

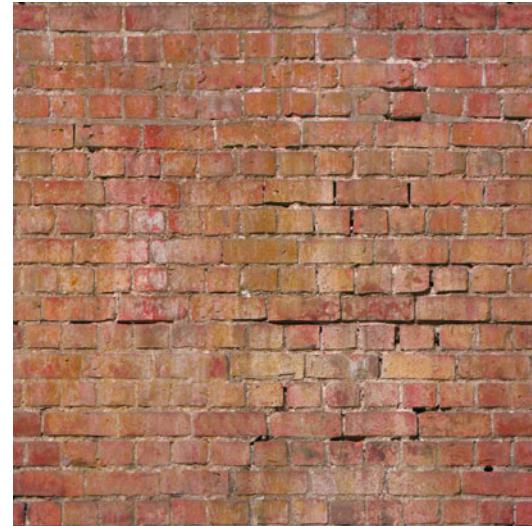
In this lesson, you learn the process of creating a texture from photographic references, and how they apply to video games and film. The texture tells the story of the untextured grey model. Textures add life to the entire environment, and give way to new ideas. Many art styles are combined when creating professional textures. Hand painted textures are created with a stylus much like a painter's brush. A great deal of time is required to get high quality results. Devising a system of texture creation can speed up production time. The process is easy to understand, but it may take some practice to get the textures just right.

Tileable and Custom

A texture map is a 32 bit RGB color file created in Adobe Photoshop or another 2D painting program. Textures are used in video games, film, TV, and advertising. Most 3D models have a texture on them, like a colored skin that shows color, specular, and fine details. Procedural textures require a mathematical algorithm to be generated. These are used mainly in film and TV production.

A tileable texture is a 2D image that is applied to a polygonal object or BSP level geometry. You create the textures from a digital photograph or a hand painted image. Tileable textures are designed to have seams in a specific area, or no seams at all. Having no seams enables a texture to be repeated over a large area. Custom textures are unique to a specific model or area. A custom texture has unique UV space and a fixed resolution. It is possible to reuse portions of a custom texture to save space and time. One way to reuse a portion of texture is to mirror from the right side of an object to the left side.

Pictured are a tiled brick texture and a custom metal prop texture.



Tileable brick texture



Custom prop texture

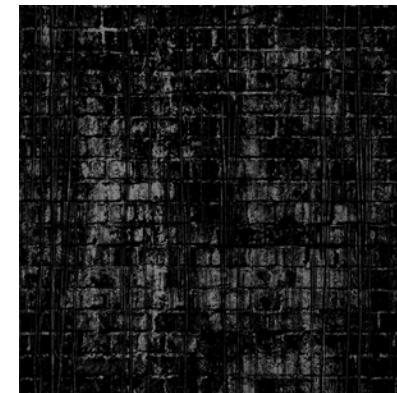
The images display a brick texture mapped on primitive objects. The brick texture is tiled once, and can be made to tile in all directions. This is a Phong shader, and it has a diffuse, specular, and normal map.



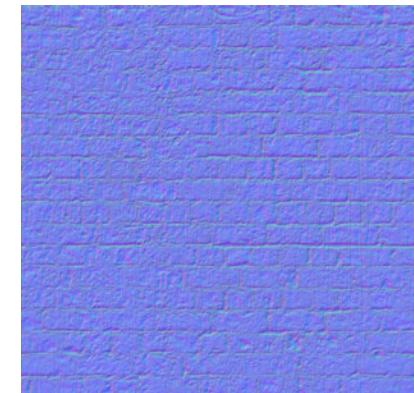
Diffuse Map



Specular Map



Cosine Map



Normal Map

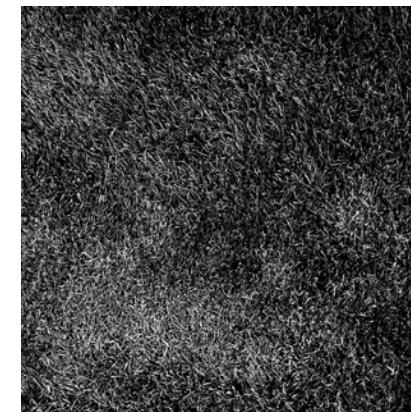
Pictured is an organic grass texture. This is a Phong shader and it has a diffuse, specular, and normal map.



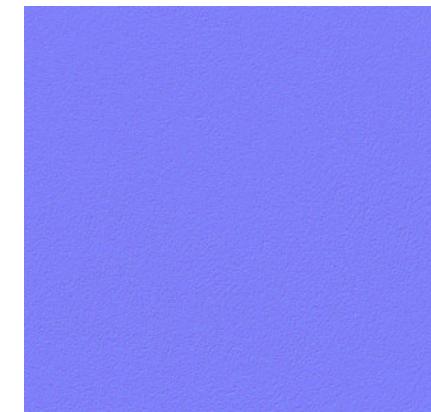
Diffuse Map



Specular Map

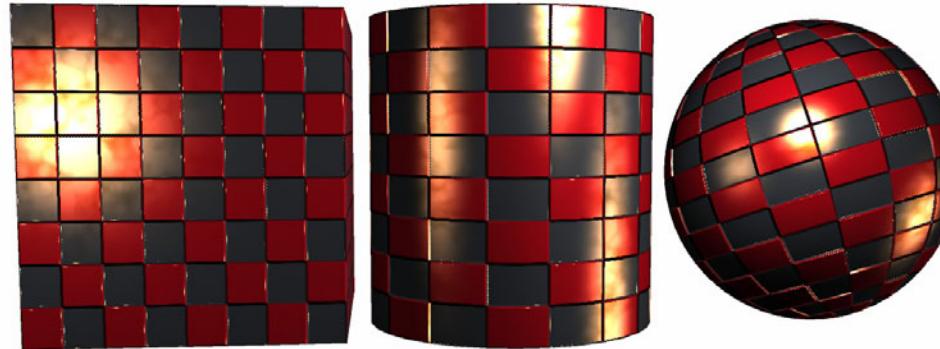


Cosine Map

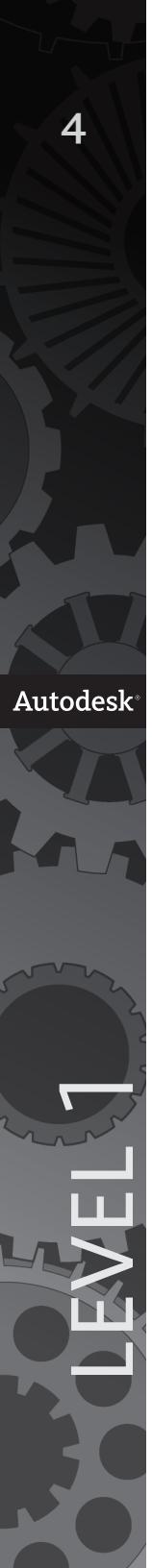
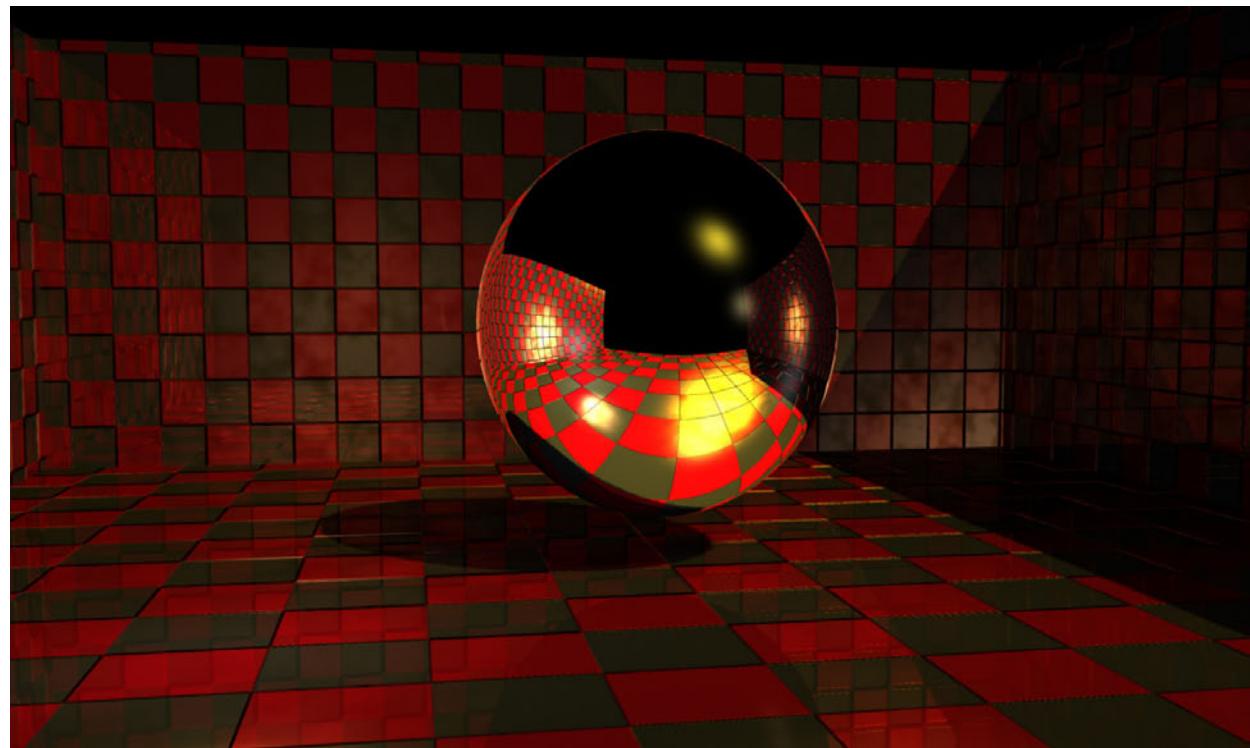


Normal Map

You create procedural textures using a node-based system in the material editor of the 3D software package or game engine. These textures are mathematically based, and can be infinitely tiled.

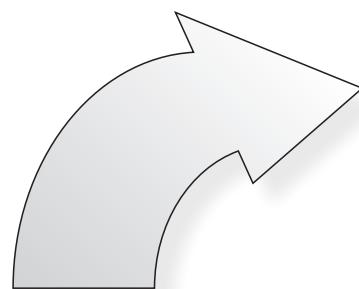
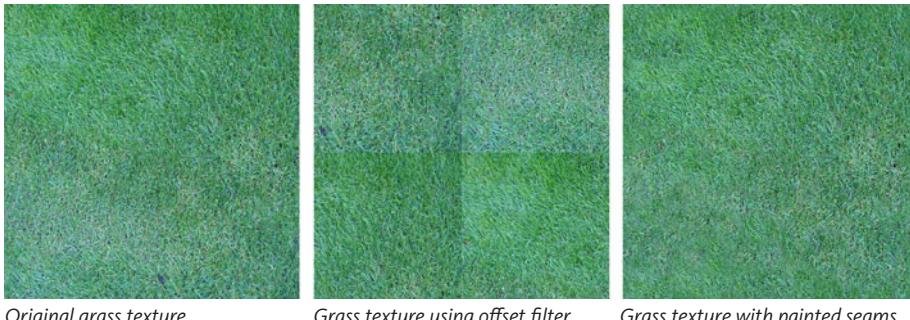


The image is a chrome shader on a sphere, in an environment with checkers on the walls and floor. Notice the yellow lights in the scene are reflected on the chrome ball. There is a directional light facing downward to the lower left, and two point lights.

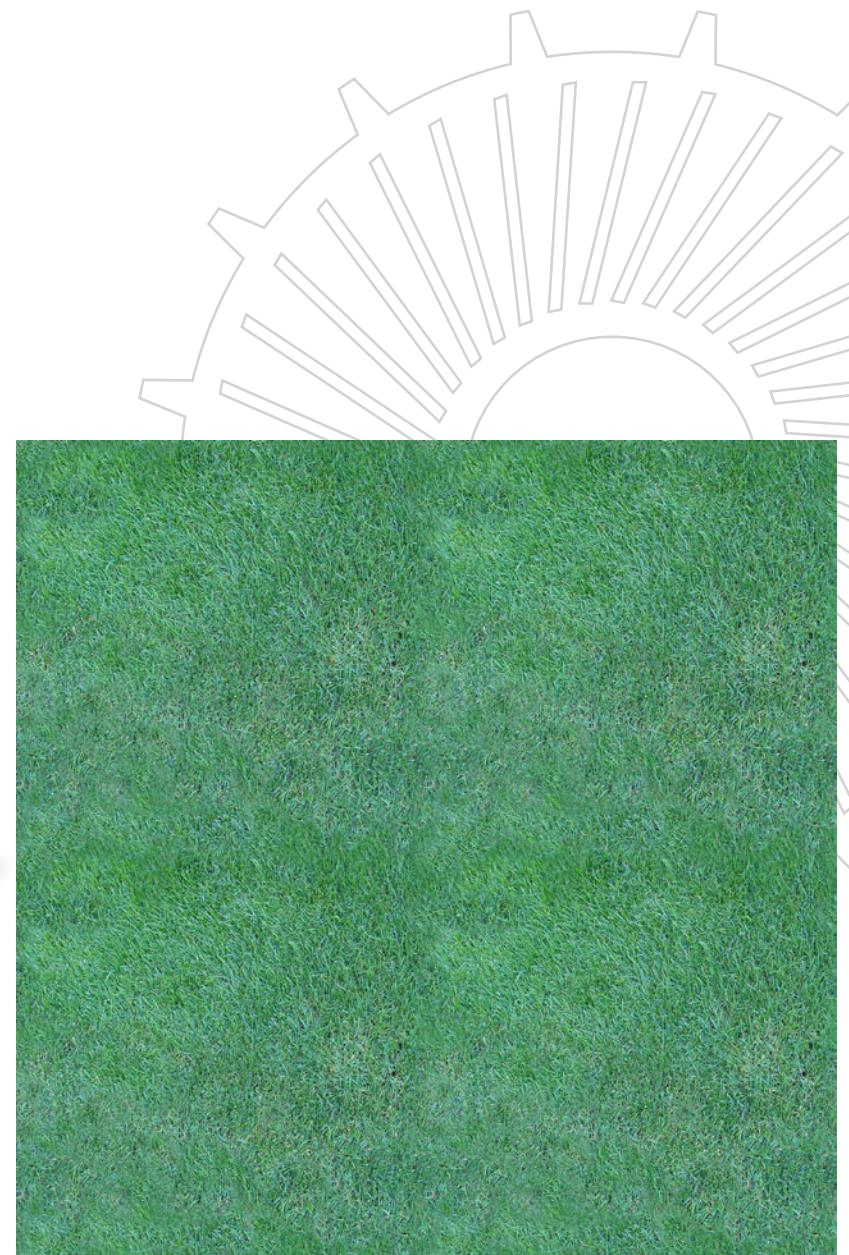


The process for creating a tiled texture that may be used vertically and horizontally is done in Photoshop. Once you have a good photograph, use the offset filter to display the seams in the middle of the texture. The goal is to paint out the hard edges. Using the Clone tool, the seams are hand painted so they are not visible. The same process is done for concrete and wood textures. It is more difficult to paint out the seams in organic textures, and may take time to perfect. Brick can be made seamless by using single or groups of bricks to cover the seams.

The images are of a grass texture, the offset texture, and the texture with seams painted out.



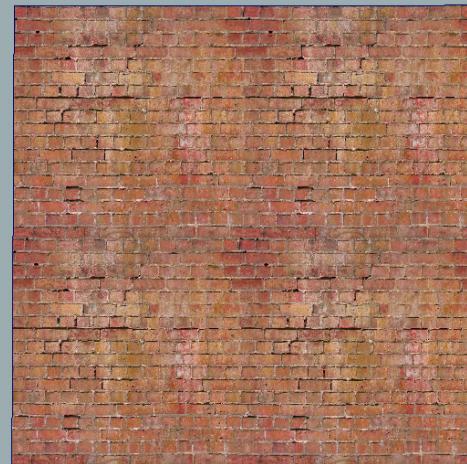
Pictured is the seamless grass texture tiled twice in both directions.



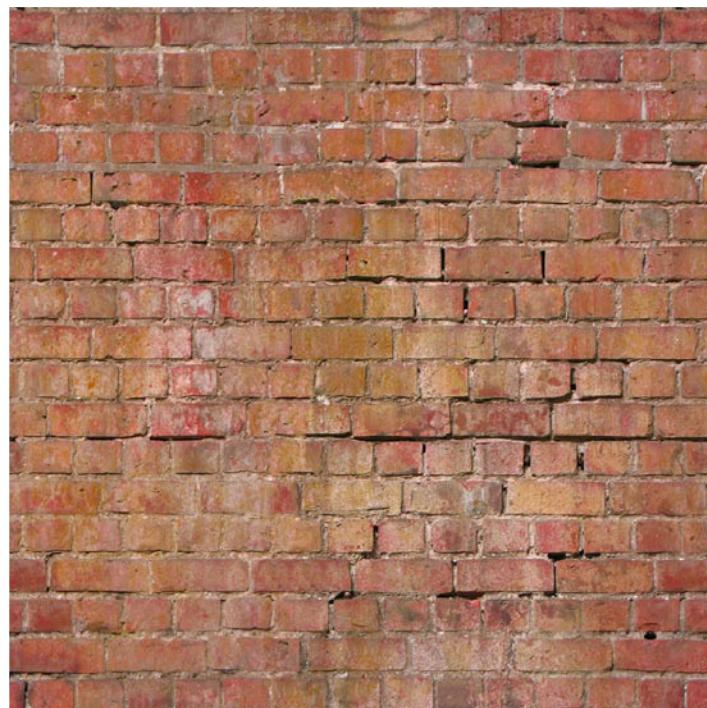
The images are the brick texture on a cube, one is tiled once, and the other is tiled twice.



UV's tiled once



UV's tiled twice



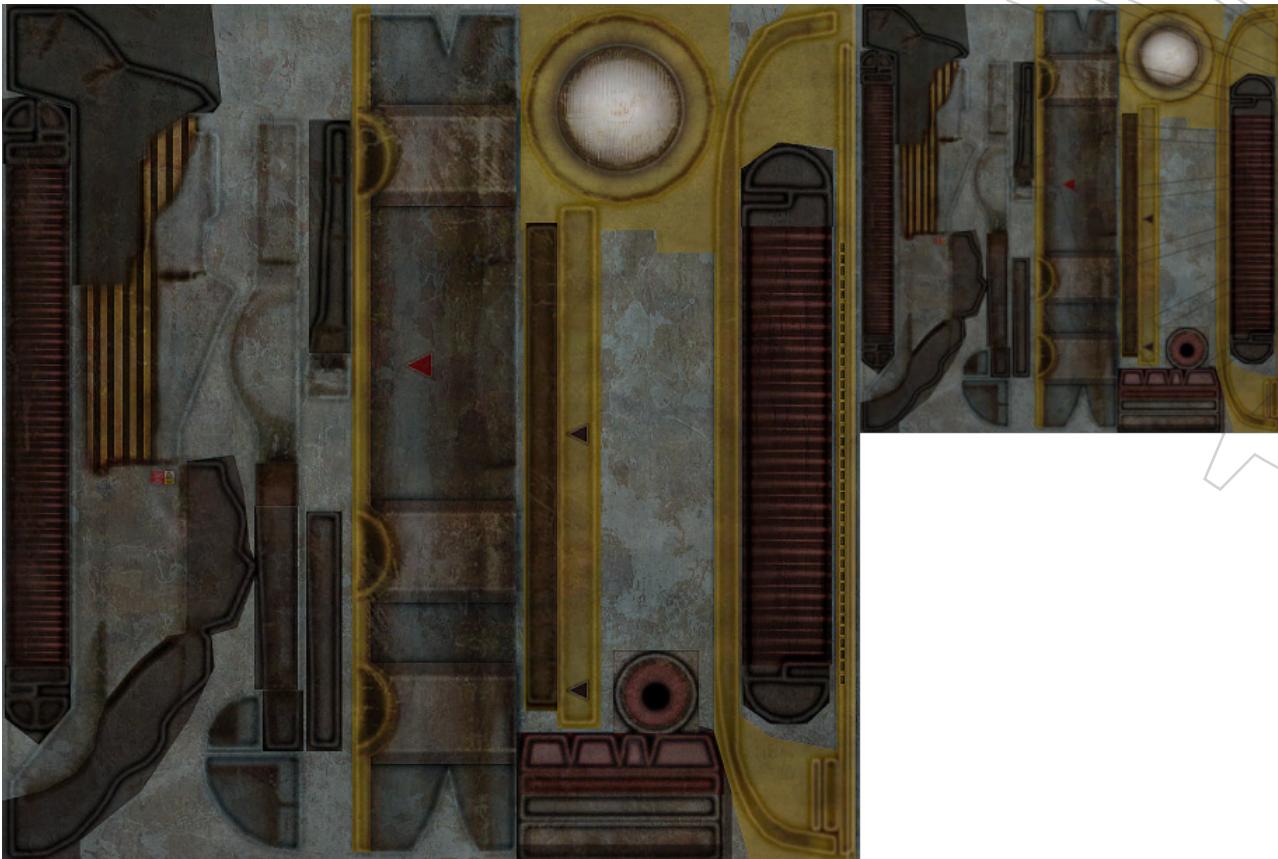
When creating a texture for film or video games, use the proper pixel size. Texture sizes are often divisible by an even number such as 8. A common texture size for the Xbox 360 and PS3

is 512 by 512, up to 2048 by 2048 pixels. When creating textures for film or TV, the current standard is 4096 x 4096 pixels. In film, textures are all custom. This means every part has its own area of texture space, so nothing looks repeated. In video games, disk space and memory are always a concern, so mirroring of textures is common. A texture can be resized for game optimization at longer distances, which is called a mipmap. The texture size is quartered several times to create a smaller file size.

The image is mipmap for a brick texture.

You create a mipmap using a plug-in for Adobe Photoshop, with the Nvidia Normal Maps and DDS filter. The Nvidia Normal Map and DDS filter create normal maps, and may also export specific settings to the DDS format. The DDS format is a compression tool for exporting smaller versions of the same texture. Creating a mipmap is usually done on the programming side, and is automatically swapped when the player gets farther away from an object. The physical resolution or polygon count is optimized in video games called a Level of Detail model. A LOD model is created at half the resolution for viewing at long distances. In film, there is no need for this since it is all rendered out for non real time viewing.

The image is mipmap for a prop texture.

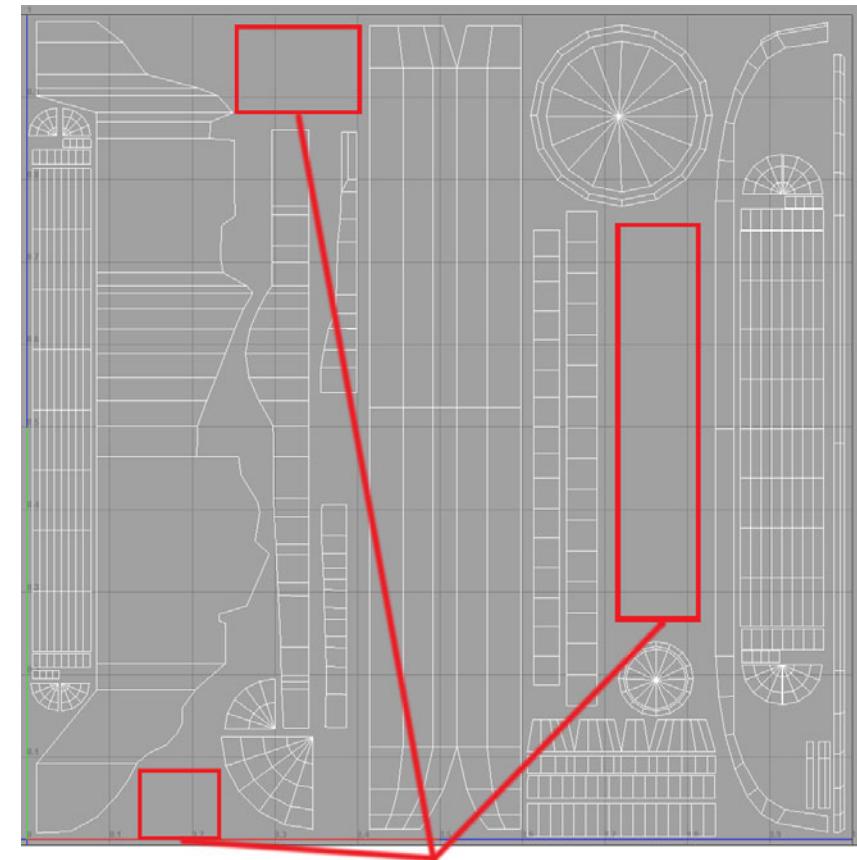
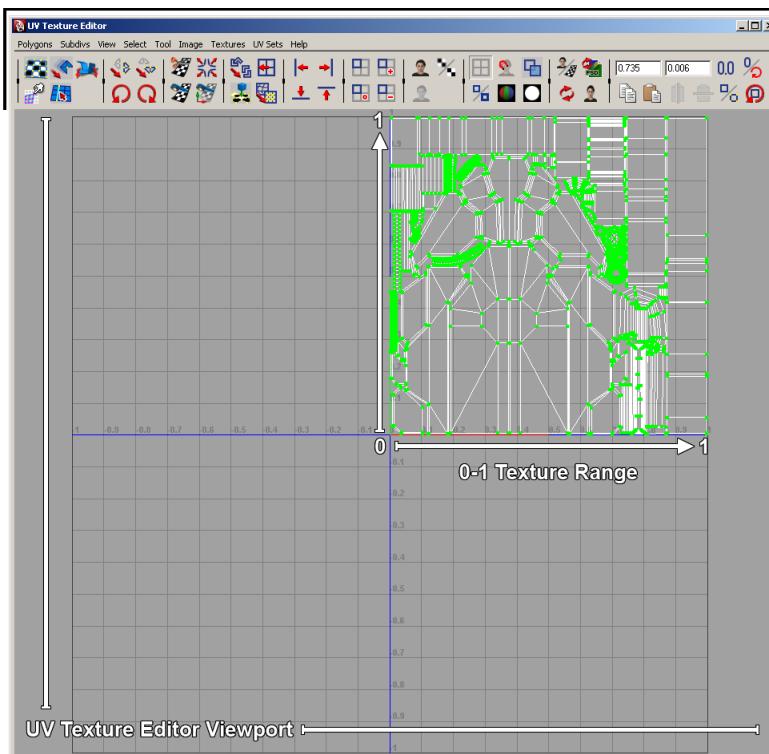


Pictured is a prop with correct UV placement, although there is some wasted UV space. Use stickers and detail variations to fill empty space.

UV Placement

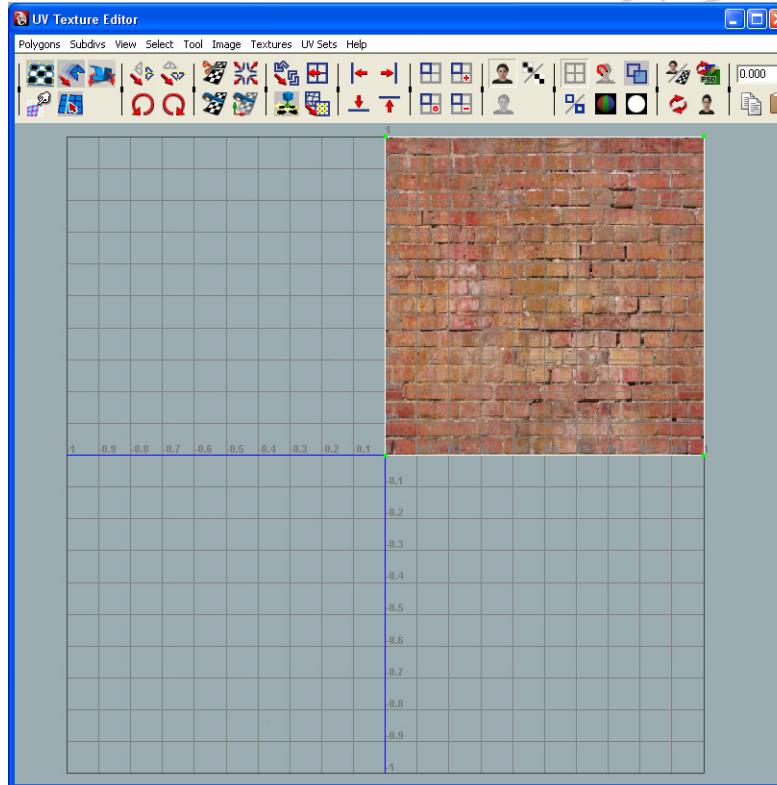
A model has a set of UVs on each polygon edge, similar to a vertex for texturing. A tileable texture usually starts on the 0 to 1 Texture Range, and can be scaled to the desired resolution based on the geometry size. It is okay to go outside of the 0 to 1 UV space when creating a tileable texture in a 3D package. In a human head model, the geometry is laid out so that there is no UVs overlapping. In some cases, there may be overlapped UVs when the geometry is mirrored or reused.

The image is the Autodesk Maya UV Texture Editor and 0 to 1 texture range.

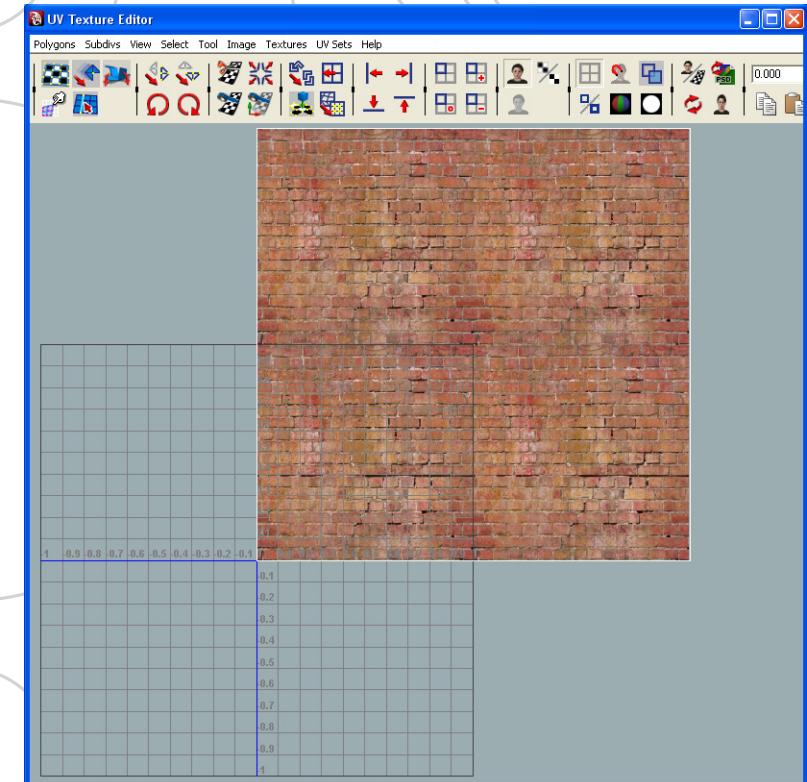


Try and fill the empty space with extra details and variations

The image displays a UV Layout with UVs in the 0 to 1 space.

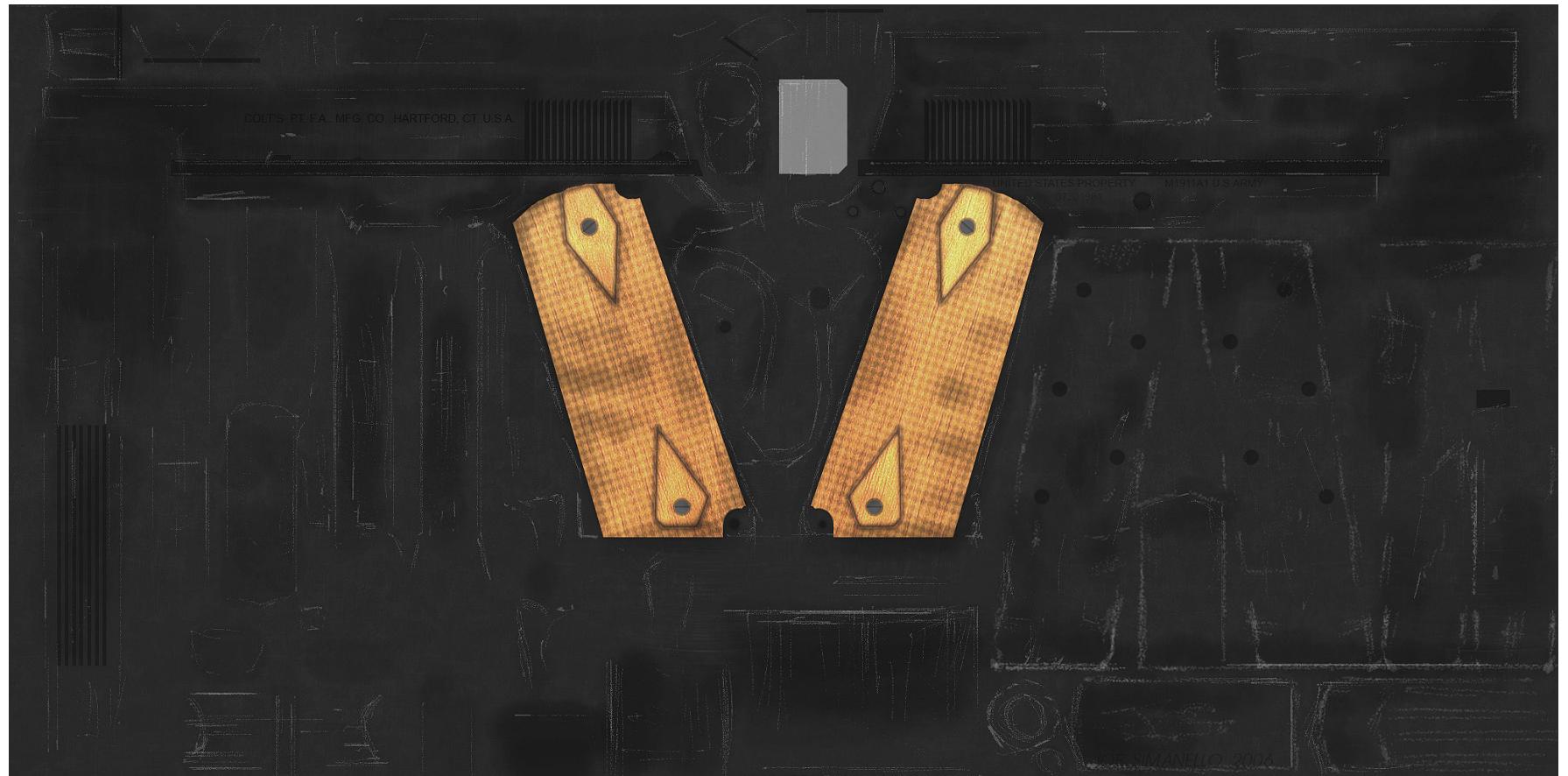


The image displays the UV layout with tiled UVs twice.

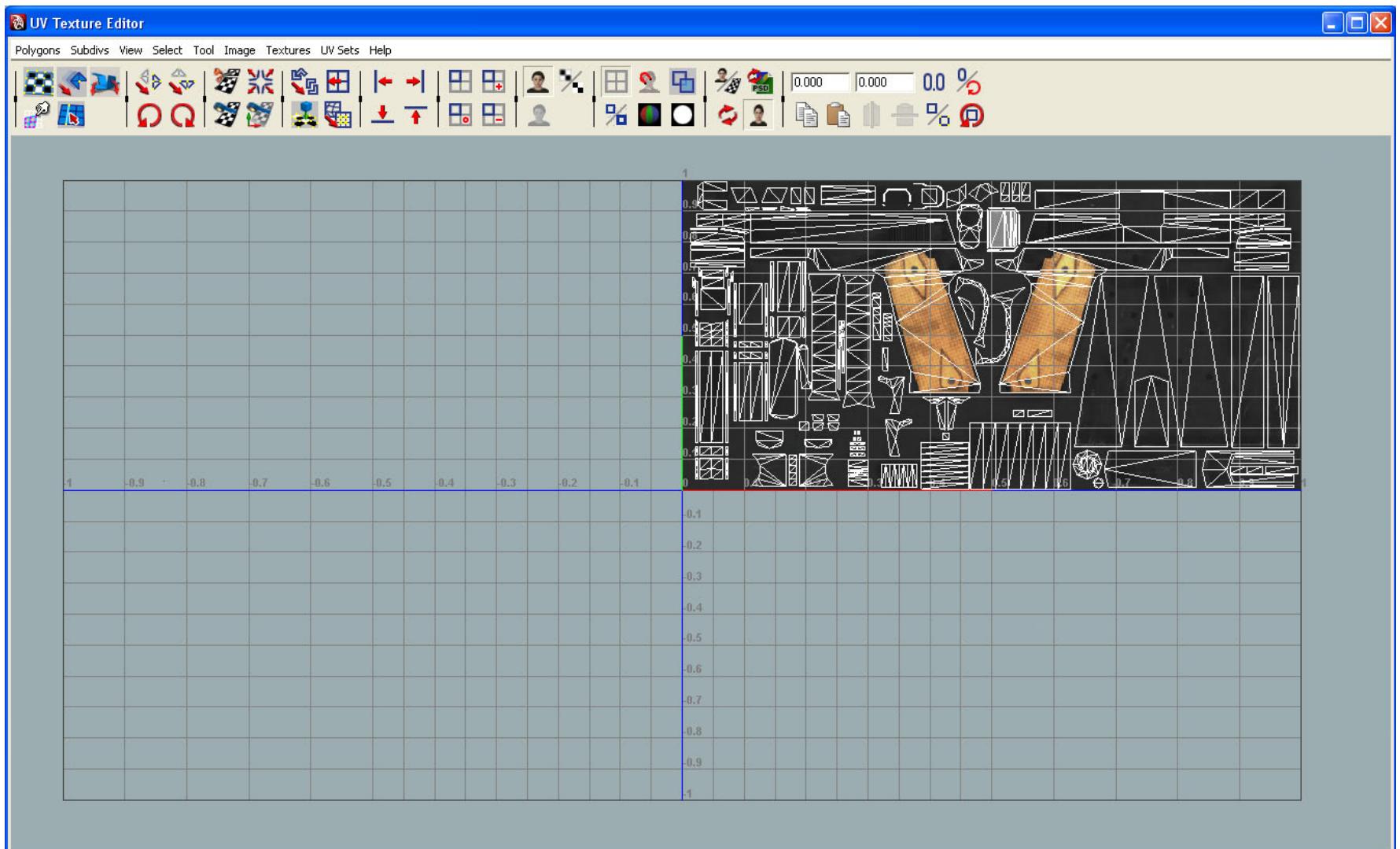


A square texture occupies the 0 to 1 UV space, such as 512 by 512. A rectangular-shaped texture, such as 1024 x 512, also occupies the 0 to 1 space. However, it must be scaled left to right to fit. When the texture is applied, it will show up in the Texture Editor and on the model as looking correct. This is a good way to save space using the 2:1 ratio textures. When creating UV layouts, think about ideal placement for optimal resolution and reuse. It might seem extreme, but the tighter the UVs, the higher the quality of the textures.

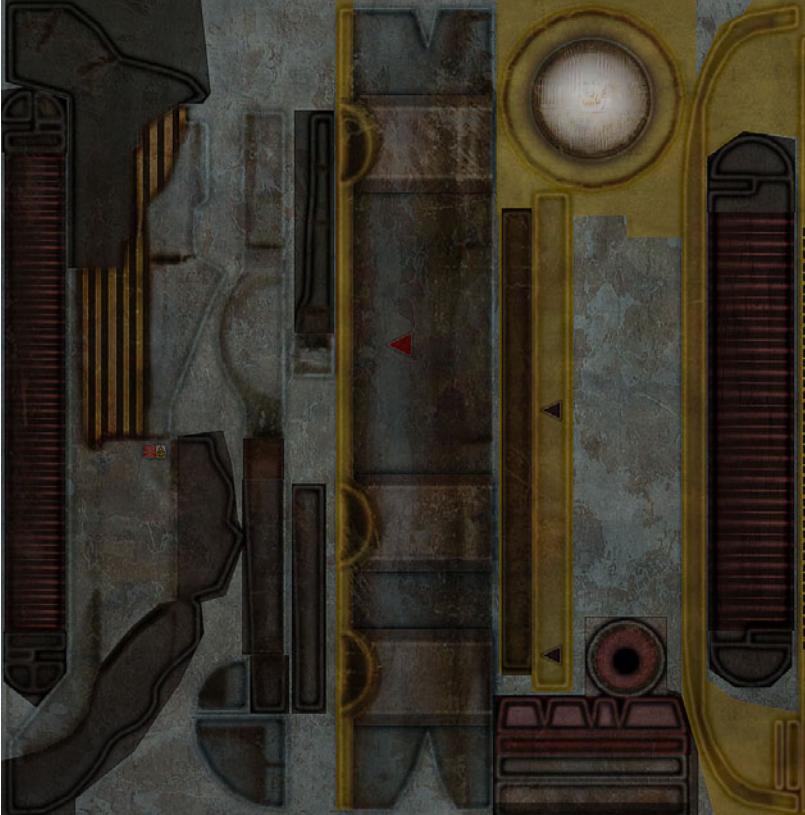
The texture displayed fits in the 0 to 1 space and is 1024 x 2048 pixels.



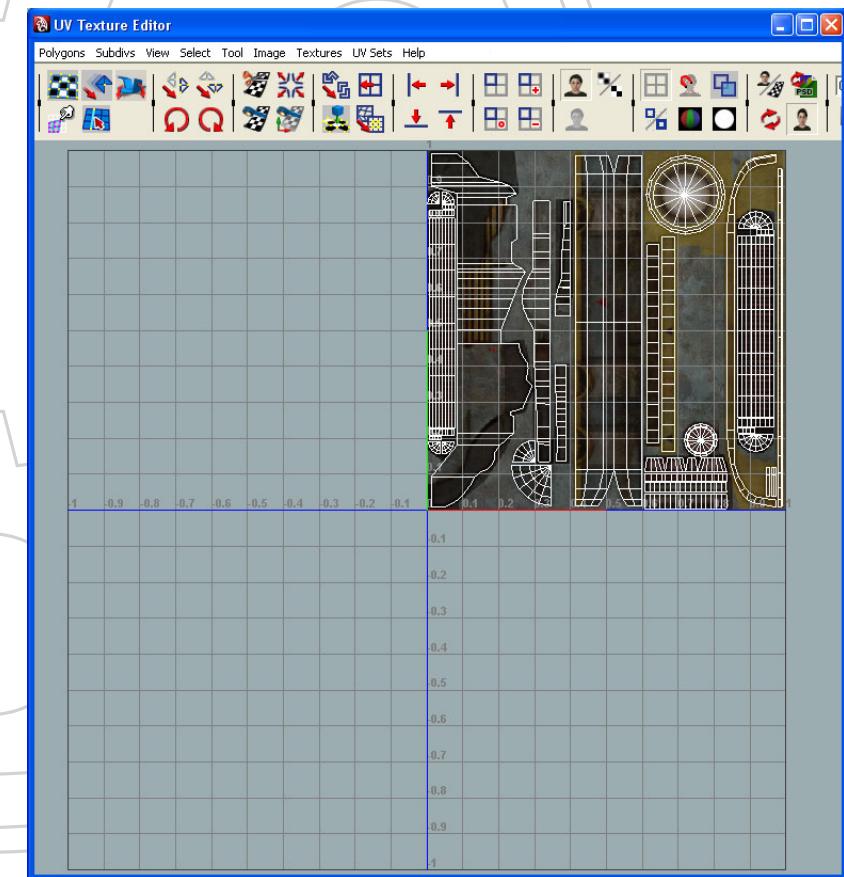
This image is the UV layout of the handgun.



The texture displayed fits in the 0 to 1 space and is 1024 x 1024 pixels.



This image is the UV layout of the prop.



The Grid

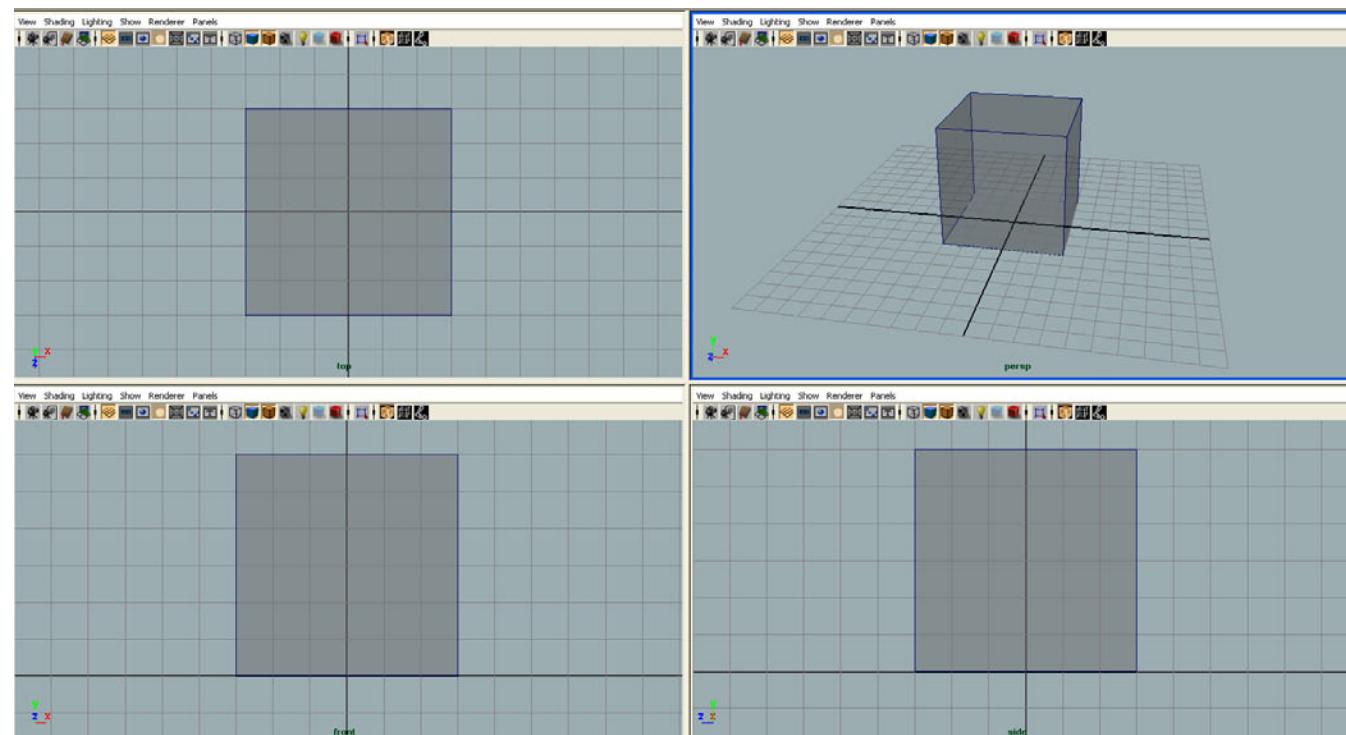
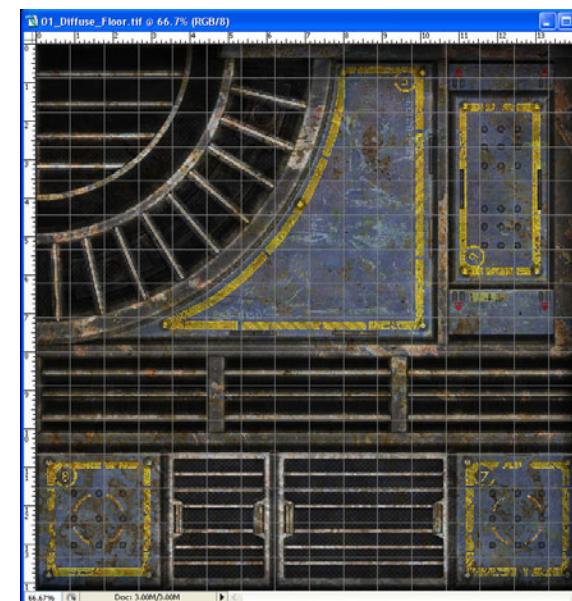
The grid refers to the coordinate system that a game engine, Photoshop, and 3D software use to align geometry and textures. The game engine is based on powers of 2. The grid is used in every 3D software package, but may have different settings. It is applicable in creating assets for film and TV. Setting up proper grid units in the 3D software and Photoshop enables you to take full advantage of reusing textures. The artist creates trim pieces that can be taken from a tileable texture and reused throughout the level. Texture sets that are the same style may be built on the grid, and will line up with the game engine or 3D geometry.

The image is a photo of a grid setup in Adobe Photoshop with a grid overlay and rulers.

In older generation video games, the textures were made to lie precisely on the grid. Today, video games have enough storage to have custom texture maps on many surfaces.

When creating environment artwork, use the 3D grid. The grid enables modular pieces to be snapped to one another. Many video games also take advantage of the 3D package unit setup, which usually matches the video game engine units. You adjust the grid for the scale and dimensions of the object being created. It is important to build the geometry clean, so there are few intersecting pieces of geometry.

Pictured here is a cube snapped to the grid in Autodesk® Maya® software.

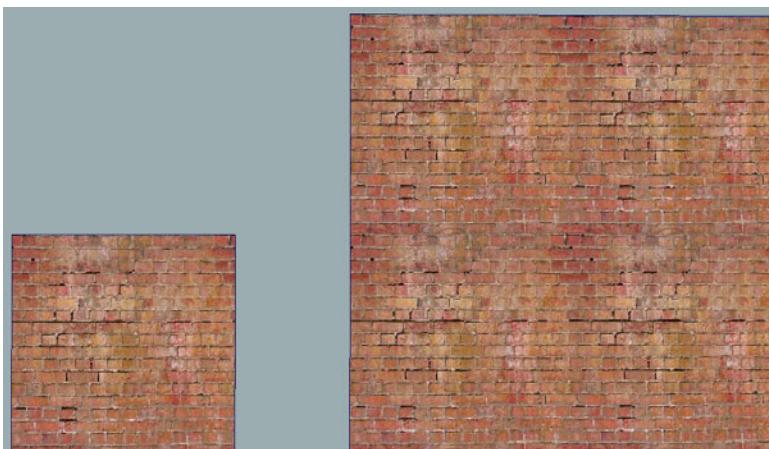


Texel Density

Texel density is the pixel resolution on the relative size of the object. The pixel resolution keeps a relative balance between the textures in a scene. It is best to keep a close relationship of resolution on the environment and characters. You make adjustments if visual flaws are apparent. Some game engines automatically use a predefined texel density, such as 4 pixels per inch. The game engine automatically repeats the texture to fit the size of the level geometry. In film, the resolution is set manually by the artist in the UV editor. There are resolution standards for games and films that export directly from a 3D package.

Texel density is the amount of pixels used per inch of geometry. A 512 by 512 pixel texture covers $7\frac{1}{2}$ feet of space, or 90 inches. A 1024 by 1024 pixel texture covers 15 feet of space, or 180 inches. The desired texel density of 5.6 pixels per inch is calculated this way for most surfaces. When creating smaller table top sized props, use a higher texel density of 8.5 pixels per inch. This means that a 512 by 512 should cover 5 feet, or 60 inches. A vehicle or portion using a 512 by 512 texture equates to 10 feet or 120 inches, with a texel density of 4.2 pixels per inch. The wheels use the 90 inch formula of 5.6 pixels per inch.

The image is a $7\frac{1}{2}$ foot and 15 foot wall using a 512 by 512 texture.



Brick wall that is $7\frac{1}{2}$ feet tall using a 512 x 512 texture

Brick wall that is 15 feet tall using a 512 x 512 texture

In Maya, enter 90 in the Projection Height and Width. It displays the amount of UV space to use. Autodesk® 3ds Max® and XSI also have settings that enable a fixed texture resolution. If your object only takes up one quarter of the 0 to 1 space when a 90 inch projection is used, then the model will only require a 256 by 256 texture. This ratio of size to pixels may be changed when more resolution is needed. There is no exact texel resolution for film or games. It is usually set by a technical director and may vary.

The image is an 8 foot prop using a 1024 by 1024 texture.

