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Entré Lindhagen, Sweden

Case Study 122

Entré Lindhagen is Skanska's new head office in Stockholm that was designed to be one of the greenest and smartest workplaces in Europe. The building is certified according to LEED Platinum Core & Shell and is pursuing LEED Platinum Commercial Interiors for both Skanska's own office and that of the other main tenant.

Aspects of Sustainability

This project highlights the following:

Green Aspects

Energy
Carbon
Materials
Water
Local Impacts

Social Aspects

Human Resources
Corporate Community Involvement
Business Ethics
Health and Safety

Project Sustainability Highlights

Economic

- Utility costs 50% lower than a conventional Swedish office building

Green

- LEED Platinum Core & Shell certification
- Pursuing LEED Platinum Commercial Interiors for two office spaces
- 55% **Energy** savings
- Environmentally responsible **Materials** and over 99% waste diverted from landfill
- 50% **Water** savings

Social

- Activity-Based Workplace design
- Healthy indoor environments

Project Introduction

Entré Lindhagen is situated in Lindhagen, western Kungsholmen, central Stockholm. Around 1,100 Skanska employees are based at the new head office, which offers a modern, flexible and multi-faceted working environment. Skanska relocated to Entré Lindhagen as the leasing contract for their previous head office expired. The company developed Entré Lindhagen to be a purpose built, green, smart and flexible office, which reflects Skanska's brand and provides modern working conditions for its employees.

The US$ 180 million Entré Lindhagen project was designed and built by Skanska Sweden for Skanska Commercial Development Nordic (Skanska CDN). The office consists of three connected buildings, between 7 and 9 floors above ground and 3 floors below ground, which include a parking garage and equipment rooms. Entré Lindhagen includes 55,000 m² of leasable office space in total and can

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Energy
Carbon
Materials
Water

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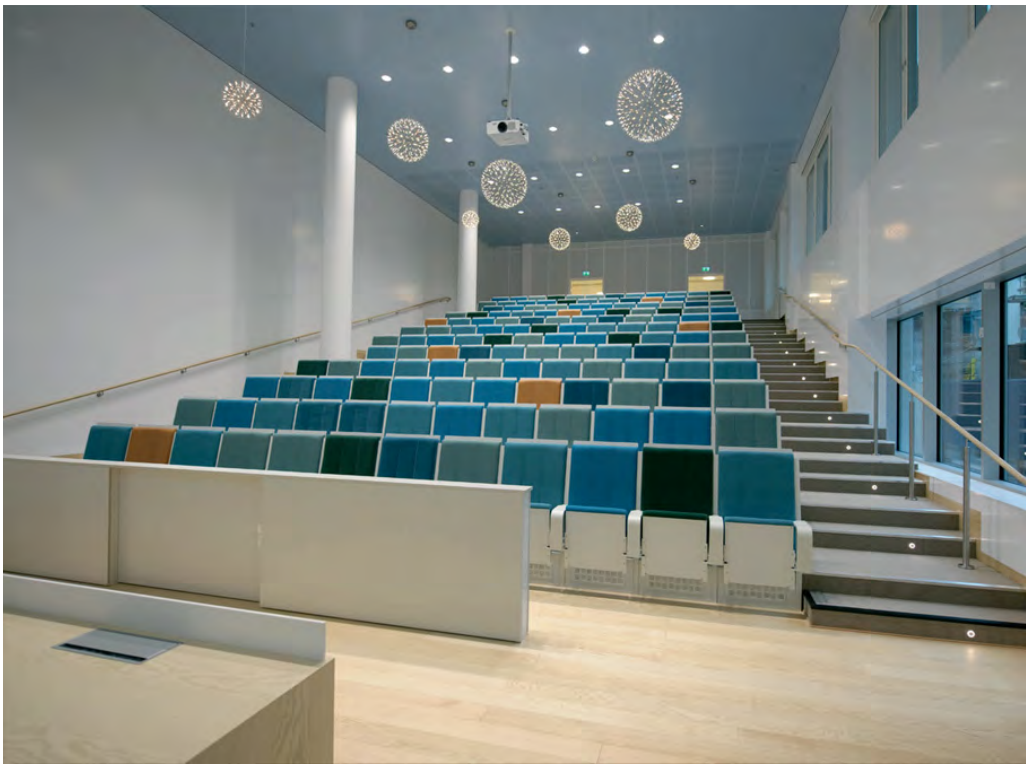
accommodate around 3,000 occupants. Skanska occupies 27,000 m² of office space in total. All three buildings have a central atrium, which functions as a main entrance and elevator lobby. The Skanska office includes a large wellness/fitness area for personnel, an education center for internal training and an employee lounge workspace for Skanska employees not permanently based at the Entré Lindhagen office. The office also has attractive common spaces, such as cafes on each level. A large privately owned restaurant and recreational center is located on the ground floor, which includes bowling, ski simulators and conference facilities.

In addition, Skanska is developing the Västermalms Atrium residential project on the site, which partially shares Entré Lindhagen's structure and is situated above its underground parking garage. Entré Lindhagen and Västermalms Atrium also share heating and cooling systems. The project consists of 165 apartments in two buildings, a preschool, a restaurant and a deli. Västermalms Atrium is owned by Skanska Nya Hem and is scheduled for completion in April 2015.

Entré Lindhagen is Scandinavia's largest green commercial building and one of Skanska's greenest commercial buildings to date. The office is certified to LEED Platinum Core and Shell with 90 LEED points, and is pursuing LEED Platinum Commercial Interiors for Skanska's office and one of Entré Lindhagen's tenants. LEED is a voluntary U.S. Green Building Council (USGBC) certification process intended to encourage and guide the construction of green and energy efficient buildings. Entré Lindhagen is also certified according to the EU GreenBuilding Programme, a voluntary initiative that requires buildings to use at least 25 percent less energy than national standards.

Contributing Toward Sustainable Development

Entré Lindhagen uses 55 percent less energy than the Swedish Code and approximately 50 percent less potable water than a typical newly constructed Swedish commercial building. The building's resource efficiency ensures that tenants spend around 50 percent less on utility bills. Entré Lindhagen is equipped with Skanska's Deep Green Cooling™ solution, efficient ventilation and lighting systems, and intelligent energy management solutions. Other green aspects include environmentally responsible materials, green roofing and a green education initiative. Entré Lindhagen promotes healthy and stimulating working environments for occupants, with a variety of high quality workspaces, and the building is designed to be highly flexible. During construction, environmental impacts were minimized, and over 99 percent of construction waste and 97 percent of demolition waste was diverted from landfill. Regional construction materials were incorporated into the project.



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Green Aspects

Energy

Energy efficiency

The heated space in Entré Lindhagen annually uses 49 kWh/m², which is 55 percent less than the Swedish energy Code. The building uses 33 kWh/m² for heating, 0 kWh/m² for cooling and 16 kWh/m² to power building systems.

Entré Lindhagen has a well-insulated façade, with U-values for the walls, windows, roof and flooring of 0.21 W/m²K, 0.8-0.9 W/m²K, 0.11 W/m²K and 0.54 W/m²K respectively. An integrated façade shading system made from aluminum strips along the south facing façades of the building to reduce excessive passive solar heating, without reducing external views and natural daylight.

The project uses Skanska's Deep Green Cooling™ (DGC) solution, which uses the relatively constant annual ground temperature of 11 to 12 °C to cool the building. The system consists of 144 boreholes under the building that are approximately 220 m deep. The pipes are part of a water-filled closed-loop system that supplies the building's chilled beams and the Air Handling Units via a heat exchanger. The system is designed to meet Entré Lindhagen's entire cooling demands in the summer and pre-warms the outdoor air to the Air Handling Units (AHUs) in the winter. Skanska holds a patent on the DGC solution in Sweden. The adjacent Västermalms Atrium residential project is also part of the DGC system, and provides additional cooling to Entré Lindhagen and receives supplementary heat from the office in the winter. The remainder of the building's heat is sourced from a Combined Heat and Power plant, which is part of Stockholm's district heating system.

The ventilation system uses around a quarter of the energy of a conventional ventilation system. The system operates at a low-speed (approximately 1 m/s), and uniformly dimensioned ventilation ducts help to reduce the need for fan motors. The building's eight AHUs are equipped with Permanent Magnet (PM) motors, which further promote low energy consumption without compromising air supply. The AHUs also recover up to 85 percent of the energy from outgoing stale air, and some of the outgoing air is used to ventilate and heat the garage levels.

The lighting system consists of a DALI (Digital Addressable Lighting Interface) control system that includes daylight and occupancy sensors to effectively control LED (Light Emitting Diode) lighting and energy efficient fluorescent lamps.

Energy efficient elevators use up to 75 percent less energy than conventional models. The elevators are equipped with regenerative drives that convert the energy from downward movements back into electricity and a Destination Control System to reduce the number of times elevators stop by optimizing elevator traffic. In addition, all office equipment is Energy Star or equivalent certified.

Renewable energy

88 percent of the building's electricity is sourced from renewable energy sources through off-site wind energy generation.

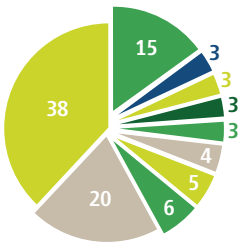
Intelligent energy management

The Building Management System (BMS) allows occupants to optimize the indoor climate in most small rooms through wall-mounted control panels. The indoor climate in open planned office spaces and communal areas are automatically controlled in order to optimize energy efficiency and the indoor climate. The BMS monitors tenant energy consumption to encourage tenants to make resource savings.

Carbon

Carbon footprinting

Skanska calculated the embodied carbon footprint of the project to be 36,800 tCO_2e. The building's structure amounted for over half the total footprint. 910 tons of "green asphalt" was used on the project,



Breakdown of Entré Lindhagen's embodied carbon footprint (%)

Precast structure – 38
Foundation structure – 20
Demolition works – 6
Ventilation – 5
Site activities – 4
Sub floor – 3
Inner walls – 3
Gound works – 3
Supplementary structural works – 3
Other – 15

which uses bio fuels instead of fossil fuels. Green asphalt reduces carbon emissions by 65 percent during manufacture and decreased the project's overall footprint by 12.5 tCO_2e.

Materials

Environmentally responsible materials

The project team checked all building materials using the Swedish environmental assessment system Byggvarubedömningen and documented all materials in an environmental logbook. Most relevant substances used on the project were checked according to LEED Volatile Organic Compound (VOC) requirements and Skanska's chemical database to ensure that only low-VOC substances were used. Most of the paint used was certified according to the Nordic Eco-label and the Asthma and allergy union. All flooring was either approved by LEED according to Floorscore® or met the testing and requirements of the Carpet and Rug Institute's Green label Plus program. The Deep Green Cooling system uses water instead of global warming refrigerants. Construction materials with high-recycled content used on the project included steel reinforcement and plasterboard.

Waste management during construction

Comprehensive waste management ensured that over 99 percent of construction waste was diverted from landfill. A key initiative on site was the use of 660 liter personal waste collection containers to ensure that waste was effectively sorted immediately at source. The system also created a sense of personal responsibility for waste management, as containers could be dealt with and traced back to individuals. Two waste management company representatives worked closely with Skanska on site to provide waste management guidance and training.

Demolition waste

An existing building on the site dating from the early 1980s was demolished prior to construction. 97 percent of the 85,000 tons of demolition material was diverted from landfill.

Waste management during operation

Entré Lindhagen is equipped with comprehensive waste management facilities, including waste sorting stations on every floor. The building has three central sorting rooms in the basement, which cover an area of 200 m^2 in total.

Water

Water efficiency

Entré Lindhagen uses approximately 50 percent less potable water than a typical newly constructed commercial building in Sweden, excluding water intended for human consumption, such as for drinking, cooking and hygienic use. Water efficient toilets and ultra low-flow 3 l/min taps were installed, compared with typical 12 l/min and 5-6 l/min low-flow taps in Sweden. Users can override the low-flow function to increase flow and temperature if desired. The roof is landscaped with drought tolerant plants and does not require artificial irrigation.

Other Green Aspects

Minimizing environmental impacts during construction

The construction site was certified according to Skanska's internal Green Workplace (Grön Arbetsplats) environmental management system, which is aligned with Skanska Sweden's ISO 14001 certification. The system surpasses Swedish regulations in terms of emission standards for site machinery, the use of energy-efficient construction lighting, requirements for chemicals and waste management. The adjacent streets were regularly cleaned and dust was minimized during the project.

Raising awareness of more sustainable buildings

Skanska has implemented a Green education initiative to inform tenants and visitors of the building's sustainability features, and to promote behavior that optimizes the building's systems. There is an informative display in Skanska's reception and there are plans to add two additional interactive displays in the reception, which communicate the building's real-time performance. Skanska also plans to add a display in the reception of the other major tenant.

Green roofing

Entré Lindhagen's green roof covers 80 percent of the roof area and 65 percent of the total site area. The green roof provides additional thermal insulation and extends the roof's lifespan by protecting it from weathering and UV light. In addition, roof vegetation can filter airborne pollution, decrease stormwater runoff and reduce the urban heat island effect in central Stockholm.

1,000 m^2 of the roof is also covered with Noxite® membrane, which is made from recycled bitumen roofing products and neutralizes nitrous oxides in the air throughout its lifespan. Noxite uses sunlight to produce an autocatalytic reaction that permanently converts harmful airborne nitrous oxides into harmless nitrates that are washed away by rainwater.

Promoting biodiversity

Entré Lindhagen has a green roof consisting of meadow flower and sedum green roofing, which can provide habitats for birds and insects in central Stockholm. Meadow flowers encourage greater biodiversity than sedum green roofs by providing more species of plant and more varied habitats. Entré Lindhagen also has three beehives on the roof, which Skanska uses to raise awareness among employees and visitors of the importance of bees in local pollination and global food production.

Social Aspects

Stakeholder dialogue and cooperation

The landlord (Skanska CDN), the general contractor (Skanska Sweden) and the tenant (several Skanska businesses) formed a tenant project group that consisted of various project stakeholders. The group met every two weeks and had over 50 meetings throughout the design phase to ensure that the building met Skanska's requirements. The group ensured that the complex Skanska tenant requirements, such as for the Activity Based Workplace, were met. The project team also had close cooperation with suppliers to identify materials that met the project's high environmental standards.

Occupational health and safety

There were 9 Lost Time Accidents on site between 2010 and 2013, despite various safety measures and initiatives employed by Skanska. The project's overall Lost Time Accident Rate was 9.5 per million hours worked.

Healthy working environments

Entré Lindhagen is well ventilated with fresh air through low-noise and draft-free air diffusers. The ventilation system is also designed with uniformly dimensioned ducts to ensure that the system can cope with sudden changes in the ventilation demand in specific parts of the building. The lighting system provides workspaces with light similar to natural daylight, which is gently toned down toward the end of the day to calm occupants. Informal spaces are lit with warmer light tones to create a more cozy and relaxing atmosphere.

Activity-based workplace (ABW) environment

Skanska's ABW environment at Entré Lindhagen offers a wide range of workspaces, from quiet concentration rooms to stimulating social spaces, and allows employees to choose the workspace that best supports their immediate needs and personal preferences. All employees belong to a home zone based on their internal unit, although

they can work wherever in the building and can change workplace several times during the day if they wish. Skanska opted to create an ABW environment following studies of its previous head office, which showed that the work environment was inefficient and did not meet Skanska's needs. ABW promotes space efficiency and cooperation through informal meetings. Entré Lindhagen intends to be a model for other Skanska offices.

Flexible office design

Entré Lindhagen is designed to be highly flexible in order to accommodate the needs of current and future tenants and promote a long useful lifespan. Most of the office space consists of open planned work environments, which can be used for various office layouts and easily altered by removing or adding flexible walls. Two main tenants currently occupy Entré Lindhagen, although the three buildings are self contained with their own entrances, elevators and emergency exits, which enables them to each accommodate a large number of small tenants, or to be sold as separate properties in the future if necessary.

Contributing toward sustainable urban development

Skanska redeveloped a previously developed site in central Stockholm and the project did not directly impact upon greenfield sites. The Western Kungsholmen area is a dense urban area and Entré Lindhagen is close to a variety of stores, restaurants and urban amenities.

Promoting more sustainable modes of transport

Entré Lindhagen has a bicycle garage for around 300 bicycles, and changing rooms and showers to promote cycling to work. The site has excellent access to public transport, including two nearby Stockholm subway lines, regular buses and a proposed new tramline. There are electric vehicle charging stations and prioritized parking for environmental vehicles in the parking garage. Skanska also manages a carpool with a fleet of electric/hybrid vehicles that can be used by employees for business and private errands.

Economic Aspects

Regional construction workforce and materials

Typically over 200 people worked on site, with a peak of 350 workers, during the construction of Entré Lindhagen. Over 80 percent of the workers were from the Stockholm area. Regionally sourced materials included the doors, insulation and timber, and most of the materials originated within LEED's 800 km regional limit.

Efficiency financial savings

Utility bills for tenants are around 50 percent less than Skanska's previous headquarters in Stockholm, which annually amounts to approximately US$ 7.8/m^2 in total. Skanska's annual savings at Entré Lindhagen amount to US$ 200,000 for heating, cooling and lighting. Residents of the Västermalms Atrium residential project will also benefit from lower energy costs as the building receives a proportion of its heating from Entré Lindhagen's waste heat.

Learning From Good Practice

As Skanska's headquarters and one of Europe's greenest buildings, Entré Lindhagen demonstrates how Skanska walks the talk on green building. Skanska will use the building as a showcase and inspiration for potential clients interested in green buildings that promote resource efficiency and realize significant financial savings.