Los Pollos Hermanos

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1 Problem Formation

1.1 Introduction

This paper is a detailed explanation of the class project undertaken by Humboldt State University's engineering 215 class, Introduction to Design. Working in collaboration with the Redwood Coast Montessori school, a problem was presented to the engineering class and then a solution was formulated and enacted. Redwood Coast Montessori is a public charter school that was founded in the fall of 2005. The school is on an old Eureka public school campus that became a community center for the Samoa peninsula. In June 2012, Arcata School District accepted Redwood Coast Montessori's independent charter school application to become a K-8 public school. Redwood Coast Montessori currently has 80 students enrolled and is located near coastal dunes in the community of Manila, outside of Eureka, California on the Pacific north coast. Redwood Coast Montessori teaches its students in a natural way, and teaches them to be environmentally friendly. Students spend long uninterrupted schoolwork time to follow their own interests as they work their way through the given curriculum. The description of the design process for this project is simplified in a black box model shown in Figure 1.1.

1.2 Objective Statement

The objective of this project is to design and build a chicken coop capable of housing up to 12 chickens for Redwood Coast Montessori. The design of the chicken coop will allow the students to safely gather eggs from the coop and care for the chickens. In addition, the coop should offer protection from predators and be durable enough to last in the coastal environment around Redwood Coast Montessori.

Figure 1.1: The Black Box model shows the state of the world before the project is completed and the state of the world after the project is completed.

2 Problem Analysis and Literature Review

2.1 Introduction

Section 2 covers an analysis of the initial problem as well as all of the literature and information reviewed while doing research for the chicken coop project. This is includes, but is not limited to, information regarding how to build a coop, good coop designs, chicken lifestyle and habits, diet, predatory dangers and prevention, and the local ecosystem.

2.2 Problem Analysis

The problem analysis presents information regarding specifications and considerations for the chicken coop. The coop must be designed in accordance with certain criteria developed between the Los Pollos Hermanos and Redwood Coast Montessori. These are presented in further detail in this section.

2.2.1 Specifications and Considerations

Considerations and Specifications are guidelines that have been delineated for the scope of the chicken coop project and were formulated in conjunction with Redwood Coast Montessori. Considerations cover ideas that Redwood Coast Montessori would prefer to have incorporated into the chicken coop design, while specifications are details that have been considered vital to the construction of the coop.

The specifications that were outlined by the Redwood Coast Montessori are as follows:

- Coop must be usable by children and possibly just 4^{th}-6^{th} graders
- Ensure that the structure will last for many years with little to no maintenance
- Chickens will be living in the run
- Run must be movable and only take about a weekend to do so
- Must house around twelve chickens

The considerations include**:**

- Designing the coop to be easy to clean and maintain
- Scaling features of the coop to make accessibility easier for children
- The dune ecosystem and Pacific north coast climate

2.2.2 Criteria and Constraints

Criteria consists of the parameters that define what must be considered when constructing the chicken coop. The constraints delineate the limits of these parameters. Criteria and constraints for this project are listed in table 2.1.

Table 2.1: Criteria and constraints

Criteria	Constraints
Cost	Limited to $400 in total ($75 per group member and $100 from Montessori)
Safety	Children will be using this product, and their safety comes first The coop design should ensure that there will be no chickens killed by predators
Durability	Must stay structurally sound for at least a decade in coastal dune environment and from regular use
Sustainability	Use of recycled materials is extensive
Movability	Run must be movable within a weekend of work
Ease of use	Must be used with ease every day by children
Education	Must provide some educational value for children

2.3 Redwood Coast Montessori

Redwood Coast Montessori is a public charter school that was founded in the fall of 2005. The school is located on an old Eureka public school campus that became a community center for

the unincorporated community of Manila, located on the Samoa peninsula. In June 2012, Arcata School District accepted Redwood Coast Montessori's independent charter school application to become a K-8 public school. Redwood Coast Montessori currently has 80 students enrolled and is located near dunes on the Pacific coast (Redwood Coast Montessori 2014). Redwood Coast Montessori employs the Montessori philosophy, teaching its students in a way that emphasizes their natural psychological development, and teaches them to be environmentally friendly. Students spend long, uninterrupted schoolwork time to follow their own interests as they work their way through the given curriculum. Redwood Coast Montessori's director wants a chicken coop for educational purposes and plans to educate the 4th-6th graders with it.

2.4 Dune Ecosystem

A coastal sand dune ecosystem, located as it is right along the ocean coastline, is a dynamic environment, subject to strong winds, tidal systems and salty air. Dune morphology is the science behind what makes these ecosystems possible. Several factors are necessary for proper dune formation. These include prevailing shoreward winds above a certain velocity, called the threshold wind velocity, a constant supply of sand, and an obstacle or tree line to decrease the velocity of wind to capture the sand (Maun 2009). These conditions, as well as the dune formation, vary from beach to beach all over the globe. The shape of a dune is determined by the type of colonizing plant species (Maun 2009). Plants can grow horizontally and vertically to combat getting buried beneath the sand (Maun 2009). As Redwood Coast Montessori is located right along the edge of a coastal dune system, it is very important to know how this environment will affect a chicken coop and the chickens housed within it. Between abrasive sand blown about by the wind and the high salt content of the air, this is a rather corrosive environment and must be taken into consideration during the construction of the chicken coop.

2.5 Chicken Safety and Predator Mitigation

Due to chickens being an essentially flightless bird confined to a limited space in a very specific area, they are very susceptible to the predations of local mammals. Raccoons, in particular, are especially attracted to chicken coops. Research indicates that the presence of chickens in a yard increases the likelihood of raccoons visiting the yard. (Kays 2014) Conversely the presence of dogs in the yard reduces the presence of raccoons and most other mammals in said yard. Thusly, the strategic placement of a chicken coop closer to dogs in a yard potentially gives the chickens added protection from mammalian predators. (Kays 2014)

2.5.1 Chili Powder

Chili Powder (*Capsicum Annum*) can be used to deter predators from chicken eggs and chicken feed. Although it is not a method that appears to be one hundred percent effective, it does appear to reduce the rate of predation upon eggs by small mammals such as rats. Although mammals find the chili to be unpleasant, birds appear to be unaffected by it, making it a non-invasive method of protecting chicken eggs and keeping rodents out of chicken feed. Repeated

use of chili on fake eggs decreases the overall predation of all eggs in the nest. The possible effects of the chili on chicken embryos has not been thoroughly studied. For those who would prefer to deter rodents without the use of poison or traps, this is a potentially viable alternative. (Baylis 2012)

2.5.2 Cannibalism and Chicken Health

The psychological and physiological health of the chicken is important for the prevention of various maladies, cannibalism being among these. To keep chickens from getting bored and aggressive, they need space to run around outside and access to ground where they can peck and scratch. In the coop, adequate spacing is important, especially adequate space on the perch. Having an area of open, vegetation free ground is also important as chickens take dust baths to cleanse themselves of parasites, and helps reduce the likelihood that they will start pecking each other. A proper diet is also important, as that will also reduce the likelihood of chickens pecking each other. Chickens may also eat chicken eggs if provided the opportunity. Consequently rodent control is of vital importance. If a rodent breaks into an egg and leaves some yolk behind, the chicken may eat it and gain a taste for egg. Once that occurs, it is very likely that the chicken will begin breaking eggs open them self to eat the yolk. This is a situation difficult to mitigate, this it is best to prevent it in the first place. (Damerow 1995) (Jarrett)

2.5.3 Roosters and Predator Mitigation

One of the benefits of having a flock with a rooster is that the rooster will help protect the chickens from predators. Roosters are quite aggressive and are equipped with a beak and sharp spurs on the back of their legs which are suitable for fighting off smaller predators. Roosters become possessive of their flock and will be aggressive in defending it. They will also scan the skies and alert chickens to when predatory birds are in the vicinity. In addition to warning the flock and defending against predators, roosters will also assist hens in finding food.(Wilderness-Survival.net 2014)(Lesa 2011)(Homesteading Today 2015)

2.6 Chicken Diet

A proper diet is of upmost importance for raising healthy chickens. The two components of a proper chicken diet are water and feed. Clean and readily available water is very important for healthy chickens. This is especially important when chickens are laying eggs, as a chicken egg contains a lot of water in it. A chicken normally consumes 1 to 2 cups of water per day at minimum. If they are laying then they will need more water. (Damerow 1995)

Chickens possess a robust diet and consume a large variety of foods. When allowed to roam free, there are many plants and insects that chickens will consume. It is also a common practice to feed kitchen scraps to chickens. Most typically, chickens are given a prepared feed that can be bought at any local feed store. Chicken feed usually comes in either pellet or crumble form and possess all of the nutrients and vitamins necessary for raising a healthy chicken. (Damerow 1995)

2.7 Children and Animal Husbandry

Several items are important to the successful implementation of a chicken-rearing program. Children must be given the opportunity to participate in the work and the children must be allowed to share the benefits. Instruction and responsibilities must start with basic concepts and tasks and grow increasingly more complex as the children learn and assume responsibility. Students will learn more from the raising of chickens if there are correlations with the children's regular subjects. Building a chicken coop can be an excellent learning experience for children, thus children should be included in the construction process as much as is safely allowable. Additionally, children should be included in the aesthetic portion of the design process, in order to provide the students with a higher degree of ownership over the chicken coop. Student's interest and quality of work in relation to the chickens can be expected to vary. The process of raising chickens can make evident strengths and weaknesses of children, some that were less evident prior to their participation in chicken rearing. If chicks are being raised it is possible that in the normal course of events, some of the chicks may die before reaching adulthood; this event can be upsetting to some children, but it can also serve as a learning experience. The process of chicken rearing is time consuming and school staff should be prepared to allocate time to the process (Baldwin 1909).

2.8 Building Materials

This section covers materials commonly used in constructing a chicken coop and chicken run.

2.8.1 Lumber

2.8.1.1 Garden Grade

The subcategories for the garden grade are heartwood and sapwood. Heartwood is found at the core of the tree, while the sapwood is located on the outer part of the tree enclosing the heartwood. Figure 2.1 is a cross-section of a tree, illustrating where the heartwood and sapwood are located in a tree, relative to each other. The heartwood has two subdivisions, construction and merchantable. Construction heart is used in areas such as decks, fences, and walls where there is possible contact with water, soil and insects. Merchantable heart is the inexpensive version of construction heart and is used in comparable situations. (ehow.com)

Figure 2.1: Picture of cross section of a tree showing location of Sapwood and Heartwood (extension.umn.edu)

2.8.2 Treatments

In today's era of lumber construction, experiments and common practice have shown that wood preservatives are highly toxic to wood destroying organisms making the structure last longer in harsher environments. Deterioration of wood used in construction is commonly caused by decay fungi; certain insects, which include termites and carpenter ants, other organisms and weathering. Of this list, fungi are the most destructive to any service lumber. (Hoffman, et al; extension.umn.edu)

2.8.2.1 Non-pressure Treatments

A wide variety of non-pressure treatments have been developed, each differing in the retentions and saturations obtained. Non-pressure methods include the thermal process, which involves heated and cooled baths that expand and retract the air inside the wood, pulling in the preservatives and with a vacuum seal the preservatives, curing the lumber. In addition to the thermal process, there are superficial treatments, which include brushing, spraying, or dipping wood in preservative for short periods of time. These treatments, although, are ideal for drier climates. (Hoffman, et al; extension.umn.edu)

2.8.2.2 Pressure Treatment

Pressure treatments force preservatives, such as oil or waterborne preservatives, into wood under higher than atmospheric pressures. In many species, deeper and more uniform penetrations and higher retentions are possible than when using non-pressure methods. Properly pressure treated wood is desirable for use in environments of high decay hazard which is suitable for coastal areas. (Hoffman, et al; extension.umn.edu)

2.8.3 Litter/Bedding

The litter used in chicken coops can range from pine shavings, hay, or straw. It is used as bedding for the chickens, but more importantly, the litter that is used can absorb moisture and take down odor that accumulates. (Luttmann p.21)

2.8.3.1 Deep Litter Method

The deep litter method is one sustainable method of managing chicken litter within the chicken coop itself. In the deep litter method, a compost pile is formed directly on the floor of the coop. As new layers of bedding and chicken waste accrue, the litter can be composted as normal with the chicken manure which is rich in nitrogen. (smallfarm.about.com)

2.8.3.2 Wire mesh

Wire mesh can be used all through a chicken coop as an effective barrier between a perch and a dropping pit. As manure accumulates in the litter below the perch, the wire mesh keeps the chickens from contact with the droppings, helping to reduce the chance of disease within the flock. (Luttermann p.20)

2.8.4 Roofing

Communal roofing is frequently composed of tarpaper, which is prepared by infusing tar into either paper or a fiberglass mat. This provides a waterproof effect that can ensure moisture control. (articles.chicagotribune.com)

2.8.5 Plastics

Plastics have numerous properties such as: transparency; litheness; pliability; permeability; water resistance; and electrical resistance. Plastic, although, has little resistance to ultraviolet radiation, which results in the corrosion of the material after several years. The denser the plastic is, the longer it takes to become fragile under the results of UV rays (Dynalab Corp 2011).

2.8.6 Sealants

Wood can be protected from water, sun, and burrowing insects by applying a sealant. Many sealants contain toxic chemicals. Natural sealants can be made using various combinations of natural products. Beeswax and olive oil can be combined to form an effective natural wood sealant. (Nyquist 2012)(Shreejan 2014)

2.8.7 Paint Primer

When painting a surface, it is crucial to place a primer coat before painting. A primer will help adhere the paint to the surface without letting the paint leech into the material painting. When painting wood, it is very important to apply a primer coat to ensure that the paint smears evenly. The primer acts like a watertight seal between the two. (todayshomeowner.com)

2.9 Construction

This section covers several construction methods and the various factors that must be taken into consideration when building a chicken coop and run.

2.9.1 Up-cycling/ Green Techniques

Up-cycling involves obtaining materials that are considered waste or items that are no longer in use and turning them into something new (Hipcycle.com). A green building is built with the idea of long term effect of the materials used taken into respect in order to diminish waste and to upturn energy and resource efficiency. By using materials that are recycled, domesticated, or sustainably attained, the general impact and potential exhaustion of natural resources can be decreased. In many cases there is greater resourcefulness and flexibility in the allowances made regarding structure design and change when building green (calrecycle.ca.gov).

2.9.2 Coop and Run

Chicken coop size directly impacts the bird's health and quality of life. Various types of problems develop when chickens do not have enough space. Disease develops and spreads more rapidly, and psycho-emotional problems, such as aggression, tension and bullying develops more readily (Natural Chicken Keeping 2013). The chicken run is an enclosed

outdoor area, often attached to the coop itself, where the chickens are allowed to roam about, yet are prevented from wandering all over the local landscape, while also being protected from local predators. Figure 2.2 illustrates and example of a chicken coop and associated run.

Figure 2.3: Example of a chicken coop and run (http://www.homegardendesignplan.com/2012/02/l101u-free-chicken-coop-plans-how-to.html)

2.9.3 Coop Size

Two to three square feet per chicken is a standard living condition for adult chickens. (Backyard Chickens 2014). In regards to the height of the coop, a low height will conserve heat, while a coop that is taller will be easier to clean. If a low roof is chosen, a hinged roof will make it easier to access the interior of the coop. (Damerow 1995)

2.9.4 Nesting Boxes

Within the coop are the nesting boxes. Size for nesting boxes are at least one square foot, big enough for chicken to stand up in. two-four hens per box (Backyard Chickens 2014). Allow for one box per three to four hens. (Natural Chicken Keeping 2013), (Damerow 1995) A perch just in front of, and below the nests acts as a kind of doormat for the nests. Elevating nests, and placing them in the darkest area of the coop's interior serves to discourage scratching in the nests and reduces egg breakage. Nesting boxes that extend outwards from the interior walls allow for increased interior floor space and can also facilitate easier egg collection and nest cleaning (Damerow 1995).

2.9.5 Roosts/perches

Roosts should be at least one to two feet above the floor of the coop, and hens should have at least one foot of clearance above their heads (Backyard Chickens 2014). Perches should be at least 12" to 18" away from walls to allow for head and tail space. There should be 9" of perch

length per medium sized chicken, and 12” of perch length per large chicken. Allow for a minimum of 18” to 24” of space above a perch. Rounded 2” x 2” boards work well for medium sized chickens. Large chickens like 4” side of 2”x4” boards. Corners of perches should be rounded (Natural Chicken Keeping 2013). If multiple perches are used, keep the perches separated by 18” horizontally. An alternative arrangement for multiple perches, is to space them apart 12” horizontally and 12” vertically, creating an ascending or descending arrangement of perches that the chickens can hop between. Perches should be removable to facilitate cleaning. An old wooden ladders often work well as a perch. Avoid using metal or plastic for perches (Damerow 1995).

2.9.6 Chicken Run Size

Adequate chicken run size is also critical for chicken health and welfare. The run is enclosed, or fenced, typically by chicken wire. Runs may or may not have an enclosed top. If enclosed, it is best to use chicken wire or something similar, in order to give the birds a sense of space. Generally chickens do not like to get wet, nor is it healthy for them to remain wet for extended periods of time, so a portion of the run should have a covered “ceiling”. Four to ten square feet per bird is recommended and Seven and a half sq. ft. for a medium sized chicken, and 10 sq. ft. for a large chicken. (Backyard Chickens 2014) (Natural Chicken Keeping 2013)

2.9.7 Chicken Run Care

Runs composed of sand should be raked daily to smooth out holes, and collect droppings and debris. Pathogens can becomes concentrated in a heavily used yard. One way to reduce this is through run rotation. (Damerow 1995)

2.9.8 Drainage

Drainage must keep out rodents, wild birds, and other predatory animals.
A droppings pit will help maintain the interior in a sanitary condition. (Damerow 1995)

2.9.9 Ventilation

Proper ventilation can ventilate the interior of the coop and offer wind and sun protection. Placing ventilation holes high on the Northern and Southern walls will allow moist warm air to escape, and it will facilitate cross ventilation during hot weather. Cross ventilation can reduce coop humidity and cool air interior air. Ventilation structures must keep out rodents, wild birds, and other predatory animals. Therefor screens on vents and vent covers should be latched to keep predators out. Fans can facilitate ventilation during hot summer months. (Damerow 1995)

2.9.10 Doors and Windows

If the coop height is low there should be a chicken door that is approximately 10” by 13” cut into the side of the wall. All doors and windows should be securable, to keep predators out. If the coop is high enough, a door should be made for humans. South facing windows will receive more light and facilitate quicker drying time after a rain. Provide one square foot or more of window space, for every ten square feet of floor space. Screens should be ¾” to keep out predators. (Damerow 1995)

2.9.11 Sanitation and Chicken Health

Adequate ventilation will reduce interior carbon dioxide, ammonia, and dust. Dropping boards allow droppings to fall through to the ground, reducing the interior ammonia concentrations, and making the cleaning process easier. Dropping boards and perches should be removable to facilitate cleaning. Wet or damp litter should be removed promptly, to reduce humidity and microbial growth. (Damerow 1995)

2.9.11.1 Coop and Run Sanitation

Proper waste management is very important for both the health of the chickens and the humans that may be handling them. Reduced exposure to chicken feces reduces the chance of disease in chickens themselves. Additionally, proper sanitary precautions must be observed when handling chickens, chicken eggs and chicken manure. If the chicken manure is to be composted, measures must be taken to be sure that all potential pathogens are killed before using the compost for whatever application. Chicken feed must be protected from rodents to prevent contamination. The presence of raccoons can also lead to disease humans through contamination of the chicken run or any area that may be accessed by both raccoons and chickens. (Pollock 2012)

2.9.12 Feed Storage

Feed should be kept off the ground in a sealed container. Plastic bins are a good type of container to use. One shouldn't buy too much feed at a time as, like any other packaged food (whether for humans or animals) begins to degrade over time once opened. It is especially important to keep feed containers closed to prevent moisture from getting into the feed and especially to prevent vermin such as rodents from getting into the feed. (Damerow 1995) (Jarrett)

2.9.13 Flooring and Dropping Boards

Wood floors should be one foot off the ground, or more, to prevent rodents from establishing nests beneath the floor. Dropping boards can be made of welded wire or wood, and they should be removable to facilitate easier cleaning. Placing dropping boards beneath perches maximizes the dropping board's effectiveness, because of a chicken's tendency to spend most of their time on the perches. Dropping boards should be elevated off of the ground and two inches of litter, or straw, should be spread out beneath the boards to absorb ammonia from the droppings. Concrete flooring is the most impervious to predators and often the easiest to clean (Damerow 1995).

2.9.14 Exterior Color

Light colored exteriors will reflect sun and keep the interior of the coop cooler (Damerow 1995).

2.9.15 Interior Lighting

Interior lighting can make a more pleasant living environment, during cold rainy weather when chickens tend to stay inside. (Damerow 1995)

2.9.16 Insulation

Insulation can be used in walls can help maintain a moderate interior temperature inside the coop. Ceiling insulation can reduce ceiling condensation, which in turn reduces the amount of water that might drip on the chickens or the litter. (Damerow 1995).

2.9.17 Poultry Compost

Composting can be defined as a controlled and accelerated decomposition process driven by biochemical reactions, in which organic wastes are broken down into stable reusable building blocks. The speed of the composting process can be maximized by achieving optimum conditions for the microbes responsible for the decomposition of the waste. The optimum aerobic composting conditions include having a carbon to nitrogen ratio of 30:1, having a 50% moisture content, and 30% free air space. Having these conditions should optimize the composting process and allow the microbes to proliferate, generating heat, and attain pasteurizing temperature of 65^{o} C (Murphy 1992). Composting chicken carcasses is also possible, if such a thing is desired, although the process is slightly more involved. (Murphy 1992)

Calcium and magnesium salts can be used to reduce NH_3 (ammonia) volatilization during aerobic decomposition of manure. Magnesium Chloride has been shown to be more effective in reducing ammonia loss than calcium chloride, and calcium chloride has been shown to be more effective than magnesium sulfate. Sphagnum peat, zeolite, and basalt may also be used to reduce ammonia loss, with peat being the most effective and basalt being the least effective. Straw also reduces ammonia loss (but not during anaerobic conditions). (Valentine 1990)

2.9.18 Feeding Stations

Two common types of feeding stations are long troughs, or hanging tubes. Feed station design should discourage food wastage and food contamination. Food wastage may be reduced by not using narrow, shallow, lipless troughs. The chances of having food contamination can be reduced by not allowing chickens to roost above the food station. Feeding stations must also be located or constructed in such a way that the food remains dry.(Damerow 1995)

3 Alternative Solutions

3.1 Introduction

The purpose of the Alternative Solution Section is to describe and document the brainstorming process for coming up with various chicken coop designs. These alternative chicken coop designs are then presented through a series of descriptions and figures.

3.2 Brainstorming

We started our brainstorming after meeting with the Redwood Coast Montessori representative Justin, so we could see what ideas he was open to before we started drawing up alternative solutions. After this brainstorming session, we met in the library, and used a white board to help visualize our ideas. Several ideas for design features were divided up between the members of the team so that various different design ideas could be pursued. After coming up with alternative designs individually, each team member presented their design ideas to the group and these were incorporated into the list of alternative solutions.

3.3 Alternative Solutions

The Alternative Solution section presents several solutions to the project. All of the alternatives presented meet the criteria, constraints, and considerations that have been established in Sections 1 and 2.

- Coop With Cinder Blocks
- Wheeled Coop
- Sunny Side Out
- Alien Coop
- The Good Ship Alice COOPer
- The American Dream
- The Roost

3.3.1 Coop with Cinder Blocks

The Coop with Cinder Blocks is designed to set atop a layer of cinder blocks to protect the wooden floor of the coop against rot and burrowing predators. This design frees the builders from having to elevate the coop. This design also introduces the task of acquiring and assembling the cinder block base. The dimensions of the floor are 7’ x 9’, with the doors being on the 7’ walls. The height is 6’ at the peak of the roof. Interior dropping boards and perches are removable. The coop is completely enclosed in the run. The area of the run is 12’ x 20’, or 240 ft^2. Figures 3.1 and 3.2 depict the exterior of the Coop with Cinder Blocks. Figure 3.3 depicts the interior design. Figure 3.4 depicts two potential locations in the fenced area behind the classroom, in which the coop and run can be located.

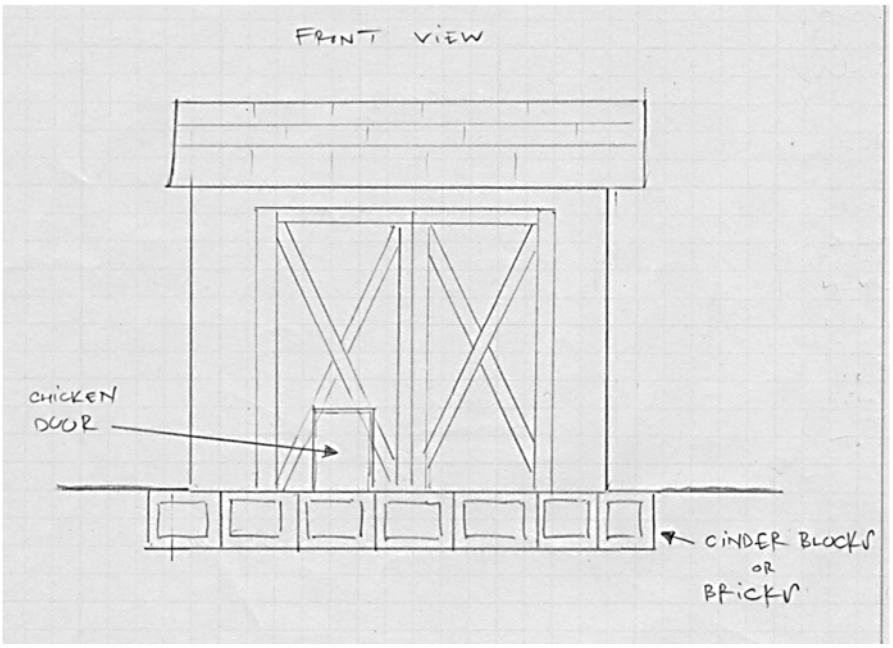

Figure 3.1: Coop With Cinder Blocks front view drawn by Seth Ehret on 10/14/2014

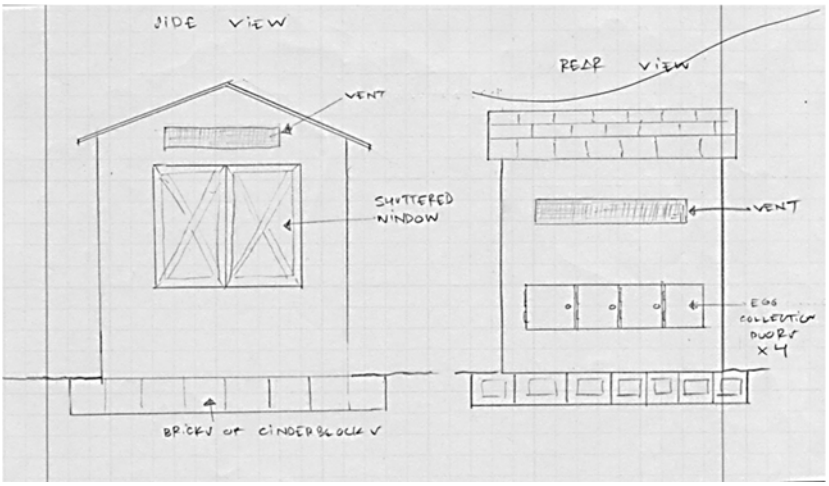

Figure 3.2: Profile and rear views of Coop With Cinder Blocks drawn by Seth Ehret on 10/14/2014

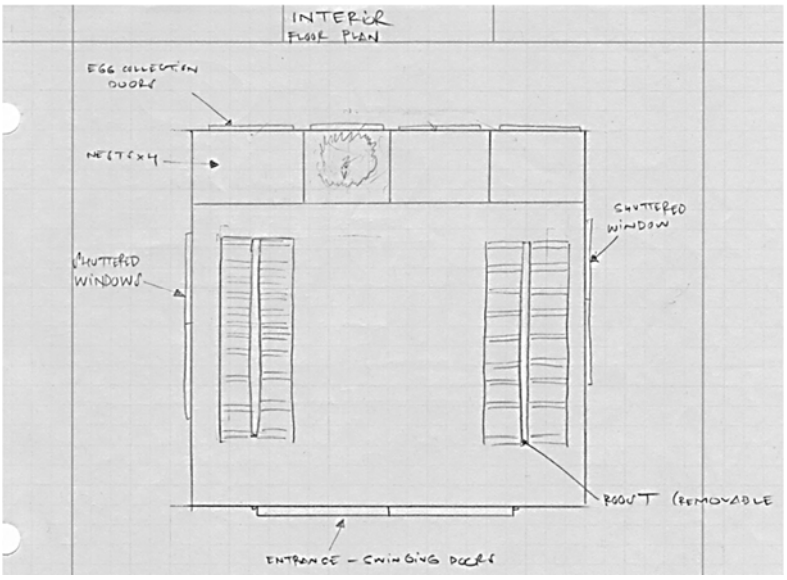

Figure 3.3: Floor Plan drawn by Seth Ehret on 10/14/2014

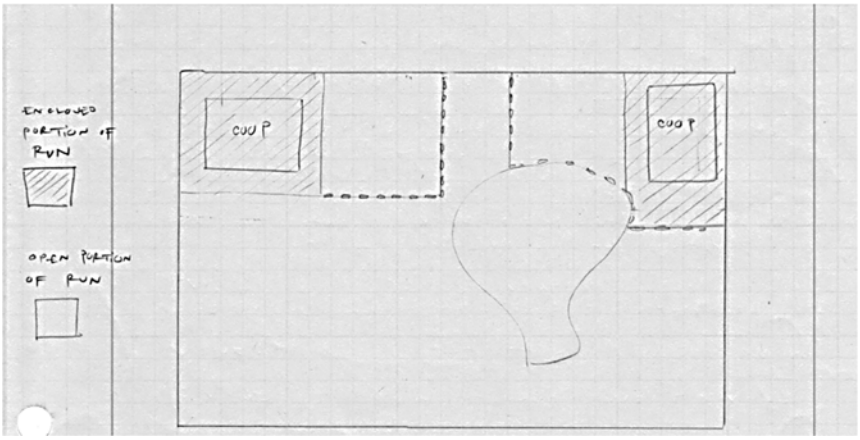

Figure 3.4: Two Potential locations for coop and run drawn by Seth Ehret on 10/14/2014

3.3.2 Wheeled Coop

The Wheeled Coop is elevated and mobile. The wheels of the Wheeled Coop design provide elevation to protect the chickens from burrowing predators. The wheels also enhance the mobility of the coop. Triangular blocks are placed by the wheels to prevent rolling. The dimensions of the floor are 7' x 9', with the doors being on the 7' walls. The height is 6' at the peak of the roof. Interior dropping boards and perches are removable. The coop is completely enclosed in the run. The area of the run is 12' x 20', or 240 ft^2. Figure 5 depicts the profile view of the Wheeled Coop. Figure 6 depicts the front of the Wheeled Coop. Figure 7 depicts two potential locations, in which the coop and run can be located.

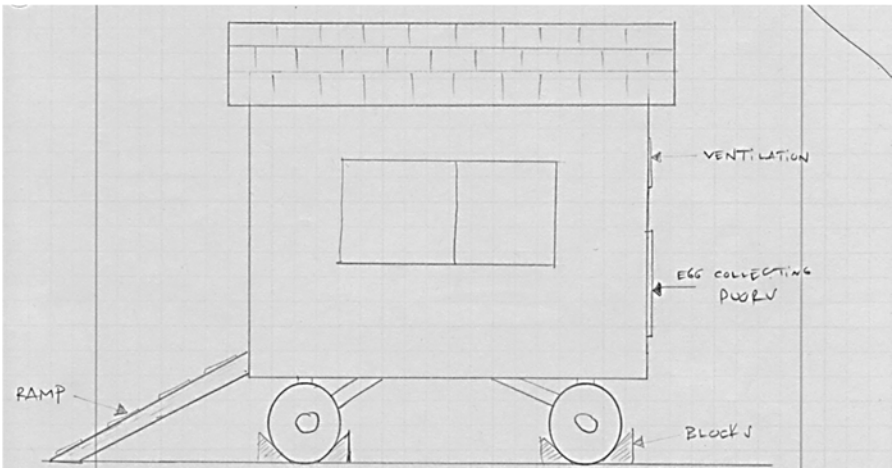

Figure 3.5: Wheeled Coop profile drawn by Seth Ehret on 10/14/2014

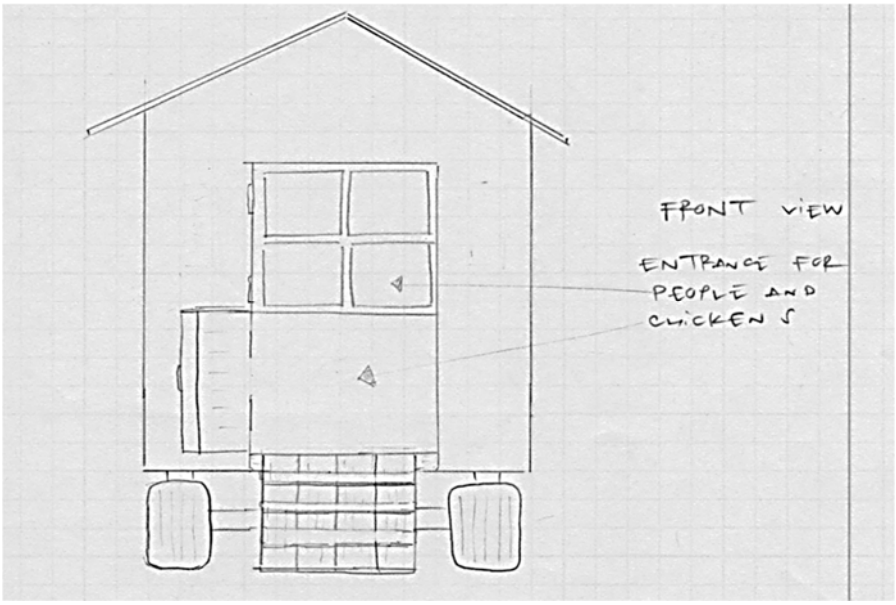

Figure 3.6: Wheeled Coop front view drawn by Seth Ehret on 10/14/2014

3.3.3 Sunny Side Out

The Sunny Side Out design utilizes a concrete walkway, already built in the school's back play area, as an outer rim for the chicken run to keep out predators that would burrow underneath the fencing. The run is constructed out of a wooden pillar frame, a roof made of corrugated plastic or metal, a metal or wood framed door, and chicken wire fencing. Each pillar is buried 3 feet deep in the sand with a square metal plate attached to the bottom of the pillar to anchor the pillar without the use of cement. The roof is slanted down toward the ocean (west) to allow the run and coop to get the greatest amount of morning sunlight (from the east). The roof is also slanted down toward the ocean to channel more wind up and over the coop instead of straight through it, allowing the temperature in the coop to stay warm and to prevent water, hay, and food from blowing away.

The coop itself is made out of wood to keep weight down so as to make it easier to move. The coop is elevated to keep it dry and give the chickens a sense of safety while they sleep. There is a ramp leading to an opening to the coop for the chickens to walk up. There are 5-6 panels that can be opened by children to retrieve eggs and lock the panels at night for the chicken's safety. The coop is not buried in the sand to allow it to be moveable. The Sunny Side Out design is pictured in figure 3.8.

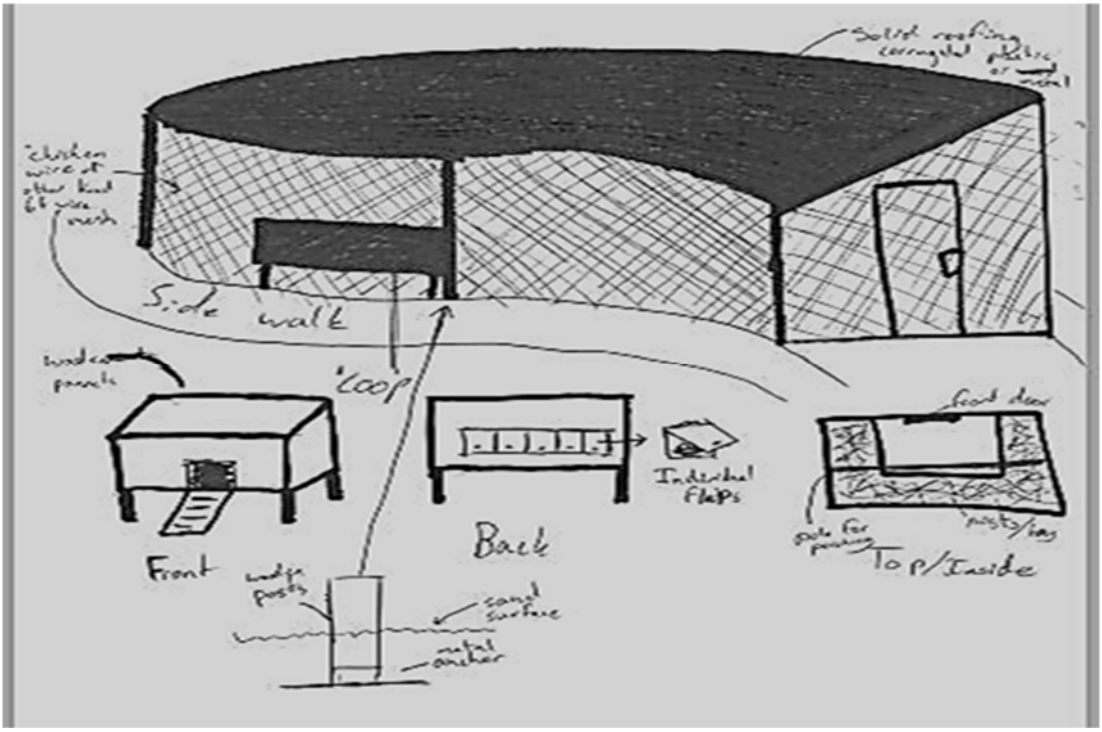

Figure 3.7: Sunny Side Out Coop drawn by Lorenzo Pagano on 10/14/2014

3.3.4 Alien Coop

The Alien Coop design utilizes another concrete walkway that is parallel with a fence already in place in the school's back play area. The run for the chickens is set in between a fence and a cement walkway. The fence and cement walkway serve as extra protection from predators trying to burrow under the run. The run's frame is made out of metal poles to increase strength and use less material. The roof of the run is made out of corrugated metal or plastic. The roof is slightly slanted to allow rain water to run off more easily and to keep the run protected from the sunlight.

The coop is a triangular prism with a bottom entrance for the chickens to walk up and into the coop. The coop is made out of wood to allow it to be light enough to be moved easily. The coop is elevated to keep it dry, and has two rows of nesting areas for the chickens to lay or roost in. The Alien Coop design is shown in figure 3.9.

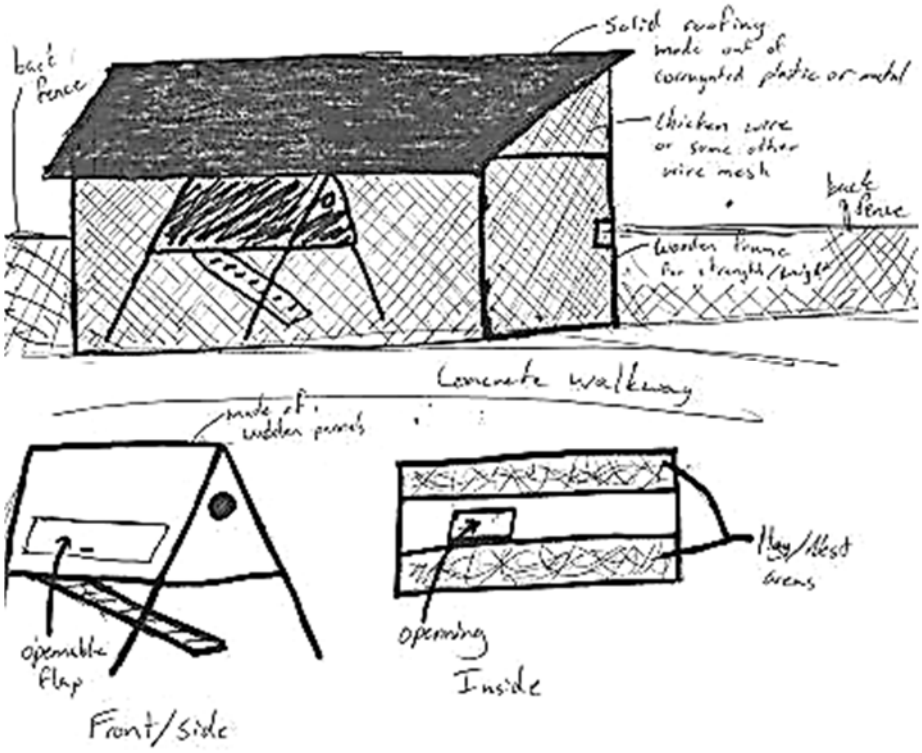

Figure 3.8: Alien Coop: drawn by Lorenzo Pagano on 10/14/2014

3.3.5 The Good Ship Alice COOPer

This coop design consisted of a rectangular 4ft. by 6ft. body, standing at 4ft. tall, not including the height of the support legs. Incorporated into the design is a rain catchment system. The coop interior contains eight nesting boxes and two large perches that span the diagonal length of the interior. The nesting boxes are close to the ground so that it is easy for children to remove eggs from them. The nesting boxes can be accessed from outside of the coop. Hinged hatches open to reveal the backside of each nesting box. There are for boxes and four hatches on one “side” of the coop and four more of each on the other. The front of the coop has a chicken sized doorway and a ramp. At the top of the front and backsides of the coop there are vents along the top that can be opened or closed as necessary. The sides of the coop have vents along the bottom and the top. The sides also possess two windows each, allowing light into the coop. The backside of the coop consists mainly of one large door that can be opened, allowing humans access to the interior so that the coop can be cleaned. The door has two handles on it. A lower handle for children to easily reach and a higher handle for adults to easily reach. The back door and all of the hatches all have latches on them to keep them secured at night.

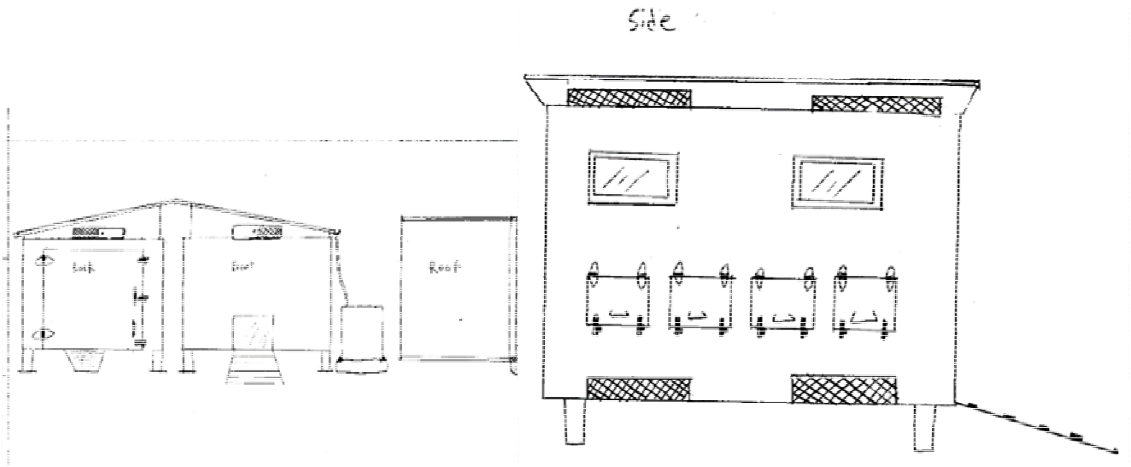

Figure 3.9: The Good Ship Alice Cooper drawn by John David Brown on 10/15/2014, shows the layout of the coop, giving locations on the rain catcher and the door latches for easy access to the nests

3.3.6 The American Dream

The American Dream Coop has the idea of easy cleaning that is achieved with a roll out floor and nests that are placed on the same type of roller system. The Coop is made of upcycled wood and a roof that is lined with roof tape for waterproofing effects. The four rows of nests that is located towards the front on the wall. Each row of chicken nests consists of 3 nests. The nests in this coop are 1ft. by 1ft. and will be bedded with straw. Towards the back of the coop, there are three roosting bars, which extends from wall to wall. The floor is which is mounted on two rollers has the ability to roll out of the coop from the back, making the coop easier to clean. The coop itself is positioned a foot off the ground adding for better security against wildlife. Ventilation is achieved by vents located at the top of the sidewall right below the roof.

Figure 3.4a and 3.12b: The American Dream drawn by Jeremy Evans on 10/14/2014, shows how the nests can roll out of the coop and illustrates on a roll out floor

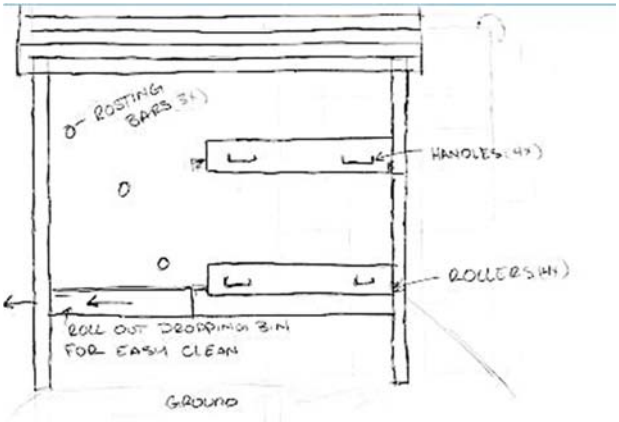

Figure 3.10a: Side view of interior

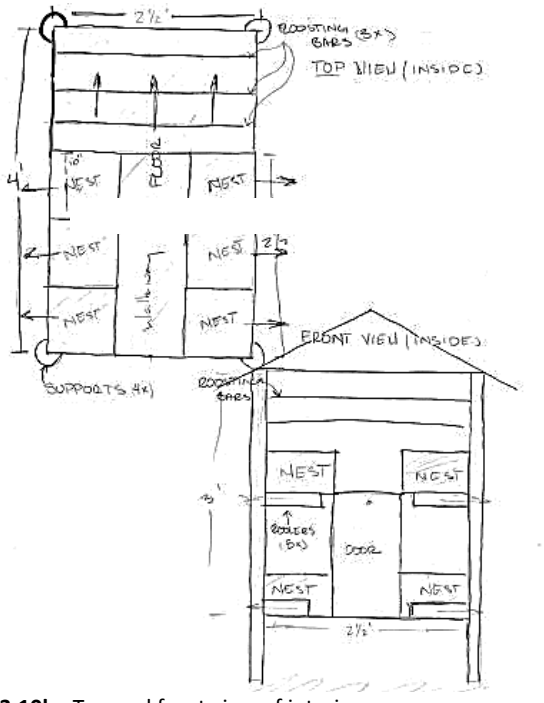

Figure 3.10b: Top and front view of interior

3.3.7 The Roost

The Roost coop is built a lot alike The American Dream coop described in 3.3.1. The difference though is the ration between roosting bars and nests. The coop itself is constructed with upcycled lumber and a pyramidal roof. The roof is lined with roof tape to make it waterproof. A row of four individual nests is located on the left wall positions on rollers, which make for easy egg extraction

and effortless cleaning. Nests are 1ft. by 1ft. and are filled with straw or wood shavings. The floor is also able to pull out, making it easier to clean. Roosting bars are positioned on the right wall attached at different heights giving optimal roosting space The Roost follows the same style of ventilation as The American Dream. Metal mesh lines along a window running the length of parallel walls where the roof meets the wall.

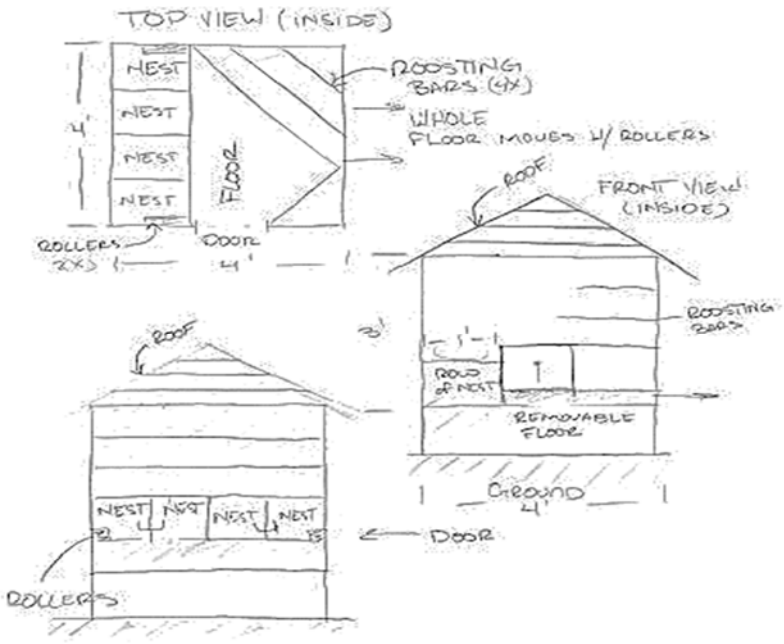

Figure 3.11: The Roost Coop drawn by Jeremy Evans on 10/14/2014**,** shows the row of nests with a removable floor and illustrates how they can be pulled out

4 Decisions

4.1 Introduction

The decision section is a process where a systematic method is used to compare and rate the various design alternatives to assist in deciding which would be the best overall design, based on various metrics. In this case the Delphi Method was used to choose one of the alternative solutions from Section 3. The Delphi Method gives a rating for each alternative solution based on criteria specified in Section 2 and produces the single best solution for the problem.

4.2 Criteria

The following criteria were developed and defined by Los Pollos Hermanos in collaboration with Redwood Coast Montessori:

Cost- The cost is the total amount of money that is to be spent on the coop. $100 of this cost will be provided by Redwood Coast Montessori.

Movability- Redwood Coast Montessori has asked for the coop to be movable around their backyard play area. The coop must be movable by adults and preferably with ease.

Durability- The coop must stay structurally sound for multiple years in the coastal dune environment around Redwood Coast Montessori. The coop must stand up to the wear and tear that the chickens and children will cause over the years.

Sustainability- The coop and run must be constructed by the process of upcycling and keeping to environmentally friendly materials.

Safety- The children that attend Redwood Coast Montessori cannot be hurt while handling things on the coop that are designated for them. Adults and children must be able to clean and maintain the coop without injury. There must be some level of sanitation to not allow any persons to become ill after use of the coop.

Chicken Survivability- Chickens must be fully protected from predators both inside the coop and inside the run, day and night. The coop must be lockable to prevent thieves from stealing chickens. The chickens must be sheltered from the elements while inside the coop and the run so they won't get too cold or wet.

Education- The Project must supply some educational value for the children at Redwood Coast Montessori.

Ease of Use- The coop must be able to be used by children and adults without minimal trouble.

4.3 Solutions

The following solution list is comprised of the alternative solutions from Section 3.

- Coop with Cinder Blocks
- Wheeled Coop
- Sunny Side Out
- Alien Coop

- The Good Ship Alice COOPer
- The American Dream
- The Roost Coop

Details of each alternative solution and figures are described and presented in Section 3.

4.4 Decision Process

The decision making process was assisted by the use of a decision matrix technique known as the Delphi Method. This was conducted through a series of steps that began with assigning numerical values to each criterion. These values ranged from zero to fifty, with zero being the least important and fifty being the most. These numerical values were assigned to each criterion following a discussion regarding each criterion. The alternative solutions were then considered, and scores were assigned to each alternative solution with respect to each criterion. When there was significant difference in opinion amongst team members regarding a particular criterion, the criterion and alternative in question were discussed until an acceptable value was decided upon. The scores were then averaged and weighted. The weighted scores were summed to yield the overall score for each alternative solution. The results of the Delphi Method are shown in Table 4.1.

Table 4.1: Delphi Matrix used for coop comparison

Criteria	Weight (0-10) High	Alternitive Solutions (0-50) High			
		Coop with Cinder Blocks	Wheeled Coop	Sunny Side Up	Alien Coop
Cost	7	10	20	11	36
		70	140	77	252
Safety	9	40	29	40	38
		360	261	360	342
Durability	9	44	33	41	36
		396	297	369	324
Sustainability	7	28	36	40	42
		196	252	280	294
Movability	8	11	50	10	28
		88	400	80	224
Ease of Use	6	44	34	32	30
		264	204	192	180
Education	6	43	43	43	43
		258	258	258	258
Chicken Survival	10	46	41	45	43
		460	410	450	430
	Total	2092	2222	2066	2304

Criteria	Weight (0-10) High	Alternative Soultions (0-50) High			
		The Good Ship Alice COOPer	The American Dream	The Roost	
Cost	7	33	18	15	
		231	126	105	NOT IDEAL
Safety	9	46	38	39	
		414	342	351	MEDIOCRE
Durability	9	43	39	38	
		387	351	351	IDEAL
Sustainability	7	28	32	32	
		196	224	224	
Movability	8	37	39	32	
		296	312	256	
Ease of Use	6	45	46	42	
		270	276	252	
Education	6	43	43	43	
		258	258	259	
Chicken Survival	10	48	45	44	
		480	450	440	
	Total	2532	2339	2238	

4.5 Final Decision

Figure 4.1: Rendered exterior view of chosen design

The final decision is a chicken coop based on a composite of several of the design alternatives. Since The Good Ship Alice COOPer scored the highest on the Delphi Matrix, it was used as the base design and from there various alterations were made. There are some elements that have been removed or altered from the original design, such as the removal of the water catchment system, moving the window location, redesigning the nesting box hatches, and changing the vent and roof designs as well as several other small alterations. Much of the roof design has been incorporated from The Roost, and the removable floor is a variation of the design described in The American Dream. The chicken run incorporates elements from the Sunny Side Up coop design, and is now attached to the front of the coop, rather than surrounding it. Figures 4.1 and 4.2 show AutoCAD designs of the coop's exterior and interior. These were used as the template for the coop construction.

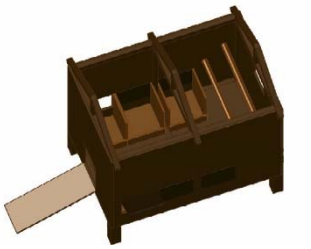

Figure 4.2: Rendered interior view of chosen design

5 Specifications

5.1 Introduction

Section 5 presents detailed information regarding the final solution, the Alice COOPer chicken coop. A detailed description of the design is included, as well a description of costs, and instructional information on how to build, use and maintain the Alice COOPer chicken coop. This section concludes with a description of the performance testing results.

5.2 Description of Solution

Section 5.2 goes into details the final solution by going over the coop itself, the roof, and finally the run that is attached.

5.2.1 Coop

The layout of the chicken coop is a simple 4'x6'x4' box, framed out by 2"x2". The walls are constructed with ½ inch plywood panels cut to size, while the floor consists of a ¾ inch plywood panel. The majority of this lumber is being sealed with all-natural wood sealant leaving the exterior sides to be primed and painted with outdoor grade paint. The coop is being lifted off the ground with four concrete stands located at each corner of the coop. Giving the coop good ventilation, there is a small gap where the roof meets the coop between the framework of the roof. This small gap is covered with chicken wire for more protection. Chickens will be able to enter the coop through a 1'x2' door located on the front side. Once the chickens walk into the coop there are three 6"x9" x1' box like nests placed on both sides. For easy retrieval of the possible eggs being laid in these nests, located on the exterior sides there is a swinging doors connected to each nest. The door will be able to pivot with hinges placed at the top. A single lock positioned at the bottom helps secure the door. Going back inside the coop towards the back there are two roosting bars at different heights giving multiple layers where chickens can roost. The roosting bars are also given a foot space in each direction giving the chickens optimum personal space. Both bars are places on U-shaped frames for the ability of removing them as you lift them up. To make the coop easier to clean, the back wall is turned into a door that is supported by two hinges on the side. Securing the back door so that it cannot be opened by anyone is another lock. Figure 5.1 shows the back side of the coop, with the main door opened and the removable floor and nesting boxes visible.

Figure 5.1 Shows the coops back and side doors with a look inside also showing the nest boxes.

5.2.2 Roof

The roof is a simple gable style design, measuring at a foot tall, it's made out of the same material as the coop. Roofing paper then sheets of tin are laid along the top of the plywood panel that lay flat on the framework. The roofing paper acts as a medium between the sheets of tin and the exposed plywood. This also helps with the insulation. Figure 5.2 shows the tin sheets being attached to the roof frame.

Figure 5.2 shows how the roof is constructed and how it looks alone

5.2.3 Run

The chicken run is laid out at 5'x10'x4'. As the main support, there is a framework made out of 2"x2". The run itself is made out of chicken wire with one inch opening to give the chickens' proper protection from predators. To add more protection, the wire runs a foot underneath the ground and buried to ward of predators digging. To get into the run, a 18"x5' door is positioned on the side of the run. The run is connected to the coop by screwing the frame of the run to the coop using 4inch deck screws.

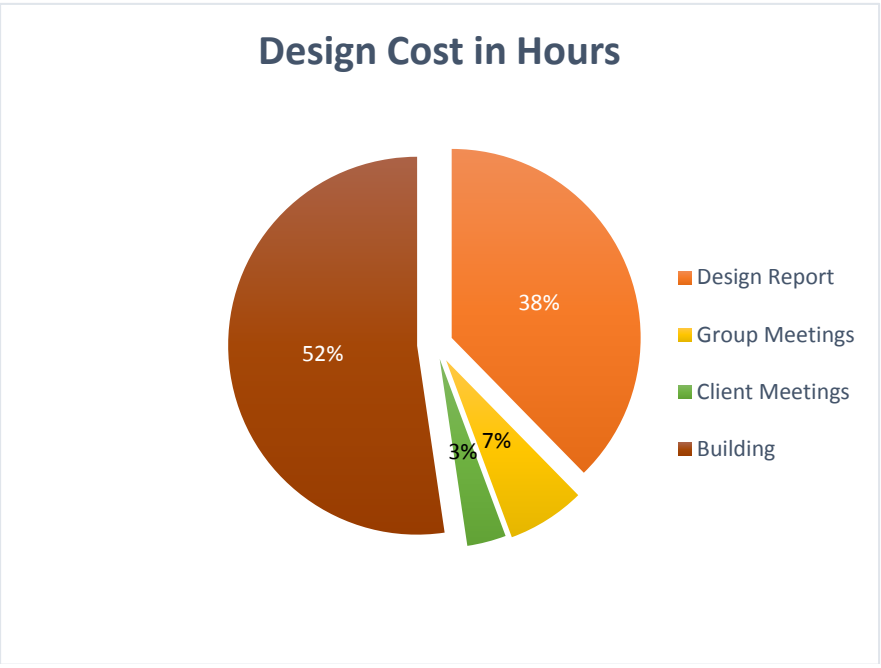

Figure 5.3 Pie chart showing design cost in terms of hours spent working on the project.

5.3 Costs

Section 5.3 goes into details on how the final solution was funded and how money and time were spent.

5.3.1 Design Cost

The design cost is the amount of time in hours that the Pollos Hermanos spent on this design project. The design hours were spilt into four categories: design report, group meetings, client meeting, and building. The total hours spent on the design project were 300 hours. Figure 1 represents the distribution of time and percentages.

5.3.2 Material Costs

The way the project was funded and the price of the material used is outlined in table 1. Due to a majority of materials being donated the total amount spent on this design project was $332. The projected retail cost of this design project is $718 and is shown in table 5.1.

Table 5.1: Shows the materials needed with their retail price and the price that was spent.

Item	Retail Cost	Our Cost
Bees Wax and Olive oil sealant	$15	$15
Circular Saw Blade	$6	$6
Roofing Paper	$20	Donated
10 4½" Cutting Disks	$10	$10
Tin Corrugated Panels	$30	Donated
4 sets of Metal Hinges	$24	$24
100 ft of 2x4	$200	Donated
50 ft of Chicken wire	$50	$50
5 boxes of Deck Screws	$30	$30
4 Locks	$30	$30
6 4x8 ½" thick CDX Wood Panels	$162	$108
1 4x8 ¾" thick CDX Wood Panels	$34	$34
Road Sign (removable floor)	$15	$15
Paint Primer	$12	Donated
Exterior Paint	$70	Donated
Wooden Dowels	$10	$10
Total	**$718**	**$332**

5.3.3 Maintenance Cost

To keep the chicken coop in good condition, semi-monthly cleaning is required to ensure that the chickens are left with a clean dry coop. Along with cleaning the coop, re-treatment of the inside with the all natural sealant should be applied every 5 years unless user desires more frequent applications. Table 2, show the estimated cost of this maintenance.

Table 5.2: Lays out the certain job and the estimated cost of such.

Job	Cost
Cleaning Coop	$5
Retreat Coop with natural sealant	$20

5.4 Instructions for Implementation and Use

This section describes and presents how to build, maintain, and relocate, an Alice COOPer chicken coop, and run.

5.4.1 How to build an Alice COOPer chicken coop

Figure 5.4: Show what the floor framework looks like.

Step 1: Assemble the floor frame

- Assemble two 6' long 2"x2" beams, and two 4' long 2"x2" beams as shown.
- Screw beams together as shown in figure 5.4.

Step 2: Floor cross beams

- Attach two 4 foot cross beams as shown in figure 4.

Step 3: Assemble the upper portion of the frame

- Assemble two 6' long 2"x2" beams, and two 4' long 2"x2" beams as shown.
- Screw beams together as shown.
- Set the upper portion of the frame aside. The upper portion of the frame will be attached to the wall frame in step 5.

Step 4: Assemble the wall frame

- Attach the 4' long 2"x2" members to the floor frame as shown figure 5.5. Once the frame piece has been attached it should be held in place until the upper portion of the frame has been completely attached to all the wall framing.

Step 5: Attach the upper portion of the frame to the wall frame

- Pick up the upper portion of the frame.
- Set the upper portion of the frame on top of the wall's frame members. Do not let go of the upper portion of the frame until it has been completely secured.
- Secure the upper portion of the frame to the wall's frame members.
- Once the upper portion of the frame is secured to all four of the wall's frame members, everyone can let go of the members they are supporting.

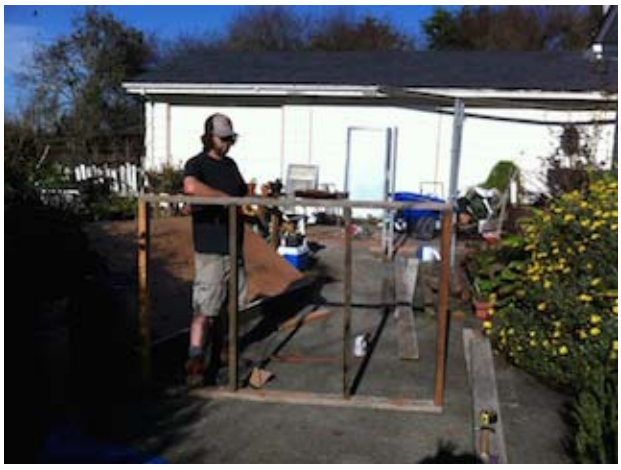

Figure 5.5: Shows how the side frames are constructed

Step 6: Installing the stationary portion of the floor

- Attach the ¾ inch 4'x4' plywood floor piece to the floor cross beams.

Step 7: Building the walls

- Cut out a 1½' x 4' section from each 4' x 6' wall piece. Cut out two 2' x ½' section from each 4' x 6' wall piece.
- Prepare to cut the 4'x5' wall pieces. Measure and mark 4' up on the 5' sides. Find, and mark the midway (2') point on the 4' aspect closest to the 4' marks you just made. Draw lines from the 4' marks to the midway point. Cut the 4'x5' wall pieces along these lines.
- Cut out a 1' x 2' from one of the 4'x5' wall pieces.

Figure 5.6: Illustrates how the walls are attached to the coop

- Cut the other 4'x5' wall piece as shown in the figure. The lower 4'x4' square will become the large door on the back of the coop. Figure 5.6 illustrates the basic framing of the coop.
- Attach the roost holders to the interior of the 4' x 6' walls

- Attach the run frame holders to the exterior of the 4' x 5' wall, which will be facing the run.

Step 8: Attaching the walls

- Attach the walls to the frame. Do not attach the 4'x4' door at this time.

Step 9: Building and installing the chicken nests

- Use ¾ inch plywood. The nests are 1'6" x 1' 4" x 1'6" (depth x width x height). Assemble the nests .
- Attach the nests to the floor of the coop as shown in figure 5.7.

Figure 5.7: shows how the nests are positioned inside the coop

Step 10: Chicken ramp

- Use the 1'x2' piece of plywood removed from the 4'x5' wall piece.
- Attach ¼" x 1" x 1' pieces of wood to the 1'x 2' piece of wood.
- Attach hinges to 1'x 2' ramp. Now attach the other side of the hinges to the floor of the coop.

Step 11: Building the roof

- Assemble the diagonal roof members and the center longitudinal roof member.

Step 12: Attaching the roof

- Lift up the roof frame.
- Place the roof frame on top of the existing frame structure. Do not release the roof frame until the roof frame has been completely secured like shown in figure 5.8.
- Have the fifth person secure the roof frame to the already existing framework. Once the roof frame has been secured to all four corners, it can be released.

Figure 5.8: Shows how the roof is set onto the coop

Step 13: Run door

- Using two 2½' , and two 4' pieces of 2"x 2" wood, assemble the run door as shown in the figure. Attach wooded 2" x 2" diagonal members into the doorframe. Cut a piece of 2½' x 4' chicken wire, and staple this to the door. Attach door hinges.

Step 14: Run frame

- Dig a 1' deep trench for the chicken wire and run frame.
- Place the 5' metal poles into the postholes. Put them 1' into the ground.
- Attach horizontal run frame members to the top of the vertical run frame members. The 10' horizontal members should rest in the holder against the coop.
- Attach 5' horizontal member along the ground. Attach the 4' vertical member to create the doorframe.
- Attach the run door hinges to the run doorframe.

Step 15: Attaching the chicken wire to frame and coop

- Wrap the chicken wire around the run frame, making sure the chicken wire extends 1' into the ground.
- Attach the chicken wire to the run frame and the coop.
- Cover the place where the chicken wire is attached to the coop with a thin piece of wood, to protect people from scratchy wire.

Step 16: Introduce your chickens to the coop and enjoy.

5.4.2 How to use the Alice COOPer chicken coop and run

Section 5.4.2 gives instruction on how to properly retrieve eggs from the coop.

5.4.2.1 Collecting eggs

- Get the key for the nesting doors bar locks.
- Chickens might try to jump out when you open the nesting doors, so be ready for this.
- Unlock the padlock and slide the securing bar out.
- Do not open nest door until you are ready to collect eggs.
- When you are ready to collect eggs, open the nest door, and collect eggs from the nests.
- If a chicken is in the nest do not shoo or push the chicken away. Simply close the nest door and try the next door.
- Secure the nests once you are done collecting eggs.

- Slide the securing bar through the slots. Put the padlock through the securing bar's hole and secure the lock.

5.4.2.2 Using the Large Rear Door to the coop

- Get the key for the large rear coop door.
- Chickens might try to jump out when you open the large rear coop door, so be ready for this.
- Unlock the coop door lock.
- Open the coop door. Watch out for chickens trying to jump out.
- Secure the large rear coop door when you are finished inside the coop, by putting the lock back in place and locking the lock.

5.4.2.3 Going inside the run

- Get the key for the run door padlock.
- Unlock the run door padlock, and carefully pull the run door open.
- Enter the run. Close the door behind you.
- If you are five feet tall or taller, be careful not to bump your head while inside the run.
- When leaving the run carefully close open the run door.
- Watch out for chickens as you open the run door.
- Exit the run.
- Close the run door, watching out for chickens as you carefully close the run door.
- Do not slam the coop door closed.
- Put doorframe latch over the door's D ring.
- Put pad lock through D ring.
- Close the lock and make sure the lock is secured.

5.4.3 How to maintain the Alice COOPer chicken coop

Section 5.4.3 gives instructions on how to properly clean and maintain the chicken coop.

5.4.3.1 Cleaning the removable roosts

- Open the large access door to the coop. One at a time, lift the roosts up and out of the roost holders.
- Clean chicken manure off of the roosts.
- Place the roosts back into their holders.

5.4.3.2 Cleaning the removable floor

- Open the large access door to the coop, if not already open.
- Slide the removable floor member out of the coop.
- Clean manure off of the removable floor.
- Return the clean floor to the coop by sliding the floor member back into the coop.

5.4.3.3 Cleaning the nests

- Access the nests from the interior of the coop, or through the nest doors.
- Remove bedding. Check for manure . Clean up any manure. Sweep up other debris.
- Replace bedding. Secure the coop when you are done.

- Dispose of bedding and debris in the compost or in the trash.

5.4.3.4 Maintaining the exterior of the coop and the run

- If desired, re-stain and/or weatherproof the exterior of the chicken coop according to schedule provided by the manufacturer of the stain/weatherproofing material you have chosen to use.
- Check for loose screws. Tighten loose screws.
- Check the chicken wire for developing holes and frayed chicken wire. Mend frayed chicken wire to prevent users from getting poked. Patch developing holes with galvanized chicken wire.

5.4.4 Moving the Alice COOPer Chicken Coop

Section 5.4.4 gives instruction on ho to properly relocate the coop and run.

5.4.4.1 Preparing to move the Alice COOPer coop and run

- Moving the coop will require four strong and healthy adults. Attempting to move the coop with less people may result in damage to the coop, or injury to movers. Two eight foot metal poles, or strong wooden poles and shovels. Gloves will also be handy.
- Choose a location that you would to move the coop and run to.
- Make sure the new location is big enough for the coop and the run.
- Grade the new location to make it flat, and dig trenches for the chicken wire and the run's framing. Dig the trenches two feet deep.
- Make sure to have a clear path to the location to which you be moving the coop and the run.
- Remove all chickens from the coop and run. Put chickens in a safe place during the move. Don't forget to give chickens food and water in their temporary space.

5.4.4.2 Moving the coop

- Remove the pieces of wood connecting the chicken wire to the coop.
- Remove the staples connecting the chicken wire to the coop.
- Carefully remove the chicken wire from the coop.
- Make sure the chicken door and the large coop door are secured, so they do not open up while the coop is being moved.
- Place poles underneath coop beneath points shown in figure.
- All four people should lift the poles at the same time. Once the poles touch the bottom of the coop continue to lift the poles and the coop.
- Move the coop to the desired location.

5.4.4.3 Moving the run

- Be careful of pokey, scratchy chicken wire. Wearing gloves can help prevent pokes and scratches.
- Dig dirt/sand away from the buried chicken wire. Chicken wire is buried 1 ½ feet deep.

- Disconnect the chicken wire from the run poles by removing the chicken wire pole attachments.
- Remove the chicken wire and set it aside in a safe place where people will not get scratched.
- Dig up the buried metal run frame posts. As you dig up the metal run frame posts, be careful not to let the posts fall and hit someone.
- Remove the run frame posts from the ground.
- The portion of the run frame containing the run door has a slightly different configuration than the other run frame components, so its removal will be different. The portion of the run frame that has the run door should be removed as a unit. If this portion of the run frame falls, or twists the run door may be damaged. Removing and moving this portion of the run frame will be most safely accomplished with four or more people.

5.5 Results

Section 5.5 goes into details on how the coop was tested and the end result.

5.5.1 Weather durability

The coop, as described in section 5.2.1, is sealed with an all-natural sealant while the exterior side is painted with outdoor grade paint. In this month of December there have been many instances of heavy rain and the coop has kept dry. Any water that has entered the coop was never able to absorb through the wood.

5.5.2 Chicken safety

Since Redwood Coast Montessori will not obtain chickens for the coop until Spring 2015, Los Pollos Hermanos have not been able to run any tests in regards to chickens living in the coop.

6 Appendices

6.1 Appendix A: References

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