

WHITEPAPER

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WORKPLACE LIGHTING

How much light at the workplace is required for biological effects?

Why you might not be interested in the topic of „Healthy Light“

While we are discussing here the activating effects of light, better sleep and higher efficiency, you would probably be happy to be able to see and read everything at your workplace without making an effort or craning your neck. Every year in spring, there comes the moment when we ask ourselves if it is the light or our eyesight which has become worse. Probably both. And now?

We show you how you can find out quickly if you have enough light at your workplace and how - if it's too little - you can maximise light with a few small changes for better results.

„Miriam Döhner, HCL-expert at Planlicht, recommends staying as close as possible to the natural light curve and not to use short-term „boosters“. Only in the morning a higher blue-content than in the natural daylight would help when the respective receptors in the eye are most active and the discrepancy between natural brightness is vast: 10,000 lux of natural light outdoors should rather be met with higher illumination levels indoors than the required 500 lux for workplaces - ideal would be appr. 1,200 lux. [...] According to Miriam Döhner the worker should have the possibility to adjust the light in order to feel more independently. They would need a special training to understand there might be some negative effects from a short-time activation of blue light during the evening hours. From an energetic point of view the projects showed the individual change is only effective for an hour. (Juliane Brau for "LICHT")

Light at the workplace

Our approach at PLANLICHT towards human centric lighting is a combination of the current standards, the results of light therapy and our own experiences. Studies, recommendations and current standards regarding the topic light in the office and light at the workplace respect the rules for a healthy architectural light planning. All this depends on the personal perception of the individual. Health and safety regulations for the workplace, when it comes to glare and eye safety.

Our experience from projects like the office building Omicron in Vorarlberg, Austria, are included into our designs and plans. From which level on is light effective? How can this be applied? Which results can be expected? Psychological light therapy carries out research on all these topics and the results are the basis for the design of our projects. So, the question is always the same and, indeed, might sound rather simple: „What would you recommend now for the office or for the workplace?“

However, the answer is not so simple. Our recommendation should be a realistic and feasible one, shouldn't it? We - and probably many of you too - would prefer that the offices would be flooded with natural light, like the roof terrace of our office, but without any distracting reflections on the screens. We would like no glare and no wind, please! To reconstruct these conditions with artificial light, we would need 10,000 lux on cloudy days, from each direction, like under the open sky but still glare-free. When the sun is shining an additional beam of light with higher intensity should be added. Voilà!

This is not possible. So much light inside a room would not only be very expensive but also quite exhausting. Since our eyes cannot roam freely while we are working at our desk like they could outdoors, they have to focus rather on short distances which is quite tiring for the eyes. Light should provide the right atmosphere for the eyes to relax.

However, how much light is now too little, enough or a lot? The standard requires 500 lux. This is then a well illuminated office. And we have gotten used to interpret the standard as if it would be a recommendation. It is rather a minimum requirement that a recommendation showing us the absolute minimum necessary. Or maximum levels. Especially when it comes to illuminating an office, the norm should not state „it shall not be under 500 lux“ rather than indicating „levels of illumination should be between 500 and 2,000 lux“ In this case nobody would opt for 500 lux. Same rule, different phrasing. However, this is exactly what is happening at the moment: we opt for minimum standards.

What would we recommend for an office then? Well, first of all we should stop with planning while sticking to the minimum standards. Dear building owners, would you really like to have only the minimum standard?

How to illuminate a workplace?

1. Adieu minimum standard. 500 lux are (in most cases) not enough

When revising the EN 12464 standard the last time, the focus was on energy efficiency and reducing costs. Cheaper light. That is what we have now and what follows is a counter-movement: better light. That, in the end, better light has to be energy efficient nevertheless is without question. According to new recommendations, workers older than 32 years require for each year 1% more light. As an example, when you are 60 years old you require almost double the light than recommended by the standard. At least 1,000 lux.

2. Illuminate according to tasks

Not the entire ceiling has to be full of luminaires to reach the recommended average illumination everywhere. Depending on the furniture and work tasks areas with 150 lux, 300 lux, 500 lux and 750 lux are planned. We can save energy due to this area-related illumination according on the work tasks, areas and partial surface illumination.

3. Wide-area illumination takes effect

Studies have showed 500 to 1,500 lux are sufficient if a wide-area illumination reaches a high number of the retinal receptors. Additionally, if the light spectre is similar to daylight and varies the light temperature according to the daytime, individuals experience the illuminations as more pleasing to the eye and it fulfils its biological purpose.” (Oliver Stefani for LightWork)

Do not forget the vertical surfaces! For monitor-based workplaces and desks the ratio 1:3 has proven to be most efficient (the wall has one third of the brightness compared to the working surface). We are talking about the luminance values which also depend strongly on surfaces and materials. A ratio from 1:2 up to 1:5 is also acceptable. The light on the walls and vertical surfaces (cupboards, etc.) adds up to a consistent illumination of the whole room, the room in general seems brighter and high illumination levels are considered less bright. Via the big illuminating areas many retinal receptors can be activated. The receptors for the biological, non-visual effects are situated in the lower part of our eyes and in the periphery and therefore activated by large overhead illuminating areas like the sky.

Applied in daily life

Which luminance value corresponds with the biological needs? In one of our projects - an office building in Vorarlberg - we were fortunate to have the possibility to carry out a sampling study. We were equipping the sample rooms with luminaires to enable a maximum of 2,000 lux and the employees should test various lighting scenarios to find out which one they prefer and suits them best.

We combined room lighting and wall illumination in order to enable that all luminaires turn darker at the same time when dimmed. In this way the brightness-ratio of wall and working area stayed the same. The employees worked in the sample rooms for several weeks and tested everything, changed the setting like they wanted and decided at the end of the test phase which lighting should finally be applied to the complete building. The result was that the preferred lighting intensity which was most comfortable to read at is 1,350 lux. This is not surprising when the norm is not read as a minimum standard. The automatic change of daylight is activating in the morning with a cooler light and transforms in the course of the day into a golden tone in the evening. Employees experience this change as pleasant and energizing. The artificial lighting programme is adapted to the natural change of attention and concentration during the day.

Light therapy

„During light therapy a patient is exposed to a minimum of 2,500 lux, even better would be 10,000 lux, and this daily over the period of a week or longer; best would be 30 to 40 minutes in the morning. In Central Europe even on a cloudy winter day a walk during the day offers sufficient light and additionally also exercise and fresh air.“ (edicine Commission of the German Medical Association, German: Arzneimittelkommission der deutschen Ärzteschaft, short AkdÄ)

Now we all should do is go out there and breath in the fresh air. For most employees a work day in winter rather looks like this: In the dark they walk to the car, drive to the company, walk inside and in the evening the same way back, also in the dark. They receive a dose of daylight only at weekends. To have more light in the office or at the workbench doesn't seem like a bad idea then. Since it's the dose that counts (or more precise: the number of photons which reach the retina) the illumination from the light therapeutic point of view does not need to be 10,000 lux and neither is it required to be consumed within half an hour. 1,250 lux over a period of two hours fulfils the same purpose.

Contrast is glare

If there is a minimum level for illumination, there has to be a maximum level. When is it too much light at the workplace? Easy: When it causes glare. Glare depends in many cases from the contrast, also from the background. Even illumination is experienced as less glaring than one rich in contrast, when very light and very dark surfaces alternate. In any way, high doses of light should be transmitted via evenly illuminated surfaces or from even light-surfaces. To calculate the glare effect, the UGR-method (unified glare rating) was introduced. In DIN 5035 part 1 standard a maximum average brightness of 500 cd/m² was set, when accordingly the glare effect should be limited to a UGR-value of 19.

„Against wide-spread believe the UGR-value is not a mere characteristic of luminaire. It is rather a combination of the »brightness level« of the lighting surface of a luminaire in ratio to the »brightness level« of the surrounding, the viewers perspective as well as the line of vision of the viewer.“
(Klaus Bieckmann for DIAL)

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