



Introduction to Materials in AutoCAD 2015

Professor John R. Bordeau – Kankakee Community College

AC5402 A material is simply an image stretched over an object to make it appear as if the object is made out various materials such as: wood, marble, brick, metal, plastic, glass, and so on. AutoCAD 2015 provides a materials library that can be attached to the objects. Once the material has been applied, you will learn how to adjust how the material is mapped to the object. Using visual styles you can immediately see the effects of the materials or you can see the full effects by rendering the scene. This class will explore the methods of creating new materials that can be added into your scene.

Learning Objectives

At the end of this class, you will be able to:

- Learn to attach and remove materials to 3D objects in a drawing.
- Learn how to change the properties of existing materials.
- You will be able to adjust material maps.
- Learn how to create and modify custom materials.

About the Speaker

John is a professor at Kankakee Community College. He has 18 years of CAD teaching experience at universities and colleges. His professional experience covers the span of 30 years, including 13 years of expertise in managing all aspects of the CAD function for large organizations with multiple engineering disciplines, and remote offices such as AECOM and STS Consultants. John's four main areas of specialization include CAD management and education, information technology, training and performance improvement, and industrial technology. His education includes an MS in training and organizational development from Northern Michigan University. The research project for his master's degree was "AutoCAD® E-Learning Objects for the Adult Learner." Additionally, he has a BS in industrial technology and applied sciences with a minor in CAD.

jbordeau@kcc.edu

Materials Overview

A **material** is simply an image stretched over an object to make it appear as though the object is made out of wood, marble, glass, brick, or various other materials. AutoCAD provides an assortment of materials that can be used in your drawings to create a realistic scene. The materials are grouped into categories to make them easier to find.

Materials are easy to attach. They can be dragged and dropped onto the objects, attached to all selected objects, and even attached based on the object's layer. Once the material is attached, you can adjust how the material is *mapped* to the object. If the current visual style is set to display materials in the viewport, you can immediately see the effects on the object. The properties of a material can also be changed to make it look shinier, softer, smoother, rougher, and so on. When you finally render the scene, you will see the full effect of the materials.

The **materials library** is the location where all materials are stored. When you install AutoCAD, the Autodesk Material Library is installed. The images in the Base Image Library are low resolution (512×512) and are used with AutoCAD materials. The Medium Image Library contains medium-resolution images (1024×1024) that are good for close-up work or large-scale model rendering. The Medium Image Library is an additional software option that you must install after installing AutoCAD. When you attempt to render, you may be asked if you want to download the Medium Image Library. Just follow the prompts to accomplish this task.

Materials Browser

In AutoCAD, the **Materials Browser** palette is used to manage the materials library. In this handout, the **Materials Browser** palette is referred to as the **materials browser**. The materials browser provides access to all materials that are available in the Autodesk libraries and from other sources. The **Materials** panel in the **Visualize** tab of the ribbon contains buttons for accessing the materials browser and the materials editor. See **Figure 1**. There are two main areas in the materials browser, **Figure 2**. The **Document Materials** area contains materials that have been selected for use in the current drawing. The **Library** area shows all available libraries from which materials may be selected. These areas are discussed in more detail in the next sections.

Figure 1.

The **Materials Browser** button is located on the **Materials** panel in the **Visualize** tab of the ribbon. The materials editor is displayed by picking the dialog box launcher on the panel.

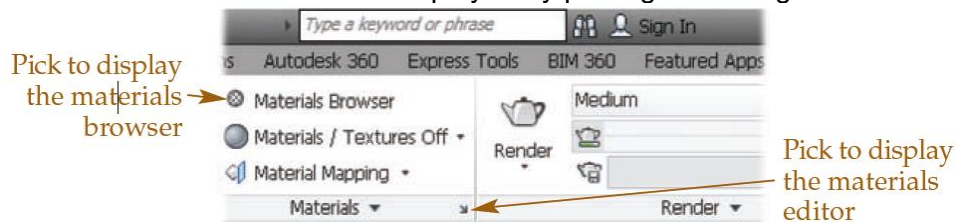
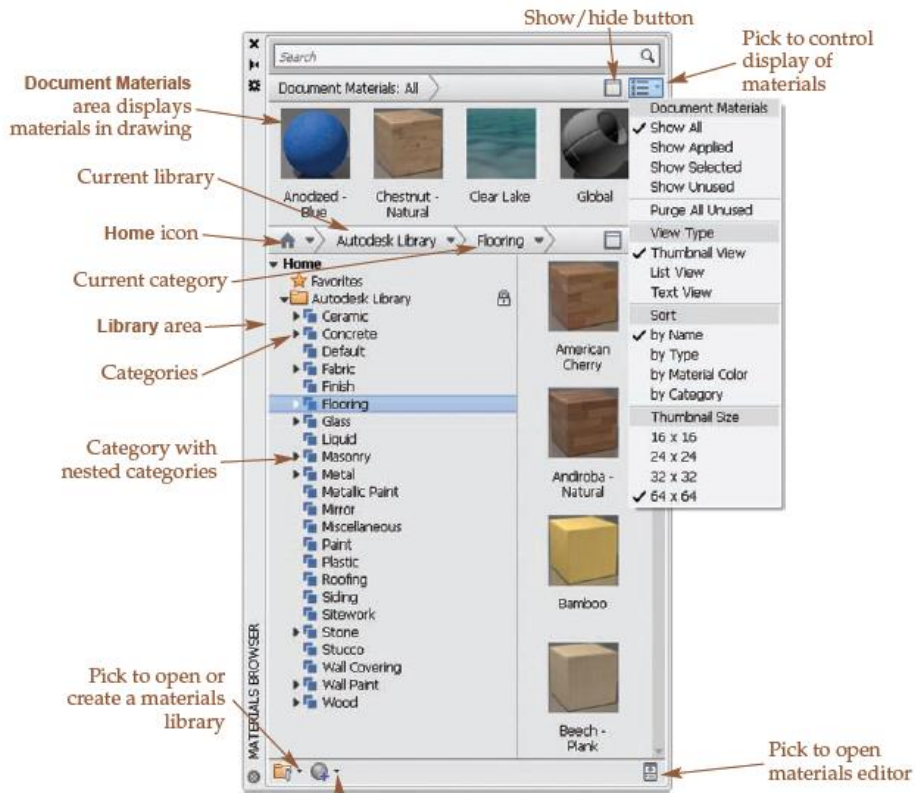


Figure 2.

The materials browser contains all of the available materials.



Documents Materials Area

Materials are added to the **Document Materials** area from the **Library** area. Hovering over a material swatch in the **Library** area displays two options. See **Figure 3**. Picking **Adds material to document** adds the material to the **Document Materials** area. Picking **Adds material to document and displays in editor** adds the material to the **Document Materials** area and opens it in the materials editor (discussed later). After you add a material to the document, a swatch for the material appears in the **Document Materials** area.

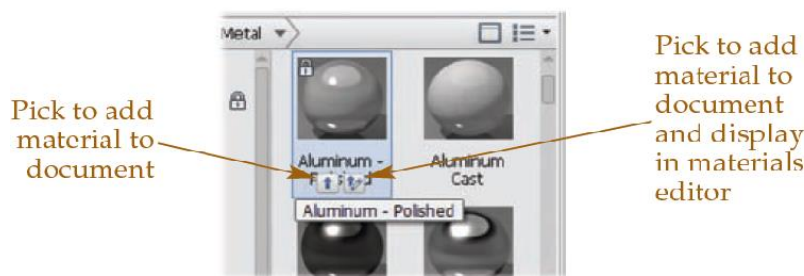
Picking the button on the right end of the **Document Materials** title bar opens a drop-down menu. The options in this menu allow you to control which materials are displayed in the **Document Materials** area. You can show all materials, only the materials that are applied to objects in the drawing, selected materials, or unused materials. Materials may be sorted by name, type, color, or category. They can be displayed in thumbnail, list, or text view, and the size of thumbnails can be changed. Refer to **Figure 2**. Picking the show/hide button on the **Document Materials** title bar hides the display of the **Library** area. Pick the button again to expand the **Library** area.

Right-clicking on a material in the **Document Materials** area displays a shortcut menu. There are several options available in the shortcut menu:

- **Assign to Selection.** This is active if one or more objects are selected in the scene. The material will be applied to the selected object(s).
- **Select Objects Applied To.** All objects in the drawing that have the material applied to them are selected in the drawing window.
- **Edit.** This displays the materials editor for editing the selected material. The materials editor is discussed later in this handout.
- **Duplicate.** A copy of the material is added to the drawing. A new material is added with the same name as the original material, but with a sequential number added to the name.
- **Rename.** This option is used to change the name of the material. It is a good idea to rename all of your materials to meaningful names.
- **Delete.** This option removes the material from the drawing. If it is currently being used in the drawing, a warning alerts you to this. Continuing with the deletion removes the material from the objects in the drawing as well as from the **Document Materials** area. It is not, however, removed from the library.
- **Add to.** This option displays a cascading menu with two choices. The material may be added to the Favorites library in the **Library** area. This is excellent for organizing materials that you frequently use and want to make available for quick access in other drawings. You can also add the material to the active tool palette.
- **Purge All Unused.** This option removes from the drawing all materials not currently assigned to an object. Pick to add material to document and display in materials editor
Pick to add material to document

Figure 3.

Hovering over a material in the **Library** area displays two buttons that allow you to add the material to the document. Picking the button on the right adds the material to the document and displays it in the materials editor.



Library Area

The **Library** area of the materials browser contains the open library files. By default, two libraries exist when AutoCAD is installed: Favorites and Autodesk Library. The name of the current library is displayed on the **Library** area title bar. You can select a different library from the drop-down list on the left end of the title bar. Picking the **Home** icon next to the drop-down list deselects the current library and displays the available libraries in the right-hand column of the **Library** area.

The Autodesk Library is composed of the materials installed when AutoCAD was installed and cannot be edited. Favorites can be used to collect and organize commonly used materials, as well as user defined materials. Favorites is empty by default, but you may add your own categories and materials to it. Custom materials are only available in the drawing in which they were created unless saved to Favorites or another user defined materials library. Custom materials that you create in a drawing but do not save to a materials library are called *embedded materials*.

To expand a library in the tree view, pick the triangle next to the library name. Libraries can have categories within them. If the category contains nested categories, a triangle appears next to the name. Refer to **Figure 2**. Pick the triangle to expand the item. Categories in the Autodesk Library are organized by material type. Categories in Favorites and user defined libraries must be created by the user. As you make selections in the tree view, the **Library** area title bar updates to display the name of the current item.

Materials are displayed in the right-hand column and change to reflect whatever category is selected. Picking the button on the right end of the **Library** area title bar opens a drop-down menu similar to the drop-down menu in the **Document Materials** area. The options in the **Library** section allow you to select which library is displayed. The view type, sort, and thumbnail size options are the same as those previously discussed for materials displayed in the **Document Materials** area. Picking the show/hide button on the **Library** area title bar hides the tree view and changes the display to a single window displaying materials.

The libraries that you assemble can be saved externally and opened in other drawings. The button with the folder icon at the lower-left corner of the materials browser provides options for managing materials libraries and categories:

- **Open Existing Library.** Allows you to select a library file (*.adsklib) and display it in the materials browser.
- **Create New Library.** Gives you the option of saving a library you assembled in the materials browser. Library files are saved with the .adsklib file extension.
- **Remove Library.** Used to delete libraries from the materials browser.
- **Create Category.** Allows you to add categories to your library.
- **Delete Category.** Used to remove categories.
- **Rename.** Allows you to rename libraries and categories.

The **Creates a new material in the document** button at the bottom of the materials browser provides a useful way to create your own materials based on the standard Autodesk material types. Selecting **Concrete**, **Metal**, **Plastic**, etc. from the drop-down list creates a material with the default settings for that material type. The materials editor is opened for you to modify the new material to your liking. Picking the **Opens/Closes material editor** button at the lower-right corner of the materials browser also opens the materials editor. Refer to **Figure 2**.

NOTE:

You cannot rename or remove the default Autodesk libraries. Categories in the Autodesk Library cannot be renamed or removed, and you cannot add categories. Categories can be added to the Favorites library.

Applying and Removing Materials

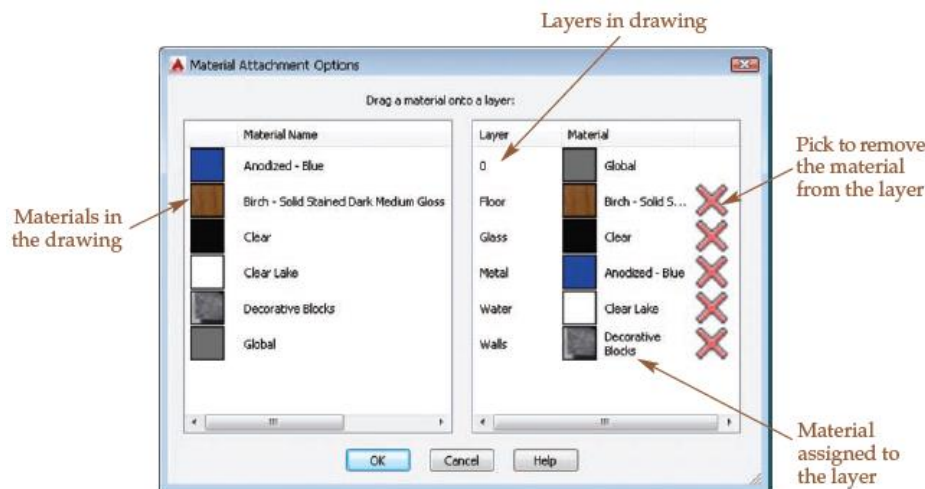
To attach a material to an object in the drawing, you can drag the material from the materials browser and drop it onto an object. To apply a material only to a face on an object, hold the [Ctrl] key and pick the face. To apply a different material to an object, simply drag the new material to the object and pick.

You can use the **MATERIALATTACH** command to assign materials to the layers in your drawing. Once a material is assigned to a layer, any object on that layer is displayed in the material, as long as the object's material property is set to ByLayer. When objects are created in AutoCAD, the default "material" assigned to them is ByLayer. If your objects are organized on layers, this is the easiest way to attach materials. You can override the layer material by applying a material to individual objects.

Figure 4 shows the **Material Attachment Options** dialog box displayed by the **MATERIALATTACH** command. The list on the left side of the dialog box shows the materials loaded into the drawing. The right side of the dialog box shows the layers in the drawing and the material attached to each layer. When no material is attached to a layer, the material is listed as Global. The Global material is a "blank" material in every drawing. To attach a material to a layer, drag the material from the list on the left and drop it onto the layer name on the right. To remove a material from a layer, pick the **X** button next to the material name on the right side of the dialog box.

The **Remove Materials** button on the **Materials** panel in the **Visualize** tab of the ribbon allows you to quickly set an object's material back to ByLayer. When the button is picked, a paintbrush selection cursor is displayed. If you select an object that has a material specifically attached to it, the material is removed. Selecting an object already set to ByLayer has no effect.

Figure 4.
Attaching materials to layers.



A material can also be removed using the **Properties** palette. To remove a material from an object or subobject, simply change its Material property in the **3D Visualization** category to Global. If a material has not been assigned to the object's layer, the property can also be set to ByLayer. See **Figure 5**.

PROFESSIONAL BEST PRACTICE TIP

A material can also be applied to an object by selecting the object in the drawing window, right-clicking on the material swatch in the materials browser, and selecting **Assign to Selection**. A material can be loaded into the drawing without attaching it to an object by picking the material and dragging and dropping it into a blank area of the drawing. This makes the material available in the drawing.

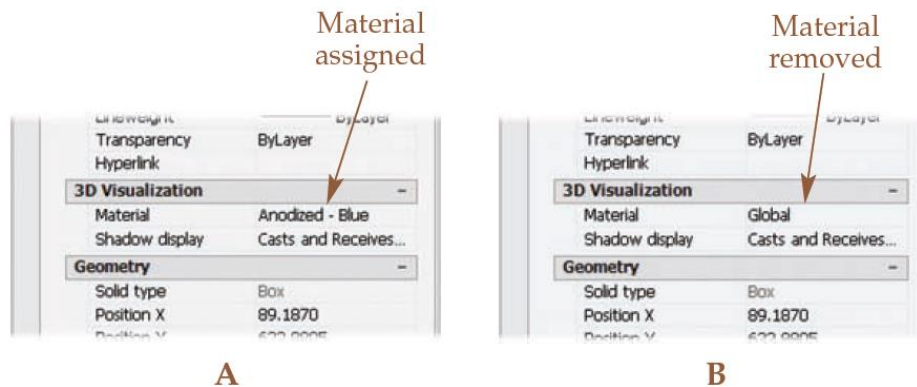
Material Display Options

Visual styles control how materials are displayed in the viewport. The Material display property of a visual style can be set to display materials and textures, materials only, or neither materials nor textures. The **Materials** panel on the **Visualize** tab of the ribbon has three buttons in a fly out that correspond to, but override, this property setting:

- **Materials/Textures Off.** Objects are displayed in their assigned colors.
- **Materials On/Textures Off.** Objects are displayed in the basic color of the material, but no other material details are displayed.
- **Materials/Textures On.** Objects are displayed with the effects of all material properties visible.

Figure 5.

Removing a material from an object. A—The material is assigned. B—The material is removed.



Material Editor

The **materials editor** allows you to create new materials and edit existing materials to your liking. The next sections discuss creating and editing materials.

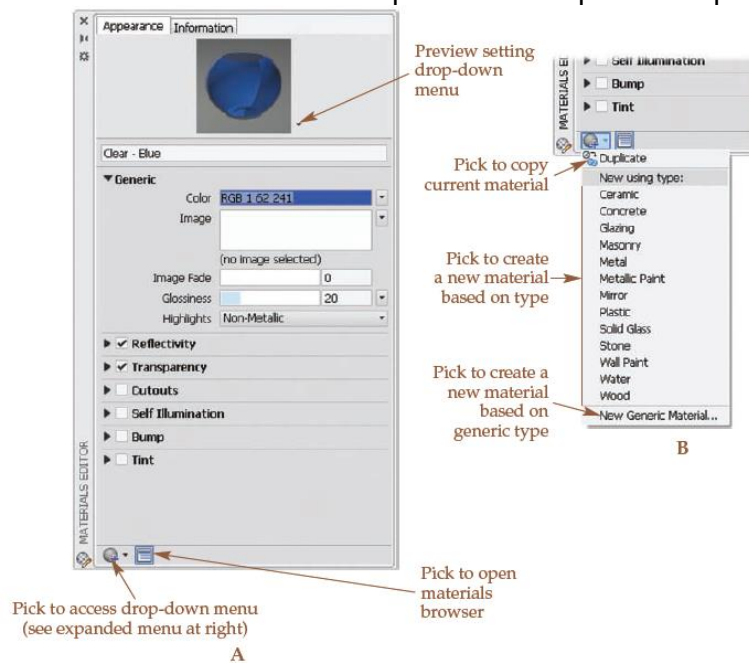
The **Materials Editor** palette is displayed by picking the dialog box launcher button at the lower-right corner of the **Materials** panel in the **Visualize** tab of the ribbon. See **Figure 6**. You can

also type the **MATEDITOROPEN** command, double-click on a material swatch in the materials browser, or pick the **Opens/Closes material editor** button in the lower-right corner of the browser. In addition, you can hover over a material swatch in the **Document Materials** area to display a small pencil icon. Picking this icon opens the materials editor.

A preview of the material appears at the top of the materials editor. The geometry used for the preview can be changed by selecting a shape from the drop-down menu located at the lower-right corner of the material swatch. There are 12 shapes from which to select: **Sphere**, **Cube**, **Cylinder**, **Canvas**, **Plane**, **Object**, **Vase**, **Draped Fabric**, **Glass Curtain Wall**, **Walls**, **Pool of Liquid**, and **Utility**. In addition, you can select the quality of the preview image. By default, the quality is set to **Fastest Renderer**, which provides a good quality preview image. The **Mental Ray** options are used for previewing the material with a much higher quality, but the resulting display will also take longer to update. The updates occur whenever you change a material property. The name of the material can be changed by editing it in the **Name** text box located in the **Appearance** tab or in the **Information** tab.

Figure 6.

The materials editor. A—A preview of the material appears at the top of the palette. Picking the drop-down menu button at the lower-left corner of the palette displays the drop-down menu shown in B. B—This drop-down menu provides options for creating a new material.



Materials created or edited in the materials editor are then added to the **Document Materials** area of the materials browser. Once the material is in the materials browser, it is a good idea to add it to one of your material libraries. Right-click on the material swatch in the **Document Materials** area, select **Add to**, and then select the library from the shortcut menu. The materials browser can be opened from the materials editor by picking the **Opens/Closes material browser** button at the bottom of the **Appearance** tab. Refer to **Figure 6A**.

Creating and Modifying Materials

There are three different approaches to creating new materials. You can duplicate an existing material. You can start with an existing material type as a template. Finally, you can start with a generic material, which is like starting from scratch. To access these options, use the drop-down menu at the lower-left corner of the materials editor.

New Material from an Existing Material

By far the easiest way to create your own material is to start with an existing material, create a duplicate, and make any needed modifications. Look through the materials library in the materials browser to find a material that is close to what you want and add the material to the **Document Materials** area. Hover over the material swatch in the **Document Materials** area and select the pencil icon to launch the materials editor.

The material selected in the **Document Materials** area of the materials browser is displayed in the materials editor. Pick **Duplicate** from the drop-down menu at the lower-left corner of the materials editor. Refer to **Figure 6B**. This creates a duplicate material with the same name and a sequential number. Change the name and the properties to your liking (discussed later) and close the materials editor. The new material is in the **Document Materials** area of the materials browser ready to use.

New Material Using an Existing Material Type

Another way to create a material is by using a material type as a template for your new material. Using the drop-down menu at the lower-left corner of the materials editor, select one of the material types under the **New using type:** option. Refer to **Figure 6B**. The material type provides certain default settings as a starting point. The following sections discuss the material types, their possible applications, and any special properties the material type may have.

PROFESSIONAL BEST PRACTICE TIP

Often, a material type can be used for a material that is completely unrelated to the name of the material type. For example, the concrete material type may actually serve well for dirt or sand. Be creative and do not limit yourself to what is implied by the name of the material type.

Ceramic

The **ceramic** material type is designed for ceramic floors. However, this material type may serve well for other glossy surfaces, such as countertops, bathtubs, or dinnerware. The **Type** property can be Ceramic or Porcelain. The **Finish** property can be High Gloss/Glazed, Satin, or Matte. The **Finish Bumps** category contains a **Type** property that can be Wavy or Custom. The **Relief Pattern** category contains an **Image** property. The image determines the relief pattern. The **Tint** category contains a **Tint Color** property that allows you to assign a tint color defined by its hue and saturation value mixed with white. This property is also available in the other material types.

Concrete

The **concrete** material type works well for concrete floors, walls, and sidewalks. This material type can be used for anything constructed of concrete, such as an in-ground swimming pool. The Sealant property can be None, Epoxy, or Acrylic. The **Finish Bumps** category contains a Type property that can be Broom Straight, Broom Curved, Smooth, Polished, or Stamped/Custom. The **Weathering** category contains a Type property that can be Automatic or Custom-Image (based on a selected image).

Glazing

The glass in windows is called glazing. Therefore, the **glazing** material type is designed mostly for use on windows or thin glass objects. The solid glass material type is designed for thicker glass. The Color property can be Clear, Green, Gray, Blue, Blue-green, Bronze, or Custom. The Reflectance value determines how reflective the material is. The Sheets of Glass property simulates the effect of multiple panes of glass.

Masonry

Masonry includes brick walls, cobblestone, tile flooring, and so on. The **masonry** material type is designed for use on objects such as these. The Type property can be CMU (concrete masonry unit) or Masonry. The Finish property can be Glossy, Matte, or Unfinished. The **Relief Pattern** category contains an Image property. The image determines the relief pattern.

Metal

The **metal** material type works well for mechanical parts and other objects made from different types of metals. This material type primarily is for raw, or unfinished, metal. The Type property can be Aluminum, Anodized Aluminum, Chrome, Copper, Brass, Bronze, Stainless Steel, or Zinc. The Finish property can be Polished, Semi-polished, Satin, or Brushed. The **Relief Pattern** category contains a Type property that can be Knurl, Diamond Plate, Checker Plate, or Custom-Image (based on a selected image). The **Cutouts** category contains a Type property that can be Staggered Circles, Straight Circles, Squares, Grecian, Cloverleaf, Hexagon, or Custom. Depending on which type of metal is selected, additional properties may be available for editing.

Metallic Paint

The **metallic paint** material type is for objects made of metal, but with a finish applied. This includes objects like car parts, lawn furniture, and kitchen appliances. The **Flecks** category contains Color and Size properties. The **Pearl** category includes a Type property that can be Chromatic or Second Color. The **Top Coat** category includes a Type property that can be Car Paint, Chrome, Matte, or Custom. The **Top Coat** category also includes a Finish property that can be Smooth or Orange Peel.

Mirror

The **mirror** material type is designed for very reflective objects, such as mirrors. It can also be used for water, glass, or any object that should have a high reflectivity. The Color property determines the color of the mirror. As discussed earlier, the **Tint** category is also available.

Plastic

The **plastic** material type is designed for use on plastic objects. The plastic can be opaque, translucent, glossy, or textured. The Type property can be Solid, Transparent, or Vinyl. The Finish property can be Polished, Glossy, or Matte. The **Finish Bumps** category contains an Image property, as does the **Relief Pattern** category. The two images do not have to be the same.

Solid Glass

The **solid glass** material type is intended for thick glass objects or a volume of liquid, such as a glass of water. The Color property can be Clear, Green, Gray, Blue, Bluegreen, Bronze, or Custom. The Reflectance property determines the degree of reflectivity of the material. The Refraction property can be Air, Water, Alcohol, Quartz, Glass, Diamond, or Custom. The Roughness property determines the polish on the material. The **Relief Pattern** category contains a Type property that can be Rippled, Wavy, or Custom.

Stone

The **stone** material type works well for stone walls, stone walkways, and marble countertops. The **Stone** category contains an Image property, which is the image applied to the material. This can be a selected image or a specified texture. The **Stone** category also contains a Finish property that can be Polished, Glossy, Matte, or Unfinished. The **Finish Bumps** category contains a Type property that can be Polished Granite, Stone Wall, Glossy Marble, or Custom. The **Relief Pattern** category contains an Image property. This can be a selected image or a specified texture.

Wall Paint

The **wall paint** material type works well for interior or exterior painted walls and other objects. The Finish property can be Flat/Matte, Eggshell, Platinum, Pearl, Semi-gloss, or Gloss. The Application property can be Roller, Brush, or Spray.

Water

The **water** material type is designed for any liquid. Pools, reflecting ponds, rivers, lakes, and oceans are examples of where this material type may be used. The Type property can be Swimming Pool, Generic Reflecting Pool, Generic Stream/River, Generic Pond/Lake, or Generic Sea/Ocean. The Color property (when available) can be Tropical, Algae/Green, Murky/Brown, Generic Reflecting Pool, Generic Stream/River, Generic Pond/Lake, Generic Sea/Ocean, or Custom. The Wave Height property sets the amplitude of ripples in the liquid.

Wood

The **wood** material type works well for various finishes used for flooring, furniture, wood trim, and so on. The **Wood** category contains an Image property, which is the image applied to the material. This can be a selected image or a specified texture. When the **Stain** check box is checked, the color of stain can be set. The **Wood** category also contains a Finish property, which can be Unfinished, Glossy Varnish, Semi-gloss Varnish, or Satin Varnish. The Used For property can be Flooring or Furniture. The **Relief Pattern** category contains a Type property that can be Based on Wood Grain or Custom (which is based on a selected image).

Generic

The generic material type is the “blank canvas” material. All properties are available to create any material needed. This material type is used to create a material from scratch, as discussed in the next section.

PROFESSIONAL BEST PRACTICE TIP

AutoCAD provides fantastic-looking materials to dress up the scene and make it look real. However, after you get comfortable with creating materials, start a library of your own materials. If your project is presented to a customer along with projects from competitors, and your competitors are using standard AutoCAD materials, your project will stand out from the crowd.

New Material from Scratch

Creating a material from scratch gives you complete control over the material. Although there are many options to consider, creating a material from scratch may be the only way to get the exact material you need to complete your scene. To start creating a material from scratch, select the generic material type by selecting **New Generic Material...** from the drop-down menu at the lower-left corner of the materials editor. Refer to **Figure 6B**. The **New Generic Material...** option is also available from the materials browser. The properties and settings are discussed in the next sections.

NOTE

New materials are placed in the **Document Materials** area and are only available in the current drawing unless added to the Favorites library or a user defined library.

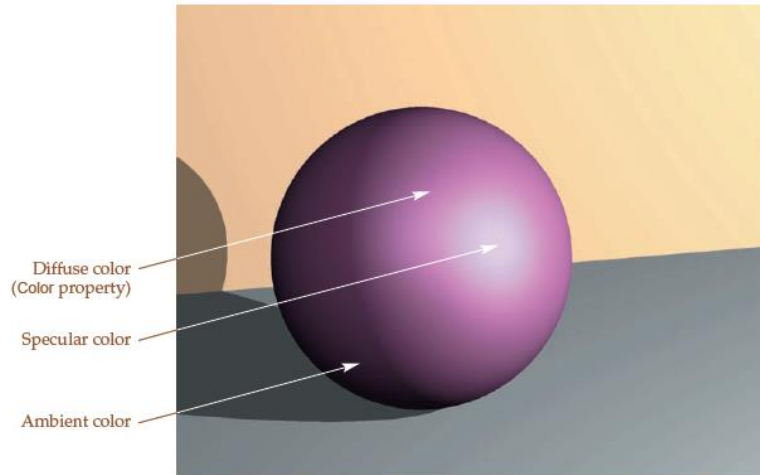
Generic Category

The **diffuse color** is the color of the object in lighted areas, or the perceived color of the material. See **Figure 7**. It is the predominant color you see when you look at the object. The Color property sets the diffuse color of the material. In AutoCAD, the ambient and specular colors are determined by the diffuse color.

The **ambient color** is the color of the object where light does not directly provide illumination. It can be thought of as the color of an object in shadows. In nature, shadows cast by an object typically contain some of the ambient color.

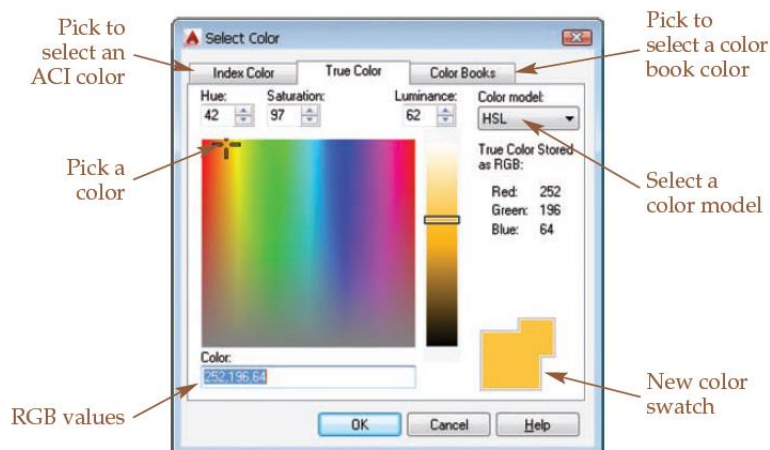
Figure 7.

The three colors of a material are illustrated here. In AutoCAD, the Color property sets the diffuse color. The ambient and specular colors are based on the diffuse color.



The **specular color** is the color of the highlight (the shiny spot). It is typically white or a light color. The amount of specular color shown is determined by the glossiness and reflectivity of the material and the intensity of lighting in the scene.

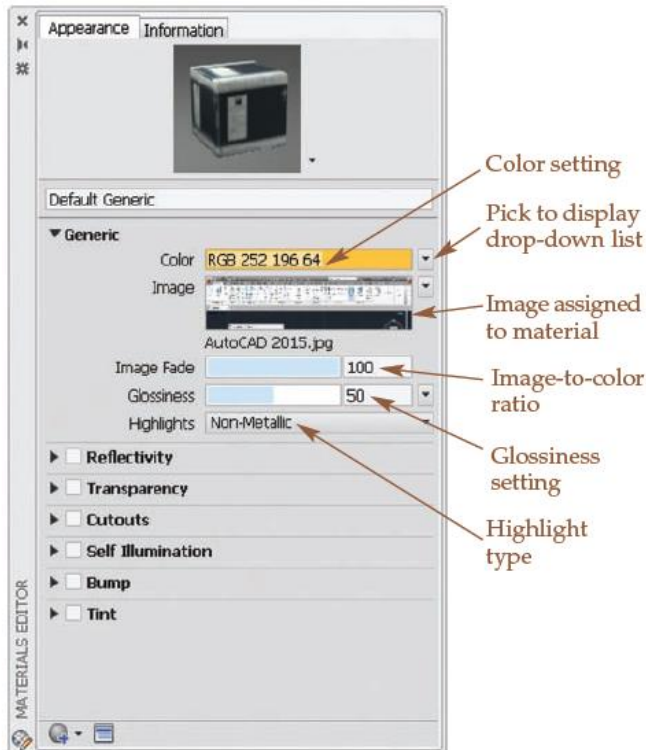
You have two options for controlling the Color property of the material. Picking the button to the right of the color text box displays a drop-down list. Selecting **Color** in the drop-down list means that you can select whatever color you wish. To set the color, pick in the text box; the **Select Color** dialog box is displayed. See **Figure 8**. If you select **Color by Object** in the drop-down list, the base color of the object is used as the diffuse color.

Figure 8. Setting a color for a material.

The Image property allows you to apply an image or texture to control the appearance of the material. Picking in the image preview area displays a standard open dialog box. When you select an image, it is applied to the material and is displayed in the material preview area,

Figure 9. Also, the texture editor is displayed with the image loaded and ready for editing, if necessary. The button to the right of the image preview area is used to apply a texture instead of an image. Textures and texture editing are discussed later in this handout.

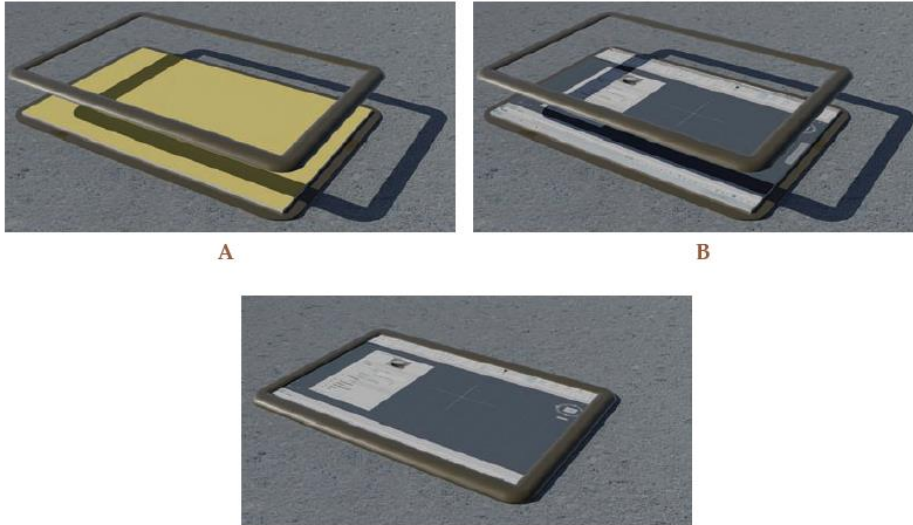
Figure 9. The property settings in the **Generic** category of a material created from scratch.



When an image, such as a bitmap image or digital photograph, is applied, the material color is replaced with the image. **Figure 10** shows an object with a computer screen image applied to the material attached to it. The Image Fade property controls the ratio between the image and the object color. When set to 100, the image completely replaces the object color.

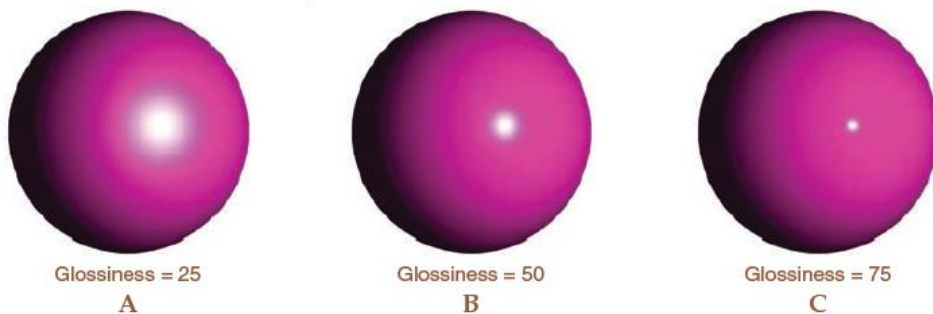
Figure 10.

A material with an image applied instead of a color to simulate a tablet screen. A—The screen object's material does not have an image applied. B—A bitmap image has been applied to the image component of the screen object's material. C—The finished tablet.



The Glossiness property controls how shiny the material appears, **Figure 11**. It is a measure of the surface roughness of a material. A setting of 100 specifies a very shiny material, such as a smooth surface. A setting of 0 specifies a matte (dull) material. The button to the right of the setting allows you to add a texture or image to the Glossiness property. The pattern is applied to the glossiness effect. **Reflectivity** must be turned on for the glossiness effect to be seen. Refer to the next section.

The Highlights property determines how the shiny areas are created. Choices for this property are Metallic or Non-metallic. Highlights are brighter when Metallic is selected.

Figure 11. Three different glossiness settings are illustrated here.

PROFESSIONAL BEST PRACTICE TIP

Highlights can be seen everywhere. Look around you right now at edges and inclined surfaces. The diffuse color of the surface typically has little to do with the color of the highlight. The color of the light source usually determines the predominant highlight color. Most highlights are white or near white because most light sources are white or nearly white. However, highlights in the interior of a home may have a yellow cast to them because incandescent light bulbs generally cast yellow light. Compact fluorescent lights cast a slightly different color, although many are designed to cast the same color as an incandescent bulb. Outside with a clear sky and bright sun, highlights may have a slight blue cast. Keep these points in mind when creating your own materials. These small details are what make a scene realistic.

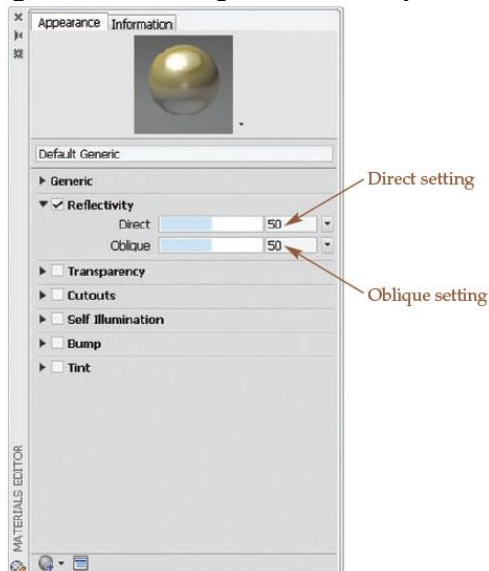
Reflectivity Category

Reflectivity is a measure of how much light is bounced off the surface. There are two basic property settings for reflectivity, Direct and Oblique. See **Figure 12**. The Direct property controls how much light is reflected back for surfaces that are more or less facing the camera. The Oblique property controls how much light is reflected back when the surface is at an angle to the camera.

Each property has a slider/text box that controls the amount of reflectivity. No reflections are created with a setting of 0. The maximum reflections are created with a setting of 100. Object color, lighting, surroundings, and other factors also determine just how reflective a material appears in the scene.

The buttons to the right of the text boxes allow you to add a texture or image to control the reflection. The white areas of the texture or image have a reflection. The black areas do not have a reflection. The degree of reflectivity varies for gray areas and the grayscale values of colors.

Figure 12. Setting the reflectivity for a material.



Transparency Category

Transparency is a measure of how much light the material allows to pass through it. Glass, water, crystal, and some plastics, along with other materials, are nearly completely transparent. **Figure 13** shows an example of using a transparent material to show the internal workings of a mechanical assembly. The **Transparency** category contains a number of properties that combine to create any transparent or semitransparent material, **Figure 14**.

The amount of light that passes through the material is controlled by the Amount property. When this property is set to 0, the material is opaque. A setting of 100 creates a completely transparent material.

Figure 13.

The material used for the housing on this mechanism has a transparency setting of about 50.

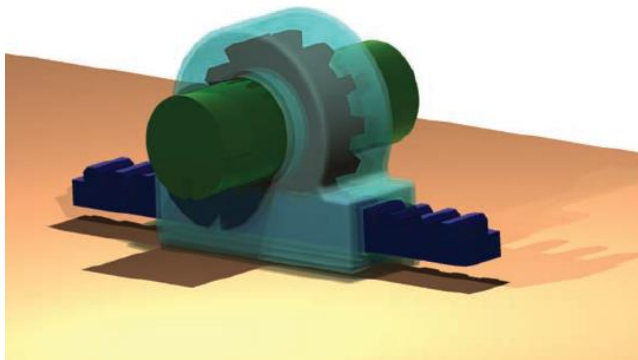
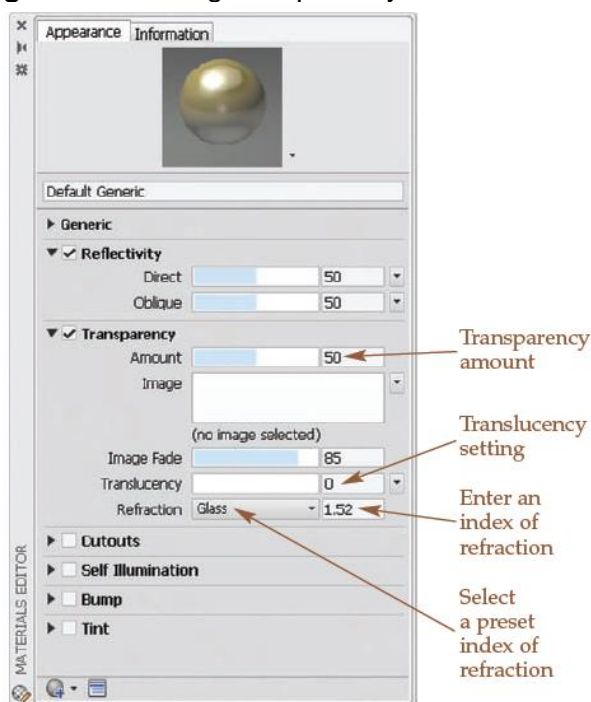


Figure 14. Setting transparency for a material.

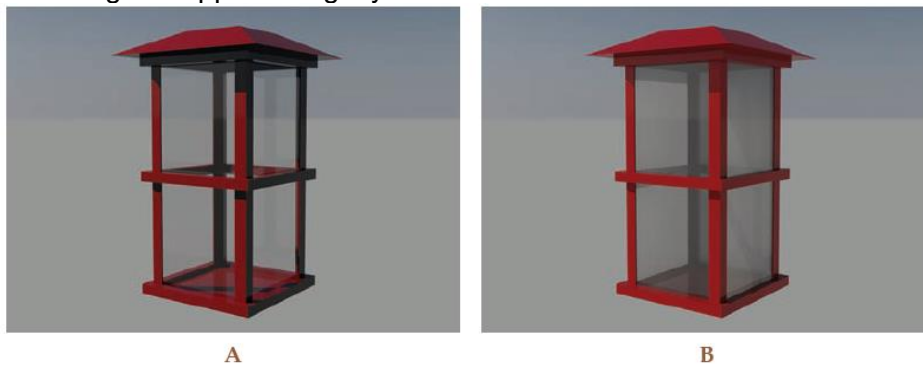


The Image property is used to add a transparency map to the material. White areas in the image or texture are transparent. Black areas are opaque. All other colors produce varying degrees of transparency based on their grayscale values. The Amount property is applied to the transparency map. Maps are discussed later in this handout.

The Image Fade property determines how much of an impact the transparency map has on the transparency of the material. A setting of 100 means the transparency is completely see-through based on the transparency map. As the setting is decreased, a higher percentage of transparency is determined by the Amount property.

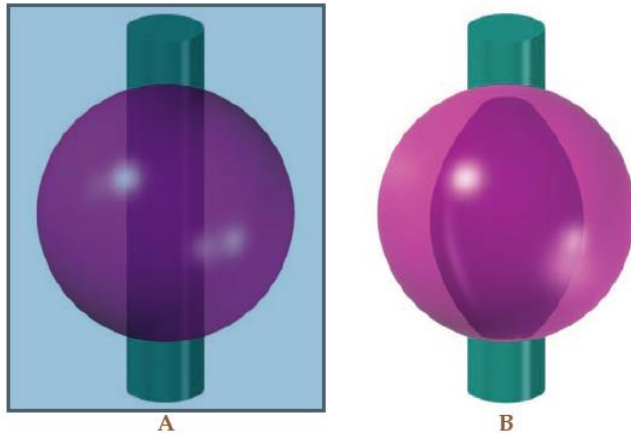
Translucency is a quality of transparent and semitransparent materials that causes light to be diffused (scattered) as it passes through the material. See **Figure 15**. This makes any object with the material applied to it appear as if it is being illuminated from within, or glowing. The thicker the material, the more pronounced the effect. When the Translucency property setting is 0, light appears to travel through the material, lighting the opposite side. A setting of 100 creates a material similar in appearance to frosted glass.

Figure 15. The effect of translucency. A—The glass material has a translucency setting of zero. B—When the translucency setting is increased, light is diffused within the material. Notice how the glass appears slightly frosted.



Refraction, sometimes specified as the **index of refraction (IOR)**, is a measure of how much light is bent (refracted) as it passes through transparent or semitransparent materials. Refraction is what causes objects to appear distorted when viewed through a bottle or glass of water. See **Figure 16**. The Refraction property sets the IOR. The higher the value, the more that light is bent as it passes through the material. The IOR of water is 1.3333. You can enter a value in the text box or select a preset IOR by picking the name that is displayed to the left of the text box.

Figure 16. The effect of refraction. A—The transparent material on the sphere has a refraction setting of zero. B—When the refraction setting is increased, the cylinder behind the sphere is distorted as light is refracted by the material.



Cutouts Category

The Cutouts property allows you to select an image or texture to use for a pattern of cutouts (holes), **Figure 17**. Black areas in the image will appear to be see-through, as if there is no object in those areas. White areas in the image have the normal material colors. This is similar to using a transparency map, but without the other transparency settings. **Figure 18** shows an example of a cutout map applied to a material.

Figure 17. Adding a cutout map to a material.

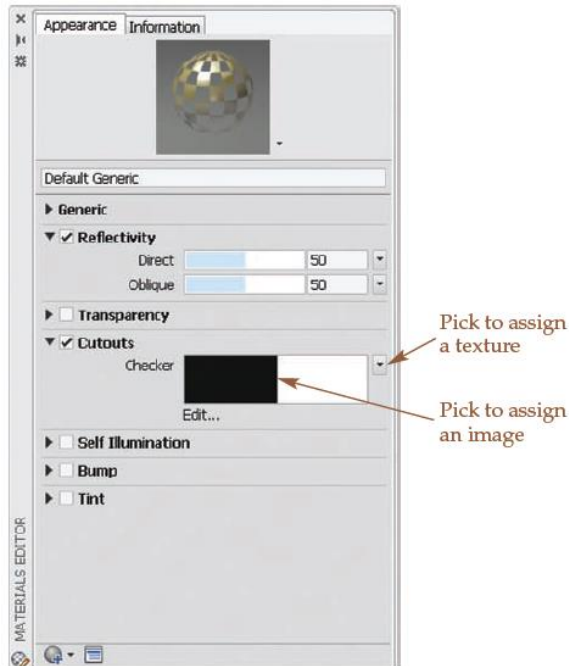
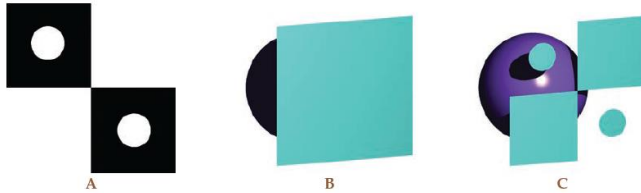


Figure 18. The effect of applying an image to the Cutouts property. A—This black and white image will be used as the cutout map. B—The material on the plane is completely opaque. C—When the cutout map is applied to the material, the dark areas of the map produce transparent areas on the object.



Self Illumination Category

Self illumination is an effect of a material producing illumination. See **Figure 19**. For example, the surface of a neon tube glows. However, in AutoCAD, a material with self illumination will not actually add illumination to a scene. This effect can be simulated with properly placed light sources. **Luminance** is defined as the value of light reflected off a surface. The **Self Illumination** category contains several properties related to self illumination and luminance, **Figure 20**.

Figure 19. The effect of self illumination/luminance. A—The globe of this light bulb does not have any self illumination. B—Self illumination is applied to the globe material.

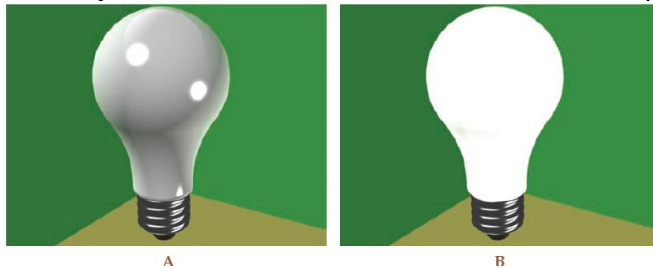
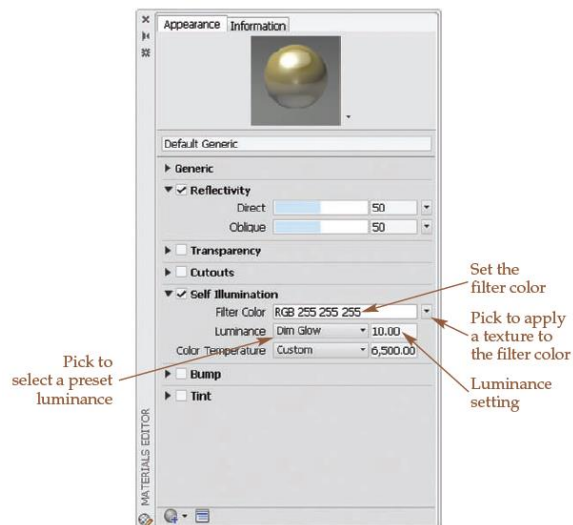


Figure 20. Setting self illumination and luminance for a material.



The Filter Color property controls the color of the self illumination effect. Pick in the edit box to open the **Select Color** dialog box. An image may be selected instead of a color. Black areas of the image are not illuminated. White areas of the image are illuminated. Grayscale values control how much the rest of the image illuminates the material. To apply a texture to control the illumination, pick the button next to the edit box to display a drop-down list.

Luminance is expressed in candelas per square meter (cd/m²). For example, 1 cd/m² is the equivalent of one candela of light radiating from a surface area that is one square meter. You can enter a specific value in the Luminance property text box. Or, you can pick the name displayed next to the text box to display a drop-down list with choices for typical materials. Some of these choices include Dim Glow, LED Panel, and Cell Phone Screen.

The Color Temperature property determines the warmth or coolness value of the color. The value is expressed as degrees Kelvin. Candles and incandescent bulbs are warm. Fluorescent lights and TV screens are cool. The drop-down list gives you choices for typical objects with different color temperatures, but you can enter a value directly in the text box.

Bump Category

The **Bump** category contains settings for making some areas of the material appear raised and other areas depressed, **Figure 21**. The image or texture used for this effect is called a **bump map**. The black, white, and grayscale values of the map are used to determine raised and depressed areas. Dark areas of the map appear raised and light areas appear depressed.

For example, to show the texture of a brick wall, you could physically model the grooves into the wall. This would take a lot of time to model and would immensely increase the rendering time because of the increased complexity of the geometry. Using the properties in the **Bump** category is an easier and more efficient way to accomplish the same task. **Figure 22** shows a bump map used to represent an embossed stamp on a metal case.

To apply an image as a bump map, pick the Image property swatch to display a standard open dialog box. To apply a texture as a bump map, pick the button next to the edit box to display a drop-down list.

The Amount property determines the relative height of the bump pattern. A setting of 0 results in a flat material, or no bumps. A setting of 1000 creates the maximum difference between low and high areas of the pattern.

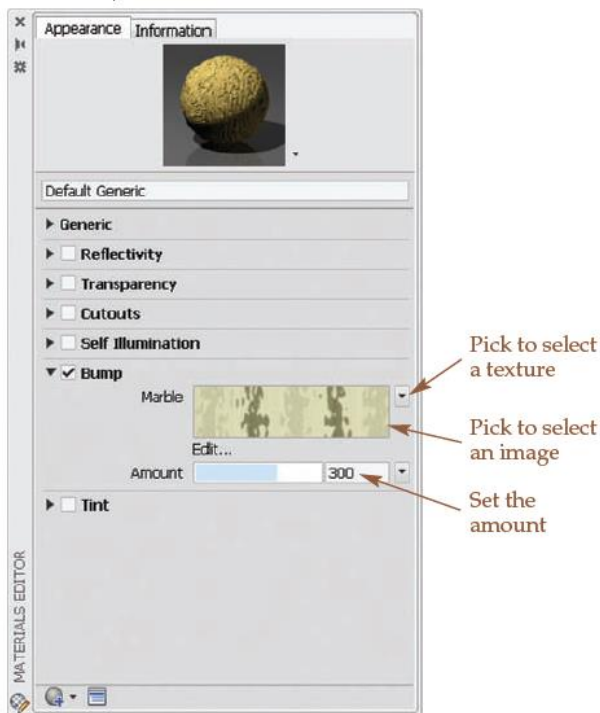
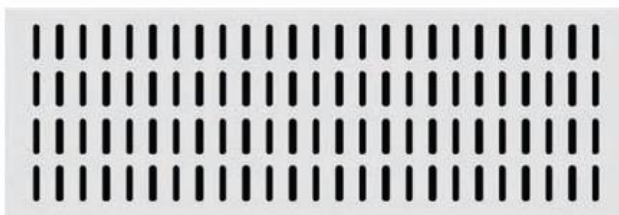
Figure 21. Making bump settings for a material.

Figure 22. The effect of a bump map. A—This image will be used as the bump map. B—When applied to the material, the bump map simulates an embossed stamp on the metal case.



A



B

Maps

As discussed in previous sections, images and textures may be applied to materials to enhance the color, glossiness, reflectivity, transparency, translucency, cutouts, self illumination, and bumpiness. The applied image or texture is called a **map**. A material that has a map applied to at least one of its properties is called a **mapped material**.

An image or texture applied to a material property may be 2D or 3D. A **2D texture**, also called a **texture map**, is really just an image that is stretched over the surfaces of the object. It may be thought of as a fixed set of pixels, kind of like a mosaic pattern, applied to the object's surfaces.

A **3D texture**, sometimes referred to as a **procedural map**, is mathematically generated based on the colors that you select. This texture extends through the object, similar to textures in the "real world." For example, if you attach

AutoCAD's wood map (3D texture) to a material property and assign the material to an object with a cutout, the grain in the cutout will match the grain on the exterior. An image (2D texture) applied to this same object will "reapply" itself to the cutout surface, not necessarily matching the pattern on the adjacent surfaces.

There are nine types of maps in AutoCAD that can be applied to material properties. The image, checker, gradient, and tiles maps are 2D texture maps. The marble, noise, speckle, waves, and wood maps are 3D texture maps. Each map has unique settings, as discussed in the next sections.

PROFESSIONAL BEST PRACTICE TIP

The term *map* may be applied to the type of texture or the property to which the texture is applied. For example, a checker map may be used as a bump map. *Checker* is the type of map and *bump* is the property to which the texture is applied.

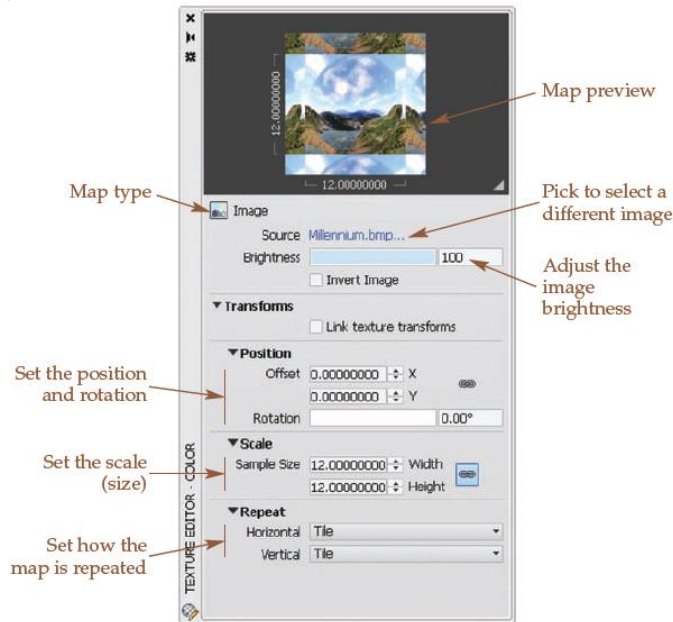
Texture Editor

The **texture editor** is used to adjust a map once it has been applied to a material property. It is automatically displayed once a map is assigned. **Figure 23** shows the texture editor with an image map displayed for editing. A preview of the map appears at the top of the texture editor. The triangle in the lower-right corner of the preview is used to resize the preview. Below the map preview, the type of map is indicated.

Maps rarely appear on the object in the correct position, scale, or angle. For example, if you are using an image map of a logo to be applied to a box for a packaging design, it may not be positioned in the center of the box by default. The map may be rotated in the wrong direction or it may be too large. The texture editor is where adjustments to the map are made.

The bottom of the texture editor contains the settings for the map. The properties that are available depend on the type of map being edited. As shown in **Figure 23**, the **Transforms**, **Position**, **Scale**, and **Repeat** categories are available and automatically expanded when the texture editor is opened for an image map. The next sections discuss the properties for each map type.

Figure 23. The texture editor is used to adjust a map once it has been applied to a material property. Shown are the properties of an image map.



Image

Applying an **image map** is straightforward. There are several file types that can be applied as a map. When you specify Image as the map for a property, a standard open dialog box is displayed. Navigate to the image file and open it.

In the texture editor, the preview area shows the image with dimensions for the size of an individual tile. If the Sample Size property in the **Scale** category is changed, the preview dimensions reflect the change. Directly below the preview are the image file name and a slider/text box for adjusting the image brightness. Refer to **Figure 23**. To select a different image, pick the name to display a standard open dialog box. A brightness value of 100 means the image is at its full brightness. A value of 0 results in the image being all black. The check box below the slider is used to invert the image colors. This produces an effect similar to a photographic negative from an old film camera but is most useful for reversing the effects of a bump, cutout, or transparency map.

In the **Transforms** category is the **Link texture transforms** check box. It is very important to check this check box if you are using the same map for different properties in the material and need them to be synchronized in appearance. For example, to make a realistic tile floor, an image of tiles is applied to the color property. The same image map is also used as a bump map to make the grout look recessed. If the scaling is changed for the bump map, but the maps are not synchronized, the grout colors and indentations may not match. See **Figure 24**. By linking the texture transforms, all transform settings are the same. Transforms are not linked by default and if you turn on linking after you have made changes, the properties may not be synchronized. Linking must be turned on for *each* material map or it will not work.

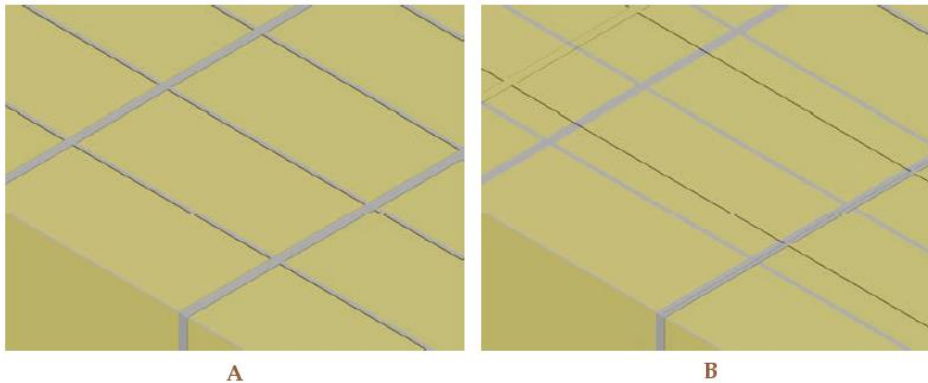
The properties in the **Position** category control the location of the map on the object and its rotation. The Offset property moves the image in the X and Y directions. The link button to the right of these text boxes locks the X and Y values together. It is off by default. The Rotation property allows you to rotate the image on the material.

The properties in the **Scale** category control the size of the image. The Width and Height properties are locked together by default. This is important to maintain a proportional **aspect ratio** for the image. The properties can be unlocked, but be aware that entering different values for width and height will stretch and distort the image.

The **Repeat** category is where you can set the image to tile or not tile. **Tiling** means that the image repeats as many times as it takes to cover the object. If tiling is turned off, there will only be one image on the object. For example, if you are using an image for a label on a box, tiling should be turned off. Otherwise, the box will be completely covered with labels.

Figure 24.

A—This material has an image map assigned to the color and bump properties. B—If the bump map is not synchronized to transformations, it may not align with the grout lines if a property is transformed.



Checker

A **checker map** creates a two-color checkerboard pattern. By default, the colors are black and white, but different colors or images can be used as well. This map type can be used for checkerboard pattern floor materials. However, by changing various properties, you can simulate many different effects and materials.

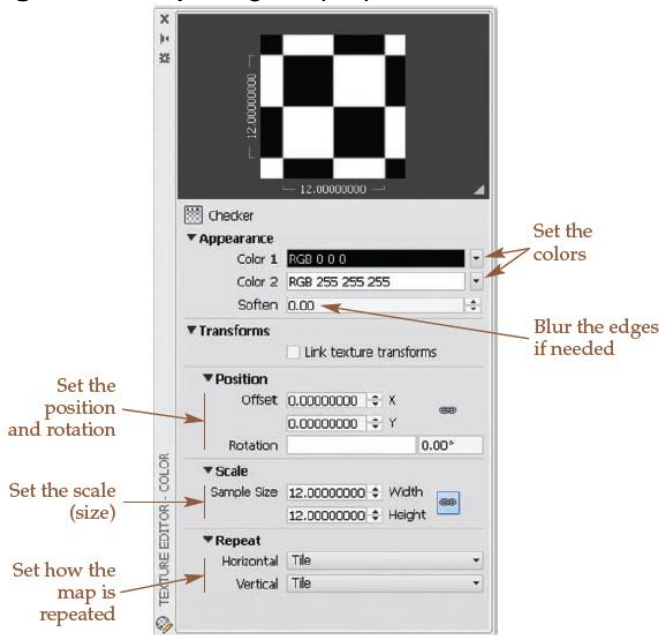
When you specify Checker as the map for a property, the texture editor displays the properties for the map, **Figure 25**. In the **Appearance** category, the Color 1 and Color 2 properties set the color of the checkers. The button to the right of each property allows you to specify an image or texture for the checker. For example, you may add a texture map to the Color 1 property and a noise map to the Color 2 property. The possibilities are endless.

The Soften property is used to blur the edges between the checkers. To change the setting, enter a value in the text box or use the up and down arrows. A value of 0.00 creates sharp

edges between the checkers. The maximum setting of 5.00 produces edges that are very blurred.

The properties in the **Transforms**, **Position**, **Scale**, and **Repeat** categories are the same as described for an image map. Refer to the Image section for details on these properties.

Figure 25. Adjusting the properties of a checker map.



Gradient

A **gradient map** is a texture map that allows you to create a material blending colors in different patterns. This is similar to creating a gradient using the **HATCH** command's **Gradient** option. When you specify Gradient as the map for a property, the texture editor displays the properties for the map, **Figure 26**.

The gradient is represented in the **Appearance** category with three nodes at the bottom edge of the ramp. Each node represents a different color in the ramp. By default, the left node (node 1) is black, the middle node (node 2) is gray, and the right node (node 3) is white. The middle node can be moved left or right, as discussed later in this section, to change where the color transitions.

There must be at least three nodes, but you are not limited to three nodes. Picking anywhere in the ramp creates a new node. Selecting a node by picking on it changes the properties directly below the ramp to the settings for that node. The Color property sets the color of the selected node.

Above the ramp is the **Gradient Type** drop-down list. The setting in the drop-down list controls the pattern of the gradient ramp. See **Figure 27**. The default pattern is linear. This results in a typical pattern similar to the ramp display. The options are described as follows:

- **Linear asymmetrical.** This gradient type is similar to the default linear type, but the transition between colors is not symmetrical.
- **Box.** The transition of colors is in the shape of a square.
- **Diagonal.** The transition of colors is linear, but rotated on the surface.
- **Light normal.** The intensity of the light source determines where the transition takes place. The right side of the ramp corresponds to the highest intensity of light and the left side of the ramp is equal to no light.
- **Linear.** This is the default. It is a smooth transition from one node to the next.
- **Camera normal.** The angle between the camera direction and the surface normal controls how the pattern is displayed. The left side of the ramp is 0° between the normal and the camera viewpoint. The right side is 90° between the normal and the camera viewpoint.
- **Pong.** This gradient is a rotated linear transition, similar to the diagonal type, but it pivots about the corner of a box and reverses in the middle of the pattern.
- **Radial.** Colors are arranged in a circular pattern similar to a target.
- **Spiral.** The gradient sweeps about a central point similar to the movement on a radar screen.
- **Sweep.** This gradient is similar to the spiral type, but the center of the sweep is at a corner instead of in the center. Also, the gradient does not repeat like the pong type.
- **Tartan.** This gradient resembles a plaid pattern. It is very similar to the box type.

Figure 26. Adjusting the properties of a gradient map.

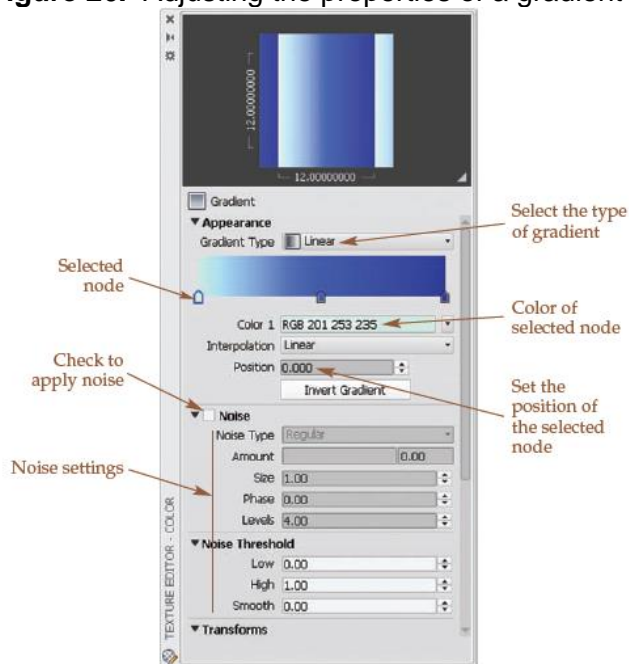
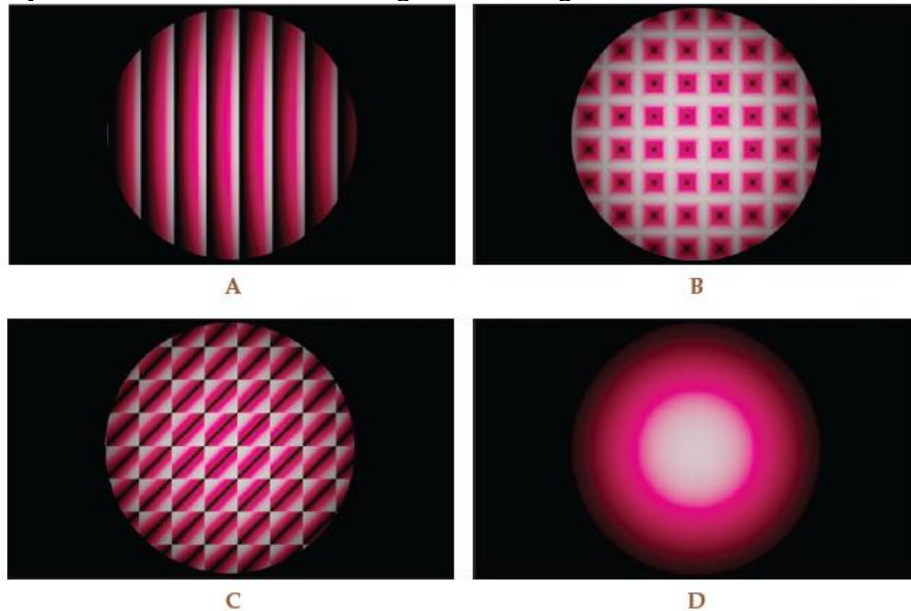


Figure 27.

There are 11 different gradient types available for use in a gradient map. The four shown here are applied to the same object with the same lighting and mapping coordinates. A—Linear asymmetrical. B—Box. C—Diagonal. D—Light normal.



The Interpolation property controls the transition of colors from one node to the next. Transitions are applied to the nodes from left to right, regardless of the node number. The options are:

- **Ease in.** Shifts the transition closer to the node on the right.
- **Ease in out.** Shifts the transition toward the node, but it remains more or less centered on the node.
- **Ease out.** Shifts the transition closer to the node on the left.
- **Linear.** This is the default. The transition is constant from one node to the next.
- **Solid.** No transition between nodes. There is an abrupt change at each node. The Position property is simply the position of the selected node in the ramp. The node on the left is at the 0 position and the node on the right is at the 1.000 position. Nodes in between will be at varying values between 0 and 1.000. You can also change this value by dragging the nodes left or right.

Picking the **Invert Gradient** button reverses all color values, inverting the gradient pattern. In effect, the ramp is flip-flopped from left to right.

Noise may be added to the gradient map to create an uneven appearance. The properties in the **Noise** and **Noise Threshold** categories are similar to those for the noise map. The noise map is described later in this handout.

The properties in the **Transforms**, **Position**, **Scale**, and **Repeat** categories are the same as described for an image map. Refer to the Image section for details on these properties.

Tiles

A **tiles map** is a pattern of rectangular, colored blocks surrounded by colored grout lines. This may be the most versatile map in the whole collection. Tiles are used to simulate tile floors, ceiling grids, hardwood floors, and many different types of brick walls. When you specify Tiles as the map for a property, the texture editor displays the properties for the map, **Figure 28**.

You first need to define the pattern for the map. The **Pattern** category contains properties for defining the pattern. For the Type property, select one of the seven predefined tile patterns or Custom to create your own. The names of the predefined patterns bring to mind brick walls. For example, a mason may use a stack bond to build a brick wall. However, remember these are only *patterns*. You can also use a brick pattern to create tile floors and acoustic ceiling panels. Four of the tile patterns are shown in **Figure 29**. The Tile Count property sets how many tiles are in each row and column before the pattern repeats.

As the name implies, the properties in the **Tile Appearance** category determine what the tiles look like. You can choose any color you wish or apply a texture or image to the tiles. Ceramic tile floors look more realistic if each tile is slightly different in color. The Color Variance property can be used to alter the color of random tiles to create a more realistic appearance. The Fade Variance property is used to fade the color of random tiles. You will have to experiment with the color variance and fading to create the look you need. Start with very low values. The Randomize property is used to alter the random color variation in the tiles. This variation is automatically applied, but entering a different random seed changes the pattern. If your scene has more than one object with this material applied to it, duplicate the material and change the seed number of the new material, then apply it to the other object.

Figure 28. Adjusting the properties of a tiles map.

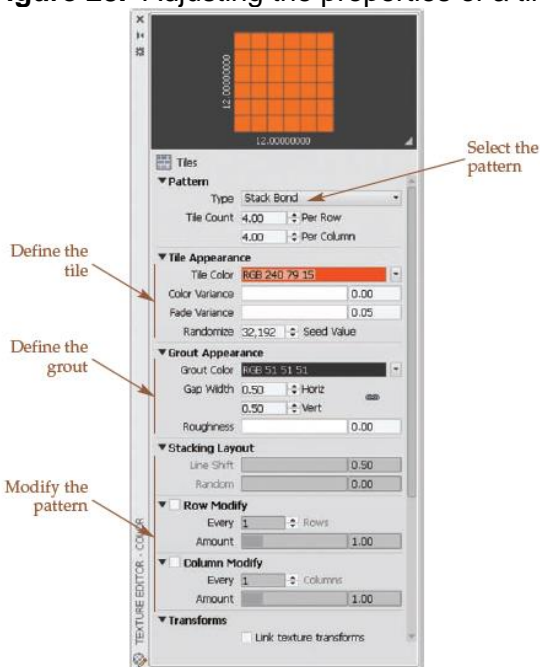
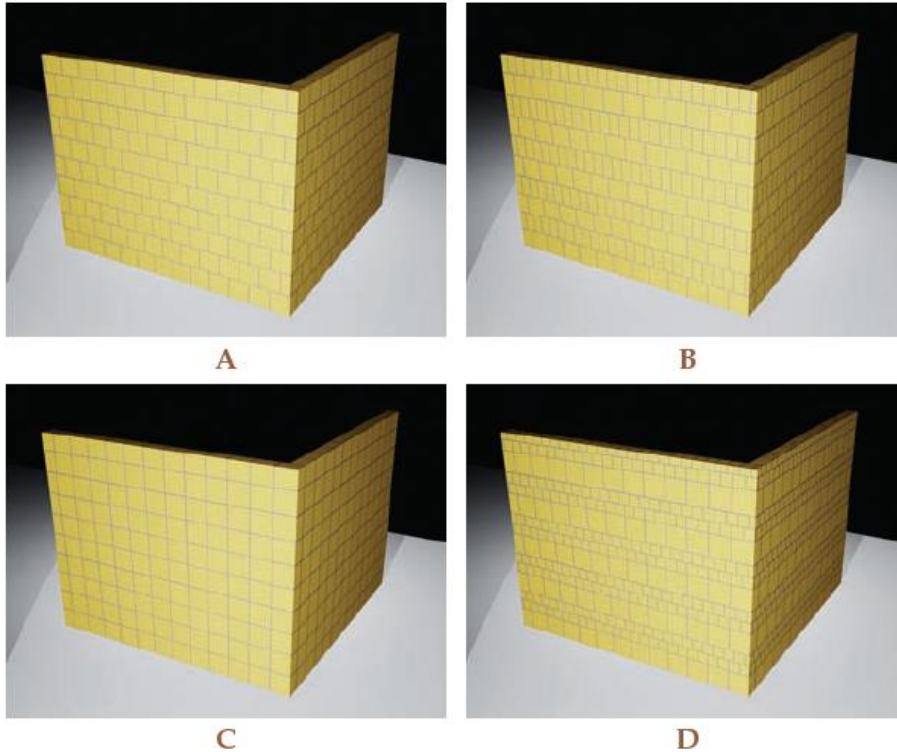


Figure 29. A tiles map can have a custom pattern or predefined pattern. Four of the predefined patterns are shown here.

A—Running bond. B—English bond. C—Stack bond. D—Fine running bond.



The properties in the **Grout Appearance** category control what the grout looks like. The grout is the line between the tiles. The Grout Color property is set to dark gray by default, but any color, image, or texture may be used. The Gap Width property determines how wide the grout lines are in relation to the tiles. There are horizontal and vertical settings. In some cases, such as for a hardwood floor material, you will have to set the scale differently on the horizontal and vertical axes to make the gap thicker in one direction.

The properties in the **Stacking Layout** category are only available for a custom pattern. The Line shift property changes the location of the vertical grout lines in every other row to create an alternate pattern of tiles. The default value is 0.50 and the range is from 0.00 to 100.00. The Random property randomly moves the same lines. This works nicely for hardwood floor materials. The default value is 0.00 and the range is 0.00 to 100.00.

The properties in the **Row Modify** and **Column Modify** categories are available with all tile pattern types, but may be disabled by default. To enable the settings, pick the check box by the category name. The settings in these areas allow you to change the number of grout lines in the horizontal and vertical directions to create your own pattern. The two Every properties determine which rows and columns will be changed. When set to 0, no changes take place in the row or column. When set to 1, every row or column will be changed. When set to 2, every other row or column will be changed, and so on. The value must be a whole number. The Amount property controls the size of the tiles in the row or column. A setting of 1 means that the

tiles remain their original size. A setting of 0.50 makes the tiles one-half of their original size, a setting of 2 makes the tiles twice their original size, and so on. A setting of 0.00 completely turns off the row or column and the underlying material color shows through.

The properties in the **Transforms**, **Position**, **Scale**, and **Repeat** categories are the same as described for an image map. Refer to the Image section for details on these properties.

Marble

A **marble map** is a 3D map based on the colors and values you set. It is used to simulate natural stone. When you specify Marble as the map for a property, the texture editor displays the properties for the map, **Figure 30**. The viewport may not reflect changes made in the texture editor, even if set to display materials and textures. You may have to render the scene to see the changes.

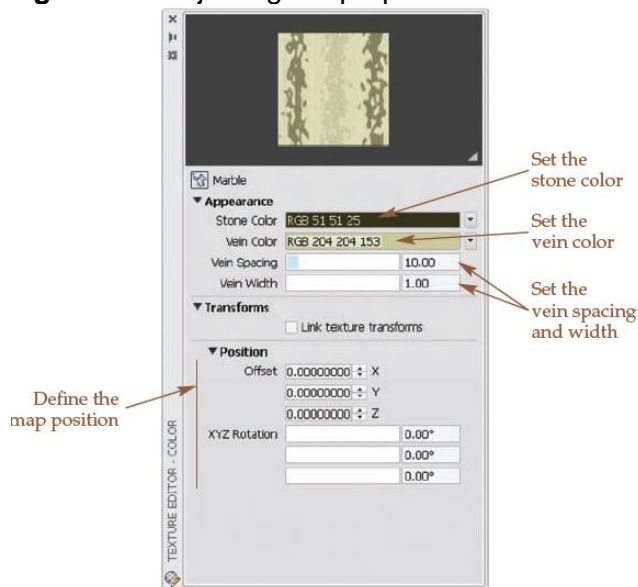
A marble map is based on two colors—stone and vein. The **Appearance** category contains the Stone Color and Vein Color properties. You can swap the vein and stone colors by picking the button to the right of the color definition and selecting **Swap Colors** from the drop-down list. The Vein Spacing property determines the relative distance between each vein in the marble. The Vein Width property determines the relative width of each vein. Each of these settings can range from 0.00 to 100.00.

The **Link texture transforms** check box in the **Transforms** category works as described earlier for an image map. Refer to the Image section for details on texture transforms.

Since this is a 3D (procedural) map, the properties in the **Position** category are different from those of the maps previously discussed. The three Offset properties move the map in the X, Y, and Z directions on the object. Simply enter a value in the text boxes. The XYZ Rotation properties control the rotation of the map around the X, Y, or Z axis. You can move the sliders or enter an angle in the text boxes.

NOTE

The mathematical calculations that create a 3D (procedural) map are based on the world coordinate system. If you move or rotate the object, a different result is produced.

Figure 30. Adjusting the properties of a marble map.

Noise

A **noise map** is a 3D map based on a random pattern of two colors used to create an uneven appearance on the material. It is most often used to simulate materials such as concrete, soil, asphalt, grass, and so on. When you specify Noise as the map for a property, the texture editor displays the properties for the map, **Figure 31**.

The properties in the **Appearance** area control how the noise looks. First, you need to select the type of noise. The options for the Noise Type property are:

- **Regular.** This is “plain” noise and useful for most applications.
- **Fractal.** This creates the noise pattern using a fractal algorithm. When this is selected, the Levels property in the **Noise Threshold** category is enabled.
- **Turbulence.** This is similar to fractal noise, except that it creates fault lines.

The Size property controls the size scale of the noise. The larger the value, the larger the size of the noise. The default value is 1.00 and the value can range from 0.00 to 1 billion. The Color 1 and Color 2 properties control the color of the pattern of noise. You can assign a color, image, or texture to the property. To swap the color definitions, pick the button next to the properties and select **Swap Colors** from the drop-down list.

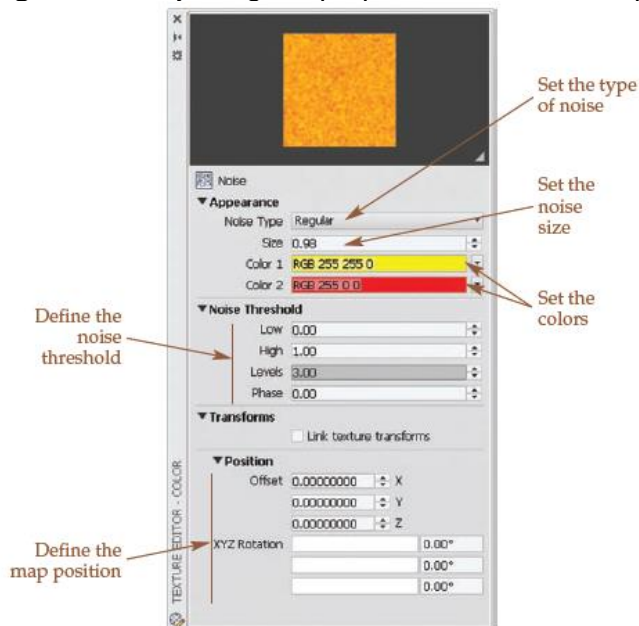
The properties in the **Noise Threshold** category are used to fine-tune the noise effect. The properties in this category are:

- **Low.** The closer this setting is to 1.00, the more dominant color 1 is. The default setting is 0.00 and it can range from 0.00 to 1.00.
- **High.** The closer this setting is to 0.00, the more dominant color 2 is. The default setting is 1.00 and it can range from 0.00 to 1.00.

- **Levels.** Sets the energy amount for the fractal and turbulence types. Lower values make the fractal noise appear blurry and the turbulence lines more defined. The default setting is 3.00 and it can range from 1.00 upward.
- **Phase.** Randomly changes the noise pattern with each value. This allows you to have materials with the same noise map settings look slightly different. You should have different patterns on different materials. This adds a level of realism to your scene.

The properties in the **Transforms** and **Position** categories are the same as described for a marble map. Refer to the Marble section for details on these properties.

Figure 31. Adjusting the properties of a noise map.

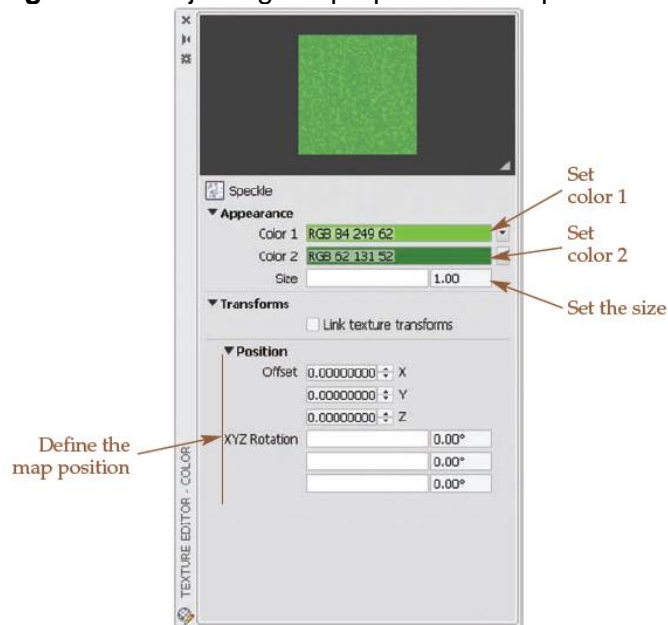


Speckle

A **speckle map** is a 3D map based on a random pattern of dots created from two colors. This map is very useful for textured walls, sand, granite, and so on. When you specify Speckle as the map for a property, the texture editor displays the properties for the map, **Figure 32**.

The settings for a speckle map are very simple. In the **Appearance** category, pick colors for the Color 1 and Color 2 properties. You cannot use maps, only colors. To swap the color definitions, pick the button next to the properties and select **Swap Colors** from the drop-down list. The Size property controls the size of the speckles.

The properties in the **Transforms** and **Position** categories are the same as described for a marble map. Refer to the Marble section for details on these properties.

Figure 32. Adjusting the properties of a speckle map.

Waves

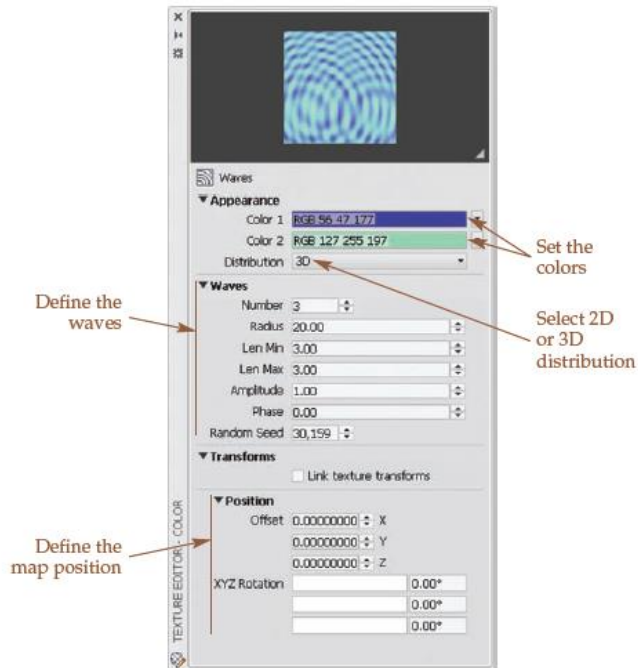
A **waves map** is a 3D map in a pattern of concentric circles. Imagine dropping two or three stones into a pool of water and watching the ripples intersect with each other. A number of wave centers are randomly generated and a pattern created by the overlapping waves is the result. As the name implies, the waves map is usually used to simulate water. When you specify Waves as the map for a property, the texture editor displays the properties for the map, **Figure 33**.

In the **Appearance** category, pick colors for the Color 1 and Color 2 properties. You cannot use maps, only colors. To swap the color definitions, pick the button next to the properties and select **Swap Colors** from the drop-down list. The Distribution property can be set to 2D or 3D. This setting determines how the wave centers are distributed on the object. Selecting 3D means that the wave centers are randomly distributed over the surface of an imaginary sphere. This distribution affects all sides of an object. On the other hand, selecting 2D means that the wave centers are distributed on the XY plane. This is much better for nearly flat surfaces, such as the surface of a pond or lake.

The properties in the **Waves** category define the pattern of waves. The Number property sets the number of wave centers that are generating the waves. The Radius property sets the radius of the circle or sphere from which the waves originate. The Len Min and Len Max properties define the minimum and maximum interval for each wave. The Amplitude property can be thought of as the “power” of the wave. The default value is 1.00, but the value can range from 0.00 to 10000.00. A value less than 1.00 makes color 1 more dominant. For a value greater than 1.00, color 2 is more dominant. The Phase property is used to shift the pattern and the Random Seed property is used to redistribute the wave centers.

The properties in the **Transforms** and **Position** categories are the same as described for a marble map. Refer to the Marble section for details on these properties.

Figure 33. Adjusting the properties of a waves map.



PROFESSIONAL BEST PRACTICE TIP

Remember, you can change the material swatch geometry in the materials editor, such as to a cube, sphere, or cylinder. Some maps, like a waves map, are easier to understand when displayed on a cube.

Wood

A **wood map** is a 3D map that generates a wood grain based on the colors and values you select. See **Figure 34**. When you specify Wood as the map for a property, the texture editor displays the properties for the map, **Figure 35**.

A wood map is based on two colors. The Color 1 and Color 2 properties in the **Appearance** category are used to specify these colors, usually one dark and one light color. To swap the color definitions, pick the button next to the properties and select **Swap Colors** from the drop-down list. The Radial Noise property determines the waviness of the wood's rings. The rings are found by cutting a tree crosswise. The Axial Noise property determines the waviness of the length of the tree trunk. The Grain Thickness property determines the relative width of the grain.

The properties in the **Transforms** and **Position** categories are the same as described for a marble map. Refer to the Marble section for details on these properties.

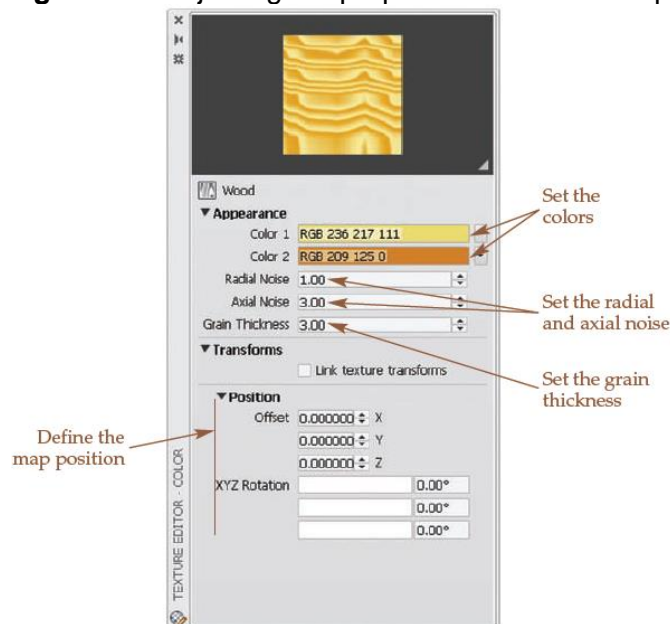
Swap Colors from the drop-down list. The Radial Noise property determines the waviness of the wood's rings. The rings are found by cutting a tree crosswise. The Axial Noise property determines the waviness of the length of the tree trunk. The Grain Thickness property determines the relative width of the grain.

The properties in the **Transforms** and **Position** categories are the same as described for a marble map. Refer to the Marble section for details on these properties.

Figure 34. A wood map is a 3D, or procedural, map. Note how the pattern matches on adjacent surfaces.



Figure 35. Adjusting the properties of a wood map.



Adjusting Material Maps

Simply applying a map to a material property rarely results in a realistic scene when the scene is rendered. The maps usually need to be adjusted to produce the desired results. Maps can be adjusted at the material level or the object level. A combination of these two adjustments is usually required to produce a photorealistic rendering.

Material-Level Adjustments

Material-level adjustments involve changing the properties of the map in the material definition. Map properties are discussed in previous sections. Sometimes, these adjustments may be enough to get the materials looking the way you want them.

Other adjustments become necessary when the same material is applied to more than one object in the same scene. If you make changes at the material level, they affect all objects with that same material. If you need different objects to have different settings, then you will have to make object-level adjustments.

Object-Level Adjustments

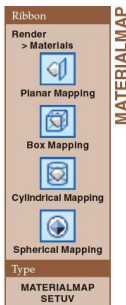
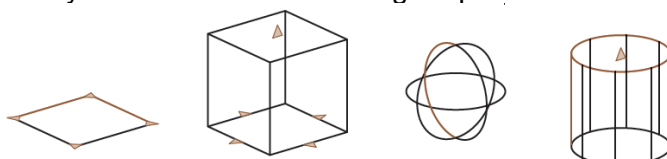
Material mapping refers to specifying how a mapped material is applied to an object. When a mapped material is attached to an object, a default set of mapping coordinates, or simply *default mapping*, is used to apply the map to the object.

AutoCAD allows you to adjust mapping at the object level for 2D-mapped (texture-mapped) materials. The **MATERIALMAP** command applies a grip tool, or **gizmo**, based on one of four mapping types: planar, box, spherical, or cylindrical. See **Figure 36**. The colored edge represents the start and end of the map. For best results, select the mapping type based on the general shape of the object to which mapping is applied. Do not be afraid to experiment with other mapping types. Any mapping type can be used on any object, regardless of the object's shape. However, only one mapping type can be applied to an object at any given time.

After one of the mapping types is selected, you are prompted to select the faces or objects. You can select multiple objects or faces. After making a selection, the gizmo is placed on the selection set. The command remains active for you to adjust the mapping or enter an option.

Drag the grips on the gizmo to stretch or scale the material. The effects of editing a color map are dynamically displayed if the current visual style is set to display materials and textures. Otherwise, exit the command and render the scene to see the effect of the edit. To readjust the mapping, select the same mapping type and pick the object again. The gizmo is displayed in the same location as before.

Figure 36. These are the four material map gizmos. From left to right: planar, box, spherical, and cylindrical. The colored edge represents the start and end of the map.



The **Move** and **Rotate** options of the command toggle between the move and rotate gizmos. Using the gizmos, you can move and rotate the map on the object. The **Reset** option of the command restores the default mapping to the object. The **Switch mapping mode** option allows you to change between the four types of mapping.

If the command is typed, there is an additional option. The **Copy mapping to** option provides a quick and easy way to apply the changes made to the current object to other objects in the scene. Enter this option, select the face or object to copy from, and then select the faces or objects to copy to. This option is also available if the **Switch mapping mode** option is entered.

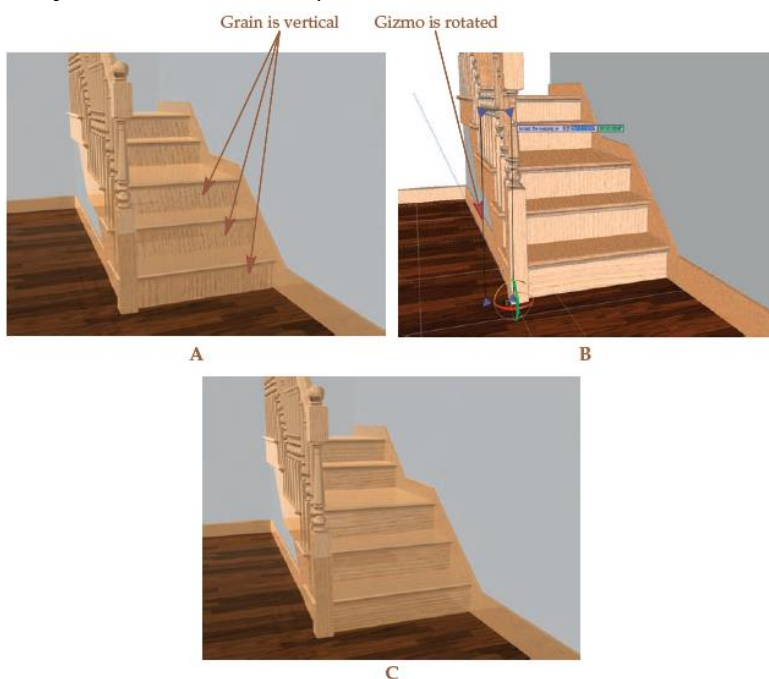
For example, look at **Figure 37A**. The grain on the stair risers is running vertically when it should run horizontally. First, apply a planar map gizmo to the bottom riser. Next, rotate the mapping 90° , **Figure 37B**. Finally, use the **Copy mapping to** option to copy the mapping to the other risers, **Figure 37C**.

NOTE

Mapping coordinates can be applied to 3D-mapped (procedural-mapped) materials, but adjusting the coordinates has no effect. This is because the 3D map is generated from mathematical calculations based on the world coordinate system. A 3D-mapped material must be adjusted at the material level.

Figure 37.

Correcting material mapping. A—The grain on the risers runs vertically instead of horizontally. B—Rotating the map with the rotate gizmo. C—The corrected rendering. (*Model courtesy of Arcways, Inc., Neenah, WI*)

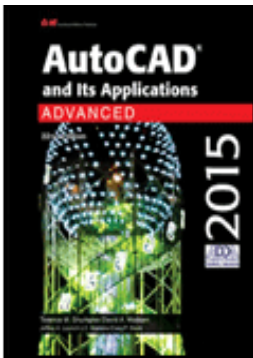


PROFESSIONAL BEST PRACTICE TIP

If you are using a reflectivity, self illumination, or bump map and need to adjust it at the object level, you cannot see the effects of the mapping change in the viewport. Apply the same map as a color map. Also, set the visual style to display materials and textures. Then, adjust the object mapping as needed. The edits are dynamically displayed in the viewport. When the image is in the correct location, remove the color map from the material.

Reference

Portions of this document are copyrighted by Goodheart-Willcox Company, Inc. and reproduced with permission from the textbook AutoCAD and Its Applications – Advanced 2015.



Professor John R. Bordeau
Kankakee Community College
jbordeau@kcc.edu

