Green Office Buildings:
Design Strategies Used in the ING Bank

Photo from The Rocky Mountain Institute

Introduction:

In 1978, the board of directors of the ING Bank set out to build a new headquarters with the following criteria – "an organic building that would integrate art, natural materials, sunlight, green plants, energy conservation, low noise levels, and water" (Browning, 1992). The new headquarters would also have to be functional yet cost-effective. In fact, the directors stated that the construction was "not to cost one guilder more than conventional construction" ("International Netherlands Group Bank" from *Rocky Mountain Institute;* Browning, 1992). Additionally, the building was to create a new image for the ING Bank as a forward thinking and creative institution.

To make the building attractive and environmentally responsive in both design and function, the board assembled a multidisciplinary team of architects, building engineers, landscape architects, energy experts, and artists to work together in designing the building. The design step took three years and the method has since been called "integrated building design"

("International Netherlands Group Bank" from *Rocky Mountain Institute*, "Integrated Design for Energy Efficiency from *U.S. DOE*). In this process, individuals representing multiple aspects of design work together to realize synergistic benefits and not only meet, but exceed original goals at lower costs through combining design components ("Integrated Design for Energy Efficiency from *U.S. DOE*).

Using a 'whole building design approach' can reduce and even eliminate capital and operating costs because features that may cost more when purchased alone, such as super-insulating windows, can reduce the cost of the whole building through downplaying the necessity of other costly elements such as a heating system ("Why Build Green?" from *Rocky Mountain Institute*). Unlike the traditional design and building process in which individuals work only within their field of expertise, the design team in this approach analyzes interconnected building issues and determines a way to integrate all building components and systems to save energy and protect the environment ("Whole Building Design" from *U.S. DOE*). In this way, the headquarters of the ING Bank in Amsterdam has become a model for green office buildings with its combination of energy efficiency techniques and aesthetic design that create an ideal working environment (*Windmill*).

Daylighting

The designers of the ING Bank worked together to identify solutions to design needs that otherwise would not be found, integrating green design strategies into conventional design criteria for building form, function, and performance ("Integrated Design for Energy Efficiency from *U.S. DOE*, Browning, 1992). One technique they employed was daylighting, which determined the maximum floor depth of the building based on the criterion that no desk can be more than 23 feet from a window (Browning, 1992) Daylighting can offer significant energy savings through offsetting part of the electric lighting load and can improve occupant satisfaction and comfort. Using natural light from windows has been shown to increase productivity and health in offices as it provides visual relief and ventilation. The first step to using daylighting is to determine which spaces will benefit most from daylight and which spaces need little or no sunlight. Office workers with tasks that require similar amounts of light can then be grouped together ("Daylighting" from *U.S. DOE*). The floor plan of the ING Bank maximizes the perimeter daylight zone. Instead of being a monolithic tower, the 538,000 square foot building is

broken up into a series of 10 slanted towers interspersed with gardens and courtyards visible from the office windows (Browning, 1992).

Another important consideration of daylighting is the use of reflectors. Light shelves and reflector systems can significantly increase the amount of useful illumination provided by a standard window (normal illumination from a window reaches a depth of 1.5 times the height of the window, light shelves and reflector systems can increase it to 2 times or more). A light shelf is a horizontal light-reflecting overhang placed above eye-level with a transom window placed above it. The light bounces off the top of the light shelf onto the ceiling, an important light-reflecting surface that can carry daylight deep into a room, while the overhang shades the window below it from window glare ("Daylighting" from *U.S. DOE*). The ING bank uses interior louvers in a similar fashion "to bounce daylight entering the top third of each exterior window onto the ceiling of office spaces" (Browning, 1992). Another way to increase the effect of daylighting is to use high reflectance paints, ceiling tiles and floor tiles on the walls, ceiling, and floor surfaces, respectively, as well as to choose light-colored materials for office furnishing ("Daylighting" from *U.S. DOE*). The ING bank uses light colored paints and pieces of colored metal at the tops of atriums to reflect light, which also adds an artistic element to the design. (Browning, 1992).

Lighting shelves

<u>Building Envelope:</u>

The ING Bank headquarters has an effective building envelope that allows for heat storage supplied by simple passive solar measures (Browning, 1992). Building envelopes consist of the building's roof, walls, windows, and doors and controls the flow of energy between the inside and outside of the building. The Dutch bank, which was built before the development of super-insulating windows, has double glazed windows that minimize conductive energy transmission (Browning, 1992; "Building Envelope" from *U.S. DOE*). Glazing choices vary

depending on the climate of the region. In hot climates, the goal is to control heat gain by keeping solar energy out while at the same time, allowing visible light in for daylighting, and solar screens that intercept solar radiation or films that prevent infrared and UV transmission are most useful because they still allow for good visibility. In colder climates, the goal is to reduce heat loss to the outdoors and allow useful solar radiation in to heat the space.

In addition to double and triple layer glazing, which uses metallic layers of coating or tints to absorb or reflect specific wavelengths (desirable wavelengths in the visible spectrum that provide daylight are allowed to pass, while others such as near-infrared and UV are reflected), the spaces in between the glazing layers can be filled with an inert gas that has low conductivity, such as argon, to further reduce heat flow out of the building through windows. There are also windows with glazings that allow tinting to increase under direct sunlight and decrease as light levels decrease ("Building Envelope" from *U.S. DOE).* Another necessary measure for heat storage is insulation, which is important for both hot and cold climates. The ING bank headquarters is a precast concrete structure sheathed with insulation and then covered with brick to prevent the heat supplied by simple passive solar measures, lighting, power equipment, and body temperatures from escaping (Browning, 1992).

<u>Passive Solar Design and Cogeneration:</u>

Passive solar design integrates building components such as exterior walls, windows, and building materials to provide solar collection, heat storage, and heat distribution. The ING Bank building uses simple passive solar measures to decrease the energy use of its Heating, Ventilation, and Air Conditioning system (Browning, 1992). It is, however, unfeasible to construct an office building that is 100% heated with passive solar measures ("Passive Solar Design" from *U.S. DOE*). This is why the ING Bank also has an on-site cogeneration facility to heat a 26,420 gallon hot water storage system that connects to hydronic radiators that help distribute heat throughout the building. The cogeneration system recovers additional heat that would otherwise be wasted from elevator motors and computer rooms while air-to-heat exchangers transfer heat from the building's exhaust air to its intake air, thereby mixing heated air with fresh air to ensure that heated fresh air continually flows throughout the building (Browning, 1992).

Additionally, the building does not use conventional air conditioning. This is an impressive accomplishment for the building's designers, who designed it to rely on passive cooling methods through ventilation and back-up absorption chillers, something largely unheard of for a building of this size ("International Netherlands Group Bank" from *Rocky Mountain Institute*). While the thermal design of the building envelope intercepts some summertime heat, mechanical ventilation and natural ventilation cool spaces (Browning, 1992). When ventilation is not enough to provide adequate cooling, the building has absorption chillers that use heat and a chemical solution to produce chilled water that is distributed throughout the building by pipes to cool air. Usually, a gas burner is used to produce the heat with a mixture of lithium bromide and water. In the ING Bank building, however, waste heat from the cogeneration system powers the back-up absorption cooling system, which is an excellent alternative to electric motor driven chillers simply because it is powered by low-grade heat that would otherwise be unused ("R&D on Heating, Cooling, and Commercial Refrigeration" from *U.S. DOE*).

Other Innovations:

To satisfy the board of directors' criteria of an organic theme, art, natural materials, water, and plants were integrated into the building's design. The rooftops, courtyards, and atriums are landscaped in a variety of ways and incorporate efficient ways of using ways of using water. Water for use in fountains and landscaping is captured by cisterns, which catch and store rainwater from the rooftops. "Flow-form sculptures" are used throughout the building not only for aesthetic purposes, but also to add moisture to the air and fill quiet corridors with a soothing sound (Browning, 1992). Flow-forms are ecologically friendly as they oxygenate and revitalize water from rooftop run-off, which increases the water's capacity to support life-forms (*Flowforms).*

Flowforms next to handrails and outside at the ING Bank (Photos from Rocky Mountain Institute)

Cost and Benefits:

The total cost of construction, including land, structure, landscaping, art, furniture, and equipment was comparable to or less expensive than the cost of other modern office buildings in Holland (Browning, 1992). Green technologies used added an additional $700,000 to the cost of the $53 million project, but this was paid back within the first three months of the building's operation ("International Netherlands Group Bank" from *Rocky Mountain Institute*). With all of its innovations, the new ING bank headquarters consumers one-tenth as much energy as its old headquarters and one-fifth of the energy of a neighboring bank constructed at the same time at roughly the same cost. Each year, energy savings amount to about $2.4 million dollars because the building is 92 percent more efficient than it otherwise would have been (Browning, 1992).

Additional benefits of the building's construction include a reduction in employee absenteeism by 15% (Browning, 1992). On average, the cost of office-space rent amounts to about $21 per square foot in large office buildings, while office workers cost about $130 per square feet, which means that an increase of one percent in productivity can significantly offset a company's entire annual energy cost. It appears that a more pleasant and comfortable working

environment makes work easier and more enjoyable, while increased fresh air and natural light can contribute to employee health and decrease the number of sick days they take.

Conclusion:

The ING Bank headquarters is proof of the efficiency and feasibility of incorporating green technologies into building construction through green architecture. Not only is the building environmentally friendly and cost efficient, but it provides immeasurable benefits for its workers and enhances the building's use as an office for 2,900 employees (Browning, 1992) If this appears to be a win-win situation, then why aren't such methods more widely used? In the past, the business model in the U.S. has focused almost entirely from a "first-cost" position, encouraging the development and construction of buildings in the least expensive way with little or no consideration of operational and renovation costs down the road. Today, however, it is almost impossible to ignore the numerous benefits of green design and such methods are becoming more widely used (Childs, 2005). Green architecture is taking root in the U.S. and not only benefiting the environment, but the economy as well. This is evidenced by the increased revenues from areas of shopping centers that use daylighting as well as the reduced absenteeism in offices with better lighting and ventilation as a result of green design.

The ING Bank met almost all the requirements set by its board of directors in 1978 and also provided many unforeseen benefits. Although the building did initially cost more to construct than a traditional building, in the end the increased costs were recouped so quickly (within three months) and with long-lasting returns (a 92% reduction in energy costs each year) that this factor is greatly outweighed by the cost-benefits of incorporating green design elements. The building incorporated art with sculptures in atriums that also reflected light, used water through flow-forms, plants through landscaping, provided low noise levels and energy conservation through an innovative heating and cooling system, and met all the building-specific requirements initially set forth. The effectiveness of these innovations is responsible for the boost in the bank's image immediately following the bank's completion. The building achieved the goal of remaking the bank's image, which in 1978 was characterized as being "stodgy, and too conservative" ("International Netherlands Group Bank" from *Rocky Mountain Institute*). "ING is now seen as a progressive, creative bank, and the bank's business has grown dramatically," climbing from the number four bank in the Netherlands to number two (Romm

and Browning, 2005). Additionally, the added effect of reducing employee absenteeism is a benefit that is tremendous in terms of the value it adds to the bank as employees are more efficient and miss less work. The ING Bank building shows that green building does not have to involve expensive technology, nor does it have to involve a sacrifice of modern day luxuries such as air-conditioning. A green office building can be completed extremely effectively through inter-field collaboration and good planning and can provide all the amenities of a conventional office without much additional cost.

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