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IRRADIANCE INTERPOLATION ARTEFACTS CAUSED BY REFLECTIONS FROM GLASS-WALLED LIGHT-WELLS

Background

It was discovered that illuminance profiles predicted at the base of a glass-walled light-well (e.g. an atrium) were always jagged and asymmetric - even when the line of calculation was along a line of symmetry. This was thought to be caused by strong reflections from near-grazing incidence rays screwing up the estimation of the irradiance gradient. Note that these were usually daylight factor calculations, so illumination was provided by a CIE overcast sky (modelled as a hemisphere using material 'glow').

A work-around was to carry out a three-pass calculation whereby the direct component from the sky (i.e. ab=1) was calculated with interpolation switched off (aa=0). This gave a smooth line without interpolation 'jaggies'. The contribution of the higher order reflections needs to be calculated with interpolation switched on, otherwise very long simulation times will result. This was done for, say, ab=5 and then again for ab=1 - all other parameters unchanged. The difference between these two predictions is the contribution of the higher-order reflections - which are largely free of the 'jaggies'. In short:

$$E = E_{ab=1,\,aa=0} + [E_{ab=5,\,aa>0} - E_{ab=1,\,aa>0}] \qquad \textbf{(1)}$$

Inelegant perhaps, but a snip to do with a C-shell script. This is the situation with *Radiance* releases up to and including 3.41p.

Greg Ward's Fix

In Greg's own words[1]: *"Improved accuracy of irradiance gradient calculation near specular surfaces by using the effective ray distance rather than the first surface intersection. (John Mardaljevic had pointed out some errors he was seeing with a particular atrium model.)"*

The effect of this change is readily apparent from the illuminance profiles (**v3.41p** & **v3.6a**) given in Figure 1. The 'jaggies' are largely eliminated and the predictions using the fix exhibit only slight lumpiness as might be expected from any Monte-Carlo based calculation. For comparison, predictions with interpolation switched off are also given (**-aa 0**) proving that the fix is doing a pretty good job. Note that 3.6a is the provisional version number for the alpha release used in this test - it is not an official release.

Conclusion

The fix is a worthwhile modification and should be considered by anyone who wants to predict illuminance in glass-walled light-wells - once the new release becomes available. In the meantime, if you encounter 'jaggies' for the scenarios described above, try the three-pass approach.

1. An entry from the next Release Notes.

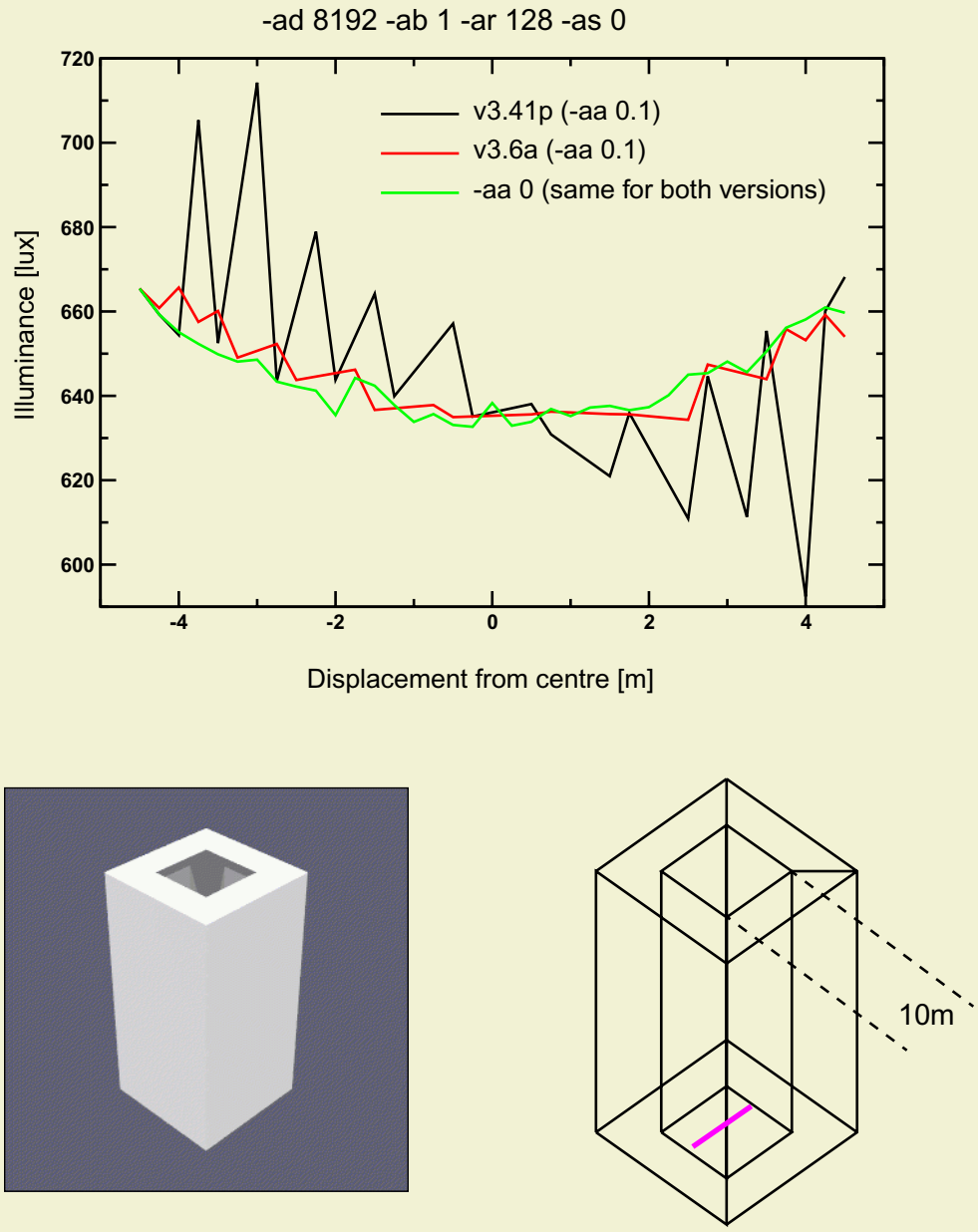

Figure 1. Illuminance profiles with rendering and line drawing of atrium model.