

Project: Green Buildings
Commerzbank Tower

“Green building is a systematic effort to create, sustain, and accelerate changes in practice, technology, and behavior to reduce building related environmental impacts while creating places that are healthier and more satisfying for people. The objective is to reduce the negative impacts of built environments while creating healthy, comfortable, and economically prosperous places for people to live, work, and play.”

- USGBC



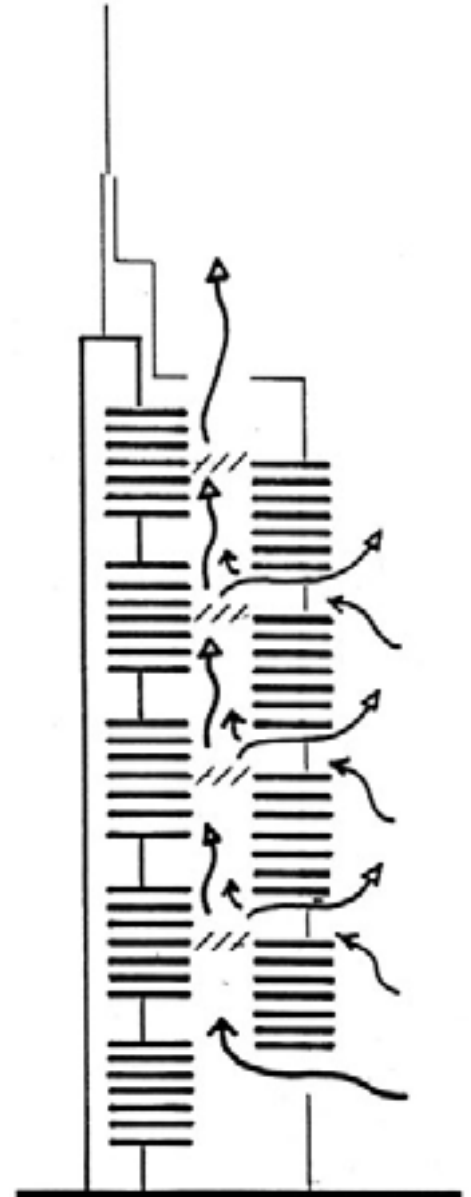
While the Commerzbank Tower is not recognized in the form LEED certification, the project is recognized as the first Ecological Skyscraper and it still can be seen as innovative even today. The tower was completed in 1997. The day the Commerzbank opened, the Financial Times adopted it as the symbol of Frankfurt. It features Big Ben and the Eiffel Tower as symbols of London and Paris. It stood as the tallest building in Europe from the year of its completion to 2005. Although the tower has become a meaningful symbol of Germany's economy, it is a true example of using innovative design strategies to achieve maximum performance, with minimal energy use, while achieving a higher standard of living for the building's inhabitants. The tower was designed by Norman Foster, an architect well known for his innovative sustainable practices.

Before analyzing the environmentally friendly systems that Commerzbank Tower employs, it's worth noting that the number one goal of Foster's design is to create a pleasant work environment for the buildings 2,000+ occupants as a means of increasing worker productivity and moral. Even modest improvements in productivity, absenteeism, and/or employee retention can substantially outweigh the traditionally sought after efficiency benefits such as energy savings. We often systematically under invest in one of the most valuable aspects of buildings, occupant experience. Green building includes a number of strategies that are intended to work together to create and sustain healthy, comfortable indoor environments. As with neighborhoods, these green building strategies are most often prescriptive or form based metrics, in this project's case measures of access to daylight or ventilation rates are key. Most large office buildings built today rely heavily on massive mechanical systems to heat, cool, and circulate air, and high levels of wattage to artificially light the space within. In usual cases only a small percentage of offices or workspaces have direct access to daylight and fresh air. Foster relies on a unique hybrid system that lights, cools, and ventilates the building using minimal man made energy.

Foster's hybrid system, and the key to this building's success as the first "ecological skyscraper", is embedded in the passive benefits created from an interconnected series of atrium spaces. It is referred to as a hybrid system because this one integrated design strategy (the network of atriums) lights, heats or cools, and ventilates the building, while creating a higher standard of living all at once. Light as well as outside air is fed to the center of the building through the roof and atrium, and through nine gardens that are four stories tall. The gardens spiral around the building façade and convert carbon dioxide gas to oxygen as it enters and leaves the building through mechanical vents.

All offices have access to natural sunlight and are able to be open to natural ventilation whether they are facing the exterior or interior of the building. People with interior backing offices may open their windows to the atrium, while people with exterior backing offices may open their windows partway to the outside. Outside opening windows are made feasible by a double layer glazing system. The first layer of glazing has operable windows that open into a cavity between a second layer of glazing. The second layer of glazing allows fresh air to enter through ventilation slots and controls relative airflow and wind forces. The windows of the building have been selectively chosen so that there is no interference with sunlight passage. Laminated glass without tint allows a maximum amount of sunlight into the tower instead of reflecting it away. Foster worked directly with Dupont to develop a transparent glass that would have the properties of both clear glazing and a fire barrier. Commerzbank's use of the doughnut plan in conjunction with the four-story sky gardens allows for every office in the building to have an unobstructed view to the outdoors. Full height windows and shallow floor plates ensure that the amount of natural light penetrating into the building is sufficient enough to substitute for artificial lighting through the majority of the workday. Frankfurt, Germany's low solar insolation and diffuse lighting conditions make daylighting an incredibly effective environmental response in that glare and unwanted direct solar gain in the region is minimal.

Natural ventilation in Commerzbank occurs at multiple scales ranging from individual rooms to several building stories, all of which vary based on climatic conditions. When looking at the building section as a whole, it appears as though the entire central atrium space acts like a giant chimney with air being exhausted out the top of the building by way of stack effect. While this was Foster's original intention when designing the building, the incredible scale of the space would have resulted in a powerful updraft of air that would have been undesirable for the building patrons. Consequently, in the final design, the atrium is segmented by glass decks into four twelve-story spaces, each consisting of three deliberately positioned sky gardens. In this particular



scheme, fresh air enters the building through windward gardens at the bottom of every twelve-story segment, and exhausted out of leeward gardens at the top of them. The glass decks are completely sealed off from the atrium space below, divorcing them from the tower's natural ventilation process, which includes both cross-ventilation and a limited amount of stack effect. The means by which natural ventilation occurs in the tower section varies for the cold winter and warm summer months. In cold winter conditions, sky garden windows are closed to store heat, but are reopened to let in desirable breezes when conditions modern office buildings full of heat-producing machinery have a higher demand for cooling, but Frankfurt winters typically require heating as well. Foster responds to this dichotomy of needs in the cladding system by utilizing double skin glazing with ventilated cavity spaces, operable casements, and Venetian blinds. Whenever heating is desired, exterior vents are closed to allow heat to build up in the cavity spaces, which protects against cold winds while improving the thermal insulating properties of the windows by as much as 20%. When cooling is required, the cavity vents and operable casements are opened to allow for natural ventilation with cool air entering low and warm air exiting high after circulating through the office.

Commerzbank tower's nine four-story sky gardens occupy three different faces, which all have distinct solar orientations. With gardens oriented to the south, east, and west, the design team recognized early on that plantings from different climates would be required to respond to the varying levels of solar exposure. The south facing gardens, which receive the most amount of solar gain throughout the year consist primarily of Mediterranean plantings including olive trees, cypresses, and a ground cover of thyme. The west facing gardens, which receive a significant amount of afternoon sun throughout the year are filled with north American plants including evergreen oaks and ornamental grasses. The northeast facing gardens, which receive very little to no sun over the course of the year are composed of various Asian plantings that thrive in shaded environments such as bamboo. To ensure that all of the plant life stays alive, the sky gardens are always naturally ventilated, even when the office interiors are being air conditioned. As a result, these environments act more as sheltered exterior spaces than interiors, meaning that there are times in the year when they may be too cool for people in indoor clothing. This is somewhat supplemented with underfloor heating, but is an adjustment that would probably not be as widely accepted.



Glass 'decks' or skylights at levels 7, 19, 31, and 43 along with the enclosing top skylight divide the atrium. The use of multiple skylight enclosures has more than one function. A half-hour fire and smoke barrier is created between sections of the building along with managing and control the fresh air ventilation in the building. The skylights divide the stack and chimney effect leading to an increase control of air quality management.

While passive strategies for heating, cooling, and ventilation are effectively implemented in Commerzbank office spaces for the majority of the year, Frankfurt's cold winter months and hot summer period require active systems as a means to create thermal comfort within the tower. When in active modes (as determined by the central building management system), Commerzbank offices utilize radiant floor heating to effectively warm objects instead of air,

While the project is full of truly genius and innovative principals, there are some criticisms towards it. Some people criticize it for its lack of renewable energy sources. People are always quick to apply solar panels to a building to consider it sustainable. The truth is that PVs would not work in Germany's cloudy climate. Wind turbines could be a feasible option and it would have been interesting to see how Foster would have integrated them into the design. Another criticism is that it does not use recycled content materials. What a lot of people do not know is that steel is actually mostly recycled content anyway. While it is true that this building may not meet every category of a sustainable building practices, the unique system of atrium spaces and gardens really sets it apart from other generic towers.

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