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Using the Allegorithmic's Substance Procedural Texture Tool in Autodesk® Applications

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Description

Texture creation has never been so easy or so powerful since the release of Allegorithmic's Substance for Autodesk® 3ds Max® and Autodesk® Maya®. In this class, we begin by examining the Substance Player and how it can be used to preview and manipulate your Substance textures. We also explore the vast library of pre-built shaders. We learn how to generate texture simple bitmaps, which are ideal for Autodesk applications, such as Autodesk® Revit-based software, Autodesk® AutoCAD®, Autodesk® InfraWorks™, and Autodesk® Showcase®, which do not yet support Substance shaders directly. Next, we dive into 3ds Max and Maya and explore the true power of Substance and learn how to create both simple and complex shader networks for compelling materials. Finally, we wrap up by learning several optimization techniques to enhance the Substance workflow such as bitmap scaling and hardware and software rendering.

Learning Objectives

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

- Explain what the Substance channels are for and how they interact with your materials
- Generate textures for other Autodesk programs using the Substance Player
- Add a substance texture to any 3ds Max or Maya material
- Optimize Substance in your workflow

About the Speaker

Mark's animation career stretches back to the wild and wooly days of the early 1990s. In 1995, he co-founded Paradigm Ranch Animation Studios, working on movie and television projects for many noteworthy clients such as Disney, Warner Bros and DDB. In 1998, Mark joined the faculty at the Art institute of Colorado teaching part time until 2012.

In 2003, he joined the Project Visualization group at Parsons Brinckerhoff (PB), serving as the team's technical lead. As lead, he manages all technical aspects of production, manages the render farm, and oversees the group's R&D and new technology initiatives. In addition to his duties with the Project Visualization team, Mark serves as a certified 3ds Max trainer in PB's Autodesk Training Center.

In 2009, Mark started the Denver chapter of the Autodesk Animation Users Group Association (AAUGA) serving as the group's president and is one of the founding members of the Visualization Society of Colorado (VSC).

Introduction

Last year, while lining up presenters for the local Autodesk Animation Users Group Association (AAUGA) meeting, I was left with a vacancy due to a scheduling conflict. With little time to find a replacement, I decided to cover the vacancy myself, but was pondering what would be a useful topic to present to the group. It would need to not only transcend the various Autodesk Media & Entertainment products, but should also cater to the various production disciplines; VFX, design visualization, gaming, etc. This was an easy choice for me to make. Substance was well integrated into both 3ds Max and Maya and had been for a while, but low and behold, it had many other ways to integrate into a myriad of different production workflows.

What surprised me, come the evening of the presentation, was the vast majority of the users had either not heard of Substance or vaguely knew of its existence. Needless to say, the users were quite excited about this tool and what it could do. Best of all, some of the Revit and Autocad users left the meeting that night with a few new ideas to explore.

What is Substance

Allegorithmic is a software developer out of France who develops unique and highly innovative technologies used in the creation of rich 3D content. Substance, the cornerstone of their product line, is a dynamic parametric shader technology used to create robust textures and materials. Using a single Substance shader you can quickly and easily create not only a diffuse channel, but a specular, normal, bump and displacement output for your materials. A vast database of Substance materials are available for purchase from several vendors, all of which can be modified to suit the needs of the user. These can all be modified via a freely available program from Allegorithmic called the Substance Player, which we will cover later. Best of all, Substance shaders are very small. Due to their procedural nature, similar to say a fractal noise shader, each of these files weigh in under 100KB.

While a fixture of Autodesk Flame for some years, Substance integration was added to 3ds Max and Maya right around the time of the 2011 product cycles. Allegorithmic has since added support to several other applications such as Unity, UDK and recently Modo.

For those wishing to create their own Substance shaders, there is an application called Substance Designer. Designer is very powerful and feature rich, though it is geared more towards an advanced user. Finally, Allegorithmic offers a product to augment the Substance workflow, which is itself a very power Substance shader; Bitmap2Material.

Bitmap2Material, or B2M as it is also known is a Substance shader that has the ability to use a bitmap as the input to the shader and output diffuse, specular, normal, bump and height channels. I am certain many of you have spent much time attempting to manually create these material channels via a plethora of methods. As we will learn later, B2M can quickly liven up the look of you materials in no time.

Which applications are supported

As of the end of 2013 when this class document was prepared, the following applications have native support of Substance shaders:

Autodesk 3ds Max/3ds Max Design (since 2011 versions)

Maya (since 2011 version)

Autodesk Flame

Unity (since version 3.4)

Epic's UDK/UE3 – UE3 support has been available as middleware for many years, but it was recently added to the UDK as of early 2013.

Modo (current version)

Allegorithmic Substance Designer/Player

What does "native" mean? This means all the product above can load the native Substance shader files, the *.sbsar format. This being the case, it is through the use of Allegorithmic's Player that you can load the *.sbsar files and export standard bitmaps such as TIFF, PNG, TGA, BMP, JPG, etc. This opens an entire new range of possibilities with all of your 3D applications such as Autodesk, Revit, Navisworks, Sketchup, you name it, which we will cover later.

Well, enough of the basics, lets delve into the Substance workflow.

Workflow

As I indicated earlier, there are several applications that support Substance shaders natively. For the purposes of this class and this document, I will focus on 3 of those applications, 3ds Max Maya and Substance Player. Let's start with Substance Player.

Substance Player

Substance Player is a free application provided by Allegorithmic, which provides users the ability to view Substance shaders, make adjustments and export bitmaps representing the various texture channels.

There are 3 main panels within the interface; 2D View, 3D View and Parameters (*Figure 1*).

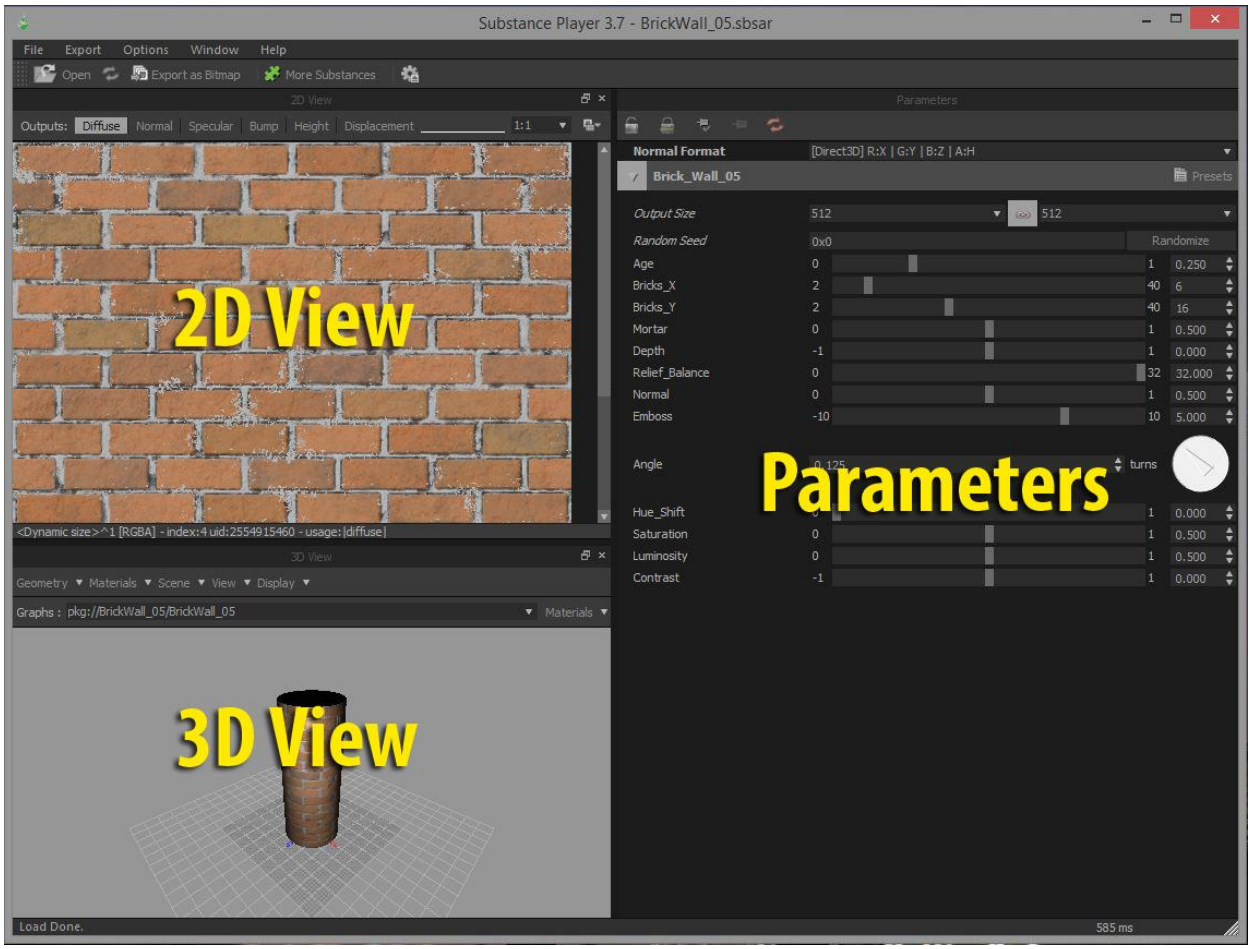


Figure 1

The 2D View displays what your Substance shader looks like including all the associated channels such as diffuse, specular, normal, etc., via the tabs listed at the top of this panel.

The tabs will change based on the shader you have loaded. As you can see the brick shader has diffuse, normal, specular, bump, height and displacement, whereas the coal shader adds an emissive channel. (*Figure 2*)

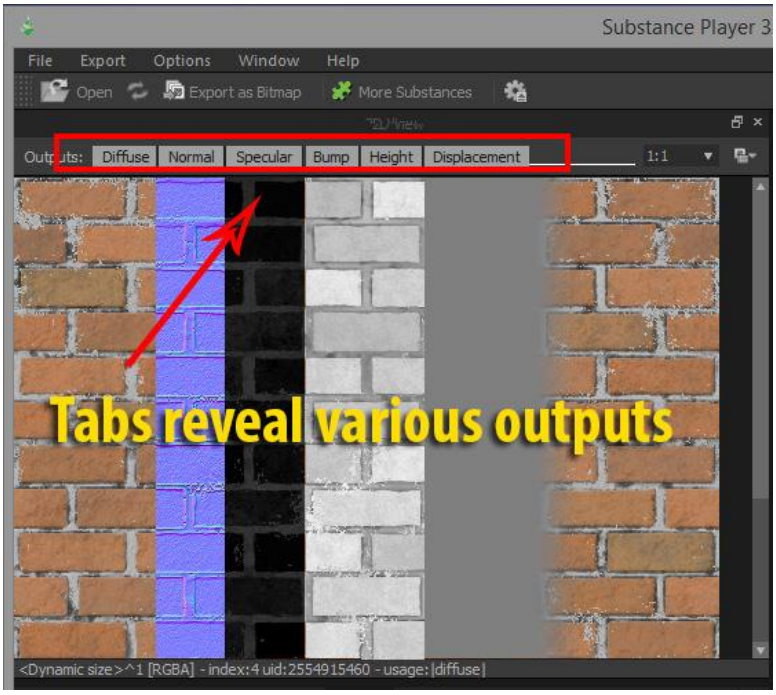


Figure 2

The 3D View panel displays the Substance shader mapped onto geometry. The default geometric object is a simple cube, but you can select different geometry by using the Geometry menu item at the upper left (*Figure 3*). You even have the option to select custom geometry via the “Load Mesh” function using fbx, 3ds, obj, dxf, and dae files.

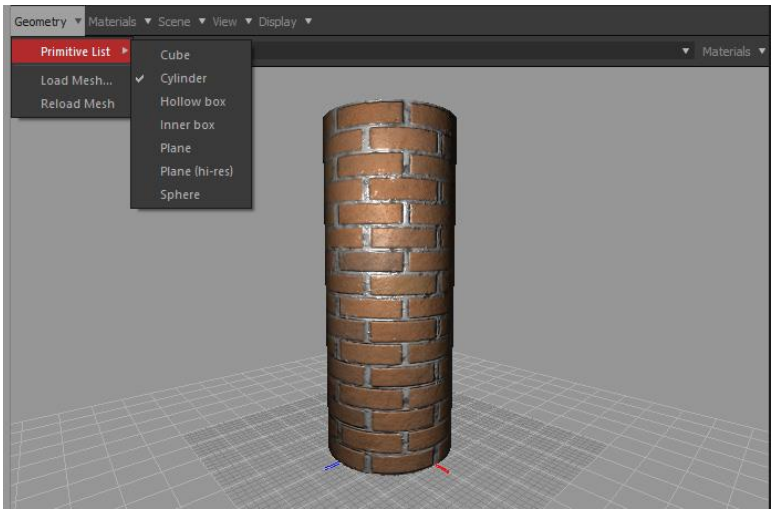


Figure 3

The Parameters panel contains all the adjustable options defined by the Substance shader. Like the 2D View, this panel often will change based on the specific Substance shader. *(Figure 4)*

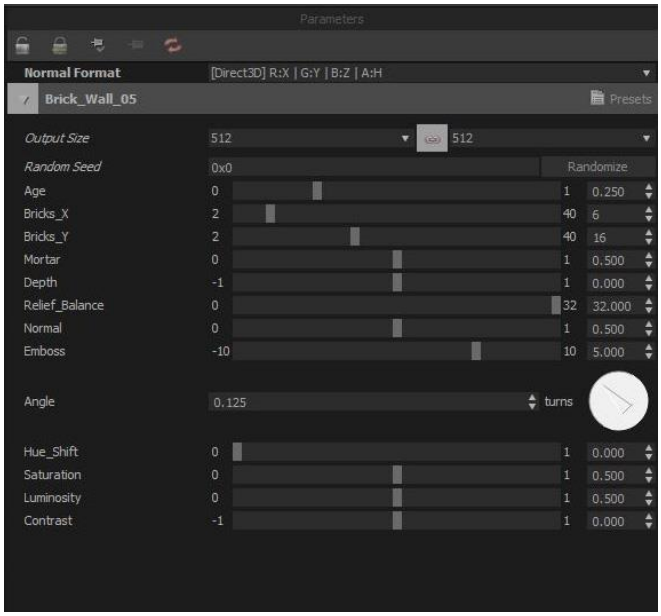


Figure 4

Finally, Player supports an export function which provides the ability to write out bitmaps representing each texture channel in a variety of formats.

Let's load a Substance Shader – **VARNISHED_WOOD.SBSAR**

Try adjusting the parameters and observe the results. Each sbsar shader has different properties. Some provide additional outputs while others are very limited. In fact, many of the Substance shaders that ship with 3ds max are simple greyscale procedurals. To export the various channels to bitmaps, click on the "Export as Bitmap" icon under the top menu.

Once the Export dialog is open, you will see that you have the ability to specify which channels will be generated, the format, and variables for the base name. Player will then generate an output log like so *(Figure 5)*:

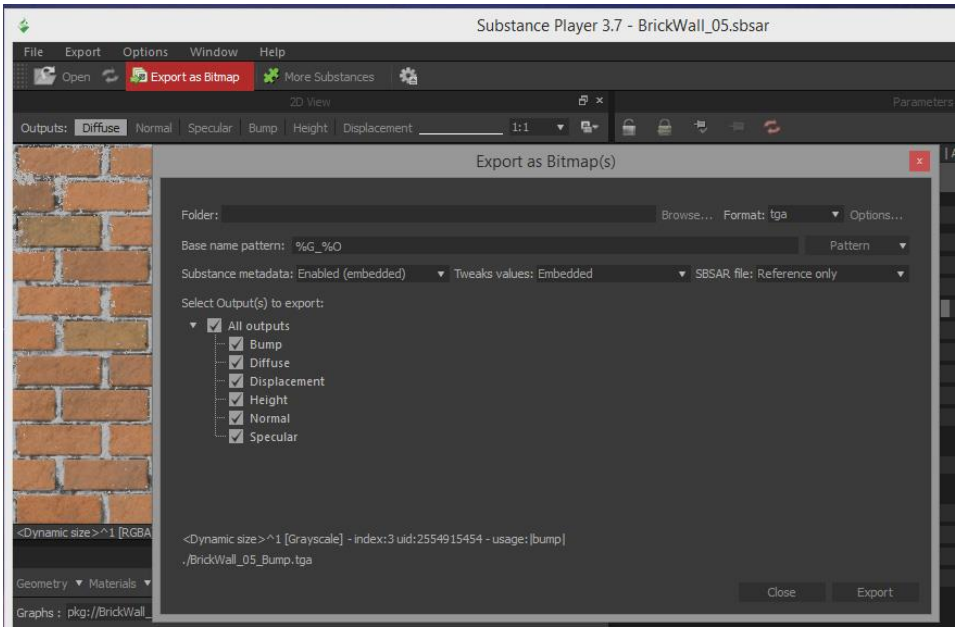


Figure 5

So again, Substance Player ultimately has two purposes; provide the user a method by which they can observe the various Substance shaders and tweak the parameters, and provide a method for manually outputting bitmaps for applications that do not support the Substance shaders natively. Later, we will work through how to use Player with a few Autodesk applications that do not natively support Substance shaders later, but first, let look at how Substance is utilized in 3ds Max and Maya.

3ds Max

The Substance shader is available as a "map" type in 3ds Max. While you can use Substance in the Compact Material Editor (CME), I highly recommend using the Slate Material Editor (SME) instead. You will find the Substance shader in the Material/Map Browser along the left side of the SME *(Figure 6).*

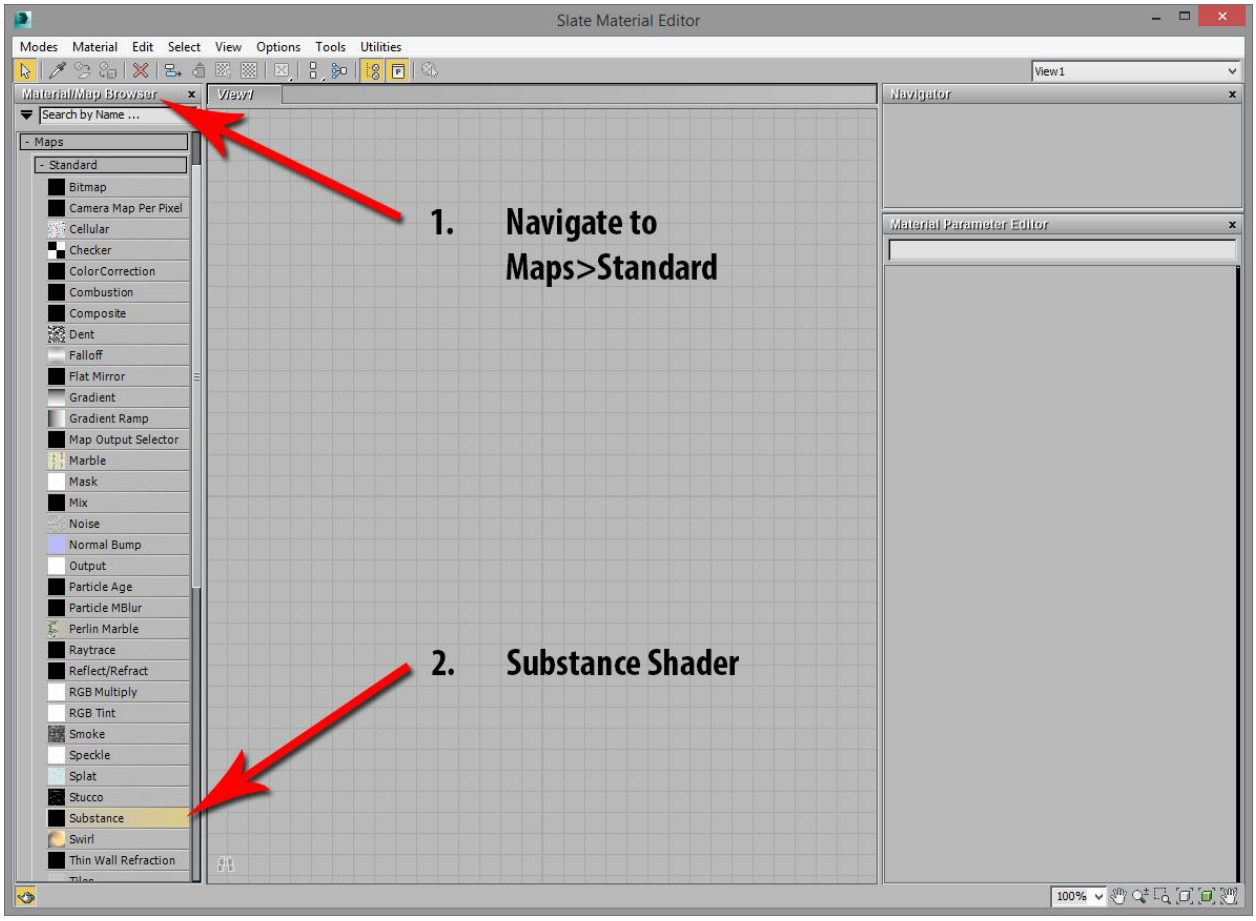


Figure 6

Let's start by loading the provided scene file, **SUBSTANCE.MAX** and open the SME. You will see four custom views named for each material. Select the "Ground" view tab. *(Figure 7)*

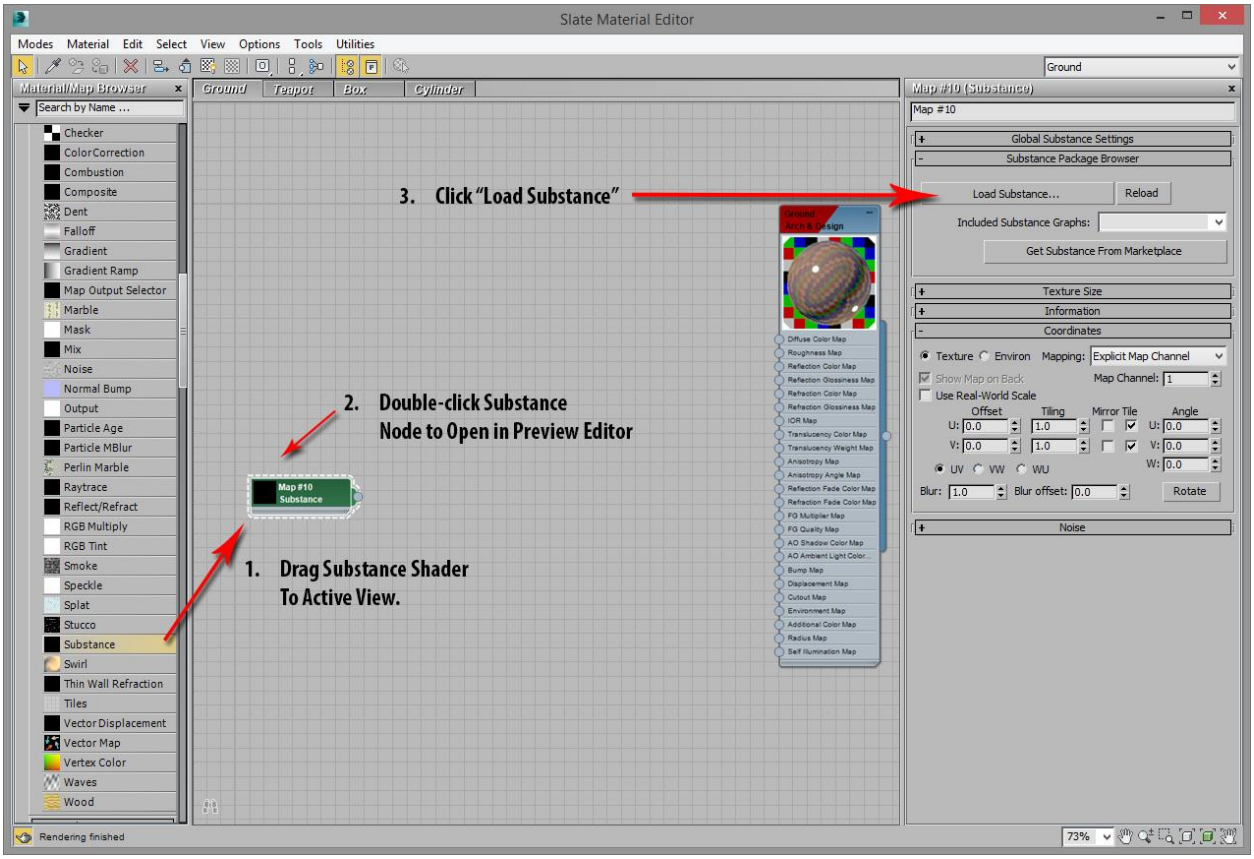


Figure 7

1. Drag a Substance Shader to the Active View area.
2. Double-click the SME Node to view it in the Preview Editor to the right.
3. Click on the "Load Substance" button. 3ds Max should default to the Substance folder located in C:\Program Files\Autodesk\3ds Max(version)\maps\Substance. Select the file called **VARNISHED_WOOD.SBSAR.**

Substance Preferences in 3ds Max

There are several preferences that you might adjust in 3ds max in order to optimize how Substance functions. Most address resolution, but one in particular allows you to select whether you use the CPU or GPU to draw your Substance shaders onscreen. You can only access the preferences via the Substance shader rollouts in the Preview Editor *(Figure 8)*.

A. The first option is under the “Global Substance Settings” rollout. It is here that you might select either Software or Hardware. I would recommend you set this option to Hardware Rendering as this will use your GPU to “render” the changes you apply to the Substance shaders. *Please note, this does not affect display in the viewport, only in the Material Editors.*

B. The next option is “Global Texture Settings”. The default is 1024 (pixels) for both height and width which should suffice for most of your work. The maximum is 2048 and the minimum is 32.

C. You will also see an option to adjust your preview resolution. Here the default is 1/2 but you can select a range of 1x to 1/8. This can be particularly helpful when you are utilizing many Substance shaders in your scene, each at 2K. While you can usually handle a vast amount of system RAM for rendering, you could easily bog down your graphics card.

D. The Texture Size rollout provides the user with individual control over the Substance shader Global Texture Settings. The “Relative” option allows the user to set a resolution that is relative to the Global setting. So in other words, if you set this value to 2x and your Global value is 1024, the rendering resolution will be 2048. The Absolute option allows the user to choose a resolution independent of the Global value.

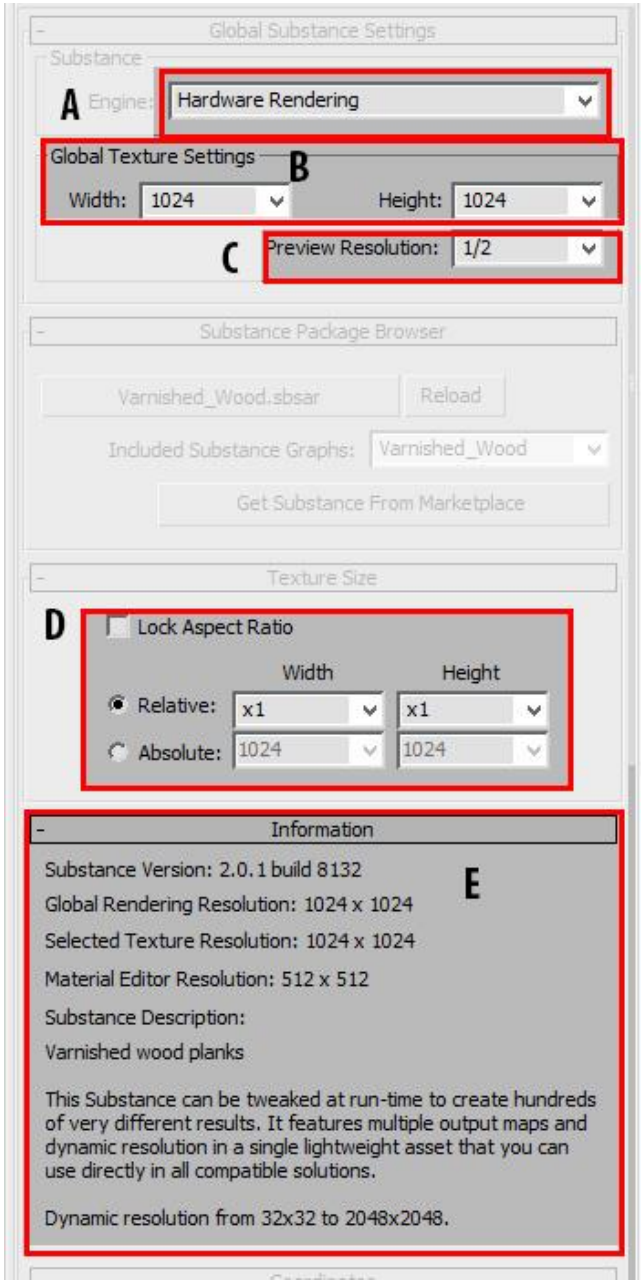


Figure 8

E. The Information rollout is very useful when attempting to determine what your Global, Selected and Material Editor resolutions will be. It also provides information as to the Dynamic resolution of the shader, specifically the minimum and maximum resolution. This is important to note as this will affect the Texture resolution. So, if you were to set your Global settings to 2048 and the relative settings to 128X, the maximum resolution value will only be 2048 as this is the maximum Dynamic resolution.

Next, we will wire (connect) the node's appropriate outputs to the correct inputs on the material. Let's start with the Diffuse channel. Place your cursor over the circle next to the Diffuse channel on the Substance node and drag a connection to the circle next to the Diffuse Color channel on the Ground Material. *(Figure 9)*

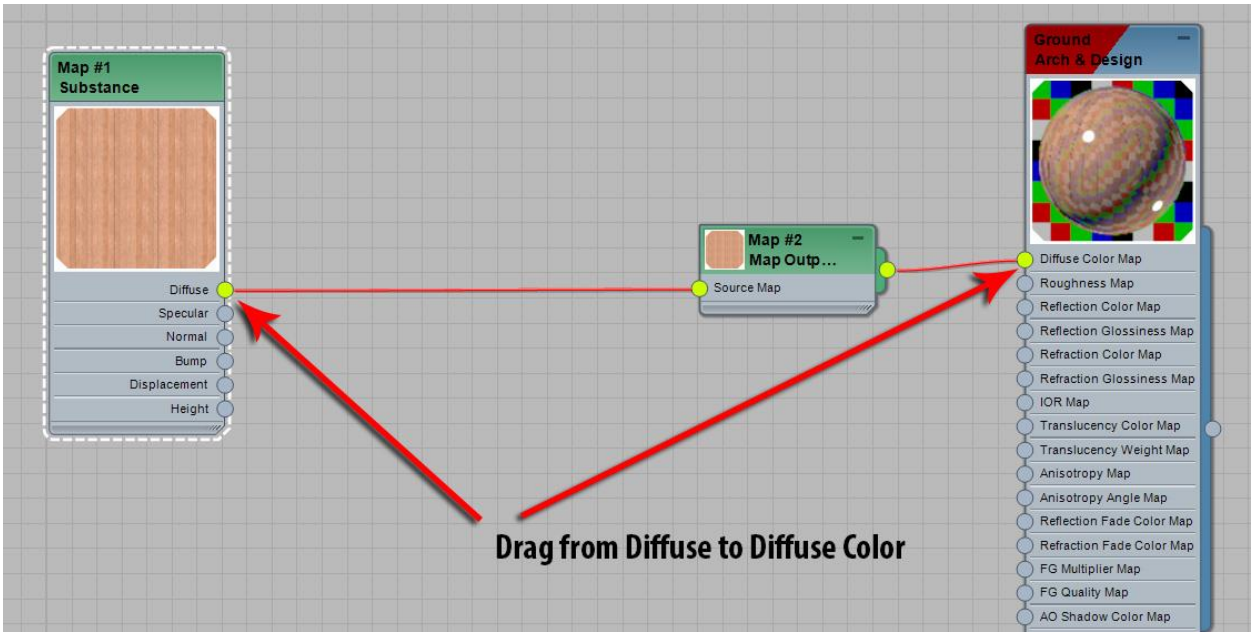


Figure 9

Wire the Specular channel to the Reflection Color Map channel. To wire the normal map requires a few additional steps. In 3ds Max there is a specific shader that provides additional parameters to function with the Bump channel, specifically the Normal Map shader. To achieve this connection, you must drag a connection from the Substance Normal channel to a blank location in the Active View, release your mouse button and you will be presented with a pop-up menu. Select Maps, then Normal Bump. *(Figure 10)*

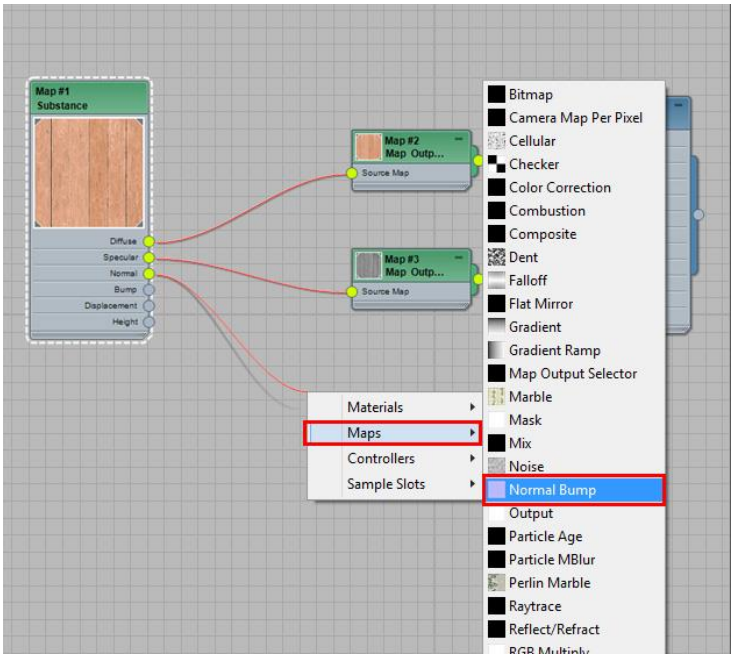


Figure 10

You be required to choose which channel to plug into, specifically Normal. *(Figure 11)*.

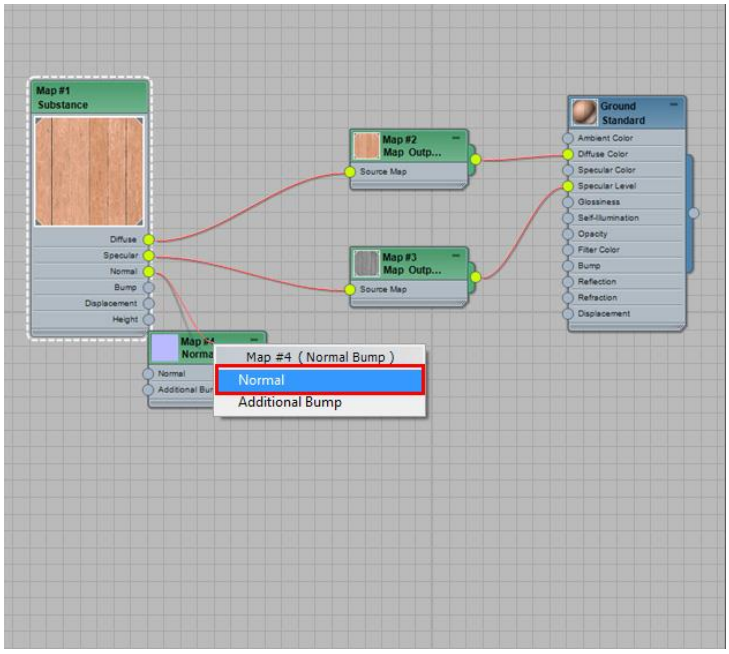


Figure 11

Complete the procedure by linking the output on the Normal Source Map to the Bump channel on your material. Your material should like the figure below *(Figure 12)*.

A quick tip, to clean up the layout, click on the “Layout All” button at the top of the SME window *(Figure 12)*.

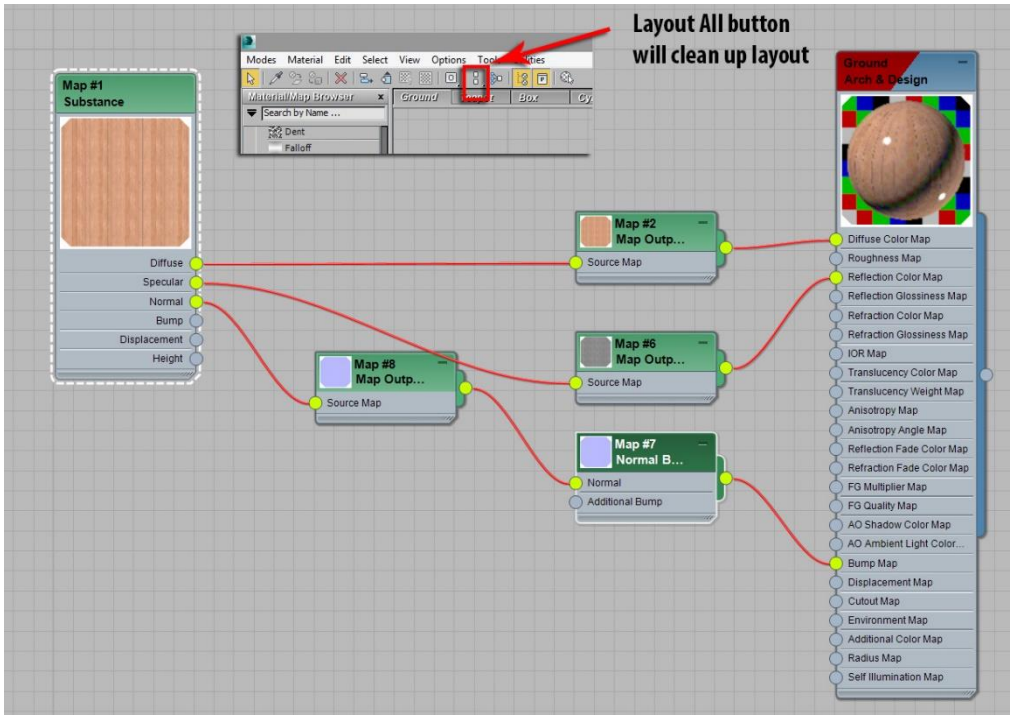


Figure 12

Repeat this process for the Teapot, Box and Cylinder materials (click on appropriate tab to reveal material). Assign the following shader to each material:

Teapot

1. **AIRCRAFT_METAL.SBSAR**
2. Coordinates – width/u 1.0, height/v 0.5

Box

1. **CORRUGATED_METAL.SBSAR**
2. Coordinates – width/u 1.0, height/v 1.0

Cylinder

1. **COAL.SBSAR**
2. Coordinates – width/u 1.0, height/v 3.0
3. You will need to wire the Emissive channel to the Self-Illumination channel on the Material. This is an example of where an additional channel has been defined in the shader.
4. Let's wire a Height map into the Displacement channel in the material. This will cause the coal chucks to displace out of the cylinder surface.

Let's take a look at the Substance Parameters in the Preview Editor, using the Ground Material. Open the Coordinates rollout, set the width/u and height/v size to 5 and 5. Now, let's move to the "Varnished Wood" parameters rollout below. Each Substance shader has different parameters based on how the shader was created, though, you will notice several repeated parameters such as Random Seed, Depth, Normal, Hue Shift, Saturation, etc. For the Varnished Wood shader, we have Age, Planks and Wood Color as the unique parameters. Let's set the Random Seed to 3, the Planks to 4 and the Wood Color to RGB 93, 18, 0. Adjust the Age value to .5. Based on the shader parameters, this affects both the varnish color and the bare wood properties. Changing the Random Seed changes the entire image to look as if it was taken from a completely different area. It is the Random Seed that allows you to utilize a specific look without using the same image over again. Let's render. (Figure 13)

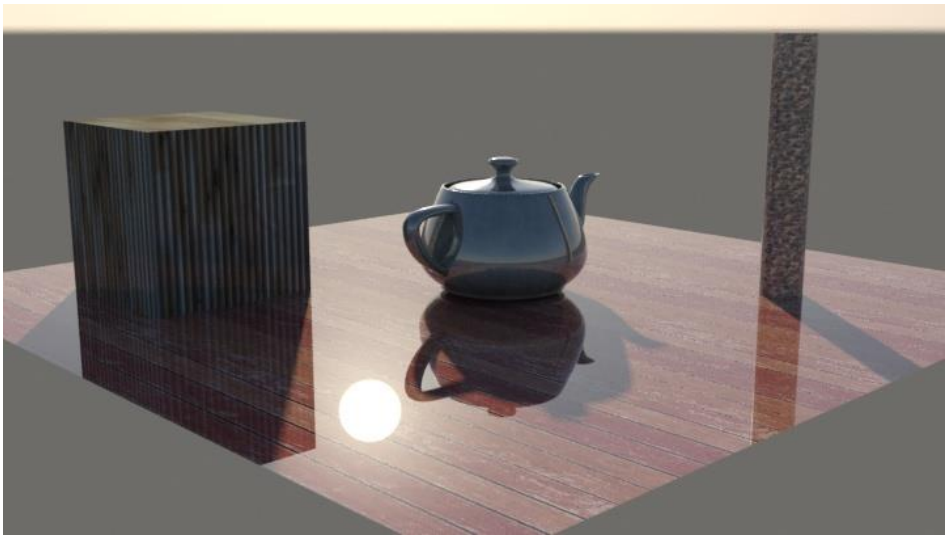


Figure 13

The base render looks fairly decent, but let's tweak the textures to see what can be done (open **SUBSTANCE_COMPLETE.MAX**). *(Figure 14)*

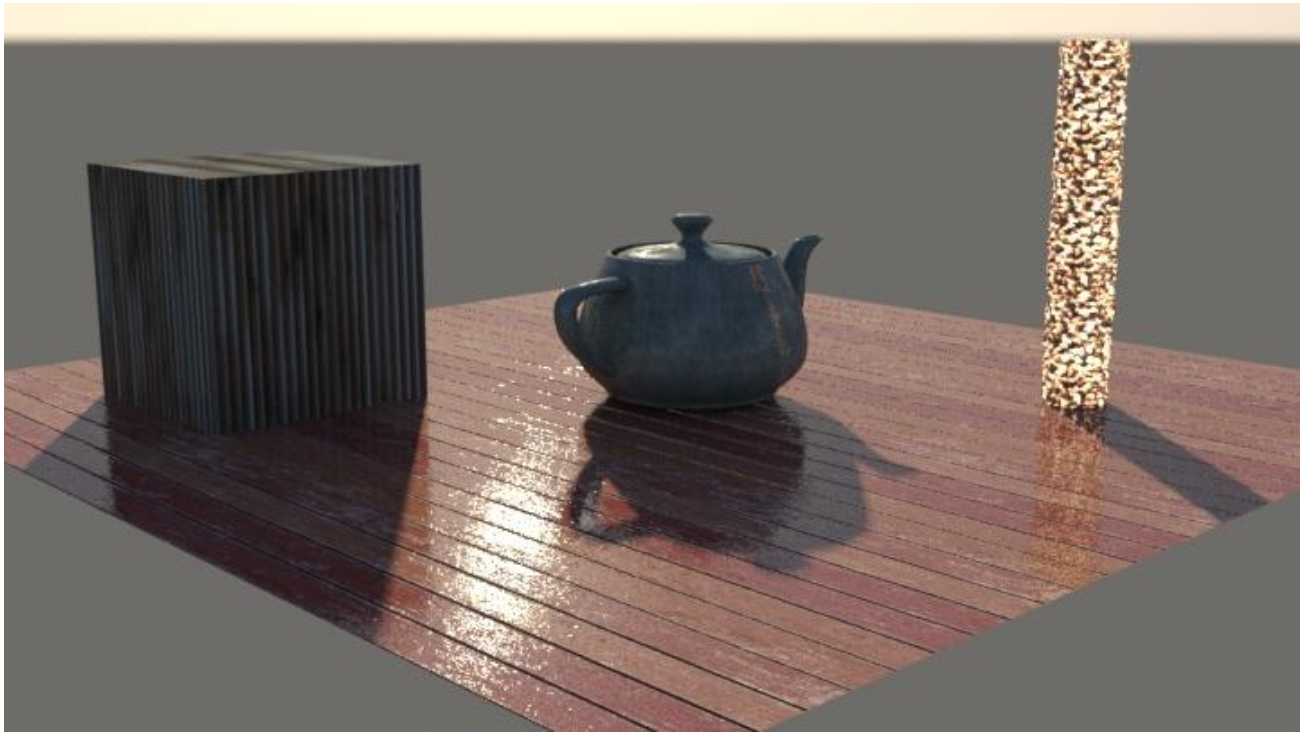


Figure 14

Maya

Like 3ds Max, there are multiple ways to assign a 2D texture or map to a material. For this, let's focus on the Attributes Editor and Hypershade. We will start with the ground plane. Open the Attribute Editor and Click on the "Ground01" Tab to access the material. Maya has a rather nifty function that will automatically apply all the relevant shader channels from a Substance shader to all the appropriate channels in the material. Click on the checker icon to the right of the color channel under the Common Material Attributes rollout. *(Figure 15)* This will open the Create Render Node window from which you will select Substance. *(Figure 16)*

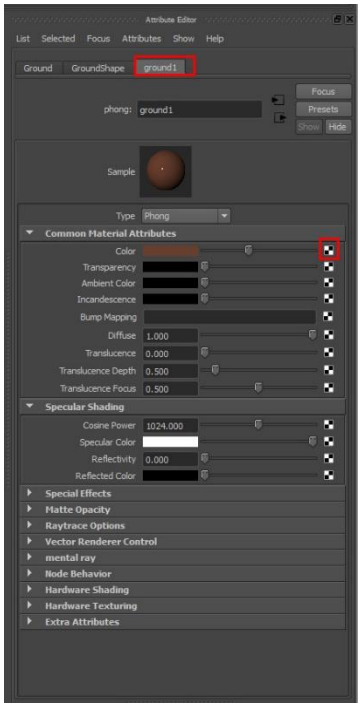


Figure 15

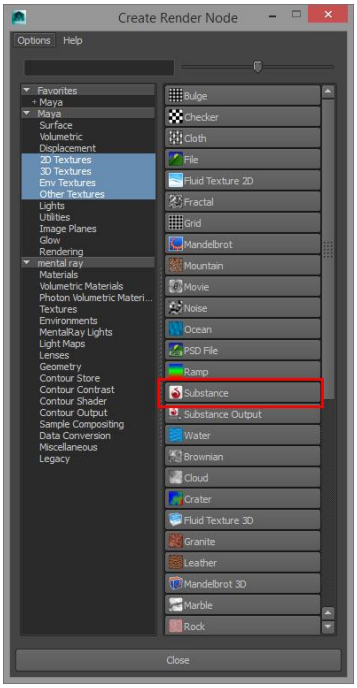
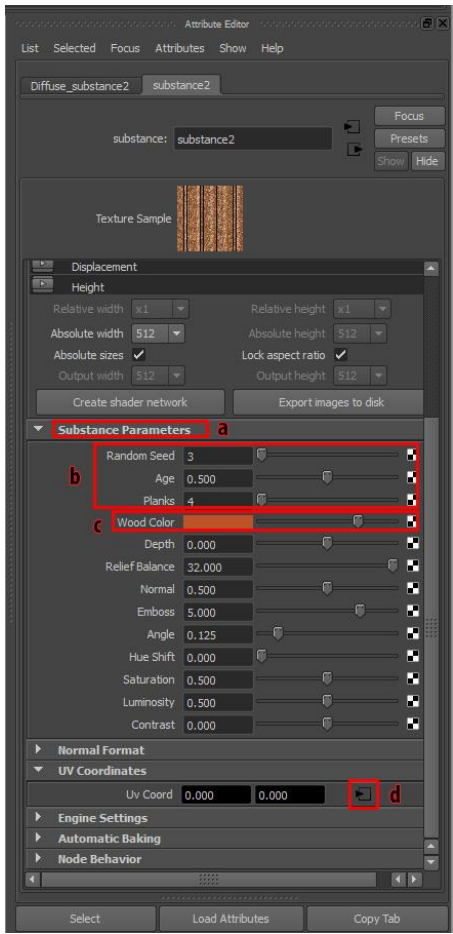


Figure 16

To add a Substance *.sbsar, click on the folder next to "Substance File" and select the "VARNISHED_WOOD.SBSAR" shader file located in the Maya Substance folder (C:\Program Files\Autodesk\Maya2014\substance\substances). At the bottom you will find a button called "Create shader network", click it. As I mentioned earlier, this will automatically plug the appropriate shader channels into the correct material channels. Like its 3ds max equivalent, there are preferences for resolution both absolute and relative. Additionally, you will find an "Export images to disk" button similar to what you would find in Substance Player.

We now need to set some of the Substance Parameters *(a)* as well as the UV mapping attributes. *(Figure 17)* Let's set the Random Seed to 3, the Planks to 4, and the age value to 0.5 *(b)*. The Varnished_Wood shader provided with Maya *(c) loaded with alternate *.sbsar)* does not appear to contain a Wood Color value in the shader graph like it was in 3ds Max so we will proceed with the default color. We will need to adjust the UV mapping attributes for this material as well. Click on the icon adjacent to the UV Coordinates rollout *(d)* to open the 2D Texture Placement Attributes editor. Set the Repeat UV values to 5 and 5. *(Figure 18)*



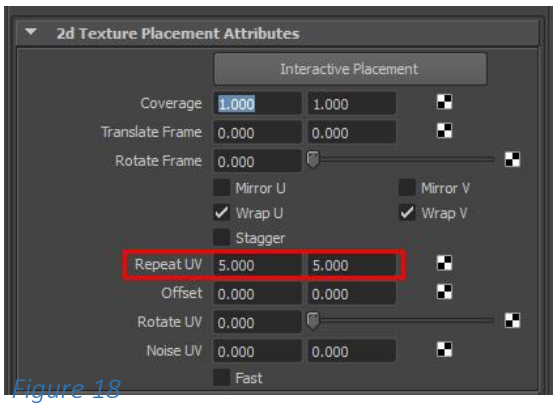


Figure 18

Apply the following shaders to the following objects with the listed parameters:

Teapot

1. **AIRCRAFT_METAL.SBSAR**
2. UV Coordinates - 2 and 2

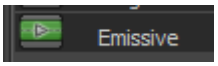
Box

1. **CORRUGATED_METAL.SBSAR**
2. UV Coordinates - 1 and 1

Cylinder

1. **COAL.SBSAR**
2. UV Coordinates – 1 and 3
3. You will need to wire the Emissive channel to the Self-Illumination channel on the Material. Just click on the Assign Icon for Emissive

Figure 17



4. Let's wire a Height map into the Displacement channel in the material. This will cause the coal chucks to displace out of the cylinder surface.

So far, we have worked through how Substance is utilized in 2 native Autodesk applications, 3ds Max and Maya. Now, let's delve into how you can leverage Substance for Autocad.

Autocad

Using Substance with Autocad requires 2 main items, Substance Player for generating the various bitmaps and Substance shaders. While there are a few sample Substance shaders that come with Player, you must purchase additional shaders from the Allegorithmic Hub (http://www.allegorithmic.com/products/substances). Allegorithmic has done a great job of creating collections of various types of materials and you can view what they look like applied to geometry via a nifty viewer based on Unity Web technology. If you have 3ds Max or Maya installed, you can use the shaders that ship with these applications, making the necessary modifications to meet your texturing needs.

For this exercise, I will use Autocad as a basis for how all the other Autodesk applications use custom textures. As you might know, most of the applications in the Autodesk software cadre, utilize the Autodesk Materials Library, which is a collection of materials with physically accurate attributes simulating real-world properties such as metals, ceramics, liquids, textiles, etc. In addition to the predefined materials, Autodesk has also provided a "generic" type, ideal for creating custom materials. Open the file called **SUBSTANCE.DWG** to begin this exercise.

If you open the Material Browser in Autocad, you will see a list of basic physical materials such as Ceramic, Concrete, Glazing, Hardwood, etc. *(Figure 19)*

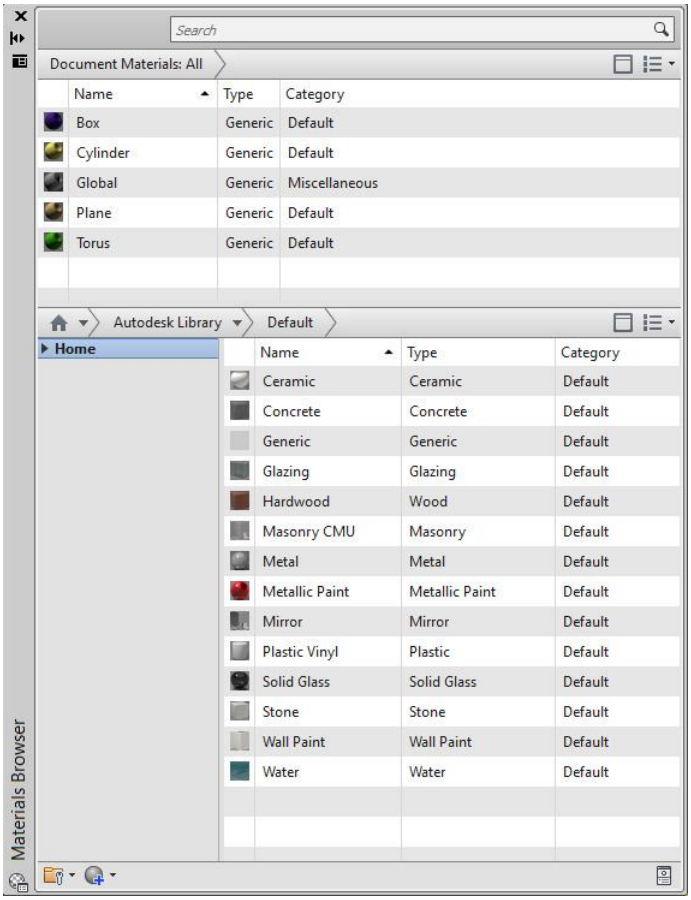


Figure 19

Each is has unique properties indicative of the material type as you can see below. *(Figure 20)*

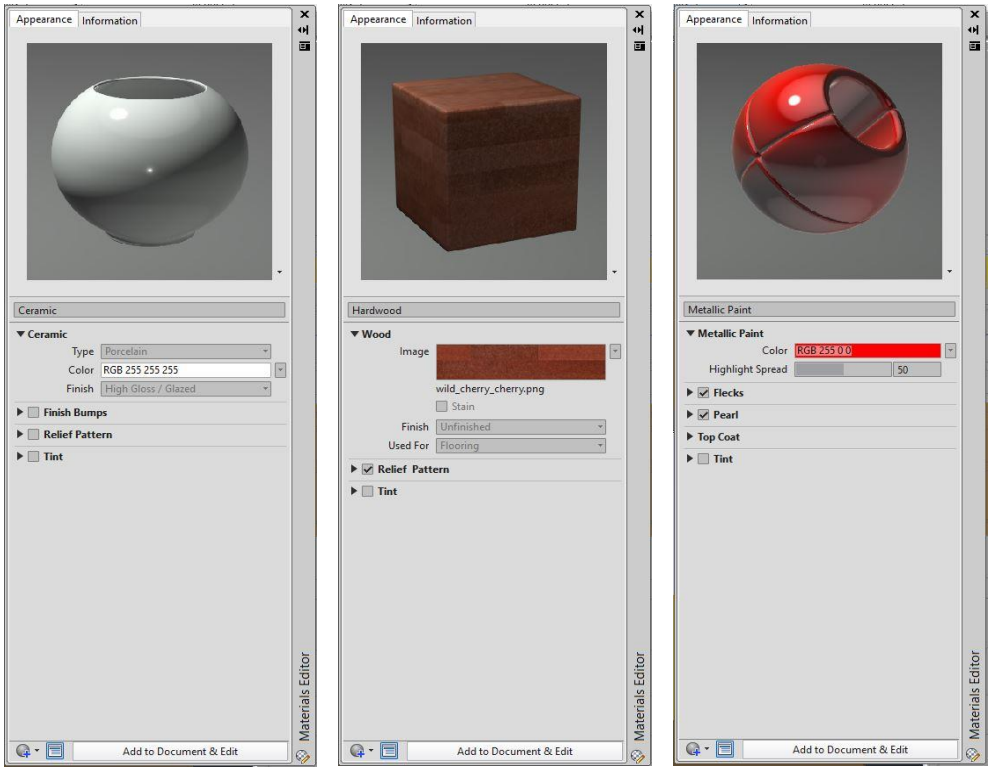


Figure 20

The Generic material on the other hand is, well, generic. In other words, it contains all the parameters necessary to create any type of material that you choose, inclusive or regardless of physical accuracy. Note, this is the same as the Autodesk Generic Material in 3ds Max. *(Figure 21)*

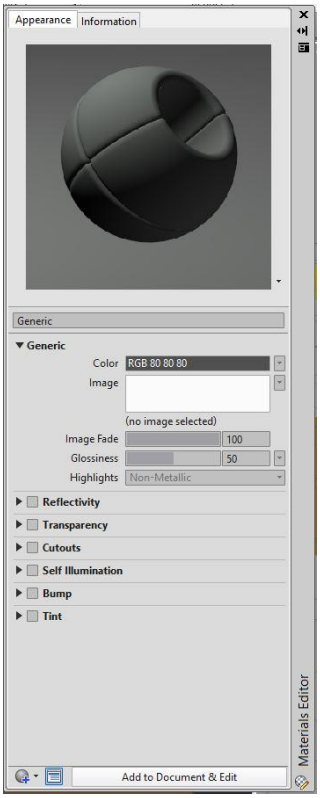


Figure 21

Let's start with the Torus Material first by double-clicking on the Torus icon to open up the Material Properties Panel. We will be assigning the Aircraft Metal textures to the appropriate channels. The diffuse texture should plug into the image channel. Click on the preview panel to load the diffuse texture and select **AIRCRAFT_METAL_DIFFUSE.PNG** from the Export folder. *(Figure 22)*

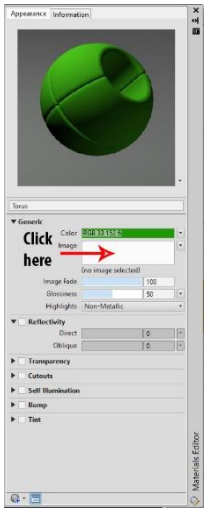


Figure 22

Next, we will need to activate the Reflectivity channel, click on the Direct sub-channel, select image from the drop-down list, and assign the map called **AIRCRAFT_METAL_SPECULAR.PNG**. We will also configure the Highlights to be Metallic. *(Figure 23)*

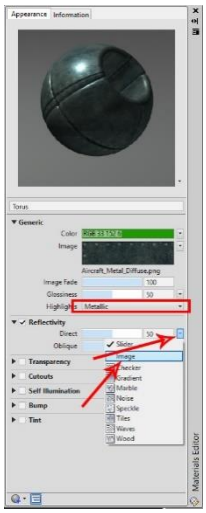


Figure 23

Repeat this same procedure for the Bump channel, assigning the map **AIRCRAFT_METAL_BUMP.PNG**. *(Figure 24)*

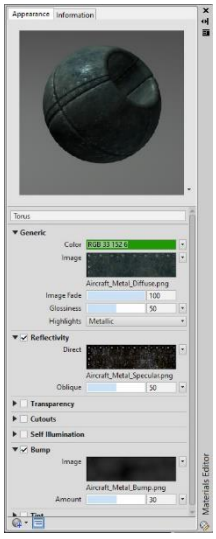


Figure 24

Ok, now let's repeat this process for the Box, Cylinder, and Plane using the Corrugated Metal,

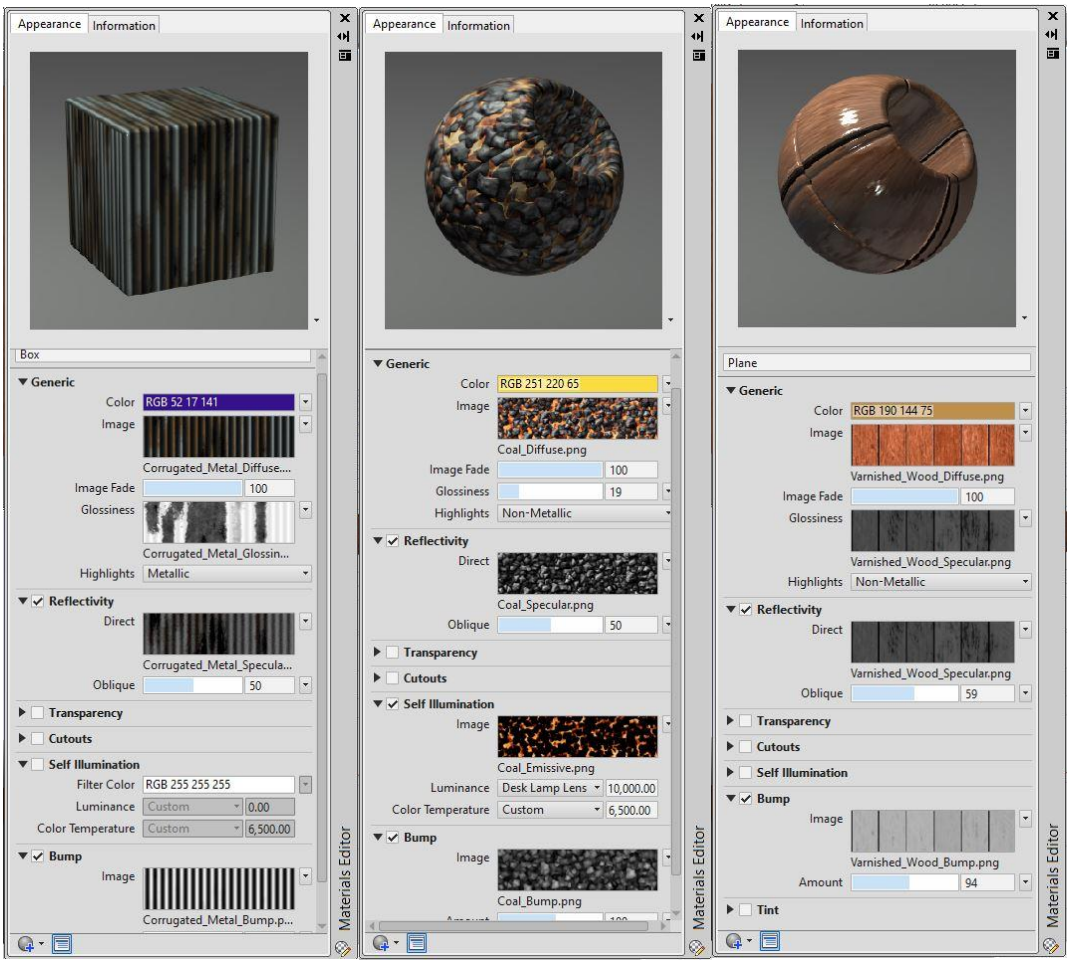


Figure 25

Coal, and Wood Varnish respectively. *(Figure 25)*

You will notice I used the Self Illumination channel for the Cylinder as well as a Glossiness map for the Box and Plane materials. The Generic Material is quite flexible and is very similar to the Arch&Design Material in 3ds Max.

As I indicated earlier, the Autodesk Materials are the same across most the Autodesk software catalog, and what you learned here can be replicated in Revit, Invertor, Civil 3D, Autocad Architecture, etc. and will transfer via your DWG file. *(Figure 26)*

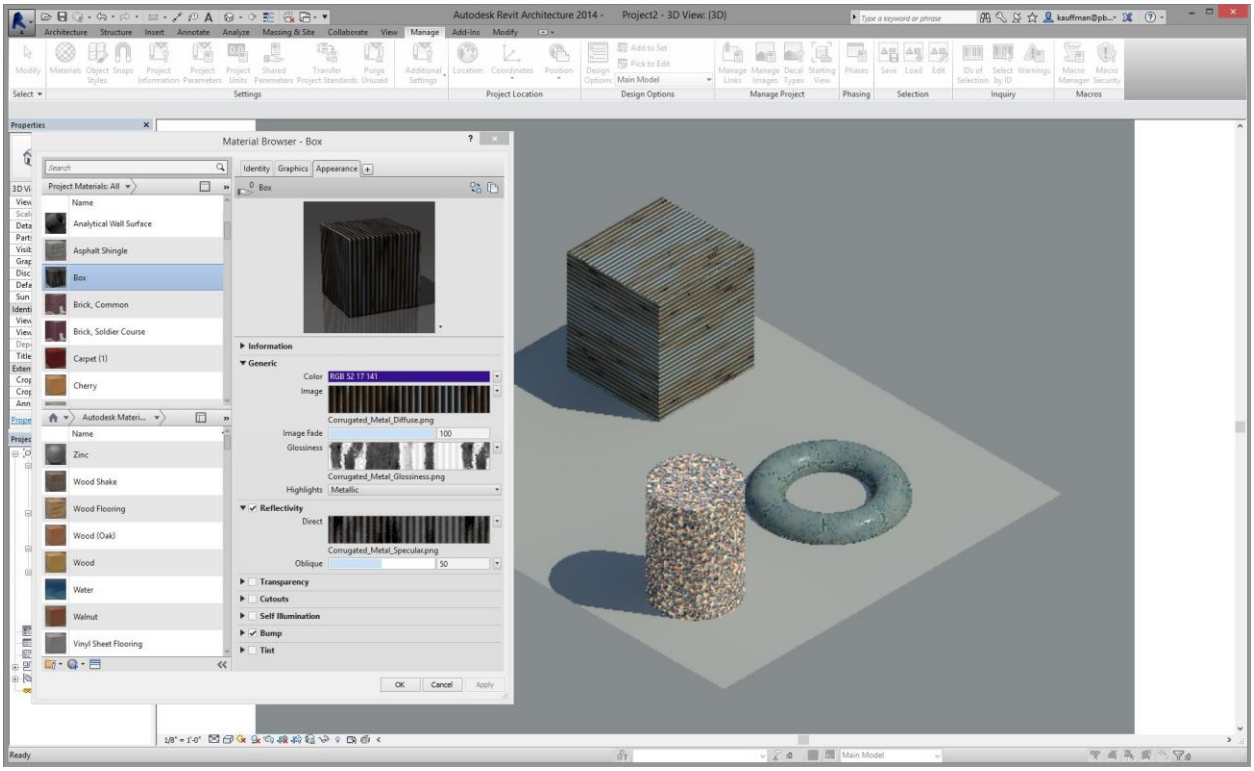
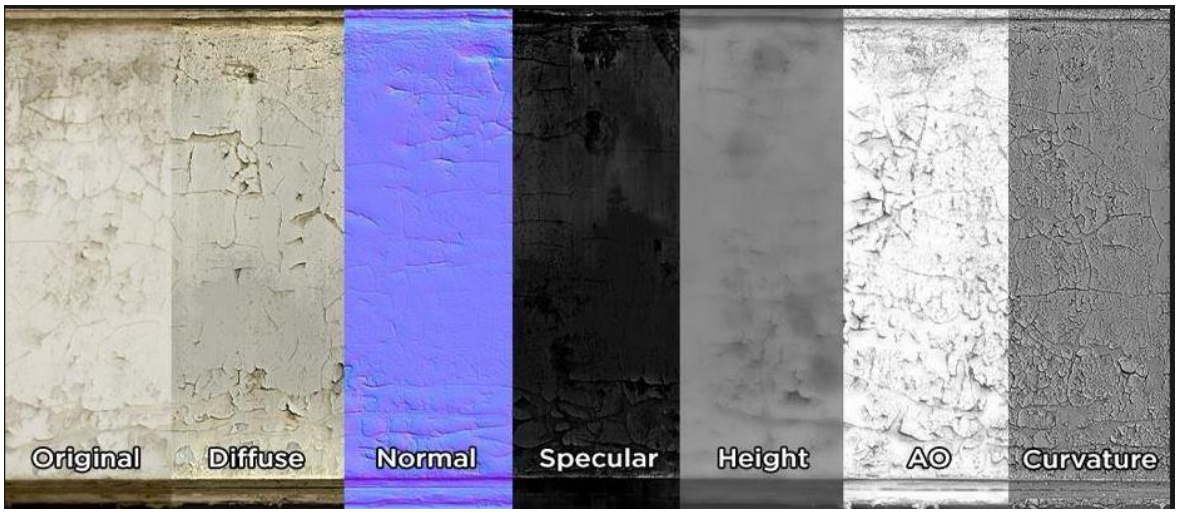


Figure 26

Bitmap2Material

So far, we have worked with prebuilt Substance shaders emulating all sorts of surfaces; brick, coal, corrugated metal, etc. Well, Allegorithmic has a very special Substance shader that can take an existing image and through the use of some clever image processing, generate



separate diffuse, specular, normal, and bum channels in real-time. It's called Bitmap2Material.

Substance Player ships with a trial version of Bitmap2Material (B2M), which should give you a good idea of what it is capable of. Open up Substance Player. Load up **BITMAP2MATERIAL_2_TRIAL.SBSAR** located here:

C:\Program Files\Allegorithmic\Substance\Player\3.x\samples

Once loaded, all you need to do is drop an image into the 2D View. (Figure 27)

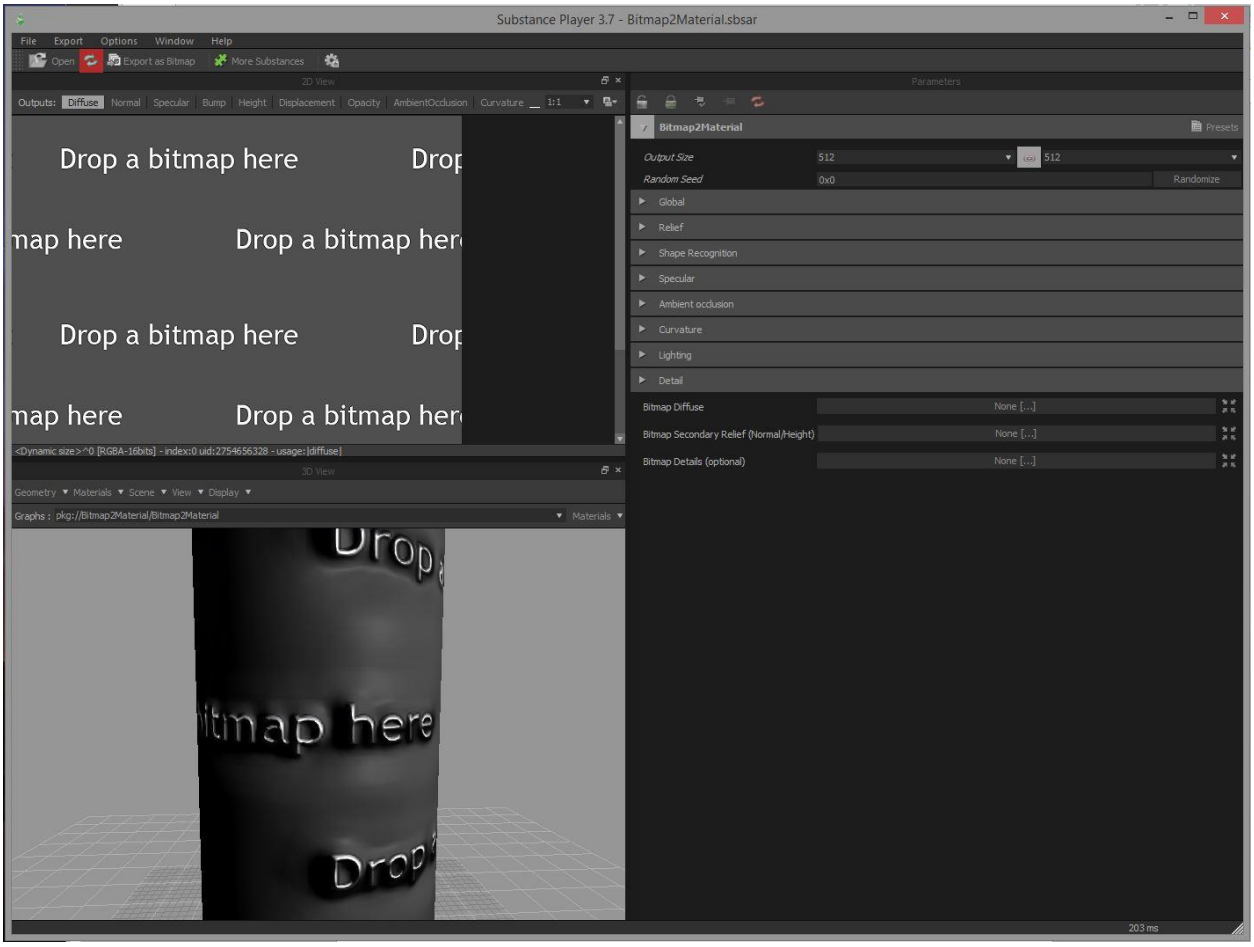


Figure 27

For this exercise, let's drop the provided image called **BITMAP2MATERIAL_ROCK.TGA** *(Figure 28)*

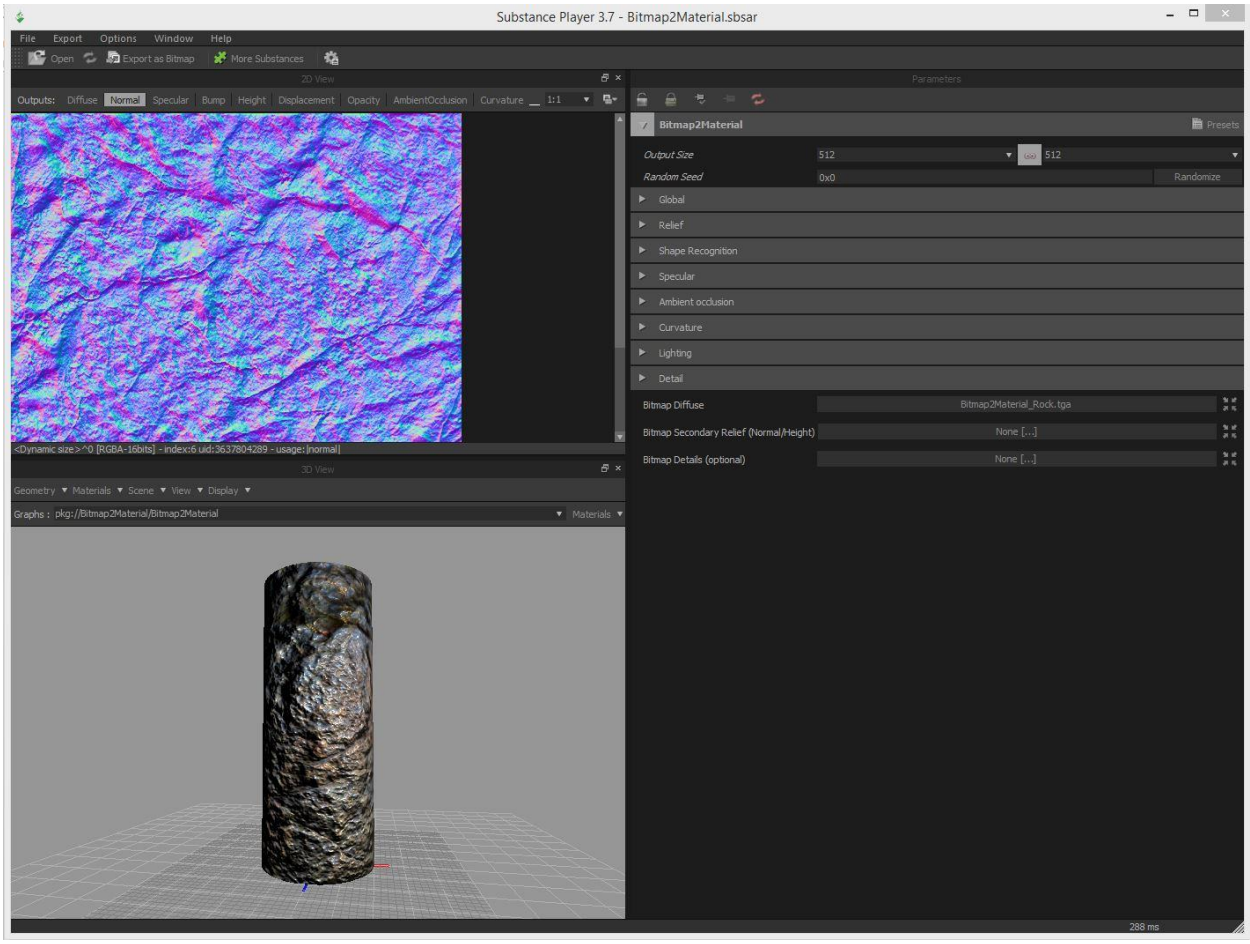


Figure 28

Like with the shaders, B2M will break out all the channels into separate images for diffuse, normal, specular, etc. Plus, you can get B2M to make your image tile using the MakeItTile Method in the global rollout. *(Figure 29)*

Figure 29