Introduction to 3DSMax
TNM061/TNGD25 Lab 2

Contents

1 Material Editor

Objects in the scene that lack a material get a default color, which is picked at random from a standard palette. The color can be changed, but this color setting is not intended for use during rendering. In order to create good materials, you use the program's built-in *Material Editor*. Click and hold the button in 3dsMax Toolbar that is depicted above, and you will get a choice whether to use the old style material editor, now called *Compact Material Editor*, or the new style *Slate Material Editor*. Both contain the same functionality, but *Compact Material Editor* is less confusing for beginners. As you get more experienced and want to create more complicated materials, you should take a look at *Slate Material Editor*, but for now, let's stick to the compact editor.

WHen you click the button, a window pops up according to Figure 1. At the top left there are a number of *Sample Slots*. The material editor is a separate part of the program which can take a while to get your head around, but it pays to learn to use it well. Good materials can fool a viewer into thinking that a scene is considerably more complicated than what it really is in terms of pure shape, and vice versa: bad and boring materials can ruin an otherwise well modelled, lit and animated scene.

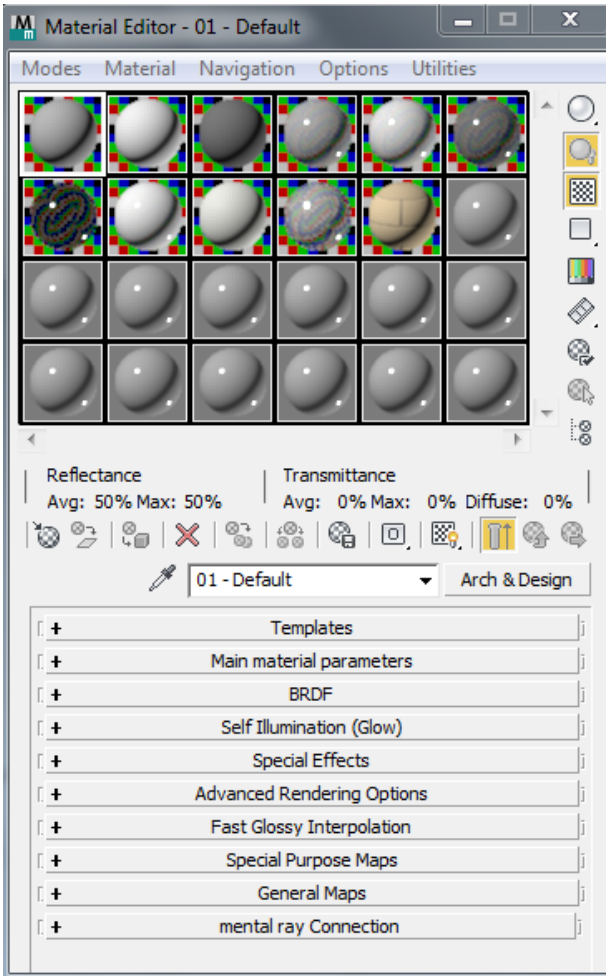

Figure 1: Compact Material editor

1.1 Materials and Maps

Two terms are used throughout the material editor: *Materials* and *Maps*. A *Material* defines the complete appearance for a surface: color, pattern, shininess, transparency, bumps and the like. A *Map* is a single 2-D image which is used to control one of the many surface properties of a *Material*. It's important that you keep this in mind, or else the material editor will be more confusing than necessary.

1.2 Sample Slots

By using the sample objects in the Sample Slots, you can keep track of your materials and maps and preview them already before you apply them to an object and render an image. The sample objects are spheres by default, but you can change this (see below). Each sample slot displays one material. You can change the materials through the material editor controls, and you can apply the material to objects in the scene. The easiest way to apply materials is to drag the material form its Sample Slot and onto the object in any of the viewports. A Sample Slot is "hot" when the material is assigned to one or more objects in the scene. This is indicated by highlighting the corners in the sample slot.

When you use the material edtor to tweak a "hot" material, that material is changed on the objects in the scene. To the left in Figure 2 you see a "hot" material which is applied to an object which is not selected, and in the middle a "hot" material which is applied to a selected object. The material to the right is a "cool" material, which is not being used in the scene at the moment.

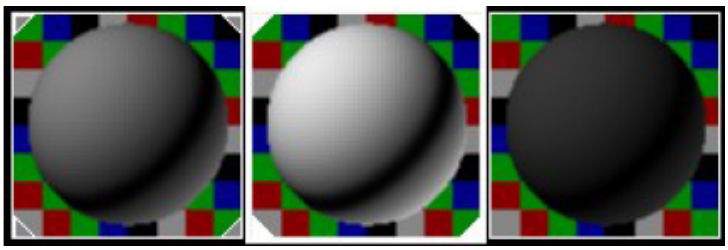

Figure 2: Sample Slots

When you right click an active *Sample Slot*, you see a pop-up menu giving you the following choices:

1. *Drag/Copy*: In this mode, you can copy the material from one Sample Slot to another or to an object in the scene by left clicking and dragging to an obejct or another Sample Slot.

2. *Drag/Rotate*: This mode allows you to rotate the sample object by left clicking and dragging in the Sample Slot.

3. *Reset Rotation*: Resets the sample object to its initial orientation.

4. *Render Map*:Renders the map and creates a bitmap, or possibly a video file if the map is animated.

5. *Options*: Shows the Material Editor Options. Same effect as the button Options, which is explained later.

6. *Magnify*: Creates an enlarged view of the Sample Slot. A double click in the sample slot does the same thing.

7. *3×2 Sample Slot*: Displays 6 Sample Slots (standardinställningen)

8. *5×3 Sample Slot*: Displays 15 Sample Slots

9. *6×4 Sample Slot*: Displays 24 Sample Slots

Note that these *sample slots* work much like a painter's palette: you can have "colors" (materials) which have been used on the canvas but are no longer present on the "palette" (in a *Sample Slot*), and you may have materials on the palette that are not (yet) applied to objects in the scene. A typical scene contains many more materials than what fits in the palette. You will often need to pick a material from the scene and put it it a *Sample Slot*. This is done by the pipette tool to the left of the name of the material. Activate a Sample Slot, click on the pipette and then on an object in the scene. The material for that object then appears in the chosen sample slot.

1.3 Tool buttons

To the right of the Sample Slots and below them there are 20 buttons in all. Each is described briefly below.

1.3.1 Sample Type

 Decides the type of example object used in the *Sample Slots*: sphere (default), cube, cylinder or a custom object.

1.3.2 Back Light

Shines a light from the back onto the sample object. This is activated by default. The effect of this is most noticeable on spheres, where the back light is seen as a rim reflection near the bottom right edge.

1.3.3 Background

Adds a multi-colored checkered background in the Sample Slot. This is useful when you want to see the effect of a varying *opacity* for a material (or, which is the same thing but opposite, a varying transparency).

1.3.4 Sample UV Tiling

Adjust the repetition along either axis (u,v) of the texture coordinates on the object when you decide the mapping of a material.

1.3.5 Video Color Check

Checks the color of the object so that it stays inside the available color gamuts for the NTSC or PAL color video standards.

1.3.6 Make Preview

Shows you a preview of the animation of the material, applied to the sample object.

1.3.7 Options

Lets you decide what the *Sample Slots* should look like. Låter dig bestämma hur *Sample Slots* ska se ut. Som of the setting that appear in the pop-up window for this button are described below.

1. *Manual Update*: SPeed up the interaction by not updating a Sample Slot until you click iut. By default the preview is updated as soon as you make a change to the material.

2. *Don't Animate*: SPeed up the interaction by not updating animated maps in the Sample Slots while you play an animated sequence or drag the time slider.

3. *Animate Active only*: Only the active material is animated.

4. *Update Active only*: Only the active material is updated.

5. *Anti-alias*: Activates anti-aliasing (edge smoothing) in the preview.

6. *Progressive Refinement*: The material is rendered first quickly using large pixels, and then a second time in more detail.

7. *Simple Multi Display Below Top Level*: With this on, which is the default, the sphere for a *Multi/Sub-object Material* shows a checkered pattern of several materials only at the top level of the material.

8. *Display maps as 2D*: Individual maps in a material are shown as 2D images instead of mapped to an object.

9. *Custom Backgound*: Lets you set a background for the *Sample Slot* which can be used instead of the checkered background.

10. *Top Light Color, Back Light Color*: These settings set the color of the tow lights that are used in the Sample Slots. *Top Light* is the one from the front and above, and *Back Light* is the one from behind and below. Change their color by clicking on the box next to the text. Change their *Multiplier* to change their intensity.

11. *Ambient Light*: Lets you change the ambient illumination (the light that is always shining on all surfaces regardless of direction or shadows) in the *Sample Slots*.

12. *Background Intensity*: Lest you change the intensity of the background in the *Sample Slot*.

13. *Render Sample Size*: Sets the size of the sphere, in order to be able to approximately match the objects in the scene that are to have this material.

14. *Default Texture Size*: Sets the texture size which Sample Slot should use for materials where you have *Use Real World Scale* checked.

15. *Custom Sample Object*: Here you can specify a custom object instead of the default shapes. There are few reasons to do so, but it could be useful sometimes.

To define a custom object in a Sample Slot, do this:

1. Create a scene with a single object in it. The object must fit inside an imaginary cube with a side length of 100 generic units, and fill that cube reasonably well.
2. Save the scene as a `.max` file.
3. In the *Material Editor Option Dialog*,  click *File name* (under *Custom Sample Object*) and pick the file you just saved.
4. Activate the *Sample Slot* where you want to see your object, and click the button at the bottom right for *Sample Type* in the material editor.

1.3.8 Select by Material

Allows you to select objects in the scene based on selected materials in the Material Editor. Clicking this button will present you with a list of all objects that have that material assigned.

1.3.9 Material/Map Navigator

Show a comprehensive overview of the hierarchy of maps in a material. For more complicated materials, this is an invaluable tool to get an overview and to navigate between different parts of a material. Terribly complicated materials are also easier to understand in the editing mode *Slate Material Editor*, as opposed to the classic mode *Compact Material Editor*.

1.3.10 Go Forward to Sibling

Moves your map selection to the next map or material on the same level of the hierarchy. This button is active only if you are somewhere below the top level of a compound material (a material with more than one map) and if there is more than one map or material on the current level.

1.3.11 Go to Parent

Moves your selection one level up in the material hierarchy. This button is active only if you are somewhere below the top level of a compound material.

1.3.12 Show End Result

When this button is active, the sample slot always shows the end result of the material, regardless of which level you are currently editing. Otherwise the sample shows the partrial result from the current level down.

1.3.13 Show Map in Viewport

Shows mapped materials on the surface of objects in the interactive renderer that is used for the viewports. This preview is very useful, bit it works flawlessly only with certain 2-D maps. In the standard version of 3dsMax its really only Bitmap, Checker, Gradient and Tiles that yield the correct results. The reason is that it takes a little too much time to render complicated procedural maps to keep the display interactive. A further limitation is that you can only show one 2D map at once in the viewports, once again for performance reasons. If the material consists of a complicated combination of different maps with procedural parts, the map won't necessarily be shown correctly in the viewports. In that case, pick a larger preview by clicking the *sample slot*, or simply test render an obejct wit the material on it. (It's generally a good idea to create complicated materials in a simple test scene with no fancy lighting, so that the test rendering doesn't take too much time to finish.)

1.3.14 Material ID Channel

Selects a material as the source for an after effect (Video Post Effect) based on what's called a "G-buffer", a separate channel which for every pixel has information which object the pixel shows.

1.3.15 Put to Library

Puts the material to a materials library. Material libraries are files where the definitions of materials can be saved without any 3-D model content. Materials for which you put down a lot of work would preferably be saved in some Stockholm library, and my work is saved to a materials library, so that they are easily accessible for re-use. Images are saved in a materials library so that they are accessible for re-use. In a project with more competitors, it's also good to use a common materials library.

1.3.16 Make Unique

A material can be shared by several objects in the scene. This button creates a unique copy associated only with the selected object. Changes made to either material then won't be making the same changes to the other object, and they need not remain perfect copies of each other. The material can't change its name, wich is confusing and invites to making errors. A more straightforward function is to simply copy the material, which is described in the next section.

1.3.17 Make Material Copy

Create an identical copy of the material and replace the original with the copy in Sample Slots . A hot material can be imported, making the copy cool. The original material will still be present in the scene, but not easily accessible from the palette.

Always change the names of every material you copy, so you know what you are doing.

1.3.18 Reset Map/Mtl to Default Settings

Resets the current material to its default settings.

1.3.19 Assign Material to Selection

Assigns the material of your active Sample Slot to one or several selected objects in the scene.

1.3.20 Put Material to Scene

Applies the material to the scene. If you have defined several materials of the same name, for example by creating a copy as described above, this button will make the selected material replace the material of other objects in the scene with that particular name. Use this function with caution, and always put relevant and unique names to your materials.

1.3.21 Get Material

Shows a *Material/Map Browser* where you pick from a list of every material and map in the scene, even those who are not assigned to an object.

1.4 The name and type of a material

Just below the tool buttons, you see a text field with the name of the material. You should always give your materials relevant names by typing something into this field. To the right of the name, there is another field where you can change the type of the material by clicking the button next to the word *Type*and then picking another type. A very useful type with lots of choices for good looking surfaces is the type *Arch & Design*, but we recommend you start by using the type *Standard* in order not to become dependent on "magic" tools without knowing what they are actually doing. A numnber of other material types are available, too many to go into any detail here, but they all work according to the same principles as the *Standard* material. The other types just have some better prepared short-cuts for specific purposes, as well as setting that are aimed at mimicking real world materials and their properties. Some are also better prepared for advanced lighting and rendering. Additionally, materials in the group *Arch & Design* are designed to work well together in a scene. However, as stated above, the other types make it a little harder to understand how they actually work, so the Standard material is recommende for your first experiments. Those materials are also not tied to any specific renderer.

1.5 Pick Material From Object

To the left of the name tag for the material/map, you find a button that lets you choose a material from an object in the scene and put it into the active *Sample Slot*. Click this button, move the mouse to the scene and click the object you want to pick the material from. In a large scene, you may need to use this function a lot, because there aren't enough sample slots to have all the materials in a large scene in the palette at the same time. For large scenes, we recommend that you create a material library. And to further stress the point: for all scenes, we strongly recommend that you put relevant names to all your materials.

1.6 Standard Material

The parameters of a Standard material are organised in severl different rollouts: two for *Basic Parameters*, and one each for *Extended Parameters*, *Supersampling*, *Maps* and *mental ray Connection*. Below is a descrption of the most important parameters in these groups.

1.6.1 Shader Basic Parameters

This group contains parameters to change the material's color, shininess, transparency and the like. THe following controls are available in the rollout:

Shading: This lets you pick wich reflection model you want to use for the material: *Anisotropic*, *Blinn*, *Metal*, *Multi-Layer*, *Oren-Nayar-Blinn*, *Phong*, *Strauss* and *Translucent Shader*.

Phong is the most basic of these and is the fastest to render, but it creates a rather plastic-looking appearance and slightly incorrect shapes for highlights on the surface when the illumination is very oblique. The error is clearly visible in the backlight region in the material editor preview.

Blinn (which is the default choice) yields more correct highlights.

Metal is a variant that gives a slightly different character to the highlights, making them look more like the ones from a metal surface. *Anisotropic* is a model you can use to simulate cloth or brushed metal, where the reflection looks different depending on whether you are looking across or along the fibers or the scratches in the surface.

Multi-layer is an anisotropic filtering as well, but in two layers, which is good for some kinds of paint, lacquer and other semi-transparent surface coatings. One effect is that you get two specular highlights with different properties.

Oren-Nayar-Blinn is a variation on Blinn where you have some more setings for the diffuse reflection. It can be used on very matte surfaces like ceramics.

Strauss uses a simpler model and has a less complicated user interface than e.g . *Metal*, but the names and types of the settings are fairly similar across different material types.

Translucent Shader can simulate the effect of objects that are not completely solid, but still not transparent enough to require the use of ray tracing. One example is marble, where the light is spread laterally just beneath the surface before exiting from a different, adjacent point. Another example is skin, where light is spread laterally just beneath the surface of the object.

2-Sided: By checking this box, you apply the material to both sides of the polygons of the selected objects. You can use this to create better looking images of transparent objects, where you are supposed to see through the object to the other side. The materials of this type can be used to create realistic images of props and scenery.

Wire: Render the objects as wireframe models. Useful for test images or special effects.

Face map: You can apply the material individually for each polygon instead of the entire object at once.

Faceted: Yoelds a facted appearance on your objects when rendered. In techinal terms, the normals are not interpolated between the vertices, but you are using a single, constant normal for each polygon.

The other rollouts are different depending on which shading you want to use. Below is a description of the parameters for the default choice, *Blinn*, which is good enough for most purposes.

Blinn Basic Parameters: Under *Ambient*, *Diffuse* and *Specular*, you set the color for different kids of reflection. *Ambient* sets the color whenlit by the ambient light. This determines the color of the object in the unlit positions of the surface. *Diffuse* sets the color for the diffuse reflection in the illuminated parts of the surface. *Specular* determines the color of the direct specular reflections, the highlights of the surface. Click the rectangle to change a color. By clicking the lock buttons,  , you can lock two different settings to each other so they always have the same color.

Surfaces don't have to be a single color. That would be boring and unrealistic. Det vore tråkigt och orealistiskt. By clicking the small buttons ti the right of the color

controls, you get a pop-up with available maps to use for the surface appearance. These are short-cuts to the most common maps in the rollout *Maps*. More on this below.

Self-Illumination makes the object "shine by its own accord": the brightness increases evenly at all points on the surface. However, this self-illumination does not send any light towards other objects in the scene. An object with this kind of self-illumination doesn't actually work as a light source, but its color is independent of the light sources in the scene.

By changing the *Opacity* you can change the transparancey of an object. Maximum opacity (100) gieve completele solid-looking objects, and minimum opacity (0) gives completely transparent (and therefore invisible) objects. *Self-Illumination* and *Opacity* also have short-cuts to their respective maps.

Specular Highlights: By increasing or decreasing *Specular Level* you get an increased or decreased intensity in the direct highlights from the illumination.

Glossiness controls how crisp and how concentrated the highlight is.

Soften can make small highlight less prominent if they are too crisp and take too much focus.

Specular level and *Glossiness* have short-cuts to one map each for varying these properties across the surface.

1.6.2 Extended Parameters

These are not used in the lab assignments. Pleas refer to the *Help* section in the program if you want to know more.

1.6.3 Maps

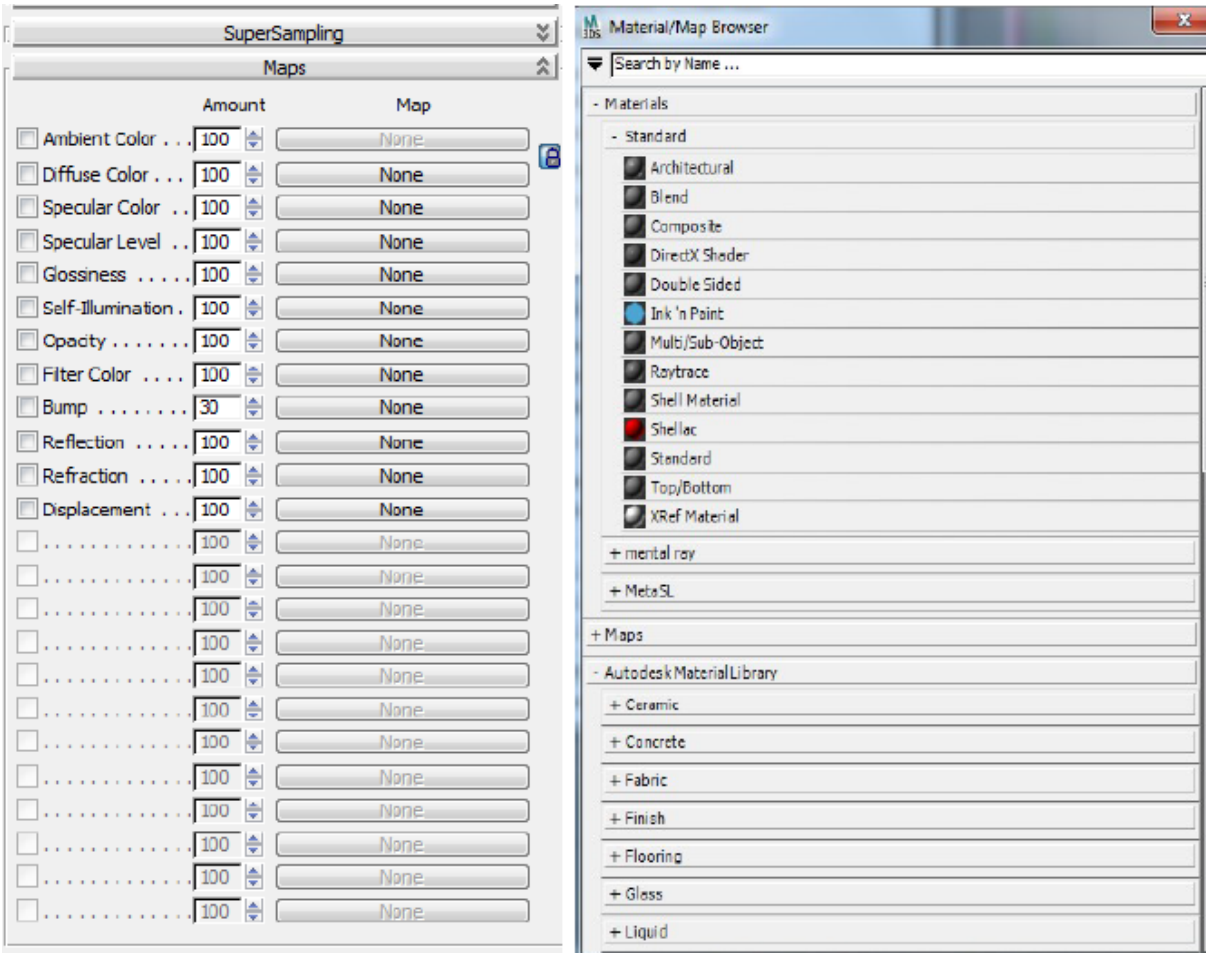

Figure 3: Maps in the material editor, and the Material/Map Browser

This rollout (see Figure 3)allows you to connect maps to the different components of a material. You can choose some of these maps also from the panel *Basic Parameters*, but this rollout gives you a better overview, and some of the maps are only accessible from here. Next to the name for each of the maps is a checkbox to turn it on and off, a spinner to set its intensity, and a wide button which you can push to pick the map type from a list. A new window, Material/Map Browser, see Figure 3, pops up. In the list of *Standard maps* you will find one kind of map which uses image files, *Bitmap*, and a lot of different so-called *procedural maps*. A bitmap is a digital image with a fixed matrix of pixels. A procedural map, e.g. *Checker*, *Tiles* or the extremely versatile *Noise*, on the contrary, are generated by a mathematical algorithm each time the scene is rendered. Procedural maps can be computed either in 2-D, based on texture coordinates, but many of them can also be computed in 3-D based on the (x,y,z) position of the surface. Most of the procedural maps are quite useful.

The first seven maps have been explained above in the section about color controls. The remaining maps are explained below.

Filter Color varies the color for light that shines through the object and illuminates other objects. *Opacity* determines how other objects are seen through the object, but*Filter Color* is a separate property which affects only the illumination of other objects.

Bump is a very common effect in computer graphics, which can make the surface look rough, crinkled, wavy, wobbly or otherwise uneven. Geometrically speaking, the surface is still flat, but the normal direction of the surface is changed locally to make the light reflections look *as if* they emanated from an uneven surface. In reality, very few surfaces are perfectly smooth, and this is a cheap way of making a material more vivid and life-like.

Reflection and *Refraction* are two other means for "cheating" to make a material appear as if it reflects its surroundings and/or refracts light that shines through it. This is simulated by an *environment map*, which in many cases doesn't even have to look exactly like the actual environment. For better looking reflections and refractions, 3dsMax can compute the environment map on the fly by rendering a panoramic view of the scene from the position of the reflecting or refracting object. If you need really accurate reflections and refractions, 3dsMax can be told to use ray tracing for these effects. Ray tracing is used routinely today for professional 3-D production, but it might still be a good idea to sometimes use simpler rendering methods to save time.

Displacement is a true modification of the position of the surface, as opposed to *Bump* which only changes the surface normal. A word of caution, though: *Displacement* creates a large amount of small polygons to be able to make the surface uneven. This requires a lot of memory and could increase the rendering time considerably.

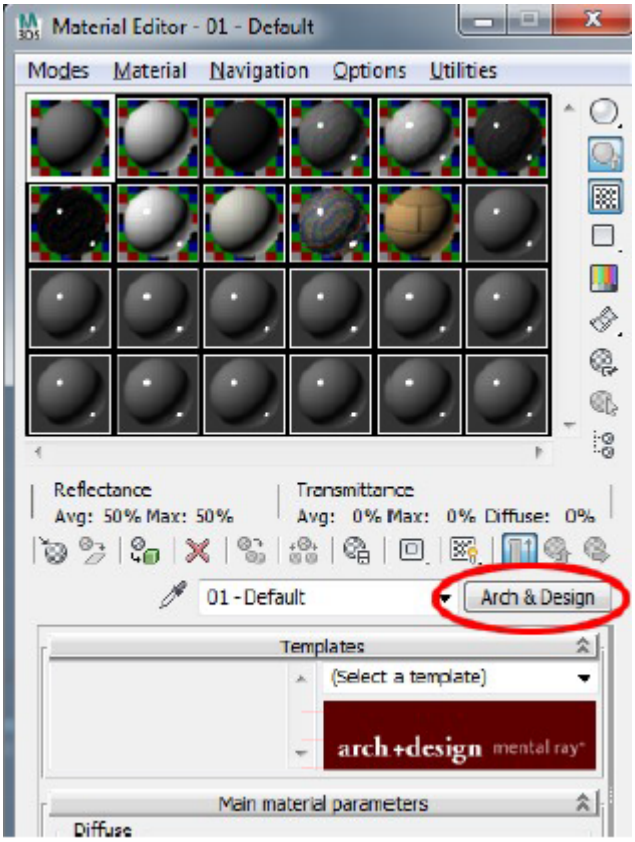

Figure 4: Change to material type Standard for this exercise.

To get started with the different options, and to see how bitmaps differ from procedural maps, try creating a simple object and test the various buttons. Create two cylinders. Select one of them, and open the *Material Editor* with the button in the *Toolbar*. The default mode is the *Slate Material Editor*, but that is unnecessarily complicated for our initial experiments. Instead, we will use the older but less complicated *Compact Material Editor*. Click and hold the toolbar button for the material editor, and you will get two options for which material editor mode to use. If you already have the Slate editor open, you can switch to Compact mode, and back again, through a choice in the menu at the top left of the material editor window: *Modes* → *Compact Material Editor*.

Pick any of the Sample Slots at the top and find the button for material type (circled in red in Figure 4). There are many types of materials in 3dsMax, and the particular version of the product we are using (3dsMax Design) has *Arch & Design* materials as the default choice. This type of material is very useful if you want to create visualizations of buildings and interiors, but they are a little bit too convenient when you want to learn and understand what you are actually doing. Therefore, click the button and pick *Materials* → *Standard* → *Standard*. Now you have an empty general material without any hidden presets. Show the rollout *Maps*. Click the button where it says *None* next to *Diffuse Color*, to assign a texture map to the diffuse color. Then, choose*Bitmap* in the *Material/Map Browser* that appears. Now the material editor changes to a panel to edit the properties of your bitmap, see Figure 5. At the top of the figure, you see the map slot (*Diffuse*), the tool *Pick material from Object* which was described previously, and the type of map we are using (in this case *Bitmap*). Additionally, five rollouts have

appeared: *Coordinates*, *Noise*, *Bitmap Parameters*, *Time* and *Output*.

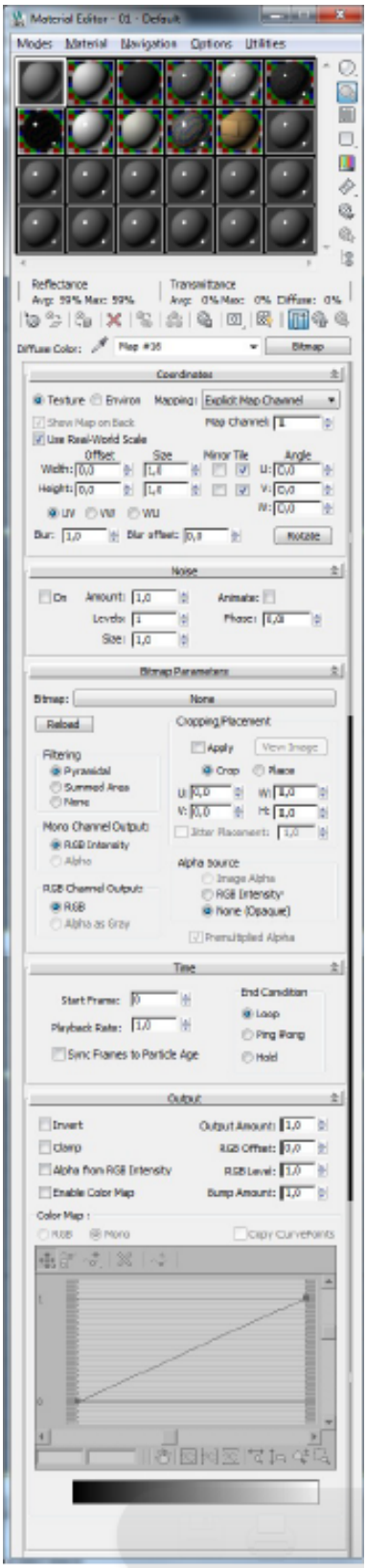

Figure 5: Controls for Bitmap

Note: The translation is not yet done for the remainder of Section 1. Section 2 is finished, though.

Under *Coordinates* you can set how the bitmap is to be applied to the object or the environment by modifying the following parameters:

Texture: Used for applying the image as a texture onto the surface. This is by far the most common use for a map. Under *Mapping* there are three different options for the *mapping coordinates*, a separate 3-D coordinate system which is associated with textured objects. In 3dsMax, they are called *UVW coordinates*. UVW referers to the texture coordinates, while XYZ refer to the object's position in the world. *Planar from Object XYZ* uses a planar mapping with UVW being parallel to XYZ. By checking *Show Map on Back* the map will be rendered also on the back facing side of objects, in a mirrored version.

Environ: Instead of locking the UVW coordinates to the surface of an object, the *Environ* mapping will instead paste the map onto the environment, so to speak. When you move the object, the map won't move with it, but if you move the camera, the map will move to create the impression of looking at a panorama. The coordinate mapping for this mode can be set to *spherical*, *cylindrical*, *shrinkwrap* or *screen*. Conceptually, the Bitmap is projected onto the inside of a virtual object enclosing the scene at a large (infinite) distance. Reflection mapping is a simple way of simulating reflections in shiny surfaces. It's old and not terribly good looking, but it's simple and quick, so it still has its uses.

Use Real-World Scale: This checkbox makes the texture map to a physical size in the world. Itäshandy if you are building scenes with accurate real world measures and are using ready-made texture libraries, but for our purposes this is just confusing. Make sure this box is not checked, and the texture mapping will work as you expect.

Offset: Changes the position of the bitmap in the UVW coordinate system. For example, if you want to move the bitmap half its width to the left, and one fourth down, set *U offset* to -0,5 and *V offset* to 0,25.

Tiling: Specify the number of times the bitmap is to be repeated (tiled) across each axis. If *Use Real-World Scale* is checked, this setting is instead named *Size*, but it works more or less in the same manner.

Mirror, Tile: These checkboxes determine whether the texture should be repeated several times across the surface (*Tile*) and whether it should be mirrored and repeated (*Mirror*) to try to hide the seam between repetitions if the image was not designed to tile seamlessly. *Tile* is very useful, but using *Mirror* is not recommended. Human observers will spot mirror symmetries very easily. Instead, edit the texture image to make it look good with *Tile*.

UV/VW/WU: Changes the 2-D mapping system which is used for the bitmap. UV projects the bitmap straight down at the surface like a projector, while VW and WU project it from the edge.

Angle: You can rotate the "projector" for the image around different axes. Rotation around W rotates the image in the plane, whie rotation around U or V yields a skewed projection against the surface. Rotation around W is very useful. The other two axes are rarely needed.

Rotate: Shows a dialog which allows you to rotate the map in a manner similar to *Arc Rotate* in the viewports.

Blur and **Blur Offset**: Specify how the blur of the bitmap changes depending on its distance to the camera. The further away the camera is, the more blurred it gets. This is to avoid distortion (aliasing) for objects which are far away. If for some reason you want a blurry-looking texture, you can increase this from the default 1.0, or if you want less blurring at a distance at the expense of some aliasing, decrease it. There is very rarely any reason to change this setting.

Under *Noise* you can add irregularities to the mapping of a texture. If you are, say, mapping the skin of a lizard, you may want small subtle movements in the plane to create an organic look, and this can be done by adding some animated noise to the UV mapping coordinates.

Under *Bitmap parameters* you find some settings for the bitmap, including cropping and transparency. Where it says *Bitmap* next to a large and initially empty button is where you select the actual image file by pushing the button and selecting a file in the dialog that pops up. The button *Reload* reads the image file anew in case it was edited in some other program while 3dsMax was running. If that is the case, the file is not guaranteed to be re-read until you restart the program or save and re-open the scene. *Filter* determines how the pixels are processed for antialiasing. *Summed area* requires more memory but gives a superior quality. *Pyramidal* is a lot simpler but will give good enough results for most purposes. *None* makes no attempt at filtering at all and is very fast, but ugly.

Mono channels output determines which channel of the image to use for the map types which use only a single channel, e.g. bump mapping. The option *RGB intensity* sums red, green and blue to compute the intensity of the corresponding gray scale image. The option *Alpha* will use the alpha channel (transparency) of the image. Not all images contain an alpha channel. JPEG images never have it. The PNG format allows it, but the image must also be explicitly saved with an alpha channel.

RGB channel output decides how the image channels are used for maps which use RGB information (*diffuse*, *specular*, *filter color*, *reflection* and *refraction*). The option *RGB* (default) uses the full RGB values from the image. *Alpha as gray* instead treats the alpha channel as a gray scale image.

Cropping/placement: These controls lets you cut out certain parts of the image or make it larger or smaller, making it possible to use the same image for different purposes for different parts of your scene. *View image* provides a visual cue for interactive placement of the image. *Alpha source* is where you decide what to use for the transparency channel. This should not be confused with the opacity map. *Alpha* decides which part of the texture image is visible, regardless of which map it is applied to. You can use this to paste an irregularly shaped decal onto a car, for example. *Output*is where you can adjust the overall brightness or contrast of the image. *Invert* inverts the image so that black becomes white and vice versa. *Clamp* limits the pixel values to 1 when you set *Output Amount* to a value larger than 1 and don't want the image to end up looking like it glows brightly. *Alpha from RGB intensity* makes an alpha channel be computed from the RGB values in the image: vhite becomes opaque (alpha=1) and black becomes transparent (alpha=0). *RGB offset* adds a constant to the RGB values of each pixel. You can set this between –1 och 1, where -1 makes the image all black, and 1 makes it completely white. *RGB level* multiplies all pixel values with a constant. *Bump amount* Lest you set the influence of this testure specifically on bump maps. This is useful if you

have several textures and want them to contribute with different strengths to the overall bumpiness of a surface. *Time* is used to decide how and at what speed to replay a video file, if it is used as a texture map. You can also decide whether it should *Loop*, go back and forth (*Ping-Pong*) or play once and then stop at the last frame (*Hold*).

1.7 Mental Ray Connection

A material of type *Standard* is not completely prepared to render with the fairly modern renderer *Mental Ray*, but in this rollout you can connect some advanced parameters to the material, or change the material to make the renderer use a completely different material. If you are planning on creating realistic models and render them with Mental Ray, you should probably use the materials designed for that renderer: the types *mental ray* and *Arch & Design*. The same goes for other renderers: they will yield the best results and give you the least trouble if they are allowed to use their own, custom materials.

2 Creating a material

2.1 A simple material

For the assignments below, you will be using the *Standard* material type. It's not the most modern or realistic of the materials in 3dsMax, and it lacks support for some of the advanced features in modern renderers, but it's useful and general enough for many purposes, and it's reasonably easy to understand.

The first thing you set for a new material is its main color. To do this, click the color box to the right of *Diffuse* and choose the color. Then you decide how shiny it should be (polished plastic or a matte surface). We choose to make it a shiny red plastic, so set *Diffuse* to a red color, *Glossiness* to 40 and *Specular Level* to 100. Look at the sphere in the preview and watch it change appearance.

Create a *Teapot* as the only object in your scene. The teapot is a useful example object, because it has doubly curved surfaces demonstrating the reflection properties of a shiny material, and it's available as a primitive in most 3-D graphics software. Increase the number of *Segments* to at least 8, to make the teapot look nice and smooth.

If you uncheck *Lid* for the teapot in the *Modify* tab, its inside will disappear as well. This is because the surface normal points away from the camera when you look at the inside, and those polygons will not be rendered. TO avoind this and show the back side of a surface, you need to check the box *2-sided* for the material. *2-sided* is useful, but takes somwehat more work to render, because without it you can eliminate half of the polygons from rendering at an early stage.

Put the lid back on the teapot and uncheck *2-sided* again.

Now, try checking the box *Wire* instead, and loo at the rendered result. What do you need to do to see the back of the object in this mode? Now, go to the rollout *Maps* in the material settings, and click the wide button marked "None" to the right of *Diffuse*. We will now pick a texture for our teapot. Pick Noise, and watch how our test ball loses its red color and instead becomes a spotted black and white. In this case, the texture replaces the constant color of the surface. The map *Noise* i a procedural 3-D texture which is not displayed absolutely correctly in the viewports, so to make sure what you are doing, you should render the image to see what you are doing.

Render the scene. The teapot now has a black-and-white spotted pattern, but retains its plastic apperarance. Change the *Size* setting for the *Noise* map until you get the pattern you want.

In case the texture is very fine grained or appears strongly pixelated, make sure the box "Generate Mapping Coords" is checked. The preview object most likely doesn't have the correct scale. This is an annoying and long standing bug in 3dsMax. In the *Modify* panel, make sure the box *Generate Mapping Coords* is checked, but that the box *Real-World Map Size* is **not** checked.

Now, let's change the pattern of the Noise map. Start by changing the colors. Change the black and white to to dark green and light yellow, or something. Render and look at the result. Now change the type of *Noise* to *Fractal* and set *Size* to 10.

Threshold (high, low) decides which threshold values you want to represent black and white. Noise varies between 0 och 1. In case you want to animate the color of an object from red to bluw, you can animate this Threshold and have the new color break out in

spots all across the surface. Animating the color itself from red to blue would have given a different result.

What we just did is the most simple kind of material with a single texture for the diffuse color. As you can see in the control panel for Noise, you can change the colors for the map from two constant colors to two textures. The Noise wiil then essentially blend between those two textures for you in a seemingly random pattern. The textures may in turn be procedural as well.

You can make very realistic scene using nothing but procedural maps for the various properties of the materials. Procedural maps are not a universal tool, but it pays to know which maps are available and what patterns they can generate. When applicable, a procedural map can solve a problem really well with very little work.

2.2 A more complicated material

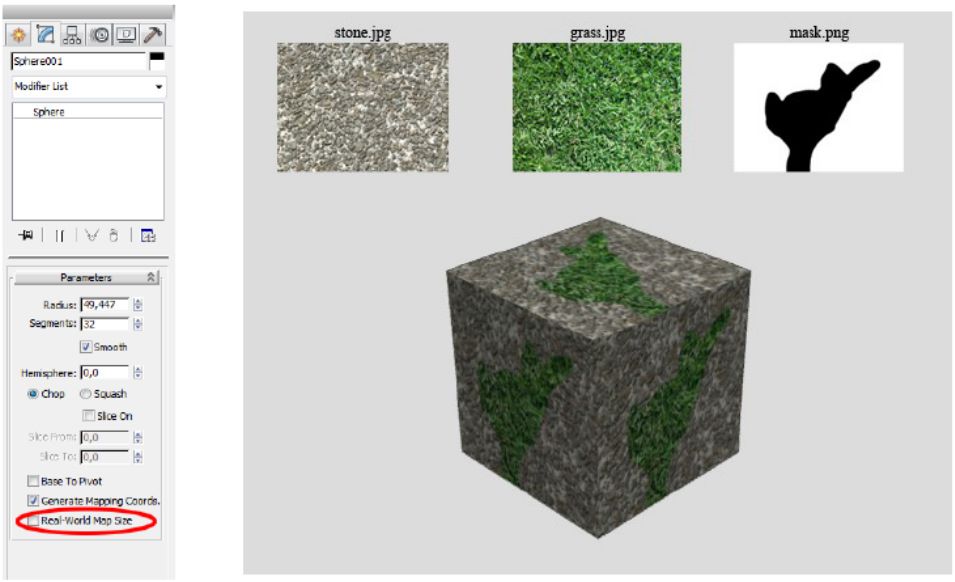

Figure 6: A material with a more complicated hierarchy

Now, let's make a more complicated material with a map built from two *Bitmap* textures combined with a *Mix* map. A *Mix* map is useful if you want to create a spotted surface with two different colors, or two different patterns. What we want to achieve is a cobbled surface partly overgrown with grass. Textures for stone and grass are fairly easy to find online or photograph yourself. We can then draw a simple black and white map to determine where the grass and stone should go, respectively. Example images are on the following address:

`http://www.itn.liu.se/~stegu76/TNM061-2017/texturer.zip`

Create a Standard material and pick a *Mix* for your *Diffuse* map. The map has three sub-maps. The first two are the patterns that are to be mixed together, and the third one is a weight function that specifies, for each position in the image, how much of the first and how much of the second map that will contribute to the result. Use three Bitmaps with the images `stone.jpg`, `grass.jpg` and `mask.png`. In case the box *Use Real World*

Scale is checked, uncheck it. Apply the material to an object and render. Depending on the object, you might want to add a UVW map to get suitable texture coordinates. Regardless of whether you use your own UVW Map or the default texture coordinates for the object, you need to make sure that *Real-World Map Size* is unchecked in the Modifier panel as well to obtain the expected result.

If you want to create more complicated combinations of bitmaps and procedural maps, we recommend looking closer into the map *Composite*, which is a more competent tool, but also more complicated than the simple *Mix*. It has similarities to the layer handling in 2-D image editing software like Photoshop. You will find a good tutorial on the *Composite* map in the *Help* system of 3dsMax.

When you are satisfied with the result from your Mix map, click on *Material/Map Navigator* to get an overview of how the material is organized in a tree-like hierarchy. You can click the different maps in the overview to navigate between them in the material editor, and also drag and drop maps from different levels in the tree to the *Maps* rollout in the main editor panel. When dragging and dropping maps between different places within the material, you will be asked whether you want to make an *Instance* or a *Copy*. By picking Instance you make a shared reference to the same map. ALl changes to the map will affect every material where it's used. If you change to a different the image file, for example, every occurrence of that image file will be changed, which might be exactly what you want. If not, you can pick *Copy*, making two separate maps with the same settings which can then be changed independently. It's important to know the difference between *Instance* and *Copy*.

Materials may sometimes need to have completely different properties at different points on the surface. One example is the ground surface we just made, with spots of grass and cobblestone. In this case, it's really not just the diffuse color that differs between the two. They have completely different structure and would probably need different settings using different maps. In such cases, it's usually wiser to use a *Blend* material, which is a special kind of material with two sub-materials and a mask specifying which material should be used for different parts of the surface. It's important to understand the difference between a *Mix* map and a *Blend* material. You can often solve a particular problem with either of the two, but one of them is usually a lot more suitable for the task.

If you want different materials for different parts of a model, and the parts can be separated by grouping polygons together, one possible solution is to use a material of the type *Multi/Sub-object*. You can read about how that works in the corresponding Help section. Basically, different polygons in a model can be assigned different materials.

2.3 A purely procedural material

Now, create a material where you avoid using a *Bitmap* altogether! Make a checkered tile floor with a *Checker* map and two *Noise* maps as sub-maps, or a brick wall with *Tiles* and two *Noise* maps as sub-maps. Or, try to mimic the material you made above with a coarse and thresholded *Noise* map to control where to place grass and stone, a fine grained *Noise* for the grass and a coarser grained *Cellular* for the stone. It's hard to get the same level of realism and level of detail as you get from a photo, but the advantage is that every detail such as color, contrast, size and type of pattern are editable with a

few simple changes of parameters, instead of using a separate image editing program and spending considerable effort.

3 Assignments for grading

- Make the *Mix* map exercise according to Section 2.2 and render an image of a plane with the material.
- Do the exercise according to Section 2.3 to create a purely procedural material. Render an image of the material applied to a suitable object.
- Make a material which creates a impression (at least when viewed at some distance) of either of the following objects when placed on a simple primitive of a suitable shape. Render an image of the result. Feel free to try more than one of the tasks if you have the time.
  - A sphere that looks like an orange or a round avocado (take care to mimic the glossiness and the bumps).
  - A sphere that looks like a meatball, preferably fresh from the frying pan and slightly charred and greasy.
  - A short cylinder that looks like a hamburger, charcoal-grilled with black stripes from the grid.
  - A torus that looks like a sugar-sprinkled do-nut. (This is a fairly difficult task if you aim for a good visual quality.)
  - A box that looks like a cobblestone made of granite
  - A box that looks like a worn wooden floor plank (use a *Wood* map as a foundation, use *Bump Map*)
  - A sphere that looks like a heavily used croquet ball with impact marks and flaked paint
  - Something else which you decide yourself - but don't make it too simple or too difficult for yourself. Ask the lab assistant first!
- Somewhat more difficult assignments if you have the time and energy:
  - Try using a *Multi/Sub-object* material to put different materials to different sides of a *Box*. Look in the Help how it works, and make sure you understand what material ends up where, and why.
  - Make a teapot without the lid with orange metal on the outside and silvery metal on the inside by using a *2-sided Material*.
  - Make thin smoke above the coffee mug from the first lab session, by using a nearly transparent material applied to a plane. Use *Noise*, preferably combined with a *Gradient*.

Present the images to the lab assistant during the lab session for assessment and feedback. Good luck, and feel free to ask questions if you want to know more. However, please don't forget about the program's built-in help and tutorials.