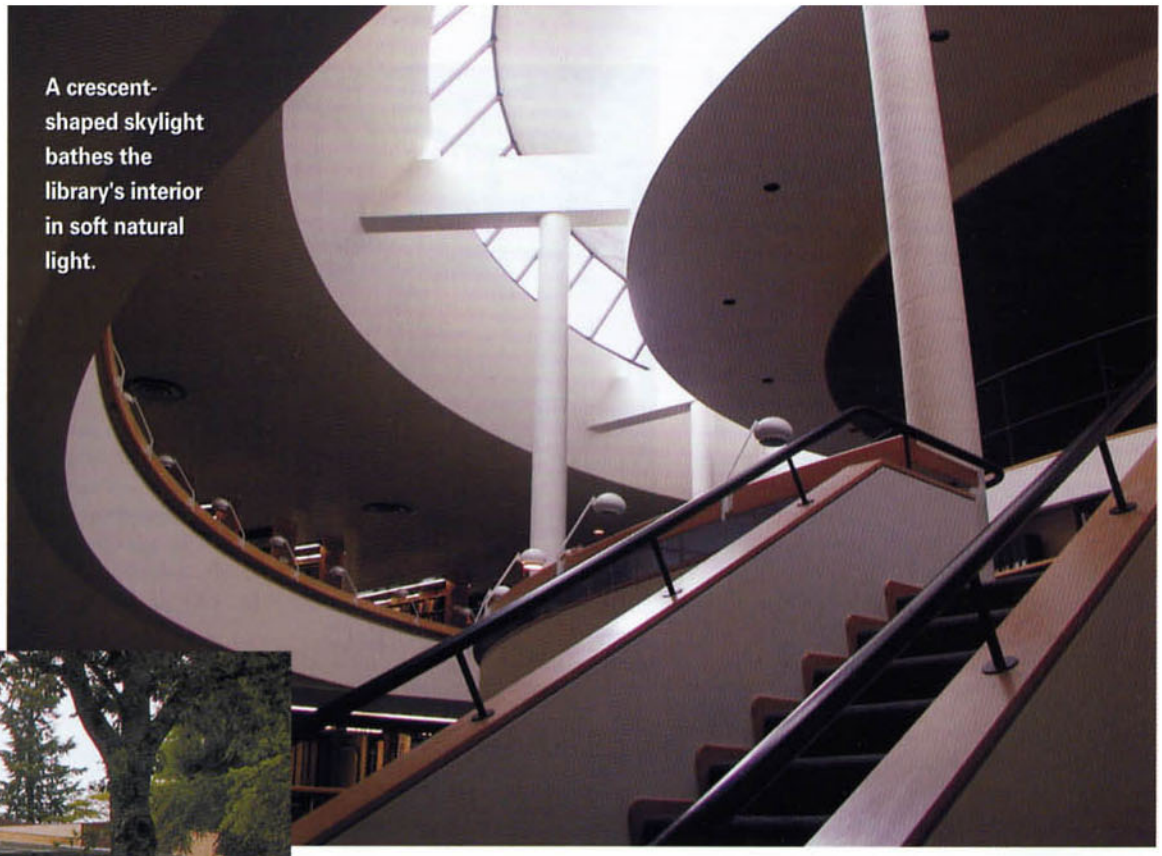
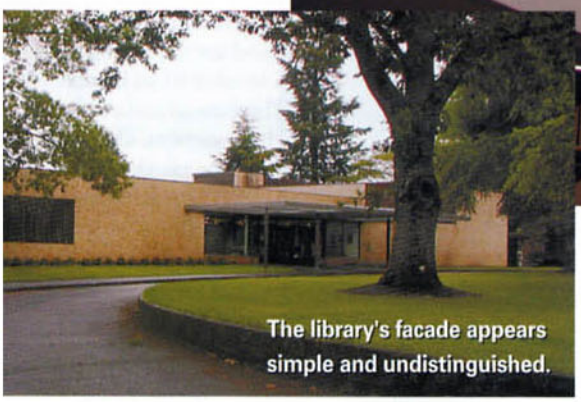


A crescent-shaped skylight bathes the library's interior in soft natural light.

All photos in this article by Nathan Good, AIA, IIDA.



The library's facade appears simple and undistinguished.

Learning from a Library

The daylighting techniques used in the Mt. Angel Abbey Library provide a superb example of how to infuse natural light throughout a space, even in a climate characterized by overcast skies. **By Nathan Good, AIA, IIDA**

Existing buildings often serve as models for much of the new construction in the developing world. A quick sketch or clay model made by an architect in the earliest stages of design can affect building energy consumption well into the future. A thoughtless decision about building orientation may create a cooling load that lasts as much as a century. But so, too, can intelligent design influence the building profession. This was the objective behind a project known as "Vital Signs," administered through the Center for Environmental Design Research at the University of California at Berkeley. The project is designed to encourage the next generation of architects to build environmentally responsible and energy efficient buildings by studying the performance of existing buildings, their patterns of energy use, and their impact upon occupant well being.

When I joined the Vital Signs project several years ago, I selected The Mt. Angel Abbey Library in Saint Benedict, OR, as my subject. The library offers many lessons in effective daylighting, from exemplary design techniques to building occupants' perceptions of space. Designed between 1967 and 1969 by Finnish architect Alvar Alto, with construction completed in 1970, the library captures an abundance of daylight in a region of the US where clear skies are an exception to the norm. Evaluating this design in terms of building performance and occupant satisfaction can provide valuable information on how we can improve daylit buildings in the future.

Aalto as Maestro of Daylight

Daylighting is not only one of the single most successful strategies for energy savings — it is also about aesthetics, color,

human health and performance, and about enabling solar and seasonal time to reach interior spaces. Aalto's understanding of daylighting is exemplified in the architecture he designed throughout Scandinavia during the middle half of this century. The Mount Angel Abbey Library, one of only three environments designed by Aalto in the US, was designed for sky conditions that were very similar to his native country of Finland, with a high percentage of cloud cover throughout the year. Only 19% of the days are clear; 20% of the days are partly cloudy, with 61% of the days cloudy.

Given the timeframe in which Aalto studied architecture (1917 to 1921), many of his instructors likely educated their students on how to design for daylight, independent of electricity. The Mt. Angel Abbey Library has demonstrated the ability operate independent of electric light. During a significant power outage after a windstorm in 1996, all of the students and staff at the Mt. Angel Abbey seminary were excused, except those who worked in the library. The library was the only building on the seminary's campus that provided adequate natural light to operate during the day, and it served as a popular gathering place for the students, staff and visitors until the electric service was restored.

Daylighting Techniques

The Mt. Angel Abbey Library is sited on the edge of a hillside, defining the north edge of the Benedictine Monk's campus. It is a modest, fan-shaped, three-story structure that uses daylight to modulate a progression of spatial experiences from the entry at the south to the heart of the library. Upon approach from the south, the pale yellow brick building's facade appears simple and undistinguished. Visitors enter beneath a metal frame canopy into a lobby area, which doubles as an art gallery and reception space. After passing though another pair of doors along the north side of the lobby and entering a space with increased natural light levels, one can look out over the centralized receptionist's desk to the main reading and book stack areas, which visually unfold into a dramatic atrium-like environment. During the day, a crescent-shaped skylight over the multi-story interior space bathes a series of radiating light shelves, reading desks and multi-level floors in soft natural light.

The building uses daylight to modulate a progression of spatial experiences from the entry at the south to the heart of the library.

Aalto used a multitude of daylighting strategies throughout the library, including conical skylights, clerestory windows, strategically placed windows with exterior sunscreens, borrowed light through glass walls, and a sensational light monitor. Overall, the library is designed with approximately 20% exterior glass, providing additional proof that excellent daylighting can be accomplished not by the amount of glass incorporated, but the way in which the glass is used. (See "Un-Glaringly Good Advice on Daylighting" by Michael Reis, *Environmental Design + Construction*, July/August 2000, pp. 33-39)

The light monitor, which crowns the central reading area and stacks, is a fascinating daylighting element in its design and effectiveness. The curved surface on the south side of the crescent-shaped light monitor opposite the north-facing glazing redirects the light at a multitude of angles. Aalto successfully sculpted three levels of floor space beneath the monitor to optimize the available daylight, enabling it to penetrate deep within the interior of a space that is far removed from exterior windows.

The light monitor has been carefully designed to minimize direct sunlight and glare into the interior — an important consideration in library design. The sloped surface of the monitor's clear glass enables the library's patrons the opportunity to view the exterior sky and its ever-changing colors and formations. The north-facing light monitor is especially effective on cloudy days, most likely because the light from the sun refracts off of the water particles in a multitude

of directions. (This effect is also commonly experienced by passengers in an airplane, who might notice an enhanced brightness in the cabin when flying through clouds, compared to flying in clear sky conditions.)

It is also worth noting a few of Aalto's other subtle daylighting techniques used in the library. Several circular skylights are strategically placed throughout the building, including the entry lobby, receptionist's desk, hallways, and over the former card catalogue area, which has been converted into a computer resource library. The skylight wells have been thoughtfully designed with flared edges to optimize the resulting daylight while minimizing glare and, in several instances, enabling views of the sky.

The carrels that serve as private offices along the north wall of the second floor have windows that run from the work surface to the ceiling. To provide natural light to the interior stacks adjacent to the carrels, Aalto designed a continuous wall of glass with diffused panes along the bottom section and clear glass within the clerestories above. This sends the light into the interior stacks of the library without compromising privacy for the office occupants.

Along the north wall of the upper floor, Aalto placed the clerestory windows high in the structure to allow the maximum amount of light to filter in. He set the clerestory windows as high into the north wall as structurally possible to obtain the maximum penetration of daylight into the interior space. Aalto also skillfully angled the ceiling's surface to follow the angled web of the roof truss, which doubles as a reflecting surface.

Orchestrating Electric and Natural Light

Shielding the view of a light source is one of the characteristics of Aalto's lighting design, whether with daylighting or with the design of electric lighting fixtures. The numerous custom electric light fixtures at the Mt Angel Library accomplish this goal through reflective curved surfaces, grilles, valances and carefully calculated view angles.

Aalto was a pioneer in the design of indirect electric light. His design of the decorative pendant fixtures throughout the library imitates the light monitor by reflecting the light source off a reflective parabolic surface. A cone screens the bulb, and grills at the base of the cone allow light to filter down while still concealing the bulb. There is also a consistency in the light levels and direction between day and night lighting.

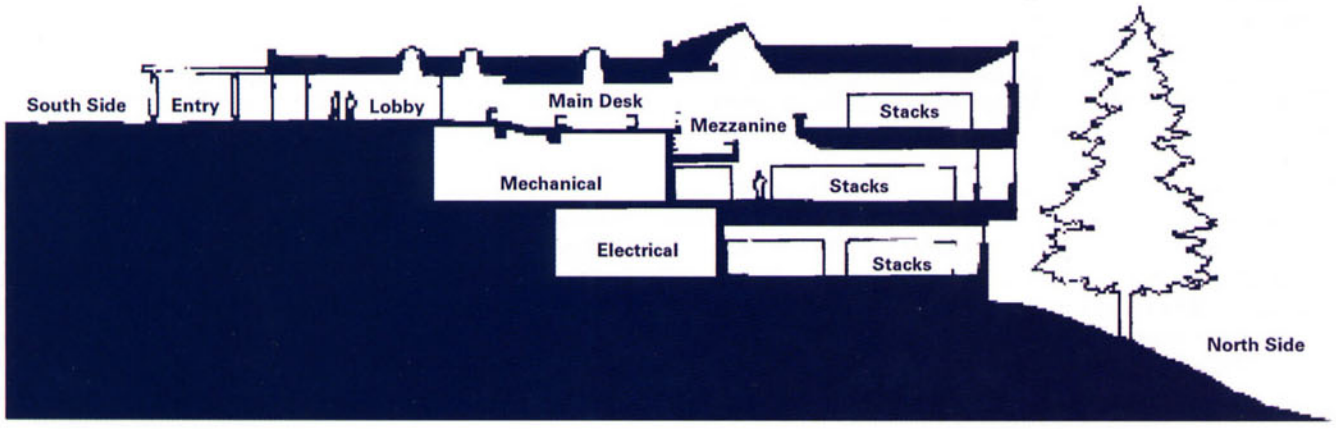
Aalto was skillful at combining electric and natural lighting. The design of the central roof monitor includes a trough for rows of indirect fluorescent light to mimic the effect of daylight during the night. Fluorescent lights placed above the library stacks provide a soft indirect light source for the viewing of the books. Gooseneck fixtures on the roof cast light through the conical skylights over the receptionist's desk, lobby, corridors, and former card catalogue area. Carefully placed task lights are located where they are needed to supplement the indirect lighting at the reading desks, the receptionist's counter, and in the carrels. The Mt. Angel Abbey Library is a living laboratory for architects and lighting designers on the combined use of these light sources.

The design of the central roof monitor includes a trough for rows of indirect fluorescent light to mimic the effect of daylight during the night.

Learning from the Occupants

Interviews with the library's staff, patrons and visitors revealed a profound appreciation for the lighting design. Eighteen regular users of the library were queried during a period of 30 days before, and 30 days after, the Winter Solstice — the shortest and often cloudiest days of the year in the Pacific Northwest. "Alvar Aalto was a master at utilizing light," said one patron. "Within the library, you can see how he has bent, borrowed, and shielded the light. Light is very important to us in this climate, and Aalto understood this."

It is not uncommon for patrons to spend long periods of time studying within the library. One individual, who has used the facility on a daily basis since the building was completed in 1976, believes



Cross-section of the library (looking west).

that the ability to maintain long periods of concentrated study during the day is due in part to the soft and subtle shifting of the natural light. This individual noted that there was considerably less fatigue to his eyes when reading in soft, subtly shifting natural light than when reading beneath a consistent electric light source.

"All of the lighting, no matter where you sit or stand, is soft. There are few shadows, even at night, when you no longer have the benefit of the soft natural lighting," another patron observed.

"It is rare to witness direct light on any of the books, which is quite surprising, considering the amount of natural light within the interior of the library," remarked another user. "With the possible exception of the computer screens, there aren't any problems with glare within the library."

Yet another user commented, "One can feel the moods of the day very strongly by the light reflecting in the building. Sunsets, sunrises, and stormy days are wonderful in the library. Even on a dark day, the library is full of light."

For the library staff, the lighting promotes a sense of well-being and worker satisfaction. "The lighting and design of the library is one of the benefits of employment here," said one staff member. "This is a wonderful place to work. I constantly receive the comments from visitors, which reinforces my desire to work in this delightful setting."

The people interviewed were overwhelmingly appreciative of the library's use of natural light. There were a surprising number of comments about how wonderful it was to experience the subtle changes to the natural light throughout the day, and how the interior light levels seemed brighter beneath the main skylight during overcast days. It is interesting to note that there were no comments requesting any control over the natural light sources. The individuals interviewed expressed a strong sense of pride in being able to work within what a few referred to as, "...a work of art."

Several circular skylights are strategically placed throughout the building, including the entry lobby, receptionist's desk, hallways, and over the former card catalogue area, which has been converted into a computer resource library.

Lighting Challenges and Opportunities

When Alvar Aalto designed the Mt Angel Abbey Library, electricity was inexpensive and plentiful. He saturated the library in light during the evening by installing an extensive number of T-12 fluorescent lamps in the light monitor and using 250-watt incandescent lamps mounted on goose-neck fixtures shining down through numerous circular skylights. At the time, the library's users welcomed this level of nighttime light — but a lot of energy was wasted. Inefficient lighting controls often resulted in light fixtures being left on throughout the night, making the problem even worse.

In 1996, the library's electric utility launched an aggressive energy efficiency campaign to enable the shutdown of their lone nuclear power generating facility. Under the direction of an electrical contractor, all incandescent lighting was replaced with compact fluorescent lamps, and the T-12 fluorescent lamps were replaced with T-8s. But because energy savings was the driving force and funding was limited, the retrofit did not include the expertise of a lighting designer or consultant with design background, and occupant satisfaction suffered as a result. The fluorescent lights did not provide the same output as the incandescent lights. Some building users were so disappointed that they put incandescent lamps back into many of the fixtures. In other instances, library staff has added light fixtures to specific areas to compensate for lost light

Moreover, the electrical contractor determined that the library would save additional energy if the lighting controls in the public areas of the library were consolidated at the receptionist's desk. Previously, each row of stacks had its own switch, and the users controlled the light as they used the area. The receptionists have admitted that it was an inconvenience to turn the stack lighting on and off at each user's request, so they

now opt to leave all the stack lighting on all the time, even on days when the building is bright enough that no additional lighting would be necessary. As a result, the facility likely uses more energy now than before the retrofit.

Today, the staff and patrons of the library have a heightened appreciation for energy efficiency. This appears to be the result of an increased awareness stemming from the California "energy crisis," linking their environmental stewardship with an enhanced knowledge of the environmental impact of generating electricity, and, as a community of Benedictine Monks, a philosophical alignment with frugality. Patrons who commonly use the library have expressed resentment at finding unnecessary lights on and have said that they would prefer to have control of the lighting.

In response to their constituents, the library's management is considering a second round of energy efficiency measures. Ideas being discussed include linking the available daylight to the fluorescent fixtures via dimming ballast and daylight sensors, replacing T-8 fluorescent lamps with T-5s, and replacing the remaining incandescent lamps with the new generation of higher-output compact fluorescent lamps. Additional lighting control strategies under consideration include installing motion and infrared lighting control sensors where appropriate, returning the lighting controls of the stacks to their previous decentralizing locations, and installing a new lighting control system for the common areas.

Influencing Future Design

Existing buildings like the Mt. Angel Abbey Library can provide valuable insights on how we can improve future building designs with regard to daylighting. While Aalto's design may incorporate an excessive use of electric light by today's standards, his daylighting techniques remain a superb example of what can be accomplished in a facility, infusing desirable natural light throughout a space even in a climate characterized by overcast skies. **EDC**

Author Recommended Reading

1. The Mt. Angel Abbey Library maintains a website for visitors at www.mtangel.edu. For a good "slide" tour of the library, direct your browser to www.mtangel.edu/library/photos/photos.htm

2. See the chapter titled "Spatial Light: Mt. Angel Abbey Library" in the book on daylighting by Marietta Millet titled, *Light Revealing Architecture*, published by Van Nostrand Reinhold, Copyright 1996.

3. Donald Canty, the former editor-in-chief of Architecture magazine, has written a small gem of a book, *Lasting Aalto Masterwork — The Library at Mount Angel Abbey*, published by Mount Angel Abbey. The book is one of the best collections of published photographs of the Mt. Angel Abbey Library and is available for purchase by contacting the library at 503-845-3303.

4. Within William Lam's noteworthy book on daylighting design, *Sunlighting as Formgiver for Architecture*, published by Van Nostrand Reinhold, Copyright 1986, there are multiple references to Alvar Aalto as a pioneer in daylighting design, and the Mt. Angel Abbey Library as "Poetry in Motion."

5. For a good overall book on the architecture of Alvar Aalto, my library includes *Alvar Aalto and the International Style*, by Paul David Pearson, published by the Whitney Library of Design in 1978.

6. My first introduction to Alvar Aalto was through the architectural classic, *Space, Time and Architecture*, required reading by all of Carleton Winslow's History of Architecture students at CalPoly San Luis Obispo. *Space, Time and Architecture* was originally written by Sigfried Giedion in 1941, published by the Harvard University Press. Giedion devotes a significant portion of his 881 page book to Alvar Aalto in the chapter titled, "Alvar Aalto: Irrationality and Standardization."

Editor's note: For more detail on the interviews conducted by the author, you can download a PDF file of "User Responses to the Lighting Design at the Mount Angel Abbey Library" from the University of California at Berkeley's "Vital Signs" website: www.arch.ced.berkeley.edu/vitalsigns/bld/Casestudies/Abstracts/cpslo_mtangel_ab.html.

About the Author: Nathan Good, AIA, IIDA, is the Director of Green Building Services, a Portland-based consulting firm that assists their architect and building-owner clients with the design of buildings that enhance the health, performance, and happiness of their occupants while simultaneously reducing the environmental impact of their decisions. Nathan is a LEED™ Accredited Professional and was named "Energy Manager of the Year" in 2000 by the National Association for Professional Energy Managers. He can be reached at nathan_good@pgn.com.

Studying A Building's "Vital Signs"

The Vital Signs Project, administered through the Center for Environmental Design Research at the University of California at Berkeley, examines the physical performance of buildings, their patterns of energy use, and their impact upon occupant well being. The project's goal is to encourage the next generation of architects to build environmentally responsible and energy efficient buildings by promoting a pedagogic approach that provides opportunities for experiential learning using existing buildings as study sites. The premise of the project is that existing buildings hold lessons on a variety of topics, from occupant well being to the operations of technical systems and building energy consumption.
For more information about the project visit www.arch.ced.berkeley.edu/vitalsigns/inf/inf_main.html.