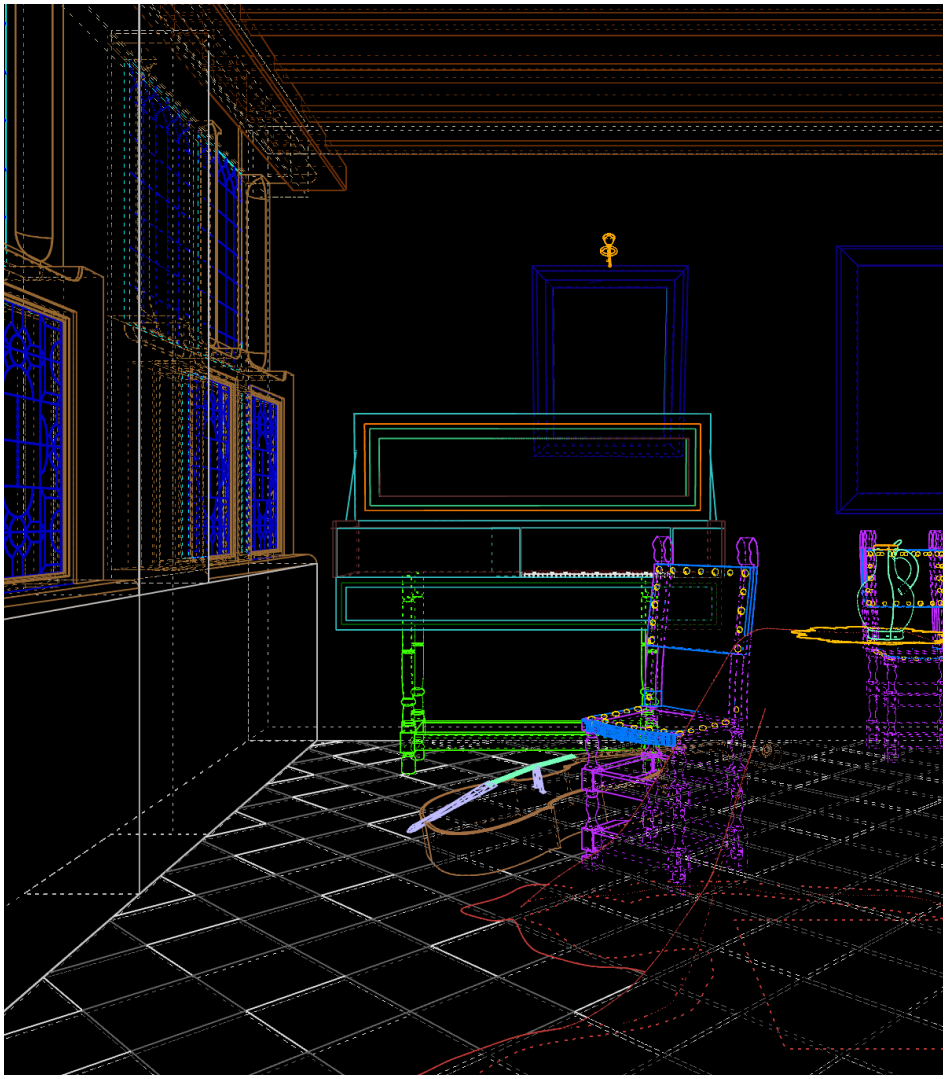
A MODELING HANDBOOK

Filippo Fanciotti

This handbook is divided in two parts: the first one is a collection of general advices, based on my personal experience, aimed to help you in building a working method which is efficient in terms of not losing informations and time during the modeling process. The second part is more about modeling and includes some tips more or less specific, still with the will of helping you to be more effective.

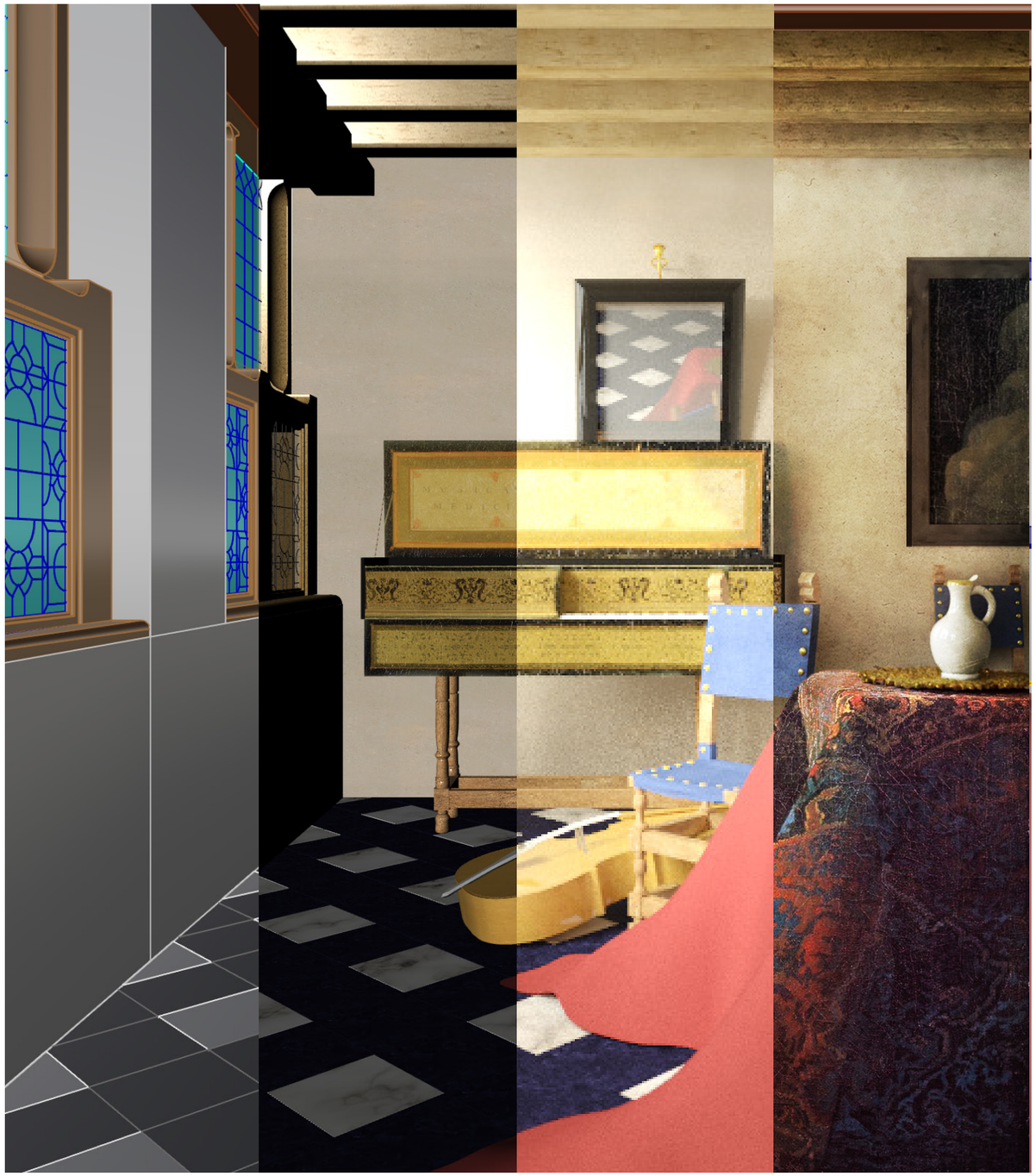
According to this task, there are several aspects that normally people take for granted but which are, in my opinion, perhaps the most important part of the visualization process; therefore the aim of this paper is to give you, as much as possible, a global overview of the visualization methods without getting in detail through the peculiar parameters of a specific software, a task that belongs to the specific literature on the subject.

The Music Lesson
Johannes Vermeer
1662-1665
oil on canvas
74.6 cm × 64.1 cm
Royal Collection, St. James's Palace, London



The Vermeer's Music Lesson, numerical model
Filippo Fanciotti
august 2016
Rhinoceros
1465 x 1465 pixels
EPFL, ENAC, LAPIS

PART 1
GENERAL TIPS



1. What to model, what not

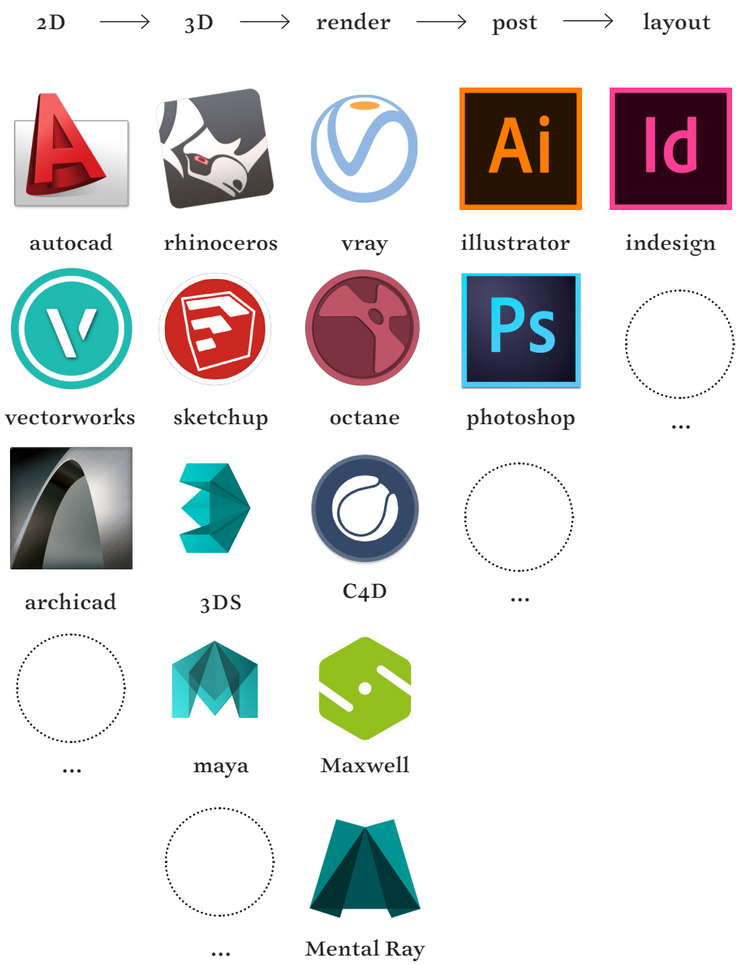
People normally waste a lot of time in modeling things nobody will ever be able to see: too small details according to the representation scale, items not visible from the selected point of view and so on. It's extremely important to decide what to show before starting modeling everything in detail. Both whether you're making a presentation, whether designing for a competition, think of your slides, panels or -as here- your final image before starting modeling like a crazy. Beyond the obvious waste of time this bad habit involves, mind that adding details burden your model a lot with all the consequences you have surely found out the hard way.

In addition, although it's something which only comes through experience, it's fundamental to identify what is better to do through modeling, what can be resolved by mapping, and what to leave out for post-production; in the following diagram I made a list of some of the most common softwares used by architects (I surely left out some important products, eg Revit and the like, but it doesn't change the point), with the aim of linking the main steps of the visualization process to specific sources.

Since almost everything can be done in every way, it's fundamental to understand that there are certain properties of each software which shouldn't be taken for granted or forgotten: if on the one hand some products are better developed to perform some steps of the iter, on the other some are particualrly bad if forced in a direction they haven't been designed for (eg sketchup for technical drawings, Rhino internal renderer for professional renders, Photoshop for making layouts and so on).

Anyway, this list is of course a simplification (you can safely model with autocad, if you feel comfortable, while the post production I mean for illustrator has to be intended for a better visualization of technical drawings); what matters is that you have to be aware of what you are doing, why you are doing it and, as consequence, find your very personal best way to do it.

in the previous page, the process behind the reconstruction of the Music Lesson, from the left: 3D model (Rhino), applications of textures and materials (Vray), light management and rendering (Vray), post-production (Photoshop).

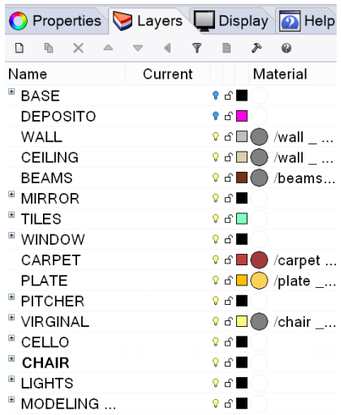


2. Divide your model by topics

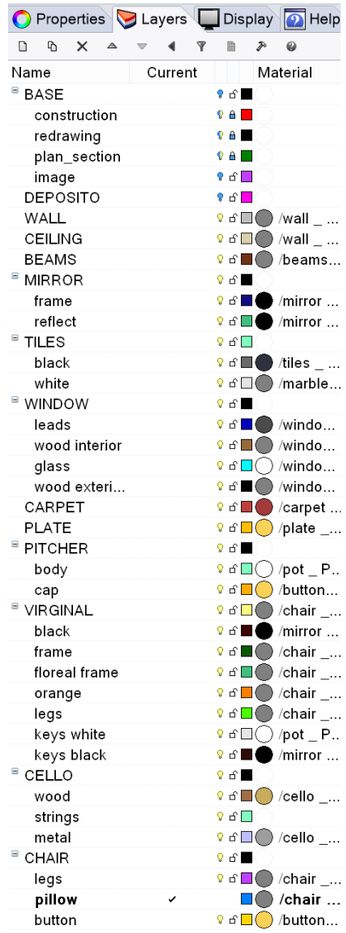
Although it can sound pretty obvious, it's very important to keep the architecture of your file clean and clear from the very beginning. This can be easily achieved by organizing its structure through the basic principles of the set theory; Layers and sub-layers (i.e. working with Rhino), classes and sub-classes (Vectorworks), Groups and layers (Photoshop) and so on: the *families* (i.e. a chair, a wall) turn into the bigger set (i.e. Layers), while the single *components* (i.e. the pillow, the backrest) become, for example, the sub-layers.

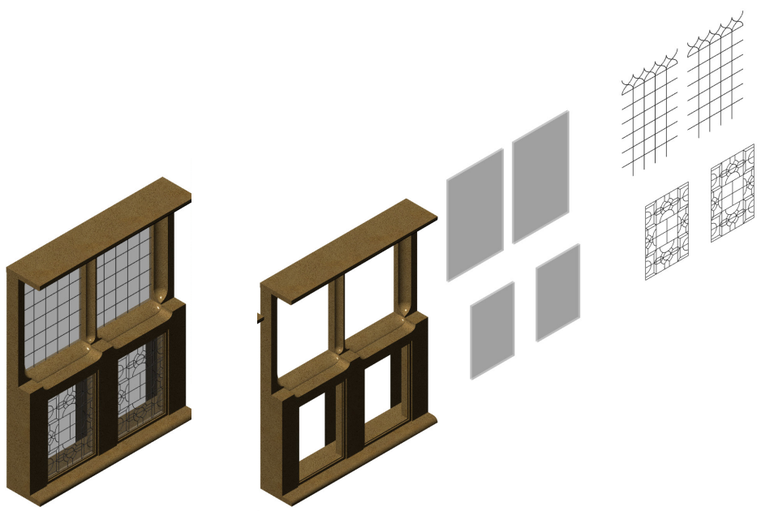
I find particularly efficient to divide the sublayers by the materials an object is made of, so it will be long easier to assign and manage materials through the material editor (another task we'll see more in detail later on). Here you have a screenshot of the structure of my *Vermeer music Lesson* file; the advantage of dividing the file by materials (= sub-layers) is that when you have to change one, you don't need to do it for every single item; furthermore, when you'll open this file after some time, you will be able to quickly recognize the parts without wasting time. You always have to imagine yourself involved in a team work; as consequence the best way to verify if the structure of your work is tide enough, is to imagine that everything you do has to be readable by anyone else without saying a word.

Layers



Sub-layers





above a screenshot of the sctructure of layers and sublayers organization in my Rhino model.

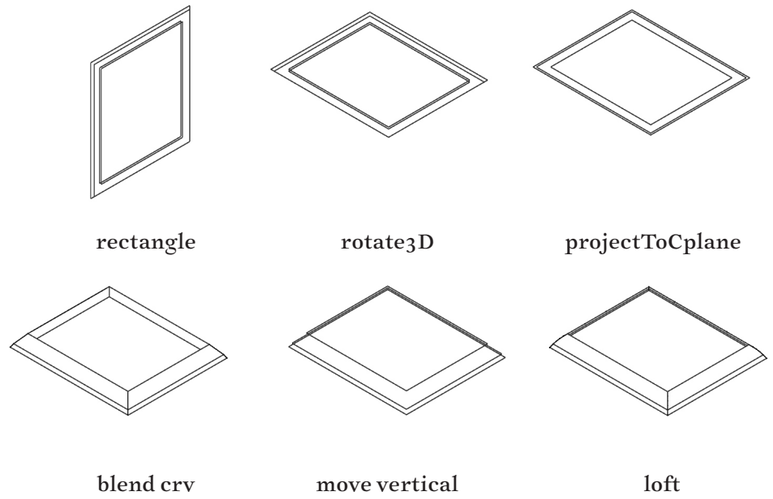
on the left a scheme of the division between elements and sub-elements composing an item according to its materials:
layer : chair
sub-layers : glass, wood, leads

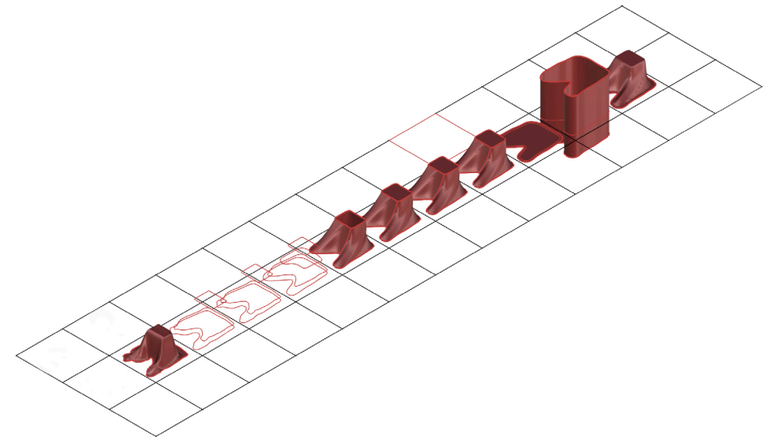
3. Keep trace of what you do

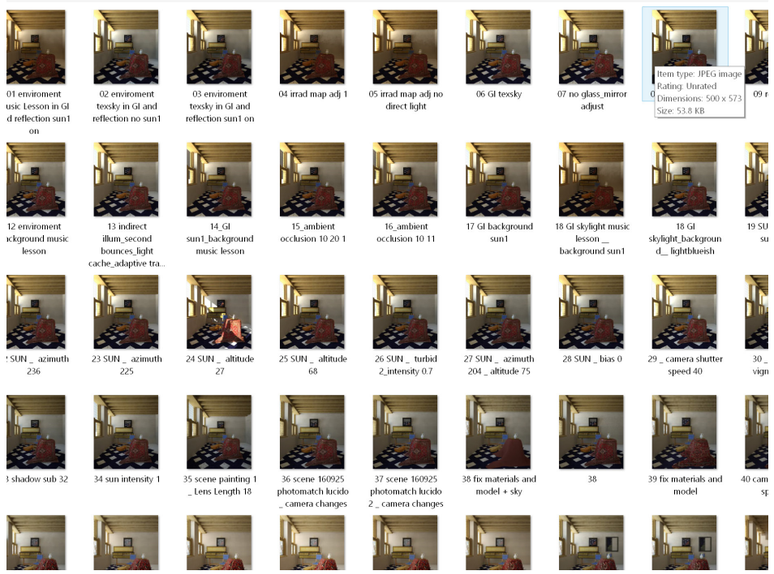
In a way similar to what discussed above, to keep trace of your steps will save you from losing important informations along the process. Saving incremental copies of your work and storying the steps behind a result are the best weapons you own.

As shown in the screenshots in the current page - although it may look particularly pedantic because it was specifically made to explain the modeling tools in a class - it's a very good habit, when modeling objects which contain a certain degree of complexity (like I did for the carpet-second image on the right-check the appendix) to make a grid containing all the steps of the process behind the final result; this way you'll be able to go back to a whatever "frozen step" and create a new form if you aren't completely satisfied with the first result achieved. Keep in mind that most of the modifications are irreversible.

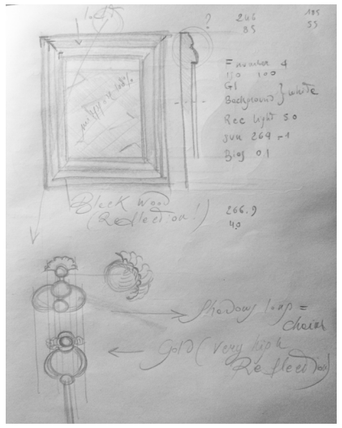
Looking at the screenshot on the right, I want to show you how this attitude will turn particularly useful during the rendering process, whereby a very little change can significantly alter a result; by keeping trace of every single step plus saving a copy of your render named by the last edit made, will make you able to get back to a previous solution without any trouble.

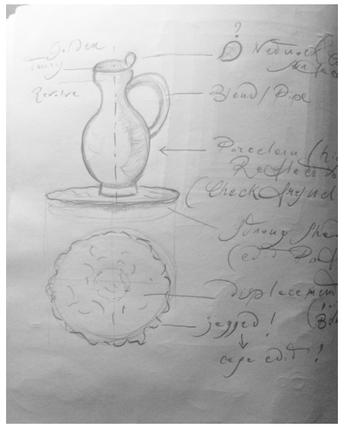






PART 11
MODELING TIPS





1. Make a sketch

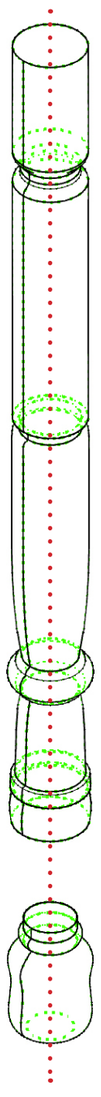
This obsolete tool is still very useful: it's very common to jump into modeling wasting a lot of time in search of a result, when studying the shape and the geometrical rules behind it - even before opening the software - is the most effective and fastest solution.

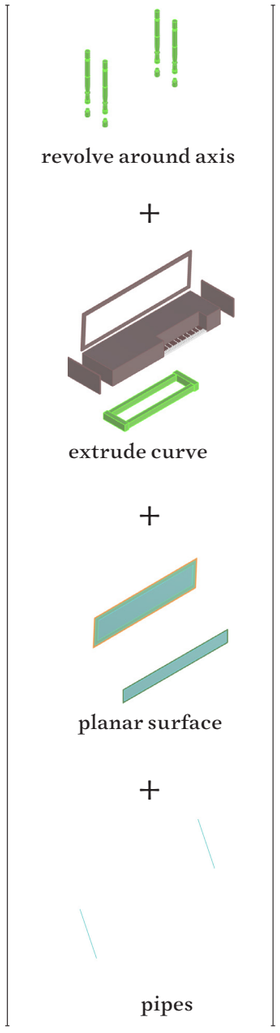
Through skecthes you automatically simplify a reality, inscribing components within regular shapes or grids, spontanously identifying axes and other useful rules that, once you'll have figured them out, you will be able to completely manage a form, and so it will turn extremely simple even to draw it with whatever software you've chosen to work with.

2. Keep it simple

Complexity is written in simple terms: look for axis, symmetries, repetitions, revolutions, etc. is the first act to do between a sketch and the model.

Just to give you an example the virginals - which can look a bit complex at a first sight - is actually nothing more but a set of revolutions (the one shown aside), linear extrusions of curves and a pair of planar surfaces; later on I'll show you that anything else has been resolved through mapping.





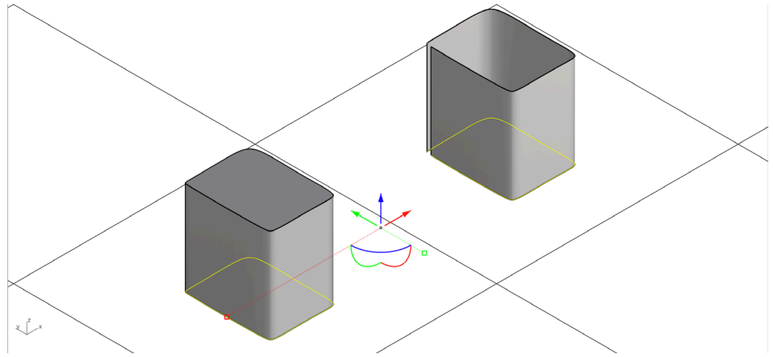
3. Draw in (clean) curves

Don't start off building solids and primitives; get used to fix and pre-filletize curves before generating surfaces. It's a common habit to hurry up a lot, getting into extrusions and then merging, making boolean unions and so on. This is the fastest way to stumble on troubles that, sooner or later, will eventually emerge (a common situation pops out when putting a texture on an object which is the result of an union between several solids, where the pattern doesn't match from one face to another). By fixing the curves from the beginning (which means to have continuous curves, without any control point in excess) and extruding or revolving them in a second time, will avoid this kind of situation.

With the same logic, when an object gets too "dirty" - due to a certain amount of operations made on it, such as holes, booleans etc. - get used to extract borders, edges and rebuild that surface or polysurface through cleaner curves.

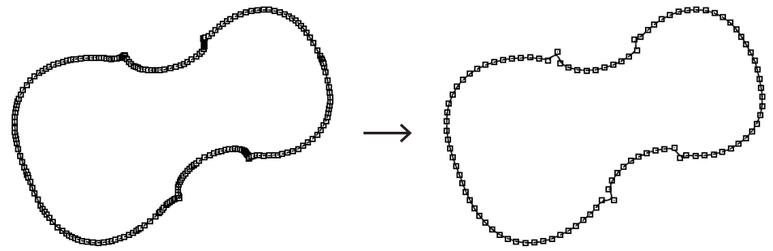
4. Make things bigger,then trim

It's always easier and long more precise to cut out a part rather than adding small parts. Therefore my advice is to make always things bigger than what they actually are - being them surfaces, solids or curves - then trim or split them using defined geometries (whether they are curves, surfaces or solids).

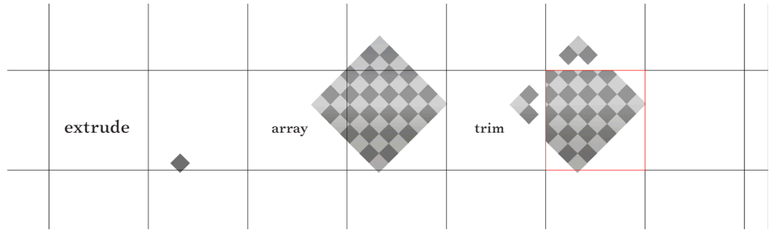


282 control points

120 control points



The first image shows how an open polysurface brings to bad extrusions, while the second one shows how the same polygon, with only the necessary control points, doesn't change in shape.



for the Music Lesson pavement I made an array of tiles, then trimmed them according to their encounter with the room's walls.

5. Details can wait

Details come later. The modeling process is similar to the act of sketching or, if you prefere, of sculpting: finishes, holes, bumps, etc. can wait.

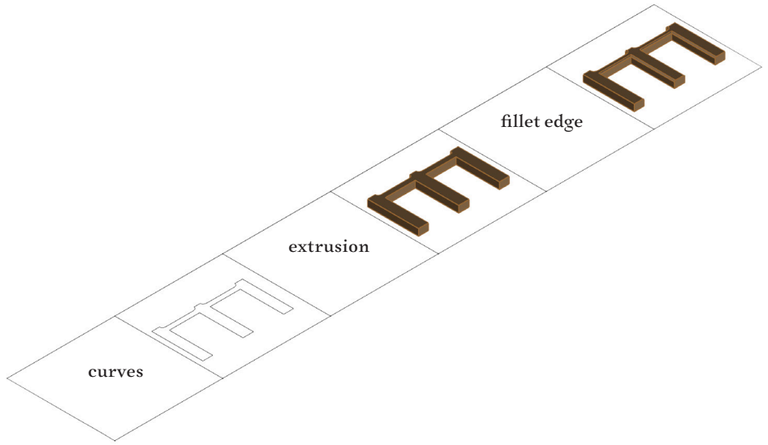
Adding details makes your file heavier plus, once certain operations are done, it's impossible to go back to a previous solution or even to do some basic operations without losing the control over the interested item (i.e. once you chamfer two faces with a defined radius, it's impossible to scale the object without scaling the radius of the chamfer too.)

6. Use nurbs rather than meshes

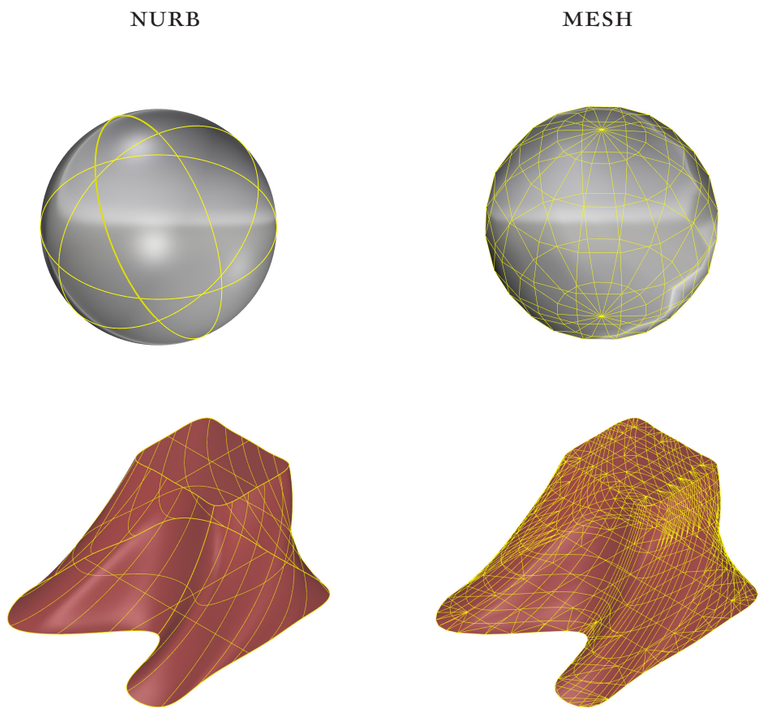
This advice is in particular addressed to some softwares (i.e. Rhino), since other ones only work with meshes (i.e. Sketchup).

- A *mesh* is a complex of triangulated polygons approximating the geometry (the more dense the triangles, the closer to the actual geometry).
- A *surface* is the actual mathematical expression of the geometry (NURBS and the like) and what you're seeing in the viewport is a translation of that expression.

[Although from a technical point of you it doesn't have anything to do with the intrinsic differences occurring between meshes and nurbs, think of the lost of information when passing from a vector file to a raster image .]



after extruding the lines obtained through the reverse perspective, the windows' frames edges have been fillet only at the very end, in order to leave the door open to any editing.



comparison between a simple sphere and the Vermeer Music Lesson's carpet built as a nurbs (left) and as meshes: you can easily appreciate the difference between the clean isocurves describing the first geometry and the triangulated faces approximating the models on the right.

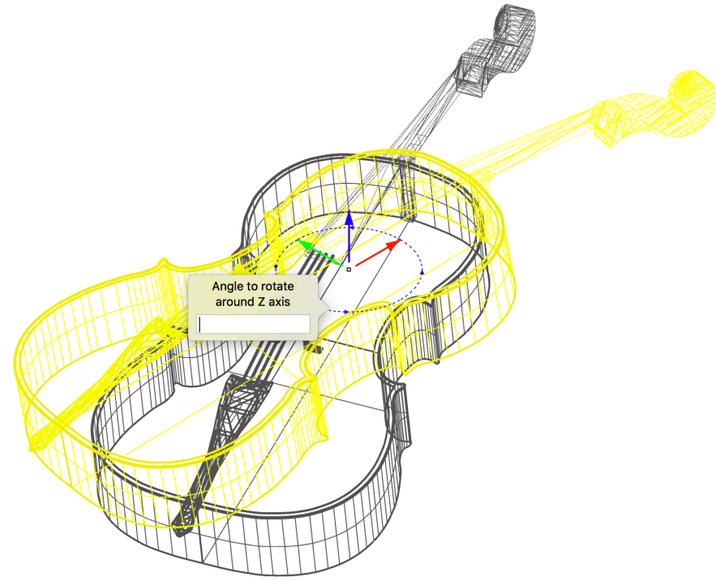
7. Exploit modeling aids

Each software has its owns, because each software has its own logic. By exploring the modeling aids you will better understand the logic behind the software you are using, therefore figuring out some operations must be done in a certain way if using, for example, whether autocad, 3DS, cinema or Rhino. (i.e., using Rhino, once you get confident with the selection filter, the gumball and the c-planes, your working method will significantly get improved).

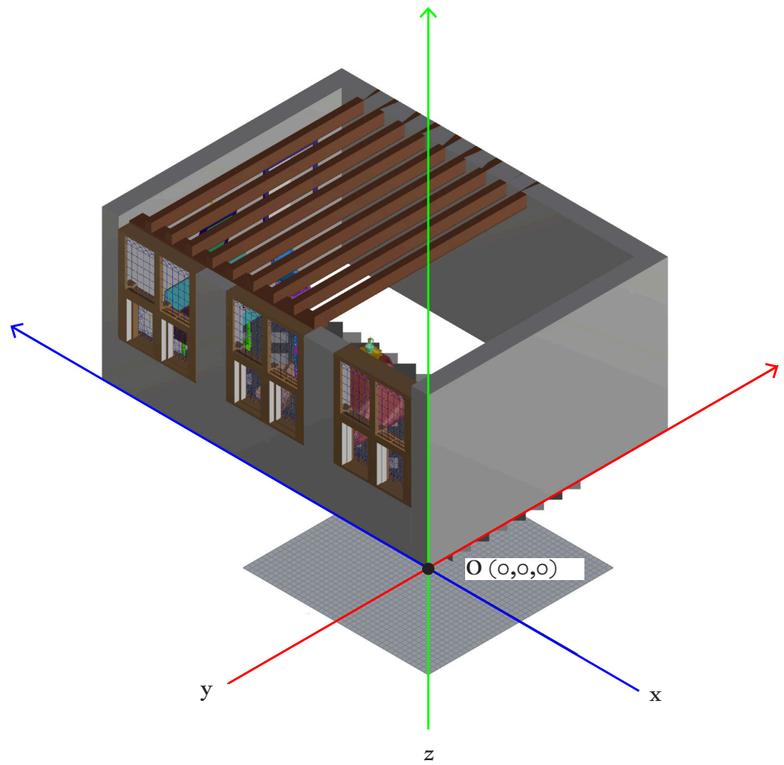
8. Define drawing Unit & Origin

Get used to work with a meaningful unit of measure according to the type of objects you are modeling. Normally industrial designers work in millimiters, while the centimeter is more appropriate for architectural drawings.

Avoid visualization troubles: by drawing close to the origin you'll save your RAM from hard calculations. Mind that once you'll start putting textures, or working with discretely complex geometries, you'll easily appreciate the improvement given by simply centering the drawing on the Internal Origin. It's also an important task to define the origin (0,0,0) on a stronghold point and, hopefully, don't change it anymore; remember that you normally storage a lot of copies of your file (plus you're often working in a team), therefore is highly desirable to benefit from the paste in place from different files.



application example of a rotation through Rhino's Gumball.



the drawing's origin has been fixed on a stronghold point.

09. Make everything editable

You can change any number of copies of an object if they are block instances by making changes to the geometry that defines the block; repeated instances of a single definition do not increase the file size much since there is only one actual definition for the block held in the file. Objects can also be updated from external files and used as libraries.

10. Sweeten up!

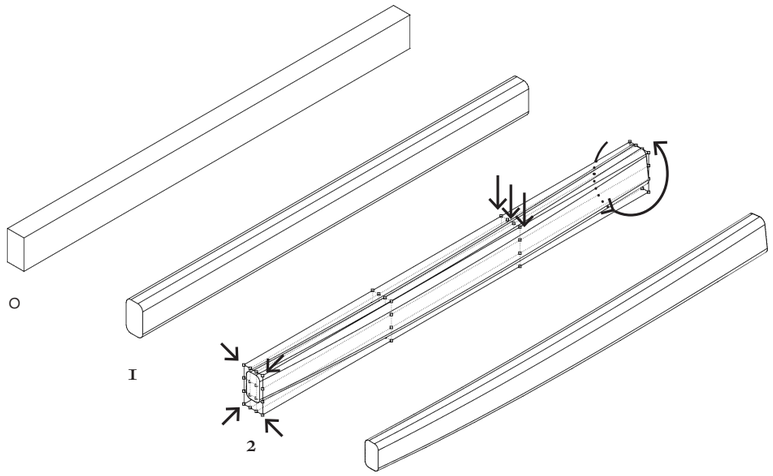
Just before rendering, you can finally start making your scene looking more natural: walls' and furnitures' edges are not as straight and perfect as the results of extrusion are; actions like fillet, chamfer and the like are very welcome to increase realism.

11. Add irregularities

Like what just discussed, adding imperfections and treating volumes as if you wish to include mechanical wears, or the passage of time, are other small tricks which will help to add a lot of verisimilitude to your scene.

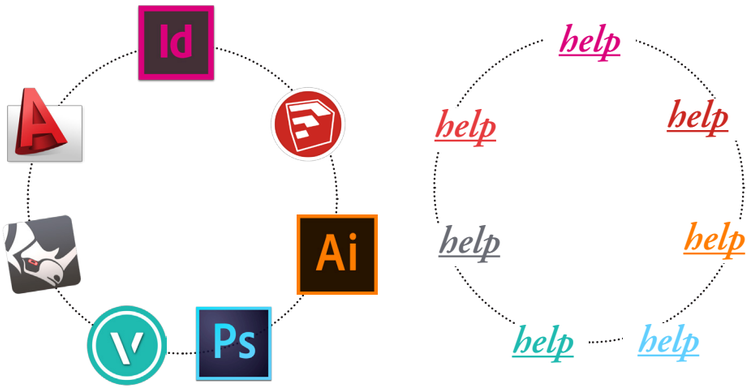
12. Ask for help

Softwares constantly evolve, sometimes the way you're doing some operations from a while can become outdated. Furthermore, don't forget that nowadays sotwares are daily implemented to talk more to each other; figuring out how they do it can be extremely useful and save you a lot of extra work of editing.



3

in the image above, two sets of transformations have been applied to the beams to make them more natural. First of all the edges have been fillet with a radius of 4 cm to make them look smoother (step 1).
A second set of operations (step 2) has been performed by using the CageEdit tool (Rhino): a virtual cage is built around an object, making the user able to apply a soft deformation to parts of it (i.e. here the beam has been smoothly scaled at the beginning, moved down in the middle and rotated at the end).



click on the colorful helps above to explore your software guidelines

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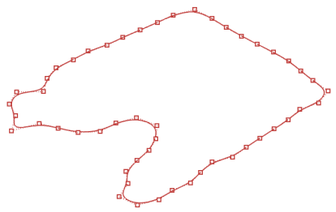
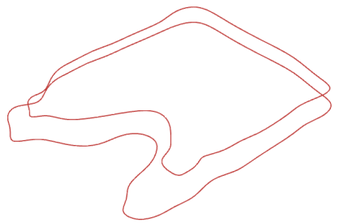
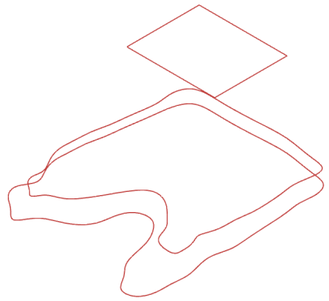
APPENDIX
modeling a carpet in Rhino



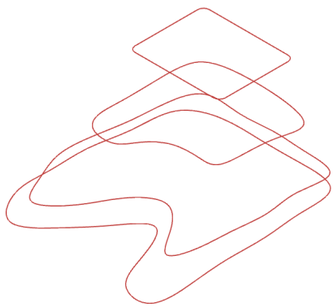
01. InterpCrv : a smooth curve (similar to a spline)to join the points extracted from the reverse perspective.



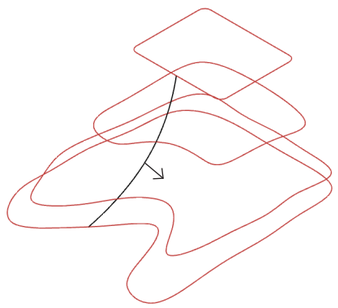
02. Offset : copies of the starting curve, gradually smaller to lay out a path for the developlment of the surface.



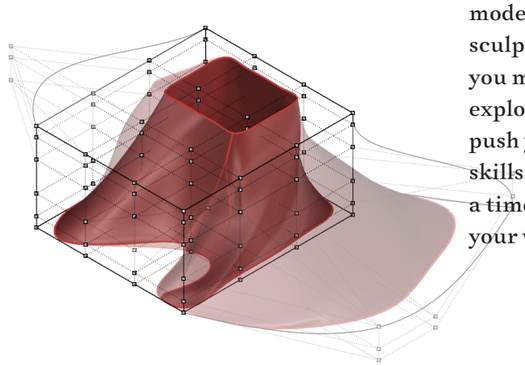
03. Rectangle : the last curve of the future shape is a simple rectangle, in orderto mimic the behaviour of the fabric touching the top of table.



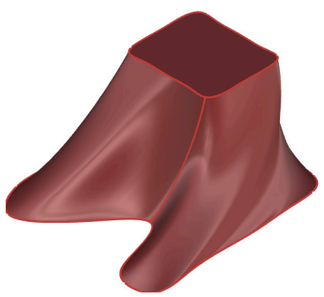
04. Edit Curves : turning on the Points, simplifying and smoothing the geometries get a cleaner surface.



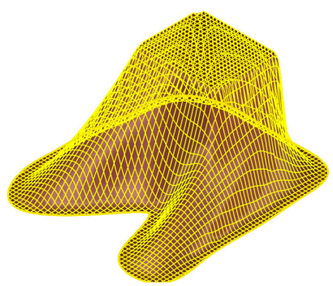
05. Loft : the previous curves become the profile to define the surface of the carpet.



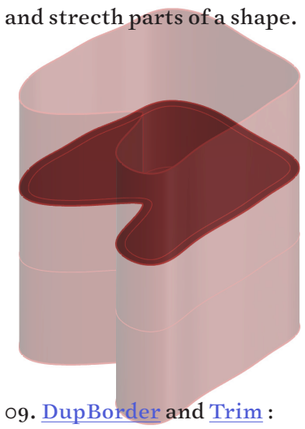
06 . CageEdit : a box of control points to smoothly move, scale and strecth parts of a shape.



07. Patch : another Rhino surface, useful when you need to create a surface out of a curve which is not planar (here to "cover" the "top" of the carpet).



08. Drape : literally drops a drape above a series of objects, so creating a continuos geometry with a defined structure.



09. DupBorder and Trim : drape is always a bit bigger than what needed, so I simply duplicated the border of the starting profile, extruded and used as a trimming geometry.

The operations explained so far are the ones I used to reach the final shape (here on the right); sometimes getting back to a previous step, extracting borders or inserting knots, deforming geometries again and again.
After some trials I decided I was satisfied with this result because, although I knew it was not perfect, it was enough for my purpose, which was to have a good base to apply a texture onto and to inform the surrounding light.
As mentioned before, I really do believe that the act of free modeling is somehow like sculpting in real life, therefore you must find a time for exploring options, a time to push yourself improving your skills for better results, but also a time for putting an end on your work.