Council on Tall Buildings and Urban Habitat

CTBUH Technical Paper

http://technicalpapers.ctbuh.org

Subject:	Architectural/Design Façade Design Sustainability/Green/Energy
Paper Title:	**Greening Modernism: Westraven Tower**
Author(s):	Hendriks, Jeroen
Affiliation(s):	Cepezed Architects
Publication Date:	2010
Original Publication:	CTBUH Journal Issue 4, 2010
Paper Type:	1. Book chapter/Part chapter **2. Journal paper** 3. Conference proceeding 4. Unpublished conference paper 5. Magazine article 6. Unpublished

© Council on Tall Buildings and Urban Habitat/Author(s)

Greening Modernism: Westraven Tower

Jeroen Hendriks

Author

Jeroen Hendriks, Public Relations & Communications

cepezed Architects
Phoenixstraat 60-b
PO Box 3068
2601DB Delft
The Netherlands

t : +31 15 215 0000 f : +31 15 213 0908
e: jeroen.hendriks@cepezed.nl
www.cepezed.nl

Jeroen Hendriks
Jeroen Hendriks studied comparative art sciences at the Free University of Amsterdam and has written extensively on various cultural disciplines such as art, photography, literature, film, theatre and architecture. He has written and edited numerous articles and several books on the work of cepezed.

Based in the city of Delft, The Netherlands, cepezed architects have gained a reputation with transparent, sustainable and technologically progressive architecture, designed for maximum usability and livability. The office strives for an unaffected design with sober but stylish materialization and a careful finishing, in which spatial and construction-technical aspects are drastically integrated. Therefore, it has also integrated its design and building processes. With the use of prefab components and the application of industrial construction methods, cepezed constantly aims to optimize the alignment of design and realization in order to meticulously control planning, costs and quality.

Cepezed was established in 1973 and is presently led by co-founder Jan Pesman (1951) and associated architect Ronald Schleurholts (1972). In 2008, the office was honored with the highest award of the Royal Institute of Dutch Architects, the BNA Cube, for its complete works.

"The renovation of the Westraven Tower in Utrecht, the Netherlands, shows how an outdated building from the early 1970s can be transformed into an example of sustainable practices in the late 2000s. How was this done? By giving it a new textile skin!"

The Westraven Office Complex in Utrecht, the Netherlands, is a combination of a renovated existing building and a new extension for the use of several divisions of the Dutch Department of Public Works. The program includes office space, conference facilities, a national meeting center, a communications center, and a "future center" named LEF for the Department of Public Works. This existing 85-meter (279-foot) tall construction has been radically renovated and reorganized, and a stretched out four-story podium has been designed around the base of the building. Various functions and facilities are based in large, open spaces in the podium, which are inviting for both meeting places and casual encounters. Much attention has been devoted to obtaining perfect equilibrium between low energy consumption and an optimum working climate. The architecture, technical installations and construction physics are fully integrated, which significantly contributes to the overall sustainability of the complex (see Figures 1 and 2).

The Original Westraven

Westraven is an area to the South of the centrally situated Dutch city of Utrecht, located between the Amsterdam-Rhine Canal and the intersection of two major motorways, the A2 and A12. It was built in the early 1970s, utilizing a so-called jack-block system, which at the time was a cutting edge construction technique of British invention. This method required that the roof had to be constructed immediately after the foundations and basement were completed. Once the roof was completed, the core, which was made out of prefabricated concrete blocks, was constructed. This means that the entire unit was jacked up to create the space needed for a new layer of blocks and the top floor. As a result, the construction of the building was gradually elevated at a rate of two floors every three weeks.

Regardless of its revolutionary construction, Westraven received a generally negative critical response, which over the years only became stronger. One reason was the strong winds at the main entry which frequently hindered people and an alternative entry had to be used frequently. Also, the monolithic office block appeared distant and the working conditions inside were below par. The substandard climate control and a dark, stuffy atmosphere also played an important role in this negative criticism.

Because of the negative feedback, but also its central location, it was decided that the building was to be renovated and that it would be expanded to accommodate additional divisions of the Departments of

...wind power

"I doubt wind power will become a common feature in high-rise inner city projects, but without this type of bold innovation, how would we ever know? Developments like this show that sustainability is increasingly becoming mainstream. That's something everyone should celebrate."

Paul King, head of the UK Green Building Council, on Strata Tower's wind turbine. From "Spin City: London's Strata Tower", www.guardian.co.uk, July 18, 2010 (http://www.guardian.co.uk/artanddesign/2010/jul/18/strata-tower-london-green-architecture)

Figure 1. Westraven Office Complex

Figure 2. Westraven building before renovation

Public Works. In addition to improving climate and the working environment, the new complex had to be open and transparent while also reflecting a certain prominence in the city. Moreover, Westraven had to set an example as a landmark of sustainability.

Opening up

The tower has been stripped to its concrete skeleton, which has been completely reused. Five large voids, of 6 meters (19.7 feet) wide and 5 meters (16.4 feet) deep, were created by removing floor segments of three successive floors, alternatively along the western and eastern façades. Now users no longer enter a dark and nondescript space when they exit the lifts at the core of the tower. Instead, they are met with an abundance of light and splendid panoramas over the Utrecht area. This not only improves spaciousness and scale, it also helps users to orientate themselves. Moreover, because of the newly created voids, the different office floors are interconnected, which contributes to both internal communication and spatial diversity (see Figure 3).

From the outside, the voids are large rectangles of solar-control glazing, which immediately grab attention because it visually stands out amidst the horizontal rhythm of the rest of the façade. As such, they serve as an important identifying element of the building.

The new thermal façades are made of floor-to-ceiling glass. This not only improves the views and the amount of daylight into the offices, but it also ensures that the occupants will always move towards light when they pass through the hallways. The interior arrangements are fully flexible, comprised of different types of rooms using a partitioning system that is largely transparent as well.

Textile Skin

In order to facilitate natural ventilation, façade panels are operable. This has been made possible because the tower has been given a second skin, which eliminates possible inconvenience caused by the wind (see Figure 4).

At the time of the preliminary design, the idea was that this outer facade would be made out of silk-screened glass, but during development the architect came up with the idea of a light-weight and consequently more cost-effective skin of Teflon-coated and

Figure 3. Newly created voids

open-weave fiber-glass textile. The soft turbulence behind the textile would neutralize the forces of the wind, so that the cavity between the textile and the thermal façade would be relatively tranquil and would enjoy a constant supply of fresh air. As a result, it

would become possible to ventilate the offices directly with fresh air from the outside without any wind pressure problems. But there would also be another important advantage as the textile skin would also function as a sun shade without impeding the views.

The façade screen was inspired by textile applications in horticulture and is extremely light-weight in comparison to other outer façade solutions. At Westraven, the textile is attached to steel balusters by means of aluminum tubes, sharing the existing construction with the window-cleaning equipment.

Because such a solution has never been attempted before, the façade screen has comprehensively been tested against a large number of technical and functional criteria. These showed that the screen reduces the forces of wind and the sun adequately, but it is also sufficiently transparent and translucent. The colorfast fabric is unaffected by water, grease and dirt, is resistant to the weather, fungus, rust and insects, and is easily cleaned if necessary. Moreover, the screen does not flutter or vibrate and has been extensively tested to address the potential icing issues of the system.

The translucence and transparency can be attributed to a combination of factors; the difference between the light intensities inside and outside, the color and degree of reflection of the textile, and the angle of the sun all play a role. In addition, the distance of the textile to the building, the mesh-size, and the thread thickness of the fabric in relation to the resolution of the human eye are also relevant factors. Because the screen is so thin, good views remains possible across a very wide angle.

Both the Government Buildings Agency and the Department of Public Works went along with the textile skin, but opted for alternation of the fabric with strips of glass at eye level. Because the textile façade has no sound-insulating properties, the building has an outer façade of glass on the north side, which is closest to the motorway.

Mechanical Installations

To further improve the interior climate, all stories have been equipped with climate ceilings. Since the construction was erected using the jack-block system, it was designed to be as light as possible at the time. Therefore, the floors were relatively thin and had been reinforced with concrete beams. The spaces in between these beams were perfect for accommodating climate-control units suitable for both heating and cooling the building by pumping hot or cold water, respectively, through the pipes. For Westraven, the supplier customized the units so that several other components, such as the sprinkler system, intercom speakers and light fittings could also be integrated; thus contributing to a tidy, clear and visually unobstructed atmosphere.

Figure 4. New textile skin

Podium

New low-rise sections have been added on either side of the tower. This added 24,000 square meters (258,334 square feet) of space to the existing 27,000 square meters (290,626 square feet) in the tower. These extensions have a V-shaped floor plan with rounded edges and are enclosed by a conservatory made of transparent material (see Figure 5). The sections are linked by an intermediate zone, with a large entrance area and two indoor gardens, while their hallways form an extension of the entrance. As a result, the ensemble, as a whole, appears as an indivisible unit in which the transition from old to new is hardly perceptible.

The structure of the extension is nearly all steel and has been dimensioned as slender as possible for both aesthetic and sustainability reasons: a slender construction of steel provides both lucidity to the building and reduces the use of material. Moreover, because of its relatively low weight and its excellent thermal conductivity, it absorbs and emits warmth faster than the more traditional and heavier concrete structure. As a result, less energy is being used for heating and cooling.

Sustainable Climate Concept

As mentioned, much attention has been devoted to obtaining perfect equilibrium between low energy consumption and an optimum working climate. For this purpose, a sustainable climate concept has been developed. The high degree of transparency of the design, for example, is not only based on architectural and aesthetical principles, but also by maximizing the use of daylight so less artificial lighting is needed. Also, a dynamic lighting system has been installed, which automatically adapts to the color and intensity of the natural light available.

Four different climate zones have been developed in order to adjust the climate concept to the actual day-to-day use of the building. The offices and workspaces are

Figure 5. New extensions at podium level

Figure 6. Integrated heating and cooling system inside the new office wings' floor slab

provided with full service climate control facilities. The floors of the new office wings have been rendered thermally active by means of a water network system that has been cast in the concrete slab components of the floors (see Figure 6). Through this network, the structure is kept at a constant temperature. In the long term, this system uses less energy than an ongoing alternation of heating up and cooling down.

Since each of the conservatories is used for completely different functions (such as the restaurant, gatherings or workshops), the standards for these particular areas are less demanding. The bulk of these enormous spaces are heated by return air passing through the edge of the office floors.

At the ground level, this is complemented by floor heating. Since the conservatories serve as a buffer between the new office wings and the direct influences of the weather outside, the demands upon the office façades are relatively low. Therefore, an indoor partitioning system could be used for these, which saves considerably on construction costs. Perforated panels in the façades also contain sound insulation and can be opened, which allows for extra ventilation through the atrium.

During the warmer periods, an opening is created in the conservatories through a sun screen system for which the same fabric has been used as applied in the greenhouse industry. When the temperature rises, the screens automatically come down. The warmth is retained in the cavity between the screen and the façade and is naturally ventilated. The same technique is used in order to obtain the warmth entering through the transparent roofs between the office wings. An additional cooling installation is integrated into the floor.

Cushions

The entrance area is wind and water tight, but only very basically heated. The roof and façade are largely composed of transparent air cushions of ETFE-foil (see Figure 7). The first three meters (ten feet) of the façade are

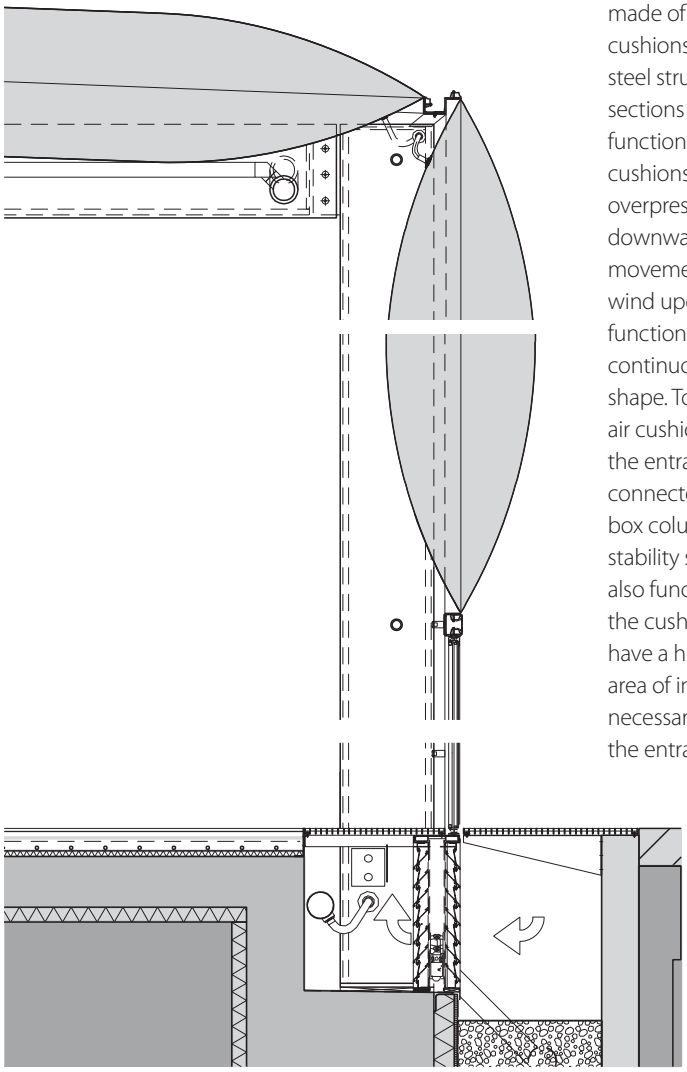

Figure 7. The entrance area's ETFE cushioning

made of glass, above which the cushions are mounted to the steel structure with channel sections that simultaneously function as a water discharge. The cushions are kept at an internal overpressure attuned to downward and upward movements, such as snow load or wind updrafts. Because they function as membranes, they continuously preserve their shape. To absorb the forces on the air cushions, the roof beams at the entrance are mutually connected with tie-bars. The steel box column profiles of the stability structure are air-tight and also function as air supply lines for the cushions. The cushions do not have a high performance in the area of insulation, but that isn't necessary considering the use of the entrance hall. All in all, the uses of cushions constitute a very cost-effective solution.

The inner gardens are sheltered from the wind and sun, but have no further climate control. They have no actual façades but are fenced from the rough weather conditions by a roof and skin of the same type of Teflon-coated glass-fiber fabric used for the outer-skin façade of the high-rise.

Heating and Cooling

The complex is equipped with a sustainable underground thermal energy storage system, which uses underground water reserves called aquifers to temporally store energy. In the winter, warm water is passed into a cold well while energy is extracted by a heat exchanger for heating purposes. In the summer, the process is reversed and cold water is used for cooling. Once heated, the water is stored in the cold well. Next to the reduced energy use, the advantage of this system is that it is environmentally safe; the water that circulates from underground to the heat exchangers and back cannot be contaminated as it always remains in the system. Moreover, the water from underground is not lost.

For additional heating and cooling, Westraven uses two heat pumps: 3.600 kW capacity for cooling and 1.200 kW capacity for heating. Two existing gas furnaces with a capacity of 2.000 kW in total have been preserved for peak capacity.

Recognition

The Energy Performance Coefficient (EPC), which is a figure used in the Netherlands to measure the energy efficiency of a building, was 33% better than required by the Dutch Buildings Decree for the tower and even 50% better for the podium. Westraven has won the Daylight Award for its exquisite balance between the use of daylight, artificial lighting and other architectural aspects and was granted the Dutch Construction Award with much praise for its sustainability on all levels. Recently, Westraven has been shortlisted for the Prime Property Award 2010, which is a European prize for sustainable real estate investment. ■

...Smirnoff

"I would expect a business whose core market is young and trendy would be attracted to this, someone like a fashion label or maybe an alcohol brand. … It sounds like they are looking to tie in a company for life, so we could be talking about the Smirnoff Tower in a few years' time."

Tony Mernagh of the Brighton and Hove Economic Partnership, on the lack of interest from prospective investors for the Brighton i360. From "Time is Running Out for the Brighton i360", The Argus UK, September 15, 2010.