THEA RENDER

physically-based unbiased, biased & gpu render engine

Thea For Rhino v2.2

www.thearender.com/rhino

User Manual

Rev.2.2 110

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1. Introduction

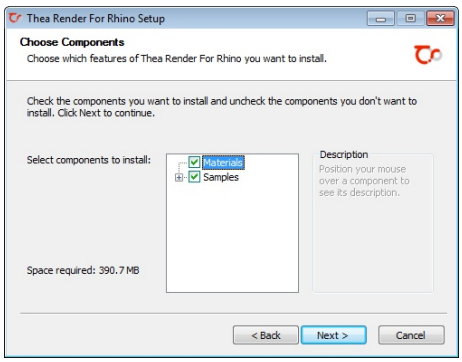
Thea for Rhino is an integrated plug-in that enables utilization of Thea Render rendering functionality within McNeel Rhino 6. The plugin enables a wide range of features which include:
* Biased/Unbiased/GPU render modes (utilizing CUDA technology)
* Physically based material interface uniform of all render modes
* Production render and fluid interactive render
* Physically based environment (Sun/Sky)
* Physically based cameras and lights using Thea for Rhino interface

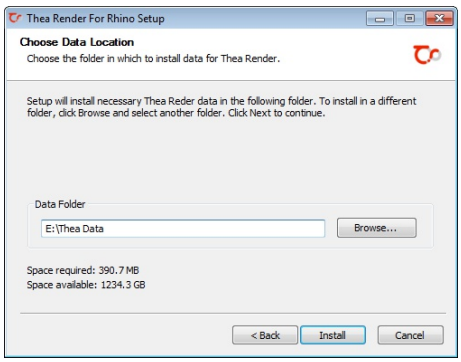
2. Installation

Download and execute the Thea for Rhino installer from the following link: www.thearender.com/downloads

Make sure you have administrator rights while installing the plug-in; right-click the installer file and select 'Run as Administrator'.
When you reach the 'Choose Components' screen, you can select whether you want to install samples for materials, ior/crf files, etc.
In the next screen, 'Choose Data Location' you can select the place on your hard disk where you want all this data to be saved.
After this step, the Rhino Installer will begin installing Thea for Rhino. When the installation is complete, click the 'Close' button and you are ready.

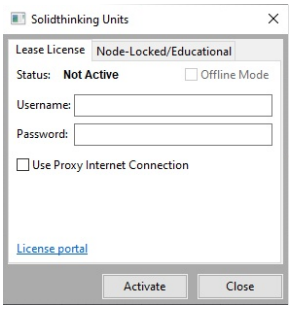
Important:
When installing Thea for Rhino you will be asked to set the path of the Thea Data and Thea Temporary folders to a location where every user has full read/write access. If the path doesn't have proper permissions, the plugin will not work properly.





3. Activation

Lease License



After installing the plug-in, open the License form window from the main menu: Thea Render > License > License Form

1. Enter the Username and Password that you used to sign-in to the Thea Portal.
2. Click on the "Activate" button to activate Thea for Rhino.

Note: The license returns to the server each time you close Rhino and it can be used on any other machine.

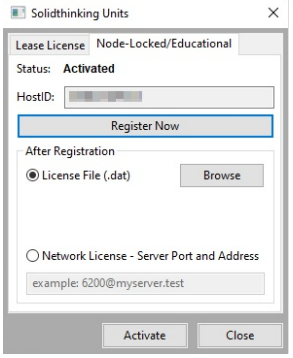
Offline Mode: This mode borrows the license from the licensing server to the specific machine. The plug-in will remain activated on the machine without the need of an internet connection. Maximum borrowing time is 14 days.

Note: You need to uncheck this option if you plan to use the license on a different machine though.

Use Proxy Internet Connection: In case your machine is behind a proxy server, you need to enter the IP Address and Port of the Proxy Server. Username and Password should also be filled if needed.

Important: All actions within the License window need an internet connection. When Offline mode is not active, the plugin checks periodically the license and if it cannot reach the server for up to 30 minutes, then watermarks will be introduced in the next rendering session.

Node-Locked / Educational



If you have a node-locked license, use this option to activate Thea for SketchUp. After installing the plug-in, open the license setup windows from the main menu: Extensions > Thea Render > License Setup

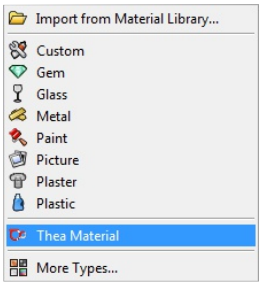
Click "Register Now" and complete the form to receive your license file by email. To activate Thea, click on the "Browse" buttton and browse for your license file. The status is displayed at the top of the license form.

Note: If you don't activate your license, you will remain in Demo mode with certain limitations.

Demo Version Limitations: Please note that when the plug-in is not licensed, the rendered image resolution will be limited (1280x720) and watermarks will be added. All other features and functionalities are fully supported.

4. First Steps

After the installation and activation of Thea for Rhino there are a couple of steps that need to be done to have a better workflow when working with the plugin.

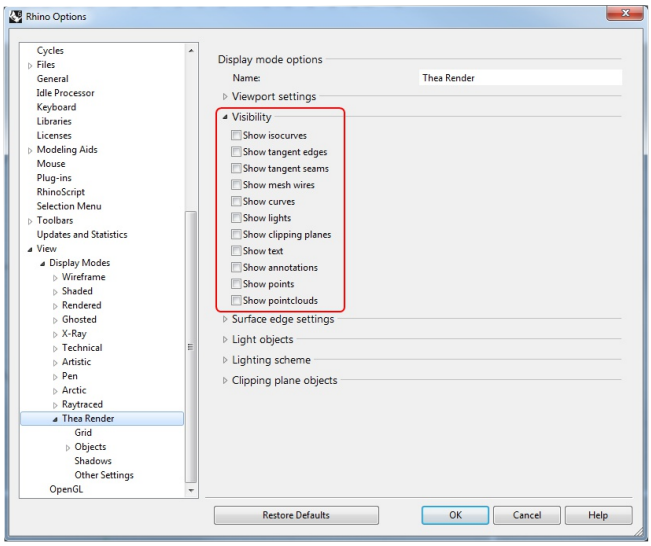


Making Thea for Rhino the default render

From the main menu select Render > Current Renderer > Thea for Rhino. When the plugin is the current renderer, you will be able to see the new Thea Material in the Materials tab.

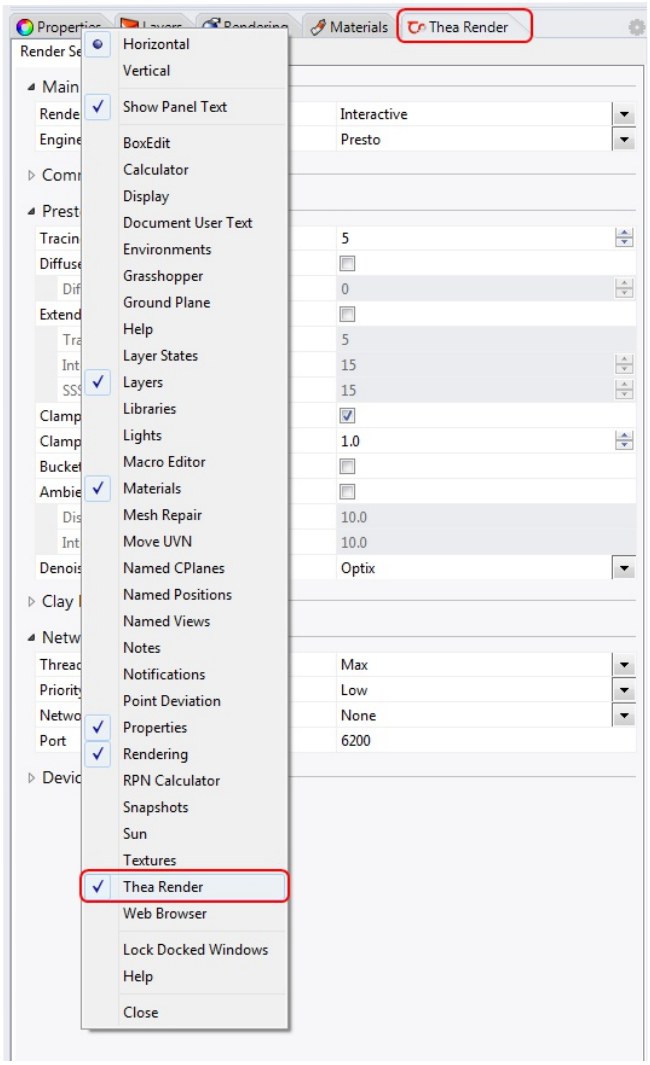
Thea Render (Display Mode)

By default, when rendering interactively in the viewport, surface isocurves, mesh wires, etc will be displayed. To disable them, go to the main menu Tools > Options > View > Thea Render and from the Visibility rollout uncheck all the parameters.



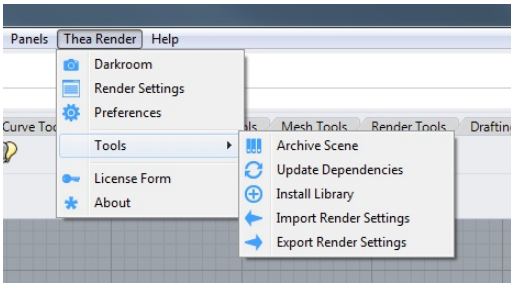
Thea Render Settings Tab

To make the Thea Render settings tab visible, right click on any Rhino's tab and select 'Thea Render' from the list or use the main menu:
Thea Render > Render Settings



5. User Interface

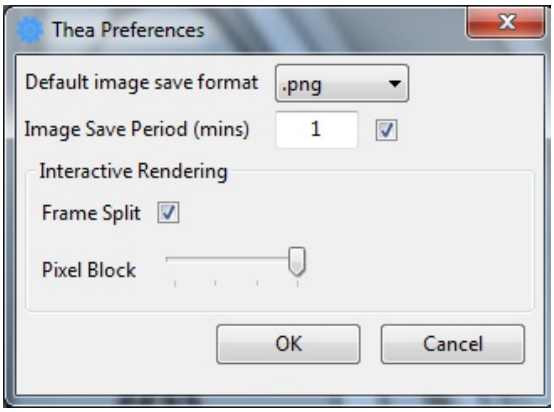
Thea Render Menu



After installing the plugin a new entry will be available in the main menu called Thea Render.

Darkroom: Opens Thea Darkroom. This is where all the rendering takes place and is explained in section 5.
Render Settings: Opens the Thea Render Settings panel.
Preferences: Some specific settings can be set through the Preferences window.
Tools > Archive Scene: Creates an archive in zip format containing the .3dm file along with all the textures.
Tools > Update Dependencies: Sets the path where Thea will search for missing textures and update materials accordingly.
Tools > Install Library: Opens Thea Library files (.lib.thea) and installs them in the Thea Data folder.
Tools > Import Render Settings: Imports render settings in xml format.
Tools > Export Render Settings: Exports current render settings to xml file format.
License Form: Opens the License Wizard window that allows the activation of Thea for Rhino.

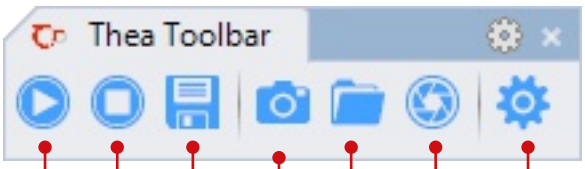
Preferences Window



Default image save format: Choose the default image format to appear when saving a rendered image from the Thea Darkroom window.
Image Save Period: Saves a copy of the image rendered in Production Mode in a temp folder for backup. Defines the interval in which the image will be saved.
Frame Split: When this option is enabled, the rendered image will be divided among all enabled presto devices during interactive render. This results in higher refresh rates during interactive render.
Caution: Slower devices may slow down interactive render, so leave this option unchecked if in doubt.
Pixel Block: Defines how 'blocky' pixels will appear during interactive rendering. Higher values give more initial noise but have higher refresh rate.

Thea Toolbar

The Thea Toolbar gives you quick access to Thea for Rhino settings and panels.



Start Interactive Rendering

Initiates Interactive Rendering in the current active Rhino Viewport.

Stop Interactive Rendering

Stops viewport rendering and reverts the viewport to the last active Rhino view.

Save Image

Saves interactive render image. Interactive Rendering needs to be in progress for this to work.

Darkroom

Opens the Thea Darkroom window.

Content Browser

Opens the Content Browser.

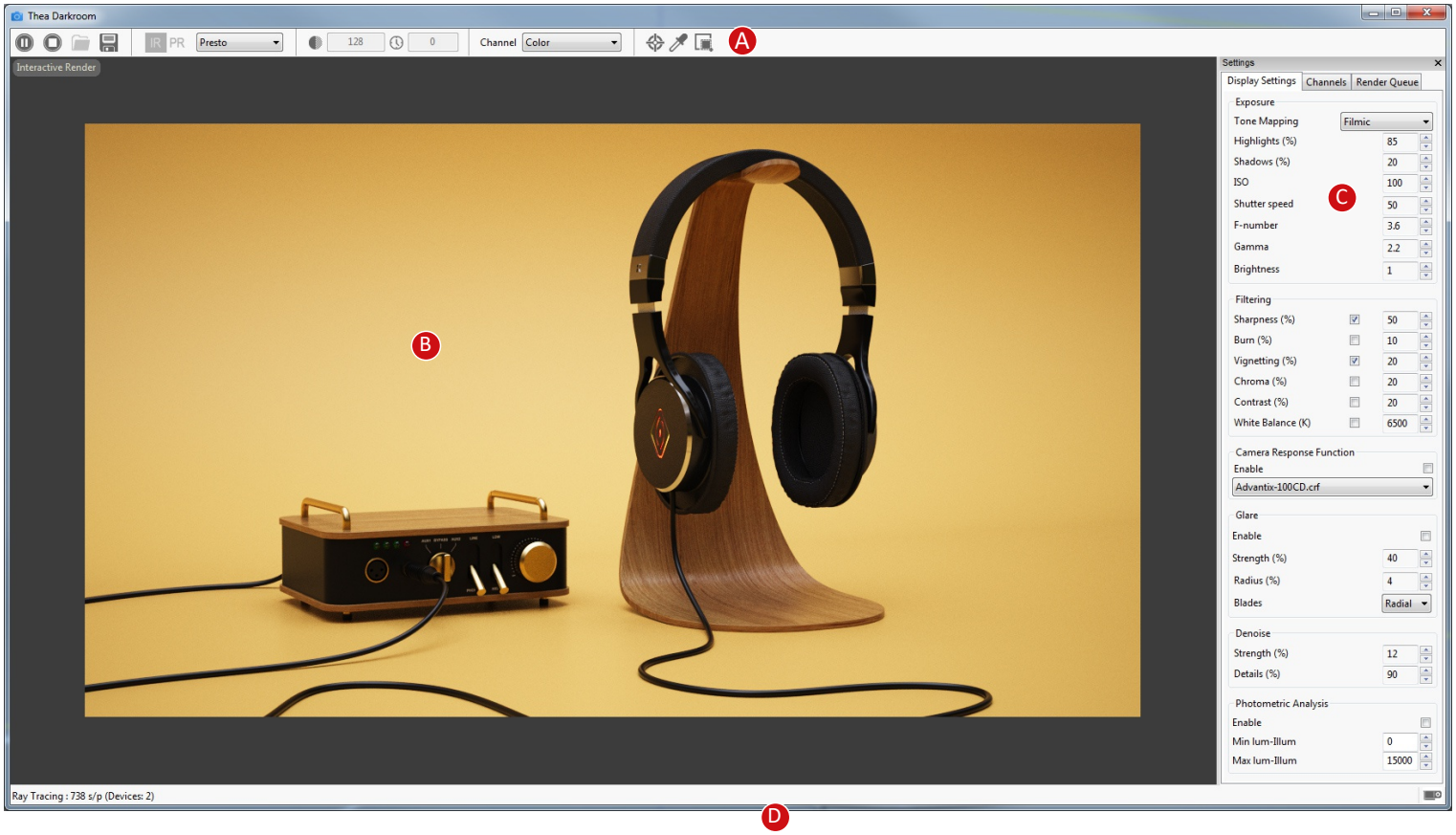
Display Settings

Opens the display settings panel. Useful when the display needs to be adjusted during viewport rendering. When this panel closes, it is docked to the Darkroom window

Preferences

Opens the preferences panel.

6. Thea Darkroom



The darkroom is the main window used to render the scene and provides a lot of useful functionality which will be presented in the following sections. The main sections of the Darkroom are: top panel, Render panel, the display settings tab, the channels tab and the Render Queue tab.

Panel A: The toolbar allows the user to perform several tasks like starting/stopping a render, define render settings and edit the camera and materials in the scene.

Panel B: This is the panel that render images are displayed. This panel is updated automatically during rendering or when the display settings are adjusted.

Panel C: The settings panel has three tabs (Display, Channels and Render Queue) that can be seen in detail in section 5.

Panel D: At the bottom of the Darkroom window you will find several information that have to do with the rendering process like samples per pixel.

Zooming & Panning

Zooming: Use the middle mouse button to zoom in and out.
Panning: Hold the Left Mouse Button to pan.
Zoom to 100%: Double click with the Left mouse button to bring zooming back to 100%.
Fit to window: When the image is larger than the viewing area you toggle between 100% and Fit to Window by double clicking with the Left Mouse button

6.1. Rendering Window

Start/Pause

Starts rendering in the Darkroom. Once render has been initiated, this button is used to pause the current render.

Stop

Stops the current render. During batch rendering, the stop button will cancel any batches in the queue.

Save Image

Saves the image of the last render that was initiated.

Pick Camera Focus

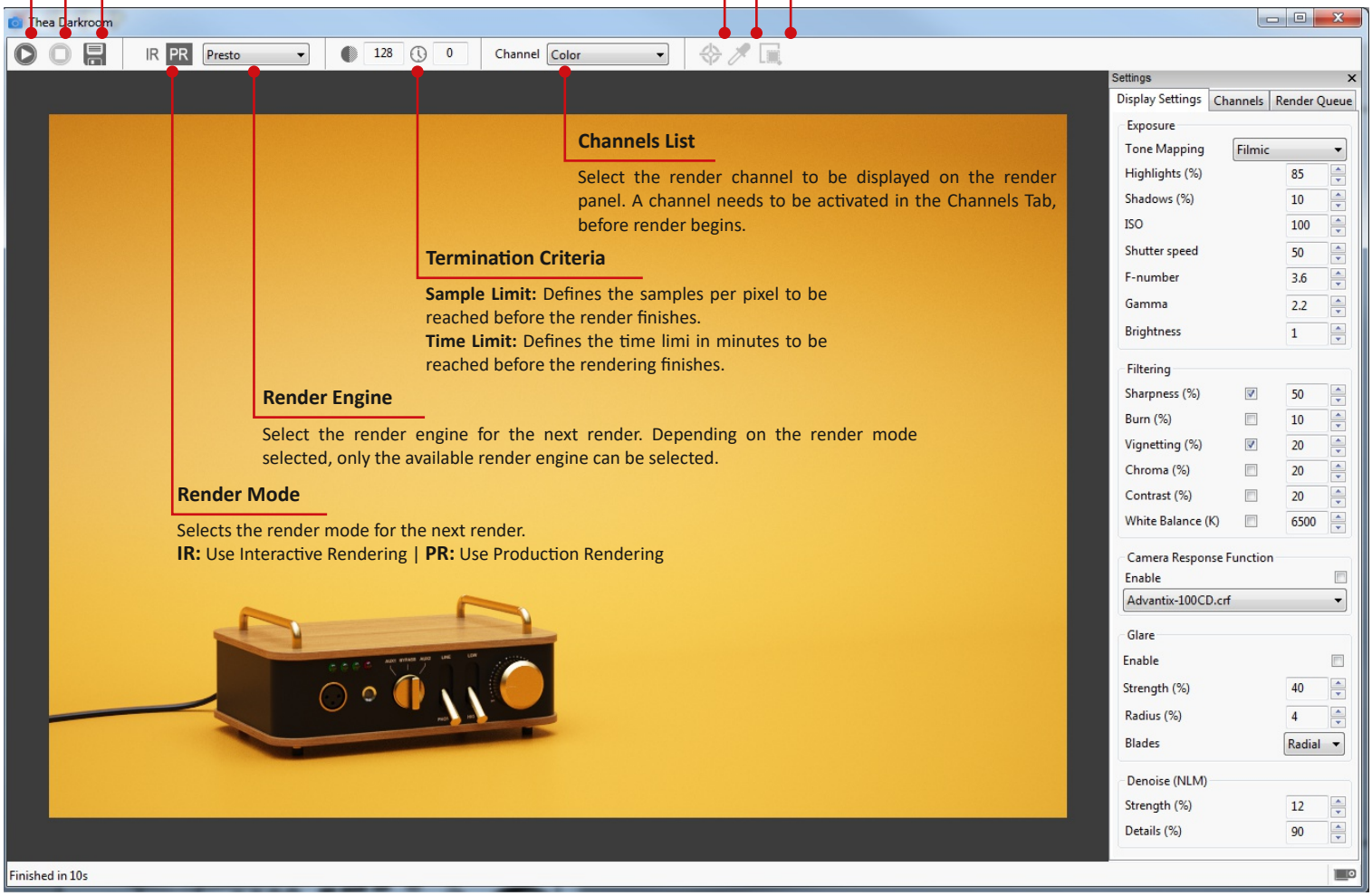
Select the point to which the camera will focus during Interactive Rendering.
Shortcut: CTRL+LMB

Pick Material

Allows picking an object's material during Interactive Rendering.
Shortcut: ALT+LMB

Region Render

Click and drag a rectangle region in the render panel and render only the specified region of the image.



Channels List

Select the render channel to be displayed on the render panel. A channel needs to be activated in the Channels Tab, before render begins.

Termination Criteria

Sample Limit: Defines the samples per pixel to be reached before the render finishes.
Time Limit: Defines the time limi in minutes to be reached before the rendering finishes.

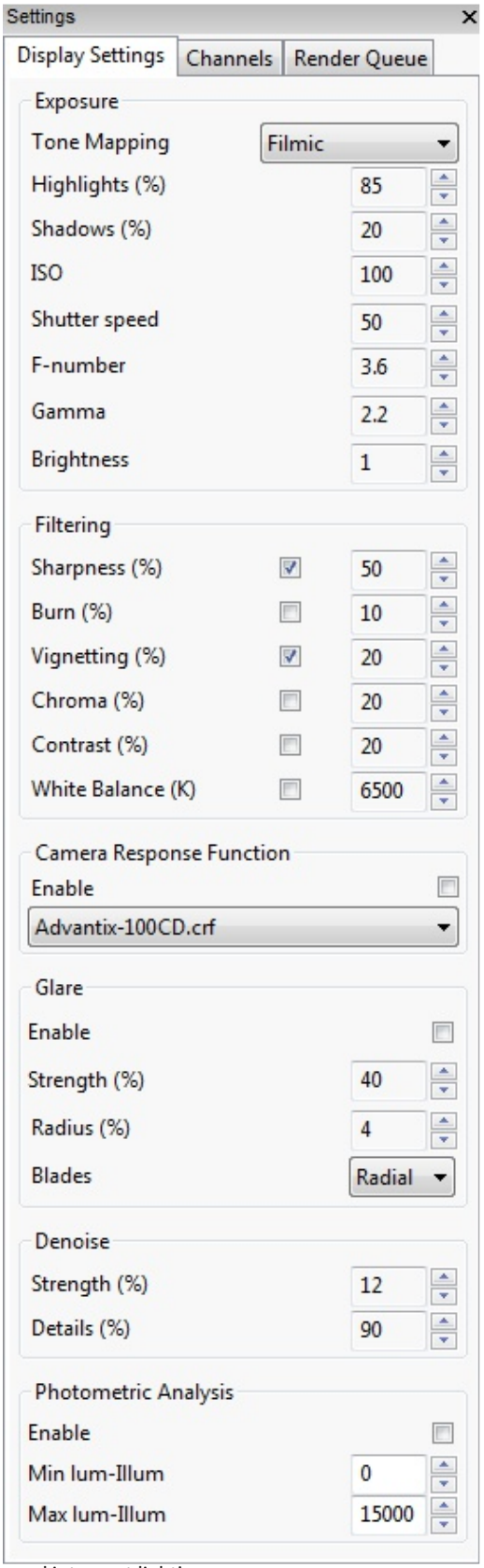
Render Engine

Select the render engine for the next render. Depending on the render mode selected, only the available render engine can be selected.

Render Mode

Selects the render mode for the next render.
IR: Use Interactive Rendering | **PR:** Use Production Rendering

6.2. Display Settings



At the Display tab we can see many options, which are related to the way we see the rendered image.
These options can be separated in 5 categories: Exposure, Filtering, Camera Response Function Glare and Denoise.

EXPOSURE
Tonemapping: Select the tonemapping method that will be used. (Standard, Filmic, Reinhard Global, Reinhard Local)
ISO: Defines how sensitive the image sensor is to the amount of light present. A Value of 100 is mostly used for exterior shots under a clear sky and Sun lighting. Higher values, usually between 400-1600 are used mostly for interior shots.
Shutter: Shutter Speed corresponds to the duration a camera shutter stays open, measured in 1/sec. Low values result in brighter images.
f-number: The lens aperture is the ratio of focal length to effective aperture diameter. Low values will make the image brighter.
Gamma: The Gamma factor typically ranges from 1.0 to 2.5. In order to compensate for the darkening of the image due to non-linear output, we apply a gamma correction scheme to the pixel values before displaying the image.
Brightness: This parameter is used to compensate for a linear scaling of the image by a monitor.

CAMERA RESPONSE FUNCTION
Camera Response Function files use real data provided by the camera manufacturers creating realistic (nonlinear) display results, as if the image was coming out of the specific photo camera.

FILTERING
Sharpness: This is the most crucial filter for controlling the filtering during downsampling the image and it is advised to be enabled at default 50% value which is a balanced value between blurring and sharpening. A value near 0% will produce a more blurred image while a value near 100% produces a more sharpened image.
Burn: The burn value can be used to compress a High Dynamic Range (HDR) in a Low Dynamic Range (LDR) image, presentable on screens and other limited range devices. Setting burn to 100% means that there is no compression.
Vignetting: In photography and optics, vignetting is a reduction of an image's brightness or saturation at the periphery compared to the image center.
Chroma: This filter enhances the colors of the image as it is increased, acting as a saturation control.
Contrast: Determines the difference in the color and brightness of the object and the objects within the same field of view. 0% equals to a disabled control. 100% is the maximum value that can be set.
White Balance (K): Can be used to change the overall color balance of a render, so that it matches the expected phenomenal appearance. A value of 6500K is usually used to balance lighting coming from Sun and make white walls appear white, despite sun power being more yellowish.
Glare: Glare is the effect when a high amount of photons arrives at film, causing lighting to flood also nearby areas. The shape of the glare itself depends on the shape of the diaphragm.
Glare Type: Select how many blades you want. Radial equals to Bloom.
Glare Weight: Controls how intense the effect will be
Glare Radius: Controls the length of the blades.

DENOISE
This is the built-in denoiser of Thea Render.
Strength: Controls how much the denoising filter will affect the final image.
Details: Controls how much of the original detail of the image will be kept at the final rendering. Higher values will try to keep as much detail as possible.

Note: You can select between the Optix and the Non-Local-Means denoiser in the Thea Render Settings. To enable denoising, make sure that you have the Denoise channel enabled.

PHOTOMETRIC ANALYSIS
Luminance and illuminance properties of a scene are the two key factors in lighting design; they describe the energy arriving to our eyes and space correspondingly, but in the way we, humans, perceive and interpret lighting.
Enable: Enables Photometric Analysis
Min/Max lum-Illum: represent the range of the Luminance (cd/m2), as you also see in Figure 5-98 and Figure 5-99. By changing these values, the false color image is being adjusted accordingly.

6.3. Render Channels

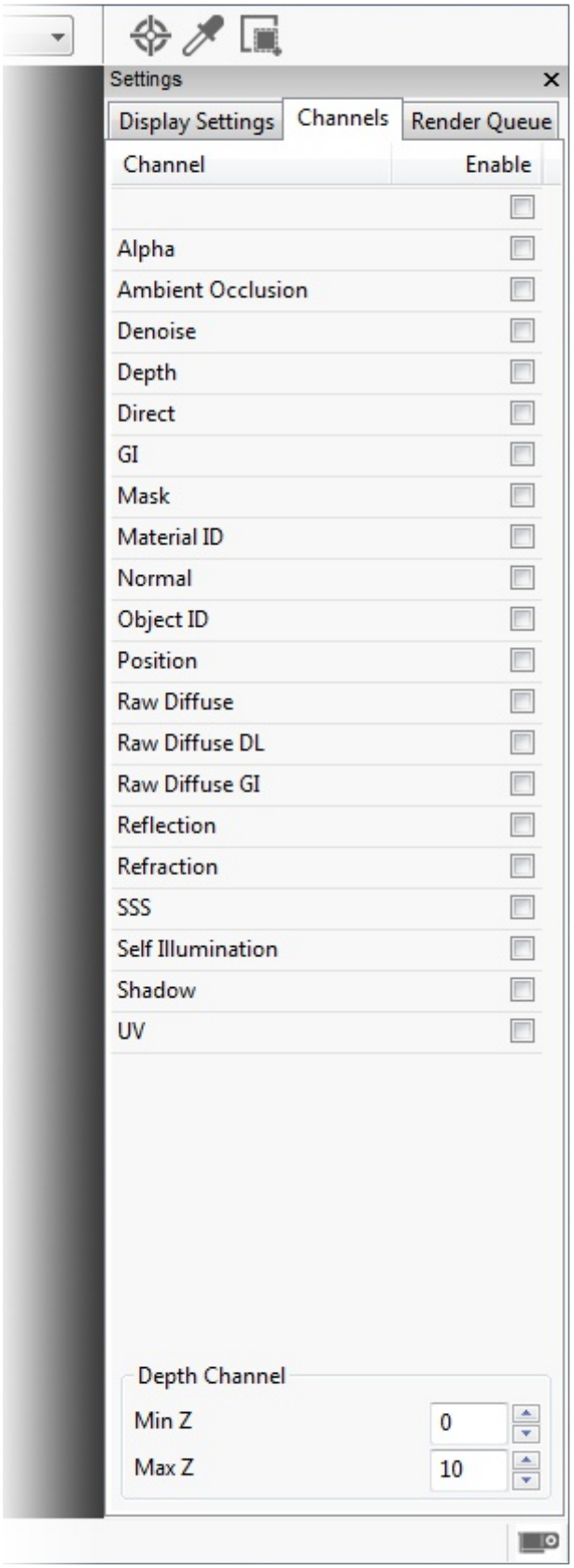
This tab is used when an additional image, other than a standard rendering, is required. This is mostly used when you intend to do postprocessing using an external image editing program.

Available channels are: Color (standard rendering), Normal, Depth, Alpha, Object ID, Material ID, and channels specific to Adaptive (BSD) rendering mode (Direct, Ambient Occlusion, Global Illumination, Subsurface Scattering, Reflection, Refraction, Transparency, and Irradiance). Some channels like Shadow Channel, Raw Diffuse Color, Raw Diffuse Lighting, Raw Diffuse GI, and Self Luminance are only available for Presto engines.

Mask passes will only appear when you assign a mask to an object.

Depth Channel
Min/Max Z (m): Controls the minimum and maximum distance along the camera Z-Axis.

Note: Depending on the active render engine only the engine specific channels will be displayed.

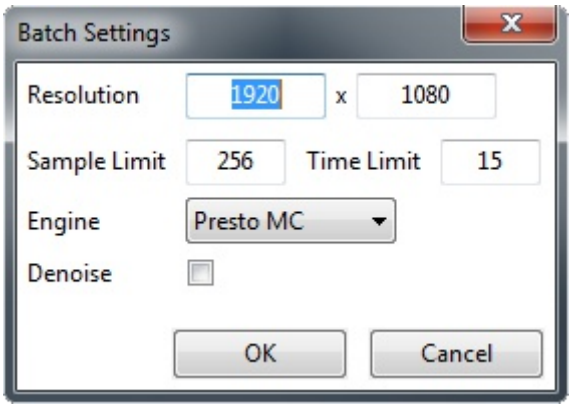


6.4. Render Queue (Batch Rendering)

The Render Queue tab lists all the named views that have been created in the Named Views panel.

By right clicking on a named view you can either edit its render settings or delete it from the queue.

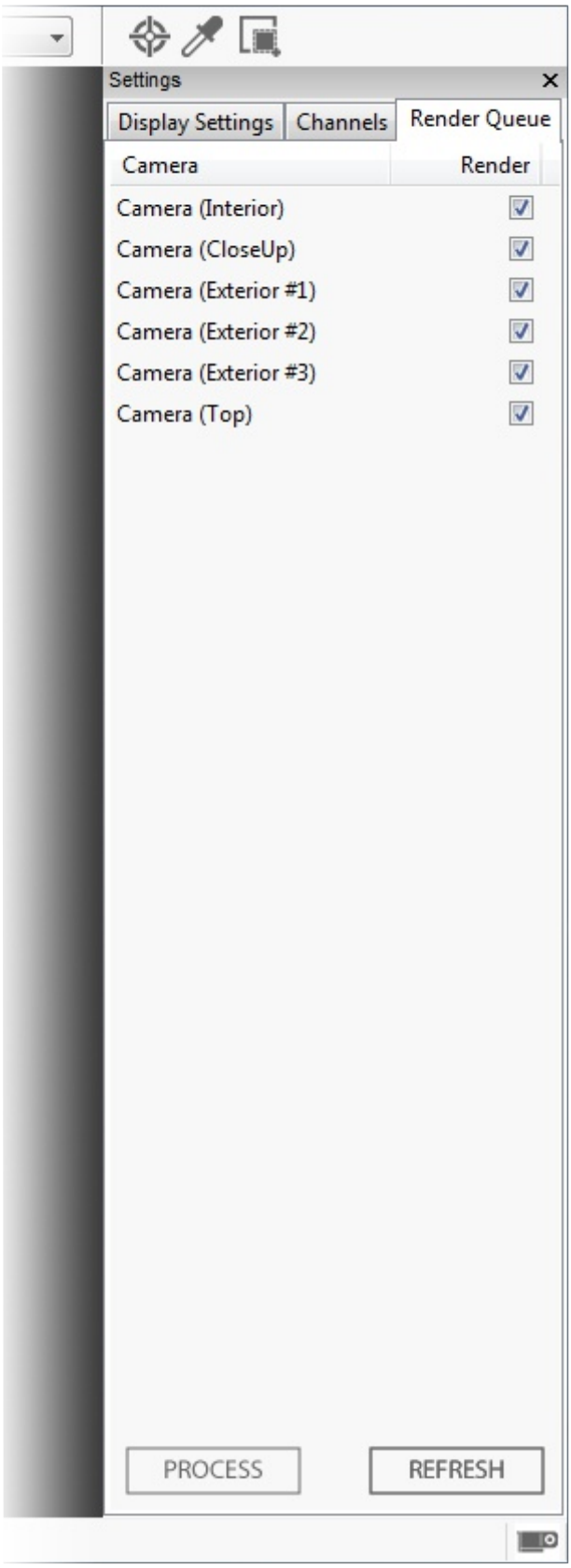
Editing Named View Settings
Editing allows the user to define settings per named view like resolution, termination



REFRESH
This button refreshes the list and syncs it with Rhino's current named views.

PROCESS
When all is set, clicking on the Process button will bring up a save dialog. Select the path where your images will be saved, the image type (png, exr, ...) and finally the name. Thea for Rhino will add the named view next to the file name you defined.
After that, Thea for Rhino will start rendering the render queue one by one in the Darkroom window.

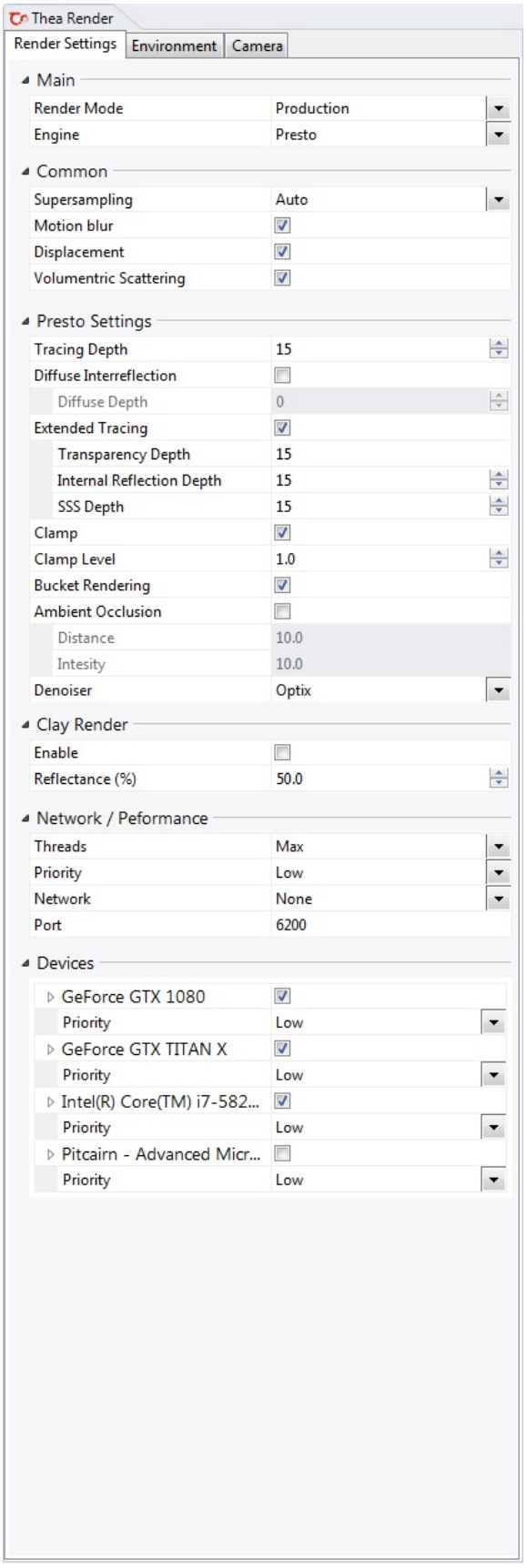
Note: Pressing Stop will terminate the whole render queue and not just the current batch.



7. Thea Render Tab

7.1. Render Settings

The Render Settings tab gives you access to all the rendering parameters.



Main

Render Mode: switch between Interactive and Production mode
Engine: displays the engine list based on the render mode that is selected

Common

Supersampling: Corresponds to the supersampling used for the image output.
None - No supersampling, Normal - 2x2, High - 3x3
Auto - No supersampling in IR, Normal in Production Mode.
Motion Blur: Enables motion blur for all visible animated objects.
Displacement: Enables/Disables displacement for every object.
Volumetric Scattering: Enables/Disables the rendering of participating media. If disabled, Volumetric (Medium) and Sub Surface Scattering (SSS) won't be rendered.

Engine Settings

This section displays the settings of the selected render engine. Find more details for all the engines in Section 11.

Clay Render

Enabling this option, all materials in the scene will be rendered as diffuse gray, giving the final image a clay effect.
Reflectance (%): Increases/Decreases the diffuse material reflectance.

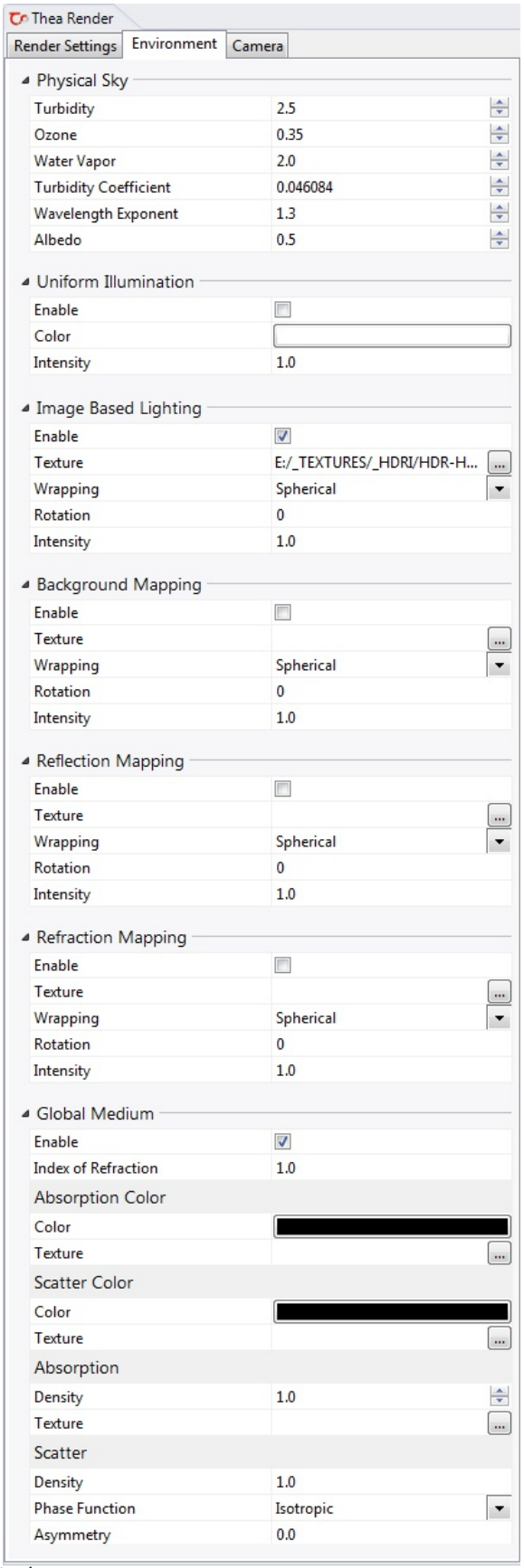
Network / Performance

Threads: they define the threads that will be used during rendering. Max corresponds to the maximum number of logical cores on your machine.
Priority: Corresponds to the priority assigned to render threads by the operating system.
Network: sets render engine in single workstation (None) or acting as Server, in network rendering.
Port: Corresponds to the server port used by the application during network rendering.

Devices

In this area you will find listed, all the compatible devices that have been recognized by Thea for Rhino. It is possible to enable/disable devices and also set their priority.

7.2. Environment



PHYSICAL SKY

Turbidity: describes the scattering of the atmosphere that is caused by haze.
Ozone: Defines the amoubt if ozone gas in the atmosphere. Values higher than 0.35 will give the sky a blue color.
Water Vapor: Describes the amounf of water vapor in the atmosphere.
Turbidity Coefficient: This is the power for exponential transmittance for atmospheric aerosol.
Wavelength Exponent: This number shows the average size of the particles in the atmosphere.
Albedo: Albedo option can influence the overall appearance of the sky. High albedo values can occur for example in winter scenes by the snow reflectance while small values occur at environment with grass. Especially in cases with high turbidity settings, changing the albedo value changes the overall brightness of the sky.

UNIFORM ILLUMINATION

Color: Define the color that will be used to light the scene.
Intensity: Controls the overall intensity of Uniform Illumination.

IMAGE BASED LIGHTING

Image-based lighting (IBL) is a convenient way to add illumination to your scene, coming from captured photos of the surrounding environment. Since a photo of a real scene can be used, the lighting is highly convincing and enhances the realism of your renders. In most cases, the images used for this kind of lighting need to be of high dynamic range (hdr) in order to provide enough lighting for a scene.
Texture: Specify the image you want to use for illumination.
Wrapping: Specifies the wrapping of the inserted image.
Rotation: Rotates the image according to the camera view we want
Intensity: Adjusts the intensity of the inserted image.

BACKGROUND MAPPING

We can specify the background mapping of our scene. This means that even if we have used already an image for illumination (which is also used as a background), we can now specify another one for background and overwrite the one that was used.
Options are the same as in Image Based Lighting.

REFLECTION MAPPING

User can specify the reflection mapping. If we do not enable this option, reflections are according to the map inserted at the IBL panel.
Options are the same as in Image Based Lighting.

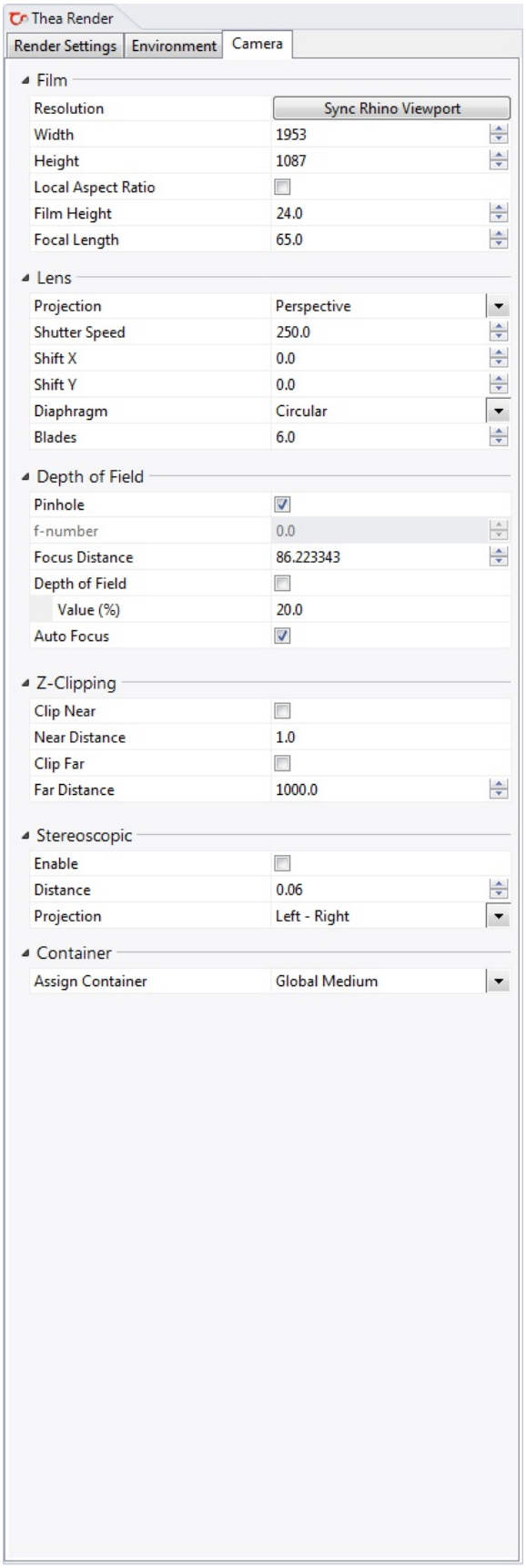
REFRACTION MAPPING

The exact same things that we described at the Reflection Mapping are valid for the Refraction Mapping panel.
Options are the same as in Image Based Lighting.

GLOBAL MEDIUM

Index of Refraction: Specifies the index of refraction of the global space of the scene.
Absorption Color: Defines the transmittance color – this is actually the color visualized after a distance of 1 meter.
Scatter Color: Defines the scattering color – this is the color that bounced particles (in the medium) have.
Absorption Density: Defines the density of absorption in 1/m units. The higher this density the higher the absorption.
Scatter Density: Defines the density of scattering in 1/m units. The higher this density the higher the scattering.
Phase Function: Defines the variation of outgoing radiance over the sphere of directions and it is the medium analog of a bi-directional scattering distribution function
Assymetry: defines the asymmetry parameter of Henyey-Greenstein phase function. This parameter is unitless and takes values from –1 (totally back scattering) to 1 (totally front scattering).

7.3. CAMERA



FILM

Resolution: Clicking on the 'Sync Rhino Viewport' button to make the resolution exactly the same as the active viewport window.
Width: Defines the width of the resolution in Production Mode.
Height: Defines the height of the resolution in Production Mode.
Local Aspect Ratio: Enabling this option will lock the Aspect Ratio of the final resolution.
Focal Length: Changes the distance from the lens to the film.

LENS

Projection: Defines the camera projection (Perspective, Spherical, etc)
Shutter Speed: Corresponds to the duration a camera shutter stays open. It can be measured in inverse time units (1/sec) correspondingly to grabbed frames per second.
Shift X: This option helps us change the horizontal direction of the current view.
Shift Y: This option changes the vertical direction of the current view.
Diaphragm: Defines the shape of the aperture. (Circular or polygonal)
Blades: When diaphragm is set to polygonal, one can also define the number of blades.

DEPTH OF FIELD

Pinhole: by enabling the Pinhole option, the f-number of the camera is set to pinhole (theoretically equals to zero and creates no Depth of Field at all).
f-number: Defines the f-number of the camera.
Focus Distance: Focus distance can be entered here or be visually defined in Thea Darkroom while in Interactive Rendering mode.
Depth of Field: When enabled, it will ignore the f-number set above and use the percentage value below.
Value (%): Lower values create a shallower depth of field.
Auto Focus: makes the camera focus at the center of the scene once enabled.

Z-CLIPPING

Clip Near: Select whether you want to clip the scene using the near distance value.
Near Distance: Defines the near distance from the camera.
Clip Far: Select whether you want to clip the scene using the far distance value.
Far Distance: Defines the far distance from the camer.

STEREOSCOPIC

Distance: Defines the distance between the eyes in meters.
Projection: Defines the projection (Left/Right, Top/Bottom, Anaglyph, etc)

CONTAINER

Assign Container: A different material can be selected as a container instead of Global Medium for the camera.

8. Interactive Rendering

Thea for Rhino can render interactively in both Thea Darkroom and Rhino's Viewports.

Rendering in Thea Darkroom
Rendering interactively in Thea Darkroom is useful for systems with multiple monitors as it allows you to have Thea Darkroom running in a separate monitor while working on your project.
To start Interactive Rendering, make sure that the option IR (Interactive Rendering) is active and click on the start button.

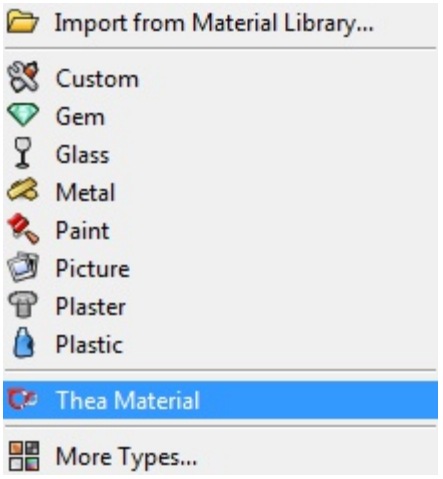
Rendering in Rhino's Viewports
Thea is capable of rendering interactively inside Rhino's viewports. To start rendering, click on the Start button of the Thea Toolbar. At any time, you can either click on the Stop button to stop Interactive Rendering or the Save image button to save the image that is currently being displayed in the viewport.

9. Materials

Materials in Thea for Rhino can be created in the same way you create Rhino materials.

Important: To be able to see the new Thea Material option, Thea Render needs to be the active render engine. From the top menu select: Render > Current Renderer > Thea Render

There are two ways to add a new Thea Material in the material list:
1. Click on the + icon in the material panel and select Thea Material from the list.
2. Click on the Thea Content Browser icon, select a material and either click on the Add button or double-click on it to add it in the material list. More details on content browser on section 8.2.

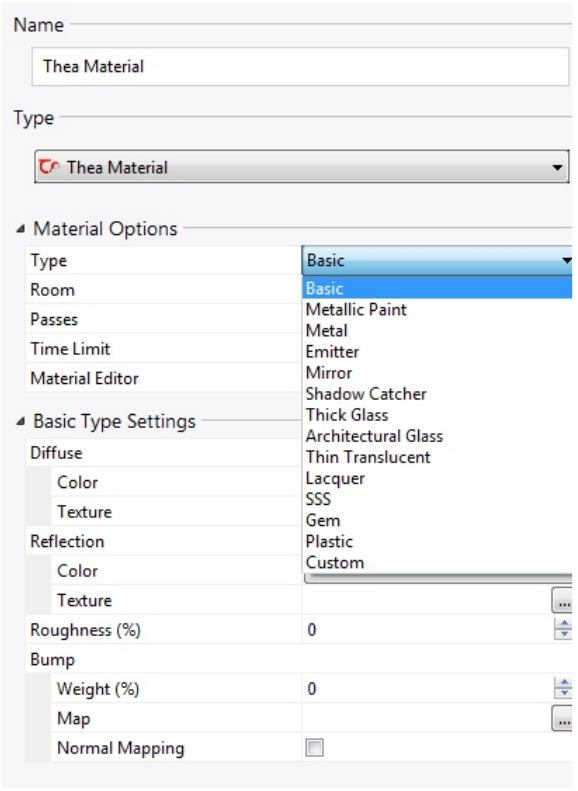


Editing Thea Materials
Thea for Rhino offers two ways to edit Thea Materiels. You can either use Material Presets as a starting point or use the Advanced Material editor to have complete control over the material parameters and make use of the advanced layering system that Thea makes use of.

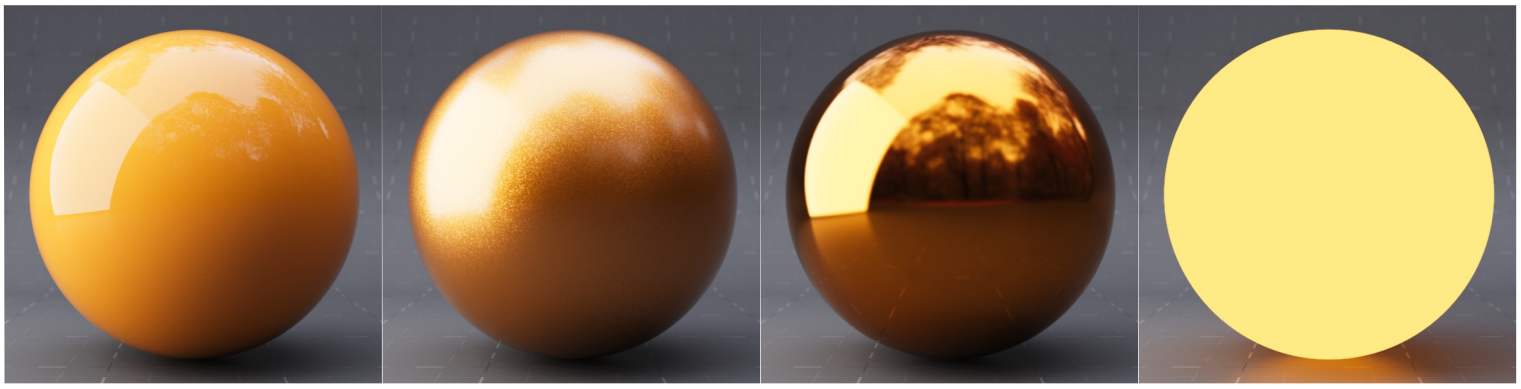
9.1. Material Presets

Material presets offer an quick and easy way to create most of the material you will need. The available types are: Basic, Metallic Paint, Metal, Emiter, Mirror, Shadow Catcher, Thick Glass, Architectural Glass, Thin Translucent, Lacquer, SSS, Gem and Plastic.

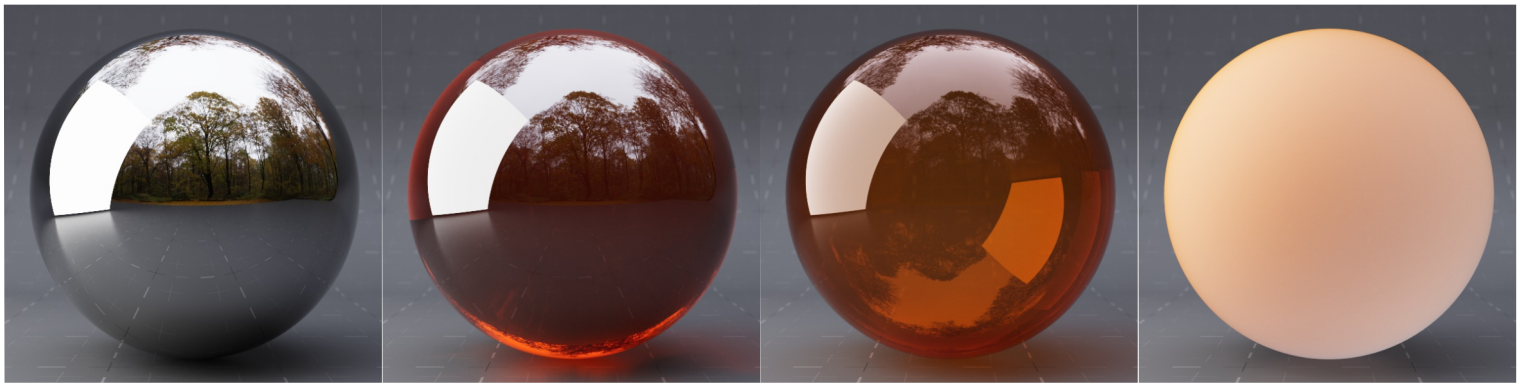
Depending on the preset type you choose, additional controls will appear in the editor.



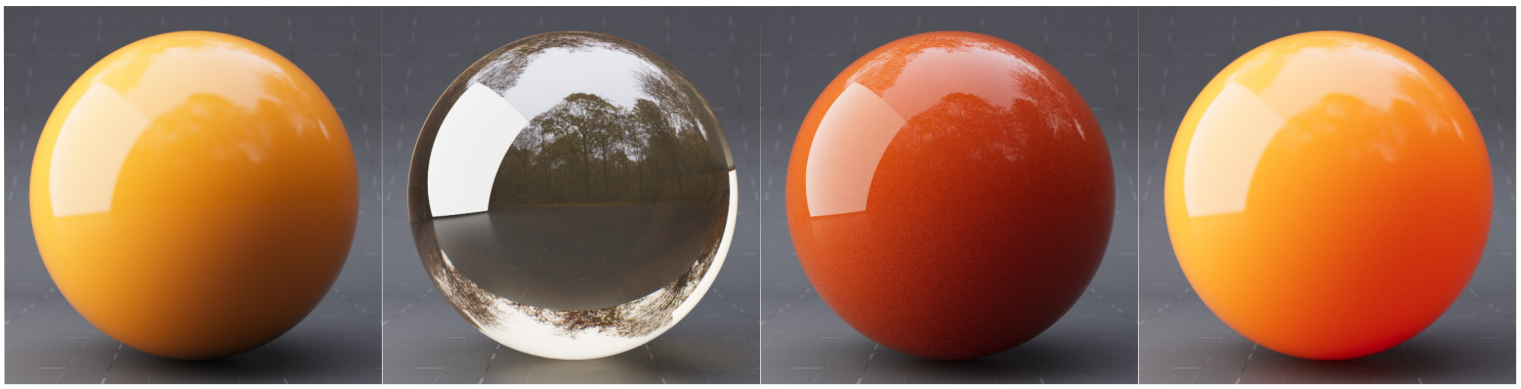
Material Presets Previews



Basic | Metallic Paint | Metal | Emitter



Mirror | Thick Glass | Architectural Glass | Thin Translucent



Lacquer | Gem | SSS | Plastic

9.2. Material Editor

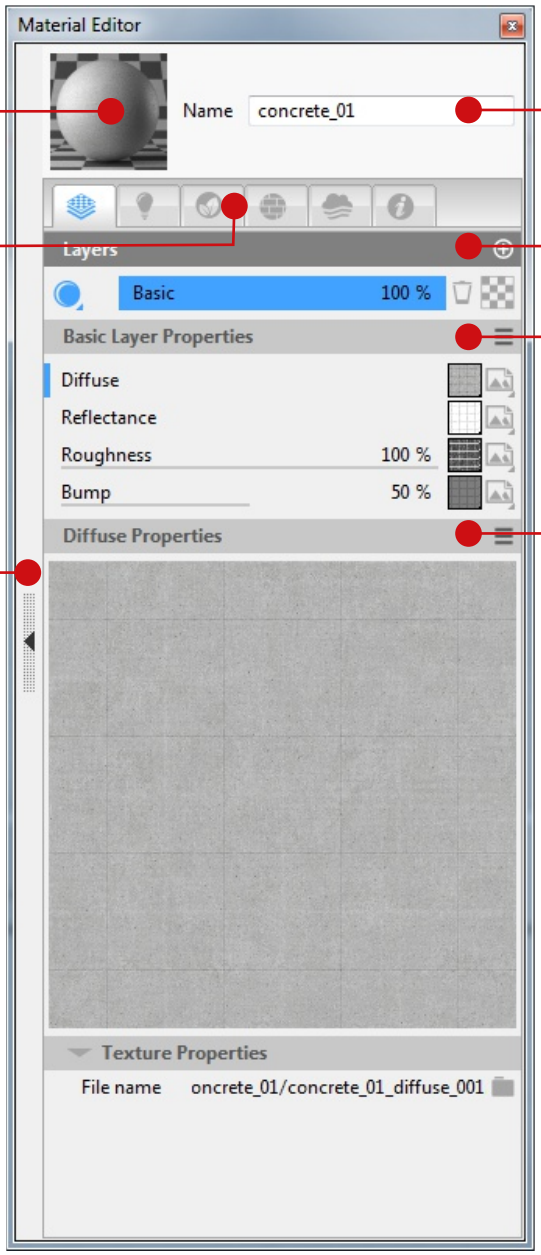
You can access the advanced material editor by clicking on the Edit button that can be found on any Thea Material. This will open a new floating window.

Advanced Material Overview

Material Preview
Double-click to enlarge preview.
Right-click to load/save .mat.pack, .mat.thea files, and select preview room.

Global Modifiers
These modifiers affect the material as a whole. Emittance, Clipping, Displacement, Medium.

Content Browser Access
Expands the panel to the left displaying the Content Browser allowing the user to directly apply materials to the current one.



Material Name
The name will also change in Rhino's materials panel

Layer Manager
Layers can be created, removed, change position, assign a layer weight map and more.

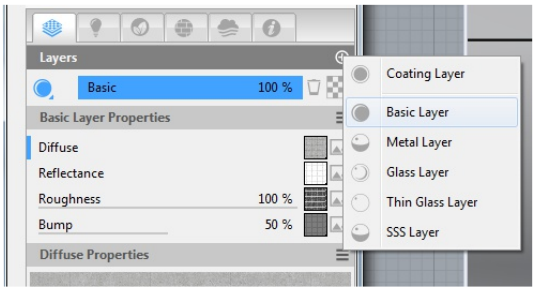
Layer Properties
Properties of the selected layer will be displayed here.

Channel Properties
Properties of assigned colors, procedurals and bitmaps will be displayed here.

Working with Layers

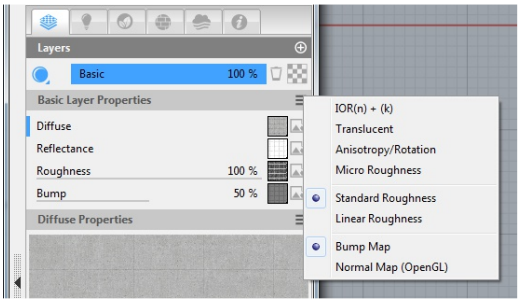
With the Layer Manager, you can create multiple layers of different type and weight.

Create a layer: click on the plus (+) icon, and then select the type of layer (Basic, Metal, Glass, Thin Glass or SSS)
Change the type of a layer: Click the icon next to the left of a layer and select a different type.
Define the weight of the layer: To change the layers percentage %, drag the colored horizontal bar. It is also possible to use a bitmap as a weight map. Click on the checkerboard icon to the left of the layer and load a bitmap texture.
Delete a layer: Select the layer and then click on the trash can icon.
Move a layer: Select the layer and then click on the up/down arrows.



LAYER PROPERTIES

Below the layer manager you can find the parameters of the currently selected layer.



Show advanced parameters: To display advanced parameters (Translucency, Micro Roughness, etc.), click the hamburger menu icon.

Note: Different parameters are available for different types of layers.

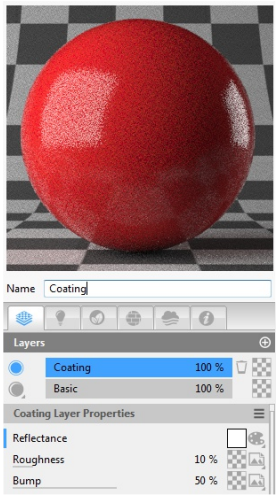
LAYER TYPES

Coating Layer

The coating layer uses a special reflection model with only the specular component. It is useful for simulating varnishes and paints on a layered material.

You can use several coating layers to simulate multiple varnishes and paints. The coating itself reflects some light, while any layers of material underneath absorb the rest of the light.

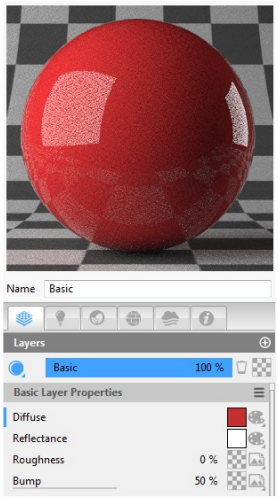
You can change the Extinction Coefficient to modify the reflectance (based on Fresnel equations) and define the absorption density of the layers of material underneath. Both the Extinction Coefficient and the Thickness of the layered material are used to calculate absorption at a microscopic level.



Basic Layer

The basic layer consists of a diffuse, translucent, and Fresnel based specular component. It is a highly energy efficient material designed to be used mostly for matte and plastic materials.

You might also use basic layers to create metals and translucent materials. Metals, in most cases, have a non-zero extinction coefficient, which corresponds to a high Fresnel coefficient under any viewing angle.



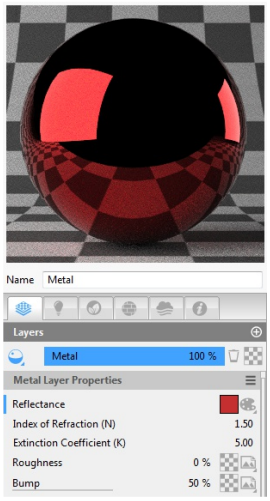
Metal Layer

You can create a metal with perfect reflection (Roughness = 0), a very rough metal (Roughness = 100), or something in between.

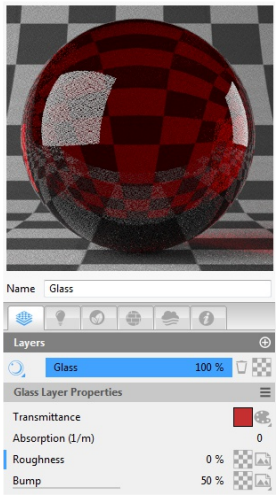
The Bidirectional Scattering Distribution Function (BSDF) uses Fresnel equations for reflections, which is controlled by the index of refraction and the extinction coefficient.

Set the Index of Refraction to around 1 to make the material less reflective. As you increase the value, reflection becomes stronger and stronger; at very high values, the reflected light takes on the color of the selected color.

Use a non-zero value for the Extinction Coefficient to amplify reflection.



Glass Layer

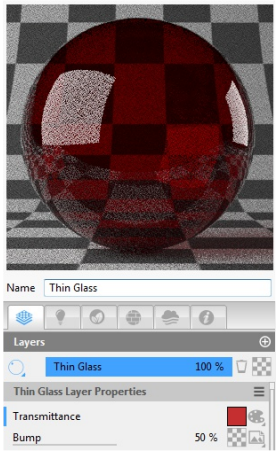


You can create a glass with perfect reflection and refraction (Roughness = 0), a very rough glass (Roughness = 100), or something in between. The Bidirectional Scattering Distribution Function (BSDF) uses Fresnel equations to balance reflection and refraction, which is controlled by the index of refraction and the extinction coefficient. Set the Index of Refraction to around 1 to make the material less reflective and more refractive. Set the value to exactly 1 to make the glass perfectly transparent. As you increase the value, reflection becomes stronger and stronger; at very high values, the reflected light takes on the color of the selected color.

Tip: To achieve perfect transparency, we recommend that you create a Thin Glass Layer instead of a Glass Layer with Transmittance enabled and the Index of Refraction set to 1.

Important: Fresnel coefficients are based on both the index of refraction and the angle of incidence. Even with a very small index of refraction, the BSDF will be quite reflective for grazing angles. A real world example is a swimming pool. When you look straight into the pool, the water is transparent; however, when you look at the pool from afar, the water reflects the environment.

Thin Glass Layer

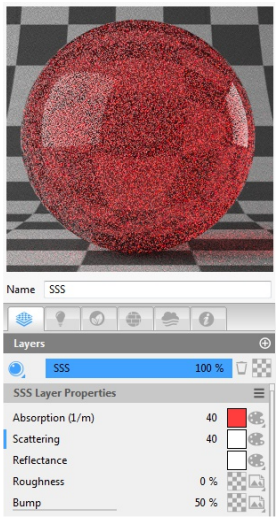


This glass model describes thin glass materials that show perfect (mirror) reflection and transparency.

Thin Glass models are very accurate models and are great for assigning to thin surfaces, such as windows and thin transparent plastics. Although you could also use a glass material with transmittance enabled and index of refraction set to 1, it is recommended to use the glass model whenever you want to achieve transparency.

Another way to achieve transparency is to actually model a surface, such as a window, as a thin double interface where refraction takes place at both sides. Using the glass model though is optimal in terms of visual accuracy and additionally, it can be traced during shadow evaluation (something like this cannot be done with the double interface model which will create shadows). The glass model does not assume the model to be closed as it does not define an interior/exterior volume. The index of refraction is used as if the model was a double interface, in order to compute the overall transmittance due to double refraction.

SSS Layer



The Bidirectional Subsurface Scattering Distribution Function (BSSDF) is a generalization of the Bidirectional Scattering Distribution Function (BSDF); however, unlike BSDF, the entry and exit points for BSSDF may differ instead of coinciding. Therefore the evaluation of BSSDF is far more difficult, as it involves the interaction of surface reflectance/transmittance along with scattering through participating media.
Besides the surface reflectance entries, there are also parameters describing absorption and scattering inside the object. In order for the SSS material to be evaluated correctly, the object should be closed (without holes).

Participating media with high albedo (i.e., when the scatter density is much higher than the absorption density) are particularly difficult to render. To accelerate rendering with minimum loss of accuracy, usually you can turn an asymmetric medium into an anisotropic medium with a synchronous decrease of its scatter density. Assuming that the asymmetry of the medium is $g > 0$, you can set asymmetry to the isotropic value of 0 and decrease the scatter density to a value that is equal to the old scatter density multiplied by 1-g. The new medium will have lower albedo, and it will render faster with minimum loss of accuracy.

Layer Parameters

Diffuse: Diffuse reflection is when light is scattered at several angles on a surface. You can select a texture, color, or procedural.
Layers used in: Basic

Reflectance: Reflectance is the texture for the specular component when you view the surface from directly above. Reflectance at the grazing angle (90 degrees) is also implicitly defined. So, the specular reflectance is calculated as a combination between user Reflectance and Reflectance 90 (white by default), depending on the viewing angle.
Layers used in: Basic, Metal, Glass, SSS, and Coating

Anisotropy: Stretch and blur highlights against the grain of the material, which is particularly useful for metals. For no anitrosopy, set the value to 0%. For full anitrosopy, set the value to 100% (the material is a perfect reflector/refractor in one direction and completely rough in the other direction).
Layers used in: Basic, Metal, Glass, SSS, and Coating

Rotation (deg): To rotate the stretched and blurred highlights created using Anisotropy, enter a value from 0 to 360 degrees or select a texture.
Layers used in: Basic, Metal, Glass, SSS, and Coating

Roughness: Adds texture to the material at a microscopic level, affecting specular reflectance and transmittance. 0% creates a perfect mirror reflection. Lower values produce crisper and brighter reflections. Increasing the roughness will spread and distribute reflections and create a more matte surface. Higher values produce bigger highlights and reflections that are more blurry and dim. At values approaching 100%, light becomes so scattered that the reflections are barely visible, if at all.
Layers used in: Basic, Metal, Glass, SSS, and Coating

Bump: Adds texture to the material at a macroscopic level. A bump map gives the illusion of texture without physically distorting the geometry, minimizing rendering time. Each layer of material can have its own bump map. The grayscale map tells Thea Render how to change the surface normals as if the surface has been displaced; the modified normals are used in lighting calculations. A bump map looks like the inverse of what you might expect: black represents the highest extreme and white represents the flattest extreme, while shades of gray represent grades in between.
Layers used in: All

Normal: This is a more detailed version of bump mapping, where you select a RGB color image instead of a grayscale image. While standard bump mapping uses grayscale values to describe the surface's hills and valleys in terms of height, normal mapping translates red, green, and blue values to x, y, and z coordinates. This creates texture in terms of normal vectors up the hill or down the valley. Specifically, the red, green, and blue values (0 to 255) are translated to x (–1 to 1), y (–1 to 1), and z (0 to 1) coordinates respectively.
Layers used in: All

Index of Refraction (n): When you place something behind a transparent object, it becomes distorted. The level of distortion is determined by the Index of Refraction, which defines how much light is bent and reflected when it comes into contact with a transparent surface. For example, air's value, 1.0, causes no distortion of background objects. A value of 1.5 means that the background objects become considerably distorted (e.g., a glass marble). A value just below 1.0 causes the object to reflect along its edges (e.g., a bubble seen from under water).
Layers used in: All

Extinction Coefficient (k): This refers to light that is likely to be lost (i.e., to absorption and scattering). The higher the extinction coefficient, the more opaque the material. You can use a value of zero or above.
Layers used in: Basic, Metal, Glass, and Coating

Translucent: Make the material semitransparent by clicking on a texture. If no texture is selected, than no translucency will be rendered.
Layers used in: Basic

Micro Roughness: Adjust the sharpness of reflections, as the viewing distance goes from near to far. When looking at a surface that is completely rough, planes that are closer appear rougher (because you can see them more clearly) while surfaces that are further away appear smoother (because you can't seem them as clearly). You can adjust the Height and Width to define the average height and width (µm) of the bumps on the surface.
Layers used in: Basic, Metal, Glass, SSS, and Coating

Thickness (µm): This refers to the coating thickness. The thickness and extinction coefficient are used to calculate the amount of light absorbed by any layers underneath the coating.
Layers used in: Coating

IOR File: You can create a physically accurate material by using an Index of Refraction file, which provides the exact index or refraction and extinction coefficient for each wavelength of a material. The file extension is .ior or .nk.
Layers used in: Glass and Metal

Transmittance: The amount of light that passes through a material.
Layers used in: Glass and Thin Glass

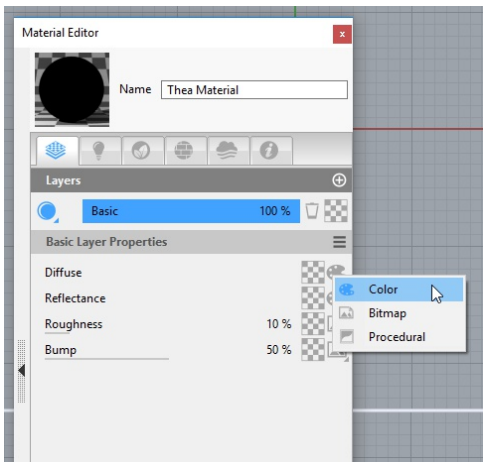
Absorption (1/m): Change the absorption density and color. You can use a value of zero or higher. The higher the density, the more absorptive the material.
Note: For a basic material, you need to select a color or a texture for translucency first. For glossy materials, you need to select a color or a texture for transmittance first.
Layers used in: Basic, Glass, SSS, and Coating

Abbe Number: Can be used to create a rainbow effect in the interior of an object, such as a gemstone. Without this rainbow effect, gemstones would look like glass. Lower values correspond to a stronger rainbow effect. Increase the value for a more subtle effect. You can look up the values for specific materials online. The Abbe number describes the variation of the index of refraction with respect to the wavelength.
Layers used in: Glass

Interference: Makes a surface iridescent, simulating a phenomenon called thin film interference. You may have seen this in soap bubbles, oil slicks on water, or peacock feathers. When light waves come into contact with a thin film, some waves are reflected from the top surface while others penetrate the film, hit the bottom surface, and are reflected. When these light waves interact, momentary streaks of color result. The iridescent colors change when the viewing angle is changed. Adjust the Thickness to change the irridescence level. 200-1000 is a good general range for making a visible change.
Layers used in: Thin Glass

Scattering (1/m): Changes the scatter density and color for a subsurface scattering material. You can use a value of zero or higher. Note that the higher the value, the longer it will take to render the material. The scatter color is used for both in-scattering and out-scattering light interaction.
Layers used in: SSS

Asymmetry: Controls the asymmetric coefficient of a subsurface scattering medium, which follows the Henyey-Greenstein phase function. You can use a value between –1 and +1, where –1 corresponds to a perfect back scattering media, +1 to a perfect front scattering media, and 0 to a isotropic media.
Layers used in: SSS



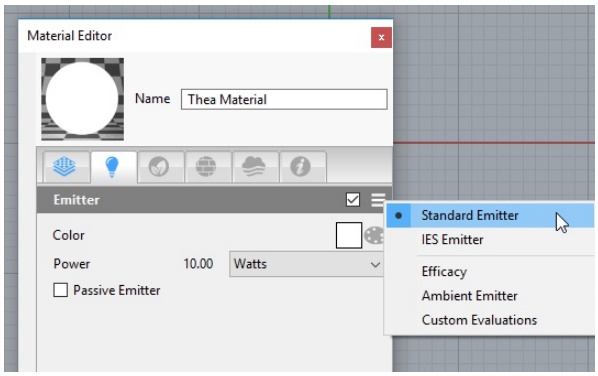
ASSIGNING COLOR, BITMAPS OR PROCEDURALS IN A CHANNEL

For each channel (e.g. diffuse, reflectance, etc) the user can assign a color, a bitmap texture or a procedural. Clicking on the palette icon to the right of each channel will display the list with the available options.

Color: Use the color selector to define the RGB values of the color. Color also has the Spectrum option that allows you to define RGB values in the visible spectrum.
Bitmap: You can use tonemapping (Gamma, Saturation, etc.), change the projection, and mix the bitmap with a color.
Procedurals: Procedurals have their own customizable settings.
Temperature: defines the color of the emitter in Kelvin. (Avalaible in emittance tab)

EMITTANCE TAB

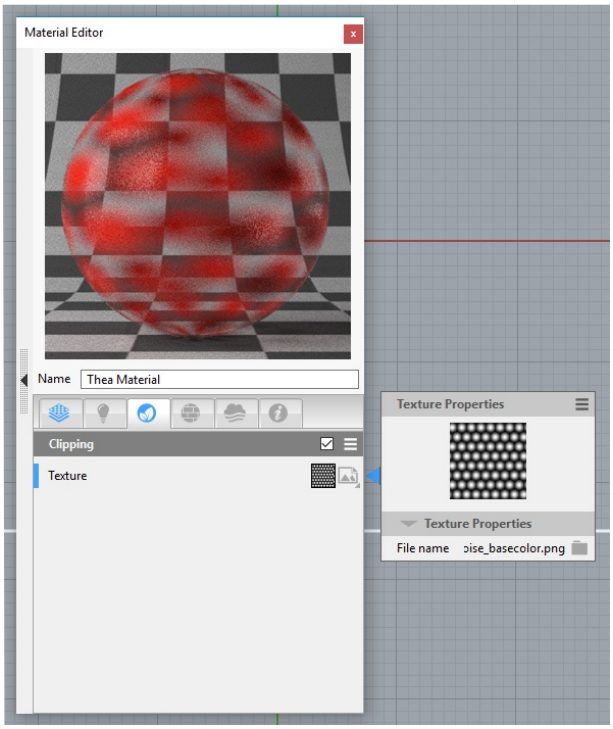
Thea Render supports both area and point light emitters. The area emitters are applied to a surface. Typically, the area emitter has a diffusion-like emission model and it uniformly distributes light along all directions in the above hemisphere. Nevertheless, more complex emission models can be defined by making use of an IES file.



Color: User can define the color of the light with the following options: Color, Temperature, Bitmap and Procedural.
Power: Defines the power of the emittance
Passive Emitter: The emitter will not cast light into the scene but one will still be able to see the area emitter "lit".
IES Emitter: To convert a Standard Emitter to IES, click on the "hamburger" icon and select IES Emitter.
Efficacy: Maximum efficacy is 683lm/w which corresponds to lights with no energy loss, meaning that all their power is converted to visible light.
Custom Light Evaluation: Custom Light Evaluation allows the user to select which components (such as Diffuse, Translucent, Reflectance, Transmittance, and SSS) will be evaluated for a given material and light, thus removing unwanted contributions and accelerating render times.

CLIPPING TAB

Clipping is a procedure that 'cuts' parts of the material based on a given texture. White/ Bright areas of the texture are kept while black ones are cut.

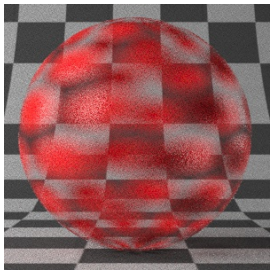


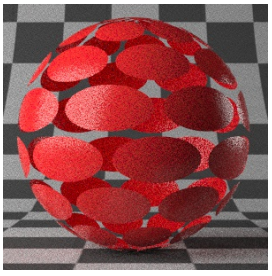
Texture: Select the image that will be used as clipping map.

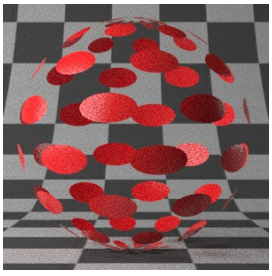
Soft Clipping (Default): The soft option respects the alpha channel of an image and will use all the grey values to clip the material.

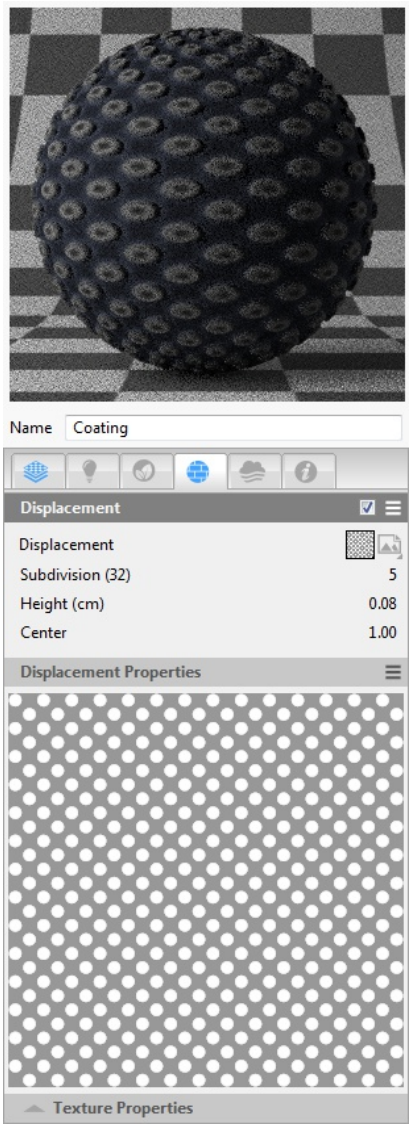
Hard Clipping: Combined with the threshold parameter, it is posibble to select which parts of the image will be used to clip the material.

Threshold: Setting the percentage very low, only total and some very dark ones will be 'cut'. Increasing it, brighter areas will be used for clipping. Setting the percentage to 100%, the whole material will be clipped, as even the total white areas will be considered as points of clipping.


Soft Clipping


Hard Clipping at 25%


Hard Clipping at 60%



DISPLACEMENT TAB

Displacement is a technique that uses a texture or height map to cause an effect where the actual geometric position of points over the textured surface are displaced, often along the local surface normal, according to the value the texture function evaluates to each point on the surface. It gives surfaces a great sense of depth and detail, permitting in particular self-occlusion, self-shadowing and silhouettes; on the other hand, it requires the most rendering time of this class of techniques owing to the large amount of additional geometry.

A displacement map is a black/white map like a bump map and the gray values of this map represent how Thea should displace the mesh.

Displacement: Select the image that will be used as a displacement map.

Subdivision: Defines the times the actual mesh will be subdivided. Large values will create a more detail surface.
Height (cm): Defines the height of the displaced surface in cm. The maximum value will be used for the white areas of the displacement map.

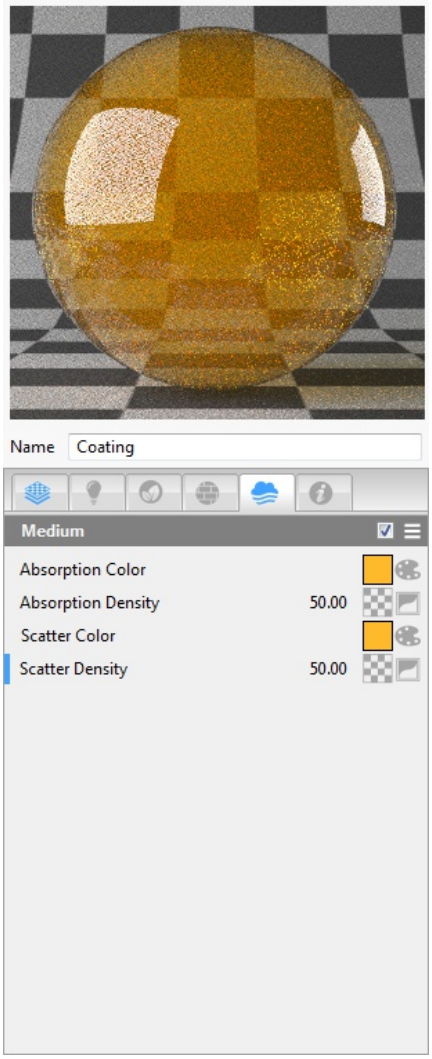
Center: Areas with black mean no displacement and white 100% displacement (corresponding to the height you have ginen). This is true when center is set to 0, but if you change to 0,5 then 50% gray color of the displacement map will represent no displacement and when set to 1 then 100% white will represent no displacement (in other words it will displace the opposite way).

This inverted displacement is sometimes useful, like for the ground plane displacement where you want to avoid intersecting with objects that are on the ground, as for example a car wheel that is on a displaced ground, so in this case you would set the center to 1.

Normal Smoothing: This option should be enabled for surfaces with smooth edges. For models with sharp edges (box, plane, etc) it should be disabled.

Tight Bounds: Helps to render faster but initialization will last longer. This is more preferred to have it enabled

Tips: A good mesh topology always helps displacement to work as expected. A pre-subdivide surface in the modeling application will make displacement work more efficiently.



MEDIUM TAB

True volumetric scattering is supported and Thea Render can solve light transport problems that include participating media. There are a lot of possibilities since mediums can be both homogeneous and a lot of supported phase functions.

Absorption Color: Defines the transmittance color - this is actually the color visualized after a distance of 1 meter (assuming unit density and no scattering). When the distance is less than 1 meter, the color shifts towards white and when the distance gets bigger, the transmittance shifts towards black. The color change with distance is strongly non-linear and thus it is recommended to avoid highly saturated colors.

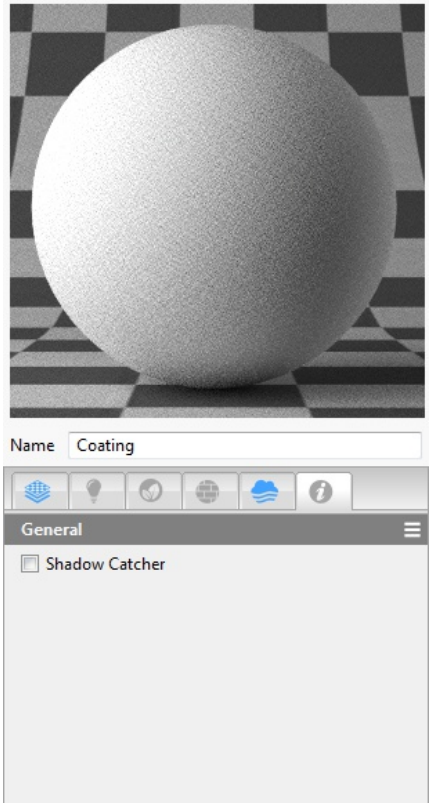
Absorption Density: Defines the density of absorption in 1/m units. The higher this density the higher the absorption. This option gives easy control to the magnitude of absorption and it is possible to set a procedural texture in order to define spatially varying absorption (heterogeneous medium)

Scatter Color: Defines the scattering color - this is the color that bounces off of particles (in the medium). The sum of absorption and scatter color (multplied by their corresponding densities) defies the extnction coefficient of a medium which is used to calculate the total absorption at a distance. The scatter color may be applied numerous times for particles that bounce inside the medium (especially for highly scattering medium) and so, it is also recommended here to avoid highly saturated colors.

Scatter Density: Defines the density of scattering in 1/m units. The higher this density the higher the scattering. This option gives easy control to the magnitude of scaterring and it is possible to set a procedural texture in order to define spatially varying scattering (heterogeneous medium)

Phase Function: Defines the variation of outgoing radiance over the sphere of directions and it is the medium analog of a bi-directional scattering distribution function (which is used for surface). The available functions are the Isotropic, Rayleigh, Mie Hazy, Mie Murky, Mie Retro or Henyey Greenstein (you can also set the asymmetry value below it). Most used phase functions are Isotropic and Henyey-Greenstein.

Assymetry: Defines the asymmetry parameter of Henyey-Greenstein phase function. This parameter is unit-less and takes values from –1 (totally back scattering) to 1 (totally front scattering). Obviously the extreme values of –1 and 1 do not actually scatter light outside the particle direction and they are not of practical use. A value of 0 is balanced scattering between back and forth directions and it is the same as using an isotropic phase function.



GENERAL TAB

General tab gives access to the shadow catcher option and Custom Light Evaluation.

Shadow Cathcer: this option can enable a material to be a shadow catcher or not. This feature is used to integrate a model into a scene with a background image as with the Shadow Catcher, we introduce realistic shadows produced by IBL, sun and Thea point lights. In addition to these enhancements the shadow catcher can produce real reflections on ground plane. To enable real reflections, we add a basic layer to our ground plane and add a reflectance color.

Applying Materials with Content Browser

The Advanced Material Editor allows the user to apply materials from the Content Browser to the material that is currently being edited.

To expand the content browser panel, click on the black arrow at the left side of the material editor.

Note: More info on the Content Browser on section 8.3

Loading a material

Double click on any thumbnail to load the material in the editor.

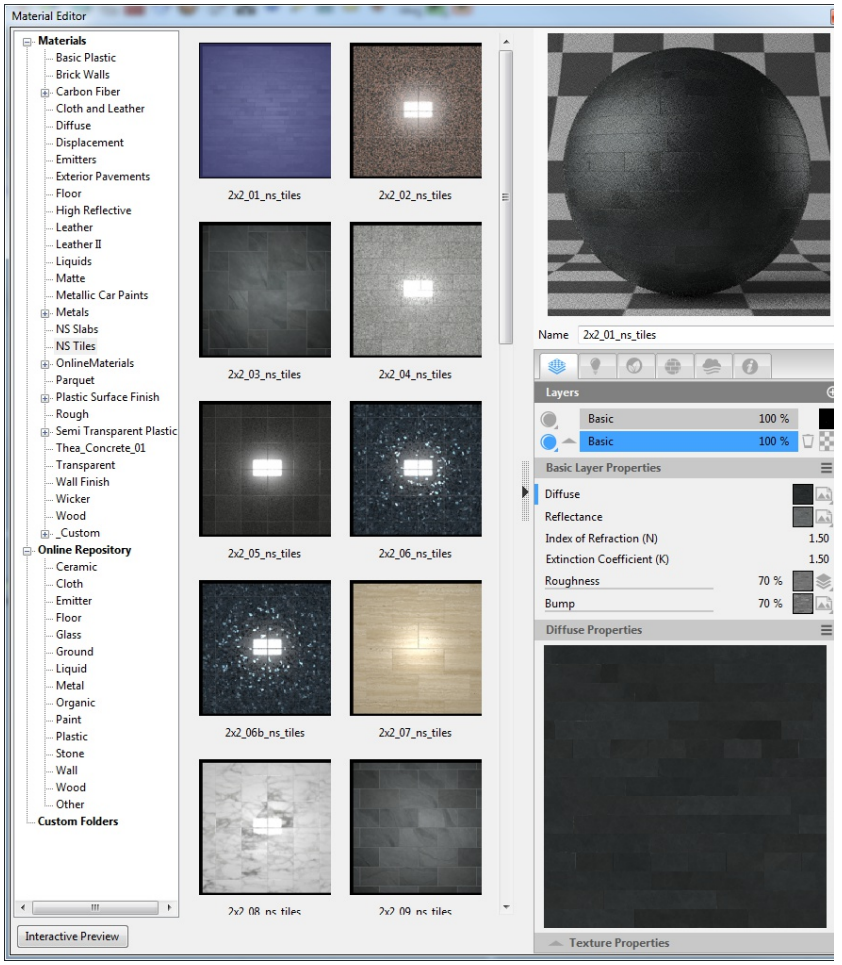
Preview material before loading

It is possible to preview a material before loading it into the material editor. To do that, follow these steps:

1. Start Interactive Rendering in Rhino's Viewport or in Darkroom.
2. Click on the 'Interactive Preview' button at the bottom of the material editor to go into Preview Mode.
3. Select any thumbnail with a single click and you will instantly see the material being applied to the scene.

Turning of the Interactive Preview button will revert the material to the previous one.

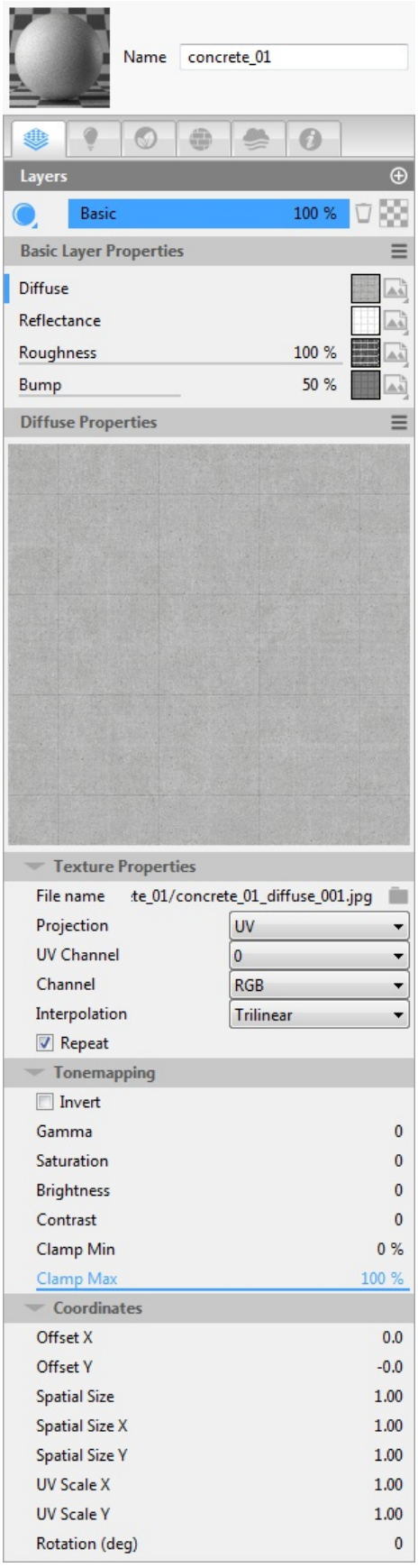
While in Interactive Preview mode it is also possible to double click on a thumbnail and load it into the current material.



9.2.1. Texture Editing/Layering

TEXTURE EDITING

The texture editing tool has two modes to work with, Overview and Edit Mode.
Overview: the user sees only the parameters that have been modified while hiding the rest.
Edit: The Edit mode displays all the available parameters for bitmap editing like Texture Properties, Tonemapping and Coordinates. Any parameter changed here will be displayed in the Overview Mode.



Editing a Bitmap

By default, the Thea Material editor is in Overview Mode, displaying only the path to the file and any parameter that has been modified allowing you to have quick access to the most used ones.

To start editing the bitmap, click on the hamburger icon and select Edit Mode.

Texture Properties

Projection: this option helps the user select the projection needed for the selected texture. From the drop down list that appears by pressing the down arrow, a projection can be selected among: UV, Cubic, Cylindrical, Spherical, Flat, Front, Shrink Wrap, Camera Map, Cubic (Centered) and Flat (Centered).
UV Channel: we see here a list of all available Channels (for example the Diffuse, the Refraction, the Bump Channels etc.) and each texture can be linked to a selected channel.
Channel: two main channels exist for a texture, the RGB channel and the Alpha channel.
Interpolation: here the user can specify the type of interpolation for the selected image. It can be set to None, Bilinear or Trilinear.
Repeat: when enabled, it forces the bitmap texture to tile in all directions.

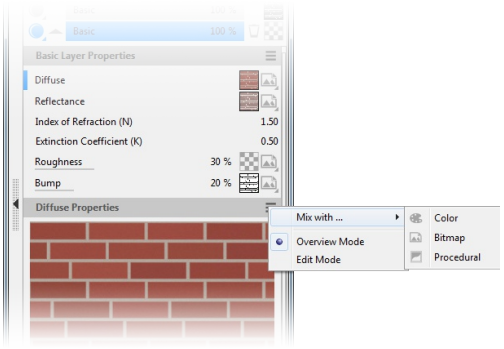
Tonemapping

Invert: this option, inverts all the colors of the texture to their complemented colors.
Gamma: user can edit here the Gamma value of the selected texture. These values range from -100% to 100%. In the next images, we see these values for the selected texture and the way they affect its final appearance.
Saturation: user can change from here a texture saturation, by giving it values from -100% to 100%. At the next textures, we have applied two extreme values for saturation, to see how they affect the tone of the texture.
Brightness: another feature that affects a texture tone is the brightness. Once again, values range between -100% and 100%. Brightness set to -100% makes the image total black.
Contrast: user can specify here the value of contrast that the texture will have.
Clamp Min and Max: from these two options, user can specify the minimum and maximum clamp of the selected texture accordingly. RGB colors range normally from 0 to 255. By setting for example minimum clamp 20%, the colors that their RGB values are less than around 51, will be “cut” and get this value. By increasing minimum clamp percentage, image turn to be whiter, while by decreasing the maximum clump percentage, image is getting darker colors. Decreasing the maximum percentage and increasing the minimum on the same time, textures tend to appear grayer, as gray color has RGV values around in the middle of the 256 colors (128, 128, 128).

Coordinates

Offset X and Y: Offsets the bitmap over the X and Y axis.
Spatial Size (X and Y): Spatial Size is used to correctly account for scaling when changing from UV to Cubic coordinates, while UV Scaling affects the scaling once UV projection is used.
UV Scale X and Y: Scales the bitmap over the X and Y axis.
Rotation (deg): Rotates the UV coordinates.

TEXTURE LAYERING



Textures can be layered and blended together to generate complex results using any bitmap, color or procedulars as layers.

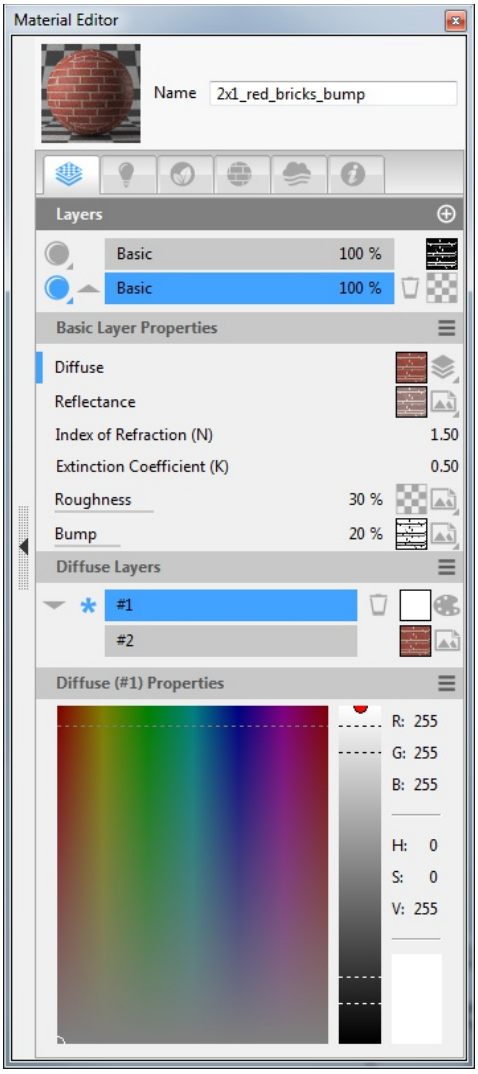
To start layering textures, select a channel (Diffuse, Reflectance, etc) that has a color, bitmap or procedural assigned to it, and from the Channel Properties panel, click on the hamburger icon and select "Mix with...".

The available options to layer with, are: Color, Bitmap and Procedural.

After clicking on the 'Mix with..' option, you will see the two texture layers one on top of the other. Deleting and moving layers is exactly the same as in Layers.

Each layer (except the one that is at the bottom) has two blending modes. Multiply(*) and Add(+). You can switch between them by clicking on the corresponding icon.

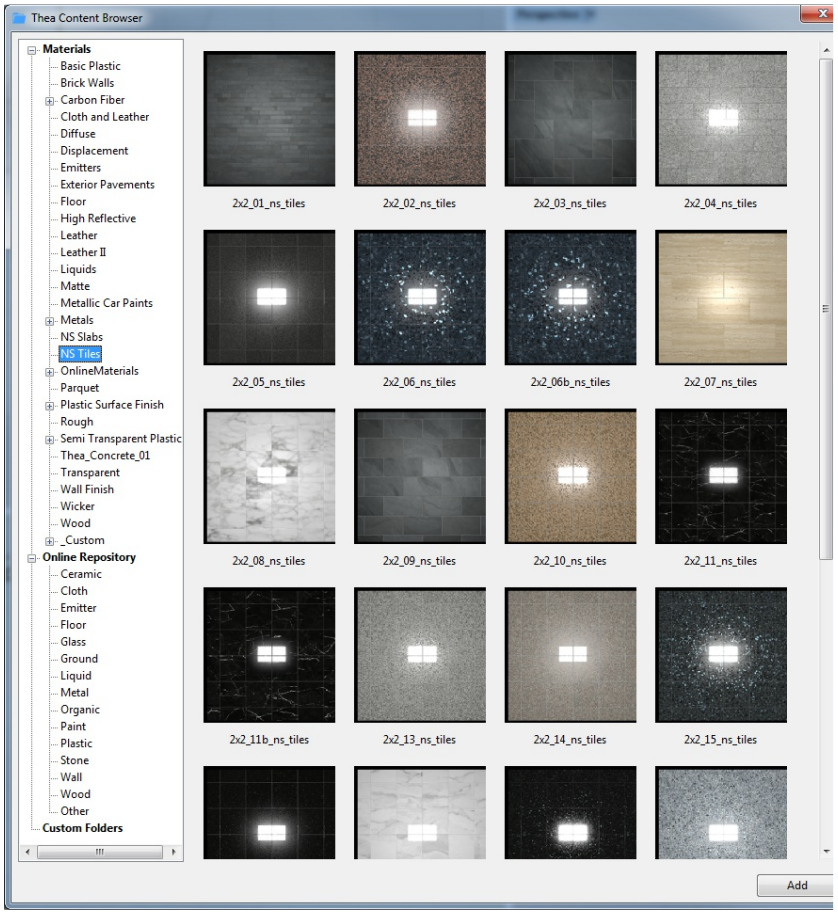
When the blending mode is in Add mode, it is possible to also adjust the layer percentage.



9.3 Content Browser

Thea for Rhino comes with ready to use materials in categories. To open Content Browser click on the folder icon on the Thea Toolbar.

The left side of the window is divided into three main categories: Materials, Online Repository and Custom Folders.



Materials

This sections list all the materials in categories that are locally saved on your machine.

Online Repository

The Online Repository gives you access to thousands of Thea materials from Thea Render's online database.

Custom Folders

It is also possible to define custom folders with Thea Materials on your hard drive. Right click on the Custom Folder title and select Add. This will prompt you to select the folder in which you have your Thea Materials collection.

To remove a custom folder, right click on its name and select Delete.

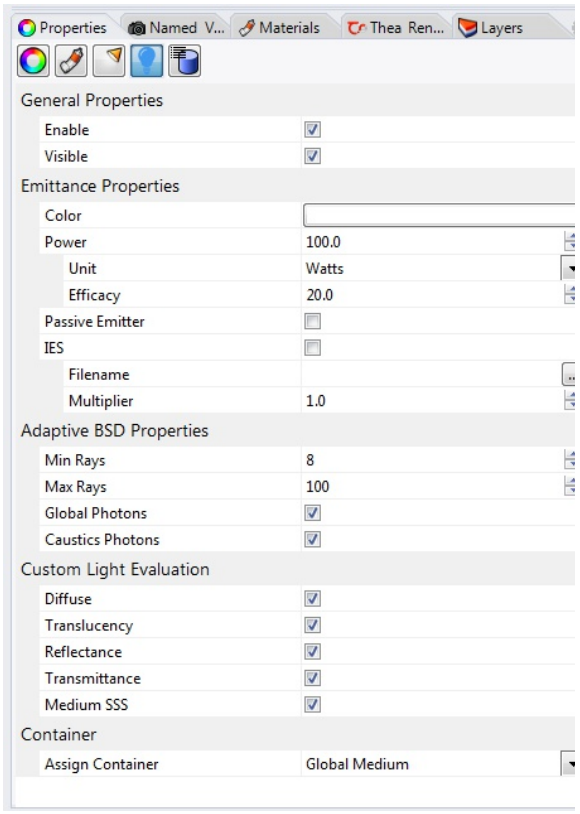
Adding Materials in the Materials panel

There are two ways to add a material in the material panel.

1st: Double clicking on a thumbnail will load the selected material in the material panel.
2nd: Select the material and then click on the Add button.

10. Light Properties

Thea light properties can be configured from a separate dialog. When a light is clicked in the Rhino viewport, the Thea light properties page is shown in the properties page. Depending on the light type, the appropriate controls are shown.



Light properties are divided in five categories which are: General, Emittance, Advanced BSD, Custom Light Evaluation and Container.

General

Color: Sets the color of the light.
Power: Defines the power of the emittance along.
Units: Defines the units that will be used for the given power.
Efficacy: Defines the energy loss of the emitter. A value of 683 lm/W corresponds to lights without energy loss.
Passive Emitter: The emitter will not cast light into the scene but one will be able to still see the emitter 'lit'.
IES: Loads and IES file. IES files describe light's emission according to measured goniometric data.
Filename: The path to the IES file.
Multiplier: Modifies the intensity of the IES light.

Adaptive BSD

Min/Max Rays: Define the effors of the direct light estimator for the particular light.
Global Photons: Defines if the selected emitter will be used for Global Photons.
Caustics Photons: Defines if the selected emitter will be used for Caustics Photons.

Custom Light Evaluation

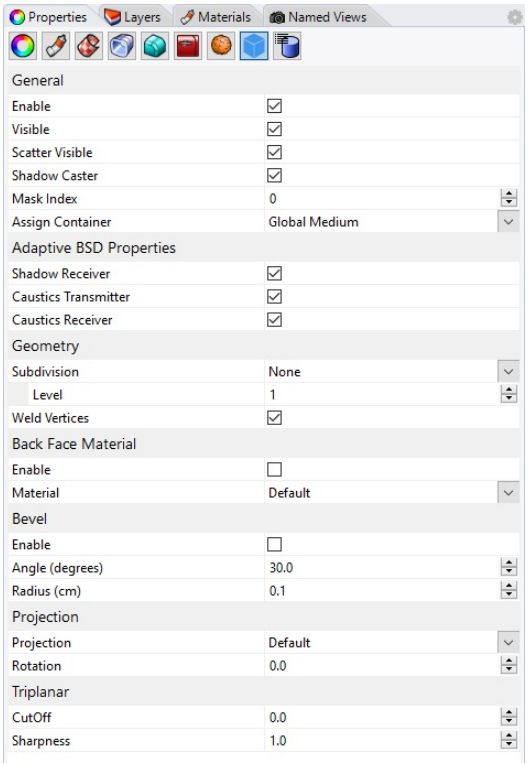
Custom Light Evaluation allows the user to select which components (such as Diffuse, Translucent, Reflectance, Transmittance, and SSS) will be evaluated for a given material and light, thus removing unwanted contributions and accelerating render times.

Container

The assign container options allows the user to assign a material as the container of the camera. By default, it is set to Global Medium but when a camera is inside an object with a material using medium, the image will render black, unless we assign that specific material to the container of the camera.
Assign Container: Select the material from the list that will be assigned as a container for the camera.

11. Object Properties

Thea for Rhino adds Thea properties to Rhino models. Those attributes can be configured by selecting the Thea Object Properties icon.



General

Enable: makes the object invisible. It will also not be visible in reflections/camera and will not cast shadows.
Visible: Hides the object from the camera. It will still be visible in reflections and will cast shadows.
Scatter Visible: The object will not be visible in reflections and refractions.
Shadow Caster: Defines whether the object will cast shadows or not.
Mask Index: Used along with the Mask render channel. Objects with a value greater than zero, will make Thea for Rhino to generate a separate channel for them when Mask channel is enabled.
Assign Container: Assigns the selected material as a container for the object.

Adaptive BSD

Shadow Receiver: gives to the models the property to get shadows that other models may throw on them. By disabling it, the model will throw shadows to the rest scene, but will receive no other shadow.
Caustics Transmitter: If true, then this surface will produce caustics on another surface.
Caustics Receiver: If true, then the surface will show caustics produced by another one.

Geometry

Subdivision: Subdivides the surface in render time. Two methods to choose from: Planar or Charles-Loop. Subdividing a surface can help displacement to give a better result. This is especially useful for flat surfaces having a few triangles.
Level: Defines how many times the surface will be subdivided.
Weld Vertices: Welds the vertices of the selected object.

Back Face Material

Enable: Turns on or off the back face material support.
Material: Select the material that will be used to the back face of the surface.

Bevel

Enable: Enables/Disables the beveled edges option.
Angle (degrees): This value allows the user to limit the effect of beveled edges to corners with an angle greater than the one defined here.
Radius (cm): Defines the radius of the beveled edges in cen meters. When the material of the object uses the Edge Ramp procedural, the same value will be used for the width of the edges.

Projection

Projection: Allows the user to select a custom projection that will override the texture coordinates of the objects. The default option will use whatever mapping is being used from Rhino.
Rotation: Rotates the texture coordinates.

Triplanar

Cutoff/Sharpness: Both parameters control the blending of the projections. Values range from 0 to 1.

Note: Projection and Triplanar options act as overrides allowing the user to make changes per object.

12. Render Engines

Rendering Modes

Thea for Rhino offers two rendering modes. Interactive and Production mode.

Interactive Mode (IR)

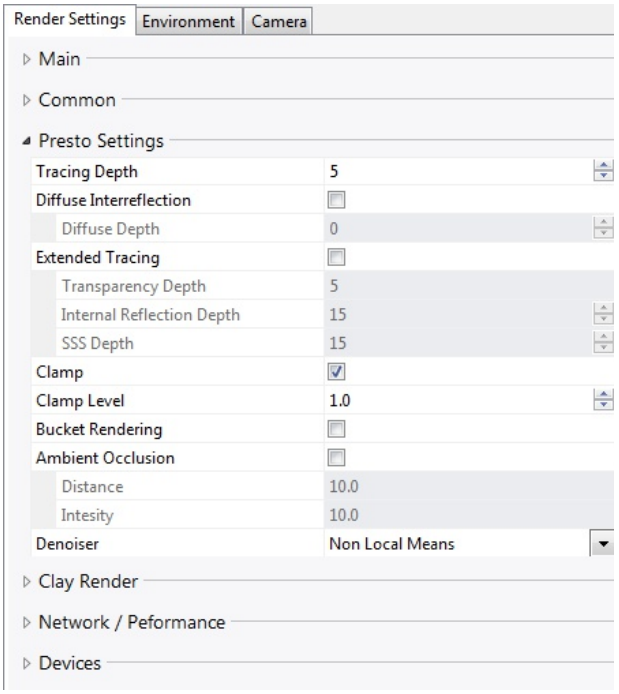
IR mode allow you to not only render the model as a static image but also interactively move the camera around the model, adjust materials and lights, modify the model and see the rendering being updated. Engines that offer Interactive Rendering are: Presto & Adaptive AMC.

Production Mode (PR)

PR mode is used for final rendering where changes to the scene do not affect the final image while rendering. All engines can be used in Production Mode (Presto, Adaptive AMC, Adaptive BSD, Unbiased TR1/TR2)

12.1. Presto

Thea Presto is an advanced render engine that has been written from the ground up and is optimised for both GPU and CPU execution simultaneously, harvesting all your computing power. The engine has been especially tuned for fast interactive rendering. This pushes GPU+CPU computing to the limits while keeping the high photorealistic quality of Thea Render.



Presto Settings

Tracing Depth: This is an important parameter for Progressive Engines. Increasing this parameter may be needed for certain cases where there are a lot of mirrors or dielectrics in the scene but it has a direct impact on render times.

Diffuse Interreflection: is a separate value to control tracing depth for diffused surfaces. Setting Diffuse Depth to 0 will remove all light bounces from the scene leaving only the direct light.

Extended Tracing: Extended Tracing can efficiently render scenes with transparent objects or materials with Subsurface Scattering while using a lower Tracing Depth.

Transparency Depth: Determines the Extended Tracing Depth for all transparent materials like Thin Glass, Glass and Clip Map.

Internal Reflection Depth: Determines the Extended Tracing Depth for transparent materials that have refraction and total internal reflection. These materials are created with the use of the Glass layer (for example solid glass or water). If you notice that you get dark areas on solid glass, the cause is often because of too low Internal Reflection Depth and not due to the Transparency Depth.

SSS Depth: Determines the Extended Tracing Depth for Subsurface Scattering (SSS) materials. In some cases increasing this value is needed to increase the brightness of bright colored dense SSS materials. (Not available when Diffuse Interreflection is enabled)

Clamp Level: Clamps the evaluation of a pixel, improving antialiasing. The number corresponds to the clamping limit. Higher than 1, clamping becomes less effective for antialiasing while less than 1 it becomes more effective but also lowering the brightness of the image more aggresively.

Bucket Rendering: Rendering high resolution images with multiple channels is usually an issue for GPUs but with the use of Bucket Rendering implementation, we are able to overcome this limiting factor and improve scalability as well.

Ambient Occlusion: used to mimic a part of global illumination making the engine to render faster.

Distance: this is the maximum distance that the sample may be evaluated to an intermediate (gray) color. After that distance, the sample is evaluated to white color.

Intensity: this value defines the intensity of the Ambient Occlusion used.

Denoiser: select the denoiser method to be used. Available methods are NVIDIA Optix and Non Local Means. To enable the denoiser make sure to also enable the Denoise channel in the Channels tab.

12.2. Unbiased TR1/TR2

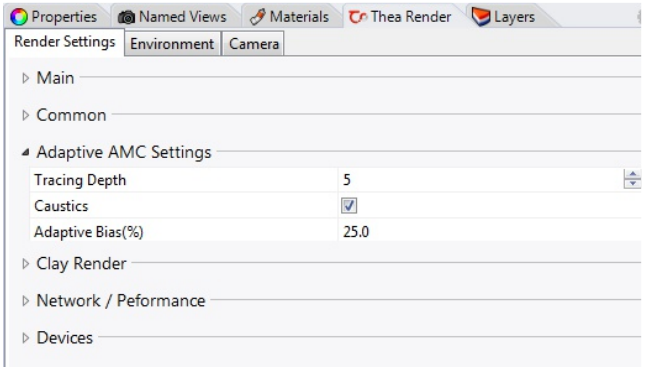
Thea Render supports a superior unbiased core which is one of the most advanced in the market and delivers stunning images without any compromises. All possible paths of lighting transfers are explored, delivering the highest accuracy without any artifacts. Sun-pool caustics and terminator artifact are robustly handled offering stunning results.

Unbiased TR1/TR2 Settings

These two engines have no settings and are controlled only by the Sample and Time Limit.
Unbiased engine TR1 is optimal for exteriors and scenes with dominant direct lighting while unbiased engine TR2 is optimal for extremely difficult indirect and caustic lighting.

12.3. Adaptive AMC

The Adaptive AMC engine is based on the Unbiased TR2 engine but with shortcuts to make it faster. It should be preffered for difficult indirect lighting situations (e.g. indirect caustics) and it can be used in both Interactive and Production Mode.



Adaptive AMC Settings

Tracing Depth: Just like in the Presto Engine, this is an important parameter for Progressive Engines. Increasing this parameter may be needed for certain cases where there are a lot of mirrors or dielectrics in the scene but it has a direct impact on render times.
Adaptive Bias: Increasing this value, several difficult paths are taken out of computations, making it faster.
Caustics: Removes the caustics path. In general, it should always be enabled.

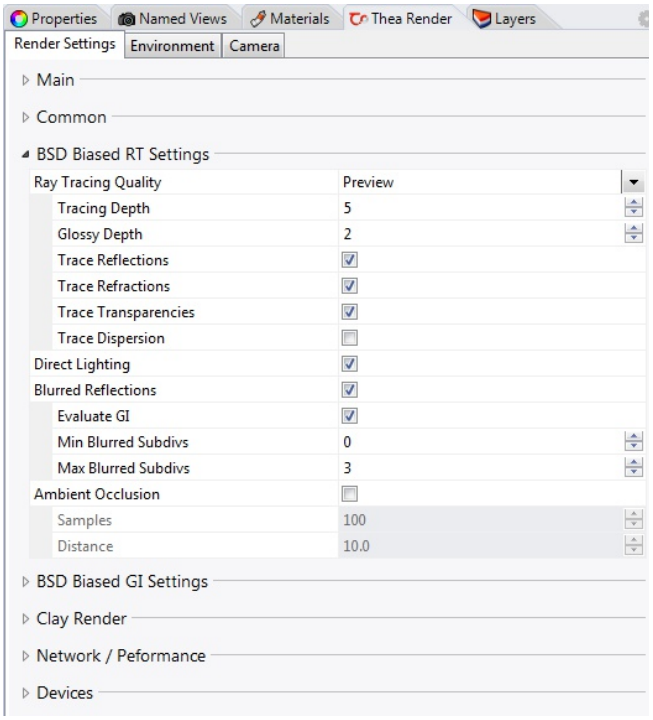
12.4. Adaptive BSD

Thea Biased engine (Adaptive BSD) uses interpolation schemes such as irradiance cache to render in shorter times and is implemented in a way that more effort is put where it is needed most. Furthermore this effort is driven by perceptual criteria generating high quality results that are perceived naturally.

Adaptive BSD settings can be divided in two sections. Biased RT and Biased GI settings.
Biased RT: contains the basic parameters in order to trace reflecting and refracting objects and evaluate direct lighting.
Biased GI: contains the basic parameters that control the quality of Global Illumination.

BSD Biased RT Settings

Ray Tracing Quality: defines the quality of raytracing



Tracing Depth: This is the main parameter influencing tracing depth for biased engine. Increasing this parameter may be needed for certain cases where there are a lot of mirrors or dielectrics in the scene, but it has a direct impact on render time.

Glossy Depth: controls tracing depth for blurred reflections/refractions. Keeping this value low will save evaluations on rough materials that in many cases contribute little to the overall image.

Trace Reflections: enables tracing of perfect reflections (glass reflection and glossy/coating zero roughness reflection).

Trace Refractions: enables tracing of perfect refractions (glossy/coating zero roughness refraction).

Trace Transparencies: enables tracing of glass and alpha mapping transparencies.

Trace Dispersion: enables dispersion for biased engine. Dispersion will raise render times considerably for the objects that exhibit this property, so having this option disabled for quick test renders is preferred.

Direct Lighting: enables/disables the direct light component of the biased engine.

Blurred Reflections: If enabled, blurred reflections and refractions will be traced in the scene. The maximum tracing depth is set by the ray tracing Glossy Depth parameter.

Evaluate GI: defines if Global Illumination will be evaluated or not.

Min Blurred Subdivs: controls the minimum number samples (in a power-of-two relation) taken on a blurred reflection/refraction.

Max Blurred Subdivs: controls the maximum number samples (in a power-of-two relation) taken on a blurred reflection/refraction.

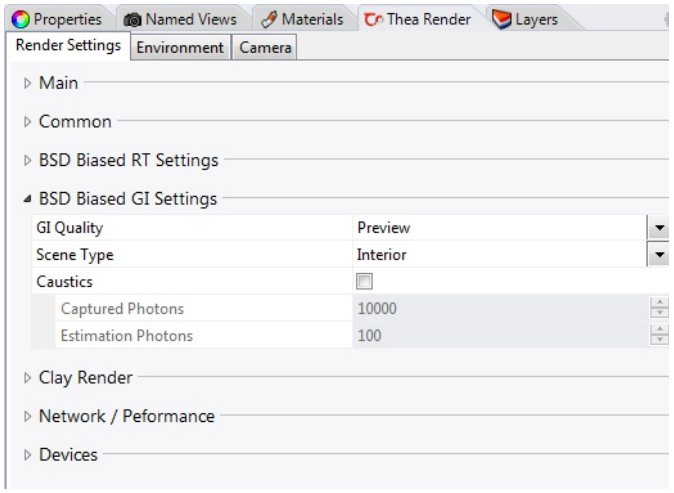
Ambient Occlusion: enables/disables the Ambient Occlusion for biased engine.

Samples: The stochastic samples taken on the hemisphere to estimate ambient occlusion. The more samples the better the accuracy but it will also take more time for the computation.

Distance: the maximum distance that the sample may be evaluated to an intermediate (gray) color. After that distance, the sample is evaluated to white color.

BSD Biased GI Settings

GI Quality: controls the quality of Global Illumination.



Scene Type: select between interior and exterior type. Using the interior type will make the engine to make use of the Field Mapping technique which accelerates these type of scenes.

Caustics: Enables/Disables caustics. Caustics are the photons that have been reflected or transmitted via at least one specular surface (like water or glass) before hitting a diffuse surface.

Captured Photons: This parameter corresponds to caustic photons captured in the map by all emitters. Usually, caustics need to be quite detailed and this value should be as high as possible. To avoid excessive memory demands, user should also control the lights emitting caustic photons and surfaces capturing caustics, to keep them as few as possible.

Estimation Photons: This is the number of caustic photons used for irradiance estimation. The higher the value the more blurry the results. Note that increasing this value will also have an impact on render times.