

Deep retrofit of an older Danish office building

IEA SHC TASK 47
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Rockwool International Office Building “Center 2”

Hovedgaden 584, 2640 Hedehusene, Denmark



IEA – SHC Task 47

Renovation of Non-Residential Buildings towards Sustainable Standards

1. INTRODUCTION

PROJECT SUMMARY

Construction year: 1979

Energy renovation: 2013

SPECIAL FEATURES

- *New facades, floors and ceilings*
- *New windows with 3 layers of glass*
- *New ventilation system with higher efficiency and heat recovery*
- *New heating system (heat pumps)*
- *New water based solar collectors*
- *New photovoltaic system*

ARCHITECT

Vandkunsten A/S

ENGINEER

MOE A/S

CONTRACTOR

Jakon A/S

OWNER

Rockwool International A/S

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2. CONTEXT AND BACKGROUND

BACKGROUND

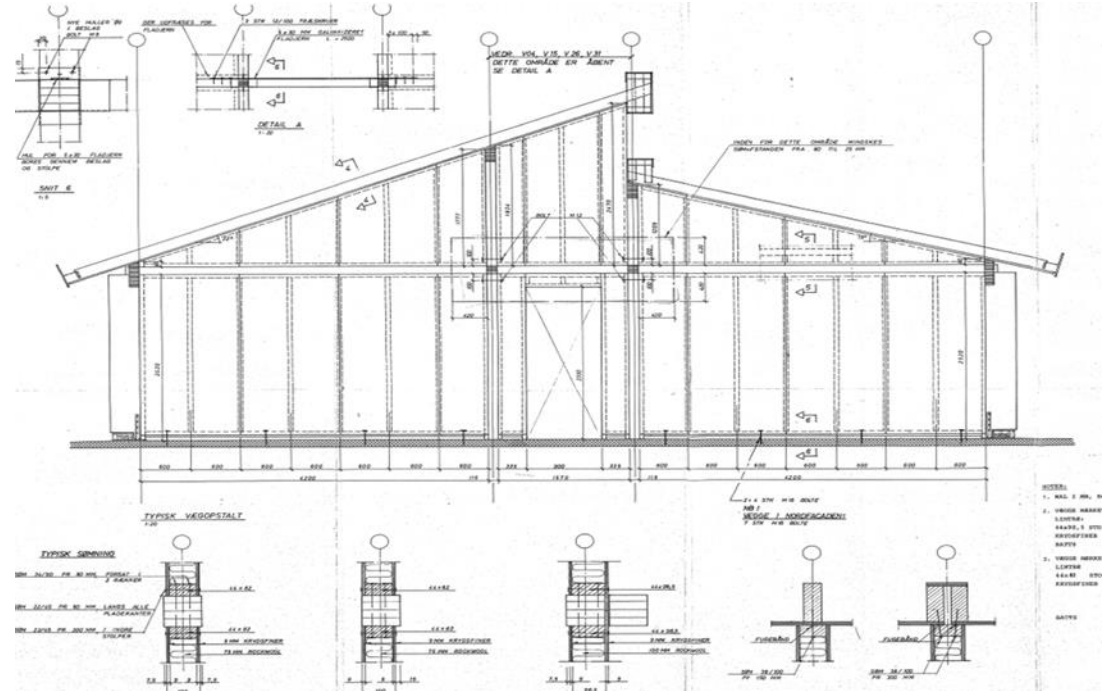
The office space was outdated and the energy performance and indoor climate were far below the current standard. The existing building was heated by electrical heating and with standard double-glazed windows. The ventilation system was without heat recovery. There is a parking lot below the building and the floor construction was poorly insulated resulting in a large heat loss through the floor.

OBJECTIVES OF THE RENOVATION

The aim of the renovation has been to upgrade the energy performance to meet the future Danish low energy class 2015 for new buildings and to achieve a high quality office work space.

SUMMARY OF THE RENOVATION

- New facades with Rockwool-FlexSystem
- 3 layer windows (U-value 0.75 W/m²K)
- Extra 180 mm Hardrock insulation and granulate in the parking deck
- LED electrical lighting
- Mechanical ventilation with heat recovery
- Natural ventilation in the top of the building
- Heat pumps with vertical 120 m deep wells
- 86 m² solar panels for hot water
- 170 m² PV (production 7 kWh/m² year)
- The renovated building will be EEC-ECO-Life certified
- Two out of four green gardens are covered by a roof to create two atriums



Existing construction



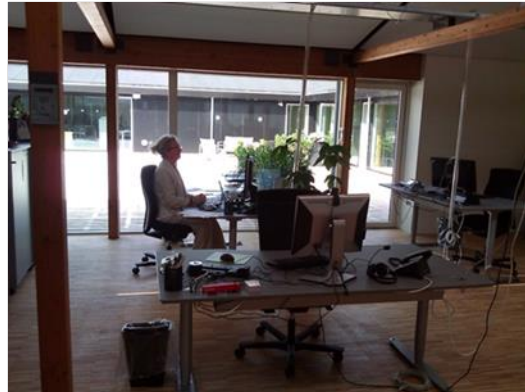
Facade before and after retrofitting

Plan

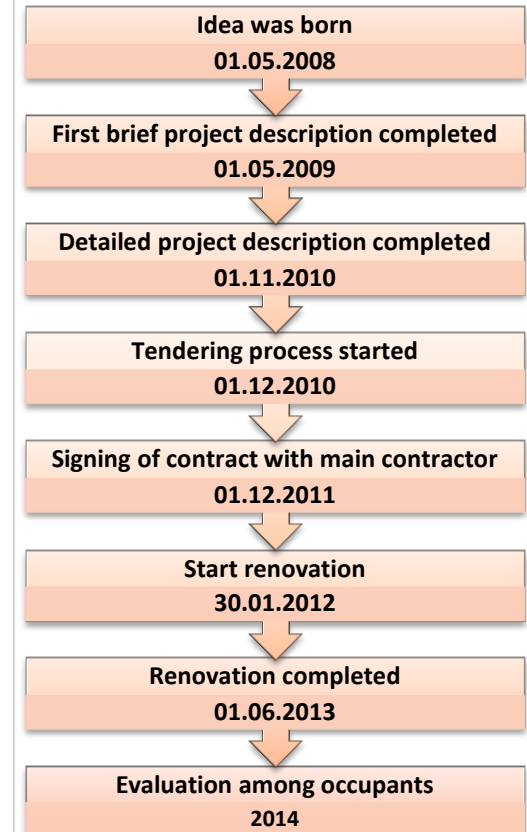


3. DECISION MAKING PROCESSES

- *Rockwool International A/S initiated the project. The main incentives for the renovation was to reduce energy consumption for the 34 year old office building and to make attractive, up-to-date working space areas for 120 employees*
- *Furthermore, Rockwool wanted to focus on the challenges and possibilities there are in raising the energy standard in industrial constructions*
- *The building had a very high energy consumption of approx. 264 kWh/m² per year*
- *An alternative to the extensive renovation was to demolish the old office building and construct a new one. However, this solution turned out to be much more expensive and to have a higher environmental impact, primarily due to the heavy concrete structure of the existing building*



Timeline for the decision making process



4. BUILDING ENVELOPE

Roof construction U -value: 0.14 W/m²K.

Atrium roof: 0.082 W/m²K

Wall construction U -value: 0.08 W/m²K

Gypsum board

Vermacel board

145 mm ROCKWOOL, A-Flexi Batts

Plywood

250 mm ROCKWOOL, FLEXSYSTEM batts

Rockpanel board

Windows: : U -value 0.75 W/m²K

Outrup windows and doors

Frames made of Rockwool

Parking deck and floor U -value: 0.06 W/m²K

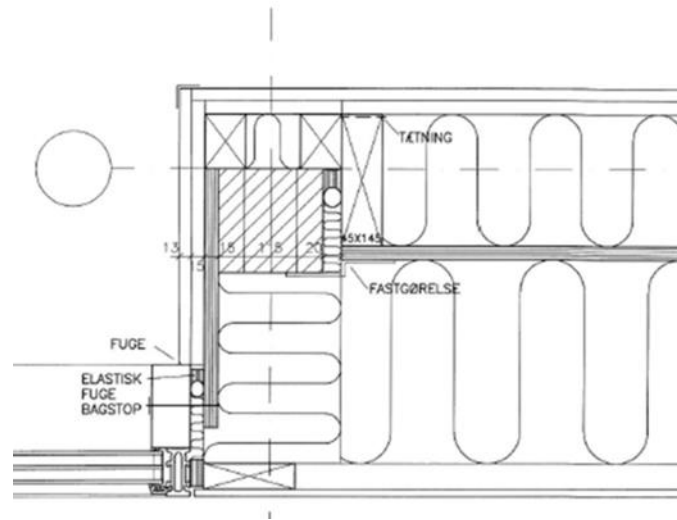
Summary of U -values [W/m²K]

	Before	After
Roof/attic	0.14	0.14
Floor/slab	0.17	0.06
Walls	0.17	0.08
Windows	2.4	0.75

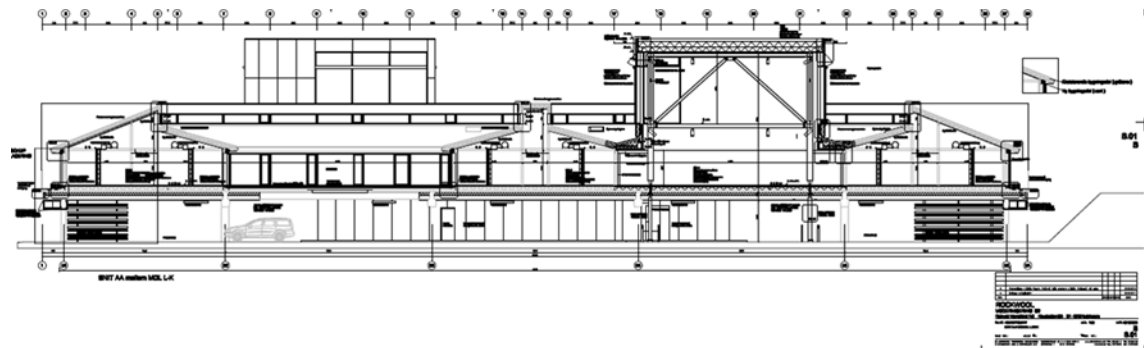
Contact person at Rockwool International A/S:

Arne Damsgaard Olsen

Facility Manager



New facade, U -value 0.08 W/m²K



New cross section

Outtrup windows and doors

U-value: 0.75 W/m²K

Frames made of ROCKWOOL



Insulation parking deck and floor: U-value: 0.06 W/m²K



5. BUILDING SERVICES SYSTEM

OVERALL DESIGN STRATEGY

The overall goal was to reach an energy level corresponding to low energy class 2015, i.e. better than the minimum requirements for new buildings.

LIGHTING SYSTEM

New LED lighting and other low energy lighting systems are installed

HEATING SYSTEM

Before the heating was electric, after renovation heat pumps (2 x 75 kW) with ground heat (15 vertical 120 m deep wells) are installed

VENTILATION & COOLING SYSTEM

Before the ventilation system was without heat recovery. After renovation a system is installed with a heat recovery rate of 84% and cooling. Indoor climate is Class A. natural ventilation in the top of the building

HOT WATER PRODUCTION

After renovation a solar collector for hot water production is installed

RENEWABLE ENERGY SYSTEMS

After renovation a 170 m² PV system is installed



86 m² heat collector mainly for hot water (production 3 kWh/m² heated floor area per year)

170 m² PV (production 7 kWh/m² heated floor area per year)

LED electrical lighting (and other low energy lighting)



Natural ventilation in the top of the building



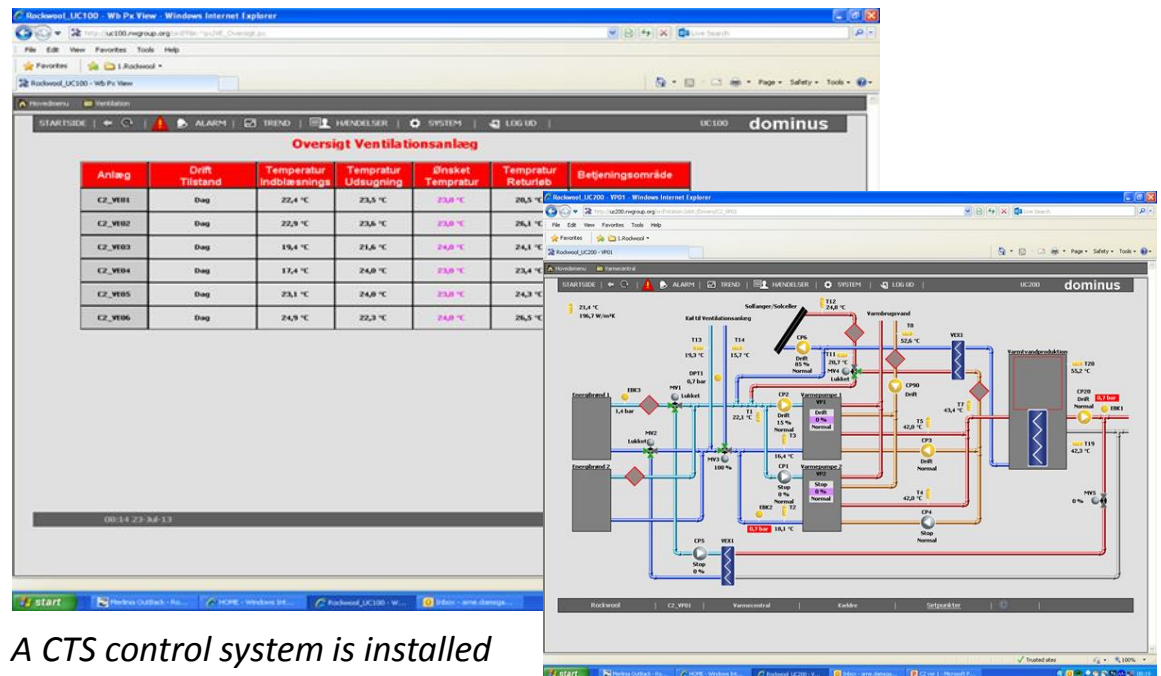
6. ENERGY PERFORMANCES

The existing building consumed 264 kWh/m² per year, and after the extensive renovation the calculated consumption will be reduced to 41 kWh/m², i.e. a reduction of 84%

In the table below are seen the energy flows (primary energy) from the different parts of the systems from the energy frame calculation

Energy flow		kWh/m ² /year
Space heating		40.9
Hot water		7.1
Hot water	EL	3.5
Ventilation	EL	7.3
Light	EL	15.5
Heat pumps	EL	25.0
Pumps	EL	2.0
Cooling	EL	4.5
Solar heat		-3.0
Heat pumps		-45.0
PV panels	EL	-16.8
Total		41.2

Item	Unit	Existing	After
		Centre 2	renovation
Area	m ²	3,133	3,626
Green gardens	#	4	2
Atriums	#	0	2
Total energy consumption	kWh/m ² /year	264	41.2
Workspaces	#	120	120



A CTS control system is installed

7. ENVIRONMENTAL PERFORMANCE

Water management

- 86 m² solar collector for hot water (production 3 kWh/m² year)

Certification / Labels

- The old building had an energy label F, the renovated building will have an A
- The renovated building will be EEC-ECO-Life certificated.

Indoor climate

- Mechanical ventilation with heat recovery (84 %) and cooling
- Indoor climate: Class A
- Natural ventilation in the top of the building

Increasing quality of life

- The building is now equipped with two atriums and two green gardens

Lighting quality

- LED electrical lighting
- Daylight

Acoustic quality

- Rockfon ceilings



8. MORE INFORMATIONS

RENOVATION COSTS

- The total cost of the renovation project is 16,700 DKK/m² (~2,242 €/m²). The part of the total cost which is directly related to the improvement in energy performance is approx. 9,700 DKK/m² (~2,242 €/m²). This cost covers all work related to the energy performance including the cost for going beyond the Building Regulation requirements
- The total costs related to the energy renovation makes up 58% of the total project cost
- The energy renovation cost savings have a payback time of approx. 41 years

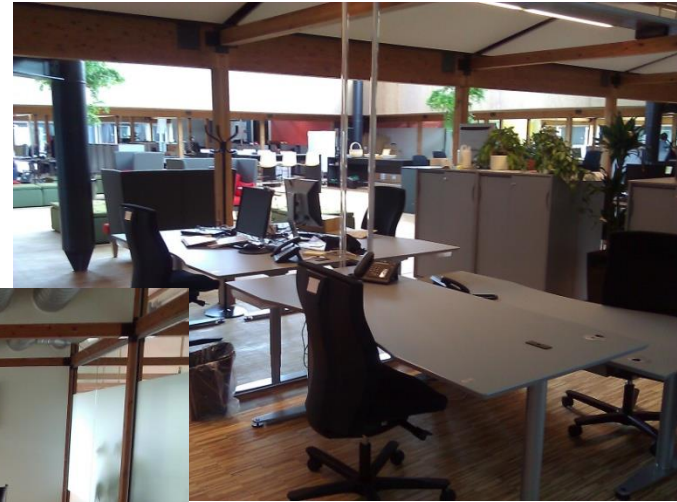
FINANCING MODEL

- All costs are covered by Rockwool International A/S
- During the renovation work it was discovered that the existing building had a severe attack of rot, mould and fungus in the existing floor. The additional cost for mould and fungus repair has been equally split between energy related cost and the cost of the renovation work

Building renovation costs including consultancy	kr./m ²	EUR/m ²
Total costs excluding furniture	16,700	2,241
Total costs for energy renovation only (including mold and fungi repair)	9,700	1,300
Building costs for a new building	kr./m ²	EUR/m ²
New building including parking cellar	25,000	3,350
Difference in costs new building and renovated building	8,300	1,100
Saving in renovation or building new	30 mill. kr.	4 mill. EUR

Cost savings (energy renovation costs only)	
Energy costs before (heating, cooling, light, hot water)	1.0 mill. kr./year
Energy costs after	0.2 mill. kr./year
Payback time	41 years

Interior design and workplaces





Thank you for
the attention

