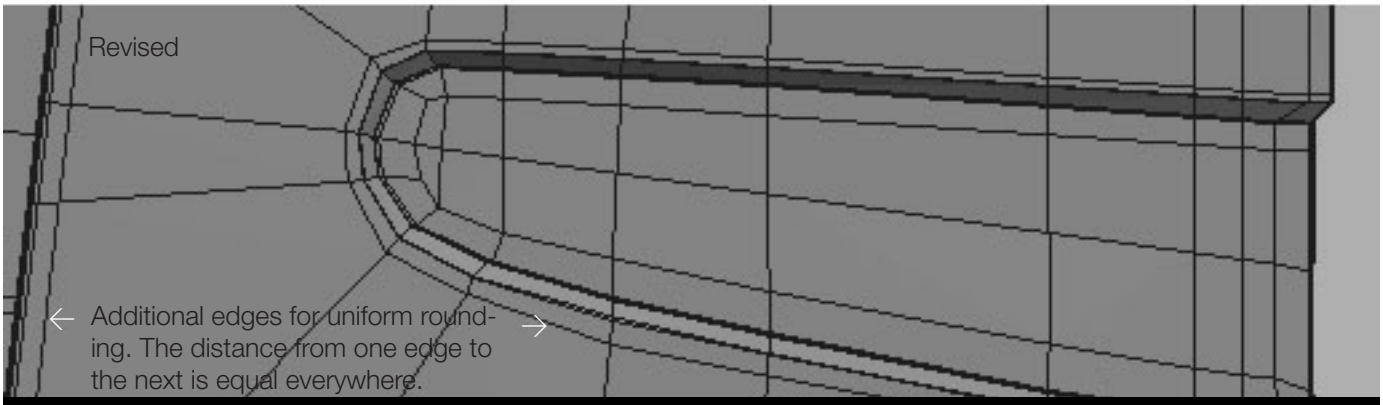


We have two clearly bent chamfers in the mesh. Thus with both, you need a number of edges to put the necessary detail. That is why it is not so bad that they share some of those edges. So we have connected the two arches, and in this way we have made loops again (they run farther than what is indicated here).

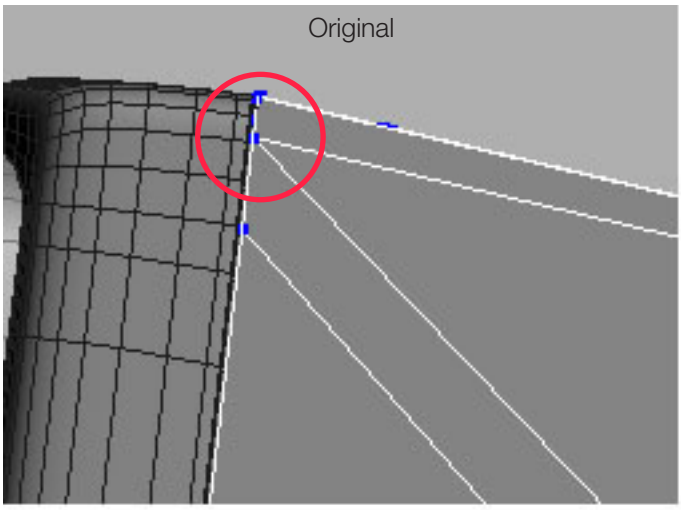


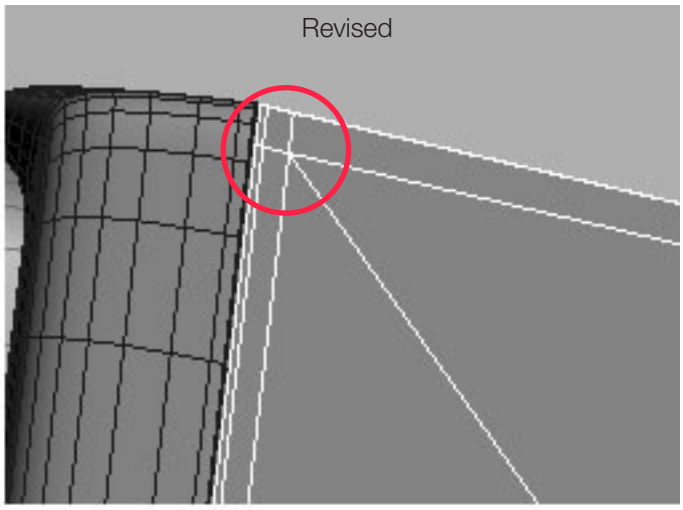
We want the rounding at the edge of the product to be the same everywhere, so we put an edge around the side of which the distance to the exterior is everywhere the same. (We also do this for all sides of the mesh). This again allows us to quickly adjust the rounding if necessary. Another great advantage: NO POLES ON THE EDGES.

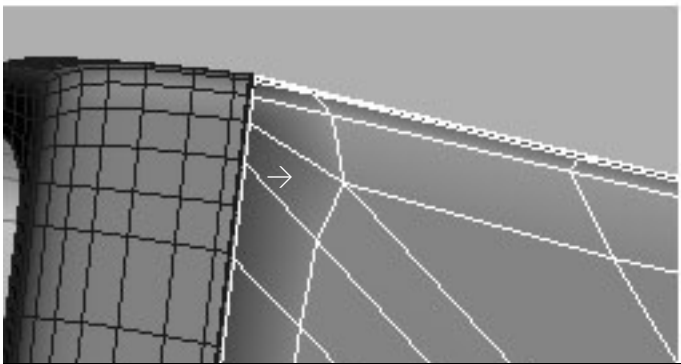


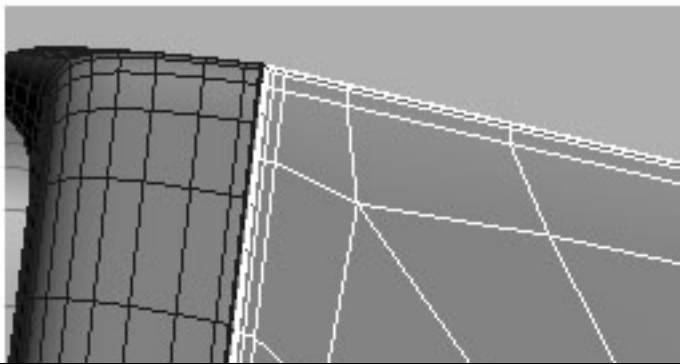


In the circle, you see a triangle, which was removed by adjusting the edges differently and by adding an edge upwards. Also notice that the center line in the top figure suddenly is bent (right circle); just let it run through, even if this means more polygons. This increases the legibility.

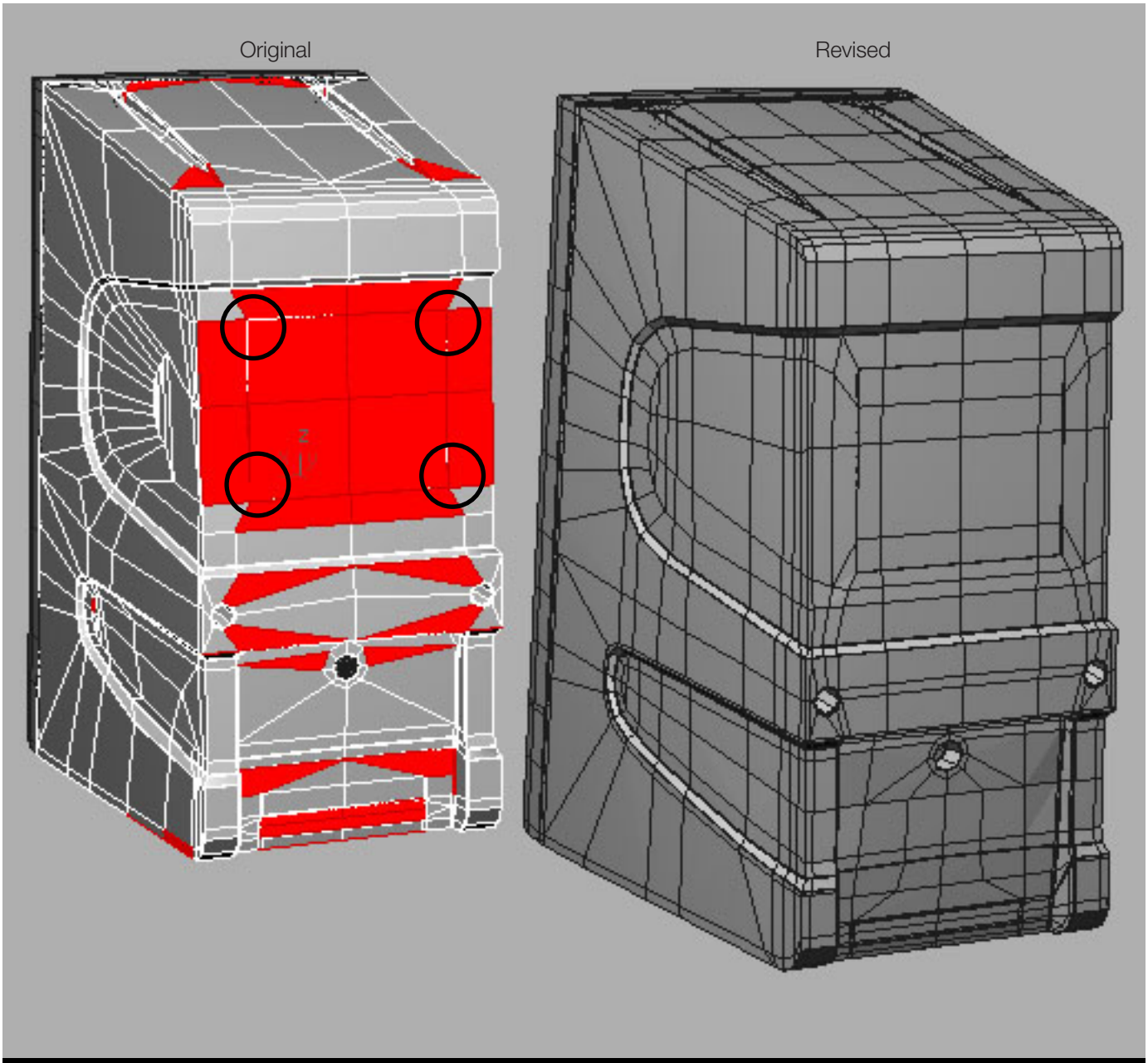




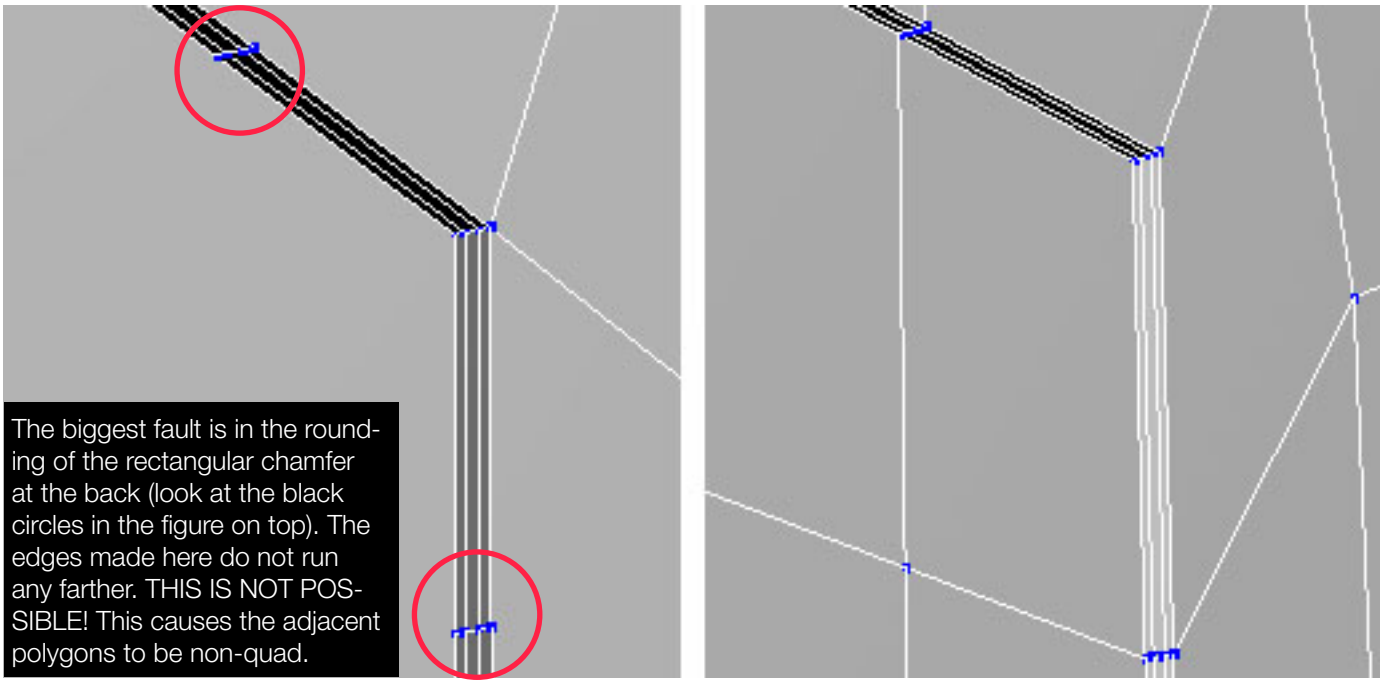




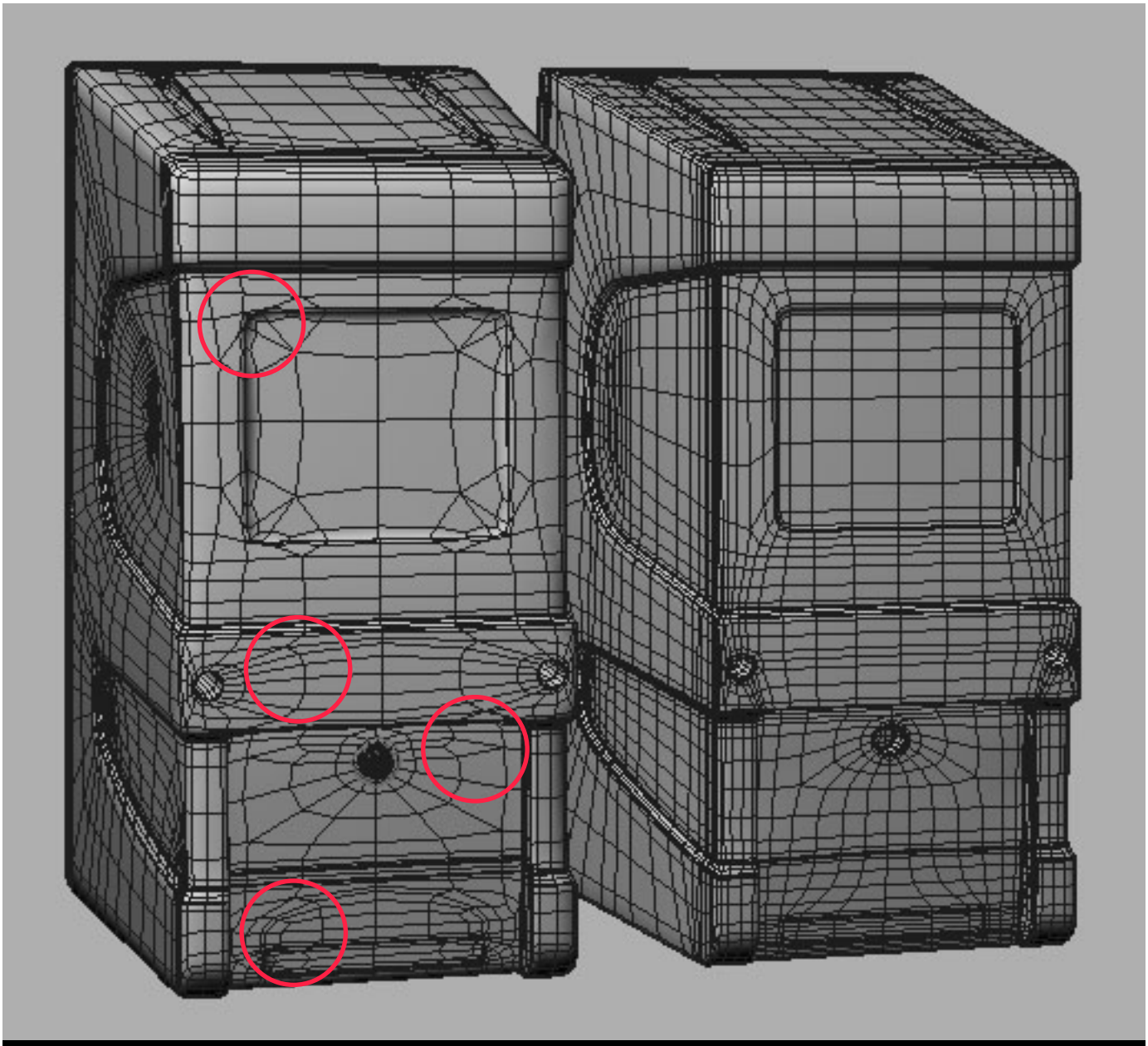
In the original, there is a pole on the edge of the mesh. When you look at the version below, on which the TurboSmooth is placed, you see that the rounding is not the same everywhere (grey shading). In the adjusted mesh, next to the first edge, an edge was added, which runs throughout the entire mesh and the pole was moved to this edge. In that way, the rounding is equal everywhere and the pole is in a less disturbing place.



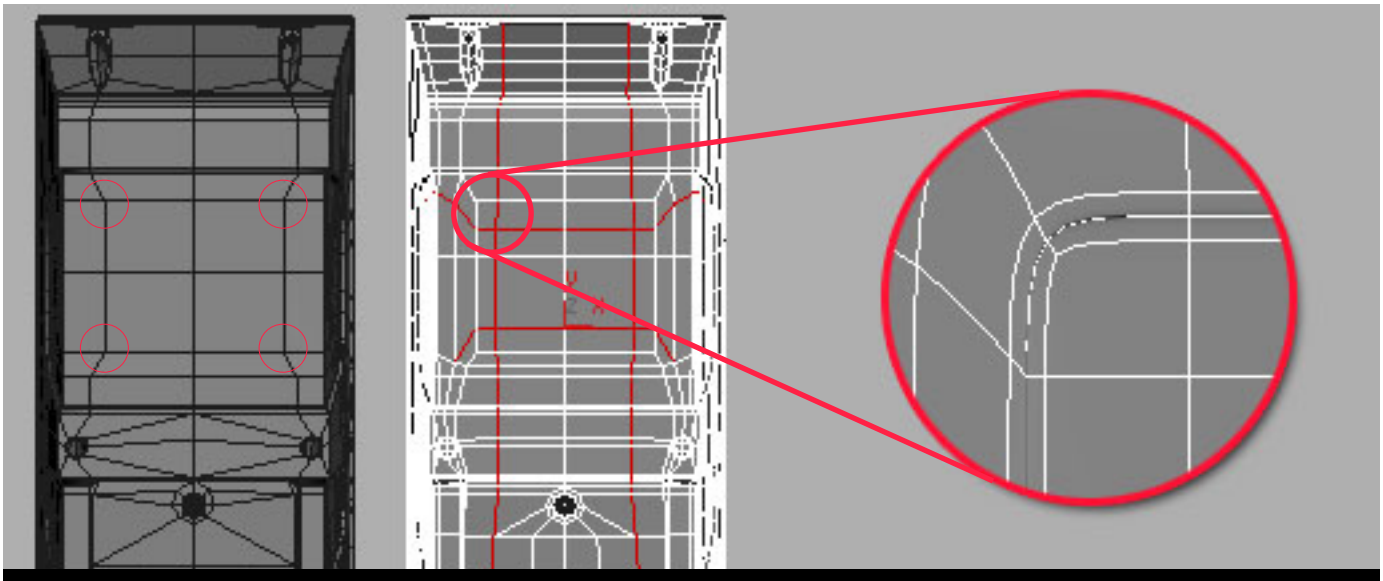
At first sight, the mesh at the back looked ok, until we checked which polygons are not quad, but triangles (Tris) or Ngons. This turns out to be quite a lot (82 in this part of the mesh, the front panel with the speakers is not included in this mesh). The adjusted version has no non-quads.



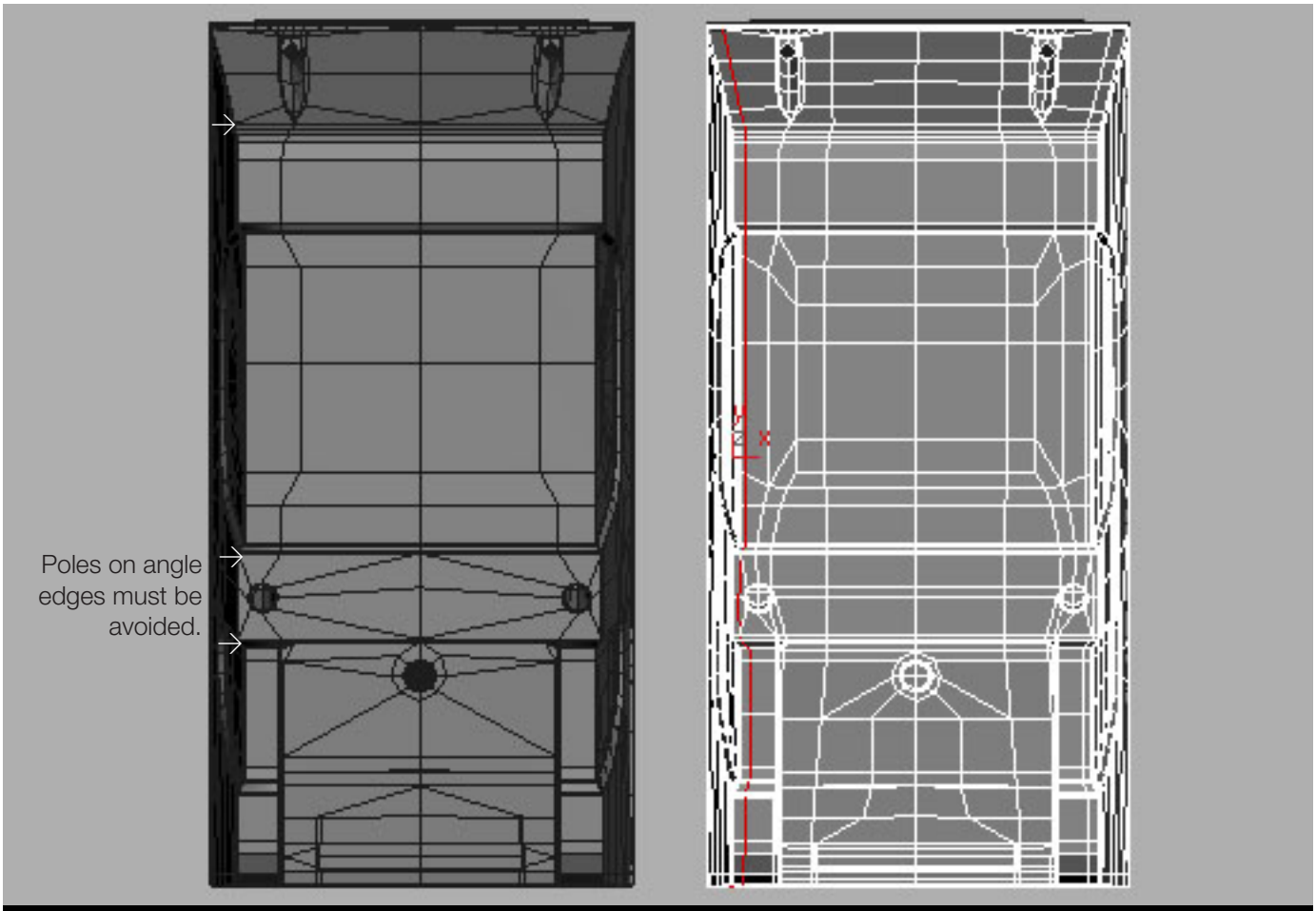
The biggest fault is in the rounding of the rectangular chamfer at the back (look at the black circles in the figure on top). The edges made here do not run any farther. THIS IS NOT POSSIBLE! This causes the adjacent polygons to be non-quad.



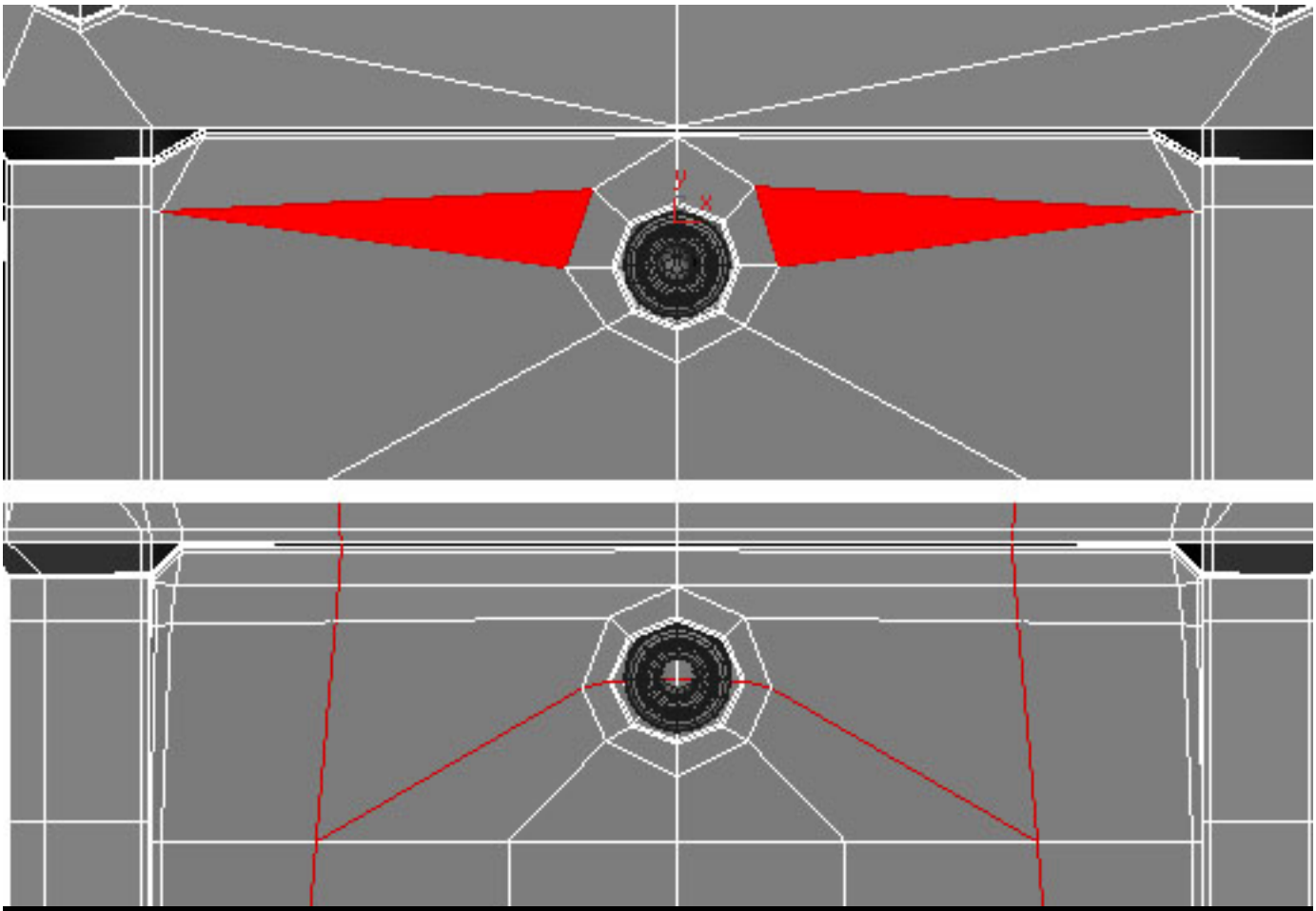
Notice how the TurboSmooth in the left mesh takes strange shapes: the edges do not run nicely through and there are pinches, which causes that the rounding is not equal everywhere. In different places in the mesh too, some edges are strangely twisted while they can actually run nicely straight through. You see that in the adjusted mesh, no additional edges have been created.



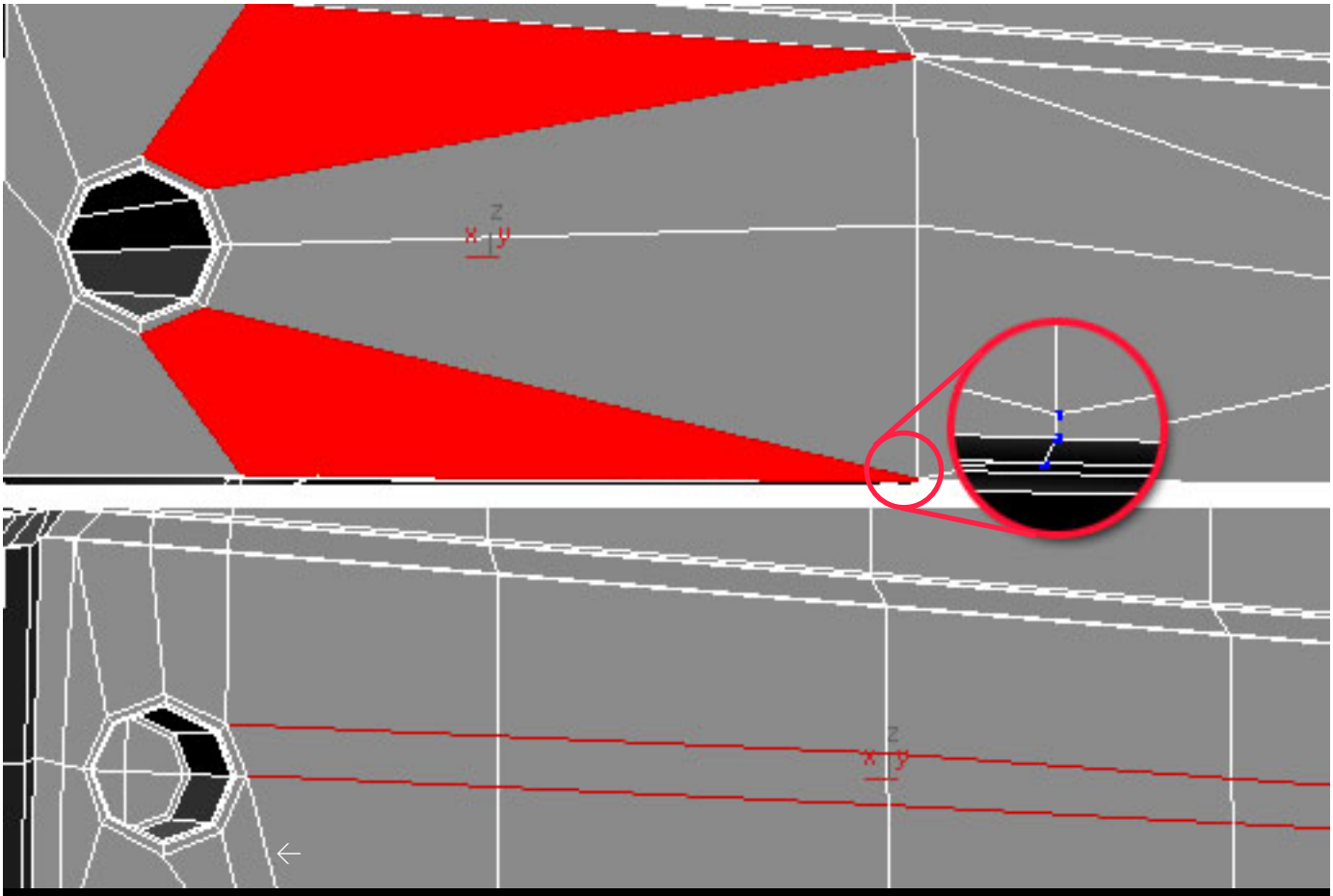
To let the rounding run smoothly in the 4 vertices, additional edges are being cut. These run through the entire mesh (this is not really necessary; however, I can still use these later on). By selecting and moving these edges, I determine how rounded these angles must be.



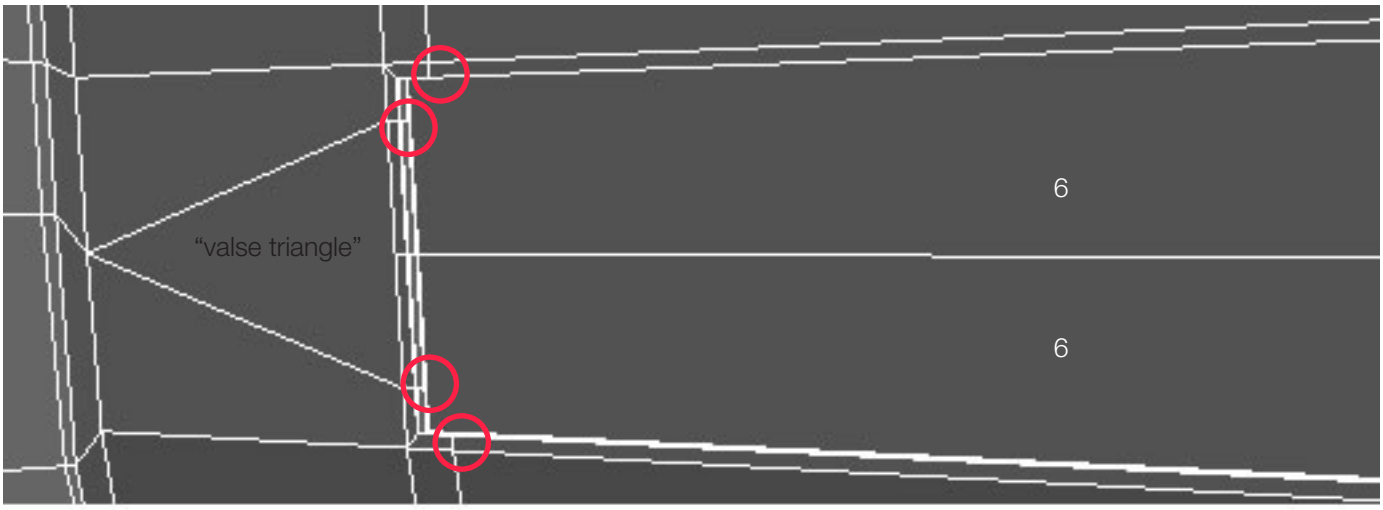
Again, an important edge is missing in the original. Place an edge against the edge of your mesh; it serves to manipulate the rounding and to set off poles, so they cannot be against the angle edges.

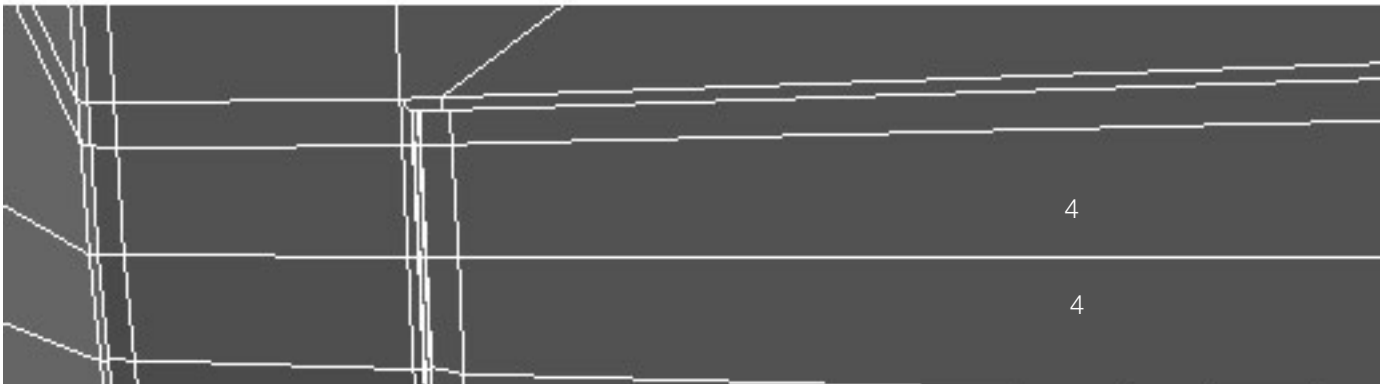


In the original mesh, there is a triangle. We can use the vertical edge we cut throughout the entire mesh to solve this problem and to make everything quad.

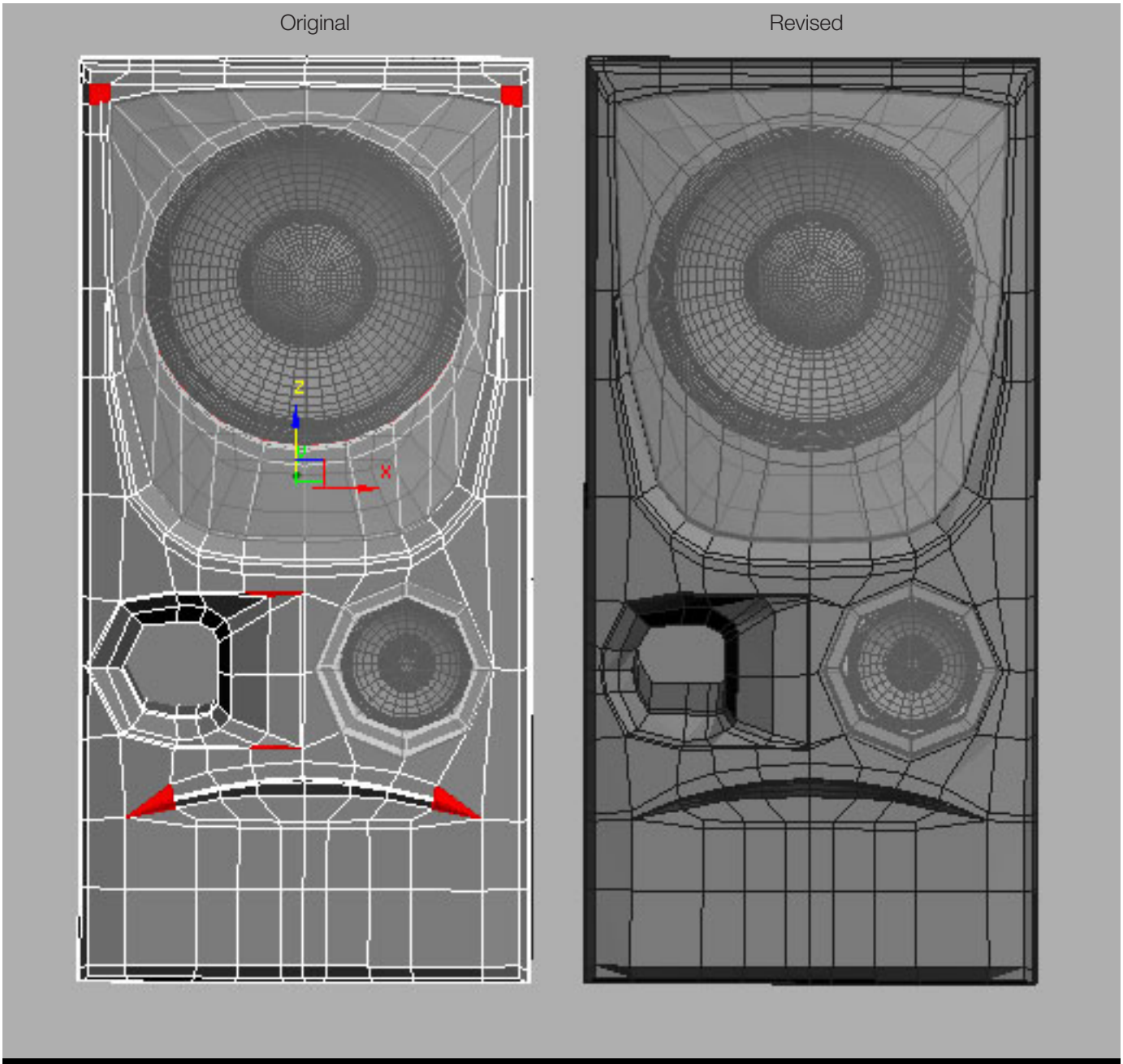


At first sight, the red polygons seem quad. However, when you zoom in, you see that the vertex is actually composed of two points, which really make it pentagons. I let the edges run nicely horizontally and at the bottom of the circular chamfer, I let the edges run down (farther down, they will come in handy anyway).

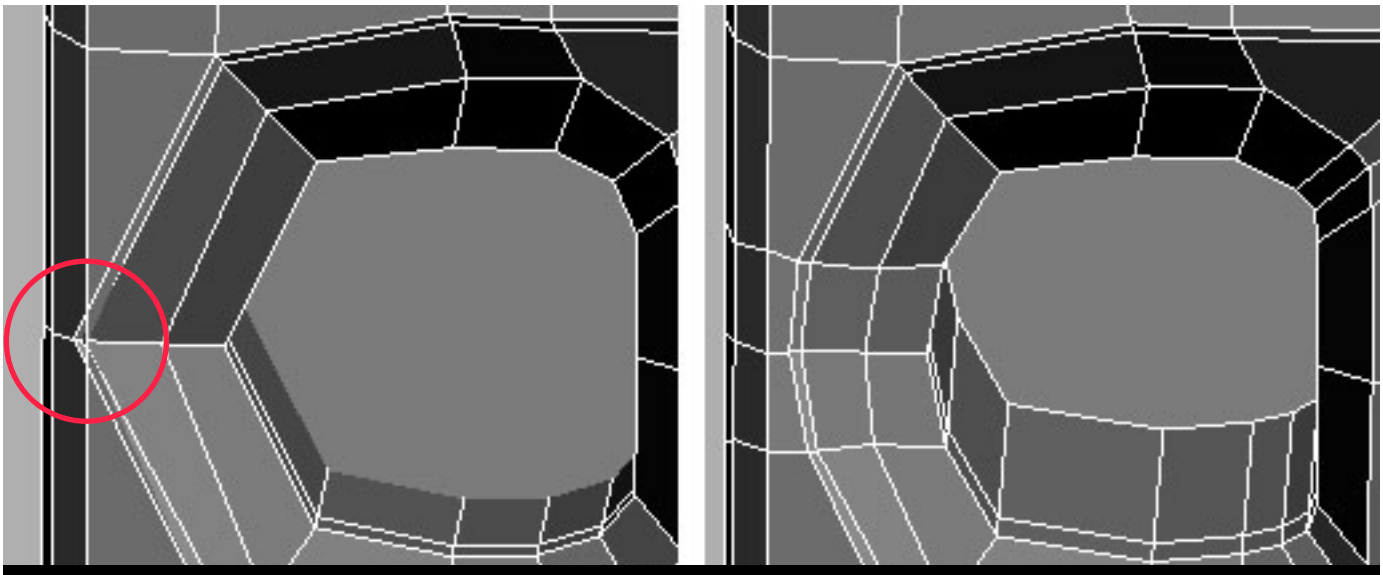




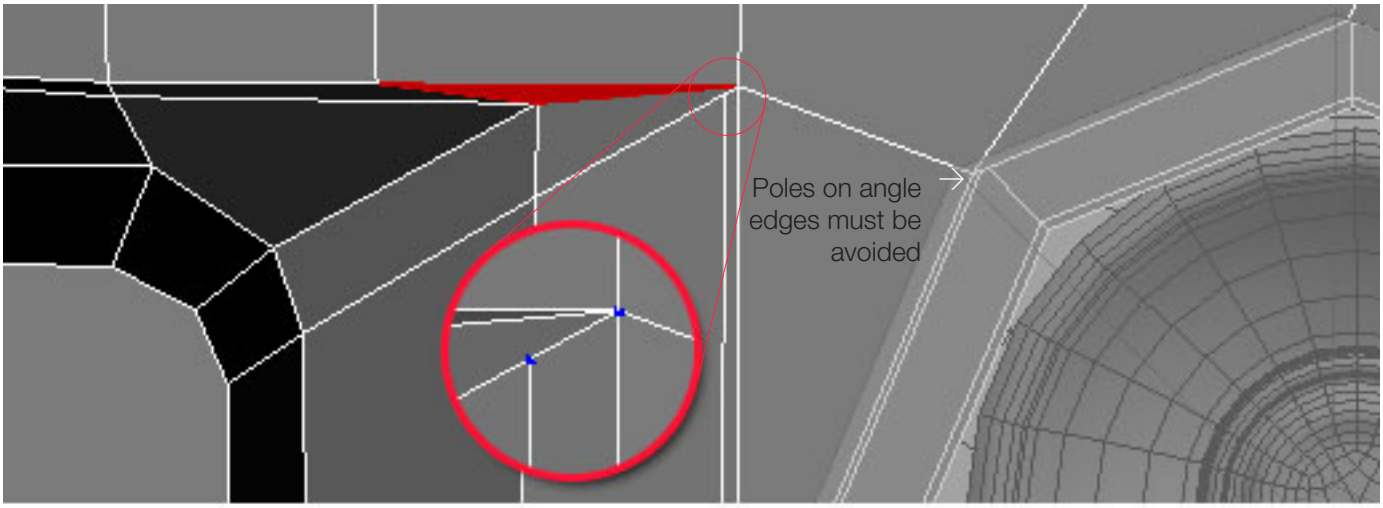
Edges that suddenly stop can NEVER occur. Either an edge goes around (loop), or it ends in a pole. Why not simply trace through the edges? And that "false triangle" is a nice try in theory; however, it was not really necessary here.

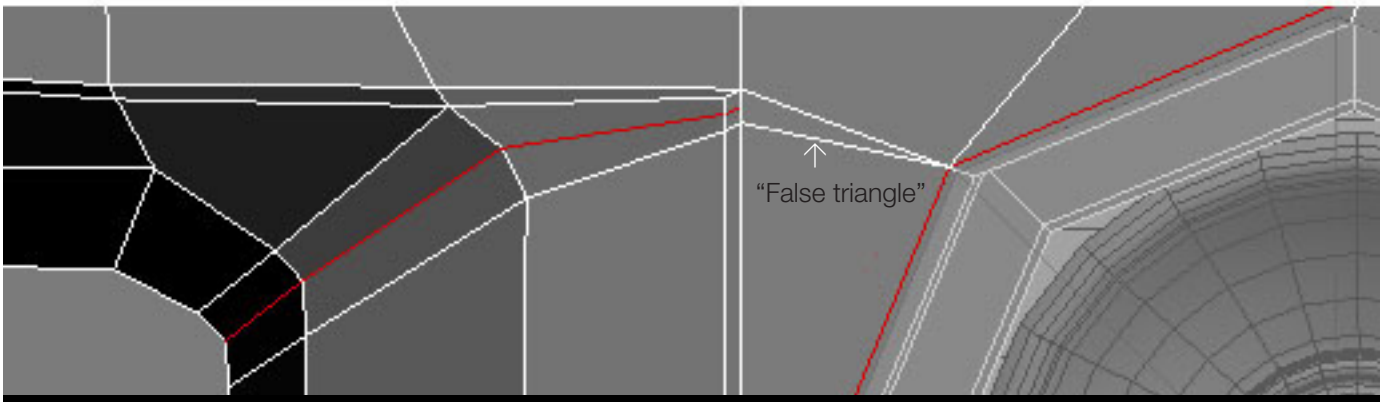


Let us take a look at the front panel and check where there are non-quads. This is not so bad. Something else attracts my attention, though. See the detail hereunder.

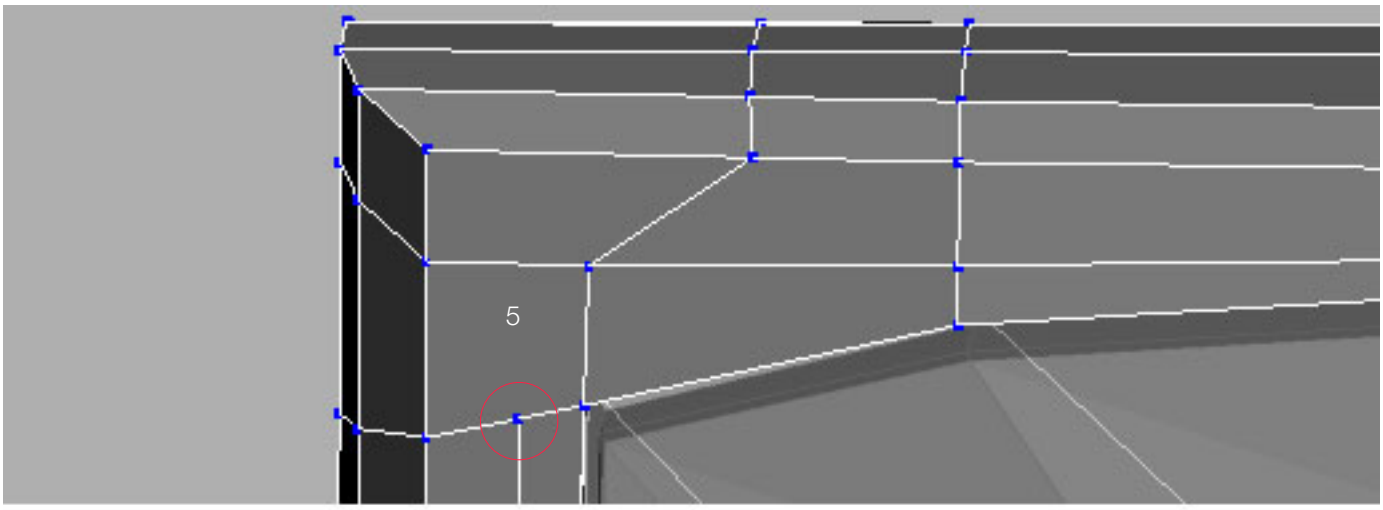


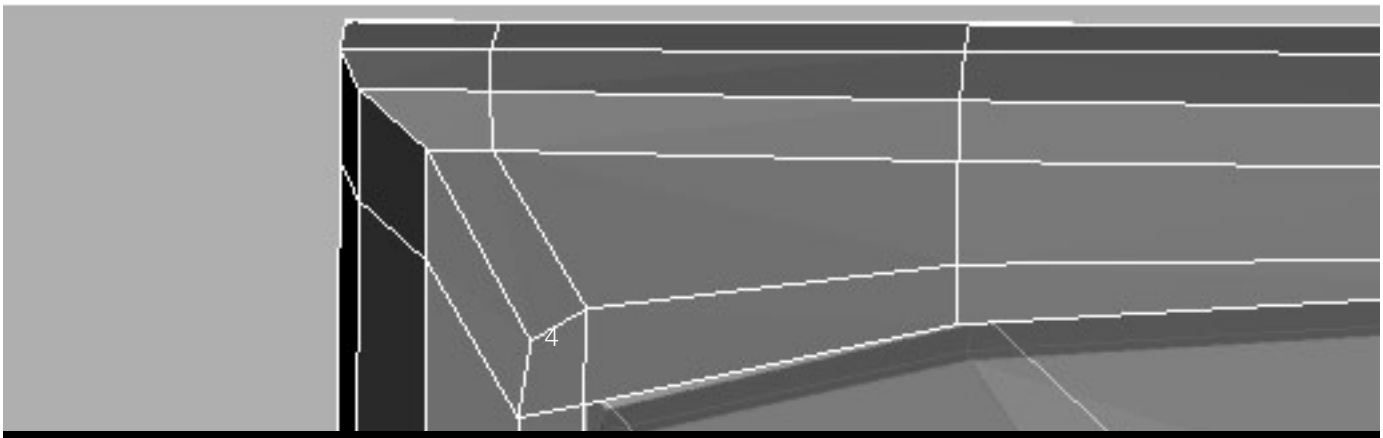
At the opening in the front panel in Robin's original mesh, you see that the polygons are in a jumble. Probably, the TurboSmooth will round this correctly, however, it is not very clean, and with a couple of additional edges, this problem is solved.



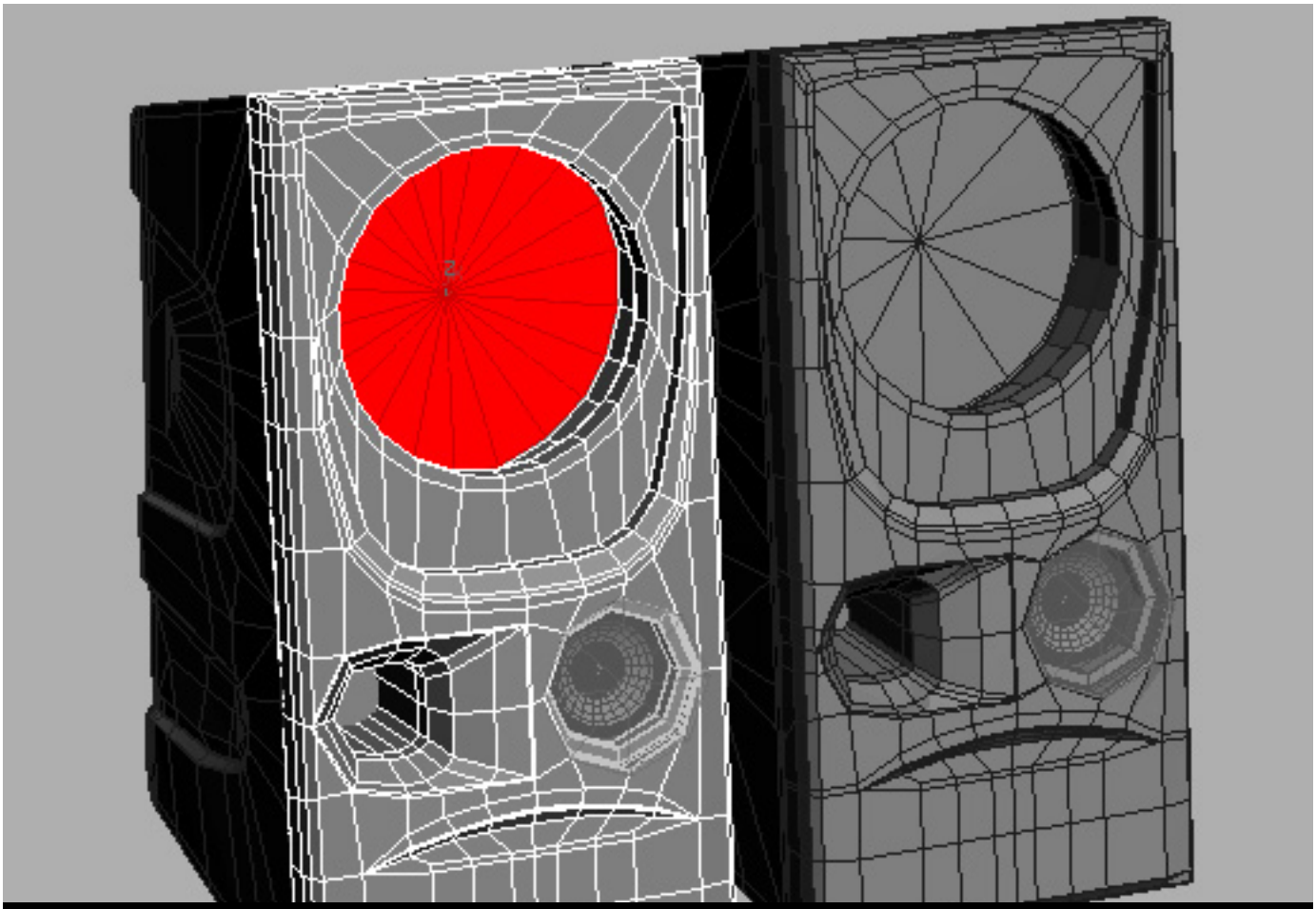


In this case, it is important to first of all place an additional edge around the speaker opening, so you can place the poles more inwards. Via a “false triangle”, it was possible to have an additional edge, which was needed to create the necessary detail.





An edge can never just stop: either it makes a loop, or it ends in a pole. Thus here, we have a pentagon, which causes problems.



The inside of this speaker exists of a number of little triangles. This is quickly solved if you move every other edge. This problem is perhaps not so bad; however, it can be solved so that everything is quad.

CONCULSION

Selecting via Loops

Now the mesh is adjusted, much more edge loops are created in the mesh, so you can select much quicker.

Manipulating

The mesh is now adjusted, so you can manipulate things much quicker. If you want to, you can very quickly adjust roundings and manipulate the size of certain shapes.

Legibility

Thanks to the adjustments, the legibility of the mesh has much increased. Thus, you can easily make your way in your mesh and you become less frustrated.
You do not get lost anymore in strange twists that run through your mesh; which cause for you not to see the vertices through the polygons anymore.

Everything Quad

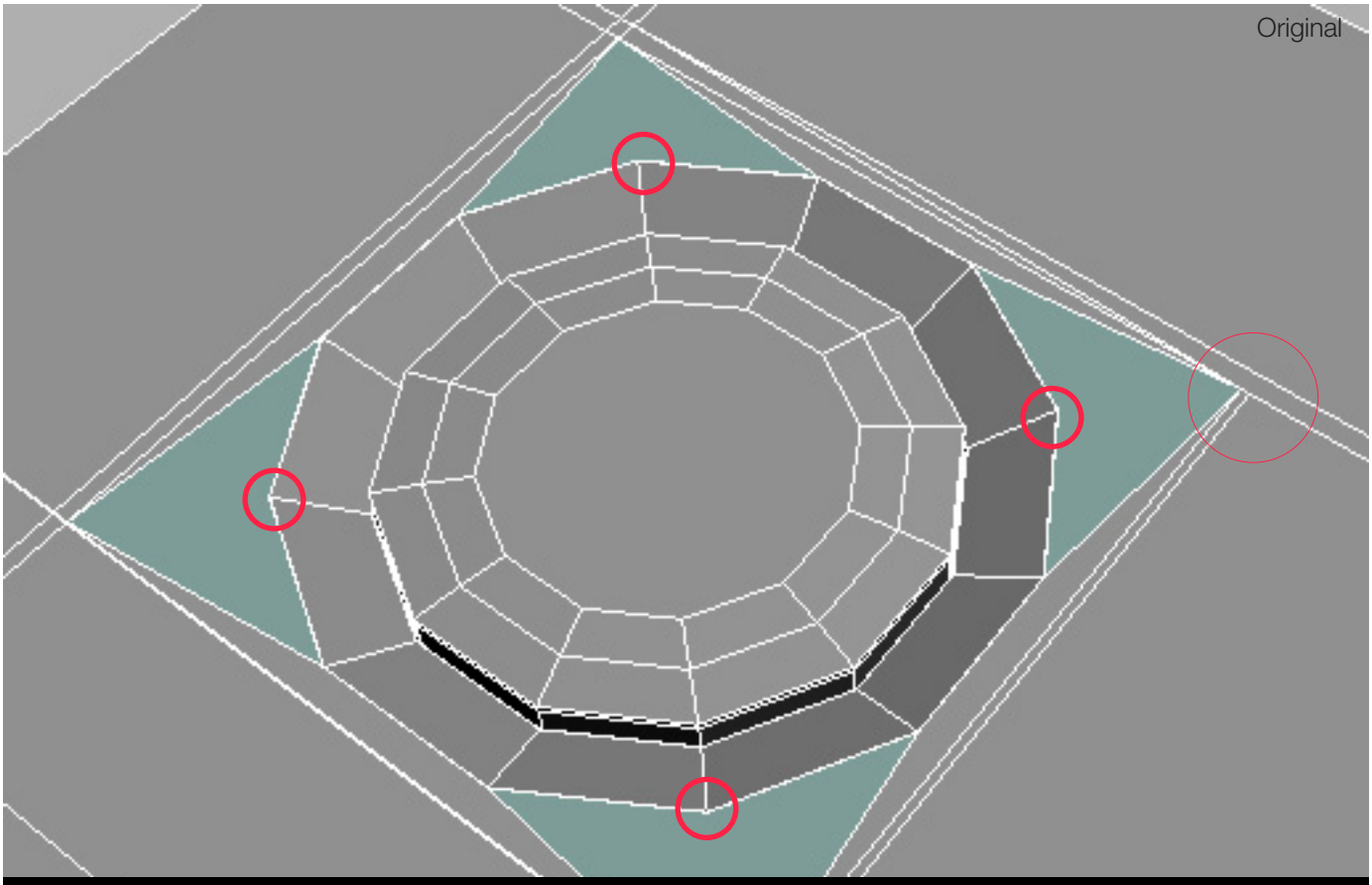
By the way: everything is quad and this makes the TurboSmooth happy!


Wii
1
2

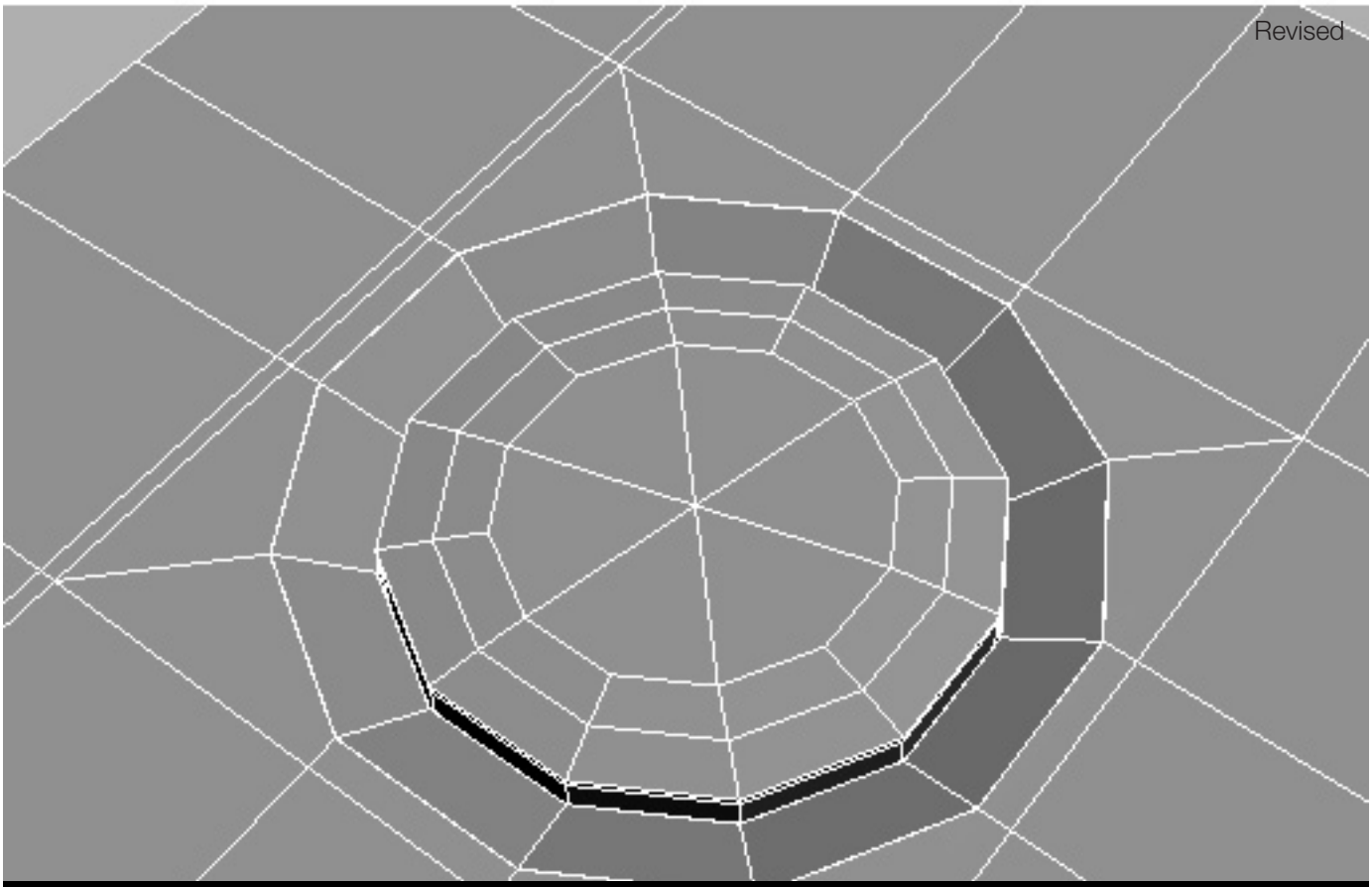
STUDENT PROJECT 2 REVISED

This Wii controller is modeled by Niels Biliet. No, this is no photo!

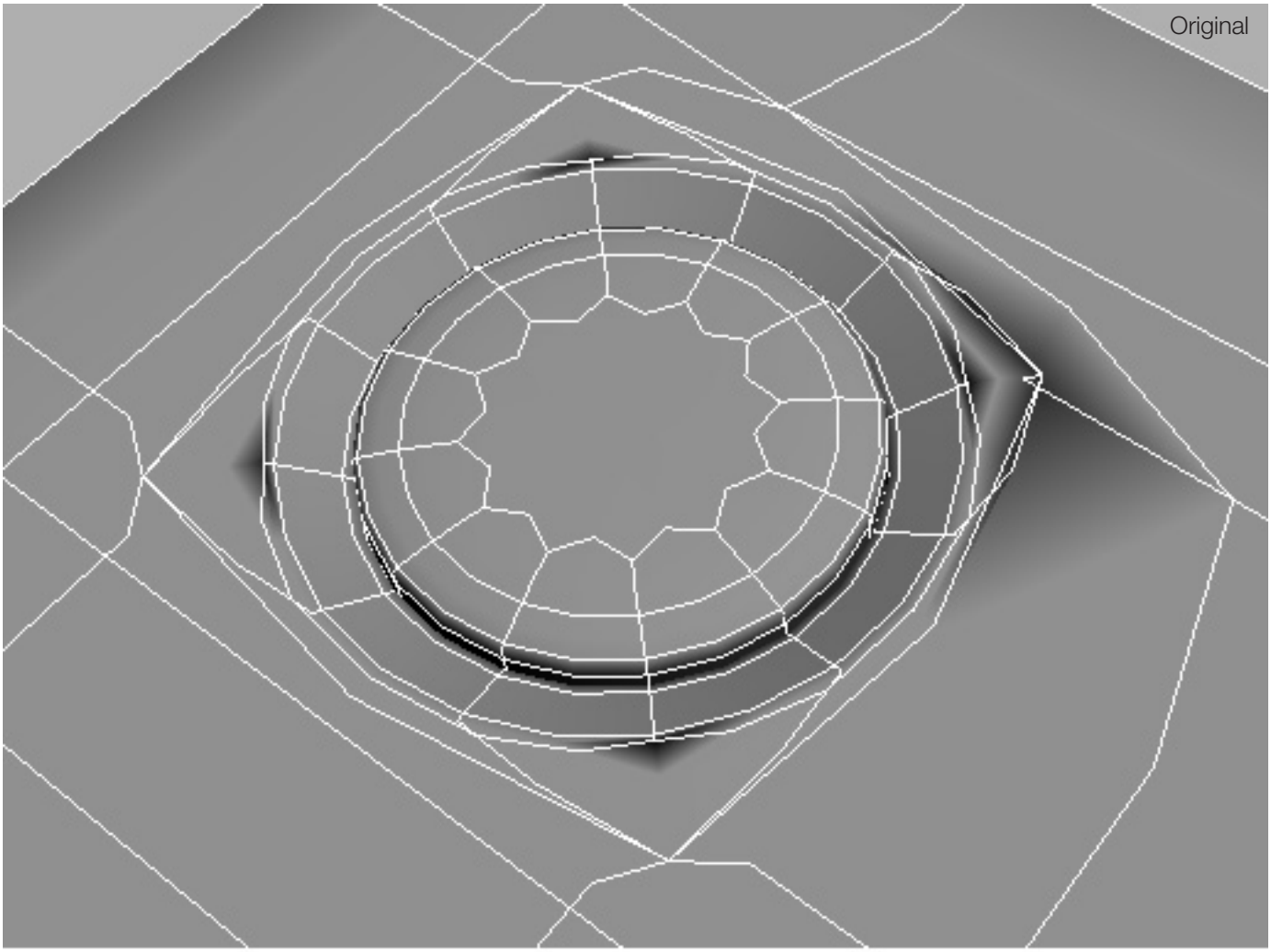
The model was excellently modeled and almost everything was quad. However, here too, I want to take a better look at some aspects and make some improvements, in order to get a better control over the mesh.

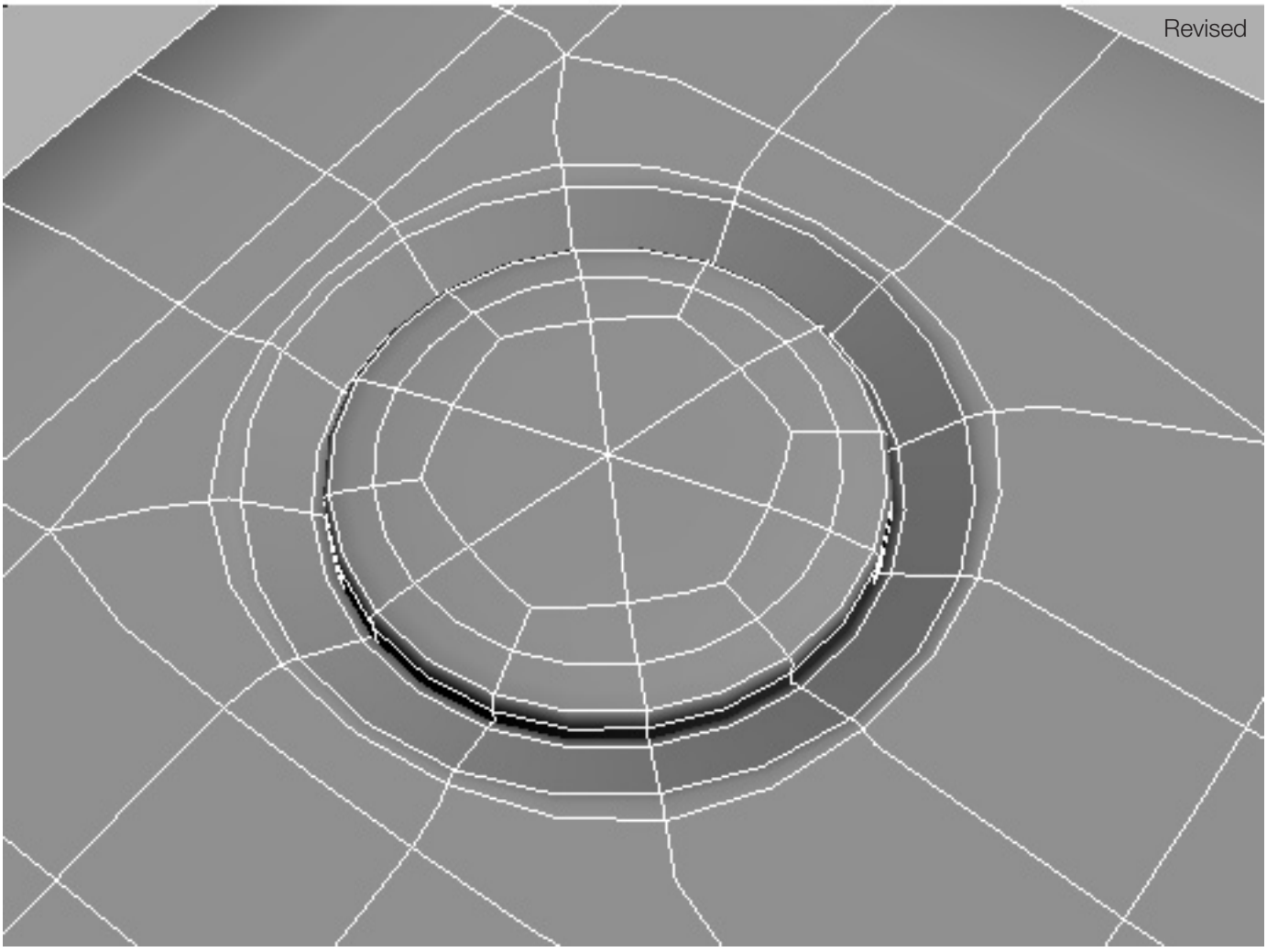


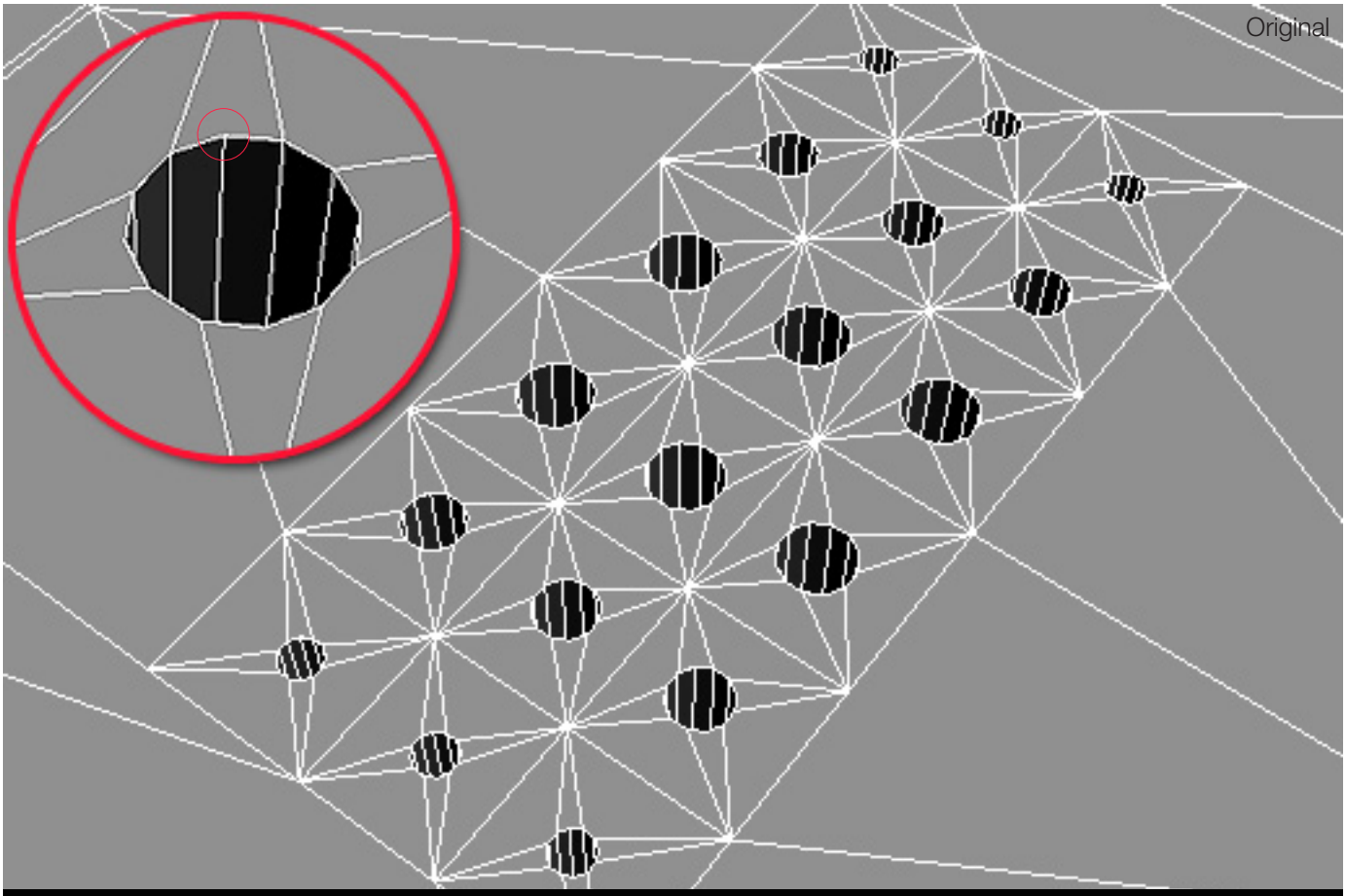
This is the “power” button of the Wii controller. What is certainly NOT DONE is indicated by the circle. An edge can never just stop; it must run through. On the next page, you see the version with the TurboSmooth on it and you see it starts to show some pinches. We also are no advocates of the shape of the polygons indicated in light blue. The polygons are arrow-shaped and are no nice quads. You can also see this in the TurboSmooth.



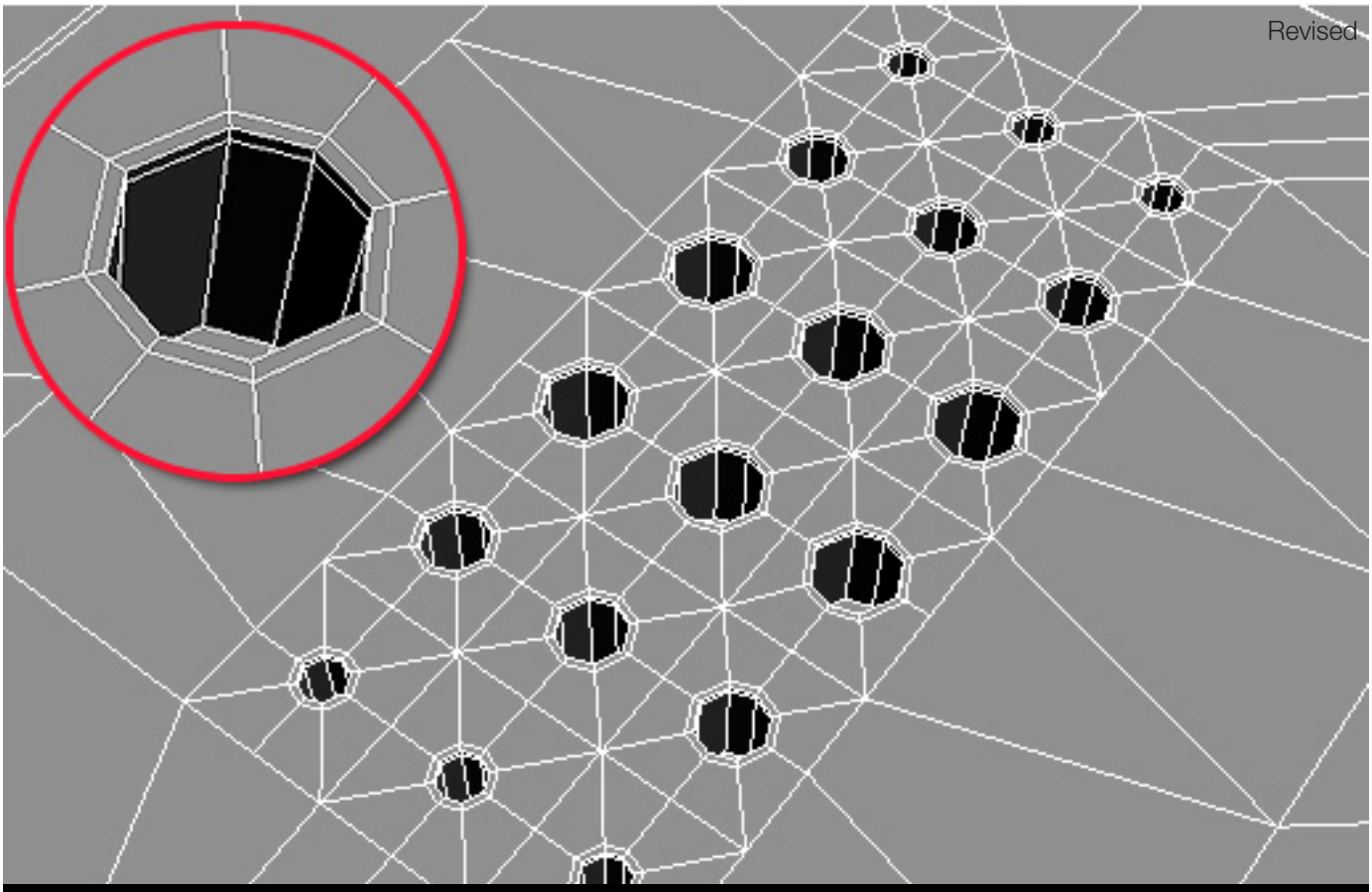
This is the adjusted version. Everything is quad again. The arrow-shaped quads have been removed, just as some edges. However, you see that more edges have been traced through outwardly. The latter can be annoying, however, most of the time, you can use these edges later on, if not, you divert them to a pole.
The middle polygon of the button was also subdivided to make everything quad.


Original


Revised



Although everything is quad, I am no fan of this method. Reason: no loops, no control. Here, it is not possible to quickly select the rim of the opening because there are 4 poles on the rim, which interrupt the loop. Neither is there a fast way to adjust the rounding.



In the adjusted version, the opening has 8 sides (instead of 12 in the figure above). Not that it matters so much, but we have fewer vertices for the same result. Neither are there any poles on the rims and two extra loops were placed next to the rim to be able to quickly adjust the rounding. We do have more edges, which we have to divert outwardly.

A LIST OF THE MOST IMPORTANT THINGS

1) Rounding: this exists of 3 edges, of which the inner is the rim, and the other two next to it adjust the rounding.

2) Rounding: make sure that the distance of the polygons from the outer to the middle rim is the same everywhere.

3) An edge can never just stop, because this results in a non-quad.

4) Preferably, you do not place a pole on the edge.

5) Try to solve problems locally.

6) And of course: make everything quad!

7) Detach parts when you see that they are also separate parts in real life or if they are made from another material. This will save you many worries.

8) Look at your mesh from all sides and see if you have flowing edges.

WHAT IS ALSO BEST TO KNOW ALREADY

A couple of aspects, which are best to know already if you start a SubD project, however, these will not yet be discussed:

Letters/Logos

Letters and/or logos, which are somewhat extruded, are not modeled in. This would cause too many problems. This is done via another technique, namely displacement.

Too much detail

Many holes, such as for instance the front panel of the speaker, are not modeled in either. This can be solved via an opacity map.

Small grooves and relief on a surface can be imitated via procedural materials. Such detail does not need to be modeled.

Unwrapping or not?

Many product visualizations show “clean” materials, the look of which can be obtained via procedural materials. Thus unwrapping such a product is not necessary.

Stickers and other prints are applied via the Planar Map technique.

However, if we want to give something an old look (for instance: a rusty old-timer, an old robot, or later on a character), we will need to unwrap all parts of the mesh. We will use another technique, namely Pelt mapping.