LIBRARY REVISITED

Natural daylighting in the University of Idaho's Library could be used to light the stack area on the top floor during daylight hours without supplemental lighting.

The original University of Idaho Library was designed by architects Whitehouse and Price from Spokane, Washington. The original building was completed in 1957 at a cost of $1,362,295. The building's footprint was 138 feet wide by 205 feet long. It consisted of a basement, a ground floor, and three additional floors. The building also housed the campus branch of U. S. Post Office from 1957 to 1990. In 1991 architects Ellis-Feeney from Lewiston, Idaho were hired to remodel the building and designed a 66,000 sq. ft. addition at a cost of $12.3 million. The addition included the new clock and stair tower, which rose 86 feet above grade. There was also a glass enclosure, known now as the fish bowl, that was added to the northeast corner. The addition caused the east entrance to be located on the north side of the building. The Library is a major depository of U.S. and Idaho Documents, the Patents Defense Mapping Agency and is a designated Earth Science Information Center. Some of the library's collections include 1.3 million volumes, 1.5 million U.S. documents, 200,000 Uncataloged Maps and 8,600 Serial Titles. There are two computer labs located on the ground floor and the fourth floor as well as four graduate rooms.

The library employs a staff of 46 people, consisting of: one Dean, 18 Faculty members, and 27 employees. Many of the employees are students that are in a work study program on campus. There are 800 seats located within the library and daily occupancy during a semester weekday fluctuates between 2,000 to 3,000 visitors.

Much of the library's floors are lit by an electric fluorescent lighting system. This includes the book stacks, two computer labs, administrative offices, and storage.

BUILDING AT A GLANCE	
Name	University of Idaho
Location	Moscow, ID
Owner	University of Idaho
Principal Use Includes	Library
Gross Square Footage	157,450
Total Cost	$13.6 Million
Cost Per Square Foot	$86
Substantial Completion/ Occupancy	1957
Occupancy	100%

Figure 1

4th Floor Study: Existing Conditions

In our study of the library we wanted to determine if there was a way to decrease the amount of electrical lighting being used

throughout the building. The best place for our study was the fourth floor, where book stacks and a computer studio are located. The space was chosen for the potential use of diffused lighting from skylights.

Our hypothesis is; natural daylighting could be used to light the stack area on the top floor of the University of Idaho Library during daylight hours without supplemental lighting.

Currently the fourth floor of the library is lit by rows of electrical fluorescent lights that run perpendicular to the 7'6" tall book stacks. Along the north side of the building there are large windows spaced 8' on center. These windows are 5'x5' and have a sill that is 3' above the floor. While the north walkway and individual study areas are lit adequately by natural daylight from the windows, the southern circulation walkway and the book stack area (located deeper into the space) currently require additional lighting to meet the ASME Standards for lighting. The ASME requirements state that the space must have at least 15 foot-candles of light when visual tasks are occasionally performed, or while reading small size print.

The current conditions in the southern walkway and the book stack areas do not meet the ASME Foot Candle minimum recommendation. As seen in [Figure 2]the northern side of the building has sufficient daylight during the day without the aid of an electric lighting system, as adequate daylight is provided from the large windows in the north facing wall. There is adequate day-lighting along the northern circulation walkway area as well. However there is a noticeable decrease of natural daylight once entering the book stacks: as seen in [Figure 3] the area to the right has sufficient daylight only when the electric lighting is turned on during the day. There is inadequate daylight along the southern walkway located behind the book stacks with the electrical lighting system turned off.

AGi32 was used to create a digital 3D model of the existing library space for calculating the daylight in footcandles. We also measured the daylight levels in the library's fourth floor using a light meter during midday on a clear sunny day. The 3D digital model

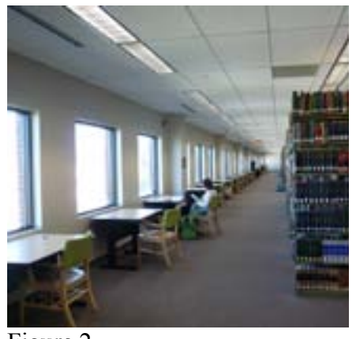

Figure 2

Figure 3

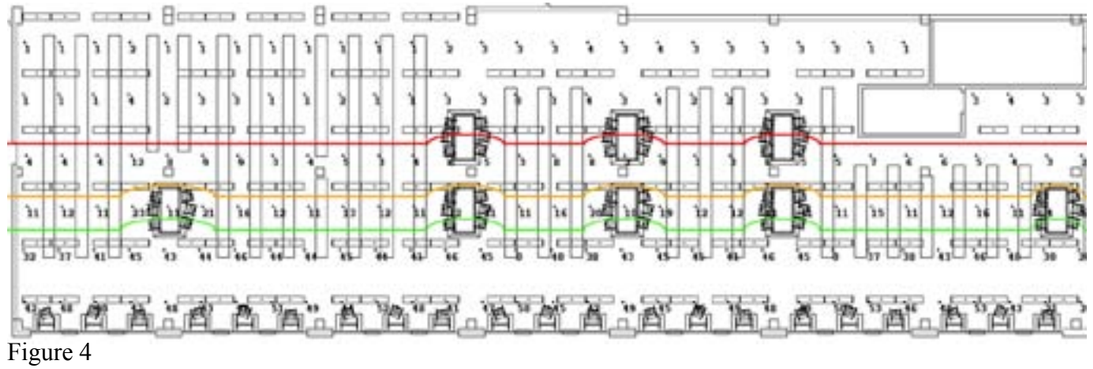

Figure 4

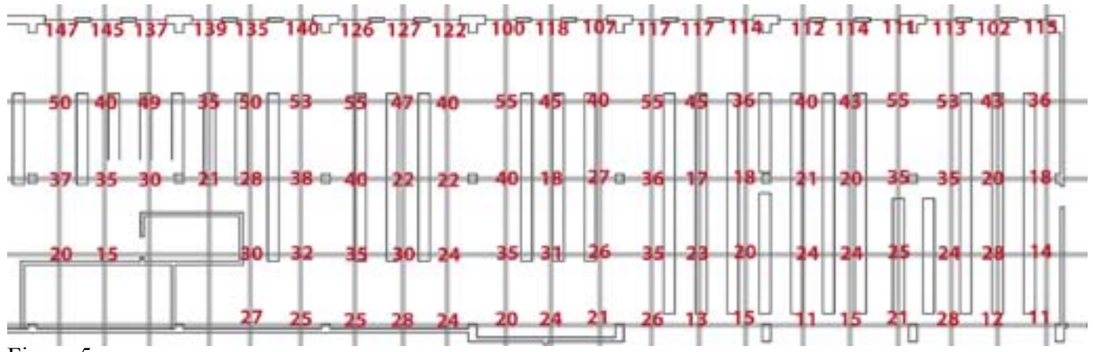

Figure 5

has north facing down and the electric lighting system has been turned off. In the daylighting plan generated using AGi32 the three colored lines indicate the quality levels of natural light penetration into the space. From the windows to just inside the book stacks the green line can be seen and indicates there is a sufficient amount of daylight for tasks such as reading and writing. At the orange line level the amount of daylight starts to become insufficient: this is only a short distance into the book stacks. It makes tasks such as reading more difficult. At and beyond the red line level there is no longer adequate daylight for tasks or for walking. The values calculated in the AGi32 3D digital model were similar to the values found using the light meters. In [Figure 5] with north facing up, the values collected with the light meter confirm the similarity in the calculations from the AGi32 3D digital model.

After analyzing the 3D digital model and the data from the light meter, we proceed to use the AGi32 model to examine changes that could be made to the space, in order to increase the daylight amounts that would meet the ASME requirements.

We used skylights that were placed between the current electrical lighting system. The skylights were spaced at equal intervals from the windows on the north wall. As seen in [Figure 6 , Figure 7] the natural light from the windows reaches further back

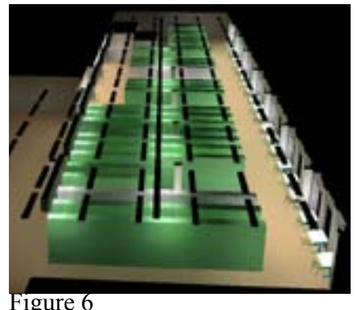

Figure 6

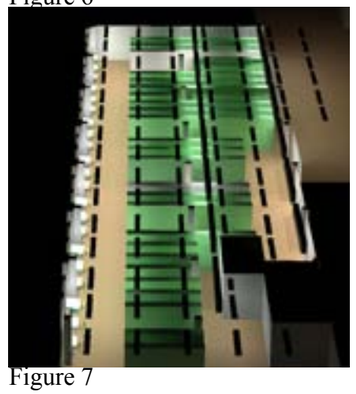

Figure 7

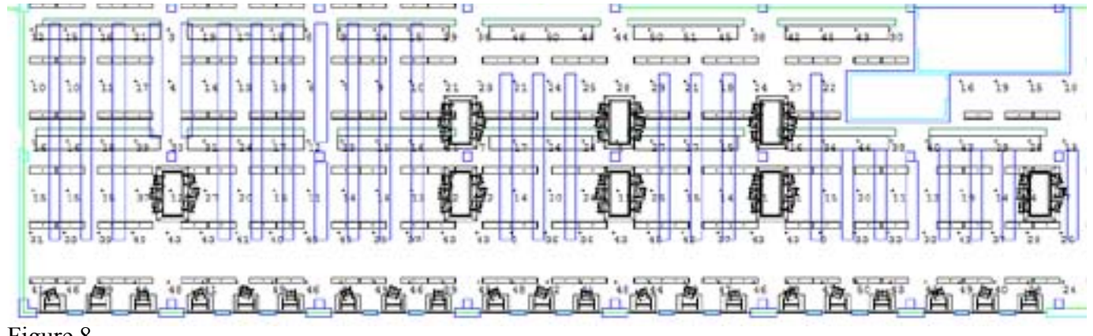

Figure 8

into the book stacks and the levels of footcandles also increased within the book stacks. [Figure 8] shows the new calculations made from the AGi32 3D digital model with the changes applied.

The light levels for sufficient task work have become adequate with the integration of the natural daylight from the skylights, and the windows located on the northern wall.

In addition to the daylight study we also produced and administered a survey to 100 students and administrative workers within the library. The survey consisted of 13 questions which asked how people felt about the daylight in the space or whether they used the space near the windows for reading. The survey was structured using the Likert scale with values ranging from "never" or "poor" to "always" and "excellent". The results from the survey are displayed in [Figure 9]. The data collected from the survey shows that the majority of the people found the space near the window to have an adequate amount of light and preferred to study in that area.

While examining the library for ways to save energy, we needed first to see how much the building currently used. [Figure 10] shows the past year energy usage for the entire library. From that data we found that the peak energy usage was in the summer and fall. This was due to the need to cool the building using air conditioning rather than natural ventilation. With that data we found that reducing the electrical load from the lights would reduce the total energy used by the library.

Along with the energy data collected, the survey of the users, and the data collected from the space in the library we also created a building certificate for the library. It is based on the European standards for building to meet energy usages. The certificate is on the following page and shows the adjusted EUI number for the building. The average EUI value for a campus building is 100. Last year's EUI value for the library is 50. The certificate also shows the carbon emissions for the building over the last three years.

Recommendations

Our hypothesis was that natural day lighting could be used to light the book stack

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ENERGY USAGE DATA

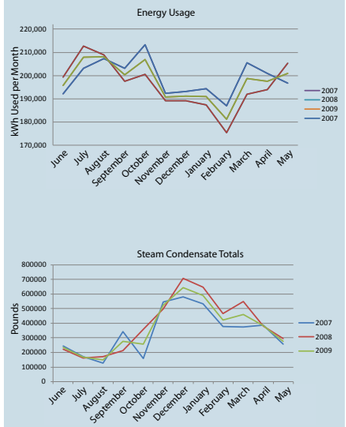


Figure 10

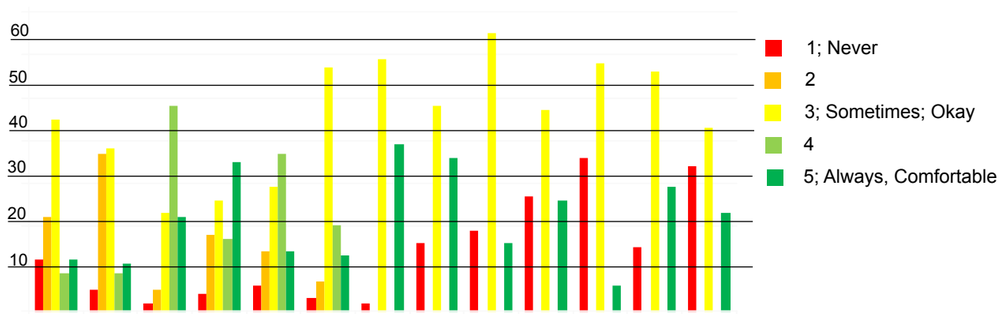
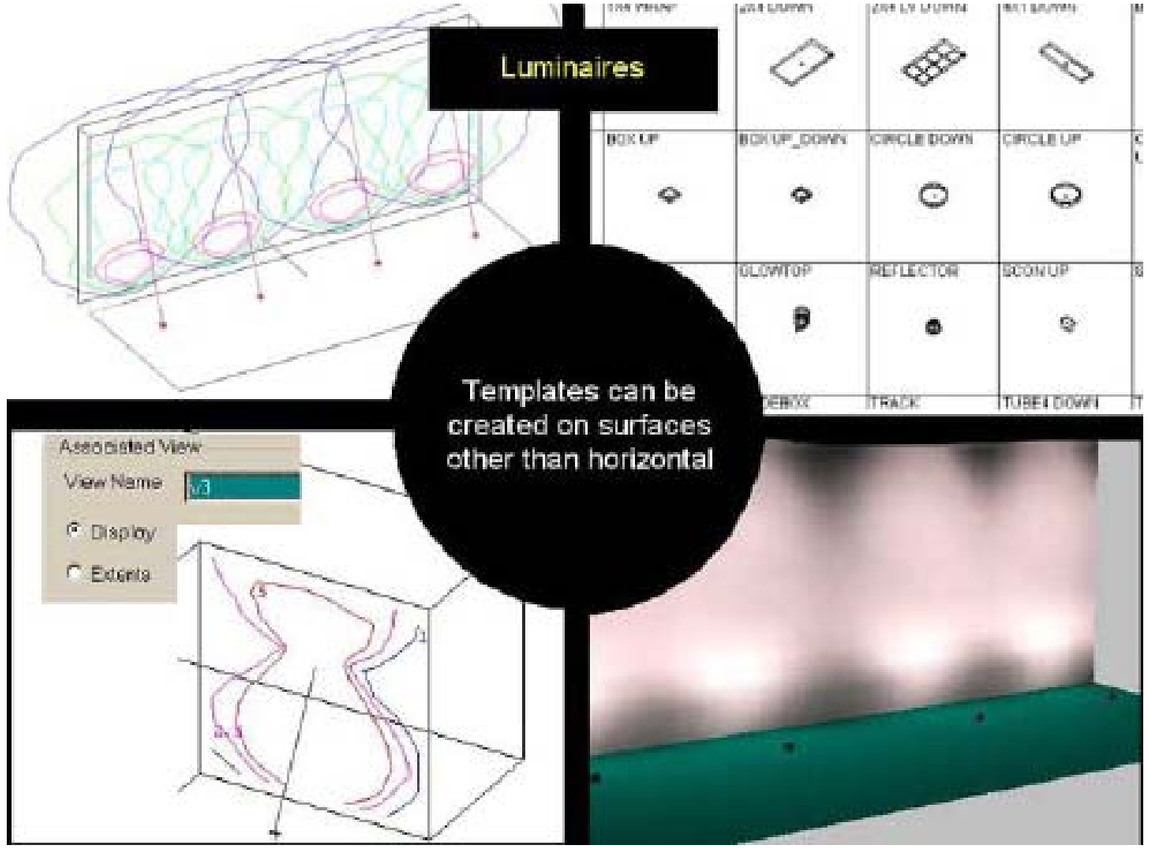
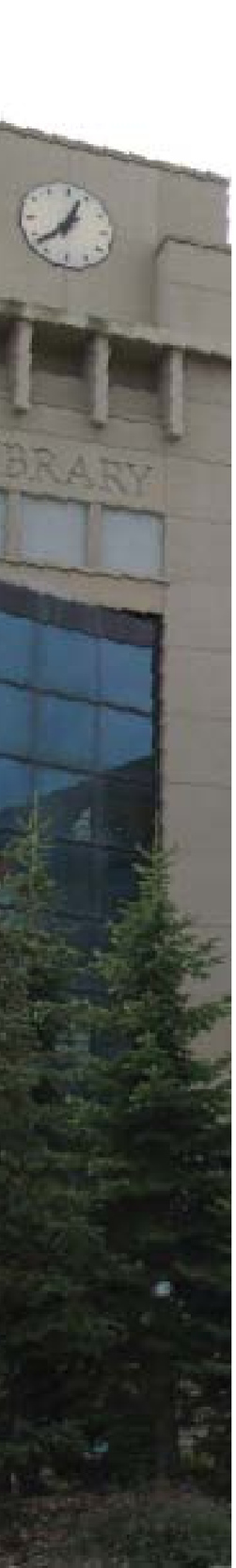
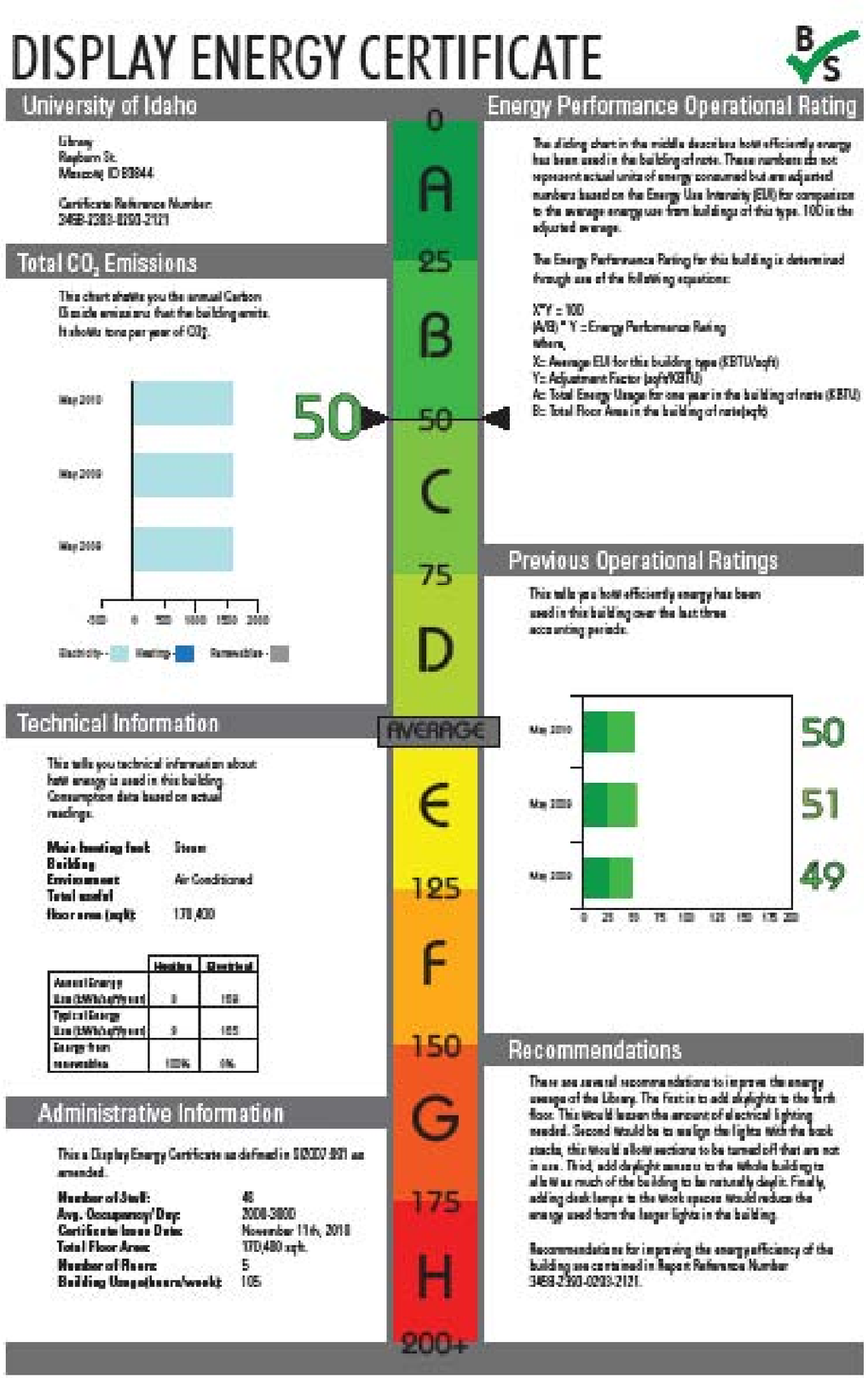


Figure 9



AGi32 lighting software by Lighting Analysts





area on the fourth floor of the University of Idaho Library during daylight hours without supplemental electric lighting. We proposed adding 13 skylights to supply the additional day light needed for the recommended 15 footcandels by the ASME. This plan shows our proposed skylight patterns. It consists of 2' x 18' areas of skylights, with two rows of skylights located on either side of the fourth bay of electric lights. The size and spacing would be based on building structure. The skylights would prevent direct southern light but allow diffuse northern light.

Another recommendation to improve the overall performance of the building is to incorporate electric dimmers to supply the electric lighting system and the natural daylight through the space.

Conclusion

The natural lighting decrease on the ceiling from the north facing windows would be supplemented by the daylight from the skylights. The skylights would even out the natural lighting of the space and make electric lighting during the day unnecessary. This would create significant reductions in energy consumption for the building. The north and southern walkways would now receive an adequate amount of daylight from the north facing windows and the skylights. Another recommendation to improve the overall performance of the building is to incorporate electric dimmers to supplement the electric lighting system and the natural daylight through the space.