

$$W_{\text{light}} = ((465 \times 0,93) \times ((1800 \times 0,43 \times 0,75) + (200 \times 0,75))) / 1000 = 315,9$$

$$W_{\text{parasitic}} = ((5 \times 6760) + (100 \times 100)) / 1000 = 33,8$$

$$W_{\text{total}} = 315,9 + 33,8 = 349,7$$

PEDAGOGICS OF LIGHT

We know how to stimulate learning



FAGERHULT



The earth is as flat as a pancake.

Being right-handed is better than left.

We can't afford new lighting.



Old truths are there to be proved wrong, not least in the world of education. At Fagerhult we concentrate on just one area and when it comes to light we have a few important lessons that we would like to share. The right lighting makes pupils feel more alert and cheerful, and produces better results. New lighting produces better

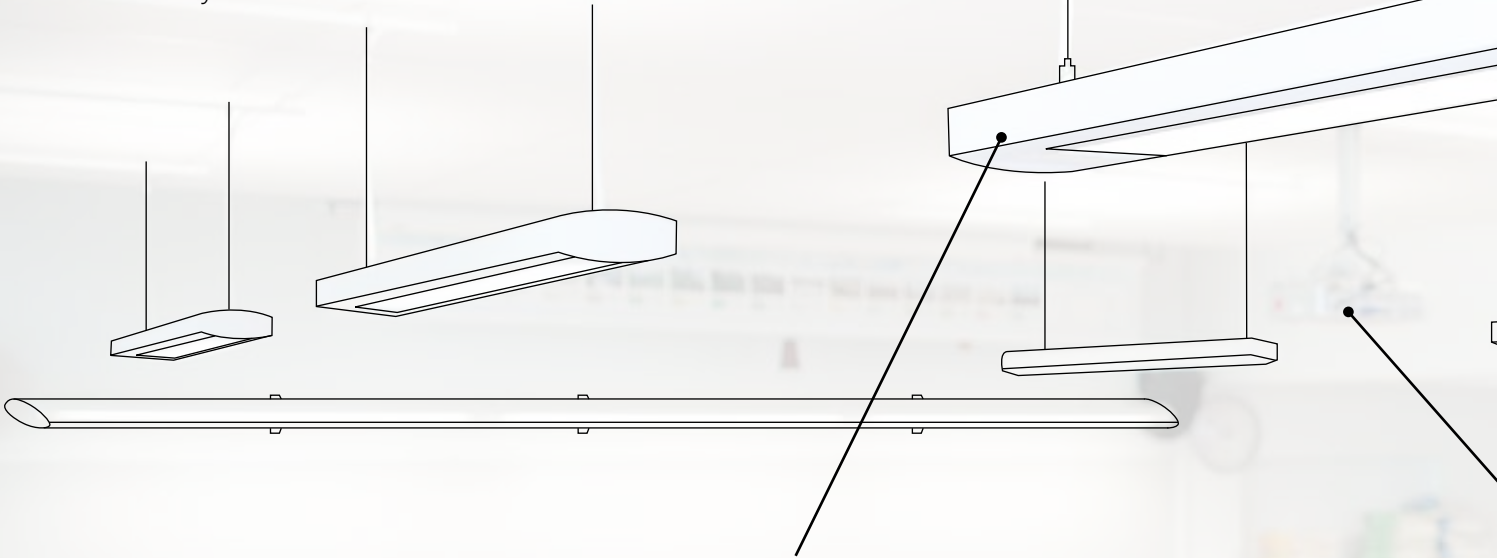
light, without costing any more, and it doesn't even have to be complicated. Wireless e-Sense Connect is an innovative, smart system that both children and adults can understand. Intuitive controls and quick installation mean you'll have your new creative learning space in no time.

Can you see the creativity?

Academic premises are a place of work. Not only for the students and teachers but also for the caretaker, the cleaner and the electrician. Welcome to the classroom where work is easier – for everyone.

Bright ceiling

Indirect light on the ceiling, 300 lx, provides good ambient light and students who are more alert and perform better.



Light on the whiteboard

Good lighting of the whiteboard that has been developed for the purpose, 500 lx.

Radio-controlled dimming

Fagerhult wireless e-Sense Connect can be installed without cabling during a "free period". An economical installation with a ceiling that is undamaged.

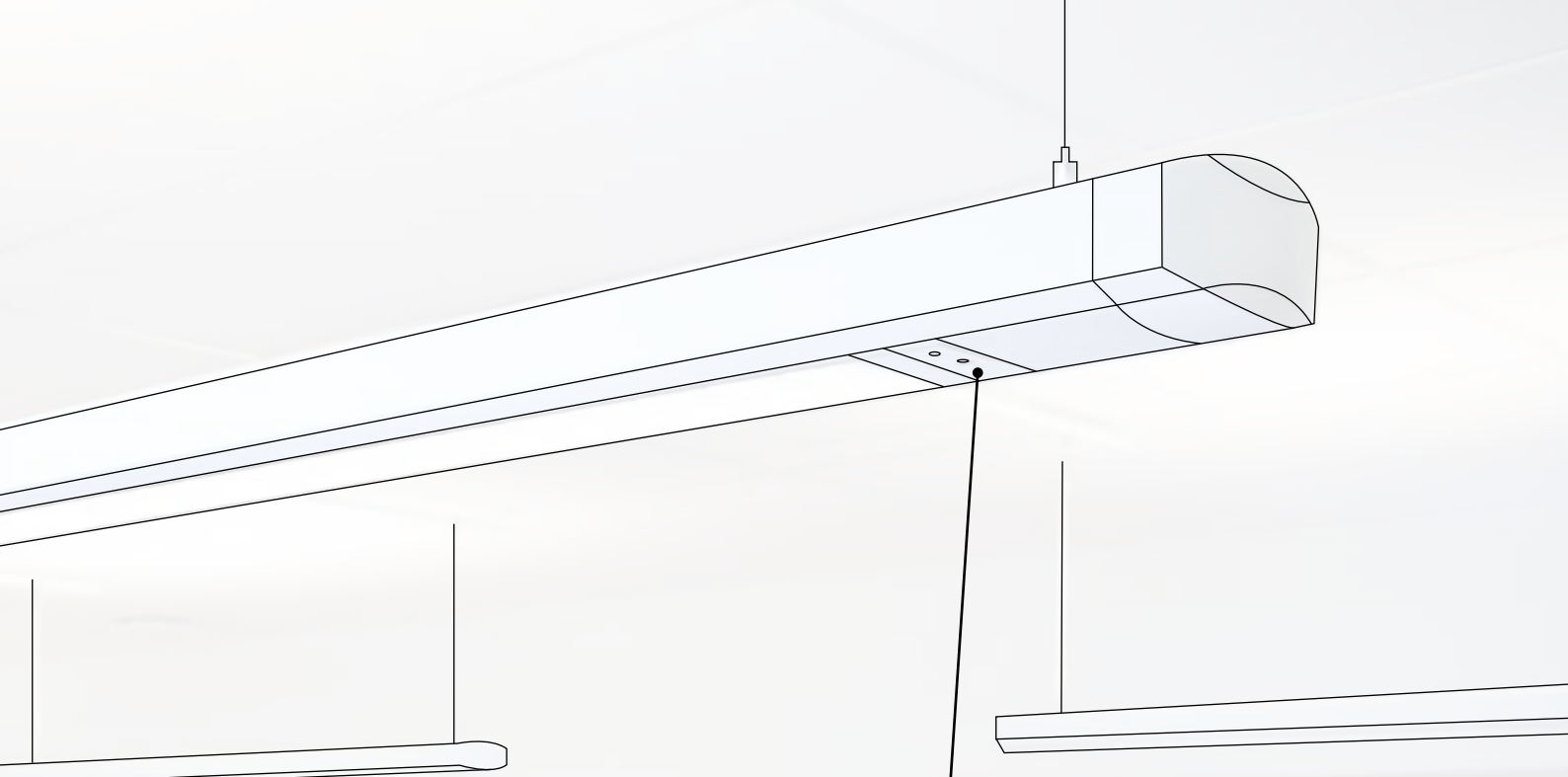


All in one place

Fagerhult wireless e-Sense Connect provides all of the lighting functions needed in the room. There is no need for servers in the basement or cupboards in the corridor.

Easy to use

A potentiometer with on/off function makes it easy to switch on the light, switch it off, or make it brighter or dimmer.



Bright walls

Vertical light on the wall, 300 lx, provides good ambient light and helps students feel more alert and perform better.

Integrated sensors

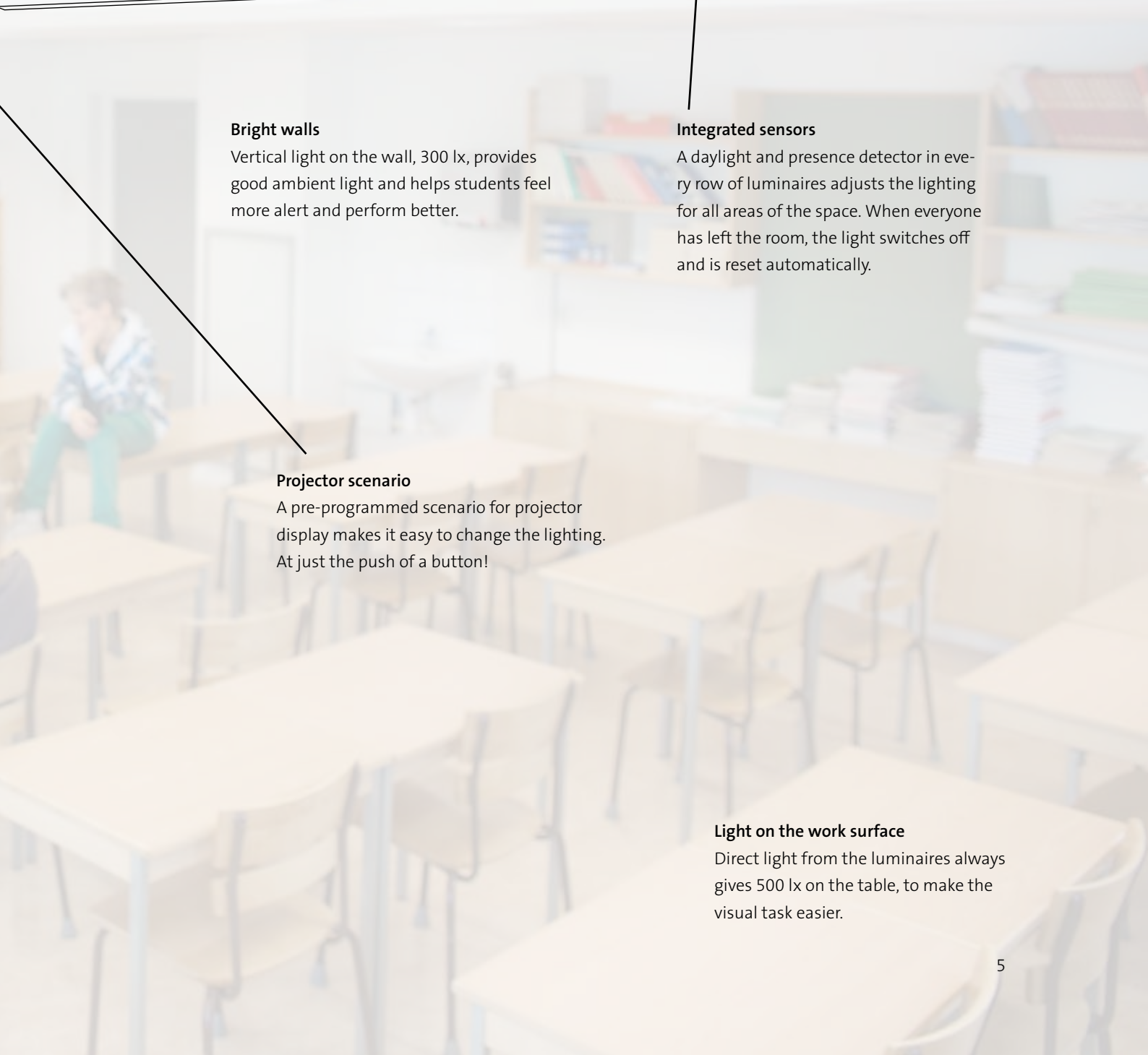
A daylight and presence detector in every row of luminaires adjusts the lighting for all areas of the space. When everyone has left the room, the light switches off and is reset automatically.

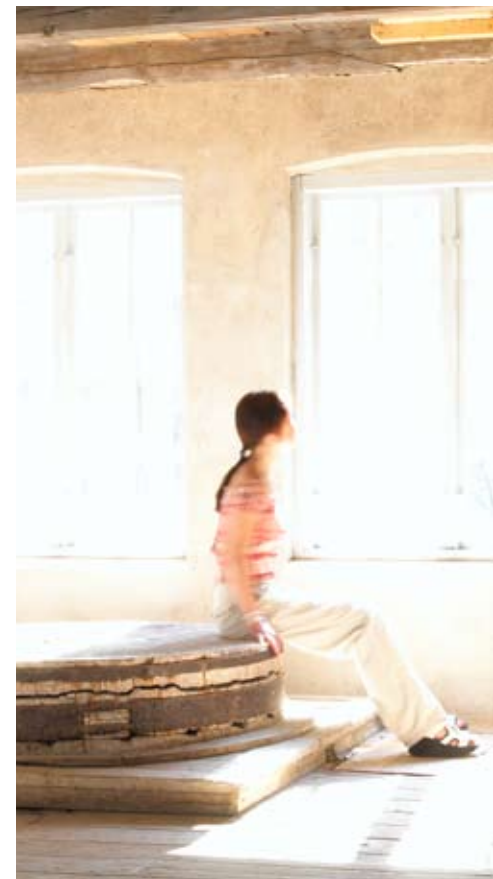
Projector scenario

A pre-programmed scenario for projector display makes it easy to change the lighting. At just the push of a button!

Light on the work surface

Direct light from the luminaires always gives 500 lx on the table, to make the visual task easier.





Higher levels of ambient lighting = better results

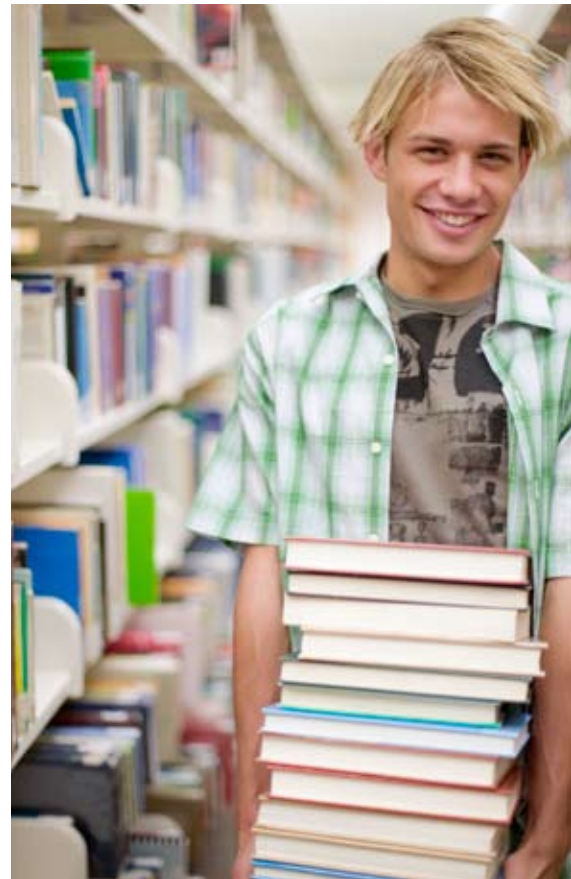
It's a well-known fact of life that light makes us feel good. Light affects us not just in a visual sense, but biologically and emotionally as well. New research has shown that good lighting actually increases job satisfaction in learning environments. Fagerhult's head of research, Tommy Govén, explains how.

How can lighting affect study results?

"Our research shows that higher levels of ambient light, that is indirect light reflected via the ceiling and vertically against the walls, make the students more alert and puts them in better mood. Our tests also show that pupils who get to work in this light get better results during the dark period of the year as well. The great thing is that this type of lighting is extremely easy to create and doesn't need to cost more either. By selecting good luminaires, with day-light control and presence detectors, you can compensate for the higher light levels."

How can you prove the connection?

"The concept of light being good for people is nothing new. It's something we feel "instinctively". We become more alert, more cheerful and more focused. We are exactly like flowers that turn to face the light! The inhabitants of the Nordic countries in particular are conscious of how the darkness can affect their energy and mood. What is new however, is that at last we have the opportunity to measure and prove the effect of light – both natural and artificial – on a purely scientific basis. In 2002 a researcher at Brown University in the USA discovered what became known as a "third receptor" in the eye's retina. This 'Third Receptor' is what transmits light impulses from the eye to the pituitary gland, which influences the secretion of stress and sleep hormones. There is, therefore, also a clear connection between light and hormone balance."



Humans are exactly like flowers that turn to face the light!

What is VBE?

“Good lighting must be adapted to human nature. That’s why we developed an evaluations system, the VBE Index, as the basis for our research. VBE is a acronym of Visual, Biological and Emotional, the three ways in which light affects us. The visual concerns the provision of the right light which helps us to see well and be able to read and work. The Biological is about how light affects the secretion of hormones in our bodies, in other words how tired or how alert we are. The emotional aspect of light is, of course, how it affects us on a purely emotional basis”.

What makes Fagerhult’s research so unique?

“That we actually studied the effect of artificial light on a biological basis by measuring hydrocortisone and melatonin levels, during a whole school year. This approach provided a completely different assurance to alternative research focused exclusively on interviews, which are based on instantaneous, subjective values. This aspect wasn’t neglected in our study however, we supplemented

the biological aspects with regular studies of the students emotional response throughout the year.”

And your next project?

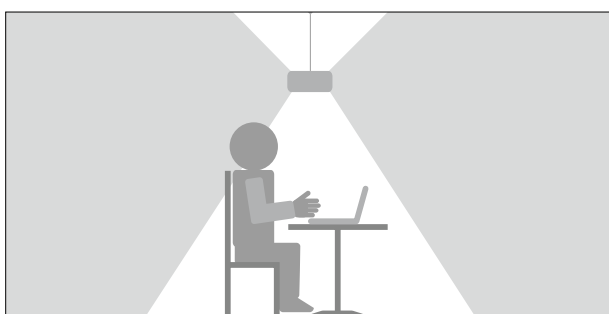
“The next project is being run in a high school in Sweden where we are aiming to create a model for energy efficiency in schools. Similar to the previous study, our research will focus on how students performance, alertness and well being are affected over an entire academic year but this time via LED light. To help facilitate these objectives we have created a custom luminaire developed specifically for this project. The most exciting aspect of this study is that the students are older and in a hormonally unbalanced age.”

How does LED fit into the picture?

“Our latest research findings show that LED technology gives a light that is perceived to be “brighter and better” than the light from a T5 fluorescent lamp, even if the lux-meter show the same value. This paves the way for even better lighting in our schools, with even greater energy savings.”

Four research projects: Proof of the effects of ambient light

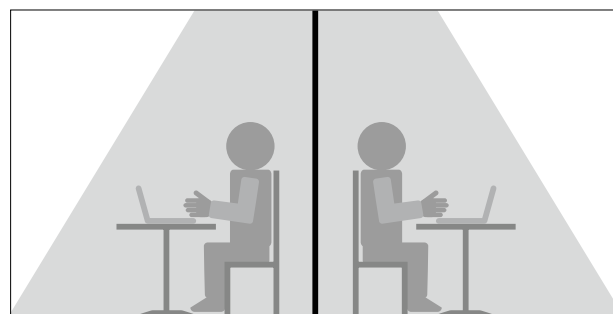
Believing is one thing; knowing is something else. At Fagerhult we have always maintained that only direct light on the working surface is not enough. That's why we have worked with combinations of direct and indirect light that also illuminate the ceiling and walls. Four different studies, undertaken during a ten-year period, confirm our view.



1. The optimal work light.

In collaboration with Jönköping University, 2001.

What light distribution is the most agreeable in a work situation? The study took place at Jönköping University and the aim was to determine what light distribution the people participating in the study preferred – both visually and emotionally. The study space was lit solely by luminaires, completely without incidental daylight. The result confirmed that a combination of direct and indirect light – which not only provides sufficient light levels on the work surface, but also creates ambient light by illuminating the ceiling and walls (vertical light) – was preferable.

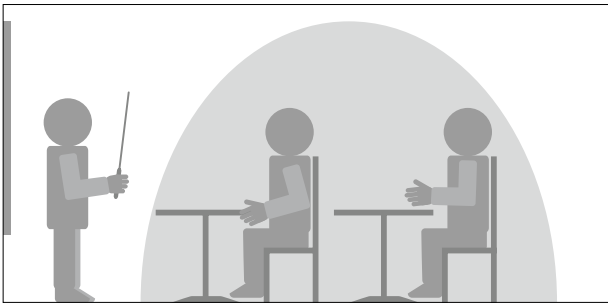


2. The effect of ambient light on alertness and well-being. In collaboration with the Faculty of Engineering (LTH), Lund University. Åhus 2007.

How does incidental light affect human well-being? The study investigated how people are affected by working in a room with three different levels of ambient light and colour temperatures. As in the earlier study, there was no daylight. During the test the participants' visual, biological and emotional reactions were studied by means of interviews and measurements of cortisol and melatonin content.

The study showed that ambient light is highly significant not only for the visual task, but also for emotional state and alertness. The most positive reactions were registered at an incidental light level of 100 cd/m^2 and a colour temperature of 3000–4000 K.

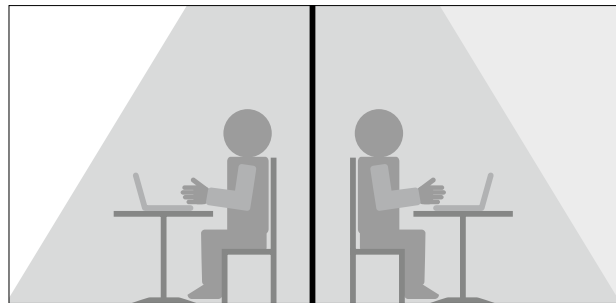




3. The effect of ambient light on learning.

In collaboration with the Faculty of Engineering (LTH), Lund University, and University College London. London 2009–2010.

The study took place at a primary school in London. The aim was to investigate how the pupils were affected by working in a classroom with a greater proportion of light on the walls and ceiling. The classroom had daylight and the lighting was designed with daylight and presence detectors to optimise energy consumption. The pupils' performance, alertness and well-being (Visual, Biological and Emotional) were studied over a period of a whole year with the help of interviews and hormone measurements. The results were then compared with pupils who followed the same school schedule in identical classrooms with standard lighting. The study showed that the pupils in the test classroom, with a higher level of ambient light, were not only more alert in the morning but also achieved better results in mathematics, reading and writing, especially during the dark period of the year.

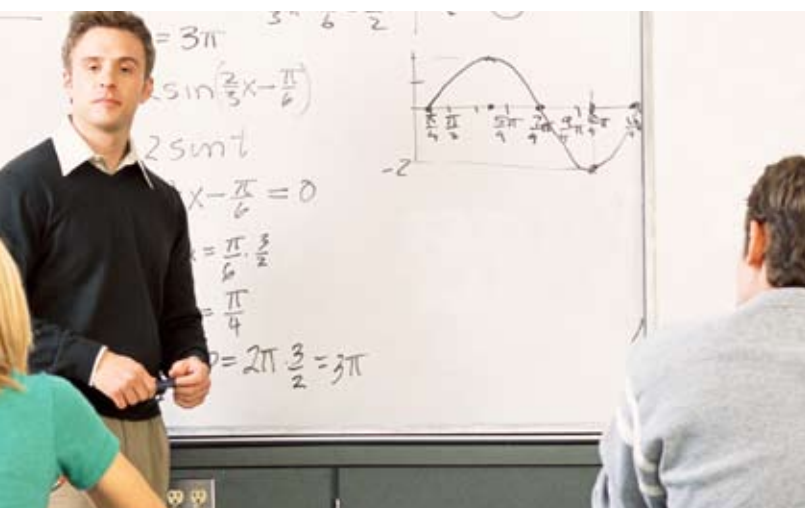


4. Opportunities for energy savings with LED.

In collaboration with the Faculty of Engineering (LTH), Lund University. Åhus, 2011.

The aim of the study was to investigate how people are affected by working in LED light. Exactly as before, Visual, Biological and Emotional aspects were studied by means of interviews and hormone measurements. The study confirmed earlier surveys showing positive effects in connection with higher levels of ambient light. It also showed that those participating in the study perceived the light from LED as brighter than from a traditional T5 light source, which presents opportunities for energy savings. Fagerhult has therefore taken the initiative in commissioning a new study, being conducted during 2012–2013 in a Swedish high-school, which aims to identify the optimal working levels for LEDs.

Learn more! Research reports and summary articles at our web site.





Principles for lightsettings in the control rooms in the London-study.



Principles for lightsettings in the experimental rooms in the London-study.

Break the rules. Dare to use more light

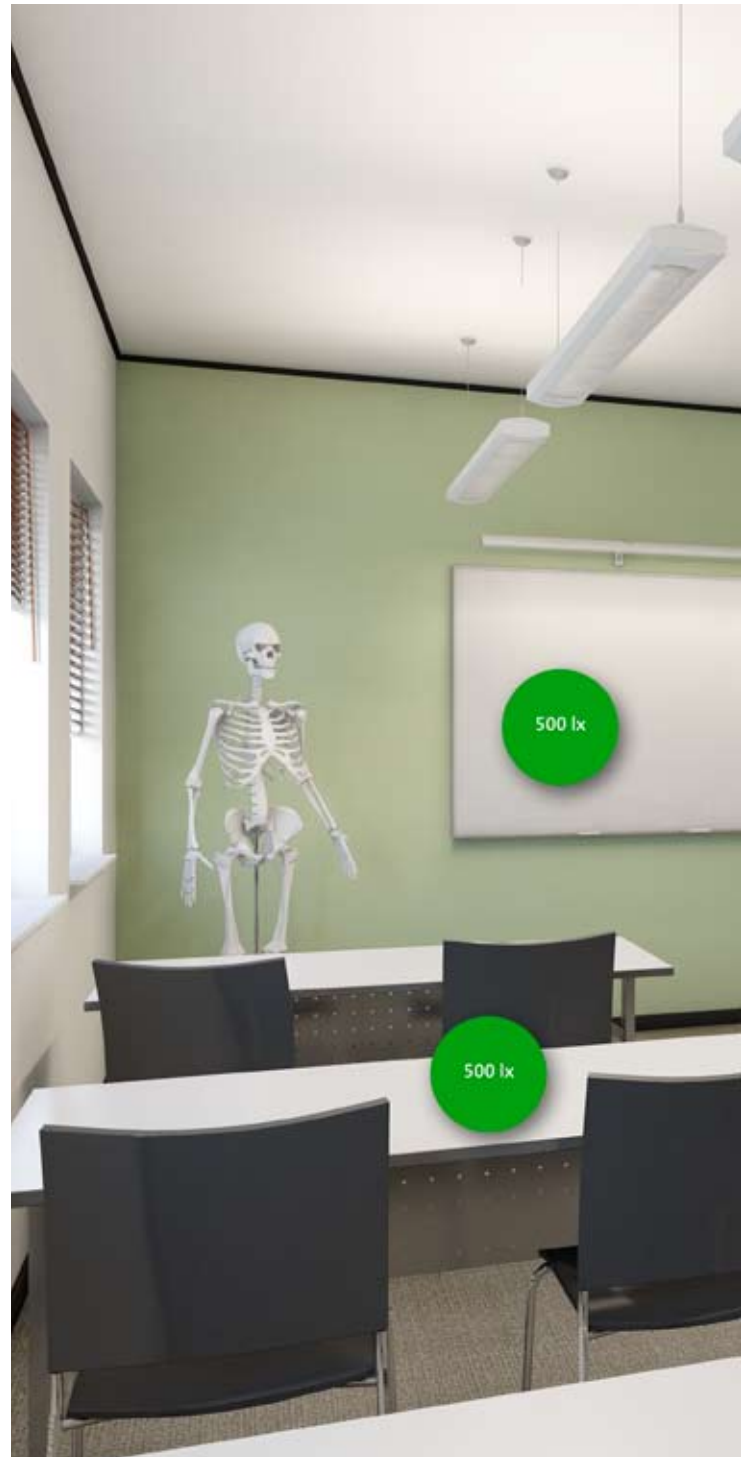
Since 2003 EU member countries have had a common standard (EN 12464-1) for light planning in workplaces. The earlier standards had comprised of lighting requirements for work surfaces, computer monitors and the immediate surroundings. Based on new research, the standard has now been revised and also sets requirements in terms of lighting of ceilings and walls. At the same time, the lighting should be adjustable in classrooms and lecture halls, and meet the energy requirements of EN 15193:2007. At Fagerhult we believe this is a step in the right direction. But if you want to get the full benefit of light's positive effects, you need more light than what the legislation requires.

Lighting of the working area

The standard requires an illuminance of 500 lx.

Indirect light in the ceiling (ambient light)

The standard states a minimum illuminance of 30 lx as the requirement and recommends a minimum of 50 lx. To achieve the positive effects reported in Fagerhult's study, we recommend an illuminance of 300 lx.



Vertical light on walls (ambient light)

The standard states a minimum illuminance of 50 lx as the requirement and recommends a minimum of 75 lx. Based on the findings of our research, we recommend an illuminance of 300 lx.



Cylindrical illuminance (in rooms with demands of good visual communication)

Cylindrical illuminance especially affects visual communication and the ability to interpret faces, events and objects. The standard requires a minimum illuminance of 150 lx in rooms with demands of good visual communication.

Lighting of the whiteboard

To ensure what is written or displayed on the whiteboard is easy to read, the standard requires a minimum illuminance of 500 lx. The lighting shall be adjustable.



Better light without increasing consumption

Enhancing the ambient lighting in the classroom produces an increase in well-being and better study results – without increasing energy consumption. New solutions with daylight and presence control optimise energy usage and compensate for increased levels of ambient light.

At the same time as Fagerhult undertook the study in London 2009–2010 (read more on page 9), a parallel study was also done on energy consumption. The study compa-

red energy usage in two similar classrooms – one had a new lighting system with daylight and presence detectors and the other had traditional lighting with manual power switches. The results showed that the an efficient and functional lighting control system made possible a definite improvement in the quality and quantity of lighting in the experiment classroom. Despite increased ambient lighting levels energy consumption could be reduced by over 30 % at a constant horizontal illuminance on the work tables.

By consciously optimising energy usage, you also make a contribution to the environment, both locally and globally.



The environment – to practise what you preach

The decision to install an intelligent control system that takes into account daylight and presence is not only related to health and financial aspects. By consciously optimising energy usage, you also make a contribution to the environment, both locally and globally. As always when it

comes to lighting, the greatest environmental impact is related to energy efficiency. At a time when there is ever greater focus on environmental education, lighting is a way to show that you practise what you preach.

Learn more! Research reports and summary articles at www.fagerhult.co.uk.







The shortcut to change. Lighting control with wireless e-Sense Connect

More and more people are appreciating the benefit of lighting that both supports the study environment and saves energy; necessitating the use of a lighting control system. Fagerhult's wireless e-Sense Connect is an innovative wireless control system – the first complete system of its kind on the market. Installation is quick and easy and involves new luminaires and a remote control. When you no longer have to spend a lot of time routing cables and making structural alterations, it's easy to make the right decision.

The path of least resistance

In an increasingly mobile and digital age the number of devices connecting to wireless networks is ever growing. The concept behind e-Sense connect focused on ensuring the user benefits from the simplicity and ease of a wireless dimming system, with safe and reliable transmissions between the luminaires. Its CRMX™ technology provides the platform through which the control unit communicates with the fitting, automatically adjusting to its environments to deliver best performance without interfering

with other wireless activities. If other devices e.g. wireless routers for IT networks, communicate on the same bandwidth, the CRMX™ signal moves to a less populated frequency. If needed, this scanning and migration process will take place every millisecond. The power used in communicating between the units is minimal and cannot be likened to the power consumption of mobile phones, for instance. The unique CRMX™ technology makes sure that your wireless transmissions never disturb, or are disturbed by, other wireless equipment. This fully automated feature offers unrivalled convenience and peace of mind during operation.

Fast and uncomplicated installation

Fagerhult wireless e-Sense Connect is a very efficient lighting system with intelligent daylight and presence control. The sensors are integrated into the luminaires and communicate with one another wirelessly via radio waves, exactly like a wireless network. Unlike a conventional control system, e-Sense Connect does not require any control cables. The programming and grouping are done

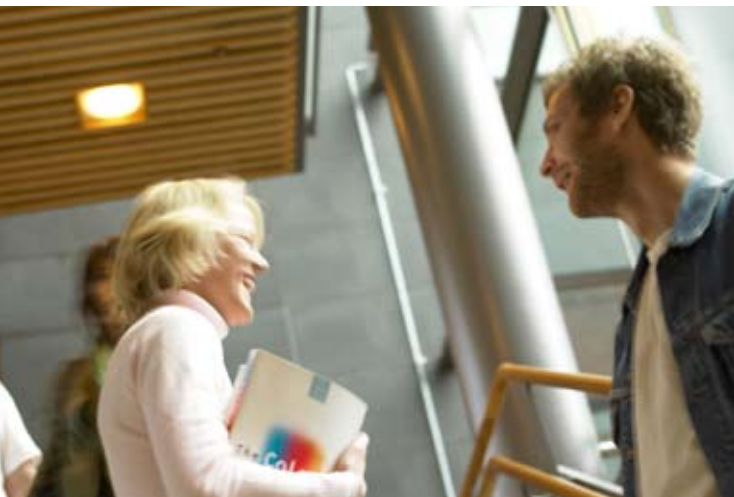
Fagerhult wireless e-Sense Connect consists of luminaires equipped with sensors that are mounted in several rows in the room.

quickly and easily via a remote control directed towards each luminaire. As the procedure doesn't involve any work with the structure of the building, this considerably shortens the time the installation takes. To facilitate on-going simplicity, individual luminaires can be easily disconnected for maintenance without the system being affected.

Intuitive control for projector mode

Wireless e-Sense Connect is easy to understand and use. The light is manually switched on, adjusting automatically to daylight and presence. Luminous intensity can also be adjusted up and down using a rotary potentiometer. This functionality is complimented with a switch containing up to four possible pre-programmed selections, for example whiteboard lighting and projector mode. The entire system is turned off and reset when the presence detectors register that everyone has left the room. Unlike a normal control system, the luminaires do not remain in stand-by mode, offering further energy savings. The light is switched on manually, and it can also be switched off manually by pressing the knob.





Technical facts

Fagerhult's wireless e-Sense Connect lighting control system has been developed for professional installation in educational establishments. The system's functions are adapted for optimum energy-saving and quality of the light for the user.

The installation and user functions focus on simplicity. The technology behind the system is the most sophisticated to have been developed for lighting control to date, and facilitates both installation, maintenance and future changes. Wireless e-Sense Connect consists of a number of active and passive units that make the system complete. A number of luminaires in the room are equipped with sensors and normally there is a sensor luminaire in each row of luminaires.

Presence detection

The sensor has a PIR module (Passive Infra Red) which detects infrared light in motion, i.e. a warm body. Information from the detection system is supplemented by a time delay so that periods of non-detection (e.g. sitting still) do not negatively affect the system, switching off the light for example.

Daylight control



There is an active system in wireless e-Sense Connect that adjusts the amount of artificial light to the amount of daylight. The sensors in the luminaires interact in order to maintain an even and balanced illuminance

throughout the entire room. Depending on whether the sun is high or low in the sky, the system makes zonal adjustments to compensate for the amount of light. You always get the right amount of light for every circumstance; offering the potential for big energy savings at certain times of the year.

Luminaire, RF unit



Every luminaire has an RF unit that controls and regulates the ballast for the light source. Radio communication is duplex and based on the latest CRMX™ technology for secure and optimal transfer of information.

Switch unit



The design and function of switches, control panels and push-buttons varies enormously between different markets. Recognition and intuitive design are the aim of the choice of units on which the control module is constructed. Wireless e-

Sense Connect has been developed on the basis of control via the switch manufacturer's standard modules. A rotary potentiometer for 1–10 V may be used, with standard push-button functions for strong or low voltage systems, with or without LED marking.



Control unit



There is a central control unit in the system which provides the link between the luminaires and their control functions. The control unit transmits over the 2.4 GHz frequency band. The RF units in the luminaire work with a technology called CRMX™,

which stands for cognitive radio multiplexer. This helps ensure that the optimal frequency for communication is secured and accessibility is guaranteed. If other devices are communicating on the same bandwidth then the CRMX™ signal moves to a less popular space/frequency. In addition to wireless radio communication with the luminaires, the control unit is also permanently connected to a switch unit adapted to user requirements.

Remote control programming tool



In a functioning system, there is communication between the luminaires' RF units and the control unit. However, the remote control can be used as a temporary tool for setting up the system. With a few basic functions, it is possible to create

a very energy efficient lighting solution with a high degree of comfort for the user. The remote control uses RF signals rather than IR signals, which means that you only need to direct it towards the luminaires when first programming the groupings.





Lighting classrooms

Lighting is essential for visual tasks and helps maintain attention levels. Few pupils spend their day staring down at the desk; frequent interaction with the teacher, fellow students and the teaching surface (whiteboard, chalkboard or interactive screen) mean that their gaze is moving around the room and their focus constantly changing. Often the contrasts between the lighting of the work surfaces, walls and the ceiling tire or strain the eye.

By using luminaires that combine direct light on the work surfaces with an indirect light aimed towards the ceiling, a varying and appropriate concentration of light is distributed throughout the room. If focusing on the teacher is made harder because of inadequate lighting, concentration levels will fall. Considering the vertical illuminance, as a rule at least one third of the work surface, helps ensure that both the teacher and teaching aids are adequately lit. Although this can be achieved with overhead lighting, dedicated wall lighting can add an extra dimension.

Classroom checklist

- Who will use the room?
Young people need less light than older people in order to perform the same tasks. As we age, our sensitivity to glare also increases, therefore more light may be needed for adult education classrooms.
- What tasks will be performed?
For reading, uniformity of light is important whereas practical and intricate tasks require high levels of light and the colour rendering properties of the light source are significant when working with design and colour. The colour rendering in general should be at least Ra 80, although for photography this value may need to rise to Ra 90.
- Which media are used?
Display screens are now commonly used within schools, in addition to projectors and interactive whiteboards. The latest LG5 (2011) introduced the concept of cylindrical illuminance and a modelling index. Measures more effective not only for using interactive technology, but also for facial recognition and therefore better communication.



Luminaire solution – DTI

DTI is a distinctive luminaire with a combination of direct and indirect light distribution for a varied environment. The luminaire both meets the need for a perfect task light on the table surface while at the same time providing indirect light on the ceiling and the walls. DTI can be supplied with Fagerhult's wireless e-Sense Connect.



Luminaire solution – Lento

Lento is a whiteboard lighting solution developed specifically for this purpose. The light distribution is via lined diffuser, which reduces indirect reflections on the board. This approach also minimises the risk of glare for pupils or teachers when turning their attention towards the board.

Lighting control in the classroom

Programmable controls in a classroom allow the lighting to be adjusted according to user and usage requirements. Lighting can respond either manually or automatically, and different scenes can be created. Maximum and minimum light levels, and on/off functions can be changed and adapted. Within a classroom the controls solution should contain an absence-detection function, with the lighting turned on manually. This ensures lights are switched off when the room is empty, while also protecting against the luminaires being switched on when not required. Fagerhult's e-Sense Connect controls system is ideal for educational institutions. Available with a range of functions, such as absence detection, daylight linking and pre-set lighting scenes, the system is designed for quick and easy installation – saving both time and money.





Lighting for Lecture theatres

Large rooms used primarily for lectures, especially with seating for more than 80 pupils, tend to be raked with the lecturer situated on a podium to ensure visibility. The various levels and steps must be lit at all times.

A larger proportion of general lighting is required so the students have good working conditions; the SLL guideline suggests between 300–400 lx on the writing surface. Extra lighting should be provided for the location of the lecturer to enable them to both read notes clearly and maintain student concentration. Visual distraction should be kept to a minimum and contrast on the teaching board or screen should also be created. A similar level of importance should be placed on the ambient light as in a classroom.

Lighting control in Lecture Rooms

The control panel should be located by both the lecturer's position and by the doors. It is likely that scenes would include full lighting for entrance, exit and note taking and a reduced light level for slides or films.



Luminaire solution – Pleiad SLD G3

Pleiad SLD G3 is an energy-effective LED-based downlight that handles demanding lighting tasks even in large rooms with high ceilings. Its unique Anti-Glare Control ring ensures a glare free light, while the high calibre LED's offer exceptional colour consistency. The longevity of the light source is a big advantage in this type of environment.



Luminaire solution – Pleiad LED Wallwasher

Pleiad LED Wallwasher provides a lot of light on the walls without glare. It's even distribution contributes towards a dynamic environment that emphasises the character of the room. Being an LED solution, the life-span of the light source helps minimise the maintenance required.

Lighting for IT rooms

The lighting requirements for an IT room differ from those of a classroom in that they require a higher average luminance. The room should be evenly illuminated, which can be achieved with a combination of direct and indirect light. To highlight the different function of the room, a variant of the lighting could be provided with a proportion of light being directed on to the walls. SLL Lighting Guide LG7 recommends that the walls should be illuminated with at least 50 per cent and the ceiling 30 per cent of the level of illuminance on the working plane.

IT room checklist

- How will the room be used?

In a space where both group work and individual study may take place and a teacher has no fixed location, good modelling of all pupils is required. The luminaires must be suitable for work at monitors, and avoid glare and veiling reflections. In instances where there are projection facilities in the room, it should be possible to dim the lights.

- What is the position of the room?

If the IT room is an area connected to corridors or another open area, spill lighting from adjacent luminaires must be considered. The control system should allow both the creation of one lit space or a smaller room within a larger area.

Lighting control in the IT room

Lighting in IT rooms should be manually switched on and automatically switched off. It is important to switch the lights on manually as the room may only be used for short and irregular periods. Switching them off automatically is essential to ensure low energy consumption and that the lighting is on only when necessary. After the last detection in the room the lighting can remain on for a set number of minutes before it is switched off. Some IT rooms border two classrooms, and switching and control can then take place from both doors.





Lighting for sports halls

Visual disturbances should be eliminated by creating an even distribution of light within the hall. Balanced lighting is necessary for all sports where the eye needs to focus on an object or people that are moving quickly. An even distribution can be created by locating luminaires to follow the length of the room in continuous installations.

Good colour rendering is also important in this space for visual acuity. Luminaires must have an excellent cut-off to avoid glare as pupils regularly look up towards the ceiling. The luminaires in a sports hall must also be robust and impact resistant, with a durable louvre or guard. They should withstand being hit by a ball at high speed and at great force, without breaking the lamp or jeopardising electrical safety. Lamps with a long life span should be specified as the luminaires are often situated in rooms with high ceilings and, consequently, maintenance can be more difficult.



Luminaire solution – Excis

Excis has been especially designed for use in sport halls. The wire reinforced louvre and the solid steel design, complemented by its rounded edges, helps prevent balls and other elements from being caught in the luminaire. As is essential for these spaces Excis provides a glare-free light even from high ceilings.

Sports hall checklist

- What activities are taking place?
Numerous sports can be undertaken within a sports hall. While a general lighting level of 300 lx will be sufficient for most activities there are some exceptions. For instance, if the hall will be used for cricket practice the high speed and characteristics of the ball require a higher lighting level (750 lx is recommended). Equally, sports halls are often used for exams where 500 lx is more appropriate.

Lighting control for sports halls

A control system is useful in a sports hall. Intensive yet irregular activities are held and the hall is often left without supervision for long periods. With the help of an occupan-

cy detector that switches off the lights after a period of inactivity it is possible to make significant energy savings. The ability to create different scenes is crucial as not only are sports halls used for activities other than sports, but the light level used for school and college sports can differ to that needed for training and matches in leagues and competitions. It is common for a sports hall to be divided into several sections with the help of partition walls, so that parallel lessons can take place in smaller areas. Automatic division of the lighting with the use of partition walls is possible with a control system. From a design perspective, when lighting controls are used the switching should, where possible, be installed in an office rather than the hall itself to safeguard against damage.



Lighting for circulation areas

The corridor has a key function that affects both logistics and perception. Providing a visually stimulating route throughout the building it's decisive for orientation, circulation and as a means of escape. As a social space in its own right, increased focus on the ceilings and walls not only facilitates communication but also adheres to EN12461-1. Luminaires placed in the centre of the ceiling create a different effect to those placed close to the wall. A combination creates life and variation, highlighting display areas as pupils pass by. Stairs need to have higher illumination levels to aid safe passage. Lighting must ensure that treads and risers are well defined.

Corridor checklist

- What size is the corridor?
In corridors with a high footfall, ceiling mounted luminaires reduce the risk of damage compared with wall mounted variations. In wider corridors, 3.5 m +, the placement of a wallwasher on the outer edge of the ceiling help avoid a lifeless space.
- Uniformity or drama?
Most corridors require a uniform distribution of lighting. This avoids pools of light upon the floor and a 'light dark' effect.
- Avoid glare!
Luminaires that are too specular run the risk of glare as you move along the corridor.





Luminaire solution – Pleiad SLD G3

Pleiad SLD G3 is an effective LED downlight with excellent light ergonomics. Its high light output is exceptionally shielded, well suited for communication areas. The high colour quality is also important for applications such as corridors where the continuous line will bring the disparities to the fore.

Luminaire solution – Vidi

Vidi is innovative corridor lighting solution with a large proportion of incidental light for a more varied experience and a clearer sense of space. Vidi ceiling helps orientation in the communication area via a combination of direct light towards the floor and indirect light towards the ceiling. Vidi corner creates vertical incidental light that accentuates the walls and increases orientation without creating a gloomy corridor feeling.







Lighting of cafés and dining rooms

As a social space these areas should provide a warm, vibrant and relaxing break from the learning environment. With lower requirements for general lighting, different sections of the room can be separated with the help of different lighting. Suspended luminaires above eating areas can create physical islands for socialising, while the serving counter and checkout can be emphasised with their own lighting. Lighting on the walls and vertical surfaces give the room character.

Lighting control for cafés and dining rooms

By including a control system in this space, you can create a variety of scenes that change the character of the room depending on its use. Fully lit for meals during the day or dimmed to a lower level in the evening when halogen light and suspended luminaires, for instance, can create a warm and intimate feeling.



Luminaire solution – Pozzo

Pozzo is a range of decorative luminaires that uses natural light as its role model. Their large opal louvres provide generous, luminous surfaces that spread the light effectively, even out towards the walls, without causing glare.

Lighting libraries

Visual comfort is essential for students searching or selecting a book and reviewing their choice. A well lit library makes it easy to navigate and find the right shelf, upon which the focus should switch towards the books. The best solution is separate vertical lighting on the shelves via a luminaire with asymmetrical distribution providing around 200–300 lx on the book spines.

Ambient general lighting over social seating spaces, with task lighting above study desks, not only helps distinguish its purpose but also provides suitable light for reading, studying and mobile devices.



Luminaire solution – Liverti

Liverti is a luminaire with a round beam that provides a good direct light with a certain proportion of indirect light out towards the walls and ceiling. The range includes both large suspended variations for higher ceilings and ceiling-mounted variations for mounting in smaller rooms and mezzanines.



Luminaire solution – Libraline

Libraline is bookshelf lighting system that has been specially developed for libraries. The luminaires high quality light distribution ensures that even the lower shelf positions are well-lit.



Outdoor lighting

With the right lighting the schoolyard becomes a safe, welcoming outdoor space that is full of life even after school hours. By using several types of luminaires at different heights, you can create individual spaces, avoiding dark and hidden away places, while making good use of the area. Post luminaires provide good general lighting whereas lower bollards assist orientation in connection with corridors and other communication areas. Use the facades to soften up the transition between outdoors and indoors; wall and ceiling luminaires create pleasant vertical light, removing dark and unwelcoming walls.

Outdoor checklist

- Choose LED luminaires. LED technology delivers optimal performance in cold outdoor temperatures, which means huge energy savings. LED luminaires are also as close as you can get to maintenance-free for many years to come.
- Plenty of movement, play and ballgames take place in a schoolyard. Choose a robust lighting solution that withstands stresses – the most robust luminaires have an IK10 rating.





Luminaire solution – Azur

Azur is a complete range of energy-efficient outdoor luminaires with LED, compact fluorescent or metal halide light sources. The luminaire has very good light quality and is available as a post, bollard or wall luminaire in a matching contemporary design. Azur is a robust luminaire with an IK10 rating.



Luminaire solution – Rondo

Rondo is a versatile range of outdoor luminaires that are available for LED, compact fluorescent or metal halide light sources. Ceiling luminaires for recess or surface mounting are an excellent complement to other luminaires in the lighting solution. Rondo is also available as a wall luminaire.

Lighting control with e-Sense

Lighting control ensures the right light is produced in the right place and the right time and in the right quantity. Lighting control can also be complicated to install and program, difficult to understand for the user and costly to maintain. We developed e-Sense so that time and money can be spent on other things.

Fagerhults e-Sense luminaires are equipped with integrated light control; an attractive, easy installation without the need of add-on or external sensors.

Fagerhult e-Sense is the easiest, quickest way to install light control. Our aim has been to eliminate all the hidden costs of installation, operation and maintenance. To avoid switches and complicated settings, install a luminaire and get a complete control system.

Daylight control

A sensor controls the level of lighting according to incident daylight. An increase in daylight turns down the lighting, which saves energy.

Presence detection

PIR (Passive Infra Red) presence detectors register movement within the supervised area with the help of people's thermal radiation. The supervised area is only lit when there is someone there.

Today there are also luminaires available with built-in microwave sensors (e-Sense Detect and e-Sense Move) that register motion using radar technology. Microwave sensors can be hidden in the luminaire without lowering the luminaire's IP rating.



e-Sense functions compared

Application	Solution	Presence control	Daylight control	Manual control
Classroom, office	e-Sense ActiLume	●	●	●
Printer room, cloakroom etc.	e-Sense smartSWITCH ON/OFF	●		●
Office	e-Sense smartSWITCH ON/OFF with dragdim	●		●
Corridors, printer room	e-Sense smartSWITCH Absence dampening	●		
Cloakroom, WC, storage, stairwells	e-Sense Detect	●		
Stairwells, normal/ service corridors	e-Sense Move	●		
Classroom, open plan office	wireless e-Sense Connect	●	●	●

Wireless e-Sense Connect



Fagerhult e-Sense Connect is an innovative wireless control system – the first complete system of its kind on the market. It is a very efficient lighting system with intelligent daylight and presence control.

The technology behind the system is the most sophisticated that has been developed for lighting control to date; it focuses on making installation, maintenance and use incredibly simple.

All luminaires are equipped with an RF unit that transfers the control signal and in the system, both with and without sensors. Communication is wireless, exactly the same as a WLAN network, which means that the luminaires just need to be connected to the mains. Unlike with a conventional control system, there is no routing of control cables, which saves time, especially when it comes to doing renovations.

When commissioning, the programming (in fact a simple grouping) is done quickly and easily via a remote control directed towards each luminaire. There is no need for either the installer or maintenance staff to learn an advanced control program when the system is installed or serviced.

Wireless e-Sense Connect is easy to understand and use. The switch unit is a simple rotary potentiometer that enables the user to switch on the light and manually control it.

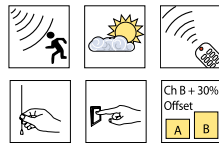
The switch unit can be expanded to provide up to four extra control functions, e.g. switching whiteboard lighting on and off and dimming selected luminaires for projector mode. The entire system is turned off and reset when the presence detection sensors register that the room is empty. The light can also be switched off manually by pressing the potentiometer knob.



Wireless e-Sense Connect is suitable in:

- Lecture rooms and larger offices.

e-Sense ActiLume



e-Sense ActiLume is a control system from Philips where the sensor has three different tasks: a presence detector, a daylight control sensor and an IR receiver for programming.

e-Sense ActiLume offers maximum comfort and energy savings up to 75 %. This immense potential for energy savings provides the opportunity of a quick return on investment.

e-Sense ActiLume is a simple system produced for “plug and play” lighting solutions. You can easily attain the perfect light control solution for a room.

The system is pre-programmed with settings for different rooms, offices, open plan offices, classrooms etc. The setting is selected with a remote control.



e-Sense Actilume is suitable for:

- A workplace as a single luminaire (the luminaire just controls itself).
- A classroom or open-plan office as master luminaire (controls one or more luminaires with DALI).

e-Sense ActiLume Connection box



The e-Sense ActiLume Connection box is a quick, efficient and complete method of installing an e-Sense ActiLume solution. Instead of connecting in the conventional manner, all cables are collected together in a connection box where they are all connected together with quick connectors.

connected together with quick connectors.

The reduced the risk of mixing up the connections, makes for quick, safe installation. All functions can be connected or disconnected without risk.

e-Sense smartSWITCH



e-Sense smartSWITCH gives automatic switching with the sensor integrated in the luminaire. Depending on connection and choice of ballast the functions on/off, on/off with pull-dim or absence dampening.

e-Sense smartSWITCH on/off

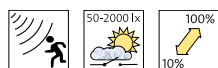
e-Sense smartSWITCH is an on/off-sensor that controls the connected luminaire via the mains. There is also a model available with pull-dim for individual setting of the lighting level the sensor only controls on/off).



e-Sense smartSWITCH on/off is suitable for:

- Workplace as a single luminaire in office premises, individual rooms as well as open-plan offices.

e-Sense smartSWITCH absence dampening



A control function that is adapted to rooms in an office that are used

sparingly. The lighting is set at a constant low level (10 %) to counteract the impression of a completely darkened room. When presence is detected, the light level is adjusted to 100 %. The time delay to return to the low level can be short, unlike control with a switch-off function where you want to avoid unnecessary starting of the fluorescent lamp.



e-Sense smartSWITCH absence dampening is suitable for:

- Cloakrooms, copying/printing rooms and corridors.

e-Sense Move



e-Sense Move is designed primarily for stairwells and is based on microwave technology in the same way as e-Sense Detect. The difference is that several luminaires can communicate with one another wirelessly. e-Sense Move does not require any routing of control cables.

The system is duplex and involves all luminaires acting as both master and slave luminaires depending on which luminaire detects presence.

When a luminaire detects presence it sends information on to one or more luminaires, which light up. Each sensor can actively “listen” to 15 other sensors.

e-Sense Move is excellent for use, for example, in stairwells of buildings with many floors. In order to optimise

energy savings you can choose just to switch on the luminaire on the level above and below the floor where presence is detected. For example, if movement is detected on level 4, the luminaires on levels 5 and 3 switch on. If you go down the stairs, the luminaire on level 3 detects your presence and sends a signal to the luminaire on level 2 to switch on, and so on. In each case the light switches on in front of the person who is on their way up or down the stairwell.

e-Sense Move can even optimise the lighting in garages. Individual installations for every luminaire mean that basic lighting can be used in the dark parts, and other shorter times for the luminaires that are located towards the entrance and doors.

e-Sense Move also has a place in service corridors, cellars and attic areas since you can determine times and levels for every luminaire.

Settings are made on the sensor unit in fixed positions.



e-Sense Move is suitable in:

- Stairwells, corridors, service corridors and garages, spaces where people are moving along and want light in the area they are moving towards.

e-Sense Detect



Fagerhult e-Sense Detect provides luminaires with unique functions. A sensor based on microwave technology involves the sensor unit being hidden in the luminaire without affecting its design or IP class. We have a selection of luminaires with this technology to suit different environments and needs.

The microwave sensor sends out a signal which is reflected back. When the time of the reflected signal changes, the sensor detects movement.

A microwave sensor can detect movement through thin walls or doors outside the space where it is located.

e-Sense Detect on/off

The microwave sensor ignites at presence (movement) and turns off after set time. The time to extinguish is set in fixed steps.

e-Sense Detect absence dampening

The lighting is set at a constant low level (10%). At detection the light level is adjusted to 100%. After the last detection and set time delay the light is dimmed to low level.



e-Sense Detect is suitable for:

- Copying and storage rooms, toilets, corridors, cloakrooms and stairwells.

Guides and Legislation

BREEAM

BRE Environmental Assessment Method. BREEAM is the world's most widely used environmental assessment method for buildings.
www.bre.co.uk

Building Regulations: Part L (Conservation of fuel and power)

Covering energy use in both new and existing buildings, Part L was amended in 2010 and will be updated in 2013. A likely amendment will be the inclusion of LENI as a recommended metric of lighting energy use (see EN 12464-1 below).

EN 12464-1: 2011 Lighting of Indoor Work Places

Crucial updates include the introduction of cylindrical illuminance and modelling as key elements, designed to discourage lighting schemes based on the horizontal plane, and shifting the emphasis to lighting for the task and for people. Daylight is also emphasised, as is the use of lighting controls and the recommendation to use LENI (lighting energy numerical indicator), a more practical and useful metric than watts per square metre, and designed to measure lighting energy use on a system basis.

EN 15193: 2007 Energy Performance in Buildings. Energy requirements for lighting

The standard was devised to establish conventions and procedures for the estimation of energy requirements of lighting in buildings, and to give a methodology for a numeric indicator of energy performance of buildings. It also gives advice on techniques for separate metering of energy used for lighting that will give regular feedback on the effectiveness of lighting controls.

The SLL Code for Interior Lighting 2012

Regarded as the definitive general interior lighting guide, the Code summarises all current European standards and building regulations including EN 12464-1 (see above). It also offers advice and guidance.
www.sll.org.uk

SLL Lighting Handbook

Designed to be complementary to the Code for Lighting and specific SLL Lighting Guides, the Handbook is intended to be the first-stop for anyone seeking information on lighting. The contents summarise the fundamentals of light and vision, the technology of lighting and guidance on a wide range of applications, both interior and exterior.

SLL Lighting Guide 5: Lighting for Education (2011)

Superseding outdated documents such as BB90, LG5 gives guidance on the lighting of all educational spaces including lecture theatres, teaching rooms, conference rooms, special-purpose rooms (such as gymnasias, art rooms and dance studios), multi-purpose rooms and so on. The latest edition is notable for its emphasis on the latest educational practice, and the importance of the right lighting for interactive learning and good communication.

SLL Lighting Guide 7: Office Lighting (2005)

LG7 covers all aspects of office lighting including legislation, standards and good practice, as well as advice on the design and operation of office lighting schemes and installations for all users.

SLL Lighting Guide 4: Sports (2006)

The guide includes an introductory section describing the general requirements for sports lighting, including illuminance, light distribution, glare, emergency lighting, planning requirements and safety. The specific requirements of multipurpose sports halls are discussed.

The EU Eco-Management and Audit Scheme (EMAS)

EMAS is a voluntary initiative designed to improve the environmental performance of organisations on a continuous basis. Those registered are legally compliant, run an environment management system and report on their environmental performance through the publication of an independently verified environmental statement.
www.iema.net/ems/emas

The WEEE Directive

www.environment-agency.gov.uk/weee



Photographer: Peter Cook



Fagerhult develops, manufactures and markets professional lighting systems for public environments such as offices, schools, industries and hospitals. Our operations are run with a constant focus on design, function, flexibility and energy saving solutions.

Fagerhult Lighting Ltd UK, Fagerhult United Arab Emirates and Fagerhult Lighting Ltd Ireland are part of the Fagerhult Group, one of Europe's leading lighting groups with operations in more than 15 different countries. AB Fagerhult is listed on the NASDAQ OMX Nordic Exchange in Stockholm.

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