Radiance Workshop :: Evaluating An Advanced Facade System
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Evaluating facade daylighting performance :: San Francisco, CA

Image and design by TEN Arquitectos

Site view from Google Earth
Initial Design and Analysis

Image and design by A+D Architecture and Design and Pfau Long Architecture
Initial Design and Analysis

June Noon Overcast

Human Acuity Filter

Luminance False Color

Illuminance Contour Lines

<table>
<thead>
<tr>
<th>cd/m²</th>
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Footcandles
Artist Jan Hendrix

Designed by Jan Hendrix
Evaluating facade daylighting performance :: San Francisco, CA, USA

Photo of the physical mock-up panel, designed by Jan Hendrix
Defining the material

**Function: mixpict**

```c
void mixpict Glass1
7 leaf_black
   Glass
grey
../refs/leaf_sm.hdr

((U+1.6)/25.2-floor((U+1.5)/25.2))
((V-5)/27.8-floor((V-5)/27.8))
0
0

void mixpict Glass2
7 leaf_specular
   void
grey
../refs/leaf_sm.hdr

((U+1.6)/25.2-floor((U+1.5)/25.2))
((V-5)/27.8-floor((V-5)/27.8))
0
0

void mixpict Glass3
7 leaf_white
   void
grey
../refs/leaf_sm.hdr

((U+1.6)/25.2-floor((U+1.5)/25.2))
((V-5)/27.8-floor((V-5)/27.8))
0
0
```

https://en.wikipedia.org/wiki/Leaf#/media/File:Leaf_Skeleton_negative_like_photogram.jpg
Testing different rendering methods

1 layer,
duplicate the pattern three times;
putting one on top of the other;
each offsets a little to create a perspective view;
the least computational power required

2 layers,
duplicate the pattern two times and offset
them a little;
putting another layer at back;
more computational power required

3 layers
3 separate pattern layers;
the most computationally thirsty

Selected for exterior rendering
Selected for interior rendering
Large Scale Pattern :: Black Frit Outside
Large Scale Pattern :: White Frit Outside
Large Scale Pattern :: Interior Rendering, Initial

Sampling errors; High ambient accuracy required
Large Scale Pattern :: Interior Rendering, After
Large Scale Pattern :: With Translucent Shades

\[
\begin{align*}
  rZ &= \text{if}(1e^{-6} - Nx, -\cos(Ny), \\
       \text{acos}(Ny)); \{\text{translation to YZ plane}\} \\
  rX &= \text{if}(1e^{-6} - Ny, -\cos(Nz), \\
       \text{acos}(Nz)); \{\text{translation to Z axis}\} \\
  rZx &= \cos(rZ)\cdot Dx - \\
        \sin(rZ)\cdot Dy; \{\text{apply YZ translation to ray}\} \\
  rZy &= \sin(rZ)\cdot Dx + \\
        \cos(rZ)\cdot Dy; \\
  rZz &= Dz; \\
  rXx &= rZx; \{\text{apply Z axis translation to ray}\} \\
  rXy &= \cos(rX)\cdot rZy - \\
        \sin(rX)\cdot rZz; \\
  rXz &= \sin(rX)\cdot rZy + \\
        \cos(rX)\cdot rZz; \\
  aDx &= \text{abs}(rXx); \\
  aDy &= \text{abs}(rXy); \\
  aDz &= \text{abs}(rXz); \\
  open &= \sqrt{\arg(11)\cdot 100}; \{\text{find open square size}\} \\
  cutoff &= 1/\tan(\arg(10)\cdot \pi/180); \{\text{calc relative depth of cloth from cutoff angle}\} \\
  spectrans &= \text{if}(1e^{-6} - aDz, 0, \text{max}(0, open\cdot (1 - \text{cutoff}\cdot aDx/aDz)/100) \cdot \text{max}(0, open\cdot (1 - \text{cutoff}\cdot aDy/aDz)/100));
\end{align*}
\]
Changing the pattern scale
Small Scale Pattern :: Exterior View
Small Scale Pattern :: Interior View

Rendering ...
Small Scale Pattern :: Clear View

Image 1: clear View, no direct jitter, pixel sampling

Calculation of equivalent VLT:
Calculating equivalent facade VLT

1. Use ximage to get the average illuminance value over a small area.

2. Adjust the VLT of the glass in the single view so that the illuminance value of the same area matches.
Small Scale Pattern :: Direct Calculation

Image 2: Direct calculation, zero ambient bounce.
Small Scale Pattern :: Substracting the direct calculation

Image 3:
Image 3 = Image 2 - Image1
Ambient setting preserved
Small Scale Pattern :: Direct Calculation with Direct Jitter

Image 4:
direct calculation
full direct jitter
no image sampling
Small Scale Pattern :: Final Image

**Image 5 (final)**
Image 5 = Image 3 + Image 4
Adding back in the direct calculation with direct jitter
Small Scale Pattern :: Clear View :: with Shades
Small Scale Pattern :: Direct Calculation :: with Shades
Small Scale Pattern :: Substracting the direct calculation :: with Shades
Small Scale Pattern :: Direct Calculation with Direct Jitter :: with Shades
Small Scale Pattern :: Final Image
Small Scale Pattern :: Final Images
Small Scale Pattern :: Final Images :: with Shades
Thank You!