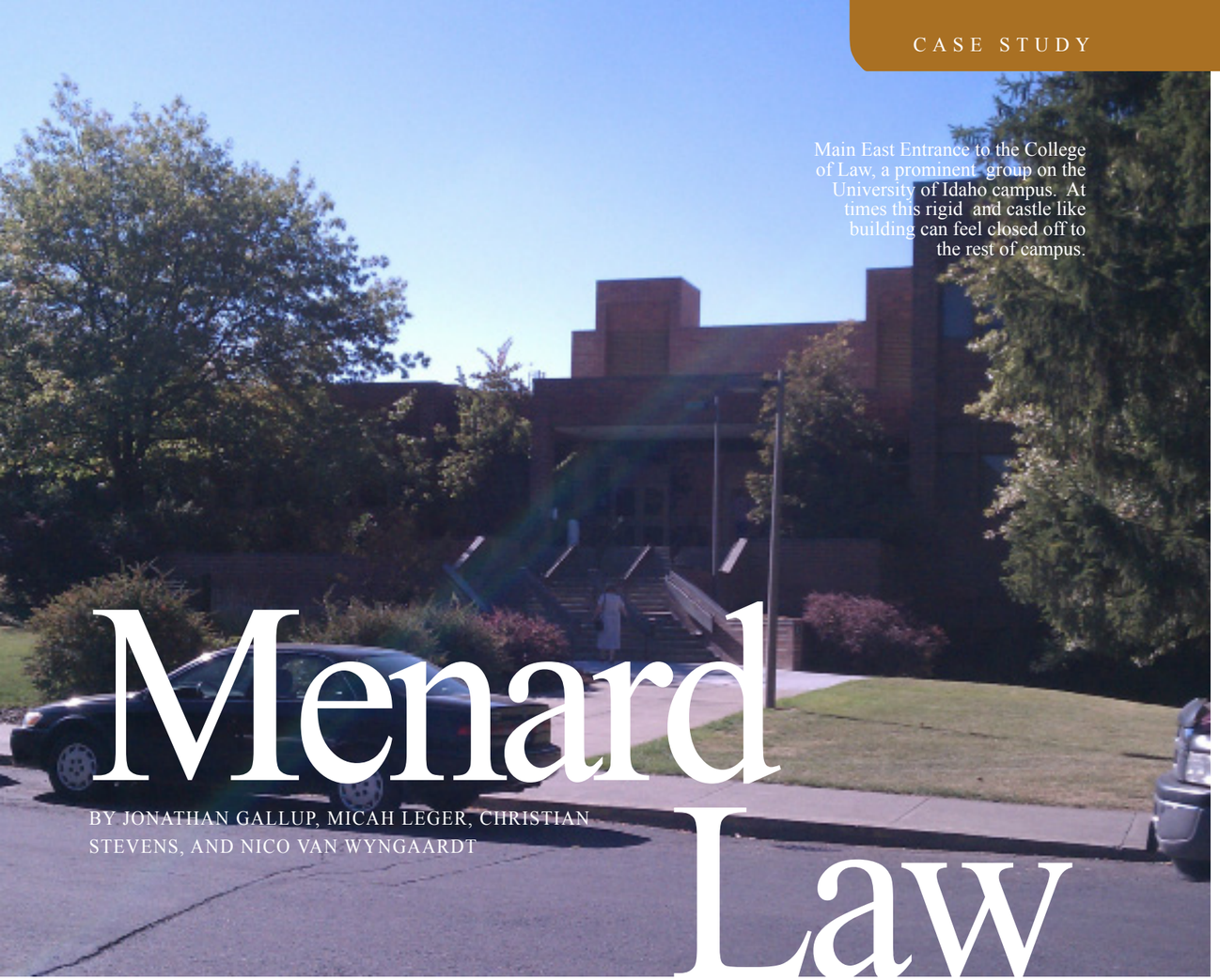


Main East Entrance to the College of Law, a prominent group on the University of Idaho campus. At times this rigid and castle like building can feel closed off to the rest of campus.

Menard Law

BY JONATHAN GALLUP, MICAH LEGER, CHRISTIAN STEVENS, AND NICO VAN WYNGAARDT

The University of Idaho's Menard Law Building is home to 342 students, 35 faculty, and19 administrative employees. The focus of our study is the top two floors of the law library which is home to 160,000 volumes and an individual study carrel for every student. The total floor area under examination is 13,312 square feet. The library has 24 north facing windows that are approximately two and a half feet wide by six feet tall. One of the main features is the two - story light well lit up by artificial lighting. Most of the stacks by the windows run North-South, but the stacks deeper in the space run East-West.

Being a central hub for the Law building, the Library's average temperature raises during school hours.

The law building is located on the corner of Idaho Ave. and Rayburn St. The law building faces east onto Rayburn Street, about 1/2 block south of 6th Street, on the west side. It is located north of the Kibbie Dome, and northwest of the main university library building. On campus, it is one of the farthest western classroom buildings.

Existing Conditions

By analyzing the Menard Law building in its current state, it's clear that with regard to performance it is not one of the best. Built in the 1970's, during a time of optimistic energy use, the building design limits many opportunities to take advantage of simple solar and lighting benefits; instead it is an electric lighting hog. Unlike most buildings on campus, who utilize multiple forms of energy (some being more efficient), so far the Law Building has stuck primarily to the use of electricity. That is, electricity to power any and all lighting fixtures in the building, as well as power to run the large HVAC equipment which will heat and cool the building when needed.

Above One of the most prominent locations within the Law Building is the Library. Not only does it house thousands of books, but it's where the majority of the student's carrels are found.

Electricity Usage

Other buildings on campus use electricity perhaps as a primary source, but are at the same time connected to the campus steam line, and/or gas line. The steam connection allows the buildings to heat their interiors with the burning of wood chips, which is a more affordable and sustainable energy provided directly from the campus steam plant. fortunately, as part of recent upgrades this past summer, Menard Law connected up to the steam line and is now using it for heating. Advantages of this will be interesting to comapre once all the energy data from Fiscal Year 2011 has been collected.

Natural Light

Natural light has and will probably always plague this building. As was stated earlier, the architectural shell was not the most thoughtfully designed in regard to outside light. Deep set win-

BUILDING AT A GLANCE

Name The Menard Law Building, College of Law

Location University of Idaho, Moscow, Idaho

Owner University of Idaho

Principal Use
Student/Faculty Education Building
Includes Classrooms, Lecture Halls, Courtroom, Library, Offices, Cafe, Lounge, Study Rooms, Administration Rooms

Employment/Occupants 396

Gross Square Footage 45,000 ft²

Total Cost $2,450,000 (1973)

Cost Per Square Foot $54/ft²

Substantial Completion 1973

Distinction/Awards none

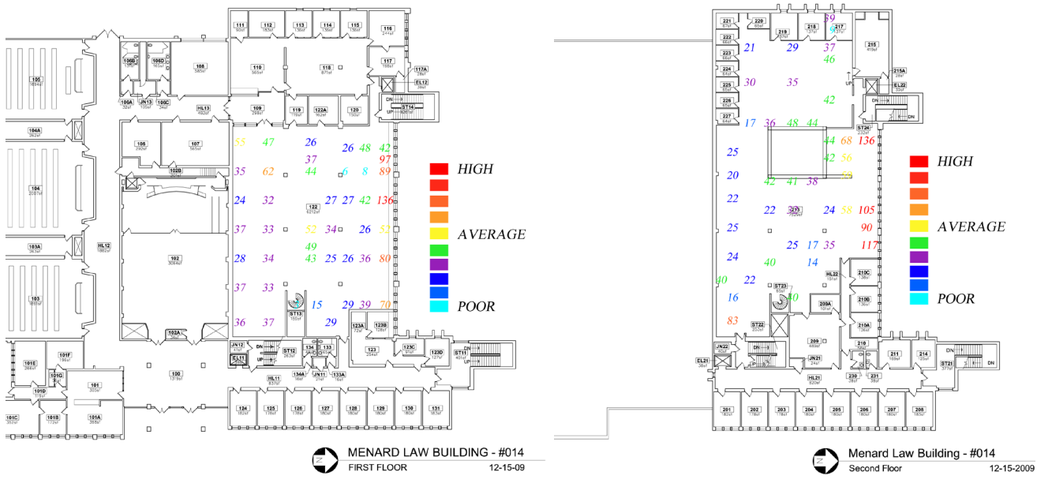
ENERGY AT A GLANCE

Energy Use Intensity
(Site, with plug loads) 255 KBTU/ft²
Total KWH 3,368,129
Total KBTU 11,495,424

Annual Energy Cost Index (ECI)
$3.66/ft²
Total Cost $164,703 (FY 2010)

Note: All energy values include plug loads except where specifically noted. Currently the Menard Law Building only uses electricity for power.

Figure A Light Distribution - Law Library 1st and 2nd Floors (in footcandles)



dows on both the East and North side greatly reduce the amount of light in the space. Southern facing windows are quite literally non-existent. In addition, there are no skylights although they did their best in the library to recreate what a 'real' daylit skylight would be like if it was run by fluorescent bulbs. The 600 ft^2 skylight, which opens up the 1st and 2nd floors of the library, houses at least 36 fluorescent bulbs. Bump up that section of roof, add some diffused glass, and you could have a very pleasant space without all the electricity usage.

In the library, where the majority of students are located, you will only find windows on one side of the space (the North). This means that currently only one or two rows of carrels are by a window, and the rest are placed in the back corners behind giant stacks of books. About 30 students or so, chosen by seniority, get to bask in this natural light, which in most cases receives 70-90 foot-candles more light than the locations in the back. I guess it may be a reward for surviving law school and making it to third year. Refer to Figure A to see the light distribution in both the 1st and 2nd floor spaces of the library.

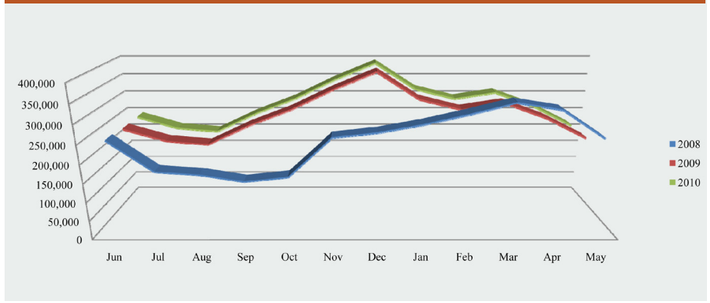
Program

Also, it's important to analyze and understand the 'program' of the Law Building. The Ground Floor consists primarily of the library, a café/lounge, and some offices. The 1st Floor consists of the library, conference rooms, lecture rooms, and administration offices. Lastly, the 2nd Floor consists of the library, and more offices. The library is situated on the north side of the building, with the primary lecture rooms on the south. The majority of classrooms and offices are all attached to the west and east sides.

As designers we asked if these are the best locations for these programmed spaces? Is the library the best spot for studying? The typical law student spends 8-10 hours a day, 5-6 days a week at their carrels doing some type of homework. We suggest that from the current conditions, the library is not the best environment for healthy studying.

By now we all know how valuable good light, ventilation, and temperature are to our health, but in these current conditions students are at least 50 ft away from the nearest window, studying in dark corners, hidden behind large and obstructive book stacks. Of course not every location is as bleak as this, but there is certianly much that could

Figure B KWH Usage - Past Three Years



be improved which will be addressed throughout this article.

Energy Evaluation

Looking back on Fiscal Year 2010, we get a good picture of what the Menard Law building's energy usage is like. In relation to other buildings, the energy usage here is quite simple to analyze because of the single source of power it uses. As was stated earlier, the law building is using electricity and steam to power its various energy needs, but the steam is only very recent. Thus, all data presented in this article will only address electricity usage and drastically affects our outcome.

For buildings in the inland northwest the worst time for energy usage is almost always during the winter months from October to January, with some winters extending into March. This is evident by looking at the energy usage graphs provided, refer to Table 1 & Figure B. Clearly, heating degree days takes the design priority in a climate like this.

Electricity Usage

Per Table 1, the month with the least energy consumption is August, with a total of 201,239 KWH and an associated cost of $9,558. The month with the highest consumption is by far December, with 393,912 KWH and a cost of $19,577. The ideal situation would be to have the graphs even out more throughout the year, but realistically, the cold winters will always be a challenge for any well designed building.

In comparison to data from the two previous Fiscal Years (2008 & 2009), the electricity usage has increased (Figure B). This can be expected because like so many other colleges on campus, enrollment for the Law program has continued to increased yearly, thus adding occupants and services required to accommodate them. Also important to note, is that the energy usage had continued to increase even though several facility improvements have been made, such as new fluorescent bulbs, and occupancy sensors. It's hard to pinpoint all the reasons why, either the occupancy was overwhelming (which is expected), or the upgrades have not succeeded due to user error or other unforeseen factors.

Energy Usage Index

Before judging a building, it is critical to look at the law build-

Table 1 Electricity Usage for Fiscal Year 2010

Meter: ELM071-0-014 (Electric)
Location: 014 Menard Law Building

Month	From	To	KWH	Cost
Jun-09	6/1/2008	7/1/2008	243,214	$11,528.34
Jul-09	7/1/2008	8/1/2008	210,536	$9,979.41
Aug-09	8/1/2008	9/1/2008	201,239	$9,558.85
Sep-09	9/1/2008	10/1/2008	253,031	$12,018.97
Oct-09	10/1/2008	11/1/2008	295,259	$14,024.80
Nov-09	11/1/2008	12/1/2008	348,298	$17,310.41
Dec-09	12/1/2008	1/1/2009	393,912	$19,577.43
Jan-10	1/1/2009	2/1/2009	322,733	$16,039.83
Feb-10	2/1/2009	3/1/2009	295,375	$14,680.14
Mar-10	3/1/2009	4/1/2009	312,785	$15,545.41
Apr-10	4/1/2009	5/1/2009	273,183	$13,577.20
May-10	5/1/2009	6/1/2009	218,564	$10,862.63

ing in comparison to other buildings on campus. The best way to do this is to look at the building's 'Energy Usage Index' (EUI), which takes the total energy usage of a building and factors in the square footage or occupancy to derive an all encompassing number. For the EUI values we discuss in the following sections, we used 45,000 ft² and an average occupancy of 396 (includes students and faculty).

From the data that we acquired we determined that for the 2010 Fiscal Year, the building's EUI was 250 (29,029 per capita). According to our research, similar education buildings should have an EUI of 280 for the average University building in the U.S. Not too bad to be under the national average, but it was also best to compare ourselves to other buildings on our own campus, since our campus is unique with its location, climate, and energy practices. With Fiscal Year 2005 as our baseline, the average U of I campus building has an EUI of 166 (46,817 per capita). That changes things, putting Menard well below par.

The Law building is not the most energy efficient building when it comes to a campus comparison, but it should be understood that the flawed design is making it highly energy dependant. On top of that, the average law student spends copious amounts of time studying there. 55 hours a week is significantly more than average students spend on campus. With that said, it still under performs, and that is an issue to address in the future.

It is greatly beneficial to do more data comparison when Fiscal Year 2011 becomes available. The implementation of the steam line from this past summer should have a great affect on the total energy usage. Perhaps the steam will be more efficient than electricity when it comes to heating domestic water.

Figure C Energy Usage Index (EUI) - per ft²

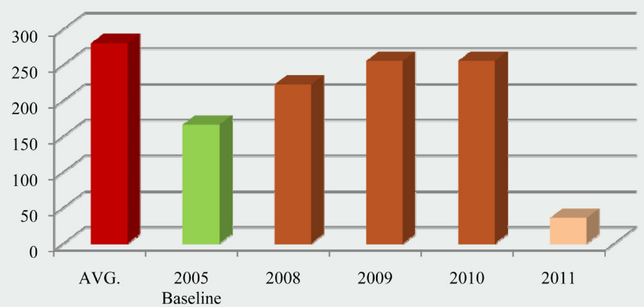
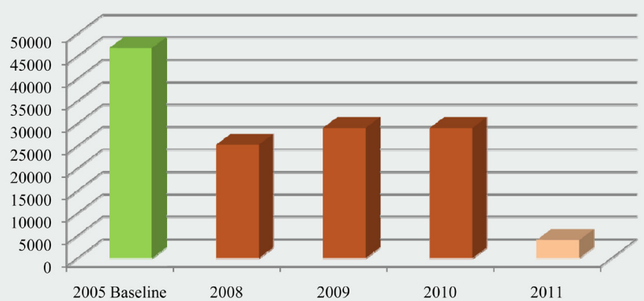


Figure D Energy Usage Index (EUI) - per capita



Maintenance and Operation

As per our tour with Facilities management, we learned that most HVAC equipment and machines used to be operated pneumatically. But as well, through years of upgrades, all systems and machines have been switched over to purely electric. In some cases we learned that this was beneficial, but in others, such as maintenance and ease, the pneumatic components were better to work with.

The facilities' manager also pointed out that the current system in the building uses a wasteful amount of filters and has to be constantly be replaced. Another problem with the system is that there are cracks in the heat tunnel that cause the heat to seep out; approximately 40% of the

heat is lost through these cracks. The facilities' manager also stated that the current upgrades in the building are not functioning to their full potential. One factor that is unaccounted for in the energy equation is the occupant engagement. When the occupants enter the building the sensors turn all the systems on, but by the time the spaces are heated the occupants may have already left the area. This oversight has contributed to lots of wasted energy.

We hypothesized earlier on in our study that the temperature in the law library raised significantly throughout the day due to people and lighting. From the data that was analyzed the hypothesis proved to be correct. Both the occupants and artificial lighting exude heat throughout the course of the day raising the average temperature in the building. This helps keep it warmer in the winter but too hot in the summer.

Occupancy Evaluation

To perform a post occupancy study, we handed out surveys to the law students throughout the library. To meet the college's commitment to Post Occupant Evaluation, we conducted and had students complete an informative questionnaire. We customized the standard questionnaire working with the Law department and distributed it to the three different user groups: academic staff, non-academic staff, and students.

Below View of the artificial skylight from the 2nd floor inside the library.

Survey Results

The results for each users group are discussed under separate subtopics below:

Temperature

According to the survey, 43% of the students that took the survey were dissatisfied with the temperature in the Menard Law Library. We found that temperatures in the morning and heating during the winter were neutral amongst the students. Cooling during the summer is where most of the dissatisfaction with the temperature comes from.

Ventilation

Approximately 33% of the students involved with taking the survey had a problem with the ventilation in the working spaces. Both fresh air and air movement in the space proved to be a huge problem in the library. A big part of this problem as discovered was that the windows were screwed shut and that the occupants did not have any individual control over the spaces that they were occupying.

Right Inside the main HVAC equipment rooms. Over the past couple of years pneumatic components have been changed out for newer electronic ones.

Noise

Overall the noise seemed to be a problem for the occupants in the building. The one thing that was surprising was that the occupants did not complain about the noise that came from the outside or the noise from any machinery, but predominantly from the people using the library. The main complaint was about students arguing and debating at their carrels. This shows that occupant participation needs to work with the design of the building in order for a successful building.

Lighting

The lighting in the space seems to work for the occupants. Occupants indicated that there are sufficient natural lighting in the space. According to the survey the artificial light in the library did not seem like a problem amongst the occupants. We found that there could be some improvements on the amount of natural lighting that could be in the library to get rid of some artificial lights while helping to save more energy and still give the occupants a comfortable working area.

Health

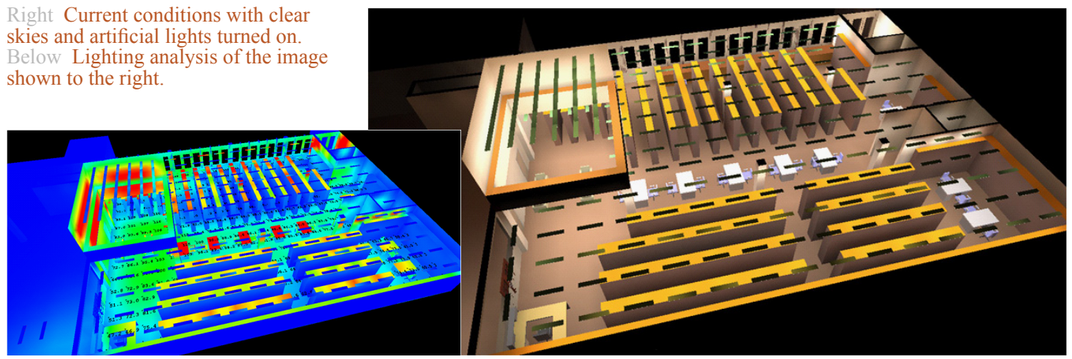
According to some of the occupants there are some symptoms like itchy eyes, dry skin, dry throat, headaches, Lethargy, Runny Nose, Dizziness, and sneezing that are caused by being inside of the building. Most of these symptoms are directly related to the ventilation of the building.

Group Results

Academic Staff

The survey indicated that the users are dissatisfied with certain

Right Current conditions with clear skies and artificial lights turned on.
Below Lighting analysis of the image shown to the right.



Right Current conditions with clear skies and artificial lights turned off. Indirect light entering the space from the north.

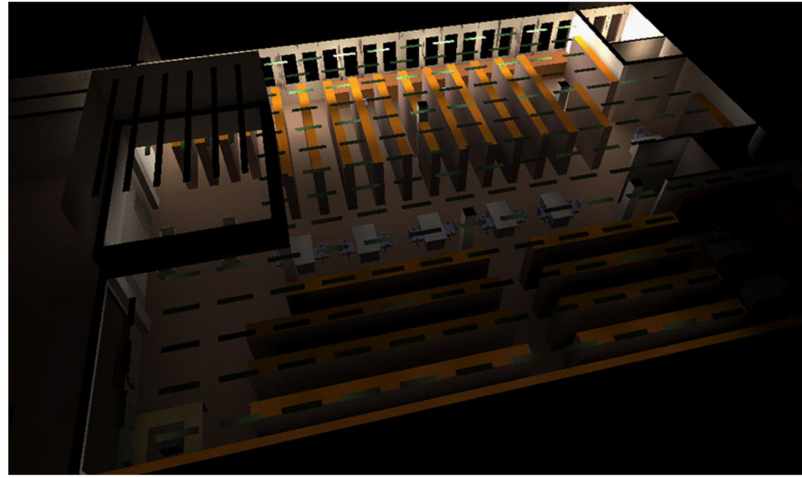
areas of their working environment. Poor scores for ventilation, heating, lighting and glare resulted in occupant discomfort. Poor natural daylight and the 'feel' of the rooms in the teaching areas was a major concern. It was advised that the college look at modifying the lighting to improve the visual environment.

Non-Academic Staff

The survey indicated that the users have some concerns with the working environment, but the overall score is on the positive side of neutral compared with other buildings on campus.

Students

The results of the questionnaire provided us with a valuable Post Occupation Evaluation enabling the college to make informed decisions on the best course of action to improve the working environment within budgetary restrictions.



Remodeling the Law Library for Lighting

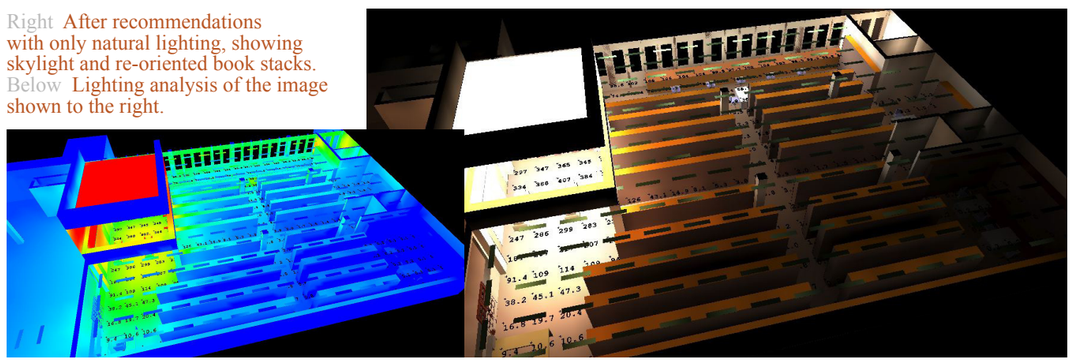
Along with conducting a physical study of the existing lighting in the law library using our Sylvania Light Meter DS2000 and Hoboware, we also modeled the space's luminance in AGi32. This allowed us to have a base for comparing our recommendations and how they affected our model in Agi32. It resulted in the following data and conclusions that influenced our decisions and final conclusions about the Law Library space. These are the final results to those investigations.

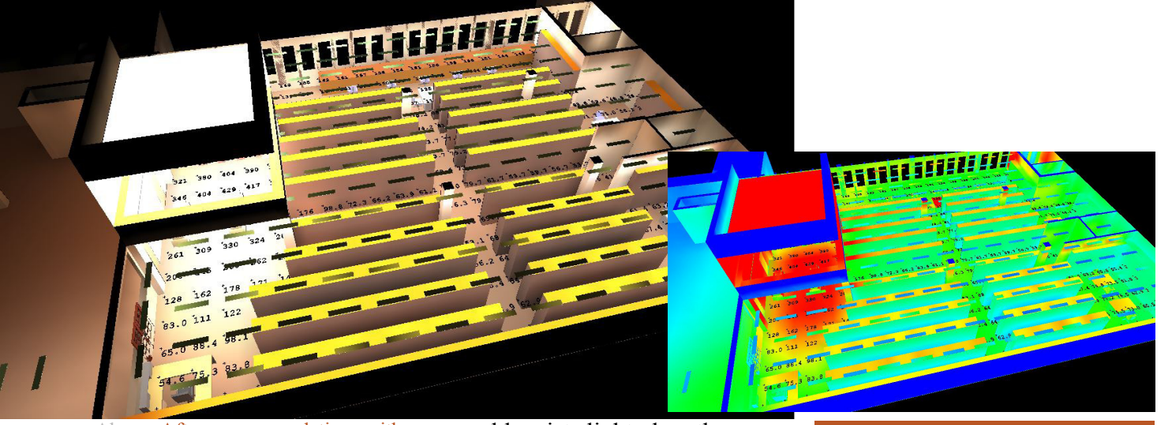
Before Recommendations

We began our task by modeling and analyzing the current lighting conditions in AGi32. What we found were a list of lighting needs including more task lighting near the rear of the building where lighting levels are lowest. AGi32 produced a model that showed us that the natural lighting from the deep set windows to north was quite adequate for naturally providing task lighting at an average of 80 footcandles (fc) near the window and a high of 106 footcandles (fc) without lights.

The windows were modeled at 2.5' by 6' composing 15 ft2 each for a grand total of 360 ft2 of north facing light. This could more efficiently be used because

Right After recommendations with only natural lighting, showing skylight and re-oriented book stacks.
Below Lighting analysis of the image shown to the right.





Above After recommendations with natural and artificial lights.
Right Lighting analysis of the image shown above.

there is no reason for the deep inset windows on the North side. As you progress through the space to the south it becomes imperative that they install artificial lighting for everything from reading to wayfinding, as expected. Currently the space's lighting levels sit at an average of 13 fc without lights on and 60 with lights. There are 187 lights on the first floor alone and 36 in the overhead artificial skylight, which could be greatly reduced if they designed some user control and rearranged the stacks.

Recommendations

Our initial recommendations were to install a real skylight in place of the false incandescent skylight currently there. We also suggested moving the stacks on the north end farther south and replacing them with the carrels from the center where people, who need task lighting, are working. This would allow the carrels to be closer to the north facing windows where abundant natural light can reach them. As long as the surfaces being used could resist slight glare the space is actually quite well lit. So these are the suggestions that we chose to test on the first floor to see the impact.

-Replace false skylight with actual skylight
-Move carrels and stacks to improve task lighting
-Provide user controls at night such as task lamps,
-Reduced number of lights, and if possible remove the depth to the windows.

After Recommendations

After following our recommendations and making changes to the model, we found the following changes improved the law library space. For example, AGi32 proved to us that when we changed the artificial sky lighting to a real skylight we not only saved on 36 florescent tubes, but we were able to increase lighting during the daylight hours from an average of 13fc to 49fc without any lights. It also improved the quality of light in the space visually.

The downside is that we may have to compensate for the lack of light during the evening hours with additional lighting for the task areas. This could be resolved with user operated task lighting and since the area beneath the skylight is not being used for carrels, it is not a pressing need. In rearranging the stacks from the north to the center and turning then 90 degrees to align them with the lights, we were actually able to increase the lighting in the aisle and add an extra stack shelf if it is needed.

ANALYSIS AVERAGES

Remodeled with Lights On
Illuminance {Fc}
Average = 89.64
Maximum = 429
Minimum = 0.0

Existing with Lights On
Illuminance {Fc}
Average = 60.23
Maximum = 155
Minimum = 0.0

Remodeled with Lights Off
Illuminance {Fc}
Average = 49.95
Maximum = 407
Minimum = 0.0

Existing with Lights Off
Illuminance {Fc}
Average = 13.29
Maximum = 106
Minimum = 0.0

Note: All lighting data/figures are given in footcandles. Digital modeling and lighting data was taken from the program AGI-32.

DISPLAY ENERGY CERTIFICATE

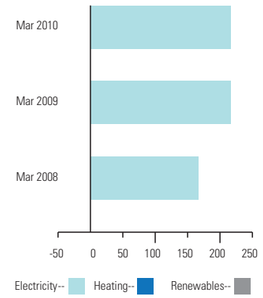
Menard Law Building

West 6th Street
Moscow, ID 83844

Certificate Reference Number:
1252-3453-5565-3568

Total CO_2 Emissions

This chart shows you the annual Carbon Dioxide emissions that the building emits. It shows tons per year of CO_2.



Technical Information

This tells you technical information about how energy is used in this building. Consumption data based on actual readings.

Main heating fuel:	Electricity
Building Environment:	Air Conditioned
Total useful floor area (ft2):	45,000

	Heating	Electrical
Annual Energy Use (kWh/ft2/year)	0	75
Typical Energy Use (kWh/ft2/year)	0	17
Energy from renewables	0%	80%

Administrative Information

This a Display Energy Certificate as defined in SI2007:991 as amended.

Number of Staff:	54
Avg. Occupancy/ Day:	396
Certificate Issue Date:	17 DEC 2010
Total Floor Area:	45,000
Number of Floors:	3
Avg. Building Usage (hrs/wk):	80

Energy Performance Operational Rating

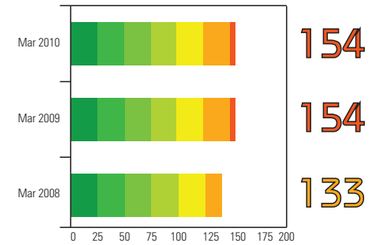
The sliding chart in the middle describes how efficiently energy has been used in the building of note. These numbers do not represent actual units of energy consumed but are adjusted numbers based on the Energy Use Intensity (EUI) for comparison to the average energy use from buildings of this type. 100 is the adjusted average.

The Energy Performance Rating for this building is determined through use of the following equations:

X*Y = 100
(A/B) * Y = Energy Performance Rating
where,
X= Average EUI for this building type (KBTU/sqft)
Y= Adjustment Factor (sqft/KBTU)
A= Total Energy Usage for one year in the building of note (KBTU)
B= Total Floor Area in the building of note(sqft)

Previous Operational Ratings

This tells you how efficiently energy has been used in this building over the last three accounting periods.



Recommendations

Simple renovations can be completed on the Menard Law building in order to make for a more sutible enviornment.

-Specifically in the library, it would be beneficial to re-align the book stack 90 degrees, such that the electric lighting runs parralel with it.

-In addition, there is adequate space for a natural lightwell to be installed, where currently electric lighting resides. This would save on electricity costs.

-Install task lighting to individual karrols,to limit the use of the general lighting scheme for after hours.

Recommendationsin Report Reference Number
1234-1234-1234-1234

Above Overall data and analysis following research was placed into a certificate which later could be placed on the building to showcase its energy performance.

In place of the stacks we moved the tables and chairs to the north where they get much more natural daylight and need far less artificial light at an average of 40 to 90 fc at each of these workstations. With higher lighting levels during the day we could potentially reduce the number of lights by 50 or so. Each lamp is a 1' x 4' Z-Lux fluorescent 53 watt bulb rated at 3150 lumens. In reducing the number of lights used in the space day and night, the building could see remarkable savings in electricity.

We feel that these savings and additional improvments and changes to the building will have long term effects that will be enjoyed by law students generations to come. We appreciate the help of the law students and faculty as well as the facility manager on our study. Our findings reveal some unexpected results and some which were obvious changes that were expected. With great lighting and an atmosphere that encourages health as well as one that saves on energy, we hope to foster pride in the establishment and be a better example to the Idaho community. Go Vandals!