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Next-Level Visualizations with Revit Advanced Materials

Daniel John Stine
Lake Flato Architects

Learning Objectives

- Learn about the improved quality possible with provided advanced materials.
- Discover the difference between legacy and advanced materials.
- Discover the new parameters and what they do.
- Learn how to manage and share material libraries within a design firm.

Description

Clients and stakeholders increasingly expect compelling and realistic imagery. Thankfully, the tools to achieve these results are getting easier to use. Come to this session to learn how to capitalize on Revit software's advanced materials and new realistic mode, and Enscape's real-time rendering engine to develop stunning still images, lively on-screen presentations, and immersive virtual reality (VR) experiences. This session will cover topics ranging from creating custom materials to managing shared libraries and more.

Speaker(s)

Daniel John Stine AIA, CSI, CDT, is a Wisconsin registered architect with over twenty years of experience. He is the Director of Design Technology at Lake Flato Architects.

Dan has presented internationally on BIM in the USA, Canada, Ireland, Denmark, Scotland, Slovenia, Australia and Singapore; including, Autodesk University, RTC/BILT, Midwest University, AUGI CAD Camp, NVIDIA GPU Technology Conference (2018), Lightfair (2018), and AIA-MN Convention (2016, 2017, 2018, 2019). By invitation, he spent a week at Autodesk's largest R&D facility located in Shanghai, China in 2016.

Dan is a member of Autodesk Expert Elite, the American Institute of Architects (AIA), Construction Specifications Institute (CSI), and Autodesk Developer Network (ADN), and is a Construction Document Technician (issued by CSI). He has presented live webinars for ElumTools, ArchVision, Revizto and NVIDIA.

Committed to furthering the design profession, Dan teaches graduate architecture students at North Dakota State University (NDSU). Sharing his passion for architectural visualization, Dan also writes blog posts for Enscape: <https://enscape3d.com/blog/>.

Dan writes about design on his blog, BIM Chapters, and in his textbooks published by SDC Publications. He has written six textbooks on Autodesk Revit and two on AutoCAD. One of his books is the #1 Revit book in North America, within the academic market.

Since Revit 2019, Revit supports new PBR shaders, which Autodesk calls **Advanced Materials**. There are a few dozen created as "formal materials" in the provided materials library, which means there is **identity** data, **graphics** data (i.e. shaded color and fill patterns) and an **appearance asset**. The latter being the main ingredient for a material to be considered "advanced". In this session we will look at several of the ones provided with Revit and a few custom options.

Revit 2021 includes a newly retooled realistic view. This mode looks better than before and, more importantly, is significantly more robust. When this mode is paired with an uncropped perspective view, there are some nice new ways to navigated within the view in 2021 as well. Finally, this session will also cover, in this context, how Revit is taking more advantage of the GPU for graphics processing... something we have been requesting for a while now!

This session will use Enscape, a Revit add-in, to show off a lot of the material tricks disussed in this session. A real-time rendering tool with live sync technology that nearly instantly updates when developing your design in Revit. It is a popular tool, that pairs nicely with Revit, given its ease of use, reasonable cost, and how fast it is. I have personally been a fan for a few years now, and even write many of the blog posts on their website and teach Escape to graduate architecture students at North Dakota State University (NDSU). FYI: Enscape is free for students!

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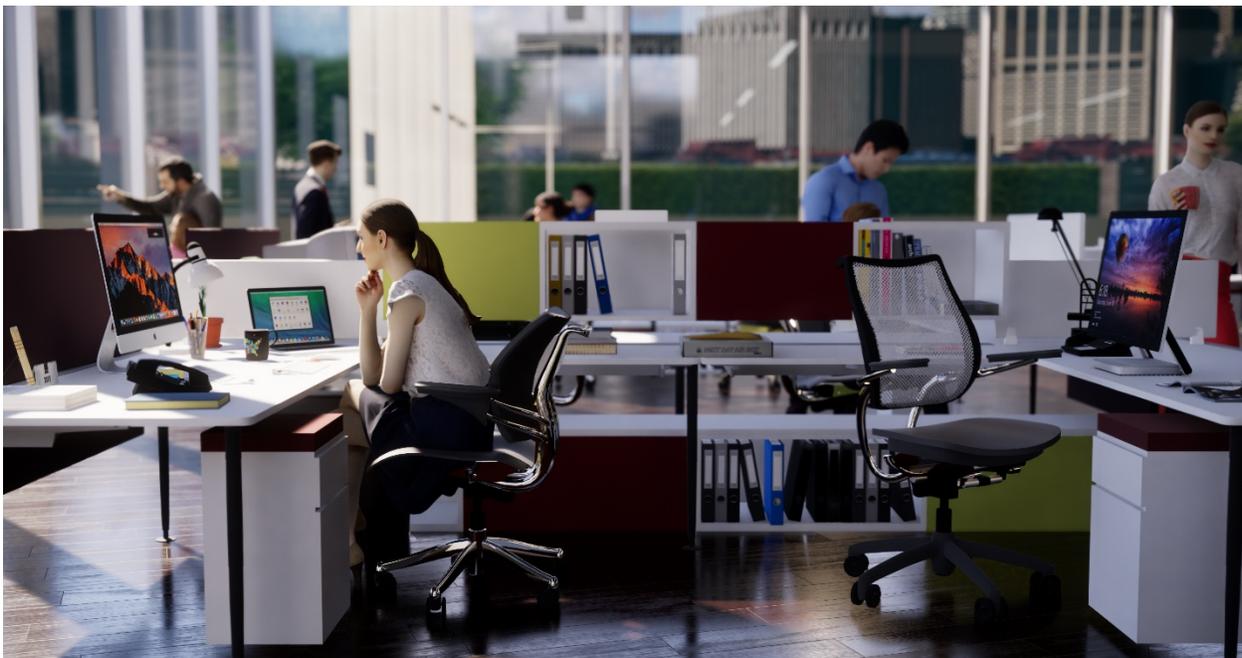
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Improved Quality Examples

To start off, let's have some fun and look at the results that are possible when working in Revit, leveraging materials more fully, and using Enscape's real-time rendering engine. The thing that might surprise you the most is that all of these images are 100% from Revit, rendered via Enscape (which is an add-in to Revit), and have absolutely ZERO post-processing. In case you don't know that post-processing is... it involves editing the rendered image to add people, adjust color, replace the sky and such. Again, these images have none of that. All the entourage and furniture is within the Revit model, which includes Enscape provided assets and ArchVision's RPC content placed within Revit and rendered in Enscape.

I created all of these images... but I will be the first to admit there are way better examples to see if you head over to the Enscape gallery, at <https://enscape3d.com/showcase/>. Not all of the examples there are from Revit, as Enscape also supports SketchUp, Rhino, ArchiCAD, and VectorWorks. But the rendering engine is the same so the same results is nearly possible in any supported design platform.

Note: The assumption is that this handout will not likely need to be printed, so I am going to maximize the images on each sheet to highlight the detail and quality.



COMMERCIAL PROJECT EXAMPLE





CITY PARK PROJECT



RESIDENTIAL EXAMPLE



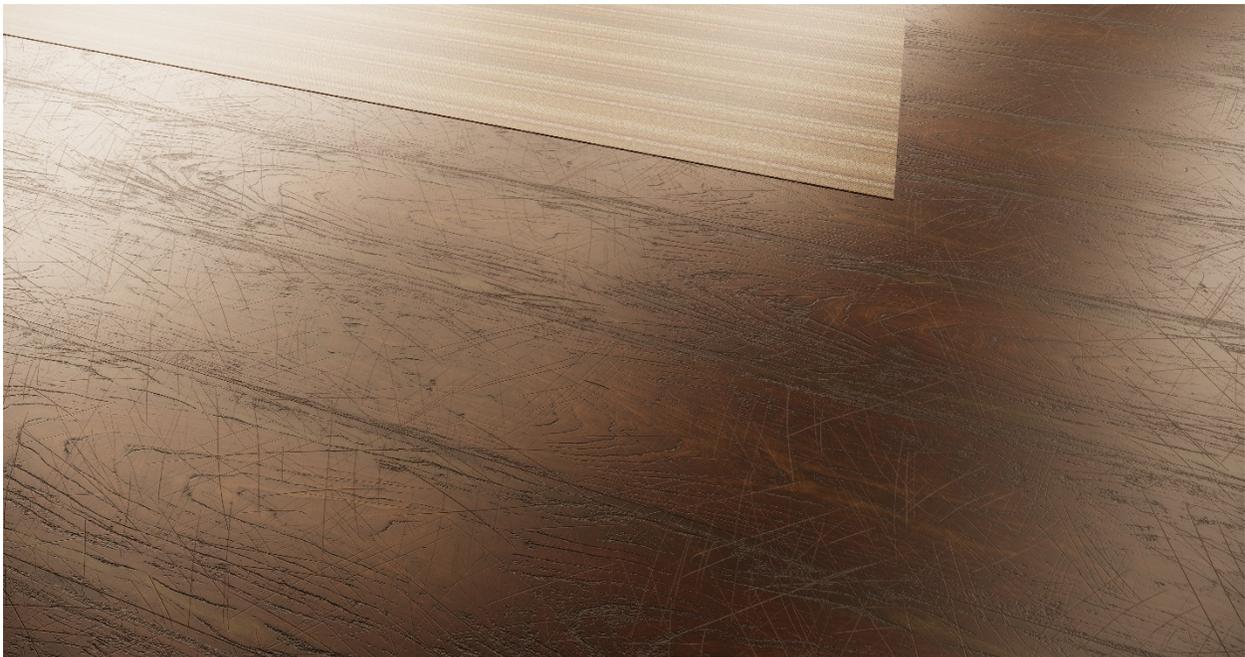
RESIDENTIAL EXAMPLE – ENSCAPE GRASS AND ENTOURAGE



RESIDENTIAL EXAMPLE – WOODGRAIN BUMP MAP



COMMERCIAL PROJECT EXAMPLE



COMMERCIAL PROJECT EXAMPLE – SCRATCHED FLOOR BUMP MAP

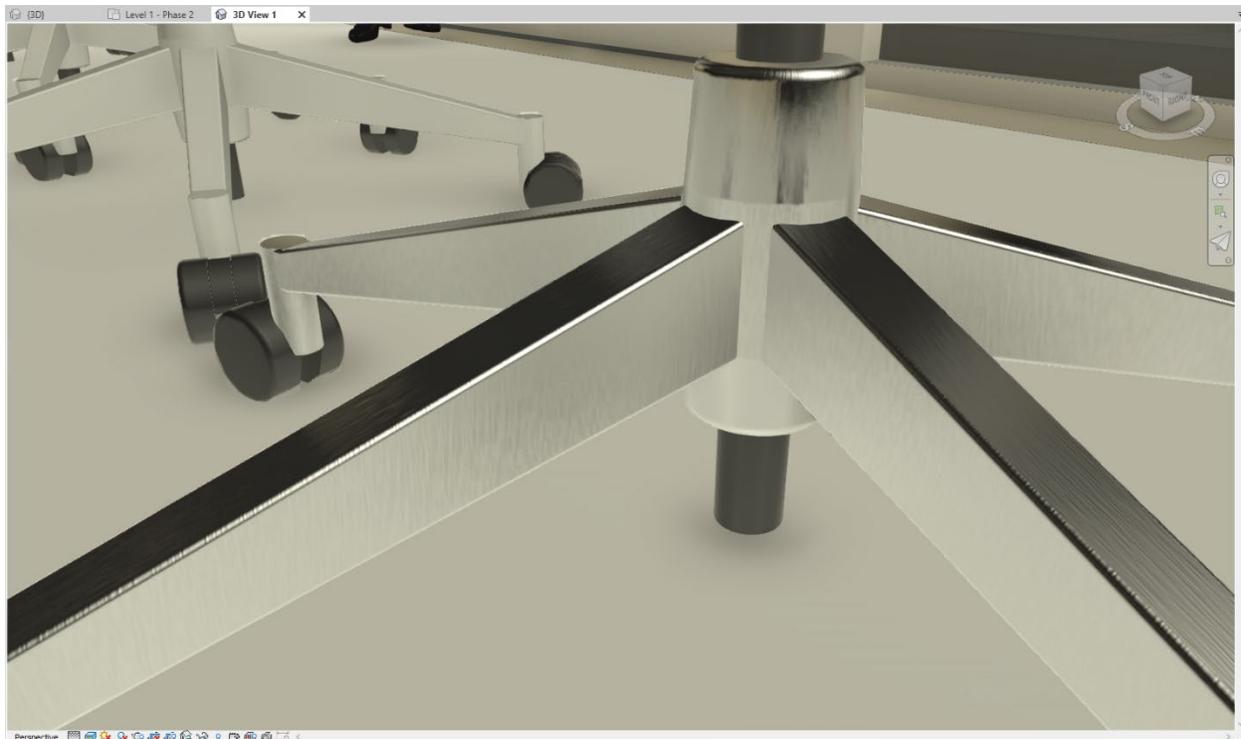


COMMERCIAL PROJECT EXAMPLE

Revit 2021 Improved Realistic Views

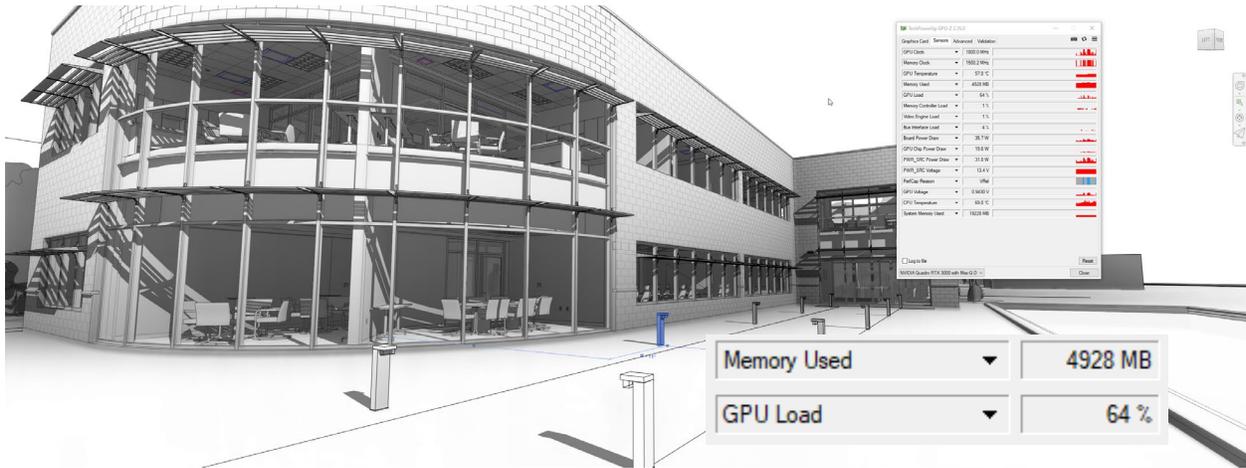
Revit 2021 offers a totally new experience in terms of performance and quality. It's not Enscape, but it does provide a much-improved experience within Revit proper.

There are even moments of "oh, wow" within this new realistic view... notice the quality of the metal chair base in the following image.

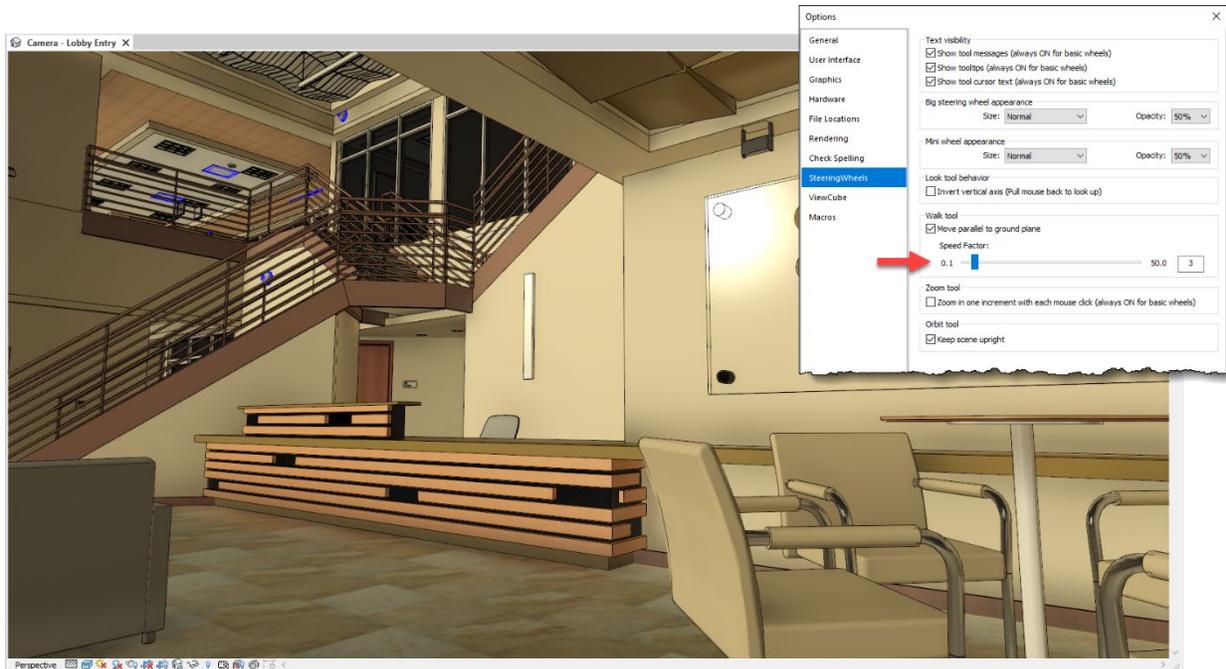


REVIT'S NEW REALISTIC VIEW IN 2021

Revit is beginning to take advantage of the computer's graphics card (GPU). Even in Hidden Line mode, in this case with anti-aliasing, ambient shadows, and shadows turned on, we can see nearly 5 GB of GPU memory in use and a GPU Load of 64% as I was making some adjustments to the view! Considering this, plus Enscape being GPU memory hungry on larger projects, architects need graphics cards with a lot of GPU memory; for the intermediate to power user I recommend the NVIDIA Quadro RTX 5000, which has 16 GB of memory... the consumer cards (GeForce) typically only have 8 GB.

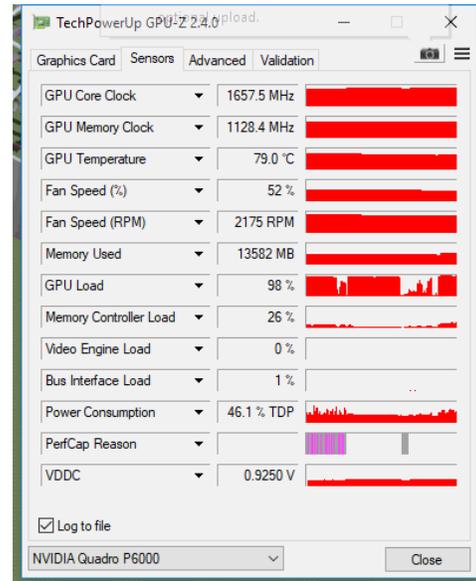


GPU LOAD AND MEMORY EXAMPLE



WALK TOOL SPEED ADJUSTMENT IN REIYT OPTIONS

The image to the right shows a larger model opened in Enscape that is using over 13 GB of GPU memory. This model would crash Enscape on any GPU with less memory.



RTX 3000

Pano (single image):

- RTX on: 6:28 minutes
- RTX off: 8:20 minutes

Cardboard Pano (double image, stereo):

- RTX on: 42 minutes
- RTX off: 55 minutes

RTX 4000

Pano (single image):

- RTX on: 3:28 minutes
- RTX off: 6:45 minutes

Cardboard Pano (double image, stereo):

- RTX on: 27 minutes
- RTX off: 41 minutes

RTX 5000 (Dell Desktop) +66% over RTX 4k

Pano (single image):

- RTX on: 1:13 minutes

Cardboard Pano (double image, stereo):

- RTX on: 9:20 minutes

The image to the left shows part of an ROI study I did on the Quadro RTX series graphics cards. I rendered the same view as a 360 stereo pano in Enscape, with and without RTX enabled.

First, this shows that Enscape use of RTX makes a noticeable difference in performance. Second, the RTX Quadro 5000 is significantly faster and totally worth the upcharge when compared to staff time. Also, note that when these cards are included with new computers they don't actually cost what you might have just Googled 😊

Legacy versus advanced materials

In Revit 2019, a new material concept was added to what is now referred to as Legacy Materials... that being Advanced Materials. The legacy materials are still fine to use, even if the name suggests otherwise, and in some cases produce better results. Looks look at the two options; which fundamentally is three options; Generic, physically based and advanced. FYI: Generic was the original, and only, material option in Revit, with the physically-based coming out several years ago (with the old NVIDIA mental ray rendering engine I think).

Legacy Materials

The following chart shows the range of settings available for the legacy materials. Notice that "generic" has the most options/flexibility for a single legacy material.

Appearance Types	Information	Tint	Relief Pattern	Cutouts	Bump	Finish Bumps	Self Illumination	Reflectivity	Transparency	Weathering
Ceramic	x	x	x			x				
Concrete	x	x				x				x
Generic	x	x		x	x		x	x	x	
Glazing	x	x								
Masonry	x	x	x							
Metal	x	x	x	x						
Mirror	x	x								
Plastic	x	x	x			x				
Solid Glass	x	x	x							
Stone	x	x	x			x				
Wall paint	x	x								
Water	x	x								
Wood	x	x	x							

LEGACY MATERIAL SETTINGS MATRIX

Ceramic specific options:

Finish Glossy
 Semi-gloss
 Satin
 Unfinished

Used for Furniture
 Flooring

Concrete specific options:

Sealant None
 Epoxy
 Acrylic

Generic specific options:

Highlights Metallic
 Non-metallic

Glazing specific options:

Color Clear
 Green
 Gray
 Blue
 Blue
 Green
 Bronze
 Custom

Masonry specific options:

Finish Glossy
Matte
Unfinished

Eggshell
Platinum
Pearl
Semi-gloss
Gloss

Metal specific options:

Metal Aluminum
Anodized Aluminum
Chrome
Copper
Brass
Bronze
Stainless Steel
Zinc

Application Roller
Brush
Spray

Wall Paint specific options:

Finish Flat/Matte
Eggshell
Platinum
Pearl
Semi-gloss
Gloss

Plastic specific options:

Type Plastic (Solid)
Plastic (Translucent)

Application Roller
Brush
Spray

Finish Polished
Glossy
Matte

Solid Glass specific options:

Color Clear
Green
Gray
Blue
Blue
Green
Bronze
Custom

Water specific options:

Type Swimming Pool
Generic Reflecting Pool
Generic Stream/River
Generic Pond/Lake
Generic Sea/Ocean

Wood specific options:

Finish Glossy
Semi-gloss
Satin
Unfinished

Stone specific options:

Finish Polished
Glossy
Matte
Unfinished

Used for Furniture
Flooring

Wall Paint specific options:

Finish Flat/Matte

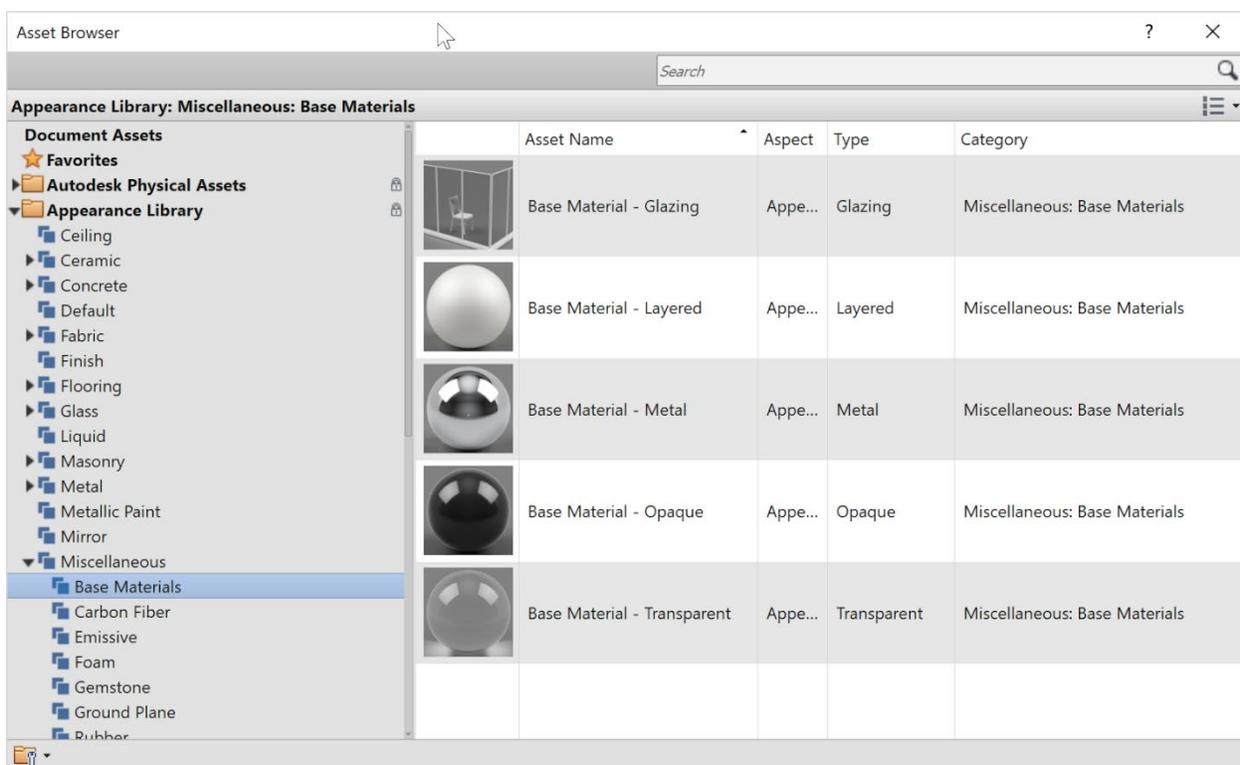
Advanced Materials

Now lets look at the new advanced materials and learn what is different about them.

Revit Advanced Materials - Base Material Templates

The new Revit advanced materials are based on PBR shaders, which is what modern rendering/gaming engines utilize. Understanding all the related options in Revit can be a bit challenging, as there is no easy way to switch between appearance assets in Revit.

In this section I will share a fundamental tip in understanding this newer option in Revit. It has to do with the provided "base material" templates...



REVIT ADVANCED BASE MATERIALS

In the image above, notice the five **Base Materials** which are all based on the newer advanced materials. These are the five fundamental shaders Revit provides and are collectively called "advanced materials"

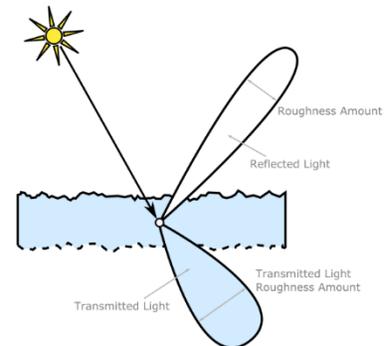
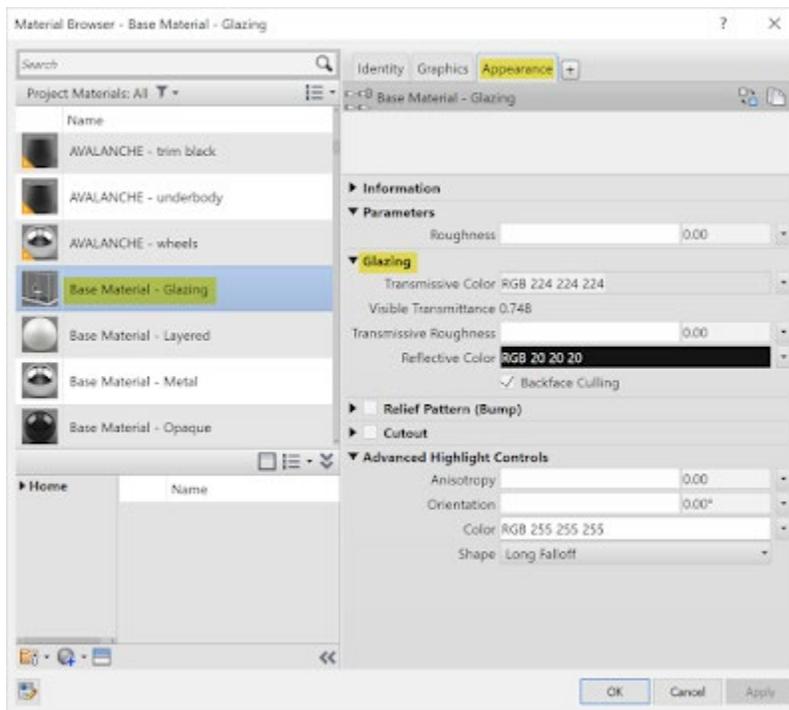
All of the provided advanced materials, such as carpet, brick, metal, etc., are all based on one of these five shader types. If you want to create a custom PBR material, you can duplicate an existing material (and its appearance asset type) and modify it. Or you can create a new material from scratch using the + icon at the bottom of the Material Browser dialog, and then use the "replace asset" icon on the Appearance tab, and select one of the options shown above.

Below are the default settings when using one of the base materials. For fun, I also rendered

each in both Enscape and Revit; the latter is the smaller image. They can all be modified significantly to look much much better. As we will see shortly.

Glazing

Glazing is different than glass, as it is optimized for architectural renderings and does not refract light and is considered as a single plane without thickness so the light and shadows created.

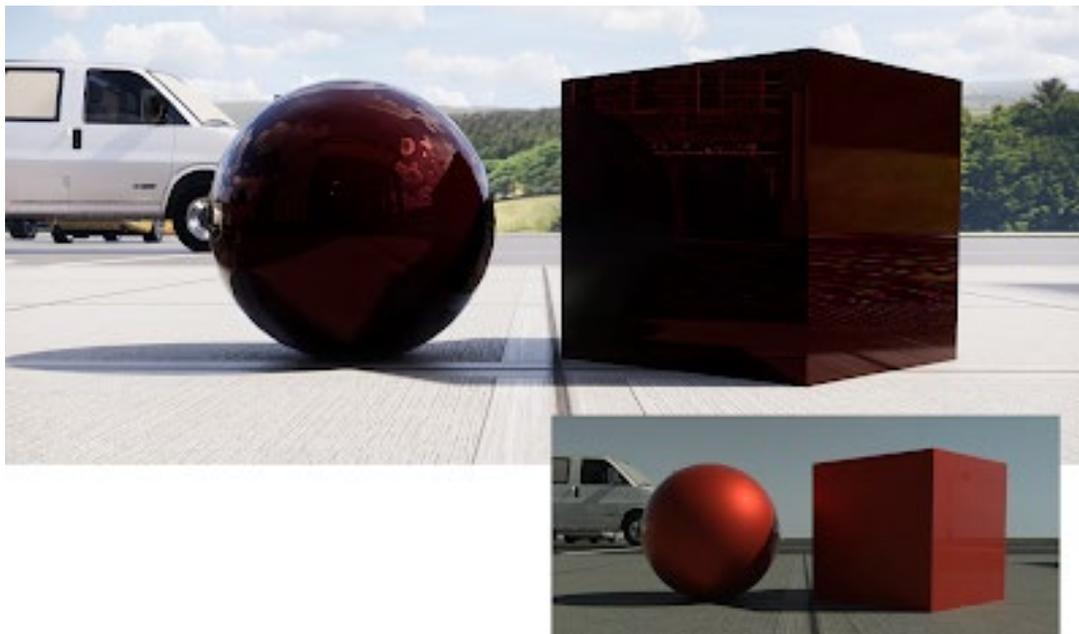
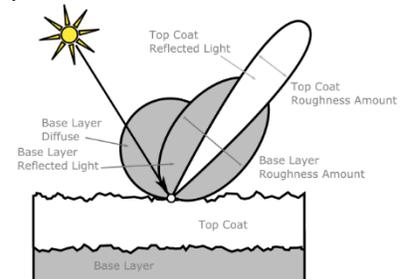
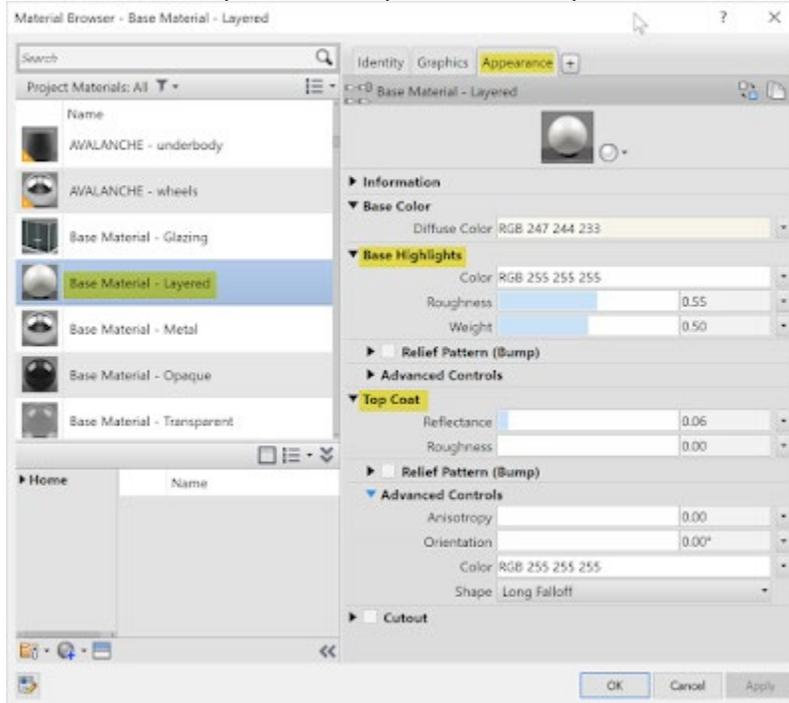


Learn more via this Autodesk help topic:

<http://help.autodesk.com/view/ARENDERING/ENU/?guid=GUID-B9907264-2182-4609-81BD-B464EEE316DF>

Layered

Layered material is used to reproduce materials that have a bottom specular surface plus a top clear coat. Examples are car paint, metallic paint, and carbon fiber panels.

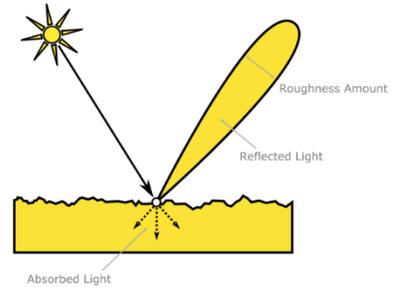
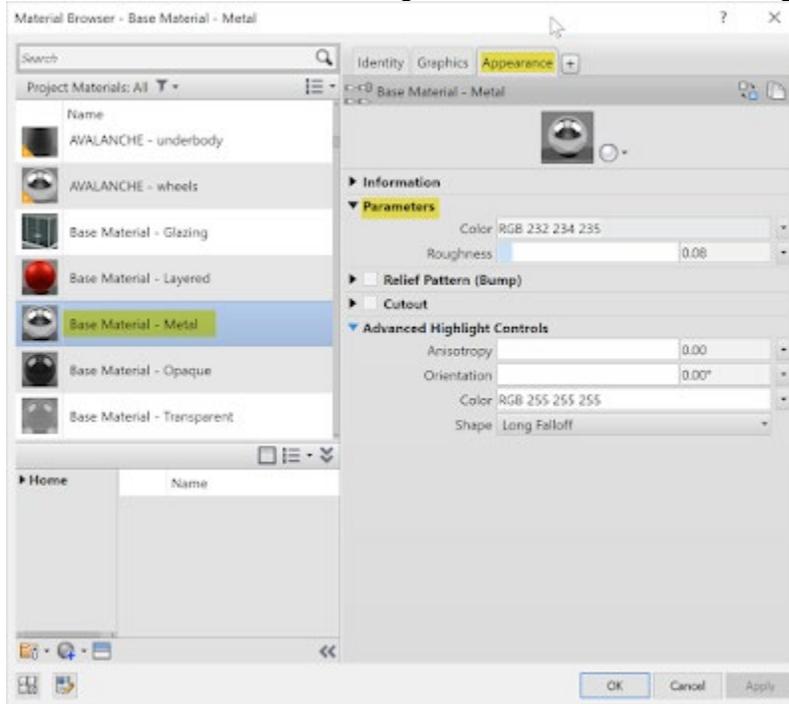


Learn more via this Autodesk help topic:

<http://help.autodesk.com/view/ARENDERING/ENU/?guid=GUID-97CC0DD3-35A8-4D8F-80A0-B1C4AD54D2B0>

Metal

Metal materials reflect all the light that is not absorbed. No light is reflected as diffuse light.

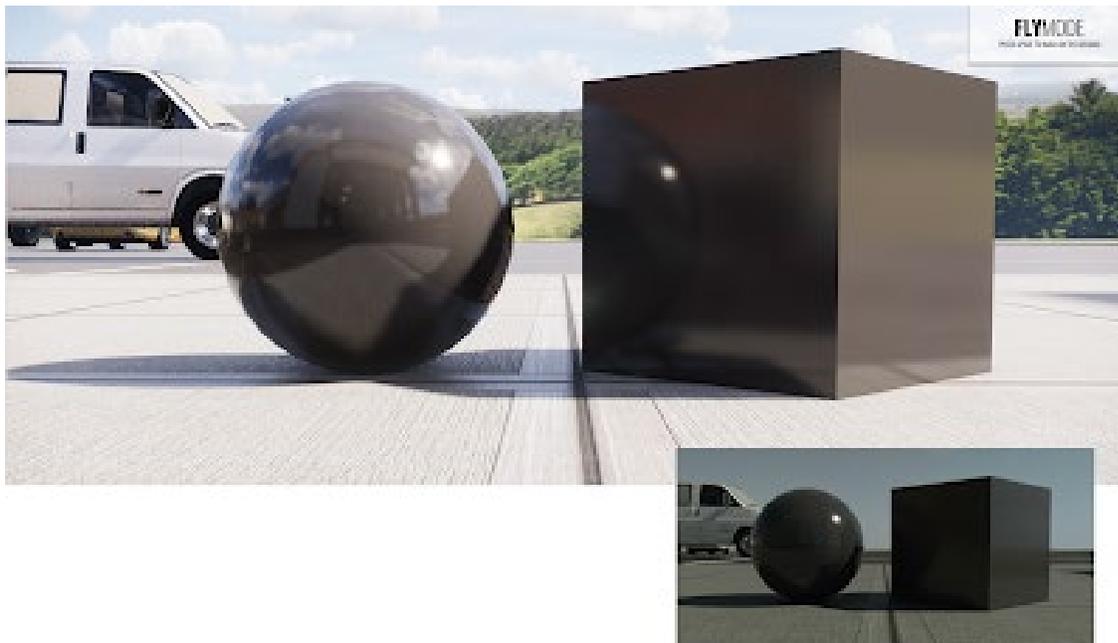
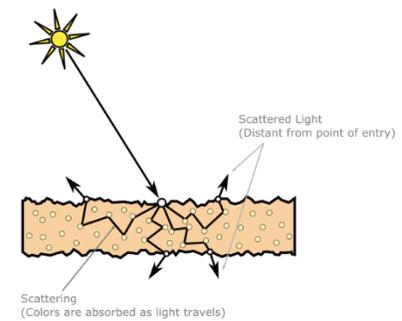
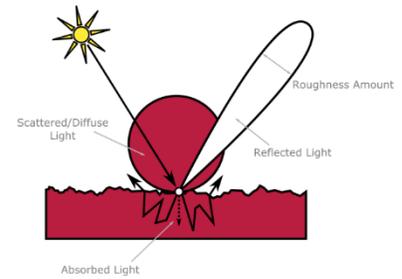
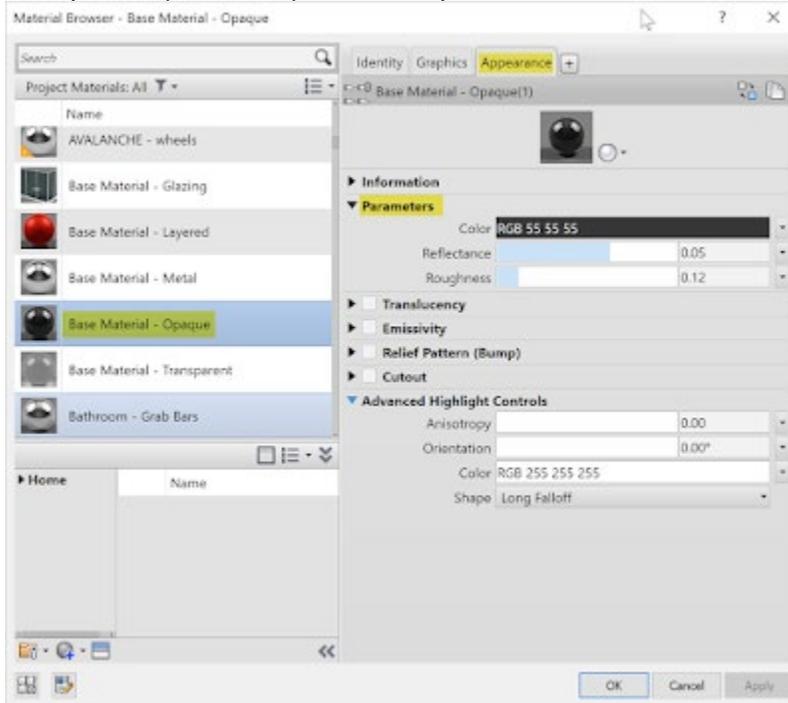


Learn more via this Autodesk help topic:

<http://help.autodesk.com/view/ARENDERING/ENU/?guid=GUID-B0F49D7F-76F7-442E-BD9B-F32F69420204>

Opaque

Opaque material refers to common materials that are neither metallic (strong reflections) nor transparent (refractive). For example, Plastic, wood, stone, and ceramic.



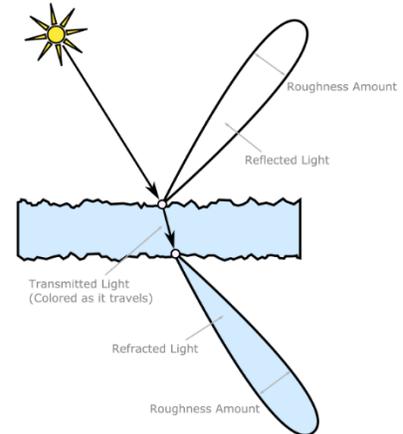
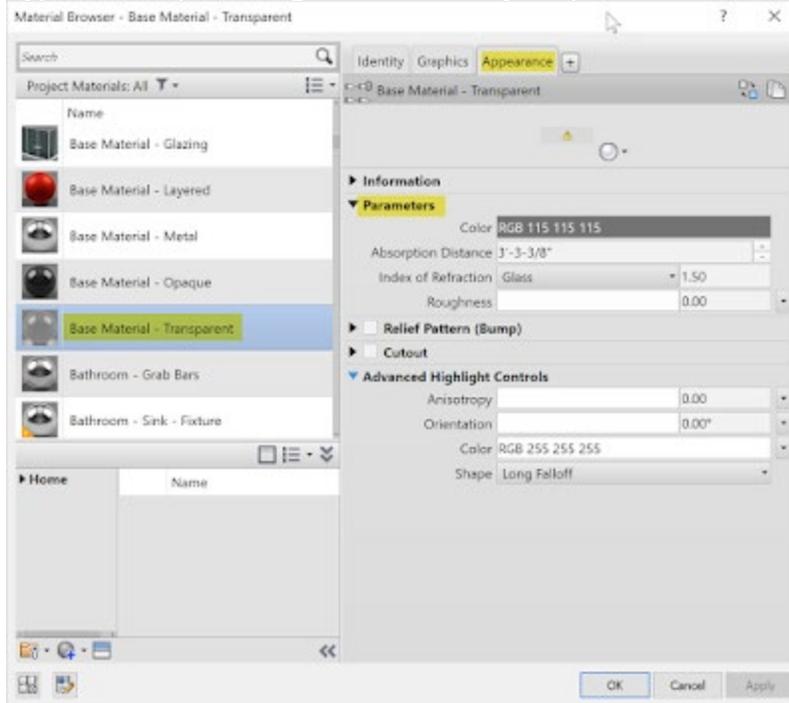
Learn more via this Autodesk help topic:

<http://help.autodesk.com/view/ARENDERING/ENU/?guid=GUID-D3BA45C9-5B7C-421B-9012-806BDA6DDA47>

Transparent

Transparent material is used for all materials where most of the light go through the material (refracted) without any scattering, but with some degree color absorption.

Typical examples are glass, water, acrylic, quartz, diamond, ruby, and emerald.



Learn more via this Autodesk help topic:

<http://help.autodesk.com/view/ARENDERING/ENU/?guid=GUID-50A91891-EC13-4A50-9D9F-95E532904FC7>

Revit Advanced Materials – Examples Installed with Revit

In this section I highlight a few of these new materials, mainly using Enscape.

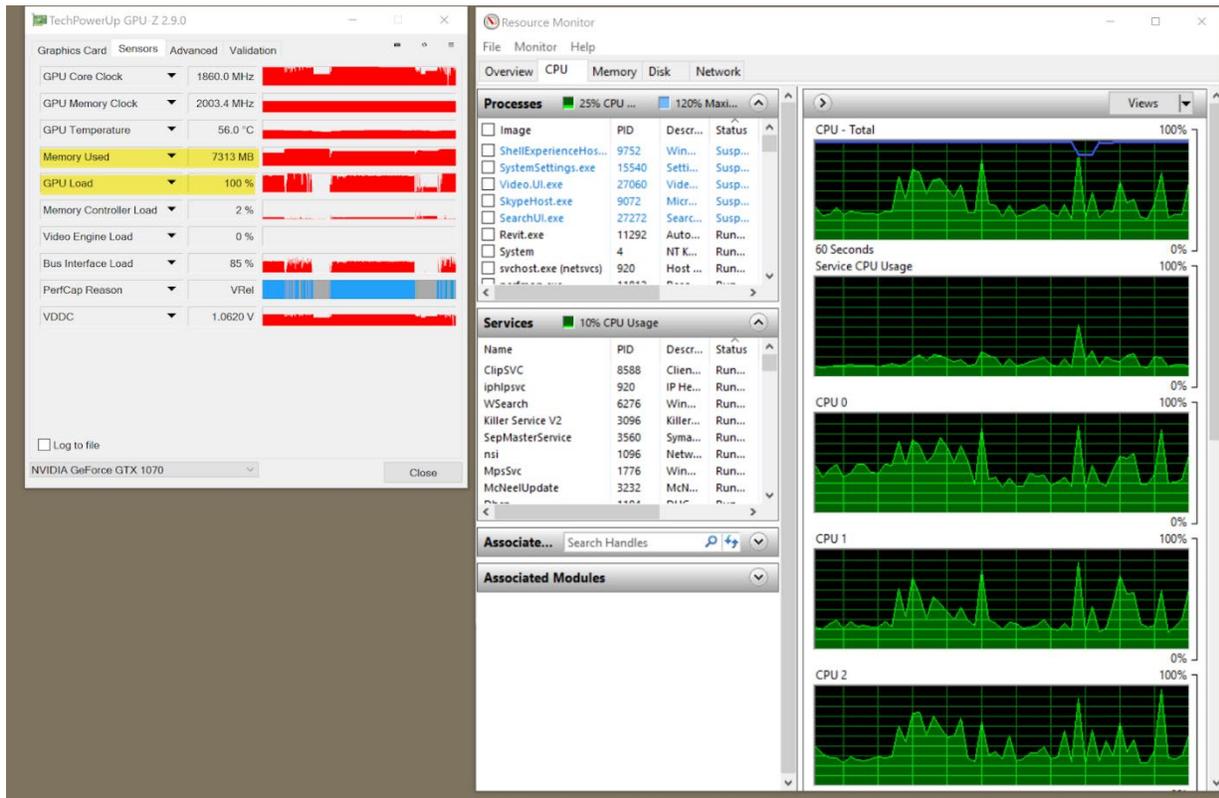


Before getting into what's cool about the advanced materials, I want to share a comparison between rendering within Revit and using Enscape.

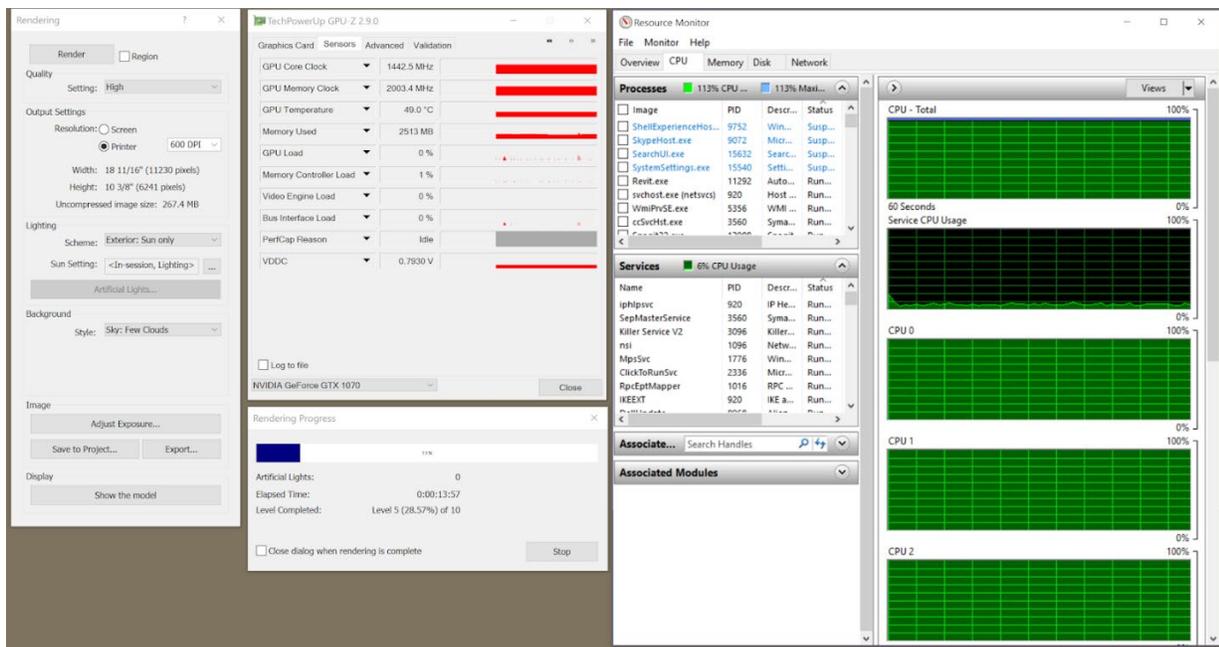
The image above is from Enscape and took about 2 minutes to save to a file. The image below is from Revit's render engine, which took about 2 hours. The Revit image has a slightly higher resolution, as Enscape is limited to a maximum of 8192 x 8192. The Revit PNG is 70MB and Enscape PNG is 40MB.



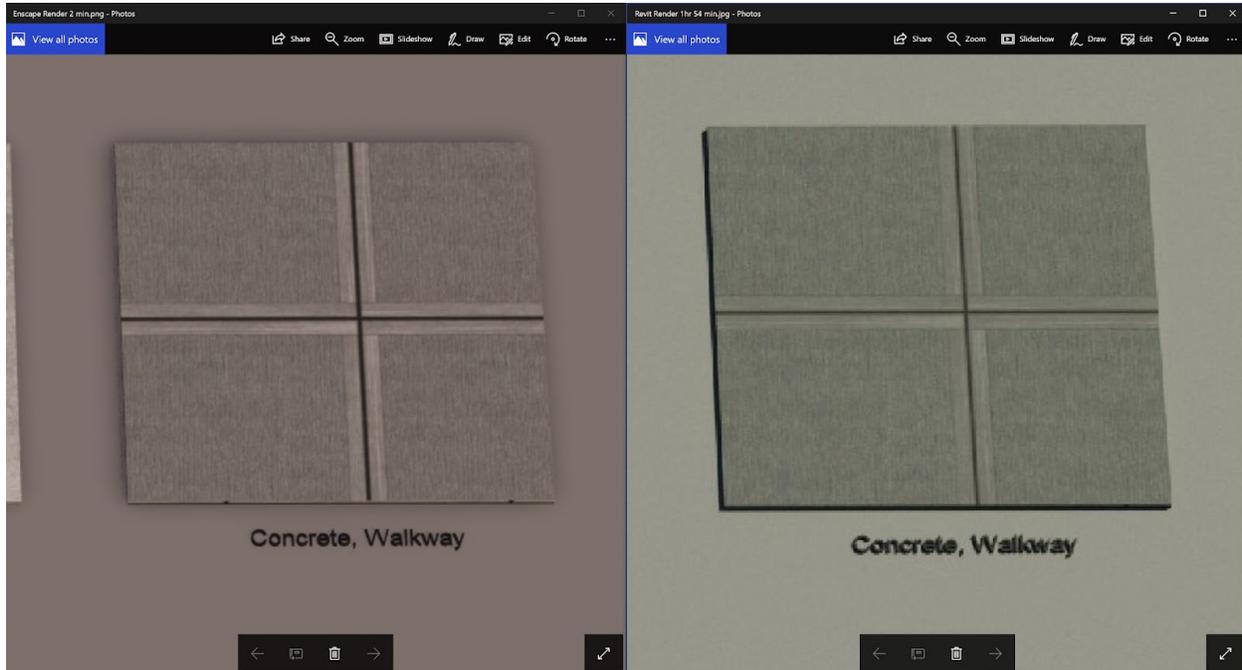
I am sure there are many things that contribute to the time and quality differences, but one of them has to do with the resources the two programs use. Enscape mainly leverages the GPU (NVIDIA) on the graphics card as shown in the next image. Also, notice the GPU memory is nearly 8GB, which may be due to the advanced materials or that I had previously used Revit rendering (I have not done any extra testing on this).



Revit, on the other hand, uses the CPU (Intel) for processing. It does use all the cores at 100% as shown in the next image, but the GPU is barely touched (just talking about rendering here).



Here is the same two images above, zoomed in on one material. Enscape on the left and Revit on the right. They are both fairly close, but one took 2 minutes and the other 2 hours!



FYI: The rest of the images are from Enscape.

Here is that same concrete sidewalk material with a little more context. It is a very nice material indeed!



The next two are a beautiful tile material...



I love this wood flooring material as well... note that all the furniture is also using the new advanced Revit 2019+ materials.



Enscape Supports Revit 2019 Advanced Materials

This is a quick mention that in less than two weeks after the release of **Autodesk Revit 2019**, and **Enscape** was supporting the new advanced materials. Check out how much better a typical commercial ceiling looks in both a Revit render and in Enscape.

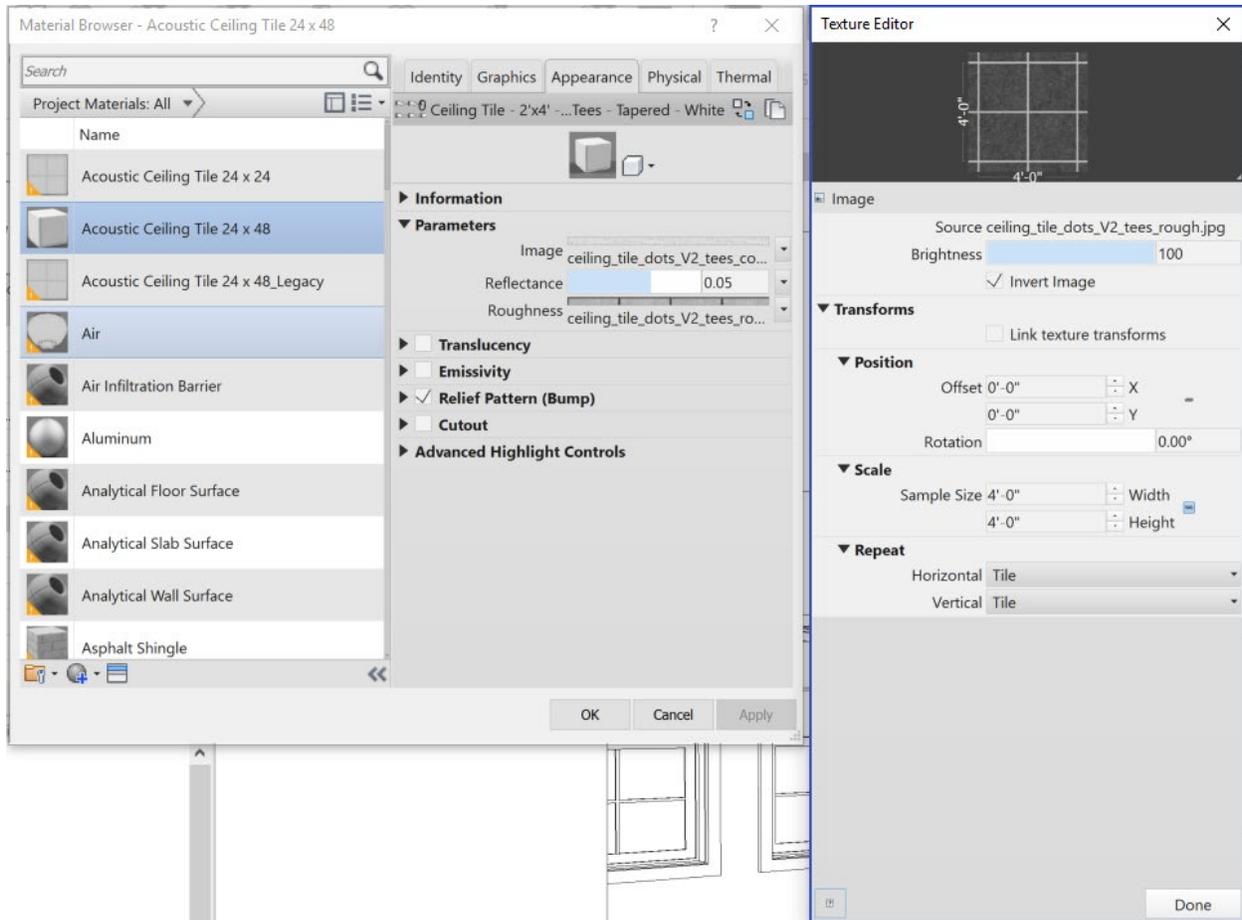
This first image is rendered directly in Revit. Super simple, but the walls, floor and ceiling are all defined by the new Revit shaders. Notice the reflection of just the metal grid in the ceiling.



Here is what that same scene looks like in Enscape, generated in a fraction of the time.



I did have to invert the **Roughness** image to get the ceiling grid reflection to match the Revit rendering.



Good stuff!

Manage and share material libraries

In a design firm with more than one person, consider developing and using a custom shared material library. Here are a few things to consider...

Sharing Materials in multiple projects and families

There are a few different ways to approach this depending on your needs. One is to create a **custom material library** (covered in the next section), another is to use **Transfer Project Standards**.

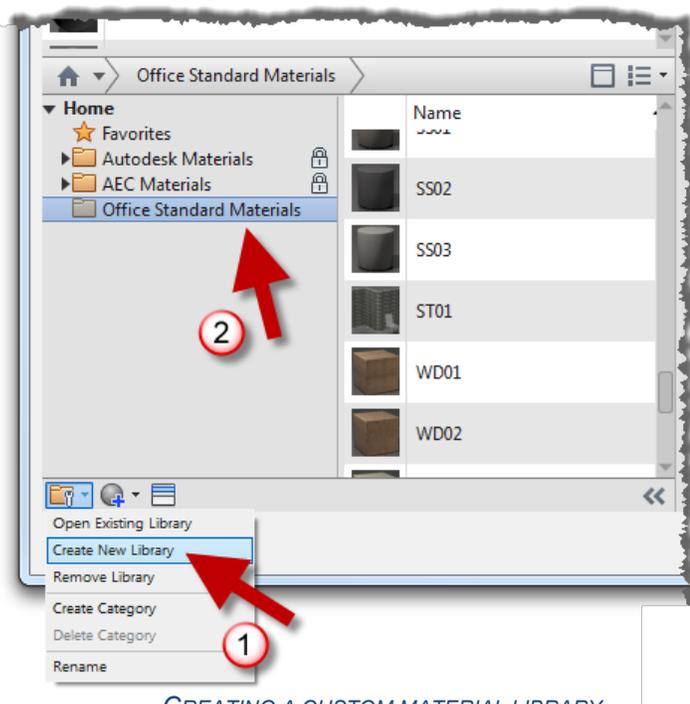
If the *Material* is already setup in the project environment, it will NOT be changed when loading families with the same *named* materials. Revit assumes the project is correct and will not change that material every time a family is loaded. With that knowledge, all you really have to do is make a dummy material with the correct name, load it into a project with the correct material (i.e. identity, graphics, appearance, etc. settings) and then open that family for editing. Now you have a family with the same settings.

Custom Material Libraries

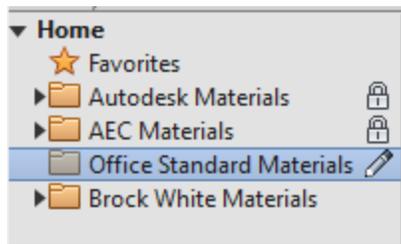
Creating a custom material library is an easy way to store and share Revit materials. This file should be saved in a shared location so everyone has access to it. It would be great if manufacturer's would start providing material libraries for their products rather than just the textures (i.e. raster image files).

Simply create a new library and name it as shown in the images in this section. You can then drag materials from a project to this folder. A lock will appear next to the library name if the file/folder is set to read-only in any way.

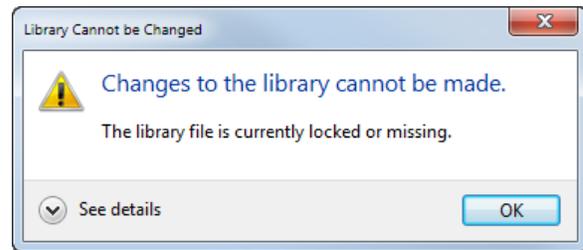
When changing a library in any way you will see a pencil icon next to the library name. This indicates that there is a lock on the file and no one else can edit it. If they try they will see the error message shown on the next page. Clicking the pencil icon will release your lock and allow others to edit it. Sometimes you will also see a refresh icon to update the version of the library you are looking at if changes have been made.



CREATING A CUSTOM MATERIAL LIBRARY



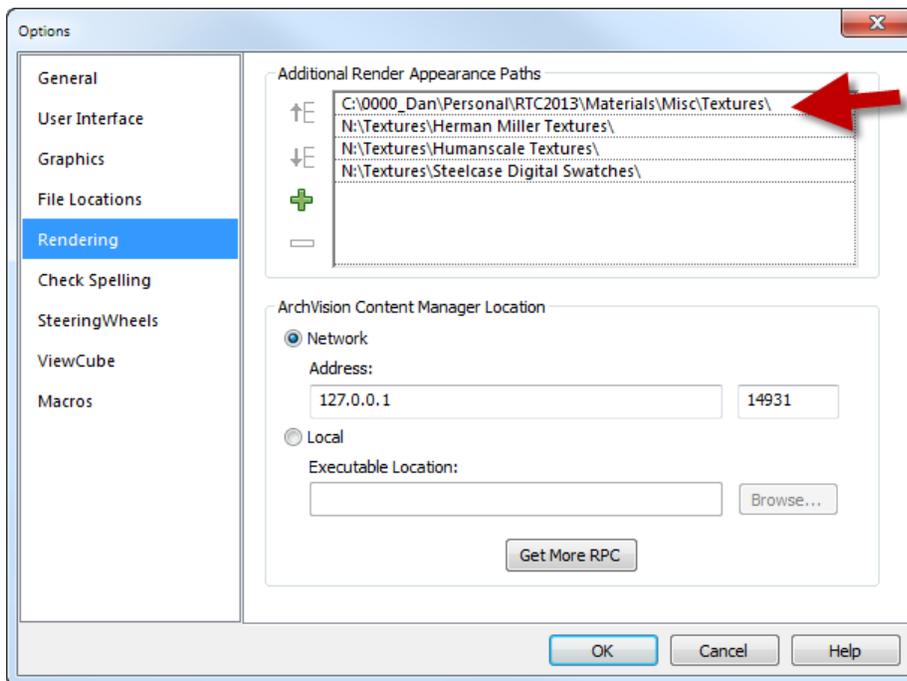
CUSTOM MATERIAL LIBRARY



FILE CAN BE MADE READ-ONLY

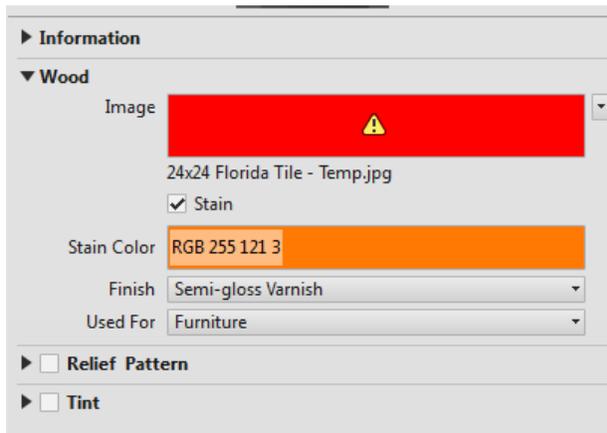
An important step to make sure the materials see the appearance textures, is to specify the path via *Options* as shown below. This is also important to set so the materials are found when rendering; if not set you will see a list of material not found during the rendering process.

TIP: After adding the render path, you may need to close Revit and reopen it get the Materials to properly see the textures.



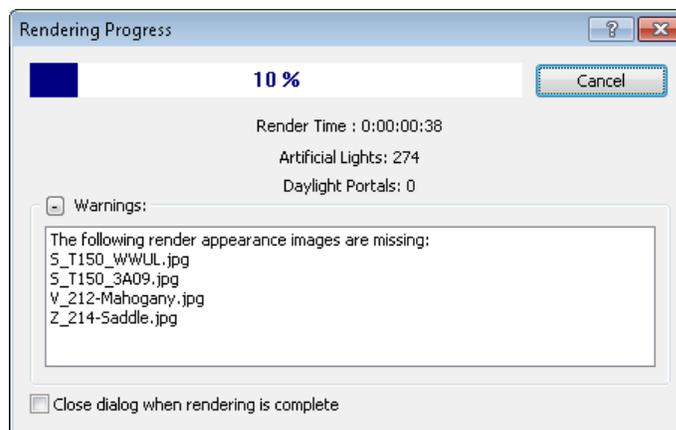
SETTING PATH FOR TEXTURES USED BY MATERIALS

When a material is not found, you will get a warning icon as shown on the next page (on the appearance tab):



WARNING FOR TEXTURES NOT FOUND

When rendering, you will also get a warning about any missing materials. When these materials are associated with a downloaded family, you may be out of luck on accessing the original.



WARNING FOR TEXTURES NOT FOUND WHEN RENDERING

Revit Material Appearance Assets and BIM 360 Design

Design teams working on Revit project in the cloud, using BIM 360 Design, currently have a disadvantage in that there is no officially supported method to share textures (i.e. jpg or png image files) via the cloud. If everyone is using VPN and has a drive letter mapped to a folder in the office that technically works, but will be very slow... even just opening the Material Editor dialog would have to search/read all of those remote raster image files, some of which can be very large.

Hopefully Autodesk will support this and similar things like mater keynote files in BIM 360 in the future. Be sure to head over to Revit Ideas and vote on these things!

Custom Assets Library in Revit

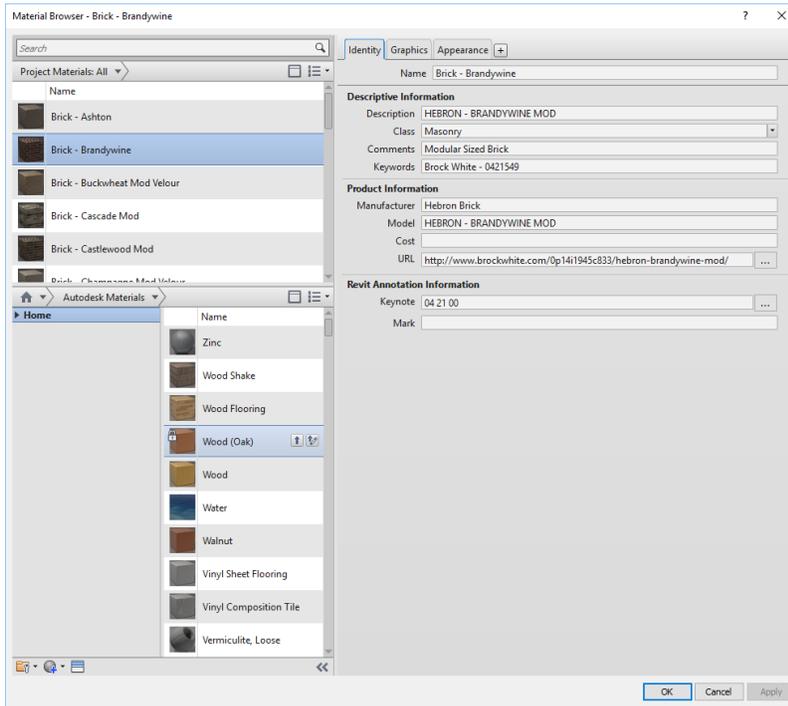
I few years ago I had an intern create a Revit material and asset library based on a brick manufacture's specs and images. A few of them are not very good due to the small sample area of the image, which creates an unpleasantly distinct repeating pattern, and a few of them do not repeat very well. However, it is a good example of how one might create a custom library for **materials AND assets**; the later will be the more interesting discussion here.

Here is a quick look at the materials in a Revit project.

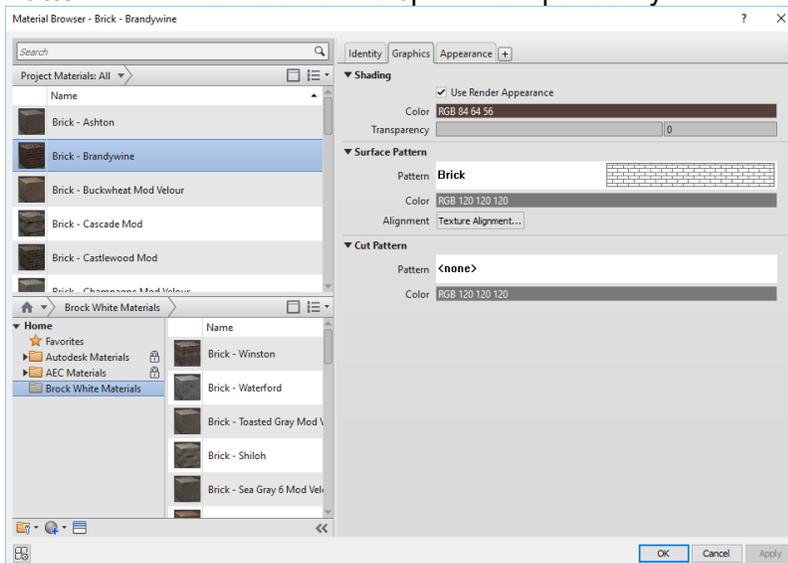


The next three images, on the next page, show the material definition for one of the brick materials.

Identity tab includes information about the product and a URL link for more information on the supplier/manufacturer's website.

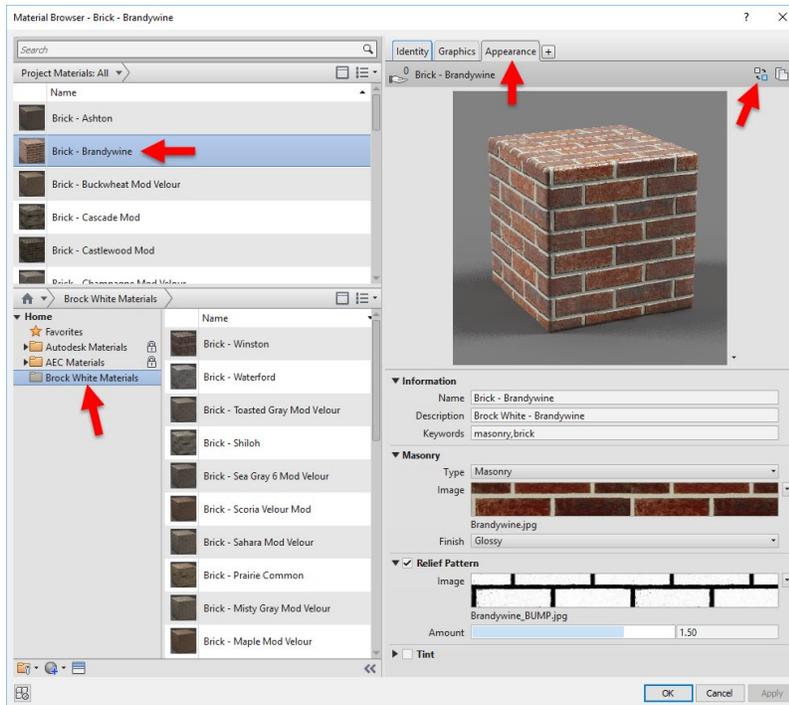


The **Graphics** tab has the shading color defined by the **Render Appearance** and the **Surface Pattern** matches the brick size/pattern. Tip: use PyRevit to create custom fill patterns (for free).



The **Appearance** tab defines the realistic/rendering/VR texture. Notice this is a **"Masonry"** material asset type and it has two images assigned. In this case, the surface pattern is a Posterized version of the original image file and the joints have been made completely solid. This step creates a little more distinction in the relief. It is perfectly fine to just use the original material as the relief (I do it often).

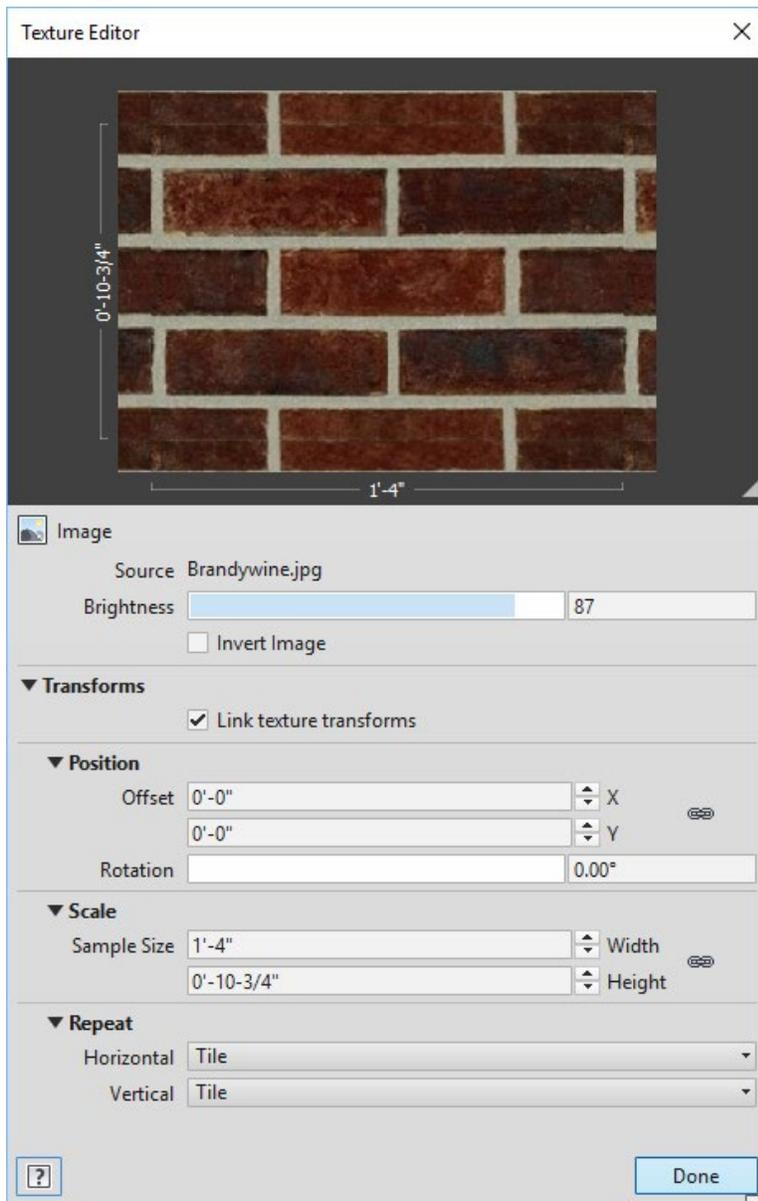
- **FYI:** I have noticed, that somethings the advanced materials get washed out in Enscape. In this case, this should be changed to a "**Generic**" material.



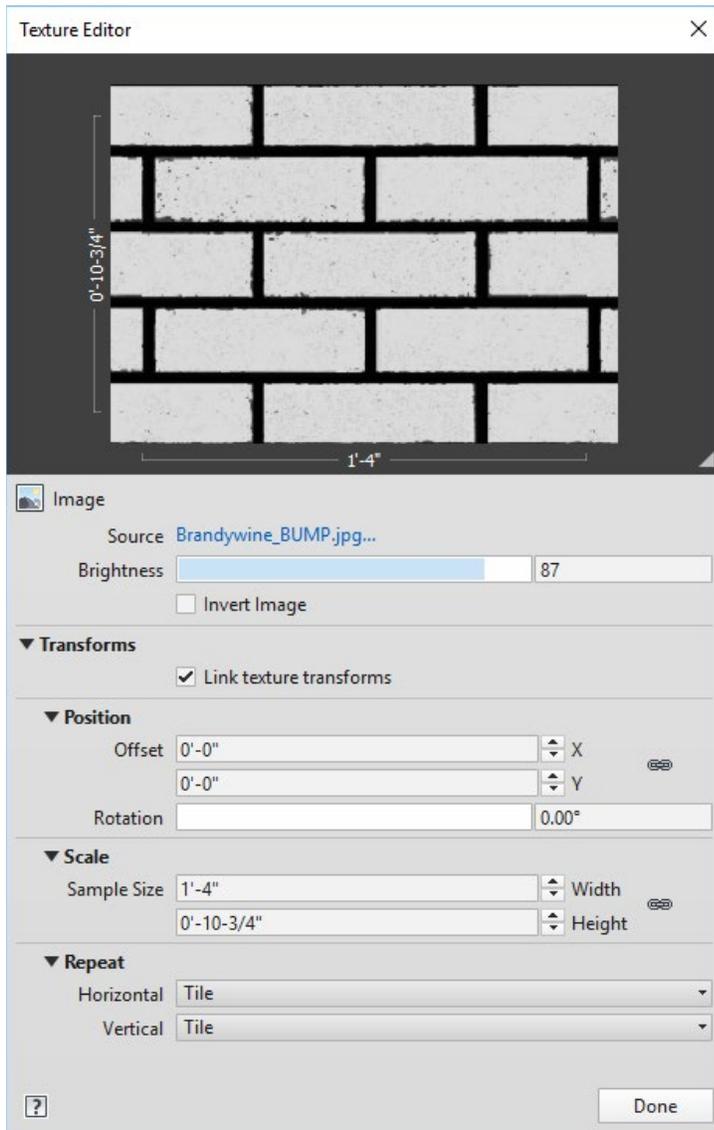
I do not recall why the **Finish** is set to **Glossy**. Below is a close up view of the material. The white highlights are related to the glossy setting and the current sun position in the view.



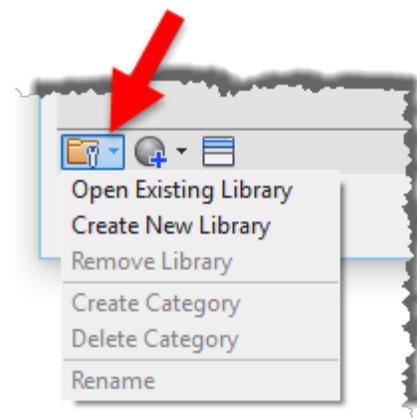
Clicking on the image swatch opens the **Texture Editor**. Here is where the size of the texture is defined (i.e. **Scale** parameters). This is also where the material is set to **Repeat** vertically and horizontally.



The same values are entered for the **Relief Pattern** image.



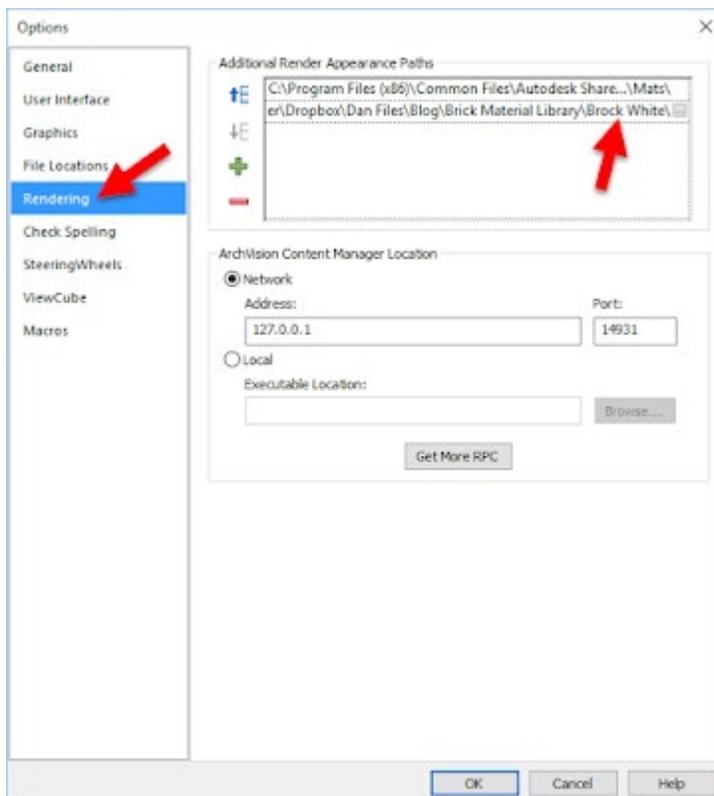
The **Material Browser** has an icon in the lower left which allows you to **create a new** material library or **open an existing** one. For the brick material library I simply created a new library, which involved providing a name and location for the ADSKLIB file.



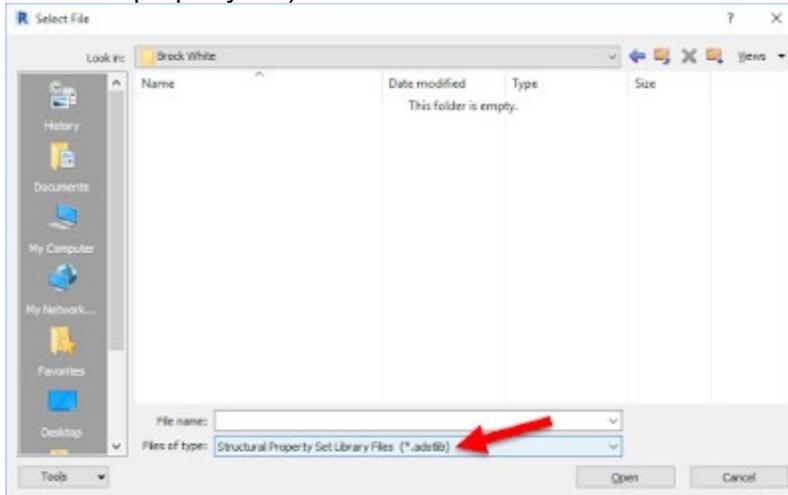
I placed all the image files (textures) in a folder along with the ADSKLIB file on the server so everyone has access to it.

Name	Date	Type	Size	Tags
Ashton.jpg	10/15/2009 2:09 PM	JPG File	90 KB	
Ashton_BUMP.jpg	6/13/2013 1:27 PM	JPG File	94 KB	
Brandywine.jpg	6/19/2013 8:26 AM	JPG File	108 KB	
Brandywine_BUMP.jpg	6/19/2013 8:28 AM	JPG File	94 KB	
Brick Materials 6-20.rvt	6/20/2013 2:26 PM	Autodesk Revit Pr...	1,492 KB	
Brock White Materials.adsklib	3/7/2014 11:02 AM	ADSKLIB File	5,137 KB	
Buckwheat Mod Velour.jpg	6/14/2013 9:09 AM	JPG File	103 KB	
Buckwheat Mod Velour_BUMP.jpg	6/14/2013 3:44 PM	JPG File	71 KB	
Cascade Mod.jpg	6/18/2013 1:17 PM	JPG File	128 KB	
Cascade Mod_BUMP.jpg	6/18/2013 3:48 PM	JPG File	83 KB	
Castlewood Mod.jpg	6/14/2013 9:39 AM	JPG File	125 KB	
Castlewood Mod_BUMP.jpg	6/14/2013 3:44 PM	JPG File	69 KB	
Champagne Mod Velour.jpg	6/14/2013 9:58 AM	JPG File	89 KB	
Champagne Mod Velour_BUMP.jpg	6/14/2013 3:44 PM	JPG File	89 KB	
Champagne Utility Velour.jpg	6/14/2013 10:01 AM	JPG File	89 KB	
Champagne Utility Velour_BUMP.jpg	6/14/2013 4:09 PM	JPG File	60 KB	
Chocolate Mod Rugg.jpg	6/14/2013 10:01 AM	JPG File	104 KB	

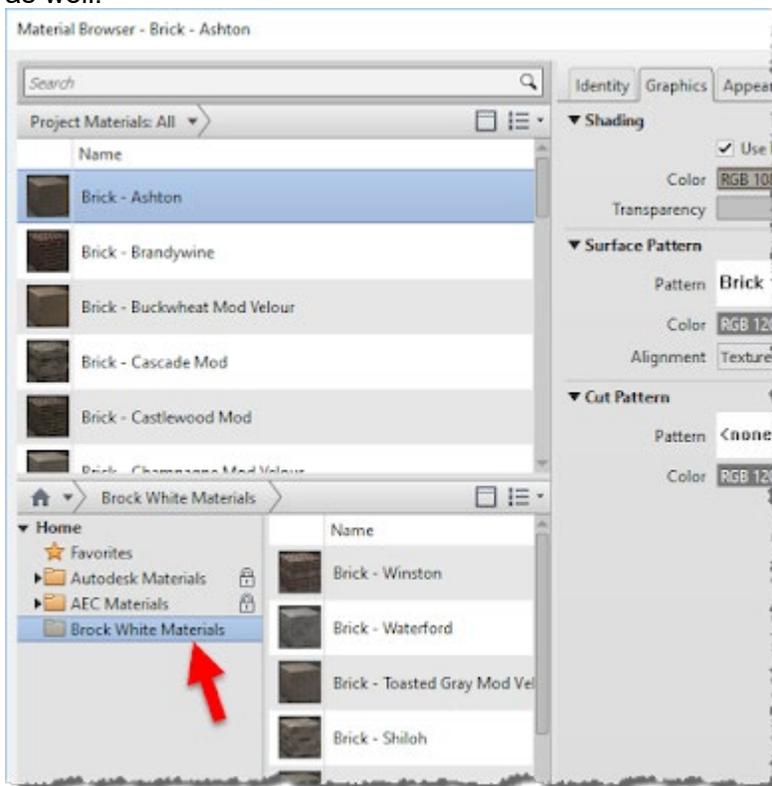
Anyone using these materials will need to add this path to the **Additional Render Appearance Paths** in Revit's **Options** dialog. If this is not done, the material will be gray. These special paths can be incorporated into a deployment. I have several in my deployment; for brick, Herman Miller, Haworth, etc.



Anyone who needs access to this library can use the **Open Existing Library** option in the **Material Browser** dialog (shown previously). Make sure the **File of type** is set to ADSKLIB (not structural property set).

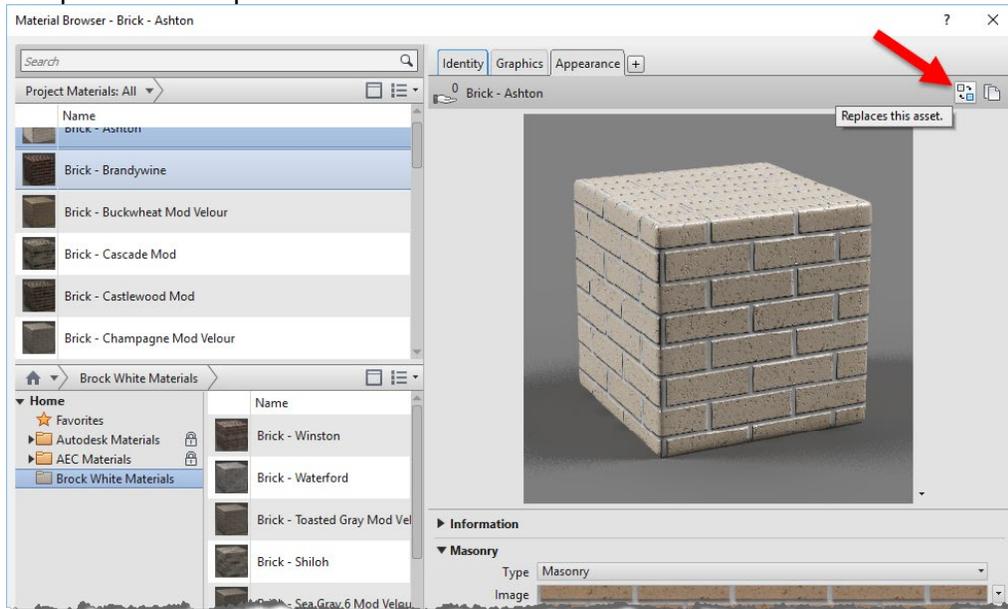


Once loaded, the new library is listed in the **Library Panel** as shown below. Materials can be loaded into the current project, just like you do with the Autodesk provided materials. Unless the custom library is in a read-only folder, project materials can be dragged into the custom library as well.

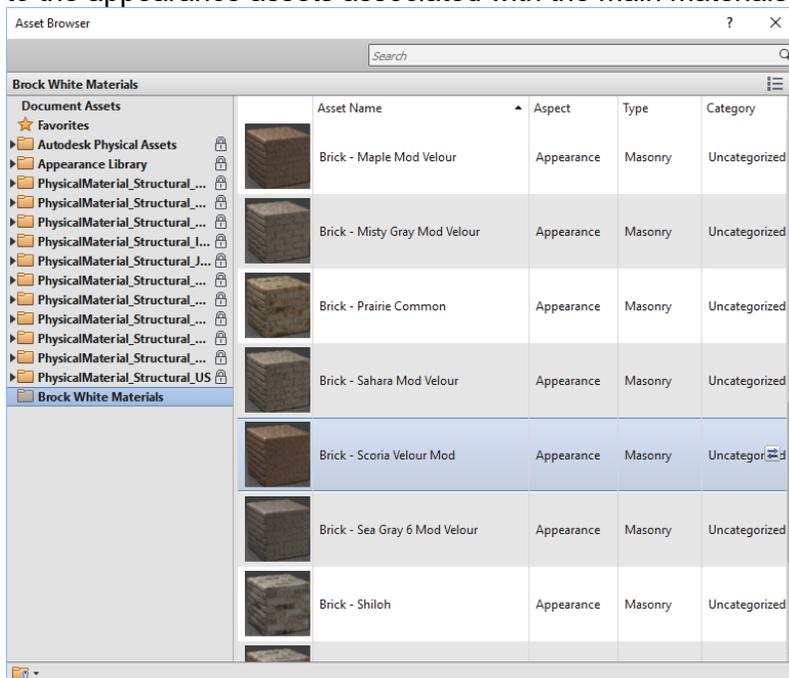


When a material is saved to a custom material library, it includes the main material and its assets (i.e. appearance, thermal, structural). Sometimes, we just want to change a brick material already defined in the project; because it is used by several walls, families, etc. In this case, it is easier to modify the existing material.

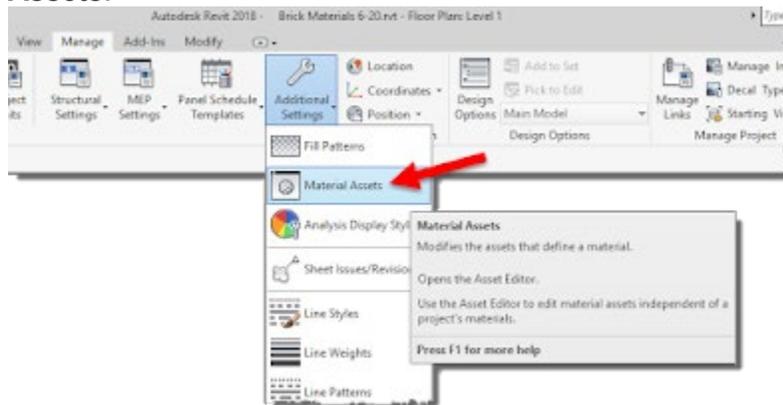
It is possible to replace a material's asset with another one...



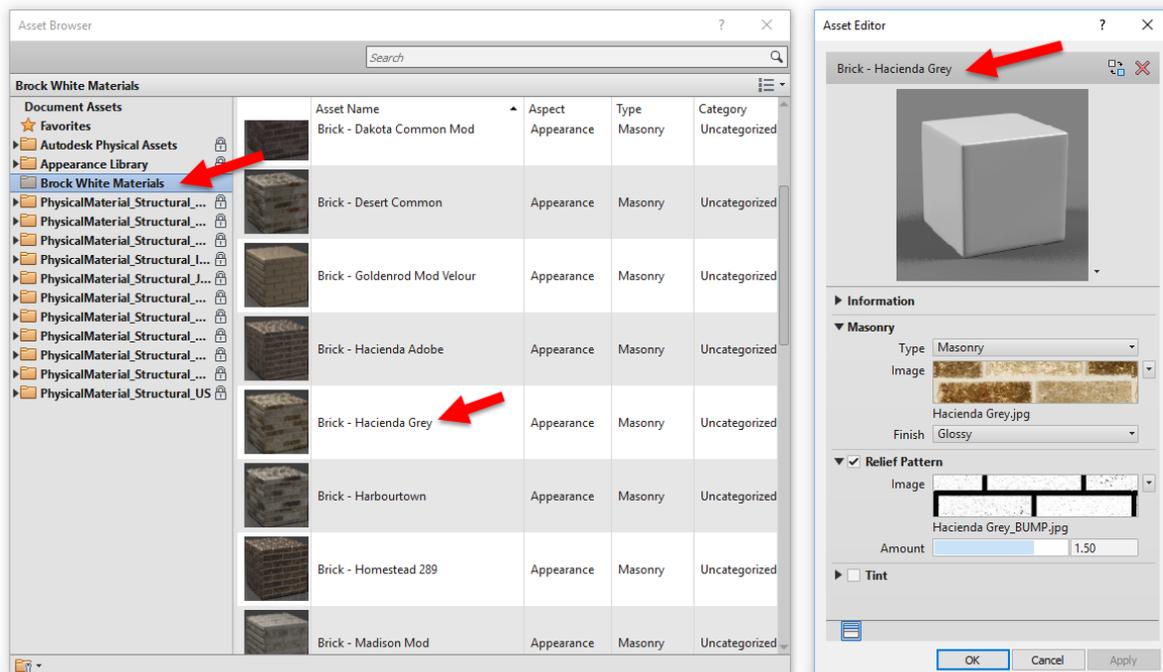
In the **Asset Browser**, we can also load the custom material library. This gives us direct access to the appearance assets associated with the main materials as shown below.



If needed, the material assets can be modified apart from the main material. This may not need to be done very often, at least in this example. However, when you need to do it, the process is not very intuitive. From the **Manage** tab, select **Additional Settings** and then **Materials Assets**.



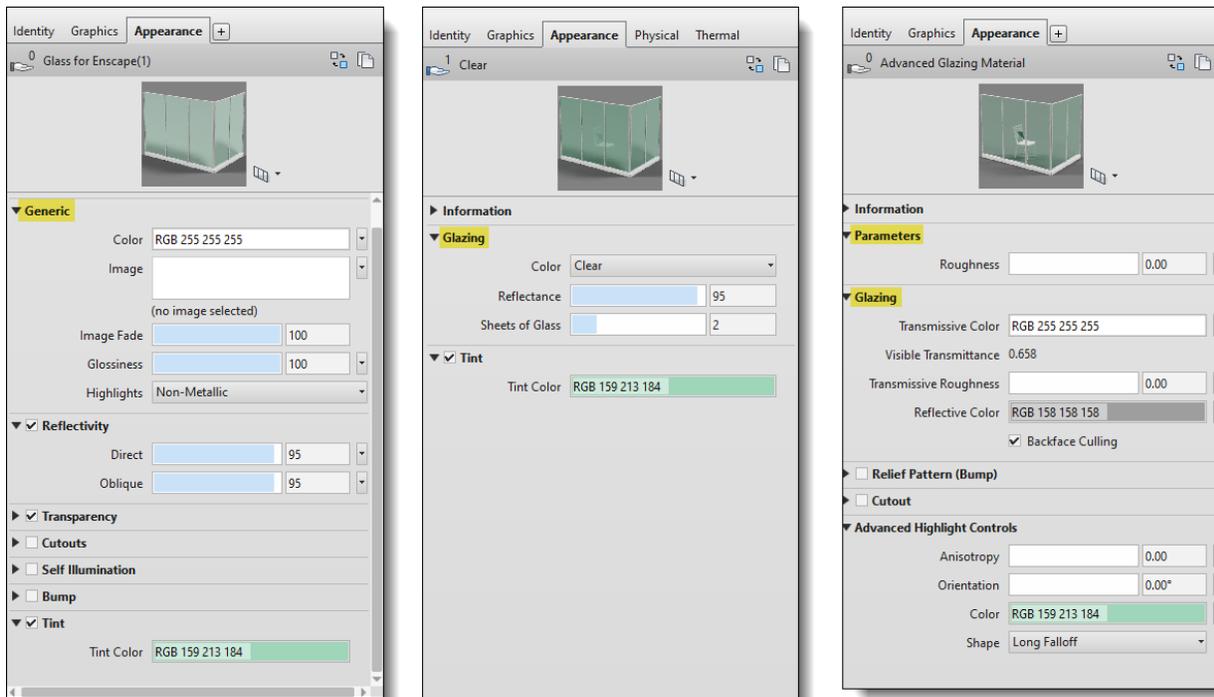
When both the **Asset Editor** and the **Material Browser** are open, double-click on a material to load its settings into the adjacent **Asset Editor** dialog as shown below.



This is a little bit of a tangled web, but getting a handle on this will make the design process and visualization efforts a little more efficient!

Glass in Revit

Using Autodesk Revit, we can achieve glazing amazing results in Enscape. The following image highlights the three options: Generic, Glazing and Advanced.



COMPARING THE THREE REVIT MATERIAL TYPES USED TO DEFINE ARCHITECTURAL GLAZING; GENERIC, GLAZING, ADVANCED

Default Glass Material

A Revit-provided template has the “Glass” material set to the **Glazing** shader option (not Generic or advanced). But the **Reflectance** value is set quite low so the initial impact in Enscape can be disappointing.

The range of reflectance can be seen in this comparative image, with a **100** setting on the left, **50** in the center, and **0** on the right. The default in Revit is 15, which is closer to the example on the right which almost looks like there is no glass in the curtain wall system.



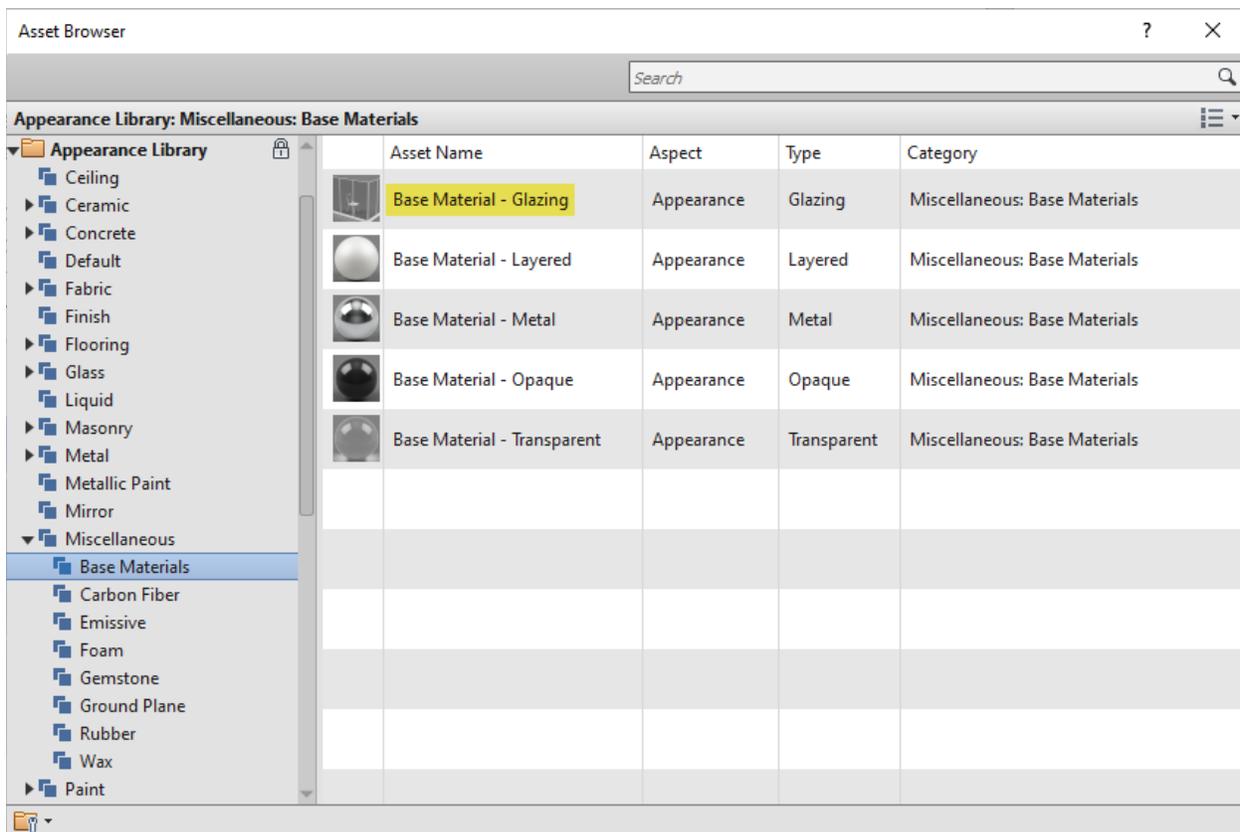
COMPARING REFLECTANCE VALUES FOR REVIT'S GLAZING MATERIAL

Advanced Material

Revit’s advanced materials, introduced in Revit 2019, have different settings for the physically based glazing shader. It should be pointed out that this “glazing” material is different than the equally new advanced “glass” material. Unlike glass, light is not **refracted** for efficiency in glazing. The result in Enscape is a surface which is always evident from any vantage point, and the reflective quality is good.

TIP: At this time, this material type is NOT recommended to achieve optimal results in Enscape. It is still touched on so the reader can better understand the differences and limitations.

Again, the *Glazing* base PBR material (aka advanced material) is different that the more physically accurate *Transparent* (i.e. glass) material that would be used for a vase or solid glass object. Rather, glazing is optimized for architectural applications and does not produce any refraction or internal reflection. These newer advanced materials have ‘base versions’ which can be used to start new materials from scratch as shown in the image below.



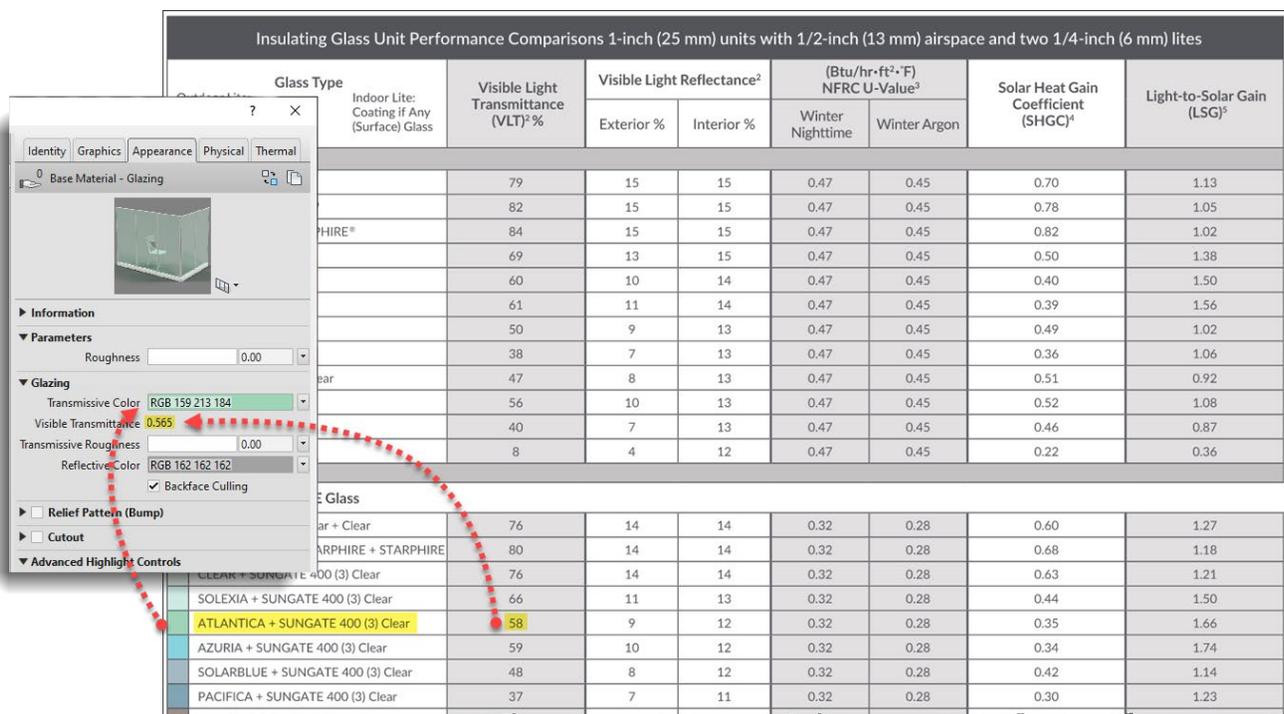
REVIT 2019 ADVANCED MATERIALS BASE ASSET LIBRARY

It is interesting that the new advanced material has a **Visual Transmittance** (T-Vis or VLT) value. Anyone specifying glazing or involved in daylight analysis or calculations will be familiar with this real-world physical property.

Revit, Autodesk Lighting Analysis, ElumTools, and, Insight also use this information for energy analysis. In the chart below we see the VLT range is from about 60 – 90%.

NAME	GLAZING TYPE NORTHERN, SOUTHERN, EASTERN, WESTERN WALLS	U- VALUE W/M^2K	U-VALUE BTU/HR-FT2- F	SHGC	VLT
Sgl Clr	Single Clear 6mm	6.17	1.09	0.81	0.88
Dbl Clr	Dbl Clear 6/13 Air	2.74	0.48	0.7	0.78
Dbl LoE	Dbl Low-E (e3=0.2)Clear 3/13 Air	1.99	0.35	0.73	0.74
Trp LoE	Trpl Low-E (e2=e5=0.1) Clr 3mm/6mm Air	1.55	0.27	0.47	0.66
Quad LoE	Quadruple LoE Films (88) 3mm/8mm Krypton	0.66	0.12	0.45	0.62

The transmissive color corresponds to the inherent color in the raw materials used to create the glass. The light assumes this color as it passes through the glass. Using Revit’s advanced material shader for glazing, when the correct color is entered, from a manufacturer’s data sheet for example, the Visible Transmittance (VLT) value is correctly calculated as well, as shown in the image below. VLT is the total amount of light which passes through the glass. FYI: Vitro example used can be found [here](#).

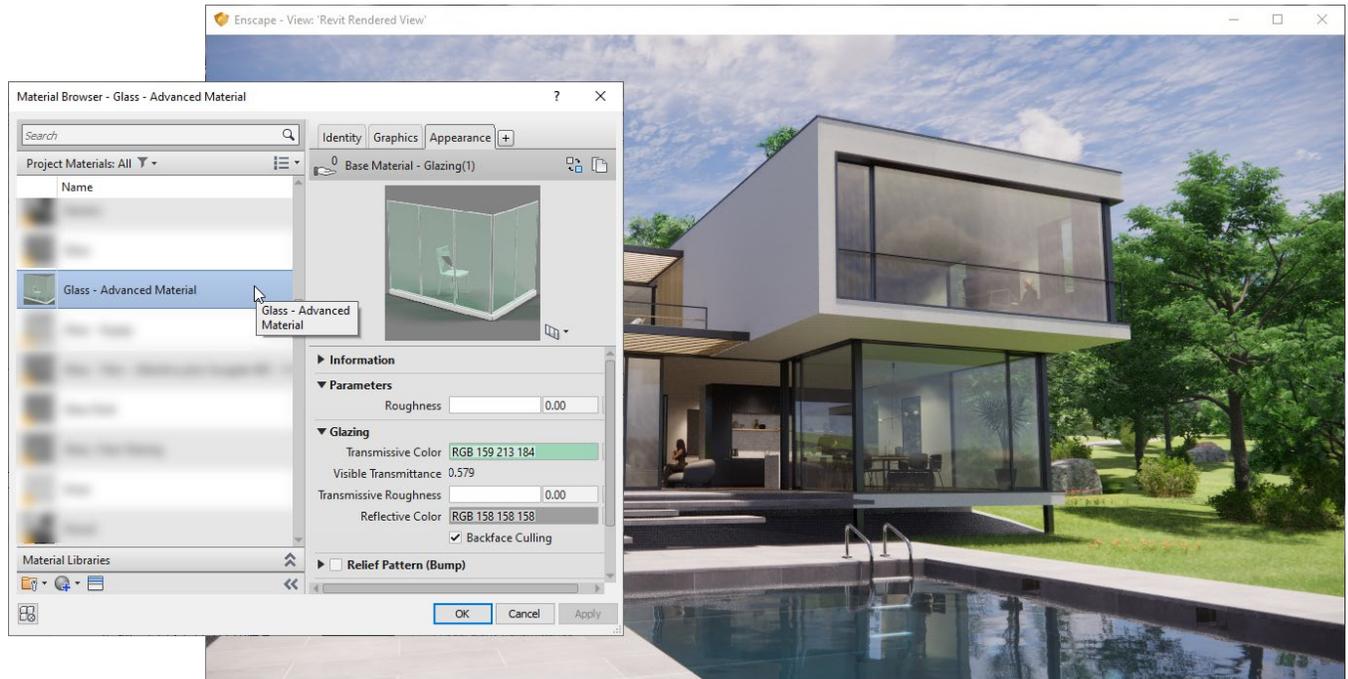


Insulating Glass Unit Performance Comparisons 1-inch (25 mm) units with 1/2-inch (13 mm) airspace and two 1/4-inch (6 mm) lites

Glass Type	Indoor Lite: Coating if Any (Surface) Glass	Visible Light Transmittance (VLT) ² %	Visible Light Reflectance ²		(Btu/hr·ft ² ·°F) NFRC U-Value ³		Solar Heat Gain Coefficient (SHGC) ⁴	Light-to-Solar Gain (LSG) ⁵
			Exterior %	Interior %	Winter Nighttime	Winter Argon		
		79	15	15	0.47	0.45	0.70	1.13
		82	15	15	0.47	0.45	0.78	1.05
	STARPHIRE®	84	15	15	0.47	0.45	0.82	1.02
		69	13	15	0.47	0.45	0.50	1.38
		60	10	14	0.47	0.45	0.40	1.50
		61	11	14	0.47	0.45	0.39	1.56
		50	9	13	0.47	0.45	0.49	1.02
		38	7	13	0.47	0.45	0.36	1.06
	Clear	47	8	13	0.47	0.45	0.51	0.92
		56	10	13	0.47	0.45	0.52	1.08
		40	7	13	0.47	0.45	0.46	0.87
		8	4	12	0.47	0.45	0.22	0.36
Low-E Glass								
	Star + Clear	76	14	14	0.32	0.28	0.60	1.27
	STARPHIRE + STARPHIRE	80	14	14	0.32	0.28	0.68	1.18
	Clear + SUNGATE 400 (3) Clear	76	14	14	0.32	0.28	0.63	1.21
	SOLEXIA + SUNGATE 400 (3) Clear	66	11	13	0.32	0.28	0.44	1.50
	ATLANTICA + SUNGATE 400 (3) Clear	58	9	12	0.32	0.28	0.35	1.66
	AZURIA + SUNGATE 400 (3) Clear	59	10	12	0.32	0.28	0.34	1.74
	SOLARBLUE + SUNGATE 400 (3) Clear	48	8	12	0.32	0.28	0.42	1.14
	PACIFICA + SUNGATE 400 (3) Clear	37	7	11	0.32	0.28	0.30	1.23

GLAZING DEFINED WITH REVIT 2019 ADVANCED MATERIAL – SPECIAL 'GLAZING' SHADER

The following image shows the results of this material definition within Enscape. It is easy to see the transmissive color within the glass, which is great! The one big limitation with this material within Enscape, at the moment, is that the glass appears frosted when receiving direct sunlight.



EXAMPLE RENDER USING REVIT'S ADVANCED 'GLAZING' MATERIAL

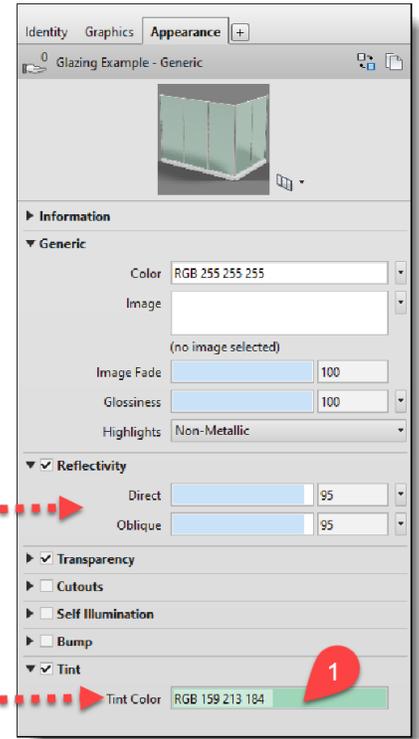
Generic Material

Revit's generic materials have the most options to control the various aspects of a material in Revit.

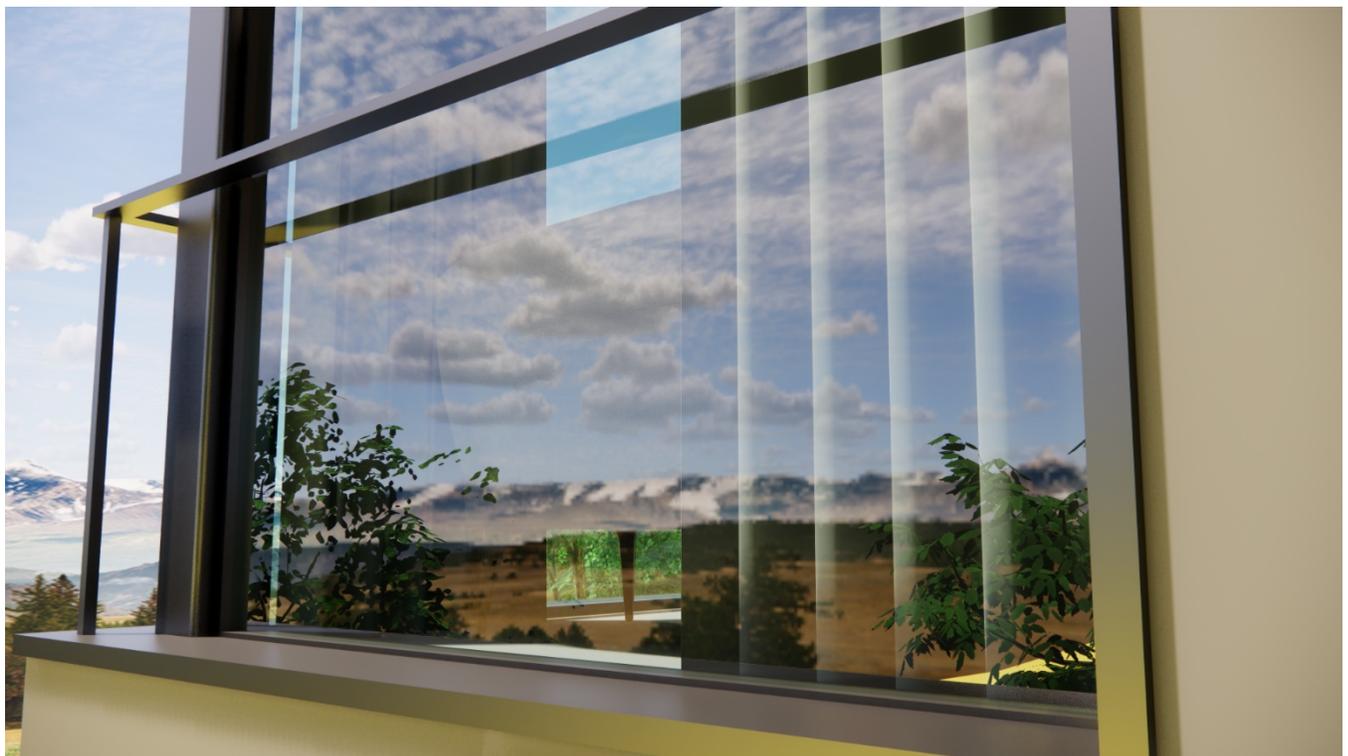
In the manufacturer data sheet shown on the next page, the glass color and reflectance can be mapped directly (tip: use an eyedropper tool in a graphics app to get the RGB value of the color). The VLT can be translated as a percentage of Revit's 255 shades of gray; thus, $255 \times \text{VLT} = \text{RGB value}$ (enter the result for all three). This is achieved using the **Tint** parameter.

Insulating Glass Unit Performance Comparisons 1-inch (25 mm) units with 1/2-inch (13 mm) airsp

Outdoor Lite: Coating if Any (Surface) Glass	Glass Type +	Indoor Lite: Coating if Any (Surface) Glass	Visible Light Transmittance (VLT) ² %	Visible Light Reflectance ²		(Btu/hr-ft ² -F) NFRC U-Value ³	
				Exterior %	Interior %	Winter Nighttime	Winter Argon
Uncoated							
	CLEAR Glass + Clear		79	15	15	0.47	0.45
	ACUITY™ + ACUITY™		82	15	15	0.47	0.45
	STARPHIRE® + STARPHIRE®		84	15	15	0.47	0.45
	SOLEXIA® + Clear		69	13	15	0.47	0.45
	ATLANTICA® + Clear		60	10	14	0.47	0.45
	AZURIA® + Clear		61	11	14	0.47	0.45
	SOLARBLUE® + Clear		50	9	13	0.47	0.45
	PACIFICA® + Clear		38	7	13	0.47	0.45
	SOLARBRONZE® + Clear		47	8	13	0.47	0.45
	OPTIGRAY® + Clear		56	10	13	0.47	0.45
	SOLARGRAY® + Clear		40	7	13	0.47	0.45
	GRAYLITE®II + Clear		8	4	12	0.47	0.45
Coated							
SUNGATE® 400 Low-E Glass							
	SUNGATE 400 (2) Clear + Clear		76	14	14	0.32	0.28
	SUNGATE 400 (2) STARPHIRE + STARPHIRE		80	14	14	0.32	0.28
	STARPHIRE® + SUNGATE 400 (3) Clear		76	14	14	0.32	0.28
	SOLEXIA® + SUNGATE 400 (3) Clear		66	11	13	0.32	0.28
	ATLANTICA® + SUNGATE 400 (3) Clear		58	9	12	0.32	0.28
	AZURIA® + SUNGATE 400 (3) Clear		59	10	13	0.32	0.28
	SOLARBLUE® + SUNGATE 400 (3) Clear		48	8	12	0.32	0.28



SETTING A GENERIC MATERIAL TO ALIGN WITH REAL-WORLD PRODUCT DATA



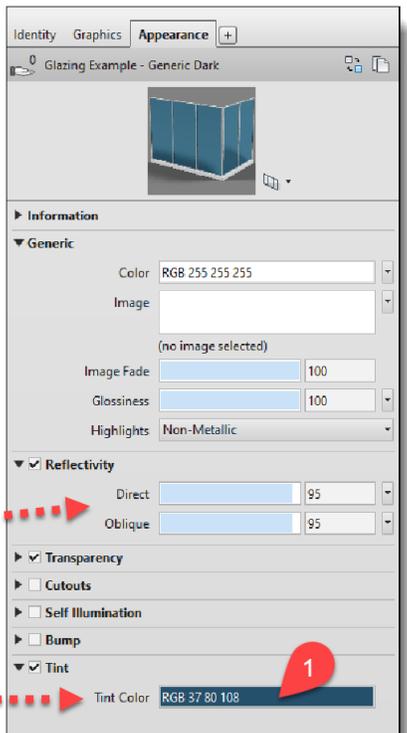
RENDERED RESULT USING GENERIC MATERIAL TO REPRESENT REAL-WORLD GLAZING

Tip: Adjust the Luminance value within Revits color dialog to adjust the VLT when using a color rather than grayscale RGB. This ElumTools article describes how to map an RGB value to a real-world VLT value:

<http://www.elumtools.com/docs/2021/Content/Using%20ElumTools/Color%20Reflectance%20or%20Transmittance.htm>

Here is another example using a much lower VLT value from the manufacturer's product line.

Insulating Glass Unit Performance Comparisons 1-inch (25 mm) units with 1/2-inch (13 mm) airsp							
Outdoor Lite: Coating if Any (Surface) Glass	Glass Type +	Indoor Lite: Coating if Any (Surface) Glass	Visible Light Transmittance (VLT) ² %	Visible Light Reflectance ²		(Btu/hr·ft ² ·°F) NFRC U-Value ³	
				Exterior %	Interior %	Winter Nighttime	Winter Argon
Uncoated							
	CLEAR Glass + Clear		79	15	15	0.47	0.45
	ACUITY™ + ACUITY™		82	15	15	0.47	0.45
	STARPHIRE® + STARPHIRE®		84	15	15	0.47	0.45
	SOLEXIA® + Clear		69	13	15	0.47	0.45
	ATLANTICA® + Clear		60	10	14	0.47	0.45
	AZURIA® + Clear		61	11	14	0.47	0.45
	SOLARBLUE® + Clear		50	9	13	0.47	0.45
	PACIFICA® + Clear		38	7	13	0.47	0.45
	SOLARBRONZE® + Clear		47	8	13	0.47	0.45
	GRAY® + Clear		56	10	13	0.47	0.45
	DARKGRAY® + Clear		40	7	13	0.47	0.45
	GRAYLITE®II + Clear		8	4	12	0.47	0.45
Coated							
SUNGATE® 400 Low-E Glass							
	SUNGATE 400 (2) Clear + Clear		76	14	14	0.32	0.28
	SUNGATE 400 (2) STARPHIRE + STARPHIRE		80	14	14	0.32	0.28
	CLEAR + SUNGATE 400 (3) Clear		76	14	14	0.32	0.28
	SOLEXIA + SUNGATE 400 (3) Clear		66	11	13	0.32	0.28
	ATLANTICA + SUNGATE 400 (3) Clear		58	9	12	0.32	0.28
	AZURIA + SUNGATE 400 (3) Clear		59	10	12	0.32	0.28
	SOLARBLUE + SUNGATE 400 (3) Clear		48	8	12	0.32	0.28



A VARIATION ON THE PREVIOUS EXAMPLE, USING A DARKER VLT VALUE



RENDERED RESULT USING GENERIC MATERIAL TO REPRESENT REAL-WORLD GLAZING

Visible Light Reflectance (VLR)

What you can adjust via the reflectivity sliders in Revit isn't 1:1 for the VLR percentage found in manufacturer's data sheets, but a subset of the range that is still physically plausible. Which means, for a "default" of 50% specularity we're assuming a mapping to the actual physical value of 4% reflected light (at an angle of 0°, we call that F0). Maximum specularity (slider at 100%) is mapped to the physical value of 12%, which is actually already above the highest plausible value for pure glass materials we found in literature at that time. Also, for materials that provide 2 sliders in Revit (direct & oblique) Enscape uses the average value of both sliders.

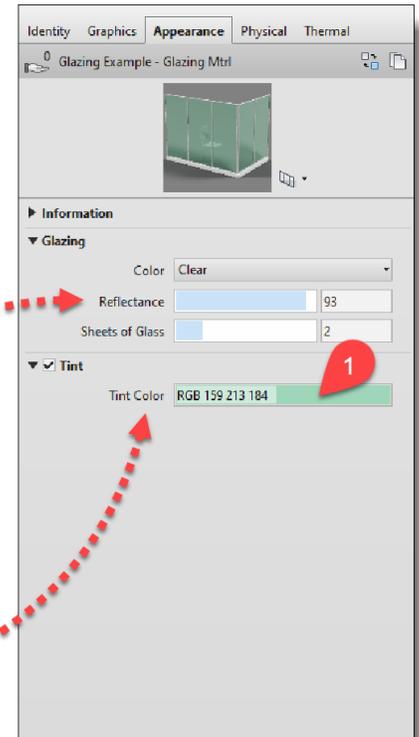


VISIBLE LIGHT REFLECTANCE VALUES RELATIVE TO REAL-WORLD RANGE

Glazing Material

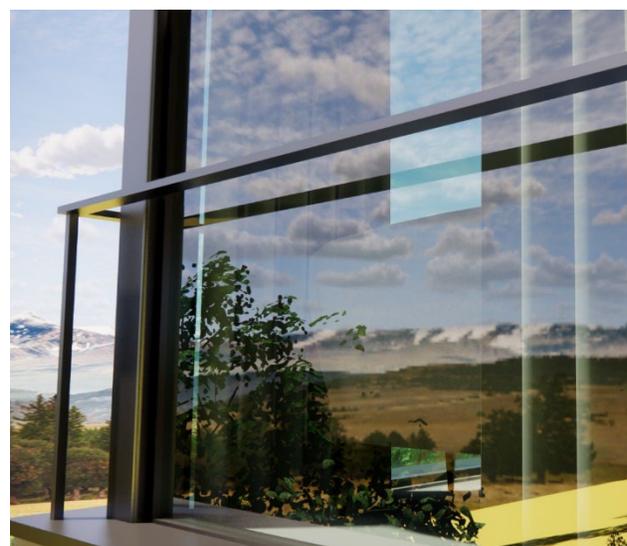
Finally, let us take a look at Revit's 'Glazing' material. Here we find that, when following the same steps just covered regarding real-world product data, the results are similar. Again, the tint drives the glazing's VLT.

Insulating Glass Unit Performance Comparisons 1-inch (25 mm) units with 1/2-inch (13 mm) airsp							
Outdoor Lite: Coating if Any (Surface) Glass	Glass Type +	Indoor Lite: Coating if Any (Surface) Glass	Visible Light Transmittance (VLT) ² %	Visible Light Reflectance ²		(Btu/hr·ft ² ·F) NFRC U-Value ³	
				Exterior %	Interior %	Winter Nighttime	Winter Argon
Uncoated							
	CLEAR Glass + Clear		79	15	15	0.47	0.45
	ACUITY™ + ACUITY™		82	15	15	0.47	0.45
	STARPHIRE® + STARPHIRE®		84	15	15	0.47	0.45
	SOLEXIA® + Clear		69	13	15	0.47	0.45
	ATLANTICA® + Clear		60	10	14	0.47	0.45
	AZURIA® + Clear		61	11	14	0.47	0.45
	SOLARBLUE® + Clear		50	9	13	0.47	0.45
	PACIFICA® + Clear		38	7	13	0.47	0.45
	SOLARBRONZE® + Clear		47	8	13	0.47	0.45
	OPTIGRAY® + Clear		56	10	13	0.47	0.45
	SOLARGRAY® + Clear		40	7	13	0.47	0.45
	GRAYLITE®II + Clear		8	4	12	0.47	0.45
Coated							
SUNGATE® 400 Low-E Glass							
	SUNGATE 400 (2) Clear + Clear		76	14	14	0.32	0.28
	SUNGATE 400 (2) STARPHIRE + STARPHIRE		80	14	14	0.32	0.28
	AR + SUNGATE 400 (3) Clear		76	14	14	0.32	0.28
	EXIA + SUNGATE 400 (3) Clear		66	11	13	0.32	0.28
	ATLANTICA + SUNGATE 400 (3) Clear		58	9	12	0.32	0.28
	AZURIA + SUNGATE 400 (3) Clear		59	10	12	0.32	0.28
	SOLARBLUE + SUNGATE 400 (3) Clear		48	8	12	0.32	0.28



SETTING A GLAZING MATERIAL TO ALIGN WITH REAL-WORLD PRODUCT DATA

Thus, of the three ways to represent glass in Enscape, the latter two being the best in achieving real-world results.



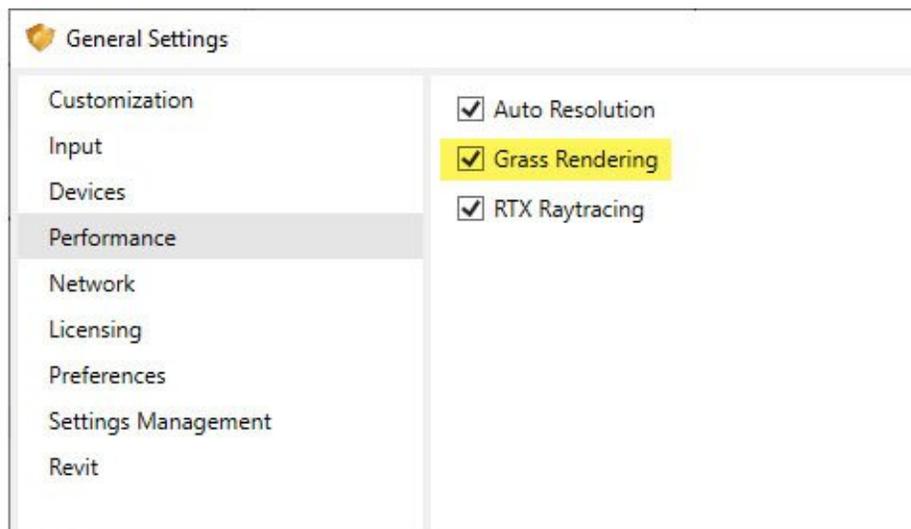
RENDERED RESULT USING GLAZING MATERIAL TO REPRESENT REAL-WORLD GLAZING

Rendering Grass in Revit

Using Autodesk Revit, we can achieve amazing results in Enscape by employing various materials to define grass. Let's look at how this works and what the options are.

Grass Height

The magic happens when **Grass Rendering** is ticked within the Enscape **General Settings** dialog and one or more Revit materials have the keywords "**grass**", "**short grass**", "**tall grass**" or "**wild grass**".



Tip: The images in this article are enhanced with Enscape assets such as people, trees, shrubs, dandelions, a basketball, and a vehicle. These components are included at no extra cost with Enscape.

Here is an example of each grass style compared side-by-side.



REVIT MATERIAL WITH KEYWORD 'GRASS' IN THE NAME



REVIT MATERIAL WITH KEYWORD 'SHORT GRASS' IN THE NAME



REVIT MATERIAL WITH KEYWORD 'TALL GRASS' IN THE NAME



REVIT MATERIAL WITH KEYWORD 'WILD GRASS' IN THE NAME

Here is what happens based on keywords used:

- **Grass:** Medium grass
- **Short Grass:** Shorter grass
- **Tall Grass:** Taller grass
- **Wild Grass:** Taller grass with varying blade heights

TIP: The keywords are not case sensitive, but you cannot change the order, e.g. “grass tall” is not the same as “tall grass” to Enscape.

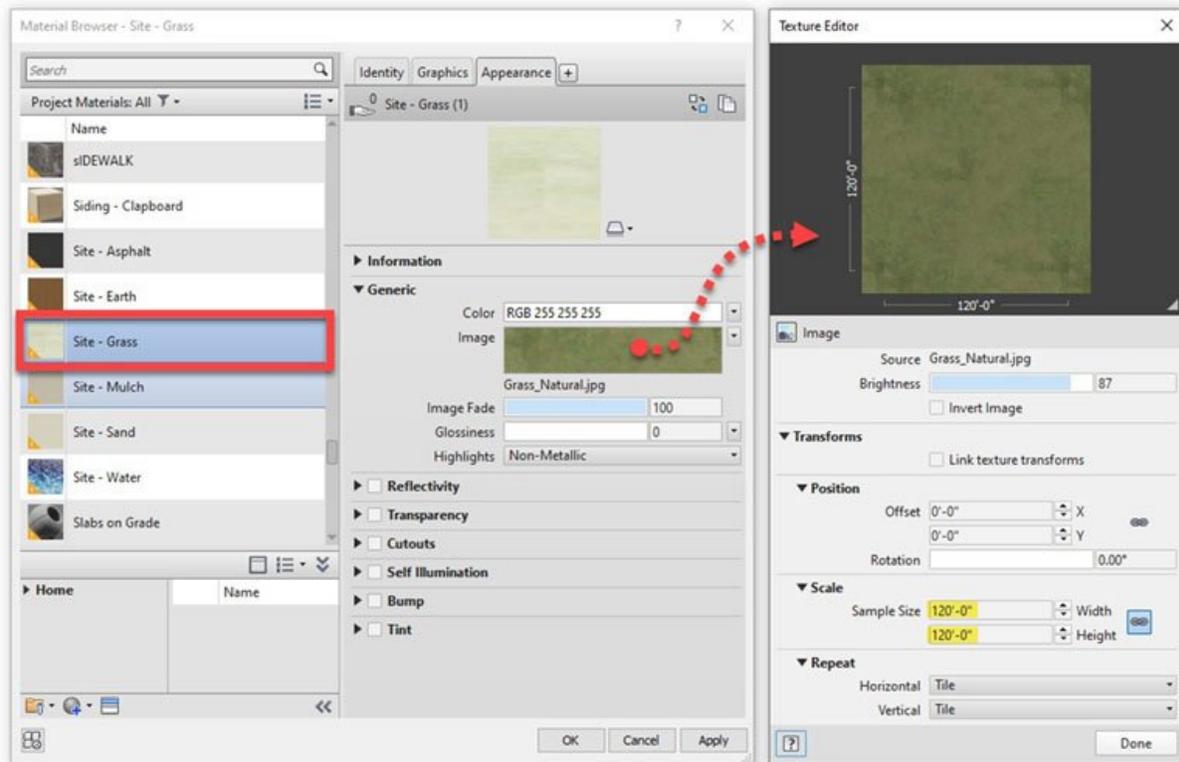
Grass Color

Because Enscape samples the color or texture assigned to the material, we can achieve interesting results. I have been using this texture for a while as it has subtle variations in color, which translates nicely to Enscape’s 3D grass. It was acquired from a larger high-resolution aerial image.



TEXTURE / OFTEN USE FOR THE GRASS MATERIAL TEXTURE

As shown in the following image, I set the texture size to 120’ square; thus, the patterning within the image is not obvious in Enscape due to the scale. Feel free to right-click and save this texture and give it a try in your project.



Here are the results in Enscape. Notice that the color is not consistent, which produces an effect that often occurs due to droughts. So, the result is more natural if this is the look you are going for.



GRASS RENDERED USING TEXTURE SHOWN ABOVE



GRASS RENDERED USING TEXTURE SHOWN ABOVE

Grass Types

Now let's look at how we can create specific, real-world, grass types. You will be happy to know it is easy.



First, notice a few grass types shown in the image above: Centipede, Bermuda, St. Augustine and Zoysia.

I found this image by searching the internet for “grass types”. I then cropped the image down to just the desired grass type (no text or lines) and saved a separate image, with a texture size of about 8-12” (20cm – 30cm) wide and 4-5” (10cm – 13cm) tall produced the results shown below. Of course, finding larger tileable samples would produce better results and look more accurate in Revit if ‘realistic view’ were ever used.

HERE ARE THE RESULTS OF MY ‘GRASS TYPES’ STUDY IN ENSCAPE:



GRASS TYPE: CENTIPEDE



GRASS TYPE: BERMUDA



GRASS TYPE: ST. AUGUSTINE



GRASS TYPE: ZOYSIA

Tip: Grass is not intended to be applied to predominately vertical surfaces, as the blades of grass are generally vertical, not perpendicular to the surface.

Out of curiosity, let's look at what the two default Revit grass materials look like in Enscape – these are the ones that install with the software. There is a big difference. The one actually called “grass” is way too dark. The other is better, but still a little off. And this will change with the lighting, so remember to consider the albedo; setting the real-world base color of a material results in more realistic looking graphics in various lighting conditions.



REVIT'S DEFAULT GRASS MATERIAL



REVIT'S DEFAULT 'PLANT' MATERIAL

With this, we can see the variety of options we have to represent grass in Revit. Some of the techniques offered in the next section on SketchUp can also be applied in Revit. However, Revit does not have the detailed sliders for height and height variation.

TIP: If the grass is poking through your floor or walk in Revit, add a Building Pad below the floor/walk to stamp out the top of the toposurface in that area.

Water Material Settings in Revit

Revit has a built-in material specifically for water. This means things like transparency and refraction are not input options as the material properties are based on real-world physical properties. The various built-in options are listed below.

Water Types:

- Swimming Pool
- Generic Reflecting Pool
- Generic Stream/River
- Generic Pond /Lake
- Generic Sea/Ocean

Water Colors:

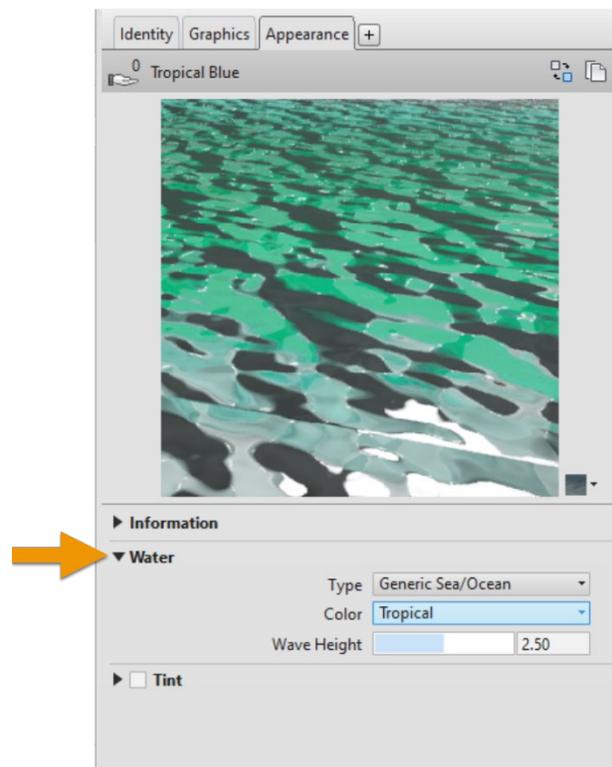
- Tropical
- Algae/Green
- Murky/Brown
- Custom

Water Wave Height:

- Value between 0.0 – 5.0

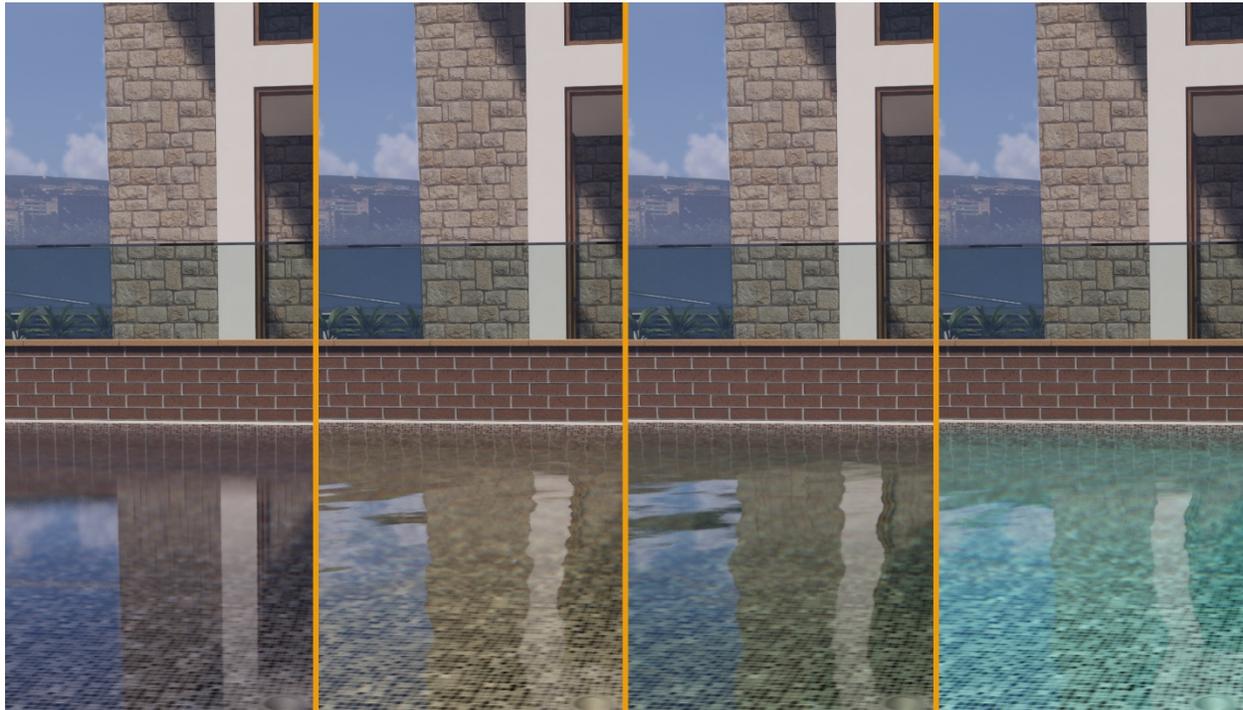
Tint:

- RGB color



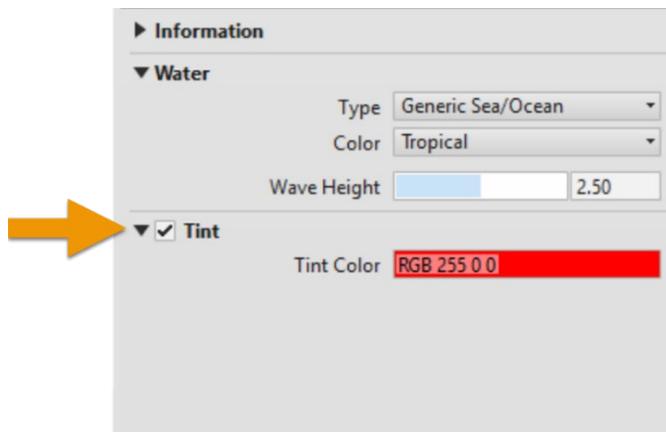
Various combinations of these settings produce unique results. In the image below are four examples, from left to right, Swimming Pool, Stream/River + Murky/Brown, Lake/Pond, and Sea/Ocean + Tropical. Usually the water setting would match the real-world condition you wish to depict. For example, an ocean-front property would naturally have the Sea/Ocean water type selected. However, the designer could choose any setting s/he wants for dramatic effect when appropriate.

It is interesting to note, that even though the Wave Height settings is the same for each of the images below, except the first one, the reflections are all different. Whenever Enscape renders water on the screen it randomizes the water's surface, resulting in a natural look.



COMPARE WATER TYPES, FROM LEFT TO RIGHT; POOL, MURKY RIVER, LAKE AND TROPICAL OCEAN

When working within Revit, the Water material is a physically-based material with water-specific settings as just described. Additionally, all Revit materials have an overriding **Tint** option. The Tint setting can be used to make water look as if a colored dye has been added; think, the Chicago River on St. Patrick’s Day in the USA.



TINT WATER COLOR



RED TINT APPLIED TO WATER MATERIAL

The following image shows how the wave height, or turbulence, can be controlled. Here we have the two extremes, one near zero, and another in the middle; 0.0, 0.50, 2.5 and 5.0. It is possible to have multiple wave heights within the same project by creating additional materials. One might do this, for example, to represent still water in a glass in the dining room and then a more active water in an adjacent body of water, such as a river or lake.



COMPARE TURBULENCE VALUES (0.0, 0.5, 2.5 AND 5.0)

Natural Example

Combining Enscape's realistic water and grass for non-architectural works can also be archived with much success. The following model is 100% Revit and Enscape without any post production. This project was quickly created, in just a few hours, as an example for a proposal to show what could be done for a park restoration project with a Landscape Architect. The four images below are the same, except with various Wave Height values applied. This image uses [RPC's](#), [Megascan](#) content, SketchUp's [3D Warehouse](#) content and one of Enscape's built-in skyboxes. Also, the sun rays are being emphasized by an increased fog setting from the Enscape Settings dialog. As you can see, the results are simply astounding:



WAVE HEIGHT SETTING: 0.0



WAVE HEIGHT SETTING: 0.5



WAVE HEIGHT SETTING: 2.5



WAVE HEIGHT SETTING: 5.0