THE IMPORTANCE OF OUTDOOR SEATING IN UNIVERSITY ENVIRONMENTS: PUBLIC SEATING PROPOSAL

By

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Abstract

Universities should support students' choices for the availability of appropriate outdoor learning environments. The goal of this project is to create a plan for the improvement of outdoor seating in educational settings at Appalachian State University (ASU). The design of this outdoor installation focuses on providing students with a choice of convenient, spacious, and accesible outdoor seating centrally located on campus. The use of 3D modeling, material research, price estimation, and the practical use of campus areas for outdoor seating were combined to reach the final design. This proposal aims to improve convenient accessibility to outdoor studying areas, increase student involvement in campus projects, and merge design and sustainability through outdoor seating. The design is delivered in the form of several documents including an argumentative explanation for the proposal, orthographic drawings, renderings, expense estimates, full bill of materials, and plan of action for renewable energy resources used for the installation.

Keywords

Outdoor learning, public spaces, outdoor seating proposal, open campus plan, university-community relationship, university social responsibility.

Introduction

As of fall 2021, ASU houses a total of 20,641 students and has increased the number of students accepted each year. Shifting toward a growing student population in a college town has introduced the importance of space available on campus, specifically for studying areas. Most of the available public studying areas include the Belk Library facilities, the Plemmons Student Union, and some exterior outdoor benches that have been installed separately. Belk Library currently holds a total of 430 seats, 144 tables, and 3 outdoor benches as studying areas. The Student Union holds a total of 1491 seats and 7 outdoor tables in total which includes spaces for group studying rooms, classrooms, and soft seating. A combination of 9 wooden benches has been spread out around campus and 4 special solar tables installed by Renewable Energy Initiatives (REI) outside of Peacock Hall.

Numbers show that the current outdoor seating availability on ASU is not big enough to accommodate the number of students the school is currently receiving. In return, such a situation causes a high influx of students in the areas previously mentioned. Since 2015, in the approach of improving the current campus facilities and expanding, ASU has developed a ten-year master plan that has worked as a framework to ensure evolution and progress as the campus expands. The plan emphasizes design standards and guidelines, which should provide architectural, open space, street, and utility criteria for future projects to help create a unified campus that adheres to campus vision. In order to include local and student perspectives in the master plan, ASU held a listening sessions which raised several concerns about more student support services, such as more study spaces and group work areas (Appalachian p.17). Participants also mentioned the need for a campus environment that reflects the values of ASU and creates a visually cohesive experience through the design of the building and outdoor spaces, as well as improvements in gathering areas such as Sanford Mall (Appalachian p.18). The open sessions allowed locals and students to push for representation from both parties, specifically for the focus on student-centered initiatives. In response to student demands, this project aims to emphasize the importance of preference in outdoor learning environments, create higher accessibility by socializing public outdoor campus spaces, and represent student involvement on school grounds.

1.0 Outdoor Education

Nowadays an outdoor learning environment is considered by many an important component in our society. For example, during the reopening of spaces during the Covid pandemic in 2020, outdoor environments opened doors for safe, shared areas, which have been highly important to normalize new health care guidelines. Aside from the impact outdoor education has had on current educational approaches during the pandemic, anecdotal evidence and formal research suggest the importance of the health and wellbeing benefits of having a connection to nature. There are not many written studies on outdoor learning, but there are a few that highlight the importance of its practice. As mentioned in a journal written by Jeff Mann, a good example of a society that follows the concept of “Udeskole” (outdoor education) is

Denmark. Denmark is recognized as a world leader in outdoor learning, and in recent national Teachout Pilot research, evidence shows that outdoor learning benefits primary school students´ physical activity, motivation for school, pro-social behavior, and even reading performance (Mann). According to C.R. Otte, improved performance in academics is linked to influences of cognitive abilities and therefore academic learning by providing intuitive and meaningful learning contacts that may improve memory and conceptual understanding (Otte). This explains the reason why certain academic-related activities like reading are improved when using cognitive activities outdoors.

Similar to the educational spaces in primary education, a well- designed campus needs a balanced interrelation between creative experiences and the built environment, which creates a space for an innovative environment and a choice for accessing outdoor spaces. Such important outdoor studying areas are often overlooked, disregarding the potential they have to bring people together or create new spaces for those who are looking for a better studying experience. Innovative Learning Environments (ILE) provide an opportunity for growth in the educational field. According to Neda Afshar, ILE focuses on indoor classroom design, but little attention has been given to the usage and design of the school grounds; outdoor areas have not noticeably changed. Although open air schools were booming during that period of time, specifically in Europe, criticism started gradually in the 1930s. Some factors highlight the inadequacy of outdoor learning spaces to its surrounding weather during wintertime specifically, the priority of cost-effectiveness and use of energy. Since then external spaces have been designed, protected, and linked to the schools´s interiors to allow outdoor accessibility when desired by the user (Afshar). Although the weather will always be a factor, the benefits that outdoor education brings to educational spaces enables campuses and schools to increase accessibility to outdoor spaces from closed buildings. One good example of it is the Summit Trail Solarium in Appalachian State University.

Allowing students to have a choice of accessibility for outdoor studying areas is essential. What makes this decision more crucial is the positioning and the design of that specific outdoor

seating. The seating has to allow students to have accessibility to the resources needed to adjust the space to their needs. For example, having accessibility to an outlet to connect one's computer while studying is a needed resource when finding a studying area. If an outlet is not near the student, the student will have to move off the space to connect their computer somewhere else. In an article by Zhonghua Gou et al. they believe the design of a learning environment has a significant impact on students´ attitudes, behaviors, and achievements. A successful learning environment should attract and encourage students to stay. In order to accomplish this, seat preference is one of the important performance criteria for research that seeks to understand suitably designed learning environments (Gou et al.).

Aside from the resources needed to make a space suitable as a learning environment, there is also an interconnection between the resources and their surrounding environment. For example, according to an article written by J.E. Dyment, outdoor learning on school grounds can be valuable for stimulating and encouraging students who are not very interested in learning in enclosed classrooms. Dyment argued that education is also improved because green school grounds deliver infinite opportunities for students to understand the interconnections between their environment and their education (Dyment). A seat preference survey, view elements, and occupancy rate measurements were conducted in a university library building in Gold Coast, Australia. This study found that specifically sky views and shading views were found positively related to occupancy rate. Based on this point, open views with appropriate shading were found as an optimal outdoor view composition. "The singularity of greenery views would less likely be attractive to building occupants" (Gou et al.).

1.1 Socializing Public Campus Spaces Through Outdoor Seating

On campus public open spaces provide many functions and substantial benefits which meet the students´outdoor needs. Public spaces enables social interaction by simply occupying the same space as others. We can see outdoor seating as public furniture spaces; these are as important as libraries and public cafeterias. According to Kelsey Sagrero, these public spaces could "potentially minimize polarization between beliefs by encouraging people to inhabit the

same space as someone that is other than them" (Sagrero 6). Big spaces on ASU´s campus, like Sanford Mall, are an example of a large centralized spaces that are occupied by both locals and the student population. These outdoor spaces are considered ideal and natural places for socializing public campus areas. Jan Gehl suggests that by meeting other people in public open spaces and through socialization, people gain information of the social world around them and of people by observing how others do work, behave, and dress. Through this information, people develop stronger ties with the surrounding world (Gehl).

Aside from having a space for studying, outdoor seating could also be a place where you meet new people or just simply get inspired by others that are sharing the same place as you. Past studies have identified positive associations between creativity and wellbeing, suggesting that public spaces that afford social interactions and social capital are associated with improved social wellbeing (Zordan). Outdoor learning has been proven to foster communication, reasoning, and interaction abilities whilst also enhancing 21st-century skills such as resilience, collaboration, conflict resolution, and self-regulation. Additional benefits attributed to participation in outdoor learning include building a sense of identity, analytical skills, life ownership, stress relief, and increasing social cohesion (Mann).

One of the main reasons why Sanford Mall is populated most of the time and is considered the central area of campus is due to its wide space to perform different activities while sharing the same space. While in Sanford Mall, one can always see people playing sports, studying, praying, and promoting campus organizations. Public open spaces are successful when they become a conducive place for social interaction. Such interactions may include individual or group activities that are either informal or suitable for recreation and accessible for all classes and ages, including disabled people and outsiders (Whyte; Rivlin; Project for Public Space; Nasution). Therefore, creating public open spaces with high levels of use that provide vitality with various activities and different user groups is necessary and crucial (Mumcu).

Another important factor, is the need for spatial attributes that can foster social activities, such as having a bench in a park or having an outdoor table to sit at outside while having

lunch. In recent years various studies which aimed to determine the design criteria of public open spaces, and their spatial attributes were conducted. The results showed that spatial attributes of successful and unsuccessful public spaces and the relations of their users to their surroundings were correlated. There is indeed a relationship between socialization and stationary activities and passive engagement with public open spaces. For the vitality of public open spaces, spatial attributes that afford standing, sitting, and leaning pave the way for social activities such as conversation, people watching, enjoying a street show with other people, etc. are important. For this reason, spatial attributes which provide opportunities for sitting and leaning are cited frequently in the studies (Mumcu).

1.2 Student Intervention on Campus Projects

In recent years, university community engagement has been implemented by many universities around the globe due to the increased importance students have given to citizen participation. According to the Carnegie Foundation, community engagement describes the collaboration between institutions of higher education and their larger communities, which enables the mutually beneficial exchange of knowledge and resources in a context of partnership and reciprocity (Driscoll 6). Activities such as service-based learning and participatory research are receiving more attention from various stakeholders such as policymakers, academics, and authorities (Grau et al.). For example, the Spanish Association for Service-Learning (Red APS), which promotes such practices, defines service learning as an educational model that combines theoretical learning with service to the community all in one project. By means of organized activities, the students use their knowledge to solve problems in an authentic situation, thus transforming and improving the real world. Students are asked to find a solution to a problem the client (community) has by developing a project, so that ultimately they both benefit from the experience (Red; Kim). Also, service learning offers an excellent opportunity to practice interpersonal skills. It improves work skills for effective 21st century job performance, such as public speaking, communication, listening, teamwork, time management, etc. (McNatt; Sumarmi).

The original plan of action to develop this outdoor seating´s project is to allow the stu-

dent community to take over the construction of the public outdoor seating´s design to provide a learning experience from it as well as a cheaper initiative for construction. Community organizations, organized by campus, benefit from the extra help they receive through students participating in service-based learning through enabling higher access to campus resources, increased relationship building capacity, improved local visibility, and participation in neighborhood planning (Blouin et al.; Klein et al.). The involvement of the student community on school grounds is crucial on every college campus. Various student led projects on ASU´s campus have led to major growth of professionalism in the students´ area while applying what they have learned in school on a higher scale. In between several influential projects on campus are for example the wind turbine in Broyhill at Appalachian state University (figure 1).

Figure 1. Broyhill Wind Turbine (REI and NRLP).

The installation of the wind turbine was carried out by REI and New River Light and Power to install a Northern Power Systems Northwind 100 wind generator. REI allocated $319,800 and NRLP provided the remaining $213,200 for its installation. The turbine is currently one of North Carolina's largest and is estimated to produce up to 147,000 kWh annually, off-setting 200 metric tons of carbon dioxide (Johnson).

ASU currently houses organizations that promote the development of student ideas on campus. For example, Renewable Energy Initiative (REI) and Student Government Association (SGA) which currently voice student opinions to higher sectors inside the university. Another example of this is Appalachian State University´s Solar Vehicle Team (SVT), Sunergy (figure2). SVT is currently a multi-disciplinary, student-led, and student-driven research project. With the help of advisors, students in the team research the most advanced technology and utilize solar-powered car competitions as a platform to advance sustainable transportation technologies. SVT started as an afternoon class led by a graduate student, Dan Blakely, who was passionate about this field. Dan brought on board other students that were passionate about the automotive world and its correlation to renewable technologies. SVT now has several accomplishments from its beginnings back in 2012.

Figure 2. American Solar Challenge 2021, Solar Vehicle team working on battery pack before the race starts in Topeka, Kansas.

Similar to SVT, this outdoor seating design proposal hopes to introduce interest in the development of outdoor seating among the student community. ASU currently offers classes in the Applied Arts department that develop skill sets needed in the construction of outdoor seating, such as Computer Numerical Control (CNC), woodworking, metalworking, and welding. With this in mind, students could give input to the proposed idea and independently build upon it with the support of different departments, which have the resources and advisors to further improve, and build the proposed idea.

2.0 Baseline and Proposal Intervention

2.1 Campus Design and Construction Approach

During the beginning of the Covid-19 pandemic, the design concept of outdoor seating developed while engaging with a quiet and lonely ASU campus. In the process of investigation, reflection, and sketching several approaches of design came through. The initial inspiration came from walking around campus and interacting with the current open social areas that the campus had available at the time. As every other facility was closed, the few students that were still on campus and locals gathered around Sanford Mall (figure 3)

Figure 3. Sanford Mall at Appalachian state.

Sanford Mall is a green, open area around 150 meters long and 50 meters wide. As the selected location for students, tour guides, and locals, Sanford Mall is considered the heart of campus. According to Boone´s local newspaper Appalachian Today, in Sanford Mall "you'll see everything from professors holding class outdoors to students studying, slack-lining, hammocking, throwing a Frisbee and pitching that perfect snowball when the weather is just right" (Today). Inspiration from Sanford Mall led to the development of different concepts of possible outdoor seating structures.

Sanford Mall is already surrounded by several concrete rock walls that stand alone as a feature of a building. In order to not disturb an existing green environment in Sanford Mall, the initial design focused on using the existing structures that could be enhanced or renovated to reduce the amount of material needed for the construction of outdoor seating. Specifically, the project focused on using one of the 8 concrete rock walls in front of Anne Belk Hall. These stone walls have been in place since before 1969 when Belk library used to be located where Anne Belk Hall is currently located, in which you can see these locations as in figure 4. As of today, they have been maintained by the Planning, Design, and Construction department of ASU.

2.2 Ideation

A central area on campus could provide students, visitors, and locals with access to outdoor seating on Sanford Mall. Several iterations from sketches to 3D models were developed using Rhino 3D Software to understand the dimensions of the space and the surroundings of the structure to create an accessible place for users. Taking into account the opinion of students during the open sessions of ASU´s Master Plan, the initial sketches and brainstorming of the design focused on a structure that represented ASU´s logo structure. This is done through the use of old and renovated structures from campus as well as ASU´s logo letters surrounding the stone wall. There are a total of 8 stone walls (figure 4) which had enough surface area for a possible installation. After discussing maintenance and spacing with the Planning, Design, and Construction department only two of them were selected due to better surface area and physical state. The site plan below highlights the different areas surrounding the stone walls that were crucial when

Figure 4. Plan site of the North side of Sanford Mall. Plan site highlights the crucial areas that were taken into consideration when developing the first concepts of the design.

deciding the dimensions of the structure that surrounds each side of the wall.

The initial three 3D models (figure 5) focused on abstract concepts of ASU´s logo that could accommodate the user in different positions and create a space to discover different ways in which to sit. The stone walls selected have an angle of 30 degrees which makes the structural letters stand out and create a natural reclining aspect adding comfort when seating. The first concepts helped understand the required dimensions needed in between each letter to create enough separation between letters to move around easily. The initial concepts developed were too abstract and too wide to provide enough space for the user to sit one next to another. Some letters required too much material due to their complex shape and did not match with the initial abstract visualization of the letters. Further improvements were made to approach a better engineered concept that focused on making the letters thinner to attach them to the stone wall and in its structure more efficiently.

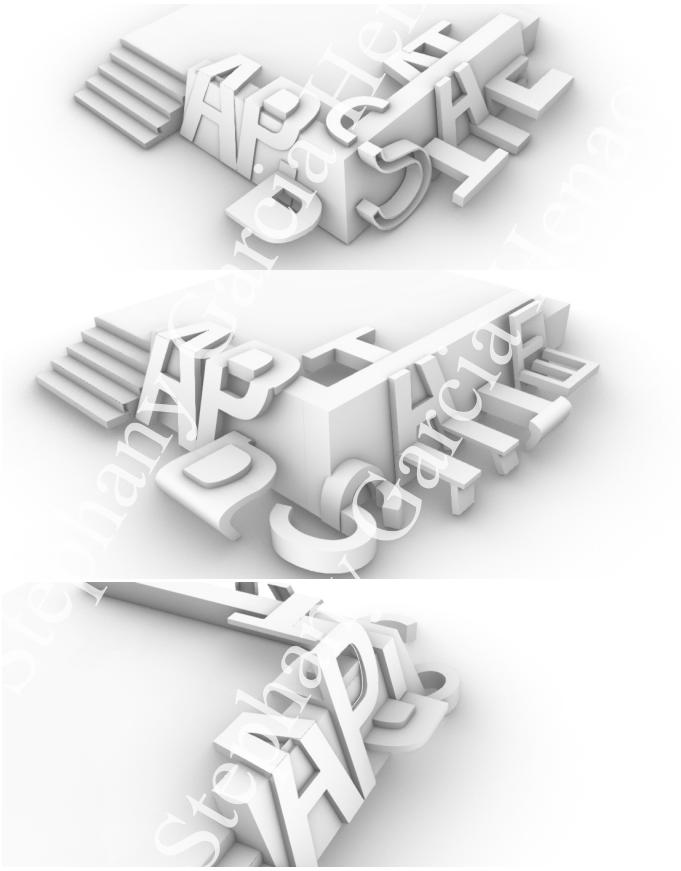
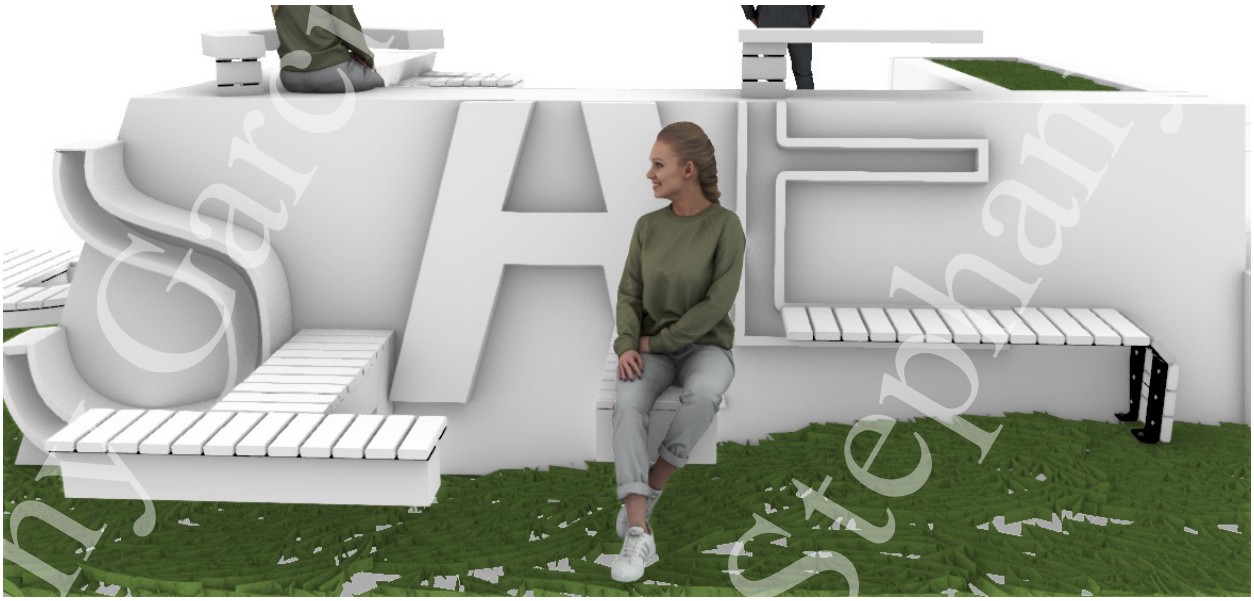


Figure 5. Rhino Software iterations.

2.3 Material and Building Engineering

After getting feedback from sophomore Industrial Design students and teachers from the Industrial Design Department, further improvements from the initial iterations were made. The pre-final concept (figure 6) focused on opening more space for the user to move around the structure, providing an opportunity to experience a visual and functional (seating) experience, this was achieved by adding tables on certain parts of the letters. In contrast to the initial concepts, the letters would no longer entirely surround the wall due to the irregular shapes of rocks at the top of the stone wall. This would not have allowed for an aligned installation of the material of the letters. Through the different iterations, advisors and those who gave feedback on the design specified how the use of selected metal, aluminum, in every section of the letters could increase the price of the construction due to complex shapes and connections that needed to be welded. The pre-final design focused on reducing welded connections through the addition of more wooden slabs in between the sheets of aluminum, which would allow for easier assembly and cheaper cost of installation.



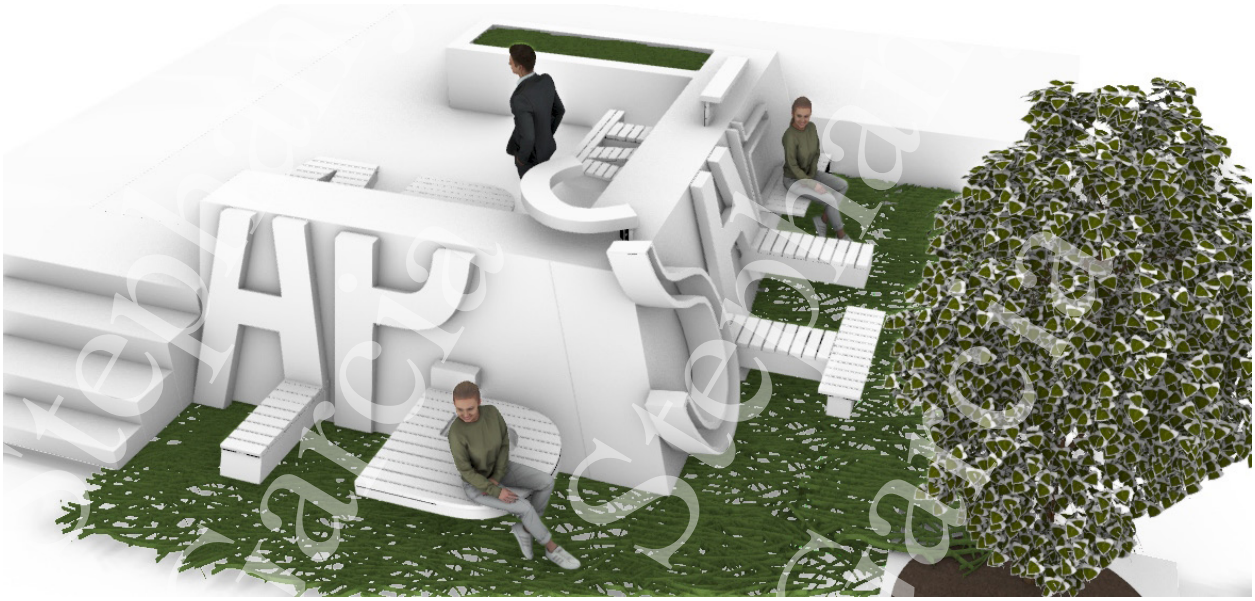


Figure 6. The first revised pre-final iteration presented with joinery methods for different materials.

When deciding material choices for the project, several options were researched to increase durability of structure while maintaining a smart budget. Aluminum was selected, in order to have a reliable and lightweight easy-to-transport material. The structural 6061 aluminum sheets had specific mechanical properties, such as corrosion resistance, making them ideal for a wide range of applications. Also suitable for applications such as building products, electrical products, piping, and recreational products.

In order to extend the life of the aluminum letters, Brazilian Walnut (IPE) wood was considered. Due to the fact that metal changes its surface temperature due to the outside weather, aluminum was combined in assembly with Brazilian Walnut (IPE) wood slabs to form the shape of the letters to provide seating comfort. This makes it easier for people to sit during hot or cold weather. According to the fact sheet on Advantage Lumber´s website, IPE offers the possibility to provide strength, density when assembling it with metal and screws, and is a less porous wood for extra durability for outdoor settings. These attributes make IPE the leader in external decking, siding, and furniture applications. IPE is dark brown-to-green wood. Its lifetime is approximately 75 years with minimal maintenance and it is highly resistant to rot, mold, and insects. This

wood has straight grain patterns, but it is difficult to work with. Pre-drilling is required prior to screwing anything, and IPE does not glue particularly well. Finishing to a smooth touch is easily achievable since it has very small pores (wood slabs).

In order to provide structural support, IPE is inserted in between aluminum sheets (¼ thick). This construction reduces the need for extra aluminum sheets on the sides of the letters and an easy assembly of the outdoor seating once the 6061 aluminum sheets are cut to size. More ¼" thick sheets are added throughout the bottom of the wooden panels to provide structural support. Different techniques of joinery were examined to construct the cheapest and most efficient way of assembling whenever working on site of construction. Bolted connections (figure 7) were the most accessible and cheapest method to join wood to the metal. To add extra support to the aluminum sheets under the wood, there are welded tube supports (figure 8) that are held in place to the stone wall by concrete wedge anchors.

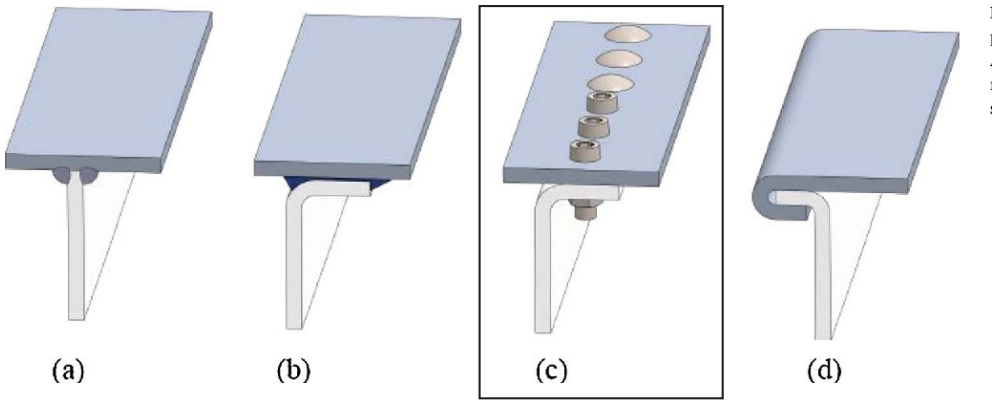


Figure 7. Joining structure and methods for wood to metal and metal to metal. Two-stage joining of sheets perpendicular to one another by sheet-bulk forming C (Silva).

According to product description by concrete fasteners´s website, a wedge anchor is a mechanical expansion anchor that consists of four parts: the threaded anchor body, the expansion clip, a nut, and a washer. It is designed for use in solid concrete only. These anchors provide the highest and most consistent holding values of any mechanical type expansion anchor (concrete). In the proposed design the concrete wedge anchors should be installed when placing an aluminum plate welded to the support tube. Welded tube plates will then attach to have a connection between the wall and the aluminum sheet. A total of 160 concrete wedge anchors are needed to install the welded plate to the concrete walls. To install the concrete wedge anchors to the stone wall, sections of the wall would have to be pre-drilled or modified to pour the concrete needed to hold the wedge plate in place.

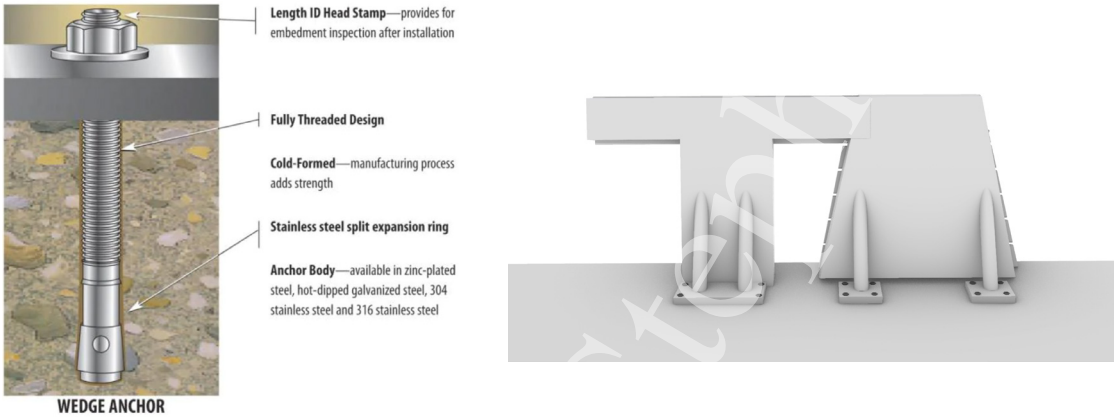
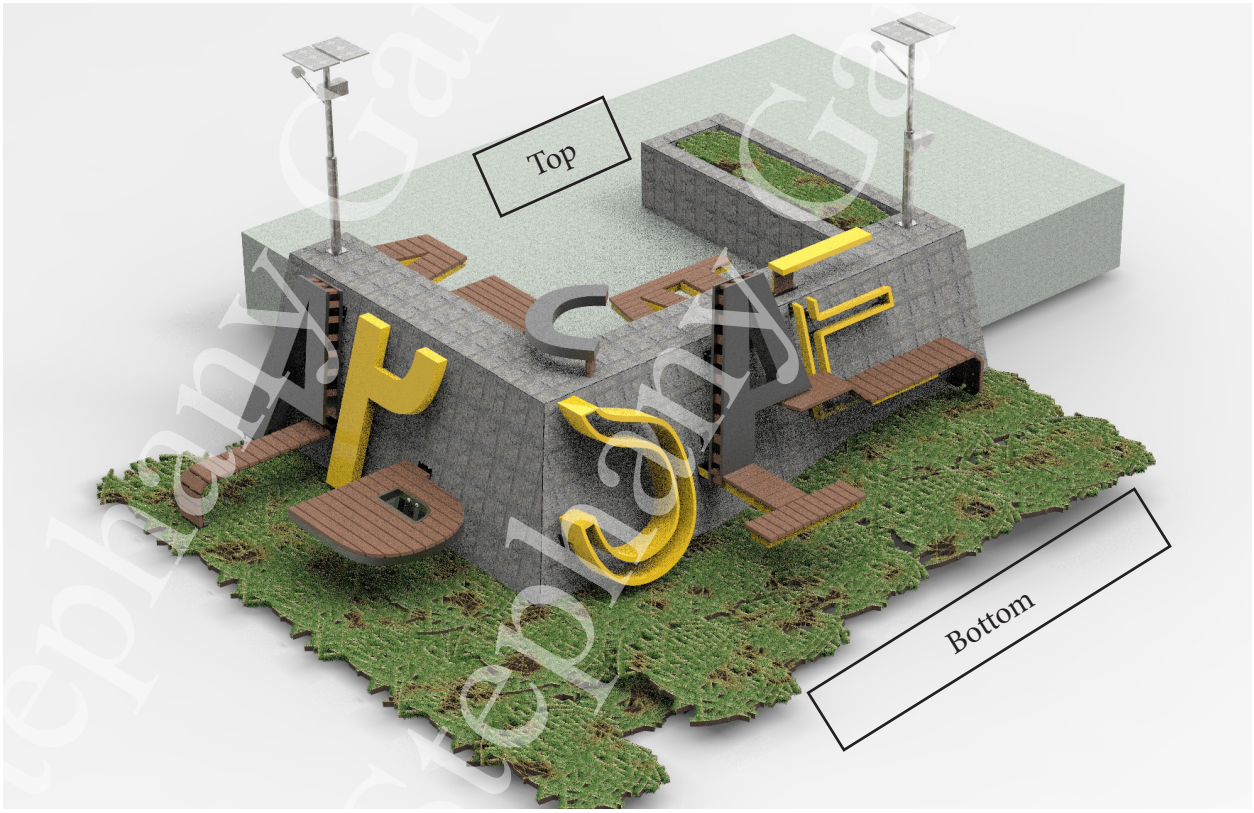


Figure 8. Concrete wedge anchor mechanism to join aluminum sheet to the stone wall. 3/8 in. x 3-3/4 in. Concrete Wedge Anchor (15-Pack) (Home Depot).

2.4 Final Design

Concept development of the final design proposal (Figure 9) combined the material and joining research done as well as additional ways in which the installation could have better usability features. One of the added features of the final concept focused on further developing the aesthetics of the installation through the choice of colors that adhered to the material properties as well as colors that represented campus. Yellow and black were selected as they fit well with campus colors and reduce the heat collected on some metallic surfaces of the letters, specifically the letters that are painted yellow. In order to add color to the aluminum, the process of powder coating (PC) finishing was ideal. According to product description of Teak´s website, PC provides a lightweight, corrosion-resistant, and durable uniform coating that protects the aluminum from weather conditions. PC is a polyester-based coating that uses uniformly sized micro-beads of polyester, electrostatic-ally charged to adhere to the base material. As the PC is charged and then baked/cured onto the base of the material, PC it does not flake or peel like paint or epoxy (teak).




Bottom Right
Right
Left
Top View (Right/Left)
Stephany Garcia

Bottom Right

Bottom Left

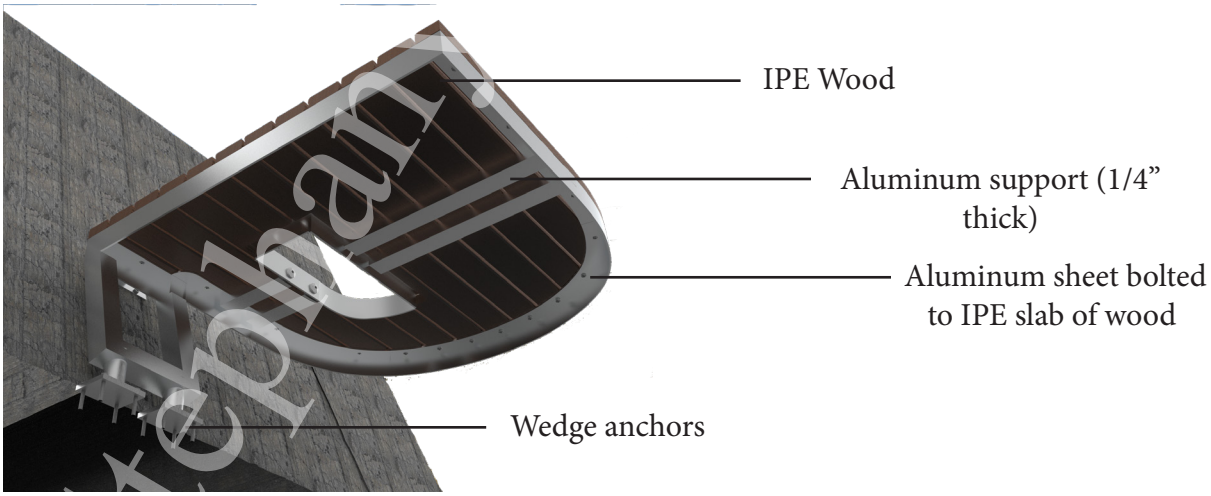


Figure 9. Final proposed design.

2.5 Sustainability and Design

In order to increase the usability of this space as outdoor seating for students, consideration of outdoor outlets was integrated into the design. This led to a partnership with student organizations that supported the initial idea of outdoor seating. Renewable Energy Initiative (REI), which is an organization that promotes sustainability on campus through student-led projects, joined the process of development. Students, Aaron Berry and Nick Crow utilized a Solar Pathfinder (figure 10) to identify areas around the Anne Belk stonewall that receive enough radiation for optimum solar panel installation.

Figure 10. REI students placing the solar pathfinder due North to trace the shading on the dome.

Tracing of the panoramic view not affected by shade throughout the year which helps find the Potential Solar radiation to find the percentage of radiation for each month.

The Solar Pathfinder allows the user to identify a panoramic view of the entire site through a highly polished, transparent, convex plastic dome. All the trees, buildings, or other obstacles to the sun are plainly visible as reflections on the surface of the dome. The sun path diagram can be seen through the transparent dome at the same time. As shown by Figure 10, the non-shaded open areas receive enough solar time throughout the year. The Solar Pathfinder helped determine the possible location of the solar panels in correlation to the surroundings that could create possible shading and affect the solar radiation. In the graph below, we can notice a diagram that shows the percentage per month translated from the solar tracing on the solar path from locations 1 and 2. As noticed, location 1 has very minimal exposure to shading and could further increase its percentages if the solar panel is held on a stand-up structure away from the ground. Location 2 is very close to the main big tree and is therefore not an ideal location for the placement of the solar panel. In location 2, the solar pathfinder shows that the solar radiation per month does not increase past 62% due to the shading of the tree that covers most of the sun that will be visible during the day. One solution for this was to create a structure around the existing street light on the second location so that the solar panel could attach to it at a higher height where the shading of the tree is not as disruptive. This led to the identification of different ways in which solar panels could connect directly to the outdoor seating.

Radiation % per Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	84%	60%	58%	84%	100 %	100 %	100 %	76%	58%	57%	60%	63%
2	58%	50%	51%	58%	60%	61%	60%	62%	59%	52%	58%	58%

Figure 11. Solar Power-Dok on ASU´s campus Peacock Hall.

Inspiration from the current solar tables installed in Peacock Hall led to understanding how both seating and solar energy could be incorporated into one another in an innovative way. The “Solar Power-Dok " (figure 11), offers exciting features, such as four 110 VAC power outlets, 4 USB power outlets, 4 Qi wireless charging spots, and automatic ambient LED lighting at night which led to a completely self-sustaining outdoor seating. In order to solve the lack of access to outdoor outlets on Sanford mall, specifically in the green area, the outdoor project integrated an additional proposal that could integrate solar panels that are connected to outdoor outlets on three tables that are placed in the final design. The idea is to have 200-watt panels that could be placed to the right sun exposure and then wired specifically to the tables.

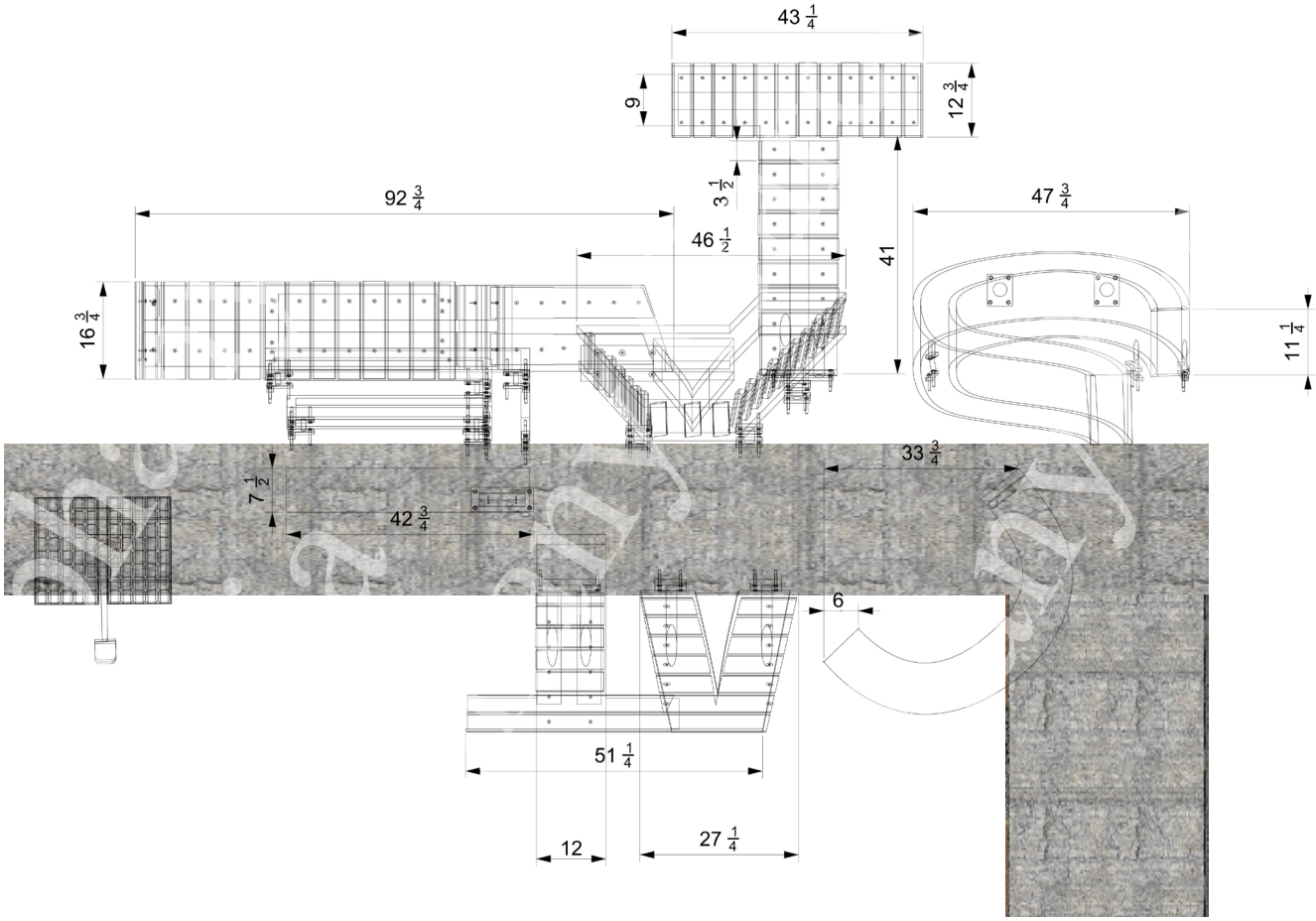
Through the research, an initial plan of action for the design of solar installation was developed. The design integrated an installation of two 200 watt solar panels, of an estimated cost of $130-260 USD, that stand on the right and left side corner of the stone wall. The solar panels would store their energy in a 100 amp-hour 12-volt Li-ion phosphate battery or on a two 100 amp-hour lead-acid battery as a cheaper option. In order to alternate from DC to AC current, a 750-watt inverter is needed, as well as a 20 amp charge controller to convert a higher voltage DC output from solar panels down to the lower voltage needed to charge batteries. In order to con-

nect everything in between, the estimated cost of branch connectors, cable entries, wires, crimp connectors, and fuses will be around $140 USD. A more detailed design of the system needs to be developed to power at least 2 computers and 1 phone.

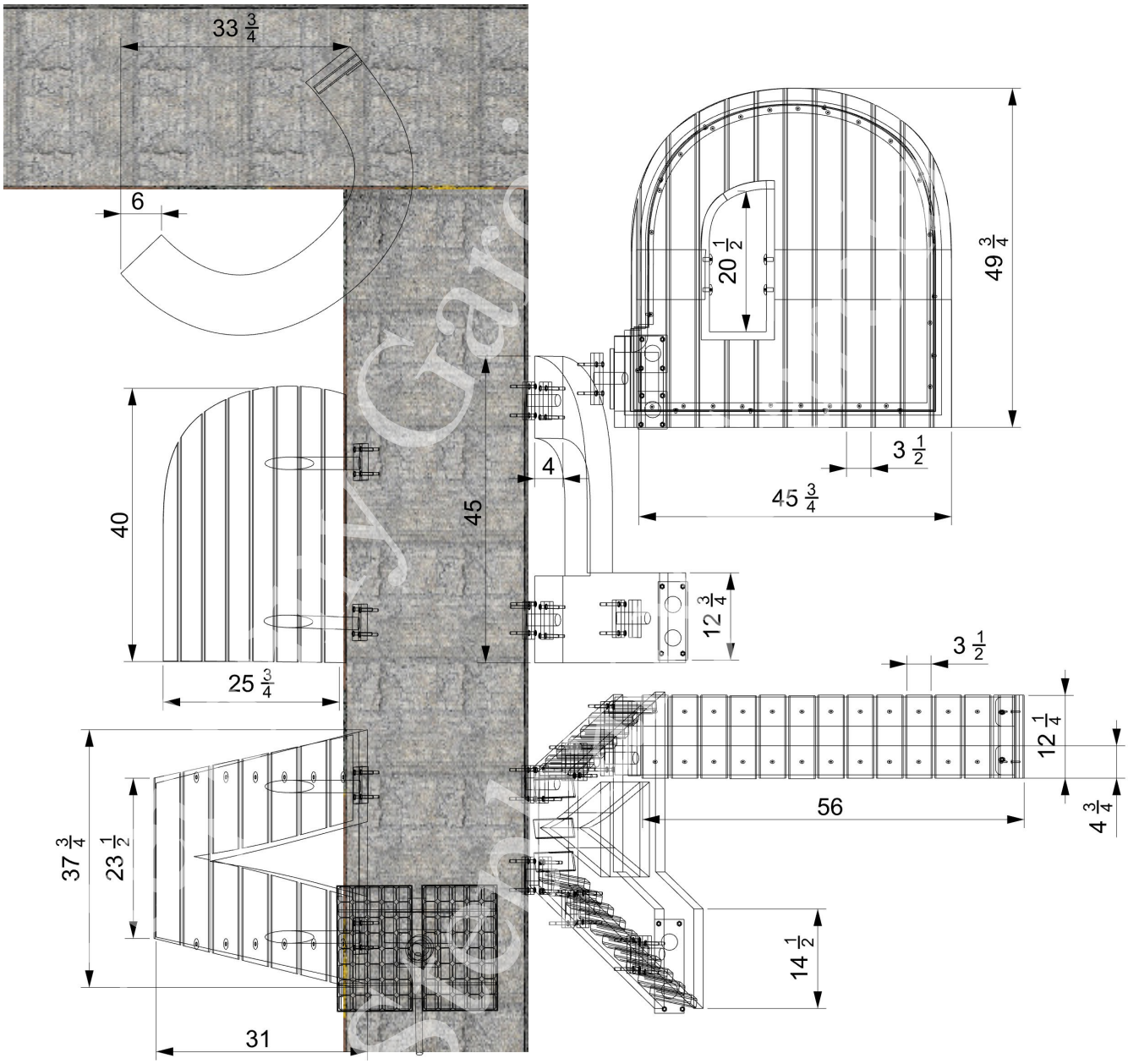
3.0 Orthographic, Materials, and Pricing

3.1 Orthographic (Inches- Fraction)

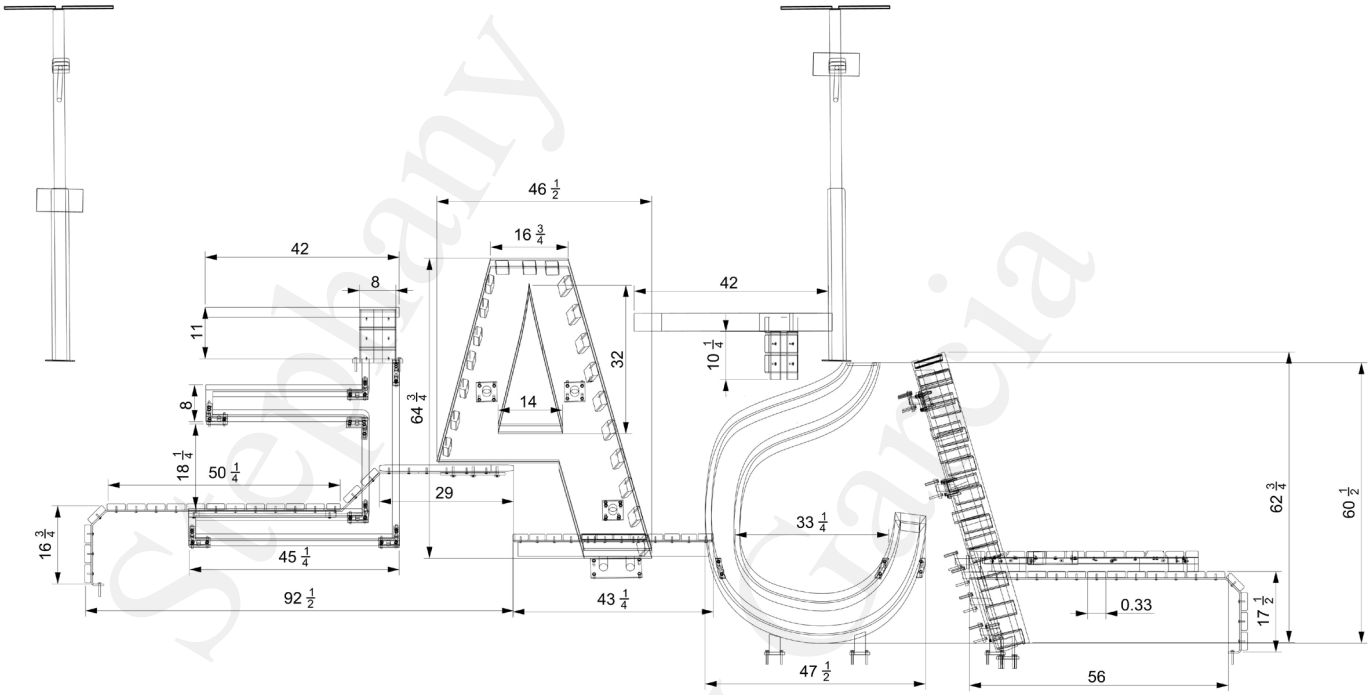
Top View of Right Side of Concrete Wall



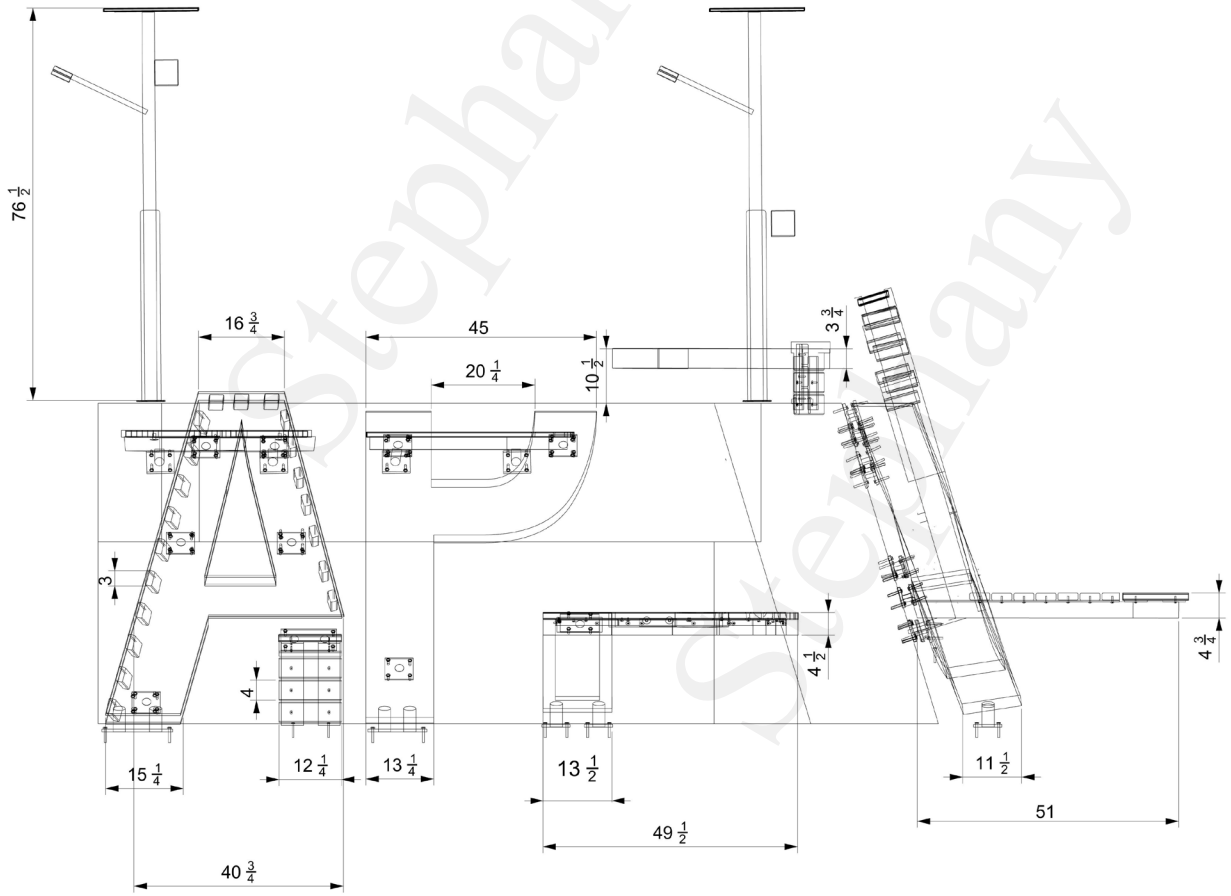
Top View of Left Side of Concrete Wall

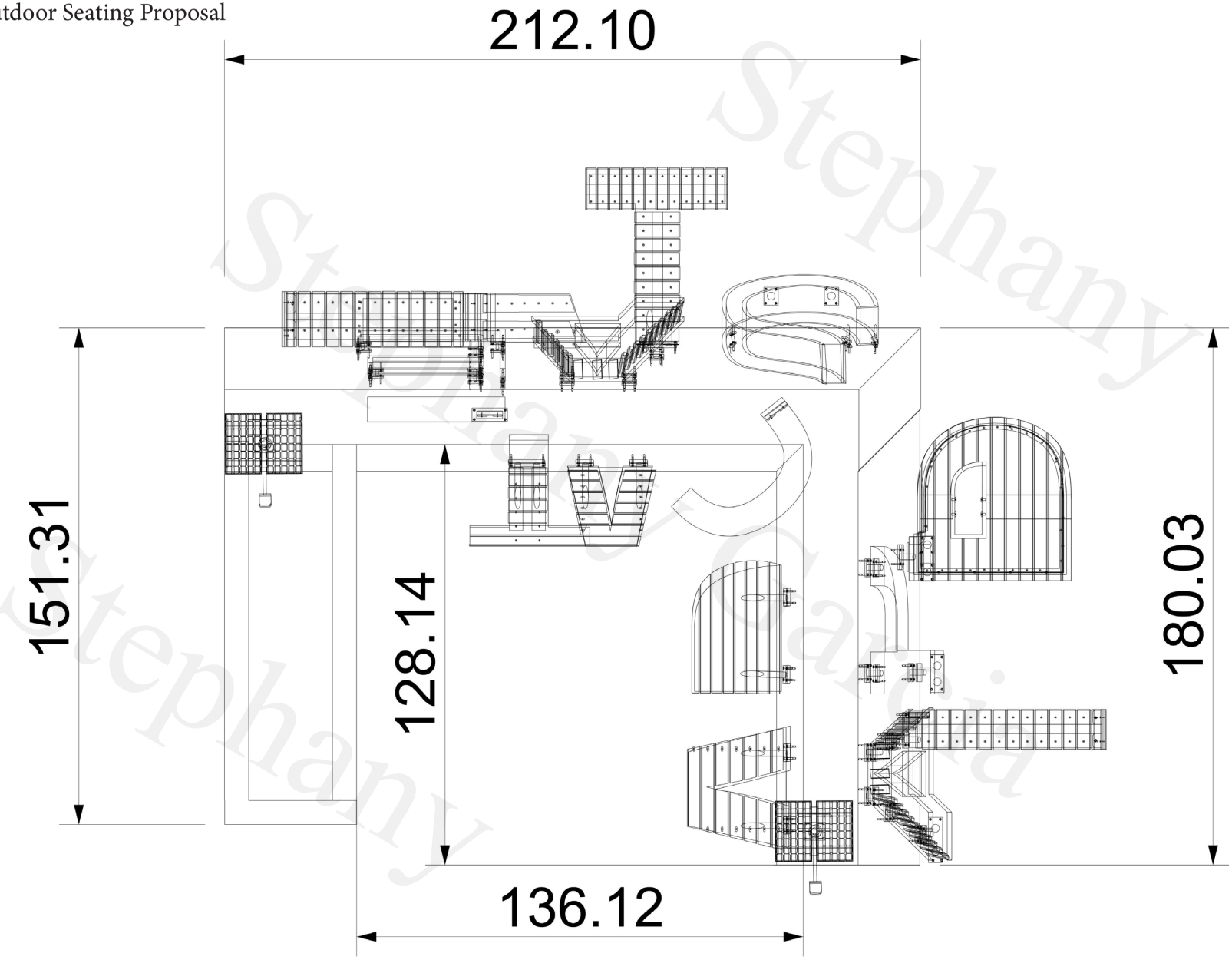


Right Wall View



Left Wall View





3.2 Materials and Quantity (Seating Structure)

Top left section	Quantity	A (seat)	Quantity	P (seat)	Quantity	S (Table)
Aluminum Sheet (1/4" thickness)	1 (welding required)	3.5ft X2.5ft	1 (welding required)	3.5ft X2.5ft	1 (Welding required)	5 ft X 4" and 3 ft X3ft
Wood	14	12"X 4"X1.5"	14	36"X 4"X1.5"	2	6"X 4"X1.5"
screws for wood/metal	25		20		4	
screws for wedge locks	8		8		4	
tube support	1	24"	1	24"	0	
Wedge Locking	2		2		1	

Bottom left Wall	Quantity	A	Quantity	A (extension)	Quantity	P (stand up)	Quantity	P (seat)
Aluminum Sheet (1/4")	2 (CNC cut)	6ft x 6ft	1	6ft X 1 ft	2(CNC cut)	5.2 ft X 4ft	1 (welding required)	3.5ft X2.5ft
Wood	20	6"X 4"X1.5"	16	12"X 4"X1.5"	20	6"X 4"X1.5"	14	36"X 4"X1.5"
screws for wood/metal	40		32		40		20	
screws for wedge locks	12		4		12		8	
tube support	0		0		0		1 (rectangular hollow)	24"
Wedge Locking	3		1	12" long	3		2	

Bottom Right Wall	Quantity	A	Quantity	S	Quantity	E	Quantity	A (extension)	Quantity	E (extension)
Aluminum Sheet (1/4")	2 (CNC cut)	6ft x 6ft	2 (CNC cut)	6ft x 6ft	2(CNC cut)	5ft X 4ft	1	6ft X 1 ft	1	6ft X 1 ft
Wood	20	6"X 4"X1.5"	40	36"X 4"X1.5"	20	4"X 4"X1.5"	19	12"X 4"X1.5"	18	12"X 4"X1.5"
screws for wood/metal	40		80		40		38		32	
screws for wedge locks	12		8		8		4		4	
tube support	0		0		0		1	24"	0	
Wedge Locking	3		2 (to ground)		2		1	12" long	2 (to ground)	12" long

Top Right Section	Quantity	A	Quantity	T	Quantity	E "Table"
Aluminum Sheet (1/4")	1 (welding required)	3.5ft X2.5ft	1 (welding required)	3.5ft X2.5ft	1 (Welding required)	3.5 ft X 10"
Wood	14	12"X 4"X1.5"	6	24"X 4"X1.5"	2	6"X 4"X1.5"
screws for wood/metal	25		12		4	
screws for wedge locks	8		8		4	
tube support	1	24"	1	24"	0	
Wedge Locking	2		2		1	

3.3 Pricing and Suppliers (Seating Structure)

	Pricing					
	Dimensions	**$**	**Total**	**Supplier**	**Total**	**Extras**
Aluminum Sheet (1/4" thickness)	3.5 ft X 2.5 ft (5)	23.22$	116.10$	Steelworks	737.07$	
	5.5ft X 4" (6)	46.44$	278.64$	Steelworks		
	3 ft X 3ft (1)	45.08$	45.08$	Hillman		
	6 ft X 7ft (6)	46.44$	278.64$	Steelworks		
	3.5 ft X 10" (1)	18.61$	18.61$	Hillman		
	Dimensions	**Board Feet**	**Total**	**Supplier**	**Total**	**parts**
Brazilian walnut Wood (Ipe)	1.90″ x 29″ - 36″ x 168″	75.83´	1,049.00	Advantage Lumber	$2,690.28	Top Left Section/ Top Right Section
	2.10″ x 31″ - 33″ x 108″	60	1,216.43	Advantage Lumber		Bottom right/left Section
	1.80″ x 29″ - 32″ x 70″	29.65	424.85	Advantage Lumber		Bottom Right section
	Quantity	**$**	**Total**	**supplier**		
Nuts and Bolts (Metal/Wood)	452-500	$254.20	$254.20	Hillman	$254.20	
	Quantity	**$**	**Total**	**supplier**		
Wedge Anchors	160-200	$63.20	$63.20	confast	$63.20	
	Quantity (3/16 " X 6")	**$**	**Total**	**Supplier**		
tube support	5	$13.90	$69.50	Hillman	$69.50	
	Quantity (4ft X4ft)	**$**	**Total**	**Supplier**		
Wedge Anchor Plates (aluminum 1/8" thickness)	40	$35.67	$1,426.80	Hillman	$1,426.80	
					Estimated Material Price	
					5,241.05$	

3.0 Discussions and Conclusion

This paper has presented a critical overview of student requests to emphasize the importance of outdoor learning environments, to create higher accessibility by socializing public outdoor campus spaces, and to represent student involvement on school grounds. The following topics were addressed in the essay through academic literature and a project proposal of an existent design by an ASU student. Through the literature reviews, research showed that outdoor seating is more than just a structural construction. Outdoor seating benefits educational approaches, which include improvement of students´physical activity, motivation for school, pro-social behavior, and even reading performance by interaction with nature outside an enclosed setting. Outdoor seating benefits social interactions in public spaces, by creating a choice of accessibility. Research shows that outdoor seating encourages people to share the space and gain interaction abilities by fostering the natural surrounding. It also creates a space for high levels of use that provide vitality with various activities and different user groups. In conclusion, outdoor seating provides an opportunity for students, specifically those in ASU, to be involved on campus projects as they have requested. This collaboration allows students to problem solve, develop interpersonal skills while working, and most importantly apply their theoretical knowledge through hands on experiences.

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