

## Photorealism without global illumination

Improve your lighting skills using Cinema 4D R17

**T**ry to imagine yourself waking up one morning with all your favourite GI render engines gone. No QMC, no light maps, no path tracing, no unbiased sleeky wizardry helping you with indirect lighting – just you, left alone with nothing but your very own lighting skills. What would your lighting skills look like?

In the Cinema 4D community's discussion of final gallery images, lighting is often nothing but a purely technical aspect – a process covered by render-engine specifications and expressed by nothing else but terms like ray depth, bounces and sample counts.

And when there are before and after comparisons of lighting with and without global illumination, the imbalance is even more obvious – most artists have simply forgotten how to light without GI. Most

artists are simply dependent on GI: they'll head for a deadline not knowing how to do a realistic and animation-proof lighting setup, which come without the computing demands of GI or the danger of flickering artefacts.

In this tutorial you will learn how to do an elegant and robust lighting setup easily capable of camera and object animation. Along the way some of the latest features of Cinema 4D R17 will help us do the job. When you show the final result to a colleague or a client it's a pretty safe bet they won't notice the difference between this and a GI render. And remember: it doesn't have to be physically correct, it just has to look physically correct.





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*Oberbilk*, 2016

Software  
Cinema 4D

Learn how to

- Implement real-world insights in a C4D scene
- Build a highly realistic, elegant and animation-proof lighting setup without GI
- Complement your lighting setup with smart custom-built shader setups
- Refine and streamline your rendering process

Concept

An everyday living room in early spring. It's worn, used and flooded with light. This is photorealism without global illumination.



**01 Set up the diffuse daylight** First of all we will implement a diffuse daylight. Windows function as 'gates' for diffuse daylight coming from the sky. To reproduce this we will use area lights placed in the windows. There is a two-part window ahead and one aside (represented by a dummy). Create an area light with area shadows in the size of your window's lower panel. Place it slightly in front of it. Set the falloff to Inverse Square with 600cm range. This creates a bright beginning and a rapid decrease of your light so you just need 25 per cent brightness. Note: for every area light in this tutorial we will restrict the light emission to z-direction only and deactivate the Specular checkbox as we will place specular-only lights later. Repeat these steps for the upper parts of the window ahead and the lower part of the window dummy. For the latter, use only 12.5 per cent brightness.

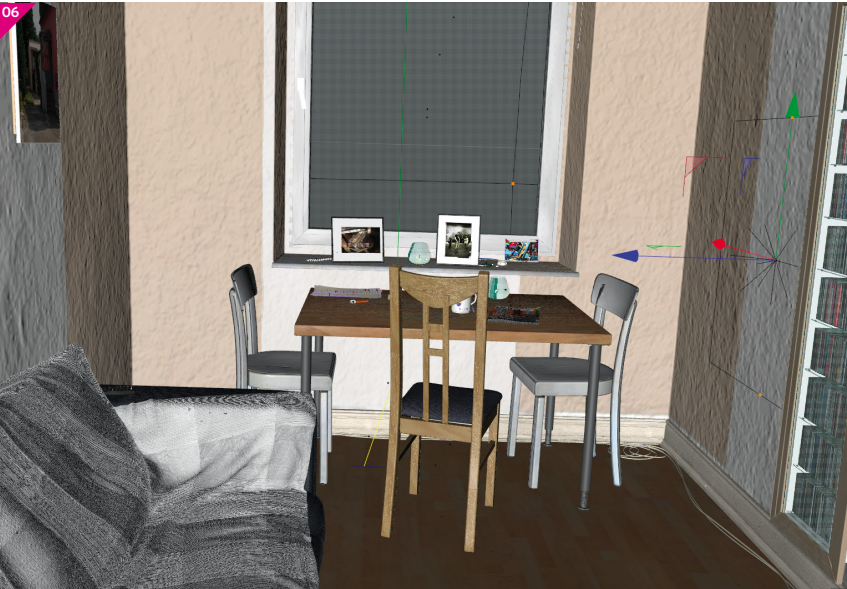
**02 Add daylight colour nuances with the new Color Chooser** Natural daylight is far from being pure white. As it bounces off every part of your surrounding, it transports the colour of participating objects. As we already know, windows function as a gate for light and this is the same principle as camera obscura: light from the surroundings passes through a gate and is reproduced upside-down on the inside of the camera. For a very diffuse version of such an effect, create a material with a gradient in the Transparency channel. This gradient should contain beige and blue, which represent the buildings and the sky. For finding the right colours, Cinema 4D R17's new Color Chooser will help as it provides Color Harmony palettes such as Complementary and so on. Apply the material to your daylight light sources and make sure the blue part is the lower part to be seen on the wall. Voila – you just made your daylight more vivid and interesting.

**03 Set up the direct sunlight** For the direct sunlight, create a light source outside the room, choose the Infinite type and choose Area as the type of shadows. The sunlight should have 100 per cent brightness and a slightly yellow colour with about 10 per cent saturation. Leave the Specular checkbox activated as we want the directional sunlight to cast speculars. For orienting the Sun, apply a Target Tag to the light source from Object Manager>Tag. Then create a Null Object, name it 'Target Sun', place it on the wall to the left to the window ahead and drag it into the Object field of the Target Tag. Position the Sun with an angle of about 40 degrees.



Cinema 4D R17's Color Chooser

The new Color Chooser in Cinema 4D R17 provides great capabilities for the systematic generation and modification of colours. You can use different modes to define colours (Color Wheel, Spectrum and Color from Picture) and use them with different Color Models. For the creation of complementary colours, eg for the light nuances of the daylight, double-click on one knot of the aforementioned Gradient. Use the Color Wheel to pick your first colour. Instantly a Color Swatch is created below the Color Wheel. Now choose Complementary from the Color Harmony symbols, click on the Color Picker and you'll be able to create another swatch.



“The quality of your indirect light can cause your lighting setup to stand or fall since it is an indicator of credibility”

**04 Add directional daylight** The light of the Sun and the sky aren't isolated phenomenons: as the atmosphere is a medium for dust and fog there is always an area around the Sun almost as bright as the Sun itself, but with a more diffuse light emission. For this purpose we copy our sunlight, reduce the brightness to 70 per cent and the colour saturation to 5 per cent. In the Shadows Tab alter the field Infinite Angle from the default value of 0.5 per cent to 7 per cent. This gives diffuse behaviour to the area shadows. Name the light source 'Skylight directional'. The result is a desaturated diffuse flare around the direct sunlight on the room's wall.

**05 Set up major bounce lights** Direct light always causes indirect light to bounce off surfaces and carry information about its brightness and colour. The quality of your indirect light can cause your lighting setup to stand or fall since it is an indicator of credibility – and an essential part of the art of lighting. As we want our lighting setup to be lightweight, we will just place two major bounce lights. For indirect sunlight, create an area light with 20 per cent brightness and area shadows in the scale and position of the wall's directly lit area. Use the wall's colour set at 15 to 20 per cent saturation. Apply an Inverse Square falloff of 1,000cm. For indirect room light bouncing off the walls, create a similar light with 75 per cent brightness at 200 x 250cm. Use a smooth linear falloff with a large range of 800cm. Place it slightly above and behind your camera and rotate it to 45 degrees down.

**06 Work on minor bounce lights** Create a copy of the first bounce Sun and name it 'second bounce Sun'. Place it slightly in front of the opposite wall. Use only half of the brightness, the saturation and the falloff distance of the original. You may want to place a small copy of a second bounce Sun with only six per cent brightness and 300cm falloff distance on the window's corner area, which will be directly lit by the Sun. This little guy points straight up and adds local indirect light to the wall around the window. Name it 'bounce Sun Windowboard'. We have now created four light sources simulating indirect light for the whole room.

**07 Create effect lights** In the final scene there are four simple point lights with or without shadow maps, they only emit specular illumination. Speculars are a very simplified and fast representation of full-grown raytraced reflections. While this is far from being physically correct it easily helps us to create beautiful rims on objects, a substitute for anisotropic reflections on the Venetian blinds or a specular representation of the Sun's indirect light (we'll explain what anisotropic means in the next step). A specular-only bounce Sun takes over the specular part of the first bounce Sun and is easier to control than its original. Other effect lights can enhance the lighting setup such as the rim couch light, which comes from the wall and is restricted to the couch. To sum up: our lighting setup contains five main lights, two main bounce lights and eight nice-to-have lights. Apart from the four bounce lights there is nothing different to a GI lighting setup.

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- Cinema 4D files
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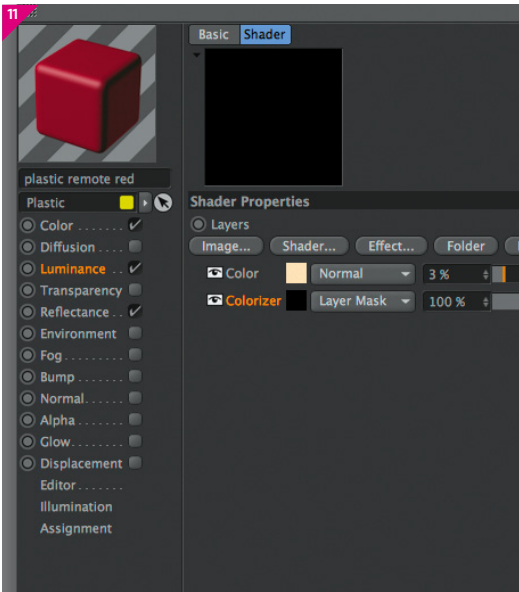


**08 Use reflectance to add realism** Reflectance covers all aspects of mirror-like or specular reflection with dedicated reflectivity models. Reflections depend on the viewing angle, which helps make objects locatable in your 3D scene. Also the reflectivity of an object lets you draw conclusions about the nature of its surface. Let's study an example – the tabletop. The diffuse reflection on the tabletop implicates that it is rugged with the surface worn down over the years. The reflectivity model is anisotropic, which means that the rough reflection is stretched in one direction as if caused by microscratches. The amount of roughness of the reflection is varied by a Layer Shader (click on the black triangle left to Roughness). The amount of reflection itself varies, as if some areas are randomly more worn down than others. This is done within the Mask tab in the Reflection Layer: it hosts a Layer Shader with several Noises, a Fresnel Shader and Bitmap textures stacked over another.

**09 Add realism through modulation** As we already know, modulation is an essential part of our scene's credibility. But there is more to variation than just reflections. When you have a closer look at the room's wall you will see that there are lots of subtle random irregularities. These are created by the Bump channel, which contains a Layer Shader with some Noise Shaders stacked over a photographed Bitmap texture of a real wall. For variations keep Noise Shaders in mind: they are nothing other than mathematical random functions being visualised and are perfect for random structures such as dirt, abrasion or subtle colour shifts.

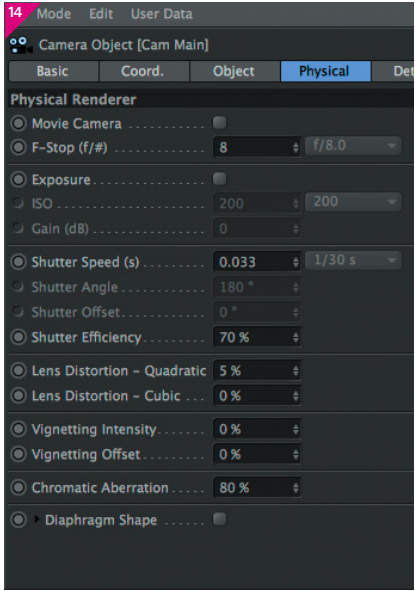
**10 Break up transparencies** Transparencies get more interesting and credible when they are broken up and made visible. In a very basic way this is done by refraction or reflectivity. In a more sophisticated way you can add Shaders or Bitmap textures to the Transparency channel. Let's see two examples in our scene. For the CD cabinet, the glass of the door has an index of refraction (IOR) slightly above one, which is physically incorrect but just looks correct. Also there is a Fresnel Shader with just seven per cent Mix Strength in the Transparency channel; the sharper the viewing angle gets, the stronger the reflection is. Because of this the native field Fresnel Reflection is set at 0 per cent. In the Reflectance channel the General Reflection Brightness is boosted to 300 per cent, so the reflection is visible, even in more transparent areas, which gives the glass a nice sharp look. For the window ahead the glass panel has an additional material tag with a texture based on photographed window dirt.

**11 Brighten up your shadows** Subtle indirect light is not very locatable and mostly appears in shadowed areas, brightening them up. So why not implement this as a material-based self-illumination appearing only in shadow areas? Let's check the material 'plastic remote red'. The Luminance channel contains a Layer Shader named Shadow Luminance. Inside this you will find a Color Shader Layer with low opacity in the main colour of the room's indirect light. This layer is masked by a Colorizer Shader below in the Layer mode. Inside the Colorizer is a Lumas Shader with only the diffuse component active. With this, the Lumas Shader acts like the Color channel saying 'Show me where I am in the light'. This behaviour is inverted by the Colorizer gradient: from white to black. If you use this Colorizer for masking the Color Layer the result is a self-illumination on the shadow-side of the object.



### Variation Shader

When it comes to modulation, there is a new Shader called Variation. It is ideal for varying material properties of lots of objects that are randomly based on user-defined specifications. Variations of a material are possible with a defineable probability that are either object-based or polygon-based. These will take place via a secondary texture, a colour gradient, random colours, gradation or UV variations.



**12 Use Smart AO** With Shadow Luminance, shadows become brighter but also a bit too flat. Let's counter this. Diffuse contact shadows mostly appear in already shadowed areas. The Ambient Occlusion shader (AO) simulates such shadows but also in directly lit areas, which doesn't look credible. For masking AO to shadows we will use a similar Shader setup as before. Copy Shadow Luminance to Diffusion and rename it 'Smart AO'. Activate the channel's Affect Luminance. Inside Smart AO replace the masked Color Layer with an AO Shader. Put a new Color Shader (white) below the Colorizer. Save Shadow Luminance and Smart AO as Presets by right-clicking the triangle next to Texture in the appropriate Material channel. Tune the look of your scene to be a bit flat by choosing '16bit' for Depth in Render Settings. This provides space for a dynamic level correction in post-production.

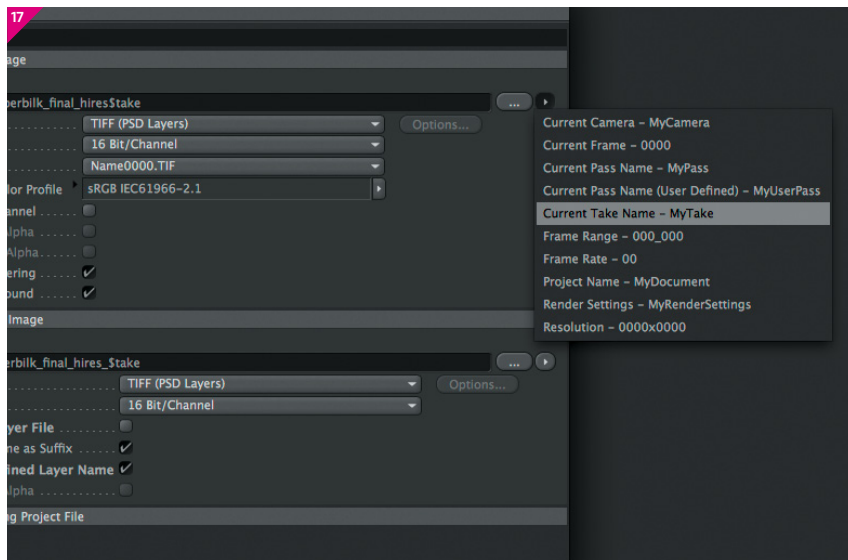
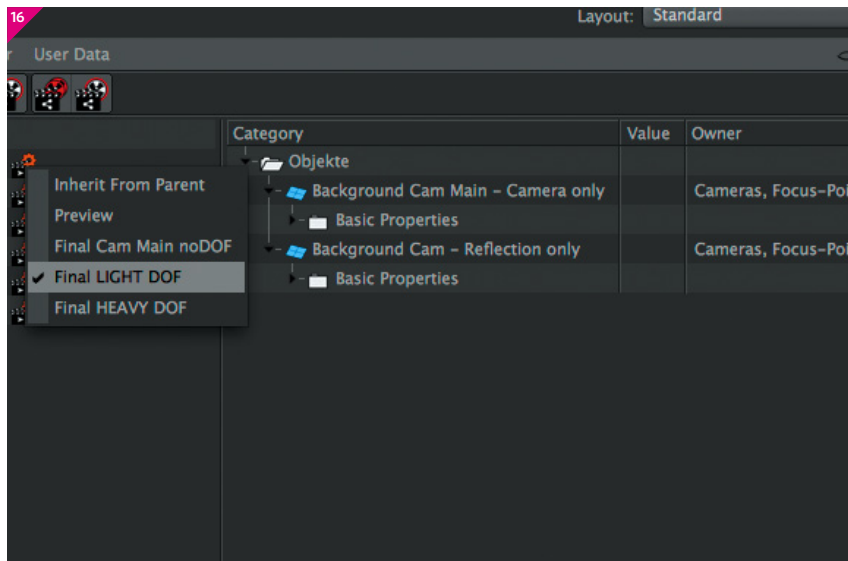
**13 Review shadows, reflections and SSS** Your scene now looks good but render times should be improved. Think about where to replace beautiful but slow and rough reflections with simple but fast speculars, eg for the beaded chain on the window. Objects that are very close to a light source casting area shadows can create extremely diffuse shadows, which slows down rendering. To avoid this go to the light's Project tab and exclude these objects from shadowcasting. Try to avoid highly transparent objects from casting area shadows by unchecking the Cast Shadows option in the Compositing Tag of all glass panels. For the direct SSS, the candle wax has subsurface scattering (SSS) applied. Caching SSS is great, but building up the cache can take up some time too. Sometimes it is faster to just use the Direct Mode in Shader>Multiple.

**14 Use the Physical Render** Select the built-in Physical Render engine (PR) from Render Settings>Render. The PR is perfect for scenes with lots of samples to be calculated such as area shadows, rough reflections and so on. In scenes solely containing sample-based calculations, the PR is even faster than the Standard Render – try this with scenes only containing geometry and ambient occlusion. Besides that, the most important feature is the PR's simulation of real camera characteristics such as F-Stop, depth of field (DOF), Lens Distortion (for wide-angle shots), chromatic aberration (for a more analogue look) and so on. The cameras of our scene have different focal lengths and Lens Distortions. Use a Null Object for defining the focus point and drag it into the field Focus Object in Camera>Object. Lower F-Stop values result in more DOF, which in return takes longer to render.

**15 Tune render settings** The following steps can speed up rendering by up to 300 per cent. Reduce Reflection Depth in Options to 2 to cut further reflections of reflections, which are often dispensable anyway. Threshold cuts off every transparency or reflection weaker than the value defined; try values between two to five per cent. For the PR settings, tune the AA parameters Shading Subdivisions to avoid moiré. Keep Shading Error Threshold as high as possible and as low as necessary to avoid grain. If necessary, increase Shadow Subdivision to three or four. For depth of field, bokeh can slow rendering. Consider switching off depth of field, rendering a Depth pass and doing DOF in post-production. Another thing to tweak is Different Render Settings in the bottom left, activate it by clicking the white square on the left. Different Render Settings can further economise your rendering.



**16 Take advantage of Cinema4D R17's Take System** The Take System lets you create variations (Takes) of your scene in one Cinema 4D file. We will use this for specifying sets of Cameras, Render Settings and background image planes. Go to the Take Manager (the vertical tab right to the Object Manager). The basic status of a scene is given as Main by default. For altering parameters across different Takes you can also use the Main Take. Create new Takes with the button New Take and name them accordingly. Click on the small white square to activate a Take. While in the Take activate the appropriate Camera and Render Setting. Inside a Take, all parameters of an object's Attribute Manager are greyed out. So for activating the proper image plane you must create an Override. Return to Main and right-click on Enabled in the plane's Attribute Manager (Basic tab), choose Override and activate the plane. Repeat these steps accordingly for other Takes.



**17 Variable names with the Token System** For naming your render output let's try another new feature of Cinema 4D R17: the Token System. This System enables you to assign variable name suffixes to your render output, eg the name of the Take. Go to the output entry of your Render Settings, click on the triangle button to the right of the file names field and then choose Current Take - My Take. This adds the variable \$take. In the case of the Take Cam\_Main the render output is named filename\_Cam\_Main.tif. Takes can be marked with the small dot on the right of the Take's name. Then simply choose what to render with the appropriate command from Take Manager>Render. Happy rendering! After completing this tutorial and re-creating the scene you will have learned a good lesson on how to light. Setting up lighting without global illumination greatly improves your skills and helps you to meet your deadline, especially when it comes to animation.

# Showcase

## Marc Potocnik

Marc is a German designer and founder of animation studio renderbaron, producing 3D animations for Audi, ZDF, BMW and so on. Since 2001, Marc has been an authority on shading, lighting and rendering, sharing his knowledge as a Maxon certified instructor and as a speaker at events such as SIGGRAPH.



## ZDF - Leschs Kosmos Cinema 4D R16 (2015)

These 3D animations were created for ZDF's TV documentary *Leschs Kosmos* episode 'The Nightmare of Flying', about the hidden dangers of aviation.



## Audi - CES 2014 Cinema 4D R15 (2013)

Styleframes for Audi's g-tron appearance at CES 2014, Las Vegas. As with all works of renderbaron, the lighting has been achieved without GI.



## Unter freiem Himmel - Subway Cinema 4D R11.5 (2010)

Scene from the first teaser for *Unter freiem Himmel*, a non-commercial movie by Marc Potocnik. This was done in Cinema 4D R11.5 - without GI and R12's Linear Workflow.