

# NVE building – Middelthuns gate 29, Oslo Norwegian Water Resources and Energy Directorate

## 1. INTRODUCTION

### PROJECT SUMMARY

Middelthuns gate 29 was constructed from 1962 to 1964 for NVE. Cellar, lower ground floor, 6 office floors and a smaller 7th floor. Protected elements both internal and external. Full internal renovation, extension and redesign of the 7<sup>th</sup> floor, new technical equipment, upgraded lifts, replaced window panes and shading devices.

### SPECIAL FEATURES

The first listed building in Norway which is upgraded to energy label B.  
Focus on universal design.

ARCHITECT: Dark Arkitekter AS

CONSULTANT: Erichsen & Horgen AS,  
Multiconsult AS and others

PARTNER: Directorate for Cultural  
Heritage

MAIN CONSTRUCTOR: Skanska

OWNER: Entra eiendom

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## UPGRADE Solutions & IEA SHC Task 47

Renovation of Non-Residential Buildings towards Sustainable Standards

## 2. CONTEXT AND BACKGROUND

### BACKGROUND

“The NVE Building” is a monument and cultural heritage of post war Norway. The partly protected building was in need of total rehabilitation, which should pay attention to protection restrictions, existing architectural qualities and modernization, as well as to energy efficiency improvement, the environment in general and universal design. The aim was to show that it is possible to combine these aspects in a comprehensive upgrade.

### OBJECTIVES OF THE RENOVATION

Critical points:

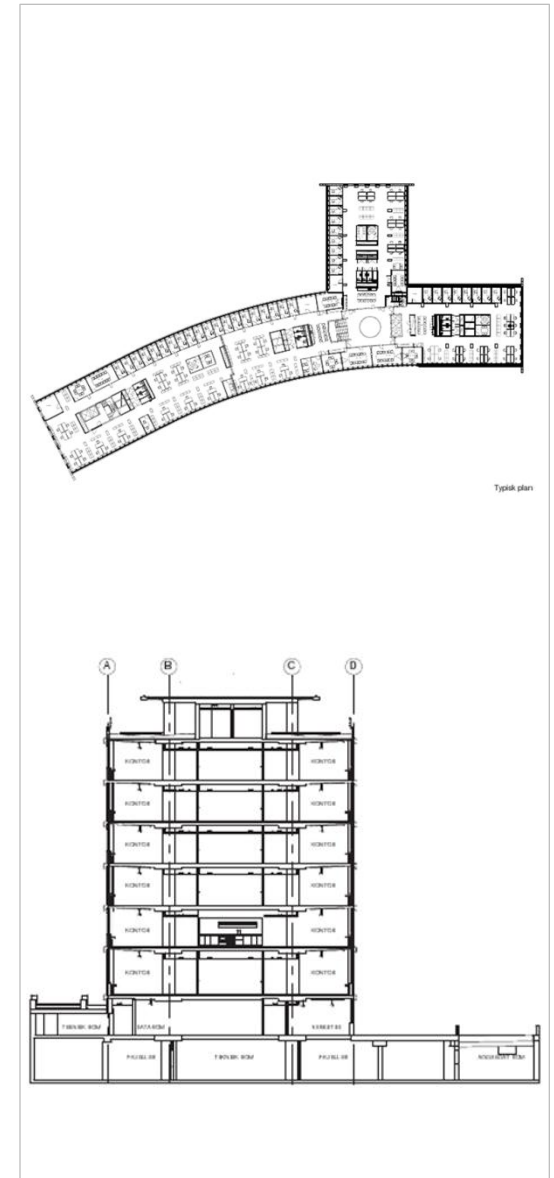
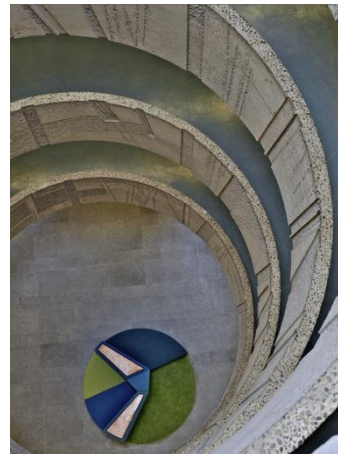
- Many special details of high architectural and material quality, taking care of sturdy materials.
- Protected façade externally and internally.
- Protected areas: canteen, main entrance, main staircase and two office wings.

### SUMMARY OF THE RENOVATION

“Overall” exemplary project.

Calculated overall demand of delivered energy:  
120 kWh/m<sup>2</sup>y (energy level B).

Costs: 152 millions NOK + VAT (< 20 mill.  
EUR)



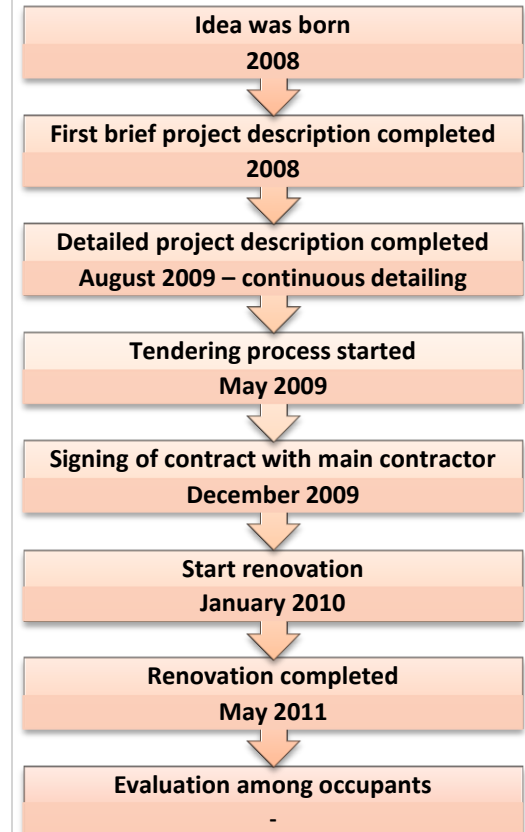
### 3. DECISION MAKING PROCESSES

#### IMPORTANT ASPECTS

- Entra (owner) and NVE (tenant) re-negotiated the leasing contract and both parties agreed that the building was in need of renovation and a more flexible layout with more open solutions. Both parties were committed to high energy saving targets
- The building is protected by the Directorate of Cultural Heritage. The office participated in the entire process and helped find acceptable goals and solutions.
- Financial support from ENOVA (public enterprise for state funding, Ministry of energy and petroleum) for conversion from direct electric heating to district heating.
- The energy ambitions were upgraded from class C to class B during the project period because B turned out to be within reach (due to better air tightness).
- Engineering, procurement and construction contract with partnership clause.



#### Timeline for the decision making process



## 4. BUILDING ENVELOPE

### Roof construction:

U-value 0.13/0.26 W/m<sup>2</sup>K (6<sup>th</sup>/7<sup>th</sup> floor)

### Wall construction:

U-value 0.11 – 0.31 W/m<sup>2</sup>K

Added insulation and sealing measures under and between windows. The wall under the windows which included protected teak panels, were updated with added insulation in the outer wall behind the radiators.

### Slab construction :

Added insulation under the cellar ceiling

### Windows:

Window panes: U-value 1.0 W/m<sup>2</sup>K

Wooden frames (only panes replaced)

Weather-strips around the windows

Total U-value 1.3 W/m<sup>2</sup>K

### Thermal bridge avoidance:

Overall thermal bridge value; 0.09 W/m<sup>2</sup>K  
(related to total treated floor area)

### Summary of U-values [W/m<sup>2</sup>K]

	Before	After
Roof/attic	0.78 / 1.12	0.26 / 0.13
Floor/slab	0.15	0.15
Walls	0.35 / 0.70 /0.65	0.31 / 0.26 / 0.65
Windows	2.5	1.3

Before



After



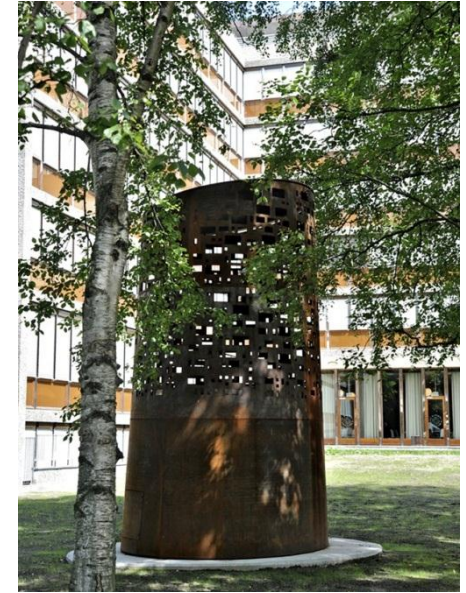
## 5. BUILDING SERVICES SYSTEM

### OVERALL DESIGN STRATEGY

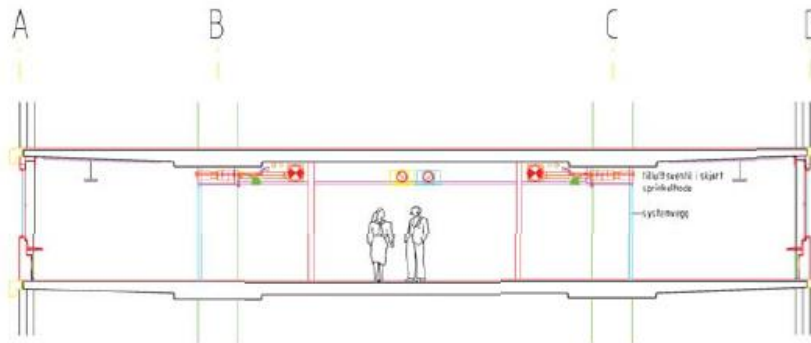
- NVE changed their indoor climate requirements and accepted more hours with temperature above 26°C degrees.
- New external shading devices.
- Office areas with good daylight conditions
- Energy efficient lighting with daylight control
- Decentralized water heaters on each floor
- District heating
- From direct electric heating to radiators
- VAV ventilation, 81-82 % heat recovery
- Ventilation ducts and technical installations in center of building cross section. No crossing of ventilation ducts due to low ceiling height.
- Use of building thermal mass. Especially in ceilings.
- Air intake for ventilation system in outside garden with air through ground ducts to improve heat recovery.
- SFP 1.57 W/m<sup>3</sup> at 80 % air flow (calculated according to NS3031)



*New radiators mounted under the windows on protected exterior walls*

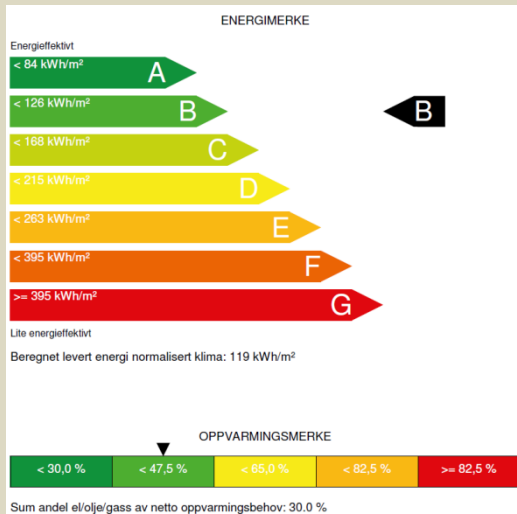


*Specially designed air intake in back garden.*



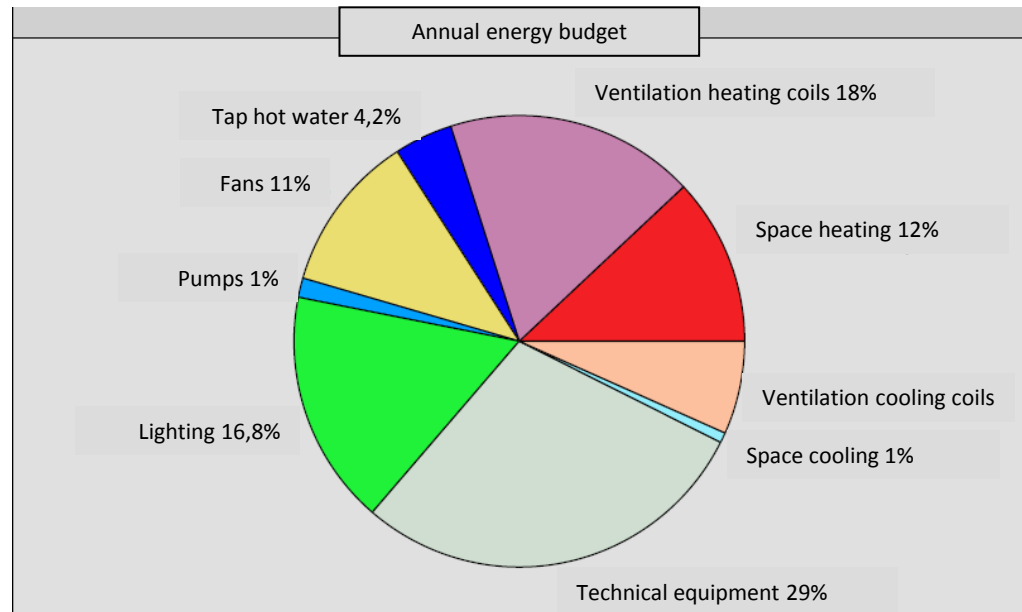
## 6. ENERGY PERFORMANCES

- First, and only so far, protected building to be renovated to energy level B or better.
- Measured overall\* energy use 2006-2008 (temperature compensated to normal year) 213 kWh/m<sup>2</sup>year, \*including all appliances
- Calculated overall\* net energy demand: 119 kWh/m<sup>2</sup>y (regulations for new buildings: 150) Net space heating demand: 36 kWh/m<sup>2</sup>y
- Calculated overall\* demand of delivered energy: 120 kWh/m<sup>2</sup>y (energy level B).
- Calculated primary energy demand not available (no common primary energy factors stated in Norway)
- Air tightness measured: 0.8 h<sup>-1</sup>



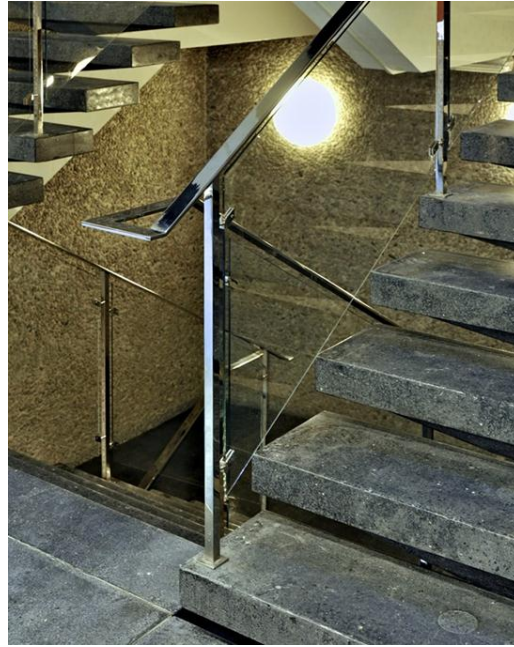
### Energy budget after renovation

Energy budget after renovation			
	Energy demand		
1a Space heating	241 315 kWh	14,3 kWh/m <sup>2</sup>	
1b Ventilation heating coils	360 687 kWh	21,4 kWh/m <sup>2</sup>	
2 Domestic hot water	84 626 kWh	5,0 kWh/m <sup>2</sup>	
3a Fans	228 601 kWh	13,5 kWh/m <sup>2</sup>	
3b Pumps	27 898 kWh	1,7 kWh/m <sup>2</sup>	
4 Lighting	338 505 kWh	20,1 kWh/m <sup>2</sup>	
5 Technical equipment	581 756 kWh	34,5 kWh/m <sup>2</sup>	
6a Space cooling	14 756 kWh	0,9 kWh/m <sup>2</sup>	
6b Ventilation cooling coils	134 117 kWh	7,9 kWh/m <sup>2</sup>	
Total net energy demand	2 012 261 kWh	119,2 kWh/m <sup>2</sup>	



## 7. ENVIRONMENTAL PERFORMANCE

- 7th floor: New exterior walls, windows and doors
- Re-use of existing teak doors (as new doors or material component)
- Good environmental profile on all new materials, documentation through BASS.
- Environmentally certified products for interior and furniture.
- All woods from sustainable forestry and no use of (new) tropical woods.
- Use of minimum 30% recycled aluminum and 50% recycled steel.
- Water saving sanitary equipment.
- Universal design according Norwegian code for new office buildings.
- Minimum 85% of building waste shall be separated on site.
- All hazardous materials for demolition identified in environmental redevelopment scheme.



## 8. MORE INFORMATION

### RENOVATION COSTS

152 millions NOK + VAT (< 20 mill. EUR)

### FINANCING MODEL

- Financial support from ENOVA (public enterprise for state funding, Ministry of energy and petroleum) for conversion from direct electric heating to district heating.
- Remaining financing from Entra (50/50 loan and equity capital). Entra has a requirement for all investments to be commercially profitable.

### OTHER INTERESTING ASPECTS

- Collaboration with the Directorate for Cultural Heritage with focus on existing qualities and – at the same time – to develop functional and flexible offices.
- Thoroughly designed concept for waste management in the building.



After renovation