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Lindhagensterrassen, Sweden

Case Study 62

Lindhagensterrassen is a residential project in central Stockholm that pioneered the use of roof-mounted solar panels to generate electricity for communal lighting and electric vehicle charging stations.

Aspects of Sustainability

This project highlights
the following:

Social Aspects

Human Resources
Corporate Community
Involvement
Business Ethics
Health and Safety

Environmental Aspects

Energy and Climate
Materials
Ecosystems
Local Impacts

Economic Aspects

Project Selection
Supply Chain
Value Added



Project Introduction

Lindhagensterrassen in northwest Kungsholmen, central Stockholm, consists of three 16-storey apartment buildings. Lindhagensterrassen buildings 3, 4 and 5 have a total of 253 private sale apartments. The project is part of several Skanska developments in Lindhagen, including six residential and seven commercial projects.

Skanska Sweden constructed the apartments for Skanska Residential Development Nordic (RDN). Construction began on the Lindhagensterrassen project in September 2007 and residents moved into the three buildings between June 2009 and the third quarter of 2010. The project includes an underground garage with 80 spaces and a park that the apartment buildings overlook. The buildings have communal terraces and some of the larger apartments have private terraces.

Lindhagensterrassen was equipped with roof-mounted solar panels to generate electricity for

communal lighting and electric vehicle charging stations. The initiative is part of a wider cooperation between Skanska RDN and the energy company Fortum, known as the Sustainable Urban Living project, which is aimed at creating very low or net-zero energy consumption buildings.

Contributing Toward Sustainable Development

The Lindhagensterrassen buildings are energy efficient and are equipped with roof-mounted solar panels that provide the buildings with renewable energy. The apartments are functional and flexible, and provide healthy living environments for occupants. The Lindhagensterrassen buildings have also contributed toward sustainable urban development and the redevelopment of the wider Lindhagen area. During construction, Skanska promoted good relations with the buyers of the apartments and encouraged their involvement in

the management and maintenance of the buildings by creating a resident-owned housing association. Comprehensive occupational health and safety considerations promoted a safe working environment for construction workers and resulted in no lost time accidents occurring on site. Local workers and regional construction materials were prioritised in order to benefit the regional economy and reduce the environmental impacts associated with long haul transportation. Direct environmental impacts resulting from the construction process were also minimised by waste management practices and the use of environmentally responsible construction materials.

Social Aspects

Customer communication and involvement

RDN's customer relations staff supported the buyers throughout the buying process and helped them to select the internal colour scheme and tiles in their apartment. RDN always conducts quality control interviews with homeowners several months after moving in to assess their satisfaction with the property and the entire buying process. RDN also created a housing association to own the buildings and maintain the facades and outdoor park areas. The residents were gradually allowed to take over and manage the association for themselves during the first year of occupancy.

Occupational health and safety

There were no serious accidents on site and the Lost Time Accident Rate per million hours worked was zero. A risk analysis was conducted prior to commencing each building and the construction team carefully considered each highlighted risk before commencing work in order to minimise the risk of accidents. Safety issues were also discussed at each weekly coordination meeting with Skanska Sweden.

Healthy living environments

The buildings have large 1.6 m high windows and partially glazed balconies to maximise natural light within the apartments. Each apartment is equipped with a mechanical exhaust ventilation system that removes polluted air from the bathroom and kitchen to promote good indoor air quality. Fresh air is drawn into the apartments through vents behind the radiators, which warm the incoming air in cold weather. The walls are sound insulated to Level B standards, which is better than Swedish building regulations demand. The buildings have common terraces on levels 3



and 15 and overlook a public park. The park was constructed as part of the project to enhance the surrounding living environment and includes recreational areas, trees, running water and a waterfall. Lindhagensterrassen is also close to bathing spots and is a five-minute walk from Rålambshovs Park.

Functional and flexible buildings

High quality materials were used in the construction of the buildings and modern appliances and IT infrastructure were installed. The apartments have an open planned layout to allow flexible space usage, and innovative space planning techniques, such as practical storage space in the hallway, were integrated into the design. The buildings have been constructed to allow the addition of heat recovery systems should the residents choose to install such systems in the future. The Lindhagensterrassen apartment buildings also include common function rooms, which residents can hire out for special occasions or to use as guest apartments.

Sustainable urban planning and public transport

The Lindhagen area is a built up neighbourhood in central Stockholm that includes residential apartments, offices, recreational opportunities and services, such as a large supermarket, a newly constructed shopping centre and several schools. The area consequently contributes toward sustainable urban planning by providing residents with opportunities to work and benefit from a

range of services in the neighbourhood. The mixed-used nature of the Lindhagen neighbourhood also ensures that the area has activity throughout the day, which contributes toward a safe and pleasant living and working environment. The area is a short walk from two Stockholm City subway stations that provide access to the green and blue subway lines. Lindhagen is well served by Stockholm City buses and a tram route connecting the area with central Stockholm is planned along the adjacent Lindhagensgatan road. Each building has secure bicycle storage facilities on the ground floor.

Economic Aspects

Local employment

Around 130 construction workers and project staff were involved in the planning and construction of the three Lindhagensterrassen apartment buildings. Around 95 percent of the Skanska team were from the Stockholm area and most project subcontractors were local companies.

Vocational training

Each worker had a specific personal development plan and attended training according to their needs. Several crane and lift courses, particularly from a health and safety perspective, were conducted due to the high-rise nature of the Lindhagensterrassen project.

Regional construction materials

The Skanska team prioritised locally sourced and manufactured materials. The buildings primarily consisted of prefabricated sections, which were manufactured around 60 km from the site in Norrtälje. Construction materials from the Stockholm area included asphalt and wood.

Energy efficiency savings for tenants

The buildings are estimated to consume around 20 percent less energy than the Swedish regulations demand, which corresponds to financial savings for the occupants of the buildings. The apartments are also equipped with individual electricity meters that promote further individual savings.

Local economic development

The Lindhagensterrassen project reused an inner city brownfield site, which was previously a hospital. Skanska's Lindhagensterrassen developments contributed toward the redevelopment of the Lindhagen area by incorporating modern and light facades, diverse architectural styles and attractive green spaces

within the built environment. Skanska's commercial and residential developments have also brought new residents and jobs into the Lindhagen area, which is expected to accommodate around 20,000 residents and 15,000 jobs by 2017.



Environmental Aspects

Waste management

Construction waste was sorted on site and recyclable materials, such as wood and metal, were processed off-site. RDN demanded the construction team to report waste management figures every three months. Around 92 percent of construction waste was recycled for Lindhagensterrassen buildings 3, 4 and 5. Each building has waste recycling facilities for all kinds of domestic waste.

Environmentally responsible construction materials

Low-VOC and environmentally responsible materials were used in the construction of the Lindhagensterrassen buildings where possible. Skanska Sweden produced a complete list of the construction materials used on the project, which categorised materials according to potential environmental and health impacts.

Energy efficiency

The Lindhagensterrassen buildings 3, 4 and 5 are designed to have a total annual energy consumption of 105 kWh/m². The windows and



Learning From Good Practice

The Lindhagensterrassen development is an innovative project that demonstrates the potential for integrating small-scale renewable energy generation into residential buildings. Skanska RDN and Fortum intend to learn from the experience of the solar panel project to contribute toward future potential projects in Scandinavia.

doors are triple glazed and the windows have u-values of $1.2 \text{ W/m}^2\text{K}$. The outer walls have 100 mm of insulation and have an average u-value of $0.23 \text{ W/m}^2\text{K}$. The apartments are designed to maximise the penetration of natural light into the building, which reduces the need for artificial lighting during daylight hours. The buildings are also fitted to the Stockholm City district heating system, which provides the buildings with efficient heating.

Solar energy system

Lindhagensterrassen building 3 is equipped with 35 m^2 of roof-mounted solar panels, which annually generate up to 5 MWh of electricity. The solar energy is used to supply 11 electric vehicle charging stations in the basement parking level and the communal staircase lighting in buildings 3, 4 and 5. The stations are free of charge for members of the housing association, which owns a communal electric car that is available to Lindhagensterrassen residents. The system is also linked to the electricity grid to ensure that any surplus is consumed. An electronic display is situated at the entrance of the building to show the amount of electricity currently being generated by the system and raise public awareness of small-scale renewable energy generation. The generation of renewable electricity from roof-mounted solar panels reduces the consumption of fossil fuels for electricity generation and vehicle fuel. Fortum and Skanska RDN shared the responsibility of managing and funding the solar panel project and no additional costs were passed onto Lindhagensterrassen residents.