TEAM GRIDIRON PRESENTS: THE CLIMBING WALL

At Redwood Coast Montessori

A group document containing the Problem Statement, Problem Analysis, Literature Review, Alternative Solutions, Decision, and Final Results for Redwood Coast Montessori's new play structure.

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1. Problem Formulation

1.1. Introduction

Team Gridiron was formed through 4 members of our 'Engineering 215 Intro to Design' class of 2014. Each group has been given a semester-long task in designing things like play structures and chicken coops, which offers our clients of Redwood Coast Montessori School with a broader variety of child-friendly activities. This school offers alternative learning skills and currently accommodates about 80 kids, ranging from Kindergarten to sixth grade. Figure 1.1.5 depicts our 'Black Box Model,' which provides a simple visual before and after the solution.

1.2. Objective

The objective of this project is to provide the students of Redwood Coast Montessori School with a safe and fun play structure inside. The design process will rely heavily on the opinion of the client(s). A black box model describing the problem and solution can be seen in Figure 1.1.

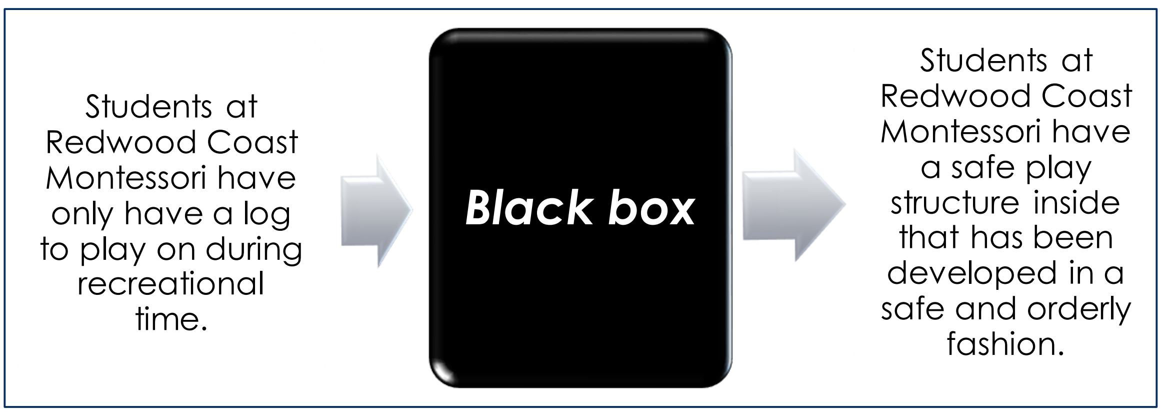


***Figure 1.1** Black Box Model for Redwood Coast Montessori's Play Structure*

2. Problem Analysis and Literature Review

2.1. Introduction to Problem Analysis

The problem analysis includes the Redwood Coast Montessori's criteria and respective constraints. The problem analysis presents our specifications, considerations, criteria, usage, and production volume.

2.1.1. Specifications

The traversing wall will need to be low enough to allow children to use without needing any other safety equipment aside from crash pads. Building materials need to be sturdy enough to withstand rough housing, and no obstructions/unnecessary obstacles should be on the wall. The traversing wall will also have varying and identifiable levels of difficulty.

2.1.2. Considerations

With over 80 children attending Redwood Coast Montessori, it is important to take into consideration the amount of children that are to be allowed on the wall at the same time. Children with special needs may not be able to participate on the traversing wall. Due to the nature of children, aesthetics should not be too intricate, or diminishable by vandalism.

2.1.3. Criterion and Constraints

Table 2.1 *Criteria and Constraints*

Criteria	Constraint
o Cost	• Must not exceed $400
o Safety	• Wall must have no sharp points or corners, and paint must be child friendly
o Maintenance	• Parts should be easily fixable/replaceable by regular staff.
o Upcycled Materials	• Recycled materials will be used whenever possible
o Age Appropriate	• Structure should be usable by children in grades K - 8
o Aesthetics	• Any art displayed on wall should reflect that of the coastal (manila dune) environment

o Easily Concealable	• Wall should be capable of being hidden by staff to reduce distractions outside of play time

2.1.4. Usage

The Climbing Wall in Redwood Coast Montessori's Gym will be an indoor play structure to be used by the students. The wall will be available whenever the staff deems it appropriate.

2.1.5. Production Volume

1 full size traverse wall will be built for full use in the Redwood Coast Montessori gym. The wall will not exceed the maximum recommended falling height for the client's age range.

2.2. Literature Review

The purpose of the literature review is to provide the appropriate background information that will build a foundation for an appropriate play structure. The structure will need to be designed specifically for children ages 5-11. The concepts that will be introduced include client criteria, climbing walls types, climbing wall designs, age appropriate play, appropriate materials, as well as the information from interviewing the client.

2.2.1. Background on the Client

Our client is Redwood Coast Montessori, a school that consists of 80 students that range from kindergarten through sixth grade. Redwood Coast Montessori is located east of the Manila Dunes in Humboldt County, California. Redwood Coast Montessori takes on a unique approach on teaching their students. The students are allowed a more hands on approach a preferential learning style. The only play structure that currently exists is a weatherworn log. Our project is to provide them with a new play structure that is consistent with their hands on learning approach. Redwood Coast Montessori have warned us that the kids can be destructive and we need to take that into consideration. The budget for the project is $400.00. Keeping in mind the school resides on the coast the salt in the air will affect an outdoor structure. Due to the public access of the school area, vandalism should be taken into consideration.

2.2.2. Health Benefits of Climbing Walls

Climbing walls provide a variety of health benefits ranging from total body workouts to developing problem solving skills (Lage 2013). An indoor climbing wall at Redwood Coast Montessori would offer students a fun alternative of physical activity as opposed to cardio exercise outside. Childhood obesity is directly linked to the lack of physical exercise. Childhood obesity among young children, ranging from ages 4 through their adolescent years, has become a growing trend that affects a large amount of the population. Positive development is associated with a physically active lifestyle. Some form of physical activity for a minimum of 3 days a week, and a moderate time range from ten to thirty minutes, is highly recommended for children as they continue to develop (Fisher 2009).

B1 development also produces at a positive rate when influenced by physical activity and exercising. Any high-impact activity, such as rock climbing, where children bear their own weight is a great influence towards maintaining healthy b1 development through the adolescent ages.(Trost 2001) For example, children develop a healthier body composition when they are engaged in regular physical activity or exercise training. Frequent activity is likely to enhance peak b1 density during a critical time in b1 development and can be influential in preventing osteoporosis. So physical activity is very beneficial in regards to the development of children (Fisher 2009).

2.2.3. Climbing Walls Effects of Physical Growth

Physical activity has a significant impact on growth, and can be regulated by consistent physical fitness and physical activity patterns. This Section is going to focus on how steady physical activity and exercising affect growth. Physical activity refers to any energy expended by moving the body, whereas exercise training is a planned, structured, and repetitive movement designed to improve performance in a specific sport (Fisher 2009).

2.2.4. Typologies of Rock Climbing Walls

There are many different types of rock climbing walls that can be designed. A few examples include traditional climbing, top-rope climbing, sport climbing, lead climbing, bouldering climbing, and traverse climbing. Each type of rock climbing offers a different climbing experience (Thibeau 2010).

2.2.4.1. Traditional Climbing

Traditional climbing is a very common type of climbing that advanced rock climbers tend to use. Unlike other types of rock climbing traditional climbing requires an extensive amount of equipment, technical knowledge and experience. Traditional climbers must be advanced because they are not given a specific routes or plan of attack, they are only given a starting point (Thibeau 2010). An example of Traditional Climbing can be seen in Figure 2.2.

***Figure 2.1** A girl participating in traditional climbing (Climbing 1998)*

2.2.4.2. Top-Rope Climbing

Top-Rope climbing has minimal equipment but offers a great amount of safety at any height good for beginning climbers. In Top-Rope climbing, each individual is given a harness that is connected to a rope. That rope hangs above, and behind the wall with a system of pulleys that prevent the climber from falling to the floor in the event of loss of grip (Thibeau 2010). An example of Top-Rope Climbing can be seen in Figure 2.3.

***Figure 2.2** A girl participating in Top-Rope Climbing (Climbing 1998)*

2.2.4.3. *Sport Climbing*

Sport Climbing requires a minimal amount of gear, however it offers a minimal amount of safety. Unlike Top-Rope climbing, Sport climbing only offers occasional localities to hook your harness on to. Throughout the climb, 1 risks the chance of falling off the wall onto the surface below (Thibeau 2010). An example of Sport Climbing can be seen in Figure 2.4.

Figure 2.3 *A girl participating in sport climbing (Climbing 1998)*

2.2.4.4. *Lead Climbing*

Similar to both, traditional climbing and sports climbing, lead climbing uses a minimal amount of gear and offers about the same amount of safety. Unlike any of the other different types of climbing mentioned before, lead climbing requires a second climber that acts as the leader. The leading climber is usually more experienced than the other climber. The leader scales the wall, similar to sports climbing, and when they reach a certain point they stop and hook themselves on the wall. This allows the second climber to climb up underneath and then attach an anchor. These steps are repeated until the wall is completed (Thibeau 2010).

Figure 2.4 *A man and woman participating in lead climbing (Climbing 1998)*

2.2.4.5. *Traverse Climbing*

Unlike any of the climbing styles mentioned before traverse climbing is a low level wall designed for sideways movement without the use of any equipment. Traversing walls usually have footholds close to the ground to help maintain a low-risk, but fun and adventurous activity (Beacon Climbing Walls, 2014). Traversing walls usually stretch from 16 feet to 98 feet, and have a climbing height of 5.5 feet (Beacon Climbing Walls, 2014).

Traversing walls allow for children of all ages to enjoy a low risk, yet moderate level of exercise through the physical nature of climbing. Educators can also use these types of walls with a low levels of training, and without the need of expert supervision (Beacon Climbing Walls, 2014). An example of Traverse Climbing can be seen in Figure 2.6.

Figure 2.5 *A boy climbing on a traverse wall (Beacon Climbing Walls, 2014)*

2.2.5. Climbing Wall Safety

Even though traverse-climbing walls focus more on lateral movement, rather than ascending and descending, there are still many different hazards that are associated with it. 1 of the main hazards is a child falling off the wall. That is where a soft falling spot, known as the "Fall Z1," comes into play. The fall z1 can be made from different materials and the depth of each material depends on the highest possible fall point in feet. Each fall z1 should extend at least six feet in each direction to ensure a safe landing from all possible points on the wall. (CPSC 2014).

2.2.5.1. *Age Appropriate Equipment*

When designing play equipment for children, an important factor to take into consideration is the child's physical ability to use and enjoy the equipment. Certain factors such as desire for risk, upper body strength, and hand eye coordination play a role in the selection of proper play structures. Playgrounds should be designed to engage the children, and encourage them to develop skills, while being on scale with their size, ability, and developmental level (CPSC 2014). The table below gives examples of appropriate equipment with respect to age.

Table 2.2 *Examples of Age Appropriate Equipment (CSPC 2014)*

		
Toddler — Ages 6-23 months	**Preschool — Ages 2-5 years**	**Grade School — Ages 5-12 years**
• Climbing equipment under 32" high • Ramps • Single file step ladders • Slides* • Spiral slides less than 360° • Spring rockers • Stairways • Swings with full bucket seats	• Certain climbers** • Horizontal ladders less than or equal to 60" high for ages 4 and 5 • Merry-go-rounds • Ramps • Rung ladders • Single file step ladders • Slides* • Spiral slides up to 360° • Spring rockers • Stairways • Swings – belt, full bucket seats (2-4 years) & rotating tire	• Arch climbers • Chain or cable walks • Free standing climbing events with flexible parts • Fulcrum seesaws • Ladders – Horizontal, Rung, & Step • Overhead rings*** • Merry-go-rounds • Ramps • Ring treks • Slides* • Spiral slides more than one 360° turn • Stairways • Swings – belt & rotating tire • Track rides • Vertical sliding poles

2.2.5.2. *Fall Z1*

Fall z1s is required by law for any elevated, hanging, or climbing structure. These z1s are put in place to ensure that children and/ or adults are protected from serious head injuries in the case of a sudden fall or crash landing. Fall z1s can be made from different materials, such as Shredder Bark Mulch. Shredder Bark Mulch is an alternative way to say shredded recycled tires that have had their inner wires removed (CSPC 2014). A list of ground cover materials are exampled in Table 2.3

Table 2.3 *A list of materials and their depth showing safest maximum height (CSPC 2014)*

Type of Material	6 "Depth	9 " Depth	12" Depth
Double Shredded Bark Mulch	6	10	11
Wood Chips	7	10	11
Fine Sand	5	5	9
Fine Gravel	6	7	10

2.2.6. Criteria for Designing Your Own Climbing Wall

When designing your own wall, there are numerous factors that must be considered before building can begin. Materials like wood, plaster, paint, molds, support beams screws and even fall z1s (Lage 2012**)**.all should be reviewed before use (Lage 2012). Among these criteria are safety, maintenance requirements, construction/fabrication, and child development (Gill, 2014). Safety can be regulated through choice of materials, consideration of height, avoidance of designs that could entangle a child, and adult supervision. The allocated space for your design must be able to completely house your climbing wall design, as well as provide enough space for children to safely climb on, around, and off the wall without any interruptions (Lage 2012**)**.

Using a set of safety criteria allow for decisions to be influenced toward a more safe solution, while incorporating opportunities for imaginative and dramatic play, varying levels of difficulty, and areas designated for solitude (Gill, 2014). This allows for both the designers and clients to rely on the structures with confidence. The advantage of having to use a set of safety criteria/regulations is that it restricts designs to adhere to more proper and safe standards. Along with all criteria previously mentioned, designs must adhere to the Public Playground Safety Handbook, which is produced by the U.S. Consumer Product Safety Commission (CSPS 2008).

2.2.7. Installing a Climbing Wall

There are different possibilities when it comes to installing climbing walls, which range from installing complete walls that were manufactured elsewhere, to designing and creating your own. Some of the benefits to designing your own climbing wall are the unlimited possibilities. Both kids and adults can let their imagination wonder, which can help to create a wall that they enjoy and are proud of. (Lage 2012).

Walls have multiple functions, and they consist of exclusion of heat or cold, rain, wind, dust, noise, as well as other undesirable climatic. Walls also regulate indoor climate, privacy, security against different forms of intrusion, and are support for ceiling and roof structures (Stulz 1993; Mukerji 1993). Walls can typically be built in 2 different ways with massive or loadbearing wall construction, or with a skeleton frame with non-loadbearing walls. The common wall construction materials include st1, earth, burnt clay and concrete bricks. Some other wall construction materials. The surface treatment of walls varies on the type of material and construction system. Treating the walls increases their durability by conveying different forms of protection from natural causes, and can improve its appearance by covering unsightly surfaces, or applying decorative effects and colors. Line and cement washes and other forms of treating the wall. Solid walls are common in hot arid climates because they have high thermal capacities and they transfer the absorbed heat to the interior with a time lag. Therefore solid walls restrain the heat when the temperatures are high, and release it when the temperatures are low. Insulation on the outside of a solid wall gives quadruple the amount of a time lag than if it were placed on the inside, but it also delays heat dissipation during the night (Stulz 1993; Mukerji 1993).

2.2.7.1. Structural Properties

The consideration of 5 structural properties for this specific design is a key part in choosing materials used in the building process. This climbing wall will be built, on a coastal region, but inside of a classroom. The outside environment won't have a big impact, unless a natural disaster was to occur (earthquake, tsunami, etc.)(Whiteneck, 1989).

2.2.7.2. Specific Gravity

Specific gravity has to be considered whether the structure is placed in water, on dry land, or in this case, a classroom. High- specific gravity uses materials such as rock, earth, and concrete; these materials are necessary for submerged structures. Low-specific gravity materials such as wood are essential for floating structures not submerged. Heavier materials are used when constructing only if the design provides the correct amount of resistance (Whiteneck, 1989).

2.2.7.3. Material Strength

Material strength in tension, compression, and flexure may determine the size of a structure, and definitely the stability of the structure. Especially given the fact that multiple children will climb on the wall on any given day, the materials used to need to be able to withstand that kind of force (Whiteneck, 1989).

2.2.7.4. Resistance to cyclical and impact loading

In the case of a wave or coastal storm, conditions that cause cyclical and impact loading, some materials would be destroyed depending on the strength of the building enclosing the climbing wall. Material flexibility should be taken into consideration (Whiteneck, 1989).

2.2.7.5. Material Flexibility

The material's ability to bend without breaking or ability to change in configuration is important because the climbing wall will experience a lot of force through the course of a day. Wood has some flexibility, while a material like steel is stiff (Whiteneck, 1989).

2.2.7.6. Resistance to seismic forces

Being built in an area that is 1 of the most seismically active, seismic forces both horizontally and vertically are going to have to be taken into consideration. The structure will have to be able to handle that excessive structural stress or be constructed of materials that direct seismic forces to planned isolated areas in the structure (Whiteneck, 1989).

2.2.7.7. Wood

Wood would be used in making the framework and maybe the wall itself. A common material that is reliable and durable, wood absorbs energy, which is a desirable feature (Fine, 2003).

Figure 2.6 *Types of wood that can be used as framework (Fine 2003)*

2.2.7.8. Moisture Content

Wood always contains some sort of moisture, except in extremely dry areas. The moisture content helps in determining its density and strength. The swelling and shrinking of wood relies heavily on magnitude of change of moisture content. Temperature affects swelling and shrinking even with indoor structures (Fine, 2003).

2.2.7.9. Seismic effects

The stress during an earthquake is great on any material. Under low severe conditions, wood performs well due to its resiliency. The flexing of wood and reduction in stress makes for a good material during seismic activity (Whiteneck, 2003).

2.2.7.10. Plywood vs. Oriented Strand Board (OSB)

Plywood is about twice as expensive as OSB, and for this reason builders tend to use OSB. The shear strength OSB is higher than that of plywood, so when using nails or screws, OSB is a better choice. There are also no soft spots (where a knot occurs in the ply) in OSB, whereas plywood may have 2 or more knots in the same area. The pull through strength was also tested as a nail was pulled from both types of wood. The plywood took 17 lbs. of force to get the nail out, while the OSB took 15 lbs. of force. OSB is about 15% heavier than plywood, and plywood is more stable as far as flexibility. Every characteristic will be accounted for each kind of wood when choosing which kind to use (Climbing, 1998).

Figure 2.7 *The difference between OSB and Plywood (Lumber and Plywood 1998)*

2.2.7.11. Steel

A number of steel bolts, screws, and brackets will be used to assemble the climbing wall. The important thing is making sure the smaller pieces keeping the whole structure together are reliable. The framework of the wall can also be made of steel (Climbing, 1998).

Figure 2.8 *Steel nuts that can be used to down frame work and foot holds (Steel 1998)*

2.2.7.12. Durability

Steel is generally tough, thick and resistant to corrosion. Just as long as the wood is right also, steel reinforcements are usually the best choice. Steel is stiff and can endure the force produced by the children (Steel, 2009).

2.2.7.13. Seismic Effects

Steel is suited for construction in areas with seismic activity. Steel possesses tensile strength, good ductility, and good toughness. Steel being the most economical of the metals, is available in a number of shapes, so angles and things of that sort shouldn't be a big issue. If the frame of the climbing wall ends up being made of steel, then the structure would be even more stable (Whiteneck, 1989).

2.2.7.14. Polyurethane

Polyurethane is a resilient, flexible, and durable material. It can be hard like fiberglass, or squishy and protective. The shape is indefinite, or can be deformed continuously and keep its original shape. This material has what is called structural memory. Many indoor climbing walls have footholds made from this material (Mithra, 2014)

Figure 2.9 Footholds made from polyurethane (Climbing 2014)

2.2.7.15. Screw- On vs. Bolt- On

The screw- on holds attach with either wood screws or concrete screws. All that is needed is thick plywood or other material. With this system, there is virtually no limit to where you can attach the screw- on hold. Bolt- on holds use an Allen head bolt and a nut that passes through the panel of the wall. With this option, foot holds can be moved easily or rotated, yet stay in place in the wall so nobody turns a piece and injures themselves (Climbing, 1998).

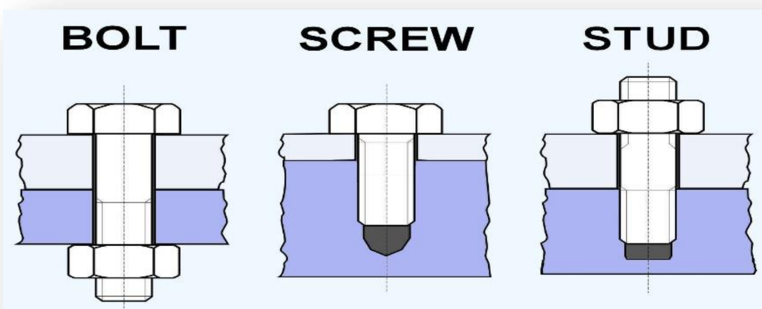


Figure 2.10 Differences between bolts, studs, and screws(Climbing 1998)

2.2.7.16. Types of Structures

There are different types of structures as well as different ways to design structures. Each structure will vary from place to place depending on the availability of materials, allotted space and even climate.

2.2.7.17. Attach to an Existing Structure

Attaching the climbing wall to an existing structure will eliminate some support braces needed, be easier to design and build, but wherever it is placed will be permanent. The existing structure has to be strong enough to handle the additional stress the climbing wall will produce (Climbing, 1998).

2.2.7.18. Freestanding

This type of wall is the most versatile of the options. Building this way will not damage the existing structure, and transporting will be easier, but the wall will not have structural sound wall supports. The climbing wall will be more difficult to design, in that an extra responsibility will be added in building the wall so it balances independently (Climbing, 1998).

Figure 2.11 *A free standing climbing wall (Climbing 2014)*

2.2.7.19. Adjustable Angles

Training will be improved with an angle in the climbing wall. This may or may not be too advanced for this age level. The designing process will probably be the most difficult with this option. Strength within the structure will also have to be stronger in some areas because they are being forced at an angle (Climbing, 1998).

Figure 2.12 *An adjustable-angle climbing wall (Climbing 1998)*

2.2.8. Types and Costs of Structures

Just attaching the climbing wall to an existing structure may be the cheapest option at first. But if the school would desire to move the wall to another spot or outside, then a freestanding wall is more versatile in that aspect for a little extra cost. An adjustable angle adds a lot of different dimensions, requires the most effort, both labor and cost wise (Climbing, 1998).

2.2.8.1. Wood

Depending on the quality of the wood, sheets of wood can range from about $8 to $45. Maybe 4 sheets will be needed; maybe an extra sheet to practice the design. That can be a total of $32 to $180. Depending on the framework material, the wood can cost more (Lumber & Plywood, 2011)

2.2.9. Footholds

The footholds mounted inside, or on the surface of the climbing wall, have to be designed to make for a comfortable, supporting step while climbing. There are different materials that can be used as a foothold. There are a host of things to consider, but most importantly the foothold has to hold up the climber.

Figure 2.13 *Footholds mounted to a climbing wall (Climbing 2014)*

2.2.9.1. Polyurethane Holds

Polyurethane is high in demand, so an investment in climbing holds would be about $60 for 30 footholds. Making holes for the footholds could be as simple and as cheap using power tools. Exact totals depend on the area measurement of the wall. Once that is known, the number of footholds needed can be designed and placed (Climbing, 2013).

2.2.9.2. Foothold Placement

Each foothold should be placed not too far from each other because kids will inhabit this climbing wall. Their limbs and reach are not fully developed; so making the kids over extend out of their range is dangerous. A length of a child's wrist to forearm (Climbing, 1998).

2.2.9.3. Size of Footholds

The footholds for these children should be medium size at most. The hands and feet of these kids won't be that big, so the holds don't have to be. Footholds to big can be dangerous for the kids if the hold is too big for their hands to grasp (Climbing, 1998).

3. Alternative Solutions

3.1. Introduction

Alternative solutions for the Traversing Wall for Redwood Coast Montessori were conceived through 2 brainstorming sessions by Team Gridiron. Each teammate selected at least 2 of the alternative solutions proposed in the brainstorming process. Each chosen structure was then designed, analyzed, and visually rendered by a member of Team Gridiron. A total of 8 comprehensive alternative solutions are exhibited.

3.2. Brainstorming

2 brainstorming sessions were held during our Thursday lab and a meeting at Mosgo's Café in Arcata. During our lab, ideas were brought forth by each team member and written down by a teammate. With the utilization of a classroom whiteboard different visual concepts were discussed by Team Gridiron to aid in consolidating solutions, and to help reduce our list to the top solutions. During our meeting at Mosgo's, solutions that helped to implement further interactive designs were discussed and sketched. Such designs include improvements to the already discussed traversing wall, as well as outdoor structures, structures that involve a musical aspect, and play established through games.

3.3. Alternative Solutions

Team Gridiron proposed a total of eight alternative solutions for the client to either decide from or give useful feedback that can help lead to a definite choice of design.

- Inverted Pyramid
- The Dome
- The Tunnel
- Ball Pit
- The Social Net-Work
- The Scatter Wall
- Freestanding Structure
- Rope Pyramid

3.3.1. Inverted Pyramid

The inverted Pyramid is an alternative climbing structure that allows students to climb up, over, and through the structure. The Inverted Pyramid gives opportunity to explore normal childhood curiosities and are not limited to; climbing, jumping, and endless imagination. This structure will be safe for children, easily maintainable, and concealable. This design will also be free standing, so that fits the criterion that team Gridiron was given from the client. This solution will also appeal to the students by giving them the chance to enjoy a new unique play structure designed for them.

The inverted Pyramid is composed of four main walls, each about six feet in height, which forms the base that it sits on when properly connected. Each Section of the wall is composed of a six foot sheet of plywood that is cut into a triangle shape minus 1 of the corners, like shown below. Each Section will also have at least two four -inch wide boards that will support the plywood and will act as the frame when combined. This will be true for both sides of each piece of plywood so that screws and hold can be placed on each side without going through both sides of the board. The floor underneath will use permanent screw on holds, and this design will use t-nuts which will be imbedded into the wooden boards which will offer easy access for staff at any time.

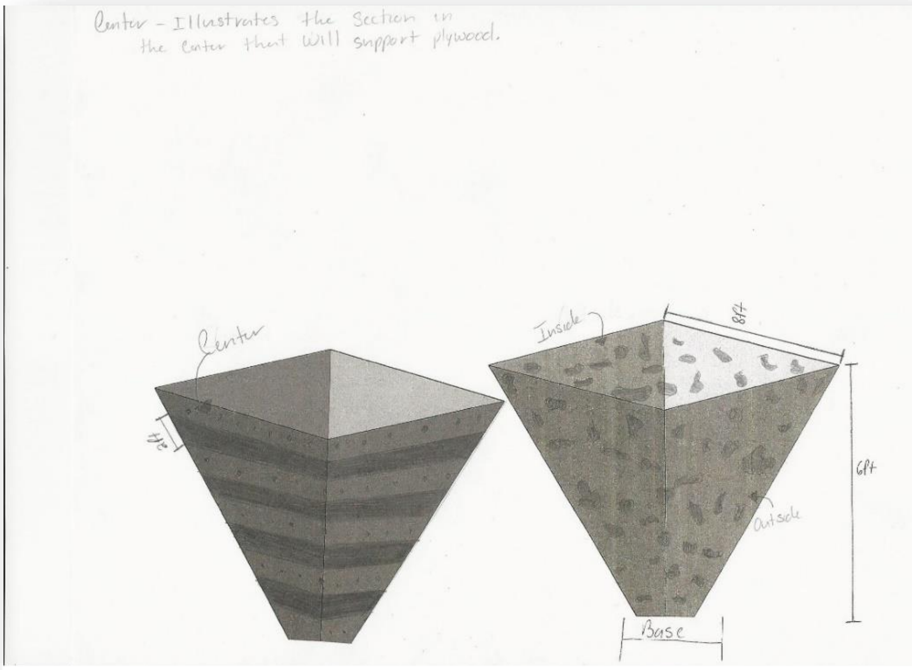


Figure 3.1 *The Inverted Pyramid (Designed my Tony Mitchell, 2014)*

The Inverted Pyramid will have a variety of different foot holds as well as hand holds. This will allow students to have an endless variation of routes they can use.

3.3.2. The Dome

The Dome is a climbing structure that is freestanding. It's a dome shaped slab of either reinforced concrete, or if it were to be placed inside, it could be made from an upcycled material known as Cobb. It will have steps to climb up so it isn't so close to the ground, and it will have a fall z1 of mats surrounding it just in case any of the kids fall. It will be completely round with various sized holes cut out of it. The holes will be used as holds for the kids to grab onto and climb to the top of the Dome. Everything will be sanded down very smoothly so that the kids do not hurt themselves or cut themselves on any sharp edges. It's appropriate for kids in grades first through sixth and will be easily maintainable by the staff at the school. If any anything were to happen to the dome climbing structure, directions will be provided on how to make Cobb, which the kids can enjoy remaking. Being concealable will depend on where it is placed once the kids are done playing on it, but it won't be too difficult to move and hide while recess is not in session. The kids can paint it as they please, or it can be painted a cool grey with sand in it to provide a textured feeling.

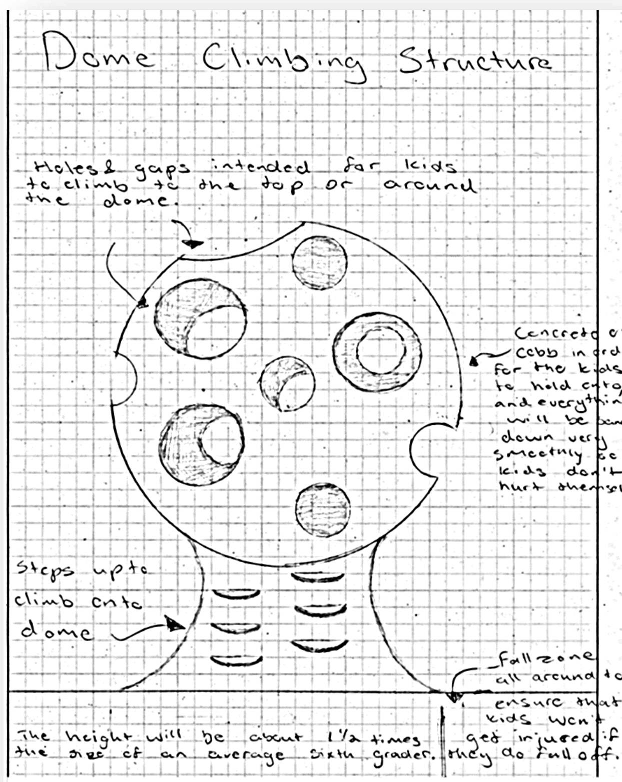


Figure 3.2 *The Dome (Designed by Greg Olivas, 2014)*

3.3.3. The Tunnel

The Tunnel will be a giant hollow tunnel with a diameter that measures less than the average child's height. It can be made from wood, or plastic, or any reinforced material that is strong enough for kids to walk through while bent over, or crawl through it. It will be completely sanded and layered with a coating so kids can't hurt themselves on it. There will be different colored glass windows so that when sunlight hits it, it gives an aesthetically pleasing design on the inside, and the outside. The tunnel can double as many different things for kids to play on the outside of it. The tunnel will be easily maintainable since it can be standing on some wedges to stay in place and when the staff wants to conceal it, it will be easily moveable. As for age appropriateness, it depends on the kid's ability to be imaginative. It is appropriate for the kids in first through sixth grade.

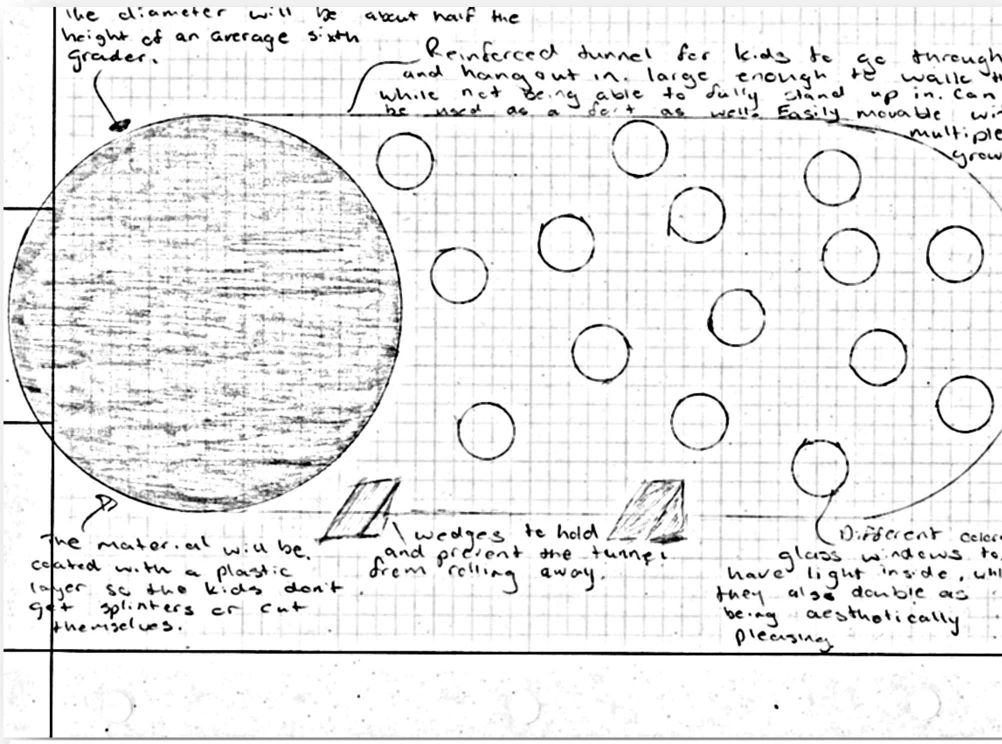


Figure 3.3 The Tunnel (Designed by Greg Olivas, 2014)

3.3.4. Ball Pit

The Ball Pit is an alternative that will give students the opportunity to climb, as well as provide an enclosure of unlimited fun. This was chosen as an alternative because it fits the criterion given by the client. This solution will also appeal to the students because it will allow them to run, jump and even climb in a safe manner that they find fun. This enclosure will be safe for students of all ages, it will be easily maintained and it will be able to be concealed. This design will also be free standing so it will not require any outside approval.

The Ball Pit will be composed of 4 main wall that acts as a border that prevents the balls from leaving the box. Each wall will be about 2 feet in height and about six feet in length. Each wall will have a latch which will allow for easy removal as well as easy assembly with more than 1 person. The gym floor along with the side of the wooden foundation will sit on and will be lined with padding to help prevent most injuries. The wooden foundation will then be filled with roughly about 3,000 balls and possibly other toys. The combination of balls along with different toys will allow for an endless variety of activities for children.

Figure 3.4 *The Ball Pit (Designed by Tony Mitchell, 2014)*

3.3.5. The Social Net-Work

The Social Net-Work is a safe rope climbing structure that combines exercise in balance, and climbing. Ropes are anchored to several logs, and attached to a steel ring in the center of the web. A single rope is started in the center, and wraps around each support rope allowing for maximum stability and tension. The web is located no more than 3 - 4 feet above the ground at the highest point. The anchored logs vary in height allowing the web to hang at an angle. The plan is to have some mats below the ropes in case of any accidents, and these mats will prevent any injuries from happening.

The Social Net-Work combines minimal amount of materials with quality materials. The rope anchors are rounded allowing for optimal safety. The use of wood rope materials accommodate for minimal maintenance. The low height, strong tension, and anchors acquiesce to a wide age range. The overall aesthetics are influenced by bio mimicry of a spider's web. The Social Net-Work is an outside structure preventing ease of concealment.

3.3.6. The Scatter Wall

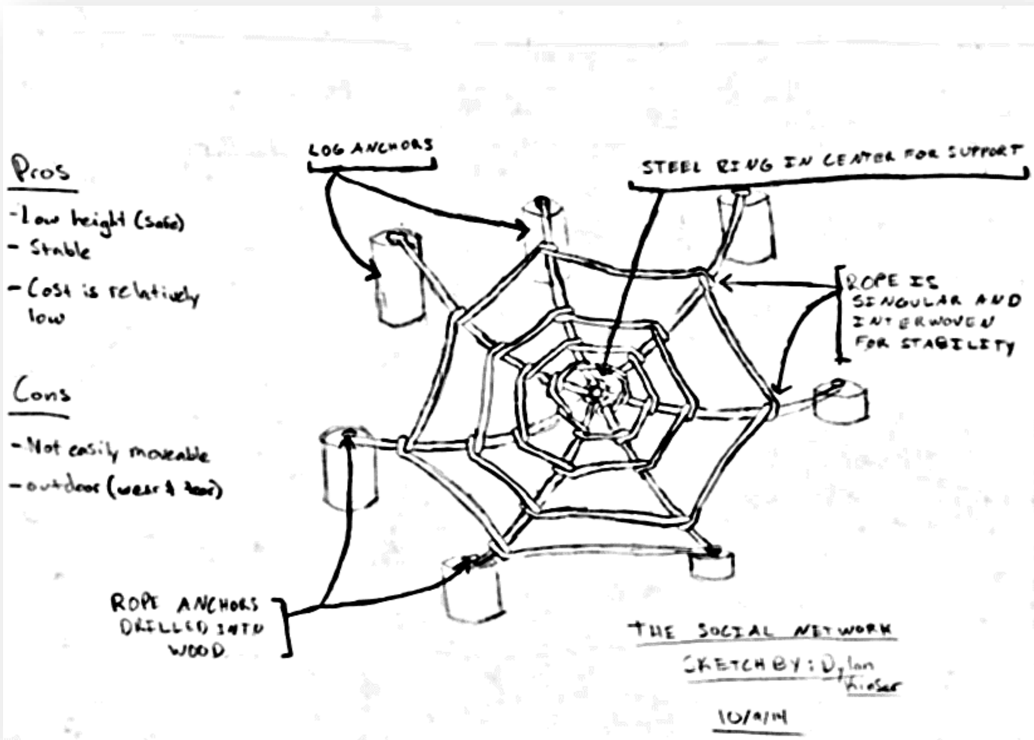


Figure 3.5 *The Social Net-Work* (Designed by Dylan Kinser, 2014)

The Scatter Wall is a traversing wall with added obstacles and depth. 2 ropes are hung from a protrusion on along the top of the wall, and connected to fold-down rope anchors that protrude parallel to the top anchors. A seat protrusion exists in the center of the structure adding depth, and opportunity for participants. Bells are located on the top left and right of the wall. The wall is 10 – 12 feet wide, and 6 – 7 feet tall. The foot/hand holds vary in distance and color for difficulty. Crash pads extend to 6 feet in front of the wall, and exceed the width of the wall.

The Scatter Wall allows for increased imaginative play, however it is accompanied by higher cost. The ropes are anchored on the bottom, as well as the top, to prevent children from swinging out of the safety z1. Protrusions on the top and bottom of the wall reduce the ease of concealment. The obstacles added to the wall give a sense of competition.

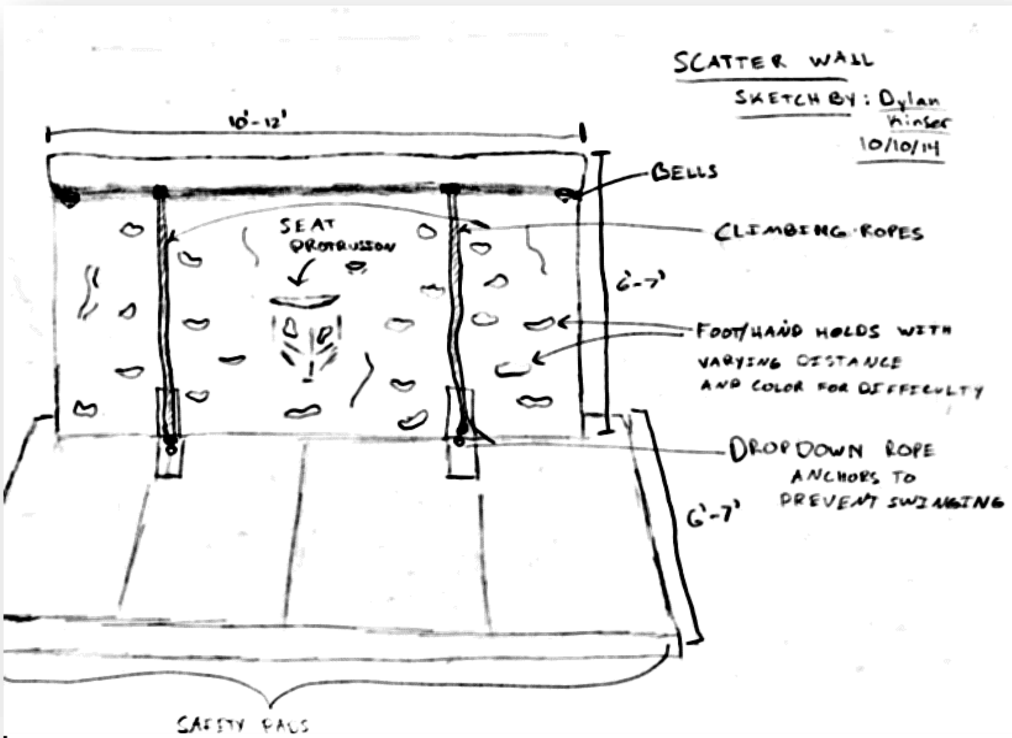


Figure 3.6 *The Scatter Wall (Designed by Dylan Kinser, 2014)*

3.3.7. Freestanding Structure

This type of wall is more versatile and won't need as much effort to get approved. Building this will not damage the existing structure, and transporting the structure will be easier. Making sound wall supports will be more difficult in this case. The climbing wall will be difficult to design, and the wall will have to balance independently. Safety requirements will be harder to meet when building a freestanding structure. Dimensions will have to coincide with the age range at Redwood Coast Montessori.

Figure 3.7 The Freestanding Structure (As Proposed by Miquan Johnson) (Climbing 1998)

3.3.8. Rope Pyramid

A rope pyramid is a climbing net in a pyramid formation. This provides versatility with climbing in that children ages 5-eleven could climb however tall the structure is, as well as 360° around it. A pole, as seen in the figure, will have to be centered to keep the climbing net h1st. The bottom of the rope pyramid will need to be attached to something to keep consistent tension intact. Like any other climbing wall, safety will factor in how it is built. Other than a stationary pole, other parts should be easily detachable. The cost of this structure will coincide with the budget of $400. Different colors as shown above can cover the aesthetics criteria.

Figure 3.8 The Rope Pyramid (As Proposed by Miquan Johnson)(Pendlewood 2014)

4. Decision

4.1. Introduction

In Section 4, this is the Section where the group will be making the decision of what will be built as the play structure for the students of Redwood Coast Montessori. Using the Delphi Method, the group is able to reduce eight alternative solutions to 4 solutions. From that point, each group member will vote for a preferred solution, and the most popular solution will be selected as the final decision. The Delphi Method is used in order to analyze and rank the criteria for the given alternative solutions in Section 3.

4.2. Criteria

This Section entails the detailed summaries of each criteria. Each criteria is defined in such a way that it specifically meets the Redwood Coast Montessori's needs.

Cost – The materials needed to fully construct any structure should be able to fit within our cost constraint.

Safety of materials – The materials that the structure consists of, or are permanently adhered to the structure, are going to be non-hazardous. The materials also will be sturdy enough to handle the stress that is going to be exerted by the school's students, as well as any possible passerby's.

Maintenance – The structure is going to be able to last long enough to avoid the need for constant maintenance. If maintenance is required, it should be minimal, and superficial until the frame of the structure is no longer suitable.

Upcycled Materials – The materials in the structure that could be made from recycled material and it can be safely used.

Age Appropriateness – Any aspect of the structure will be made safe in accordance with play structure age appropriate guidelines.

Aesthetics – The aesthetics will be appropriate for all ages, and should try to match the look and feel of the manila community/ecosystem.

Ease of Concealment - The structure is able to be easily concealed if indoors. This is intended to help the instructors let the children know when it is acceptable to use the wall.

4.3. Solutions

This list provides the eight alternative solutions evaluated as provided in Section 3:

- Rope Pyramid
- Tunnel
- Dome Structure
- Rock Climbing Wall
- Inverted Pyramid
- Spider Net
- Ball Pit
- Scatter Wall

4.4. Decision Process

The decision matrix technique known as the Delphi method was used to come up with our final solution. The first step we took was assigning a weight for each criteria discussed in Section 2. On a white board we wrote out each of our criteria, and the alternative solutions in order to help determine our final decision. On a scale of 1-10, with 10 being the most important, we weighed each criteria based on its importance and averaged out the weights in order to be fair. Our weighted criteria is shown in Table 4. 1. We then erased the criteria so it wouldn't affect our judgment while ranking the alternative solutions. On a scale of 0-50, with 50 ranking as the best fit for the criteria, we ranked each of the solutions based on how they each met the criteria. After each was taken down, we averaged out the rankings in order to come to our final solution. Each alternative solution was multiplied by the criterion weights; the sum of the multiplied scores were used to come up with our solutions in order from 1-8, with 1 being the best fit for each of the criteria. We then took the top 4, and anonymously voted on the top 2 we each wanted to work on. The final vote count is how we ended our decision process and ultimately made our final decision.

Table 4.1 *Criteria and Weights (Greg Olivas 2104)*

Criteria	Weights
Safety	9
Cost	8
Aesthetics	6
Maintenance	8
Concealment	4
Age Appropriateness	5
Upcycled Material	4

4.5. Final Decision

Even though the Delphi chart in figure 4.5, concludes that the best option is the Spider Net. In order to agree on a final design the top 3 choices were put up for another vote. This vote concluded that the best decision for the clients will be the Climbing Wall. This design will be good for Redwood Coast Montessori because it satisfies all the criterion that were mentioned before in Section 4.2 and in Table 4.1, and it also has the option to be put inside or out. Once the Climbing Wall is completely put together, it will take only a small amount of maintenance. This maintenance can be done by any of the staff members.

Table 4.2 *Delphi Matrix (Tony Mitchell 2014)*

		Alternative Solutions (Weight 1-50)							
Weights 1-10		Rope Pyramid	Tunnel	Dome	Rock Climbing Wall	Inverted Pyramid	Spider Net	Ball Pit	Scatter Wall
Safety	9	35 / 315	44 / 396	29 / 261	39 / 351	39 / 351	43 / 387	49 / 441	35 / 315
Cost	8	29 / 232	33 / 264	20 / 160	29 / 232	34 / 272	34 / 272	33 / 264	21 / 168
Aesthetics	6	41 / 246	33 / 198	40 / 240	45 / 270	37 / 222	44 / 264	31 / 186	43 / 258
Maintenance	8	36 / 288	39 / 312	38 / 304	32 / 256	32 / 256	40 / 320	40 / 320	34 / 272
Concealment	4	20 / 80	20 / 80	20 / 80	20 / 80	20 / 80	20 / 80	20 / 80	20 / 80
Age Approiate	5	39 / 195	35 / 175	25 / 125	40 / 200	34 / 170	33 / 165	39 / 195	35 / 175
Upcycled Material	4	14 / 56	35 / 140	23 / 92	20 / 80	19 / 76	24 / 96	14 / 56	18 / 72
Total		1412	1565	1262	1469	1427	1584	1542	1340

Rank based on chart		Rank from team vote	
1st		1st	
2nd		2nd	
3rd		2nd	
4th		4th	

5. Specifications

5.1. Introduction

This Section includes detailed descriptions of the final solution chosen in the last Section. Multiple images and views will be exhibited in order to present the audience with a detailed visual of the final design. The costs of this design will be analyzed through a table, which includes the design costs in hours, the costs of materials, the costs of implementing the design, as well as the costs of maintenance. Detailed instructions on how to implement, use, and maintain the design will also be provided. This Section concludes with results of the design testing and any issues that may occur.

5.2. Description of Solution

The structure of a climbing wall is a solution because it fits the criteria of a play structure. 2 of the most important criteria, cost and safety, were met with diligence and the help of the design process. With a number of donated materials assembling a wall with a frame and secure structure was not too difficult. The labor work added up to 2 eight-hour working days as intended. The solution was found through a majority vote amongst other solutions. Probably 1 of the toughest solutions to produce, it was created safely; not to mention this structure is better than the log currently in place.

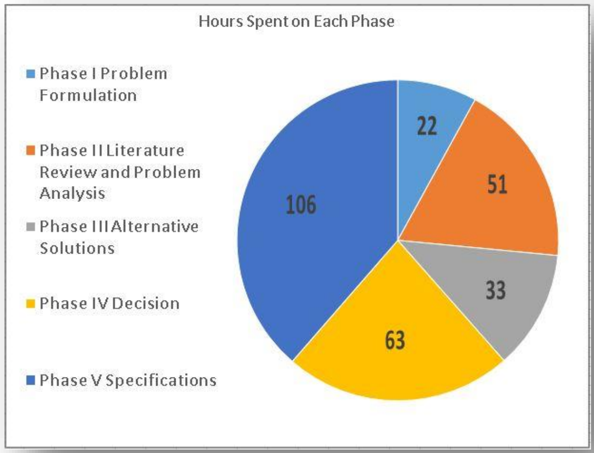
5.3. Costs

The costs that went into labor, materials, implementation, and maintenance will be discussed in this Section. Design and implementation costs will be measured in hours; materials costs will be measured in dollars; and maintenance will be measured in dollars for replacement materials and hours of the labor.

5.3.1. Time Costs

The time costs represent the hours committed to this project for each individual phase. Currently, a total of approximately 213 hours has been spent on the overall design of this project. A majority of the hours were spent on testing and implementing the solution, however the hours are spread in a pretty balanced fashion. Total hours spent on the project can be seen in Table 5.1.

Table 5.1 *Total hours spent on the Climbing Wall project*



5.3.2. Material Costs

The cost of materials for this design was 1 of the biggest issues. The retail cost of this design was $1,124.11, but thanks to a number of donations that price was lowered to $380.93, meeting our budget. Savings in all totaled approximately $700. Table 5.2 gives a detailed account of material expenses.

Table 5.2 *Material Costs of Team Gridiron*

ITEM	QUANTITY	RETAIL COST ($)	OUR COST ($)
PLYWOOD	5	42.18	37.96
2X4X8 LUMBER	30	2.78	2.50
BOX WOOD SCREWS	1	29.98	26.98
7/16" BIT	1	7.97	7.17
SAND PAPER	4	0.96	DONATED
ROLLER & PAINT TRAY	1	3.96	DONATED
PAINT GALLON	4	30.99	DONATED
PRIMER	2	23.99	DONATED
SILICON	1	5.92	5.92
PLASTIC ROLL	1	17.14	17.14
CLAY	1	9.73	9.73
ROCK CLIMBING HOLDS	179	3.00	0.25
CORNER BRACE	4	1.73	1.73
CORNER BRACE OFFSET	4	1.66	1.66
1/2-13X4 HEX BOLT	12	0.59	0.59
1/2-13X2-1/12 HEX BOLT	12	0.29	0.29
1/2 LOCK NUTS	24	0.25	0.25
FLAT WASHER	56	0.15	0.15
1/2-6X3-1/2 HEX LAG	8	0.46	0.46
PAINT ROLLERS	1	2.48	2.48
	TOTAL	**$1,126.46**	**$380.93**

5.3.3. Implementation Costs

The implementation costs of the design is measured more so in hours of labor than in dollars. The installation of the design will not cost m1y, but will indeed cost time. 2 eight-hour workdays are needed in order to complete implementation.

5.3.4. Maintenance Costs

Maintenance is designed to be relatively simple, and with the holds provided by Far North Climbing Gym, the frequency of changing/replacing the holds should be at least every 5 years. Before they were taken down, these holds were up for about seven years and showed no sign of deteriorating. There were about 180 holds provided, so replacement cost shouldn't be an issue. By hand, holds should take about 2 minutes each if replacement is necessary. With the help of a drill this process should take seconds. Paint touch-up will be needed about every 2 years, at $25-$30 per can. Table 5.3 gives a list of these tasks, the frequency of replacement, and time it takes to fix.

Table 5.3 *Maintenance Tasks, Frequency, and Time it takes to fix*

MAINTENANCE TASK	FREQUENCY	TIME [HOURS]
Replace Dirty Holds	Mid School Year	0.50
Replace Broken Holds	Immediately	0.30
Change Route	Each School Year	1.00

5.4. Instructions for Implementation & Use of Model

First of all the foundation of the climbing wall, the frame, has to be built. With this, a 2x4x8 feet piece of wood is placed at the top and bottom of the frame. Within those 2 pieces is eight pieces of 2x4x4 feet equally distributed 16 inches apart along the 8ft. long frame vertically. A total of 4 of these frames were constructed in the same way. 4 sheets of 8x4 feet plywood are painted with 2 coats of primer base paint, and when dried, are covered with 2 coats of exterior paint as well as a textured coat. 2 8x2 feet pieces are painted the same way and are designed to cover a gap that will appear at the top of the climbing wall. When the walls are completely dry, they are attached to the constructed frame by drill at least eight points: the 4 corners, 2 points in the middle, and 4 points along each of the 4 sides. With the plywood attached to the frame, holds will be placed according to the body proportions of K-8th graders. Now that the climbing wall is setup it is ready to mount. This is as easy as lining the frame up with the wall it will be mounted on and drilling the frame onto the wall with screws going straight down along the frame.

Figure 5.1 *The Climbing Wall frame after being put together (Team Gridiron 2014)*

5.5. Results

After assembling a prototype of the climbing wall and standing it up vertically, it held together securely. 4 subjects climbed on a quarter Section of the wall and the subjects climbed up and down the structure safely and confidently. The same result should happen when the wall is mounted. There is a pretty long gap that travels through the middle of the climbing wall, but that gap will be sealed with a good amount of caulking material.

Figure 5.2 *Climbing Wall before adding final touches (Team Gridiron 2014)*

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6. Appendices

6.1. Appendix A: Group Member Project Hours

Table 6.1 *Dylan Kinser 10 Week Project Hours*

[All time in hours]						
Date	Task Description	General Course Time		Project Time		Total Course Time
		Task	Total	Task	Total	
9/19/2014	Meeting with client	0.0	0.0	2.5	2.5	2.5
9/20/2014	Brainstorming ideas	0.0	0.0	1.5	4.0	4.0
9/20/2014	Making Trello Profile	0.0	0.0	0.2	4.2	4.2
9/20/2014	Writing Cover Memo	0.0	0.0	0.3	4.5	4.5
9/20/2014	Review of Phase 1	0.0	0.0	0.8	5.3	5.3
9/22/2014	Timesheet #1	0.3	0.3	0.0	5.3	5.7
9/25/2014	Literature Review	0.0	0.3	1.0	6.3	6.7
9/27/2014	Meeting with client	0.0	0.3	1.0	7.3	7.7
9/28/2014	Literature Review	0.0	0.3	2.8	10.1	10.4
9/29/2014	Excel #2	1.0	1.3	0.0	10.1	11.4
9/29/2014	Word Formatting #1	0.5	1.8	0.0	10.1	11.9
9/30/2014	Literature Review/editing	0.0	1.8	4.5	14.6	16.4
10/1/2014	Literature Review editing	0.0	1.8	4.5	19.1	20.9
10/1/2014	Timesheet #2	1.0	2.8	0.0	19.1	21.9
10/2/2014	Literature Review editing	0.0	2.8	1.0	20.1	22.9
10/2/2014	ACAD #1 (2D)	1.0	3.8	0.0	20.1	23.9
10/3/2014	ACAD #1 (3D)	1.5	5.3	0.0	20.1	25.4
10/3/2014	Timesheet #2	0.5	5.8	0.0	20.1	25.9
10/6/2014	Problem Analysis	0.0	5.8	1.0	21.1	26.9
10/7/2014	Gantt Chart	0.0	5.8	3.0	24.1	29.9
10/8/2014	Gantt Chart	0.0	5.8	1.0	25.1	30.9
10/8/2014	Problem Analysis	0.0	5.8	1.0	26.1	31.9
10/9/2014	ACAD #2	1.0	6.8	0.0	26.1	32.9
10/10/2014	Meeting with client	0.0	6.8	0.3	26.3	33.2
10/10/2014	Alternative Solutions	0.0	6.8	1.5	27.8	34.7
10/11/2014	ACAD #2	2.0	8.8	0.0	27.8	36.7
10/13/2014	Alternative Solutions	0.0	8.8	1.0	28.8	37.7
10/14/2014	Alternative Solutions	0.0	8.8	1.0	29.8	38.7
10/15/2014	CADME	0.0	8.8	0.5	30.3	39.2
10/16/2014	Team Evaluations	0.0	8.8	1.0	31.3	40.2
10/17/2014	Meeting with client	0.0	8.8	0.3	31.7	40.5
10/17/2014	Meeting with team	0.0	8.8	1.0	32.7	41.5
10/18/2014	Section 4 - Decision	0.0	8.8	3.5	36.2	45.0
10/18/2014	Timesheet #3	0.5	9.3	0.0	36.2	45.5

10/20/2014	Section 4 - Decision	0.0	9.3	1.5	37.7	47.0
10/22/2014	Team Meeting	0.0	9.3	3.0	40.7	50.0
10/24/2014	Meeting with client	0.0	9.3	0.3	41.0	50.3
10/25/2014	Team Meeting	0.0	9.3	4.0	45.0	54.3
10/27/2014	Timesheet #4	0.2	9.5	0.0	45.0	54.5
11/6/2014	ACAD #3	1.0	10.5	0.0	45.0	55.5
11/6/2014	Team Meeting	0.0	10.5	1.0	46.0	56.5
11/7/2014	Meeting with Client	0.0	10.5	0.8	46.7	57.2
11/9/2014	ACAD #3	0.2	10.7	0.0	46.7	57.4
11/11/2014	Construction	0.0	10.7	7.5	54.2	64.9
11/12/2014	Presentation	0.0	10.7	1.0	55.2	65.9
11/13/2014	Design ACAD	0.0	10.7	4.0	59.2	69.9
11/17/2014	Poster Draft	0.0	10.7	3.0	62.2	72.9
11/19/2014	Project Presentation	0.0	10.7	1.0	63.2	73.9
11/20/2014	Project Presentation	0.0	10.7	1.0	64.2	74.9
12/4/2014	Construction	0.0	10.7	4.0	68.2	78.9
12/5/2014	Meeting with client	0.0	10.7	0.8	69.0	79.7
12/7/2014	Construction	0.0	10.7	3.0	72.0	82.7
12/8/2014	Final Timesheet	0.5	11.2	0.0	72.0	83.2

Table 6.2 *Tony Mitchell 10 Week Project Hours*

Tony Mitchell All time in hours						
Date	Task Description	General Course Time	Total	Project Time	Total	Total Course Time
9/19/2014	Met with client	0.00	0.00	0.75	0.75	0.75
9/20/2014	Team brainstorm	0.50	0.50	1.50	1.50	2.00
9/20/2014	Research	0.00	0.00	1.00	1.00	1.00
9/20/2014	Section 1 writing	0.00	0.00	1.00	1.00	1.00
9/20/2014	Time Sheet	1.00	1.00	0.00	0.00	1.00
9/21/2014	Assignments	1.00	1.00	0.00	0.00	1.00
9/26/2014	Client meeting	0.00	0.00	0.75	0.75	0.75
9/27/2014	Group meeting	0.00	0.00	2.00	2.00	2.00
9/28/2014	Word/Excel/Research	2.50	2.50	2.00	2.00	4.50
9/29/2014	Research	0.00	0.00	1.75	1.75	1.75
9/30/2014	Group meeting	0.00	0.00	2.00	2.00	2.00
9/30/2014	Literature Review	0.00	0.00	1.50	1.50	1.50
10/1/2014	Section 2 writing/editing	0.00	0.00	2.50	2.50	2.50
10/2/2014	Auto CAD in Class	1.50	1.50	0.00	0.00	1.50
10/2/2014	Section 2 Formatting	0.00	0.00	2.00	2.00	2.00
10/5/2014	Auto CAD #1	1.00	1.00	0.00	0.00	1.00
10/6/2014	Meeting	0.00	0.00	0.25	0.25	0.25
10/7/2014	Meeting	0.00	0.00	0.50	0.50	0.50

10/8/2014	Meeting Far North…	0.00	0.00	0.75	0.75	0.75
10/8/2014	Letter For Donations	0.00	0.00	1.50	1.50	1.50
10/9/2014	Drawings For Justin	0.00	0.00	1.00	1.00	1.00
10/10/2014	Drawings For Justin	0.00	0.00	0.75	0.75	0.75
10/10/2014	Client Meeting	0.00	0.00	0.25	0.25	0.25
10/11/2014	Alternative solutions	0.00	0.00	1.50	1.50	1.50
10/11/2014	CAD 3D #1	0.45	0.75	0.00	0.00	0.75
10/12/2014	Auto CAD #2	1.45	1.75	0.00	0.00	1.75
10/12/2014	Word	0.25	0.50	0.00	0.00	0.50
10/13/2014	Alternative Solutions	0.00	0.00	1.00	1.00	1.00
10/14/2014	Alt. Solutions Drawings	0.00	0.00	1.75	1.75	1.75
10/15/2014	Evaluations	2.00	2.00	0.00	0.00	2.00
10/15/2014	Meeting	0.30	0.30	0.50	0.50	0.80
10/16/2014	Meeting with Lonny	0.00	0.00	0.00	0.00	0.00
10/16/2014	Meeting with Group	0.00	0.00	0.75	0.75	0.75
10/17/2014	Client/Group meeting	0.00	0.00	0.00	0.00	0.00
10/18/2014	Group Meeting	0.00	0.00	4.00	4.00	4.00
10/19/2014	Excel	0.50	0.50	0.00	0.00	0.50
10/21/2014	Visit Montessori	0.00	0.00	1.00	1.00	1.00
10/22/2014	Meeting	0.00	0.00	2.50	2.50	2.50
10/23/2014	Group Discussion	0.00	0.00	1.50	1.50	1.50
10/24/2014	Client Meeting	0.00	0.00	0.75	0.75	0.75
10/25/2014	Group Meeting	0.00	0.00	2.00	2.00	2.00
10/25/2014	Visiting Companies	0.00	0.00	3.00	3.00	3.00
10/29/2014	After Class Discussion	0.00	0.00	0.50	0.50	0.50
10/30/2014	Picking up Donations	0.00	0.00	0.75	0.75	0.75
10/31/2014	Client Meeting	0.00	0.00	0.75	0.75	0.75
10/31/2014	Research	0.00	0.00	1.50	1.50	1.50
11/1/2014	Visit Montessori	0.00	0.00	2.50	2.50	2.50
11/4/2014	Donations Inquire	0.00	0.00	4.00	4.00	4.00
11/6/2014	CAD	0.00	0.00	1.50	1.50	1.50
11/6/2014	Far North Climbing	0.00	0.00	0.75	0.75	0.75
11/6/2014	Shopping for materials	1.00	1.00	1.50	1.50	2.50
11/7/2014	CAD Design	0.00	0.00	2.75	2.75	2.75
11/7/2014	Client Meeting	0.00	0.00	0.75	0.75	0.75
11/8/2014	Group meeting	0.00	0.00	1.00	1.00	1.00
11/9/2014	CAD, TimeSheet	2.00	2.00	0.00	0.00	2.00
11/10/2014	Climbing hold design	0.00	0.00	4.00	4.00	4.00
11/11/2014	Donations Inquire	0.00	0.00	0.50	0.50	0.50
11/11/2014	Gathering Materials & Building	0.00	0.00	8.00	8.00	8.00
11/13/2014	Presentation	2.00	2.00	0.00	0.00	2.00

11/14/2014	Presentation	2.00	2.00	0.00	0.00	2.00
11/14/2014	Research	0.00	0.00	2.00	2.00	2.00
11/15/2014	Research/Specifications	0.00	0.00	5.00	5.00	5.00
11/17/2014	Group meeting	0.00	0.00	0.25	0.25	0.25
11/19/2014	Group meeting	0.00	0.00	0.25	0.25	0.25
11/20/2014	Building/ Presentation	0.00	0.00	5.25	5.25	5.25
11/21/2014	Client Meeting	0.00	0.00	0.45	0.45	0.45
12/2/2014	Building	0.00	0.00	0.25	5.00	5.00
12/4/2014	Visit to Montessori	0.00	0.00	0.25	3.25	3.25
12/5/2014	Group/Client Meeting	0.00	0.00	0.25	1.00	1.00
12/6/2014	Group Meeting	0.00	0.00	2.00	2.00	2.00
12/7/2014	Building	0.00	0.00	0.25	2.50	2.50
		Totals	13.30		101.70	122.00

Table 6.3 *Greg Olivas 10 Week Project Hours*

TEAM GRIDIRON - GREGORY OLIVAS						
All time in hours						
Date	**Task Description**	**General Course Time**		**Project Time**		**Total Course Time**
		Task	**Total**	**Task**	**Total**	
19-Sep-14	**Meet Client**	1.0	1.0	1.0	1.0	2.0
20-Sep-14	**Team Brainstorm**	2.0	3.0	2.0	3.0	6.0
20-Sep-14	**Time Sheet**	1.0	4.0	0.0	3.0	7.0
26-Sep-14	**Meet Client**	1.0	5.0	1.0	4.0	9.0
27-Sep-14	**Literary Review**	5.0	10.0	5.0	9.0	19.0
28-Sep-14	**Literary Review**	3.0	13.0	3.0	12.0	25.0
29-Sep-14	**Literary Review**	2.0	15.0	2.0	14.0	29.0
30-Sep-14	**Literary Review**	2.0	17.0	2.0	16.0	33.0
2-Oct-14	**Literary Review**	1.5	18.5	1.5	17.5	36.0
4-Oct-14	**Time Sheet**	0.5	19.0	0.0	17.5	36.5
5-Oct-14	**AutoCad**	2.0	21.0	0.0	17.5	38.5
6-Oct-14	**Team Meeting**	0.0	21.0	2.0	19.5	40.5
7-Oct-14	**Phase III**	1.0	22.0	1.0	20.5	42.5
8-Oct-14	**Meet Matt Deshazo**	0.0	22.0	1.0	21.5	43.5
8-Oct-14	**Phase III**	1.0	23.0	1.0	22.5	45.5
9-Oct-14	**AutoCad**	0.5	23.5	0.0	22.5	46.0
10-Oct-14	**Meet Client**	0.0	23.5	0.8	23.3	46.8
12-Oct-14	**AutoCad**	2.0	25.5	0.0	23.3	48.8
12-Oct-14	**Word Assignment**	1.0	26.5	0.0	23.3	49.8
13-Oct-14	**Alternative Solutions**	1.5	28.0	1.5	24.8	52.8

14-Oct-14	**Team Meeting**	0.0	28.0	1.0	25.8	53.8
15-Oct-14	**CatMe Survey**	0.5	28.5	0.5	26.3	54.8
15-Oct-14	**Team Evaluation**	2.0	30.5	2.0	28.3	58.8
15-Oct-14	**Team Meeting**	0.0	30.5	1.0	29.3	59.8
16-Oct-14	**Team Meeting**	0.5	31.0	0.5	29.8	60.8
17-Oct-14	**Meet Client**	0.0	31.0	0.5	30.3	61.3
18-Oct-14	**Phase IV**	4.3	35.3	4.3	34.5	69.8
18-Oct-14	**Time Sheet**	1.0	36.3	1.0	35.5	71.8
19-Oct-14	**Final Decision**	1.0	37.3	1.0	36.5	73.8
23-Oct-14	**Donations Request**	0.0	37.3	0.5	37.0	74.3
24-Oct-14	**Meet Client**	0.0	37.3	1.0	38.0	75.3
25-Oct-14	**Team Meeting**	2.0	39.3	2.0	40.0	79.3
7-Nov-14	**Meet Client**	0.0	39.3	1.0	41.0	80.3
8-Nov-14	**Team Meeting**	1.0	40.3	1.0	42.0	82.3
11-Nov-14	**Team Meeting**	0.0	40.3	7.5	49.5	89.8
12-Nov-14	**Project Presentation**	2.0	42.3	2.0	51.5	93.8
13-Nov-14	**Project Presentation**	1.0	43.3	1.0	52.5	95.8
14-Nov-14	**Meet Client**	0.0	43.3	1.0	53.5	96.8
15-Nov-14	**Team Meeting**	0.0	43.3	2.0	55.5	98.8
17-Nov-14	**Appropedia Page**	1.0	44.3	1.0	56.5	100.8
19-Nov-14	**Project Presentation**	1.0	45.3	1.0	57.5	102.8
20-Nov-14	**Project Presentation**	0.5	45.8	0.5	58.0	103.8
23-Nov-14	**Appropedia Page**	2.0	47.8	2.0	60.0	107.8
28-Nov-14	**Appropedia Page**	2.0	49.8	2.0	62.0	111.8
1-Dec-14	**Appropedia Page**	2.0	51.8	2.0	64.0	115.8
4-Dec-14	**Team Meeting**	0.0	51.8	5.5	69.5	121.3
5-Dec-14	**Meet Client**	0.0	51.8	1.0	70.5	122.3
6-Dec-14	**Team Meeting**	0.0	51.8	2.0	72.5	124.3
7-Dec-14	**Team Meeting**	0.0	51.8	4.0	76.5	128.3
7-Dec-14	**Appropedia Page**	3.0	54.8	3.0	79.5	134.3
7-Dec-14	**Time Sheet**	0.8	55.5	0.0	79.5	135.0

***Table 6.4** Miquan Johnson 10 Week Project Hours*

Miquan Johnson						
(All time in Hours)						
Date	Task Description	General Course Time		Project Time		Total Course Time
		Task	Total	Task	Total	
9/19/2014	Met with the client(s)	0.00	0.00	0.75	0.75	0.75

9/20/2014	Team Brainstorm	0.00	0.00	1.50	2.25	2.25
9/20/2014	Research structure designs	0.30	0.30	0.75	3.00	3.30
9/20/2014	Sec 1 Outline	0.50	0.80	1.00	4.00	4.80
9/21/2014	Time Log	0.50	1.30	0.00	4.00	5.30
9/22/2014	Organize Section 1 for submission	0.00	1.30	0.75	4.75	6.05
9/24/2014	Research possible materials	1.50	2.80	0.00	4.75	7.55
9/25/2014	Visit library to find research books	0.00	2.80	0.75	5.50	8.30
9/26/2014	Writing portion of Sec. 2	0.00	2.80	2.00	7.50	10.30
9/28/2014	Excel Time spreadsheet (1)	1.00	3.80	0.00	7.50	11.30
9/28/2014	Word Format #1	0.50	4.30	0.00	7.50	11.80
9/28/2014	Writing portion of Sec. 2	0.00	4.30	7.00	14.50	18.80
9/29/2014	Cite sources and get figures	0.00	4.30	2.00	16.50	20.80
9/30/2010	Organize members' portions into Lit. Rev.	0.00	4.30	2.00	18.50	22.80
10/2/2014	Organize Lit. Rev.	0.00	4.30	2.00	20.50	24.80
10/3/2014	Look over problem analysis	0.20	4.50	0.00	20.50	25.00
10/5/2014	Excel Time spreadsheet (2)	0.75	5.25	0.00	20.50	25.75
10/6/2014	Problem Analysis	0.00	5.25	1.00	21.50	26.75
10/8/2014	Gantt Chart	0.00	5.25	1.00	22.50	27.75
10/8/2014	Problem Analysis	0.00	5.25	0.50	23.00	28.25
10/9/2014	Word Format #2	0.50	5.75	0.00	23.00	28.75
10/10/2014	Meeting with client	0.00	5.75	0.50	23.50	29.25
10/10/2014	Alternative Solutions	0.00	5.75	1.50	25.00	30.75
10/12/2014	ACAD #2	2.00	7.75	0.00	25.00	32.75
10/14/2014	Alternative Solutions	0.00	7.75	1.00	26.00	33.75
10/15/2014	CADME	0.00	7.75	0.75	26.75	34.50
10/16/2014	Team Evaluations	0.00	7.75	1.00	27.75	35.50
10/17/2014	Meeting with client	0.00	7.75	0.50	28.25	36.00
10/18/2014	Meeting with team	0.00	7.75	0.50	28.75	36.50
10/19/2014	Excel Time spreadsheet (3)	0.00	7.75	0.75	29.50	37.25
10/22/2014	Discussed design of wall	0.00	7.75	0.50	30.00	37.75

10/23/2014	Went over delphi chart & next plans w/ Lonny	0.00	7.75	1.00	31.00	38.75
10/24/2014	Met with client & spoke briefly	0.00	7.75	0.50	31.50	39.25
10/25/2014	Went to locations, asked questions & for donations	0.00	7.75	2.00	33.50	41.25
10/26/2014	Word Format #3	0.75	8.50	0.00	33.50	42.00
10/30/2014	Draw up designs for client	0.50	9.00	0.00	33.50	42.50
10/31/2014	Met with client	0.00	9.00	0.75	34.25	43.25
11/6/2014	ACAD #3	1.00	10.00	0.00	34.25	44.25
11/8/2014	Met with group	0.00	10.00	1.00	35.25	45.25
11/9/2014	Excel Time spreadsheet (4)	0.75	10.75	0.00	35.25	46.00
11/11/2014	Began construction of wall	0.00	10.75	8.00	43.25	54.00
11/14/2014	Meeting with client	0.00	10.75	0.50	43.75	54.50
11/14/2014	Meeting with team	0.00	10.75	0.50	44.25	55.00
11/15/2014	Section V Draft	0.00	10.75	3.00	47.25	58.00
11/16/2014	Section V Draft	1.00	10.75	0.00	47.25	58.00
11/18/2014	Presentation	2.00	12.75	0.00	47.25	60.00
11/19/2014	Presemtation	1.30	14.05	0.00	47.25	61.30
11/20/2014	Presentation	0.00	14.05	2.00	49.25	63.30
11/1/2014	Section V edits	1.00	15.05	0.00	49.25	64.30
11/4/2014	Building	0.00	0.00	4.00	53.25	68.30
11/7/2014	Building	0.00	0	2.30	55.55	69.00

6.2. Appendix B: Brainstorming Sessions

6.2.1. Brainstorming Session (1)

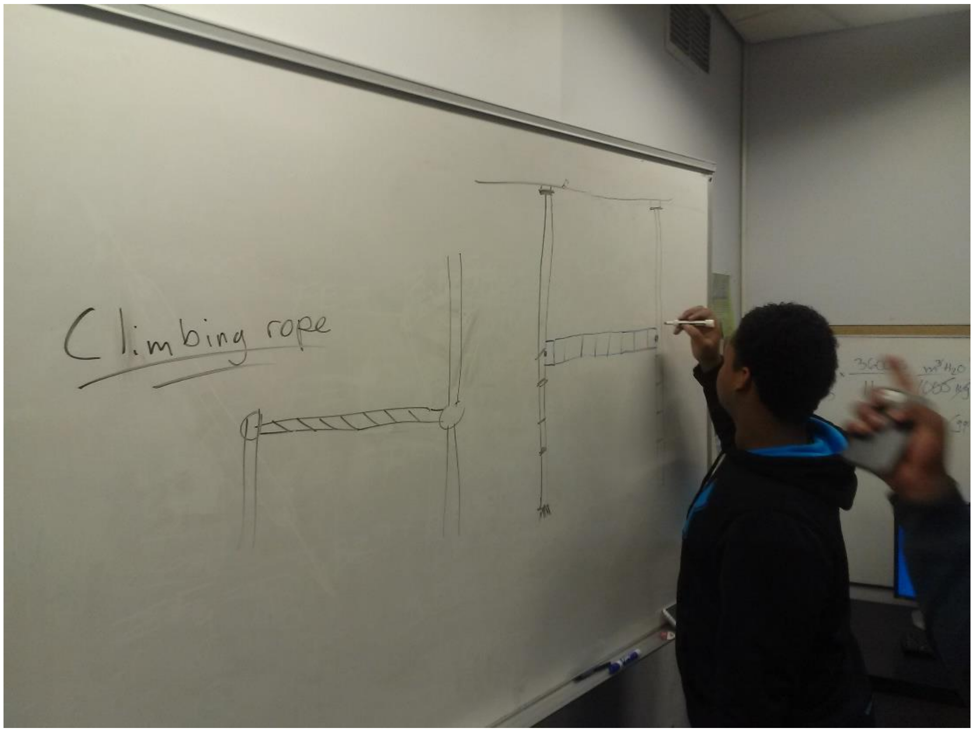

Figure 6.1 Tony Mitchell proposing a Climbing Rope

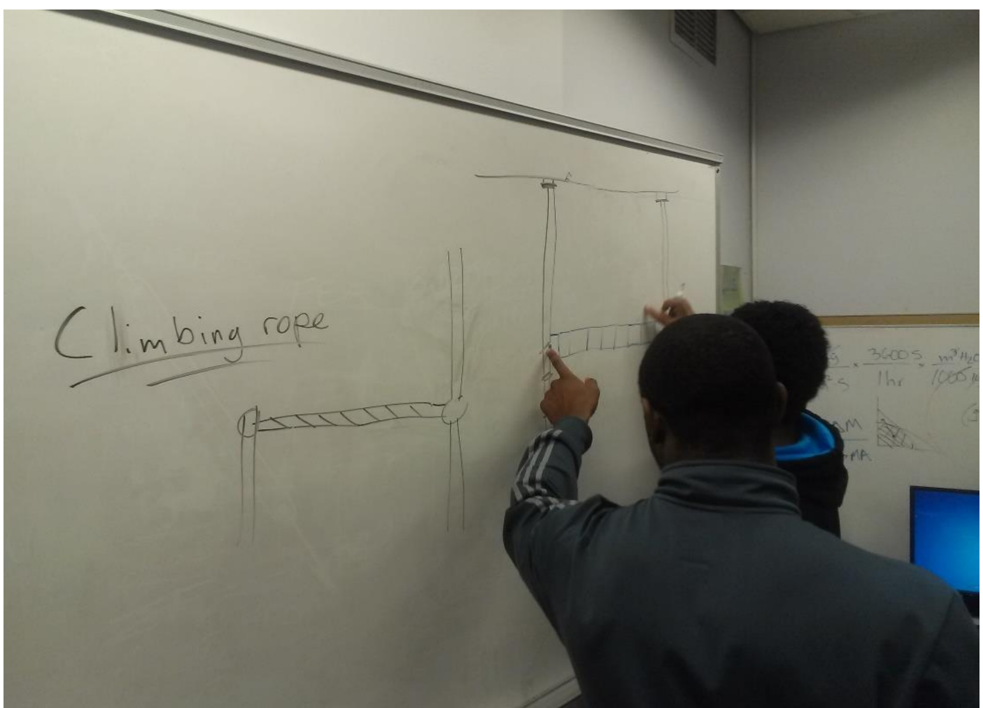

Figure 6.2 Tony Mitchell and Miquan Johnson discussing a Climbing Rope

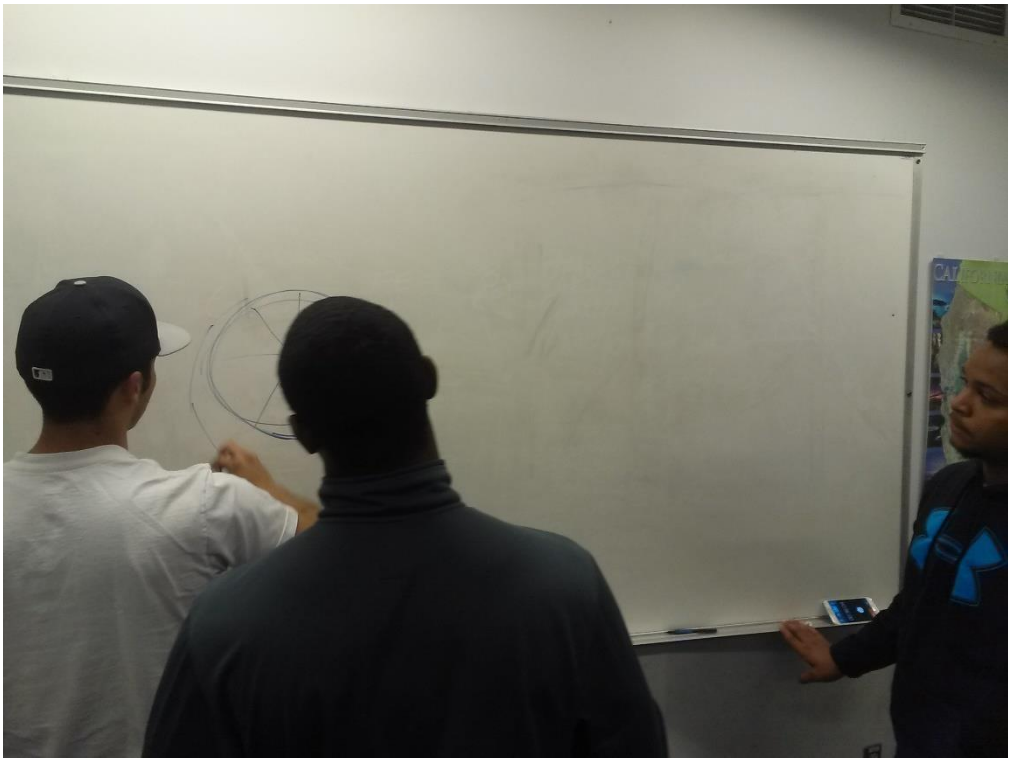

Figure 6.4 *Tony Mitchell, Miquan Johnson, and Greg Olivas brainstorm a Merry Go Round*

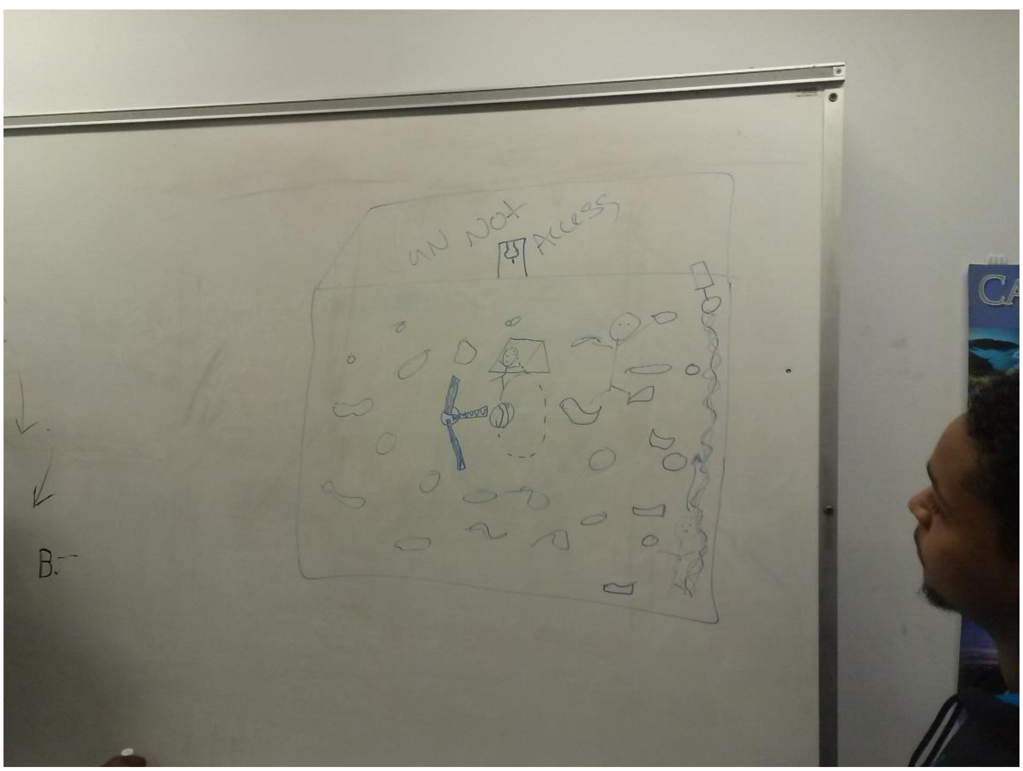

Figure 6.3 *Tony Mitchell discussing an elaborate Traversing Wall with the team*

6.2.2. Brainstorming Session (2)

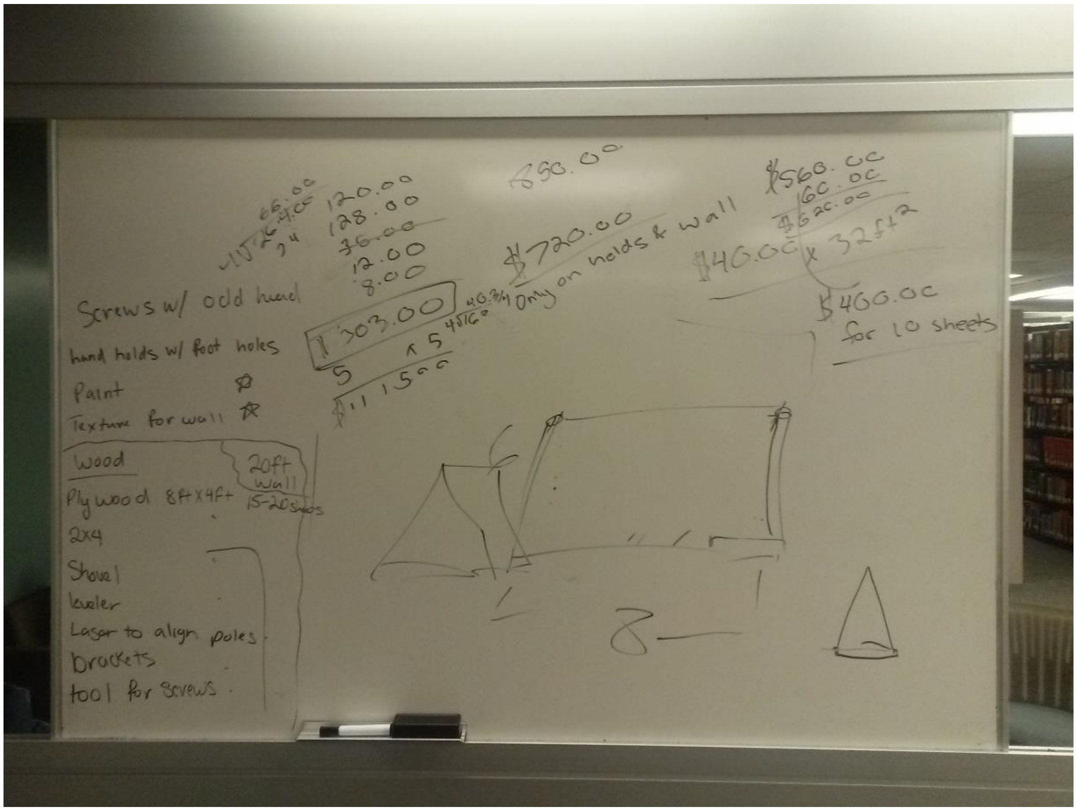

Figure 6.5 A "What If" brainstorming session on costs of an Outdoor Climbing Wall