VELUX®

OSRAM Culture Centre

Copenhagen, Denmark

An energy renovation project

OSRAM Culture Centre

Copenhagen, Denmark

Facts

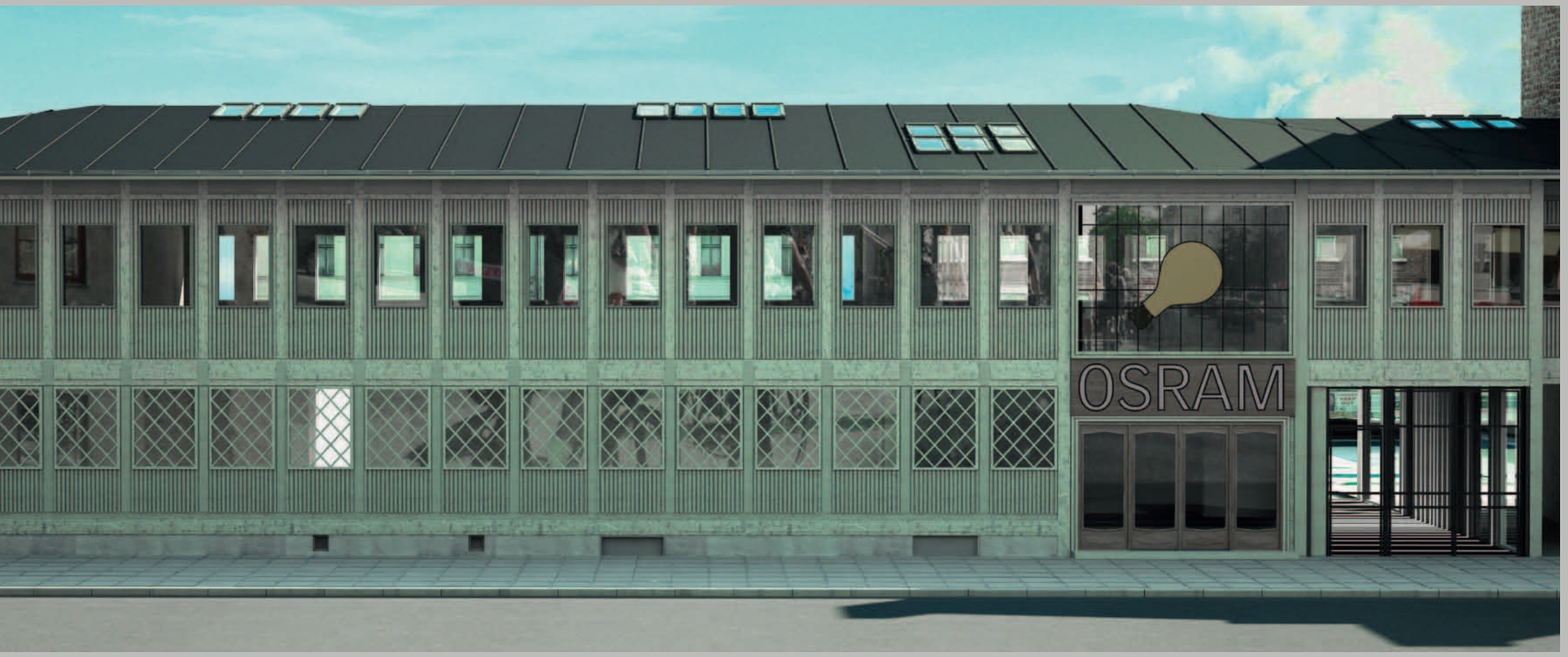
Built in 1953 as an industrial building. First prefabricated house in Copenhagen. Built as an office and warehouse for Nordisk Glødelampe Industri A/S.
Architects: Karl Weidemann Petersen MAA and W. Marke.
Built by: Højgaard & Schultz.
Situated on Valhalsgade in the northern part of Copenhagen.

Further, the cultural centre »OSRAM« was one of the cornerstones of the whole neighbourhood's role as CO_2 demonstration area in connection with the United Nations Climate Change Conference 2009.

The Challenge

To energy renovate a former industrial building, now in use as culture centre, among other things by utilising daylight and natural ventilation to improve the indoor climate.

In connection with the Climate Change Conference, the City of Copenhagen was initiated strategic cooperation with a number of Danish enterprises for the purpose of mutual profiling on climate-friendly buildings. The target to minimize the resources required (and, consequently, the CO_2 emission) both during construction and upkeep. The renovation of the culture centre "OSRAM" is a part of this cooperation and is a spearhead for possibilities and methods of renovating old industrial and commercial buildings worth preserving.



Visualization. Osram Culture centre.

Before renovation.

A Solution

Access to daylight

The project is based on a new and more appropriate lay-out of the ground floor. There are two main entrances; the new one from the garden including the gate in the access/escape route. In the large entrance hall penetration of the ceiling will create double room height in part of the room.
From the entrance hall a passage along the street façade gives access to two large flex rooms and three smaller activity rooms. The large rooms open towards the garden and the activity rooms have glazing high in the walls allowing "used" daylight to enter, but prohibiting glimpsing from the other rooms. Lavatories and a bathroom are located in the eastern corner. In the southern corner there is an office facing the garden and new window slits to the gateway.

This lay-out presents several advantages
The passage along the façade is a partly heated room, which will reduce the heat loss through the façade. As this façade is symbolizing the house architectonically, it would be hard to reinsulate it without damaging the present expression. By replacing reinsulation with a room high double wall of energy efficient glass, the architectonic expression will be maintained and the heat loss reduced, though somewhat less than by traditional, external reinsulation.
On the first floor the present lay-out is maintained apart from the area around the front stairs where you can now look and communicate to the entrance hall and the passage downstairs.

On the first floor there is access to the great hall and the three offices making up the primary rooms on this floor. Roof windows are installed above the great hall, the offices and the hallway and fitted with electrically operated sun screening and opening devices for natural ventilation.
The roof windows in the hallway will contribute highly to creating a light and inviting entrance area and to making the passage more open. The present window holes in the great hall are relatively small and the roof windows will improve the daylight conditions considerably. At the same time the roof windows will contribute actively to adjust the indoor climate when a lot of people are gathered for activities like folk dance, lectures and private parties.

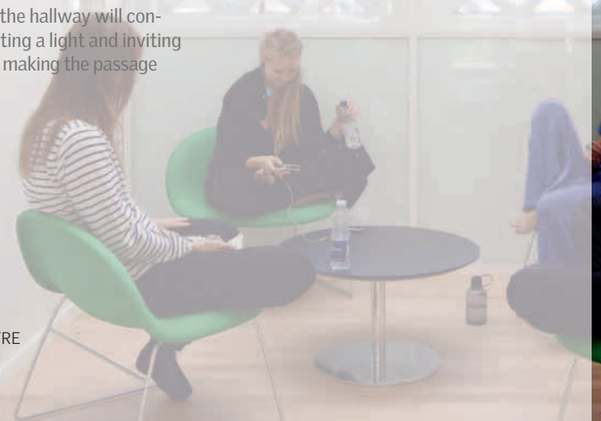
The gateway
The lines in the pavement are lines of light from LED light sources. They indicate the absence of natural light and, therefore, the density of lights is higher in the middle of the gateway. The light lines can be seen as rays of light bringing light to the middle of the gateway, which is so deep that no direct sunlight can get there.

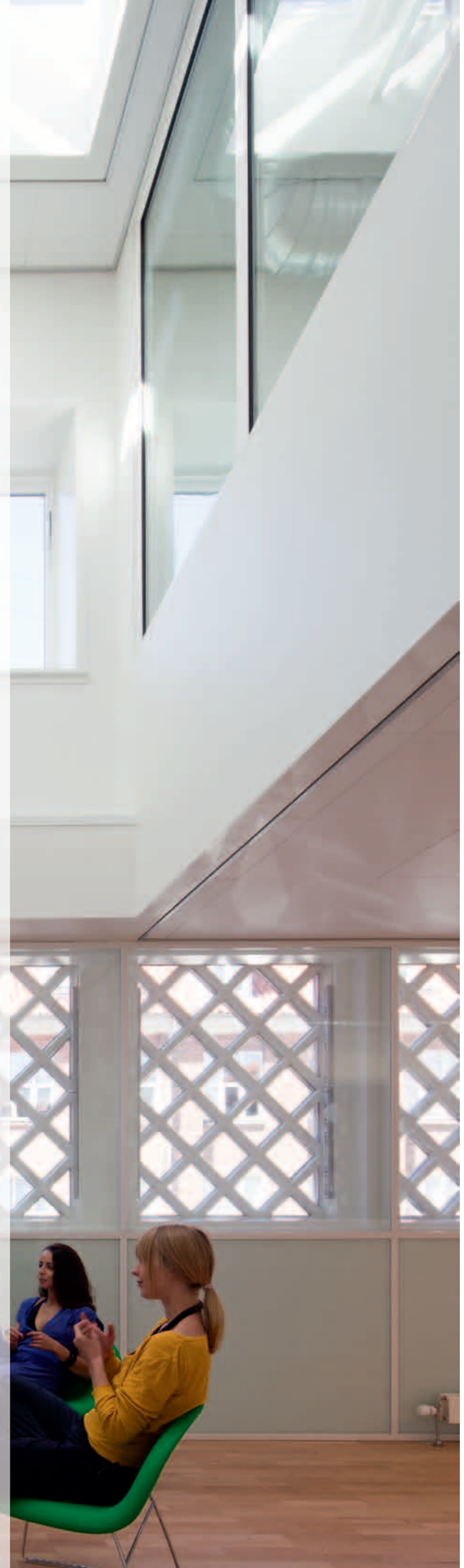
Long slits are cut out for windows in the wall. These lines correspond with the lines in the pavement and will contribute to the general lighting of the gateway during the dark hours, as well as ensure a visual and transparent connection between the interior and the exterior of the building.

Garden courtyard concept
The courtyard/garden on the south-east side of the building is designed to correspond with the elements of the gateway design.

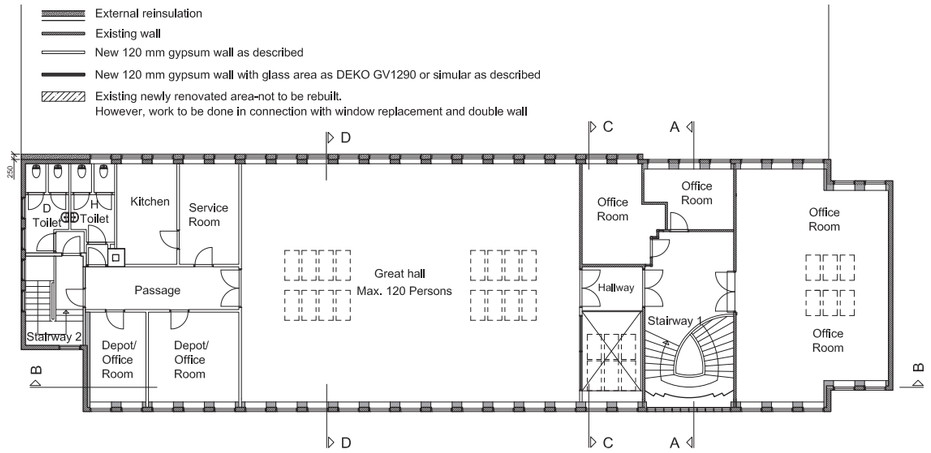
The LED light lines through the gateway follow a rigid order, while the path of LED lights in the courtyard follows a much more free structure. The order of the lights is designed to simulate the walking pattern of people visiting the place.

The courtyard/garden will be a small oasis in the centre of the large city, to be used for different kinds of events, but also simply as an area for a quick breath of fresh air.

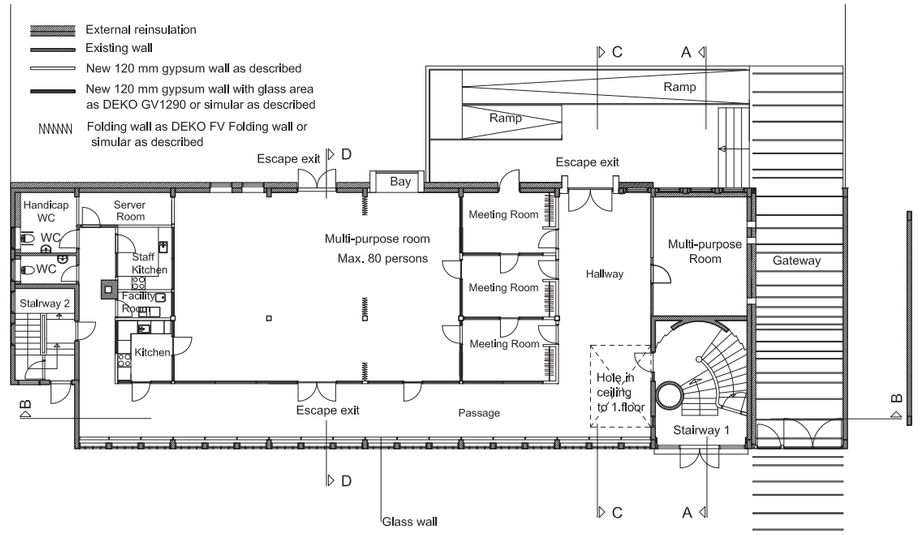




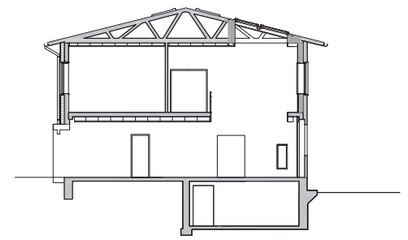
First floor



Ground floor



Section C-C



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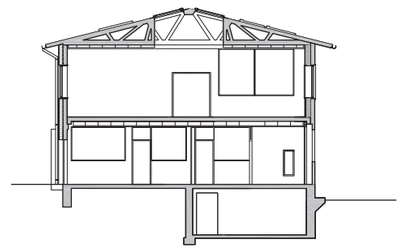
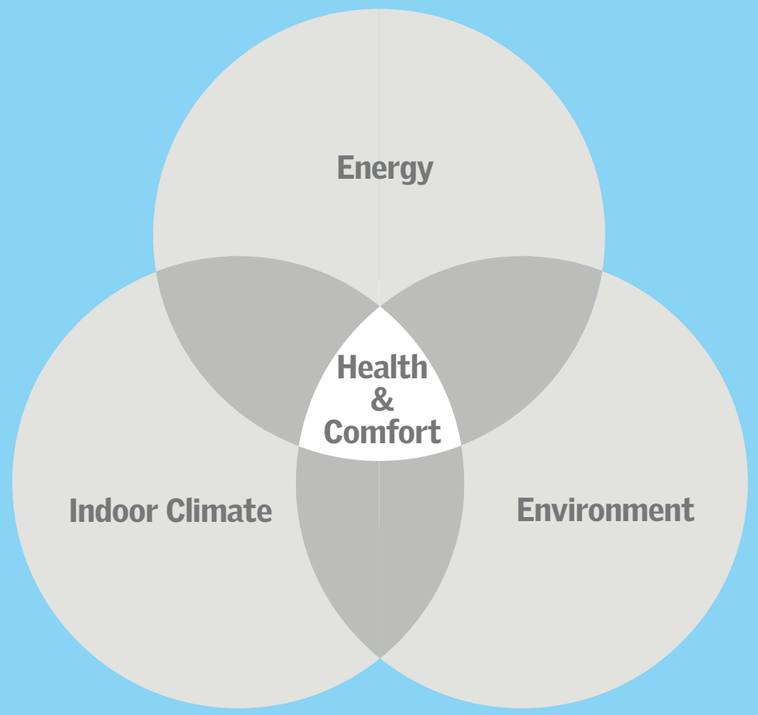


Active House

An initiative supported by VELUX



Energy challenge
is that buildings consume approximately 40 % of all produced energy (European figures). Considering the total energy consumption throughout the whole life cycle of the building is an important tool in the concern for climate changes, security of supply and for reducing global energy consumption.

Indoor Climate challenge
is that we spend 90 % of our time indoors, but less than 30 % of the building mass contributes to or provides a healthy indoor climate. We humans need fresh air and daylight when we are indoors. It has a positive effect on our health and well-being as well as our ability to learn.

Environment challenge
is that although the challenges we face are global, the local environment differs greatly, and many present solutions are only viable within fixed parameters. We need an open-minded approach to flexible solutions that take into account local cultural and infrastructural differences.

An »Active House« meets the future demands for sustainable buildings and has been developed with focus on health and comfort for the people living in it.

It has been designed to interact with local conditions and will to a wide extent use natural resources to make the house CO_2 neutral.

Energy

To reduce CO_2 emissions and optimise energy performance, it is necessary to consider the building as a whole, not just the sum of its components.

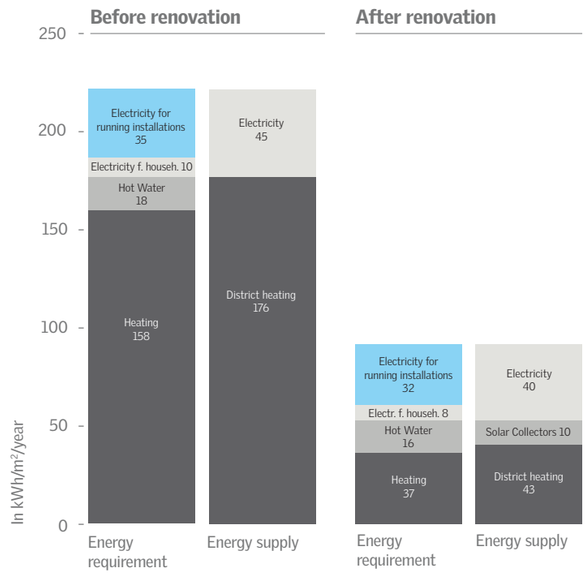
Energy efficiency needs to be incorporated into the very design of the building and the available natural resources, such as sun and wind, should be exploited to a maximum.

For instance, windows should be considered as energy contributors. They should be placed strategically to allow for solar heat gain and optimum natural ventilation; and different types of windows should be used for north and south facing installation.
In the OSRAM Culture Centre project it was decided to use the super low-energy pane ––65 in the north facing VELUX roof windows and a standard energy pane for the south oriented windows to allow maximum solar gain into the rooms. A flexible building envelope shall prevent overheating and possible glare in peak periods and, therefore, the VELUX roof windows have been fitted with electrical awning blinds, controlled either by the users or by the fully automatic control system NV Advance™ from WindowMaster.

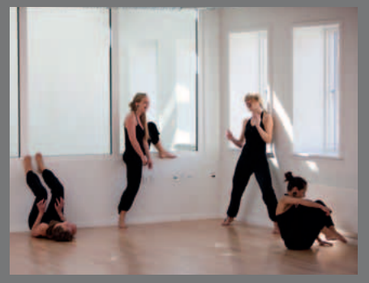
Solar collectors can provide up to 70 % of the energy required to produce domestic hot water. If solar thermal collectors were installed in every home in Europe, the saving could amount to some 20,000,000 tons of oil – equivalent to taking 20 million cars off the road every single year. The sun is the most powerful source of energy we have and we should make maximum use of it.

VELUX solar collectors will be integrated in the south facing roof area for production of hot water.

In connection with the new terrace, a reflecting pool for collection of rainwater from the roof is established. At the reflecting pool a new green wall will be made where the plants are watered by the pool. In this way the load on the sewer is lessened and the free resource, the rainwater, is utilized.



Indoor climate



Maximum daylight and ventilation are preconditions for ensuring optimal indoor comfort and minimal energy consumption consistent with future standards.

In a world with increasing health problems (partly due to e.g. the rising incidence of allergies), the indoor climate is an essential factor to be considered when designing a house.

Several studies document that daylight has a positive effect on health, productivity, children's learning abilities and the general well-being. Similarly, fresh air via natural ventilation is vital for producing a healthy indoor climate, reducing the consequences of toxic emissions from sources such as electronic devices and chemicals in the home – and thereby minimising the risk of allergies.

In the OSRAM Culture Centre project it was decided to use the stack effect by placing VELUX roof windows up high in the ridge and cutting a hole in the deck to the ground level thus allowing the effect to work at both levels. In addition, this allows better vertical communication and lets the daylight from south penetrate down to the ground level on the north side of the building.

Maximize natural daylight
The new design/lay-out of the rooms has focused on bringing balanced daylight into each room by moving the ground floor access hall from the centre of the building to the north and thereby creating a public climate zone where the diffuse northern light is mixed with "used daylight" through double-glazed panes fitted high in the internal walls between meeting rooms and the new access hall.

Climate zones
The new access hall also solves the challenges of the preservation-worthy north façade. There will be an internal glass wall. It will not have the same effect as insulation, but it will create some kind of medium-insulated zone, a transit area. Consequently, it does not need full heating and the standard insulation can be avoided that would, otherwise, have spoiled the expression of the old concrete facade.

Automatic control of natural ventilation
The planned complete solution for natural ventilation for the project OSRAM Culture Centre is based on the fully automatic control system NV Advance™ from WindowMaster.

The control system NV Advance™ is among the world's most advanced control systems for natural ventilation and guarantees adequate air change as well as efficient night cooling. It will monitor all 28 strategically placed VELUX roof windows incl. sun screening as well as 4 selected VELFAC façade windows. Window opening will be controlled automatically to optimize the indoor climate proportional to indoor and outdoor temperatures as well as the use of the building.

The building is divided into a number of ventilation zones each with their own sensors and parameters. In this way the climate in the zones will be monitored individually based on wind direction, wind speed and air pressure on the façade of the zone as well as indoor and outdoor temperatures and CO_2-level in the zone. The ventilation zones are controlled dependent on the air pressures on the facades, which are calculated by means of CFD calculations carried out specifically for this project. This results in optimization of the window openings according to 16 different wind directions and is an important part of the control strategy. A calendar module controls ventilation according to the season (summer/winter) and time of day (night, morning, daytime) and also optimizes the ventilation according to the following forms of ventilation:

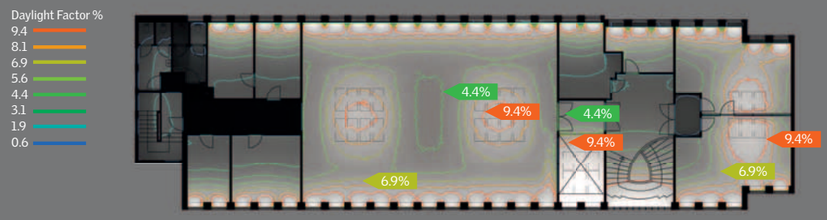
- **Fresh air function** – just before work begins in the morning or during scheduled brakes, the building is ventilated so the air will feel fresh and pleasant.
- **Night cooling** – efficient cooling of the thermal mass of the building when it is unused at night to avoid too high day temperatures during summer. The cooling of the building is adapted according to the thermal load the day before.
- **Pulse ventilation** – opening of windows and closing shortly after to allow minimum air change in the building – especially suited for cold periods and to avoid heat loss.
- **Trickle ventilation** – continuous air change, especially suited for hot periods and to create refreshing air currents.
- **User controlled** – if the user wants to take control of the ventilation it is possible to overrule the control system by switches or the user interfaced NV Visual™.
- **Safety function** – in case of rain or storm windows will close for safety reasons.

Apart from precise control of the natural ventilation, other systems such as e.g. sun screening, radiators, mechanical ventilators or light control can also be integrated into the system to ensure optimal indoor climate with minimal energy consumption. This is all controlled by the service module NV Visual™, which enables change of parameters for the system via the internet. Every single zone is visualised in NV Visual™, which also enables easy monitoring of the indoor climate, window openers, radiators, etc.

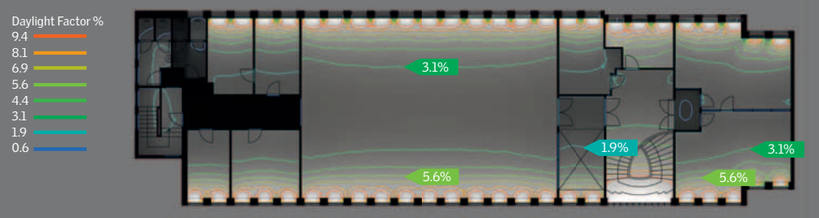
Hybrid ventilation
The project also includes a mechanical ventilation system mostly operating in the ground floor meeting rooms, but also as back-up in other parts of the building in peak periods.

Daylight factor, first floor

With roof windows

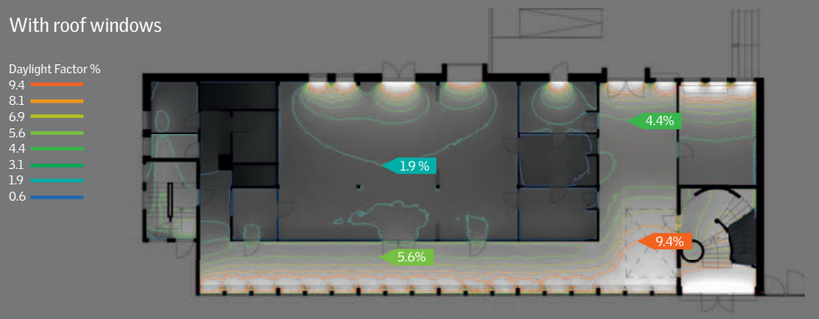


Without roof windows

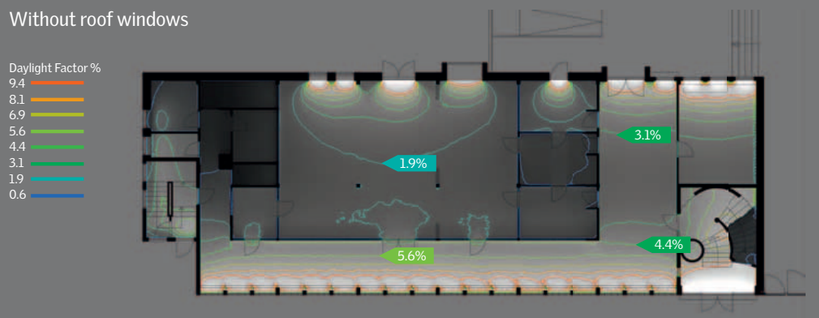


Daylight factor, ground floor

With roof windows



Without roof windows



Facts

The daylighting performance of OSRAM Culture Centre has been specified using the daylight factor (DF) as performance indicator.

The daylight factor is a common and easy to use measure for the available amount of daylight in a room. It expresses the percentage of daylight available in the interiors, on a work plane, compared to the amount of daylight available at the exterior of the building under known overcast sky conditions. The higher the DF, the more daylight is available in the room. Rooms with an average DF of 2 % or more are considered daylit. A room will appear strongly daylit when the average DF is above 5 %.

The daylight factor analysis has been performed using computer simulations of Radiance. The figures on the left show the daylight factor levels obtained on each floor for 2 different variants evaluating the impact of the installed roof windows on the finalized design.

The comparison of results shows the positive effects of adding roof windows on the daylight conditions of the first floor. The roof windows deliver high levels of daylight in the centre part of the main room, as well as in the meeting rooms at the end of the building. The use of roof windows also contributes to raise the daylight levels on the lower floor via a new opening in the existing structural floor situated below the skylights in the hallway.

Environment

OSRAM Culture Centre is a part of the project Neighbourhood Renewal.

What is neighbourhood renewal?

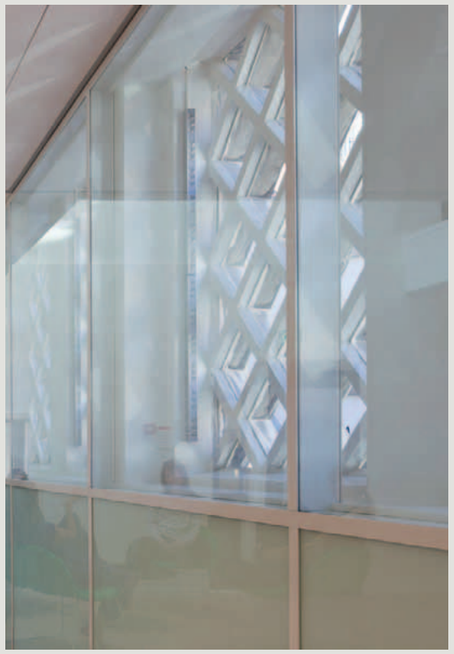
Neighbourhood renewal is an effort focusing on a defined part of the town and working on its problems and potentialities. Neighbourhood renewal is a kind of preferential treatment of one distinct part of town where local, municipal and governmental efforts are united for 5-6 years to push-start a new and positive process of development.

The objective of neighbourhood renewal is to try out the possibilities of accomplishing an effort that will combine improvement of housing and open spaces with improvement of the social environment and cultural life of the neighbourhood. The aim is to turn the trend of development in this part of town, which has experienced increasing social problems and is being physically run-down. In 2008 the municipality of Copenhagen decided to appoint the Culture Centre in Valhalsgade as spearhead of the city's environmental goals as well as demo project when the city was hosting the UN Climate Change Conference in December 2009.

It has been essential from the beginning to be in constant and open dialogue with the daily users of the building in order to find the right solution, which based on the users' knowledge, will incorporate their requirements and dreams together with the energy demands and the indoor climate required in the future building and for the use of it.
It is stressed that the implemented environmental initiatives must be relevant in connection with the actual use of the building, its location and status in the local area.
E.g. it is important to use building methods and materials that will be of inspiration for citizens in the neighbourhood and housing associations. It will also be relevant to carry out environmental projects, which do not themselves contribute considerably to a better environment, but on the other hand will make the users of the house reflect on monitoring and visibility of energy and water consumption.

Pia Allerslev, Mayor of Culture and Leisure in Copenhagen, politically responsible for all the city's buildings and behind the energy renovations, says:
"The project in Valhalsgade is important for the municipality – and not least the citizens. Here we can see how energy savings can be combined with renovation of a run-down building and provide the building with new qualities. We need this kind of solutions if we are going to solve the great climate challenges and I hope we can transfer these ideas to the many renovation projects, which will be carried out in the coming years."

In the EU today, we spend 90 % of our time indoors. But up to 30 % of the building mass neither contributes to nor provides a healthy indoor climate.



The Culture Centre after renovation.

Intelligent houses of the future will be designed to control the indoor climate automatically; smart enough to know when to insulate from cold, when to protect from heat and when to provide ventilation.

Photos taken after the energy renovation:

The upper photo shows: The great hall on the first floor. Roof windows are installed above the great hall area and are fitted with electrically operated sun screening and opening devices for natural ventilation. The present window holes in the great hall are relatively small and the roof windows will improve the daylight conditions considerably. At the same time the roof windows will contribute actively to adjust the indoor climate when a lot of people are gathered for activities like folk dance, lectures and private parties.

The lower photo shows: The passage from the entrance hall along the street façade with the new glass wall of energy efficient glass. The architectonic expression has been maintained and the heat loss reduced.

The photo to the left shows: The look down through the new opening in the floor to the entrance hall and the passage downstairs. The roof windows are contributing highly to create daylight and an inviting entrance area.

Photos: Torben Eskerod

VELUX Products

used in the OSRAM Culture Centre

VELUX creates better homes with daylight and fresh air through the roof. Our product range contains a wide range of roof windows and skylights, along with solutions for flat roofs. In addition, VELUX offers many types of decoration and sunscreening, roller shutters, installation products, products for remote control and thermal solar collectors for installation in roofs. The VELUX Group, which has manufacturing companies in 10 countries and sales companies in just under 40 countries, is one of the strongest brands in the global building materials sector and its products are sold in most parts of the world.

The Group has around 9,000 employees, of which approx. 3,000 are based in Denmark. The VELUX Group is owned by VKR Holding. VKR Holding is a limited company wholly owned by family and foundations. The main shareholders are the charitable VELUX foundations.

For more details, visit **www.velux.com**

Windows

VELUX roof windows. Pivot hung versions. Model GGU INTEGRA®. Electrically operated roof window including remote control and rain sensor for automatic closing in case of rain.

VELUX roof windows facing north have super low-energy panes type --65

VELUX roof windows facing south have low-energy panes type --73

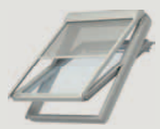
Solar collectors

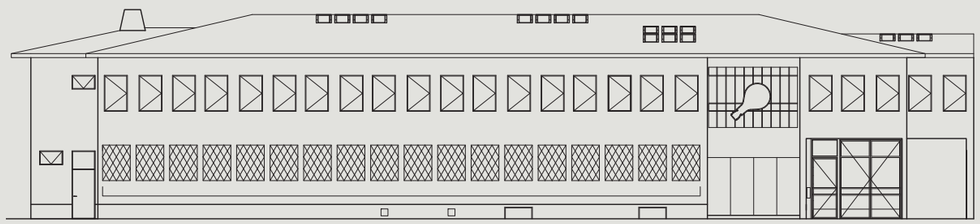
VELUX solar collectors for hot water supply. Model CLI.

Sunscreening products

Interior sunscreening - Roller blinds. Electrically operated. Model RML.

Exterior sunscreening - Awning blinds. Electrically operated. Model MML.





OSRAM Culture Centre
Copenhagen, Denmark

Building owner
City of Copenhagen

KØBENHAVNS KOMMUNE

Consultant
Wissenberg A/S

Architect
Tegnestuen T-plus

Engineer Electricity
PME Elrådgivning Aps

General contractor
Enemærke & Petersen A/S

Partners
Danfoss A/S
Louis Poulsen Lighting A/S
Osram A/S
Pilkington Denmark A/S
Rockwool A/S
VELFAC A/S
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