

Painting With Light

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This paper presents results from our basic computer education at the School of Architecture in Copenhagen, a snap shot of where we are now.

Two years ago it was made obligatory for the students to attend a two week computer course in both their first, and second year. The aim of these courses is to teach the students to experiment with form, and to use the computer for presenting their ideas and projects.

Light is central in both courses, and in our development of the courses. The last years we have been studying light trying to develop methods, that makes it possible for the students to create a credible lightning of their 3d models. These studies has raised more questions than answers, but we have succeeded in finding some techniques, that obtained the wanted results.

The Programs

The programs we teach is form•Z for modelling, Photoshop for image processing, and Freehand for layout. In the mid ninethies form•Z was chosen by the school as our basic modelling program. It is a very all round program, it has an easy interface, and the students can rent it for \$100 a year, which is important, as the school recommends, that the students buy their own computers.

The Courses

The programs are thought through exercises. After a walk through the students make the exersice. Since the beginning of our computer teaching we have realized, that you only learn to use the programs through practice, therefore both courses includes a



*Figure 1
Lise Lycke Nielsen*

period of three days for practicing. In both courses the students are expected to present the results of their practice on posters.

Light

The new courses doubled the length of our basic it-education, and the major part of this extra time was decided to be used on working with light.

First Year

The school took a rather untraditional approach to this, by deciding not to teach the students computer rendering at the first years standard courses, but instead they got a course in pencil drawing. The idea behind this was to force the students to imagine the light in their models, but also to compensate for a cut in their general drawing courses. se fig 1, 2, 3
This was both a good and a bad idea. It was good, because it is important for the architect to be able to imagine light. It was especially good for the ex-

perienced drawers, they quickly constructed an underlay, a print in thin grey lines, on which they could preform their skills. The combination of Photoshop and pencil was also a good idea. The illustrations below shows transformations of a faint pencil drawing. se fig 4, 5, 6

But for the most the pencil presentation were a defeat. In the courses where computer rendering was chosen, more students experienced success.

But the greatest disadvantage of the pencil courses was, that the students got bored. Our former standard courses started with, how to view a model, how to render it with lights, and how to choose predefined materials. With this knowledge the faster students were occupied, and having fun, whenever they had finished an exercise. se fig 7, 8

And as the illustrations show, you can make nice renderings with simple light. The outdoor image is rendered with a parallel, shadow casting light, simulating the sun, and a point light without shadows,

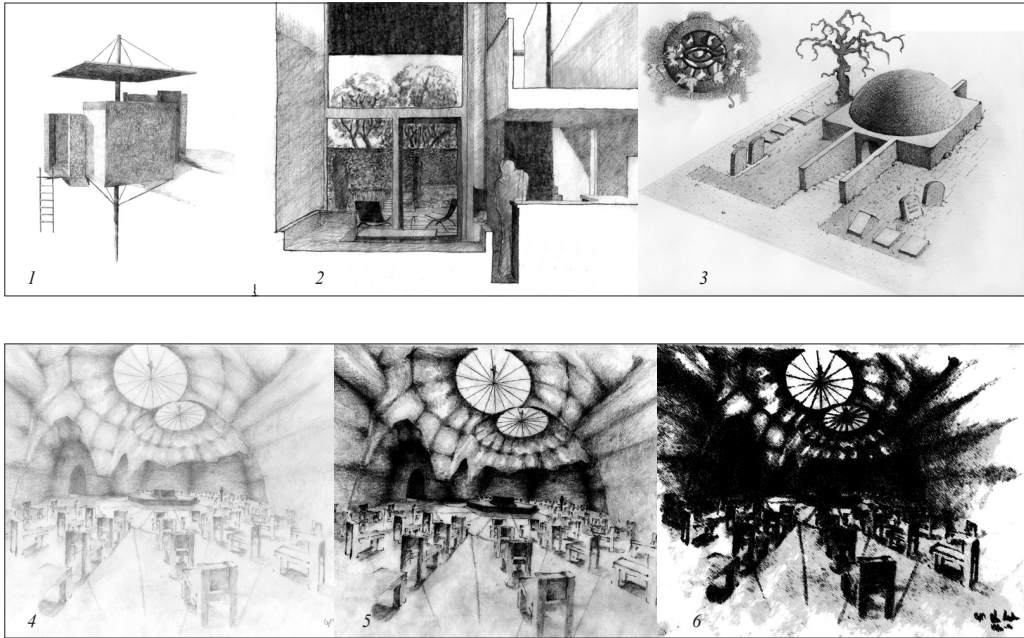
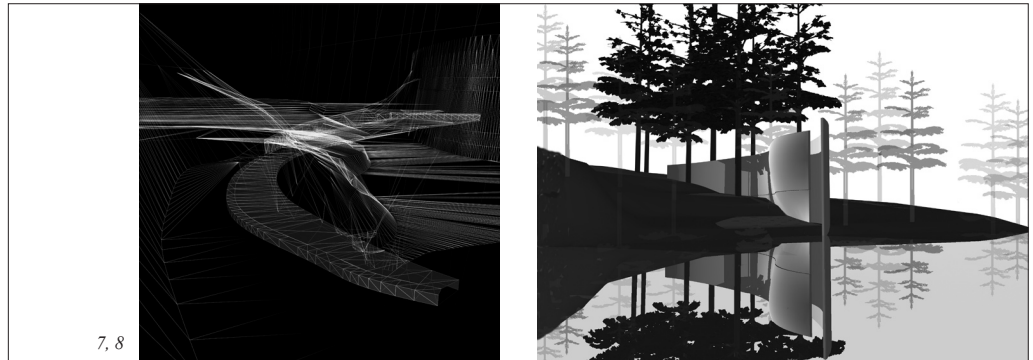


Figure 1, 2 & 3
Angelica Waldh
Hanne Gro Larsen
Filip Andreas Juhl

Figure 4, 5 & 6
Pencil and Photoshop,
Peter Tycho Axelsen

Figure 7
Hidden lines and Photoshop,
Rasmus Palmqvist

Figure 8
Render and Photoshop,
Emma Hansson 2442



placed in the opening of the building, makes an illusion of the reflecting light. se fig 9, 10

Second year

The big challenge in the new courses was the second year. It includes advanced modelling, and more Photoshop and Freehand; but the main emphasis is on rendering.

Photo realism

Today photo realism is the mantra in computer rendering, and it is obtained through complex rendering algorithms, that calculates how light interacts with and is reflected from the surfaces of the model. So it would be natural for us to teach photo realism at our second year courses, but there was a problem.

Radiosity is the classic rendering algorithm for calculating the reflecting light in a model, and for years it had been part of form•Z; but it was very difficult

to handle, and the results did not match the efforts. Therefore we turned to other programs to see, what they could do.

We selected 3d Studio and Maya. 3d Studio was already part of our courses for the older students, more for modelling than for rendering. And Maya, which we did not know, but thought of by the students, as the solution to all problems.

We hired two skilled users to take teachers and selected students on a one week walk through in both programs. We did that in one of our daylight-laboratory rooms. The goal of each introduction was to render the space, we were sitting in. Both programs (or tutors) failed. There was problems getting the light into the space, and when it did, huge parts of the model got overexposed.

So we turned to form•Z's old, lowtech, standard light sources to see, how much light we could produce without using radiosity.

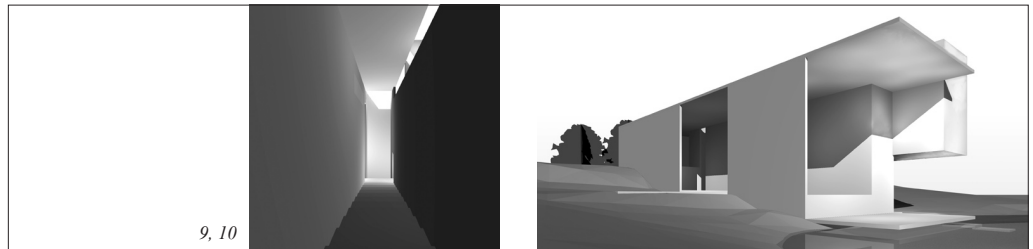


Figure 9 & 10
Rendering with simple light,
Neel Gøbel Andersen

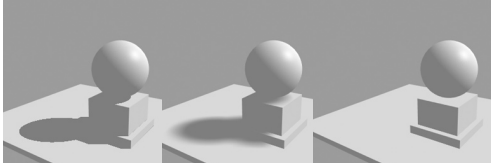


Figure 11a, 11b & 11c
Hard shadows
Soft shadows
No shadows

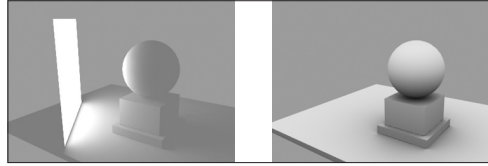


Figure 12a & 12b
Point light
Directional point light

The Tools

The basic light sources of a rendering system can very well be compared to different kinds of painting tools.

Parallel Light

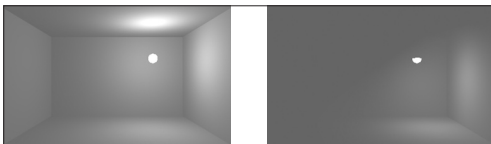
Parallel Light is used to simulate sunlight. It tones flat surfaces as if painted with a paint roller, while curved surfaces are nicely smoothed. It casts shadows, which can be hard or soft. A parallel light not casting shadows, can be used for toning surfaces in a model. se fig 11a, 11b, 11c

Point Light

Point lights shines in all directions, and it tones all surfaces in different shades. It can be used as a bulb, but its ability to accentuate the corners between surfaces makes it a good toner. Point lights can also be directional, and it can be compared to an airbrush. se fig 12a, 12b

Area Light

Area lights are the most advanced of the basic light sources. It is created by point lights placed on one or more surfaces. Area light can be made to create an illusion of the light coming from the sky. That can be created by placing a dome- or box-shaped area light around the model, but most systems includes a special light source for that, e.g. 'Global Illumina-



tion' or 'Atmospheric Light'. se fig 13a, 13b

Area Sun

An area light can also be used for creating a sun casting soft shadows. When a parallel light casts a soft shadow, the whole shadow is blurred, but using a huge, distant Area Light, you get a shadow, that is sharp near the object and gets softer by the distant. This is typical for shadows on a clouded day. se fig 14a, 14b

Ambient Light

Beside these 'physical' lights rendering works with the overall Ambient Light, which lights up all surfaces equally, and create a lighter image of less contrast. se fig 15

Painting with light

With these tools we developed a method, we called 'Painting With Light'. The different light sources are looked upon as painting tools, and our motto is tricks and cheats. The photographer and all his hidden lamps is our model, and our goal is not reality but vision and credibility.

Global Illumination

Global Illumination is the basic layer of paint, because its amassing ability to visualize 3d model. The building system bellow is rendered with Global

Figure 12a & 12b
Area light
Global Illumination

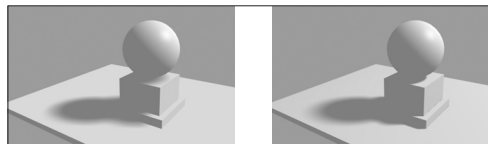


Figure 13a & 13b
Soft shadows form a Parallel Light
Soft shadows form an Area Sun

Figure 15

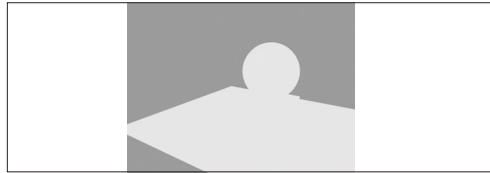
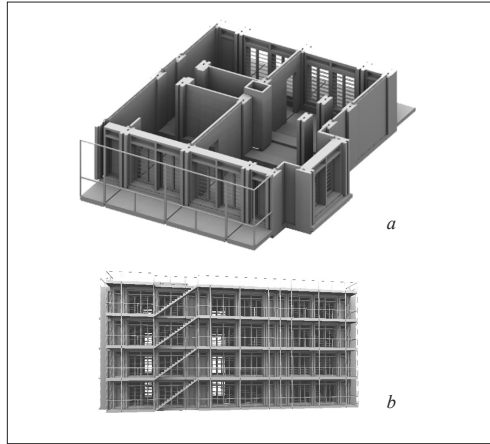


Figure 16a & 16b
Global Illumination. Building
system, Casper Gregersen

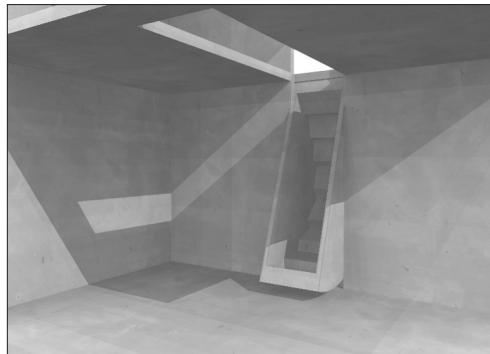


Illumination only. se fig 16a, 16b

Outdoor Rendering

Often Global Illumination and a Sun is all you need to make outdoor renderings. The next rendering easily compares to a very skilled hand drawing. se fig 17a, 17b, 17c

Figure 17a, 17b & 17c
Global Illumination,
Sun.
Majken Vilhelmsen



Indoor Rendering

Rendering indoor is more difficult, because most of the light is reflections. The next example is a favorite, because it is a lousy model, rendered with a simple light setting, but the result expresses the student's vision of his space.

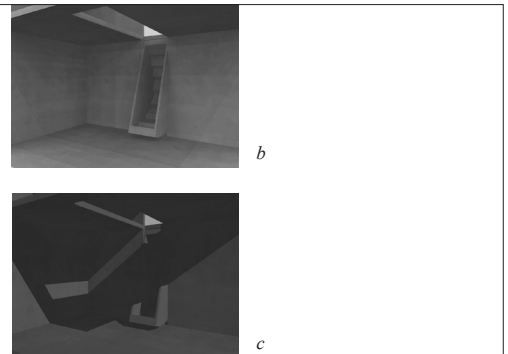
The light is pouring in though the huge panorama window. The sun is a shadow casting parallel light, while the light from the sky is an Area Light placed outside the window. The reflections from the floor is created by three directional point lights, not casting shadows. se fig 18a, 18b, 18c, 18d

Casa Gaspar

Our model of Gaspar House by Alberto Cambo Baeza was build in the beginning of the nineties with AutoCAD for our first experiments with rendering. It was chosen, because it is a building living by light, and you find beautiful photographs for comparing. It was used for our first experiments with form•Z's radiosity, and naturally it was chosen, when we started painting with light. se fig 19

The model is rendered with nine light sources. They are the basic Sun and Global Illumination, and the reflections form the walls are made by Area Lights casting shadows. On top of that the Ambient Light lightens up the entire rendering. On the image of the door, you see the subtle details on a very narrow grey scale. se fig 20a, 20b, 20c & 21

Casa Gaspar has been the topic for a rendering



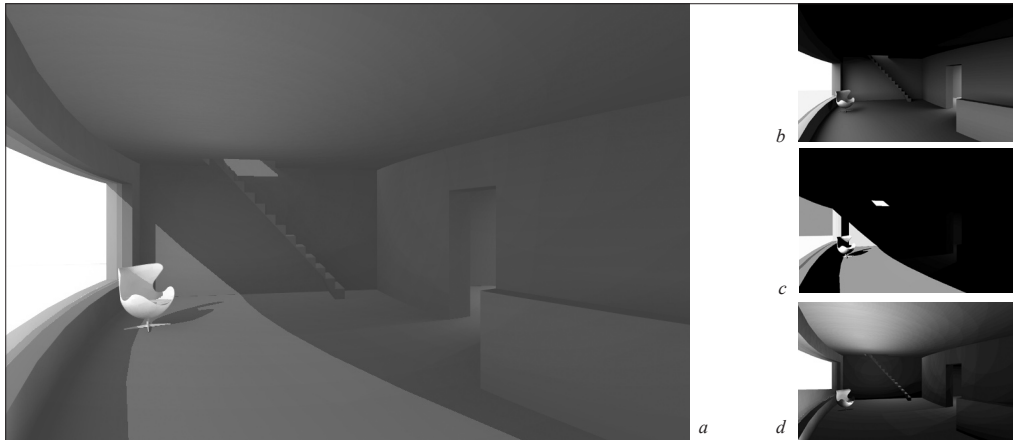


Figure 18a, 18b, 18c & 18d
Sky,
Sun,
Reflections.
Anders Kragh

competition on ‘www.cgarchitects.com’, and we find, that our rendering easily compares to the results on the website.

Balancing light

On the second year the students are supposed to bring a prebuild model, which they render in the practice period. The renderings below are from these courses. They all use Global Illumination and

several other light sources, and as you see, they are all nicely balanced. se fig 22, 23, 24

Time and Quality

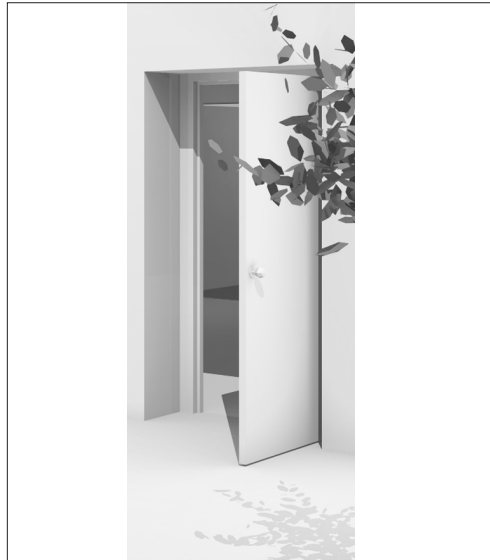
Balancing lights is a very time consuming process. Every time you change the intensity of one lights source, you have to rerender all the lights of the model. This takes a long time (hours, days). And that is a problem, because time becomes the deciding



Figure 19
form•Z, Radiosity

Figure 20a, 20b & 20c

Figure 21
Global Illumination + Sun
Reflection from ground



factor of the quality of the rendering. To solve this problem we have developed a method for balancing the light using Photoshop.

Setting Light Intensities with Photoshop

In the following example the lightning of a monument is manipulated with Photoshop. The starting point is a rendering with a single parallel light, Sun. The Sun is set to an intensity to 100%, and the material of the monument is set to a reflection, so that the rendering spans from black to white.

Using the Curve function of Photoshop the light in the image can be 'scaled'. In the below examples

the light of the original rendering has been scaled 50% and 200%. The results are virtually indistinguishable from renderings, where the intensity of the sun has been set to 50% and 200%. se fig 25a, 25b, 25c

Rules for Scaling

A rendering with millions of colors can show a scale of 256 shades of grey from black to white. Scaling the light with Curves will never give more shades than contained in the original. Both the scaled examples above only consist of 128 shades.

The rendering to the right is the monument rendered with a Sun of 5%, a very dark image of only 13 shades of gray. When scaled 20 times, the result will, as you can count, still consists 13 shades. As you see, there are limits for scaling. se fig 26

You can scale down, as much as you want, because you scale a lot of shades to fewer, the result will always be in the quality of the 256 greyscale. But scaling up will increase the steps between the shades, and if you do it too much, the steps will become visible. As a rule, you can scale down as much as you want, but do not scale up more than 200%.

Real time rendering with Photoshop

All renderer's dream is to render in real time. This dream can partly come true with Photoshop. Rendering can be looked upon as a two step process. First the lights sources of the model have to be decided and placed, and then they must be balanced.

Figure 22, 23 & 24
Maria Walther
Marthe Frey Eriksen
Charlotte Lykke Guldbaek



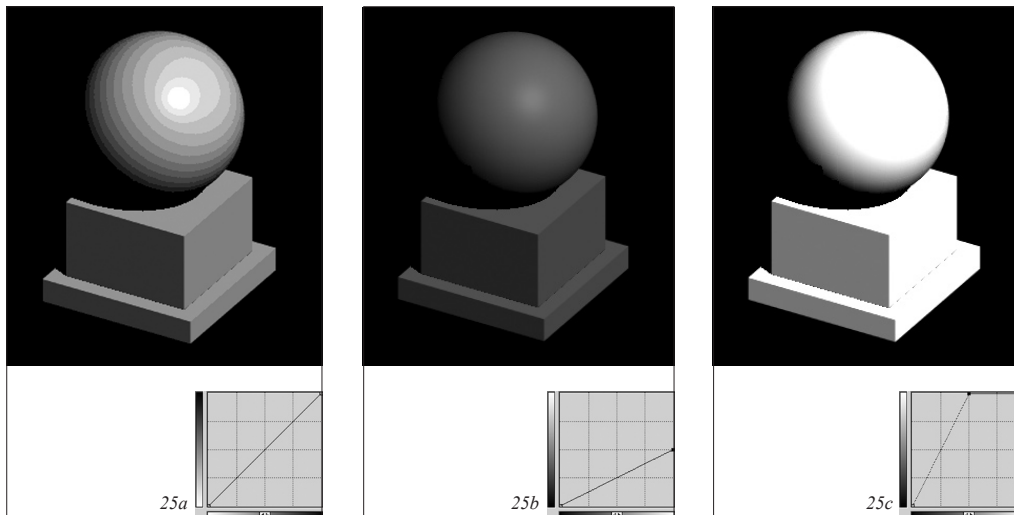


Figure 25a, 25b & 25c
Original rendering
Light scaled to 50%
Light scaled to 200%

The last and most time consuming step can be done with Photoshop.

Basic Renderings

The starting point is separate renderings of each light source. In the following example the monument is rendered with an Area Sun, a Global Illumination, and the Ambient Light. se fig 27a, 27b, 27c, 27d

Transparent Layers

When the basic renderings are made, they must be gathered as layers by copying and pasting them into one single Photoshop document.

Next all layers must be made transparent. In the Layer Style window you select Blending Mode: Linear Dodge. Linear Dodge makes an additional blend, which means, that a 30% grey put on top of a 40% creates a 70% grey. This is exactly the same as adding the lights in a rendering program.

Adjustment Layers

Then each layer must be grouped with a Curves Adjustment Layer. Activate each layer, and then select Layer/New Adjustment Layer/ Curves. Remember

to 'Group With Previous Layer' in the 'New Layer' window. The illustration shows the basic renderings and their Adjustments Layers.

Balancing Layers

Now you only have to double click a 'Curves Layer', pick the right handle of the curve, and move it along the edges of the coordinate system, and you are turning up and down the intensity of the light source. No rerendering, all in real time. Below you see the balanced monument. se fig 28a, 28b, 28c, 28d

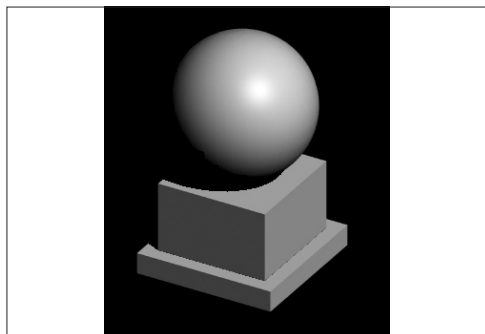
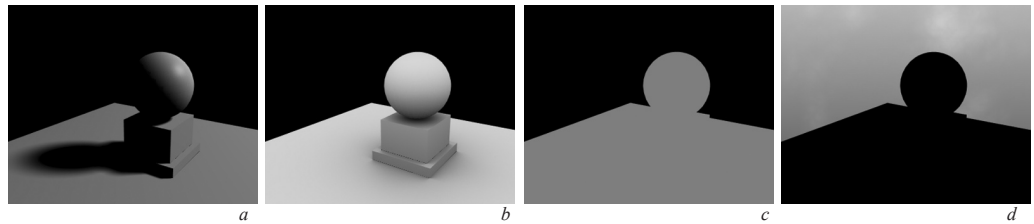


Figure 26
5% light scaled 20 times.

Figure 27a, 27b, 27c & 27d
Basic renderings: Sun, Global
Illumination, Ambient Light,
and Background.



Background

All the renderings have a black background. A background image can be added by rendering the model with no light and a background. se fig 29a, 29b, 29c

In this way you can balance lights and save a lot of time with Photoshop. And if you are a renderer, you should try it. The basic renderings can be quit sloppy. They must never be over exposed or extremely dark, but besides that every thing goes.

Calculating Back

When a rendering is balanced in Photoshop, it is quit easy to calculate the same light settings for the rendering program from the Curves settings in Photoshop. This can be useful for rendering of new views or making animations.

Layers and Materials

After having developed this method, we found out, that we were not the only ones working with rendering in layers. On the website www.3drender.com/jbirn/ea/Ant.html you will find a similar technic working with materials. Here the single properties of the materials are rendered one by one.

Studying light

Our department of light has played a central role in the development of the rendering course. Model photographs taken in their daylight laboratory has been compared to computer renderings, and their expertise has been indispensable for judging the credibility of our renderings. se fig 30

Our experiments shows, that the rendering programs are doing quite a good job, but we have not been able to recreate the light splashing from the spot of the sun, as you see it on the example 'Room with a Window. se fig 31

The Future

At this years second year courses we have chosen 3d Studio for rendering. It is a program we already have at the school, and it renders better and faster than Form•Z. We will still encourage the students to render in layers for Photoshop, and to use extra light sources where it is needed.

In the future we will work on integrating rendering with courses in light, freehand drawing and photographing.

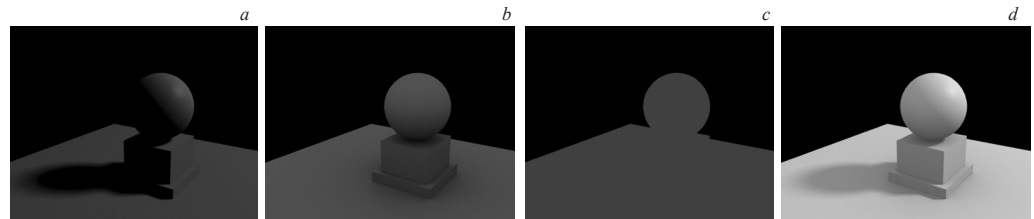


Figure 28a, 28b, 28c & 28d
Sun 50% + Global Illumina-
tion 38% + Ambient 50% =
Final Rendering.

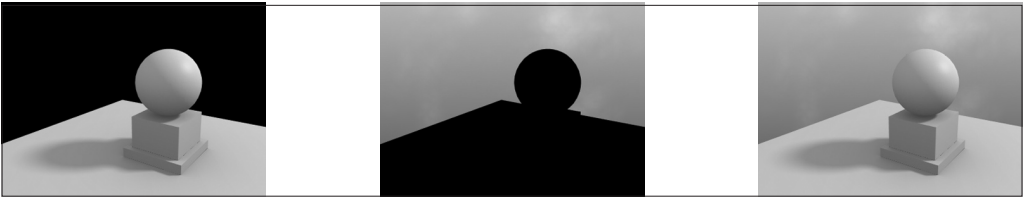
But our great ambition is to develop ways to render on different levels of abstraction, and make the students able to create renderings, that is more than real, as it has always been a tradition of architects.

This Paper

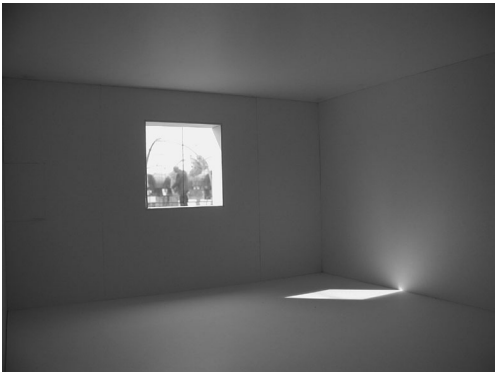
In this paper you have seen, how it is possible to make nice renderings with a simple rendering program. The method for balancing lights with Photoshop has dramatically increased the quality of our students renderings, as it is no more lack of time, that ends the balancing process.

It is our hope, that you can use our experiences in your own teaching. From the website www.karch.dk/Institut4 you can download all the illustrations of this paper, also the layered Photoshop files, so you quickly can start to experiment your self.

Niels Henrik Jensen



*Figure 29a, 29b & 29c
Rendering + Background*



*Figure 30 & 31
Global Illumination,
Room with a Window:
A Splash of Light.*