BUILDING FOR THE FUTURE: UNITED NATIONS APPROACH FOR THEIR BUILDINGS

Yong Han Ahn[1]

In combating climate change the United Nations should lead by example.
Ban Ki-Moon
United Nations Secretary-General

INTRODUCTION

The term "Sustainable Development" was first used in the Brundtland Report from the United Nations World Commission on Environment Development (WCED) in 1987. In this report, sustainable development was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The United Nations is a world leader in working to reduce greenhouse gas emissions causing climate change. These efforts include the Kyoto Protocol in 1997 that committed 37 countries to reducing greenhouse gas emissions, and the United Nations Framework Convention on Climate Change (UNFCCC) that has the goal of stabilizing greenhouse gas concentrations in the atmosphere at a certain level, preventing dangerous anthropogenic interference with the climate system. The building sector is the single largest contributor to global greenhouse gas emissions, with one third of global energy use taking place in offices and homes. With this in mind, the United Nations designed and constructed their new office facility in Nairobi, Kenya, which houses the headquarters of both the United Nations Environment Program (UNEP) and the United Nations Human Settlements Program (UN-HABITAT). The building has been described as a United Nations showcase for how future buildings can reduce and recycle, be energy- and water-efficient, and maximize sustainability without compromising the quality of the working environment. Thus, the purpose of this building was to represent one of the key, low-cost ways of combating climate change, while reducing electricity bills and dependence on fossil fuels. The building also improves the quality of the working environment to significantly influence productivity, health, and well-being.

KEYWORDS

sustainable building, net zero building, daylighting, United Nations

[1]Ph.D., LEED AP + BD&C, Assistant Professor in the Department of Construction Management at East Carolina University, yonghan77@gmail.com.
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FIGURE 1. Front view of the United Nations' Building in Nairobi, Kenya.

To achieve the UN's sustainability goals, the project team first wanted to make the new building energy neutral, where the electricity requirements of the building and its occupants were met over the year by the power generated by solar panels. The first step was to estimate the potential energy needs of the building, which totaled 750,000 KWh, or approximately 42.5 KWh per square meter per year. The following steps have been implemented to reduce energy consumption in the building.

The first step was to locate the building facing north–south, achieving maximum daytime lighting with minimum heat intakes, and elongating it on an east-west axis. In addition, consideration was given to heating and cooling, internal and external lighting, and computers and IT infrastructures, in order to reduce energy consumption in the building. The next approach was to design the simple chimney in Figure 2. This simple design enables the building to act as a chimney, where warm air is drawn up from the ground level, travels through the office areas, and finally escapes beneath the sides of the vaulted roof, maintaining comfortable temperatures in the offices and air circulation throughout the building. In addition, operable windows were installed to give staff some control over their environment and also help airflow and temperature regulation. The design team adopted an open office layout to not only encourage a productive working atmosphere, but also to greatly assist in airflow and cooling loads.

Since lighting is a major consumer of energy (20%) in this office, the project team ensured that everyone had adequate light in which to work while making dramatic reductions in energy use, for both cost and sustainability reasons. To find the best solution, the project team commissioned a comprehensive study that combined sophisticated software and detailed climate data for Nairobi to model light availability in the building year-round. The combination of low-energy bulbs and tubes with a light level and presence detection controller and daylight sensing, can yield savings of up to 70 percent of lighting loads in the building. These approaches also improve the indoor environment with adequate daylight levels in all areas.

FIGURE 2. Simple chimney design concept for the building.

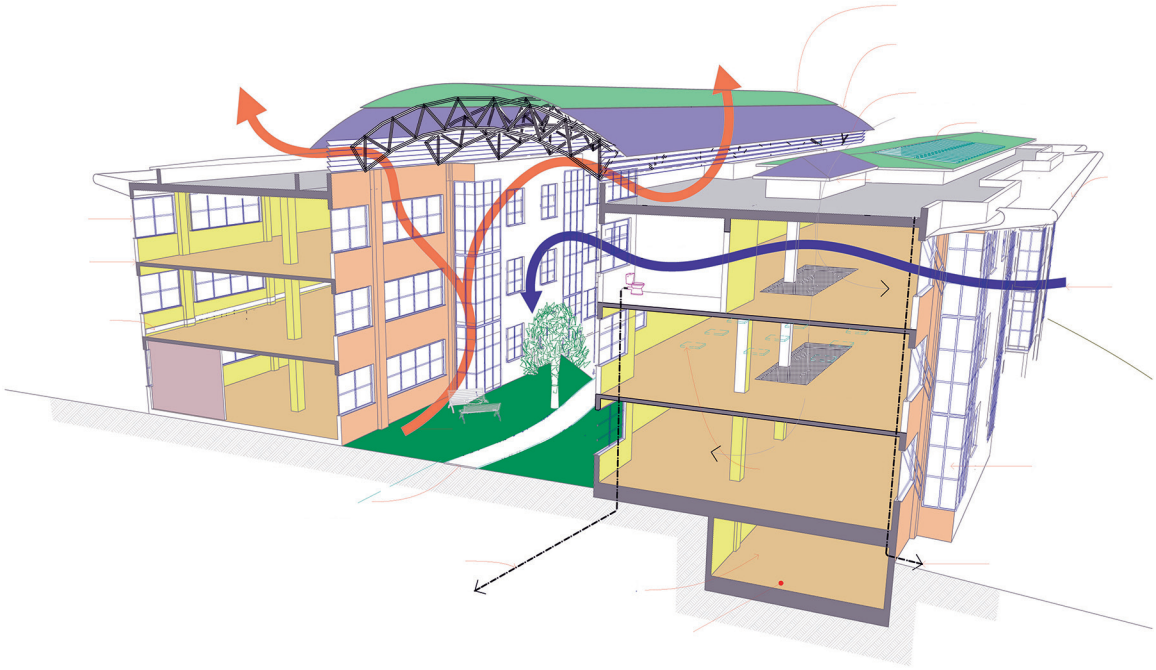

FIGURE 3. Lighting strategies to reduce energy consumption and improve the indoor environment.

FIGURE 4. Photovoltaic panels to generate electricity in the site.

In addition to passive energy-saving strategies in the building, part of the quest for energy neutral was met by renewable energy (solar) generated by 6,000 m^2 of photovoltaic panels (Figure 4). Because of Kenya's sunny climate, these panels generate the estimated annual electricity needs of the building (750,000 KWh). In addition, any excess solar power produced can be used by other buildings on the campus. Furthermore, the payback period, estimated on the basis of current electricity prices, was around 10 years, which shows how the building can be energy neutral and economically sound.

The project team implemented green procurement for IT equipment and designed an energy-saving data center to reduce energy consumption in the building. Air conditioning in the data centers accounted for up to 90 percent of IT energy consumption. Therefore, the use of air and cool water to maintain server temperatures removed the need for costly air conditioning. Green procurement ensures a full life cycle approach is taken to IT, in addition to saving time, money, and energy.

The project team adopted a rainwater harvest system that could capture 7.5 million liters of rainwater from the roof for the purpose of irrigating the landscaped areas around the building. The project team also adopted water-saving taps and lavatories to reduce water consumption and installed a wastewater treatment system to treat wastewater in a state-of-the-art on-site aeration facility. The treated wastewater was used to irrigate the landscaped compound and reduce the need for fresh water in the landscape. Thus, with high-efficiency fixtures, rainwater and recycled water can meet all the irrigation needs of the building compound.

FIGURE 5. Energy-saving design for the data center and green procurement.

FIGURE 6. Collect rainwater to irrigate plants.

The project team also considered the landscaping of the new building, which offered a terrific opportunity to not only create a stunning environment, but also to show how beautiful and creative gardens can be created and maintained using minimal amounts of water. Plants that require minimal water are planted beneath the atrium in each block to encourage biodiversity and create cool and beautiful interior gardens. In addition, indigenous species were used in combination with plants from other locations in Africa, reflecting the incredible botanical variety that is part of Kenya's history.

FIGURE 7. Landscape near the building.

FIGURE 8. Recycled-content carpet and low-emitting paint.

The project increased the demand for building products, including carpet that incorporated recycled content materials to reduce the impacts resulting from the extraction and processing of virgin materials (Figure 8). In addition, the project team used low-emitting materials like adhesives and sealants, paints, and other materials to reduce the quantity of indoor air contaminants that were odorous, irritating, and/or harmful to the comfort and well-being of installers and occupants.

In addition to implementing sustainable building strategies and technologies, the United Nations partnered with a local design and construction team that possessed the necessary knowledge and experience for sustainable design and construction. This strategy incorporated Nairobi's weather, the limitations of building materials, and labor sources into the building's design and construction. It also helped the local economy and job creation in the region and motivated construction professionals to integrate sustainable design and construction in other projects.

UNEP's sustainable office in Nairobi, Kenya, provides a model of the sustainable practices and processes that will help to ensure sustainable development in the building sector. The first step is bringing together project stakeholders who have sustainable building experiences to create a collaborative working environment. It is also critical to set up clear objectives for the building from the start. These objectives include energy neutrality, no fresh water used for landscaping, and an overall reduction in water usage of 90%. In addition, the future occupants should be included in the early design phase in order to design the optimal environment that will enhance the occupants' health, productivity, and well-being. It is also necessary to understand the concept of total cost of ownership for the building so that the owner can invest additional resources to minimize the total cost of ownership. The project team should also know how to use tools including energy simulation, daylighting simulation, etc., to help make better decisions. The project team should also keep an eye on developing new technologies that can achieve the goals of sustainability without increasing the price. These sustainable practices in the building sector can reduce energy consumption, greenhouse gas emissions, and resource consumption, while improving the indoor environment and maintaining the first cost premiums. The UN's approach in their Nairobi building can be a leading example of sustainable building not only in Africa, but also in the world.