

## *Back To The Roots Through Light*

Active Light – a holistic approach to the design of light solutions for active people's lives

**Daylight has reliably accompanied mankind since ancient time, a fact that continues to astonish. Intuitively, it promotes the natural rhythm of life and has characterised the development of our sense of vision. Light constantly gives us new images and releases emotions. It controls physical processes and influences our biological clock. Active Light uses natural light as a role model; it supports the elementary relationship of man and light dynamically in time and space. The uniqueness and the interaction of human beings, architecture and activities require different lighting moods over the passage of time, which Active Light achieves at suitable moments through changes in intensity, light colour and direction.**

### **The Three Levels Of Light Effect**

Light, natural daylight as well as artificial light, affects man at three levels. Purely visually, it supports our perception, emotionally it affects our mood and the biological effect is directly linked to all physical processes. Over a period of 24 hours, it is our subtle companion and fulfils diverse requirements of modern life in leisure and in the working world, in the outdoor and indoor space.

Daylight is the original source of light that has always shaped mankind since ancient times and with which he has an elementary connection. Not necessarily visible or perceptible, light with its many facets instead subconsciously influences how we experience the world, e.g. through changing intensities, directions of light or shade as well as light colours. However, in the industrialised world, people spend about 80 per cent of their day indoors, where the essential dynamics of natural light barely manage to make a mark. Over the last few years, technology has achieved important milestones in the production, distribution and control of light, thereby broadening the possibilities of artificial light planning in combination with daylight. "Active Light" by Zumtobel reveals this potential and takes into account the special relationship between man and light. Active Light uses natural light as a role model and brings the necessary dynamics of the light back into people's everyday lives. This is applied through changes of intensity, light colour and direction at the appropriate time, adapted to the respective activity.

The approach of Human Centric Lighting (HCL) is increasingly becoming the focus of light planning, which, in addition to visual and emotional building blocks, requires simultaneous examination of biologically active light. By being active outdoors, even on dark winter days, the body receives a high dose of light, which has a positive effect on the hormonal balance and all physical biochemical processes. The more time a person spends in closed rooms, the sooner his biological clock loses its natural rhythm, which can lead to poor sleep quality and health issues.<sup>1</sup> Biologically effective artificial light can support and activate people in indoor areas in addition to daylight.



The dynamics of daylight characterise human life. Active Light combines daylight and artificial light in a holistic approach to architecture and people. © Zumtobel



Active Light supports people at three levels - visually, emotionally and biologically. © Zumtobel

The extent to which well-being, emotional mood, and health are affected by light has seen a new dimension with the discovery of another type of receptor in the human eye.<sup>2</sup> Since the turn of the millennium, the light-sensitive ganglion cells on the retina, which contain the visual colouring substance melanopsin, have increasingly become the focus of light science. The melanopsin-containing ganglion cells have their highest sensitivity in the low-wavelength spectral range and are therefore considered as blue-sensitive. Against this background, it is even clearer that natural light plays a fundamental role for man and nature during the course of the day and throughout the year. However, the elementary relationship of man to light not only manifests itself in these physical contexts, which are increasingly taken into consideration with light solutions in the sense of Human Centric Lighting, but also in social behaviour.

Social psychologists at the University of Bretagne-Sud point out that the weather situation determines human behaviour. In the case of sunshine, we are more open to other people, have higher confidence and hand out our telephone number more quickly than on dreary rainy days. It is also interesting that in this study even a reference to possible good weather for the following days influenced the amount of money given as a tip.<sup>3</sup> Sunshine or rain therefore influences human social behaviour and the personal handling of money.

#### **The Four Dimensions Of Light**

Compared to widely used artificial light solutions, natural light changes constantly and exhibits a variety of intensities, light directions and light colours. Some variations are obvious, like the change between sun and clouds or the change over the course of the seasons. Others, on the other hand, are not necessarily consciously felt, not least due to the influence on body functions by the aforementioned melanopsin ganglion cells of great importance for humans and their well-being.

Therefore the Active Light approach distinguishes four dimensions of light: Intensity, direction, colour, and time.

- The position of the sun in nature mainly determines the light intensity or strength, the reflected light of the moon, but also the weather in the year, month and day.
- The direction of light is also directly influenced by the position of the sun and the clouds. It has always been a key factor in the selection of location and design of the man-made environment. In addition, the interplay of light and clouds creates shadings that provide varied and pleasant moods as well as orientation.
- Throughout the day, the natural light changes its light colour or colour spectrum. Through its non-visual system, the human body registers these subtle nuances and responds accordingly, e.g. with the

release of the sleep hormone melatonin. Towards the middle of the day, when the sun is at its highest point, the cooler colour temperatures from the blue range are mixed into the spectrum and the light gets an activating effect. In the afternoon, towards the evening, warmer colour temperatures dominate with a calming effect.

A Zumtobel study in cooperation with the Fraunhofer Institute shows that there are also different preferences in the light colour due to age, working time and individual needs.<sup>4</sup>

- Over 24 hours, light is our subtle companion. From its change throughout the day and night, natural phases of activity and recreation occur. Although the life and work style of modern man has changed dramatically over the past 50 years, the circadian rhythm, i.e. man's "biological clock" is still primarily controlled by its original light source - the sun and its dynamics.

### **Active Light Links Us Back To Our Roots**

Even if today's society is probably the best networked of all time; people are increasingly losing contact to their biological clock. According to nature, every human being is an individual and brings different individual and personal prerequisites to adapt his organism to new conditions. There are, for example, different compensators, such as late or early types that are able to cope with the temporal and social requirements to a better or worse extent.<sup>5</sup>

Many lighting designers who, in addition to the normative approach, pose an architectural challenge in the focus of their work, are not always aware of the effects of light on man. And so supposedly well-functioning buildings with outstanding design elements are handed over to users. Good architecture and lighting design, however, is characterised by the fact that man and his constantly changing living and working conditions are reflected in it. Active Light solutions focus on human centric lighting. They transfer spaces from static passive to a dynamic active state.

With dynamic lighting, Active Light supports contrasting space moods: In this way, the same space can be staged openly or privately for the perception of man. The room atmosphere moves solely by the change of light between cold-sober and warm-habitable character. Bright working light forms the contrast to the muted candlelight mood. The association with a fireplace already had a highly emotional and social function for our ancestors. Light design can release these natural emotions. People come together as before, and are supported in their joint creative work. Perhaps, thanks to the meeting place "fireplace", creativity is attributed to dimmed light.<sup>6</sup>

Over the past few years, technological milestones in light generation, distribution and control have also expanded the possibilities for artificial light planning. Artificial light has achieved a new degree of design, which allows the requirements of man, space and time to be combined through - the intangible element - light. Different visual tasks or visual perceptions of the user, as well as the individual preferences depending on the time of day or weather, or the changing work and space requirements, constantly define the requirements for artificial light. With dynamics adapted to the needs, artificial light makes a valuable contribution to stabilizing the natural biorhythm of humans, especially in low-light environments.

The dynamics of natural light are determined by means of technologies such as tunableWhite from Zumtobel, which allows continuous variation of intensity and light colour from warm-reddish to cold-bluish during the day, brought back indoors. Such technology, in combination with the appropriate luminaires and the most modern control system and sensors, provide the user with the right light at the right time in the right intensity. In addition, he has the possibility to adapt the lighting situation to his needs. This has a significant influence on the assessment and acceptance of a light solution.<sup>7</sup>

The positive effect of nature can never be completely replaced by technology. Nevertheless, a study on the effect of artificially created natural scenes suggests a positive effect. The subjects without daylight influence indicated that they found the landscape images in their work environment as pleasant. In addition, the assessed quality of working time and productivity improved.<sup>8</sup> Also, the neuroscientist, Colin Ellard, describes positive results in his book "Places of the Heart" when nature is simulated by technology.<sup>9</sup>

### **Active Light In Practical Application**

Active Light is based on natural daylight, it does not compete with it, but instead works with it - and complements it as required. The human being and his needs are always the focus of attention, but depending on the application, the main focus of Active Light varies.

### **Active Light In The Office – Creating Light Creates Inspiration**

If light in the office is understood as a holistic lighting ecosystem, Zumtobel believes that it is in a position to ensure more comfort amongst employees. In light intensity, different work and vision tasks and individual vision play a decisive role, in addition to the basic planning variables and standards.

Against the background of the fact that light also affects humans at a biological level, the problem discussed here becomes clear with today's

usual office lighting: Contrary to sunlight, which varies its intensity and colour temperature throughout the day, artificial light is static and its illumination intensity is usually about 500 lux and a colour temperature of 4000 Kelvin.

In addition, the global user study by Zumtobel and the Fraunhofer IAO on the perceived light quality in the office showed that there are not only different preferences in the light colour, but that the standard lighting intensity of 500 lux is perceived as too low in the workplace and there are too few possibilities for intervention to influence the light situation as a user.<sup>10</sup>

Active Light follows the principles of Human Centric Lighting and brings the dynamics of natural light back to the office day. With rather cold white light moods to the middle of the day and early afternoon and with warmer lighting moods in a lower intensity towards the evening, it supports a person and his biorhythm. The increasing consumption of LED light via television or other electronic devices during the evening hours can have a counter-productive effect. As a result, the human being is exposed to a too high, activating light dose at the wrong time of the day. Sleep consequently suffers.<sup>11</sup>

Zumtobel provides lighting solutions through Active Light for specific lighting conditions in the office so that the user can make use of individual control options as far as possible, depending on the task and individual preference, and he is able to work with a lighting intensity of up to 800 lux. The right light at the right time also has a positive influence on the cognitive performance and therefore on the creativity of the human being.<sup>12</sup>

#### **Active Light In Industry – Creating Light Creates Precision**

Active Light makes industrial employees even more focused and integrates activity-based lighting. Based on the knowledge about the biological effect of light, the employees are supported by the temporal adaptation of the intensities, also in connection with the light colour. The result of a field study on changing spatial light in relation to the productivity of permanent morning shift workers at an industrial workplace indicates that a variable spatial lighting that exceeds the standard illumination is positive on humans both during the early shift and at night.<sup>13</sup> In this way, Active Light can make a valuable contribution, especially to shift workers, for an adapted synchronisation of their sleep-wake rhythm and consequently for a regenerative sleep. Intelligent lighting control systems and innovative sensors also allow that through the number and location of the persons, their frequency and movement patterns, the right lighting scenario is provided for the respective activity and therefore safety, precision and quality is promoted.



Active Light provides light in the right intensity and colour at the right time. For this purpose, the natural light and its dynamics are modelled throughout the day and thereby support the natural organic rhythm in the spirit of Human Centric Lighting. © Zumtobel

"The objective is to provide the right light at all times: If one bends over the product at short notice during a delicate assembly step, additional light from the side is added to assist. If a visual inspection is carried out after assembly, the light intensity is increased for the duration of the task. In order to assist the day-night rhythm and for a regenerative sleep, the light in the last hours of the late shift is reflected in a warmer light colour, with a clearly reduced blue content. Depending on the age of the employees, the lighting corrects the age-dependent cloudiness of the eye," explains Tobias Strölin from Fraunhofer IAO.<sup>14</sup>

#### **Active Light For Shop & Retail – Creating Light Creates Emotion**

Together with the Gruppe Nymphenburg, Zumtobel carried out the laboratory and field study "Limbic®-Lighting",<sup>15</sup> which captures the emotional responses of different personality types to specific light scenarios. Active Light integrates the insights gained from the Zumtobel study, in order to provide the customer with the preferred light mood and, on the other hand, to present brands and products in the best possible way. At an emotional level, Active Light creates a light mood that positively affects well-being and thus also the length of stay in the business. At a visual level, Active Light provides a targeted approach through orientation and variation of luminance intensity with respect to space and time.<sup>16</sup> Shadows resulting from the change in the light direction create a skilful dramaturgy in the production of the products. In addition, Active Light concepts based on dynamic light colours, adapted to the respective product, improve the quality assessment. With high-quality architecture and attractive goods presentation, not only does the willingness to purchase increase, but also the acceptance of higher prices.

#### **Active Light For Art and Culture – Creating Light Creates Imagination**

In the area of art and culture, the focus is on unrestricted art appreciation as well as the protection and preservation of the works of art. The materials that are often very sensitive to environmental influences, in particular light, require careful illumination, which, at the same time ensures optimum viewing comfort for the viewer and gives the person an authentic experience.

Active Light in art and culture takes into account all the conservative and visual aspects and reconciles them with the movement patterns of the visitor in space and time. Technologies such as tunableWhite are not only able to vary the colour of the day with the day, but they can also match the materialisation, art form, and the working technique of the artist. Finally, the artists' messages are not only characterised by the choice of colour, but also by the history of the work, place, daylight or artificial light and the like. Specifically, different light colours or



The ATIVO contrast sensor integrates existing daylight, keeps the defined light level constant and detects moving objects. The greatest strength lies in the free layout of the rectangular detection zones, up to five for each sensor. © Zumtobel



1.



2.



3.

During the Limbic® Lighting study, it was possible to filter out three light scenarios: BALANCE (left) with moderate accent lighting, STIMULANCE (centre) with contrasts, creates different spots by accent lighting, and DOMINANCE (right) with homogeneous light effects.

spectral distributions are necessary to show the effect of a work in its entirety. A specific luminaire type cannot generally cover such a wide band of variation. Active Light uses identical tunableWhite lights and state-of-the-art control technology so that a wide range of light can be matched to each object individually.

### **Active Light Outdoors – Creating Light Creates Interaction**

Dynamic lighting moods adapt to the movement and behavioural patterns of people during different dark phases at night. This is possible with a flexible lighting solution, which operates on several levels. Human Scale Lighting by Zumtobel gives the means to provide public spaces with more radiance, thereby strengthening their attractiveness and identification with them. The impact on the night ecosystem remains at a minimum since an Active Light solution harmonises all the three levels of light (visual, biological and emotional). If the users of an outdoor space are integrated in the planning, a lighting solution is created that serves both human beings and the environment alike. This improves the sense of security, orientation and quality of stay in public areas. The light also has a social dimension as it promotes the communication and interaction of people.

### **Active Light As A Connection Between Man And Architecture**

With Active Light, Zumtobel has formulated a visionary objective: "Creating Light Creates Life". The dynamic artificial light is based on the naturally given, elementary relationship between man and light in all spheres of life. With the help of state-of-the-art technology, Active Light offers the possibilities to dynamically reconcile the original needs of people with the requirements of modern life. The interaction of nature, people and technology sets the course for new light-planning and architectural approaches with a holistic aspiration.



The modular lighting family SUPERSYSTEM OUTDOOR gives light fresh charm. A new examination of vertical and horizontal surfaces of the outdoor space is carried out by means of the multizonal light distribution with swivelling tubes. © Zumtobel



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