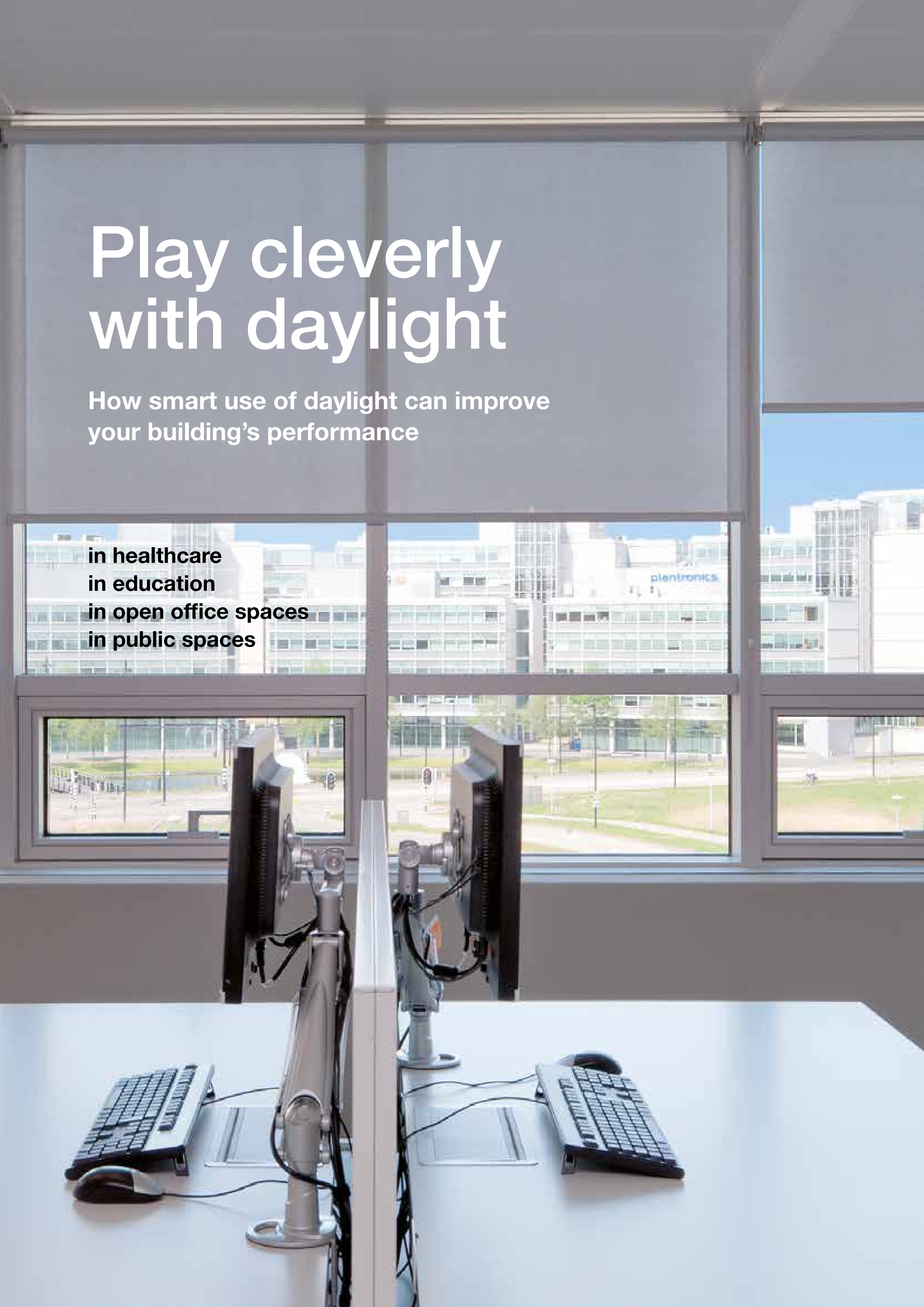
Play cleverly with daylight

How smart use of daylight can improve your building's performance

in healthcare
in education
in open office spaces
in public spaces



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I. Introduction

Sun and light control have a major positive influence on the balance and use of energy in a building as well as on improving (work) comfort. In this whitepaper we will explain how important daylight is to our wellbeing, how glass façades work and how effective solar and light control can contribute to the indoor climate and the sustainability of building interiors. Our conclusion: early incorporation of solar and light control in the conception of buildings will enable architects to increase the functionality of buildings without undue loss of aesthetic quality.

Huge savings potential

Buildings use almost 40 per cent of the total amount of primary energy (heating, cooling, hot water heating, fans, lighting and humidifying) consumed in Europe. In many offices, half of that energy is needed for cooling. This is why a large part of European building legislation not only targets the safety of the construction, but also deals with sustainability and energy efficiency. The potential savings are enormous: buildings that use 250 kWh/m^2a are not an exception, whereas current technology has brought numbers under 100 kWh/m^2 within reach. Some legislation raises the bar even higher, starting at 15 kWh/ m^2a. In fact, the Passiefhuis and Active Houses schemes take 15 kWh/m2a as the standard and the European Union is aiming for all buildings constructed from 2020 onward to have an energy consumption of almost zero. Blinds, together with glazing, window frames, walls, roofs and floors, are only one part of a building's envelope, but they have a significant influence on overall energy performance.

Sun and light control are broad terms and encompass all the techniques that reduce excess solar energy and light. These techniques vary from the use of shade produced by natural objects, such as trees, to fixed awnings, roller shutters and fully automated exterior and interior blinds. Effective solar and light control is always a matter of customisation. Light intensity and warmth vary according to geographic location and season and change constantly throughout the day. On top of that, several specific factors need to be taken into account, such as a building's position, the façade's orientation and the user's profile. Despite these many variables, it is possible to regulate incoming solar heat and light in such a way as to reduce a building's energy consumption as well as increasing the end user's comfort.

Project: Maison Communale Montigny-Le-Tilleul, Belgium | **Architect:** V+ & Bureau Bouwtechniek | **Product:** External Roller Blinds

II. The importance of daylight

Sunlight has a fundamental impact on architectural design. The challenge for architects is to use daylight in its purest form (see Text box 1 for a real example). Why? Daylight is good for us and has a positive impact on our well-being. People function better in a work environment with daylight and an outside view. Research [2] shows that both these factors lead to higher job satisfaction and that they also provide clear health benefits. Light is essential for synchronizing our biological clocks. All in all, daylight is by far the most sustainable and effective light source.

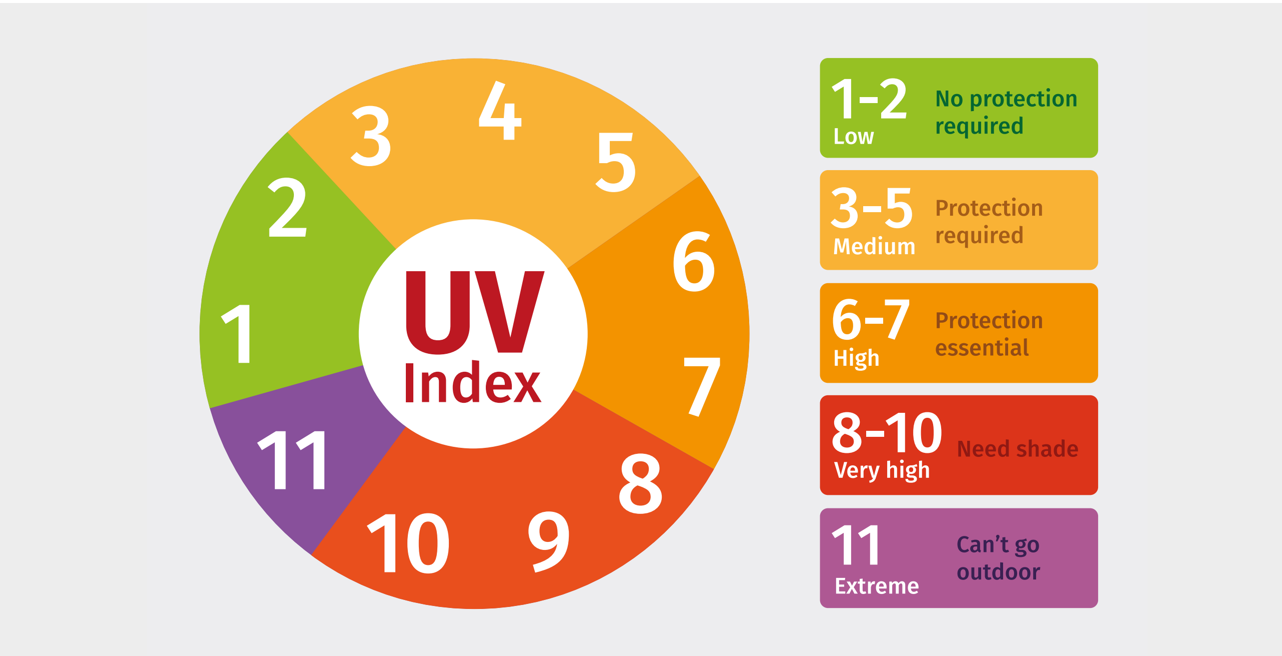
Solar radiation

Let's take a closer look at daylight first. Sunlight is made up of various kinds of radiation. These can be divided into three groups:

- Infrared: this is an invisible form of radiation with a longer wavelength than red light
- Visible light: a form of radiation that makes the world around us visible to our eyes
- Ultraviolet radiation (UV): like infrared, this is an invisible form of radiation with shorter wavelengths than violet light

Most of the sun's UV radiation is held back by the atmosphere that surrounds the earth. The ozone layer, especially, plays an important part in this. While the atmosphere works as a UV shield, it does not ward off all UV radiation.

- UV-A quite easily reaches the earth's surface and is the least harmful of the three types of UV. However, in higher dosages, UV-A can still lead to sunburn and skin cancer.
- UV-B is mostly held back by the atmosphere, but a good amount still sifts through to the surface when there is a cloudless sky. UV-B is the main cause of sunburn and skin cancer.
- UV-C is the strongest form of UV radiation, but it does not reach the earth's surface.



Background light: an evolutionary explanation
In a scientific study from 2008 [1] user satisfaction with the physical workplace was measured in 779 workplaces in nine different buildings. This study brought to light that a lack of daylight and outside views are two of the most important factors for dissatisfaction in the workplace.

Going inside normally involves a decrease in light intensity of a factor of approximately 100. If you consider the fact that since the Industrial Revolution man has spent most of his time indoors, it is unlikely that in the barely ten generations that have passed since the revolution our bodies have been able to completely adapt to this change. This explains why a lack of natural daylight in office spaces makes us feel uncomfortable. In fact, there are indications that the higher rate of near-sightedness among children in the West is linked to the far lower levels of light to which we are exposed nowadays.

In short, our bodies are not yet used to this low light intensity. In other words, we really do need daylight.

Daylight improves:

- Our quality of life, happiness and sense of well-being
- Our health (and healing)
- Concentration and ability to learn in educational institutions
- Our productivity and the profitability of enterprises
- (Social) safety
- Visitor numbers and buying behaviour in retail

Numerous studies also show that exposure to a low amount of ultraviolet (UV) radiation offers many additional health benefits, whereas overexposure to UV-B radiation can cause significant damage to our skin and eye tissue.

Biological clock
Daylight is also very important for our biological clock. A photoreceptor is a special type of neuron in the retina. It is able to convert light into nerve impulses. The two most well-known photoreceptors are the rods and cones, which are responsible for our eyesight. But there is a third type: the photosensitive ganglion cells. Their role is not yet entirely clear, but what we do know is that these cells stimulate the production of melatonin, a substance that is essential to a healthy sleep-wake schedule. Research shows that even blind people are affected by it.
A neurological study from 2013 [2] shows a strong correlation between sleep quality and exposure to daylight. Office workers who had a work space close to a window received 173 per cent more light during work hours than colleagues who sat further away from the window. The first group slept an average of 46 minutes longer every night. Office workers with less daylight also scored less in the areas of vitality, sleep quality, sleep efficiency and sleep disturbances.

Vitamin D
Daylight is important for the production of vitamin D, a vitamin in our skin that has an important role in regulating cell growth. Vitamin D deficiency causes bone-softening diseases, such as rickets among children and osteomalacia among adults. It also increases the risk of breast, prostate and ovarian cancers as well as diabetes and multiple sclerosis.

SAD
Seasonal Affective Disorder (SAD) is a form of depression tied to the seasons. It is also popularly known as autumn or winter depression, or spring fatigue. It is possible to combat this disorder with light therapy. Daylight helps prevent SAD and is used in treatment methods. About 5 per cent of the population suffers from SAD and this depression is more common among women than among men. SAD can be recognized by reduced interest in most activities, sleepiness, increased irritability and increased appetite. These symptoms usually disappear in summer. Although the precise cause is unclear, we know that exposure to bright light is often an effective treatment. This can be done with numerous light-giving products and even with special glasses. However, working near a window will provide at least as much light, which means daylight is also an effective remedy for SAD.

In a study from 2011 [3] the relationship between daylight, outside views and absenteeism was researched. Outside views and daylight combined explained a statistically significant 6.5 per cent variation in terms of lower absenteeism.

Figure 1
The renovation of a.s.r.: daylight and outside views

In the renovation of the a.s.r. offices in Utrecht, the Netherlands, daylight and outside views were important focus points. The shortcomings of the original building, erected in 1974, were evident: deep floors and high parapets meant that most workplaces had no natural light or outside views. During the renovation, extra daylight was brought in from above through open spaces in the office floors. As well as daylight, these vides provide a sense of spaciousness and contact between the floors, contributing to another objective: creating an open environment. The concrete guardrails have been replaced by a double glass façade from floor-to-ceiling, which acts as a ventilated cavity wall in summer, and in winter prevents excessive cooling as a heat buffer. In the orientation-dependant façade design, both blinds and screens were used to regulate glare and light pollution. Thus an office building was created that is light, transparent, spacious and sustainable, and that in 2014 was named the best office building in The Netherlands. In 2015 it was also nominated for the Golden Phoenix (Gulden Feniks) award.

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III. The pros and cons of glass façades

We spend more than 90 per cent of our lives indoors. That makes a healthy indoor climate very important. The World Health Organisation (WHO) estimates that in the EU 100,000 people die every year because of an unhealthy indoor climate caused by poor ventilation, a lack of natural light, and a lack of comfort related to cold and warmth (figures from 2012).

It is very important for our well-being that daylight reaches us through the building's façade. Glass plays a crucial role in this. But the benefits of glass façades in terms of energy and well-being are countered by disadvantages, too, such as glare and the risk of overheating. Let's take a look at the most important pros and cons.

Advantages
The advantages of glass façades can be sub-divided into non-energetic and energetic benefits.

Non-energetic benefits of glass (façades):

- Ensures daylight in buildings;
- Improves the spatial environment;
- Creates a visual connexion with the (natural) outside world;
- Can be used as a structural façade element and an aesthetic component.

The effects that daylight and outside views have during working, shopping or learning have been investigated in various studies.

The most important findings are:

- Cognitive test scores improved up to 20 per cent for people who in work office areas near daylight and an outside view;
- Reduced absenteeism in the new LEED Gold and Platinum offices of up to 39 hours annually per employee;
- An average improvement of up to 6 per cent in monthly retail sales in buildings with daylight;
- An increase of 21 per cent in test scores during one academic year for primary school students, in which they spent most of their school time in natural light;
- A decrease of 2.6 days in the number of recovery days spent in hospital for patients in sunny rooms;
- A large decrease in pain medication after surgery among patients staying in sunny rooms.

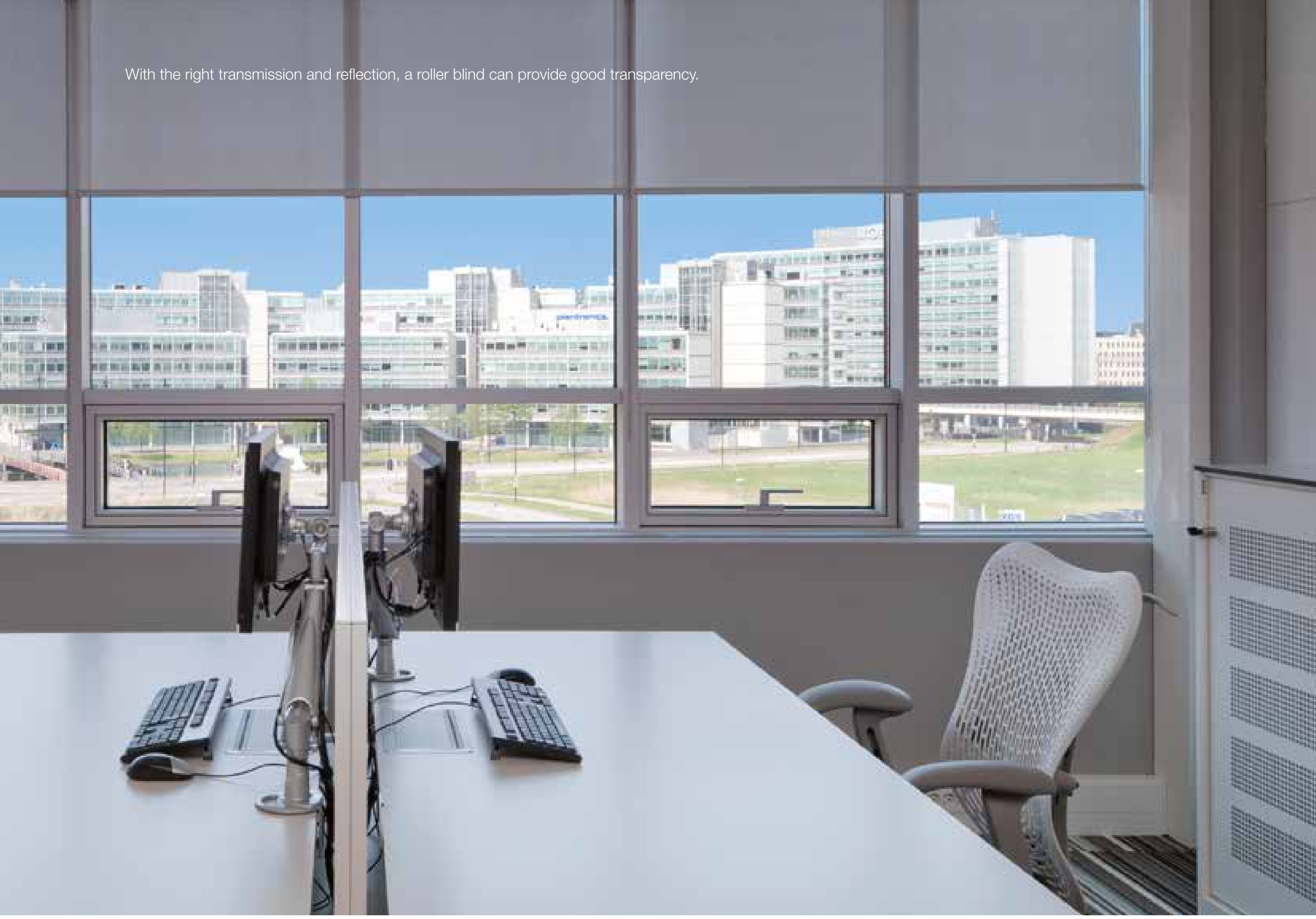
Energetic benefits of glass (façades):

- Saves energy by using solar heat (in winter);
- Saves energy by reducing the need for artificial light.

The downside of glass façades
Glass façades however, do have drawbacks, for the building's users as well as for its energy performance.

Too much daylight can lead to:

- Annoying reflections that make working (at computer screens) more difficult or even impossible;
- Heating up the building (in summer), which:
  - Impairs user comfort and productivity;
  - Requires energy for cooling down the building.



With the right transmission and reflection, a roller blind can provide good transparency.

How does a glass façade work?
Depending on the design, a façade consists of 40 to 60 per cent glass. In every building, daylight is necessary to create a pleasant environment, but in a well-insulated building, glass can be the weakest link from an energy standpoint. The Triple Glazing factsheet from the Lente-Akkoord, an joint initiative of Aedes, Bouwend Nederland, NEPROM, NVB and the Dutch Minister of the Interior aimed at realizing an energy reduction of 50 per cent in buildings constructed in 2015, has this to say about the subject: 'Even with HR++ glass, a window loses eight times as much warmth as a façade of the same size with an R-value of 5 m2 K/W. In order to achieve energy-neutral constructions, energy loss through the building's shell must be mitigated. The transparent parts cannot fall behind. In the last decades, the quality of glass has improved enormously and in the last few years triple glazing has gained ground in construction. This helps to further reduce energy loss.'

Buildings release a relatively high amount of heat via glass. On the other hand, transparent components allow (free) sunlight and warmth to enter the building. How much energy this represents depends mainly on the angle of the glass in relation to the sun. For a designer, the art lies in finding the balance between retaining warmth through maximum insulation (in winter), on the one hand, and blocking out heat (in summer) to prevent the building from overheating, on the other. To achieve this, the first option is blinds. A second option is to use coatings: a low-E coating to reflect the heat back into the building and solar control coatings to reflect the sun's heat. Glass coatings have a major influence on solar heat gain (g-value) and daylight (TI value) and these vary according to the type of glass used. In offices, we want the TI value to be as high as possible and the g-value as low as possible. This is because in offices cooling is the key issue: it costs more to cool down a building than to heat it. We call the relationship between the g-value and the TI value 'selectivity'. Ideally, we want glass

Project: TNT Headquarters Hoofddorp, The Netherlands | Architect: Paul de Ruiter | Product: Roller blinds

with a value higher than 2. This means its TI value is twice as high as the g-value. If this is the case, the glass in question is called high-selectivity glass.

As well as solar coatings, serigraphs can be applied to the glass to resist solar heat. Like the glass itself, these screens have a big impact on the design and offer no flexibility. Also, despite what you might expect, research has shown that the effect of serigraphed façades on reducing reflection, glare and dazzle is negligible. The Lente-Akkoord's conclusion: 'By applying a controllable light barrier, the end user can continuously adjust the daylight to a comfortable level. So adding (triple glazed) glass to a well-insulated building shell must be balanced with the overall energy concept.'

Visual comfort
Earlier, we mentioned one of the downsides of glass façades: light reflection. This brings us to the issue of 'visual comfort'. The reflection of light creates glare and unpleasant, sometimes even unworkable, conditions, especially for people working at a screen. The human eye is an extraordinary organ with a wide dynamic range that adapts rapidly to circumstances. At the beach, for example, we might read a book with an illuminance of 60,000 lux, while in an office, sitting at a computer, most people experience 3,000 lux (vertically exposed to the eye) as annoying (see Figure 2). In The Netherlands, a building's outside façade will typically receive between 70 and 80,000 lux. Depending on the glass and the distance to the wall (the deeper inside the building you are, the lower the intensity), light intensity at 2 to 3 meters from the inside of the façade is still 10 to 20,000 lux. When working at a screen, 2,000 lux is the maximum that can be experienced as comfortable. The aim for both indoor and outdoor awnings is to provide such visual comfort.

Energy savings

As we mentioned earlier, more daylight means we need less artificial lighting. Saving on artificial lighting can reduce excess heat and increase savings, if daylight controlled lighting is used. Around 30 to 40 per cent of an office's energy consumption comes from lighting. By linking the right autonomous systems to the blind system, it is possible to save up to 50 per cent of the energy used for artificial lighting.

Cooling is another area for potential energy savings. Reflective glass is not enough to achieve this. Achieving optimal working comfort and saving energy on climate control calls for solar and light control measures. Because the radiation energy that penetrates the glass is dynamic, the best results are achieved with a dynamic system.

A note on insulation

Finally: from what we have seen so far, we can conclude that reflective glass façades contribute to effectively insulating a building. The standards for wall, roof and floor insulation have been raised in recent years and improved detailing has made it increasingly possible to build air-tight. The downside of insulation is that in summer it prevents heat from escaping from buildings. Effective climate control and air conditioning systems are vital to any healthy building. This means merely applying reflective glass is not enough. Solar and light control are both closely linked to healthy (working) conditions in a building.

Figure 2

Lux and lumen

In the age of light bulbs, choosing a light source was usually all about getting the right wattage. Nowadays, light architecture involves light colour (kelvin), luminous flux (lumen), intensity (candela), illuminance (lux), brightness (cd/m^2) and colour rendering index (CRI). A lumen is used for the total luminous flux in a beam of light. In fact, lumen are watts weighed according to (photopic) eye sensitivity. A lux measures luminance emittance (also known as illuminance: lm/m^2) and takes into account the surface area over which the light is spread. A light source of 1,000 lumen, spread over 1 square meter, illuminates that square meter with 1,000 lux. The same 1,000 lumen, spread over 10 square meters, illuminates the area with only 100 lux. Luminance describes the brightness as we observe it with our eyes; it is measured in cd/m^2 (candela per m^2).

Figure 3

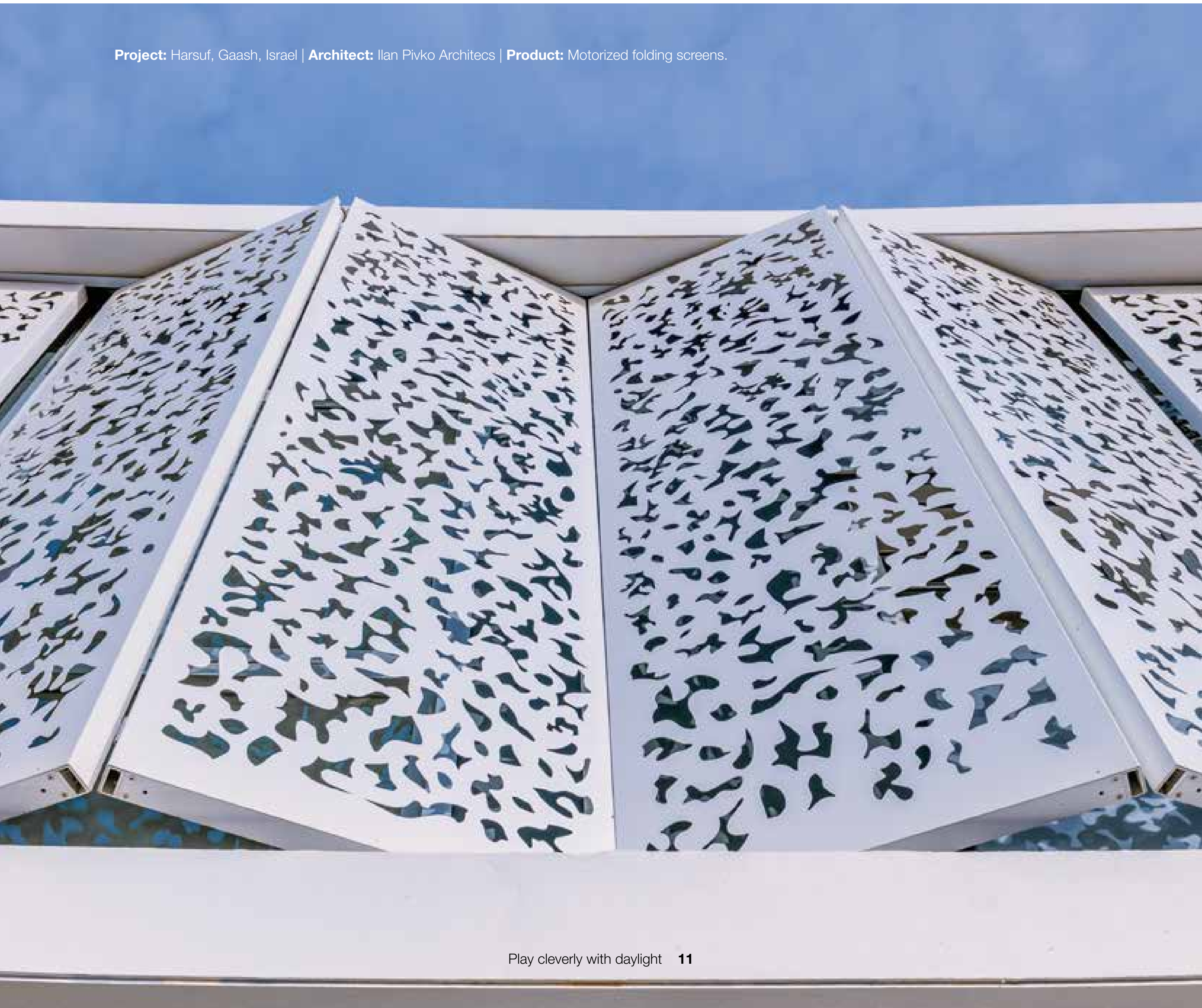
Never too much daylight

Exposure to too many UV-B rays is bad for our health. Inside buildings there is no possibility of this happening. Windows make up an average of 20 to 50 per cent of a building's wall surface and they block many of the UV-B rays. On top of that, window glass allows almost no UV-B rays through that are bad for your health. Protection against UV-B is often designated with a 'sun protection factor', like the ones depicted on sunscreen bottles (Sun Protection Factor: SPF). Clear float glass that is 6 millimetres thick offers the same amount of protection as SPF 30 sunscreen. Solar control coatings offer higher protection. Laminated glass reduces UV penetration to almost zero. So, harmful UV radiation in buildings is reduced to between 0.01 and 0.2 per cent of the levels outside – which corresponds to a protection factor between 500 and 10,000.

IV. Façade orientation

Façade orientation greatly influences our choice of how much glass, what type of glass and which blinds to use. In Europe, façades that face north receive the lowest level of solar radiation. Direct sunlight will only reach these façades early in the morning and late at night in summer. For façades that face east or west, the pattern is similar. Façades that face south receive the largest amount of radiation before noon, whereas façades facing west peak after noon. This applies to the direct and most intense forms of radiation. The rest of the day, facades facing east receive mainly diffuse sky radiation after noon, while façades facing west do so before noon.

South-facing façades are exposed in sunlight almost all day. That is why it is essential to increase the glass area of southern façades to maximize the amount of natural heat gained in winter (especially for residential buildings). At the same time, it is important to shield these façades from the sun during the summer in order to prevent overheating. The sun's position is lower during the winter than during the summer. So the amount of direct sunlight these façade receive during winter is higher than it is during the summer. Although the use of solar warmth is important during this time of the year, it is important to avoid glare for the comfort of the building's end users.



Project: Harsuf, Gaash, Israel | **Architect:** Ilan Pivko Architecs | **Product:** Motorized folding screens.

Preventing overheating

Not all (free) sun warmth that enters a building is usable. During the summertime a heat surplus can occur. This needs to be taken into account in building offices, and even more so in the design of buildings intended for more fragile people, like the elderly or the sick. Large glass areas facing east or west, particularly, create a real risk of overheating. The chances of overheating can be reduced by using (automatically controlled) windproof screens, blinds and shutters for exterior solar control. For glass facing south, the summer sun can effectively be blocked by adding permanent solar control in the form of deep overhangs. For façades facing north, blinds are not usually needed. However, light control remains essential here to ensure optimum working conditions, depending on how each work space is situated. Think, for example of, light reflected from nearby buildings.

None of the above solutions can be standardised. Achieving optimum thermal management and visual comfort depends on too many factors for that. For example, the downside of a deep overhang on a south-facing façade is that it takes away a lot of daylight. The amount of daylight that enters a space is linked to how high the glass is: the higher the light's entry the deeper it will penetrate the interior space. An overhang pushes this height outward, as it were, thereby also pushing back the daylight zone. In other words, a solid overhang may effectively prevent overheating,but it will also reduce the use of total daylight capacity. Also, an overhang does solve the problem of glare.

Figure 4

A study of the effects of shading

In a large study [1] by the European Solar-Shading Organization (ESSO) the positive effect of shading on the energy required for heating and cooling was further demonstrated. ESSO researched the heat and cool performance of office buildings in four different European climates (Brussels, Rome, Stockholm and Budapest) by using blinds combined with six types of glazing. Positive results were found in every case. Maximum energy savings on cooling were always found for south and southwest orientations. Assuming that the same amount of energy is required to heat and to cool a space, ESSO estimates the energy savings potential for dynamic shading systems at 30 and 14 per cent, respectively, for cooling and heating.

Exterior solar control turns out to be the most effective way to control the sun's heat and to lower indoor temperatures. Blinds are an effective form of warmth insulation and a way to control daylight, prevent glare and to ensure visual comfort for the building's users. An integrated outdoor and indoor solar control system is optimal for a combined solution aimed at cooling, heating and visual comfort, the ESSO concludes.

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V. Sun and light control

The primary function of solar light control is to create thermal comfort, an important factor in achieving a quality indoor environment and a feeling of well-being for a building's users. As more and more buildings are built with large areas of glass, developing strategies to improve light, reduce glare and regulate heat is essential to managing thermal comfort and saving energy. We examined these last two factors in detail in the previous chapter.

Types of radiation
When it comes to solar control it is important to block the sun's radiation from the solar spectrum – the wave lengths between 280 nm and 2500 nm.

These can be divided into:

- o UV rays;
- o Visible (between 380 and 780 nm) rays;
- o And short wavelength infrared rays.

To achieve adequate sun control, these factors must also be taken into account:

- Direct radiation, the solar radiation that is neither absorbed by the atmosphere nor reflected directly onto the façade;
- Diffuse radiation, the solar radiation that is distributed throughout the atmosphere and is sent out in every direction;
- Reflected radiation, the reflection from direct and diffuse radiation on the ground and surrounding areas.

Project: TNT Headquarters Hoofddorp, The Netherlands
Architect: Paul de Ruiter
Product: Roller blinds

Project: Grafisch Lyceum, Rotterdam, The Netherlands
Architect: Van den Berg Kruisheer Elffers Architecten
Product: Roller blinds

Exterior sun and light control

Designers, in general, have an aversion towards exterior sun control as it is seen to affect the façade's design. This is true, if designers fail to include the effects of sun and light on the interior in their design and blinds then have to be screwed onto the façade 'as an afterthought'.

Exterior blinds also require maintenance and are not always practical, for example, in strong winds, which (often) occur around high-rise buildings. On the other hand, it is also true that exterior blinds are easier to handle in terms of building physics. For instance, it is quite common to place external blinds in the cavity walls of double-skin façades: there, the blinds are more easily accessible and maintenance-friendly. When solar control is incorporated in a building's design, and sometimes even in a deliberately iconic fashion, it can actually be quite attractive (as well as practical).

Exterior sun and light control can be divided into:

- External Roller Blinds;
  - Standard roller blinds;
  - Wind-resistant ZIP screens;
- Shutters;
  - Sliding shutters;
  - Folding shutters;
  - Non-standard shutters;
- Slat systems;
  - Roll-formed panels;
  - Extruded panels;
  - Non-standard lattices;
- External Venetian Blinds (see Figure 5).

Figure 5

External Venetian Blinds

With venetian blinds, aluminium exterior blinds with horizontal panels, it is simple to regulate solar warmth and light very precisely. This contributes to a comfortable indoor climate. Given that the user can shut out heat, the interior temperature remains moderate. This means that less energy is needed to cool down a space like an office building, for example. Exterior venetian blinds are produced to be sustainable: the panels are made out of 70 to 80 per cent recycled aluminium. The panels are available in grey and brown shades, in wood tones, duo tones and frost colours. This type of outdoor blind was recently added to the office of oil company Statoil Fornebu in Norway, winner of the WAN Awards, in the 'Commercial' category.

Project: Statoil, Forneblu, Norway | **Architect:** a-lab (Arkitekturlaboratoriet AS) | **Product:** Exterior Venetian Blinds

Interior solar and light control

For those who do not want exterior blinds, there is a range of options for interior solar and light control. Solutions are available in various materials and qualities, both energy- and light-efficient, without compromising the façade's design. The advantages of interior sun and light control are that they are cheaper, offer greater flexibility in terms of design, colour, material and uses, have less impact on design, and are maintenance-friendly and wind- and weather-resistant.

Research on the effects of roller blinds, a widely used solution for interior sun and light control, shows that an effective roller blind reduces the penetrating warmth by 50 to 60 per cent. On top of that, most available roller blinds reduce entering light to less than 5 per cent. Heat and glare are blocked. At the same time, an important advantage of an effective blind is that it allows you to maintain visual contact with the outside environment, even it has been fully lowered.

Interior sun and light control can be divided into:

- Roller blinds
- Horizontal venetian blinds
- Plissé and Duette shades

BREEAM

Solar and light control are included in sustainability certification schemes like LEED and BREEAM. In The Netherlands, BREEAM sets requirements to combat light pollution based on EN 14501 Blinds and Shutters – Thermal and visual comfort – Evaluation of properties. This standard divides interior solar control into classes according to performance. A distinction is made according to the amount of direct and diffuse light a roller blind allows through. The classes are defined according to the effect on thermal and visual schemes, comfort (0 = very low impact, 4 = pronounced positive effect). BREEAM starts at classes 3 or 4, in which less than 5 per cent direct and less than 2 per cent diffuse light are considered the most comfortable levels. Darkly coloured shades or blinds with a reflective metal layer have no problem meeting this requirement. Effective venetian blinds also tend to meet BREEAM requirements.

Figure 6
Screen Nature Ultimetal

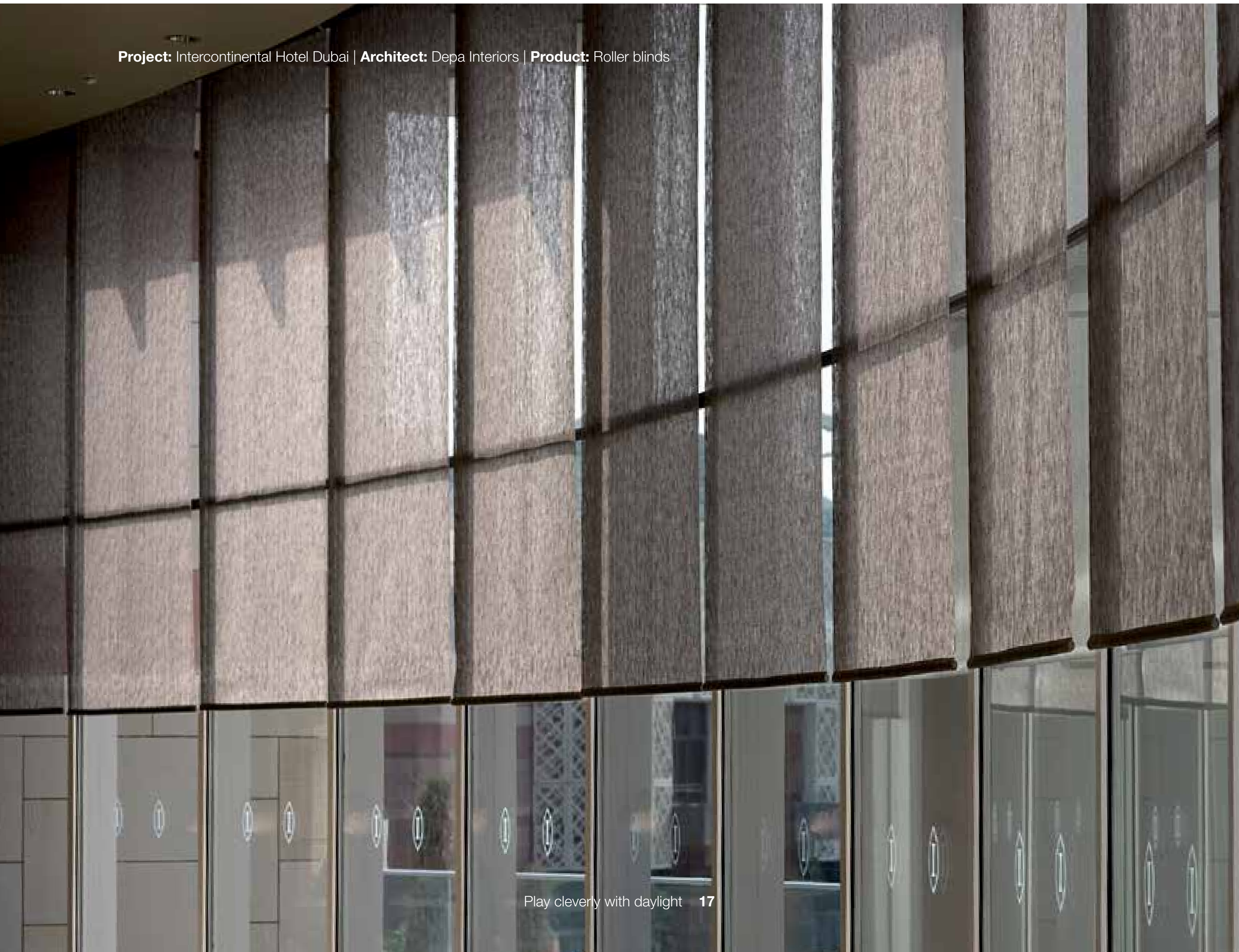
Screen Nature Ultimetal (SNU) interior sun control is a PVC-free fiberglass cloth for interior solar control that is Greenguard-certified. This new cloth combines very high visual and thermal comfort with excellent environmental performance and substantially lower power consumption. For an office space with a lot of glass the amount of energy needed for cooling can be reduced by about 25 per cent with this solution. Its excellent light and heat reflection halves the amount of solar heat that enters the building, so that in summer a much lower cooling capacity suffices. Made of fiberglass coated with a reflective aluminium layer, the fabric is non-flammable, PVC-free, odourless, free of toxic fumes and, above all, recyclable.

VI. In conclusion

Solar control is crucial to improving energy efficiency and managing daylight in existing buildings and in designing sustainable, energy-efficient new buildings. The fact that solar control has such a substantial impact on reducing a building's energy usage and on improving thermal and visual comfort for end users makes it all the more remarkable that light and heat resistance technologies are not yet applied far more widely than they are today.

Solar control enables us to adjust the properties of windows and façades weather conditions and user needs, without compromising on the aesthetic quality of the building and its facades. Effectively managing such systems enables building owners and managers to maximize natural heat gain in the winter, reduce the heat load of a building in the summer, while increasing user comfort. Applying sun control products does require knowledge of materials and products, though – from the ins and outs of solar transmission and light reflection to the influence both of these have on indoor environments and the (working) conditions in a building. Taking into consideration the characteristics of a building, its location and its façade orientation, architects and their advisors face the challenge of finding the perfect balance.

About the author
Marco Groothoff has been editor of Dutch technical journal Glas in Beeld for over 25 years and is also a freelance author.



Project: Intercontinental Hotel Dubai | **Architect:** Depa Interiors | **Product:** Roller blinds

VII. What you can do

After reading this information, you probably still have questions. For example, would you like to know more about the possibilities exterior and interior sun control can offer? Whatever your question, please feel free to contact your regular sun protection partner. Naturally, Hunter Douglas can also assist you with advice.

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WTCB.be
The different functions of sun control

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