(Left)
A rendering of three tea candles on a granite countertop, after some Photoshop work to blur the background and diffuse the candle glow.

Big deal—but takes all day to render these precious fourteen-hundred pixels because of cast glass refraction calculations.

(Right)
An actual digital photograph of three tea lights on my bathroom countertop clearly shows the radiant glare from a cheap lens and the refracted ring of light encircling the tea lights from each candle shining through the thick glass bases.
We can't directly do that with a LightWorks effect; we must add a specific light source to do it.

Candlelight and Crystal

This exercise studies light, refraction and modeling at the macro level in ArchiCAD —about as small as it can get and way more detail than you could ever use. Based on a typical "tea light," a squat candle nestled in a heavy glass base, this exercise builds a plausible flame model, lights the scene with plausible candlelight and addresses the importance of how the heavy refractive glass base interacts with light energy.

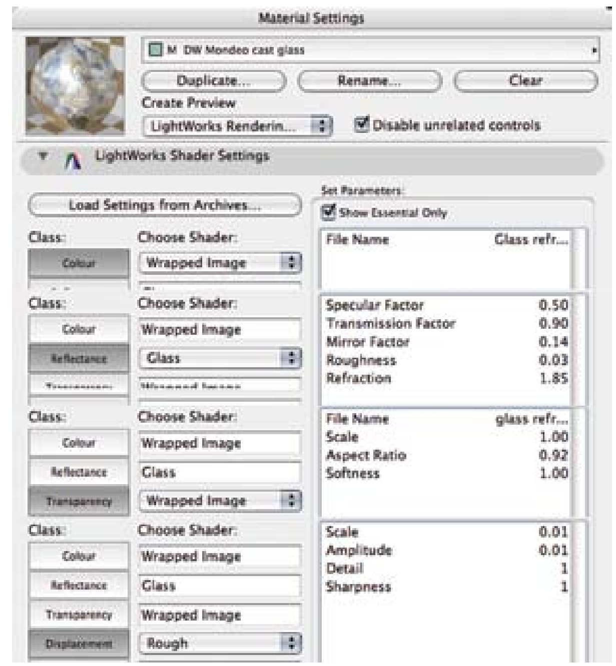
The Situation

The delight of the tea light is basking in the bedazzling refraction of the weighty base as it cradles the candle and how this radiance glows in a modest space. Our challenge is to model this light behavior without benefit of the refractive refocusing of the candles by the glass (the bright rings surrounding each real light in the adjacent photograph). Study the related material settings to uncover the details of solving this situation.

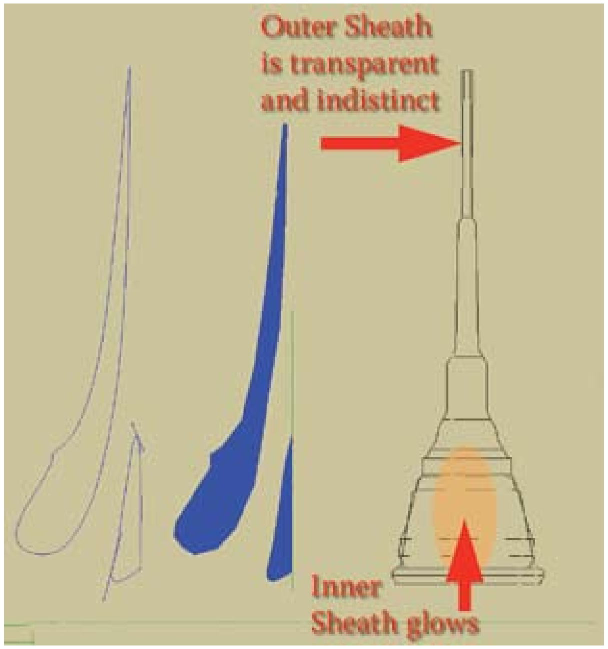
The Base

The base was swept with *Profiler,* following the actual tea light profile (no guessing). Accurate measurements showed it was NOT flat on top, but sloped slightly down and outward. The only problem with *Profiler* is that a rotated profile has a matching start and end face seen in a transparent object as a visible plane traveling through the glass. Take care to hide this seam away from the camera by placing it directly behind the flame in line with the camera viewpoint—sneaky.

Cast glass or lead crystal has a high refractive index, a highly polished surface and contains irregularities caused by thermal

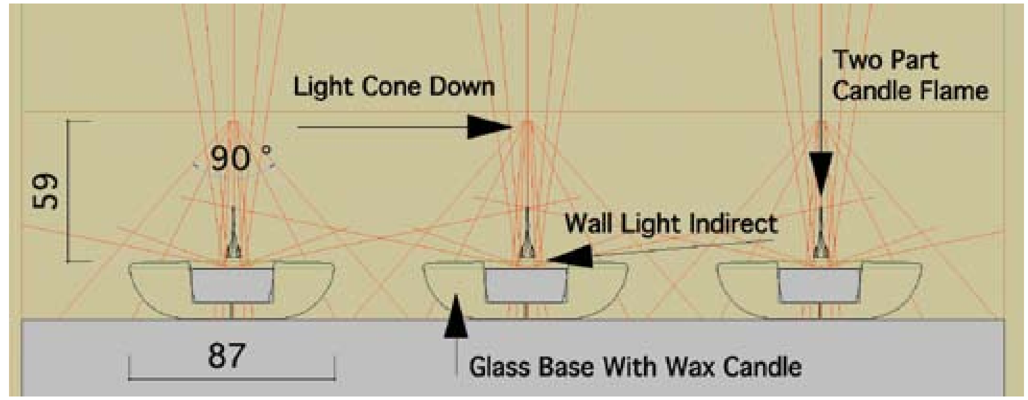


Cast Glass Tea Light Base: *The high refraction clear material is given subtle sophistication with a large transparent texture map for some enigmatic distortion like induced by shrinking during cooling after casting.*
(Left) *Glass Refracted texture map.*



(Left)
Spline to fill to profiled candleflame components.
Outer is translucent and glowing inner is opaque and glowing.

(Right)
Three tea lights and bases show light configuration for light and shadow casting.



curing. The base model lacks imperfections and roughness that enhance material refraction. This variation uses a subtle texture map to disrupt the even passage of light through the object, simulating irregularities in the casting.

The Flame Model

The intense, opaque core flame and its surrounding translucent plasma halo were created in two parts with *Profiler* sweeps. The flame assembly doesn't actually glow, but reflects light energy (with the addition of some emission shader) from the light sources in such close proximity to it.

Readers skilled in GDL should reduce *Profiler* RESOL to 5 from the default 32 to speed imaging of these two shapes, which will be obscured later. RESOL controls the number of facets a swept object has through the swept path.

For this exercise, I elected to represent a flame from an overly long wick having an excessive plasma tail. Candle users often trim wicks to reduce flame size at this point in the burn cycle. You might choose otherwise.

Relative to the tea candle photo where the wicks were new and the flames small, the model flames are absurd. In profiling the flames using a fill, even the finest magic wand setting produced a crude geometry that did not follow the tiny shape.

The Wick

I skipped modeling the wick, but GDL enthusiasts may wish to make an ON/OFF option for their tea lights, in which case you'd also want to make a black and a white wick for "new" and "used." Perhaps consider also making the wax shrink parametrically as the candle wax is consumed by the flame…just a thought.

The Candle

Nothing but wax. Emulating the translucent reflection of wax requires a small amount of plain coverage transparency shader in addition to the translucent reflection shader. Qualities of transparency and translucency are closely related and in some cases a patterned texture map as a transparency mask can help bridge between refraction, transparency and translucency. In *LightWorks*, translucency is merely a specialized specular reflection shader.

The Light Sources

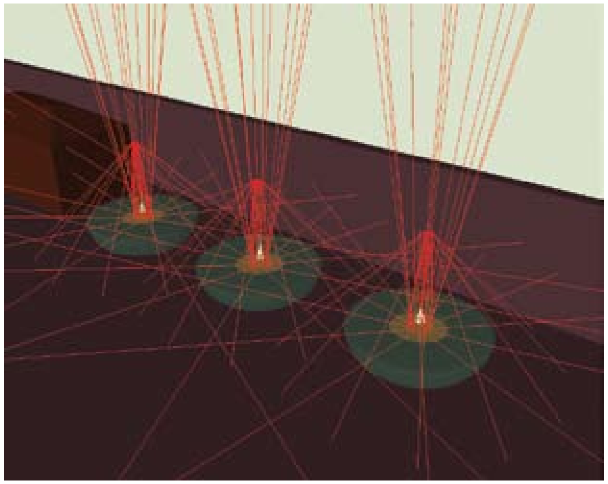
Two light sources create the essential, if not complete, light effect required.

The basic light source is the supremely versatile Wall Light Indirect, the only one of *ArchiCAD's* lights than can actually be seen as a physical light source. It shines straight upward from the top surface of the candle wax.

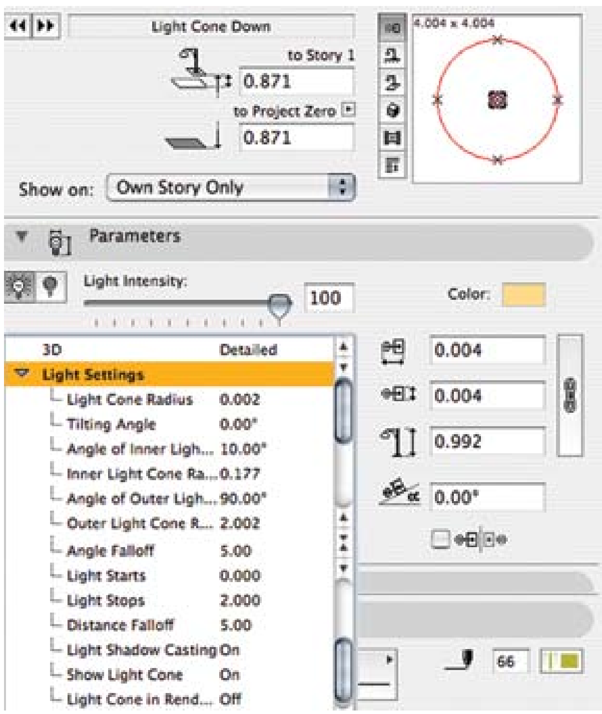
The supplemental light source is the merely versatile Light Cone Down shining directly downward from a strategic position hovering above the flame at a height sufficient to cast light over the edge of the base, creating a ring of light emulating the refracted ring in the photo. Referring to the study in the lighting chapter, the best shadow edge/angle falloff definition was found with an outer light cone set somewhere between ninety and one hundred and twenty degrees. Without too much forethought, I chose ninety degrees, placing the light just over two inches above the top of the base. The adjacent illustration shows the light cone array over the glass base.

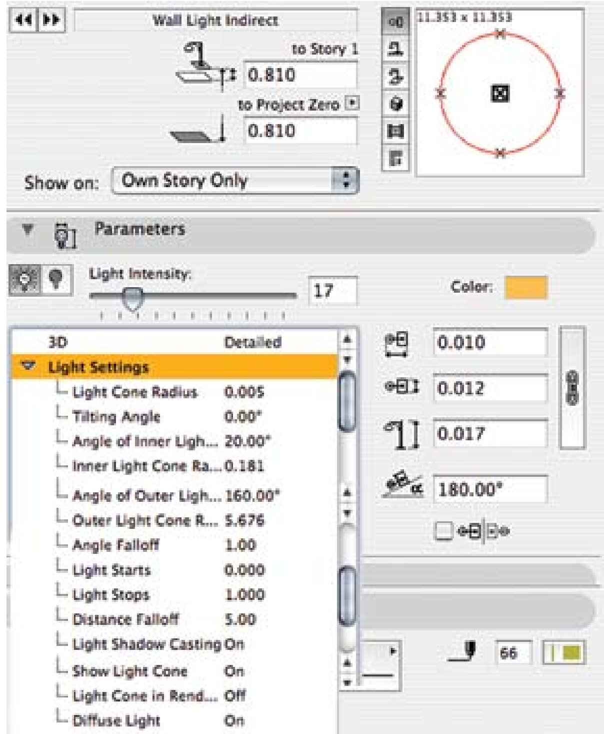
The *Photoshop* Tricks

Comparing the rendering to the photo, it is obvious that the rendering is so much sharper than a noisy, high ISO digital image made with a lousy camera lens. The lousy lens, however, brings a romantic radiant glow to the overexposed candle flames. To emulate the flame glow required a tiny amount of Diffuse Glow

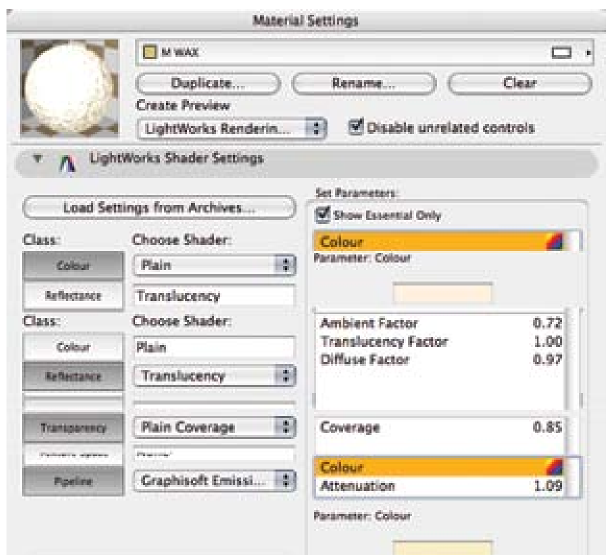


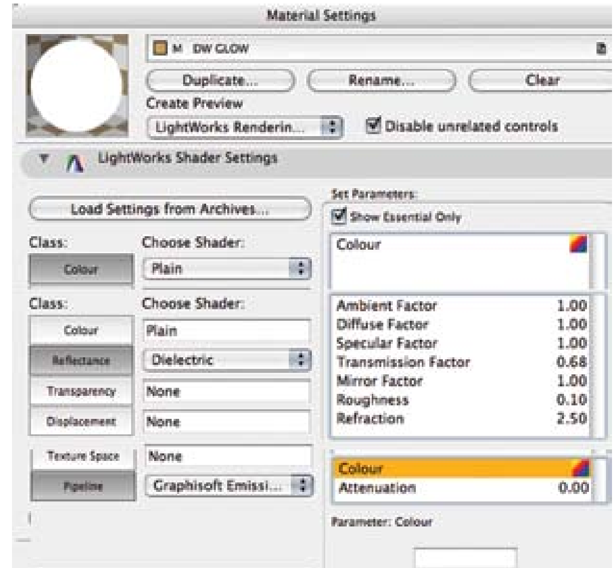
(Above) ***The Candle Light Array:*** *Positioned for rhythmic light circle overlap. Uplighting creates the general radiant light and counter reflections, down lighting establishes the bright circle surround.*
(Below) ***The DownLight:*** *Light Cone Down. Note the high falloff designed to emulate candle light and short light stopping distance to prevent energy contribution to the overall scene.*



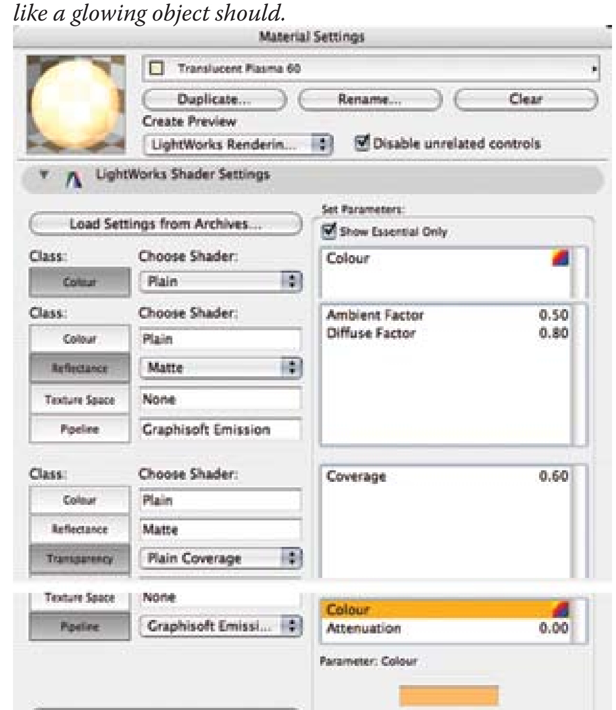


(Above) ***The UpLight:*** *Wall Light Indirect creates the general radiant light and counter reflections. Extreme falloff and abrupt light stop.*
(Below) ***The Candle Wax Material:*** *Translucent reflection combines with slight transparency for a waxy appearance.*





(Above) ***The Candle flame Core:*** *Designed to be a solid glowing undefined form—will be shrouded by transparent plasma described below.*
(Below) ***The Candle Flame Plasma:*** *Off-gassing vapor is not as hot as the core, hence a darker color for the surrounding mantle.*
Emission Attentuation = 0 results in lack of modeling, just like a glowing object should.



filter applied in *Photoshop*. Diffuse glow refers to the background color as set in *Photoshop*—it should be set to white. Not at all obvious—it's a trick!

A second trick is graduated blurring applied from the upper right hand side of the image where the door leads to the bedroom. My illustration strategy acknowledges distant context: vital to convincing the viewer he is operating in a real environment, not just a stage set.

The third trick is to induce some grain (noise) into the image, blending the low-light scene like high speed camera photo sensors would.

The Render Time

The main rendering with three candles took my 2 x 2.0 G5 ten hours to render these fourteen hundred pixels at top quality. *["Holy CPU cycles, Batman!"]* This is another example of how high refraction with only a few light sources can exponentially increase rendering time from what should have been just a few minutes.

Further fallout from having ridiculously high standards, the glass base is also over-resolved, sixty-four segments instead of eighteen (which might have been enough) and too many polygons and high refraction combine into a time sponge.

Errors like this can ruin a job, especially if it is an animation and the excess refraction and over-polygonated*[!]* surfaces are repeated in many frames. Here, have another cookie while we wait.

General Illustration Notes

Study the countertop, particularly the foreground reflection. Intended to emulate a plastic laminate finish using a granite pattern photographed from stone. Using the adjacent material settings, the diffuse, dappled surface

Before "After": *Rendering is too sharp—the eye is led away from the scene to the background context elements included in the composition to support scene plausibility.*

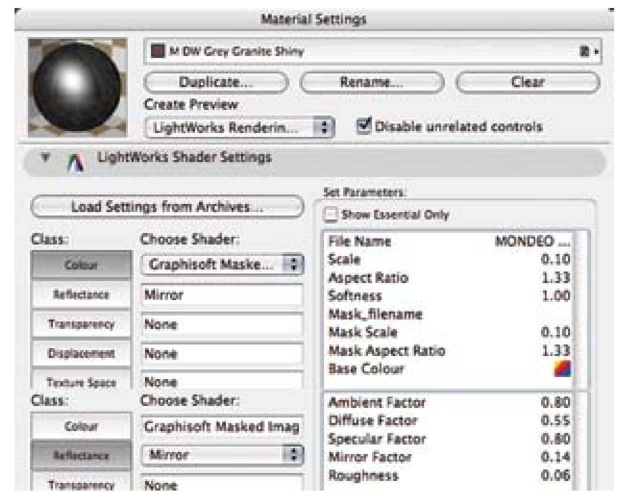
also conveys a sense of rough shadow cast from the outer lip of the glass bases… a very satisfying visual effect.

Article Conclusion

Satisfying illustrations rely on close attention to remembered impression rather than literal detail accuracy. Often, an object or scene has subtle qualities, which can be caricatured, in the model or with a light effect, satisfying the eye without providing the complete, excruciating truth. Only careful study of an object's light behavior can reveal its imaging secret, and a hint as to what could be left out.

Here, lacking radiosity, the typical solution for intensely lit scenes, we rely on diffuse glow and distorted cast glass effects to carry the day.

After "Before": *Photoshop tricks—graduated blur confirms subject, diffuse glow makes it pretty and adding 2% noise completes the dark, romantic effect.*



Counter Top Material: *In building a scene with candlelight, the precise reflectivity of adjacent surfaces provide theatrical support for the romance of the light—minimal mirror with .06 roughness achieves the ideal satin look.*

(Left) *Granite texture map from a photo.*