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The process of creating a 3D model of a hotel interior

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Abstract

Thesis is about the process of a creating a 3D model of a hotel interior. 3D modelling is popular nowadays. 3D uses in different areas of our life, in cinematography, in science, in architectural field, etc. Model is based on interior of ProPiter family hotel. ProPiter hotel is a small hotel in the central area in St.-Petersburg. ProPiter is a beautiful place with unique handmade interior design. Contains theory part, which tells about 3D modelling of interior and 3D modelling in general including description of modulation types, lightning types and techniques, texturing, rendering. Covers most types of modelling like: polygonal modelling, spline modelling, digital sculpturing, NURBS modelling, procedural modelling and boolean modelling. Also, contains part about implementation of a project, the process of modelling in details. Implementation part includes floor planning, creation of the model's frame, creation of objects and visualization.

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1. INTRODUCTION

Nowadays modern technologies are developing fast and technological innovations have become a necessary part of development. In particular, when it comes to the design of drawings, 2D illustrations do not satisfy any more, 3D models have already replaced them. 3D models are common in almost all fields and in architectural industry, and in particular, interior design.

These technologies make our abilities wider and make it possible to implement different ideas that we could previously only imagine. We can create absolutely any object that does not even exist in life, but to make it so that the audience will believe in its existence. Companies that work in the field of design and architecture use the services that make 3D visualization more often nowadays. No scheme, no drawings, no calculations cannot be as demonstrative as a model of the buildings and their interiors made in detail and illustrated with the help of 3D technology. 3D visualization of interiors allows us to make brochures and presentations, which could be further demonstrated to the customer. The visualization of the interior creates an effect of presence and gives the opportunity to turn around 360 degrees to see every detail. It allows us to take a virtual walk through the interior areas of a business center, a country house or an apartment to see how it looks with all its style, furniture and decorative elements.

The design projects of the interior made with 3D modeling software and the traditional techniques used in the past are very different. First of all there is the unique combination of several properties: scaling accuracy, photo-realistic images and the ability to make changes easily. If earlier the designer's ideas have been presented as drawings made using pencils or paints, now a sheet of paper for the designer is the PC monitor. Certainly, in case of any changes in a project, even small ones, a classic sketch had to be started anew. Sometimes the number of sketches had reached a dozen, and of course all of them, except one had been thrown away.

Created on the computer scene it is easy enough to make changes. Of course, to create such a scene we need to work hard, too, but the resulting products have a much greater efficiency. Often the scene made for one project can be used for the different ones, in a totally new modified form. Models of furniture made for one project can result in a big library and save time while doing other projects. Various companies produce such

libraries of models, which is a great help for the designer and significantly accelerate work processes. The important part is the work with the textures of objects, for example, when creating flooring, tiles or wallpaper. We can easily scan or take a picture of a real sample of the material with a digital camera, and then assign it to a specific object.

3D visualization of interiors and architectural objects allows creating good-looking objects and making an impression on customers. Visualization is able to present information better than words. 3D visualization successfully manages with this task. When potential guests are choosing a hotel they pay attention not only to the services provided by the hotel, but also to its appearance.

The main task that I set to myself in this work is to make a 3D model of a small hotel and to show its interior in all detail. That model can be used in hotel's website for promotion in future. The name of the hotel, which I will model, is ProPiter Hotel.

The Family hotel ProPiter is the embodiment of love for St. Petersburg, an ode to the city, its islands, streets, courtyards, its power and glory. The founders of the hotel gathered here all that St. Petersburg and its inhabitants are famous for and proud of. They embody it in all the hotel rooms, filling them with unique design, rare things, creativity and imagination. Guests can spend the night in the "music courtyards", relax on the "roof" of St. Petersburg, or settle in St. Petersburg "library. They can also stay in the "Hermitage", to dream on the bridge in a white night and breathe the fresh sea air. This all is done by hand, every small detail. The owners have put a piece of theirs souls in everything in the hotel. Therefore, there is an atmosphere of family hospitality and St. Petersburg romance. Because of the hotel's uniqueness, it will be not easy task to implement all the details in my model and to show that incredible place as it looks like in real life. However, I will try to do my best.

When I started working on my thesis I had a question "how to make a 3D model of a hotel?". I studied a lot of techniques and methods of creating 3D models. I write about them in my work and describe the process of creation a model.

2. 3D MODELLING

Traditionally drawings are made in 2D (X and Y-axes) on paper, canvas, wood etc. This way displays only one side of the object. The picture itself is flat. However, if we want to get an idea about the whole object, it is necessary to draw an object from all sides. 3D model shows object from all sides, X, Y and Z-axes. In other words, in a special software creates a three-dimensional image, for example, a car (Picture 1).

PICTURE 1. Example of 3d modeled car (http://www.itshop.ru/)

The advantage of this method is that, for example, in cartoon creation animators can locate already prepared volume model to any place and make it move. Another advantage is that, the model can be drawn only one time and then used in other projects copying, modifying, deforming etc. For regular 2D drawings, in general, this is impossible. The third advantage is that we can create absolutely detailed models, for example to make even the screws on the clock, etc. In general terms, this screw can be imperceptible, but as soon as we zoom the camera, all details will be seen.

When dealing with 3D graphics, we can identify the following five main steps which are necessary to obtain the final product:

1. Modeling - creating objects that will be on stage
2. Texturing - determination of surface properties of objects to simulate the properties of real objects (color, texture, transparency, brightness, etc.)

3. Lighting - adding and placing light sources in the same way as it is done in the theater, for example; at this stage, also, setting shadows
4. The animation - changing the position of the object or its properties (color, transparency, etc.)
5. Visualization - creation of the final image or animation

The final step is the editing and production of the final product. The chapter about 3D modelling is based on information found in Alan H. Watt (2000) and Tozik (2008) books.

2.1. Modeling

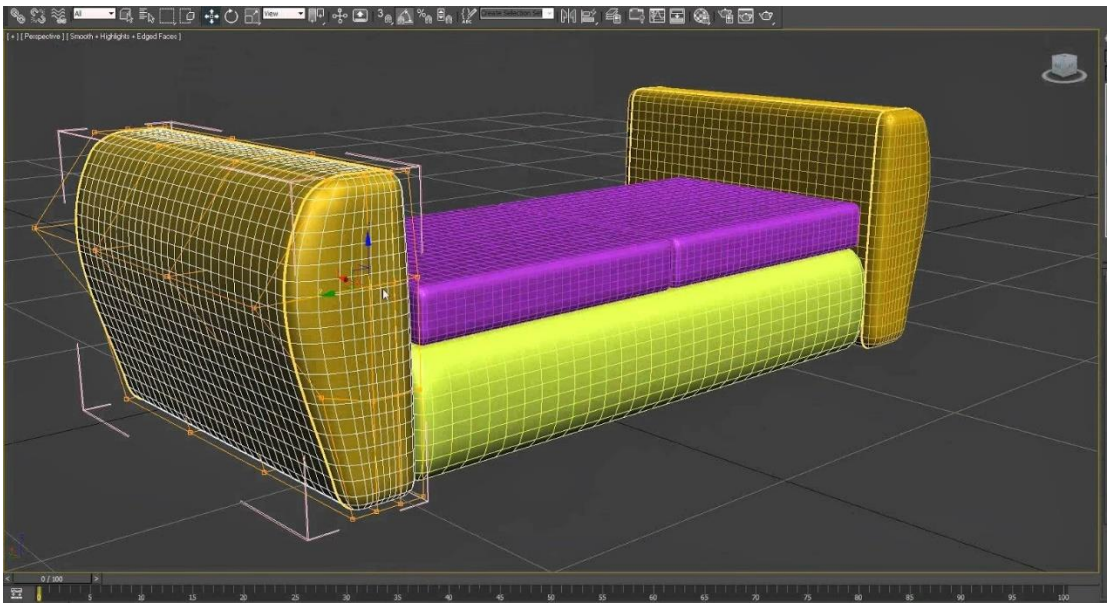
For successful modeling, it is important to consider how real objects can be transformed into computer models. Without careful observation and visualization of the outside world, it is impossible to create the model in the right way. It is one thing to just look at the subject, and quite another to watch, implying its reconstitution as a 3D model.

To model good objects, we must create a virtual world thinking as painter, sculptor or architect and examine the objects and the process of their creation. We should be able to divide objects with complex shape into simple elements that are much easier to model. All this will help to create high-quality models and complex objects in the scenes of the virtual world.

There are several ways of 3D modelling, which can be used in different situations. For creating an object in the scene, we need to take into account the special characteristics of its geometry. As a rule, the same object can be modeled in several ways, but there is always a way which is the most convenient and consumes less time. In this thesis, created for the model items are assumes certain restrictions on their complexity. We cannot create photorealistic objects (high-poly objects), since they require high PC efficiency, and this can cause problems for users to launch the final model. When working on 3D objects for interactive systems we should take into account these restrictions and create optimized objects, but without quality loss. The balance between optimal quality and complexity is one of the main problems in creating objects for interactive systems. (Boardman, 2004.)

2.1.1. Polygonal modeling

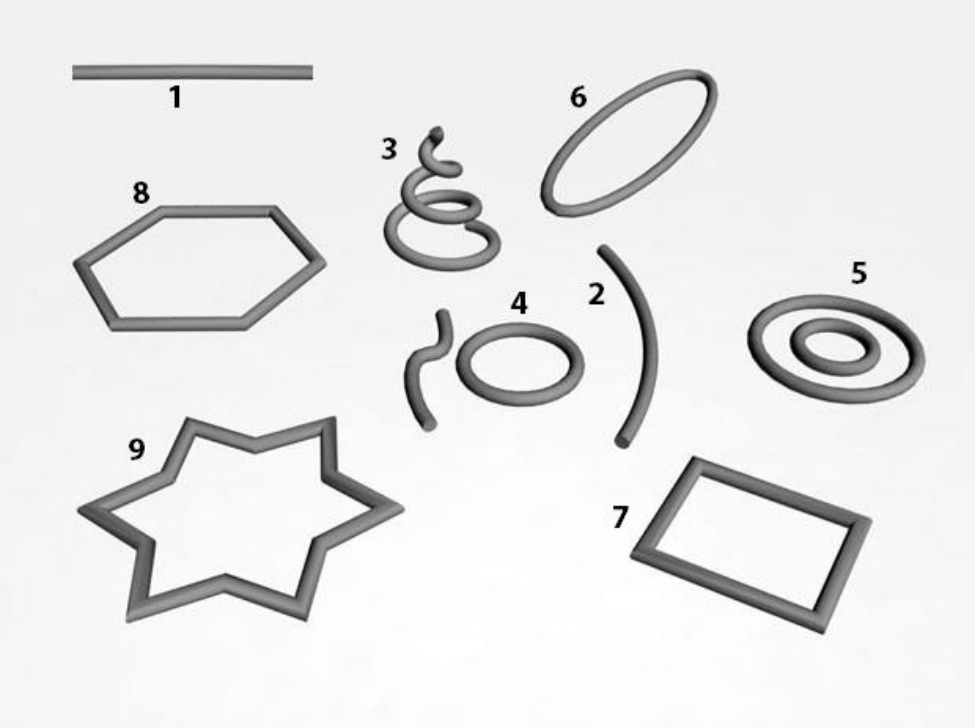
Polygonal modeling is popular way of modeling. The main idea in that the surface consists of simple geometrical two-dimensional polygons (see Picture 2). Computer games have triangles, for other purposes usually rectangles and shapes with a large number of angles are used. However, when creating a 3D object usually using quadrilaterals. If necessary, quads (polygons) can be turned into triangles. If an object is represented as a set of polygons (especially organic objects such as body), it is clear that the smaller size of polygons and larger number of them will make a model closer to the original. On the other hand, large number of polygons decreases performance. The more polygons and the more points on which they are based, and therefore the processor must process more data. Consequently, 3D graphics is always a compromise between quality and performance models. In this regard, even exist terms: high poly and low poly, i.e. high and low polygon models. Games use low polygonal models, as they perform real-time visualization. However, in the design of architectural structures usually are used high polygonal models. In addition, models in games are represented by triangles to improve performance: GPUs are able to process quickly hundred millions of triangles per second. Usually, in polygonal modeling objects have only the skin, but are empty inside. This means that if we model the cube, and then remove one of the walls, we can see the void inside. (Mario Russo, 2010; Murdock, 2013)



PICTURE 2. Example of polygonal modeling

2.1.2. Spline modeling

This is one of the ways to build 3D models. Creating a model by building a spline cage using the spline. Most editors of 3D graphics have the possibility of spline modeling, and editor's toolkit includes the following spline primitives (see Picture 3):



PICTURE 3. Spline primitives (http://www.pearltrees.com/)

1. Line,
2. Arc,
3. Helix,
4. Circle,
5. Donut,
6. Ellipse,
7. Rectangle,
8. NGon,
9. Star,
10. Section,
11. Text.

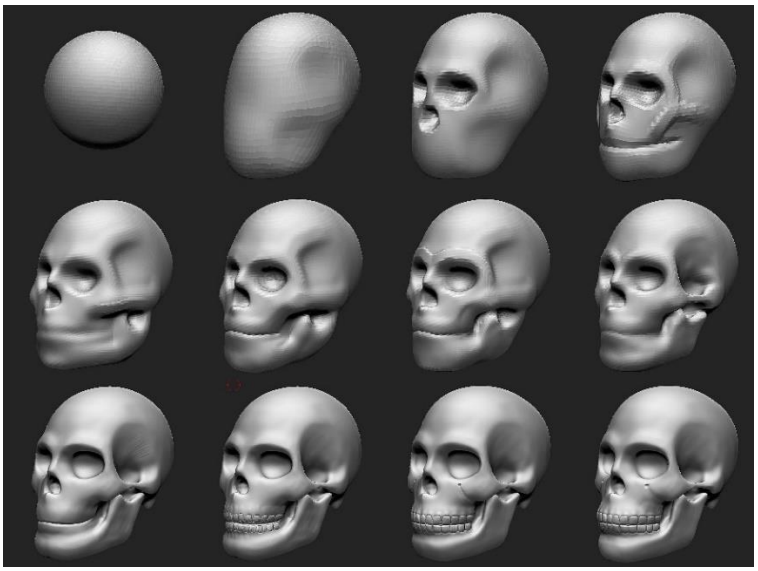
By default, spline primitives are not displayed on the visualization stage and are used as ancillary facilities, but if necessary, they can be visualized. Based on spline shapes we can create complex geometric three-dimensional objects. This method is commonly

used in modeling symmetrical objects, by rotating spline profile on axis, as well as asymmetrical objects by imparting volume on the selected section of spline shape. (Kerlow, 2004)

2.1.3. Digital sculpturing

This is a method of creating bulk and detailed models in special software. The process is similar to sculpting and carving like real sculptors making something out of clay (see Picture 4). The basic method of creating 3D sculptures is the deformation of model parts by creating a concavity or convexity by using a virtual brush. As we can work with a real sculpture, we can add and remove layers. We can add more solid polygon mesh for better handling of individual sections, and easily switch between levels of the detail's grid, moving from the creation of complete shape at low-polygonal level to work at more detail level at high-polygonal level.

The main feature of a digital sculpture is that it allows creating a model with a high level of detail (tens and hundreds of millions of polygons) that is unachievable by traditional methods 3D modeling yet. This makes it the most preferred method to produce photorealistic scenes and models. Currently high polygonal (for sculpting, the model should have a huge number of polygons) realistic models of people or animals are mostly achieved using this kind of modeling software. Frequently blank model creates with polygonal modeling, and then transforms with digital sculpturing. Chapter mostly based on William Vaughan (2011).



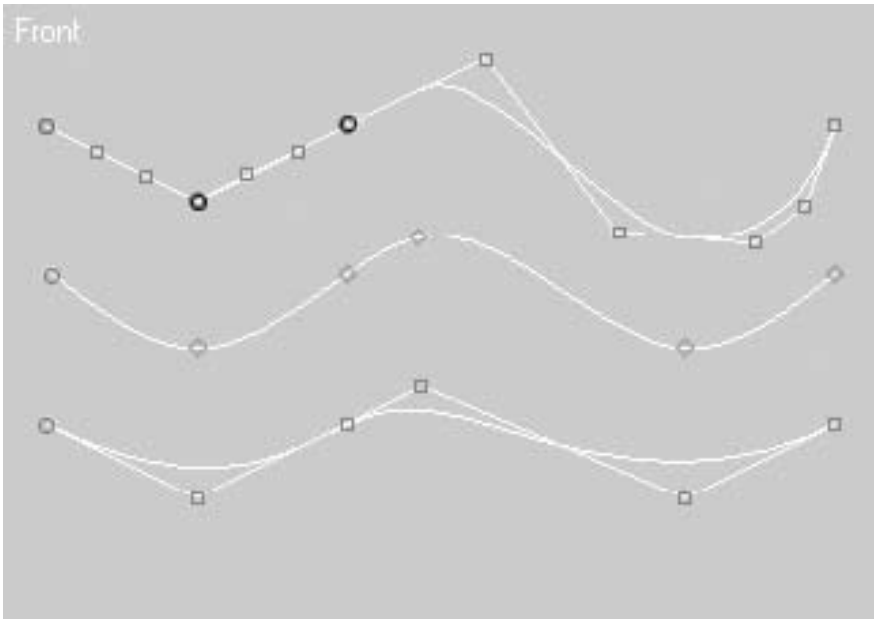
PICTURE 4. Example of digital sculpturing (www.behance.net)

2.1.4. NURBS modeling

NURBS (Non-uniform ration B-spline) ─ the mathematical form used in computer graphics to generate and representations of curves and surfaces. NURBS curves always have a smooth shape (see picture 5). Most often, this method is used for organic modeling, character's face animation. It is the most difficult method to learn, but at the same time the most customizable.(Timofeev, 2010)

NURBS modeling, as well as polygonal modeling, is superficial and non-parametric. However, it has the following important features:
- It is ideal for modeling complex smooth surfaces, because the surface remains smooth even in the presence of the minimum required number of segments and vertices, while polygonal modeling requires increasing the number of segments and vertices to obtain a smooth surface.
- It has advanced features for soft editing of the shape of smooth objects. This means that it is easier to work with it, as fewer segments and vertices are easier to change without reducing the smoothness of the surface.

NURBS curves used in this type of modeling can be two types: PC (Point curves) and CV (Control Vertex) curves. Point curves are managing vertexes, located directly on the line or object, and Control Vertex curves control points that are outside the line or object. (Boardman, 2004)

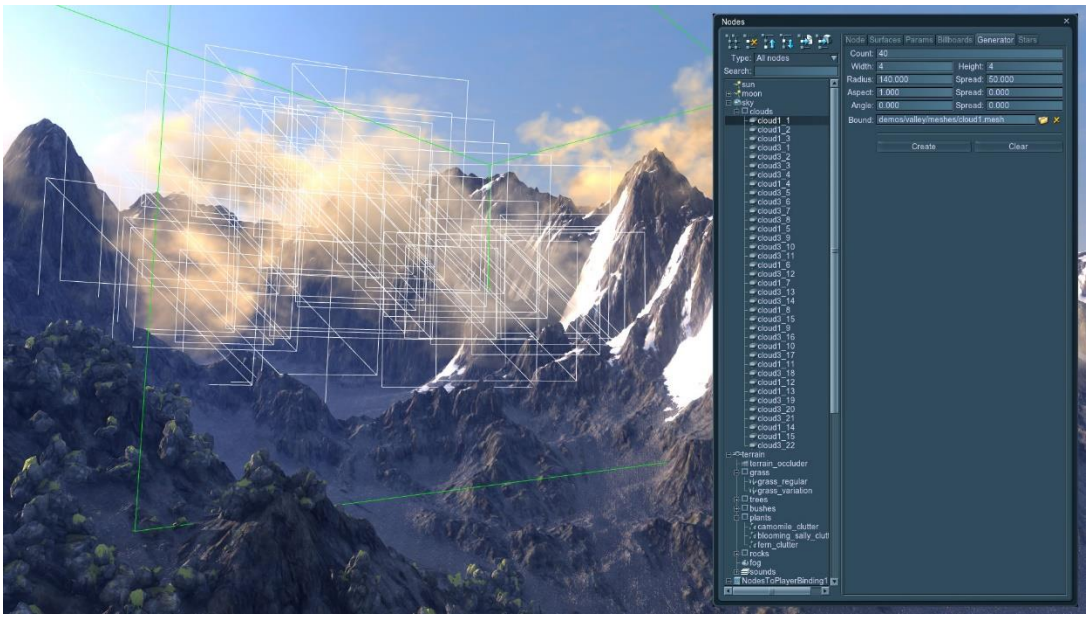


PICTURE 5. Example of NURBS curves (http://www.nnre.ru/)

2.1.5. Procedural modeling

Procedural modeling is the creation of 3D objects and textures algorithmically instead of manual modeling. A simple procedural rule can be used to create multiple 3D models. For example, a rule can use GIS object attribute information (number of floors, type of roof, wall material, etc.) to create a set of 3D models (see picture 6). The larger the number of attributes is, the more accurate the model is created.

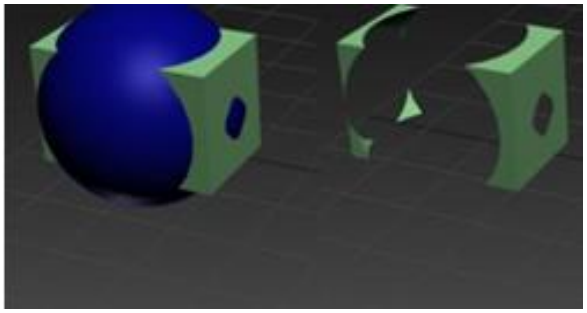
Powerful software has animation tools for particle system properties, which can significantly simplify the creation of a variety of atmospheric conditions, which would be impractical and inefficient to achieve using nonprocedural methods. It should be mentioned that the particle might be exposed to gravity and can change size, color and speed. After the necessary calculations, the particle is rendered. The particle can be visualized as the point, the triangle, sprite or a full 3D model. (Ebert, 2014)



PICTURE 6. Example of Procedural modeling (http://www.nnre.ru/)

2.1.6. Boolean modeling

Convenient and fast way of modeling 3D objects is using Boolean operations. The key principle is crossing two objects, and as a result another object appears (see picture 7). Can be made by the union, subtraction or the intersection of original objects.

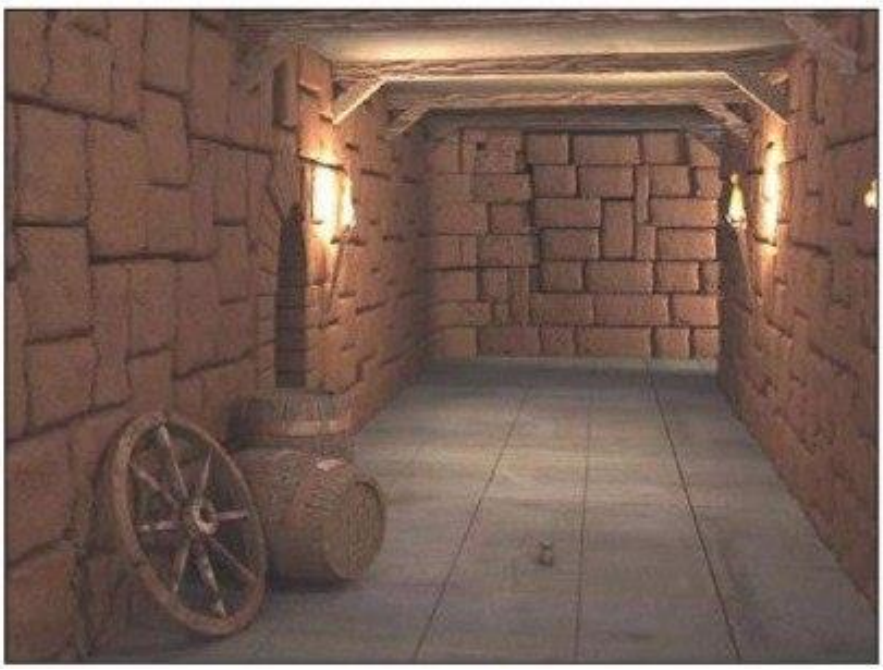


PICTURE 7. Example of the Boolean function Subtraction

This method is well suited for working with the architectural and technical elements, but it is not advisable to work with organic objects such as people, animals and plants. Despite the fact that this method is very common, it have drawbacks leading to errors of the resulting model (distortion of the proportions and shape of the original objects). For this reason, many users are using additional modules to avoid errors in the final geometry of objects. (Tozik, 2008)

2.2. Texturing

After 3D objects creation, we need to proceed to the next important stage of the project - texturing. Any objects that surround us in real life, have their own characteristic pattern by which we can correctly identify the object.



PICTURE 8. Example of texturing (Tozik, 2008)

Texturing is a very difficult task for a beginner in my opinion. In real life, we perceive objects as they are without considering the reflection and refraction, the amount of glare and other physical parameters of the object. In three-dimensional graphics, all the properties of the material must be configured manually. Texture is a collection of information about the object's appearance: material, gloss, reflectivity, transparency, self-illumination and many other parameters.
Such an abundance of parameters describing the features of any texture can accurately convey the look of the material. Through skillful use of textures, can be achieved realism of the scene, its beauty (see picture 8). Without textures a model looks like plastic with a single solid color, smooth surface. (Chopine, 2011.) For this purpose, any program has a 3D modeling material editor with sets of ready materials, or user can develop set of materials.

Color is one of the simplest properties of the material. However, even the use of color has many aspects. Color can be major, determining coverage of the entire object, streamlined, mirrored, etc. Also, in materials creation widely used texture maps. In the process of creating the material, can be used multiple texture maps. Texture is a bitmap applied over the surface of the models, to impart color or for illusion of relief. Using textures can be easily represented as a pattern on the surface of a sculpture. The use of textures enables reproducing small objects on the surface. For example, the scars on the skin, folds in clothing, small stones and other objects on the surface of walls and soil.

The number of pixels per texture unit determines the quality of the surface texture. Since the texture itself is an image, texture resolution and its format play an important role, which then affects the overall impression of the quality of graphics in 3D applications. Texture is a component of the material and applied to the object only through materials. For example, in 3ds MAX there is no word ”texture”, instead of this word it has Map. Maps are like the materials. They can be selected with a special menu.
The word "texture" is used most often in relation to the graphic picture which was painted or obtained in any other way (scanned, rendered, photographed with a digital camera, found ready). The texture – is the material property.
There are special slots in materials into which Map can be applied for different properties (transparency, color, etc.). The same Map can be applied in different slots, also

to multiple other slots. That is, the same Map (texture) may determine different properties of the material or even several properties. Materials may be different; the main material or the composite material. Composite material is the material that allows creating a composition of several other materials. The composite material maps and textures can be used to determine how the materials will be mixed. Commonly, textures are used with light and dark areas. One material placed in the dark areas, another in light areas. Materials smoothly blend together in grayscale.

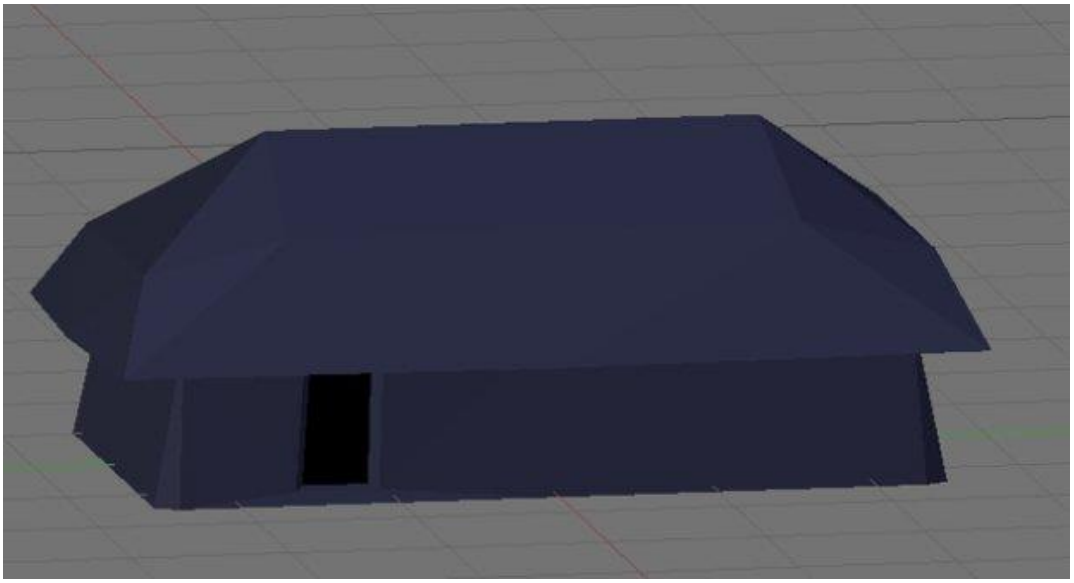
Similarly, there are basic maps and composite maps. But, it is difficult to make a clear distinction, because slots for maps are available in many procedural maps. That is, if the map itself implies the existence of two types of sections, we can choose any color for each section, any card that will fill the land. (Tozik, 2008.)

Now that it is clear what texture means, next we can take a look at techniques of texturing. The first one is texturing of certain natural landscape where we have the irregular surface, landscape with elevations and depressions, simulation of soil sand, grass, water and so on. This technique uses many high-resolution textures. However, textures has not so high-resolution to cover the whole landscape by one bitmap image. In this technique uses square or rectangular images, and sides of image must be divisible by16 (256x256, 512x512, 2048x2048, 2048x512 and so on). The larger the image, the more detailed they will appear in a scene or in the game and the more items are transferred.

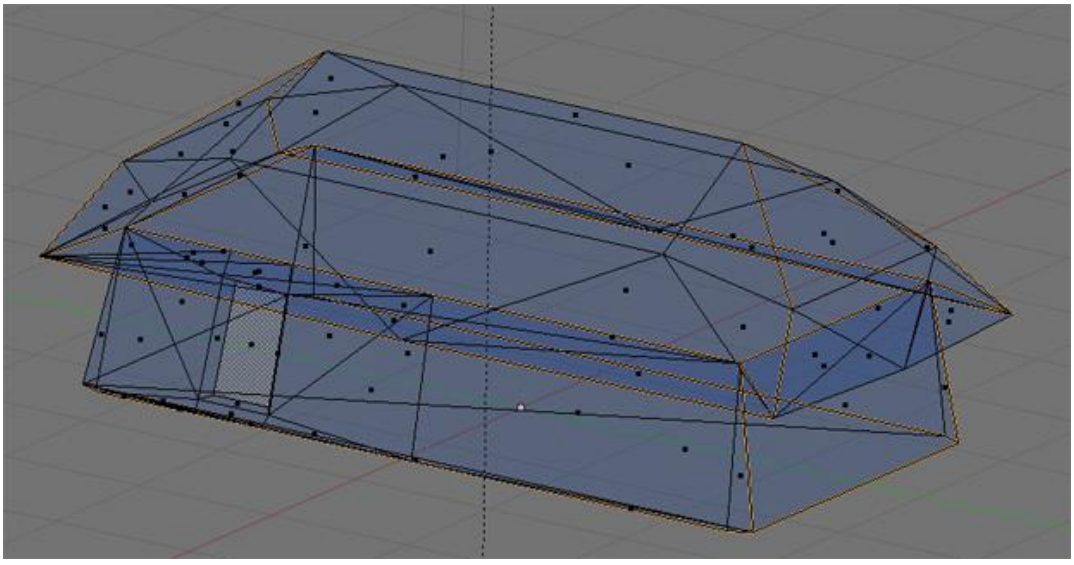
Textures need to be joined to each other seamlessly, and this will require special preparation. The simplest way is the division of the original image, such as photographs of four equal cross-unit and the movement of these fragments relative to each other. After that, it is necessary to cover up internal seams formed, and also to mask repeating fragments, like texture that is representing, for example, grass or sand should look as realistic as possible.

There are many ways of combining several textures. For example, in 3D editors we can assign different materials (and different textures) on a different group of vertices on the same surface. Stencils may be used to indicate where one texture will be fully or partially transparent, and where not.

The second example is a medium-sized 3D model which requires quite complex, but a single texture for all its surface. Here we use UV Unwrapping. UV Unwrapping is a projection of the whole surface of a dimensional figure on a plane for the subsequent arrangement on it raster images. In simple words the UV Unwrapping - a "cutting" of 3D shapes on the set seams, so it could go on the plane with minimal distortion of proportions. It is necessary to avoid large-scale distortion of texture. The same bitmap image should have the same resolution on different fragments of model. After unwrapping is ready, it can be exported in to any bitmap editor and used as a template over which the texture is drawn with all possible details. The process of UV Unwrapping according to Iljin (2009) simple and fast. At the start, we have 3D model that can be seen in Picture 9.

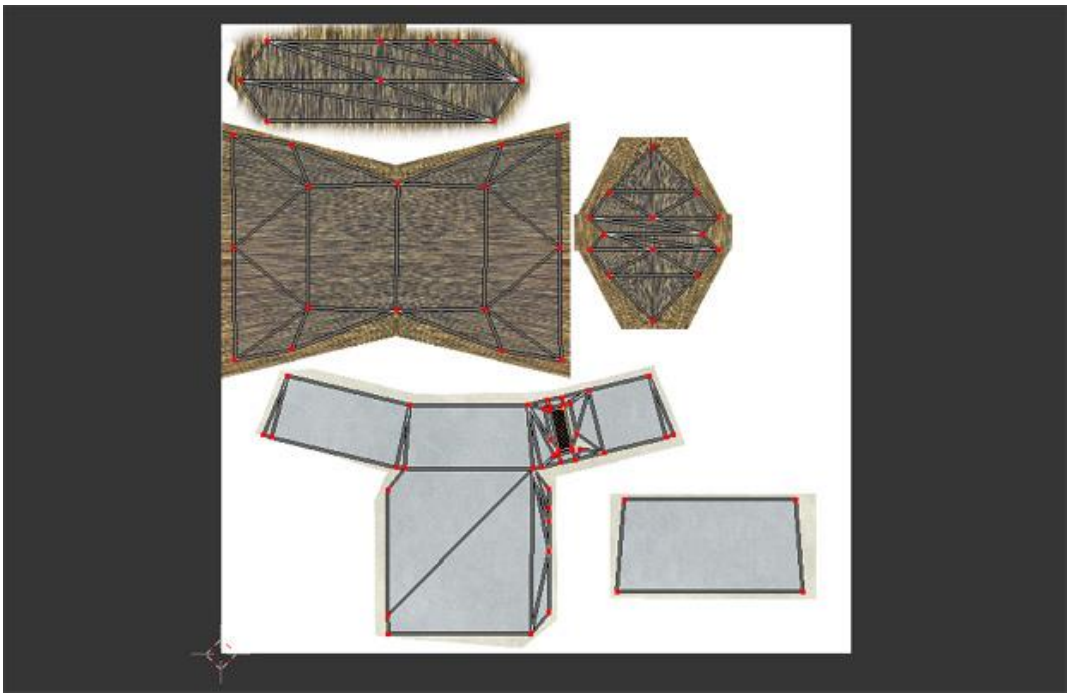


PICTURE 9. Object without textures and materials



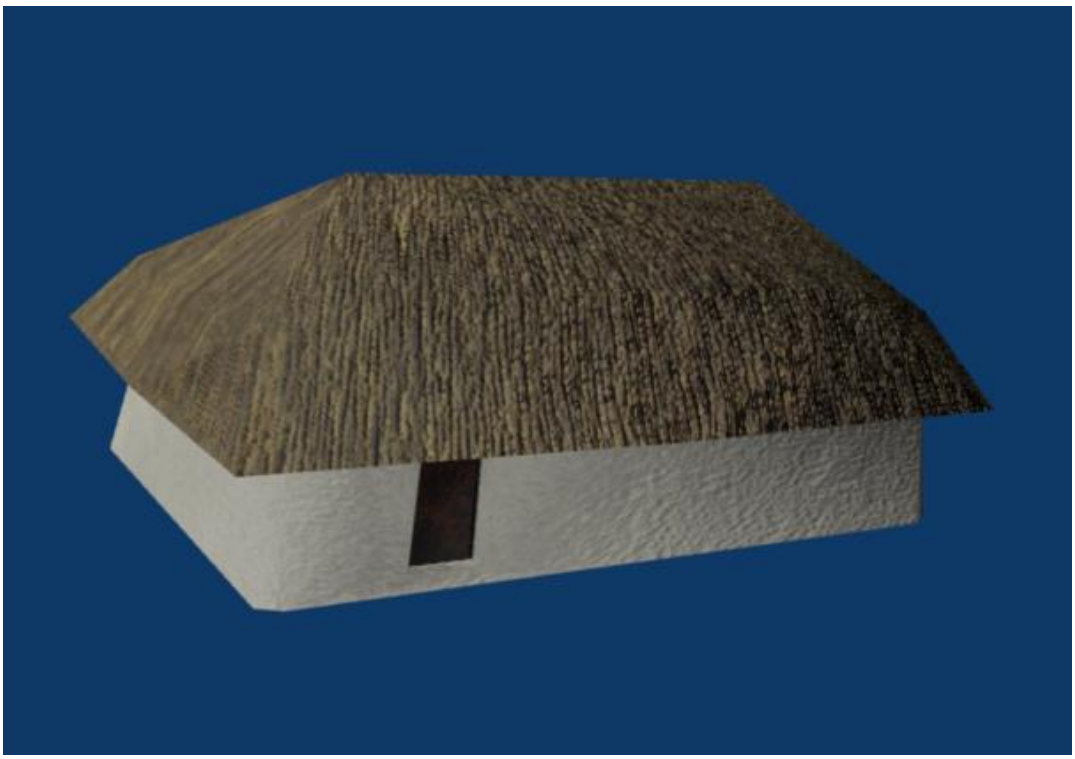
PICTURE 10. Example of UV unwrapping

On the Picture 10 demonstrated UV unwrapping. Orange color means seams where the model will be "cutted" for positioning on the plane. In fact, UV unwrapping is about the same as the tailor's pattern.



PICTURE 11. Example of UV unwrapping.

One the Picture 11 the model is cut. That's how UV unwrapping looks (gray line and red dots). Right on top of it is painted texture. As can be seen, "straw" is positioned to match with the orientation in the roof space.



PICTURE 12. The result of UV unwrapping

From Picture 12, we can see the result, a rendered model with textures. Pictures of UV unwrapping according Iljin (2009).

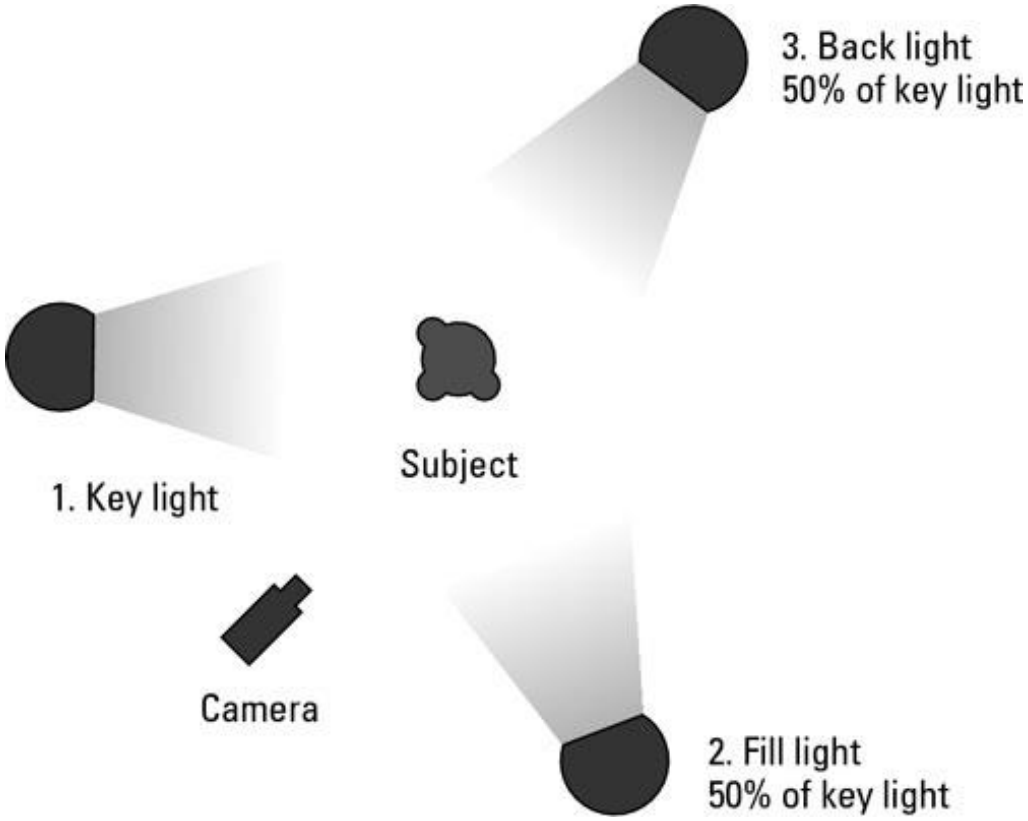
2.3. Lightning

Lighting is an extremely important aspect which must be carefully considered, when designing a realistic or stylized work. This is not only a way to illuminate the model; light creates the atmosphere and mood of the scene and is a key component of its aesthetic perception. There are several basic concepts of lighting according to Ratcliffe and Mack (2008). Pictures in following chapter about lightning according Nestor (2004).

Three-point lighting

The placement method called triangle lighting is often used in the photographic, cinematographic and theatrical fields. In many cases, this arrangement is also called Hollywood triangle. It serves as the basis for the creation of more complex lighting systems. Most often, this method is used when it is necessary to highlight a single object

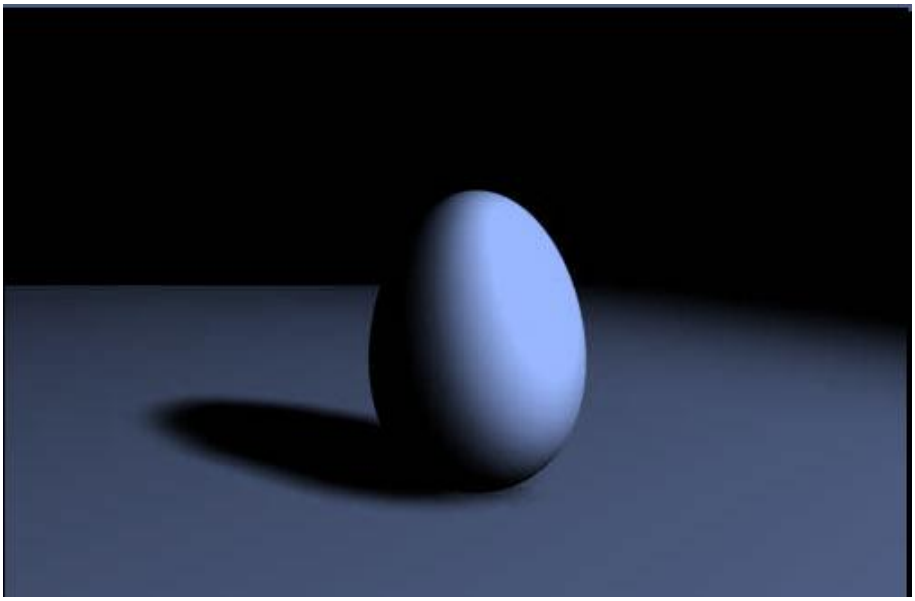
or a group of objects, and can be successfully used when working with three-dimensional graphics programs. As we can see on the Picture 13, the basic arrangement is quite simple and contains three illuminators - a key light, fill light and the back light.



PICTURE 13. Three-point lighting

Key Light

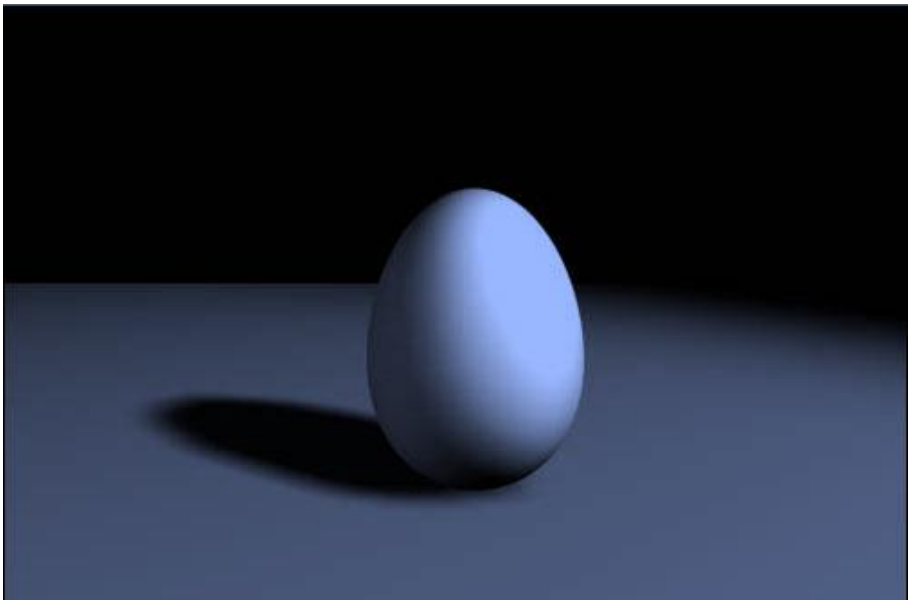
As the name implies, it is the main scene illuminator. Most often, it is placed behind the camera at an angle to the axis of ten to fifty degrees. Normally, this light source is placed first in the stage (see picture 14).



PICTURE 14. Key light

Fill light

The second light source included in the triangle lighting is called fill light. The main role of this light is to reduce contrast and reveal details that are in the shadow of an object or character. The fill light should be weaker than the key light and at an angle of thirty to seventy degrees from the camera axis on the side opposite to the key light (see picture 15).



PICTURE15. Fill light

Back light

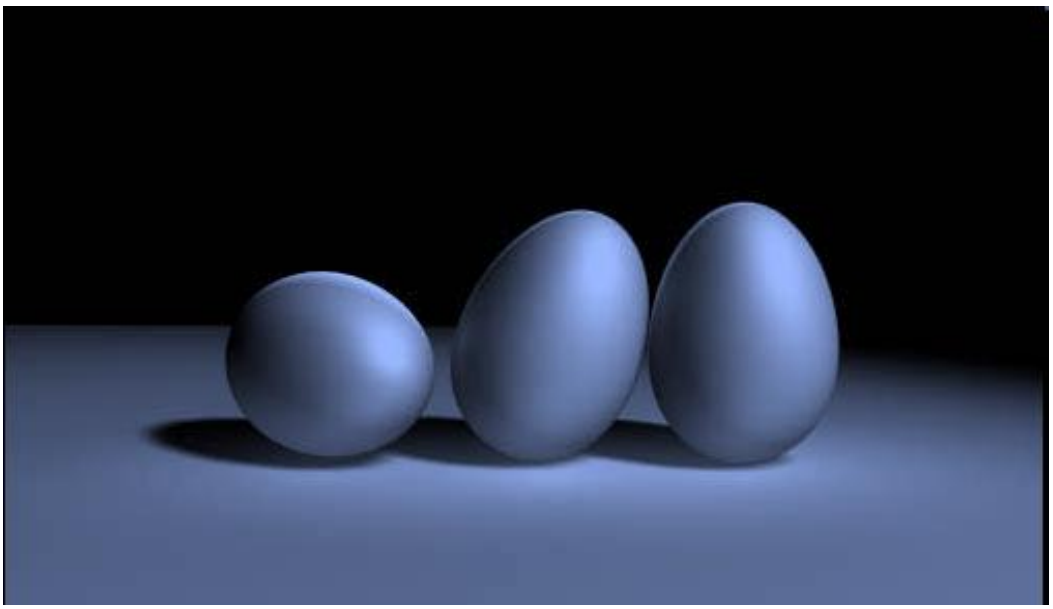
Back light is the third type of lighting used in triangle lighting. It is sometimes called rim light and it has two main tasks. First, it adds depth to the scene, separating the

foreground object from the background. This is an important task, if the background is quite complexly organized. Second, the light is used to illuminate the object contours. Back light is usually located above and behind the subject and directed precisely against the camera. In most cases, the intensity is higher than with fill and key lights.

These three types of lightning are basis for creating complex lighting systems. But, three-point lighting is not the only one method. There are also other commonly used methods of lighting: front, side, reverse and a high contrast.

Front lighting

Front lighting occurs very frequently and is very similar to a triangular base arrangement. In this case, the key light is placed approximately in the same place and the camera illuminates the subject. When using front light, there is a danger that the model will look flat due to the absence of the transitions from light to shadow on the subject. Therefore, it is better to place the light at least at a slight angle to the camera axis (see picture 16).

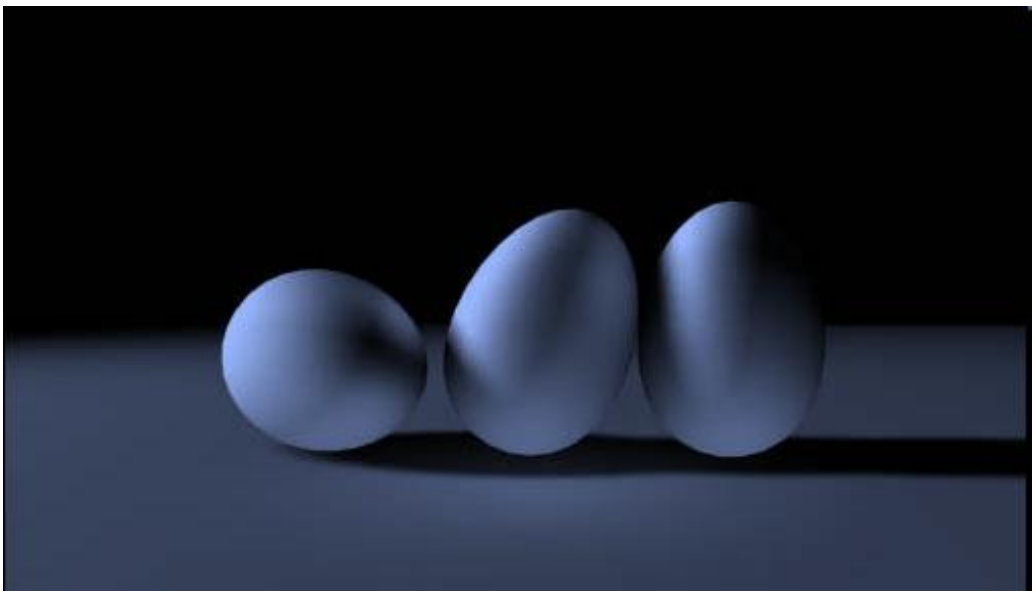


PICTURE 16. Front light

Side lighting

Side lighting is used when the primary light source or the key light is on the left or right of the object (perpendicular to the axis of the chamber). Such a method emphasizes the contour of the object, but should be used with caution in order not to receive

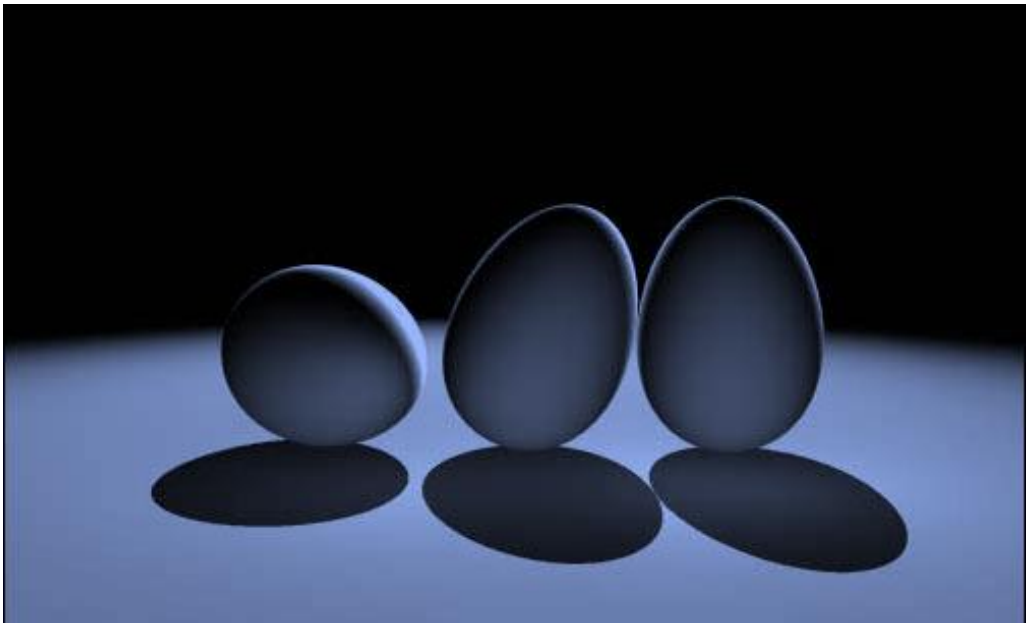
a "one-sided" composition, as all objects in the scene will be covered only from one side (see picture 17).



PICTURE 17. Side light

Reverse lighting

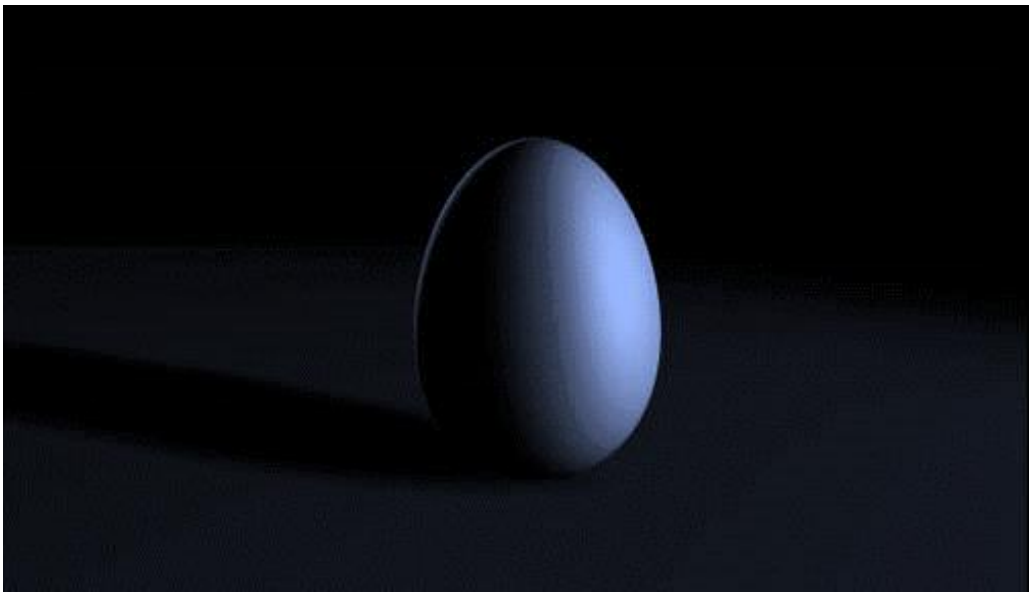
Reverse lights are significantly different from the standard methods described above. While frontal and side lighting are designed to draw the viewer's attention to the texture and volume of the object, reverse underlines its silhouette, creating the effect of a flat image. Objects, especially the characters, lighted that way often look mysterious or scary (see picture 18).



PICTURE 18. Reverse light

High contrast lighting

High contrast lighting is rarely used, but it is quite an interesting method. This method is named so, because it uses a very weak fill light, or none at all. This method provides a high contrast between bright and dark areas of a scene.



PICTURE 19. High contrast light

2.4. Animation

Animation is the most difficult stage of the three-dimensional modeling. Three-dimensional animation requires the author's knowledge of physics and mathematics. In addition, it needs to be one person, who writes and directs. (Tozik, 2008.)
Creating a smooth and logically correct movement requires much more effort than the other elements of 3D modeling. Creating a real character complicates the task repeatedly.

Animation is the illusion of movement created by viewing rapidly changing frames. To create movement, the author defines only key frames, and the software creates a movement between them. Visualizing a three-dimensional effect is represented by two-dimensional images, the sequence of which creates the illusion of motion. (Kerlow, 2004.)

2.5. Visualization

Visualization is needed to form the final image. Once we press the Visualize button, the computer starts to perform a very difficult job. According Larchenko (2011) it is necessary to consider the following aspects:

Image quality. Various settings allow us to increase the quality of the generated image, including better anti-aliasing for smoother diagonal lines and accounting for complex reflections. The goal is high quality in a reasonable time.

Lighting. Various types of lighting can be many times increase the rendering time. We should be careful when using such "advanced" tools such as radiosity (technique for modeling light fluxes for the construction and visualization of three-dimensional images of scenes) (radiosity) and volume lights, requires considerable time for computing resources.

Image Size. Scene size also affects the rendering time. For example, the scene of 16 000x16 000 pixels, of course, would require much more time than the scene of 800x600 pixels. Increased resolution requires more time. Although it should be noted that effects such as, for example, caustics - light stains due to scene objects when illuminated objects with highly reflective or refractive characteristics, require time, regardless of the size of the generated image.

File format. We need to remember that some graphical formats do not use compression algorithms and save images without loss of quality. Others on the contrary, use compression algorithms, which can lead to a loss of quality. Selecting the file format depends on what we intend to do with the file after the rendering.

Experience. This is the best way to achieve excellent results. Each scene is unique, and the settings that work well for one scene may not always be optimal for another. We should take time with small-scale experiments, before we start to visualize a complex scene.

3. INTERIOR MODELING

3D model of interior is an excellent way to imagine and estimate the appearance of further interior or demonstrate already existing place at its best. According to Schreyer (2015) to create a good, high quality interior model there are following steps:

Measuring and Photos

To make good quality 3D model of interior, designer need to have measurements of future model, including doorways, arches, windows, and so on. Also, it is always a good idea to have photos of an interior, it is helpful when need to make all details and of course photos can be used for textures.

Floor Planning

After all measurements are made, floor planning can be started. In the beginning needed to set the unit of measurement in the software and then start a sketch considering all measurements.

Creation of the frame

Before designing the interior designer need to make a frame of future rooms, it is an essential step in the creation of the project. The frame should be with floor, walls, doorways, windows, etc. To ensure the accuracy of modeling in the software there are various options such as alignment, input of exact values, rotation, scale and much more options. After all actions, designer gets an empty model of a project.

Furnishings

In the made model can be placed furnisher, that needed. Filling the rooms with furniture, accessories and other elements of the interior is the most important stage of any interior project. Furniture can be modeled the individual files, and designer can create own library with models. Then all parts can be gathered in one model.

Selection and assigning of textures

That step makes model realistic. At this stage, designer have to work hard and look for suitable material. Texture can be draw himself, made from photograph or can be chosen from material library.

Lighting

It is necessary to place all the lights, mostly like in real rooms, to make model realistic. This may take a dozen of light sources.

Visualizing

This is the final step of all work. Can be made in different ways: photo of the model, panorama, video or interactive tour. Visualization should show the model from best sides and look realistic. Good placement of cameras are very important.

All of those steps can be done in different ways and using various methods, my way of modelling I will describe in the next chapter.

4. PROJECT IMPLEMENTATION

After examining all methods of the modeling, lighting, texture and rendering I have started implementation of the task. For that model, I used several 3D modeling software, to obtain better results. I chose these software because I was previously familiar with them, they have user friendly interface, and in the end they produces a high-quality model.

4.1. Used tools

Autodesk AutoCAD

In this work, for working with drafts I used Autodesk AutoCAD. Autodesk AutoCAD software package for creation drafts and working with them on the computer. AutoCAD can be effectively used to solve a wide range of tasks: drawing, constructing, design works etc. Despite the large number of commands (in their latest version of the 300), AutoCAD has a user-friendly interface and an efficient system of dialogue with the user. AutoCAD is a system that allows automating the drafting and graphic works. The AutoCAD graphical package there is everything for creating a draft. In addition, in manual drafting, an automated environment has all the features, graphics primitives (point, line, circle, etc.), editing commands (erasing, moving, copying, and so on.), the commands for primitive properties (reference thickness, type and color graphics). AutoCAD provides the designer the ability to integrate graphics into a single unit, which is stored with a name and, if necessary, inserted into any drawing that saves the designer from the drawing of the same repetitive drawing elements. The developers of

the system, focusing on a wide range of users, have laid in a huge package of customization options. Advanced users can customize the toolbar and create new ones, develop slide films, enter new types of lines and hatch patterns, forming a new menu. The Built-in AutoCAD AutoLISP programming language allows describing common objects in parametric form. By calling such an object, the designer can change the size and geometrical shape, thus providing a multi-variant graphic. In addition to the creation of two-dimensional drawings, AutoCAD allows modeling three-dimensional objects and giving a three-dimensional drafts photorealistic view.

Google SketchUp

For modeling my motel, I mostly use SketchUp. This is really flexible, convenient and ”light” software. SketchUp is a program for creating and editing three-dimensional graphics. The main idea of SketchUp is a simple interface that allows even non-professional users to learn working with the program.

The program implements the concept of direct modeling of geometry in which the user first builds a flat contour from the available primitives, then pulls it in order to create or subtract volume, and then gives the correct shape of the model by dragging its elements (vertices, edges, and faces) with the mouse pointer. SketchUp supports the import and export of different formats of three-dimensional and raster graphics. The program has a library of components that can be replenished by the elements and library materials. (Brixius, 2012) It is available in two versions, free and commercial SketchUp SketchUp Pro. The free version also includes a set of geographic information in the Google Earth system package.

Professionals and amateurs use SketchUp for architectural design, interior design, furniture design, game development and three-dimensional visualization. Google maintains a library of three-dimensional models (buildings, bridges, cars, furniture, people, animals, fictional characters and so on.) with free access to find and add new models.

For SketchUp there are plenty of modules, plugins from other developers, created with the software in the language Ruby. Programs in Ruby are platform-independent and are interpreted at run time. It is possible to integrate them in the binary code compiled for a specific target platform. (Stine, 2012.)

Autodesk 3ds Max

Autodesk 3ds Max is a full-featured professional software system for creating and editing three-dimensional graphics and animations, developed by the company Autodesk. It is contains advanced tools for designers and professionals in the field of multimedia and has an extensive set of tools, techniques and tools for creating three-dimensional models, including polygonal modeling, NURBS modeling and modeling based on Bezier surfaces (Editable patch). It has convenient mechanism for character animation which allows building a logically connected sequence of bones and components of the mechanisms. It has a large number of built-in modules and visualization tools that facilitate the modeling of complex special effects. In addition to the standard package, there are Parties to develop solutions that can be used to extend the functionality of the program, in order to achieve a more realistic visualization. The Autodesk 3ds Max workspace by default has several different views on the subject (top, front, left) and a perspective view. We can easily switch between them using the hotkey Alt+W. This is a very helpful feature.

Thea Render and PanoramaStudio

One of the program for rendering I decide to use advanced render software Thea Render. Also I decide to use PanoramaStudio. This software allows creating panoramic images. It automatically combines the images together, while providing a smooth and seamless transition from one to another. Before operating with the original images, we can crop, rotate and scale them. PanoramaStudio supports the formats JPG, TIFF, PSD, BMP, PNG, PCX, RAS, IFF, TGA and many RAW files. The program automatically detects focal length, can automatically correct lens distortion as well as to improve the prospects. The resulting images can be further processed by the means of filters. PanoramaStudio Features which are the following:

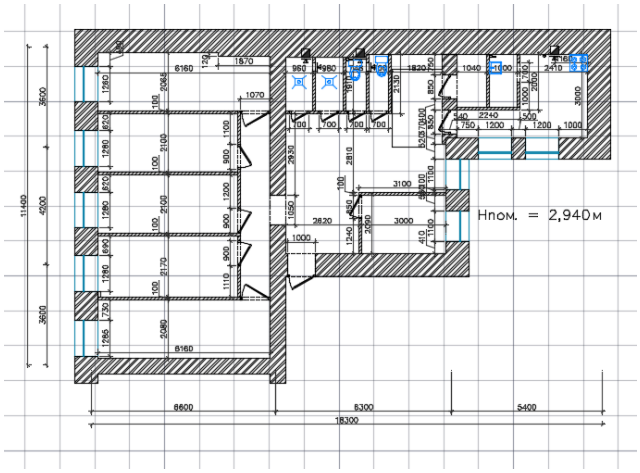
- A very simple interface, large work area with the possibility of 2D and 3D view
- Auto-leveling single and multiple images
- The ability to perform seamless connection of panoramic images
- Auto Exposure compensation
- The ability to export panoramas in various image formats.

4.2. Tasks

For model creation, I made several tasks using software that I choose. I will describe main steps and methods that are used. First I will start with floor planning and end with visualization.

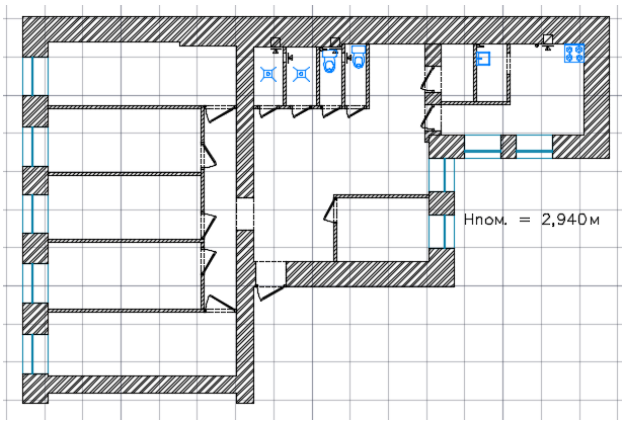
4.2.1. Floor planning

Using all measurements, I started with floor planning. I set sizes and all that needed. There is an appropriate commands for draft settings for selection the correct sheet size and drawing scale. To apply the size of the project needs and specify its location in the draft.



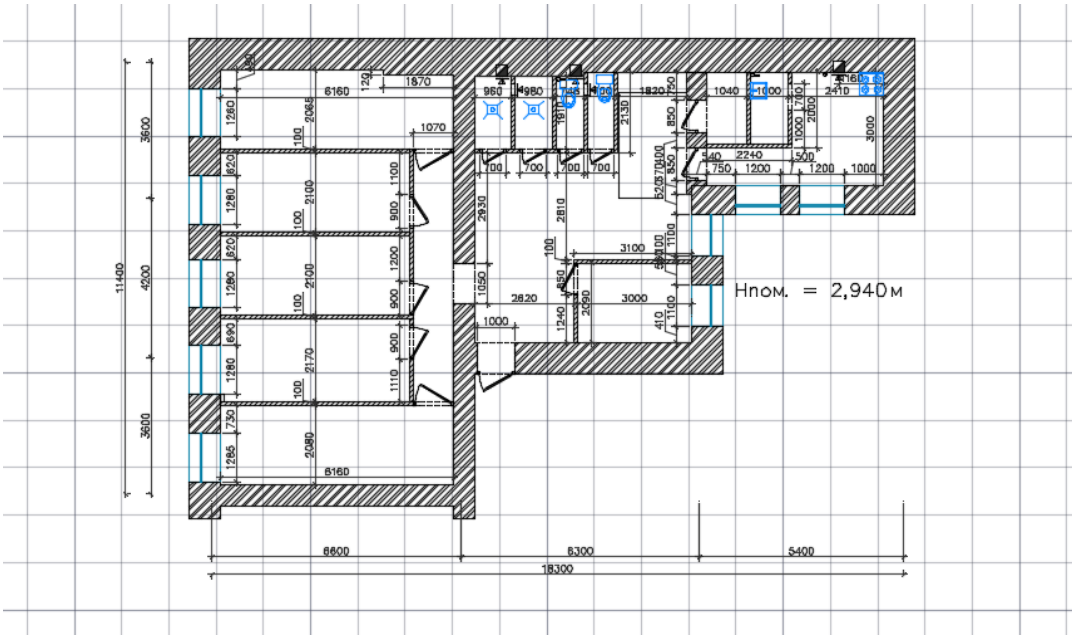
The dimension and extension lines, arrows, and inscriptions are performed automatically.

In an automated environment, there is no need for designers to strain eyes when working with certain small parts of the drawing, as it provided by software, image controls on the screen. The draft on the screen, if necessary can be increased or reduced (similarly to viewing images through the lens). In addition, it is possible to create images of individual elements of draft or individual components on different layers. This allows us to control the compatibility of parts.



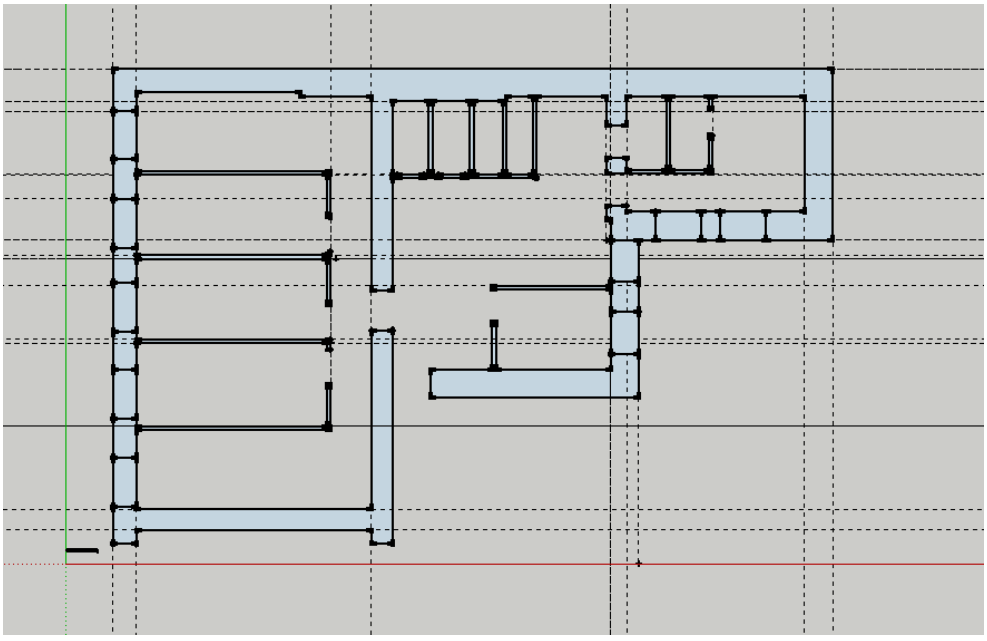
PICTURE 20. Different layers

By enabling or disabling layers, we can display or hide the details of the overall layout, creating convenience in the selection of various options of product design. Layers are useful even in the simple drawings. Ability, quickly select a group of objects for their editing, can be achieved by placing the drawing blank, sizes, labels and axis lines on separate layers (see picture 20). After some work, I got the draft for my future 3D model.



PICTURE 21. Draft of a project

Then I created a shape of my motel. By using a draft, I have built walls and floor in SketchUp. Then by using several tools, like lines, rectangles, eraser and tape measure, I have built my base.

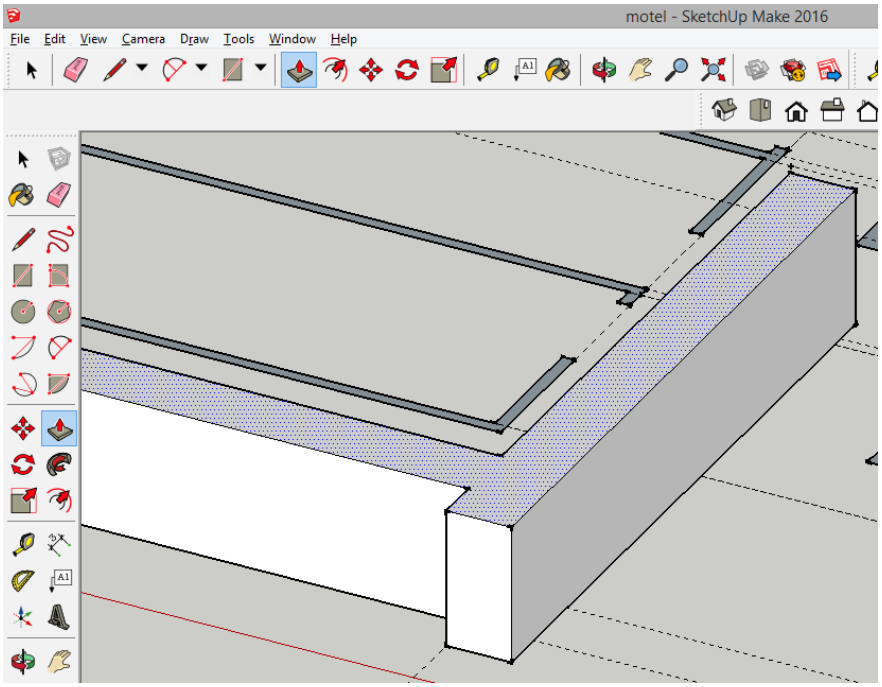


PICTURE 22. Draft of a project in SketchUp

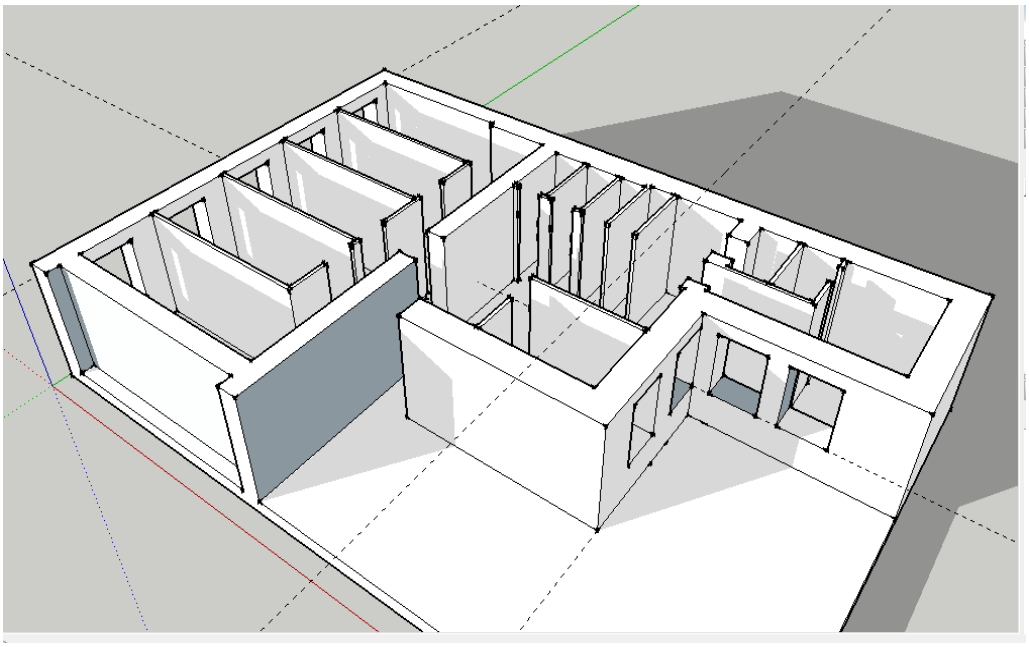
4.2.2. Creation of the model's frame and objects

After our draft is done, it is time to build the walls. Using the Push/Pull tool. Usually, in 3D editors, this function is called extrude. This tool does not operate with edges,

but only with the surfaces. It is easy to use this tool. First, we need to select the surface that want to extrude, then select the Push/Pull tool and move it up or down, left or right. I built the walls this way. After implementing this tool on my base, a 2D draft becomes a 3D model.



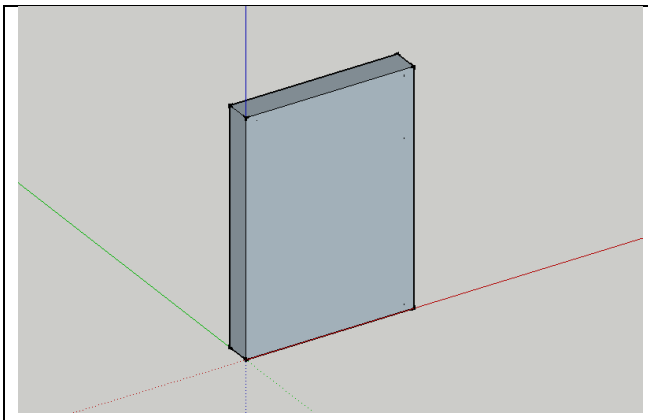
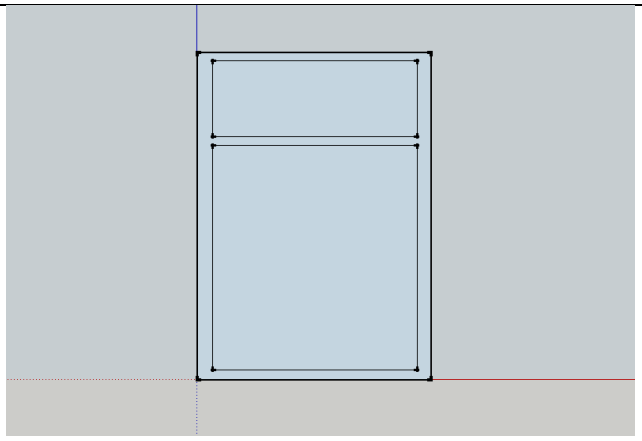
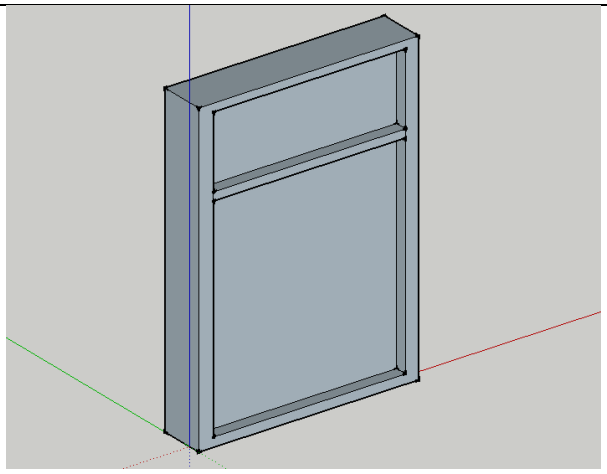
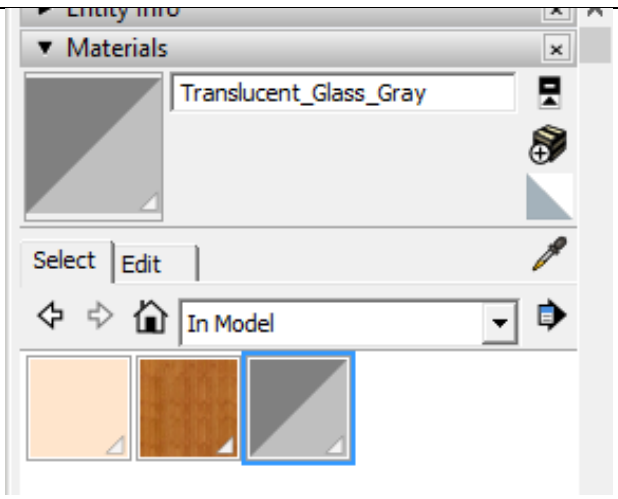
PICTURE 23. Push/Pull Tool

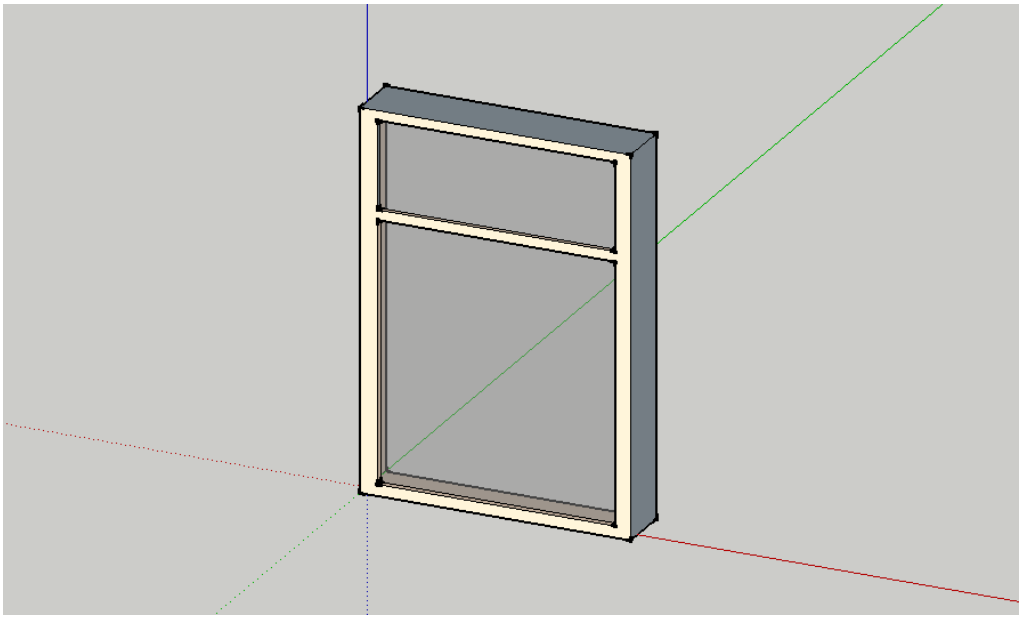


PICTURE 24. 3D model floor and walls

After we are done with the floor and walls, it is time to think about doors and windows. Starting with windows, we need to take care of following steps that describes in Table 1.

TABLE 1. Process of window creation

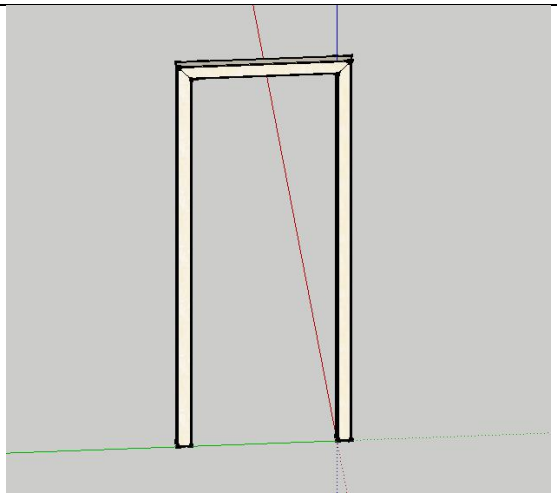
	At the beginning, we draw a box (rectangles) and set correct sizes.
	After box is ready, we draw borders of the glass and make its own design.
	Using Push/Pull tool we push parts, where there will be glass.
	Using the Material menu, applying textures on the window.

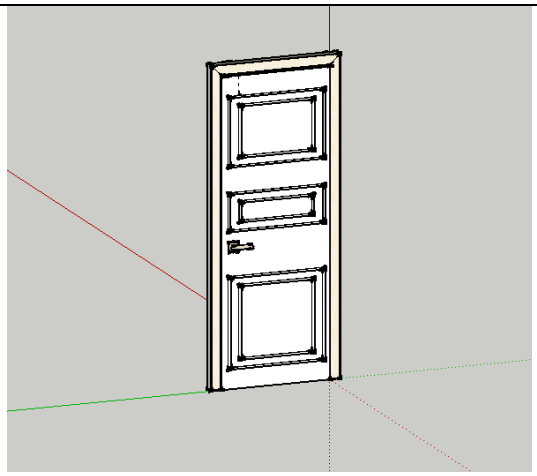
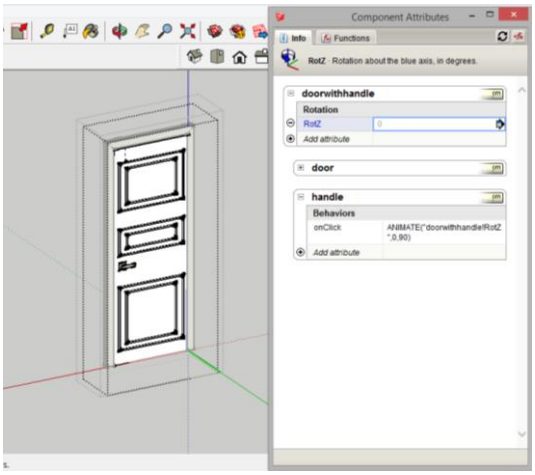


PICTURE 25. Ready window

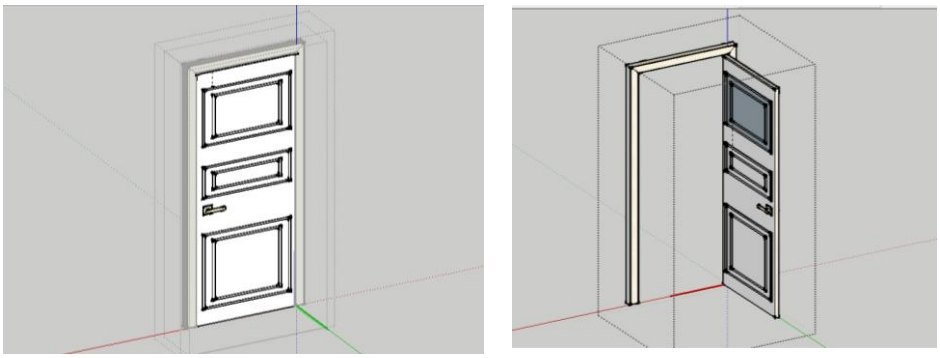
After instructions in Table 1, window is ready and can be placed in model. When moving on to doors, the process of modelling them is almost similar. There is only one nuance. I need my doors opening and closing, and we need to get familiar with dynamic components. The main difference from the static objects, in that dynamic objects respond to user actions. (Chopra, 2011) These objects have all the same features and capabilities as the "normal" ones. In addition, they support all the same tools and ways to manage the components in the scene. The process of the door creation shown on the Table 2.

TABLE 2. Process of dynamic door creation

	- First, we need to make a doorframe and make a component. - The frame should be assigned to axes, otherwise the dynamic component will not work.

	- When modelling a door and a door handle, they also need to be components.
	- Then, we are opening Component Attributes where we add a new attribute onClick on the component “handle” - After component, we inserting ANIMATE function.

The Animate function is the following: ANIMATE("attribute",state1, state2,...stateN), where we need to change “attribute” to the name of our component that should move. In my case it is “doorwithhandle” and also we need to change “states1” to 0 and “state2” to 90 (degrees on which it will rotate). Then for our door that should move we add the attribute RotZ. Attribute RotZ means that the object will rotate on Z axis. After all these steps, we have door that opens by clicking on the handle.

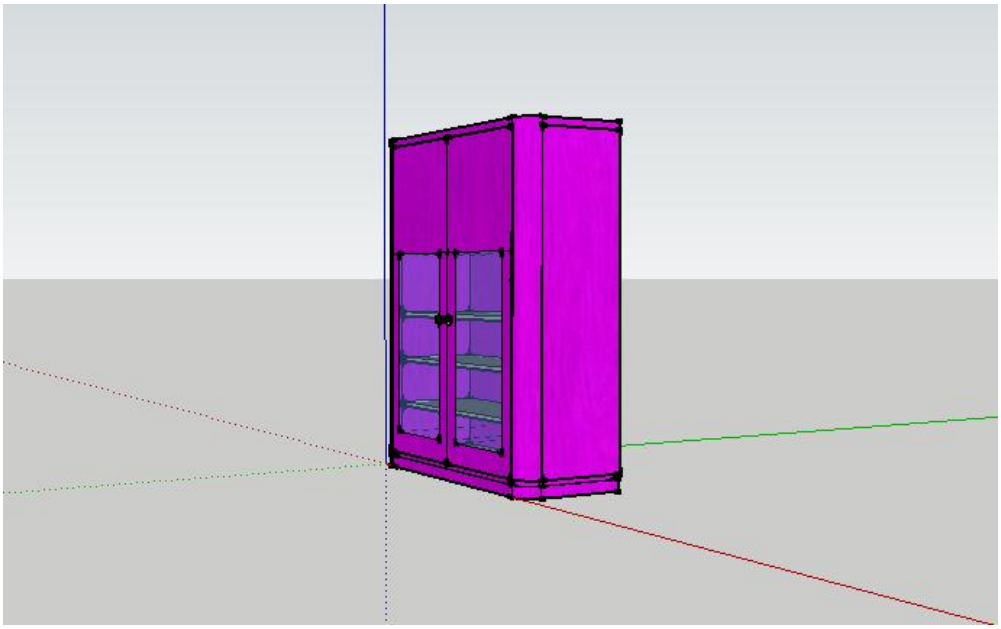


PICTURE 26. Dynamic door

Further, when our doors and windows are finished, and our walls and floor textured, it's time to start modelling the furniture. Some furniture that did not contain a large

number of small parts, I made also in SketchUp. For example, purple cupboard as in the Picture 27.

PICTURE 27. Cupboard in the hall of a motel

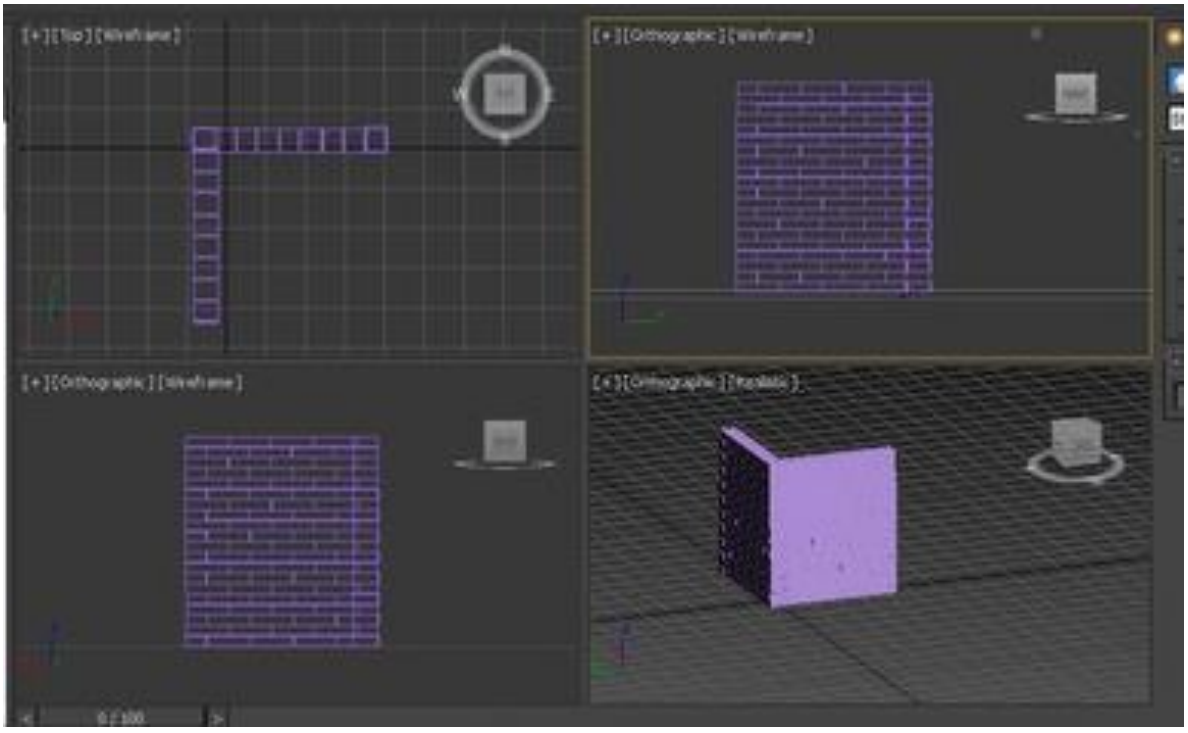


PICTURE 28. Cupboard made in SketchUp

4.2.3. Creation of complex objects

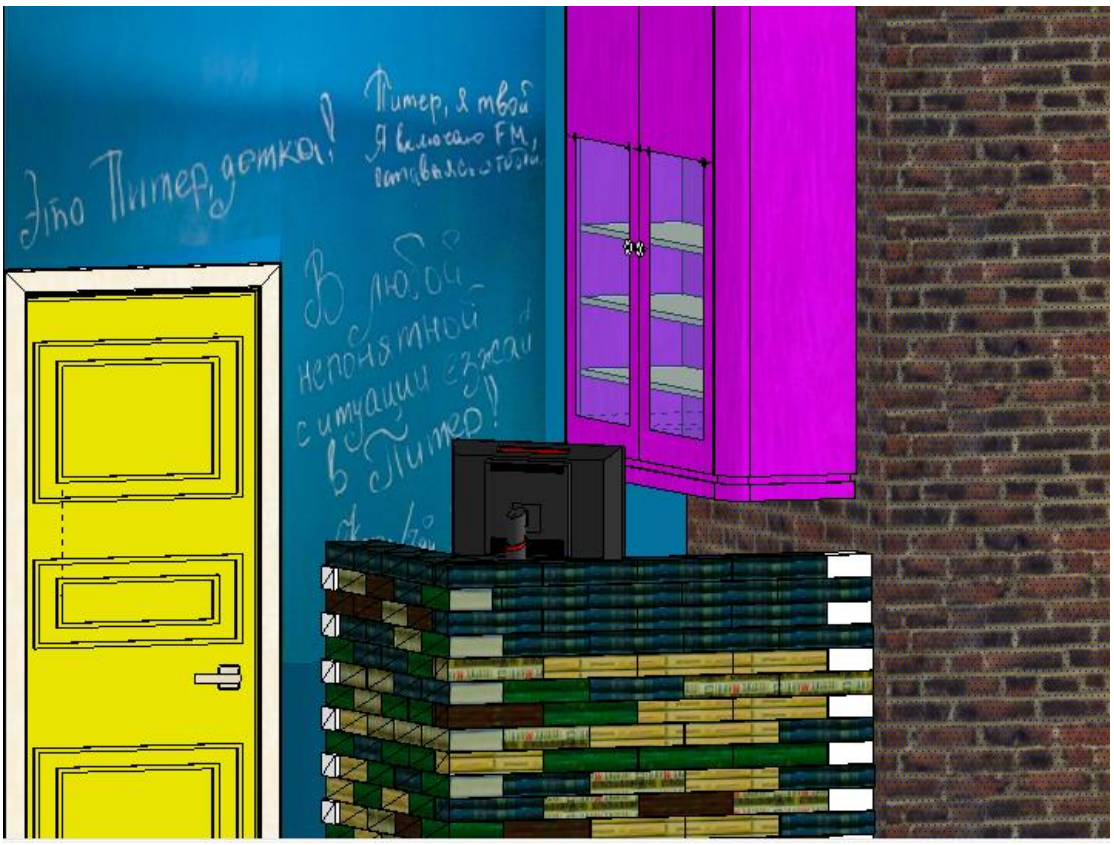
For more complex objects, it is better to use Autodesk 3ds Max. To model a hand-made reception desk (Picture 27) I have been using 3ds Max. This desk made of old books bonded together. The process of creating the reception began with the creation of a book. For this purpose, I used the Box tool. This tool allows creating a box of any size. It is necessary to change the size of future books in accordance with the real. Length, Width, Height and the value of the number of segments into which the object will be divided can be changed in the drop-down menu Parameters.

When our book is ready, we need to multiply it and put together, similar to brick wall. Workspace with several different views helps a lot. I can see from all sides that everything is going right.



PICTURE 29. Example of 3ds Max workspace

When the reception desk is done, it is time to move it in its place in our motel model. In other words, we need to transfer it from 3ds Max to SkechUp. To do this, we need to save the reception desk model in .3ds format, which easily accepts SketchUp. They also works in the other direction, 3ds Max and SketchUp are readily compatible. After I put it all together, I get the following result like on Picture 30.

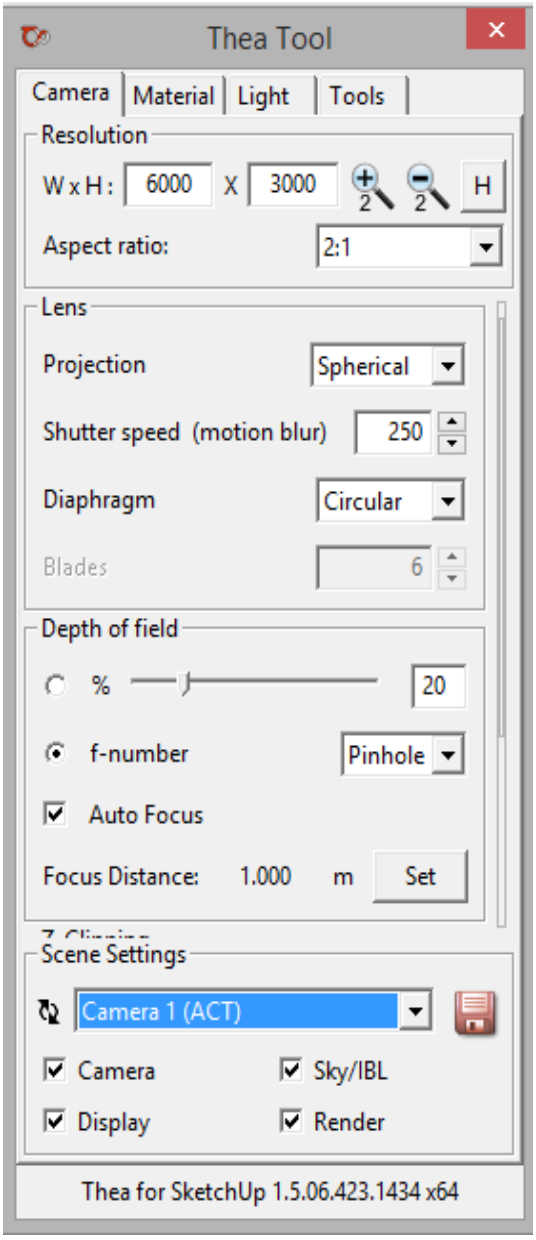


PICTURE 30. 3D model of motel hall

4.2.4. Visualization

When all the furniture is ready and placed and the 3D model is done, we need to take care of the "virtual tour" where we can take a look what we have done. First, for rendering I will use Thea Render.

To make a render we need to download Thea Render plugin and install it on our PC. Then, if the installation is done correctly, we will find Thea Tool in SketchUp. First of all, we need to get panoramic image through a spherical camera. To do this we need to place a camera in our model and choose a view that we like to show. Then we need to open the Thea Tool settings.



PICTURE 31. Thea Tool settings

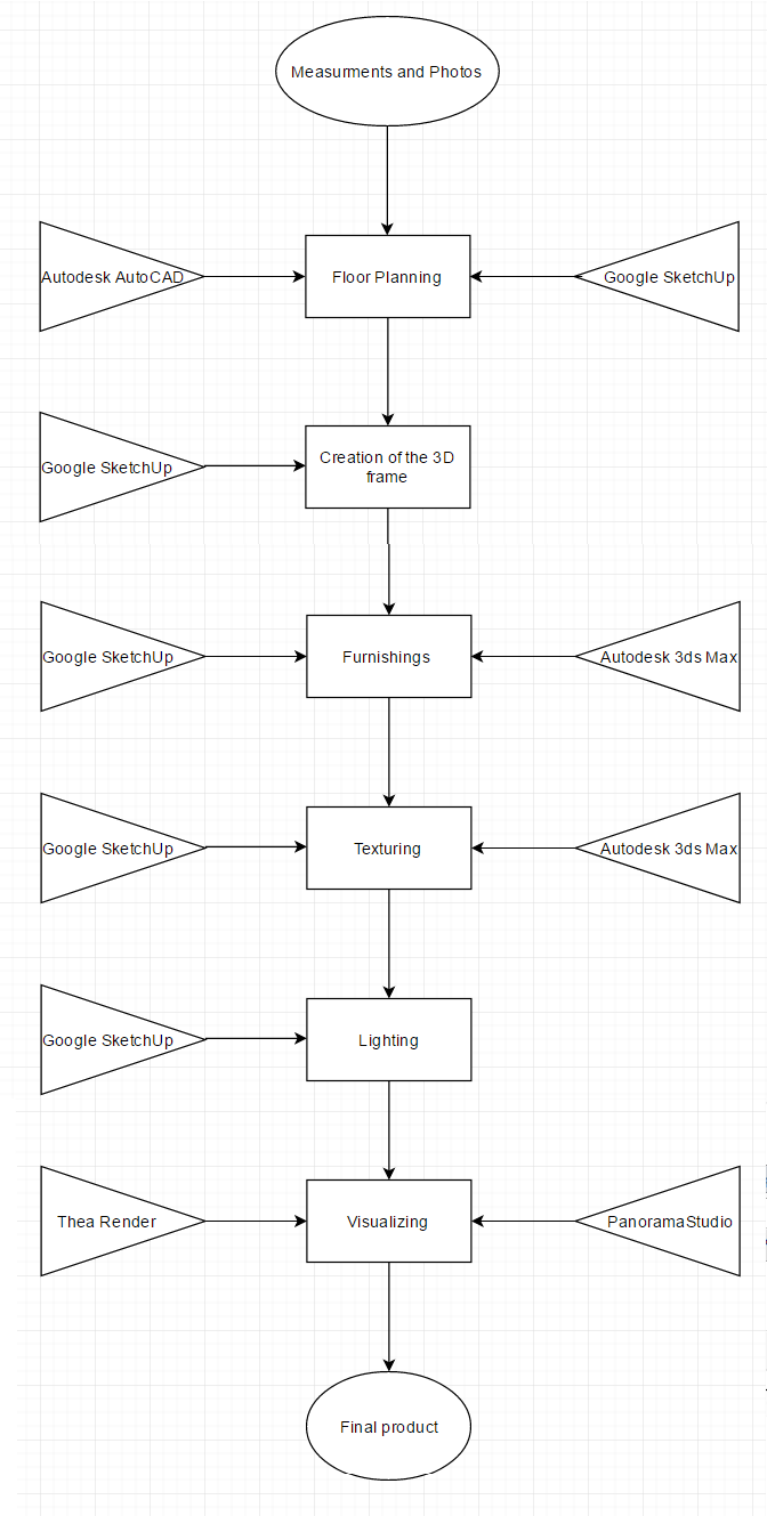
To configure Thea Tool settings we need to take a look on Lens sub-menu (Picture 31). There we need to choose Spherical type of Projection. Talking about resolution is better to choose 6000x3000. For better quality of picture is good idea to set higher resolution, but it is difficult to render and will take more time. Otherwise, there is no risk of poor quality that means that I can use 6000x3000.
Then we set 2:1 in Than Aspect ratio and in Scane Settings sub-menu we choose camera that prefer.

After configuring setting there are two options: render, by using built in plugin or export to Thea Studio.After the rendering process we will get a panoramic picture. Finally, I continue with PanoramaStudio.

After all steps we made, we need to open our panorama in PanoramaStudio. There we need to chose ”Full 360 degree panorama” and not to forget that we are using Spherical projection. Next, we can add hotspots, to travel over our created rooms. After that, our job is almost done. We need to click on File menu and find “Save as Interactive Panorama” In new window, in setting field we can find “field-of-view settings” where we can set a starting point of the virtual tour. Also, the quality of panorama can be changed from settings. Then we can press “save” and after some time we will get an HTML file that can be loaded on a web site.

4.3. Results of modeling

At the end of modelling, I can assume that for creation a 3D model should be several software used. One software for all purposes is not enough if we want to get high quality 3D model. My work process can be shown as a following flowchart (Picture 32).



PICTURE 32. Flowchart of working process.

5. CONCLUSION

Today, almost every business is using a 3D editor in the daily routines. Working with a 3D editor allows to realize any project, with an unlimited number of solutions for each of them. For example, in the construction of dwellings, buildings or in landscape design, construction companies pre-prepare and bring a project to life in 3D. This approach allows companies to demonstrate the project to customers in the best possible way.

During the implementation of this thesis the basic techniques of creating 3D models have been studied, as well as ways to visualize them. After studying most popular three-dimensional modeling products, the following were selected for the realization of the project: Autodesk AutoCAD program for working with drafts, Autodesk 3ds Max for polygon modeling and of complex objects, Google SketchUp for creating a basic model and elements, PanoramaStudio and Thea Render for creating a virtual tour of the finished 3D model.

I have made a 3D model of a hotel, and tell about process of model creation, as I planned in the start of my thesis work. I studied many techniques and used some of them. Of course, 3D models can be done in another ways and my model could be done differently, and in next project, I will test other solutions. In future, it would be great to make a real virtual tour, not just panorama view. I am planning to do it one day, so ProPiter hotel can use my model in their promotion and growth.

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