

Project U.A.R.

EDSGN 100

Section 016

Team #3

Submitted to: Wallace Catanach



Byran Woodside II

Emails: bsw5173@psu.edu

Tong Zhu

tyz5064@psu.edu

Hellen Sarmiento

hqs5185@psu.edu

Index

Cover Page	1
Index	2
Executive Summary	3-4
Introduction & Mission Statement	5
Customer Needs Analysis	6-9
External Research	10
Concept Generation	11
Concept Selection	12
Final Product Design	13-17
Total Cost Range	18
Conclusion	19
References	20-21

Executive Summary

Project U.A.R was created with the intent of incorporating and increasing the aluminum content in the Pennsylvania State University, under the instructions of ALCOA. The objective our project is to implement a new aluminum roofing system to every building in the university, that is not only more durable but also ecofriendly. One purpose of the aluminum roofs is to be able to recycle the aluminum we use every day and make stronger and better roofs. In the long run the metal roofing will be more cost effective than the old roofing materials. Metal roofs are proven to be more expensive but much better quality and resistant roofs. Aluminum roofs may also be used as a heat as the material can absorb and reflect solar rays. And finally, the aluminum content that would be used would have been made out of recycled aluminum material, so instead of going to the Earth's natural resources, we will exploit the materials we already have available.

We surveyed individuals in order to collect information that would allow us to revise and improve our idea. The process minimized design concepts and made it possible for us to create metrics, matrixes, and concept selection. We came down to the conclusion that the customer wants the use of aluminum's lightweight, strong, and versatile factors in hopes of efficiency or sustainability. Additionally, we researched valuable facts about aluminum's properties online, so we have a clear idea of what was being done. Finally, the structure and how the aluminum content will be implemented were decided after all of the previous research that was noted.

The project may present with some risks. Either relating the ability of the aluminum roof being able to handle the harsh and fast changing weather, or the ability of the university to afford the change of every building's roof, there will always be risks and difficulties. Another risk or problem could be that all the buildings were built in different time eras so there could be a problem with the materials at the time and the compatibility they share with the new ones. The aesthetic might also want to be preserved and the roofs might threaten that.

Introduction

We, team members of Team 3, were back to the drawing board when we were given the task to construct a product or a product system that would be made out of recycled aluminum to increase energy efficiency or sustainability of that product or product system. Sadly, we lost a team member, but that did not stop us from clarifying the problem, brainstorming, analyzing customer needs, generating matrix and metric tables, eliminating concepts, and putting it all together to create a final product.

The problem at hand is that people will only recycle when they are given a reason or a motive that will benefit them; the environment is not enough to convince people to recycle. Instead of seeing this as a problem, Alcoa Incorporated view this issue as an opportunity to change today's generation and have made us realize a solution to the problem. We have decided to use recycled aluminum components to create an aluminum shielding on the roof of the Forum Building in Penn State. When we were given the task at hand, we were instructed to create a product or product system that could be implemented in our university, thus why we chose the Forum Building.

Mission Statement

Our mission is to use all the properties of aluminum, ensuring that it increases energy efficiency and/or sustainability of a product or product system and the product or product system must be able to be implemented on University Park campus of Penn State.

Customer Needs Analysis

We surveyed 20 people from our generation of people because in a sense, we are the future and our responses relate more to the problem than if say a 40-year old man responded. We are trying to make our youth or generation recycle more. One of the main goals of the project, and like most business projects, was to satisfy all the customers' needs. The survey was done to establish those needs and use them for analytical purposes.

Questions	Yes	No
1. Is the change in roofing more efficient?		
2. Is the change in roofing more sustainable?		
3. Do you think the roofing would be better with aluminum covering?		
4. Do you know anything about the Penn State roofing now?		
5. Do you know anything about roofing in general?		
6. Do you like shiny things?		
7. Do you mind noise when it rains or hails?		
8. Do you like the design of the roofs?		
9. Do you recycle aluminum cans?		
10. Do you care about the roofing at all?		

The data from the survey was then used to prepare a customers' needs statement table.

Custom Statements	Need Statements
I want the full use of the aluminum content.	The shielding will use all the properties of aluminum.
I want to spend my money's worth, however nothing too expensive.	The shielding will be affordable.
I wish to reduce my cooling cost.	The shielding will reflect solar radiant heat.
I do not want to harm the environment or create an environmental hazard.	The shielding will be eco-friendly.
I want my entire roof to be covered.	The shielding will maximize the area of the roof.
I wish to use some form of aluminum as the covering of my roof.	The shielding will be made out of a form of aluminum
I do not want poor installation of the covering.	The shielding will be easily and properly implement.
I want the covering to have an appeal to others and myself.	The shielding will have an attractive design.
I do not want to spend too much money on repairing the covering.	The shielding will be requiring low maintenance.
I want my covering to last.	The shielding will last a long time.
I want my covering to be shiny.	The shielding will be shiny.

The customers' needs statement table was then analyzed further to how important each need was. This is used to see which needs should most definitely be in our product and which needs may not be as needed; however, we did try our best to implement all of the needs.

Needs Statement	Importance (1-5)
The shielding will use all the properties of aluminum.	5
The shielding will be affordable.	4
The shielding will reflect solar radiant heat.	3
The shielding will be eco-friendly.	5
The shielding will maximize the area of the roof.	4
The shielding will be made out of a form of aluminum	5
The shielding will be easily and properly implemented.	3
The shielding will have an attractive design.	4
The shielding will be requiring low maintenance.	3
The shielding will last a long time.	5
The shielding will be shiny.	5

A customer needs and metric chart was then created to analyze the customers' needs to a further extent.

Need	Metric	Number of Tiles	Recycled Aluminum	Total Mass	Total Area	Energy Efficient	Durable	Thickness	Safety	Environmentally-Friendly	Performance	Climate Control	Expansion & Contraction
Energy Efficient		X	X		X	X		X			X		
Cost		X	X	X	X			X				X	
Shininess		X			X		X		X	X			
Eco-friendly		X	X						X	X	X		
Provide the Properties of Aluminum						X	X	X	X	X		X	X
Practical for the Area		X	X			X	X		X		X	X	X
Maintenance & Repair		X	X	X	X		X	X	X			X	X

External Research

Never re-roof again with the Miracle Metal, aluminum. Of all the aluminum produced during the last 100 years, 75 percent of it is still in use around the world, Aluminum is considered both the infinite recyclable and the miracle metal for its ability to be endlessly recycled, remelted and reproduced. Strong yet lightweight, aluminum is one of the principal metals used in aircraft construction, and is the ideal metal for roofing. Aluminum Shingles can be walked on. They are fully supported by the roof's sheeting, which prevents damage from foot traffic, or hail. Because the shingles lie directly over tarpaper, and the plywood sheeting, there is virtually no noise from rain or hail. Aluminum shingles are good for the environment. Aluminum shingles are made using over 90%-recycled aluminum, and even after many decades of protecting your home, your Aluminum shingles will have value as a recyclable material, and will not end up in the garbage dump or land fill.

Unlike heavy conventional shingles, Aluminum shingles can be installed over existing shingles in most cases. This feature alone may save you thousands of dollars. Besides being nailed down, each Aluminum shingle interlocks on all 4 sides with surrounding shingles. They also lock securely into flashings around all roof edges. This makes an aluminum roofing shingle extremely wind proof. All nails are covered in the locking process. This adds to the roof's clean, beautiful appearance, and also prevents the nails from working loose.

Concept Generation

We evaluated the customer needs and their responses to the surveying and decided to have two concepts based off of our idea for using aluminum in roofing. We came up down to aluminum roofing and aluminum roof covering as our two main concepts that would be evaluated even further. (Rating: 1-5 & Weighted Score: Weight % X Rating)

		Aluminum Roofing		Aluminum Roof Covering	
	Weight %	Rating	Weighted Score	Rating	Weighted Score
The shielding will use all the properties of aluminum.	15%	5	0.75	5	0.75
The shielding will be affordable.	10%	4	0.4	4	0.4
The shielding will reflect solar radiant heat.	5%	4	0.2	3	0.15
The shielding will be eco-friendly.	15%	5	0.75	5	0.75
The shielding will maximize the area of the roof.	5%	4	0.2	4	0.2
The shielding will be made out of a form of aluminum	10%	5	0.5	4	0.4
The shielding will be easily and properly implement.	5%	5	0.25	4	0.2
The shielding will have an attractive design.	5%	3	0.15	3	0.15
The shielding will be requiring low maintenance.	5%	4	0.2	3	0.15
The shielding will last a long time.	15%	5	0.75	5	0.75
The shielding will be shiny.	10%	5	0.5	4	0.4
Total Score			4.65		4.3

Concept Selection

The concept we selected due to our concept-scoring table was the aluminum roofing. We saw the aluminum roofing as an opportunity to maximize the satisfaction of the customers and the satisfaction of Alcoa Incorporated.

After extensive research, we found out that the aluminum material that would be used on the roof would provide several factors that would benefit the Forum Building.

Sustainability: The aluminum roofing would last between “40 to 70 years” while regular asphalt roofing would last between “12 to 20 years” (State Farm Learning Center, 3).

Energy Efficiency: The aluminum roofing would reflect solar heat and in doing so it could reduce the cooling cost of the building by “10% to 25%” (State Farm Learning Center, 3).

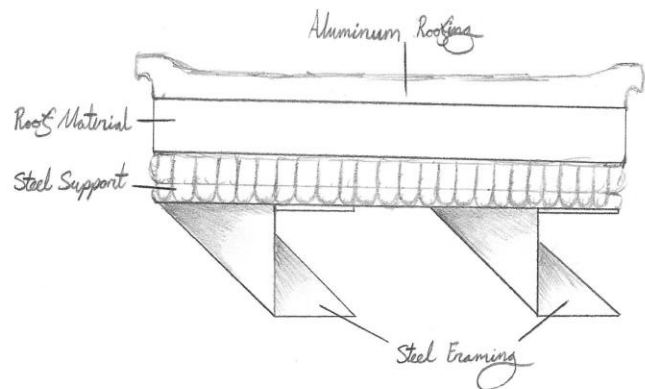
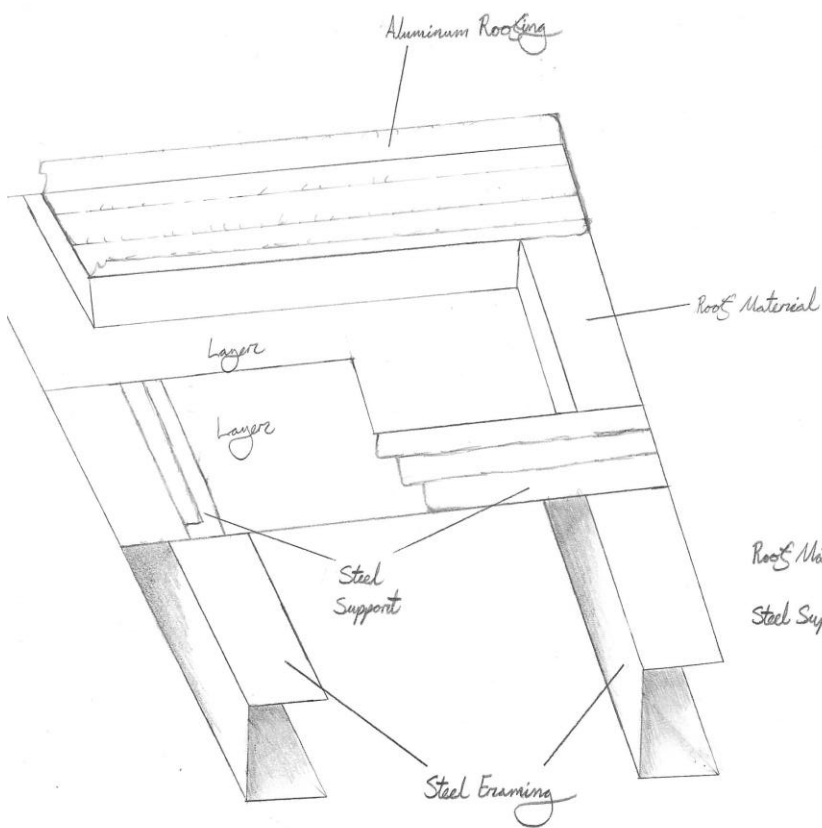
Environmentally Friendly: The aluminum roofing would be made of “95% recycled content” and would be “100% recyclable” (State Farm Learning Center, 3).

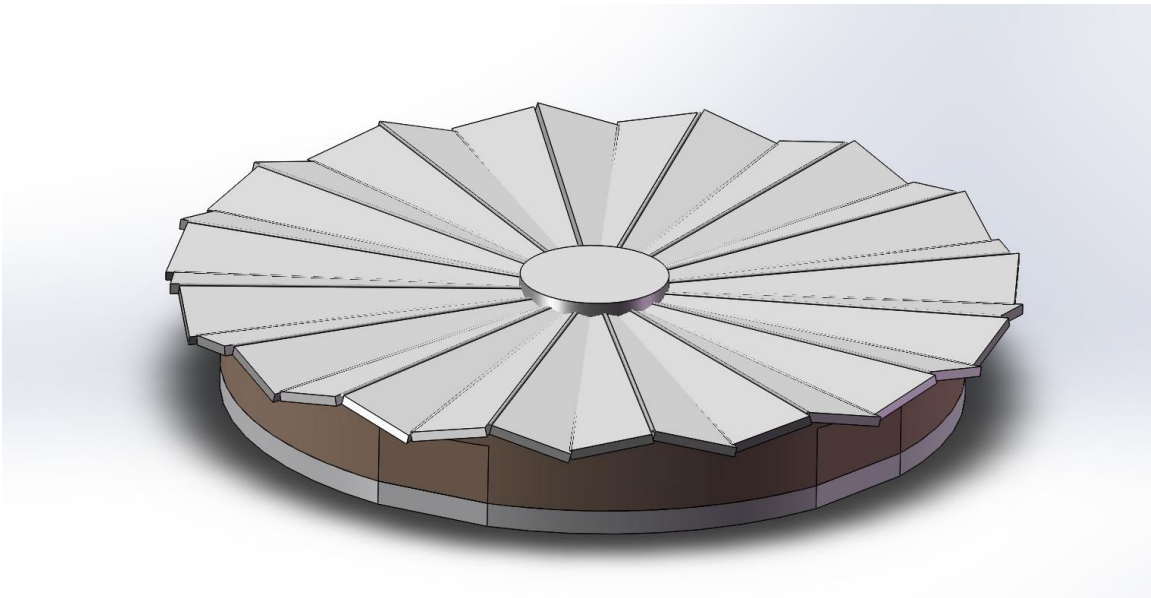
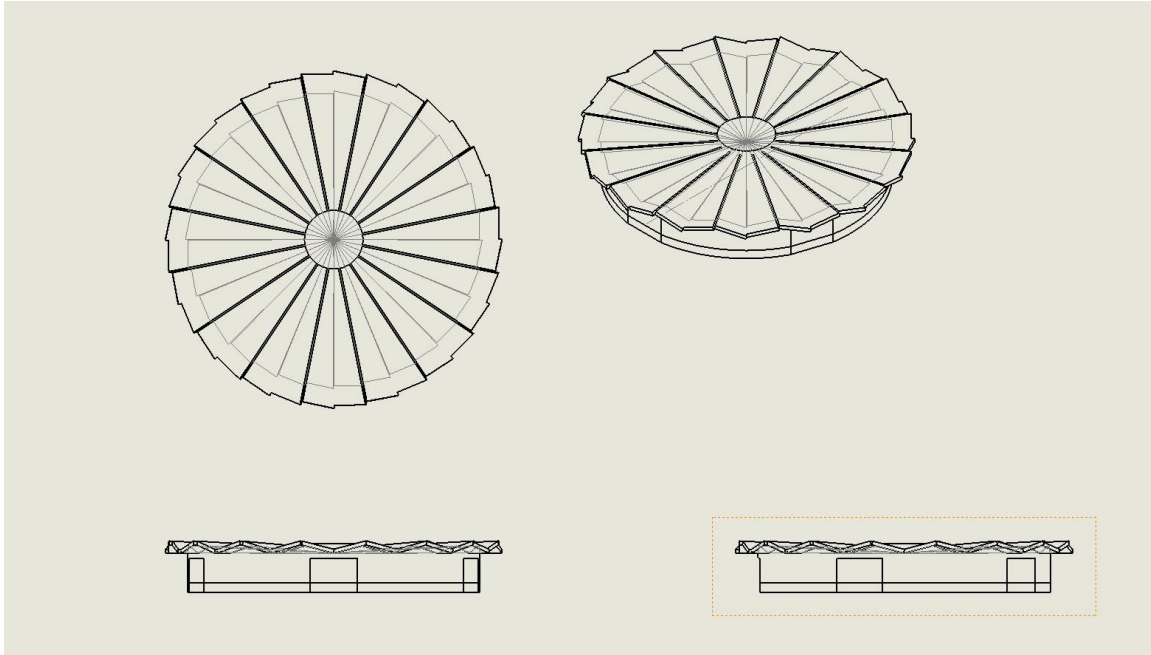
Design

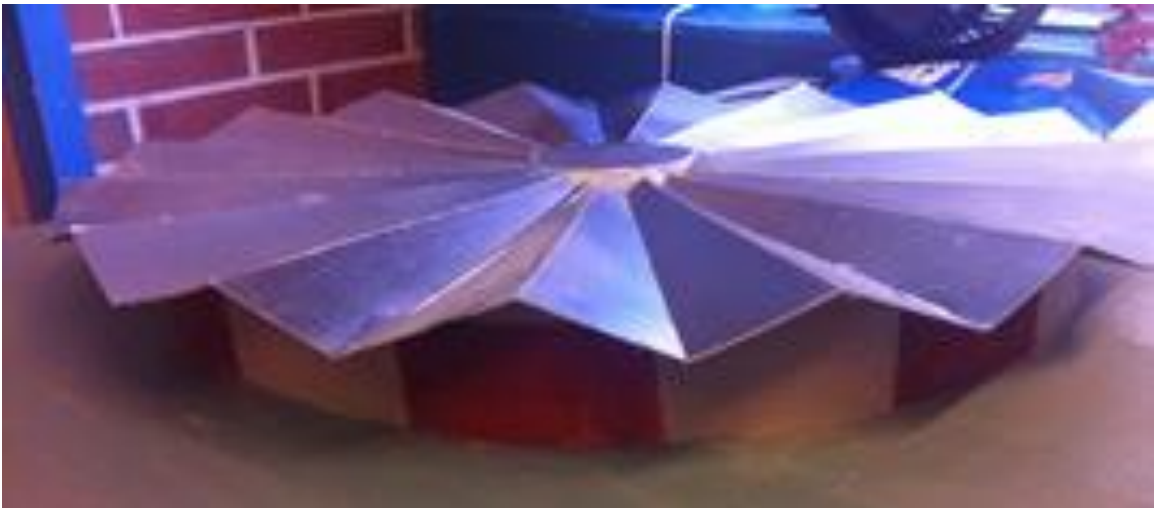
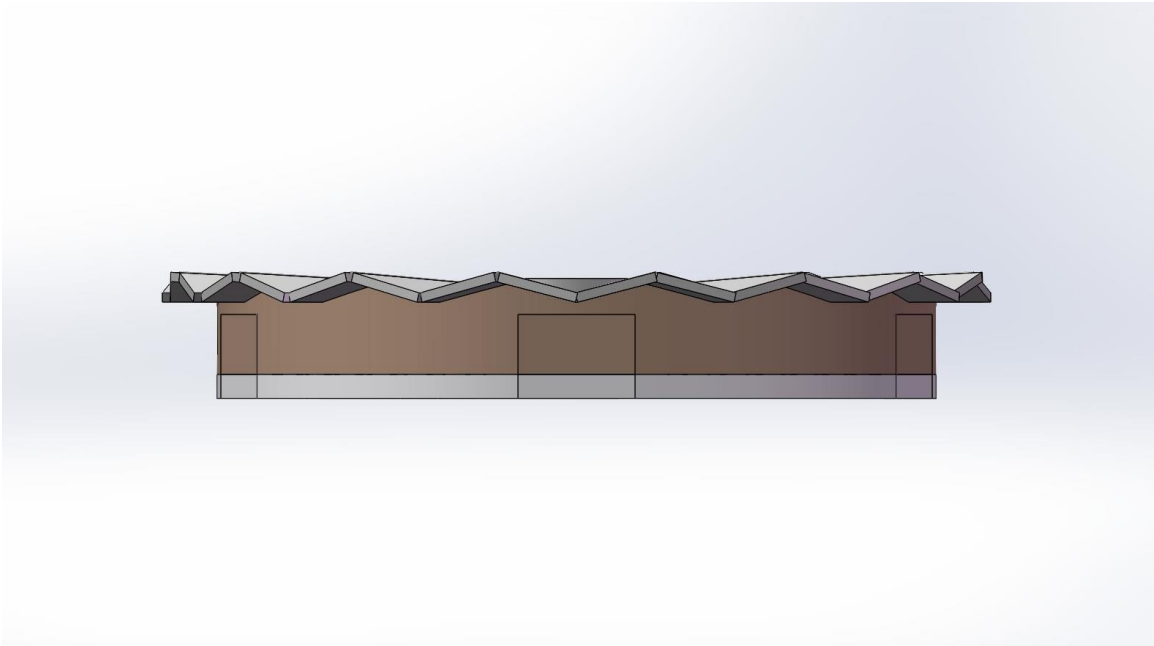
The over all style chosen carefully by our team was the “Standing Seam Style.” The style consist of the roof panels, the key element are the ribs that divides each panel. The ribs are there to let the aluminum expand and recoil after different types of weather. Also if the roofs were slanted with vertical paneling it would be very hard for debris and water to get stuck and cause damage to the roof. The paneling will need the gasket screws to hold the roof firm. Of course these screws will have to be also made of aluminum; when metals are in close contact with each other it's more likely for corrosion to occur.

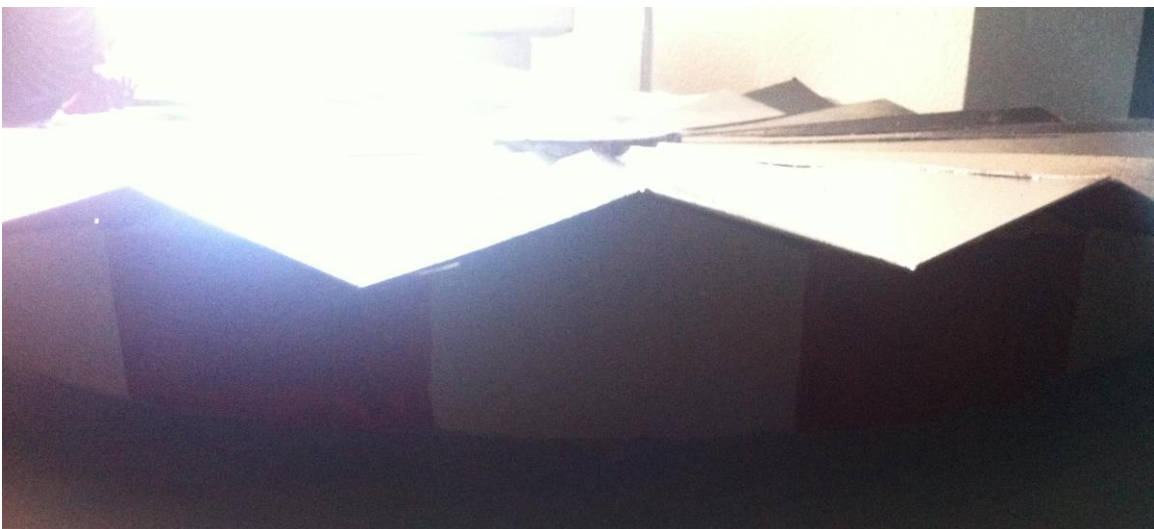
The best way to go for the second most important part, if not the most important part is the coating. Kynar 500 is the best company in the market known for their sustainability and their long lasting products. Their coating process would run by first putting the corrosion resistant primer, then the chemical pretreatment layer, after comes the Galvalume corrosion layer. The aluminum core comes into play, after the Galvalume and the chemical layers are re applied, we have the commercial grade metal primer, and last but not least the Kynar 500 premium paint coating. Kynar has a great reputation amongst the costumers yet they can't help but ask why they can't get better. Our design for each panel is after the Aluminum skin we will insert a non-combustible mineral filled core and then add another layer of aluminum skin. The aluminum skin will of course be thinner then the regular aluminum core but the non-combustible core will give it sturdiness and add at least seven to nine years to the 45-50 years of regular aluminum roofs.

People believe that metal roofs in general have a bad appearance and send a kind of shack look to everything. Unfortunately this perception has slowed down the aluminum roof industry. Many modern and futuristic as well as classic building structures are using aluminum roofs. They are both tasteful and innovative, besides being cost efficient and sustainable.









Total Cost Range

We have supplied a price range for customers who wish to spend the bare minimum, customers who wish to have the average aluminum roofing, and customers who want only the best of the best. Depending on what our customers' budget, the following this provides the details of what they would be spending their money on:

Aluminum Roof Costs zip code 16802 square feet 22802			
	Basic	Better	Best
Aluminum Roof - Material Prices	\$119,711 - \$145,249	\$141,600 - \$170,787	\$167,139 - \$192,677
Aluminum Roof - Installation Cost	\$12,050 - \$19,199	\$18,123 - \$25,068	\$23,838 - \$32,911
Aluminum Roof - Total	\$131,760 - \$164,447	\$159,724 - \$195,855	\$190,977 - \$225,588
Aluminum Roof - Total Average Cost per square foot	\$6.50	\$7.80	\$9.13

Conclusion

Through the use of the 8-step engineering process, we of Team 3 were able to develop an unplanned, basic idea to a detailed, working product. Starting with asking people questions about our idea, leading to a full out analysis of research and information, and ending with a final product, showed that team work and putting in 100% of effort can create wonders for future engineers, like ourselves. During the process, we discovered more strengths and weaknesses as a team and as individuals as this project was the second project working we worked on together. We have a clearer understanding of what real engineers and engineering-teams go through when they have to develop a product. It takes hard work and time to fully develop the product; maybe if we kept working on our product we could fully develop a product with the least amount of flaws. Nevertheless, we enjoyed working together for the last time and now know that being an engineer is not a profession that is just given to you, but a profession that is earned through constant hard work and time.

Works Cited

"Cost of Aluminum Roofing." *Aluminum Roof Costs*. N.p., n.d. Web. 25 Nov. 2013.

<http://www.homewyse.com/costs/cost_of_aluminum_roofing.html>.

"Metal & Copper Roofing Blog." *Pros and Cons of Going Over Existing Roof Material*. N.p., n.d. Web. 10 Nov. 2013.

<<http://www.metalroofnet.com/metal-roofing-blog/bid/85382/Pros-and-Cons-of-Going-Over-Existing-Roof-Material>>.

"The Pros and Cons of Metal Roofs." *State Farm Learning Center*. N.p., n.d. Web. 10 Nov. 2013.

<<http://learningcenter.statefarm.com/residence/maintenance/the-pros-and-cons-of-metal-roofs/>>.

"Architecture House Ideas: Businessaffordable Steel Roof Truss Designroof Truss Drawing." *Architecture House Ideas: Businessaffordable Steel Roof Truss Designroof Truss Drawing*. N.p., n.d. Web. 30 Nov. 2013.

<<http://architecturehouseideas.blogspot.com/2013/02/businessaffordable-steel-roof-truss.html>>.

"Are All Metal Roof Coatings the Same?" *Metal Roof RSS*. N.p., n.d. Web. 16 Nov. 2013. <<http://www.finalroof.com/metal-roof-coatings.html>>.

"Classic Metal Roofing Systems." *ClassicMetalRoofingSystems.com*. N.p., n.d. Web. 25 Nov. 2013.

<<http://www.classicmetalroofingsystems.com/products/standing-seam/specifications/>>.

"Copper & Aluminum." *Zappone.com*. N.p., n.d. Web. 2 Dec. 2013.

<<http://www.zappone.com/>>.

"Metal Roofing: A Lifetime of Beauty and Strength."

InterlockRoofing.com. N.p., n.d. Web. 5 Dec. 2013.

<<http://www.interlockroofing.com/>>.

"Aluminum Lock Roofing Inc." *AluminumLockRoofing.com*. N.p., n.d.

Web. 5 Dec. 2013. <<http://www.aluminumlockroofing.com/>>.