Radiance Workshop :: Evaluating An Advanced Facade System

08.19.2015

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LOISOS + UBBELOHDE

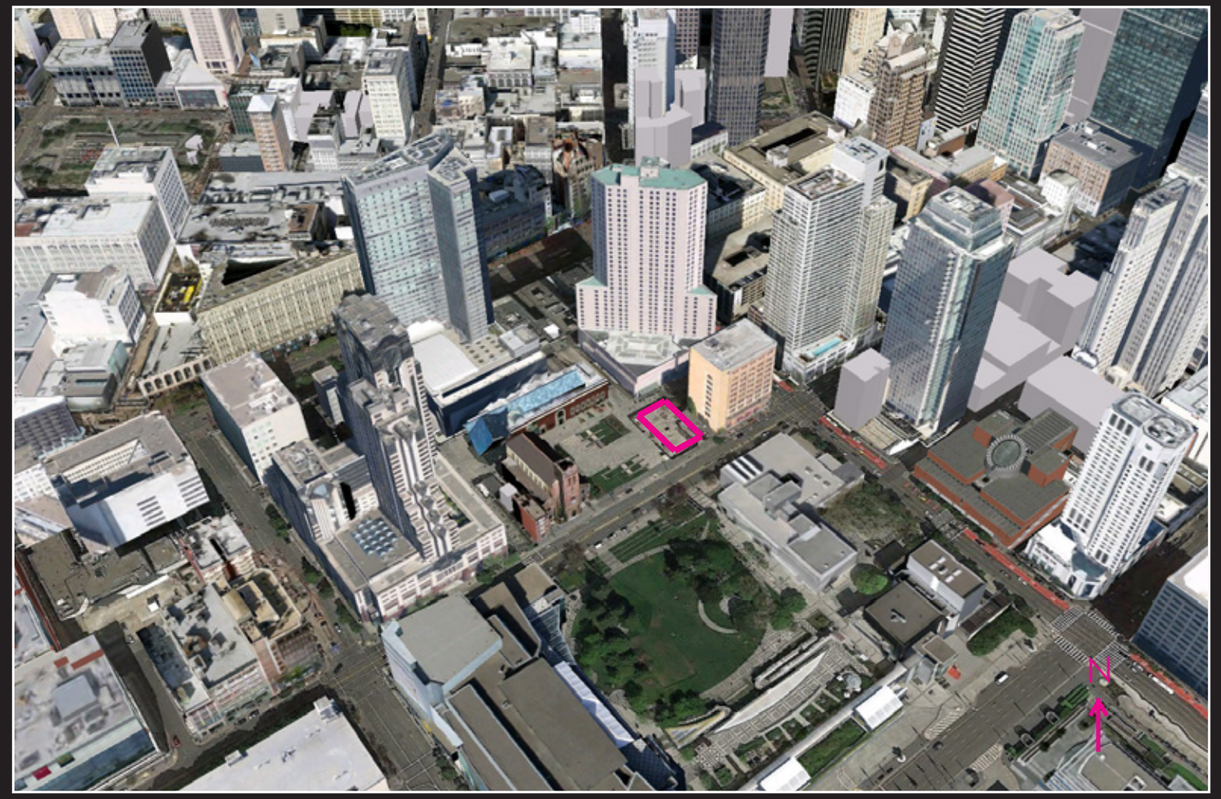
ARCHITECTURE . ENERGY

1917 Clement Ave Building 10A
Alameda, CA 94501-1315

510 521 3800 coolshadow.com

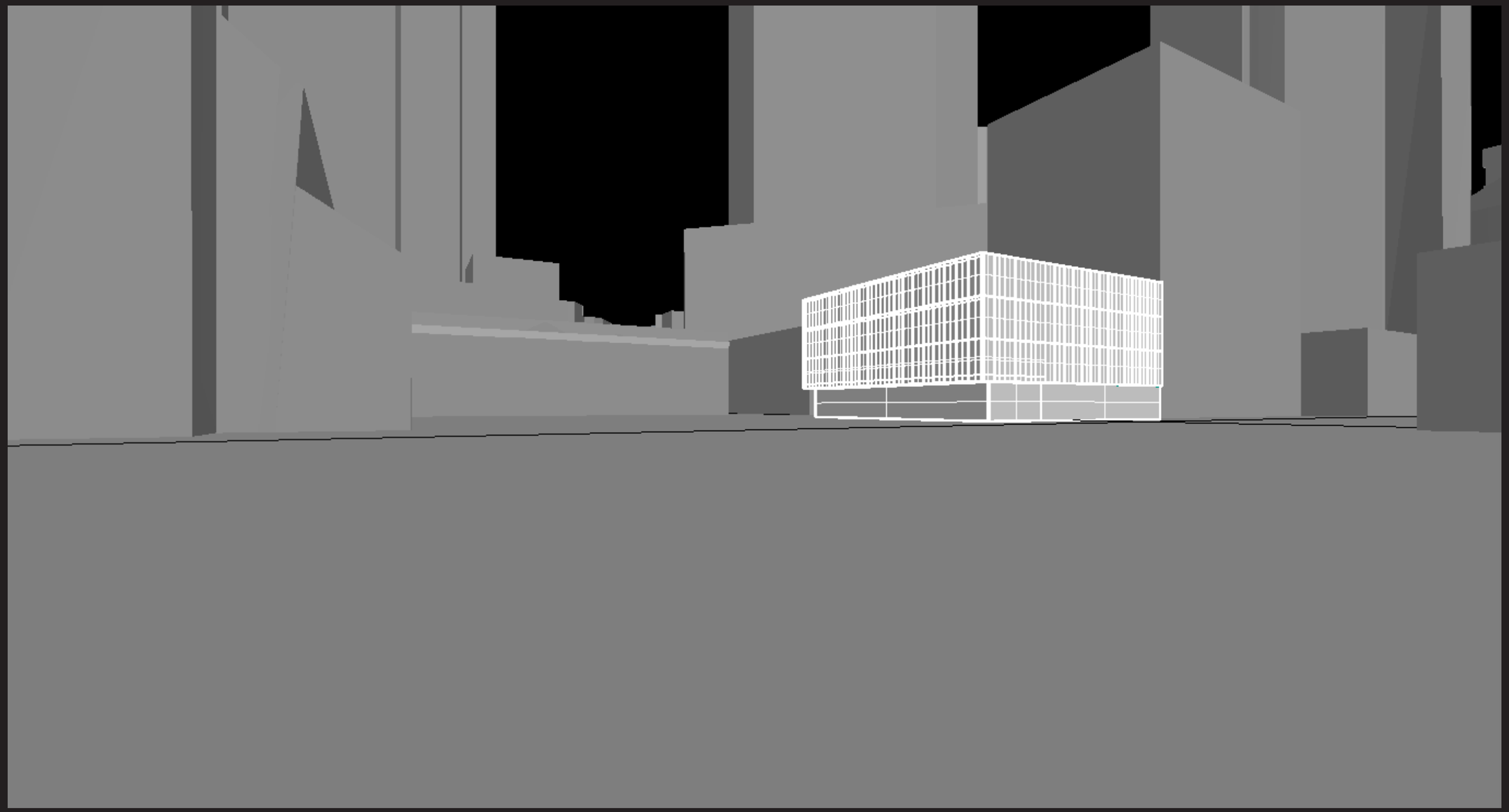
Evaluating facade daylighting performance :: San Francisco, CA

Image and design by TEN Arquitectos



Site view from Google Earth

3D Model



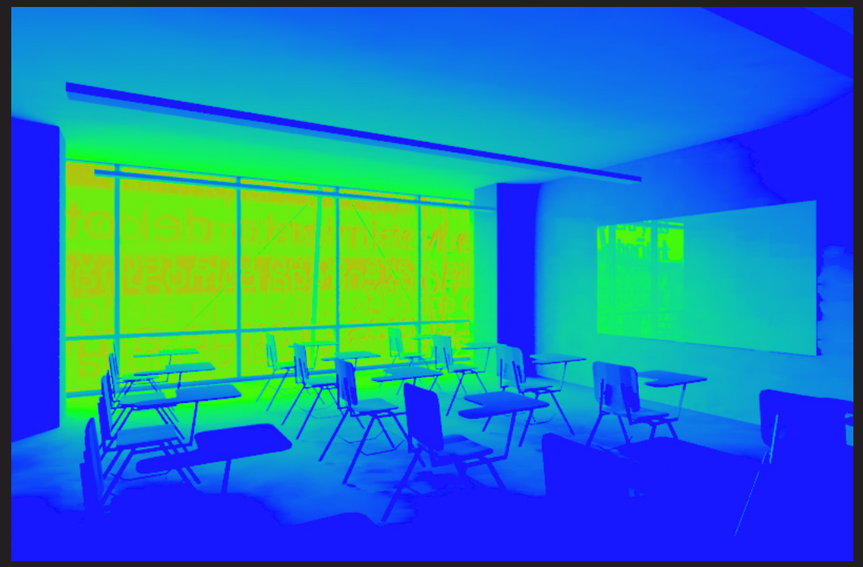
Initial Design and Analysis

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

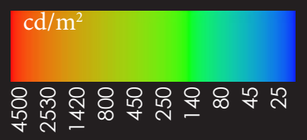
Initial Design and Analysis

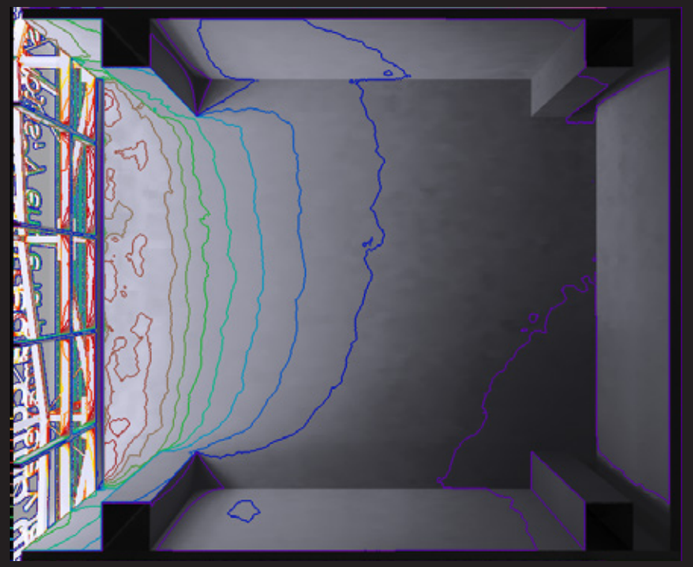
June Noon Overcast

Human Acuity Filter

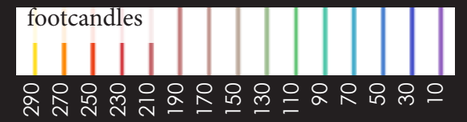


Luminance False Color

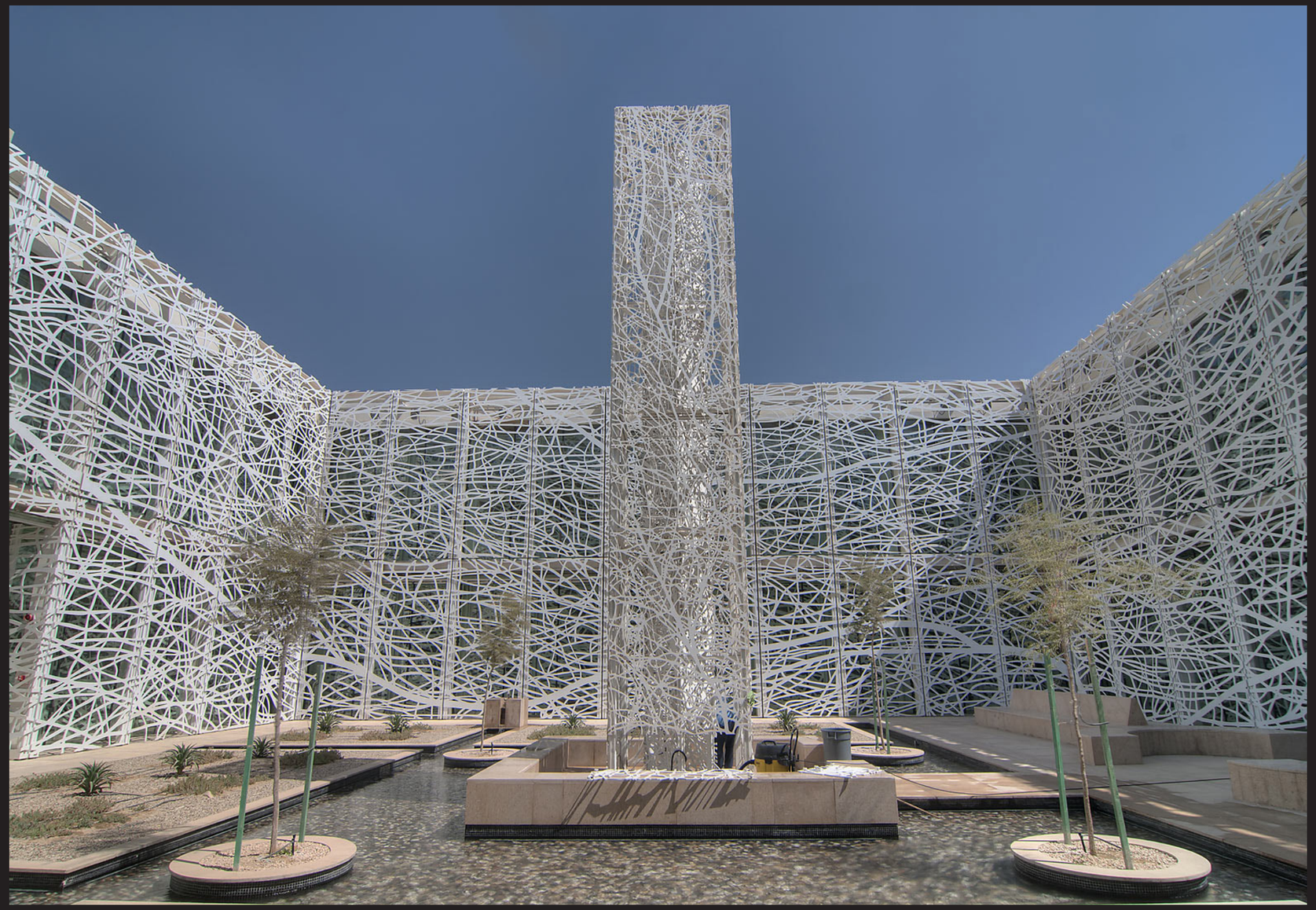


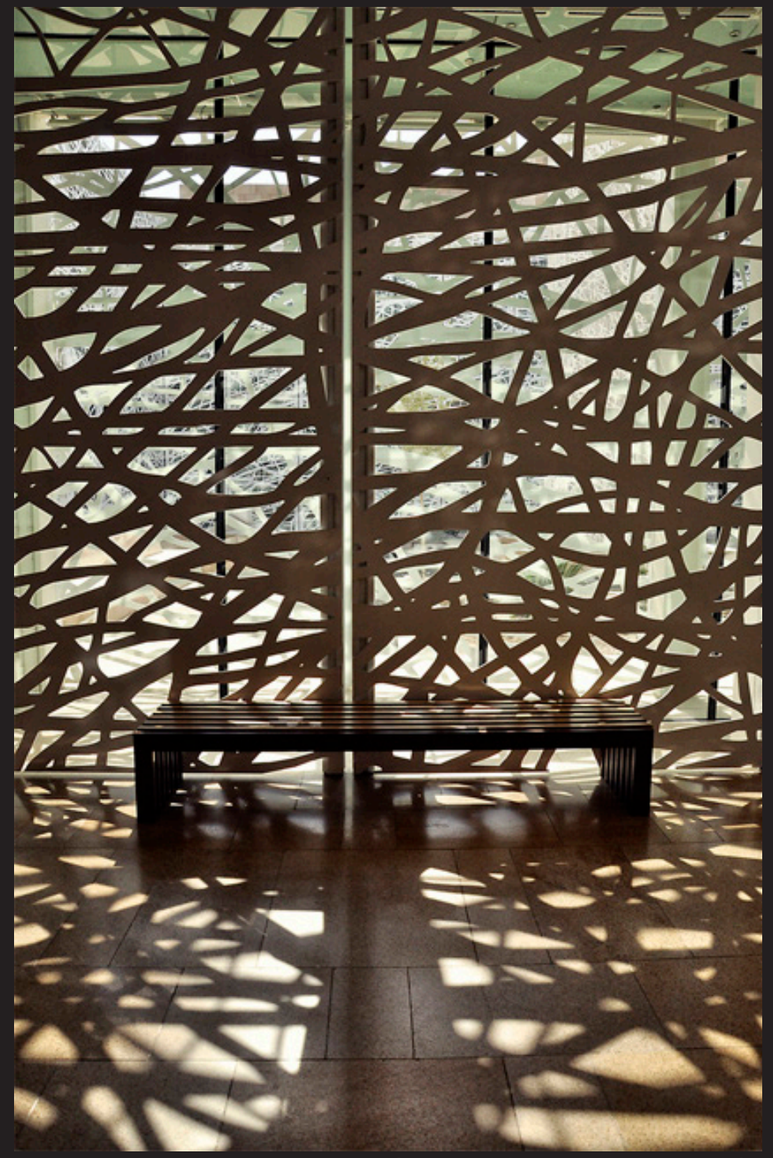


Illuminance Contour Lines



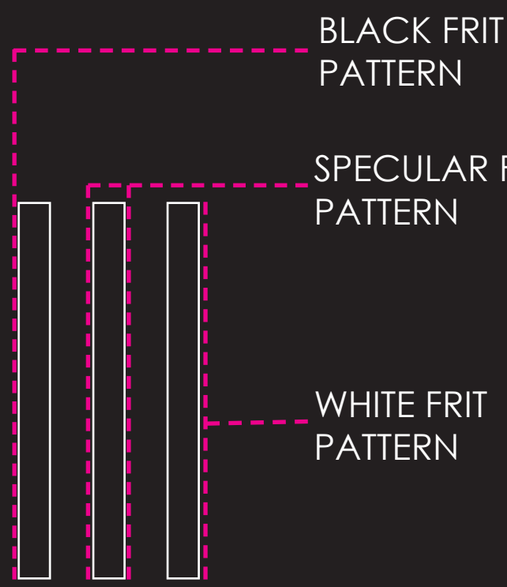
Artist Jan Hendrix

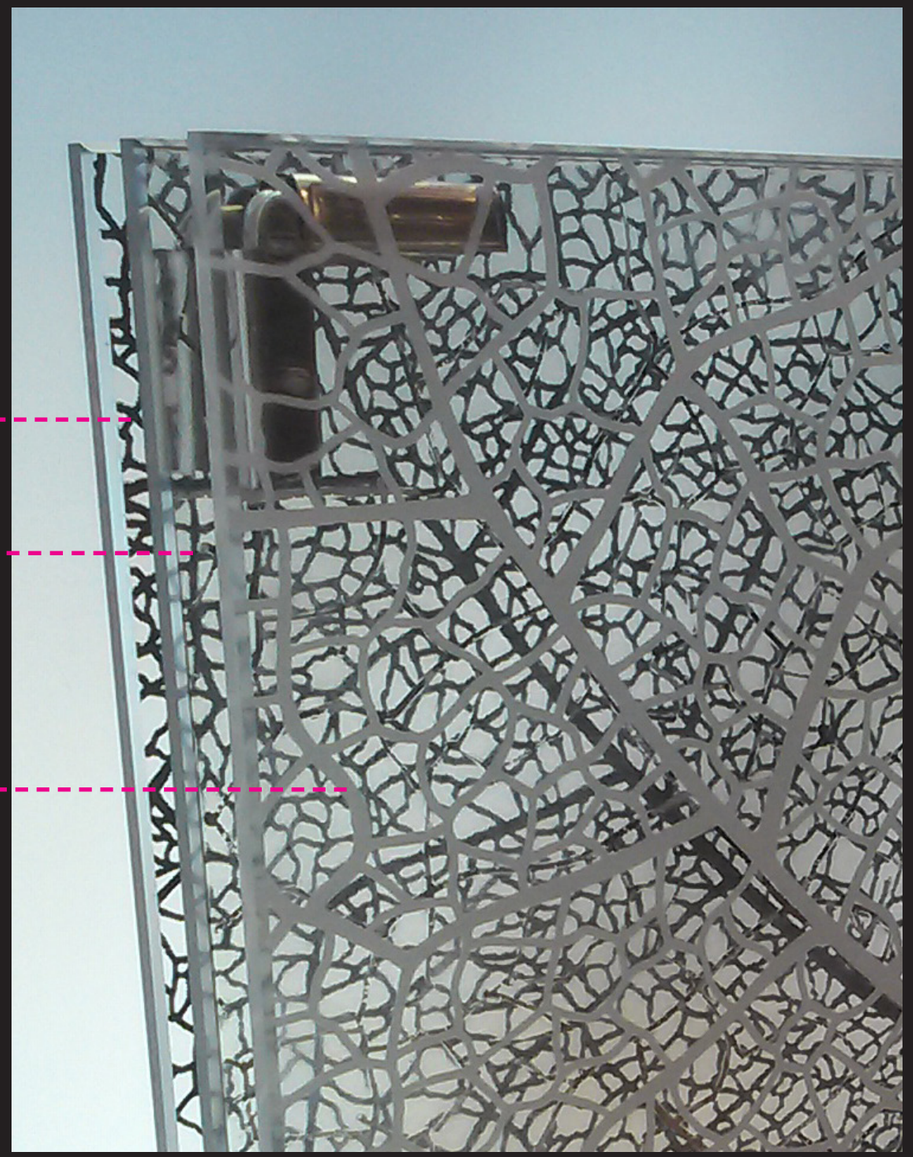




Designed by Jan Hendrix

Evaluating facade daylighting performence :: San Francisco, CA, USA





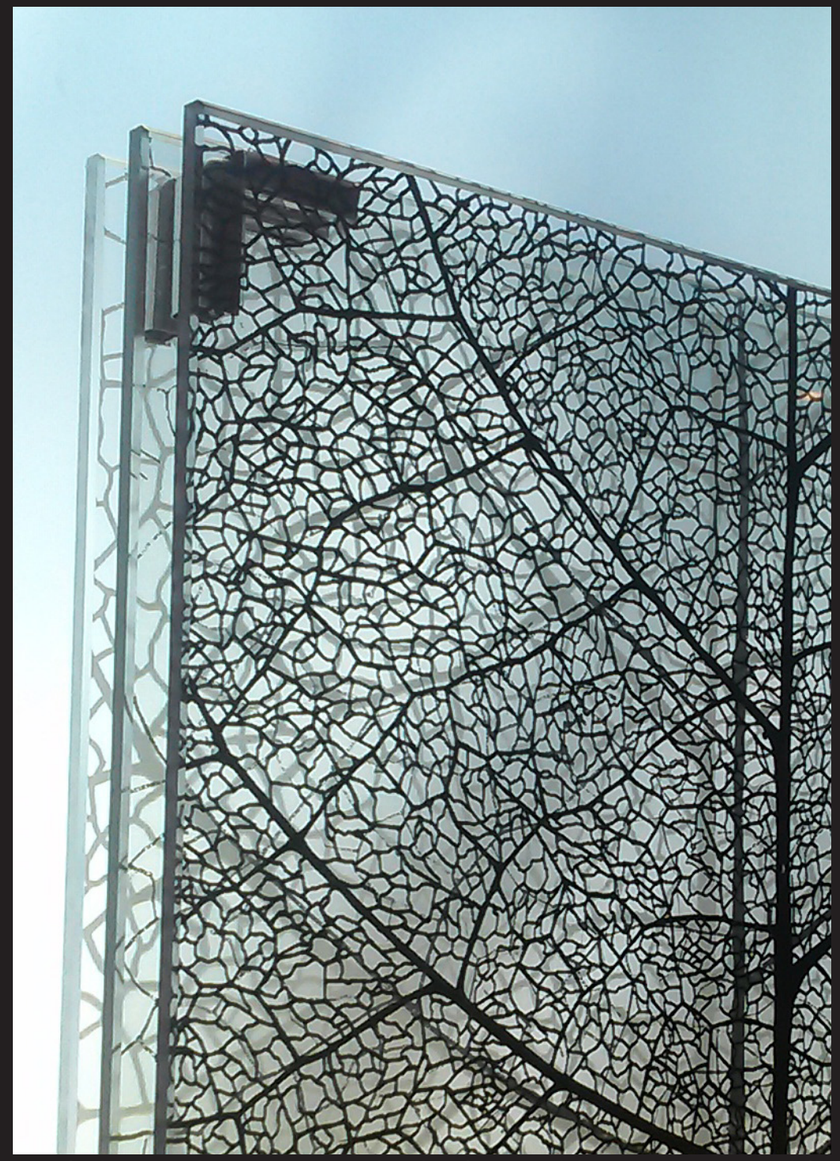


Photo of the physcial mock-up panel, designed by Jan Hendrix

Defining the material

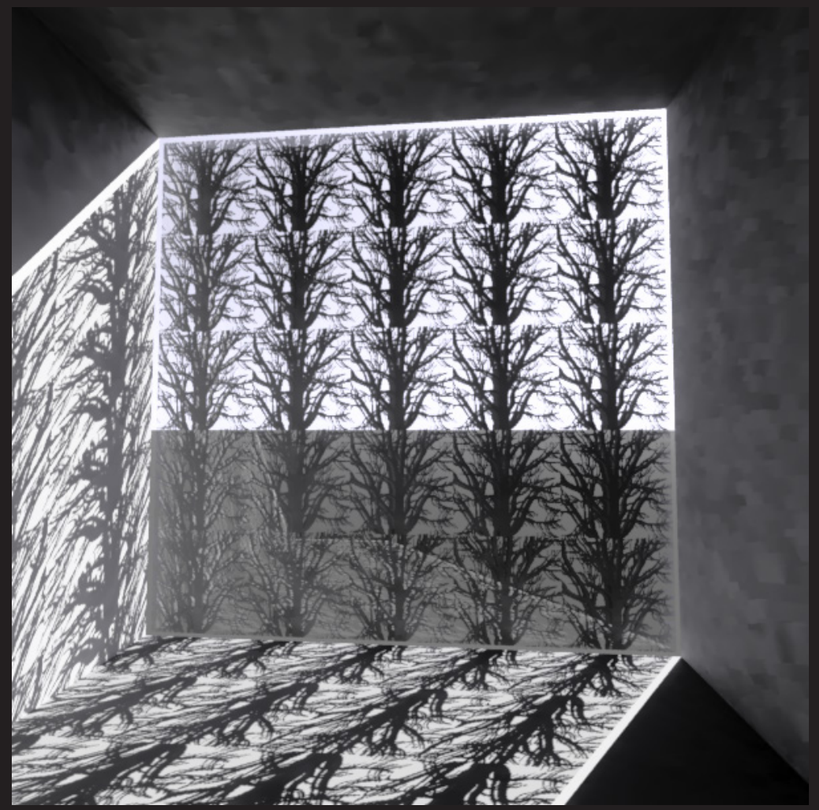
Function: mixpict

```
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
```

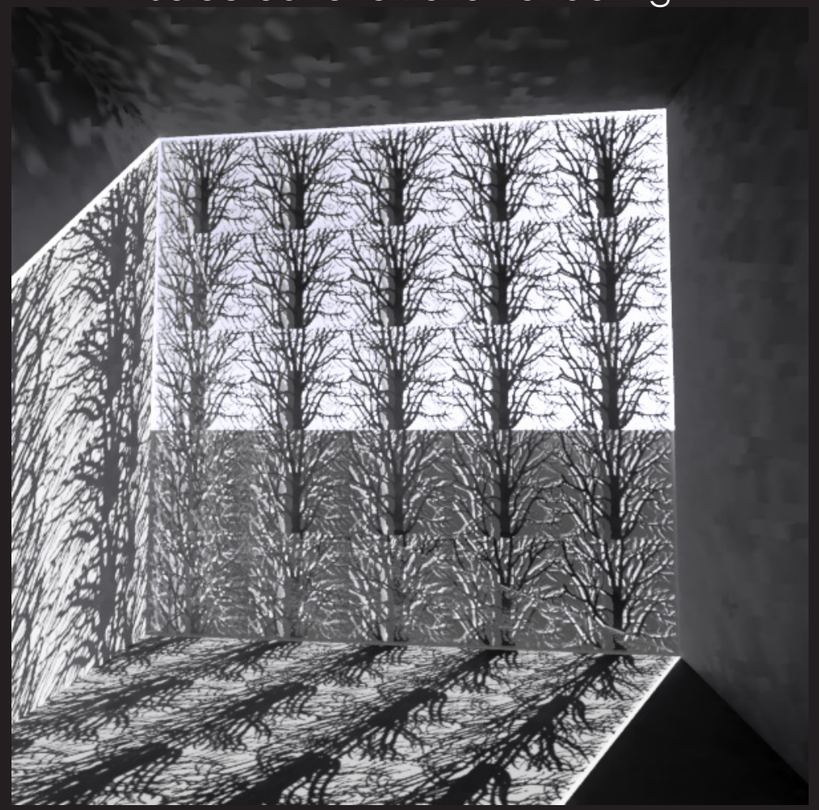
https://en.wikipedia.org/wiki/Leaf#/media/File:Leaf_Skeleton_negative_(like_photogram).jpg

Testing different rendering methods



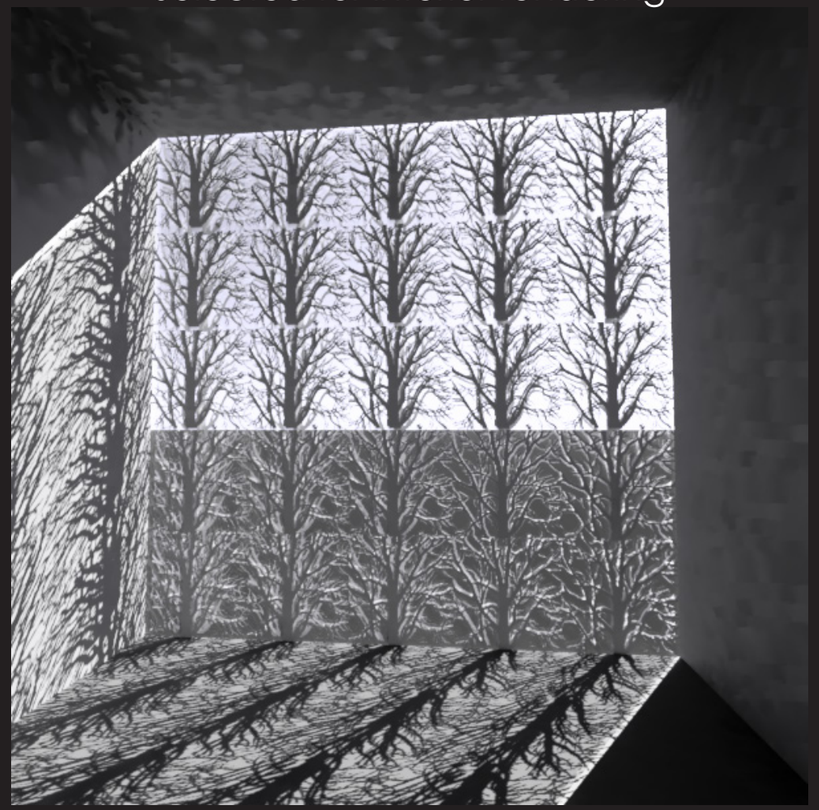
1 layer,
duplicate the pattern three times;
putting one on top of the other;
each offsets a little to create a perspective view;
the least computational power required

Selected for exterior rendering



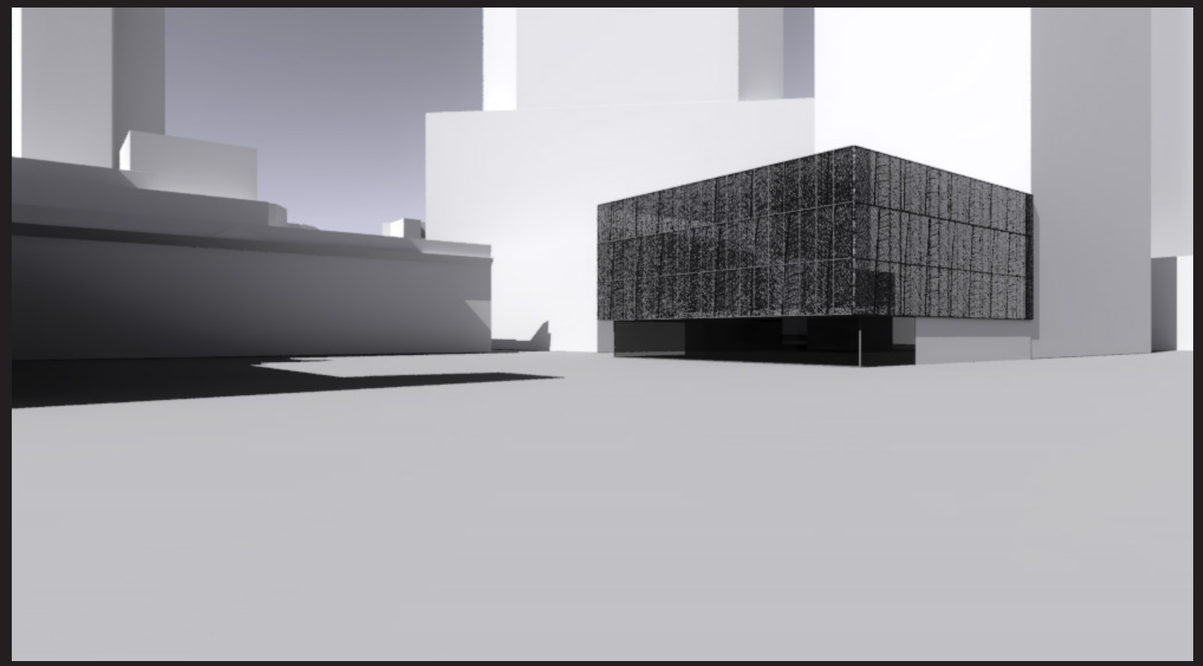
2 layers,
duplicate the pattern two times and offset them a little;
putting another layer at back;
more computational power required

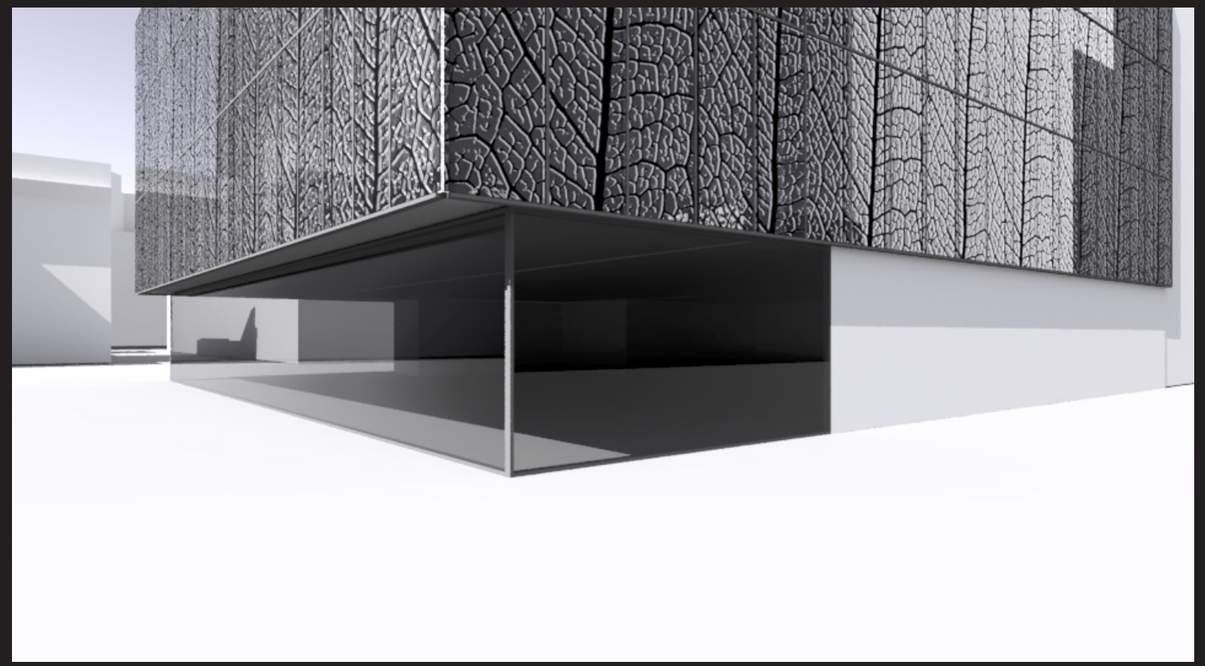
Selected for interior rendering



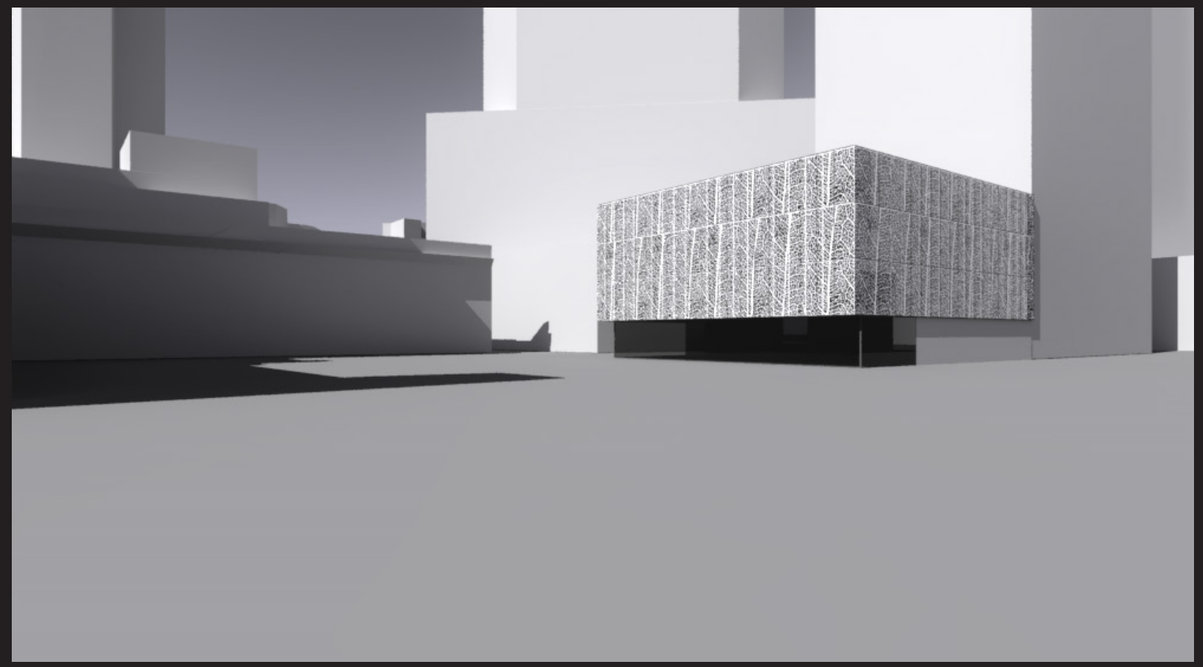
3 layer
3 sperate pattern layers;
the most computationally thirsty

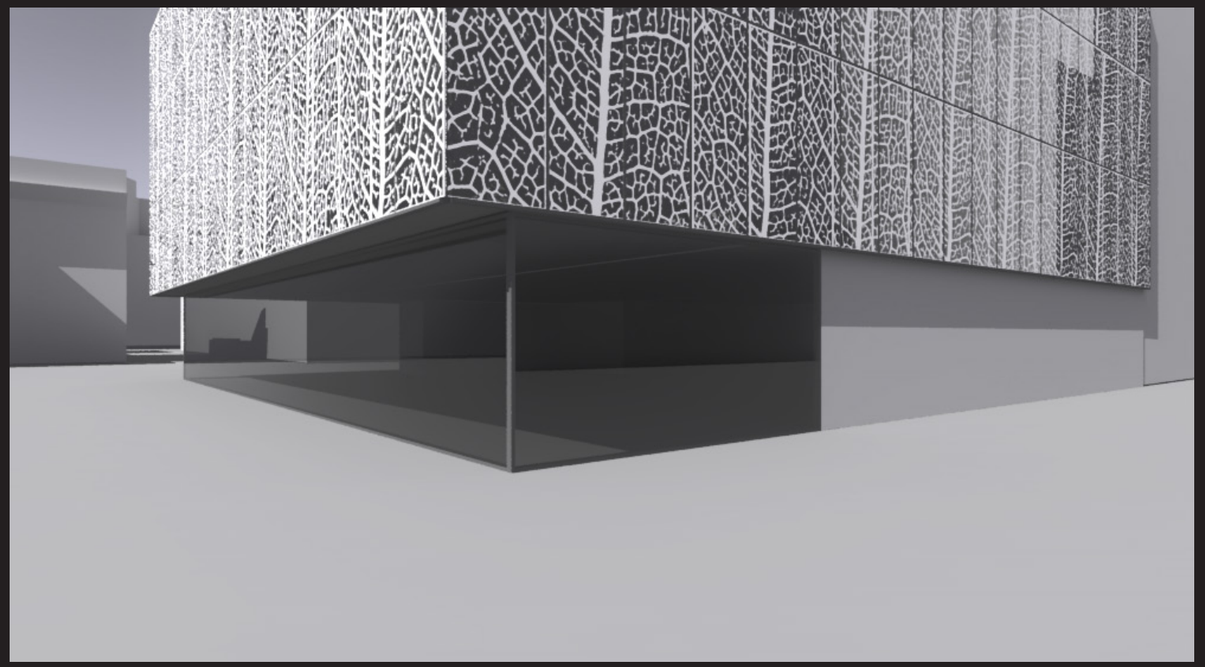
Large Scale Pattern :: Black Frit Outside





Large Scale Pattern :: White Frit Outside



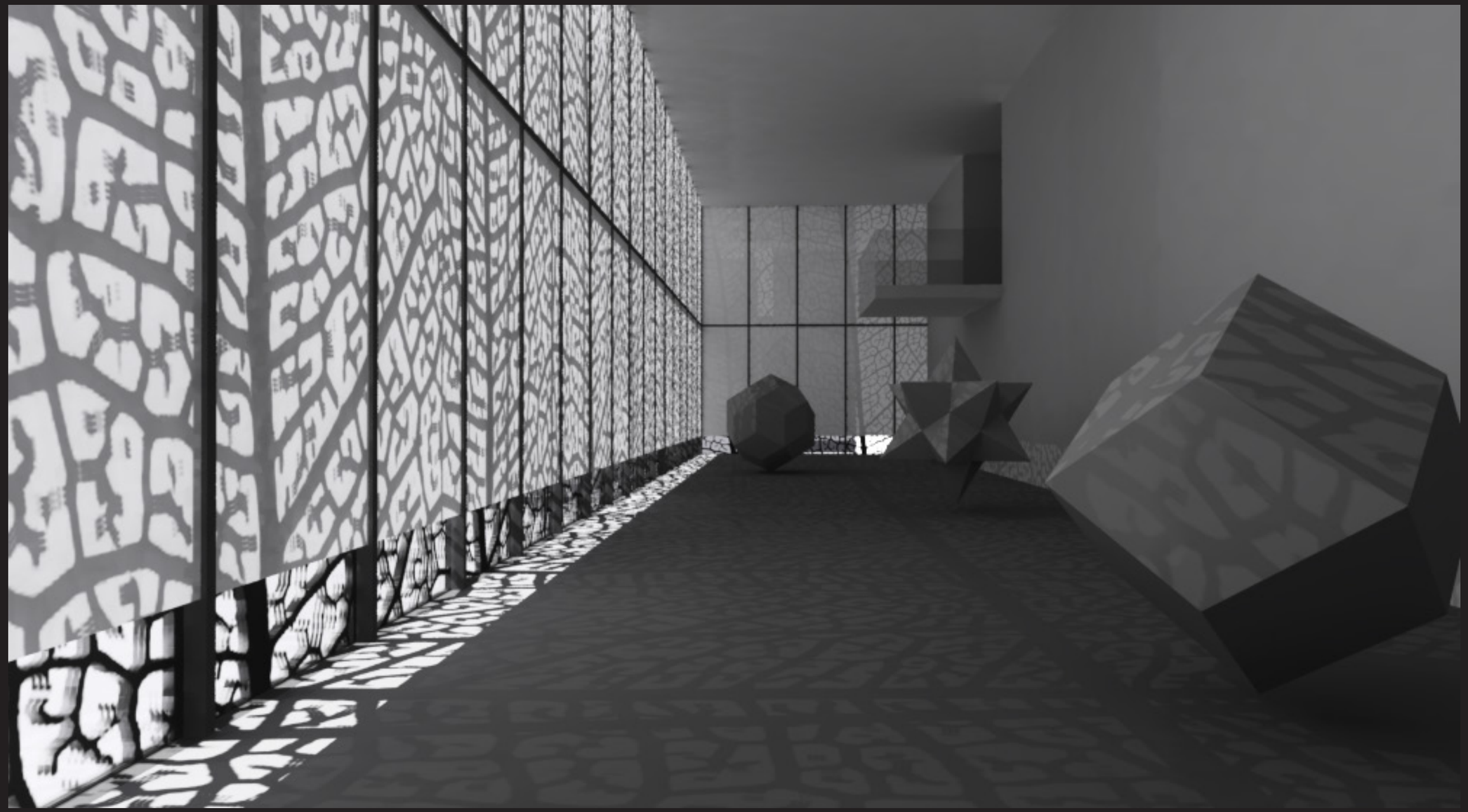


Large Scale Pattern :: Interior Rendering, Initial

Sampling errors;
High ambient accu-
racy required

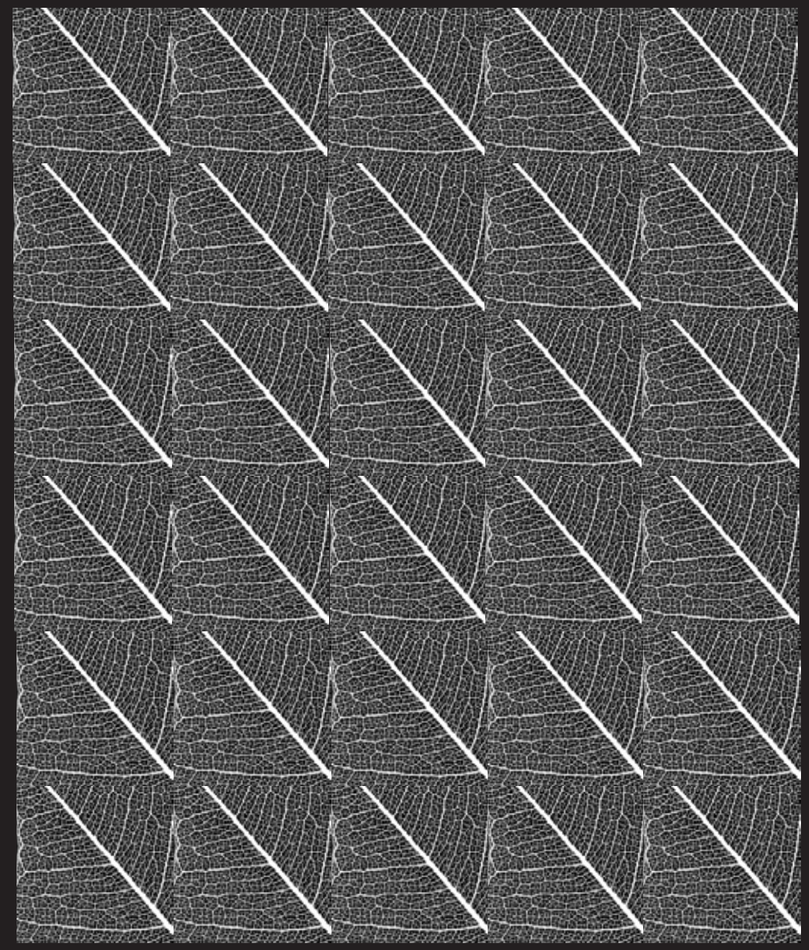
Large Scale Pattern :: Interior Rendering, After

Large Scale Pattern :: With Translucent Shades

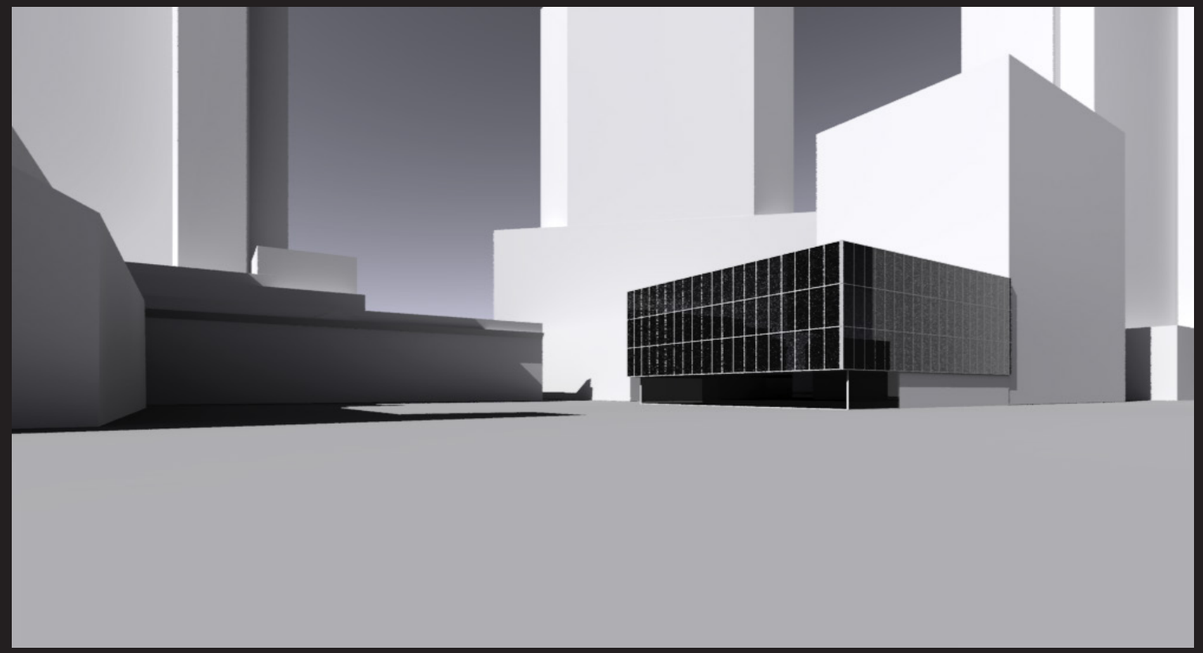


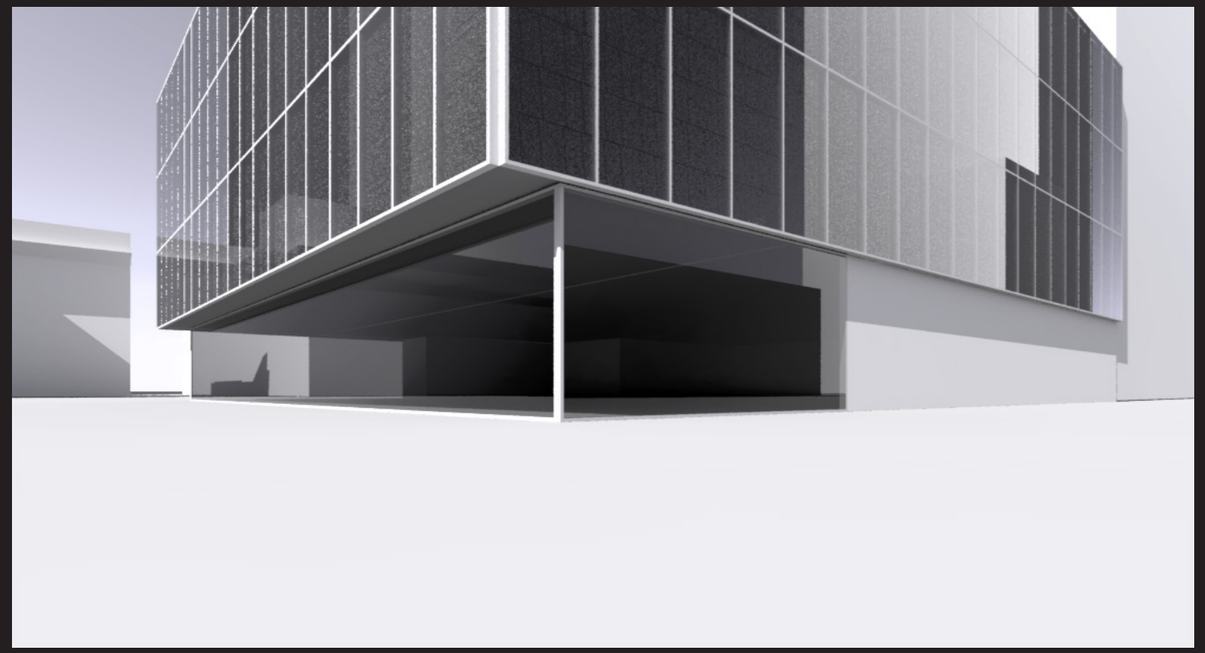
```
rZ = if(1e-6 -
Nx, -acos(Ny),
acos(Ny)); {transla-
tion to YZ plane}
rX = if(1e-6 -
Ny, -acos(Nz),
acos(Nz)); {transla-
tion to Z axis}

rZx = cos(rZ)*Dx -
sin(rZ)*Dy; {apply
YZ translation to
ray}
rZy = sin(rZ)*Dx +
cos(rZ)*Dy;
rZz = Dz;

rXx = rZx; {apply Z
axis translation to
ray}
rXy = cos(rX)*rZy -
sin(rX)*rZz;
rXz = sin(rX)*rZy +
cos(rX)*rZz;

aDx = abs(rXx);
aDy = abs(rXy); aDz = abs(rXz);
open = sqrt(arg(11)*100); {find open square size}
cutoff = 1/tan(arg(10)*PI/180); {calc relative depth of cloth from cutoff angle}
spectrans = if(1e-6 - aDz, 0, max(0, open*(1 - cutoff*aDx/aDz)/100) *max(0, open*(1 - cutoff*aDy/aDz)/100) );
```

Changing the pattern scale



Small Scale Pattern :: Exterior View





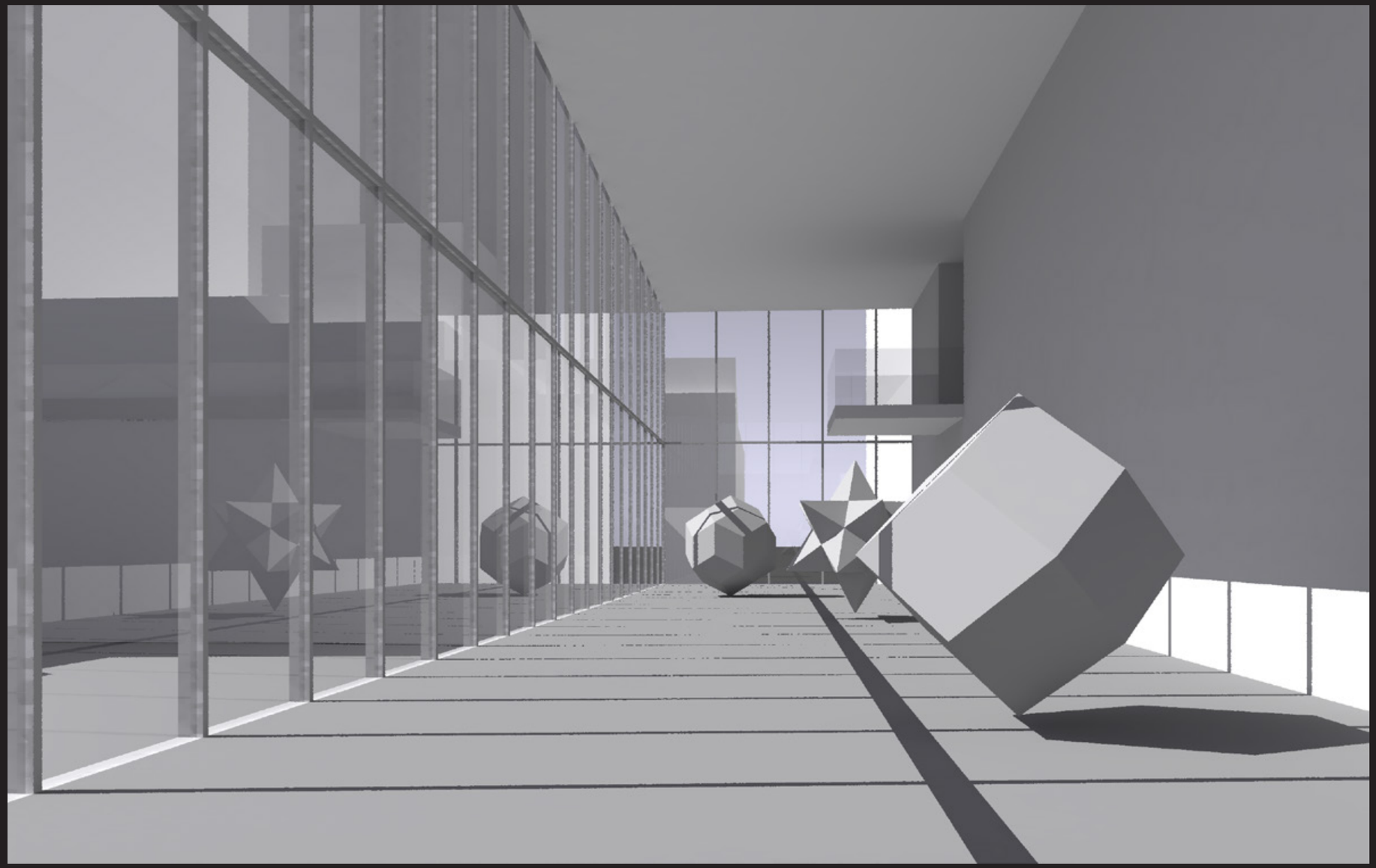
Small Scale Pattern :: Interior View

Rendering ...

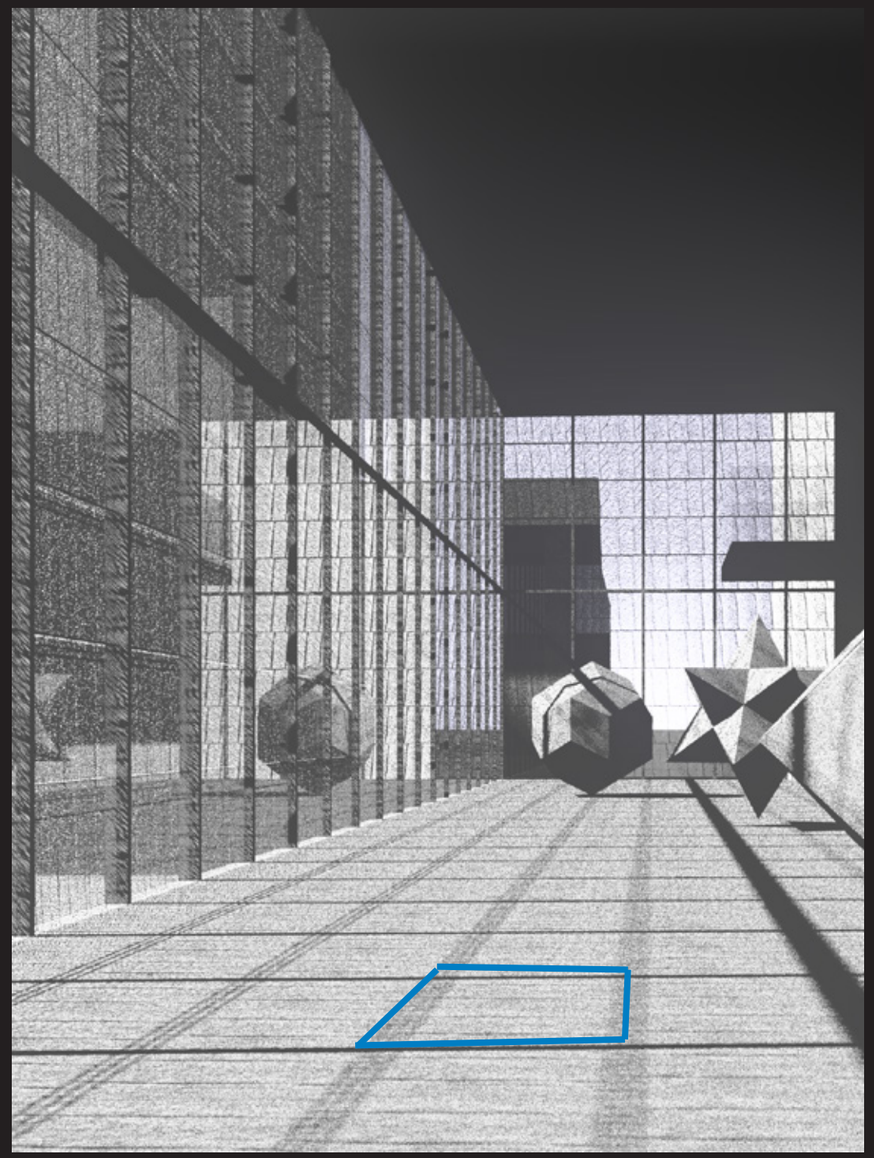
Small Scale Pattern :: Clear View

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

Calculation of equivalent VLT:

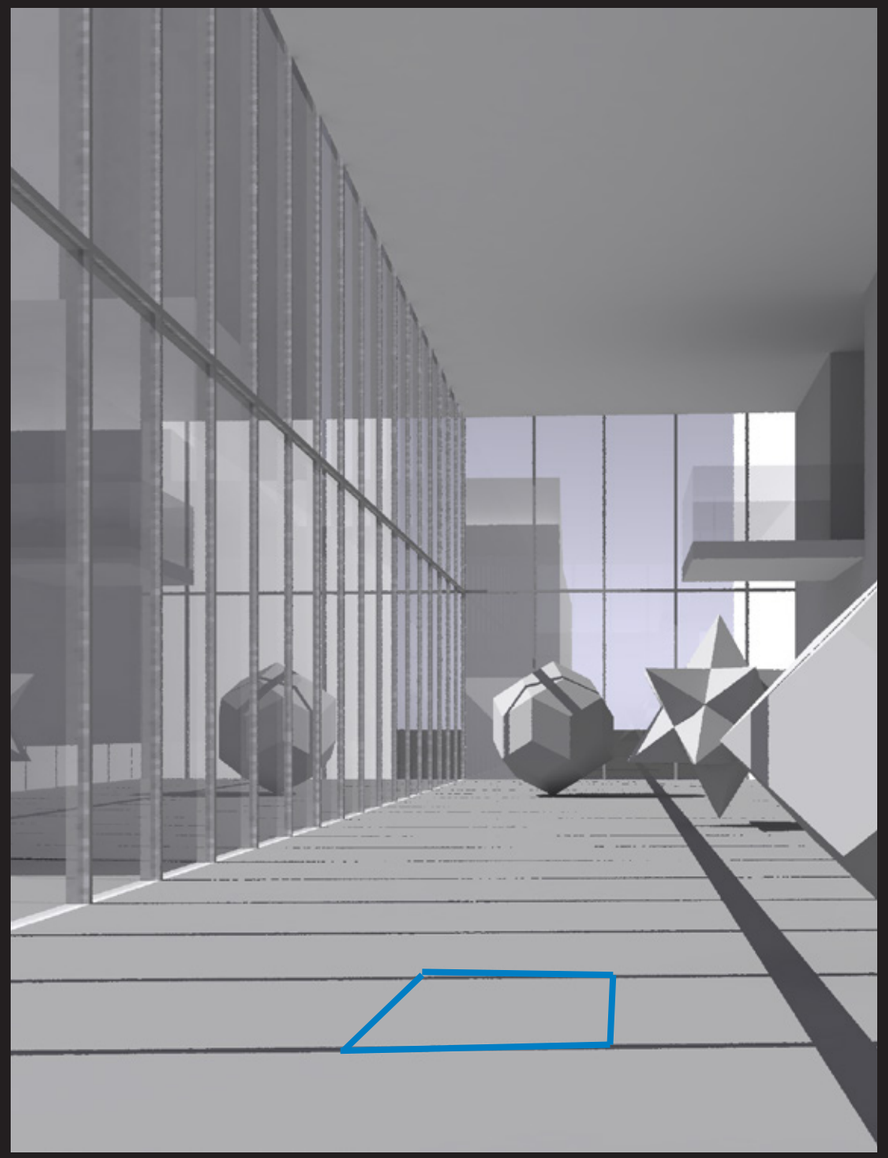


Calculating equivalent facade VLT



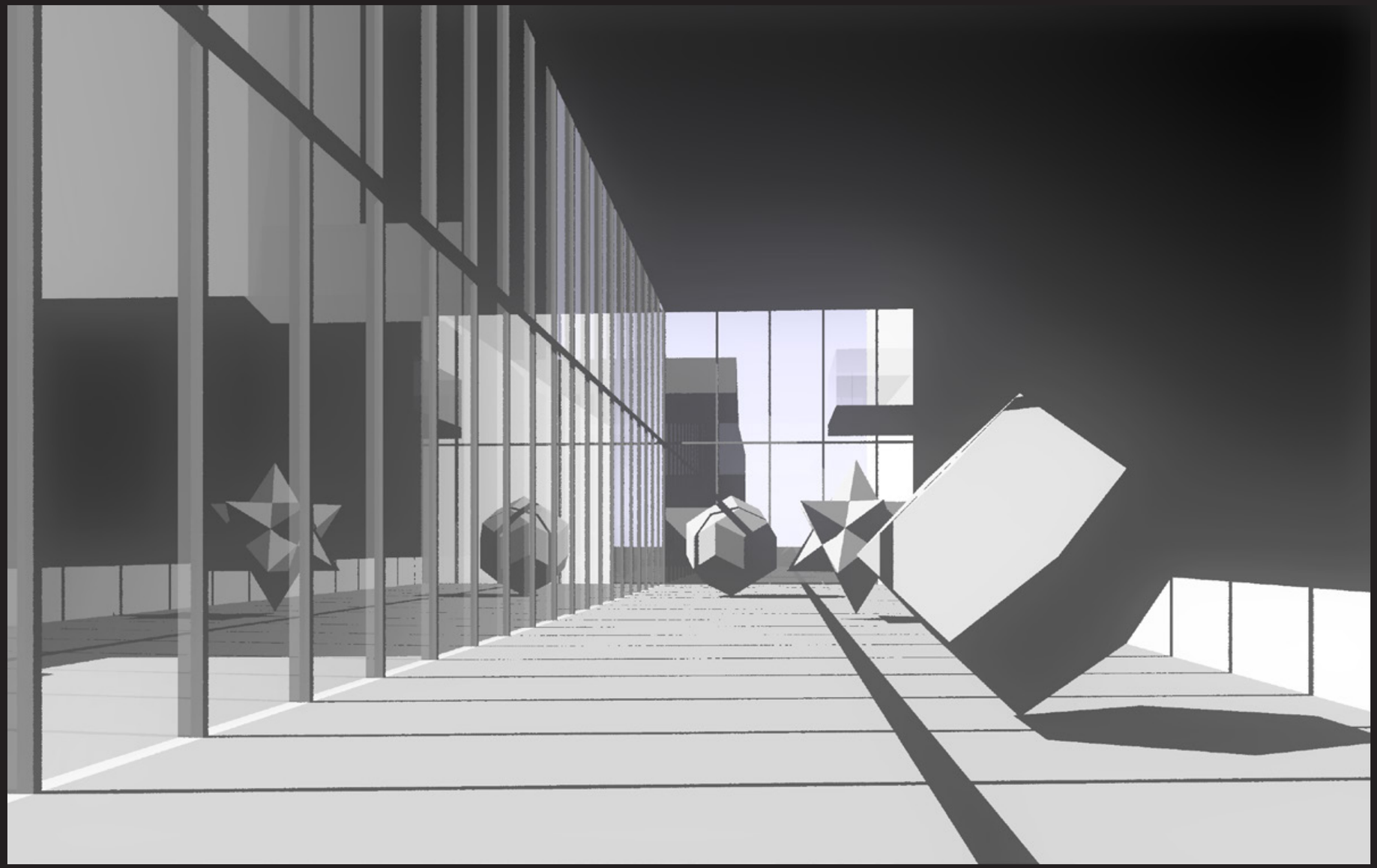
1. use ximage to get the average illuminance value over a small area

2. Adjust the VLT of the glass in the single view so that the illuminance value of the same area match



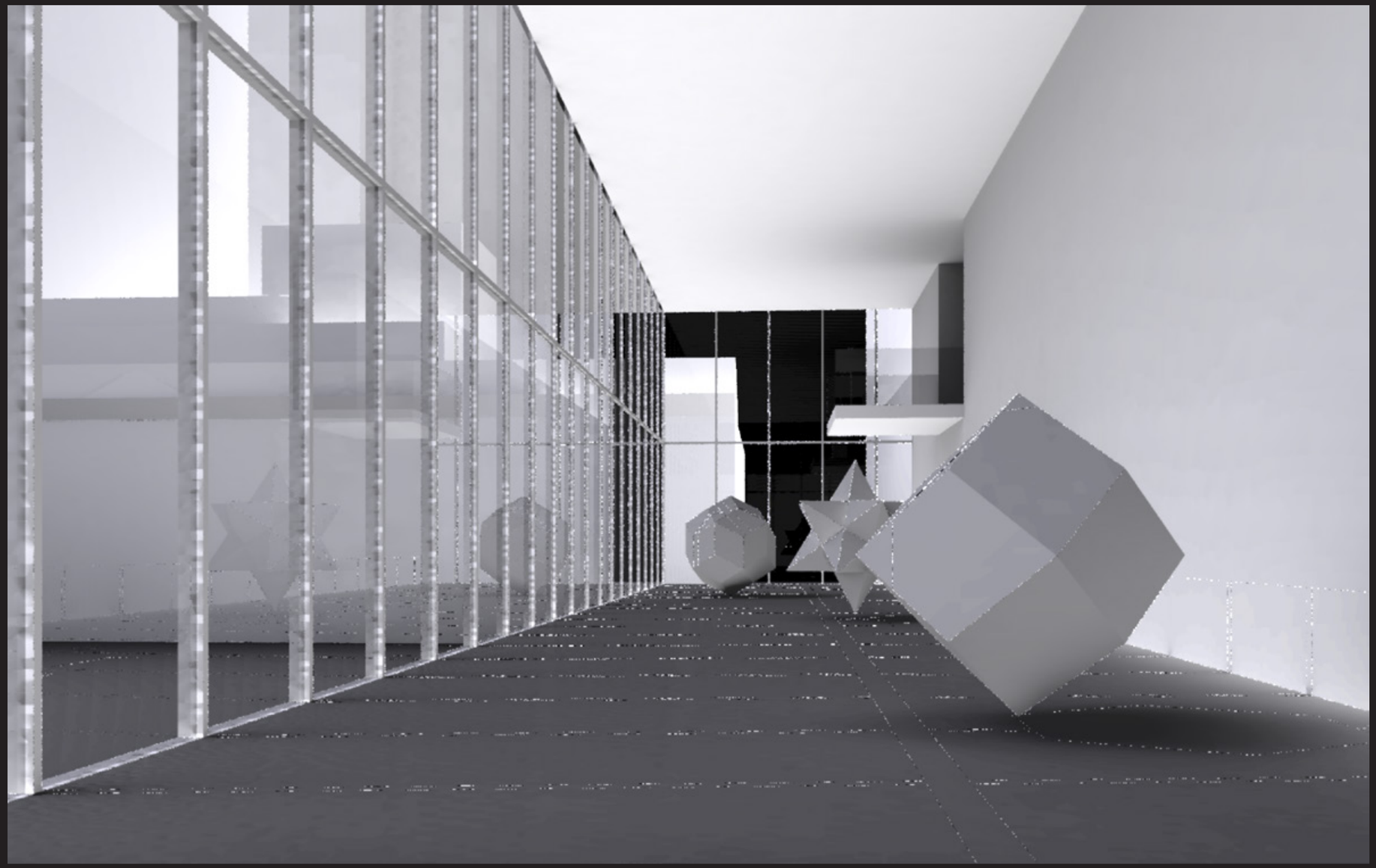
Small Scale Pattern :: Direct Calculation

Image 2:
Direct calculation, zero ambient bounce.



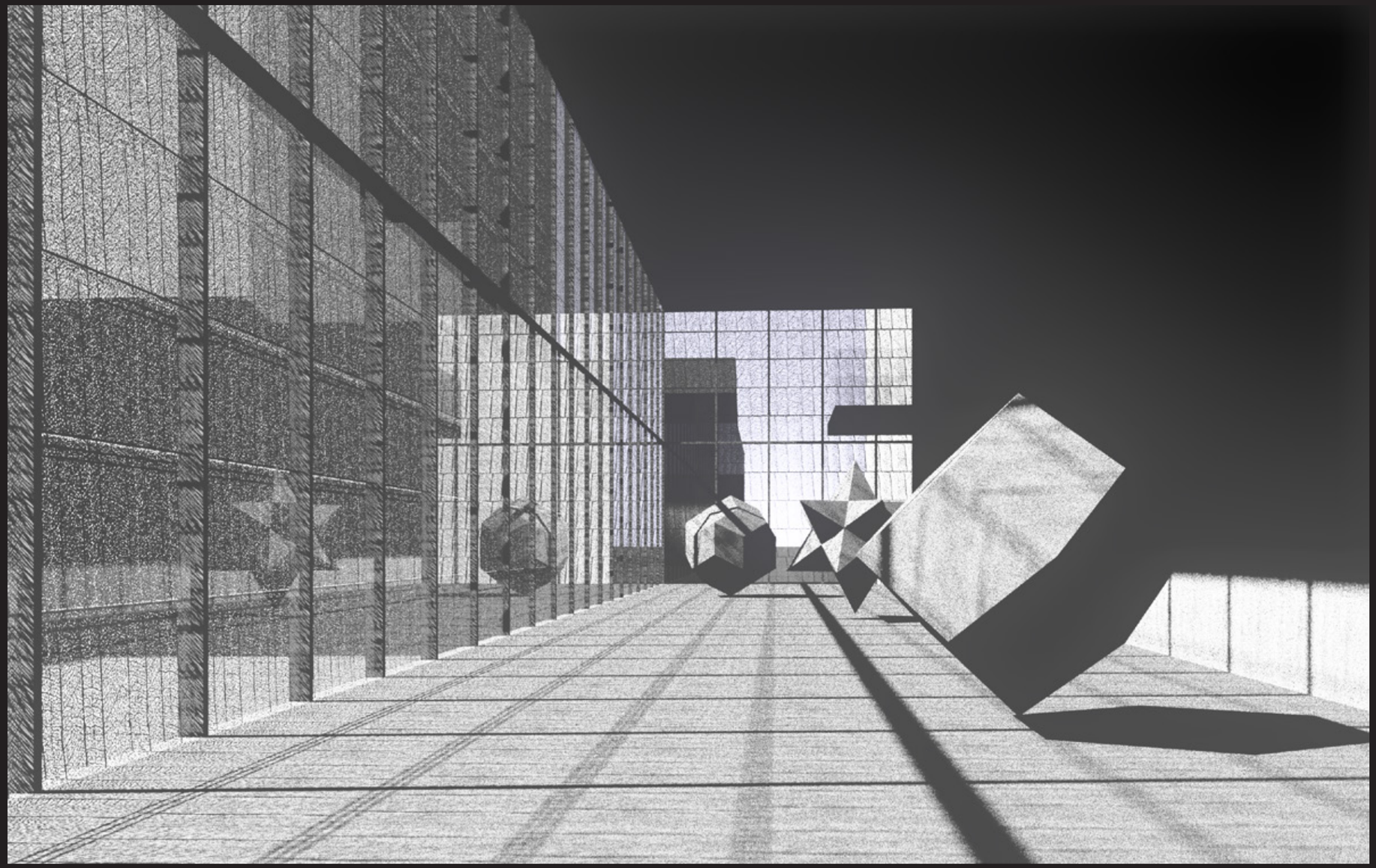
Small Scale Pattern :: Substracting the direct calculation

Image 3:
Image 3 = Image 2 - Image1
Ambient setting preserved



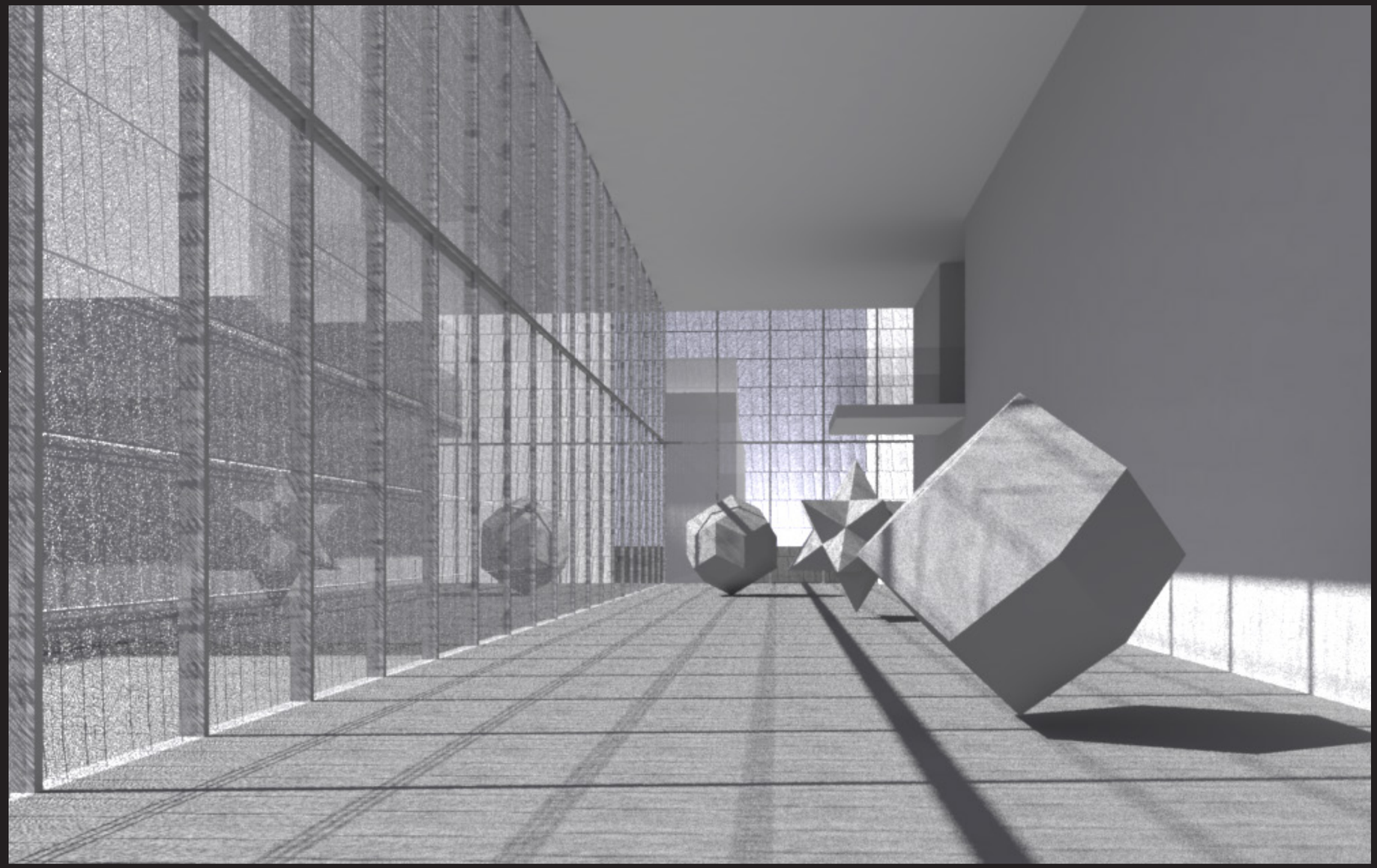
Small Scale Pattern :: Direct Calculation with Direct Jitter

Image 4:
direct calculation
full direct jitter
no image sampling

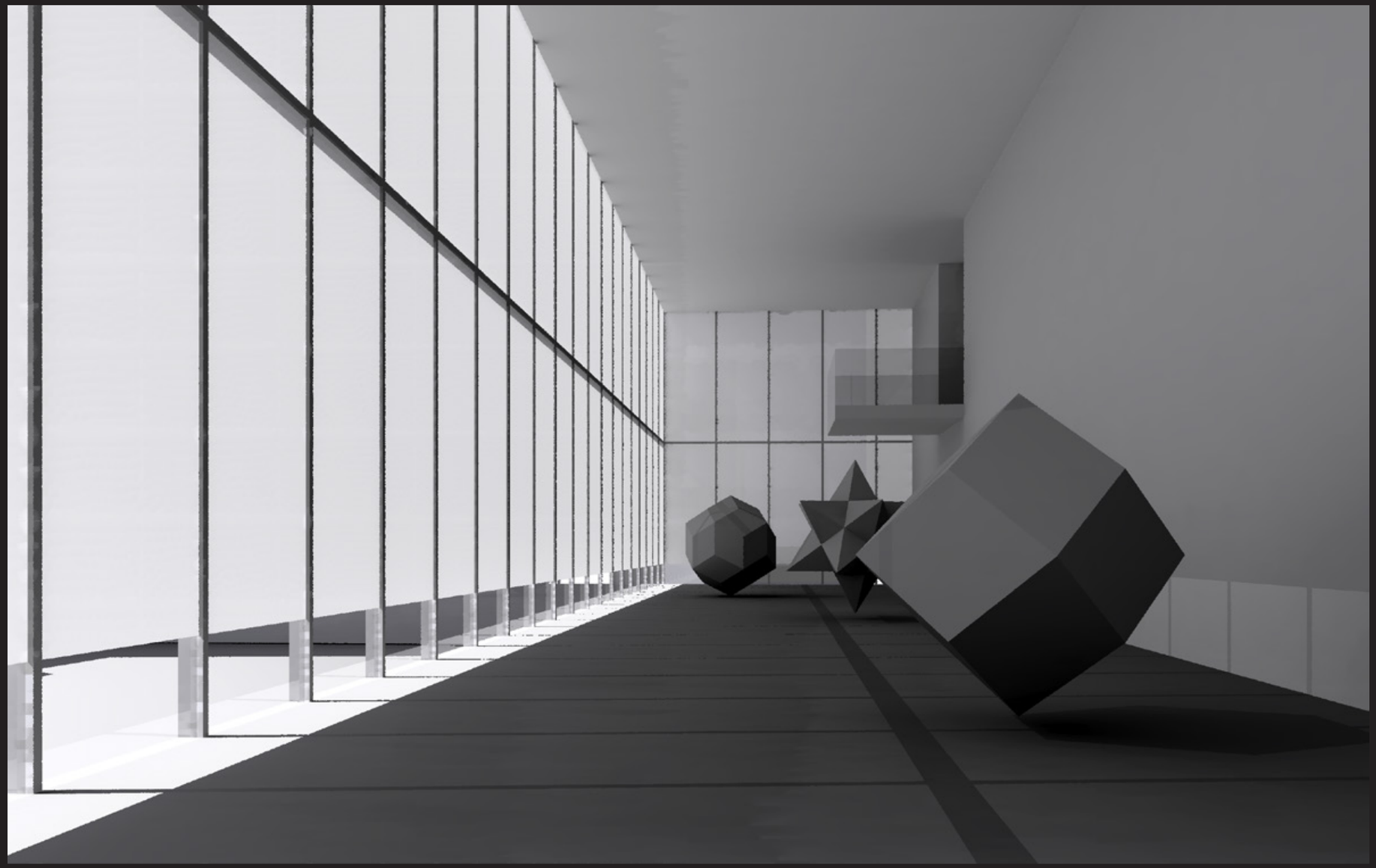


Small Scale Pattern :: Final Image

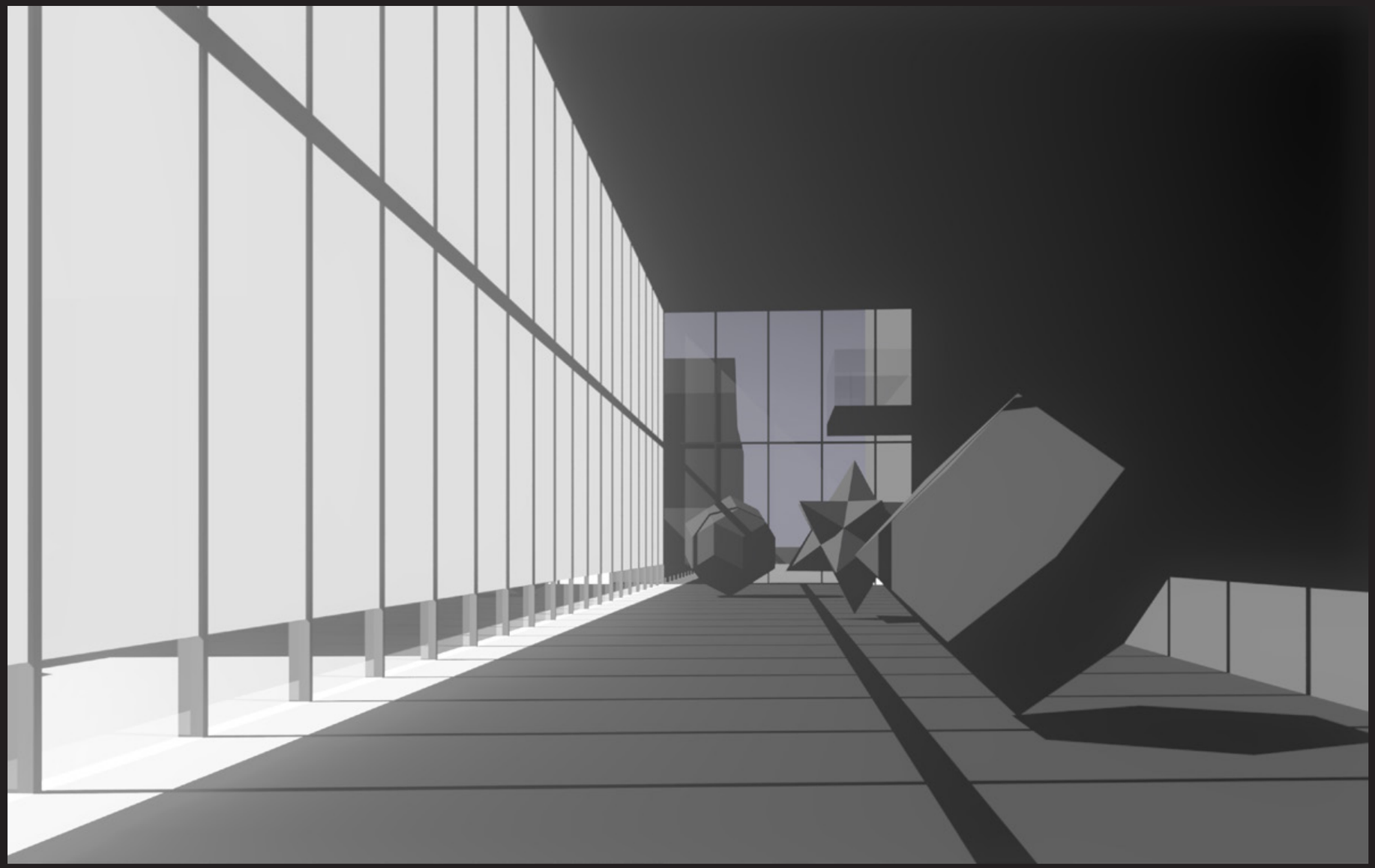
Image 5 (final)
Image 5 = Image 3 + Image 4
Adding back in the direct calculation with direct jitter



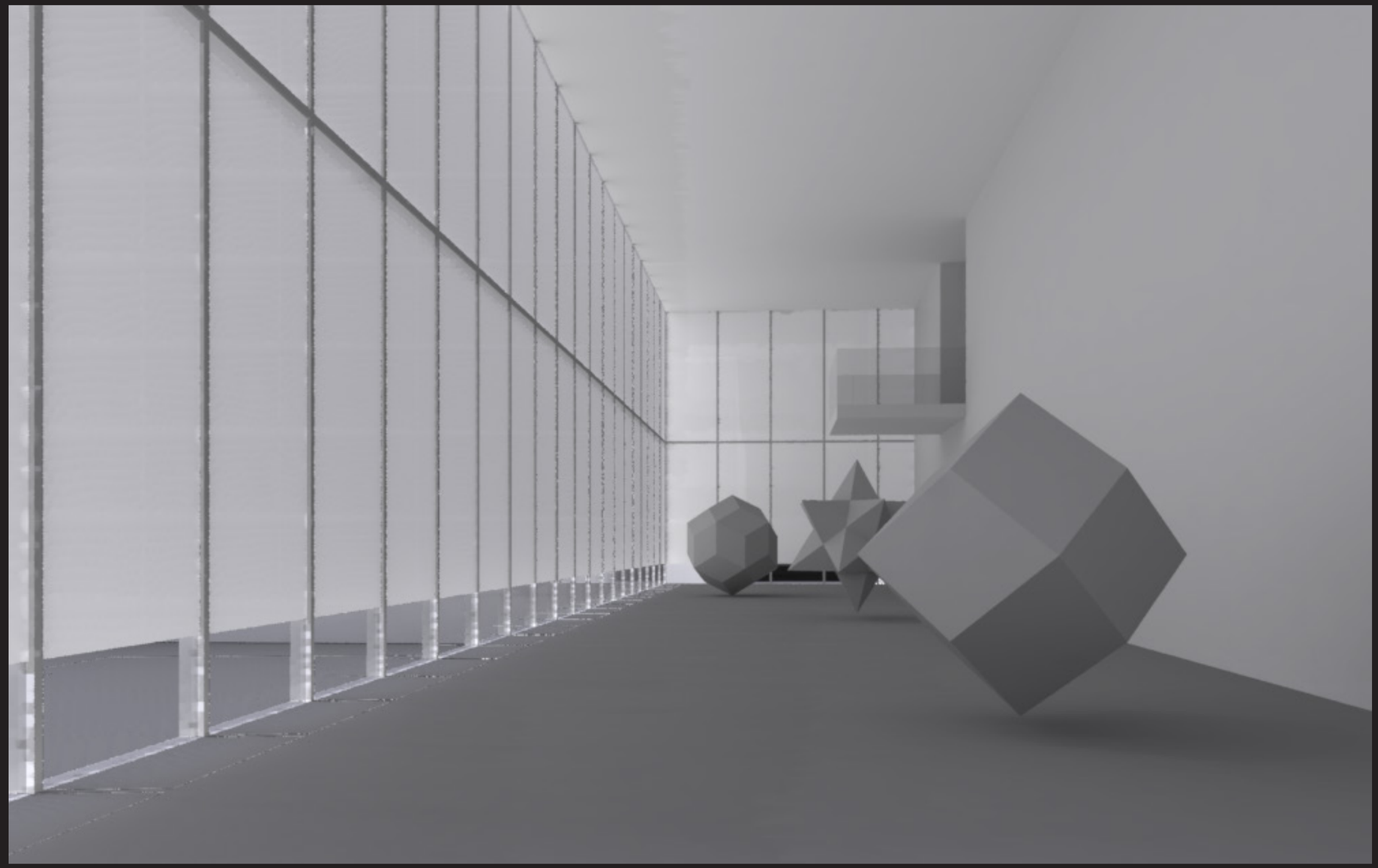
Small Scale Pattern :: Clear View :: with Shades



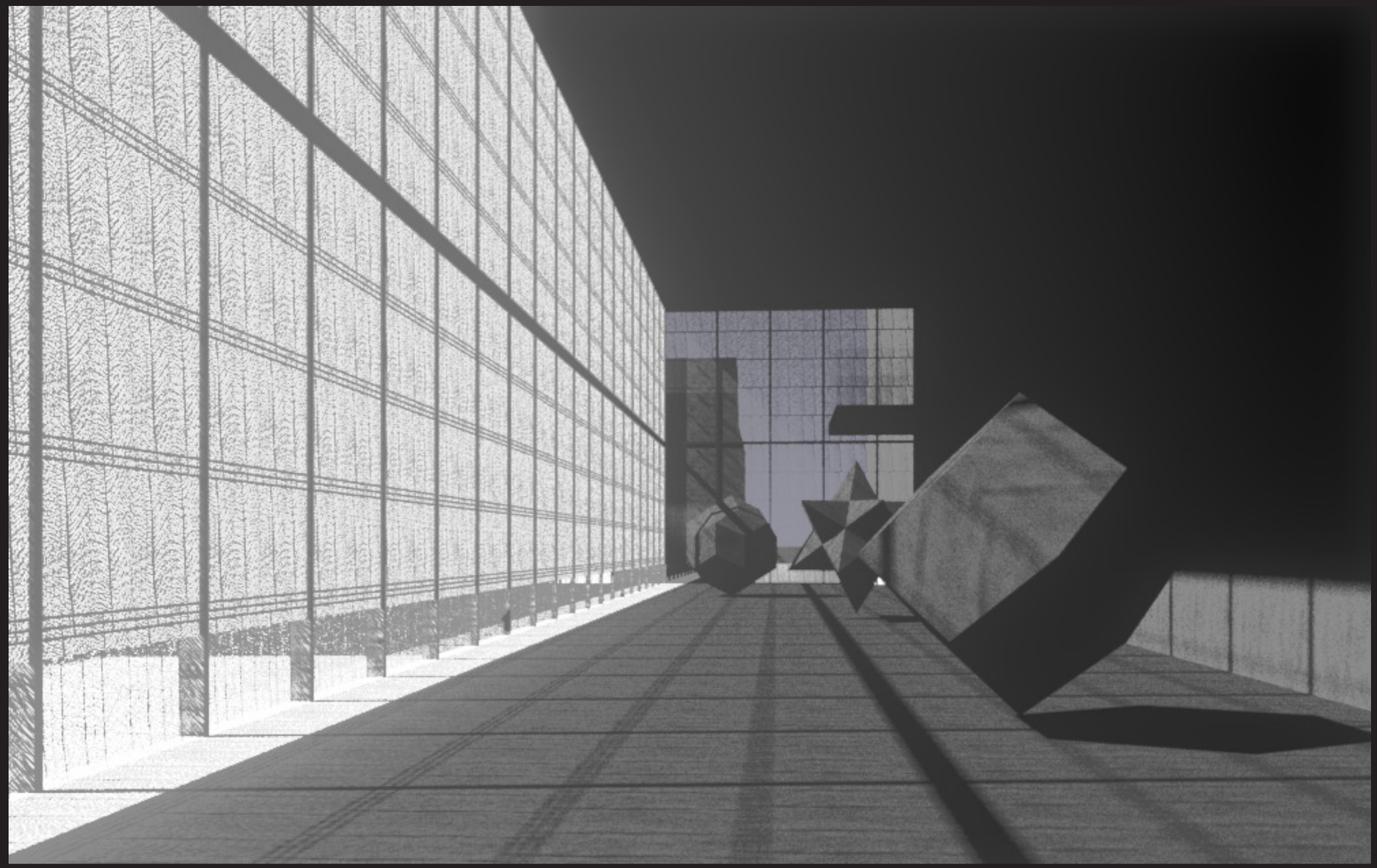
Small Scale Pattern :: Direct Calculation :: with Shades



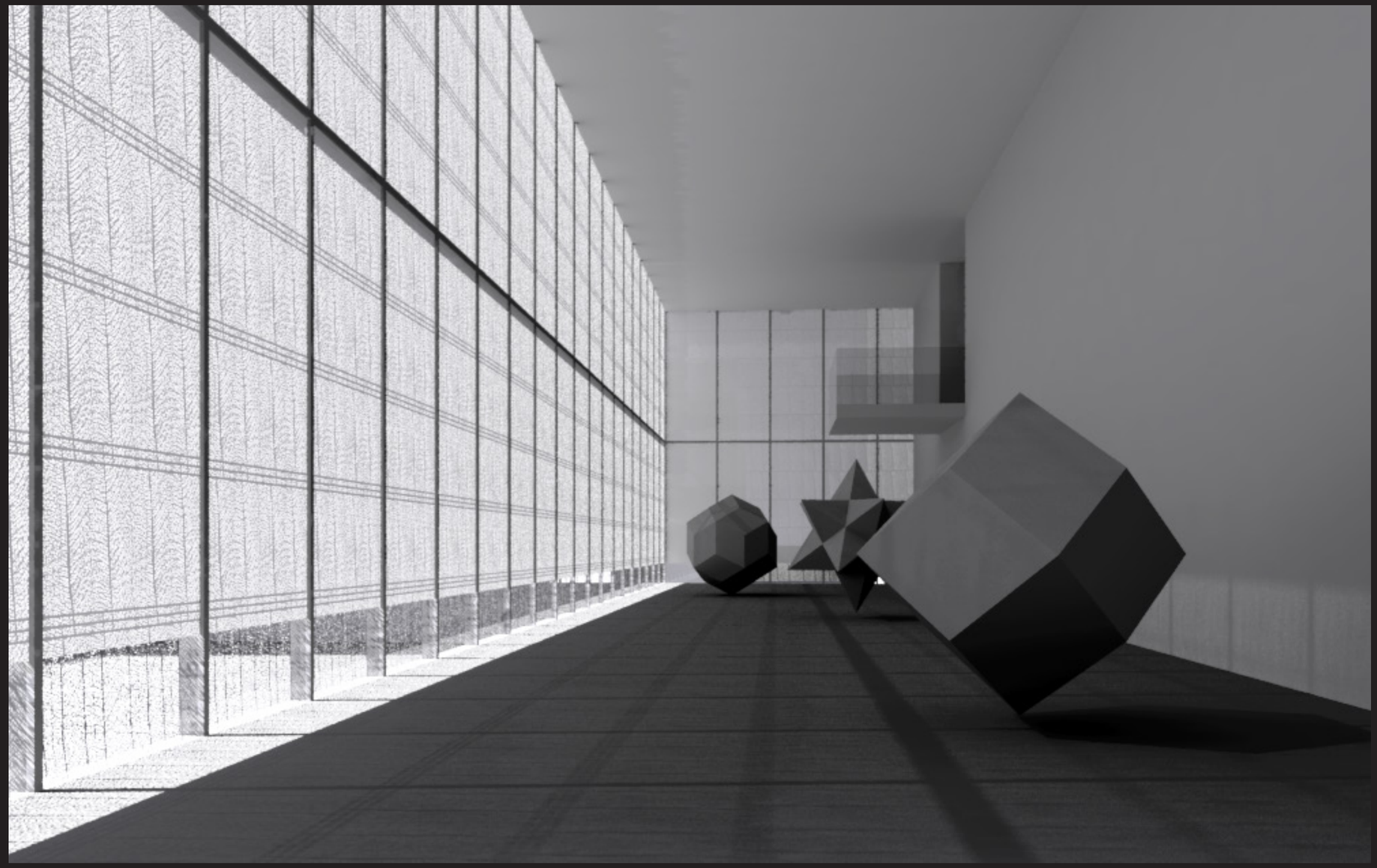
Small Scale Pattern :: Substracting the direct calculation :: with Shades



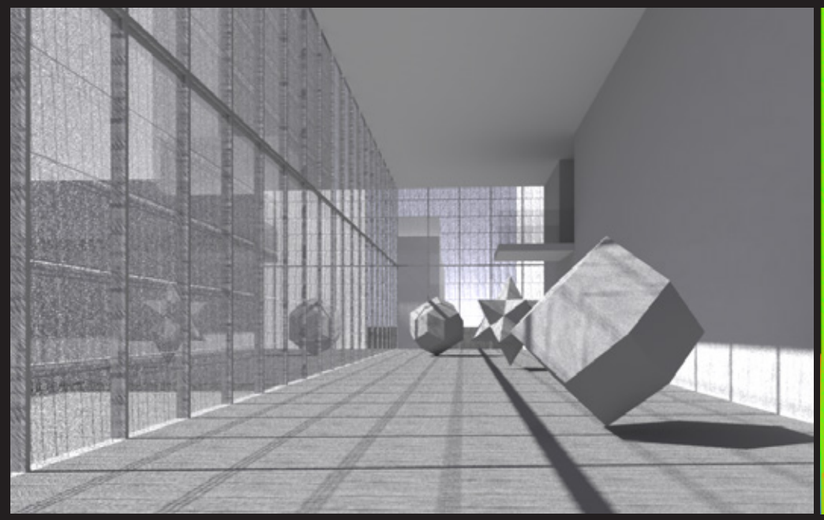
Small Scale Pattern :: Direct Calculation with Direct Jitter :: with Shades

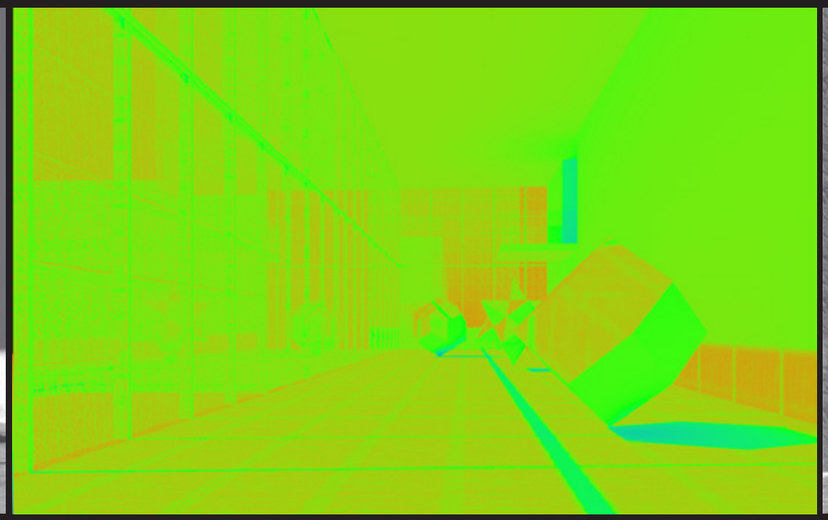


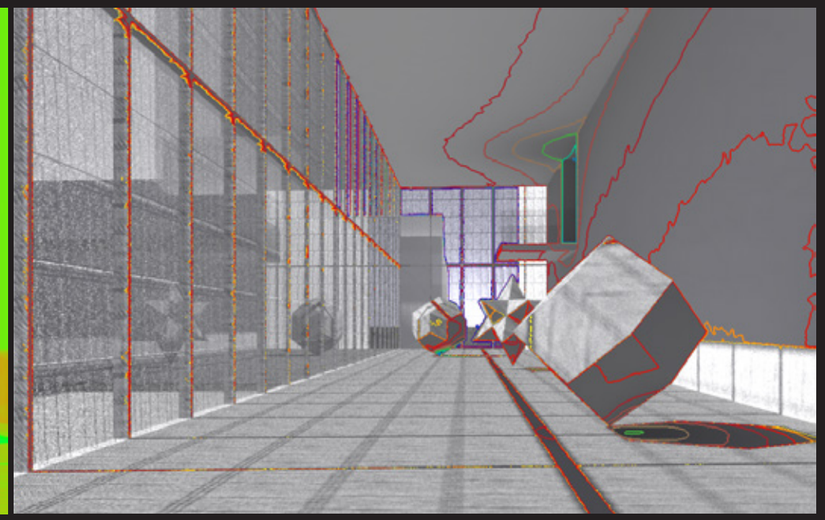
Small Scale Pattern :: Final Image



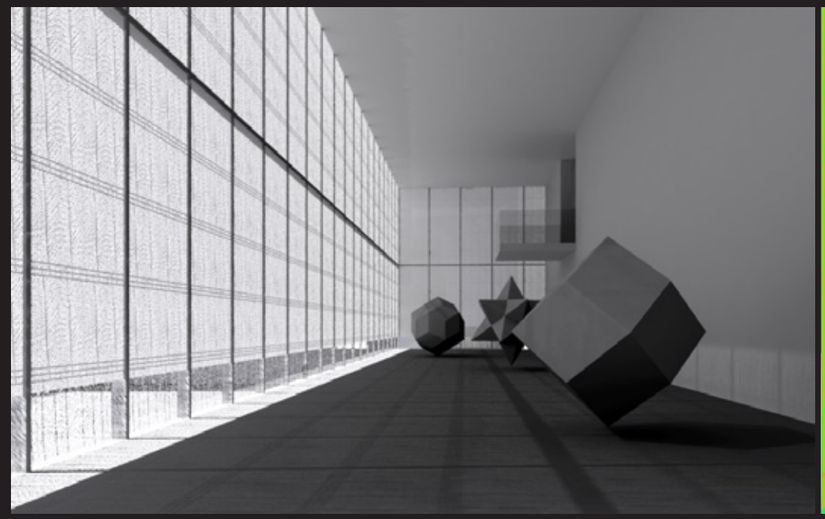
Small Scale Pattern :: Final Images

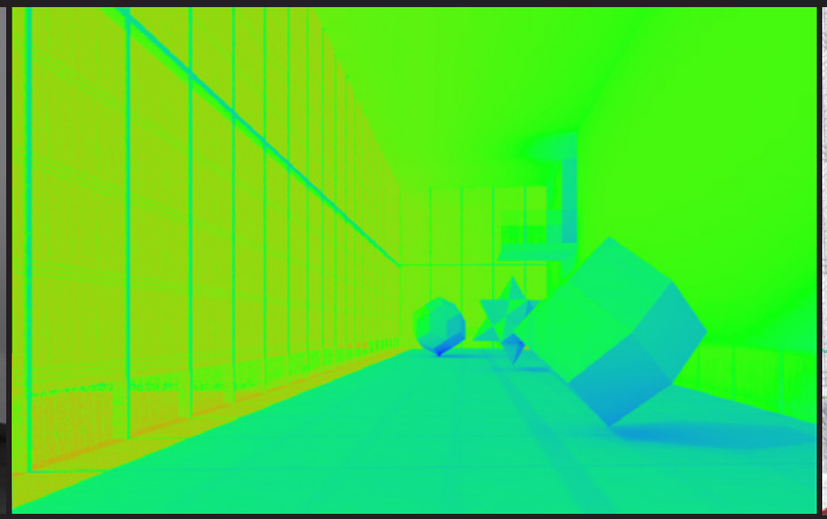


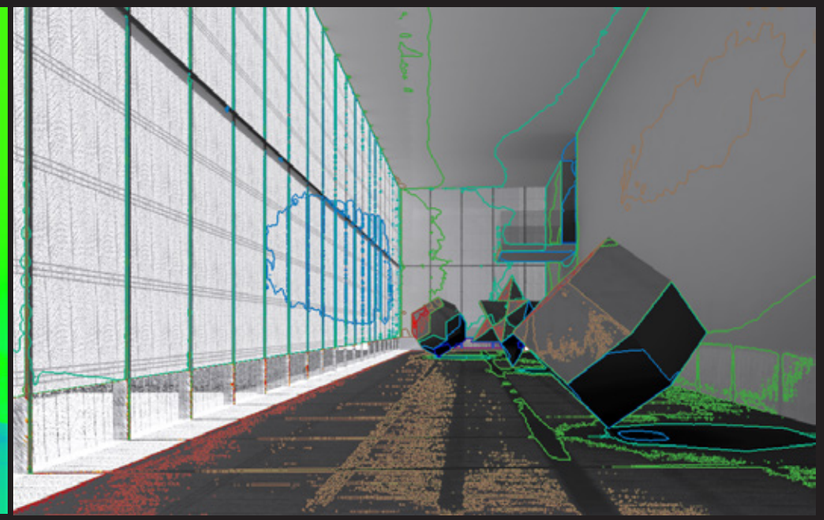




Small Scale Pattern :: Final Images :: with Shades







Thank You!