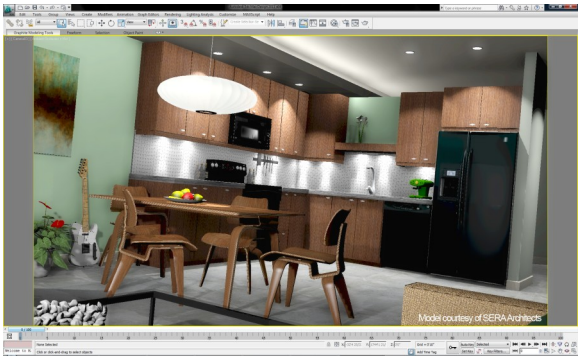
Mapping and Rendering

When rendering models using software, certain elements can be applied to create a higher level of realism. Some of these are listed below;



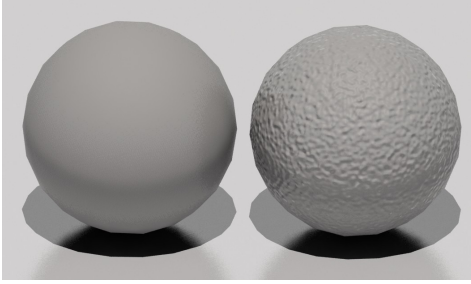
- Bump map
- Texture map
- Displacement map
- Lighting
- Environment/scene

Bump Map

Bump maps are grayscale textures you map to objects, to create the illusion of surface relief on an otherwise flat object. They are:

- unable to cast or receive shadows
- unable to be seen if you silhouette the mapped object
- takes less time to render than displacement maps

Before applying bump map



After applying bump map

Although the sphere with the bump map may appear to have physical raised and lowered areas, it is just an illusion created by the grayscale texture. The 'bumps' on the object will not show in the object's shadow, as illustrated above.

Texture Map

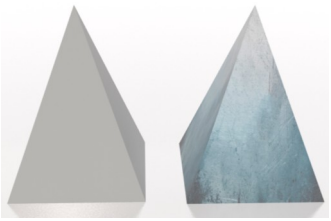
A texture map is the application of a 2D image/colour to the surface of a 3D object. Some characteristics of a texture map are:

- It does not show depth of colour
- It is shown in plain colour

A texture map can be a 2D image saved from the internet which is then applied to a 3D model. An example is given below.

Image from internet

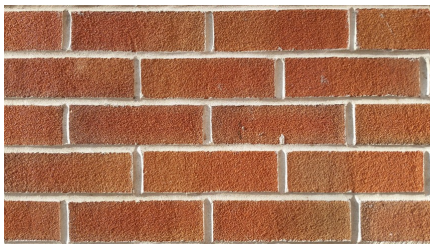
3D model of pyramid before and after image of texture was applied

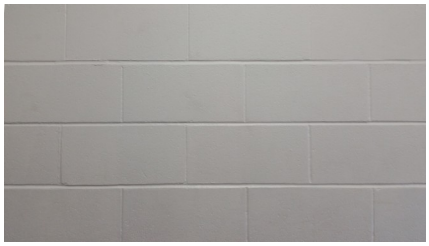


Capturing Real Materials

There are different methods which can be employed to make renders as realistic as possible. One popular method is to capture the look of real materials and apply these to the model. This can be achieved using a **hand scanner**, or simply by **photographing** the material. An example is given below;

The 3 different materials shown were all photographed using a **camera**. These were then imported into a PC as .JPEG files.

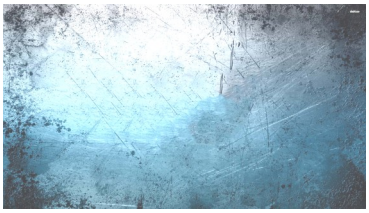




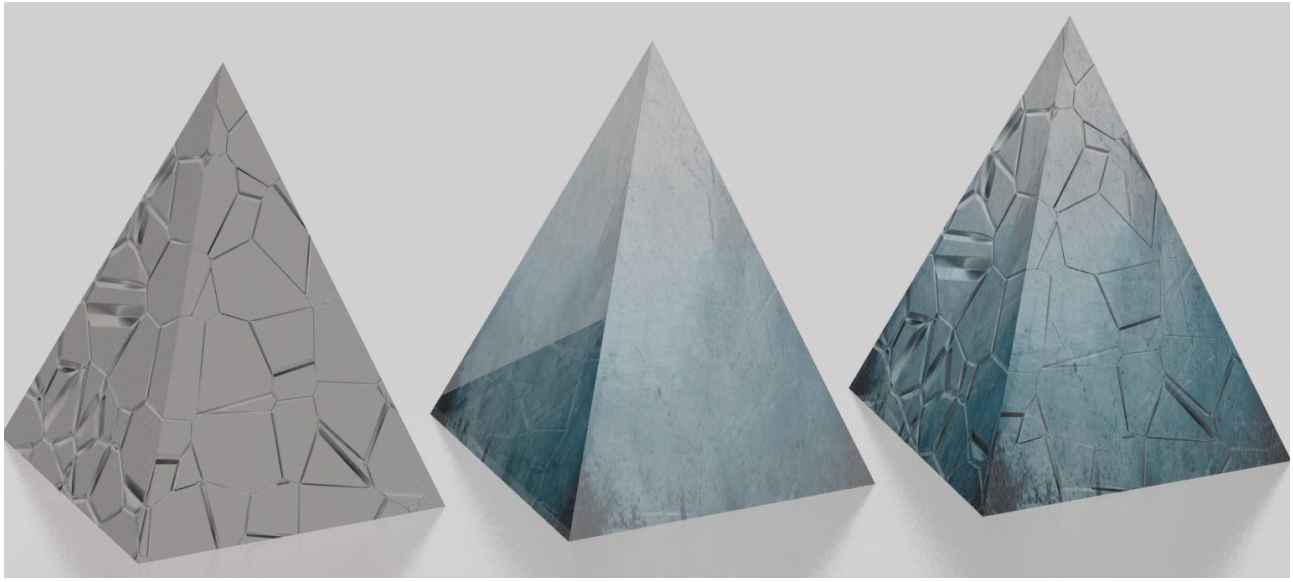
Following this the materials were imported into 3Ds Max and used as **texture maps** to make the room layout look as realistic as possible.

Creating Materials

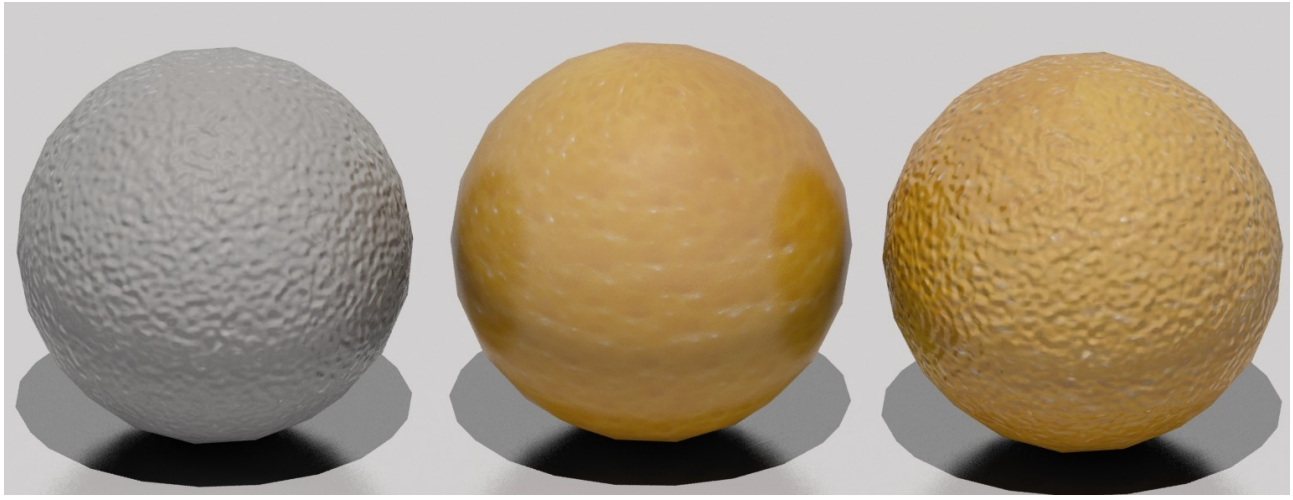
When creating materials to render a 3D model it is common practice to add both **texture maps** and **bump maps** to the model. The bump map will create the illusion of 'surface relief' (3D texture effect) on the model, whereas the texture map will give the model the visual characteristics of the material being simulated (different colours, shades, patterns etc.). Some examples are given below.



Bump map applied | Texture map applied | Combination of both

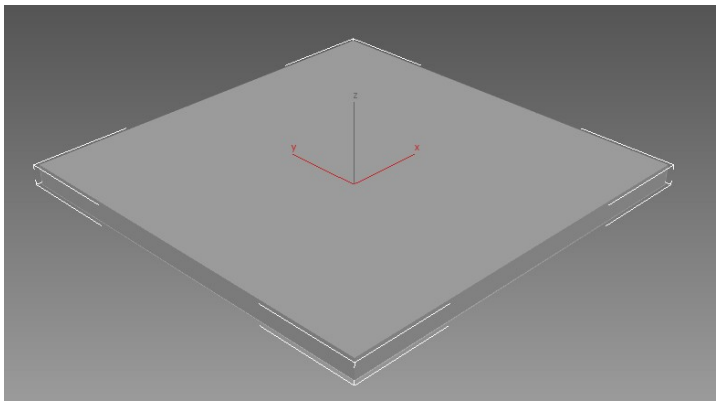


Bump map applied | Texture map applied | Combination of both



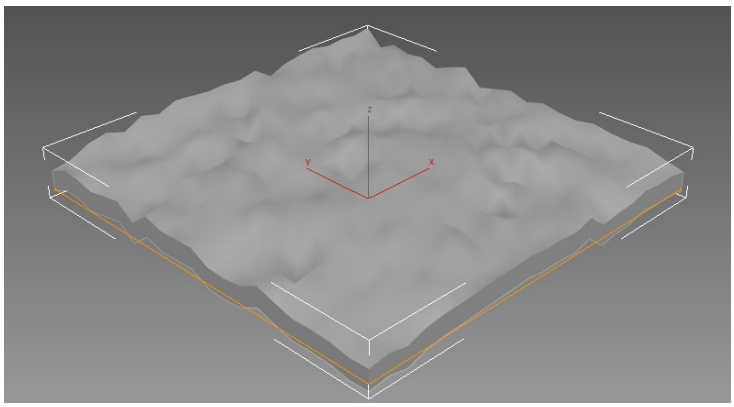
Displacement Map

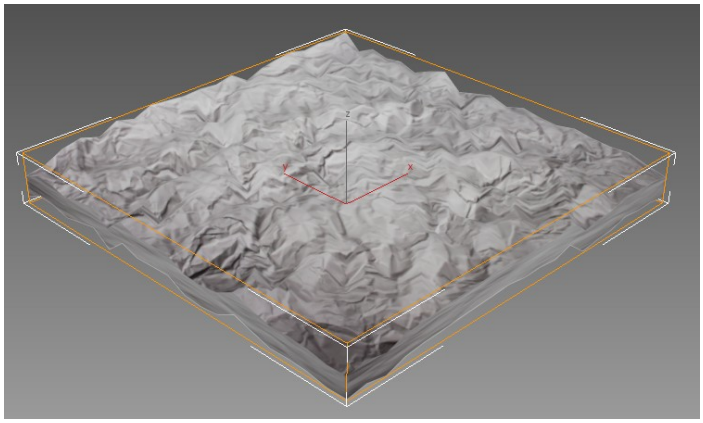
Displacement mapping is an alternative computer graphics technique in contrast to bump mapping, using a **texture** or 'height' map to cause an effect where the actual geometric position of points over the textured surface are **displaced**. It gives surfaces a greater sense of depth and detail and allows shadows to be cast of the 'displaced' parts of the model. Rather than creating the illusion of surface relief (like a bump map), this method creates **actual** surface relief by altering and moving the physical properties of the 3D model. An example is given below.



I created a cuboid using 3Ds max. I wanted to achieve a 'creased paper' effect on the top surface so I selected an appropriate image from the internet which mirrored the effect I needed.

I applied a **displacement map** to the model using the internet image as my texture to mimic. The software used the image to plot the displacement areas. I was able to increase the displacement effect gradually until I achieved the correct height of displacement (shown opposite).





I then also added the image of creased paper as a **texture map** to further add to the realism of the model.

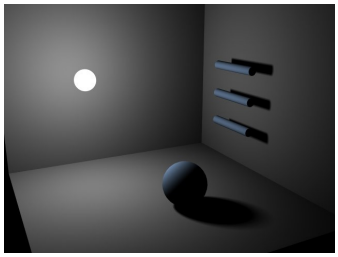
The displacement map created the 3D creased effect and the texture map made the model look more like paper.

Displacement maps have the following characteristics:

- they are able to cast and receive shadows
- they are able to be seen if you silhouette the mapped object
- takes more time to render than bump maps

Lighting techniques **(information courtesy of www.3D-ace.com)**

There are several well established 3D lighting techniques, and it is often predetermined by the type of an environment, which technique is most appropriate in the case. For instance, some techniques work well in an interior environment and make very little sense in an exterior modelling. The same approach works for the "studio" lighting as it requires procedures that differ much from lighting for 3D animations and films. Let's make an overview of some **standard lighting options** that are available in most 3D software packages:

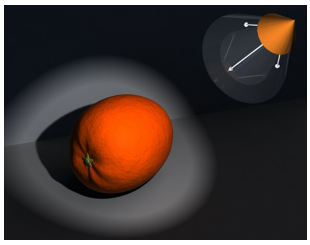


Point or Omni Light

A point light casts rays in every direction from a single, small source in 3D environment. It has no specific shape and size. Point lights can add "fill lighting" effect to a 3D scene, as well as simulate any light source like candles, Christmas tree lights, or others.

Directional Light

It is the opposite of omni light, it presents a very distant source of light (like the moon light). Directional rays go parallel in a single direction. This type of 3D lighting is often used to simulate sunlight. To change the illumination of the scene you can adjust the position or colour of the light and rotate the directional light source.



Spot Light

There are targeted spot lights and free sports, which means that they have no target objects. It is often used to simulate light fixtures, for example desk lamps or streetlights, as it casts a focused ray of light.

Volume Light—*Volumetrics*

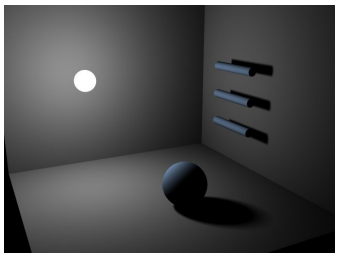
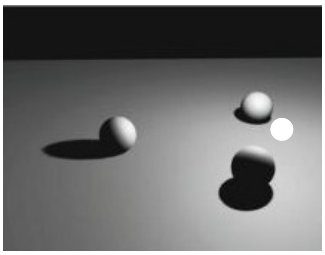
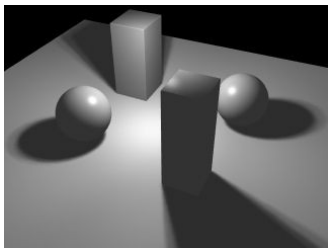
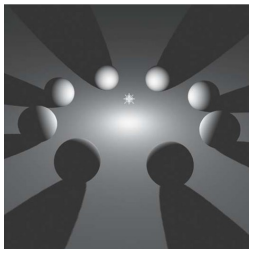
It is similar to omni light as it casts rays in all directions from a certain point. Yet, a volume light has a specified shape (any geometric primitive) and size. This volumetric light illuminates only surfaces within the set volume. **Volume Light provides the effect of smoke, fog, and so on.**

Ambient Light

An ambient light is not similar to any other light type. It casts soft rays in every direction, though it has no certain directionality and emits no shadow on the ground. Often it sources as addition to the colour of the main light source for a 3D scene. When sun rays pass through the window of a room they hit the walls and are reflected and scattered into all different directions which averagely brightens up the whole room. This visual quality is described by ambient light.

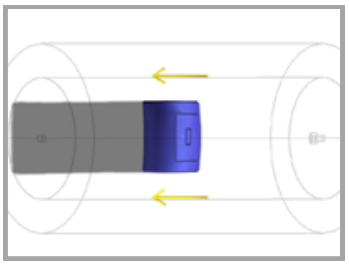
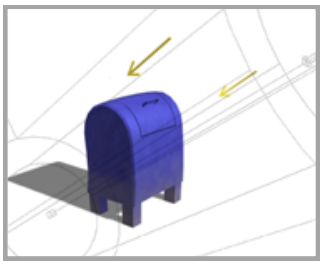
Lighting techniques—**Examples**

Point or Omni Light

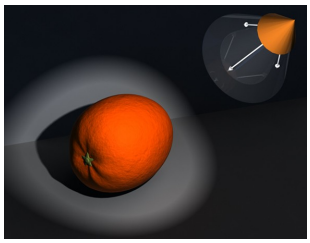
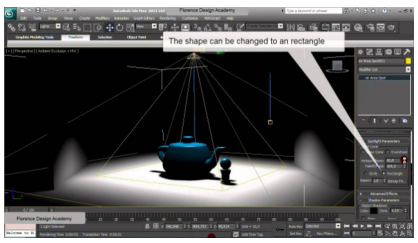





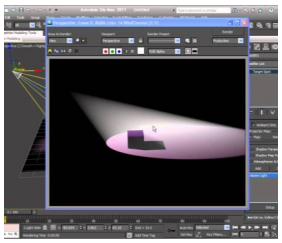
Directional Light



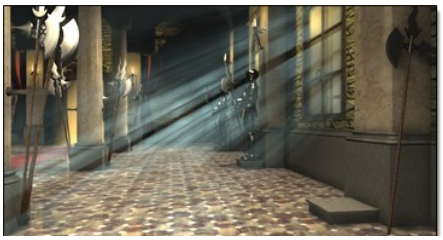
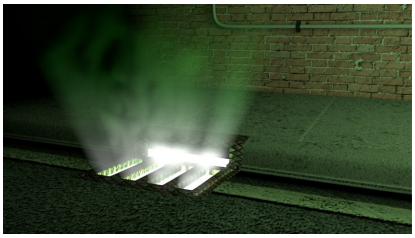



Spot Light

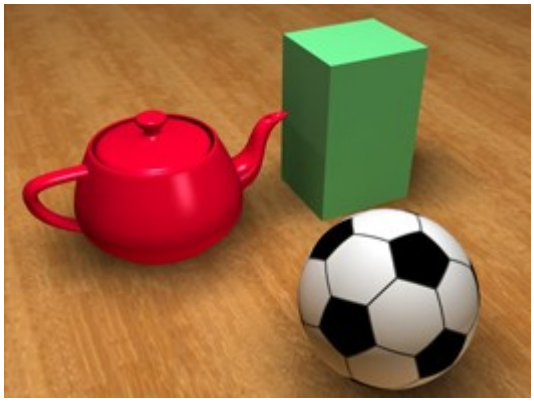





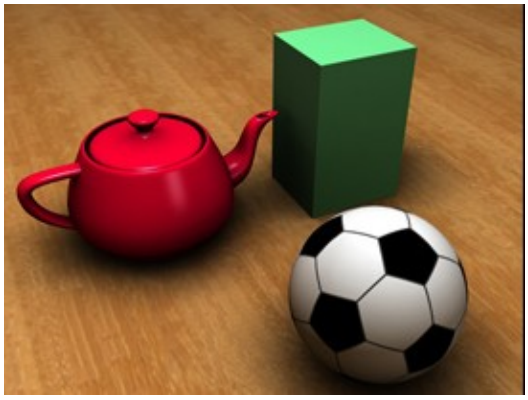

Volume Light—*Volumetrics*

Ambient Light



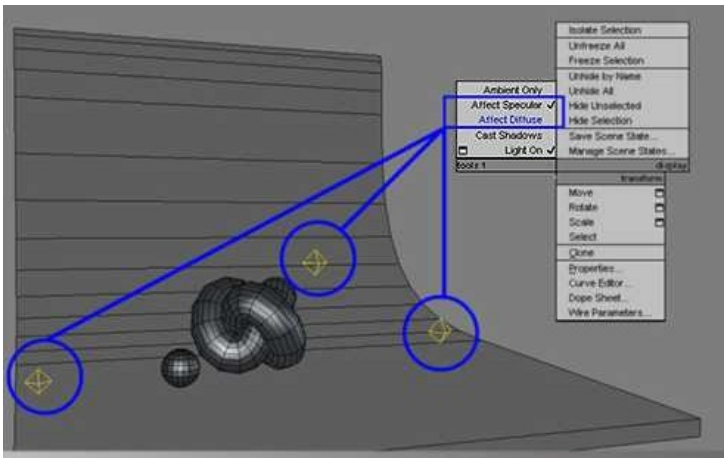
Before ambient occlusion is added



After ambient occlusion is added

Specularity

The SQA describe specularity as, “the reflective capacity of material to create ‘rings’ of light reflection”. Most 3D rendering packages will offer the option to add, remove and edit the specularity of materials. This will edit the ‘highlights’ on the object and can make it appear more or less glossy. Some examples of how this is used within 3Ds Max are shown below.



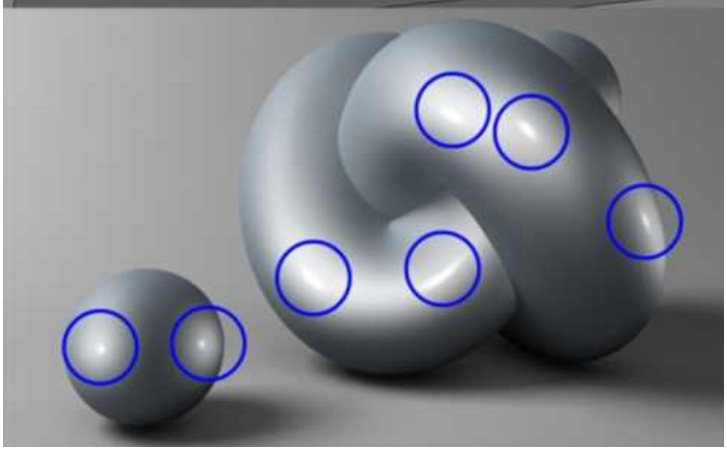


Image Based Lighting (IBL)

A popular method of simulating lighting in a 3D CAD render is a technique knows as **Image Based Lighting (IBL).** This would require the CAD technician to take a panoramic photograph (often using specialist camera equipment). This photograph would be wrapped around a sphere in the 3D software package and the model being rendered would be placed in the centre of this sphere. The software will generate lighting based on the illumination levels and positions in the photograph and render the model using this lighting. The link below will demonstrate how IBL can be used to illuminate an indoor environment. https://www.youtube.com/watch?v=VKmJt3VzrtA

Scenes/Environments

3D models are often placed within a scene/environment. The location of the environment is generally selected based on where the model would be most commonly used in a real life context. This helps give context to anyone viewing the model and can be useful for promotional purposes. An example of a bench is given below, with and without an environment. The environment enhanced the overall quality of the rendered and gives the model context (it is used in an outdoor 'square' setting where benches are commonly used).