SKANSKA

Blå Jungfrun, Sweden

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Case Study 68

Blå Jungfrun is an energy efficient apartment project in Stockholm that was constructed to passive house standards with proven conventional construction techniques.

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

Pernilla Ivarsson at Reflex Arkitekter

Project Introduction

The Bl Jungfrun residential development is situated between Farsta and H kar ngen, around 10 km south of central Stockholm. The development consists of four buildings that are 5 and 6-storeys high, and accommodate a total of 97 rental apartments. The buildings are of similar design and incorporate apartments that range between 53 and 111 m^2 in area.

Skanska Sweden constructed the US$ 18 million project for the Stockholm housing association, Residents moved into the first two buildings in the second quarter of 2010 and into the last two buildings in the final quarter of 2010. Skanska constructed the apartment buildings with prefabricated frame structures and prefabricated concrete wall sections that were cast and covered with a plastic insulation fa ade on site. The project also included street works, the creation of 68 street parking spaces, site landscaping and a 5-year period of post-occupancy energy monitoring.

Bl Jungfrun was the first high-rise public rental apartment development in Stockholm to be constructed according to Swedish passive house standards. The apartments do not have a conventional space heating system and are primarily warmed by building occupants, household appliances and passive solar heating. The apartments consequently consume less than half the energy of a conventional Swedish apartment building due to the reduced need for space heating.

Contributing Toward Sustainable Development

The Bl Jungfrun passive house apartment buildings are energy efficient and emit less carbon dioxide due to their reduced total energy

Skanska Color Palette™

Energy

Carbon

Materials

Water

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consumption. The apartments also provide high quality living environments for residents, and are designed to be functional and flexible homes. During the design and construction phases, Skanska developed inventive passive house solutions, together with the client, that used conventional construction techniques. The project benefitted the regional economy by employing local workers and subcontractors, and through the sourcing of regional and Swedish construction materials. The project was constructed in accordance with Skanska's internal Green Workplace environmental management system, which surpassed the Swedish environmental regulations. Environmentally responsible construction materials were also sourced and a high proportion of the construction waste was recycled off-site. Skanska provided passive house training for project workers and site visitors, and Smartboxes were installed to monitor energy consumption and to raise awareness of resource consumption among residents.

Social Aspects

Partner cooperation

Skanska worked closely with the client during the design and construction phases to develop passive house solutions that use conventional construction techniques. Skanska will continue to work with Svenska Bost der until 2015 to monitor energy efficiency and the indoor climate of the Bl Jungfrun apartments.

Occupational health and safety

There had been one minor accident and the Lost Time Accident Rate for the project was 13 as of March 2010. Special safety initiatives included the monthly nomination of the safest worker of the month.

High quality living environments

The Bl Jungfrun apartments were designed to promote optimal indoor temperature and air quality for residents. The apartments are very well insulated and have a relatively constant indoor temperature. Small occupant-operated electric heaters were installed in the apartments to provide additional heating during periods of extremely cold weather. The thick insulation and cast in-situ concrete structure also ensure that there are no cold drafts and that there is minimal noise disturbance from neighbors and passing traffic. The ventilation system promotes good indoor air quality throughout the year by extracting air from bathrooms and kitchens, and supplying conditioned fresh outdoor air to the bedrooms and living rooms. All apartments also have a south-facing terrace or balcony. The plastic insulation is airtight and ensures that no moisture can penetrate the structure to cause mould or damp, which are typical issues for passive housing.

Functional and flexible homes

The Bl Jungfrun apartments are equipped with state-of-the-art communications networks and Smartboxes, which enable residents to book one of the communal washing machines or register a

fault. The apartments are also designed to be flexible to allow various apartment layouts and to promote a long useful lifespan for the buildings. The apartments are open-planned and have broadband connections in every room, which allows various room uses. The absence of radiators also allows flexibility in placing furniture.

Sustainable urban planning

Bl Jungfrun is situated 300 m from the nearest bus stop and 650 m from the H kar ngen subway station, which allows access to central Stockholm in 20 minutes. The development is located in a built up suburb with access to a range of services, including shops, schools, a healthcare center and the Farsta Centrum shopping centre.

Promoting more sustainable transport

Cycle racks are available to residents and visitors outside the apartments to encourage cycling. The Smartboxes are connected to the Bl Jungfrun broadband network and display real-time public transport information for the local subway stations.

Economic Aspects

Local workers and subcontractors

Around 100 workers were involved in the construction of the project, and the majority was from the Stockholm area. Subcontractors from the Stockholm area provided plumbing, ventilation, flooring, plastering and excavation services.

Regional construction materials

The 6000 m3 or 15 000 tons of concrete used on the project was sourced from Skanska´s own concrete plant, around 10 km from the site. Swedish wood and steel was used on the project.

Vocational training

Skanska trained project workers and informed site visitors on the passive house techniques used to construct the buildings. This education raised awareness of energy efficient buildings among construction workers, subcontractors and visiting members of the public.

Financial savings due to energy efficiency

The Bl Jungfrun apartment buildings cost around 6 percent more to design and construct than a conventional building, due to the passive design features the buildings incorporate. However, the buildings consume around half the energy of a conventional building and will make significant financial savings throughout their lifespan. Significantly, the project was profitable without government financial incentives or grants, and the additional costs have not been passed onto the residents who pay rent comparable with conventional apartments in the area.

Environmental Aspects

Minimizing environmental impacts during construction

The construction site was certified according to Skanska's internal Green Workplace (Gr n Arbetsplats) environmental management system,

which is aligned with Skanska Sweden's ISO 14001 certification. The system included higher emission standards for site machinery, energy efficient indoor and outdoor site lighting, and stricter standards for chemicals and waste management than the Swedish building regulations demand. Energy use was also continuously monitored during construction and the buildings' energy efficient heat recovery ventilation systems were used during construction to efficiently dry the building structures, which typically requires mobile drying machinery that consumes large quantities of energy.

Environmentally responsible construction materials

The buildings were insulated with expanded polystyrene, which is a very lightweight, non-toxic material that consists of 98 percent air and is free from Chlorofluorocarbons (CFCs) and other harmful gases. All construction materials complied with Skanska's chemical database and environmentally responsible substances included the indoor paint, which was certified according to the EU Flower ecolabel.

Waste management

Construction waste was sorted on site and recycled at appropriate local recycling facilities and 95 percent of project waste had been recycled as of March 2010. The quantity of construction waste generated on site was also reduced by the use of prefabricated structures that were manufactured off-site.

Energy efficient housing

The Bl Jungfrun apartments are designed to annually consume 43 kWh/m^2 for space heating and hot water compared with the Swedish energy standards that demand less than 110 kWh/m^2, and the Swedish passive house standard that recommends less than 45 kWh/m^2. The apartments annually consume approximately 65 kWh/m^2 in total, including tenant electricity. The apartment buildings are airtight and initial air tightness tests measured air leakage from the apartments to be 0.11 l/s m^2, which far exceeds the Swedish passive house requirements of under 0.3 l/s m^2. The buildings were constructed with thick insulation and minimal cold bridges to minimize heat loss. 250 mm of wall insulation has been used, compared with the Swedish standard of 150 mm, which provides a u-value of 0.13 W/m^2K. Greater roof and foundation insulation has also been used than in conventional buildings, and the roofs and foundations have u-values of 0.10 W/m^2K and 0.15 W/m^2K respectively. Efficient windows with a u-value of 0.9 W/m^2K have been installed, which exceeds Svenska Bost der's internal requirement of less than 1.3 W/m^2K. The heat recovery systems transfer heat from outgoing air to incoming fresh air with an efficiency of 87 percent. The local district heating system is used to provide efficient supplementary heating to the incoming air, as well as to efficiently supply hot water. The south-facing balconies are designed to act as sunscreens for the apartments below to prevent overheating during the summer. The apartments also have individual electricity, heating, and hot and cold water meters to ensure that residents only pay for what they use and to promote further savings.

Reduced carbon dioxide emissions

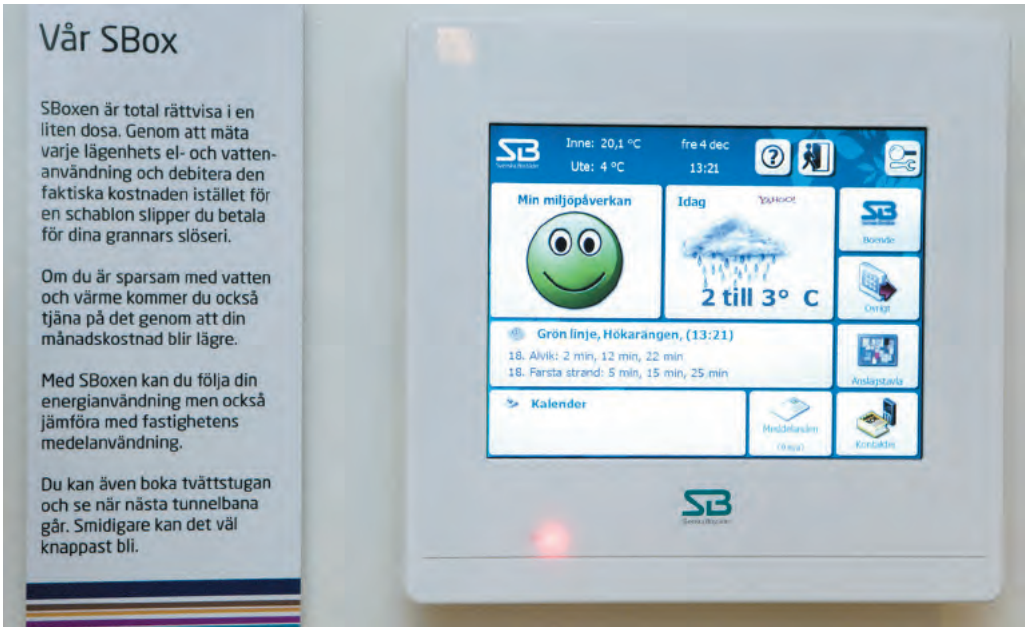
The apartments annually produce around 4 kg of CO_2 per m^2 for heating and hot water, compared with a building that meets the Swedish building code heated with district heating, which produces 10 kg of CO_2 per m^2. Total CO_2 figures, including landlord and tenant electricity consumption, are 15 kg/m^2 and 20 kg/m^2 respectively for Bl Jungfrun and a building that meets the Swedish building code. The conversion factors of 0.35 kg/kWh for electricity and 0.1 kg/kWh for district heating have been used to calculate the above figures.

Resident energy efficiency awareness

Each apartment is equipped with a Smartbox, which displays the apartment's real-time energy and water consumption, together with the projected utility bills residents can expect to pay. Smartboxes have a user-friendly touch screen display and color-coded smiley faces are used to simply communicate how much energy and water is being consumed. Residents can also view how much CO_2 their energy consumption equates to, as well as their historical energy consumption.

Public passive house awareness

Skanska launched a blog for the Bl Jungfrun project that documented the construction, project energy calculations and the indoor environment of a passive house apartment. The public was invited to pose questions about the project and passive housing in general, which were answered by a Skanska environmental engineer through the Bl Jungfrun blog. Skanska led one guided tour per week on average during construction, including delegations from Svenska Bost der, the French Chamber of Commerce and a Japanese company. Educational information concerning passive housing has also been placed in the entrances of the apartment buildings to raise awareness of low-energy buildings among visitors.



Learning From Good Practice

The Bl Jungfrun project cost effectively met Swedish passive house standards through the inventive use of proven construction techniques. There is consequently potential for other projects to reach Swedish passive house standards by using conventional construction techniques in a similar manner.