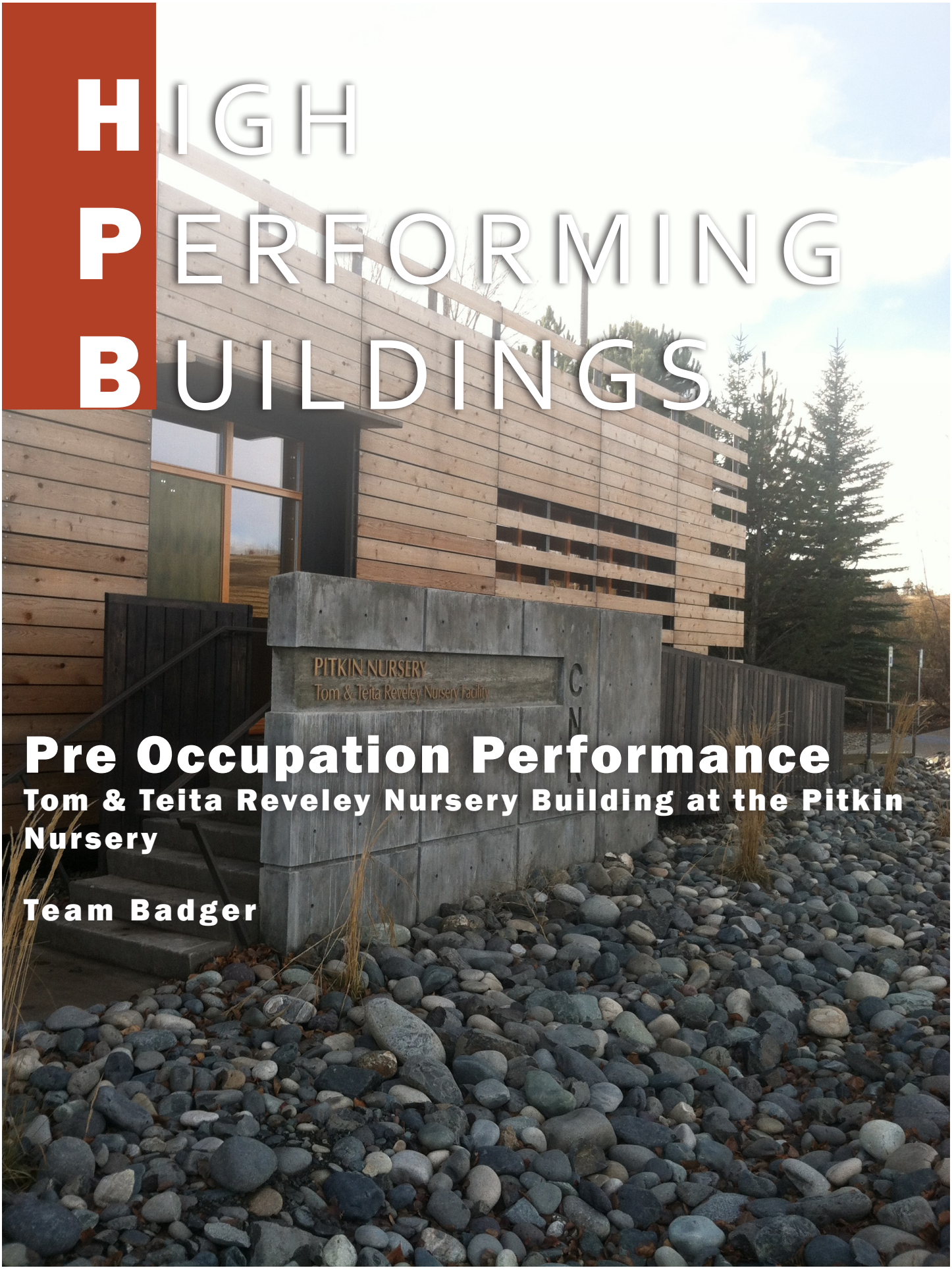
HIGH PERFORMING BUILDINGS



Pre Occupation Performance

Tom & Teita Reveley Nursery Building at the Pitkin Nursery

Team Badger

IDAHO WOODEN MASTERPIECE

By: Tessa Grundler, Ryan Mccolly, Ben Ferry

"This building is made of wood and lots of it."

-The President

The University of Idaho's College of Natural Resources newest addition, the Tom & Teita Reveley Nursery Facility is a shining example of the College of Natural Resources commitment to research, teaching and sustainability.

With the nursery having been in operation since 1909 it has become an important part of the University of Idaho Legacy and continues to thrive through the ever changing times of the university.

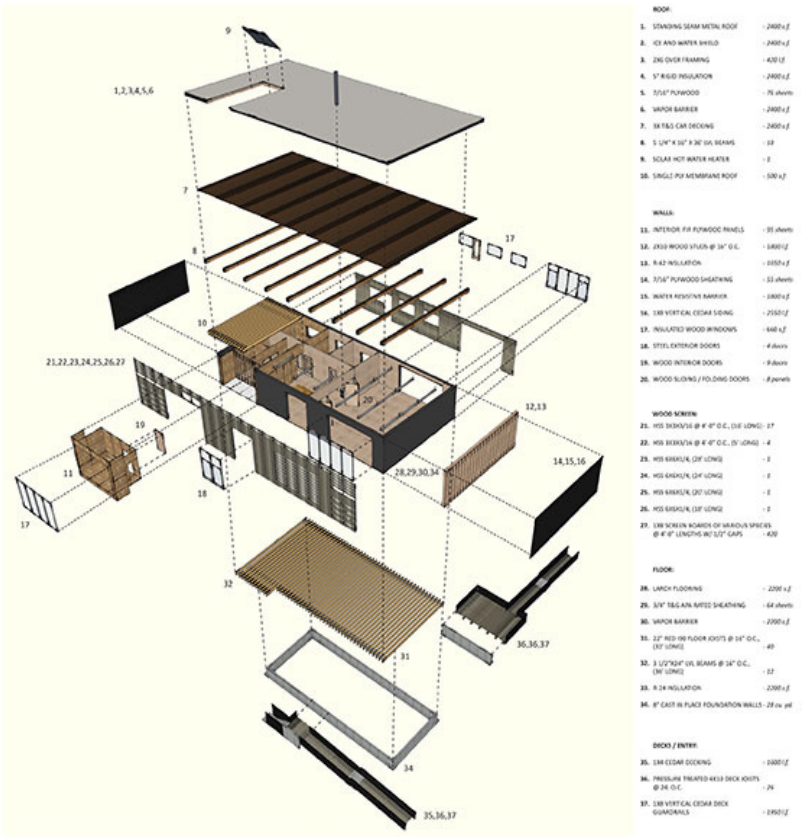
The award winning Reveley Nursery Facility at the Pitkin Nursery provides the University of Idaho a sustainable place to work and learn. All the wood used in the building is locally sourced from the state of Idaho. It provides and excellent teaching tool in not only the understanding of the materials found at the nursery and in the state of Idaho, but it is also an excellent example of the application of local materials carried out flawlessly and demonstrating how sustainable practices can be effectively implemented in building practices .

Through careful research and data collection our team set out to prove or disprove four hypotheses. We were interested in temperature swings within the offices, comfort, glare, and the overall building's EUI.

The first hypothesis stated: The south east office will have greater temperature variances than the other offices. We decided to record the temperature with HOBO data collectors. We set the hobos up in each office and recorded the temperature at five minute intervals. After gathering the data we checked the temperature variances in each room to see if we had proved or disproved our hypothesis.

The second hypothesis stated that the north east shop would be comfortable the majority of the time. In this experiment we used the HOBOS to collect not only the temperature readings, but also the relative humidity and we compared the average findings with the desirable range of comfort being between 68 degrees Fahrenheit and 78 degrees Fahrenheit, and with the relative humidity being between 30 and 70 percent.

"All the wood used in the building is locally sourced from the state of Idaho."



The image above is an exploded axon-ametric view of the Pitkin Nursery. [http://www.uidaho.edu/inspire/ways/academics/cnr/college-priorities/pitkin-nursery-project]

The third hypothesis stated the offices will have glare due to the one window light source. We tested this hypothesis by taking photos of the rooms at the same location and analyzed them using the Schiler Glare method.

The fourth and final hypothesis stated the building will have an EUI of less than 35. We tested this by comparing the yearly and monthly averages. Then we took the number and divided it by the area to get the EUI.

BUILDING AT A GLANCE

Name: Tom & Teita Reveley Nursery Facility

Location: Moscow, ID

Owner: University of Idaho

Principal use: Office/Educational

Occupancy: Educational

Gross Sq ft: 2,130

Awards:
AIA State Regional 2014
AIA Idaho Honor Awards 2014

DATA AT A GLANCE

Name: Pitkin Nursery

Office #1:
Max temp. 76 deg
Min temp. 65 deg
Avg. temp. 69 deg

Office #3:
Max temp. 78 deg
Min temp. 65 deg
Avg. temp. 69 deg

Shop:
Max temp. 75 deg
Min temp. 61 deg
Avg. temp. 68 deg

Max Humidity 51 %
Min Humidity 28 %
Avg.Humidity 41 %

Outdoor:
Max temp. for Oct. 81 deg
Min temp. for Oct. 33 deg
Avg. temp. for Oct. 57 deg

Max temp. for Nov. 68 deg
Min temp. for Nov. 2 deg
Avg. temp. for Nov. 35 deg

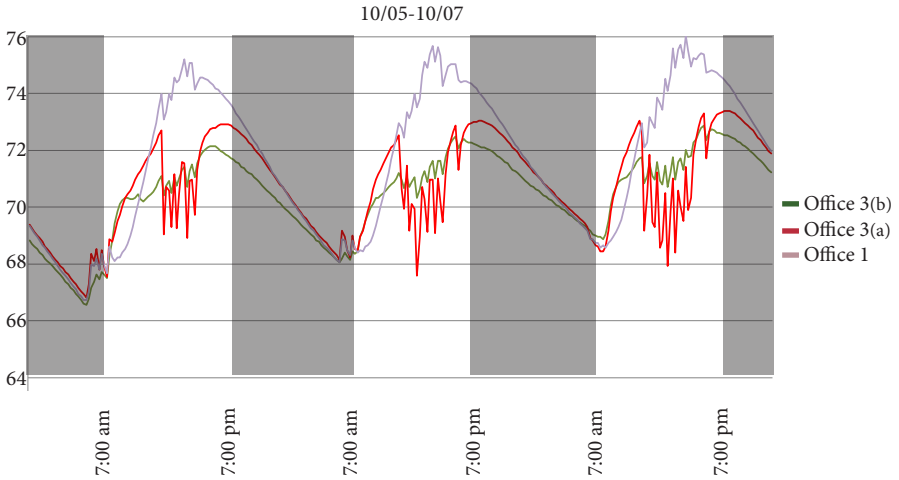
This is a hobo logger. A device that is used for measuring temperature, relative temperature, and relative humidity. The device is generally placed at average heights in rooms to understand temperature displacement.

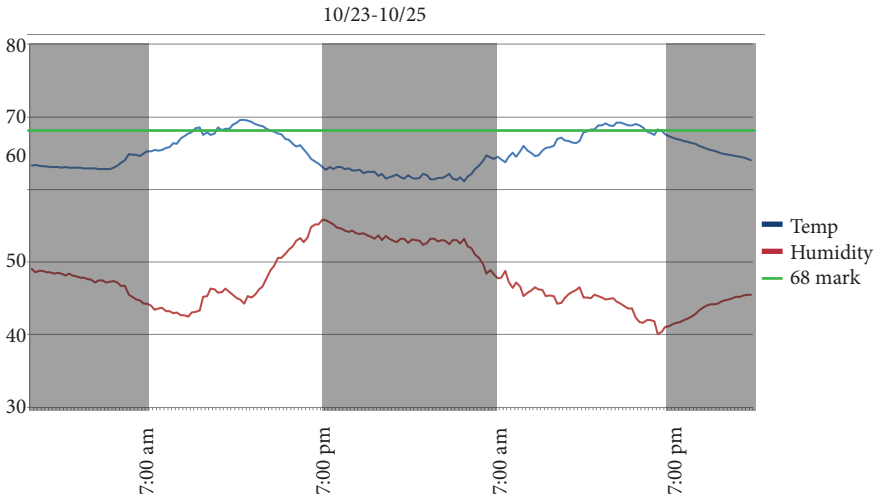
We used several different methods to collect data from the building. We placed HOBO sensors in several locations around the building in order to collect temperature and humidity readings. They also were used to reinforce daylighting readings. We also took measures of the air circulation using air pressure sensors to find the output of the HVAC system. To analyze glare we took pictures of the offices where someone might be working and analyzed them through RASCAL to see exactly where the glare might be and when it might occur. These tests occurred on a biweekly basis for a period of 4 months.

The results shown below are from a two to three day period to see the temperature swings throughout a comparative day. The offices are proving our hypothesis of the third office having greater temperature swings than the other offices. The shop variance throughout this period remained in the relative comfort zone.

The first image shows relative temperature of the offices over a two day period.

The second image shows the relative temperature and humidity of the shop over a two day period





Analyzing the potential or actual glare of a space is a difficult process due to the fact that glare can be very subjective and there is no definitive rule for when glare occurs. The basic rule of thumb is that if there is a light-to-shadow ratio of 1:3 there is a potential for glare. Though glare is not always noticeable even at a ratio of 1:10 depending on many factors including size, orientation, and location. Our glare analysis for this building focused on the southern offices. We hypothesized that in two of the offices with South facing windows glare would be a problem for the users. Because of the low sun angle in the winter these offices are particularly susceptible to glare. Without some way to block this light, we thought, there would be an uncomfortable amount of glare.

To test this hypothesis we took pictures of the offices in positions that someone might be working. Images were taken every two weeks to see what the differences might be at different times of the year. The images were all taken around noon because if the sun was getting through the windows at noon it was reasonable to assume that it was in the space for at least several hours that day.

Once the pictures were taken the images were edited to go through a conversion program called RASCAL and then into another program called Culplite. Through these programs it is possible to see the potential areas for glare. In the program they are highlighted yellow in the converted image and more specific information in the program gives the user an idea of where the greatest and least of the glare might occur.

Top left image: office 1 on October 9th, at noon.
Top right image: office 2 on October 9th, at noon.
Bottom left image: office 1 on November 20th, at noon.
Bottom right image: office 2 on December 4th, at noon.

ENERGY AT A GLANCE

Name: Pitkin Nursery

Simulation Projected Annual Energy:

Total EUI: 81 Kbtus/sq/yr

Energy EUI: 13 Kwh/sq/yr

Fuel EUI: 41 Kbtus/sq/yr

Life Cycle Electric: 652, 447 Kwh

Life Cycle Fuel: 21,108 Therms

Projected Energy September
Electricity Usage: 854 Kwh
Fuel Usage: 19 Therms

Projected Energy October
Electricity Usage: 947 Kwh
Fuel Usage: 140 Therms

Projected Energy November
Electricity Usage: 960 Kwh
Fuel Usage: 241 Therms

Recorded Energy September
Electricity Usage: 475 Kwh
Fuel Usage: 57 Therms

Recorded Energy October
Electricity Usage: 585 Kwh
Fuel Usage: 77 Therms

Recorded Energy November
Electricity Usage: 860 Kwh
Fuel Usage: 360 Therms

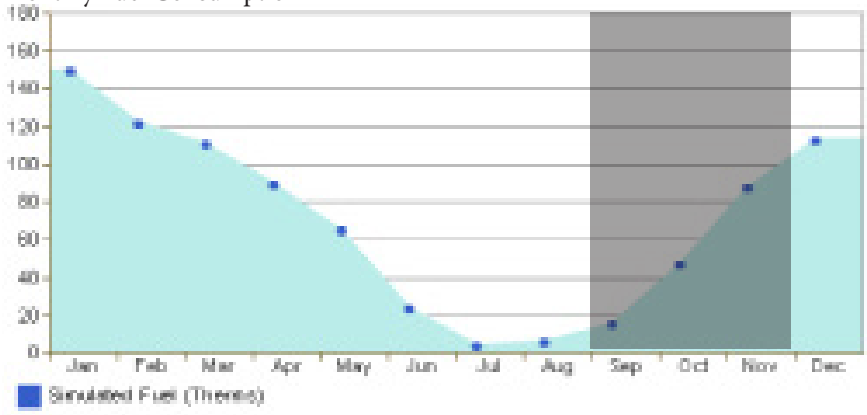
Anticipated EUI: 90 Kbtus/sq/yr

The data shown here is based off of Green Building Studio software. The physical data taken is of a period from September to November

Using a program called Revit and green building studio to compare data. The software is being used to compare the accuracy of annual predictions of energy usage to the physical documented data collected. The software looks at electricity, fuel, HVAC, lights, and other miscellaneous usage. It also takes into account the walls, floors, and ceilings insulation R-values in energy results.

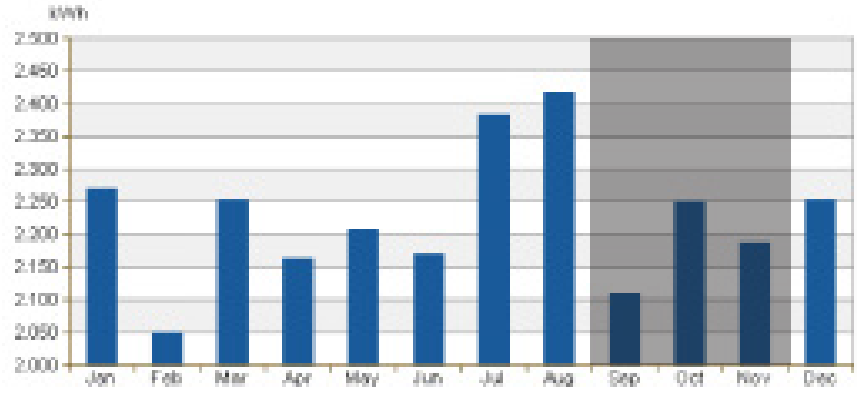
The chart below along with the charts on the next page show the energy model and its annual predictions. It also breaks down the monthly consumptions of fuel and electricity. The greyed out areas of the monthly consumptions of the comparative areas to our physical data taken. If the data matches up, the software data can be used for the annual prediction of energy usage and will prove its accuracy.

Monthly Fuel Consumption



The above imag: Is the monthly fuel consumption predicted from the software. The greyed over area is the comparative months of physical data taken.

Monthly Electricity Consumption



The above image: Is the monthly electric consumption predicted from the software. The greyed over area is the comparative months of physical data taken.

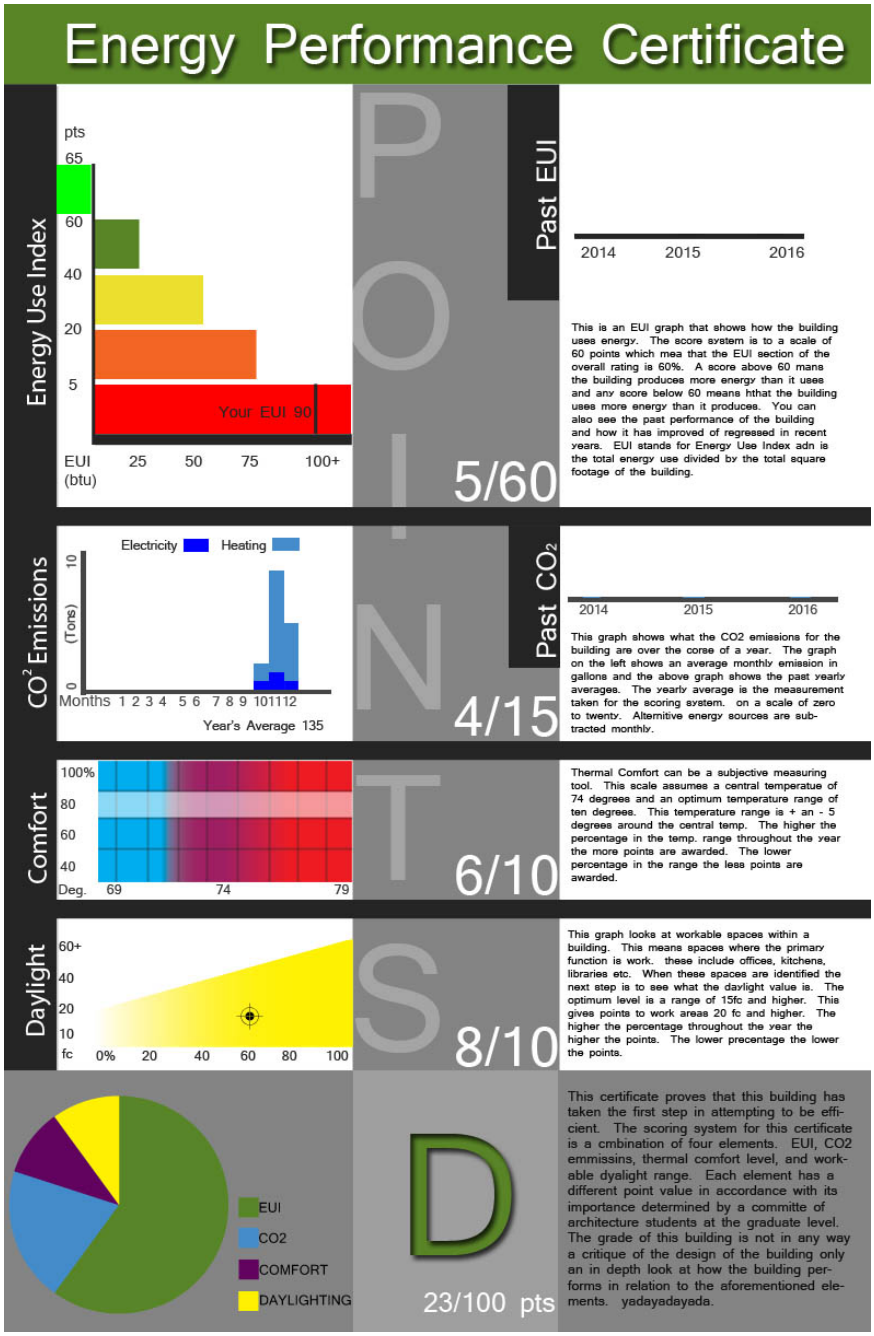
LESSONS LEARNED

We found that in the offices of the building do indeed have a large amount of glare potential during the winter months. Since the sun can be tracked through the window, glare will happen throughout the day for the users. The single window sources admit a lot of sunlight into the spaces which can cause occupants to be uncomfortable. A simple solution would be user control shading devices such as venetian blinds.

The east office did not have a large temperature swing , due to the HVAC system being always on, either cooling the spaces or heating, it remained comfortable. This causes unnecessary energy consumption. The building does not need to run 24 hours, especially when occupants are not using the building at night.

The north shop occasionally fell outside of our predetermined comfort zone, mainly in the mornings and evenings. Checking readings from 7am to 7pm over the past 3 months the temperature dropped below 68 degrees each month about 20% and dropped below 30% humidity 10% in each month.

As for the simulation, EUI, and projecting energy uses are not the same. Since the building is unoccupied not a lot of energy is being used besides heating and cooling, and the running fan distribution. The projected fuel has been below the actual monthly readings and the projected electricity has been above the monthly readings. The software that we are using has a difficult time trying to simulate unoccupied spaces and it cannot predict severe temperature changes, for example, when it was very cold this November.



Energy Certificate

ABOUT THE AUTHORS

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