

Commerzbank. Frankfurt, Germany.

Sir Norman Foster & Partners.

Derek McCallum

The skyscraper is by nature an artificial world, but that does not mean it has to be completely separate from it. In the design of the Commerzbank building in Frankfurt, Germany, Sir Norman Foster & Partners have re-evaluated the idea of the skyscraper as something that is open and permeable, constantly modifying and reinterpreting the world of nature. It explores the nature of the office environment and asks: how can it be ecological? Commerzbank makes it its purpose to create a closer relationship between the occupant and the environment in an effort to produce the optimal balance between human comfort and sustainable design. By exploring the way Foster uses natural ventilation and natural light in his design we can see just how ecological and environmentally friendly the office tower can be. In addition, examining supplementary ecological features and considering the broader based applications of the tower's design will allow us to determine how future buildings will need to address the environment in order to be successful and sustainable.

Commerzbank, one of the largest banks in Europe, commissioned Foster in 1991 to design a new headquarters next to their old head office in the historic Kaiserplatz area of Frankfurt's booming downtown core. The 300m, 56-floor skyscraper – Europe's tallest – carefully integrates itself with the historic vernacular of the Kaiserplatz by providing an entrance discreetly between two shops, covered by a glass atrium that makes it look more like a side-street market or gallery. The more modern, grandiose entrance faces the old Commerzbank towers on Grobe Gallusstrabe¹. The tower, more conventionally, also acts as a symbol for Frankfurt's economic



power and emerging prominence as Europe's banking capitol. However, its careful design is also symbolic of a city trying to design and build in the most ecological way possible².

The Commerzbank building utilizes many environmentally friendly techniques in order to save energy and simultaneously create an extremely pleasant working environment. Natural ventilation plays a key role in this program. Every single office in the building, even those on the uppermost floors, has an operable window so that the employee may create his or her own microclimate. The window can be opened when one is warm, and closed when one is cold. The windows mediate between the internal and external environment by controlling ventilation, heat loss, solar heat gain, and day lighting. This is possible due to an innovative façade system composed of three

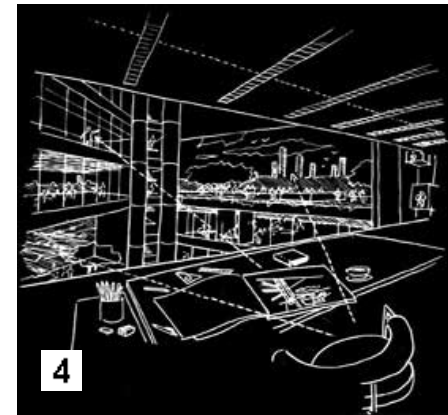


layers. The inside layer consists of a double-glazed, bottom hinged window which acts as the main envelope between inside and out. An outside layer of fixed glass acts as the second layer. The third layer is a ventilated cavity between the other two in which air enters at sill level and is exhausted through a slot at the top of the window. Within the cavity are blinds that reduce glare in the office as well as solar heat gain. Since they are essentially external, they stop the heat before it enters the building, unlike conventional blinds. This system allows the windows to be open even in driving rain or high winds. The cavity – which improves the thermal insulating properties of the window up to 20% - and natural ventilation help Commerzbank use 25-30% less

energy than buildings of comparable size³. In order to carry the sensation of fresh air throughout the entire building, Foster implemented something of a first for the skyscraper – the sky garden.

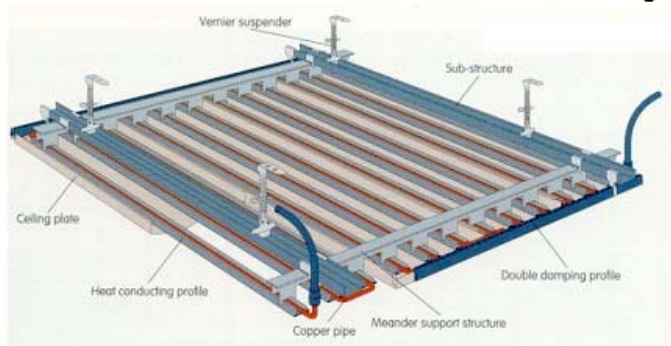
Spiraling around the building's triangular plan are nine gardens, each four stories high and containing a different array of plants, depending on its orientation. The gardens become a meeting place for the building's

workers and bring daylight and fresh air to the inner offices. The east gardens contain bamboo, Japanese maples, magnolias, and azaleas to create an oriental theme; the south gardens contain olive trees, lavender, cypresses, and pomegranates to invoke the Mediterranean; North America is represented in the north-facing gardens with rubinia, maples, and sequoias⁴. The garden façades also contain operable windows for natural ventilation and are set back from the main façade at a slope of three degrees to reduce glare. The walls are supported by tubular trusses that are heated by a hot water system to prevent cold downdraughts and condensation within the garden space⁵. Running from the plaza level to the very top of the building is a central atrium. This allows direct natural light into all interior offices, as stipulated by German law. In the summer, sunlight is admitted through the glass roof and reflected throughout the core, and in the winter, the sun penetrates the garden facades. In this manner, every single office has access to natural light and has the ability to be day lit. Foster chose a triangular plan for the tower, placing the core functions (elevators, stairs, washrooms, mechanical services, etc.) in the three corners, which freed up the central space needed for the atrium. Divided into sections containing one garden on each side of the building, the atrium ensures one area is always on the windward side and one on the leeward side. This guarantees natural air intake and exhaustion⁶. Foster's sketch above shows how by allowing each office, even those deep with the tower, access to natural light and fresh air, humanity and nature have been brought into the workplace.



Commerzbank has multiple other systems in place to lower energy consumption and improve its sustainability. With the building's high insulation quality and abundance of glazing, heat is provided through

conventional radiators located at the sides of the windows. The cooling system, however, is far more innovative.



Cool water – absorbed through environmentally friendly refrigerating machines attached to municipal streams - is pumped through tubes in the ceiling panels and cools the building down without resorting to energy-intense air conditioning. Water has a high capacity for absorbing heat and moving it around uses less energy than circulating air, which needs to be constantly replaced. Water can be recirculated. For economical and financial reasons, the tower

does not provide hot water in washrooms. Instead, water being stored in towers to be used for the cooling system is used to flush toilets⁷. This further reuses water and conserves it as much as possible. Although the building is extremely well day lit, artificial lighting is provided in all inner hallways, internal meeting rooms, and each office – for use at night and inclement weather. The lighting reacts to the presence of people and after a time turns off automatically. This saves a considerable amount of energy and money, considering many skyscrapers leave lights on all day and well into the night regardless of who is in the building⁸. All of these systems, including ventilation, are controlled and monitored by a central ‘smart’ computer. When the weather is suitable, all air systems close down automatically and a green indicator light, located on a panel in every office, indicates that the windows should be opened. When the light is red, mechanical systems are activated and the windows are locked. The computer operates on an intelligent algorithm system, essentially trial and error, to learn when to switch modes for the optimal balance between human comfort and energy efficiency. Weather stations, located at each garden level, monitor solar radiation, air temperature, air pressure, and wind speed/direction to assist the computer⁹.

While the building makes many positive gestures towards environmental design, it is always possible to go farther. With all the natural light entering the building, it is a shame there is no real thermal massing or other way to store this free heat and have it radiate throughout the building. If garden floors were made of stone or tile instead of reflective surfaces, it would be yet another way to lower energy consumption. Another way the abundant light could have been put to use is with the use of photovoltaics or solar panels to ease the load on the mechanical energy system. These could have been placed in any one of the gardens, the atrium, the façade, or even the roof. The roof would also have been an ideal place to collect wind energy, since velocities are higher at higher altitudes. The environmental systems Commerzbank has in place work beautifully and are a fantastic start to a truly ecological language, but certain aspects most certainly could have been carried further.

It is important, however, to have Commerzbank initiate the conversation of sustainable design in large-scale architectural projects since this is a realm often unconcerned with the environment. The idea of natural light permeating every space in a building is one which should be accounted for in all buildings, for light not only animates a space and improves the quality of life for the occupants who use it, it is a source of free light and heat. Placing atria in other office towers, apartment buildings, or other structures which would otherwise contain inner rooms is a way to achieve all of these goals. The gardens created here by Foster are another way to improve human enjoyment of a building as well as reduce the reliance on mechanical ventilation systems. The gardens are an excellent social gathering place and produce fresh oxygen while absorbing carbon dioxide. The gardens could easily be adapted and modified to fit almost any building type in architectural discourse and thereby reduce energy consumption in that building by up to 30%, as it does for Commerzbank. Sustainability is also important in the way a building responds to its surroundings. The tower brings in water from streams and uses this water for three separate purposes (tap water, toilet water, and water for the chilled ceilings). It also is respectful of neighboring buildings ensuring successful integration with the natural environment. Architects who begin to consider these

sustainability issues will encourage all design to become more mindful of the environment and its rewards to create a more prosperous built environment.

Commerzbank proclaims itself as the world's first ecological skyscraper. In providing schemes to reduce the reliance on mechanical light and air systems while simultaneously improving human comfort, Sir Norman Foster has created a building that should stand as a model for future large-scale projects. As energy and pollution grow ever more significant an issue in the urban environment, architecture must begin to respond in a more meaningful and genuine way. Commerzbank is an important step in starting this discourse of taking responsibility for the environment and the repercussions of being such a large and potentially wasteful building. In conclusion, sensitivity to nature must become central to all architectural practice if we hope to create a built environment suitable for the demands of the future.



¹ Davies, Colin. "Commerzbank, Frankfurt." Surrey: Watermark Publications UK, 1997. p. 84.

² Norman Foster and Partners: Construction of the Commerzbank, Frankfurt.
<http://www.fosterandpartners.com/internetsite/html/Project.asp?JobNo=0626>

³ Davies. p. 198-199.

⁴ Volker, Fischer and Horst, Grüneis. "Sir Norman Foster and Partners: Commerzbank, Frankfurt Am Main". Stuttgart: Druck und Bindearbeiten, 1997. p. 13.

⁵ Davies. p. 237.

⁶ Commerzbank: A Sustainable Skyscraper Norman Foster
http://web.utk.edu/~archinfo/a489_f02/PDF/commerzbank.pdf

⁷ Volker, Fischer and Horst, Grüneis. p. 17.

⁸ Ibid. p. 19.

⁹ Davies. p. 261.

Image Credits

- 1 Norman Foster and Partners: Construction of the Commerzbank, Frankfurt.
<http://www.fosterandpartners.com/internetsite/html/Project.asp?JobNo=0626>
- 2 Architects, Buildings, Projects: Commerzbank Headquarters.
<http://a4d.hypermart.net/architecture/projects/combank/combank.shtml>
- 3 Ibid.
- 4 <http://www.fosterandpartners.com/internetsite/html/Project.asp?JobNo=0626>
- 5 Zent Limited: Products
<http://www.zentlimited.demon.co.uk/products.html>
- 6 <http://www.fosterandpartners.com/internetsite/html/Project.asp?JobNo=0626>

Bibliography

Commerzbank: A Sustainable Skyscraper Norman Foster

http://web.utk.edu/~archinfo/a489_f02/PDF/commerzbank.pdf

Davies, Colin. "Commerzbank, Frankfurt." Surrey: Watermark Publications UK, 1997.

Norman Foster and Partners: Construction of the Commerzbank, Frankfurt.

<http://www.fosterandpartners.com/internetsite/html/Project.asp?JobNo=0626>

Volker, Fischer and Horst, Grüneis. "Sir Norman Foster and Partners: Commerzbank, Frankfurt Am Main".

Stuttgart: Druck und Bindearbeiten, 1997.