The Pennsylvania State University
University Park Campus

SUSTAINABILITY PROPOSAL
Aluminum: Sustainable Solutions

Design Team #3
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Submitted to:
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ACKNOWLEDGMENTS

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SECTION 1  EXECUTIVE SUMMARY

The majority Pennsylvania State University main campus buildings are over 30 years old and are in need of renovations to become more environmentally friendly and energy efficient. In an effort to make our campus facilities more green, our design team has decided to focus our efforts on improving the Hammond Building. We have developed a plan to install aluminum window louvers on the Hammond building to lower the necessity of air conditioning required to keep Hammond building a comfortable learning environment for students and faculty. In addition to making the Hammond building more environmentally friendly, these window louvers will improve the aesthetic appeal of the building in keeping with the cutting-edge look of the buildings around campus.

By utilizing the inherent properties and natural abundance of aluminum, our plan will effectively improve the Hammond building at a low cost. As an abundant, naturally anti-corrosive and heat reflective material, our aluminum louvers will reflect heat away from the building in the summertime at a low cost for material, installation, with a minimal requirement for any longer term maintenance.
SECTION 2 INTRODUCTION

2.1 LOCATION.

Penn State University Park main campus is located in central Pennsylvania, Centre County. It is located in the small college town of State College, Pennsylvania which is bordered by Mount Nittany. This four-seasons campus is subject to excessive heat in the peak of summertime as well as harsh winter weather.

2.2 CAMPUS SETTING.

Penn State is a large campus hosting approximately 40,000 students every year. Most of the buildings on campus are roughly 30 years old. In order to keep with the increasing amount of students, the University is constantly constructing new buildings around campus as well as making renovations to the older facilities. There is a huge focus on making the campus facilities all LEED (Leadership in Energy and Environmental Design) certified.

2.3 WHAT IS SUSTAINABILITY.

Sustainability is the equilibrium between producing what we need as humans, and keeping the natural world productive so that future generations can, also use the same resources.

2.4 BENEFITS OF ALUMINUM.

Aluminum is a light metal that naturally generates a protective oxide coating which makes it highly corrosion resistant. It’s corrosion resistance provides effective protection against degradation from water, salt, air, and temperature. It is an excellent heat and electricity conductor that is commonly used in power transmission lines. Aluminum is also a good reflector of light and heat. It’s lightweight, natural ability to withstand corrosion, and it’s heat reflection abilities makes it an ideal material for a window louver and heat reflector. Combined with other elements aluminum can from alloys as strong as steel at about a third or half the weight.

Applied as a window louver, aluminum has the ability to reduce the energy costs of old buildings making them more environmentally friendly while providing a modern look.
2.5 SUSTAINABILITY OF ALUMINUM.

Unlike many materials such as wood, natural fibers, and plastics, the unique physical properties of aluminum do not change with physical or mechanical processing. This allows for aluminum to be recycled and reused without any loss in quality, making it inherently sustainable.

The aluminum industry is one of the lead industries to adopt a transparent lifecycle approach to address sustainability. The life cycle of aluminum starts with raw material extraction and processing. The first step to manufacturing aluminum is bauxite mining to produce aluminum, which is the third most abundant element in nature. The mined bauxite is processed into pure aluminum oxide (alumina) at chemical processing facilities prior to being converted to aluminum by electrolysis. At reduction plants, pure aluminum is extracted from the alumina by electrolysis.

Due to its abundance and sustainability, the production of aluminum has been increasing worldwide since 1950. The packaging industry mainly consists of sheet and foil aluminum for beverage cans, containers, and wrapping. The sheets of aluminum are also used for roofing, sidings, airframes, boat hulls, and other structures.

At its end of life, aluminum can be recycled an infinite amount of times without losing its properties. The recycling abilities of aluminum conserve energy and other natural resources. It saves up to 95% of the energy required to produce the aluminum which in turn avoids the emissions and greenhouse gases produced from the production. Used aluminum is valuable and economical, since it uses less energy to produce it makes it self-sustaining.

2.6 CURRENT PRACTICES.

The majority of the newly constructed buildings at Pennsylvania State University use aluminum framing and louvers around the windows for a modern look and efficient framing. Pennsylvania State University Park campus currently has 11 LEED (Leadership in Energy and Environmental Design) certified buildings with 9 more pending certification. Penn State’s LEED policy exceeds national standards as the university continues to pursue more environmentally sustainable building renovations and developments. Current LEED projects on campus involve the Forest Resources Building, Rec Hall addition, Student health center, and other buildings on campus.

There are goals and plans in place to renovate the 600 ft long Hammond Building, built between 1958 and 1960 and reconstructed in 1977. Some of the renovations have already been put in place, however there is still the issue of extra heat in the summertime which could be prevented with the use of aluminum louvers.

2.7 GUIDING PRINCIPLES.

Based on personal experience, the problem we are experiencing with the Hammond building is that in the morning when the sun is rising, all the glass windows in the hallway magnifies the sun’s heat raising the temperature to an uncomfortable level inside the hallway. Our goal is to shield this effect by adding aluminum louvers to the windows in order to provide effective shielding while still maintaining a pleasant line of sight to the street.
2.8 STAKEHOLDER ENGAGEMENT.
Those affected by our proposal include teachers and instructors of the Hammond building, as well as students attending class. Also the schedule of maintenance staff who attend to the building's overall appearance will have to change slightly with new duties with the louvers.
SECTION 3  BACKGROUND

3.1  SPONSOR BACKGROUND.
Alcoa is the world’s leading producer of aluminum, and the world’s largest miner of bauxite and refiner of alumina. In addition to inventing the modern-day aluminum industry 125 years ago, Alcoa innovation has been behind major milestones in these markets: Aerospace Automotive Packaging Building and Construction Commercial Transportation Consumer Electronics. Alcoa is a large company which employs approximately 61,000 people in 30 countries across the world.

3.2  PROJECT OBJECTIVES.
Aluminum has many distinct properties, most of which are already used in use worldwide. One of its best properties is that it can be recycled without losing too much of the original item. Our goal for this project is to use Alcoa’s recycled aluminum and put it to good use, and in this case good use is making aluminum louvers for one of the buildings in Penn State. To be more specific Hammond building will be the building that the louvers will be added to. The point of this is to cut down on the usage of air conditioning, and in turn, cut down of energy. If the louvers work well on the Hammond, it could potentially be applied to other buildings on campus.

3.3  PROJECT BACKGROUND.
Aluminum is a lightweight, strong, and versatile material. Since the discovery of the process to economically produce aluminum in 1888, it has played an important role in many markets. From the Wright flyer to the Boeing 787 Dreamliner, from cookware to high performance automobiles, aluminum has been the material of choice. Today, increasing the efficiency of energy usage and seeking solutions that are increasingly sustainable are of extreme importance, and aluminum can provide solutions to meet these critical needs. Its strength and light weight allow aircraft and ground vehicles to save fuel while providing us with the performance we need. Aluminum is highly recyclable, allowing new products to be created with a fraction of the energy use without sacrificing performance. In fact, over 70% of the aluminum ever produced remains in use today.

3.4  SCOPE OF THE PROPOSAL.
As current students who utilize the Hammond building we have personally experienced the unpleasant effects of the morning sun in the hallway of our classroom. Our proposed solution for this problem is to use the beneficial properties of aluminum to our advantage in eliminating the uncomfortable heat of the sun as best we can. The aluminum will be used in the sense of louvers to deflect the sun’s hot rays and improve the overall appearance of the
building. In addition to this technical report, a model of the design will be provided for future reference. By using aluminum’s rust-resistant and heat reflective characteristics, our design will exhibit sustainability and efficiency when applied to the problem areas of the Hammond building.

Section 4 Qualifications

4.1 Credentials.
Ian Sell: Bartender for 2 years and a lifeguard for the past 3.
James Miller: Worked for LaMonica and Sons general contracting from 2011-2012. Worked for Longwood Gardens for one summer, 2013.
Matt Bulifant: Three years of fire hose and ladder testing experience.

4.2 Design Team Members.
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SECTION 5  METHODOLOGY

5.1 GOALS.
The goal of our project is to reduce the overall heating and cooling cost of Hammond Building, and to make Hammond more pleasing to the eye.

5.2 METHODS.
We were given the parameters by Alcoa that we had to use aluminum to improve something here at Penn State. We recognized that Hammond has a problem with sunlight, the first day of classes, which lead us to try and think of a way to block or reduce the sunlight that enters Hammond. Taking inspiration from multiple buildings that already have the louver shades in place, we decided as a group that the installation of louver shades would greatly improve Hammond.

5.3 IMPROVEMENTS.
At the moment, Hammond Building uses a lot of extra energy to cool down the halls during the warmer seasons, like late spring, summer, and early fall. This is due to the amount of sunlight the East side of the building receives when the sun rises. Since the building has multiple classrooms and offices on the East side, these rooms and any hallways get extremely hot. To compensate for the excessive heat, they use more Air conditioning. Louvers are designed to reflect sunlight and heat while providing shading and still have a clear line of sight out of the windows. The louvers would cut down use of air conditioning by an estimated 20%, which in cooling a big building such as Hammond, would result in a lot less energy used. With metal on the outside of the building exposed to the elements, we would need to have some sort of coating or protector on the louvers to prevent rusting or any degrading of the aluminum.

5.4 IMPACT.
Our design would impact Hammond in a multitude of ways. First, by making the building cooler, it would provide a less distracting atmosphere for the students and faculty to work in. A better working environment would result in more productivity by the faculty and even the students. Also, by making the building look better, it would increase the property value of itself and the buildings around it. Finally, the building would just look better and not be as much of an eye sore on the outskirts of campus.

5.5 ESTIMATED COSTS.
As of 2003, Penn State has embarked on a large building boom. Since the average age of most University Park buildings in 35 years, the University has formed a budget for building renovations and rebuilding to provide students and faculty with cutting-edge facilities. The University is using $769 million from a multi-year expense plan, which is anchored by a $240 million in state support over a six-year period.
In this cost estimate, keep in mind all values are approximate. The lowest price of aluminum window louvers is $20 per square meter. The Hammond building is 200 meters long with three floors of windows. In order to cover the three spans of windows we would require 150 meters length of windows for all three floors. The cost of the louvers would be $18,000. Additional construction materials and labor would be $10,000 totaling this project to be $28,000. To reduce the cost in half we could consider only installing the louvers on the south facing windows (windows facing college ave.). By installing the louvers on the south facing windows, solar heat gained in the summer will be reduced by up to 65% for $14,000.

The long term cost effectiveness of this project will pay off in the end with the reduced amount of air conditioning required in the summer, which will not only save the university money but will also be more environmentally friendly. By using aluminum, these louvers will require little to no maintenance and upkeep throughout the years which will in turn minimize any additional long term costs. The aesthetics of the aluminum louvers will also add to the professional and cutting edge ambiance of the campus overall.

5.6 MODEL. Along with our own design, below are attached links for further reference. [http://www.archlouvers.com/Sunshades.htm?gclid=CJ2hxKXE7roCFWWrNOgodvHsA8Q](http://www.archlouvers.com/Sunshades.htm?gclid=CJ2hxKXE7roCFWWrNOgodvHsA8Q) - designing the sunshade louver.

[http://www.charlottetentandawning.com/contact.htm](http://www.charlottetentandawning.com/contact.htm)

*Surface treatment to enhance corrosion resistance
** Melting point of aluminum
5.7 IMPLEMENTATION.

We estimate that our proposal would take about one month to fully install all of the louvers, which could be done over Summer break with plenty of time to spare. Not that the product installation would be a very large bother to people, but it would be more convenient if it could be done while students and staff were not present.

5.8 SCHEDULE.

We believe that a good timeframe to begin the project would be during the Summer, due to the fact that there will be the least amount of students or faculty in the building itself. The building is said to undergo construction within the next few years, so while they are remodeling the building we suggest that would be the best time to add on the louvers.
SECTION 6  DISCUSSION

Our design will reflect light away from Hammond building while adding to the aesthetics of this old building for approximately $28,000. The long term benefits of these louvers will outweigh the cost of installation. With our louvers, the university will save money from air conditioning, which will in turn protect the environment by requiring less energy in the summertime. With Aluminum as our material of choice, the louvers will require minimal maintenance throughout it’s lifetime, and when they are no longer used the Aluminum will go on the be recycled and reused in a different form. Our Aluminum louvers will add to Pennsylvania State University promoting the use of sustainable materials to reduce harm to our environment for future generations on our campus.
SECTION 7 SUMMARY

There are many benefits to the use of our Aluminum louvers on hammond building. The first is reducing heating and cooling cost of Hammond, the louver shades will do this by blocking and reflecting some of the sunlight from entering Hammonds windows. The advantages of using aluminum to build the louvres is aluminums superior durability in the face of mother nature. A disadvantage of this project would be the time and money invested in a building, while there are currently other construction projects going on around campus. This louvre design could be an easy green addition to any building on our campus.