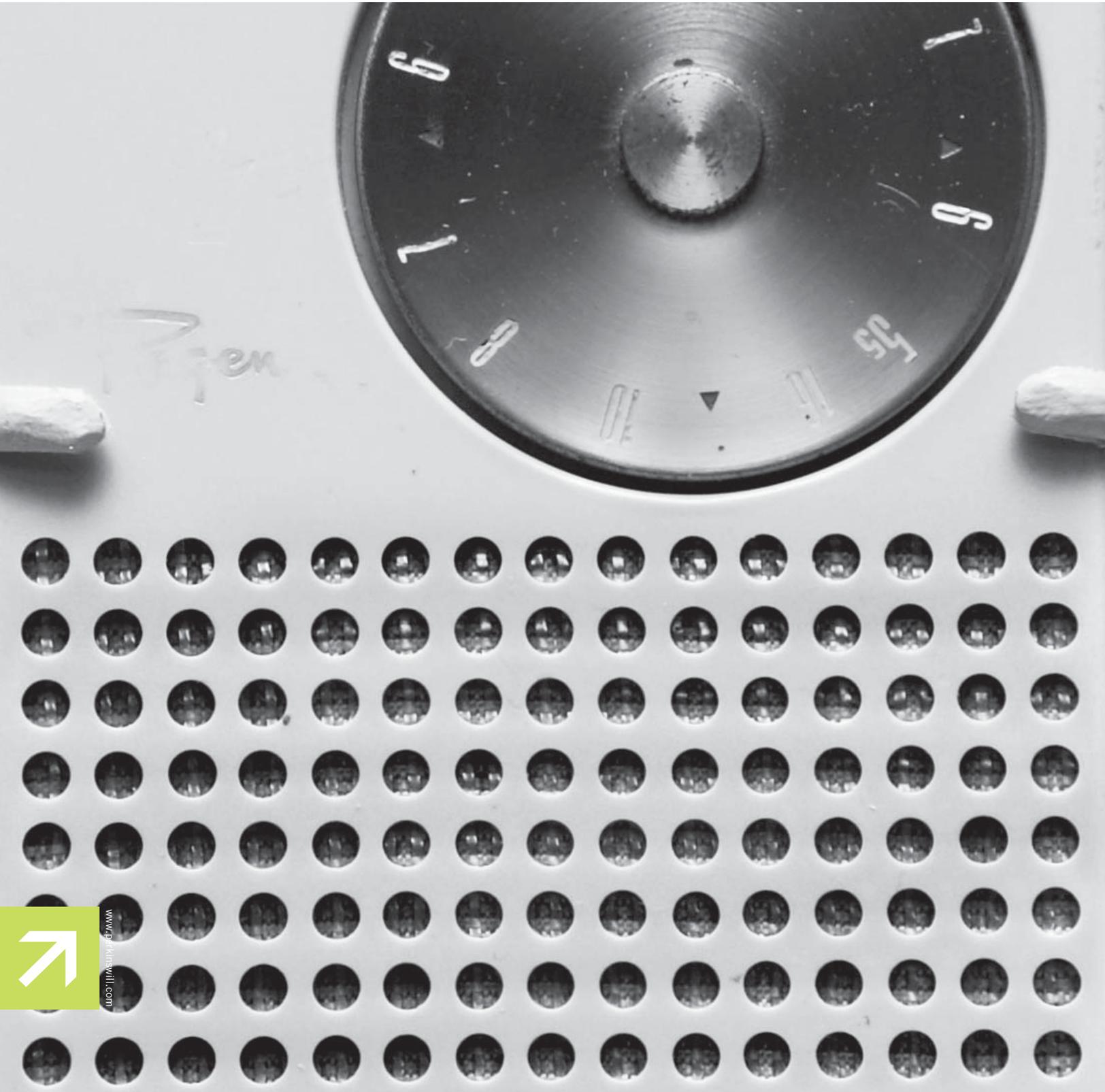


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04.

QUANTIFIABLE BENEFITS OF ACCESS TO NATURE IN BUILDINGS

Sky Garden Analysis for a Commercial Office Tower

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ABSTRACT

“Sky garden” is the term given for vertically stacked, three-story tall landscaped interaction hubs, flanked by formal and informal conference spaces. The design intent of the sky garden is to create an environment that serves as a tool for increasing business performance. A literature review was conducted to determine if that premise is supported by scientific evidence.

Studies in the literature examined benefits from access to nature either by personal experience, images or by exterior views within office and healthcare environments and in laboratory settings. Research showed benefits for access to nature in the following three categories:

- Performance indicators include improved opportunities for collaboration and communication, positive impact on recruiting and retention, positive message about investment in staff, which equates to trust building, alignment in key workplace initiatives and notable marketplace differentiator in leased environments.
- Psychological indicators include stress reduction, increased mental agility and innovative thinking, positive perceptions, background noise management, increased motivation and productivity.
- Physiological indicators include improved air quality and daylighting, increased humidity, reduced absenteeism, dust, carbon dioxide, mold, bacteria and chemicals.

KEYWORDS: nature, productivity, health, performance, indoor environment, indoor air quality, stress

1.0 INTRODUCTION

The increased focus and awareness on sustainable design has sparked a renewed interest in research that examines not only building performance, but the impact that poor workplace design has on its occupants. It is accepted knowledge that elevated levels of workplace stress, noise, varying comfort conditions (i.e. temperature, humidity, etc.) and poor indoor air quality have a direct impact on worker health (increased absenteeism) and performance.

In light of this perception the owner of a 1.1 million gross square foot [GSF] corporate office tower was considering sky gardens on its associate floors. The client wanted to base their investment decision on documented benefits.

For this paper “sky garden” refers to vertically stacked, three-story tall landscaped interaction hubs, flanked by

formal and informal conference spaces. The design intent of the sky garden is to create an environment that serves as a tool for increasing business performance.

A literature review uncovered several potential benefits of providing this type of solution. They include improvements on individual and group performance and in key psychological and physiological indicators.

Performance indicators include improved opportunities for collaboration and communication, positive impact on recruiting and retention, positive message about investment in staff, which equates to trust building, alignment in key workplace initiatives and notable marketplace differentiator in leased environments.

Psychological indicators include stress reduction, increased mental agility and innovative think-

ing, positive perceptions, background noise management, increased motivation and productivity.

Physiological indicators include improved air quality and daylighting, increased humidity, reduced absenteeism, dust, carbon dioxide, mold, bacteria and chemicals.

While these potential benefits are quite positive, given the competing need to maximize facility utilization in other ways, the research question was whether it was appropriate to include one or two sky gardens. The question is quantifiable as investing 18,000 square feet [SF] for both, versus investing 10,000 SF for only one. For the two sky garden option, they would be located on opposing corners of the building and on alternating floors so that the benefits of the amenity are experienced across the entire office floor plate.

2.0 PROBLEM

The purpose of this paper is to examine the degree to which the benefits of the sky garden may be assessed in order to determine whether the additional 8,000 SF is a good investment. In order to better understand the value of the investment, the design team conducted a literature review of studies and case studies that examined the benefits of access to nature in buildings.

3.0 METHODOLOGY

The method for this research was to examine published research and building case studies in three areas of study: work performance indicators, psychological indicators and physiological indicators. The working assumption was that features that have the potential for a positive impact on employees [improving performance, health, comfort, etc.] will provide a positive return on investment. Moreover, providing parity in access to these types of features is an important aspect of assuring the benefits. In addition to the literature review, research included area analyses and construction cost estimates.

4.0 RESEARCH STUDIES

4.1 Work Performance Enhancements

- BMW cites “the human factor is the No. 1 criterion in determining a company’s relative success. Accordingly, we see our associates not as a cost factor, but instead as an essential performance factor. This is especially true because any human resources policy that is not oriented towards the associate will always lead to negative cost effects in the long run, thus proving uneconomical.”¹

- Including natural settings has been found to be an effective means to evoke positive market identity²

- “Our research shows that a change as simple as adding flowers and plants can be important in the most meaningful way to businesses in the modern economy...people’s productivity, in the form of innovation and creative problem solving, improved – which in certain circumstances could mean the difference between mild and great business success.”³

- Hospital staff heavily use gardens for positive escape from work place pressures and to recuperate from stress. Growing evidence has begun to appear that hospital gardens increase staff satisfaction with the work place and may help hospital administrators in hiring qualified personnel.²

- When plants were placed in the reception area of a hospital the users perceived it to be more ornate, more interesting, more cheerful, more welcoming, more relaxing, less stressful, more expensive, tidier, quieter. There were no negative findings.⁴

- It is a common human resource rule that in order to attract and retain top employees, the workplace must offer aspects of what inspires employees during “off” time. Gallup polls indicate that two-thirds of the American work force cite gardening as their favorite hobby.

- Providing spaces where people can communicate and interact easily can spur conversations that can help to build trust.

- The investment group Winslow Management Co. manages \$225 million in assets for environmental non-profits, pension funds and individuals; found that publicly traded companies that occupy LEED certified buildings outperformed the Dow Jones Industrial Average by as much as 20%.

4.2 Psychological Factors

- Dr. Roger Ulrich is a behavioral scientist, Director of the Center for Health Systems and Design, Texas A&M University. Dr Ulrich is also a professor of landscape architecture and is an internationally recognized expert on the influences of surroundings on human well-being and health. He has concluded that when stress is decreased, then creativity and innovative thinking can flourish.³

- Problem-solving skills, idea generation and creative performance improve substantially in workplace environments with interior landscaping. Both men and women demonstrated more innovative thinking in the presence of plants than they did in an environment with art sculpture or no decorative objects.³
- Natural settings have been shown to illicit positive emotional states. One's emotional state has been shown to have profound effects on virtually all aspects of thinking including higher and lower-order tasks. Therefore because natural settings elicit positive emotional states, exposure to such environments may facilitate creative problem solving or high-order cognitive functioning via their ability to alter one's emotional state.⁵
- A growing number of studies have shown that exposure to unthreatening natural environments create positive shifts in emotional states – whether the subjects are stressed or unstressed at the beginning of the study. This yields a plausible hypothesis that exposure to positive natural environments should encourage creativity and higher order cognitive function.⁵
- Urban scenes containing prominent vegetation resulted in higher levels of psychological recovery than those without vegetation. It suggests that people were more wakefully relaxed during exposure to natural landscapes.⁵
- Interior plants can absorb, diffract or reflect background noise in buildings, thereby making the environment more comfortable for the occupants thus reducing stress.⁶
- Once the planting was introduced, 93% of the employees working in these areas felt healthier and more motivated to work. They also felt more valued as employees.¹
- Plant transpiration in an office environment creates a humidity level exactly matching the recommended human comfort range of 30% to 60%.⁹
- When the air is too dry, people are vulnerable to colds and flu. When the humidity is too high, people can develop other complaints. Through their natural processes of transpiration and evaporation, office plants add moisture to the dry overheated air often found in sealed office environments. At the same time, studies show that plants do not add moisture in significant amounts when the air is already moist.⁸
- Plants in the office provide an inexpensive method of cleansing the air of chemicals emitted from modern office equipment, such as computers, photocopiers and fax machines. Allowing these gases to build up can cause headaches and irritation to the eyes.¹⁰
- When plants were included in the offices, study participants were exposed to 13 commonly used foliage plants. The score sum of 12 symptoms was 23% lower during the period when participants had plants in their offices. This translated into a 14% decrease in absenteeism.¹¹
- Most absences (30%) had been due to respiratory illness, but once the plants were introduced these figures fell substantially. The study by BMW demonstrated that the improved air quality in the planted offices generally reduced illness.¹
- Office employees with plants in their offices had less subjective health complaints linked to the room climate than the test persons that had no plants in their office. The symptoms that were reduced the most in the “plants-group” were headache and skin irritation of the face, scalp, ears and hands.¹¹
- The United States Green Building Council (USGBC) and the Green Guide for Healthcare (GGHC) recognize the significance of a connection to the natural world. They cite, “Places of respite connected to the natural environment are key elements in defining a supportive, high performance healing environment with proven effects on patient, family, physician and staff well-being and improved clinical outcomes.” They award credit to building projects that provide places of respite to connect patients, visitors and staff to the natural environment for 5% of the usable area.¹²

4.3 Physiological Factors

- Responding to fatiguing challenges or stressors is accompanied by persistent declines in cognitive functioning or performance. Restoration through exposure to natural settings could be evident in gains in cognitive performance.⁷
- It was found that productivity could be enhanced by as much as 12% in the presence of plants. Study participants also reported feeling more attentive when plants were present.⁸

5.0 CASE STUDIES

Research Case Study 1

Study:

'Impacts of Flowers and Plants on Workplace Productivity'³

Date: 2003

Researcher: Dr. Roger Ulrich, Texas A&M University

Issue: Do flowers and plants promote innovation, ideas?

Approach

- Eight month study, 101 participants.
- Participants solved creative problems in different typical workplace environments. The various options were: workplaces with either flowers and plants, sculpture, or a control with no added decorative elements.
- Subjects self rated their moods four times, while performing two creativity tasks and one attention demand task.
- Researchers measured how many ideas participants generated. They also measure the originality flexibility of those ideas.. Evaluations were based on Torrence Test of the Creative Thinking and Profile of Mood States.

Results

Both men and women demonstrated more innovative thinking in the environment with flowers and plants.

Men generated a higher number of ideas; 15% more. Alternatively the women generated more creative and flexible solutions.

Conclusion

Flowers and plants have a beneficial impact on state of mind and emotions.

The key to a gaining the competitive edge in the modern economy is a happy, productive work force. Workers' idea generation, creative performance and problem solving skills improve substantially in workplace environments that include flowers and plants.

Quote from Dr. Ulrich: "People's productivity, in the form of innovation and creative problems solving, improved – which in certain circumstances could be the difference between mild and great business success."

Research Case Study 2

Study:

'Interior plants may improve worker productivity and reduce stress in a windowless environment'⁸

Date: 1996

Researcher: Virginia Lohr, Washington State University

Issue:

What is the impact of interior plants on human stress and productivity?

Approach

- 96 participants age 19-46 with 78% under 25.
- Study was conducted in a computer lab at Washington State University.
- The room had no windows and was lit with fluorescent lamps. The walls were painted off-white. The only color was the burnt orange desk tops. Temperature and relative humidity were held constant.
- Participants were tasked to hit a key corresponding to a shape on the screen as quickly as possible. One hundred symbols were shown in a randomized sequence.
- Subjects were randomly assigned to be tested in either the computer lab with plants (floor, table, and hanging) or the lab without plants. Plants were not in a direct line of sight, but rather visible in subject's peripheral view.
- Researcher measured blood pressure, pulse, and emotions using the Zuckerman Inventory of Personal Reactions. Measurements were taken both prior to and after the experiment was completed.

Results

The pre-task test results were similar for both groups. When plants were added to the lab, the subjects were more productive (12% quicker reactions on the computer task). However, the number of errors was not statistically significant between groups. Pulse was the same in both groups and while blood pressure rose in both groups while during the task, the blood pressure of subjects in the room with plants increased less. Subjects also reported feeling more attentive when the plants were present.

Conclusion

Flowers and plants reduce stress levels and increase productivity in an office environment.

Research Case Study 3

Study:
*'Effects of Vegetation Views on Stress and Health Indicators'*¹³

Date: 1994

Researcher: Dr. Roger Ulrich, Texas A&M University

Issue:
The effects of viewing plants on restoration or recovery from stress and health related indicators or outcomes pertaining mainly to large-sized vegetation such as trees and shrubs rather than to small plants and flowers.

Approach

- One hundred and twenty subjects watched a stress-inducing movie then were randomly assigned to a "recovery" period in which they viewed a non-stressful movie. One group viewed a videotape of urban environments without nature, and the second video showed a green park-like setting.
- Subjects self-rated feelings and four physiological measures: skin conductance, muscle tension, pulse transit time, and heart rate.

Results

Recovery from stress based on feelings and physiological measures was much faster and more complete for the group viewing natural settings. For this group blood pressure, muscle tension, and skin conductance were reduced more quickly and the reduction was also greater than in the control group.

Conclusion

Views of plants and other nature can reduce stress and in certain situations may have beneficial health-related influences.

Research Case Study 4

Study:
*'View through a window may influence recovery from surgery (1984) in "Health Benefits of Gardens in Hospitals"*¹²

Date: 2002

Researcher: Dr. Roger Ulrich, Texas A&M University

Issue:
Are there health related benefits that patients and staff can realize by simply looking at gardens and plants?
Approach

- Ulrich compared gall bladder surgery patients who had a bedside window view of either trees or a brick wall.
- Subjects were similar in age, weight, general medical history.

Results

Subjects with a "nature view" had shorter hospital stays and suffered fewer minor post-surgical complications. For these patients the staff more frequently recorded positive comments about their conditions. Those with the "wall view received significantly more negative evaluation comments. People with the "nature view" also requested fewer doses of strong narcotic pain drugs.

Findings of other studies in this literature review: Patients and families report better satisfaction with the healthcare provider and overall quality of care in the presence of indoor and outdoor gardens, plants, or window views of nature.

Conclusion

Viewing gardens can measurably reduce patient stress and improve health outcomes. This is a key factor in the major resurgence in interest internationally in providing gardens in hospitals and other healthcare facilities.

Many healthcare employees use gardens as an effective means for achieving a restorative pleasant escape from work stress and aversive conditions in the hospital. This positive effect results in increases in staff satisfaction with the workplace, which may in turn help hospitals in hiring and retaining qualified personnel.

Building Case Study 1

Project: Genzyme Corporation¹⁴

Date: 2005

Architect: Behnisch Behnisch and Partners

Issue:
Design of a revitalized office environment for a biotechnology company integrating a diverse range of sustainable systems.

Design Features

The bright atrium, surrounded by interior gardens, seating areas, and cafes is credited with the project's success. This central space visually connects work areas. Employees reported positive effects of these spaces on their well-being.

Results

Joan Wood, vice-president of leadership and organizational development conducted a post-occupancy survey in October of 2005 to assess the impact of the design on employee productivity.

Seventy-two percent of the staff attributed increased output to the daylighting. Genzyme experienced reduced employee turnover. Wood said, “We had an intuitive sense that it would be a nice place to work, but we didn’t think about these returns in investment. We’ve had a 5% lower sick rate and an 88% improved sense of well-being.” Survey results showed the following perceptions:

- 75 percent - the clear glass encourages connection between colleagues
- 88 percent - direct views and access to the interior gardens improves sense of well-being;
- 72 percent - lighting features increase alertness and productivity
- 66 percent - the open office plan increases collaboration
- 58 percent - individual control of temperature improves the quality of the environment.

Conclusion

The openness of the Genzyme Center creates spaces that are brighter, transparent and well ventilated. Direct views and access to interior gardens has significantly lowered sick rate, improved productivity and improved employee sense of well-being. Communication and collaboration between employees has increased also.

Building Case Study 2

Project: Commerzbank, Frankfurt, Germany¹⁵

Date: 1997

Architect: Foster and Partners

Issue:

Develop large scale urban office building that adheres to strict German laws regarding the quality of the work environment and the integration of the sustainable design features.

Design Solutions

The building is triangular in plan with a central atrium. The perimeter office segments are interrupted by four-story tall occupied winter gardens that rotate around the façade of the building on alternating floors.

The winter gardens allow vast amounts of light to drop within the building and provide pleasant views to those working deeper within the building.

They also provide a buffer zone of insulation between the office and the outdoors. Finally, the garden spaces provide a much more green, natural space for those working in the building which is something lacking in the typical urban work environment.

Results

The sky gardens plants purify the air and provide excellent air quality to the tower offices. Plantings were selected based on their orientation and solar exposure, resulting in different microclimates for each sky garden.

Coneybeare states, “Perhaps the measure of the Commerzbank’s success should not be simply in its conceptual popularity, but in the actual figures of the energy saved and increased worker productivity.” Proof of increased productivity is yet to be determined, but employees perceive that their productivity has increased and that they do not feel tired when leaving the building.

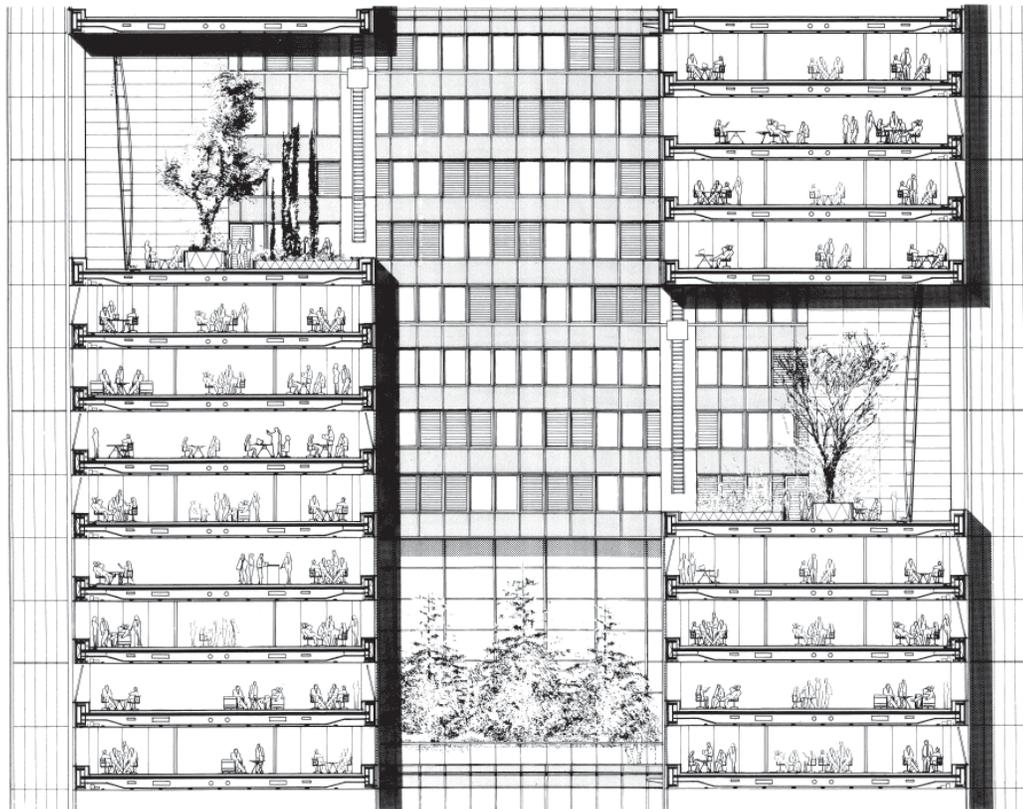
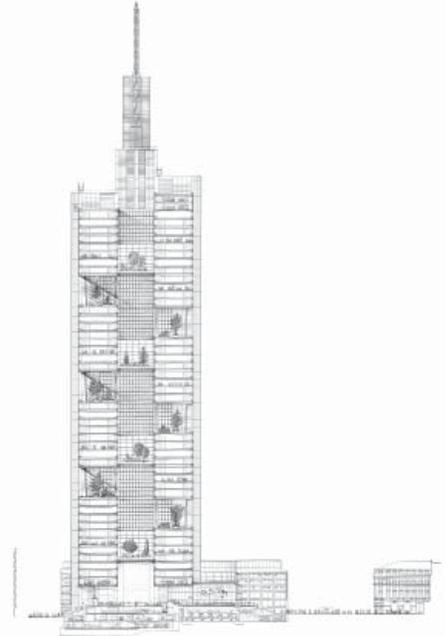
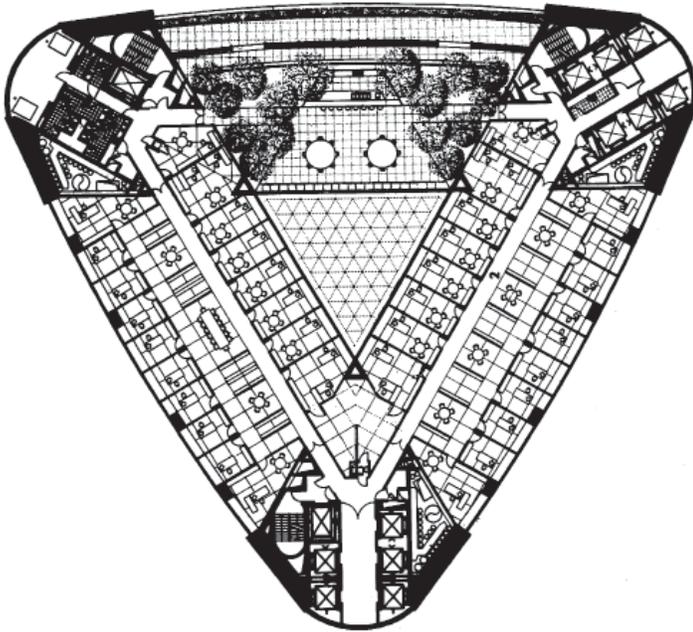
Conclusion

Strict German laws exist regarding employee comfort in the work environment. Aside from a well ventilated workspace, lighting is of great concern. Virtually all offices must have a window to provide light and a view outside. The building’s façade design provides that light in quantities sufficient to make the workplace pleasant.



PROJECT: Commerzbank, Frankfurt, Germany
All Images on this page Courtesy of Commerzbank and Foster + Partners

Quantifiable Benefits of Access to Nature in Buildings



PROJECT: Commerzbank, Frankfurt, Germany
Drawings Credit: Foster + Partners

Building Case Study 3

Project: BMW, Munich, Germany¹

Date: 1999

Architect: Karl Schwanzer

Issue:

BMW sponsored a study on the health benefits of interior plants in offices in response to ongoing health complaints from staff at their Munich headquarters.

Process

BMC collected and analyzed extensive data comparing productivity and absenteeism in the planted “green” and the unplanted “non-green” work areas.

Results

The well-being of the work force clearly improved in the planted areas. Beate Klug, the health and safety officer for BMW commented, “once the planting was introduced, 93% of the employees working in these areas felt healthier and more motivated to work. They praised the reduction in noise levels and favoured working in the “green” work place.”

Statistics showed that 30% of prior absences were attributed to respiratory illnesses. Once plants were introduced absences fell significantly.

They also found that the plants contributed to better humidity levels, reducing airborne particles and generally making the office more comfortable.

Conclusion

“The human factor is the number 1 criterion in determining a company’s relative success. Accordingly, we see our associates not as a cost factor, but instead as an essential performance factor. This is especially true because any human resource policy that is not oriented towards the associate will always lead to negative cost effects in the long run, the proving uneconomical.”

Building Case Study 4

Project: Bank, Amsterdam, Netherlands^{16, 17}

Date: 1987

Architect: Architectenbureau Alberts Nen Van Huut

Issue:

Reposition the fourth largest bank in the country that was viewed as “stodgy and too conservative.”

Process

The board’s vision for the building was to be “organic” integrating “art, natural materials, sunlight, **green plants [emphasis added]**, energy conservation, low noise, and water.”

Design Features

Despite its organic form the building uses the latest technologies including a specially designed security system and options for individual climate control. It incorporates natural ventilation and passive solar heating. Octagonal interior atriums in the core of each of three towers bring daylight to open plan office spaces. Natural materials such as wood, stone, plants, and water are prevalent throughout the building’s interior and exterior. The building is energy efficient using 92% less energy than a conventional building of similar size.

Results

Productivity gains coupled with a 15% reduction in absenteeism. The bank’s tremendous growth and large number of employment applications were at least partially attributed to the building’s design.

Conclusion

The bold new image of the bank – resulting from the building – is credited with elevating International Netherlands Group from number 4 to number 2 among Dutch banks.



PROJECT: ING Bank, Amsterdam, Netherlands

Photos: Architectenbureau Alberts & Van Huut BV

Quantifiable Benefits of Access to Nature in Buildings



PROJECT: ING Bank, Amsterdam, Netherlands
Photos: Architectenbureau Alberts & Van Huut BV

6.0 CONCLUSION

As the published research and building case studies show, the benefits of an integrated, landscaped interaction hub within a workplace environment may yield tangible benefits, summarized as follows:

- I. Work Performance Enhancements
 - Lease market differentiator
 - Recruiting and retention tool
 - Alignment with the client's corporate workplace initiative
 - Investment contributes to trust building
 - Increased communication and collaboration
- II. Psychological Factors
 - Stress reduction
 - Increase in innovative thinking
 - Increase in mental agility
 - Increased motivation
 - Increase in productivity
 - Positive perception
 - Absorption of background noise
- III. Physiological Factors
 - Reduced illness/absenteeism
 - Improved air quality
 - Increase in humidity level

- Reduced dust
- Reduction of carbon dioxide
- Removal of chemicals
- Less airborne mold and bacteria
- Daylighting is improved

This first goal of this study was to determine the benefits of access to nature. Given the positive evidence, the second objective was to evaluate whether one or two sky gardens were justified. The following discussion outlines the benefits of each option.

Architecturally providing two sky gardens allows:

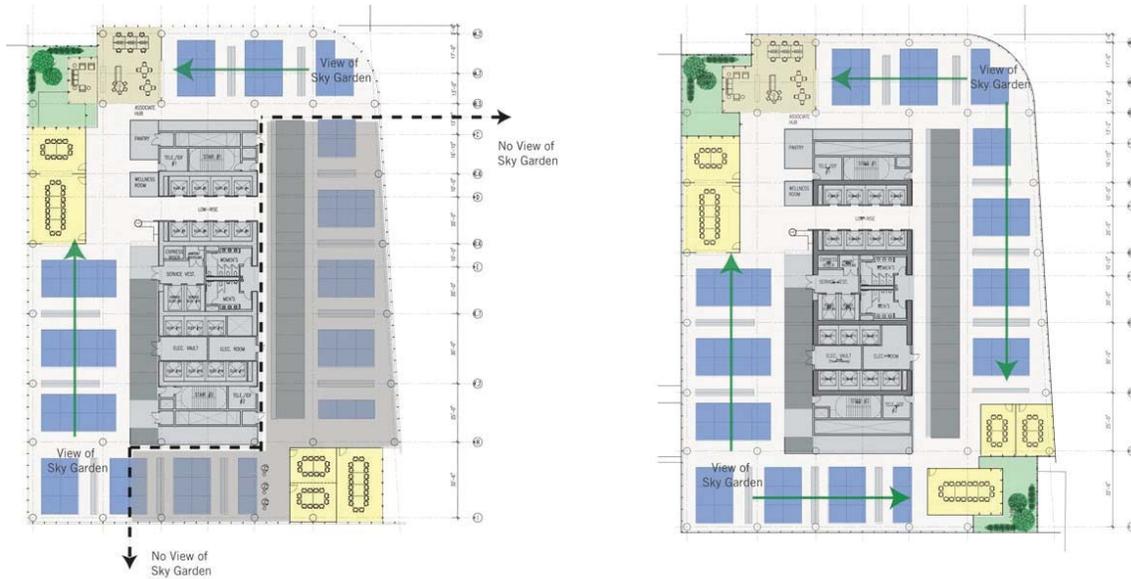
- Occupants access to daylight
- Views to natural setting
- Reduction of status corner – more democratic floor plan
- Encouragement of affiliative behavior
- High-rise floor elevator lobbies open directly onto the main conference areas making space more attractive to lease by giving a sense of arrival and connectivity

Comparatively, providing one garden:

- Limits the number of employees with view to a natural setting
- Level of natural daylight is diminished for half of employees
- On high-rise floors the elevator lobby does not open on to the associate hub or main conference room thus leasability is compromised

Given the potential to positively affect 54 personal workstations/offices per floor, the benefits are more easily quantified. As an example, if absenteeism is reduced by one day per year due to the improved environment [a very conservative estimate given the research and case studies just reviewed], and 1,350 associates are involved, that saves 1,350 days per year of lost time. With these and other potential benefits as identified above, the 8,000 SF investment of the second sky garden is clearly quite small comparatively.

Thus, the research justifies the inclusion of two sky gardens in lieu of one in order to give all associates equal access to the benefits of nature in the workplace.



Two Sky Gardens provide a more balanced experience for the tenant.

PROJECT: Floor plans comparing one sky garden to two sky gardens

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