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Osram Culture Centre – Copenhagen, Denmark

Valhalsgade 4, 2200 Copenhagen N

1. INTRODUCTION

PROJECT SUMMARY

Construction year: 1953
Energy renovation: 2009
No past energy renovations

SPECIAL FEATURES

Insulation of thermal envelope using alternative methods - Energy saving ligting - Solar collectors - Energy efficient windows – Daylighting - Automatically controlled natural ventilation

MAIN CONSULTANT

Wissenberg A/S

ARCHITECT

Tegnestuen T-plus

ELECTRICAL CONSULTANT

PME Elrådgivning A/S

PARTNERS

Danfoss A/S, Louis Poulsen Lighting A/S, Osram A/S, Pilkington Denmark A/S, Rockwool A/S, VELFAC A/S, VELUX A/S & WindowMaster A/S

OWNER

City of Copenhagen

Brochure authors: Jørgen Rose and Kirsten Engelund Thomsen
Danish Building Research Institute, AAU
Contact: jro@sbi.aau.dk

IEA – SHC Task 47

Renovation of Non-Residential Buildings towards Sustainable Standards

2. CONTEXT AND BACKGROUND

BACKGROUND

Built in 1953 as an industrial building. It was the first prefabricated house in Copenhagen. Built as an office and warehouse for Nordisk Glødelampe Industri A/S.

OBJECTIVES OF THE RENOVATION

•To renovate a former industrial building, now in use as Culture Centre, by utilizing daylight and mechanical and natural ventilation to improve the indoor climate.
•To minimise energy consumption by improving the thermal envelope and utilizing energy saving lighting.
•To minimize the resources required (and, consequently, the CO_2 emissions) both during construction and upkeep.

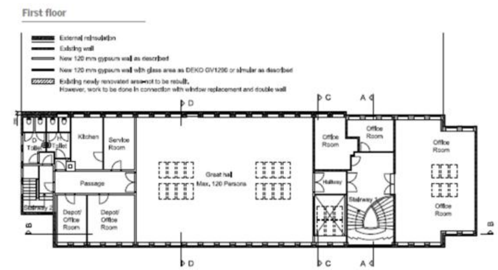
SUMMARY OF THE RENOVATION

•Created a more appropriate layout of the ground floor and first floor.
•Penetrated the ground floor ceiling to double the room height in part of the entrance and to improve daylighting.
•Glazed Indoor walls in the upper part, avoiding glimpsing, but improving daylight.
•Installed roof windows above the great hall; installed electrically operated sun screening and opening devices for natural ventilation in offices and hallway on first floor.
•Added inside insulation to the protected façade on ground floor using floor to ceiling energy glass.
•Added inside insulation to the protected façade on the first floor using mineral wool and plaster boards.
•Added outside insulation to the façade towards the garden using mineral wool and hard pressed mineral cover plates.
•Installed new thin frame windows with energy glass.
•Changed single glass to double energy glass in the original teak wood main entrance.
•Installed mechanical ventilation with highly efficient heat recovery.
•Installed low energy lighting.
•Installed LED lighting for decorative purposes and to make visible in the neighbourhood.
•Improved access for disabled people.
•Primary energy: 288 kWh/m^2 pr. year before renovation, 153 kWh/m^2 pr. year after, i.e. a total reduction 47%.

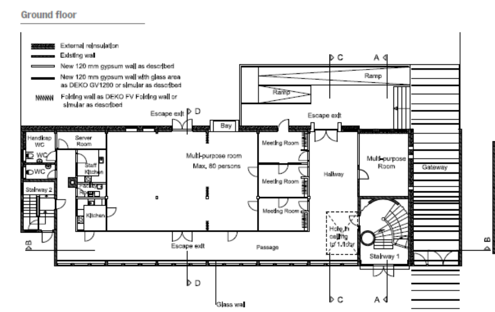
•Cost: 11 mio. DKK (1.5 mio. €)

Façade facing garden - Before renovation

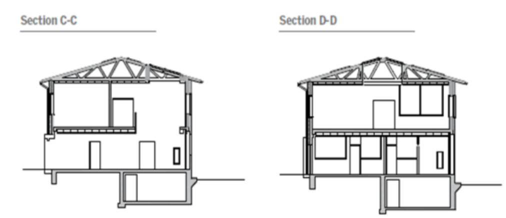
Façade facing garden - After renovation



First floor



Ground floor



Sections

3. DECISION MAKING PROCESSES

WHY RENOVATION

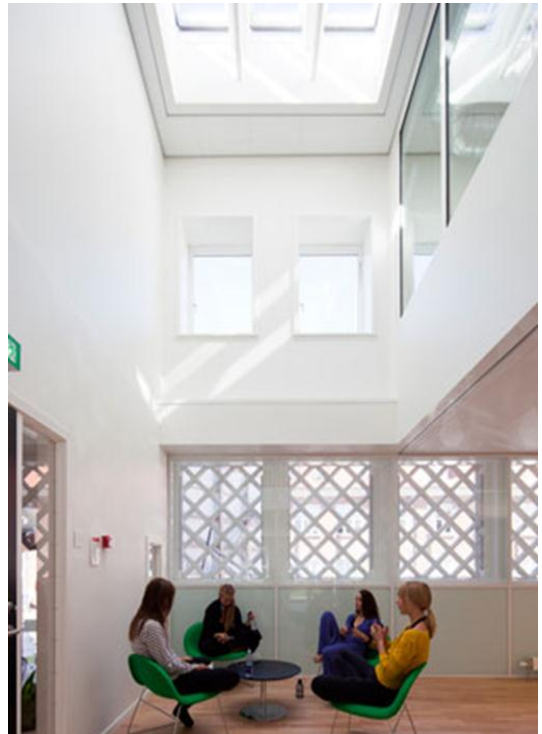
As a part of Neighborhood Development Project in a former semi industrial area of Copenhagen, the City of Copenhagen initiated an energy renovation of the cultural center “OSRAM”. The intention was to create a significant cultural base in the neighborhood and to use the energy project as an example and inspiration in the local community. The daily users and the local administration of “OSRAM” were deeply involved in the programming of the renovation project.

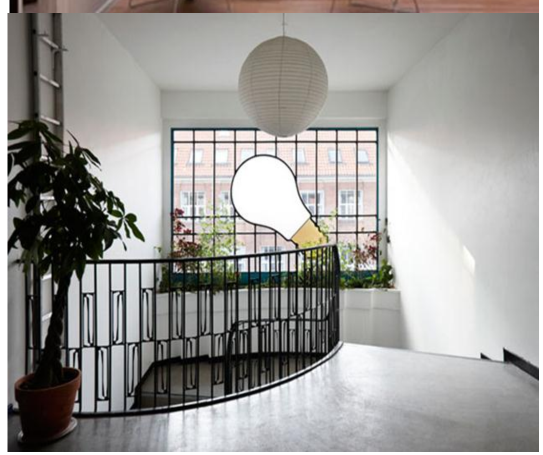
In connection with the Climate Change Conference (COP15 2009), the City of Copenhagen initiated strategic cooperation with a number of Danish enterprises for the purpose of mutual profiling on climate-friendly buildings. The target to minimize the resources required (and, consequently, the CO_2 emissions) both during construction and upkeep. The renovation of the culture center “OSRAM” is a part of this cooperation and is a demonstration for possibilities and methods of renovating old industrial and commercial buildings worth preserving.

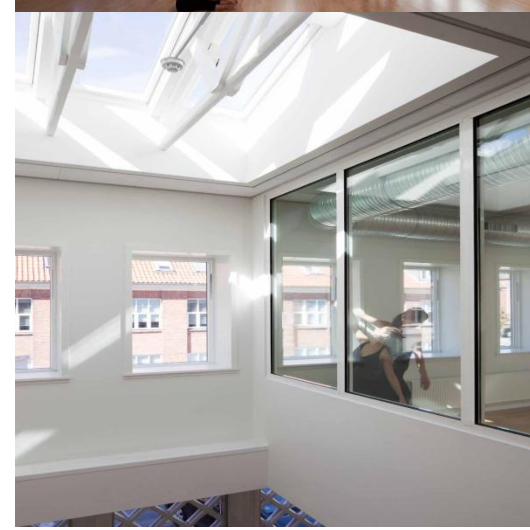
PUBLIC FUNDING

The project received public funding from several institutions and initiatives:

- *Københavns Kommune Energipulje (Copenhagen Energy Pool)*
- *CO_2 neutralitet i eksisterende bydele (Pool for CO_2 neutrality in existing city districts)*
- *Byfornyelsesmidler (Urban renewal funds)*
- *Tilgængelighedspulje (Accessibility pool)*







4. THERMAL ENVELOPE

ROOF

The original roof insulation was mineral granules and later supplemented with batts for a total thick-ness of 150 mm. The center of the roof has a footbridge with an extra 100 mm of insulation, no extra insulation was added.

DECK ABOVE THE GATE

The deck above the gate (to the right of the entrance) was 120 mm concrete.

380 mm of insulation was added on the outside.

WALLS

The walls are a mix of prefabricated concrete elements, concrete columns and uninsulated brick walls.

380 mm of insulation was added on the inside. The lower part of the back façade was insulated on the outside.

WINDOWS/DOORS

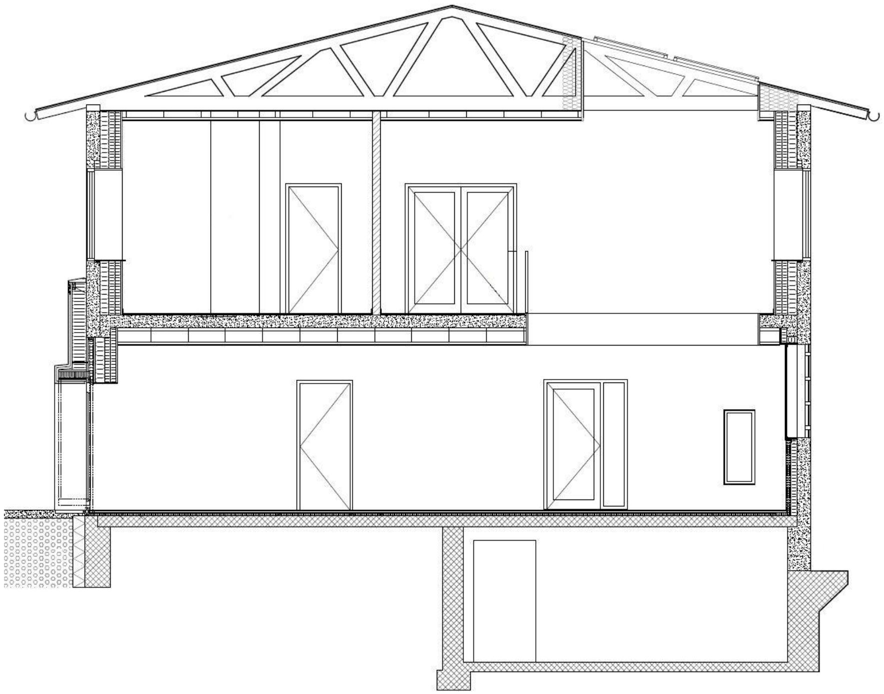
The windows in the building ranged from single glass windows with different levels of sashes to standard windows with two layers of glass. The main entrance door had a single layer of glass. The two other entrance doors to the building were relatively new.

All windows were changed to low energy windows except for the façade windows on the ground floor. Here a floor-to-ceiling glazing was added on the inside to preserve the expression of the façade. Skylights were installed in roof.

SLAB FLOOR AND BASEMENT DECK

Half of the ground floor was a deck construction facing ground. It consisted of 120 mm concrete on 120 mm cinder. The remaining part faced the partially heated basement and consisted of 200 mm reinforced concrete.

No insulation was added to the slab/deck. 100 mm insulation was added to the outside of the foundation.



Cross section of the renovated building.

Construction U-values [W/m²K]	U-value before	U-value after
Roof	0.20 – 0.30	0.20 – 0.30
Deck above the gate	3.90	0.09
Walls	1.65 – 3.73	0.09
Windows	2.70 – 5.90	1.20
Doors	1.00 – 5.20	1.00 – 1.50
Slab floor and basement deck	0.57 – 2.37	0.57 – 2.37

5. BUILDING INTERIOR SYSTEM

HEATING SYSTEM

The original heating system relied on district heating using steam supply. The heat distribution system was a single pipe system.

The new heating system is district heating using hot water supply. The heat distribution system is a two pipe system and thermostat valves have been added to the radiators.

DAYLIGHTING

In addition to the existing windows, the renovation building added 24 m^2 of roof windows. 16 roof windows of 0.66 m x 1.40 m and 12 roof windows 0.66 m x 1.18 m, to increase the amount of daylighting in the building.

VENTILATION

The original ventilation system was a simple mechanical exhaust system where air was removed from toilets and kitchens.

In the renovated building, mechanical ventilation with heat recovery was installed and this was supplemented by natural ventilation via the roof windows. The natural ventilation is controlled by electric motors based on the indoor climate.

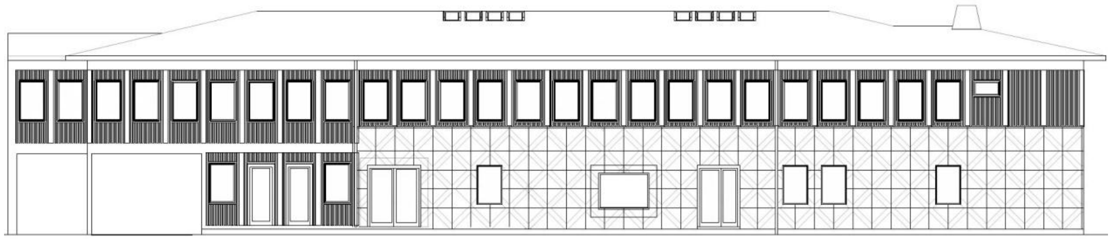
HOT WATER PRODUCTION

The original system was based on district heating using steam supply.

Solar heating was added to the building to supplement the district heating using hot water supply.

PHOTOVOLTAIC PANELS

There are no photovoltaic panels installed yet, but there are plans to add a total area of 4.8 m^2.



Façade of the renovated building

The old façade was preserved by adding floor-to-ceiling glazing on the inside.

Daylighting and natural ventilation via roof windows.

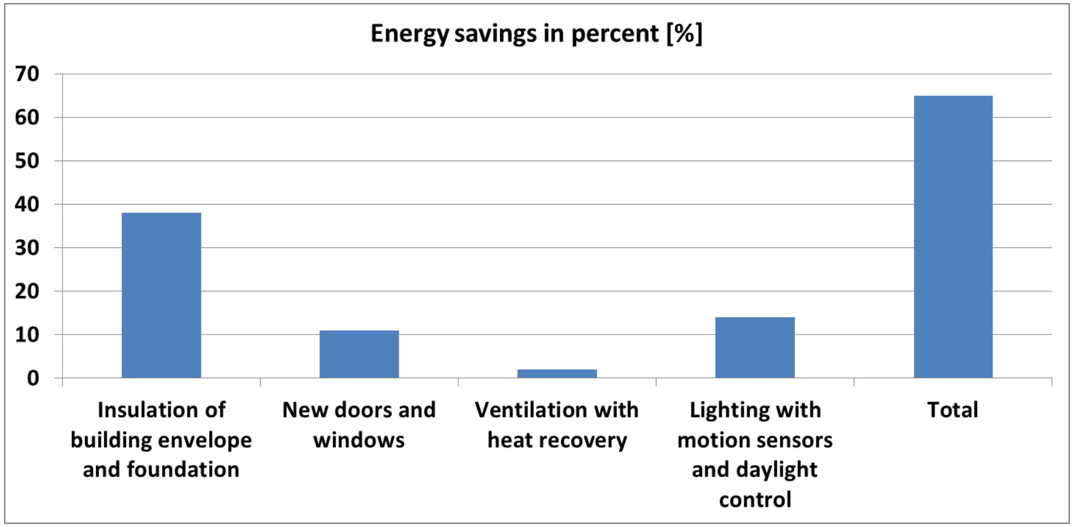
6. ENERGY PERFORMANCES

ENERGY CONSUMPTION [kWh/m²]

Energy use [kWh/m²]	Before	After
Electricity for installations	35	32
Electricity for household appliances	10	8
Domestic hot water production (district heating)	18	16
Heating (district heating)	158	37

ENERGY SAVINGS [kWh/year]

Energy saving measure	Electricity	Heat
Façade insulation		60,000
Windows/doors		70,000
Inside glazing		20,000
Heating system		15,000
Lighting system	9,000	
Controls	500	10,000
Solar panels		6,000
Total	9,500	181,000



The ground floor of the back façade was insulated from the outside.

7. ENVIRONMENTAL PERFORMANCE

INDOOR CLIMATE

The indoor climate of the building was improved significantly by the renovation process. Daylighting levels in the building were raised by introducing roof windows, raised daylight levels on the first floor and on the ground floor (see pictures).

The insulation of the building envelope along with the installation of new windows increased the thermal comfort in the building. The increase in air tightness and the removal of cold areas (windows and walls) have helped to remove draught and general discomfort in the building.

INCREASING QUALITY OF LIFE

Another important aspect of the building renovation is the improved lay-out of the building and the flexibility with which the building can now be used. The improved indoor climate has also helped to make the entire building area useable.

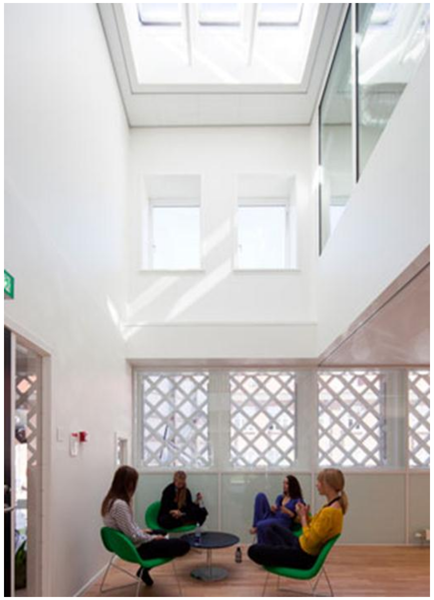
INDOOR AIR QUALITY

The indoor air quality has improved significantly with the introduction of a combined mechanical and natural ventilation system. The mechanical system has heat recovery and ventilates the building during winter. When indoor temperatures or CO_2 levels in the building get too high, the automatic natural ventilation is initiated (opening of roof windows).

LIGHTING QUALITY

The lighting systems in the building have also improved. The general lighting system is fitted with automatic control so that the electric lighting is dependent on daylight levels in the building (there is a manual override to this function).
Also, decorative LED lighting was added to the window sills in the original façade windows of the building, making it possible to set the scene for any arrangement in the building.

Decorative multi-colored LED-lights were placed in the window sills.



The roof windows have a significant and positive influence on the daylighting level in the building.

8. FURTHER INFORMATION

RENOVATION COSTS

The total renovation costs (investment total), the part of the investment actually related to energy savings (investment energy), the energy savings per year (savings), the simple payback time (payback time) and the expected CO_2 emission reductions (CO_2 reduction) are given in the table.

The total investment for the renovation project was approximately 564,000 € of which 212,000 € were directly aimed at energy reductions. The expected total savings per year was 13,000 €; resulting in a simple payback time for the entire project of approximately 18 years. Estimated CO_2 reductions ~~of~~ are approximately 29 tons per year.

OTHER INTERESTING ASPECTS

Since summer 2010 the Osram building has held many different events for children, adolescents, families, institutions, schools and other interested parties.

Besides offering cultural events for the local population, the Osram building also rents out halls and rooms for individual and business activities. Many associations, organizations and individuals have already benefited greatly from the many facilities. The house is also geared for companies that want to have meetings, conferences and workshops in the "green" surroundings and offers excellent AV facilities.

Energy saving measure	Investment total [€]	Investment energy [€]	Savings [€/yr]	Payback time [yr]	CO_2 reduction [kg CO_2/yr]
Façade insulation	120,267	86,667	3,600	24.1	7,740
Windows/doors	70,933	20,000	4,200	4.8	9,030
Inside glazing	48,000	48,000	1,200	40.0	2,580
Heating system	60,533	13,333	900	14.8	1,935
Lighting system	220,654	26,667	1,968	13.6	5,292
Controls	35,600	6,667	709	9.4	1,584
Solar panels	8,000	6,667	360	18.5	774
Total/mean	563,988	212,000	12,937	17.9	28,935