Kindergarten Vejtoften, Høje-Taastrup, Denmark

Vejtoften 1, 2630 Taastrup

1. INTRODUCTION

PROJECT SUMMARY

Construction year: 1971
Energy renovation: 2010
No previous energy renovations

SPECIAL FEATURES

- *Insulation of thermal envelope*
- *New windows with 3 layers of glass*
- *New ventilation system with higher efficiency and heat recovery*

MAIN CONTRACTOR

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ARCHITECTURAL ADVISOR

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PARTNERS

Rockwool A/S

OWNER

Municipality of Høje Taastrup

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IEA SHC Task 47

Renovation of Non-Residential Buildings towards Sustainable Standards

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

2. CONTEXT AND BACKGROUND

BACKGROUND

Built in 1971 therefore the kindergarten had minimal insulation and needed basic repairs. It is 1 of 27 kindergartens in the municipality of Høje-Taastrup that will undergo an extensive energy renovation. The method will be similar in all projects.

OBJECTIVES OF THE RENOVATION

- *The main objective was to achieve an overall renovation of the existing building, i.e. roof was leaking, windows were worn out and the building was suffering from uncomfortable draught.*
- *This was achieved while also minimising the energy consumption by adding insulation to the façade, replacing existing windows, improving air tightness of the building envelope and replacing the ventilation system.*

SUMMARY OF THE RENOVATION

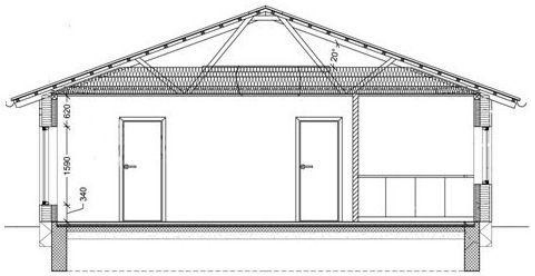
- *Roof: 390 mm's insulation was added to the existing 145 mm's. New asphalt roofing was installed.*
- *Wall: The existing construction had 95 mm's insulation. This was replaced by a new construction with 95 mm's + 195 mm's of insulation. A new cladding of fibre-cement was added.*
- *Base/foundation: The original base had no insulation and therefore 200 mm's of insulation was added on the outside to a depth of 400 mm.*
- *Windows: Existing traditional double-glazed windows were replaced by larger triple-glazed windows, as shown in the photos.*
- *Ventilation system: The original ventilation system was replaced by a more energy efficient system.*

•Total cost of renovation: 1.5 mio. DKK (200,000 €) or 4,300 DKK/m² (575 €/m²)

Façade facing playground - Before renovation

Façade facing garden - After renovation

Floor plan. Total heated area is 330.4 m²



Vertical section

3. DECISION MAKING PROCESSES

WHY RENOVATION?

The main incentives for the renovation was to both reduce energy consumption and improve indoor climate.

The kindergarten was built in 1971 and therefore had a very poor insulation level to begin with and the windows were reaching a state where they had to be changed.

There are 27 kindergartens of this kind in Høje-Taastrup. Instead of making minor energy renovations on all 27 institutions, it was more cost-effective to completely energy retrofit a few at a time. All the kindergartens will undergo similar energy renovations over the next few years.

PUBLIC FUNDING

The kindergarten is owned by the municipality of Høje-Taastrup, which has financed the entire project without external funding.

Above: Façade before renovation
Below: Existing insulation and windows

Above: Old insulation has been removed and new windows have been installed
Below: New insulation has been added

4. THERMAL ENVELOPE

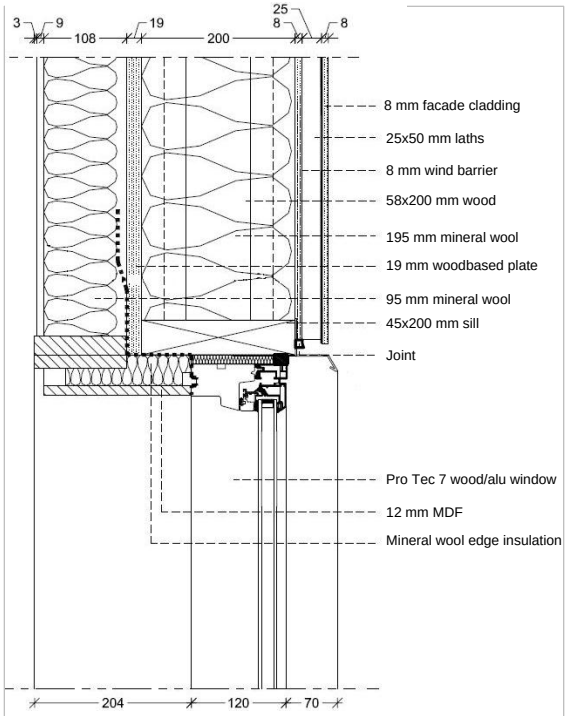
SUMMARY OF U-VALUES [W/m^{2}K] BEFORE AND AFTER RENOVATION.

	Before	After
Slab floor	0.65	0.65
Roof	0.34	0.06
Façade	0.45	0.11
Windows	2.60	0.50 - 0.70

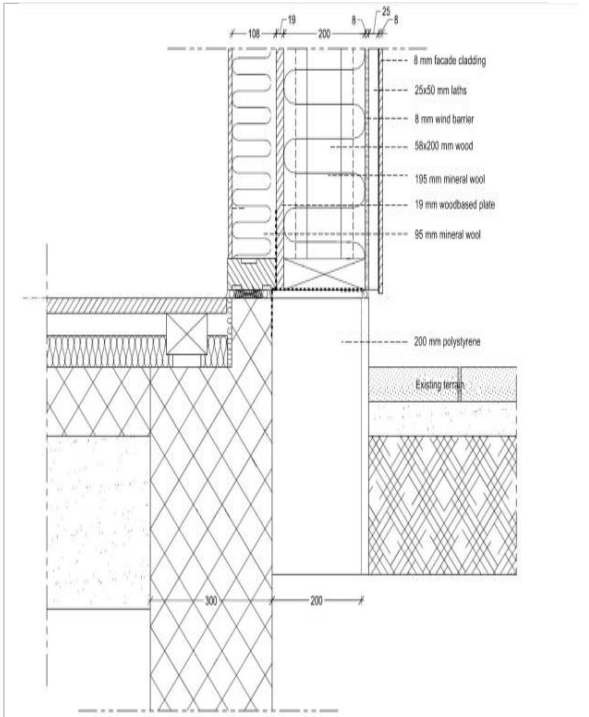
As it can be seen in the table above, the floor slab was not insulated. Energy renovation of the floor slab would have been quite expensive and required a much longer period in which the kindergarten was inoperative.

THERMAL BRIDGES

From the cross sections shown to the right, it is clear that the thermal bridges have been reduced significantly. The foundation was insulated with 200 mm polystyrene to a depth of 400 mm, which reduced the heat loss through the slab floor and foundation considerably.



Cross section window/wall joint. The existing insulation of 95 mm was replaced and a new layer of 195 mm insulation was added to the exterior wall. The window was moved out in the construction. The original thermal bridges in the wall and the thermal bridge at the joint are reduced significantly.



Cross section floor slab/wall. 200 mm x 400 mm insulation was added to the base of the building to reduce thermal bridge effects. In addition to reducing the heat loss this has also raised the temperature of the floor and thereby improved the indoor climate. Now the entire floor area is useable for the occupants.

5. BUILDING INTERIOR SYSTEM

OVERALL DESIGN STRATEGY

HEATING SYSTEM

Heating of the building is based on district heating, and no changes were applied in connection with the renovation.

COOLING SYSTEM

There is no cooling system installed in the building.

VENTILATION

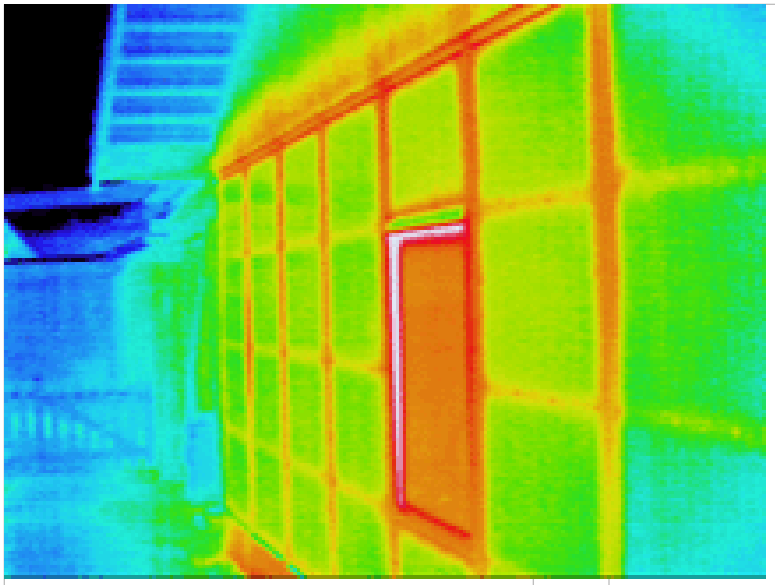
The existing ventilation unit was replaced, i.e. maintaining the duct system. The original unit had a 60% heat recovery efficiency and a specific electricity use of 2,988 J/m^3. The new unit has a 72% heat recovery efficiency and a specific electricity use of 2,060 J/m^3

HOT WATER PRODUCTION

Domestic hot water production in the building is based on district heating, and no changes were applied in connection with the renovation.

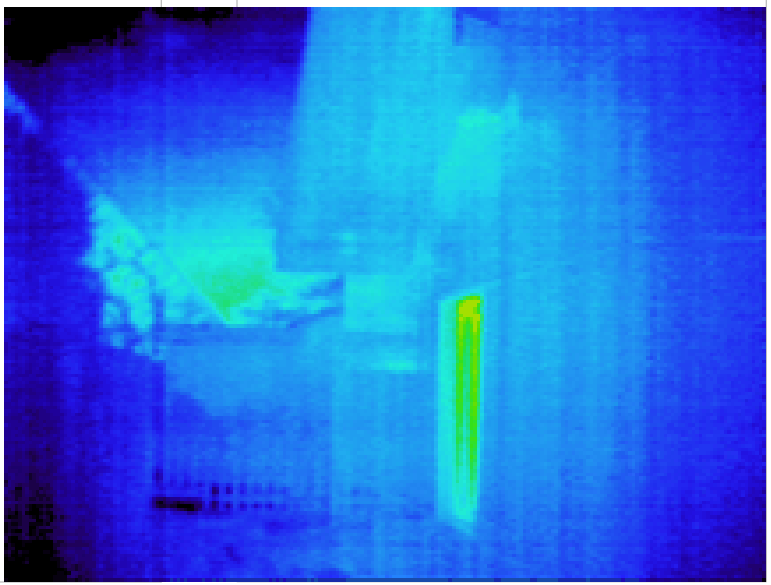
RENEWABLE ENERGY SYSTEMS

The building has no renewable energy systems.



Left: Thermography before renovation. Notice how the beams in the existing wall and the frame of the window create large thermal bridges. Also the window itself is showing a significant heat loss.

Right: Thermography after renovation. The thermal bridges have disappeared almost completely, and it is clear that the two layers of insulation are efficient in reducing the heat transmission through the thermal envelope. The heat loss through the window also has clearly decreased.



6. ENERGY PERFORMANCES

CALCULATIONS

The heating demand was expected to be reduced by 23,370 kWh pr. year. In addition the electricity use was expected to be reduced by 18% equal to 1,824 kWh pr. year.

Table: Calculated energy consumption

[MWh]	Before	After	Saving
Heat	37.2	13.9	23.3
DHW	8.0	8.1	-0.1
Elec.	10.1	8.3	1.8
Total	55.3	30.3	25.0

MEASUREMENTS

Measurements of the energy consumption for heating and domestic hot water was carried out before and after the renovation.

Table: Measured energy consumption for heating and domestic hot water consumption

[kWh/m^2]	Year	Heat
Before renovation	2010	151
After renovation	2011	69

Left: Facade facing the playground before renovation. The painted facade required regular maintenance.

Right: Facade facing the playground after renovation. The new facade requires little/no maintenance.

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CLARIFICATION: the energy calculations and given energy numbers will be according to the national standards which might vary between countries., i.e. numbers are not always comparable

7. ENVIRONMENTAL PERFORMANCE

INDOOR CLIMATE

- *The indoor climate has improved dramatically as a consequence of the facade insulation, new windows and insulation of the foundation.*
- *The facade insulation and new windows have significantly reduced thermal bridges around windows and the airtightness of the building envelope has increased. The overall effect is a building with less draught and a generally improved thermal comfort.*
- *The indoor air quality has improved due to the new ventilation system. The new ventilation system has a higher heat recovery rate and thereby the system is less likely to generate draught during the cold winter season.*

INCREASING QUALITY OF LIFE

- *The quality of life has increased significantly in the kindergarten. Now the occupants (children and staff) are able to use the entire floor area during winter. Before the renovation the floor area near exterior walls and windows were too cold reducing the useable area. The new windows, extra insulation in the walls and insulation of the base have reduced the heat losses and removed draught near windows and thermal bridges at the building base.*

8. FURTHER INFORMATION

RENOVATION COSTS

The kindergarten is 350 m^2 (total area) and houses 50 children spread over 3 classrooms.

The total cost of the renovation was approximately 1.5 mio. DKK (200,000 €) corresponding to approximately 4,300 DKK pr. m^2 (575 €/m^2)

The extra cost of renovating the building envelope to a higher energy standard was approximately 167,000 DKK or 478 DKK/m^2 (22,250 € or 64 €/m^2) to covers better windows (3-layers of glass) and better insulation. The prices include follow-up work, i.e. relocation of sewer (to make room for more insulation) and a much more solid façade construction including a new vapour barrier to minimize the risk of condensation and mold-growth and thereby ensure a better indoor environment.

Extra investment in low energy is profitable, because the energy savings throughout the building envelope life (set to 40 years) becomes even greater. The total net savings will be approximately 240,000 DKK (32,000 €) for a typical institution.

This calculation includes expenses for the cheapest form of heating, i.e. district heating. If the building was heated instead by electricity, i.e. as suggested in several scenarios of a future fossil-free society which is also the case in today's society and outside of district heating and natural gas areas, energy savings would be even greater.