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Bromma Blocks: Hangar 3, Sweden

Case Study 73

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

GREENBUILDING

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Energy

Carbon

Materials

Water

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Hangar 3 in the Bromma Blocks retail center in Stockholm, Sweden, involved the redevelopment of a 1940s airport hanger into a modern and energy efficient shopping mall, as part of a project that strived to reduce environmental impacts during construction.

Project Introduction

Bromma Blocks is one of Sweden's leading retail centers, and is situated in western Stockholm, close to Bromma Airport. The center is a blend of historic buildings and modern architecture. Hangar 3 involved the redevelopment of a heritage-listed airplane hangar originally constructed in 1948. The project added 25,000 m^2 of modern retail space to Bromma Blocks, which now includes around 60,000 m^2 of retail space in total.

Skanska Sweden carried out the US$ 130 million project for KF Fastigheter between June 2008 and September 2010. The project involved redeveloping Hangar 3 into a modern retail center and adding 12,500 m^2 of new space. The three-floor building accommodates around 70 retail stores, a food hall, cafes and restaurants. A new 11,000 m^2 underground parking garage with 330 vehicle spaces was also constructed, which involved the excavation and removal of 40,000 m^3 of soil and rock. Hangar 3 was originally built on marshland so Skanska installed three different types of pile foundations to stabilize the ground in order to construct the underground parking garage. The pile foundations have a combined length of 10,000 m and the project team used 3D and 4D techniques to plan the complex construction process.

The project was certified according to the European Union's GreenBuilding Programme, which is a voluntary initiative aimed at improving the energy efficiency of non-residential buildings in Europe. According to the programme, a building must consume at least 25 percent less energy than the national standards demand in order to be certified. Hangar 3 consumes around 26 percent less than the Swedish building code for newly constructed buildings. Skanska also worked together with the client to find innovative solutions to reduce environmental impacts during construction, make the supply chain more effective and promote resource efficiency.

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Contributing Toward Sustainable Development

Hangar 3 in the Bromma Blocks retail center created a modern shopping mall that is energy efficient and promotes a healthy indoor environment for shoppers and retail employees. The project also reused an existing heritage-listed building and Skanska worked to preserve the historic character of the structure. During construction, high standards of health and safety were set and pioneering techniques were developed to effectively communicate changes to safety and working procedures to the workforce. The construction project benefited the regional economy by utilizing workers, subcontractors and construction materials from the surrounding area. Skanska identified innovative solutions to reduce environmental impacts during construction together with the client, and worked with project partners to minimize greenhouse gas emissions and construction waste.

Social Aspects

Project partner cooperation

The project was conducted according to a partnering model, which involved Skanska developing cost-effective project solutions together with the client. Collaboration began in late 2006 with preliminary studies, project planning, formulation of the project budget and the development of a project team contract. Early collaboration and planning together with the client was crucial to the development of environmental processes and objectives to reduce the overall environmental footprint of the construction process. The establishment of clear aims was important for a project of this size and enabled the 250 workers to be aware of the project's objectives, which were included in the team contract and the project induction.

Occupational health and safety

Four minor accidents occurred on the project during construction and the Lost Time Accident Rate was 5.6 per million hours worked in total. Skanska prioritized comprehensive safety training for all workers and every employee was required to check in to the site on arrival by swiping their personalized access card. Skanska promoted an open work environment to encourage the identification of safety inadequacies and risks, and procedures were established to ensure they were quickly mitigated. Information channels were set up to effectively communicate changes to safety and working procedures, including the innovative use of monitor screens to instantly inform the construction team on site. An automated external defibrillator was also stationed on site in the event of a member of the workforce developing a life threatening cardiac condition.

Healthy indoor environment

Additional glazing was added to increase natural light within the building and 22 percent of the fa ade is now glazed. Existing glazing was replaced with reflective solar control glass to limit glare and solar heat gain. All ventilation air that is supplied

to the indoor environment is conditioned fresh outdoor air and no stale indoor air is recycled within the building. The ventilation system is capable of high temperature cooling at a low air velocity, which provides a good indoor thermal climate without creating cold drafts. A management system was also installed to monitor and optimize the indoor climate.

Functional and flexible building

The public spaces and walkways were designed to be intuitive and extensive signage was erected to facilitate navigation around the building. The hangar has a single load-bearing pillar in the center, which facilitates future alterations and redevelopment work, including potential changes in building use.

Sustainable urban planning

The project redeveloped and reused an existing structure and did not directly impact on greenfield space or natural habitats. Two thirds of the new retail area created by the project is contained within the hangar. Stockholm municipality plans to build a new city quarter around Bromma Blocks, with thousands of new homes earmarked for construction in the next 15 years. There are also plans to extend the suburban light rail system to run through the area.

Cultural preservation

Hangar 3 is a heritage-listed building and Skanska worked to preserve the historic character of the structure. The project preserved the structure's unique single pillar bearing design that supports the 1,500 ton roof. Parts of the exterior were also incorporated into the design to maintain the building's historical character, such as the original hangar doors, which required extensive restoration work to blast away several layers of toxic lead tetroxide long-lasting anticorrosive paint.

Economic Aspects

Local construction employment and subcontractors

The construction site was one of the largest in Stockholm at the time, with around 250 workers on site during the peak of construction. Over 90 percent of the workforce and subcontractors were from the Stockholm area.

Local and regional construction materials

Locally sourced materials included the concrete and asphalt used on the project. Materials from the surrounding region, within 400 km, included the wooden facades, doors, slab reinforcements and structural framework.

Reduced construction costs

Various efficiency measures were incorporated into the construction process, which reduced the environmental footprint of the project and also made financial savings. An initiative to reduce transport related emissions made financial savings of over US$ 210,000 by working with logistics companies to make the delivery of construction materials more efficient. A foundation reinforcements solution involving steel fiber saved US$ 800,000, compared with a conventional reinforcement solution. The use of the local district-heating network during construction saved US$ 10,000 when compared with the use of heating oil.

Reduced operational costs

The energy efficient measures incorporated into the retail center create direct financial savings throughout its lifespan. The areas redeveloped and constructed in the project use around a quarter less energy than the Swedish building standards.

Environmental Aspects

Reducing environmental impacts during construction

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

EcoPar ultra clean diesel motor fuel was used on the project, which reduces CO_2 emissions by 30 percent compared with conventional diesel fuel. EcoPar also cuts NO2 emissions by 50 percent

and reduces the creation of some carcinogenic substances by over 90 percent compared with conventional fuel. In addition, EcoPar decreases the likelihood of workers suffering from negative health effects from diesel fumes, such as headaches and nausea.

Reduced greenhouse gas emissions during construction

Skanska worked closely with the client to meet their requests to reduce the project carbon footprint by investigating and identifying low-carbon solutions. Transport related CO_2 emissions were reduced by around 500 tons by working with logistics companies to organize consolidated deliveries and by replacing road transport with rail or sea transportation. Site deliveries were consolidated to around one delivery per day by effective communication between the logistics coordinator and the project team and by storing construction materials at a short-term storage facility. The project team worked with logistics companies to request rail transport during the procurement phase and 336,600 ton-kilometers of rail transport was used instead of road transportation. Electricity generated from environmentally responsible sources was used during construction, which avoided almost 109 tons of CO_2 when compared with conventional Swedish electricity. The local district heating system was also used to provide site heating during construction instead of heating oil, which saved over 80 tons of CO_2. Steel fiber foundation reinforcements were used on the project, which saved around 370 tons of steel and avoided the greenhouse gas emissions associated with steel manufacturing and material transport to the site.

Waste management

Construction waste was sorted on site into 15 fractions and only 2.8 percent of the waste materials were sent to landfill. The project involved excavating 40,000 m^3 of material to construct the underground parking garage. The majority of the excavated material was contaminated with tar, petrochemicals and substances such as arsenic and cadmium, and was properly treated off-site by specialist waste treatment contractors. The excavated material also contained 17,129 m^3 of stone and rock, which was crushed on-site and reused as backfill. The reuse of material on-site as backfill avoided approximately 150,000 km of road transportation that would have been needed to remove and dispose of the material.

Energy efficiency

The building is estimated to annually consume 108 kWh/m^2 in total, including energy for electricity, heating, cooling and warm water, compared to the current Swedish standards of 146 kWh/m^2 for a new building. The redeveloped building uses around 80 percent less energy for space heating than prior to the redevelopment, despite being over a third larger in size. Energy efficiency measures include the replacement of the existing inefficient glazing by well-insulated glazed facades with a U-value of 1.3 W/m^2K.

Efficient cooling is supplied by the local district cooling system and is distributed throughout the building by a self-regulating passive chilled beam system that provides a cooling effect of 40 W/m2 in the retail areas. A low-speed ventilation system has been installed, which provides 3.3 l/s and m2 and uses stale air to heat the underground garage. Heat is then recovered from the used garage air and reused to heat fresh air entering the retail areas at an efficiency rate of 70 percent. The building's heating system is consequently almost self-sufficient with any necessary heating provided by the efficient local district heating system. Timers control lighting in the public spaces and motion detectors activate lighting in store restrooms and cleaning cupboards. Motion detectors also dim staff corridor lighting down to 10 percent when not in use. Energy efficient LED (Light-Emitting Diode) lighting has been used to illuminate the building's external facade.

Water efficiency

All toilets are low flush and toilets in the personnel area can flush with either 2 or 4 liters of water. Taps are fitted with devices that automatically limit the water flow to half the standard flow, but are capable of full flow if held by the user. All public toilets and taps are controlled by infrared sensors, which ensure they only use water when necessary.

Learning From Good Practice

Skanska's early involvement in the project and their work with the client to identify environmentally responsible solutions helped to realize significant environmental and economic savings during construction and throughout the lifespan of the building.