A DESIGN METHODOLOGY FOR

EARLY EDUCATION FACILITY PROTOTYPES IN HAWAIʻI

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ABSTRACT

Hawai‘i does not have a state-funded preschool program and the cost of private preschools makes early education a less viable option.[1] If the state of Hawai‘i were to set up a state-funded preschool program, a set of design guidelines would be needed to ensure that each facility provides optimal learning experiences for students and supports the needs of the parents and community. The purpose of this dissertation is to create a design methodology and design guidelines for early education facilities in Hawai‘i supplemented by an evaluation process. The goal is to design quality educational facilities for Hawai‘i’s communities that incorporate Hawaiian culture into the design. Three prototype facility designs were explored to demonstrate the methodology and evaluation process and one was developed further in order to show the process through the final design phase.[2] This dissertation assesses whether this process can be beneficial for communities in Hawai‘i and discusses related challenges.

[1] (Staff 2015), (Hawaii News Now 2014), (Kalani 2014)

[2] A final design phase in this dissertation is similar to a typical design development phase and is interpreted as a completed design shown in floor plans, sections, and 3D modeling. The structural, mechanical, plumbing, and electrical components may not be fully developed.

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PREFACE

This dissertation focuses on design standards and methodology for early education facilities in Hawai‘i while also exploring ways of bringing culture and the community into the design. The focus on early education came from my family's background. My grandfather on my father's side was, a teacher, principal, and later worked for the Department of Education while my grandmother was also a teacher. My grandfather on my mother's side was a high school detention counselor. My step mother is a kindergarten teacher and I have aunties and uncles who are teachers, school health aide, and school coach. My family's history of involvement in education instilled a passion in me to pursue school design and design in general for the benefit of the youth. This dissertation allows me to express my interest in both architecture and education and allows me to express my love for my home.

Through this dissertation, I am able to voice my concerns for the state of early education facilities while providing a structure for designing high-quality facilities. I truly believe that it is important to create a strong foundation for learning and to encourage parent and community involvement in education. Parent and community involvement is not only beneficial to the younger children but at the same time, it helps to strengthen bonds between parent or guardian and child or between people living in the same community. By setting this structure for design of early education facilities, I hope to highlight that it is not only about providing the physical space, but also understanding how children, teachers, parents, and the community perceive and interact with the school; consideration for various activities that may take place to lead the design; and understanding the importance of connecting the school to the surrounding community or the local culture so children can feel more at home in the school.

I would like to thank my committee members for your support and guidance over the past year; your ideas and feedback have helped me to shape and refine this project, I am very grateful.

CHAPTER 1. INTRODUCTION

According to results of the Programme for International Student Assessment (PISA) 2012 exam that was given to 15-year-olds in 34 developed and developing countries, the United States ranked at and just below the world average in reading, math, and science.[3] Many methods for improving academic performance exist, such as incorporating new curriculum or changing the structure of the school day.[4] Another method encourages greater family and community involvement in school in order to foster a passion for and commitment to learning. This dissertation focuses on the latter method and begins at the foundation of learning: early education. Studies have shown that participation in an early education program can lead to higher rates of success later in a child's life.[5] Hawai'i, however, lacks a cohesive, high-quality early education program in the public school system. One way to help change this is to create a set of design guidelines and design methodology for early education facilities that optimize learning experience by providing an environment for quality education, accessibility for high rates of enrollment, and inspires parent and community involvement. Therefore, we must determine how to improve the quality of existing school facilities and identify elements that would encourage student, parent, and community involvement.

Academic Achievement and Enrollment Rates

As mentioned above, the United States ranked below average on the 2012 PISA exam for math and science and at average for reading (see figure 1.0).[6] In order for American students to receive better education, to rank higher internationally, the system may need to change. This could mean incorporating curriculum that is more challenging or designed to better fit individual needs. It could also mean changing the schedule of the

[3] "Program for International Student Assessment (PISA) Results from PISA 2012: United States," Organization for International Cooperation and Development, accessed January 30, 2017. http://www.oecd.org/pisa/keyfindings/PISA-2012-results-US.pdf

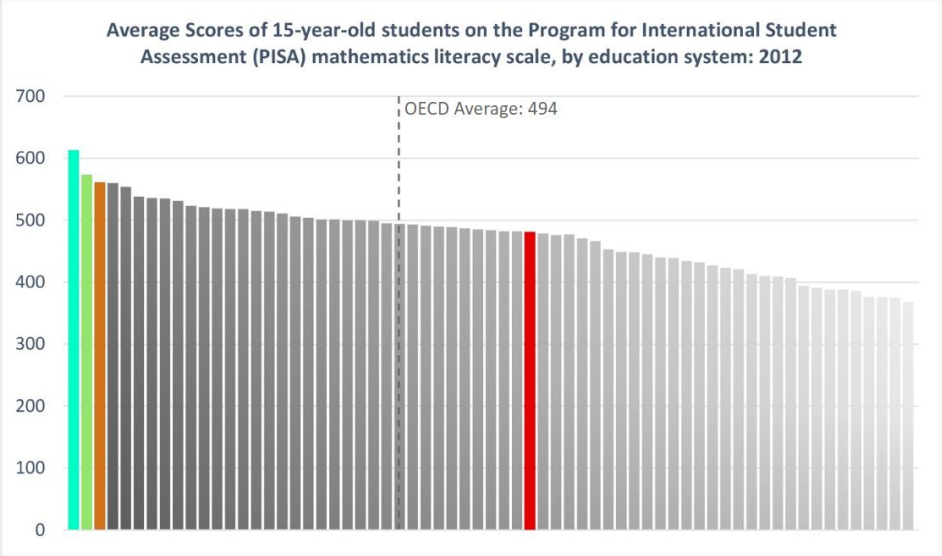
[4] (Edutopia Team 2005) Concepts for improving education and schools are listed under different categories or different angles of the education environment, the quality and resources of the school are one of the categories.

[5] (Jones, Greenberg and Crowley 2015), (Schweinhart, et al. 2005), (Wallace 2015)

[6] (Kena, et al. 2015)

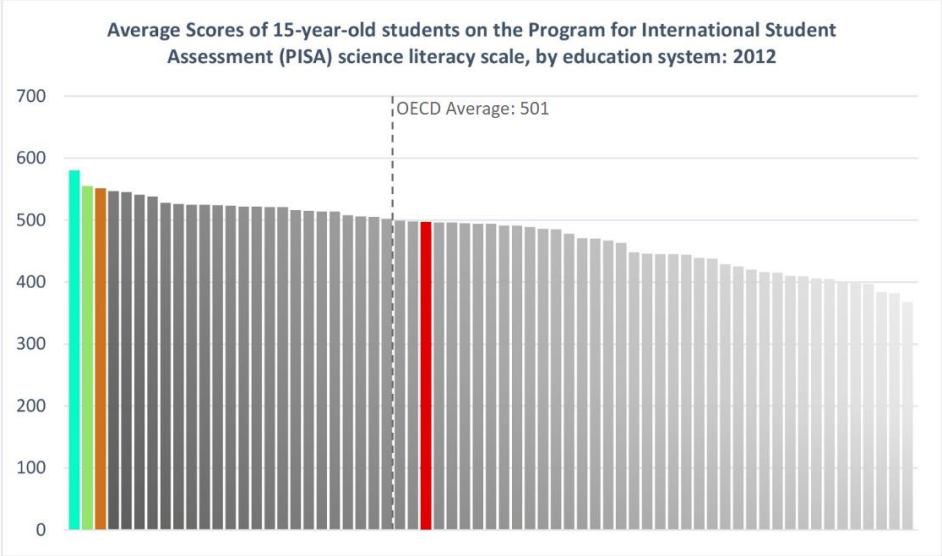
school day, such as the number of classes per day, the duration of each class, or the length of breaks between classes. Facility design can also play a role in improving the state of American education. Most education facilities in the U.S. are in desperate need of improvements. School facilities average over 50 years and the National Center for Education Statistics estimated in 1999 that $127 billion is needed to renovate schools in order to meet today's facility quality standards.[7]

Figure 1.0 Programme for International Student Assessment 2012 average scores

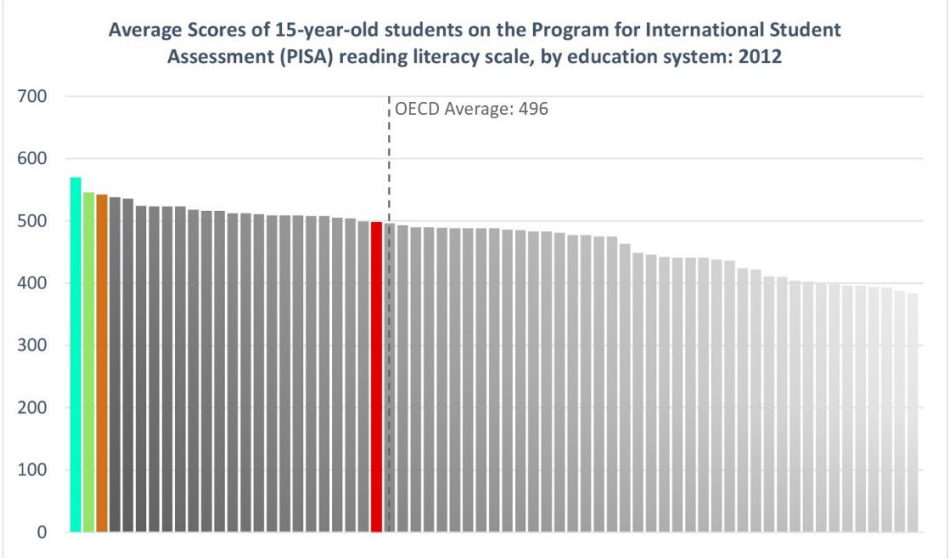


Mathematics: Shanghai-CHN is ranked first with a score of 613 Singapore is second with a score of 573, and Hong Kong-CHN is third with a score of 561. The United States is ranked 30th with a score of 481. Data is from *The Condition of Education 2015.*

[7] (Perkins and Bordwell 2010)



Science: Shanghai-CHN is ranked first with a score of 580, Hong Kong-CHN is second with a score of 555, and Singapore is third with a score of 551. The United States is ranked 28th with a score of 497. Data is from *The Condition of Education 2015.*



Reading: Shanghai-CHN is ranked first with a score of 570, Hong Kong-CHN is second with a score of 545, and Singapore is third with a score of 542. The United States is ranked 24th with a score of 498. Data is from *The Condition of Education 2015.*

There is also a need for a greater number of early education facilities. The percentage of three to four-year-olds and five-year-olds enrolled in full-day preprimary programs has steadily increased from 39% to 60% between 1990 and 2013[8] There are numerous possible reasons for this trend the examination of which is beyond the scope of this dissertation. However, another statistic showing the academic levels of parents and the corresponding rate of enrollment of their three- to five-year-olds may partly explain the trend. The *Condition of Education 2015* shows that 75% of children whose parents attained a graduate or professional degree were enrolled in a preprimary program, while the percentage was 70% for parents with a bachelor's degree, 59% for parents with a high school credential, and 55% for parents with less than a high school credential.[9] In other words, those with higher academic degrees are more likely to enroll their children in preprimary programs.[10] Perhaps these parents want the same educational opportunities for their children and thus decide to begin their children's education as early as possible.

Some studies, examined in greater detail in chapter two, show that participation in an early education program can lead to higher rates of success later in a child's life, including overall academic achievement. It is possible that participation in an early education program can lead to better academic achievement, which in turn can lead to a higher chance of enrolling one's children in an early education program. Thus, a cycle is created. The more people that strive for higher academic degrees, the more people join the cycle, the greater the need for preprimary programs. No matter the reason for these trends, the fact remains that enrollment rates are increasing as is the need for more and better quality early education facilities.

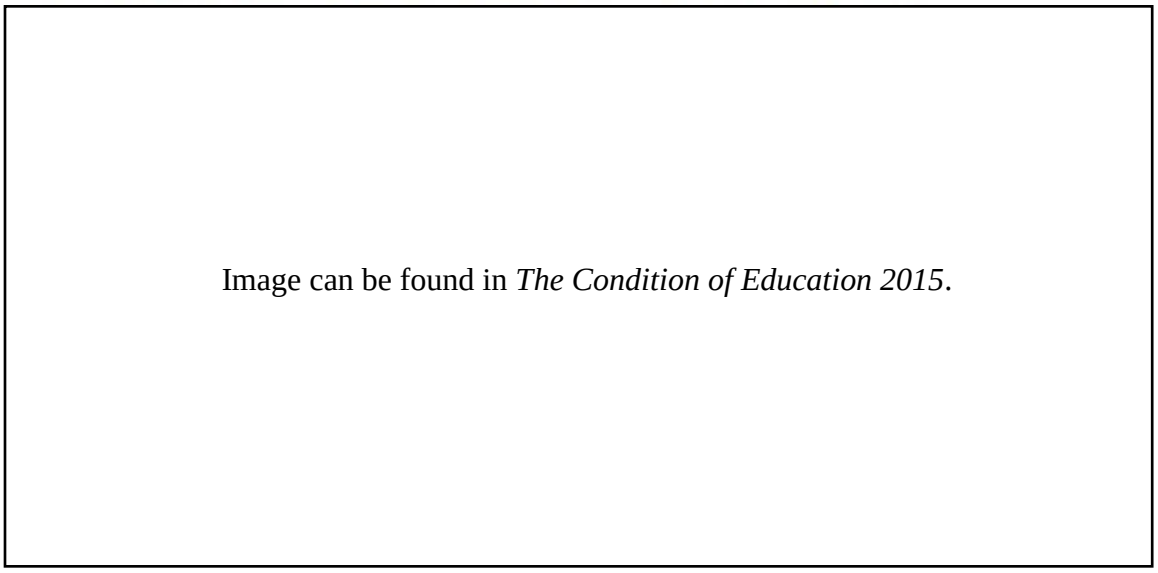
Even though rates of enrollment are increasing, overall participation in early education programs is still relatively low compared to other countries. Of the 33 member nations of the Organization for International Cooperation and Development (OECD) that participated in the 2012 PISA exam, the United States ranks 29th, well below the OECD average of enrollment of three-and four-year-olds in a preschool program in 2012.[11]

[8] (Kena, et al. 2015)
[9] (Kena, et al. 2015)
[10] (Kena, et al. 2015)
[11] (Kena, et al. 2015)

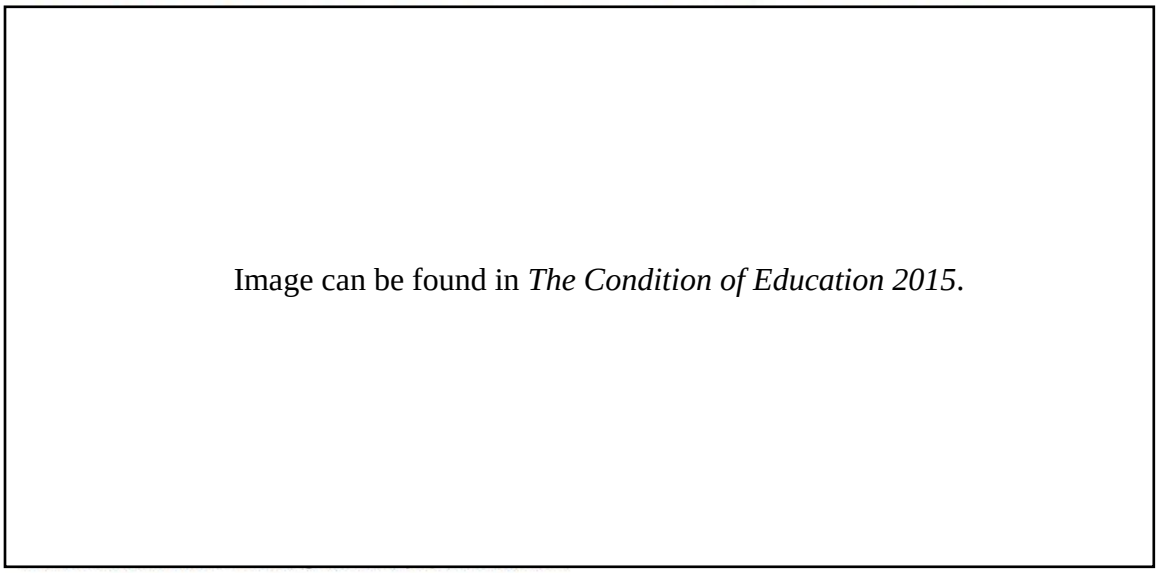
Figure 1.1 shows the 2009 reading and math scores of fourth-grade students in Hawai‘i compared to those in other states. In reading, students performed average and below average. Even though students performed fairly well in math relative to those in other states, overall scores have decreased between 2005 and 2009.[12] Moreover, Hawai‘i's students do not meet proficient levels in either math or reading.

Again, in order to improve the status of education in Hawai‘i and meet the needs of its youth, this dissertation explores the option of improving the quality of facilities and identifying ways to increase parent and community involvement. In chapter three, studies on the impact of physical environment on student performance provide information on how to improve facility design and elements that can be provided in schools to entice parents and the community to become more involved.

Figure 1.1 NAEP scale equivalents of state grade 4 and 8 reading and mathematics standards for proficient performance, by state: 2009



[12] (Kena, et al. 2015)



Images and data are from the *Condition of Education 2015*.

Foundation for Learning

Birth to age three is a critical period in the development of a child's cognitive skills.[13] Participation in early education programs can help parents take advantage of the potential during this critical period. Helping a child develop his or her cognitive skills and discover positive social behaviors offers a greater probability of success in later years. Studies on the correlation between early education programs and success in adulthood have shown that participation in an early education program can increase the chances of higher academic achievement, larger income, and lower crime activity.[14]

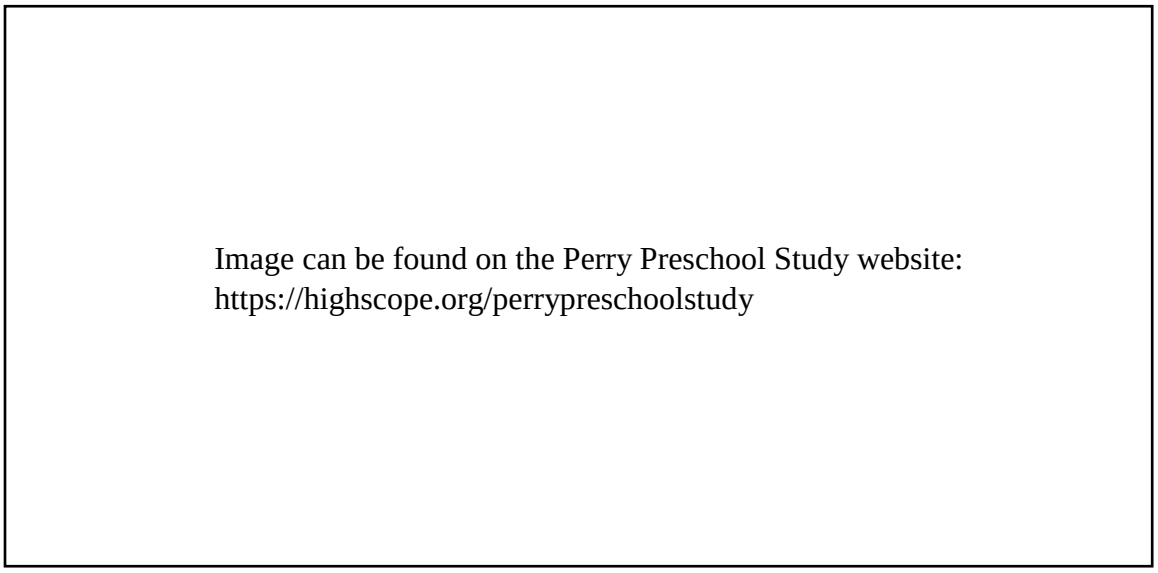
"Early Social-Emotional Functioning and Public Health: The Relationship between Kindergarten and Social Competence and Future Wellness" is a 20-year study that compares the lives of a group that participated in an early education program to a group that didn't. The results show a link between the early social-emotional development of the group that participated in an early education program and later

[13] (Institute 2016)
[14] (Jones, Greenberg and Crowley 2015), (Schweinhart, et al. 2005), (Wallace 2015)

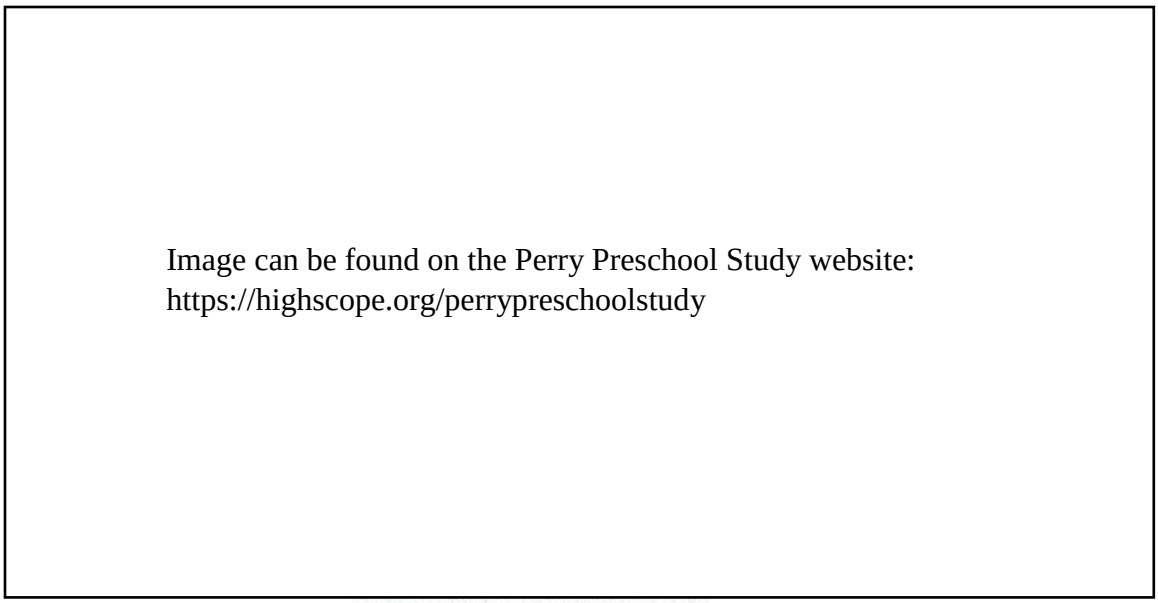
academic and career achievement as well as lowered criminal activity, substance use, and mental health problems.[15]

The High Scope Perry Preschool Program is similar to the 20-year study, but focuses more on a cost-benefit comparison between those who participated in the Perry preschool program and the control group, who did not participate in any preschool program. Figure 1.2 shows the results of the study in terms of achievement rates and the overall cost-benefit analysis. According to the study, males who participated in the Perry preschool had 11 to 34% higher lifetime earnings than males in the control group and females who participated had 19 to 36% higher lifetime earnings than females in the control group.[16] The results also showed lower rates of criminal activity, which benefited to the participants' communities as well.

Figure 1.2 Major Findings: High/ Scope Perry Preschool Study at 40 and High/ Scope Perry Preschool Program Public Costs and Benefits



[15] (Jones, Greenberg and Crowley 2015)
[16] (Schweinhart, et al. 2005)



Images and data are from the *Lifetime effects: The High/ Scope Perry Preschool study through age 4.*

Ultimately, these studies show that participation in an early education program can lead to higher rates of success for the individual and can contribute to the overall success of the community. In other words, increasing the quality and accessibility of early education facilities can build better, more successful communities with a strong foundation in learning.

Affordability and Accessibility

This section explores the current status of Hawai‘i’s education system and focuses on early education, including the lack of a state-wide program and the cost of private preschools. Because Hawai‘i does not have a state-wide preschool program, most families that wish to enroll their children in preschool must find private schools or day care programs. In Hawai‘i, these can cost more than in-state college tuition.[17] In 2014, the state passed a law that requires children to be five years old by July 31st of the year they begin kindergarten. At the same time, the junior kindergarten program (a transition

[17] (Staff 2015), (Hawaii News Now 2014), (Kalani 2014), (Wong, Living Hawaii: Where Child Care Can Cost More Than College 2014)

program into kindergarten for three- to five-year-olds) was eliminated.[18] This puts late-born children at a disadvantage; they must start school a year later than their peers and the only options prior to this are expensive private school or day care programs.

On a more personal level, convenience is also an issue for many families. Convenience here means not only the physical proximity of preschools, but also the duration of the programs. The less expensive options are usually only half day programs or are too far from where parents work making full-time employment difficult.[19] Being able to afford a conveniently located full-day program for children is important for families anywhere and Hawai‘i is one of the most expensive states to live in.[20] A state-funded early education program would be a huge help for families. Moreover, strategic placement of these facilities close to work centers and in areas that currently lack early education facilities would further help families and could possibly increase enrollment rates.

If a state-funded preschool program were to be created, not only would many families throughout Hawai‘i benefit, but it would also give the DOE an opportunity to be innovative and create standards for an ideal early education setting in Hawai‘i.

Expected Outcome

This research focuses on three different areas: existing facility standards, to establish current expected quality levels for school facilities; studies showing which aspects of the physical environment increase positive outcomes in students, to identify elements for the school design; and finally, precedent studies in Hawai‘i and other areas, which include facility examples and changes in design approach.

These three areas of focus contributed to the creation of a set of design guidelines for early education facilities in Hawai‘i. As part of this process, three prototype facilities

[18] (Wong, Many Children Face Exclusion from Hawaii Kindergarten in 2014 2013)
[19] (Wong, Many Children Face Exclusion from Hawaii Kindergarten in 2014 2013)
[20] (CNBC 2016) Hawai’i ranked 49th overall, 50th for cost of living, 43rd for education, and 50th for cost of doing business.

that reflect three different situations were explored using the design methodology explained in chapter four. The expected outcome of this dissertation was to identify different ways of designing high-quality and accessible early education facilities that fit the needs of Hawai‘i’s residents. The three prototypes were evaluated for quality of design, as defined by the facility guidelines. The results of the evaluation helped determine which prototypes follow the new design guidelines and which are more difficult to accomplish due to physical context. One prototype was chosen and developed further than the other two in order to show an example of a complete early education facility design produced according to the design methodology and to demonstrate methods of incorporating Hawaiian culture into school design.

This dissertation concludes with an evaluation of the design methodology and its effectiveness on the three prototypes. The assessment of the methodology and prototypes will reveal the challenges that accompany designing culturally-sensitive school facilities and designing to increase family and community involvement in schools. The assessment will also reveal what can be gained from this process for students, parents, and the community.

CHAPTER 2. EXISTING FACILITY STANDARDS

Chapter two is a review of the resources detailing existing facility standards for early education and elementary schools. Each source's topics are explored and considered for the design guidelines for this research. The following resources vary from national standards to standards for different areas, but all are important to this research in understanding the fundamentals and typical requirements for the design of early education facilities.

The American Institute of Architecture's *Building Type Basics for Elementary and Secondary Schools* (from here on referred to as *Building Type Basics*) focuses on the design of elementary and secondary school facilities, but also includes a portion on early education. It is one of the many resources for design standards. The book gives a brief overview of early education facilities and covers the requirements for square footage per child and per program space (see figure 2.0).[21]

Figure 2.0 *Building Type Basics for Elementary and Secondary Schools* recommendations for early education program spaces and size

Space	SF/ Child
Activity/ Classroom	42
Staff Support/ Storage	38
Observation (Parents)	9
Non Assignable Space	20
Total	109

Space	SF
Entry	200
Reception	120
Admin Office	120
Director's Office	160
Staff Break/ Toilet	350
Conference Room	200
Quiet Rm/ First Aid	100
General Facility Storage	200
Total	1450

Data are from *Building Type Basics for Elementary and Secondary Schools.*

[21] (Perkins and Bordwell 2010)

It also discusses possibilities for creative program spaces in early education facilities, such as an Exploration Lab, a Creation Lab, and a Health and Wellness Suite.[22] These creative program spaces offer a different approach to facility design that focuses on changing activities and therefore changing the layout of spaces within the facility.

The predesign portion of the text explains the process step by step from assembling a planning committee, to gathering data and assessing existing facilities, to holding workshops with the planning committee for designing the facility. Some questions listed in "Workshop 1" may be considered when designing an education facility such as: "How will students be using this school in 5, 10, 20 years? How will the community be using this school in 5, 10, 20 years? How will teachers be using this school in 5, 10, 20 years? How will this improved facility benefit students, teachers, and the community?"[23] These questions can help direct the design of the prototypes and establish goals for the facilities.

Another portion of the text that should be emphasized is site programming and sustainable site design strategies. Sustainability in school design and program is important for the future of education. Sustainable strategies, according to *Building Type Basics*, includes building and material reuse, use of recycled products, use of regional materials, and control of indoor pollutants.

Technology in schools can include computer labs, computers in classrooms, wiring internet use for certain classrooms or for the entire school, and audiovisual equipment. It is standard for teachers to have teacher desks in most cases which means accommodations for computer use needs to be set up in all offices and in most classrooms. For preprimary children, however, computer use may not be a common part of daily activities. Standards for technology use per age group can be found in the American Architectural Foundation's "Design for Learning."[24]

Wayfinding is another topic that needs special attention for younger children. Effective wayfinding techniques include signage, change in wall type or color, and

[22] (Perkins and Bordwell 2010)
[23] (Perkins and Bordwell 2010)
[24] (American Architectural Foundation 2016),

furniture arrangements.[25] There is a difference between wayfinding design techniques for adults and those for children younger than five. For example, signage should be placed at a level that matches a child's line of sight. When designing an early education facility, one must consider both the needs of the young children and those of the supervising adults.

Another resource for the new guidelines is the "Child Care Services" page of the NYC Department of Health and Mental Hygiene website. This site details more technical aspects of designing child care facilities and lists regulations for facilities in New York City. It is useful to compare these to Hawaii's regulations, but also to keep in mind the inherent differences between the two contexts; the regulations for a typical early education setting in New York City reflect a high-density urban environment whereas regulations for Hawai‘i must vary from high-density urban to rural. The New York City regulations are, however, a beneficial resource for developing Hawai‘i's urban early education facilities.

The following includes aspects that are included in the new guidelines: staff-to-child ratio per classroom; maximum group size per classroom; minimum square footage per student; and physical environment elements such as restroom facilities, ventilation, lighting, outdoor play areas, sanitation, maintenance, equipment, and furnishings. It is important to note that the NYC standards for minimum square footage per student differ from those listed in the *Building Type Basics* text. The NYC standards require a minimum of 30 square feet per child,[26] while *Building Type Basics* requires at least 35 square feet per child, but recommends 42.[27] The NYC standards were published in 2009 and *Building Type Basics* in 2010. Therefore, for the new guidelines, the most recent resource will be used, that is a minimum of 35 square feet but a recommended 42.

The *National Health and Safety Performance Standards: Guidelines for Early Care and Education Programs*, a collection of national standards put out by the National Resource Center for Health and Safety in Child Care and Early Education (NRC) and

[25] (Perkins and Bordwell 2010)
[26] (NYC Department of Health and Mental Hygiene 2009)
[27] (Perkins and Bordwell 2010)

used for facilities in Hawai‘i, is Hawai‘i’s most important resource to consider. Completed in 2015, it is the most recent resource and continues to be updated online. Because of this, these standards will be used rather than similar standards in other resources.

The following three NRC standards are included in this project’s new guidelines: staff-to-child ratios per classroom, group size per classroom, and minimum square footage per child. For example, the guidelines require one teacher per every seven three-year-olds, no more than 12 three-year-old children per classroom, and a minimum of 42 square feet per child but a recommended 50.[28] This differs from the NYC standards which require one teacher per ten three-year-olds, no more than 15 three-year-old children per classroom, and a minimum of 30 square feet per child.[29] The NRC standards for staff-to-child ratio, group size, and square footage per child will be used over all other resources.

The NRC standards also makes suggestions for program spaces for each developmental stage and age group. Program activities considered in the new guidelines and prototypes are meant for a three- to five-year-old children. Possible program activities and elements include: play and learning opportunities that have both indoor and outdoor settings; equipment and materials for motor skill development; expressive activities such as art, storytelling, and sensory play; reading; and opportunities for observing nature.[30]

With Hawai‘i’s year-round tropical climate, we have one of the best settings for outdoor learning. Early education facilities can take advantage of this by implementing more outdoor program activities and program spaces, such as butterfly and bird observation.[31] Such activities, along with those involving local vegetation and aquatic life, can be incorporated into lessons about the native species, the difference between native and invasive species, and Hawai‘i’s ecological history. To create settings for observing birds and butterflies, certain plant species that attract other species could be

[28] (American Academy of Pediatrics 2011)
[29] (American Academy of Pediatrics 2011)
[30] (American Academy of Pediatrics 2011)
[31] (American Academy of Pediatrics 2011)

incorporated into the landscape design. Designers should take into consideration the ideal environment for different plant and animal species.

Facility standards for school location, layout, and construction are also included in the new guidelines. This entails standards for openings and exits, steps and stairs, exterior areas, ventilation, heating, cooling, hot water, lighting, noise, electrical fixtures and outlets, and fire warning systems.

For a Hawai‘i-specific resource for existing early education facility design guidelines, the most relevant is the Hawai‘i Department of Education (DOE) *Education Specifics (EDSPECS) for Elementary Schools*. Because this contains no specifications for early education, the specifications for elementary schools will used as a resource for the new guidelines.[32]

Some important aspects of the *EDSPECS* include the functional relationships matrix (see figure 2.1), philosophy and facility design concept questions, square footage per program space, considerations for restrooms, and the HI High Performance School Guidelines. The functional relationships matrix show how the program spaces relate to one another. For example, student activity spaces should have access to administration spaces and be located near counseling offices, but have no relationship to parent resources and thus do not need to be situated nearby.[33] This is important in understanding how a school should be laid out, which rooms should be next to each other, which can be farther apart, and how an adult or a student will navigate throughout the school.

Among the *EDSPECS* philosophy and facility design concept questions, the following are included in the new guidelines: “What are the goals of this school? What are the elements of the school that support these goals?”[34] And, “What are the influences of the community’s characteristics?”[35] These are important questions to answer at the

[32] (Hawaii State Department of Education n.d.)
[33] (Educational Specifications (EDSPECS) For Elementary Schools 2008)
[34] (Educational Specifications (EDSPECS) For Elementary Schools 2008)
[35] (Educational Specifications (EDSPECS) For Elementary Schools 2008)

beginning and end of the design process to clarify and ensure the goals for creating the school are being carried out.

Figure 2.1 Elementary School Relationship Matrix

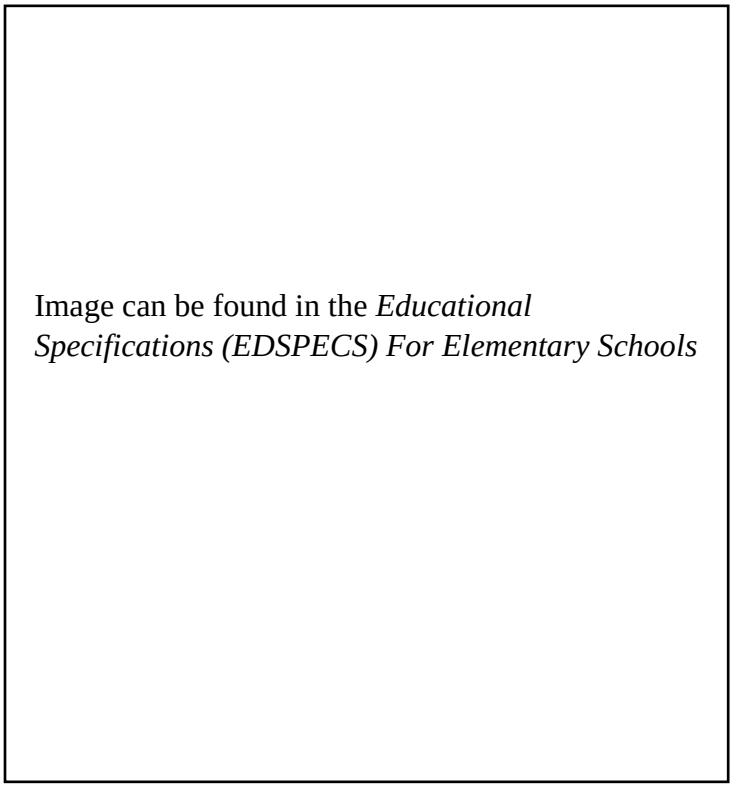


Image and data are from the Hawai'i State Department of Education, *Educational Specifications (EDSPECS) For Elementary Schools*.

The *EDSPECS* lists several program spaces by program type with ideal square footage. It is important to note that these are based on a full elementary school setting with a minimum enrollment of 550 students.[36] Therefore, the size of some program spaces meant to accommodate an entire elementary school, like the open play field or the school kitchen, can be reduced. Moreover, certain program spaces do not need to be included in an early education facility, such as breakout rooms, open flexible spaces used when a typical classroom setting is not needed. This kind of flexibility is inherent in preschool classrooms while traditional classroom elements, like individual desks and chairs, are not as common.

[36] (Educational Specifications (EDSPECS) For Elementary Schools 2008)

For efficiency, some program spaces can be combined or found in the larger community. If an early education facility is located adjacent to a public library, is it necessary to include a separate program space for a library within the facility? In many cases, it is more efficient to use existing resources in the surrounding community. Program spaces like the dining area and indoor multipurpose space could be combined. Dining tables and chairs can be moveable to fit the needs of various events and activities. This would cut costs for building program space and make more efficient use of existing space. Several public schools in Hawai‘i make use of such combined spaces. These multipurpose spaces that can also be opened to the community for events like town hall meetings, community organization meetings, and other activities. Lastly, it is important to note that though preschool-age children don’t require as much variety in program spaces, they do require more square footage per child, as previously discussed.

All of the above-mentioned resources were considered for the new guidelines. They cover existing standards for program size and type for early education facilities as well as build quality. They provide insight into the planning process of a new facility and information on the kind of regulations that may need to be met in order to ensure the safety and security of an early education facility. The next chapter explains other considerations for the new guidelines. The complete set of guidelines is listed in chapter five.

CHAPTER 3. IMPROVING FACILITY DESIGN

Chapter three identifies ways to improve quality and accessibility in early education facility design by focusing on four different areas. The first section focuses on the relationship between the built environment and student success. Studies about this reveal key design elements that can boost the quality of the learning environment and therefore positively influence a student's wellbeing and work ethic.[37] The section reviews several studies and the main results of each study are designated as design aspects that require special attention for the new guidelines.

The second section reviews existing early education precedent studies in order to distinguish concepts that can be applied to the design methodology and facility design guidelines. The third section explores current methods of integrating culture in design, and the final section examines the current status of education in Hawai‘i and possible progress for the future.

Relationship of the Built Environment and Student Performance

The first study that will be discussed, "Child Development and the Physical Environment" conducted by Gary Evans, identifies environmental aspects that can be detrimental to a child, including behavioral toxicology, noise, crowding, schools, and the quality of home and neighborhood settings. In the discussion about schools, the main topics covered are school size, degree of openness in the classroom, and ambient qualities.

Evans argues that smaller numbers of students, both in overall school size and classroom size, have been linked to better attendance, greater extracurricular involvement, and more reported feelings of connection to the school.[38] A smaller classroom size is associated with more one-on-one time between students and teachers and stronger connections between students, while a small overall student body is associated with feelings of connection and pride in the school and can lead to higher rates

[37] (Burton 2010)
[38] (Evans 2006)

of participation.[39] The new design guidelines emphasize the importance of smaller classroom sizes and strictly enforce the most current teacher-to-student ratio and maximum number of students per classroom. Though it is not as important to instill a sense of school pride in preschool-age children, it is important to ensure that they are able to receive individual attention from the teachers. Therefore, teachers should not feel overwhelmed and classrooms should be designed to follow the teacher-to-student ratio and maximum students per classroom. This also means that the classrooms should be designed to feel comfortable enough to accommodate the particular number of children.

The degree of openness of a classroom relates to a feeling that the space is comfortable and uncrowded as long as it has the necessary boundaries to minimize distractions and noise levels.[40] Early education classrooms are typically divided into different activity spaces. Each space needs to have clear boundaries, and spaces that require keeping a group's attention on one teacher need boundaries that can block out noise and distractions from other sections of the classroom. Boundaries do not have to be solid walls. For early education facilities, it may be more effective to have moveable dividers, flexible enough to change space as needed. For napping areas, however, perhaps more solid boundaries are necessary. Whatever the form or material, it is important that these boundary elements do not create a feeling of crowdedness in the space. These boundary elements will be an important consideration for the new guidelines.

Ambient qualities in a classroom refer to temperature, lighting, acoustics, and ventilation. Evans argues that a cooler, more comfortable environment leads to better concentration for students.[41] For example, if a classroom feels hot due to a lack of air-conditioning or ventilation, students may feel uncomfortable about the environment and be unable to concentrate on their work. Ambient qualities are addressed in most existing design standards, but for the new guidelines, the focus is specific to preschool-age children.

[39] (Evans 2006)
[40] (Evans 2006)
[41] (Evans 2006)

The school size, the degree of openness in the classroom, and ambient qualities are all topics that can be considered for the design of early education facilities in Hawai‘i. As seen in chapter two, the design of program spaces is determined by the expected number of students in a room and the ideal square feet required per student. This can ensure the size of the spaces won't feel too crowded. The degree of openness in the classroom can be manipulated with the use of furniture and other methods of creating boundaries. For ambient qualities, Hawai‘i has a year-round tropical climate that can be used to the school's advantage for the comfort of the school occupants.

The second study, "The influence of school architecture on academic achievement," is an investigation of the relationship between certain design aspects and student performance. The author, Kenneth Tanner, writes that the physical environment has a direct effect on a person's behavior or attitude, a person's behavior or attitude has an effect on how they learn, and therefore the physical school environment has an effect on a student's ability to learn.[42] For example, poor indoor temperature leads to student discomfort and distraction which in turn impedes a student's ability to concentrate let alone thrive. Tanner collected the reading and math scores of 44 elementary schools in the state of Georgia and compared them to the design patterns in each school. He identified 39 distinct design patterns and assessed the functionality, adequacy, safety, and quality of each. Of the 39, only five showed a significant positive influence on the students' test scores. These are pathways, outdoor space, technology for students, technology for teachers, and overall impression. These five will be given special attention in the new design guidelines.

Pathways refer to how students navigate through the school, to the accessibility of the school as a whole and that of each program space, and to the quality and aesthetics of the school. It would be beneficial to include pathways as a topic for the design of early education facilities since it is directly related to the occupants of the school and how they perceive and interact with the spaces. Designers would want the occupants to be able to easily navigate through the school and to feel that the spaces were organized in a way that best fits their needs. Outdoor spaces refer to the existence, availability, and quality of

[42] (Tanner, The influence of school architecture on academic achievement 2000)

outdoor spaces. In chapter two and further discussed in this chapter, outdoor spaces are emphasized in school design, especially for younger children. Outdoor spaces are included in the design of early education facilities for this dissertation. Technology refers to the appropriate use and quality of technology available for educational purposes, activities, and student use. There could greater exploration of how technology can aid in education for schools in Hawai‘i and therefore consideration for technology is included in the design guidelines. Overall impression of the school relates to how students perceive their school, like does it feel inviting or do the students feel a connection to it. The overall impression of the school can be viewed as a topic that helps to ground the school to its community. Designing the school so that it is received well by the students, parents, and community of a specific place.

The third study, “The walls speak: The interplay of quality facilities, school climate, and student achievement,” is a survey of the perceptions of teachers from 80 Virginia middle schools on the quality of their schools in relation to student performance. The purpose of the study was to find a relationship between the quality of facilities, resources within the schools, school climate, student socioeconomic status, and student achievement.[43] The survey consists of statements about the school facilities which the teachers rated based on how frequently they perceived each statement to be true. Six statements reveal a positive relationship between school facilities and student achievement, including: Facilities are adequate to support learning, the building is a comfortable place to be, the building is pleasing in appearance, there is adequate space for teaching and learning, classroom equipment and furniture is in good condition, and facilities receive regular maintenance.[44] There are also three aspects not related to the physical environment that showed a positive relationship: academic press, teacher professionalism, and community engagement.

The six statements related to the physical environment can be taken into consideration when designing a school that supports teacher and student performance.

[43] (Uline and Tshchannen-Moran 2008)
[44] (Uline and Tshchannen-Moran 2008)

They have been incorporated into this project's design process. The three non-physical aspects can also be addressed through facility design. For example, adequate spaces such as offices and meeting rooms for parent-teacher conferences and staff organization can be provided to support teacher professionalism. Also, spaces such as teachers' lounges, storage spaces, and comfortable classroom environments can help teachers feel comfortable at the school and increase motivation and performance (which relates back to one of the six statements, adequate space for teaching and learning). Community engagement can be accomplished by providing shared spaces for students and the community. Inclusion of shared community spaces should consider that needs or wants of the surrounding community in a particular area. For example, if a neighborhood has been contemplating starting a community garden then a nearby school could provide a garden on campus for student and community use.

In a fourth study, "A sound foundation? What we know about the impact of environments on learning and the implications for Building Schools for the Future," the authors argue that there is a lack of evidence on the influences of specific elements of the physical environment on student performance. They found, however, that a detrimental environment can influence attainment (test scores and grades), engagement (classroom participation), affect (student behavior or attitude), attendance, and well-being (student health).[45] Therefore, when designing a learning environment, it is beneficial to consider the various ways certain design aspects can impact students. The study assessed elements of the school environment based on three categories: qualities that lead to a detrimental environment, design aspects that have an influence on students but still need more evidence, and design aspects that add value to the environment. For the new guidelines, consideration was placed on the aspects determined to add value to the school, which are (verbatim): build quality, lighting and color, displays, and storage.[46] Lastly, the study highlights the importance of involving the students, teachers, and surrounding community in the design of the school.[47] If everyone collaborates, it can ensure that adequate spaces

[45] (Woolner, et al. 2007)
[46] (Woolner, et al. 2007)
[47] (Woolner, et al. 2007)

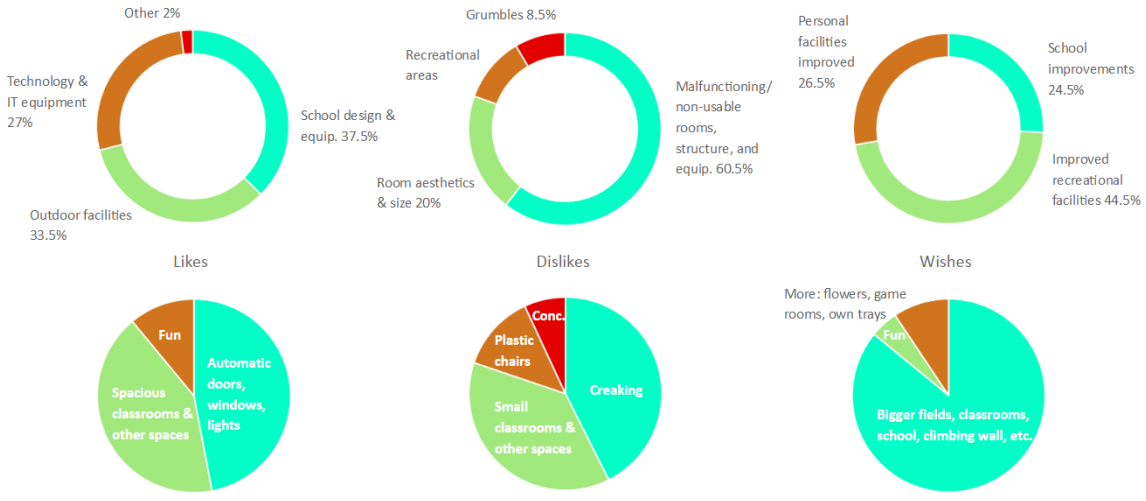
will be provided to fill the needs of the students and teachers and can foster a relationship between the school and community.

The final study, "A child's eye view of primary school built environments," investigates how a child perceives school. It was conducted not only to prove that there is a link between the built environment and student performance, but principally to gain information on the student's view of school.[48] The results list the specific qualities of school that the participants like, dislike, and wish to improve on. The needs and desires of the students is an important perspective to consider when designing a school. A similar study could be conducted in Hawai'i to gain an understanding of the existing conditions of schools as well as the needs of students.

For this study, the authors interviewed two primary schools in the United Kingdom. They distributed grade-appropriate surveys to upper grade levels and held discussions with the younger grade levels. According to the results, the students of both schools wanted larger classrooms and facility spaces, more outdoor recreation space, better technology and equipment, and a brighter, more colorful environment (see figure 3.0).

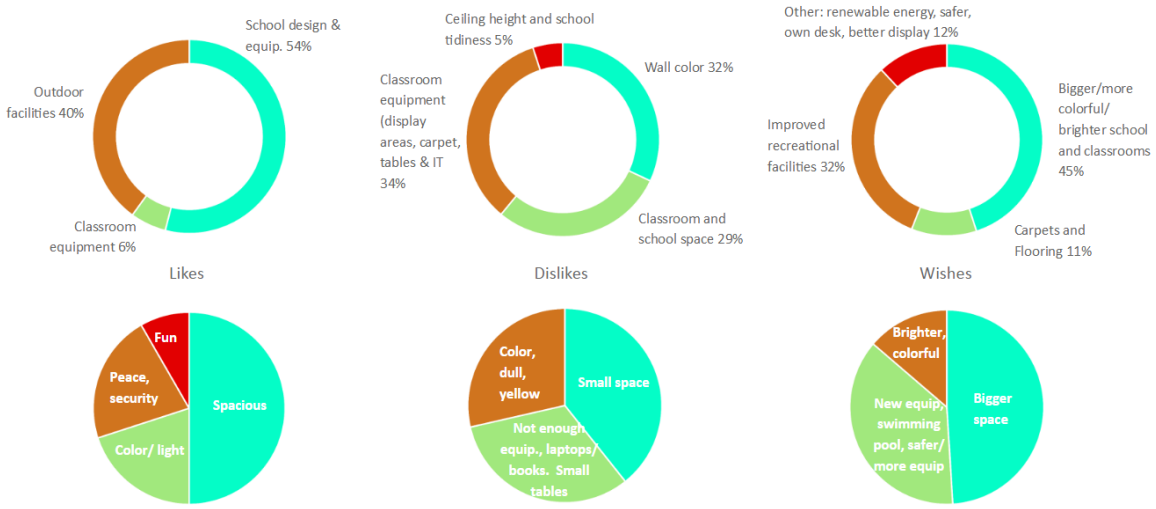
Figure 3.0 Survey results from Rolls Crescent Primary School and Darley Churchtown Primary

School



[48] (Barrett, Zhang and Barett, A child's eye view of primary school built environment 2011)

Results for Rolls Crescent Primary School



Results for Darley Churchtown Primary School. Data is from *A Child's Eye View of Primary School Built Environments.*

Summary of Findings

Though these studies relate to various settings outside of Hawai'i, there are common aspects among the studies support the idea of good facility design. Good facility design can help improve the quality of school environments, therefore, increasing the chances for better student performance. These design aspects can be applied to early education facilities while taking into consideration Hawai'i unique environment. The studies highlight aspects such as allowing for natural light and providing outdoor spaces which are aspects that facilities in Hawai'i can take advantage of in design because Hawai'i has the ideal climate for these design considerations year-round. These design aspects are highlighted in these studies because they have been proven to lead to good facility design with positive outcomes resulting from students. It would be beneficial to include these aspects in the facility design guidelines for Hawai'i early education facilities.

The following list is a summary of the top design considerations from the reviewed studies that support a positive school environment which were chosen for the new guidelines (listed in the order in which they were discussed):

- School size: Smaller schools are linked with better attendance, more extracurricular involvement, and a greater sense of connection to the school.
- Openness: Openness produces a sense of comfort as long as distractions and noise levels are minimized and activity areas are set with clear boundaries.
- Ambient qualities: Proper heating, ventilation, and air-conditioning systems are necessary; students concentrate better in cooler environments.
- Pathways: Easy-to-navigate pathways positively influence school experience. Pathway design considerations include width of corridors, proximity of spaces, signage, minimal use of corridors, as well as grouping together of similar programs.
- Outdoor spaces: Outdoor spaces positively influence school experience and include adequate space for a variety of activities, recreational equipment, and outdoor classroom settings.
- Technology for students: Appropriate technology provided for students in classrooms and other program spaces supports learning.
- Technology for teachers: Appropriate technology provided for teachers in classrooms and other program spaces supports teaching experience.
- Overall impression: The school's overall impression affects student and parent connection and involvement.
- Facilities adequate to support learning: Size of facility, condition of facility and equipment, comfort of facility, and adequacy of materials and equipment affect learning.
- Building comfort: It is important for the space to feel cool and comfortable, have, operable windows, and air-conditioning. For younger children, the classroom should feel home-like for an easier transition.
- Pleasing building appearance: For students, the facility should look fun and welcoming. For parents and faculty, the facility should look professional and supportive of the students.
- Adequate space for teaching and learning: Sufficient size of activity spaces, outdoor play areas, and classroom and program spaces helps prevent crowdedness.

- State of classroom equipment and furniture: The condition and quality of classroom equipment and furniture affects the learning environment. Equipment, furniture, and finishes can be easily replaced or refinished in most cases.
- Frequency of facility maintenance: The regular maintenance and improvement of the facility, which includes designating space for maintenance work and storage, supports a positive learning environment.
- Build quality: Quality of construction and facility design affect the learning environment.
- Lighting: Appropriate lighting design considerations include use of light fixtures, optimization of natural light in all spaces, and building orientation. Ideally, each room has plenty of natural light as well as different options for alternative lighting sources.
- Color: The colors on furniture and finishes should be stimulating and playful.
- Display: Space provided to display information for parents encourages involvement in child's education. Space provided to display student work allows students to feel good about their progress in school and encouraged to do better and participate more often.
- Storage: Adequate storage should be provided in classrooms, faculty spaces, and other necessary program spaces.
- Occupants: Involving faculty, students, and the community in the design of the school and providing spaces designated for community use.
- Larger classrooms and facility space: Adequate size of classrooms both indoors and outdoors supports teaching and keeps spaces from feeling crowded.
- More outdoor recreation space: It is important to provide appropriate and adequate outdoor recreational space, equipment, and storage.
- Better technology and equipment: Technology should be incorporated into the design of the classrooms and other program spaces.
- Brighter, more colorful environments: Classrooms and other facility spaces should be bright with adequate lighting and colors used that are stimulating and playful.

- Surfaces: Hard surfaces, such as concrete floors and plastic furniture, should be used minimally.
- Personal space: Individual desks, personal storage, and well-designed classrooms provide areas for quiet individual work and play.

It is important to note that some results are repeated across multiple studies. This may indicate the value of these aspects which thus require greater consideration for the new design guidelines.

In the studies, an implied or stated importance is placed on viewing aspects of the school from the perspectives of different users. This is emphasized in the new guidelines in order to encourage designers to see the facility design from the perspectives of the students and faculty. This is beneficial for understanding the reasons certain design aspects are more important or need more attention than others and will hopefully lead to better design decisions oriented toward creating conditions where the occupants can thrive. The information in the new guidelines (see Appendix) is broken down into three categories: design perspective, faculty perspective, and student perspective. The first category represents aspects that are important to the designer in creating a high-quality facility and the second two categories are aspects that are important to the faculty and students.

Precedent Studies

The following precedent studies are examples of early education facilities in New York City and Hawai‘i. The locations of the studies range from highly-dense, urban environments to more spacious, suburban settings and cover various program types including full-day and half-day programs, early education centers, classroom settings within elementary schools, and community-based programs. The goal of this section is to examine the conditions of early education facilities within a variety of program types and settings and to identify the different types of program spaces in each. For simplicity, the titles of the schools and programs have been simplified to private school, public school, or community program.

New York City Private School[49]

The first school is one in a group of community-based private schools in Manhattan. The school is set within an existing mid-rise building and has three levels; the lower level houses the early education program for two- to four-year-olds and the two upper levels house the older grades. This project was recently completed by Perkins Eastman and focuses on experimental learning. Because the school does not have access to a secure outdoor space, the designers needed to find a way to bring the outside indoors. They incorporated nature into the facility design through elements such as furniture color, arches made to resemble trees, and the flow of corridors designed to mimic a river. Large windows overlooking the adjacent plaza allow natural light to enter the space and provide a visual connection to the outside world.

Other notable aspects of the facility include: Activity spaces in the classrooms are clearly defined by furniture arrangement. Although the facility is inside an existing mid-rise building, the architects were able to include a high-ceilinged, multi-purpose auditorium. In the elevator lobby, large cubbies line one wall to display student work. Classrooms include whiteboard dividers or curtains to allow for varied uses of space. Technology is incorporated into the design with ceiling-mounted projectors in each classroom. Finally, the early childhood center classrooms are equipped with child-sized sinks and toilets and lockable cabinet storage.

New York City Community Program[50]

This facility is part of an organization that runs community programs that support women, children, and low-income families. When a family applies for the program, social workers meet with the family members to assess a child's health, speech abilities, home conditions, and more, in order to determine the kind of education needed and to better understand family background. Families who need more assistance are given the opportunity to participate in the organization's other programs or to take part in their

[49] (Conversation with Facility Member at a New York City Private School 2016)
[50], (Conversation with Facility Member at a New York City Community Early Education Program 2016)

child's education and learn together directly. Committees within the organization partner with community groups to fill the needs of the children and parents. For example, health assessments are conducted by students from the nearby School of Dentistry and children with speech disabilities are personally coached by students from New York University's Speech Therapy department.[51] This system is beneficial to the families and helps build a stronger community.

Other notable aspects of the facility include: The classrooms provide a variety of activity spaces but are smaller in overall size than those of the previous study. Each classroom has operable windows and air-conditioning. Each group teacher is provided a desk in the classroom for work on a computer or laptop. Each classroom has toilet facilities and storage for students' personal belongings. A full kitchen is used to prepare school meals and a rooftop garden is also available for the school's use. Adult bathrooms are located in the hallways, separate from the classrooms. The teacher's lounge provides tables and a computer for staff use. Since the program is part of a larger organization, more office spaces and restrooms are included in the facility.

New York City Private School versus Community Program[52]

Because the New York City private school is a new facility set within an existing building, Perkins Eastman was able to analyze the space and arrange the program in a way that best fits the space; the quality of the spaces, equipment, and furniture are in the best condition for the setting. Activity spaces are clearly defined and the flexibility to open up classrooms will benefit the school as it grows. Technology is incorporated through projectors in classrooms, a media room, and consideration for computer use throughout the facility. School lunches are delivered to the school with minimal preparation required; any food preparation that is required can be done with the equipment in the teacher's lounge. The school also provides plenty of personal space

[51] (Conversation with Facility Member at a New York City Community Early Education Program 2016)
[52] (Conversation with Facility Member at a New York City Private School 2016), (Conversation with Facility Member at a New York City Community Early Education Program 2016)

areas; nook-like spaces set throughout the facility, adjacent to the main circulation paths, provide private places for student use.

The community program differs from the private school in a number of ways. The community program is set within an existing building and renovations are made as the program changes. Therefore, even though space may be limited, the program is flexible enough to make changes as needed. Community involvement is another difference; the program provides spaces for community partnerships including rentable offices, a teacher's lounge, and community use of the rooftop playground during after school hours. The program also has a full kitchen for food preparation for the students. Some of the foods are grown in the school garden, which is used as a part of the early childhood program that teaches children how to grow and prepare food.

The two schools are also similar in several ways. In both, classrooms are divided according to activity and have spaces for open play. Both include auditoriums for performances, meetings, and other gatherings for students, faculty, or community. Both provide space for the display of student work as well as information for the parents. Lastly, they both work to ensure the physical comfort of the students through access to daylighting, options for additional artificial lighting, and operable windows for natural ventilation.

Hawai‘i Community Program[53]

The Hawai‘i community program is a large facility that occupies an open plot of land on the island of O‘ahu. It consists of an administration building and a preschool complex. The preschool complex is comprised of three clusters with four classrooms each. This program is intended for three- to four-year-olds and classrooms with twenty children and two to three teachers. Each classroom is divided into activity spaces and has restrooms for children, cabinets for some storage, and a storage closet shared with the adjacent classroom. The classrooms have clerestories through which natural light can enter; however, it has been noted that naptimes are difficult because teachers are unable

[53] (Conversation with Facility Member at a Hawai'i Community Early Education Program 2016)

to darken the rooms. Each classroom cluster has an office space for teachers and a laundry room. Sinks are provided inside and outside of the classrooms. Outside of the classrooms is a large outdoor play area with a garden space, playground equipment, and climbing rocks.

The administration building has two levels with preschool program offices as well as offices designated for other organizations. In this way, the Hawai‘i community program is similar to the reviewed New York City community program. Both create partnerships with community groups for the benefit of the children and families and provide spaces within the facility for the use of community organizations. The Hawai‘i community program also provides workrooms, breakrooms, different-sized meeting rooms, and large multipurpose spaces.

The design of the school takes into consideration cultural aspects. The gardens outside of the classrooms are not only used to teach children how to grow and prepare foods but are also used to educate them about native plant species. A large grass area with seating outside the administration building provides a setting for Hawaiian culture-based activities. The large indoor multipurpose space is also used for cultural activities. The layout of the office spaces and classrooms, through the use of large windows facing the mountains in the distance, creates a visual connection to the outside environment. The cultural influence is also seen in the plantation-style design of the buildings, the colors and materials of the finishes, and the landscaping that incorporates many native species.

Hawai‘i Public School[54]

As mentioned in the first chapter, Hawai‘i does not have a state-funded preschool program. However, the Hawai‘i DOE does include preschool classrooms in nineteen elementary schools across the state.[55] Some of the schools that do not have a preschool program do provide a classroom for a special education program intended for preschool-

[54] (Conversation with Facility Member at a Hawai'i Public School 2016)
[55] (Hawaii State Department of Education 2016)

age children. This study reviews a special education program at a public elementary school on O‘ahu. The program is intended for four- to five-year-olds with one teacher per eight children.

The special education program is set in a recently-built portable classroom on the campus grounds, separate from existing buildings. The portable consists of two classrooms—one exclusively for the use of the special education program and the second shared with Kapiolani Community College (KCC) for night classes and programs outside of school hours. The portable contains an office space for the teachers, a storage closet, and a janitor’s closet with a shower. It also includes a small home-like kitchen that can be used by both the preschool program and KCC. The preschool uses the kitchen, together with the school garden, as part of its food education program. The school garden is used by all grade levels and includes an outdoor classroom setting. Members of the community donated most of the plants in the school garden and also helped build the portable building, including installing the railings and painting the exterior.

Summary

Although the settings for the New York precedent studies are far different from the settings for the Hawai‘i precedent studies, it is beneficial to compare these examples. There are aspects that are common among all examples, as well as aspects that are unique to New York that Hawai‘i can learn from. One similarity is the general layout of the classrooms. In every case, classrooms are divided into different activity spaces using furniture, flooring types, or other boundary elements. The classrooms also have restrooms for children and storage for classroom materials. In every study, participants noted that more classroom space and facility storage space would be of benefit. Outdoor spaces were highly valued, especially the inclusion of a garden for educational purposes. New York City’s dense, urban environment makes it more difficult to find outdoor spaces for school use, whereas Hawai‘i has greater opportunities, as these precedent studies show. Finally, all of the studies incorporate elements that give a home-like feel to the classrooms, helping to make spaces feel more comfortable for preschool-age children and easing the transition from home to school.

Culture and Design

The following section relates to culturally-sensitive design. A larger debate exists concerning how Hawaiian culture can be effectively and appropriately translated in design for Hawai‘i’s built environment. Hawaiian culture is rooted in a strong physical and spiritual connection with the land or natural environment and the integrity of this connection should be maintained when cultural aspects are brought into the built, urban environment. Therefore, the goal for this section is how to bring elements of Hawaiian culture into the design of educational facilities while still appropriately maintaining and emphasizing a connection to the land.

In New Zealand, called Aotearoa by the Māori people, the government is working on creating guidelines for merging culture and the built environment using the concept of cultural landscape. Cultural landscape is not a new concept; it is common in the field of preservation. In order for a site to be inscribed on the United Nations Education, Scientific, and Cultural Organization (UNESCO) World Heritage List, certain criteria need to be met, some of which relate to cultural landscapes. UNESCO defines the term as natural environments with connections to the culture of the people in that area.[56] This definition is intentionally open-ended, making the designation of cultural landscapes flexible. Culture differs from place to place and depends on a community’s values and views of its unique cultural landscapes. In their book *New Cultural Landscapes*, Maggie Roe and Ken Taylor argue that it is a challenge to create a universal definition and set of guidelines for cultural landscapes because the concept itself is comprised of complex relationships, varying values, and evolving landscapes.[57]

Aotearoa’s Te Aranga Māori Cultural Landscape Design Strategy is a set of suggestions and guidelines for incorporating design aspects that involve the land and native culture.[58] According to the guidelines, cultural landscape can refer to both rural

[56] (World Heritage Convention 2016)
[57] (Taylor 2014)
[58] (Te Aranga Maori Cultural Landscape Strategy 2016), (Public Health Advisory Committee 2008)

and urban areas.[59] This design strategy is part of Aotearoa's Urban Design Protocol which was established by the Ministry for the Environment for quality urban design.[60]

Re-thinking Urban Environments and Health, a document put together by Aotearoa's Public Health Advisory Committee, is meant not only to help designers to be culturally sensitive and to align with the Te Aranga Māori Cultural Landscape Design Strategy, but also as a reference for policy makers. Some concepts mentioned include healing the environment, finding best practices for bringing Māori aspirations into the built environment, and drawing from the Māori cultural landscape.[61] Depending on the area and the surrounding community, this can be accomplished in a variety of ways.

Those in Aotearoa face the same challenges as people in Hawai‘i: how to maintain a cultural and spiritual connection in urban areas. Some of the strategies recommended in *Re-thinking Urban Environments and Health* include maintaining the integrity of the land and waterways, recognizing the significance of the names of places, and working towards understanding scale and the sympathetic relationships between the people and the environment.[62] Maintaining the integrity of land and waterways could be a part of the active healing of the environment in which key natural features are identified, protected, and thus emphasized in importance to the community. The significance of names refers to the traditional names of places and natural features as well as the meanings behind them. For example, the Hawaiians had several different names for rain, wind, and ocean movements depending on the area and variations of the elements. An understanding of the reasons certain names were given to certain areas or natural elements could be used as design inspiration in urban areas.

Bronwyn Fredericks of Central Queensland University discusses the relationship between design and culture in her article "There is Nothing That Identifies Me to That Place." Through an assessment of a women's health care facility, Fredericks examines foreign influences on design in Australia and what this means to the native people. The goal of the study was to find ways to encourage aboriginal women to use the facility.

[59] (Public Health Advisory Committee 2008)
[60] (Ministry for the Environment 2005)
[61] (Public Health Advisory Committee 2008)
[62] (Public Health Advisory Committee 2008)

This was a challenge because the facility was ultimately not culturally sensitive;[63] the way the spaces in the facility were laid out, the choice of finishes, and even the art pieces reflected foreign influence and arguably the oppression of the aboriginal people.[64] This article shows that even small details matter. The choice of colors and materials of interior spaces should be carefully considered. If the goal is to encourage aboriginal people to come to the facility, art pieces should not depict the foreigners of the land. The layout of spaces should also be carefully considered; in this case, spaces specifically intended for the use of the aboriginal women should not be placed at the back of the facility in a place that feels unwanted and removed from the greater part of the facility.[65]

Each of these aspects can also be considered for culturally sensitive design in Hawai‘i. In Hawai‘i, some places are clearly designed for foreigners and tourists, like hotels and grand shopping malls, but in many cases, these places seem to have more cultural aspects incorporated into the designs than facilities used mostly by locals, like schools and health care facilities.

The final example in this section is a document created by Group 70 International together with the Office of Hawaiian Affairs (OHA), a study of a site for future development. “Strategic Management Framework Kaka‘ako Makai: Cultural Landscape and Ancestral Connectivity Analysis” documents the history of the site, presents general research on Hawaiian culture, states the scope of the project site and scope of analysis for the site, explains the project’s core values and guiding principles, gives recommendations for how to incorporate these values and principles into the project, and discusses some of the known cultural beliefs and practices that could also be included. These cultural beliefs and practices are place names; celestial, atmospheric, and meteorological patterns; and relationship with the land and ocean.[66]

The OHA laid out five statements regarding the *‘āina* (land) to be developed: “space matters as a cultural layer; spaces should facilitate relationship building; value-added development—what is the commercial and cultural worth for the community;

[63] (Federicks 2009)
[64] (Federicks 2009)
[65] (Federicks 2009)
[66] (Group 70 International 2013)

living culture in a living world; and, planning for the next five generations."[67] These statements could be beneficial in relation to school design projects as well. The document is helpful as an example design framework that focuses on the inclusion of Hawaiian culture. It provides information on the history of the Hawaiian people and explains the core values and guiding principles of Hawaiian culture. These values and principles will ensure the design projects do not simply incorporate cultural elements arbitrarily but rather embed Hawaiian culture into the soul of the project.

Summary

The examples above demonstrate how culture can be brought into design in different ways and from different perspectives. For the purpose of this dissertation, cultural aspects will be implemented into the school design using the following methods:

1. Building symbolism
2. Maintaining a connection to the land
3. Program spaces

Building symbolism means the form of the building will reflect aspects of Hawaiian culture in a symbolic way. Maintaining a connection to the land can be implemented using visual, physical, or spiritual design elements. Connection to the land could also mean incorporating climate factors into the site design and using sustainable strategies. Finally, program spaces means providing spaces within the facility for culture-based activities and giving special consideration to the arrangement of such spaces.

The OHA Kaka'ako Makai document review shows that it is beneficial to both designer and client to create a process for how site research can be translated into design. For this dissertation, the following process will be implemented in one of the prototype early education facility designs:

1. State the scope of the cultural analysis.

[67] (Group 70 International 2013)

2. Research general aspects and existing examples of integrating culture in design, including existing frameworks and studies on methods. This is relevant if the designer or client wants to use an existing method or process for the project.
3. Research the specific site and include both a typical site analysis and research on cultural landscape aspects, or aspects of the site that have a significant tie to culture that could be emulated in the design through the three methods mentioned in the previous paragraph (building symbolism, a connection to the land, program spaces) or through one of the existing methods in step two.
4. Organize the information using an existing process or method researched in step two or the three methods mentioned in the previous paragraph. Figure 3.1 is an example chart for organizing the information by building symbolism, a connection to the land, and program spaces. This chart is also used to generate design ideas for each cultural aspect found in the research from steps two and three.
5. Present the information to the client and community. During this step, the design ideas generated in step four can be presented to the client and community in a way that is easy to understand. This can be accomplished with a written explanation, as in figure 3.1, or with diagrams, or simplified visual representations of the ideas, as in figure 3.2. It is important to consider presenting the design ideas to the community surrounding the project site since the project could have an effect on the neighboring buildings, businesses, or on the community as a whole. It is also important to include the community in the design of new projects, especially public buildings, as a way of strengthening community relationships and providing it with a sense of neighborhood ownership.
6. Implement appropriate design ideas. After presenting the design ideas to the client or community, it is important to obtain feedback on the design elements that are most liked or found to be most appropriate. If the designer is not an expert in Hawaiian culture, community feedback can be important for understanding which design ideas are appropriate for the site and respectful of the culture. A lack of

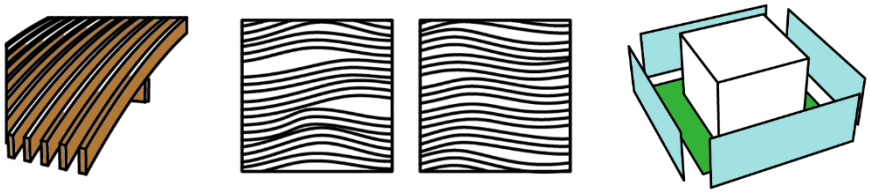
cultural knowledge could lead to misunderstandings within the community and negative responses to the designer and project.

Figure 3.1 Example cultural ideas chart for the Community prototype

Cultural Landscape Aspects	**Building Symbolism**	**Connection to Land**	**Program Spaces**
Views and Orientation			
Natural Features			
Climate Analysis			
History and Legends			

Design idea chart intended to be filled out by the designer or researcher. Design ideas are derived from various research topics relating to cultural landscape aspects and are organized by different methods or representing the research in design: Building symbolism, creating and maintaining a connection to the land, and program spaces.

Figure 3.2 Example illustrations reflecting the design ideas chart



Kapālama ‘ao‘aoa Classroom surroundings

Figure 3.2 shows examples of visually represented design ideas for one of the prototype facility designs. The first image emphasizes the use of wood materials in the design. It derives from the place name *Kapālama*, which means “wooden enclosure.”[68] The second image shows a wavy pattern that represents the type of wind found in the Kapālama *ahupua‘a* (Hawaiian land division), *‘ao‘aoa*, which means “sea breeze.”[69] The last image shows a concept for classroom spaces; the classroom is surrounded with green spaces and with a type of screen boundary beyond.

[68] (Ulukau Hawaiian Electronic Library 2004)
[69] (Ulukau Hawaiian Electronic Library 2004)

Hawai‘i’s Education System

Department of Education (DOE)

The purpose of this section is to gain a basic understanding of the Hawai‘i DOE school system regarding existing conditions for early education facilities. The school system is comprised of fifteen complex areas with two to four school complexes per complex area.[70] There are a total of 255 elementary, middle, and high schools across the state. The state does not fund a state-wide preschool program, but as previously mentioned, the DOE began to include some preschool classrooms in a few elementary schools. A total of nineteen schools participate; five are located on O‘ahu which means space is very limited.[71]

Ka Hei

In 2008, Hawai‘i’s Clean Energy Initiative was established with the goal of achieving one 100 percent renewable energy use by 2045.[72] In response, the DOE made a plan to achieve 90 percent clean energy by 2040.[73] The DOE launched the Ka Hei program in 2014, a five-year initiative that takes a step toward this goal by introducing sustainability into the curriculum and setting new standards for schools.

The Ka Hei program publishes reports on the program’s progress. As of January 2016, two schools have retrofitted their lights with LED systems, 27 schools have completed energy audits, Power Purchase Agreements have been made to incorporate photovoltaic systems for 34 schools on O‘ahu, 176 schools are beginning to update their curriculum to align with HI Common Core and Next Generation Science Standards, and thousands of students have participated in a Ka Hei lesson to increase awareness of sustainability in schools.[74]

[70] (Hawaii State Department of Education 2016)
[71] (Hawaii State Department of Education 2016)
[72] (Hawaii Clean Energy Initiative 2016)
[73] (Ka Hei 2016)
[74] (Ka Hei 2016)

The Ka Hei program demonstrates a shift in education in Hawai‘i. What does this mean for the future of the state's education system? Will Hawai‘i continue on this path, incorporating studies involving sustainability and the environment? These are questions for school designers to consider as they design for these changes in program and curriculum. The initiatives the Ka Hei program is implementing are design aspects, such as photovoltaic systems, that should be considered in the early process of designing a school.

Funding

When considering funding for schools in Hawai‘i, the two most important aspects to consider are the type of school and the type of funding. Public state school funding differs from public charter school funding.[75] Also, there is a difference in funding for Operating Budget and Capital Improvement Projects (CIP). Operating Budget refers to the annual budget allotted per school for the operation of the school. The Operating Budget includes money given to the schools per student, decided using the Weighted Student Formula. This budget differs between state schools and charter schools; state schools are given about $14,000 per student and charter schools about $7,000 per student.[76] Other sections of the Operating Budget include Utilities and Food Service, and the Pre-K program.

The Pre-K program section of the Operating Budget was allotted $3 million for the 2016-17 school year for the thirty schools that include a preschool program.[77] This is not much; if the budget was split evenly between these thirty schools, each school would receive $100,000 to cover materials, teachers' salaries, and more. Even so, the schools that have preschool programs do receive additional funding for other services that could contribute to the preschool programs. Therefore, if one were to decide between creating a new early education facility in a public school or a charter school, it seems best to

[75] (Hawaii State Department of Education 2016), (Hawaii State Department of Education 2016)
[76] (Hawaii State Department of Education 2016)
[77] (Hawaii State Department of Education 2016)

choose the public school to ensure that the school receives better funding and can remain operational.

State public schools also receive funding for CIPs which includes improvements to infrastructure; new schools; new additions to schools; improvements to science facilities; energy improvements; and program support such as ADA compliance, restrooms, and playgrounds.[78] The design of new early education facilities would mostly be concerned with the CIP Capacity portion for new schools or additions. For the 2016-17 school year, $16.1 million was allotted for the Capacity portion to all schools in the state.[79] This amount could be enough to construct a new early education facility; however, it is distributed not only to schools planning new facilities but also to all schools in need of improvements.

From looking at the Operating Budget and the CIP, it is clear that if new early education facilities are to be developed, they must fit within the existing budget or there needs to be more funding. Changes to the funding is beyond this dissertation, but the designer has control over the choice in facility setting, types of spaces within the facility, and choice of materials. In chapter five, some program spaces were chosen to be excluded in the prototype design in order to keep the total construction cost low. Also, one prototype is in an interior alteration to an existing elementary school building which will further help to keep costs low.

Hawai‘i’s Future

As school curriculum evolves alongside the values of the state, it is important for school design to follow suit in order for schools to fit the needs of Hawai‘i’s families and children. With the implementation of the Ka Hei program, Hawai‘i's public education curriculum appears to be moving toward a greater incorporation of environmental and sustainable studies. Does this mean the curriculum will eventually focus on studies involving water, life skills, and technology? Does this mean more outdoor facilities are

[78] (Hawaii State Department of Education 2016)
[79] (Hawaii State Department of Education 2016)

needed in the design of the schools? These are questions designers of Hawai‘i's schools should consider.

Urbanization and Redevelopment

Another consideration in the design of future education facilities in Hawai‘i is the role of the transportation sector. On O‘ahu, for example, construction of the rail from East Kapolei to Ala Moana is in progress. This development will have an impact on schools in the neighborhoods surrounding the rail stations. The Department of Planning and Permitting is working to implement changes to the neighborhoods surrounding the rail stations.[80] The general idea (though it will vary from place to place) is to build up the neighborhoods that are within walking distance of rail stations, to create a greater density of mixed-use buildings within pedestrian-friendly environments in anticipation of the greater number of pedestrian commuters passing through. These areas will experience a reduction in car use and parking needs and thus new school facilities could be intentionally located within walking distance of rail stations in the high-density urban settings.

O‘ahu also has areas currently undergoing development or redevelopment. The Kapolei and Kaka‘ako neighborhoods have ongoing housing and retail projects aimed at urbanization and development.[81] With an increase in housing and thus population, these areas may eventually require new schools. These schools could be designed based on existing standards or other examples of schools in urban settings like the New York precedent studies. With the implementation of the Transit Oriented Development plans, an increase in urbanization means to schools that there will be greater considerations for walkability, less vehicle traffic, and higher density of people and buildings. This could mean less need for vehicle parking, but also possibly a challenge in securing outdoor spaces for schools with the increase in development projects. This would relate to site design for schools in consideration of adjacent buildings or future building projects and

[80] (City and County of Honolulu 2016)
[81] (City and County of Honolulu 2016)

current circulation paths connecting to the school and how that may change with expected use of the rail system. Planning of school facilities should take into consideration options for minimizing parking and maximizing outdoor spaces that won't be blocked by adjacent buildings for sunlight and views or are within a safe walking distance from the school facility.

CHAPTER 4. EARLY EDUCATION DESIGN METHODOLOGY

This chapter will focus on a methodology for designing early education program prototypes based on the research from chapters two and three, including the research on school funding and facility types. This early education design methodology involves three major groups of research:

1. Research on new facility design guidelines involving existing design standards, studies on the connection between the built environment and student performance, and precedent studies (chapters two and three)
2. Research on possible financial models for each early education prototype (chapter four)
3. Research for the site selection process involving different aspects of site analysis (chapter four).

This methodology was applied to three prototypes developed up to the schematic design phase, each of which applies to a different context in Hawai‘i. One of the prototypes was developed up to the design development phase using the culture design process explained in chapter three.

Existing Facility Types

Facilities

Early education facilities are typically identified as either home-based or center-based. A home-based facility is one that is within the caregiver's home in a residential area.[82] Home-based facilities are considered small or large depending on the number of children. A small facility can have up to six children and a large facility can have up to twelve. The child-to-teacher ratio from existing standards applies equally to center-based and home-based facilities, therefore large facilities may need more than one teacher. Center-based facilities are not set in the caregiver's home and can be located outside of a residential area. Center-based facilities do not have a limit on number of children as long

[82] (American Academy of Pediatrics 2011)

as the child-to-teacher ratio is applied and the appropriate space is provided per child per classroom.

Both home-based and center-based facilities exist in Hawai‘i. There are several home-based facilities which can be found on search and resource sites like PATCH.[83] Center-based facilities include those at private schools, charter schools, and the preschool classes at public elementary schools. The Hawai‘i Community Program precedent study is an example of a private, center-based facility. Center-based facilities can be simple, stand-alone facilities in an open lot in a commercial, residential, or mixed-use area, or can occupy space within an existing building.

Another potential group of existing buildings for early education facilities are the recreation centers at public parks. These centers are used by community organizations such as summer school programs, marital arts classes, club sports, boy and girl scouts, and other community clubs. Most of these programs take place during after-school hours or during school breaks. During school hours, recreation centers are rarely used. These centers, if used, can be improved to fit the needs of an early education program, improvements that can benefit all the community organizations that already use the center. Placing early education programs in recreation centers would keep the buildings in use all year which would discourage vandalism and maintain a livelier feeling in the parks. Furthermore, recreation centers and park spaces are located in most neighborhoods throughout the state, simplifying site designation and up-front costs. Most recreation centers include additional facilities such as basketball courts, tennis courts, a swimming pool, or playground equipment; these could be existing assets for the early education program. However, recreation centers are usually located on public park land with P-2 (preservation type land use) zoning; education and childcare are not listed as allowable uses for this type of zoning. Therefore, new school facilities would not be able to be built on park lands, but could be built on land that allows for schools and function similarly to recreation centers.[84] This would help to increase community

[83] (PATCH Hawaii 2010)
[84] (City and County of Honolulu n.d.)

participation in education. The prototypes will include shared community spaces for this purpose.

For this dissertation, three prototypes were developed as examples of the design process and implementation. These prototypes fit different contexts found in Hawai‘i in response to the different needs of resident families. The prototypes considered for this dissertation are:

- A program occupying classrooms within an existing elementary school building (School setting prototype).
- A program occupying a space within an existing building in a high-density urban area (Urban setting prototype).
- A new stand-alone facility that fulfills the needs of a specific community (Community setting prototype).

Philosophies

Not only are there different facility types for early education programs, but there are also different school philosophies. The school philosophy indicates what kind of curriculum the school will use and also what kinds of spaces are needed or included within the school facility. Typical early education program philosophies include:[85]

- Montessori: Focuses on individual learning and on providing individual attention to students.
- Waldorf: Encourages creativity with a set routine in a home-like setting.
- Reggio Emilia: Promotes student-initiated and student-led activities.
- Project-based: Focuses on cooperation between students with a less structured program.
- High/Scope: Focuses on academic skill and skill development of at-risk children.

[85] (Quinn 2015)

- Religious: Focus varies but includes religious content.
- Community: Focus varies but program includes the use of recreational facilities.
- Cooperative: Focuses on parent involvement; includes parents in the learning or other services of the school. This is typically a less expensive option because parent involvement relieves some work for teachers or staff.
- Play-based: Focuses on age-appropriate play-based activities rather than academics.
- Language Immersion: Focuses on learning a new language.

Most if not all of the above-mentioned philosophies can be found in schools in Hawai‘i. For this dissertation, philosophies are not specified for the prototypes but are considered when listing the types of activities that could take place in the prototype relevant to each philosophy.

Prototype Methodology

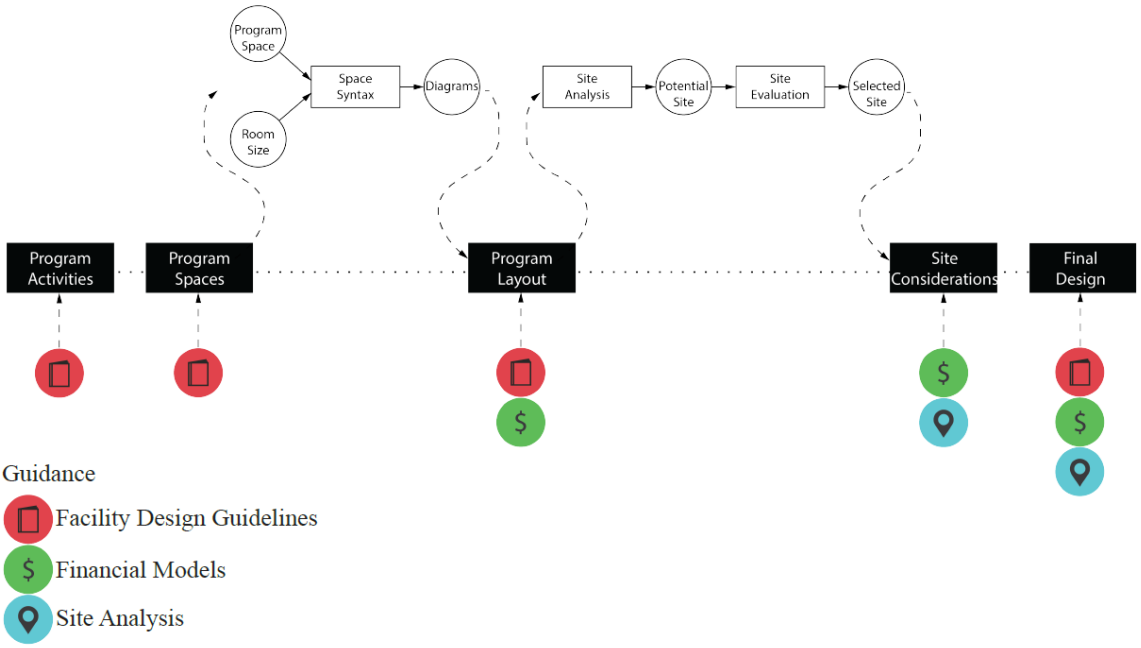
This section describes the full process for designing a new early education facility for this dissertation. The examples in this process use the three prototype settings described in the previous section: school, urban, and community. Figure 4.0 shows the process flow chart. The steps taken for the guidelines are as follows:

1. Program Activities: Program activities are listed based on existing early education standards and precedent studies. Each program activity is associated with appropriate program philosophies and program spaces. More than one program space may be considered appropriate for each activity.
2. Program Spaces: Program spaces are listed in the program activities chart and are organized by program type using Space Use Codes.[86] Each program space has an ideal size, which is either given as a set square foot area or a size based on the number of students per classroom. This list can be used to select program spaces appropriate to a facility to begin the design process.

[86] (NCES National Center for Education Statistics 2006)

3. Program Layout: The program layout section uses the Space Syntax Grasshopper program that can be accessed on the Rhinoceros 3D modeling program.[87] This program is used in order to find quick solutions for laying out the spaces of a future facility and can be easily modified to change the size or quantity of spaces while updating the diagrams in real time.
4. Site Considerations: Site considerations consists of a site analysis section and a site evaluation section. It is necessary to apply both to a project site in order to identify the most appropriate and ideal site for the planned early education facility.
5. Final Design: Taking into consideration the facility design guidelines, the financial models, and the site considerations, the conducted research can be translated into design ideas to apply to the overall design of the facility. This final design phase involves two traditional architectural phases, schematic design and design development, and involves the implementation of cultural aspects into the design, as discussed in chapter three.

Figure 4.0 Design Methodology for Early Education Facilities



[87] (Grasshopper 2016)

The icons in the process chart show how each step is influenced by different areas of research (figure 4.0). Facility Design Guidelines are the result of research on existing design standards and on the connection between the built environment and student performance. The full Facility Design Guidelines chart can be found in chapter three. The financial models and site analysis portion will be explained later in this chapter. See Appendix for a summary document of the design methodology.

Program Activities

The process begins with a list of program activities. This list was drawn up from the research in chapters two and three. The existing facility design standards provide typical program and activities per age group. The results from the studies on the connection between the built environment and student performance supply categories or design aspects to which special attention should be paid. The precedent studies cover typical programs and activities found in Hawai‘i and New York City. Each activity and program space mentioned in the research was extracted and added to the list. The program activities list is linked with program philosophies (see Appendix) so that one is able to see which philosophies are associated with a particular activity. There may be more than one philosophy per activity. The program activity chart is intended to provide the designer with information on the types of program spaces needed for specific activities. The list is not comprehensive; more activities could be added.

Program Spaces

The Appendix displays a chart of program spaces. Each program activity is associated with an appropriate program space. The activities and spaces may overlap; some activities can be held in more than one program space and some program spaces can host multiple activities. Therefore, the types of spaces that should be included in a facility are flexible. Each program space is associated with an ideal room size. The program spaces are then associated with the three different prototypes.

Each program space is given a space use code, as defined by the *Facilities Inventory and Classification Manual* (FICM).[88] Space use codes are associated with a color to identify spaces by room type in diagrams. The colors and numbers legend for the space use codes are shown in figure 4.2. The codes associated with each program space are shown in the Appendix.

Figure 4.1 *Facilities Inventory and Classification Manual*

100: Classroom Facilities

300: Office Facilities

500: Special Use Facilities

600: General Use Facilities

WWW: Circulation Area

XXX: Building Service Area

Some spaces were not included in the prototypes when found to be inappropriate. For example, the school setting prototype will not include a kitchen and dining spaces since an elementary school setting should already have such services. Each prototype's list of program spaces is organized into two options (see figure 4.4): one option is for a full program and the second option eliminates spaces that may not be necessary or combines spaces to avoid redundancy. An example is the café space for the urban setting prototype. The café provides program space for parents so they can be more included in the school; however, this space is not critical to students' learning or care and is therefore removed in the second program option.

[88] (NCES National Center for Education Statistics 2006)

Figure 4.2 Program space options for each prototype

Elementary School Setting: 2 classrooms with 12 children each = 24 total children + 4 teachers

Program Type	Space Use Codes	Program Space	Size of Space	Quantity	All program spaces	Minimum program spaces
100: Classroom Facilities	110	Activity/ Classroom	42 sf/ child	2	✔	✔
	110	General Indoor	35 sf/ child	1	✔	
	110	General Outdoor	75 sf/ child	1-2	✔	
	115	Non-Assignable Space	20 sf/ child	2	✔	
	115	Classroom Storage	80 sf	2	✔	✔
	115	Classroom Toilet	80 sf	2	✔	✔
300: Office Facilities	310	Administration Office	120 sf	1	✔	✔
	310	Director's Office	160 sf			
	315	Staff Support/ Storage	380 sf	1	✔	✔
	350	Conference Room	200 sf			
500: Special Use Facilities	590	Media Lab	1,200			
600: General Use Facilities	610	Indoor Multipurpose Room	1000 sf			
	610	Outdoor Multipurpose Room	1000 sf			
	630	Serving Kitchen	600 - 905 sf			
	630	Serving/ Dining Area	975 - 1500 sf			
	630	Cafe	350 sf			
	645	Quiet Room/ First Aid	100 sf	1	✔	
	645	General Facility Storage	200 sf			
	645	Laundry/ Shower Room	100 sf	1	✔	✔
	650	Staff Break/ Toilet	350 sf			
	670	Playground	2,000 sf			
	670	Covered Playcourt	75 sf/ child			
	670	Open Play Field	75 sf/ child			
	675	Outdoor Storage	80 sf			
	675	Stage, Storage, and Toilets	1240 sf			
WWW: Circulation	W05	Observation	9 sf/ child	1-2	✔	✔
	W05	Entry	200 sf	1	✔	
	W05	Reception	120 sf			
XXX: Building Service	X02	Maintenance Room	80 sf			

Grand Total
All Program Spaces = 5,144 sf
Minimum Program Spaces = 2,144 sf

Urban Setting: 4 classrooms with 12 children each = 48 total children + 8 teachers + 1 director

Program Type	Space Use Codes	Program Space	Size of Space	Quantity	All program spaces	Minimum program spaces
100: Classroom Facilities	110	Activity/ Classroom	42 sf/ child	4	✔	✔
	110	General Indoor	35 sf/ child	1	✔	✔
	110	General Outdoor	75 sf/ child	1-4	✔	
	115	Non-Assignable Space	20 sf/ child			
	115	Classroom Storage	80 sf	4	✔	✔
	115	Classroom Toilet	80 sf	4	✔	✔
300: Office Facilities	310	Administration Office	120 sf	3-4	✔	✔
	310	Director's Office	160 sf	1	✔	✔
	315	Staff Support/ Storage	380 sf	1	✔	✔
	350	Conference Room	200 sf	1	✔	
500: Special Use Facilities	590	Media Lab	1,200	1	✔	
600: General Use Facilities	610	Indoor Multipurpose Room	1000 sf	1	✔	
	610	Outdoor Multipurpose Room	1000 sf			
	630	Serving Kitchen	600 - 905 sf	1	✔	✔
	630	Serving/ Dining Area	975 - 1500 sf	1	✔	✔
	630	Cafe	350 sf	1	✔	
	645	Quiet Room/ First Aid	100 sf	1	✔	✔
	645	General Facility Storage	200 sf	1	✔	✔
	645	Laundry/ Shower Room	100 sf	1	✔	✔
	650	Staff Break/ Toilet	350 sf	1	✔	✔
	670	Playground	2,000 sf			
	670	Covered Playcourt	75 sf/ child			
	670	Open Play Field	75 sf/ child			
	675	Outdoor Storage	80 sf			
	675	Stage, Storage, and Toilets	1240 sf			
WWW: Circulation	W05	Observation	9 sf/ child	1-4	✔	✔
	W05	Entry	200 sf	1	✔	✔
	W05	Reception	120 sf	1	✔	
XXX: Building Service	X02	Maintenance Room	80 sf	1	✔	✔

Grand Total
All Program Spaces = 13,603 sf
Minimum Program Spaces = 7,133 sf

Community Setting: 4 classrooms with 12 children each = 48 total children + 8 teachers + 1 director

Program Type	Space Use Codes	Program Space	Size of Space	Quantity	All program spaces	Minimum program spaces
100: Classroom Facilities	110	Activity/ Classroom	42 sf/ child	4	✔	✔
	110	General Indoor	35 sf/ child	1	✔	✔
	110	General Outdoor	75 sf/ child	1-4	✔	
	115	Non-Assignable Space	20 sf/ child	4	✔	
	115	Classroom Storage	80 sf	4	✔	✔
	115	Classroom Toilet	80 sf	4	✔	✔
300: Office Facilities	310	Administration Office	120 sf	3-4	✔	✔
	310	Director's Office	160 sf	1	✔	✔
	315	Staff Support/ Storage	380 sf	1	✔	✔
	350	Conference Room	200 sf	1	✔	
500: Special Use Facilities	590	Media Lab	1,200	1	✔	
600: General Use Facilities	610	Indoor Multipurpose Room	1000 sf	1	✔	
	610	Outdoor Multipurpose Room	1000 sf	1	✔	
	630	Serving Kitchen	600 - 905 sf	1	✔	✔
	630	Serving/ Dining Area	975 - 1500 sf	1	✔	✔
	630	Cafe	350 sf	1	✔	
	645	Quiet Room/ First Aid	100 sf	1	✔	✔
	645	General Facility Storage	200 sf	1	✔	✔
	645	Laundry/ Shower Room	100 sf	1	✔	✔
	650	Staff Break/ Toilet	350 sf	1	✔	✔
	670	Playground	2,000 sf	1	✔	✔
	670	Covered Playcourt	75 sf/ child	1	✔	
	670	Open Play Field	75 sf/ child	1	✔	
	675	Outdoor Storage	80 sf	1	✔	
	675	Stage, Storage, and Toilets	1240 sf	1	✔	✔
WWW: Circulation	W05	Observation	9 sf/ child	1-4	✔	✔
	W05	Entry	200 sf	1	✔	✔
	W05	Reception	120 sf	1	✔	
XXX: Building Service	X02	Maintenance Room	80 sf	1	✔	✔

Grand Total
All Program Spaces = 20,953 sf
Minimum Program Spaces = 10,253 sf

Program Layout

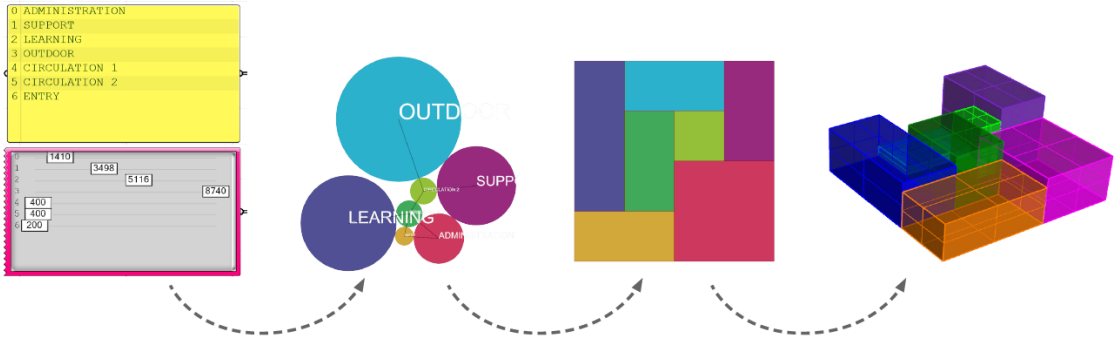
For the program layout, a grasshopper script called Space Syntax is used to generate diagrams in order to begin the design of the facility.[89,90] It can be used to create bubble diagrams, adjacency diagrams, rectilinear forms, and more (see figure 4.3) based on the inputted data, which is comprised of the list of program spaces with ideal room sizes. In figure 4.3, a general program (based on the types of program spaces shown in figure 4.2) is listed in the yellow box and the associated sizes (by square feet) are assigned in the magenta box. The box for inputting square feet is a slider scale that allows the user to adjust the size of the program as needed, with changes updated in real time. This allows the user to see the changes to the diagrams instantly as he or she adjusts the space size. This means, for example, that the designer could see the differences in the arrangement of the facility with a large indoor, small outdoor area compared to a large outdoor, small indoor area. Being able to experiment with the sizes and layout of the spaces grants the designer flexibility. Space Syntax is also helpful in terms of budget. If the ideal size of the school exceeds the budget set for the facility, changes can be made within the program to reduce the size of the spaces.

For this dissertation, the adjacency diagrams are used to continue the program layout process. The depth diagram (figure 4.4) is used to understand circulation of the spaces from the entrance to the last intended space. The starting point in the depth diagram (depth line 0) can be switched out to any of the listed program spaces. Using this, the designer can see how one would navigate through the facility depending on the user's starting point and destination. This can be especially helpful in understanding the flow of the facility as children or parents move through the school. Ideally, most spaces designated for use by children should be close together. Administration spaces should be located near the entrance for ease of access for parents. The depth diagram, starting with the entrance of the school, also helps the designer to understand the privacy level of the spaces. As an example, the spaces along depth lines 0-1 could be considered part of the

[89] (Grasshopper 2016) 'Grasshopper' is a plugin for the Rhinoceros 3D drawing program. It is used for algorithmic modeling.
[90] (Nourian 2016)

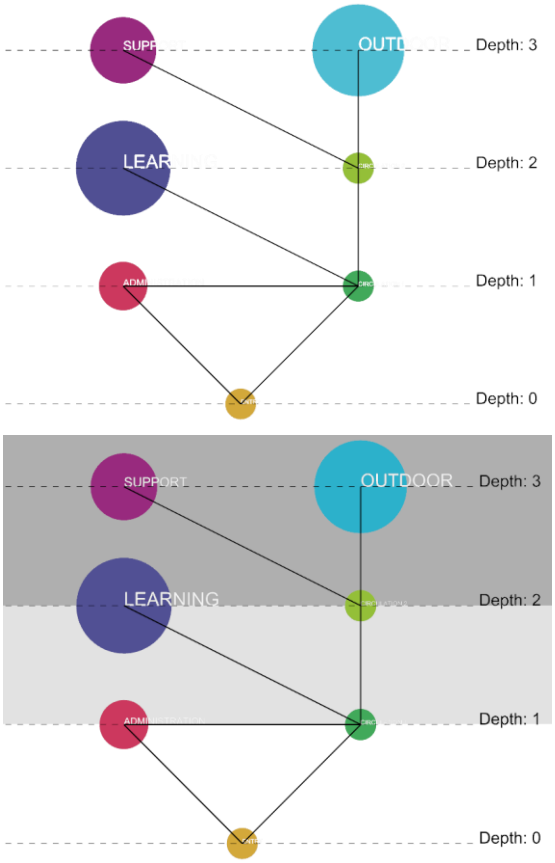
public realm; those along depth lines1-2 could be semi-private; and those along depth lines 2+ could be considered private spaces, away from public view (see figure 4.4).

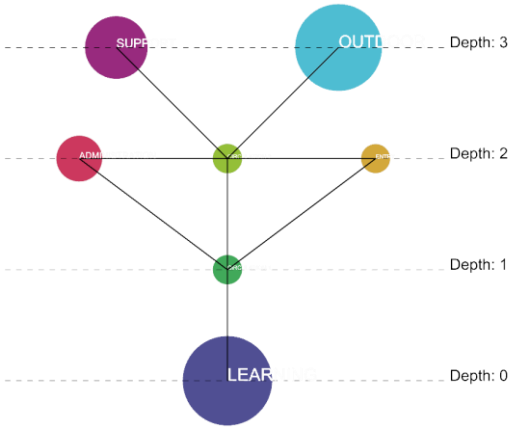
Figure 4.3 Diagrams generated using the Space Syntax script in the Rhinoceros program



The program spaces are listed in the yellow box and the associated room sizes in square feet are inputted in the magenta box. This illustrates some of the diagrams that can be created using the Space Syntax grasshopper script.

Figure 4.4 Studies using the diagrams from the Space Syntax script

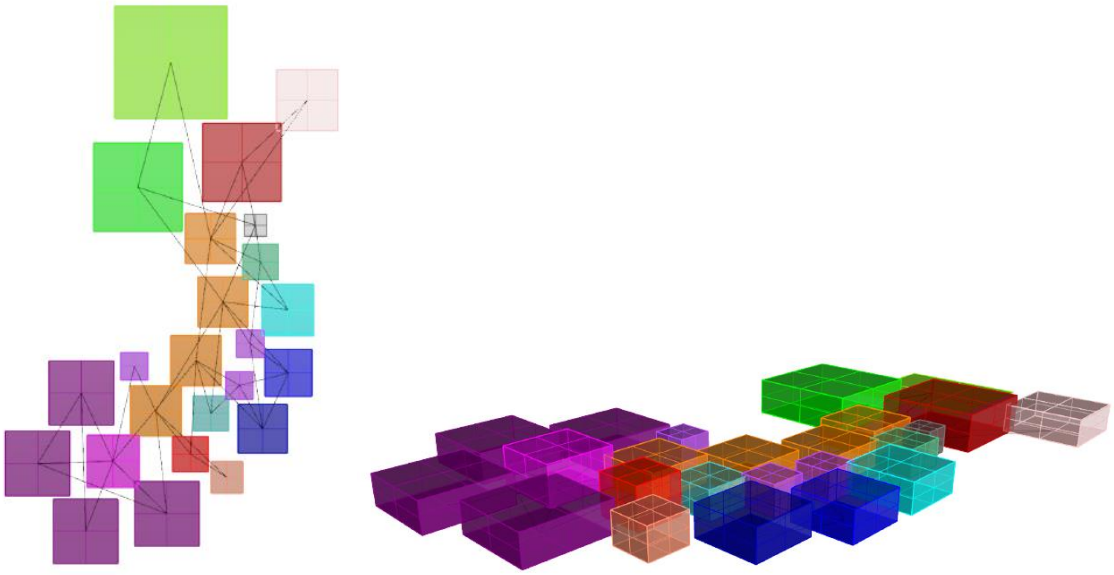




The first image shows the starting point at the entrance while the second image shows the starting point from the learning type spaces (classrooms, indoor activity spaces). In the last image, with the starting point at the entrance of the facility, the spaces designated on depth line 0-1 could be considered spaces easily accessed by the public, depth line 1-2 could be considered semi-public spaces, and depth line 2-3 could be considered private spaces.

The bubble diagrams are the basis of the arrangement of spaces for the early education facility. This diagram also shows the adjacency of the spaces. For example, classrooms and administration spaces should be relatively close to the entrance for easy wayfinding for parents but outdoor spaces do not need to be near the entrance. The bubble diagram is converted into rectilinear spaces while remaining in the same bubble diagram arrangement. This gives the exact size needed for each space as inputted in the slider scale box in figure 4.3. The rectilinear spaces can then be extruded to a desired height in order to begin looking at the space volume and the overall massing of the facility. Heights of the program spaces vary depending on intended use (figure 4.5). For example, the multipurpose spaces that include stages may require higher ceilings in order to accommodate for stage performances and special effects equipment, while administration spaces do not need a high ceiling and may be designated with the typical office ceiling height of eight to nine feet.

Figure 4.5 Extrusions of the program layout



The left image shows the individual program spaces in a bubble diagram. The right image shows the program spaces extruded at varying heights.

Site Considerations

The site for a new early education facility may be pre-selected or its location may be the responsibility of the designer. In both cases, it is beneficial to the designer to analyze the site using a site analysis and site evaluation process. The site analysis portion of this dissertation discusses aspects that help a designer select an appropriate site for a school facility and also introduces cultural ties. It is a suggested list of what to research when looking for potential sites. Some aspects include state regulations and others are suggestions intended to help the designer understand the different sites being considered. The site evaluation section analyzes a site more closely to evaluate it using a scoring system.

Thus, through site analysis, a designer can identify multiple potential suitable sites, use the evaluation process to compare the sites based on the scoring system, and finally, select the most ideal site. The following is a list of site analysis aspects:

- Urban Land Use: Identify urban areas for implementation. Agricultural and conservation sites are not suitable for a school facility.[91]
- Traditional Hawaiian Land Division: Identify the *mokupuni* (island), *moku* (district) and ahupua‘a of potential sites.[92]
- History and Legends: Seek an understanding of the history and legends associated with the site.[93]
- Existing and Potential Elementary Schools: Identify schools that already offer a preschool program and are in need of renovation or an addition. Also, look for schools that anticipate including preschool classes but do not have a preschool program.[94]
- Demographic Studies: Could include various studies such as density by determining population per square mile in order to identify areas with a high population that may need a new school facility.[95] Other studies could include

[91] (City and County of Honolulu 2016), (Hawaii State Data Center 2013)
[92] (AVA Konohiki Website Team 2016), (Kamehameha Schools/ Bernice Pauahi Bishop Estate 1987)
[93] (Internet Sacred Text Archive 2011), (University of Hawai'i at Manoa n.d.)
[94] (Hawaii State Department of Education 2016)
[95] (State of Hawaii Office of Planning 2016)

academic or financial attainment in relation to the studies in chapter one that highlight participation in early education programs show higher rates of academic and financial achievement later in the participant's life.[96,97]

- Zoning and Building Type: Identify areas and buildings appropriate for an educational or child care program. These include zoning type AG-2, C, R-20, R-10, R-7.5, R-5, R-3.5, A-3, AMX-3, B-1, B-2, BMX-3, BMX-4, IMX-1, and the Kaka'ako Community Development District.[98]
- Infrastructure: Identify site-specific water, utilities, and transportation elements, including water and sewage pipes, flood zones, and public transportation.

Some of the site analysis aspects do not apply to all prototypes. For example, identifying existing and potential elementary school sites is not relevant for the urban and community setting prototypes.

During the site analysis process, more than one potential site may be found. The site evaluation process helps to compare these, choose the most ideal, and extract site design concepts. Part of designing a building that is culturally sensitive is being able to draw inspiration from the land and the history of the culture and community. The site evaluation process includes a scoring system with a range from zero to five and includes a chart for identifying cultural landscape aspects and possible ways to translate this information into the design of the building (see figure 4.6). A percentage score is determined by dividing the given score by the total possible score of five for each category ($S_i \div 5$). This percentage is multiplied by the weight value percentage for each category in order to get the total category score ($S_i \div 5 \times W_i = C_i$). The sum of each category score gives the total percentage of criteria met for potential sites. The following is a list of site evaluation aspects and scoring details:

- Community Assets [score of 0-5, weight value 30% of total score]:

[96] (Jones, Greenberg and Crowley 2015)
[97] (Schweinhart, et al. 2005)
[98] (City and County of Honolulu n.d.), (City and County of Honolulu 2016)

    - The community has child service organizations, family service organizations, club organizations, religious sites, recreational facilities, existing schools in the given area, government and public safety places, art and theatrical places, museums, and retail services.[99]
    - Existing community resources are available for use by early education program.
    - Existing community resources are lacking, which means implementation of an early education program would bring resources to the area.
- Site Access [score of 0-5, weight value 20% of total score]:
    - Site has clear and easy access to facility for students, parents, and guardians.
    - Site has opportunities for drop-off area and parking.
    - Site has clear and easy access to facility for emergency vehicles.
- Site Surroundings [score of 0-5, weight value 20% of total score]:
    - Appropriate barriers surround school.
    - Pollution and noise can be controlled and minimized.
    - The functions of surrounding properties will not negatively affect the facility; this includes but is not limited to safety, circulation, and conflict of functions.
- Cultural Landscapes:
    - Climate Analysis [score of 0-5, weight value 10% of total score]:
        - Note types, names, and cultural significance of local rain and winds.
        - Site design use of sun path, types of rain, wind direction, etc.[100]
    - Natural Features [score of 0-5, weight value 10% of total score]:
        - Includes mountain range, valley ridge, streams, coastal areas, vegetation, etc.[101]
        - Note the names and significance of the natural features.

[99] (U.S. Department of Education 2016), (Office of Innovation and Improvement 2014)
[100] (State of Hawaii Office of Planning 2016), (Alameida 1997), (Alvarado, Index of Winds 2005), (Alvarado, Index of Rains 2005)
[101] (Map Data 2016), (USGS 2016)

- Identify the on-site native plant and animal species and their significance.
- Site has proximity to natural features for use in early education program.

- Views and Orientation [score of 0-5, weight value 10% of total score]:
  - Identify primary and secondary views from the site.
  - Understand orientation of the site in cultural terms in order to understand the site's place on the land and proximity to key areas.

Figure 4.6 Site Evaluation chart

Site(s)	Community Assets $W_1 = 30\%$	Site Access $W_2 = 20\%$	Site Surrounds $W_3 = 20\%$	Views and Orientation $W_4 = 10\%$	Natural Features $W_5 = 10\%$	Climate Analysis $W_6 = 10\%$	Total Score
Potential Site 1	$S_1 = x$	$S_2 = x$	$S_3 = x$	$S_4 = x$	$S_5 = x$	$S_6 = x$	
	$C_1 = x\%$	$C_2 = x\%$	$C_3 = x\%$	$C_4 = x\%$	$C_5 = x\%$	$C_6 = x\%$	$D = x\%$
Potential Site 2	$S_1 = x$	$S_2 = x$	$S_3 = x$	$S_4 = x$	$S_5 = x$	$S_6 = x$	
	$C_1 = x\%$	$C_2 = x\%$	$C_3 = x\%$	$C_4 = x\%$	$C_5 = x\%$	$C_6 = x\%$	$D = x\%$

i = Categories 1-6

S_i = Score of 0-5

W_i = Weight value of each category

C_i = Category score; ($S_i \div 5 \times W_i = C_i$)

D = Decision factor;

Represents the percentage of criteria met for an ideal early education facility site; ($\sum C_i = D$)

$S_i = 0$ in any category disqualifies the potential site
$S_i = 1$ It is unfit for an early education facility site
$S_i = 2$ Needs improvement for an early education facility site
$S_i = 3$ Meets expectations for an early education facility site
$S_i = 4$ Exceeds expectations for an early education facility site
$S_i = 5$ Exceptional quality for an early education facility site

Final Design

It is important to include facility design guidelines, financial models, and site considerations in the development of the facility. The cultural research conducted for the site can be translated into design ideas for the facility. The culture-related design ideas are organized into three categories: building symbolism, creating a connection to the land, and considerations for program spaces. The massings created in the Rhinoceros program can be imported into other architectural programs such as Revit to further develop the design and to create architectural drawings. The result of the design phase depends on the needs and the vision of the client or the surrounding community. This final design phase also involves two traditional architectural phases: schematic design and design development. If the process moves forward, the next phases are construction document, bidding, and actual construction phases, the completion of which brings the project to its end. These final phases are not included in this design methodology for early education facilities.

For cultural elements to be implemented into the design, the following steps should be employed:

1. State the scope of the cultural analysis.
2. Research the history of the culture as well as existing example frameworks and studies on methods used to integrate culture in design.
3. Research the specific project location in relation to the culture.
4. Organize the information using an existing method identified in step two or by the three categories: building symbolism, a connection to the land, and program spaces. Use this information to generate design ideas for the project.
5. Present the information to the client and/or community.
6. Implement appropriate design ideas.

During the final design phase, changes can be made to the program layout in order to best fit the site, both physically and symbolically. For example, if the shape of the project site conflicts with the layout generated in the Space Syntax file, the designer can make adjustments to the layout to fit the shape of the site while still maintaining the circulation pattern in the Space Syntax layout.

The layout of the program spaces can also reflect cultural aspects of the design. The designer can use the layout generated by Space Syntax as a starting point and rearrange certain spaces to represent cultural elements, such as the Hawaiian ahupua‘a system of land division. The layout of each ahupua‘a varied between and within the islands. The designer could research the particular ahupua‘a layout related to the project site or incorporate a design of a more general representation of the ahupua‘a system as a whole. One ahupua‘a concept that will be used in this dissertation is explained by Luciano Minerbi in *Indigenous Management Models and Protecting of the Ahupua‘a*. According to Minerbi, ahupua‘a systems were typically divided into three main zones, *mauka* (mountain zone), agricultural zone, and *makai* (coastal zone).[102] The mauka zone was the forested areas of the mountains where Hawaiians typically collected firewood, timber, birds and feathers, and forest plants. Dry *kalo* (taro) fields, kalo *lo‘i* (irrigated terrace), tree crop plantations, and other food crop fields were located in the agricultural zone. In the makai zone, Hawaiians gathered shellfish, limu, salt, and fish.[103] To incorporate these zones into the design of an early education program, a designer could assign certain program spaces to each zone.

For this dissertation, outdoor spaces will represent the mauka zone for forest activities (identified as the 670-675 space use codes), student-occupied spaces and food-related spaces will comprise the agricultural zone as harvesting and skill development (identified as the 110-115, 590, and 610-650 space use codes), and staff-occupied spaces will comprise the makai zone for management activities (identified as the 310-350 space use codes). The entry and reception spaces will be exempt as these depend on site conditions or existing building access.

[102] (Minerbi 1996)
[103] (Minerbi 1996)

Financial Models

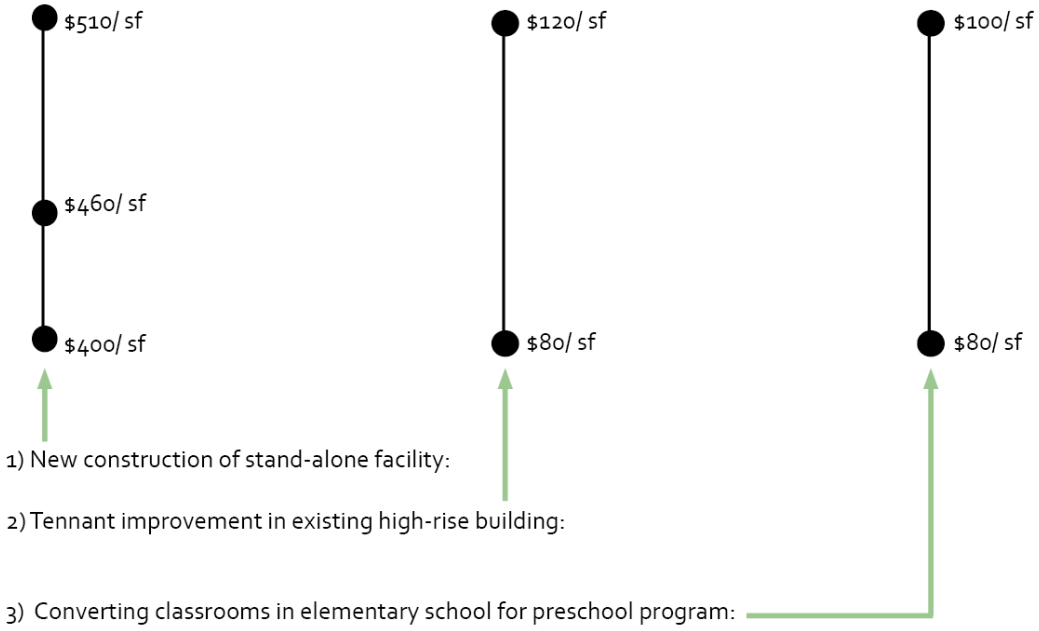
This dissertation includes three financial models, one for each prototype (see figure 4.7). Each financial model is range cost based on an estimated dollar amount per square foot. The dollar-per-square-foot cost was determined based on recent school projects or renovation projects in Hawai‘i. The estimated dollar-per-square-foot costs are based on the following projects and information:

1) New construction of stand-alone facility:
    a. Two portable facilities on an elementary school campus for a preschool program[104]
        i. $600,000 total cost
        ii. 1,520 square feet
        iii. About $400 per square foot
    b. Eight classroom buildings on an elementary school campus for elementary grades[105]
        i. $6,000,000 total cost
        ii. 13,000 square feet
        iii. About $460 per square foot
    c. New full elementary school campus including preschool program and elementary grade levels[106]
        i. $40,000,000
        ii. 78,404 square feet
        iii. About $510 per square foot
2) Tennant improvement in existing high-rise building
    a. $80-$120 per square foot[107]
    b. $2.30 per square foot equals estimated monthly rental cost[108]

[104] (Waikiki Elementary School Mindful Learning Center n.d.)
[105] (Belt Collins Hawaii LLC 2013)
[106] (Hawaii State Department of Education 2015)
[107] (Conversation with Architect on Typical Office Renovation Projects 2016)
[108] (Conversation with Architect on Typical Office Renovation Projects 2016)

3) Conversion of classrooms in an elementary school for a preschool program
    a. Typical elementary classroom size of 980 square feet[109]
    b. $80,000-$104,000 cost per classroom to convert to preschool program[110]
    c. About $80-$100 per square foot

Figure 4.7 Financial Models



[109] (Educational Specifications (EDSPECS) For Elementary Schools 2008)
[110] (Hawaii State Department of Education 2008)

CHAPTER 5. EARLY EDUCATION FACILITY DESIGN

This chapter demonstrates and evaluates the effectiveness of the design methodology through its application to three different prototypes in three different settings. The methodology was created for center-based facilities that can accommodate any number of children and a variety of program spaces. The three prototypes for this dissertation are the School prototype, the Urban prototype, and the Community prototype. All three are set on the island of O‘ahu. The School prototype is set on an existing elementary school campus; the Urban prototype in an office building in a high-density, urban neighborhood; and the Community prototype in an area chosen based on demographic studies. The methodology begins with a description of the goals for the prototype followed by a list of potential program activities, the selection of program spaces, a site analysis, and the creation of the final design. Only the Community prototype was completed to the full concept design stage; the School and Urban prototypes end at the schematic design level. Figure 5.0 gives a brief summary of the three prototypes through each section of the design methodology.

Figure 5.0 Summary of prototypes

Methodology	**School Prototype**	**Urban Prototype**	**Community Prototype**
Age group	3-4 years	3-4 years	3-4 years
No. of Classes	4	4	2
Students per classroom	12	12	12
Student to teacher ratio	1:7	1:7	1:7
Program Activities	(See Appendix)	(See Appendix)	(See Appendix)
Program Spaces	• Classroom Facilities • Office Facilities • General Use Facilities • Circulation Area • Building Service Area	• Classroom Facilities • Office Facilities • Special Use Facilities • General Use Facilities • Circulation Area • Building Service Area	• Classroom Facilities • Office Facilities • Special Use Facilities • General Use Facilities • Circulation Area • Building Service Area
Program Layout	Space Syntax program layout	Space Syntax program layout	Space Syntax program layout
Site Considerations: Site Analysis	• Urban Land Use • Existing and potential	• Urban Land Use • Demographic Study	• Urban Land Use • Demographic Study • Views and Orientation

	elementary schools • Views and Orientation • Natural Features • Climate Analysis • Community Assets	• Views and Orientation • Natural Features • Climate Analysis • Zoning • Community Assets	• Natural Features • Climate Analysis • Zoning • Community Assets
Site Considerations: Cultural Landscape Analysis	• Traditional Hawaiian Land Division • History and Legends • Views and Orientation • Natural Features • Climate Analysis	• Traditional Hawaiian Land Division • History and Legends • Views and Orientation • Natural Features • Climate Analysis	• Traditional Hawaiian Land Division • History and Legends • Views and Orientation • Natural Features • Climate Analysis
Site Considerations: Site Evaluation	• Waikīkī Elementary school site	• Downtown site in an existing office building	• Kapālama site chosen for the prototype facility
Final Design: Program Spaces	• Classroom Facilities • Office Facilities • General Use Facilities • Circulation Area	• Classroom Facilities • Office Facilities • General Use Facilities • Circulation Area • Building Service Area	• Classroom Facilities • Office Facilities • General Use Facilities • Circulation Area • Building Service Area
Final Design: Program Layout	Space Syntax program layout applied to existing building A site: • Use of existing spaces • Division of given space	Space Syntax program layout applied to existing tenant space: • Revised program layout to reflect three ahupua‘a zones	Space Syntax program layout applied to property along Kauluwela Place and Liliha Street: • Revised program layout to better fit the site • Accommodations for access from Kauluwela Place and the Liliha Public Library
Final Design: Cultural Aspects	• Program activities • Cultural aspects to relate to theme of elementary school	• Program activities • Program layout to reflect ahupua‘a zones	• Program activities and program spaces • Legends and place name meaning regarding Kapālama • Connecting to kalo gardens in the surrounding area • Accommodations for various outdoor activities • Considerations climate aspects in design and orientation of facility
Final Design: Community Aspects	• Community assets	• Community assets • Program spaces • Access to facility	• Community assets • Program spaces • Access to facility

Methodology Implementation

The goal of this dissertation is to improve the quality of early education in Hawai‘i facilities in order to provide an ideal learning environment by setting the standard of design for early education. Each of the prototypes has different goals, implementations of programs, and site interventions. The goals are as follows:

1. School prototype: to fit within the existing state public school system, to expand on a state-funded preschool program, and to encourage interaction between grade levels.
2. Urban prototype: to benefit local working families in terms of convenience and accessibility and to anticipate the increased urbanization of certain areas.
3. Community prototype: to benefit the community, to bring together community organizations, to incorporate existing resources, and to improve statewide education levels.

Program Activities

The Appendix shows a list of program activities with associated program philosophies and program spaces. The culture-based activities are listed under philosophies; this is to ensure that cultural aspects are being considered for program spaces from the start of the design process. As mentioned in chapter three, incorporating culture in the design of the early education prototypes for this dissertation can be accomplished through building symbolism, maintaining a connection to the land, and considerations for program space type and layout. Though the directors and teachers of early education programs are ultimately responsible for choosing the activities that will take place in a facility, it is important for the designer to provide spaces that can accommodate both cultural activities and a wide variety of early education activities. This design methodology provides flexibility in choosing which activities and program spaces will be included in a facility, which forms the basis of the design.

Program Spaces

Drawing from the list of activity spaces, figure 5.1 shows the program options for all three prototypes with the culture-based activity spaces highlighted. It shows that any indoor activity space could potentially host culture-based activities. Since Hawaiian culture emphasizes a physical and spiritual connection to the land, the outdoor spaces that are appropriate for preschool-age cultural activities may be the most important spaces to include in a facility. This also aligns with the results from the studies reviewed in chapter three on the relationship between the physical environment and student performance.

The size and number of program spaces will depend on the number of students and teachers the facility is set to accommodate. The number of classrooms, students, and teachers for each prototype is listed below:

1. School prototype
    a. Student ages: 3-4 years
    b. Number of classrooms: 2
    c. Students per classroom: 12
    d. Teacher to student ratio: 1 to 7
2. Urban prototype
    a. Student ages: 3-4 years
    b. Number of classrooms: 4
    c. Students per classroom: 12
    d. Teacher to student ratio: 1 to 7
3. Community prototype
    a. Student ages: 3-4 years
    b. Number of classrooms: 4
    c. Students per classroom: 12
    d. Teacher to student ratio: 1 to 7

School prototypes will be smaller due to the limited amount of space in most elementary schools and will therefore include only two classrooms with twelve children and two teachers each. Thus, the School prototype is designed for a total enrollment of 24 children and four teachers, and both the Urban and Community prototypes for 48

children and eight teachers. If the elementary school for which the School prototype is developed requires a preschool program director, it is assumed that the director's office will be located with the main administration offices on campus. Since these prototypes are intended for three- to four-year-old children, the types of activities and program spaces have been designed to fit the specific needs of this age group. Each classroom has been designed to provide 42 square feet per child while additional program spaces, such as a music or art studio, will provide the minimum of 35 square feet per child.

For the program spaces listed in figure 5.1, the first prototype option will include all ideal spaces and the second only the minimum necessary spaces. In order to create feasible options, all three prototypes have been designed with the minimum program spaces. As each prototype is applied to a site, the sizes of spaces may change depending on available space, existing community assets near the site that could potentially replace program spaces within the early education facility, and given budget. For this dissertation, no budget was established, however, an estimated building cost based on the financial models defined in chapter four was determined for each prototype.

Figure 5.1 Program Spaces with highlighted culture-related spaces

Activities to Spaces	Program Type	Program Space	Size of Space	Elementary School Setting	Urban Setting	Community Setting
- Individual desks - Small group desks - Large group desks - General activity with sink - General activity without sink	Learning/ Play	Activity/ Classroom	42 sf/ child	✓	✓	✓
- Quiet Room - Food Lab - Water play area - Music room		General Indoor	35 sf/ child	✓	✓	✓
		Non-Assignable Space	20 sf/ child	✓		✓
- Indoor Multipurpose room - Adult Multipurpose room - Stage		Indoor Multipurpose Room	1000 sf		✓	✓
- Media Lab		Media Lab	1,200		✓	✓
	Support	Observation	9 sf/ child	✓	✓	✓
		Entry	200 sf	✓	✓	✓
- Quiet room		Quiet Room/ First Aid	100 sf	✓	✓	✓
		General Facility Storage	200 sf		✓	✓
		Classroom Storage	80 sf	✓	✓	✓
		Classroom Toilet	80 sf	✓	✓	✓
		Laundry/ Shower Room	100 sf	✓	✓	✓
- Kitchen - Food Lab		Serving Kitchen	600 - 905 sf		✓	✓
- Children's Dining		Serving/ Dining Area	975 - 1500 sf		✓	✓
		Cafe	350 sf		✓	
- Admin storage	Administration	Staff Support/ Storage	380 sf	✓	✓	✓
		Reception	120 sf		✓	✓
- Small meeting room		Administration Office	120 sf	✓	✓	✓
		Director's Office	160 sf		✓	✓
- Staff break room - Staff toilets - Staff workroom		Staff Break/ Toilet	350 sf		✓	✓
- Large conference room		Conference Room	200 sf		✓	✓
		Maintenance Room	80 sf		✓	✓
- Outdoor class setting - Small group tables - Large group tables - Water play area	Outdoor Facilities	General Outdoor	75 sf/ child	✓	✓	✓
		Outdoor Storage	80 sf			✓
		Playground	2,000 sf			✓
		Covered Playcourt	75 sf/ child			✓
		Stage, Storage, and Toilets	1240 sf			✓
		Open Play Field	75 sf/ child			✓
- Outdoor Multipurpose room		Outdoor Multipurpose Room	1000 sf			✓

Elementary School Setting: 2 classrooms with 12 children each = 24 total children + 4 teachers

Program Type	Program Space	Size of Space	Quantity	All program spaces	Minimum program spaces
Learning/ Play	Activity/ Classroom	42 sf/ child	2	✓	✓
	General Indoor	35 sf/ child	1	✓	
	Non-Assignable Space	20 sf/ child	2	✓	
	Indoor Multipurpose Room	1000 sf			
	Media Lab	1,200			
Support	Observation	9 sf/ child	1-2	✓	✓
	Entry	200 sf	1	✓	
	Quiet Room/ First Aid	100 sf	1	✓	
	General Facility Storage	200 sf			
	Classroom Storage	80 sf	2	✓	✓
	Classroom Toilet	80 sf	2	✓	✓
	Laundry/ Shower Room	100 sf	1	✓	✓
	Serving Kitchen	600 - 905 sf			
	Serving/ Dining Area	975 - 1500 sf			
	Cafe	350 sf			
Administration	Staff Support/ Storage	380 sf	1	✓	✓
	Reception	120 sf			
	Administration Office	120 sf	1	✓	✓
	Director's Office	160 sf			
	Staff Break/ Toilet	350 sf			
	Conference Room	200 sf			
	Maintenance Room	80 sf			
Outdoor Facilities	General Outdoor	75 sf/ child	1-2	✓	
	Outdoor Storage	80 sf			
	Playground	2,000 sf			
	Covered Playcourt	75 sf/ child			
	Stage, Storage, and Toilets	1240 sf			
	Open Play Field	75 sf/ child			
	Outdoor Multipurpose Room	1000 sf			

Urban Setting: 4 classrooms with 12 children each = 48 total children + 8 teachers + 1 director

Program Type	Program Space	Size of Space	Quantity	All program spaces	Minimum program spaces
Learning/ Play	Activity/ Classroom	42 sf/ child	4	✓	✓
	General Indoor	35 sf/ child	1	✓	✓
	Non-Assignable Space	20 sf/ child			
	Indoor Multipurpose Room	1000 sf	1	✓	
	Media Lab	1,200	1	✓	
Support	Observation	9 sf/ child	1-4	✓	✓
	Entry	200 sf	1	✓	✓
	Quiet Room/ First Aid	100 sf	1	✓	✓
	General Facility Storage	200 sf	1	✓	✓
	Classroom Storage	80 sf	4	✓	✓
	Classroom Toilet	80 sf	4	✓	✓
	Laundry/ Shower Room	100 sf	1	✓	✓
	Serving Kitchen	600 - 905 sf	1	✓	✓
	Serving/ Dining Area	975 - 1500 sf	1	✓	✓
	Cafe	350 sf	1	✓	
Administration	Staff Support/ Storage	380 sf	1	✓	✓
	Reception	120 sf	1	✓	
	Administration Office	120 sf	3-4	✓	✓
	Director's Office	160 sf	1	✓	✓
	Staff Break/ Toilet	350 sf	1	✓	✓
	Conference Room	200 sf	1	✓	
	Maintenance Room	80 sf	1	✓	✓
Outdoor Facilities	General Outdoor	75 sf/ child	1-4	✓	
	Outdoor Storage	80 sf			
	Playground	2,000 sf			
	Covered Playcourt	75 sf/ child			
	Stage, Storage, and Toilets	1240 sf			
	Open Play Field	75 sf/ child			
	Outdoor Multipurpose Room	1000 sf			

Community Setting: 4 classrooms with 12 children each = 48 total children + 8 teachers + 1 director

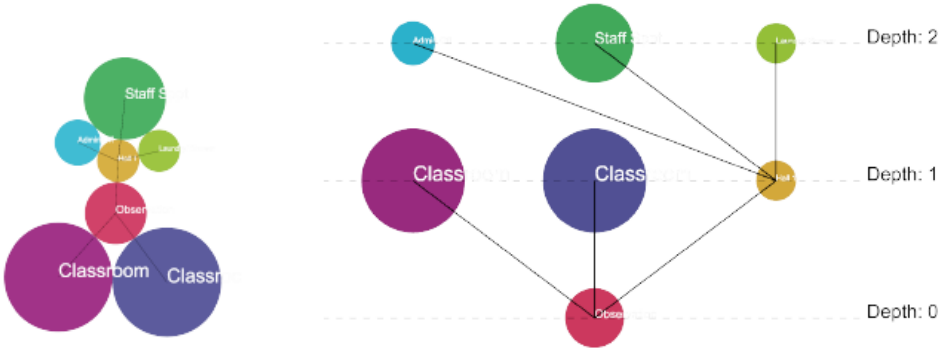
Program Type	Program Space	Size of Space	Quantity	All program spaces	Minimum program spaces
Learning/ Play	Activity/ Classroom	42 sf/ child	4	✓	✓
	General Indoor	35 sf/ child	1	✓	✓
	Non-Assignable Space	20 sf/ child	4	✓	
	Indoor Multipurpose Room	1000 sf	1	✓	
	Media Lab	1,200	1	✓	
Support	Observation	9 sf/ child	1-4	✓	✓
	Entry	200 sf	1	✓	✓
	Quiet Room/ First Aid	100 sf	1	✓	✓
	General Facility Storage	200 sf	1	✓	✓
	Classroom Storage	80 sf	4	✓	✓
	Classroom Toilet	80 sf	4	✓	✓
	Laundry/ Shower Room	100 sf	1	✓	✓
	Serving Kitchen	600 - 905 sf	1	✓	✓
	Serving/ Dining Area	975 - 1500 sf	1	✓	✓
	Cafe	350 sf			
Administration	Staff Support/ Storage	380 sf	1	✓	✓
	Reception	120 sf	1	✓	
	Administration Office	120 sf	3-4	✓	✓
	Director's Office	160 sf	1	✓	✓
	Staff Break/ Toilet	350 sf	1	✓	✓
	Conference Room	200 sf	1	✓	
	Maintenance Room	80 sf	1	✓	✓
Outdoor Facilities	General Outdoor	75 sf/ child	1-4		
	Outdoor Storage	80 sf	1		
	Playground	2,000 sf	1	✓	✓
	Covered Playcourt	75 sf/ child	1	✓	
	Stage, Storage, and Toilets	1240 sf	1	✓	✓
	Open Play Field	75 sf/ child	1	✓	
	Outdoor Multipurpose Room	1000 sf	1		

The charts above show that the community prototype has a greater opportunity for including program spaces associated with culture-based activities than the urban prototype which may lack outdoor spaces.

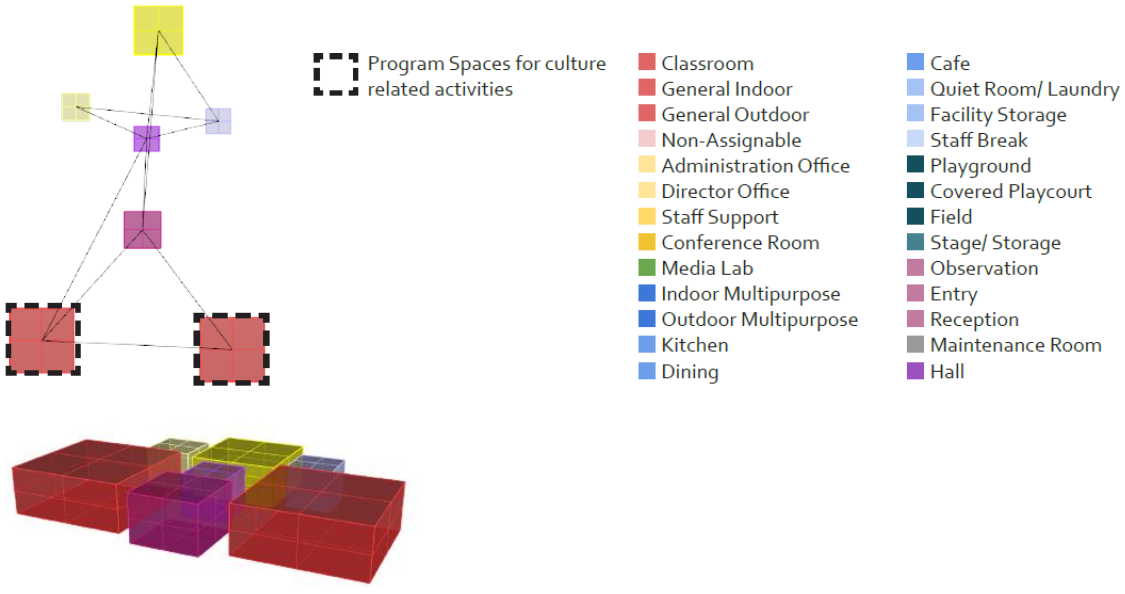
Program Layout

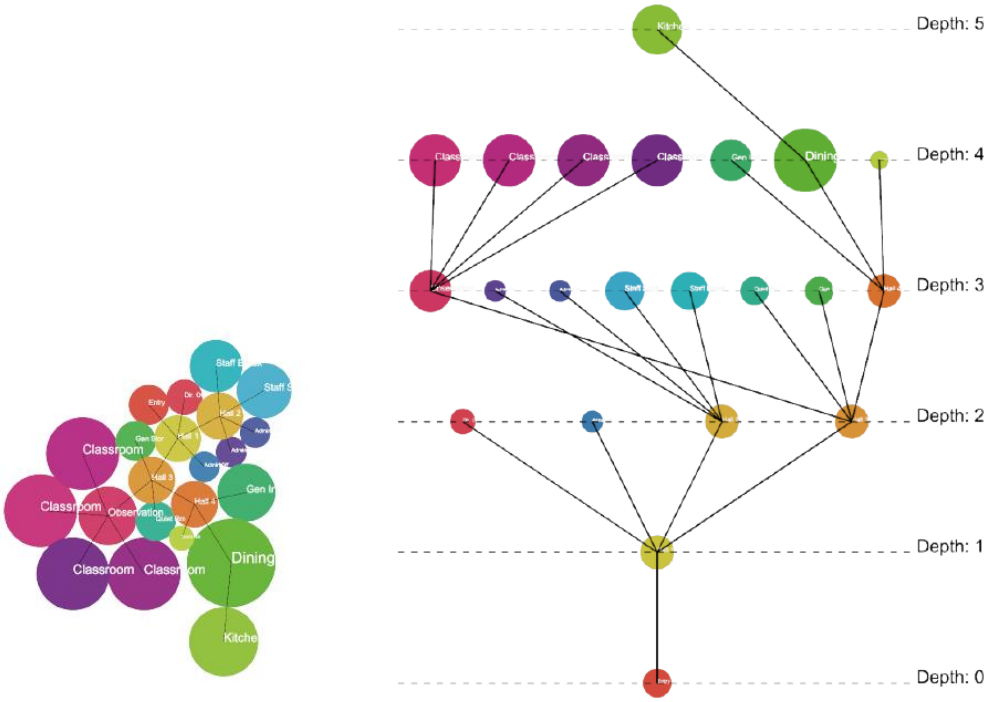
Figure 5.2 illustrates the arrangement of program spaces by prototype using the space syntax program. The diagrams created show adjacency, circulation, and private versus public spaces (see figure 5.3). They illustrate the layout of spaces from the different perspectives of distinct occupants. They also help show how the spaces are accessed and which spaces need to be within reasonable range of each other. Figure 5.2 also highlights the program spaces that can host the culture-based activities listed in figure 5.0 and shows all program spaces extruded to appropriate heights to illustrate the possible form of the facility.

Figure 5.2 Program Layout for the School, Urban, and Community prototypes

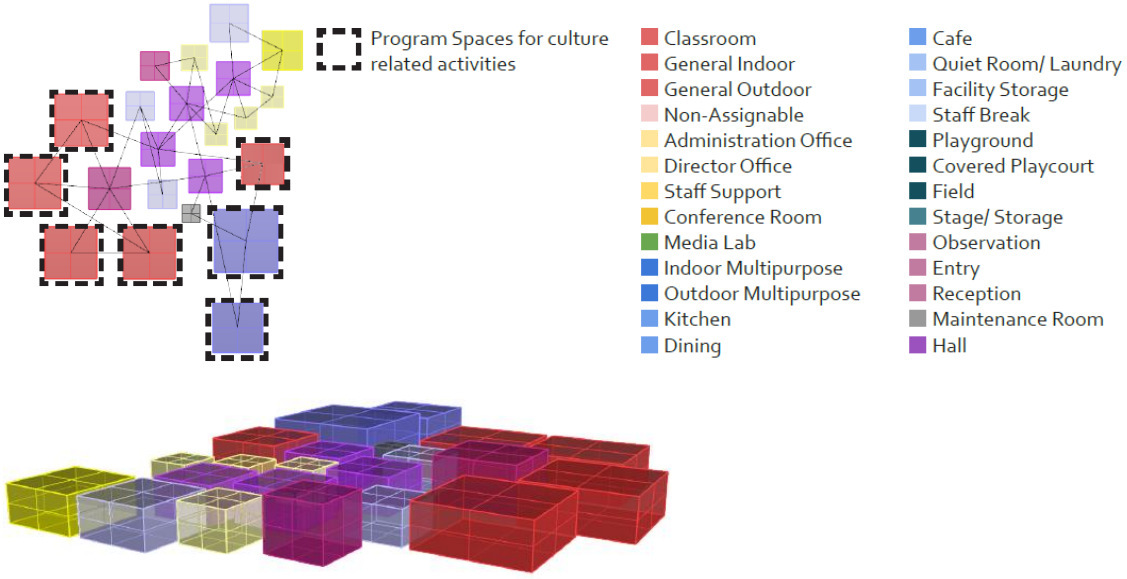


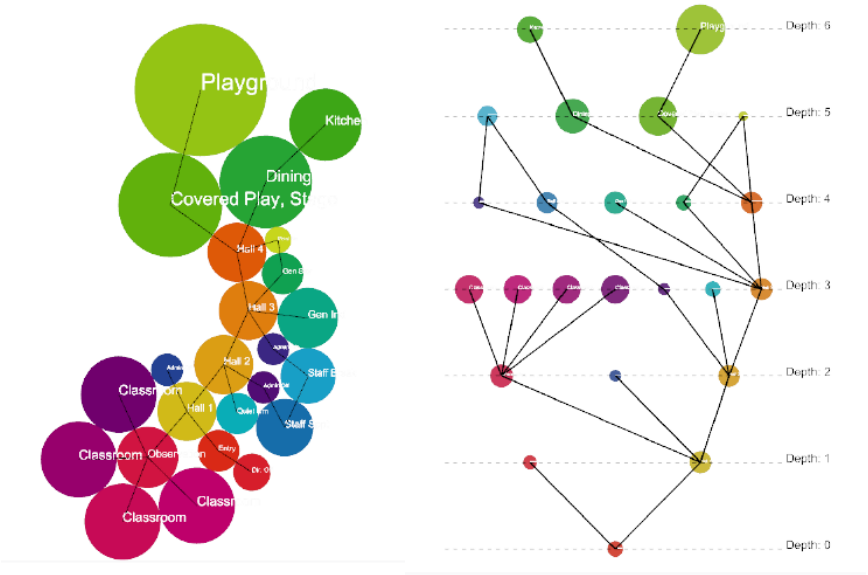
Above: the initial layout of the program spaces for the School prototype. Below: the program layout diagram converted into rectilinear shapes.





Above: the initial layout of the program spaces for the Urban prototype. Below: the program layout diagram converted into rectilinear shapes.





Above: the initial layout of the program spaces for the Urban prototype. Below: the program layout diagram converted into rectilinear shapes.

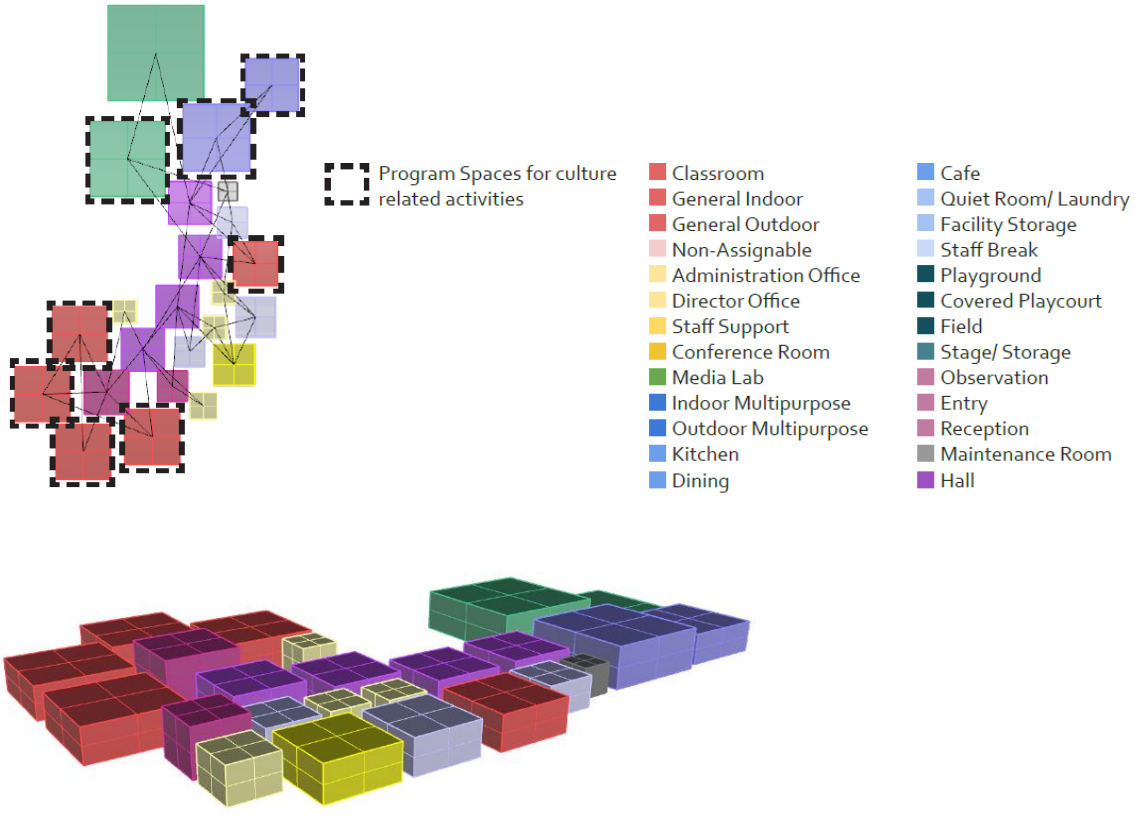
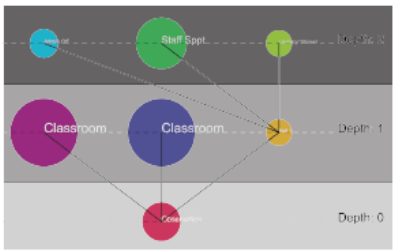
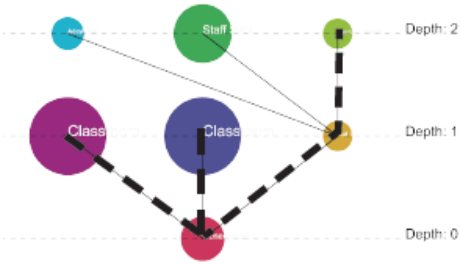
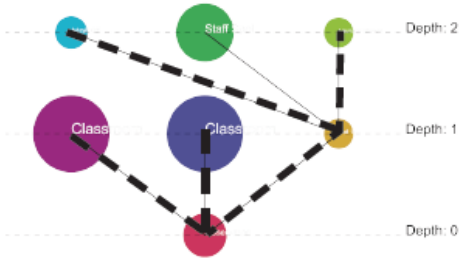


Figure 5.3 Analysis of the School, Urban, and Community prototype layouts





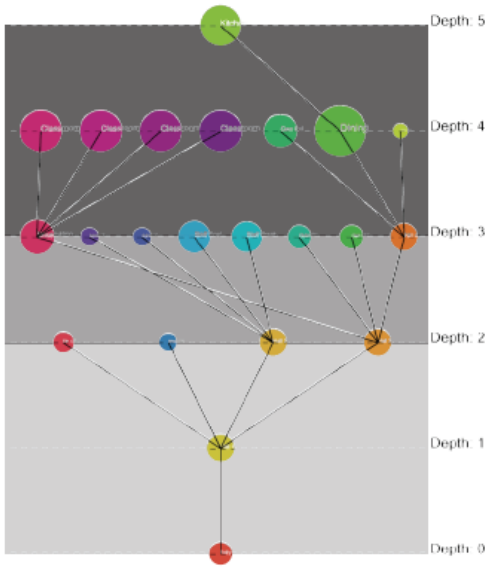
Rooms accessible by students

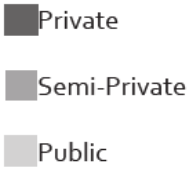


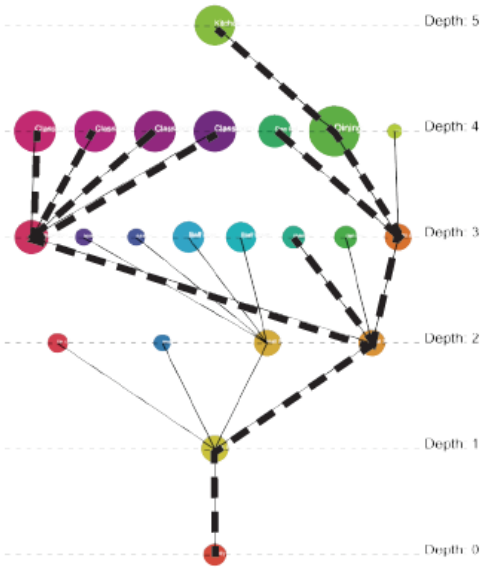
Rooms accessible by parents/ guardians

Above: The School prototype diagrams analyzed by public versus private spaces and by circulation paths.

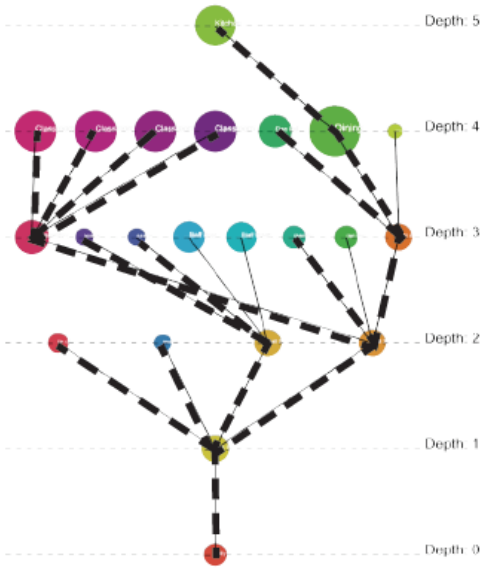
Below: The Urban prototype diagrams analyzed by public versus private spaces and by circulation paths.





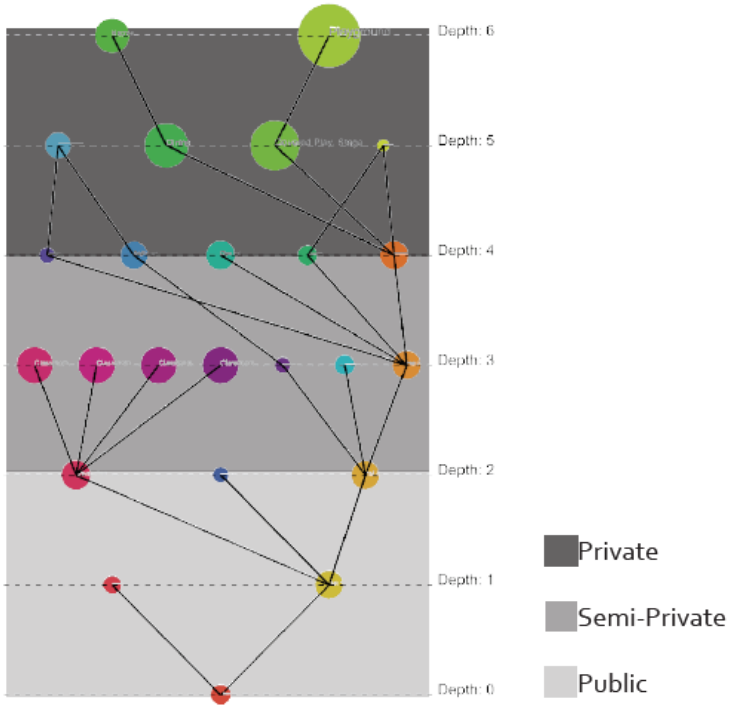


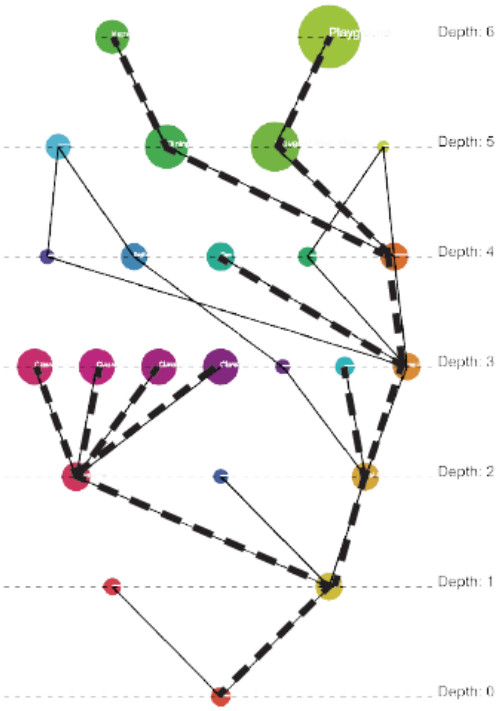
Rooms accessible by students



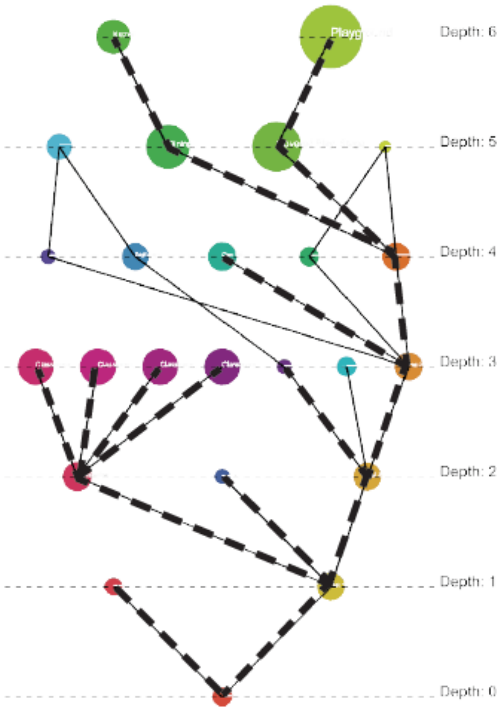
Rooms accessible by parents/ guardians

Below: The Community prototype diagrams analyzed by public versus private spaces and by circulation paths.





Rooms accessible by students



Rooms accessible by parents/ guardians

Site Considerations

The sites for the School and Urban prototypes were preselected and the Community prototype site was determined first through exploration of potential sites using demographic studies and using the site evaluation process to select one of the potential sites. The School and Urban prototype sites were still analyzed according to the site considerations. The School prototype is set in an existing building on the Waikīkī Elementary School campus and the Urban prototype site occupies the available tenant space on the ground floor of the City Financial Tower in downtown Honolulu. From the demographic studies, the two potential sites for the Community prototype are in reference to the Linapuni Street census tract and the Mayor Wright Housing census tract.[111] The site analysis for the three prototypes are discussed in the following order:

1. Site Analysis: All Prototype Locations
    - Urban Land Use

[111] (Hawaii 2009-2013 ACS 5-year Estimates by Census Tracts - Selected Data n.d.)

- Traditional Hawaiian Land Division
- History and Legends

2. Site Analysis: School Prototype
    - Existing and Potential Elementary Schools
    - Views and Orientation
    - Natural Features
    - Climate Analysis
    - Community Assets
3. Site Analysis: Urban Prototype
    - Density Study
    - Views and Orientation
    - Natural Features
    - Climate Analysis
    - Zoning
    - Community Assets
4. Site Analysis: Community Prototype
    - Demographic Studies
    - Views and Orientation
    - Natural Features
    - Climate Analysis
    - Zoning
    - Community Assets
5. Site Evaluation: Community Prototype

Figure 5.4 shows a larger scale version of the site analysis portion that can be applied to all prototype sites (done to avoid repetitive diagrams). Figures 5.5 to 5.7 show the smaller scale site analysis portions of each individual prototype site. Lastly, the two potential sites for the Community prototype are discussed and evaluated.

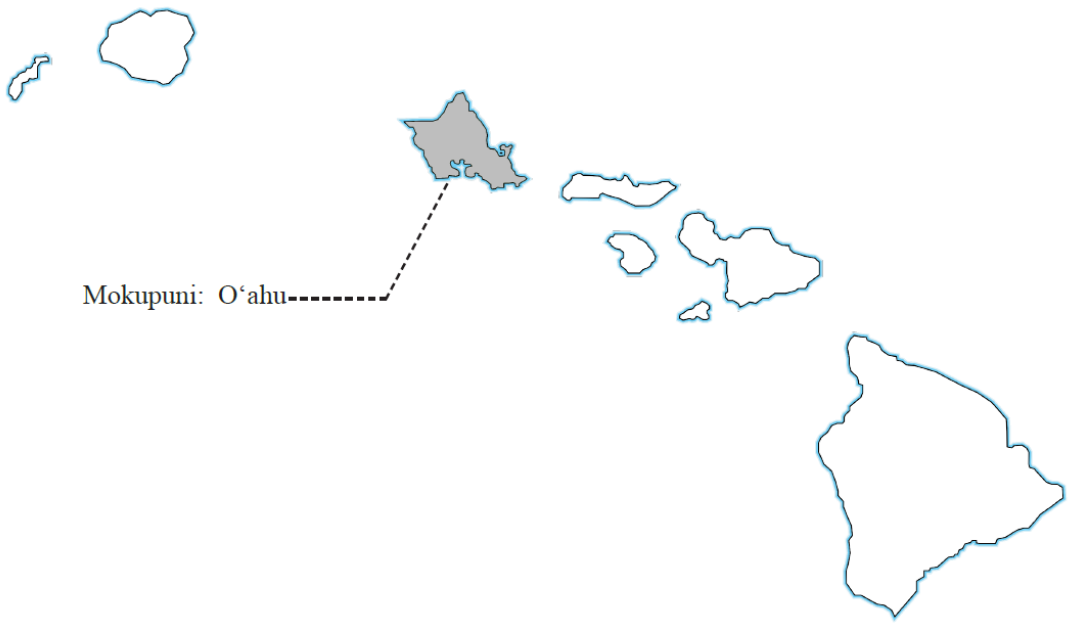
Site Analysis

All Prototype Locations

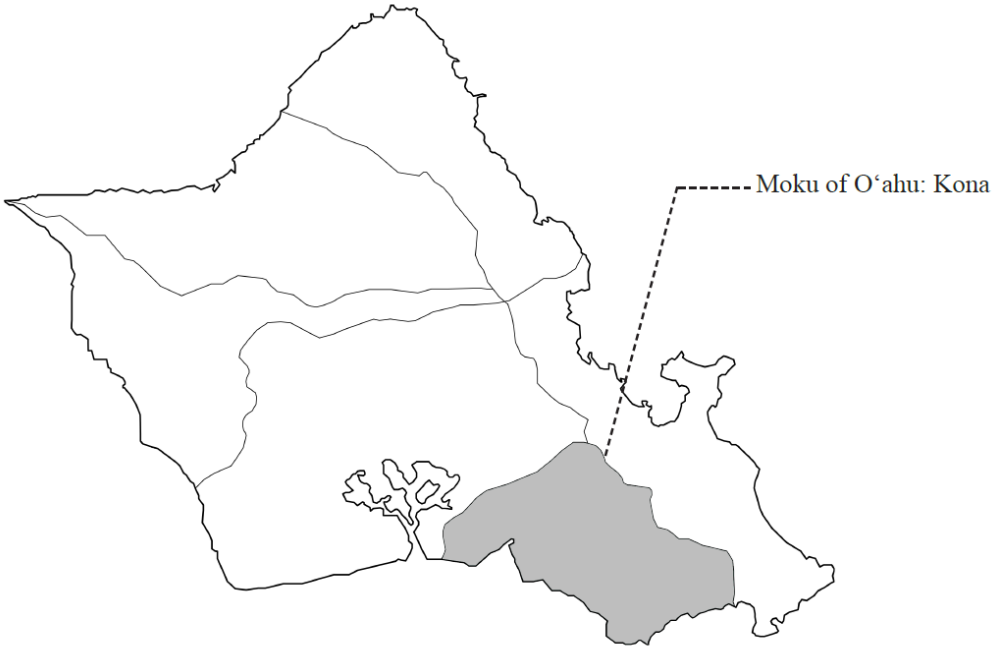
The site analysis begins by identifying the urban land use areas on Oʻahu. Only the areas identified as urban land are suitable for school facilities. The land use areas not shown in figure 5.4 are designated for agriculture or conservation. Concerning traditional Hawaiian land division, all of the prototype sites are located on the same island in roughly the same area; therefore the site analysis maps will encompass all sites (see figure 5.4). All prototype sites are located in the Kona moku (district) on the mokupuni (island) of Oʻahu, and the potential sites are either within the Kalihi, Kapālama, Honolulu, or Waikīkī ahupuaʻa, as shown in figure 5.4. Once the ahupuaʻa of each potential prototype site is identified, aspects of the site's history or legends associated with the ahupuaʻa are also identified. This information can then be applied to the design of the facility. The designer should refer to the cultural design idea chart to organize the information collected.

Figure 5.4 Site Analysis for all prototypes

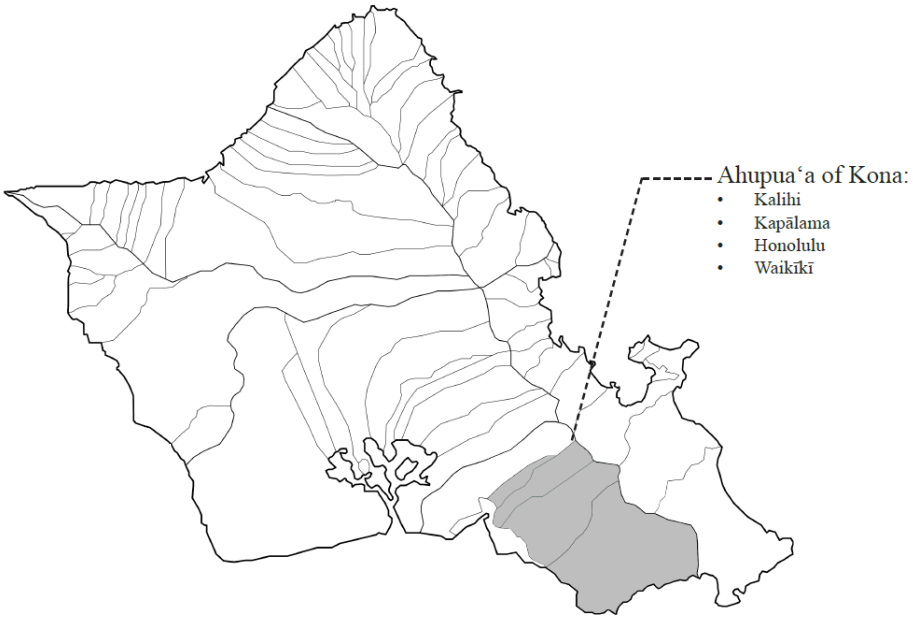
Map identifying urban land use areas. All unshaded areas are designated as agricultural or conservation land.



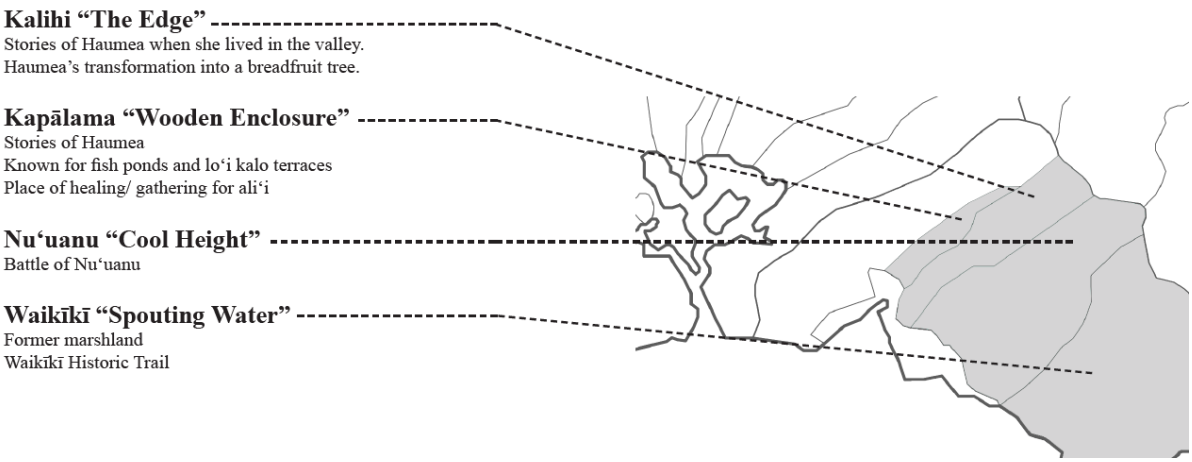
Traditional Hawaiian land division, mokupuni.



Traditional Hawaiian land division, moku.



Traditional Hawaiian land division, ahupuaʻa.



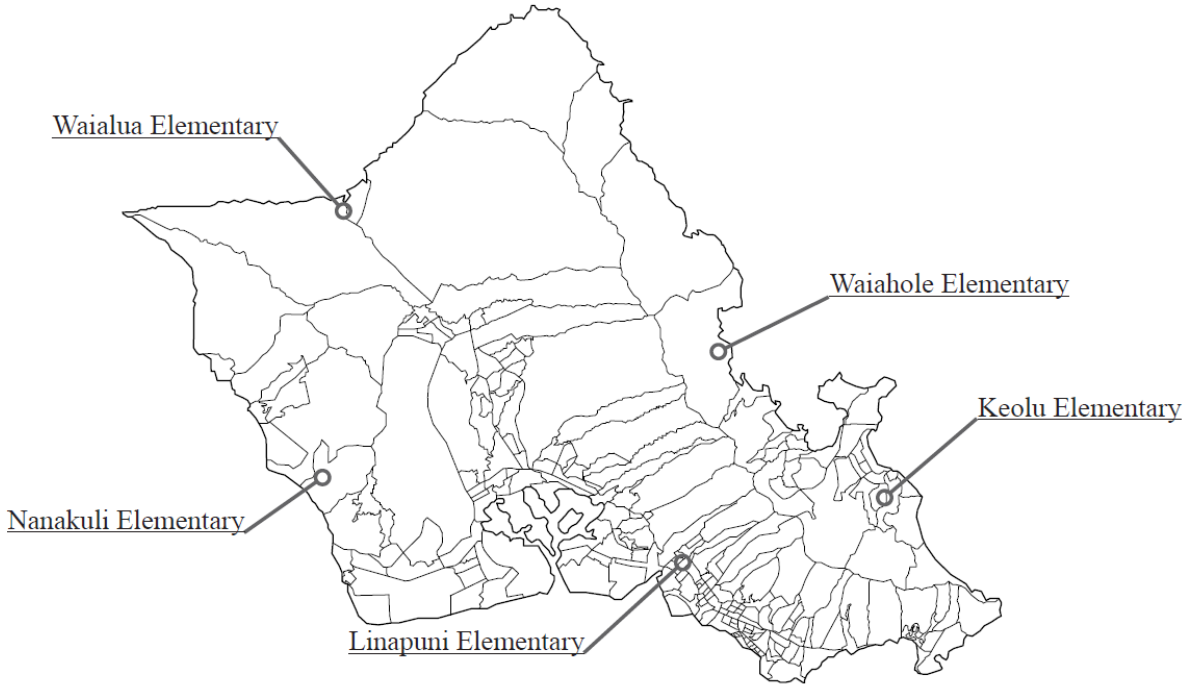
History and legends associated with the specific ahupuaʻa.

School Prototype

Figure 5.5 shows specific site analysis aspects for the School prototype. The process begins with identifying existing elementary schools that offer preschool classes and schools that could potentially add a preschool program. The next step is to conduct an analysis of each potential site's cultural landscape aspects (views and orientation,

natural features, and climate analysis) and community assets. As shown in figure 5.5, Waikīkī Elementary school is the location designated for the School prototype.

Figure 5.5 Site Analysis for the School prototype

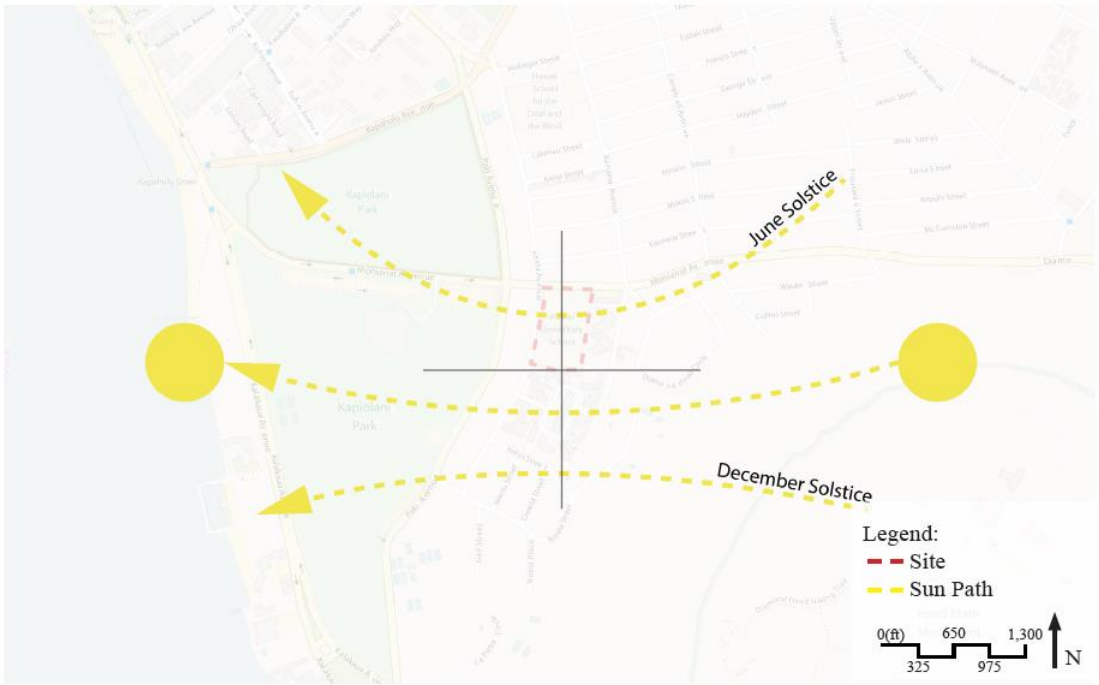


Map of existing elementary schools on O‘ahu with preschool classes.

Map of a potential elementary school on O‘ahu for preschool classes. Waikīkī Elementary is the location designated for the School prototype.

The location of the Waikīkī Elementary school site in the Waikīkī area along Monsarrat Avenue, adjacent to Kapiolani Park.

Map identifying the views and orientation for the site in terms commonly used in Hawai‘i; mauka means the mountains and makai, the ocean. The map also identifies key natural features near the site.



The sun path for the site.

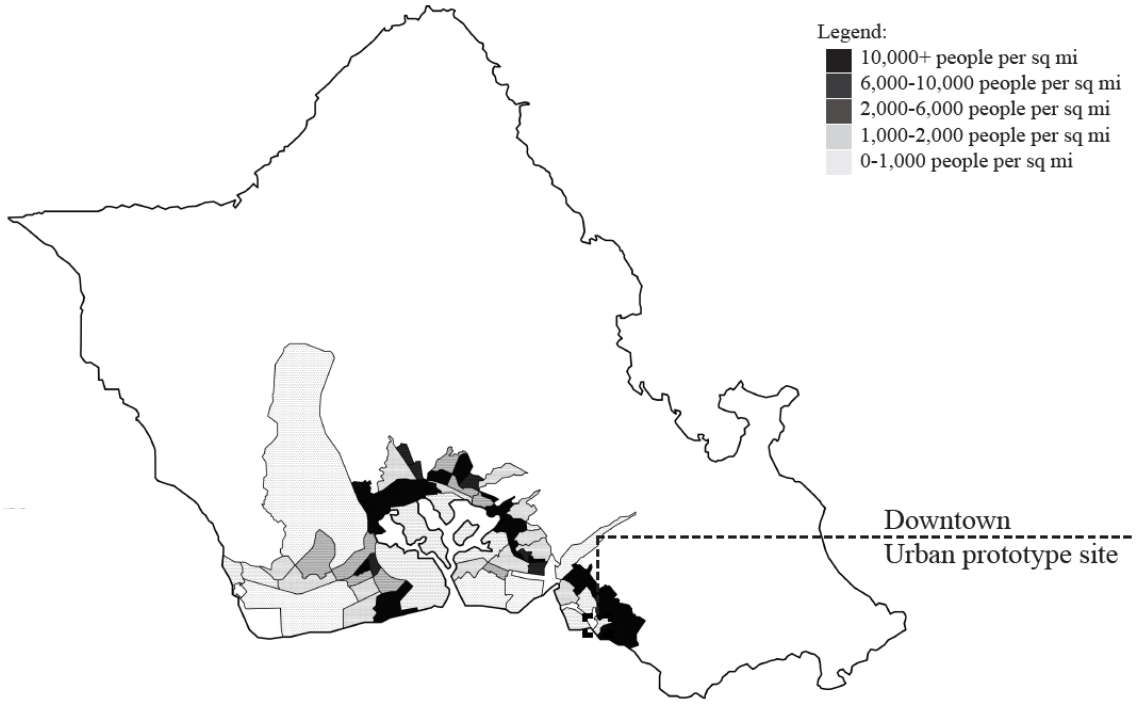
Wind direction, annual rainfall, and type of wind specific to the site. This type of wind is associated with the Waikīkī ahupua‘a and is identified by its Hawaiian name and meaning.

Map identifying the community assets near the site. The legend on the left lists the different community assets. Some of these are also listed here. The walking distances are defined by the Honolulu Transit-Oriented Neighborhood Development Plans.

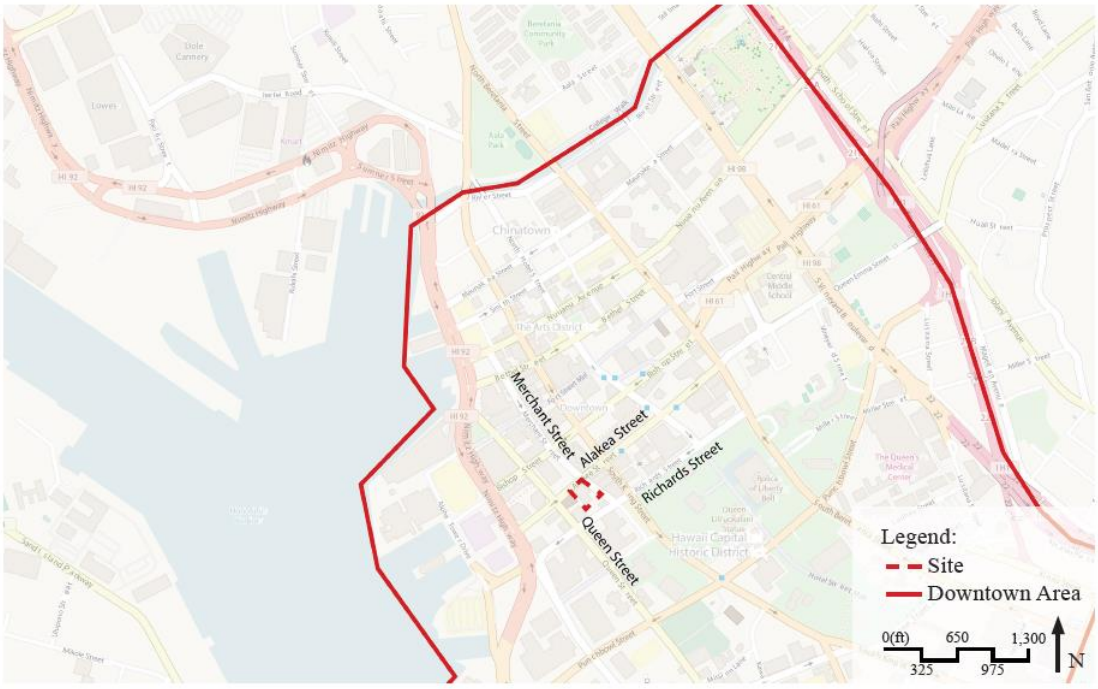
Urban Prototype

+Figure 5.6 shows specific site analysis aspects for the Urban prototype, located in the City Financial Tower. The first illustration is a map of the densities of different areas in Honolulu and shows the prototype site located in a high-density environment. This is followed by analyses of cultural landscape aspects (views and orientation, natural features, and climate analysis), the zoning classification for the site, and the identification of community assets in the surrounding area.

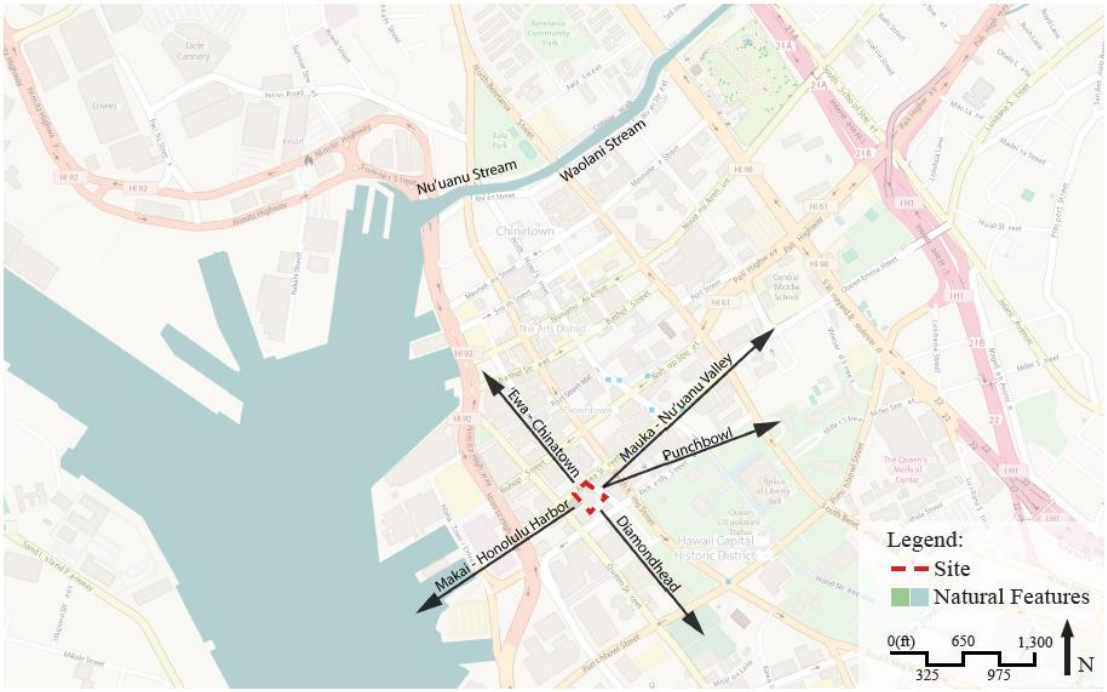
Figure 5.6 Site Analysis for the Urban prototype



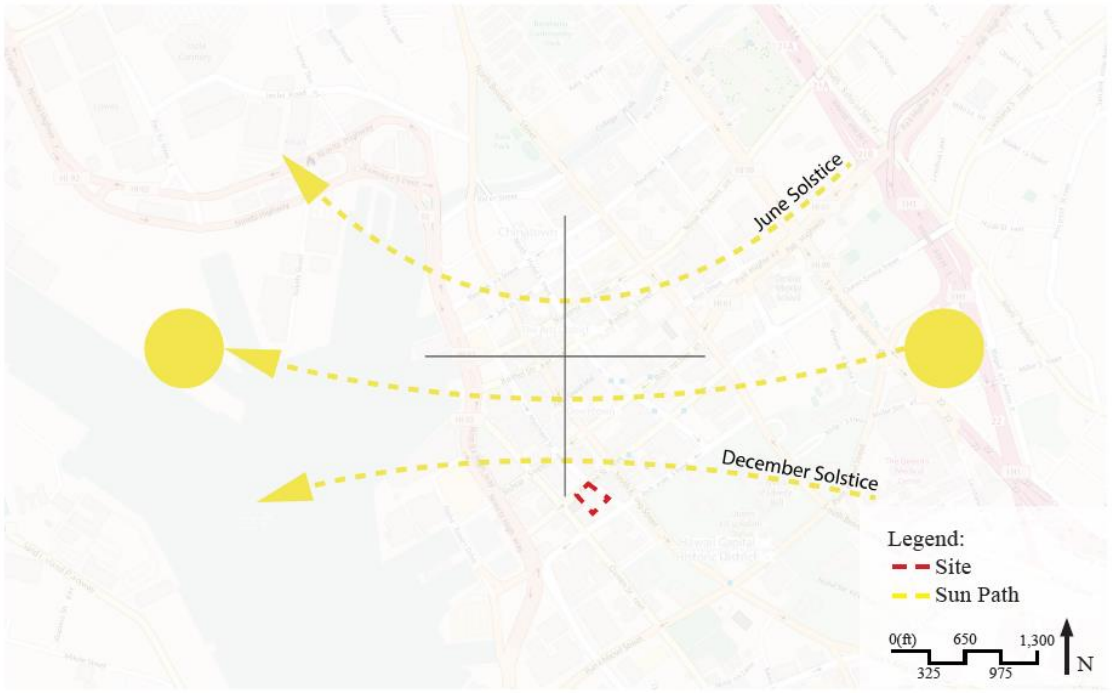
Map of different area densities from Honolulu to Kapolei. The Urban prototype is set in City Financial Tower in the downtown area of Honolulu, which has a density of about 12,000 people square mile.



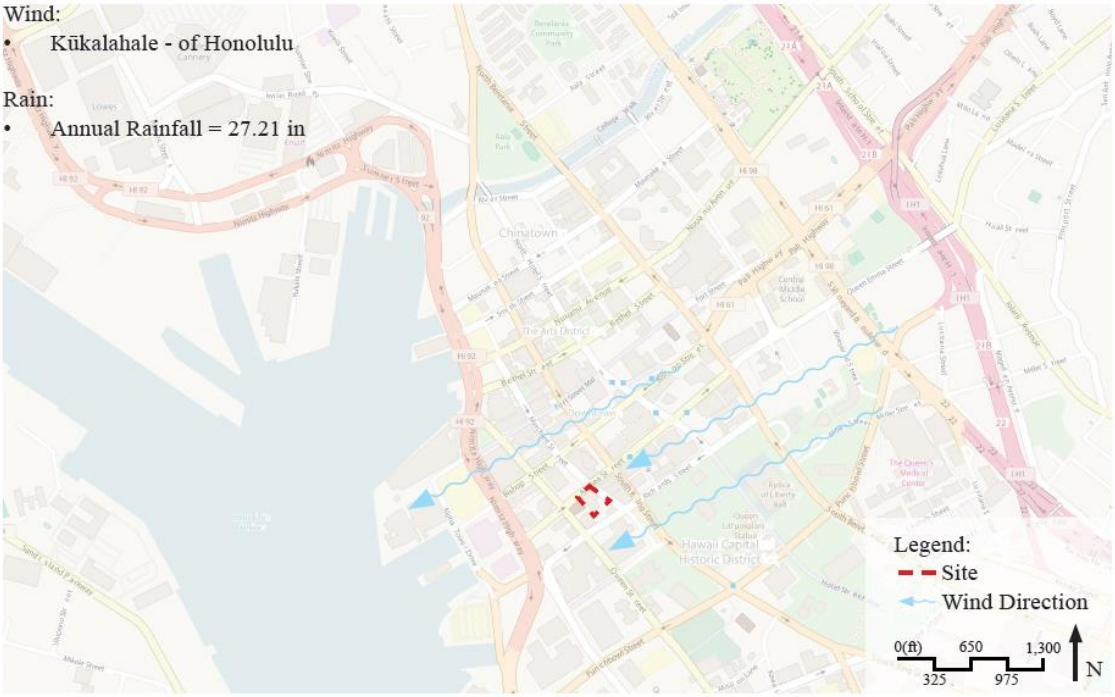
The location of the City Financial Tower site in the downtown area as identified here.



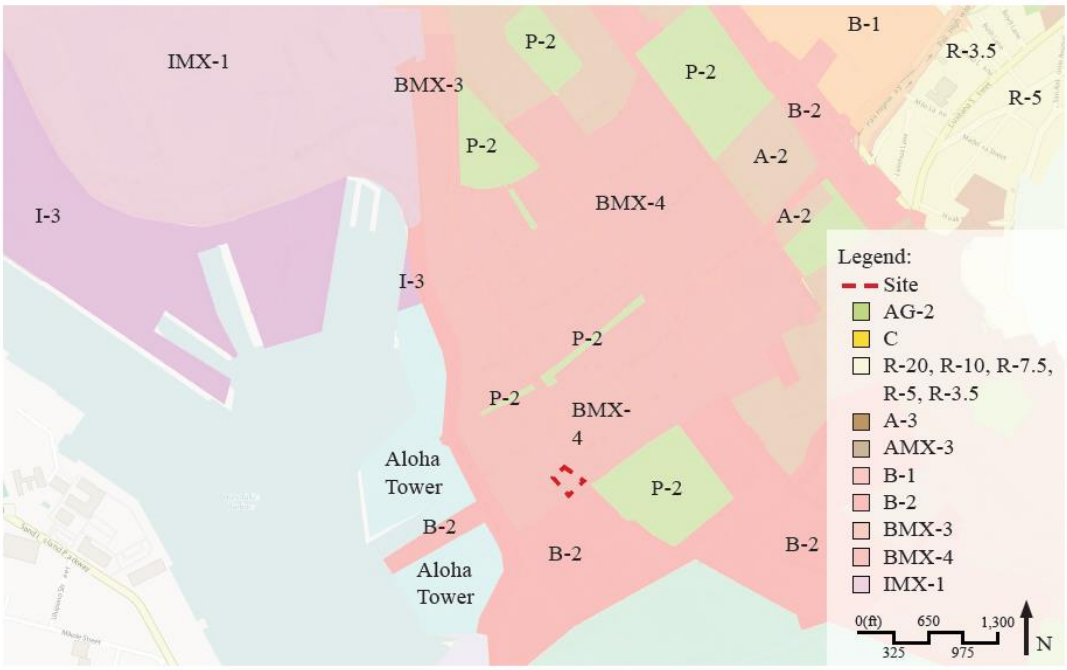
Map identifying the views and orientation for the site in terms commonly used in Hawai‘i. The map also identifies key natural features near the site location.



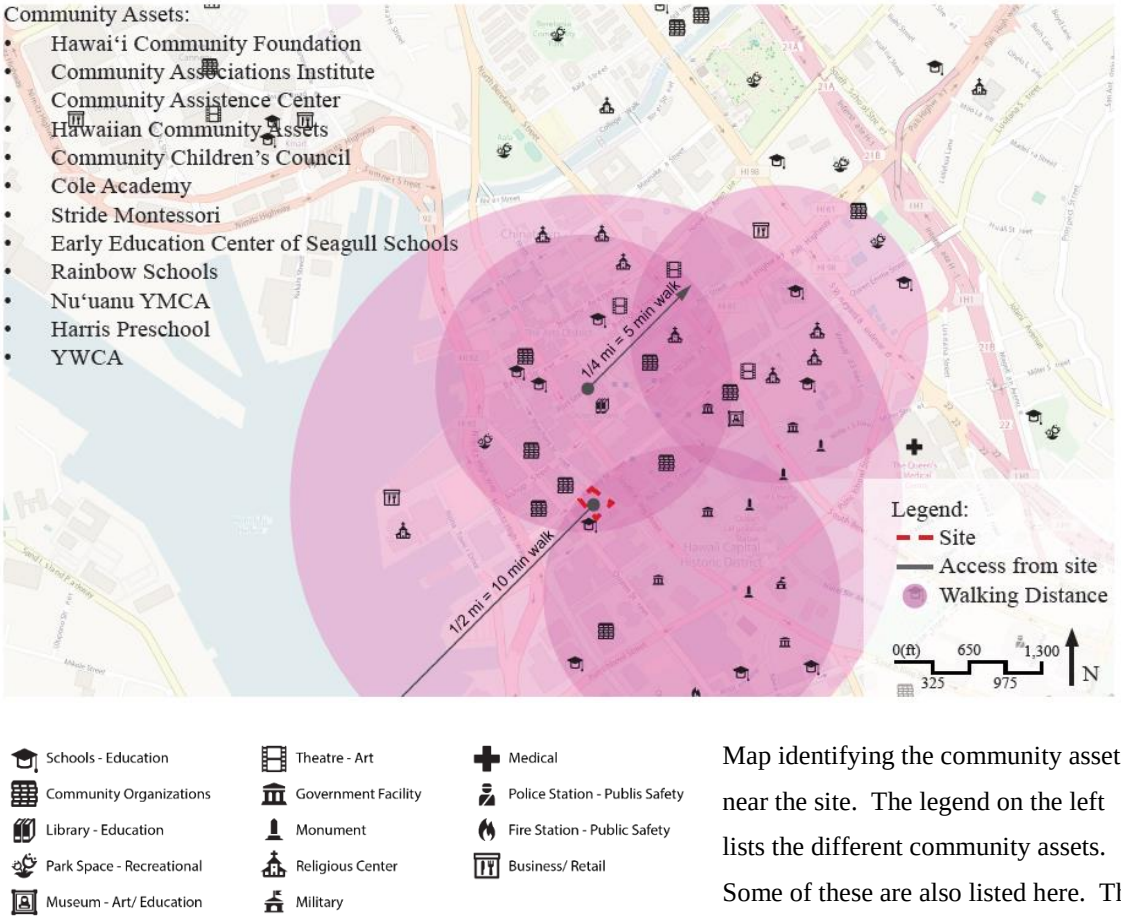
The sun path for the site.



Wind direction, annual rainfall, and type of wind specific to the site. This type of wind is associated with the Honolulu ahupua‘a and is identified by its Hawaiian name and meaning.



Map of the zoning classifications for the Urban prototype site and surrounding properties. The legend identifies the zoning classifications that are appropriate for school functions. All other zoning classifications are not suitable for school functions.

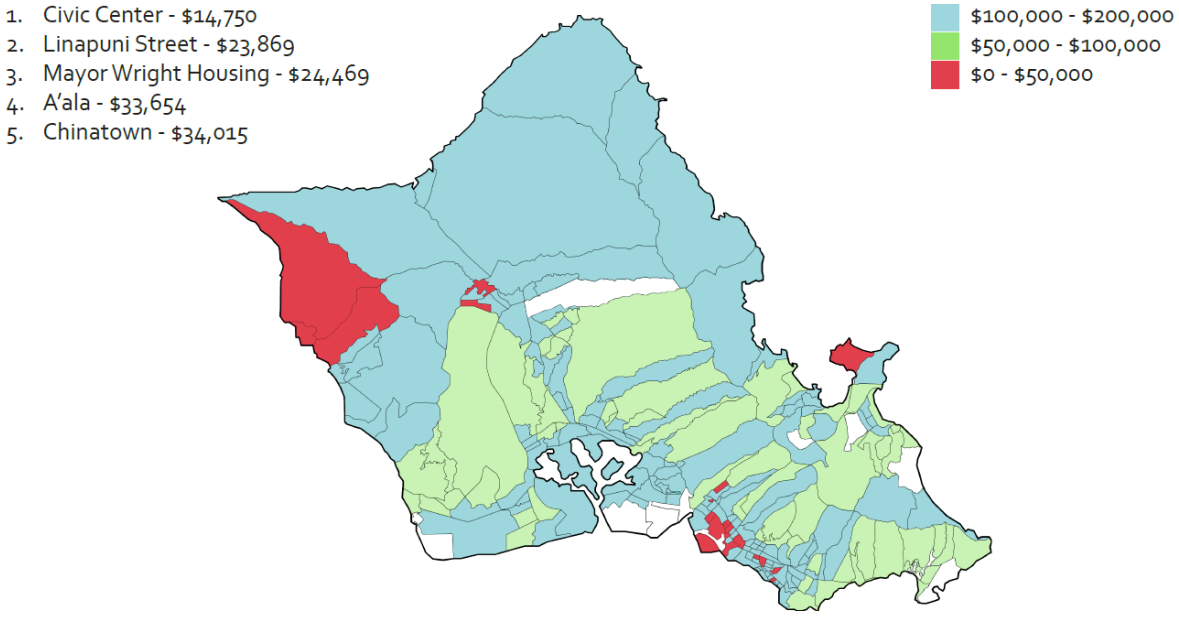


Map identifying the community assets near the site. The legend on the left lists the different community assets. Some of these are also listed here. The walking distances are defined by the Honolulu Transit-Oriented Neighborhood Development Plans.

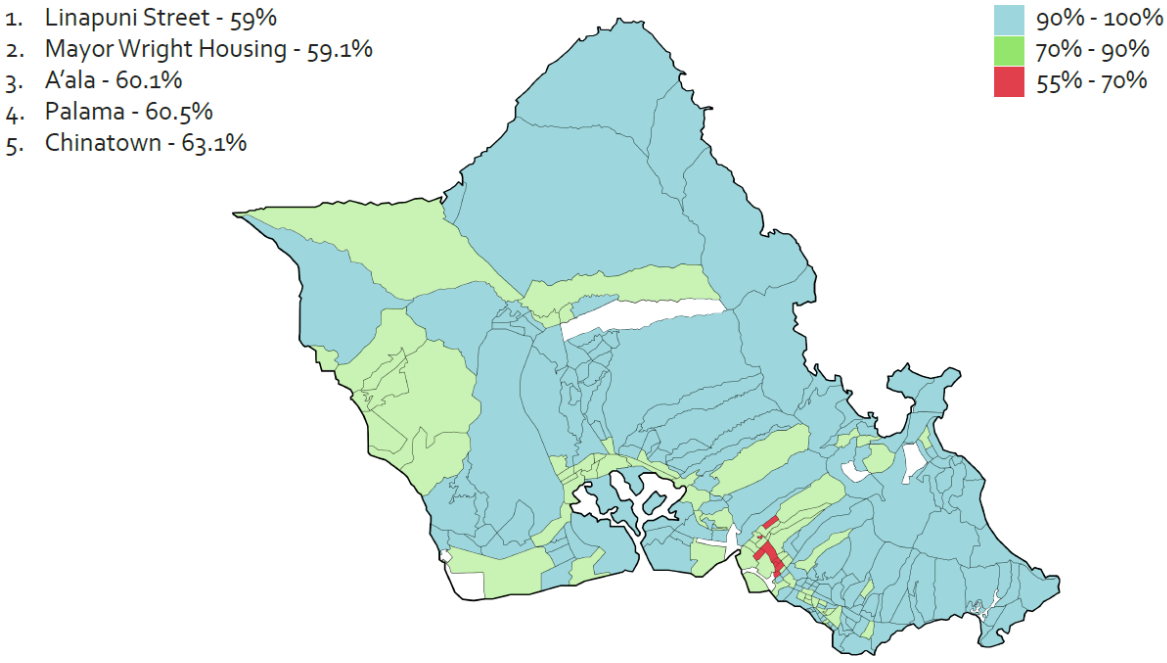
Community Prototype:

Figure 5.7 shows specific site analysis aspects for the Community prototype. The first illustrations are maps with demographic breakdowns of O'ahu that identify areas that could benefit from the intervention of an early education program as well as sites in which a program could be integrated and make use of existing community resources. This is followed by analyses of cultural landscape aspects (views and orientation, natural features, and climate analysis), zoning classifications for the sites, and the identification of community assets in the surrounding area. As shown, two potential sites for the Community prototype were chosen, the Linapuni Street census tract and the Mayor Wright Housing census tract. Evaluations of the two sites are shown in figure 5.8.

Figure 5.7 Site Analysis for the Community prototype

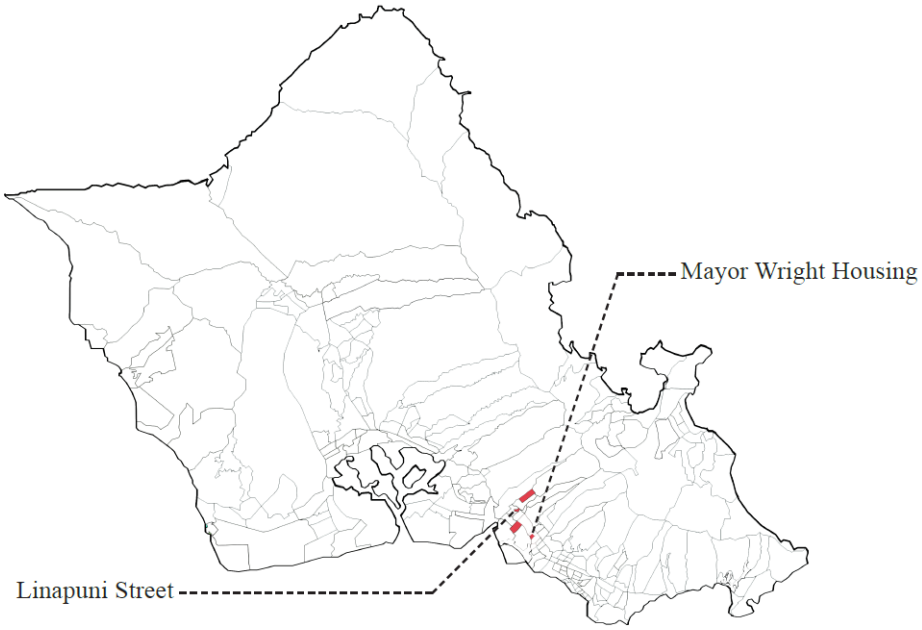


The median family income of the census tract for O'ahu. The information is from the *Hawaii 2009-2013 ACS 5-year Estimates by Census Tracts*. Studies on the connection between early education and adulthood success have shown that participation in an early education program can lead to higher educational and financial attainment. The census tracts identified here potential sites for an early education facility.



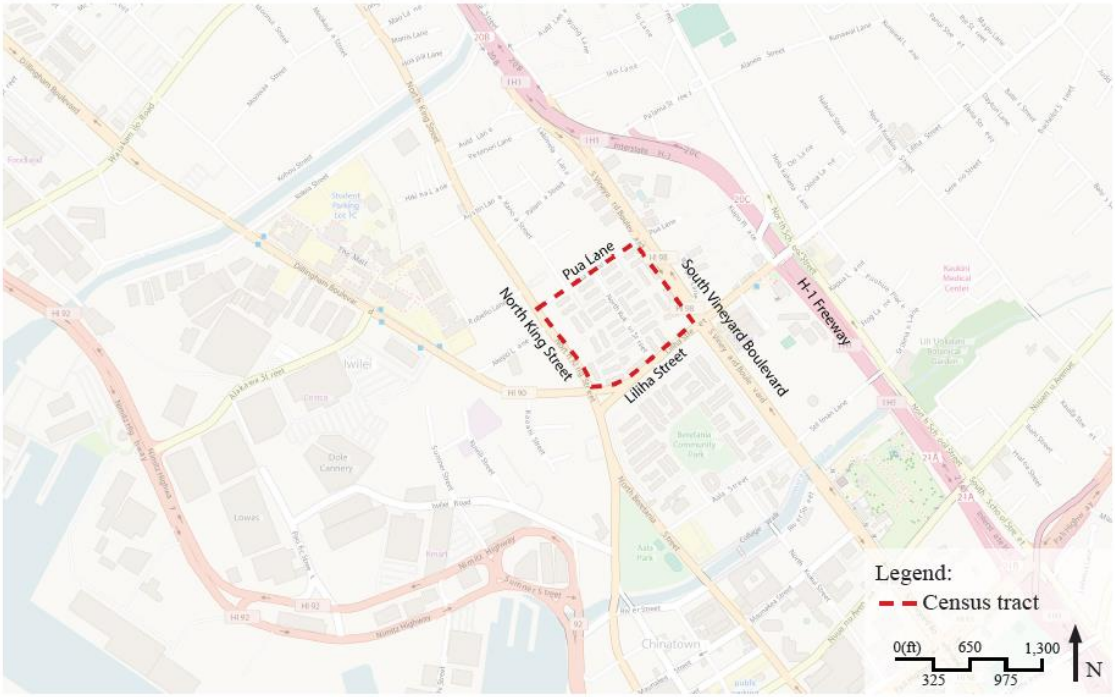
Population with a high school degree or higher, per census tract for O'ahu. The information is from the *Hawaii 2009-2013 ACS 5-year Estimates by Census Tracts*. Studies on the connection between early

education and adulthood success have shown that participation in an early education program can lead to higher educational and financial attainment. The census tracts identified here could be potential sites for an early education facility.

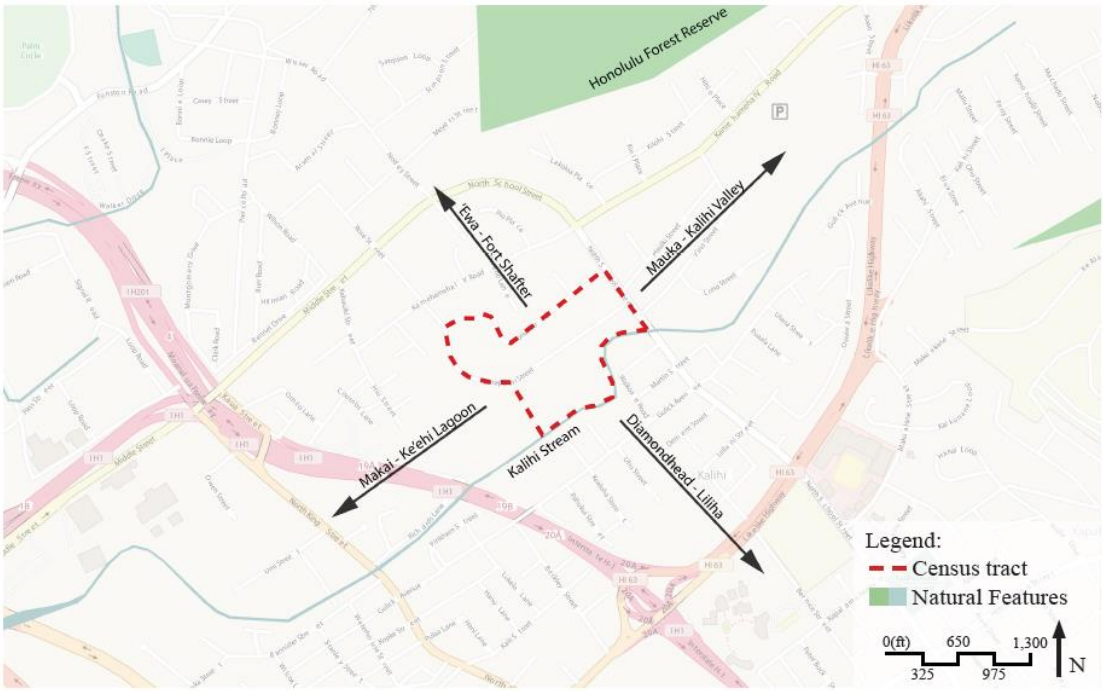


The location of the Linapuni Street and Mayor Wright Housing census tracts, as identified in the demographic studies. These are the two potential sites that were analyzed for the Community prototype.

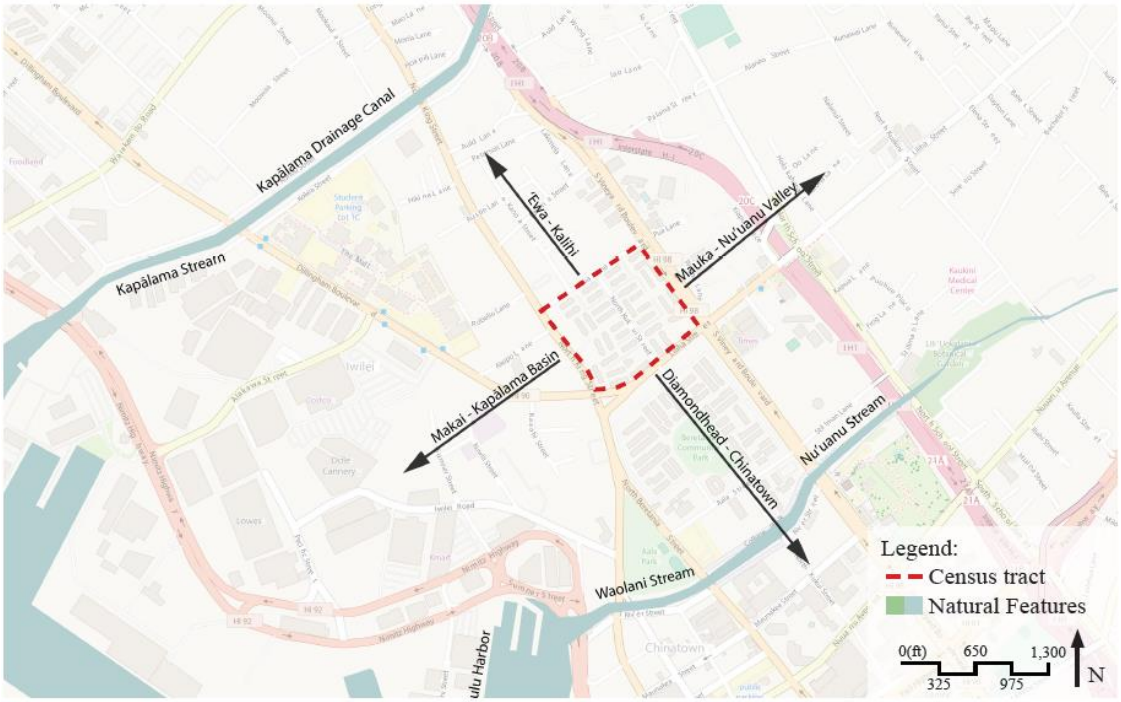
The location of the Linapuni Street census tract.



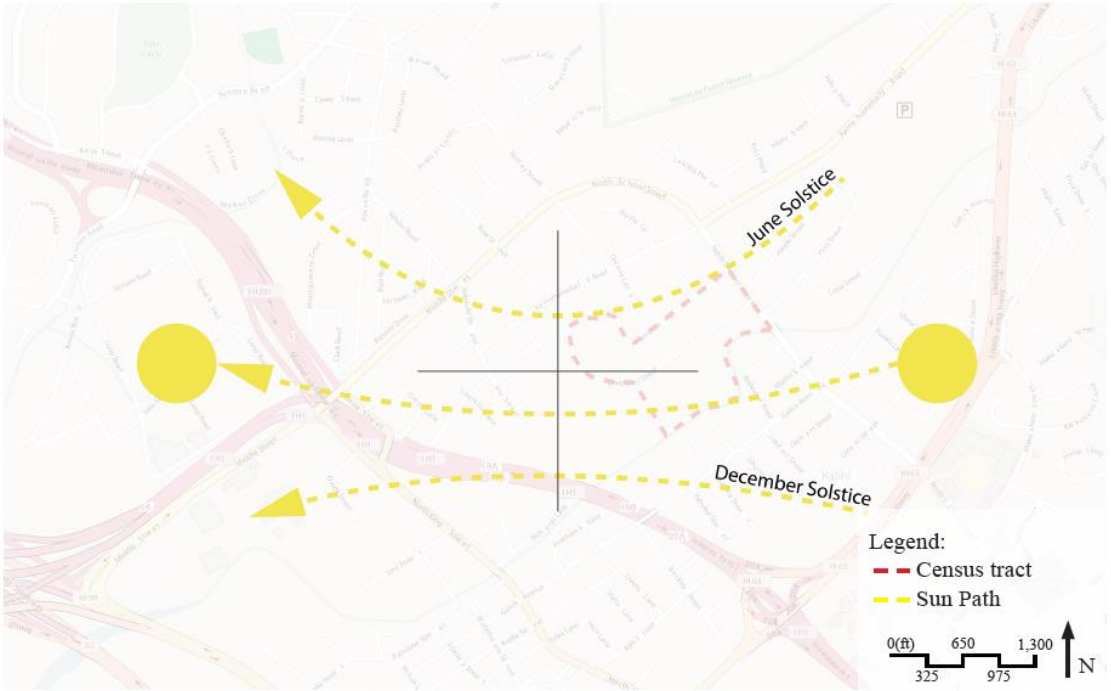
The location of the Mayor Wright Housing census tract.



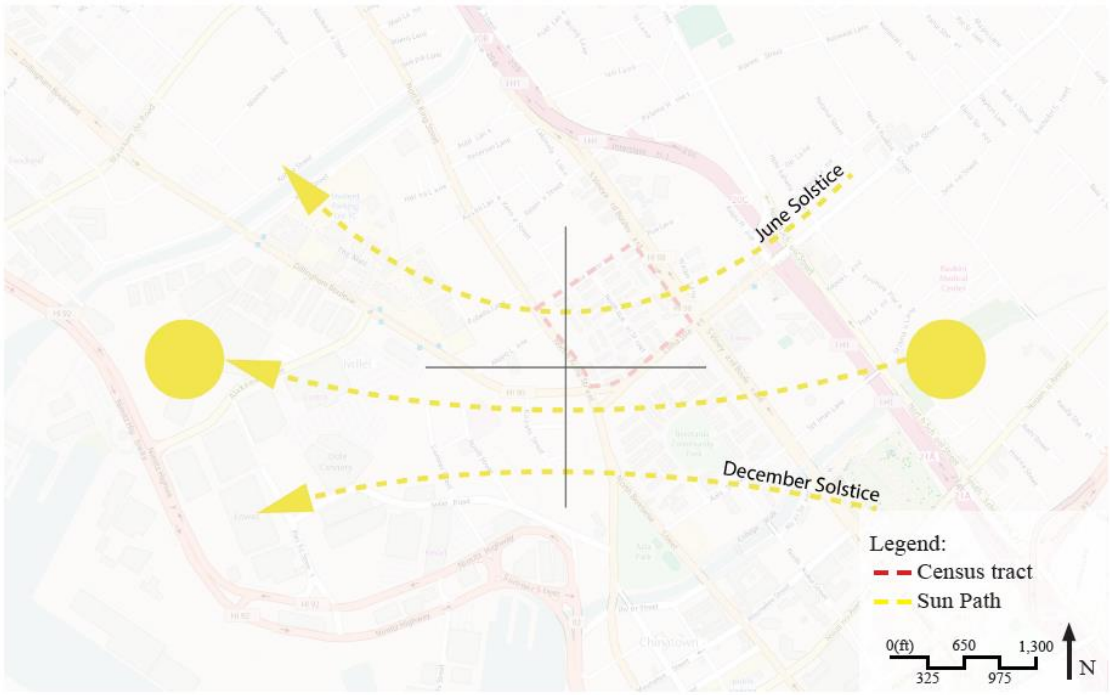
Map identifying the views and orientation for the Linapuni Street census tract in terms commonly used in Hawai‘i. The map also identifies key natural features near the site location.



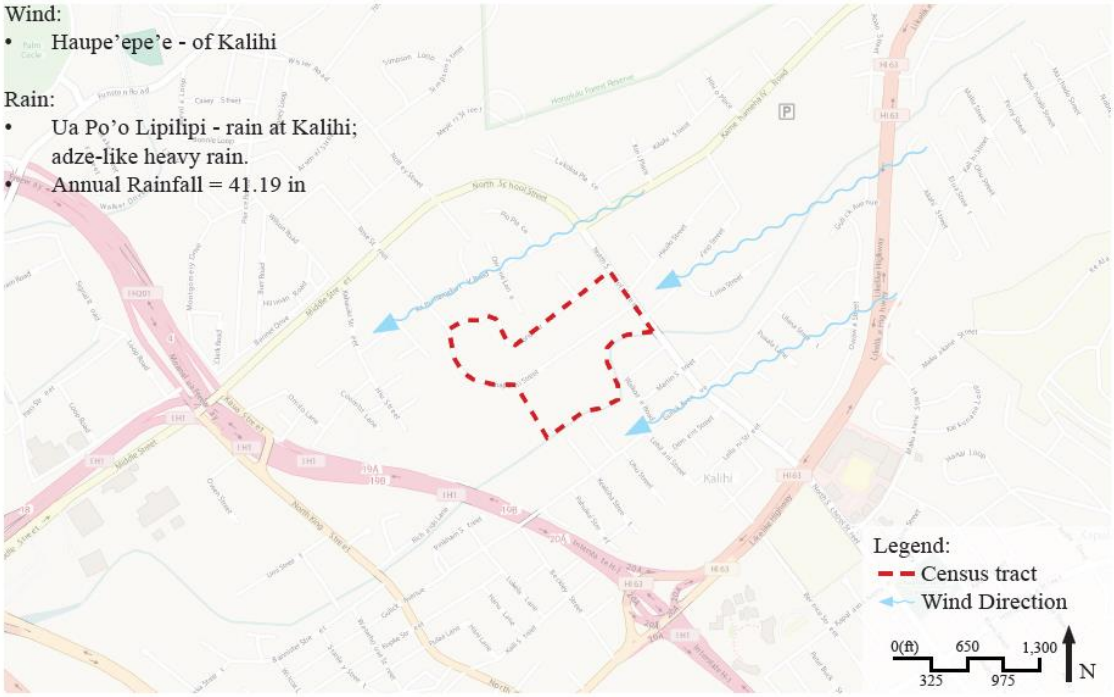
Map identifying the views and orientation for the Mayor Wright Housing census tract in terms commonly used in Hawai‘i. The map also identifies key natural features near the site location.



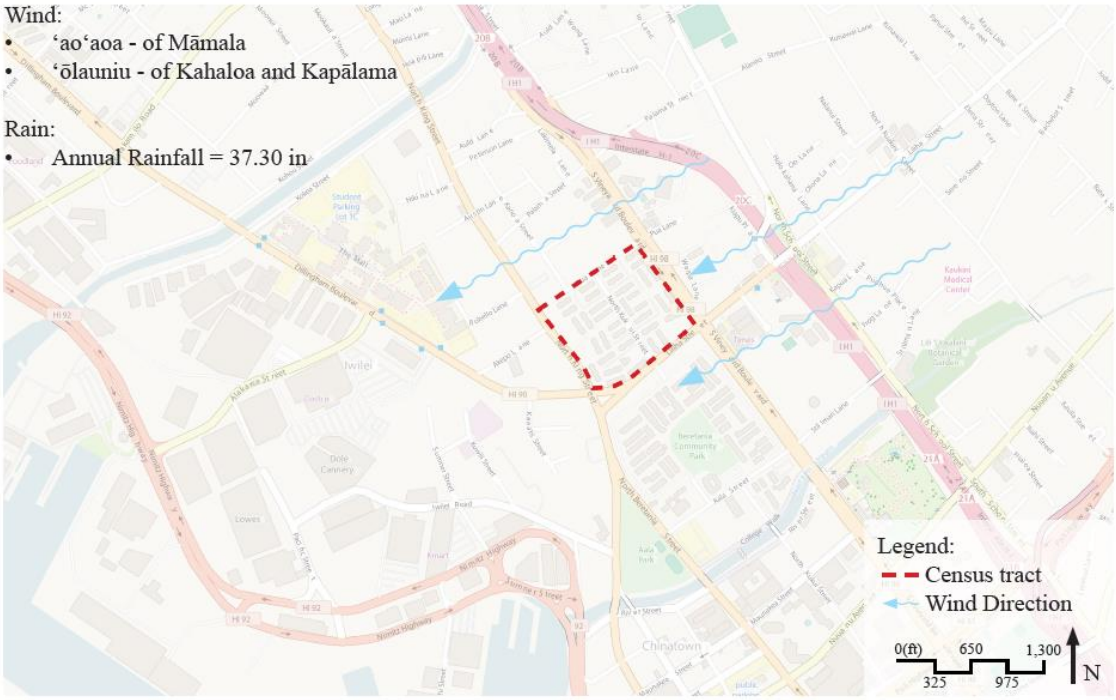
The sun path for the Linapuni Street census tract.



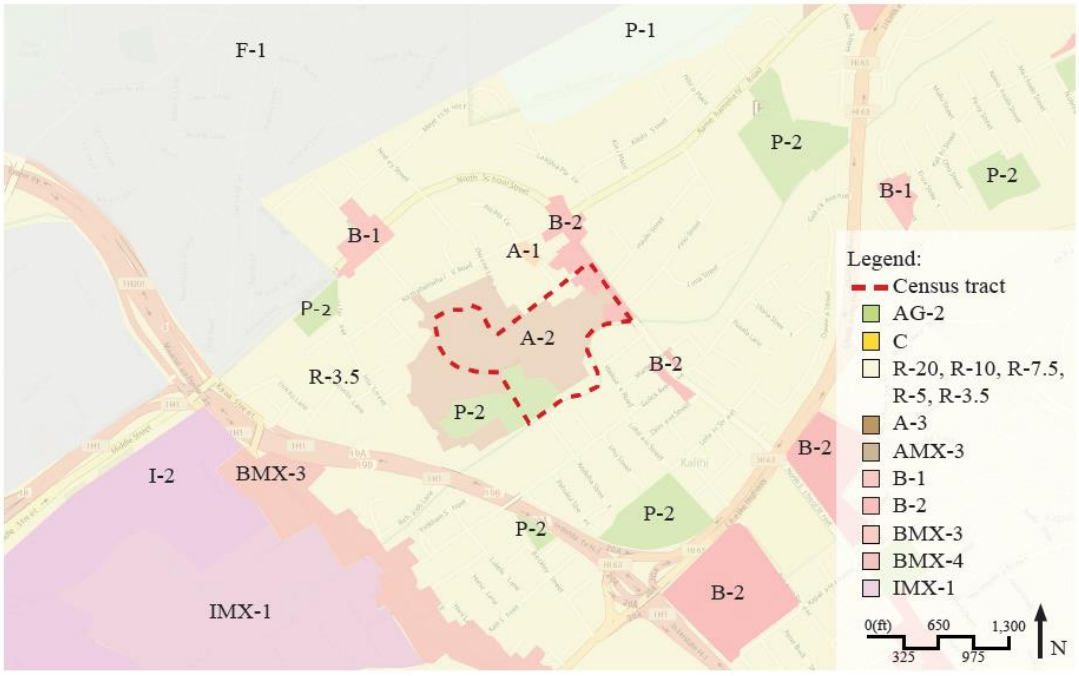
The sun path for the Mayor Wright Housing census tract.



Map of the Linapuni Street census tract showing wind direction, annual rainfall, and type of wind specific to the site. This type of wind is associated with the Kalihi ahupua'a and is identified by its Hawaiian name and meaning.

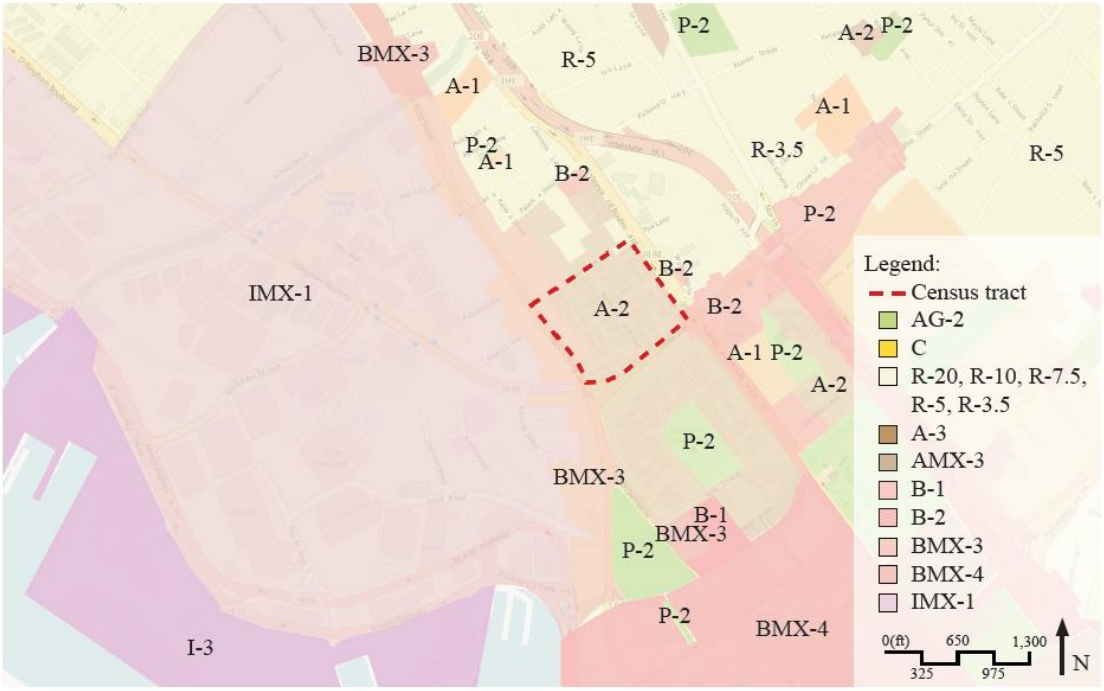


Map of the Mayor Wright Housing census tract showing wind direction, annual rainfall, and type of wind specific to the site. This type of wind is associated with the Kapālama ahupuaʻa and is identified by its Hawaiian name and meaning.

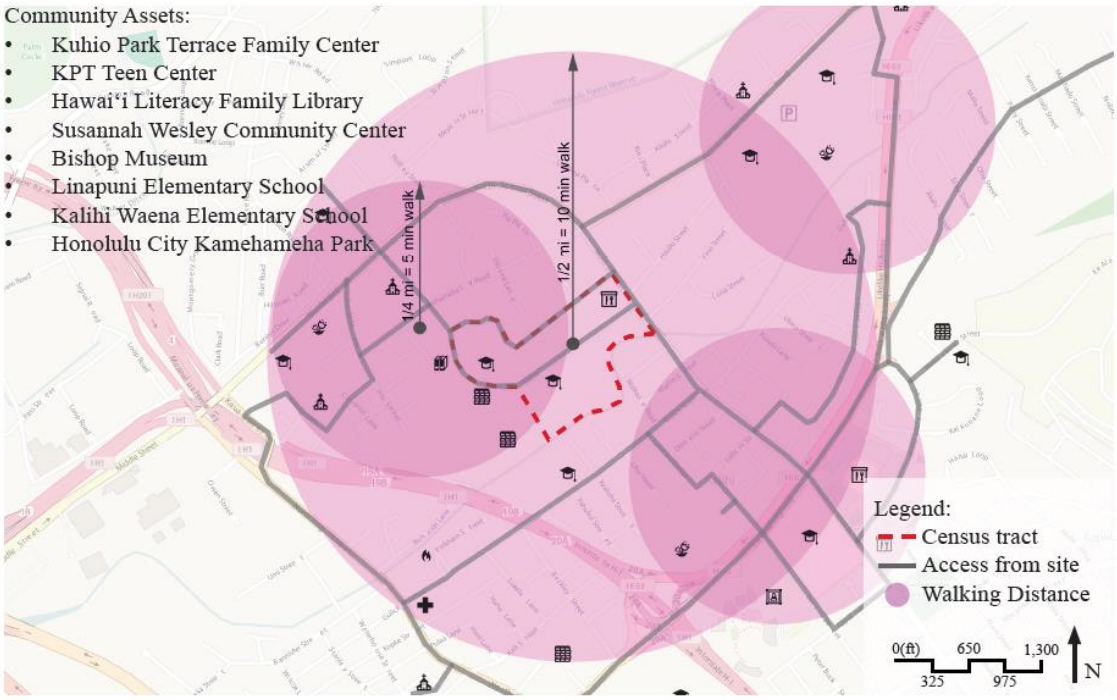


Map of the zoning classifications for the Linapuni Street census tract and surrounding properties. The legend identifies the zoning classifications that are appropriate for school functions. All other zoning

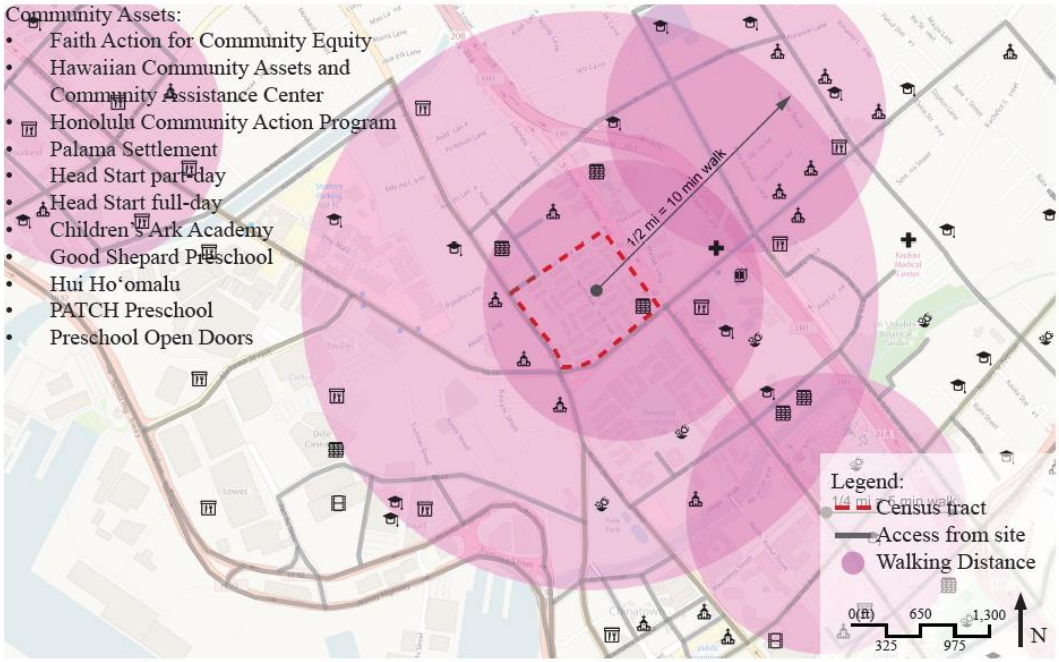
classifications are not suitable for school functions. The A-2 and P-2 classifications that make up the Linapuni Street census tract are not considered suitable for school functions and thus the prototype site must be located outside of the census tract area, but ideally within walking distance in order to meet the demographic needs.



Map of the zoning classifications for the Mayor Wright Housing census tract and surrounding properties. The legend identifies the zoning classifications that are appropriate for school functions. All other zoning classifications are not suitable for school functions. The A-2 classification that makes up the Mayor Wright Housing census tract is not considered suitable for school functions and thus the prototype site must be located outside of the census tract area, but ideally within walking distance of the census tract in order to meet the demographic needs.

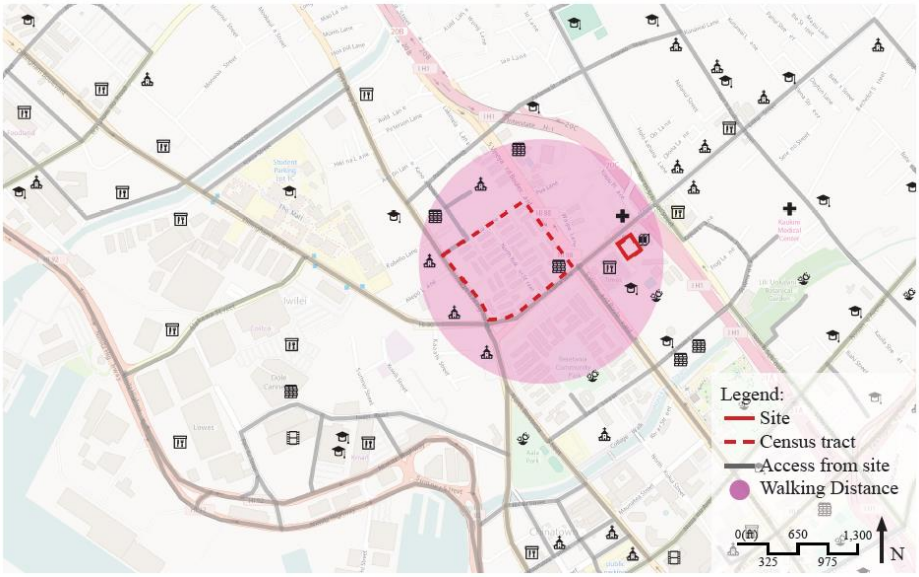


Map identifying the community assets near the Linapuni Street census tract. The legend on the left lists the different community assets. Some of these are also listed here. The walking distances are defined by the Honolulu Transit-Oriented Neighborhood Development Plans.



Map identifying the community assets near the Mayor Wright Housing census tract. The legend on the left lists the different community assets. Some of these are also listed here. The walking distances are defined by the Honolulu Transit-Oriented Neighborhood Development Plans.

The site near the Linapuni Street census tract that was considered for the Community prototype is the property shown in the map above along North School Street. This potential site was a part of the site evaluation process.



The site near the Mayor Wright Housing census tract that was also considered for the Community prototype is the property shown in the map above along Liliha Street. This potential site was a part of the site evaluation process.

Site Evaluation

Community Prototype:

Figure 5.8 provides an evaluation of the two potential sites for the Community prototype. Each site was analyzed according to community and cultural landscape aspects and was scored using the rubric detailed in chapter four. There are five topics, each with a possible score of zero to five, where the total possible score for any category is five.

For community assets, certain aspects of the surrounding area were identified as places or organizations that could be beneficial to the early education program. These include resources that can be shared with the school such as libraries, community centers, and recreational facilities. They also include places that may enrich program learning experience such as museums, parks, zoos, aquariums, and theatres.[112] Identifying community organizations that focus on family services that would consider partnering

[112] (U.S. Department of Education 2016)

with the school could also be beneficial in terms of increasing availability and accessibility of help and services for the families involved. Other sources of potential community assets are places such as government buildings, public safety services, and local businesses that could collaborate with the school program to put together events, providing new experiences for the children. In turn, the school itself could become an asset to the community. For example, there may be some areas that have numerous existing but disparate resources where a new school could unite these in one central location, benefiting the larger community. There may also be areas that lack community resources; introducing a new school with spaces designated to share with the community could become a valuable community asset.

Figure 5.7 identifies the community assets of each potential site and highlights each site's access paths. The maps also indicates walking distances from a central point. The larger circle represents a half mile radius from the census tract which is about a ten-minute walk and the smaller circles represent a quarter mile radius, about a five-minute walk. These maps show clusters of resources that are within walking distance of each other. The clusters with the greatest number of resources could be further examined for placement of the early education facility site.

Cultural landscape aspects help incorporate Hawaiian culture in the design of educational facilities with the goal of creating a facility design that fits into the natural environment and is open and welcoming for local residents. The information drawn for the scoring for each potential site is shown in figure 5.4 and figure 5.7.

The total scores for each potential site are shown in figure 5.8. The site near the Mayor Wright Housing census tract scored higher and was chosen as the ideal site for the Community prototype. It has greater opportunities for including existing community assets in the program and for designing a facility that connects with cultural landscape aspects.

Figure 5.8 Site Evaluation for the Community prototype

Site(s)	Community Assets $W_1 = 30\%$	Site Access $W_2 = 20\%$	Site Surrounds $W_3 = 20\%$	Views and Orientation $W_4 = 10\%$	Natural Features $W_5 = 10\%$	Climate Analysis $W_6 = 10\%$	Total Score
Linapuni st tract	$S_1 = 2$	$S_2 = 3$	$S_3 = 3$	$S_4 = 4$	$S_5 = 3$	$S_6 = 4$	
	$C_1 = 12\%$	$C_2 = 12\%$	$C_3 = 12\%$	$C_4 = 8\%$	$C_5 = 6\%$	$C_6 = 8\%$	D = 58%
Mayor Wright tract	$S_1 = 5$	$S_2 = 4$	$S_3 = 3$	$S_4 = 2$	$S_5 = 3$	$S_6 = 2$	
	$C_1 = 30\%$	$C_2 = 16\%$	$C_3 = 12\%$	$C_4 = 4\%$	$C_5 = 6\%$	$C_6 = 4\%$	D = 72%

i = Categories 1-6

S_i = Score of 0-5

W_i = Weight value of each category

C_i = Category score; ($S_i \div 5 \times W_i = C_i$)

D = Decision factor;

Represents the percentage of criteria met for an ideal early education facility site; ($\sum C_i = D$)

$S_i = 0$ in any category disqualifies the potential site
$S_i = 1$ It is unfit for an early education facility site
$S_i = 2$ Needs improvement for an early education facility site
$S_i = 3$ Meets expectations for an early education facility site
$S_i = 4$ Exceeds expectations for an early education facility site
$S_i = 5$ Exceptional quality for an early education facility site

Final Design

The final design portion of the design methodology consists of applying the program layout to the selected site. The level of completion for the facility design can be determined by the designer or client. For this dissertation, the School and Urban prototypes are completed up to the schematic design phase and the Community prototype up to the design development phase. It is within this section that cultural aspects play a greater part in the design.

During the schematic design phase, the designer can incorporate more detail into the design and the facility begins to transform from a diagrammatic to a more architectural form. At this stage, the designer can start to follow more closely the standards and concepts laid out in chapters two and three. The full set of design

guidelines are listed in the Appendix. The guidelines are intended for use throughout the design process, for consistent evaluation of the quality of the facility and to ensure it meets the top requirements. The studies on the connection between the built environment and student performance provide design aspects that require specific attention; they point out areas shown to be essential for creating an ideal learning environment.

It is also at this stage that cultural aspects can be brought into the design of the facility. Figure 5.14 shows the cultural landscape aspects from the site evaluation process for the Community prototype. It lists possible ways in which the cultural landscape aspects can be translated into the design according to the three categories mentioned in chapter three: building symbolism, creating a connection to the land, and providing program spaces for culture-based activities. Since each site is unique, this chart is meant to be completed by the designer during his or her research of the site. Conversations with the client or the community may be helpful for narrowing down which cultural aspects are the most appropriate and feasible for the site.

During the design development phase of the architectural process, the mechanical, electrical, plumbing, and structural components of the project are developed.[113] During this phase the facility design should be nearly complete and should be conveyed in a way that the client or community can understand. The designer should continue to refer to the new guidelines and cultural concepts throughout this phase.

The prototypes will be discussed in the following order:

1. School Prototype
    - Schematic Design
2. Urban Prototype
    - Schematic Design
    - Cultural Concepts
3. Community Prototype

[113] (AIA Best Practices 2007)

- Schematic Design
- Cultural Concepts
- Design Development

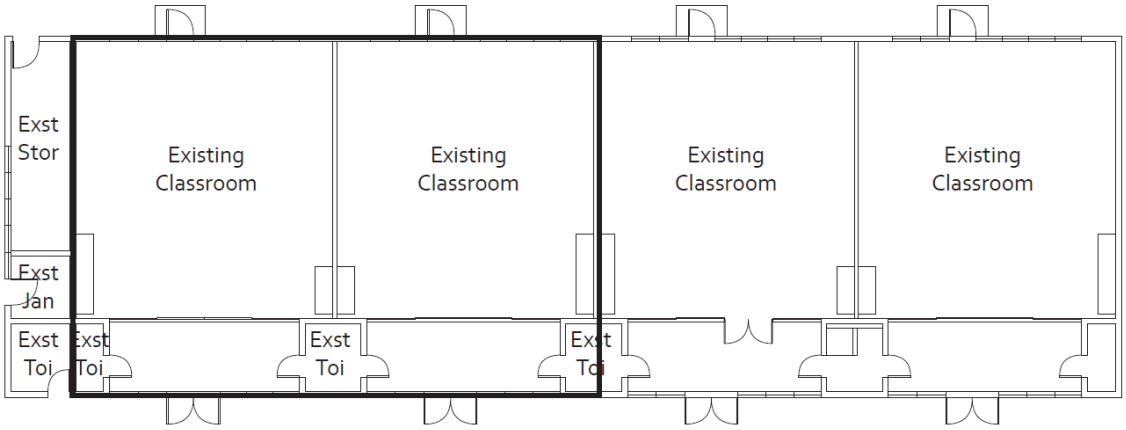
School Prototype

The School prototype's location is the Waikīkī Elementary school. The prototype is theoretically set in two classrooms in building A shown in figure 5.9. The total area for the School prototype program, shown in figure 5.1, is about 2,100 square feet. This means the prototype would fit into two existing classrooms in building A, which have a combined area of about 2,250 square feet. Thus, the program size for this prototype will be slightly larger than the original plan. It is expected that the initial program layout will change when applied to the site in order to fit the available space. Figure 5.9 demonstrates how the School prototype is applied to the two existing classrooms and shows the final layout.

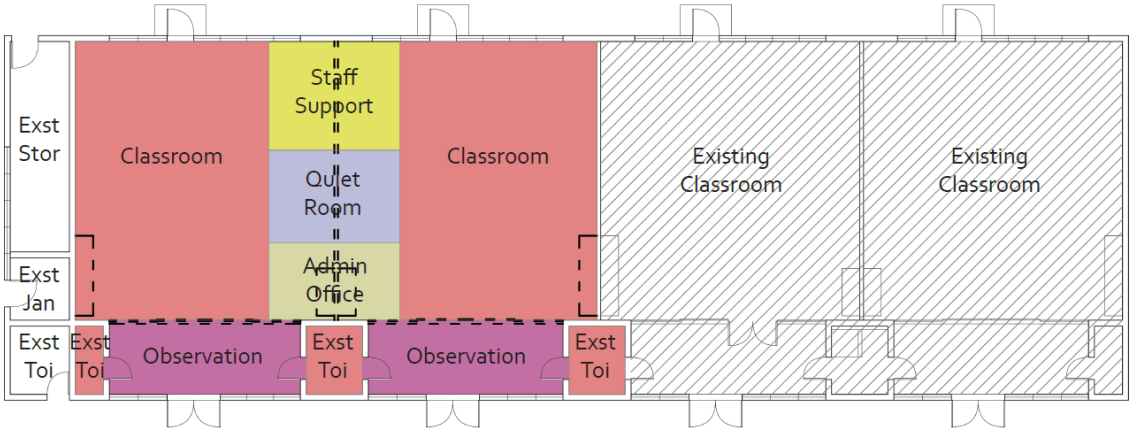
Figure 5.9 Final Design for the School prototype

The map above shows the location of building A on the Waikīkī Elementary school campus.[114]

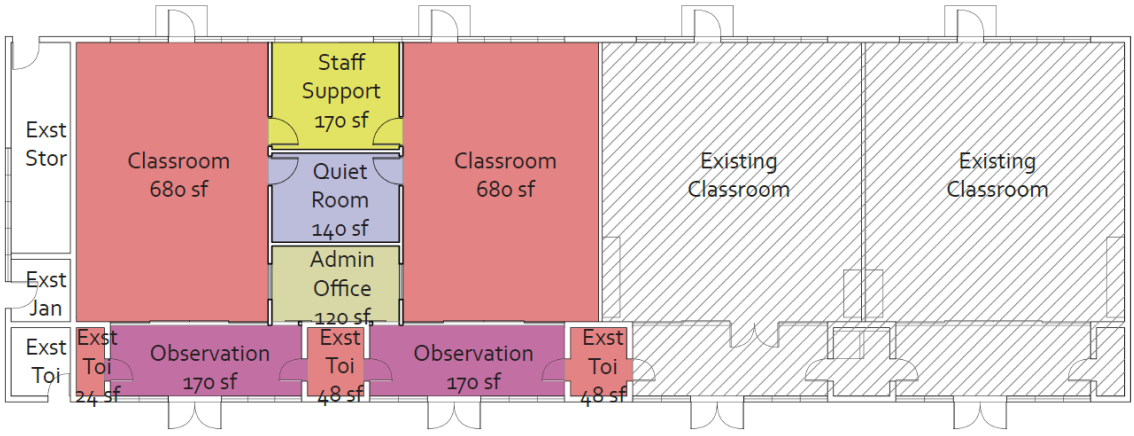
[114] (Map Data 2016)



Ground floor layout of building A and the two existing classrooms to which the School prototype will be applied.



Floor plan of the changes that would be made to the existing classrooms with the School prototype program spaces.



Floor plan of the final layout of the School prototype with a shared staff support room, a quiet room, and an administration office.

The School prototype consists of two classrooms with 42 square feet per child and 12 children per classroom, an administration office, a staff support room, a quiet room with a shower, a children's toilet, a janitor's closet, and an observation space for parents. Because the existing building already has a children's toilet, a janitor's closet, and an observation-type space, these will not be altered and are excluded from the estimated building cost. In the existing floorplan, both classrooms have direct access to the outside giving the program the potential of creating classroom gardens, as other grade levels do on campus. The School prototype is able to make use of many of the school's existing resources, including its outdoor facilities.

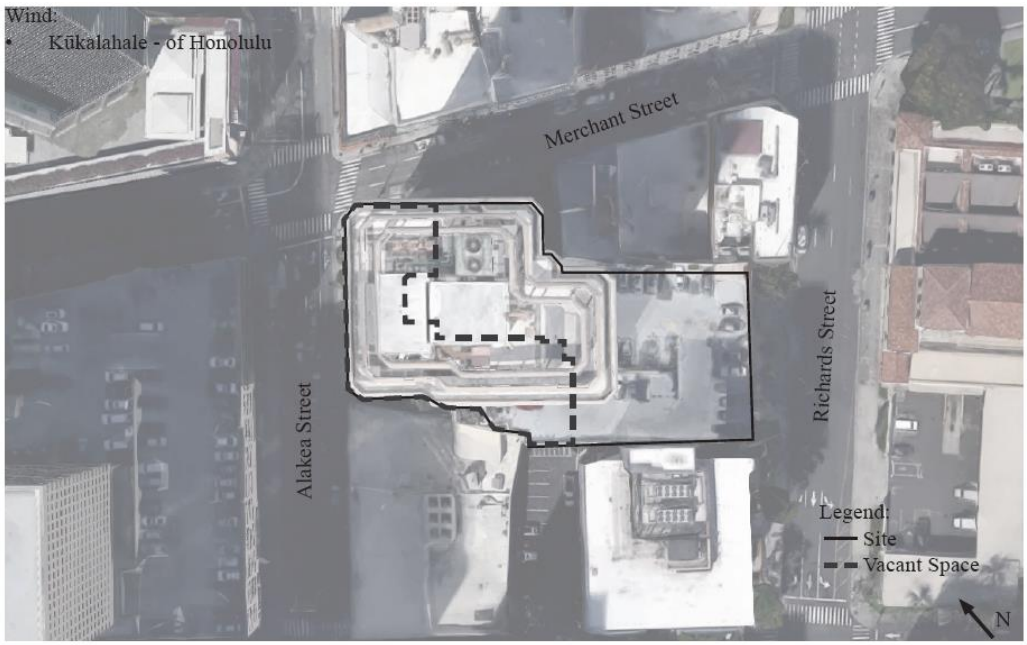
The cultural aspect categories, building symbolism and connection to the land, could not be incorporated into this prototype design. The classroom spaces could potentially accommodate culture-related activities, but are limited to the size of existing activity spaces within the classrooms. Because no changes are made to the exterior of the building with this prototype, it must therefore rely on the existing form for maintaining a connection to the land. Fortunately, both classrooms have direct access to the outside and the gardens. They also both have windows in the front and back, providing a visual connection to the outside and the possibility of cross ventilation. However, the building is not ideally oriented for the site's north-east wind direction, shown in figure 5.5.

Urban Prototype

When the Urban prototype program layout was applied to the preselected site, the City Financial building, adjustments needed to be made. Even though this program uses the minimum program option, the total program area is still larger than the given tenant space. Some program spaces were thus combined with other spaces. Using the Space Syntax program, the classroom sizes were reduced to align with the 35 square-feet-per-child minimum rather than the 42 square-foot minimum. Two spaces, the observation and facility storage spaces, were also eliminated. On the same floor of the building, another tenant space is available across from the designated space. Since it is a smaller space and is separated from the main area, the only appropriate program for this space would be one that caters to the parents and encourages their involvement. Since this

prototype is designed for working parents, the smaller separated space could be a program that is convenient to them, such as a yoga studio, a laundry service, a mini general store, or any other type of convenient service. For this prototype, a café may be the most appropriate choice (see figure 5.10).

Figure 5.10 Initial Design for the Urban prototype

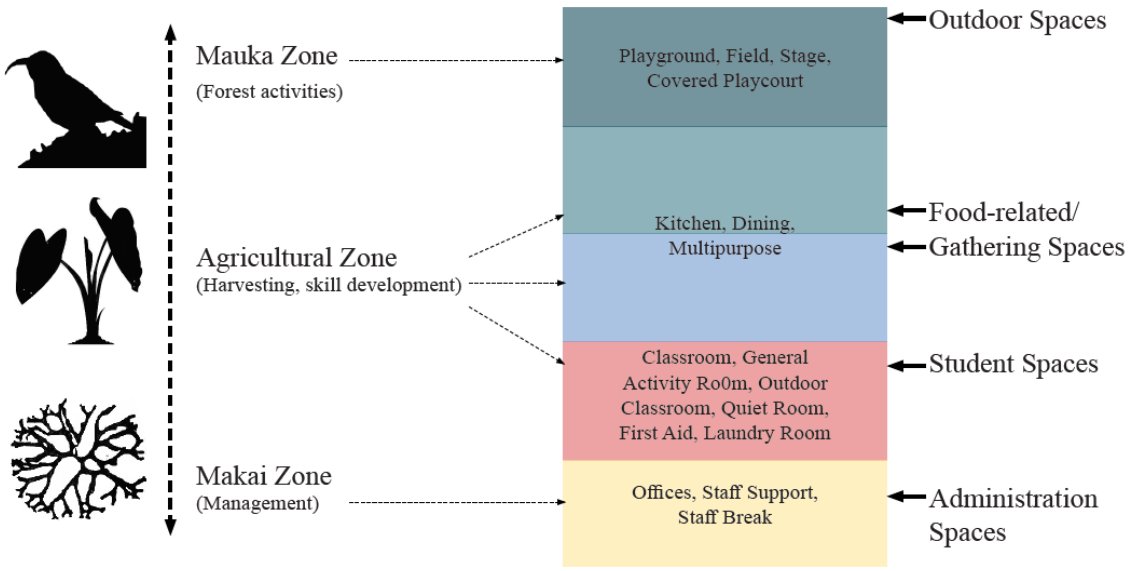


The map above shows the City Financial Tower and the size of the available space on the ground floor for the Urban prototype.

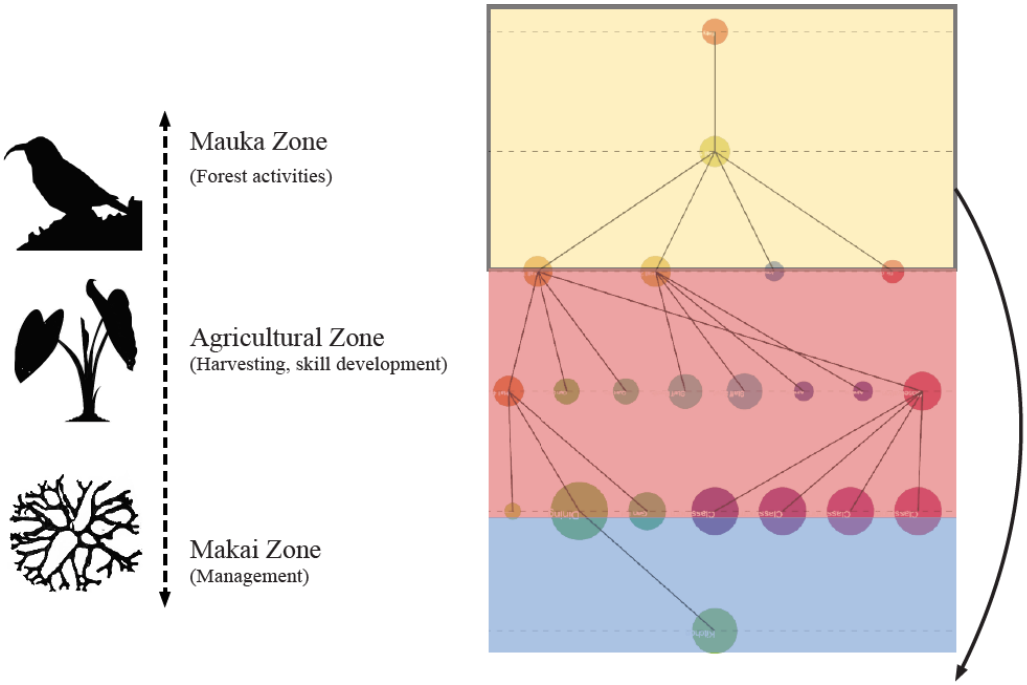
Floor plan of the initial layout in the available tenant space.

The Urban prototype includes more program spaces on a larger site than the School prototype. Similar to the School prototype, the Urban prototype cannot make changes to the exterior of the building, but does have an opportunity to apply cultural aspects in the design and layout of program spaces. As discussed in chapter four, program spaces can be arranged to reflect an ahupua‘a system; this was done for the Urban prototype, which was divided into three zones, the mauka, the agricultural, and the makai. For this prototype, the mauka zone, defined by forest activities, was assigned to the outdoor program spaces. The agricultural zone, defined by harvesting and skill development activities, was assigned to gathering spaces, food-related spaces, and other student spaces. Finally, the makai zone, defined by management, was assigned to administration spaces. Figure 5.11 illustrates how these zones are reflected in the layout of the Urban prototype and figure 5.12 shows the final layout for this prototype.

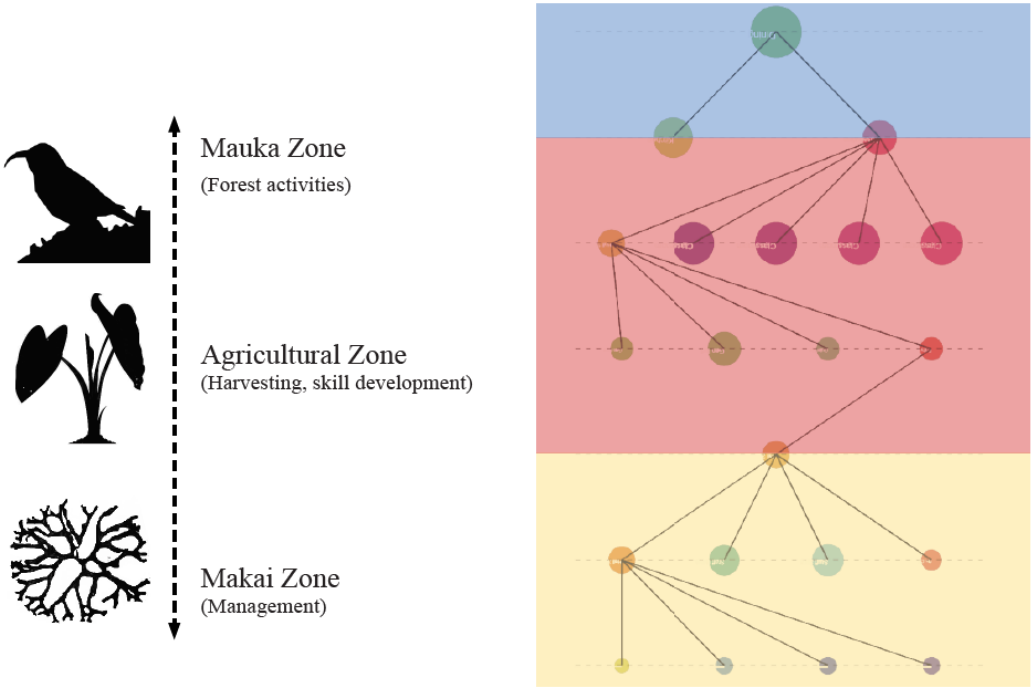
Figure 5.11 Applying ahupua‘a zones to the Urban prototype



The left half of the image shows the three zones of an ahupua‘a system as described by Minerbi. The right half lists the program spaces associated with each zone.

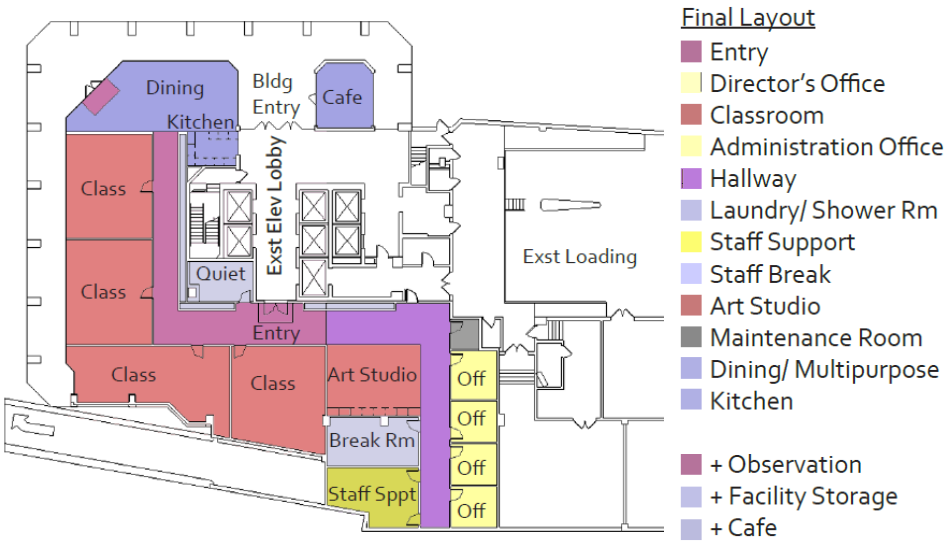


Here, the right half shows the initial program layout for the Urban prototype and the types of spaces. For the initial layout, the administration spaces are on the mauka side of the site. However, in order to follow the three zones, the administration spaces will need to move to the coastal side of the site.

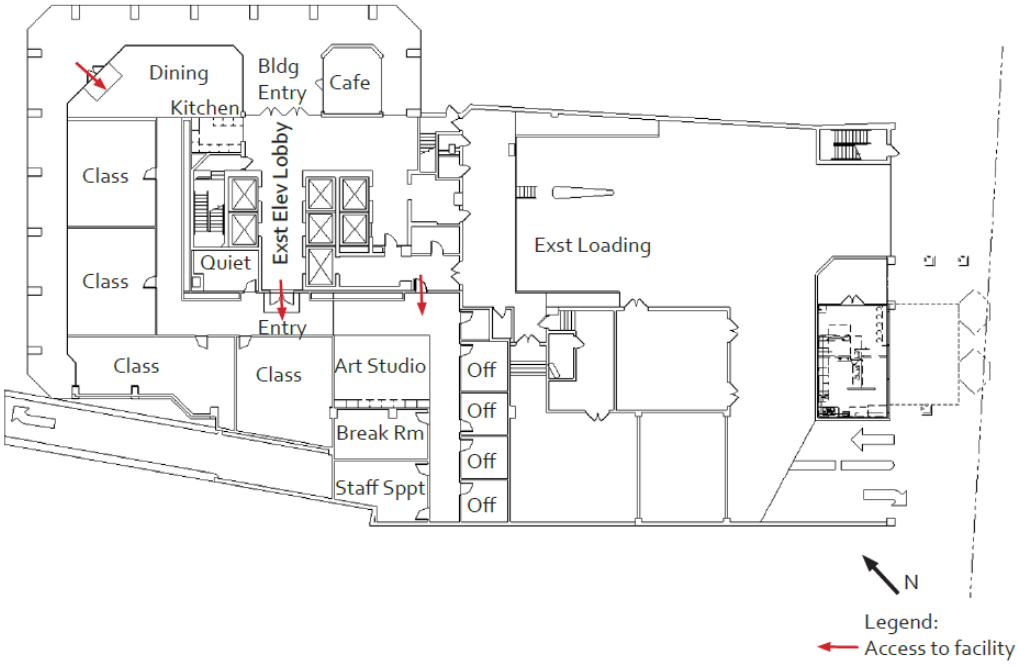


The program layout was rearranged in the Space Syntax program and now shows the administration spaces on the coastal side.

Figure 5.12 Final Design for the Urban prototype



Floor plan of the final layout of the Urban prototype after considerations were made for the three ahupua'a zones.



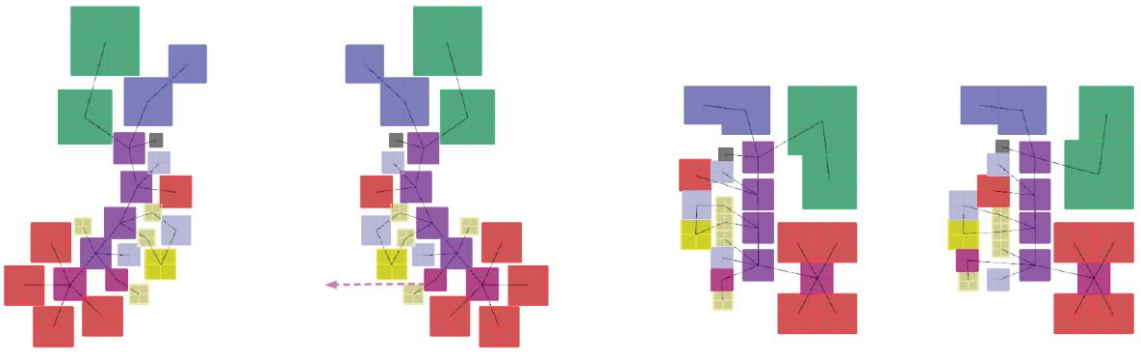
Floor plan of the access to the facility with the main entry from the existing elevator lobby. The total area of the Urban prototype is 5,944 square feet or about 6,000 square feet.

Community Prototype:

In figure 5.13, the Community program layout is applied to the site as a diagram in order to examine how the program fits the site and determine what kind of adjustments may be needed. The images show that the initial prototype layout needed to be changed in order to fit to the shape of the site and to fit within the property boundary. Though this is a new stand-alone building, there are still limitations to the size and arrangement of the facility. The final prototype layout is shown in figure 5.13 at the finished schematic design level. Figure 5.14 shows how cultural aspects are incorporated into the design.

Figure 5.13 Initial Design for the Community prototype

The map above shows the location of the Community prototype site along Liliha Street, next to the Liliha Public Library.



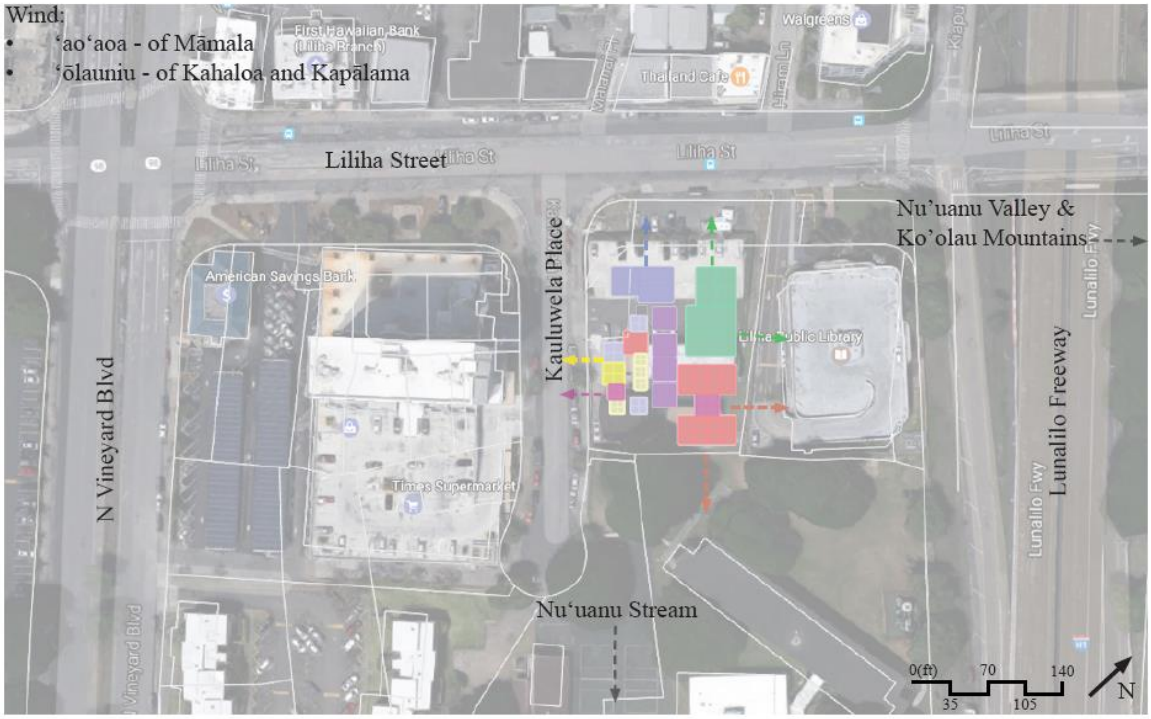
1. Original Layout

2.Mirrored to face entry to Kauluwela Place

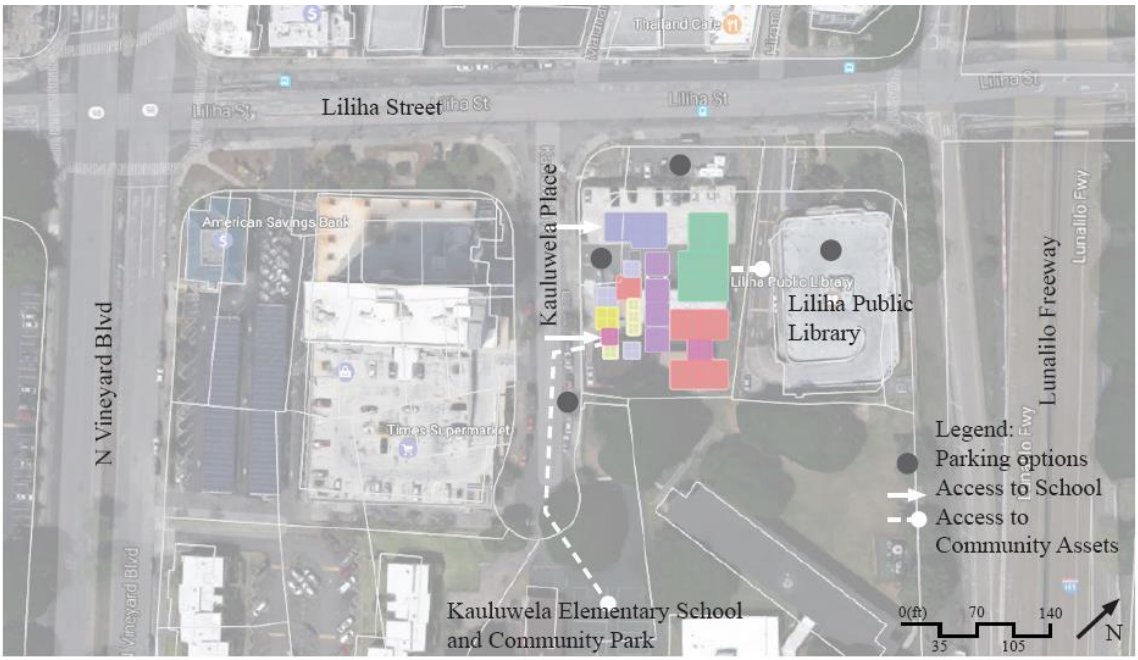
3.Condensed to fit in property

4.Modified for circulation

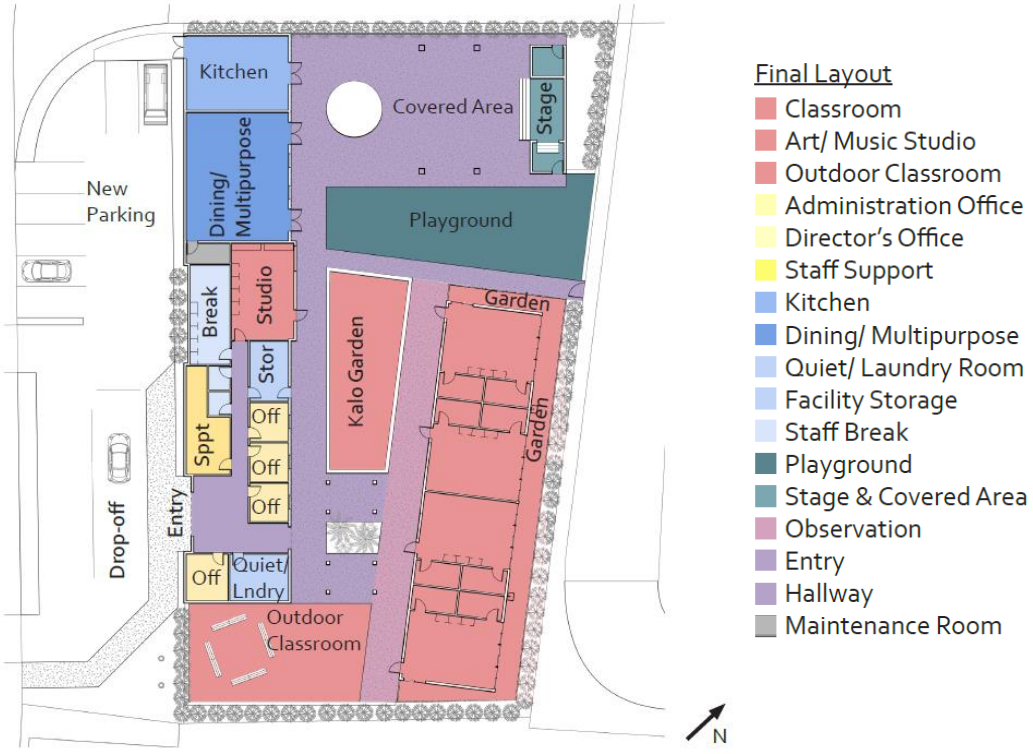
The diagrams above show how the initial layout is modified in order to fit within the site while maintaining circulation paths between program spaces.



Map of the modified layout applied to the site.

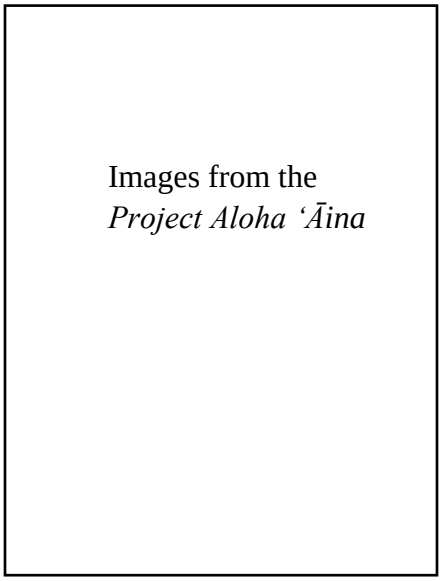


Map showing how the facility can be accessed and the potential adjacent community assets. Program spaces like a media room and some outdoor spaces could be removed if community assets can be included in the program.



Floor plan of the final layout of the Community prototype.

Figure 5.14 Cultural aspects for the Community prototype



The images above illustrate the history and legends of the site which are then translated into design elements and included in the cultural design idea chart below. Images and information are from *Project Aloha ʻĀina* [115]

Cultural Landscape Aspects	**Building Symbolism**	**Connection to the Land**	**Program Spaces**
Types of wind: ʻAoʻaoa – of Māmala (sea breeze)[116]	• Screens, façade design, or other patterning that reflects the description of the wind. • The building form as a whole reflects the description of the wind.	• Direction of the wind is considered in design for natural ventilation.	• Operable windows included for program spaces. • Certain program spaces designed to block wind like the outdoor covered stage area for hula or other performances or activities.
Natural features: Nuʻuanu and Kapālama Streams	• The building form reflects or mimics the flow of the stream.		
Natural features: Kalo gardens	• The building form reflects the kalo terraces that was once seen throughout Kapālama and Kalihi.	• Implementation of a kalo garden in the school as a connection to the Loʻi Kalo Mini Park and the Garden of Niuhelewai.	• Implementation of dryland kalo in the outdoor classroom or other outdoor space for activities relating to the harvest and preparation of kalo.
Natural features: Kapālama ahupuaʻa	• The building form as a whole becomes a small-scale representation of the entire Kapālama ahupuaʻa.	• Landscaping reflects the commonly found native plant	• Special consideration is taken for selection of plant species in order to attract certain native

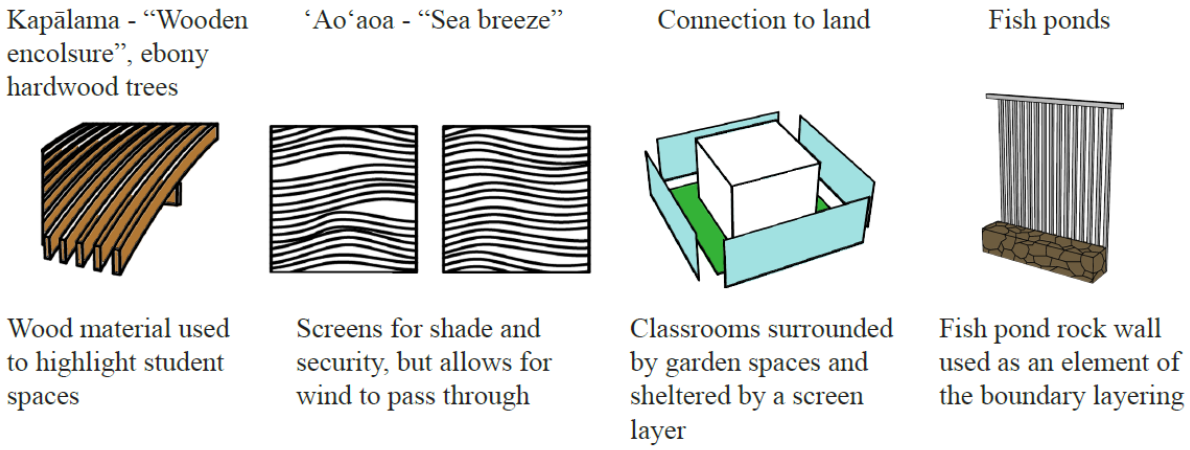
[115] (ʻĀina 2007)

[116] (Winds and Rains of Hawaii n.d.) (Ulukau Hawaiian Electronic Library 2004)

	• Building materials and form reflect the place name – wood enclosure, ebony, hardwood trees with small flowers and fruits.[117]	species in the Kapālama.	bird and insect species as part of the early education program. • Program spaces renamed to reflect areas within the Kapālama.
History and Legends: Haumea	• The building form represents the stories of Haumea or other stories regarding Kapālama • Wall space is left open for murals to depict stories or the history of Kapālama. • Building materials and finishes reflect the history of the land or the Hawaiian culture.	• Landscaping reflects the kalo terraces and fish ponds once seen in Kapālama.	• Consider if a special program space is needed to dedicate to learning about the history of the land and culture. • Program spaces renamed to reflect aspects of history or legends.

1The map above shows the location of the Community prototype in respect to the kalo garden at the Honolulu Community College and Lo'i Kalo Park.[118] The Community prototype could incorporate the historical connection to the site, which was once fruitful with kalo terraces and fishponds, and include a kalo garden.[119]

[117] (Ulukau Hawaiian Electronic Library 2004)
[118] (Map Data 2016)
[119] ('Āina 2007)



Illustrations of the design ideas in the cultural chart that are implemented in the design of the Community prototype.[120]

Part of creating culturally-sensitive designs is the inclusion of outdoor spaces that are adequate for certain activities. The cultural aspects included in the Community prototype are a kalo garden, which provides connection to other nearby gardens and represents the history of the land, as well as the incorporation of the tropical climate through building orientation, cross ventilation, and natural sunlight (see figure 5.15). Figure 5.15 shows a site plan of the final Community prototype design. The wind specific to the Kapālama ahupua'a is integrated into the prototype through the design of the screens that surround the classrooms, shown in figure 5.16. A rock wall element, reminiscent of the fishponds mentioned in the site's history, surrounds the outdoor facilities. Wood material is used to symbolize the name meaning of the Kapālama ahupua'a and also to differentiate the student program spaces.

In order to further develop the Community prototype, a 3-D model was created using Revit. Figure 5.16 shows images of the model. This design development level can help the client to better visualize what the school will look like.

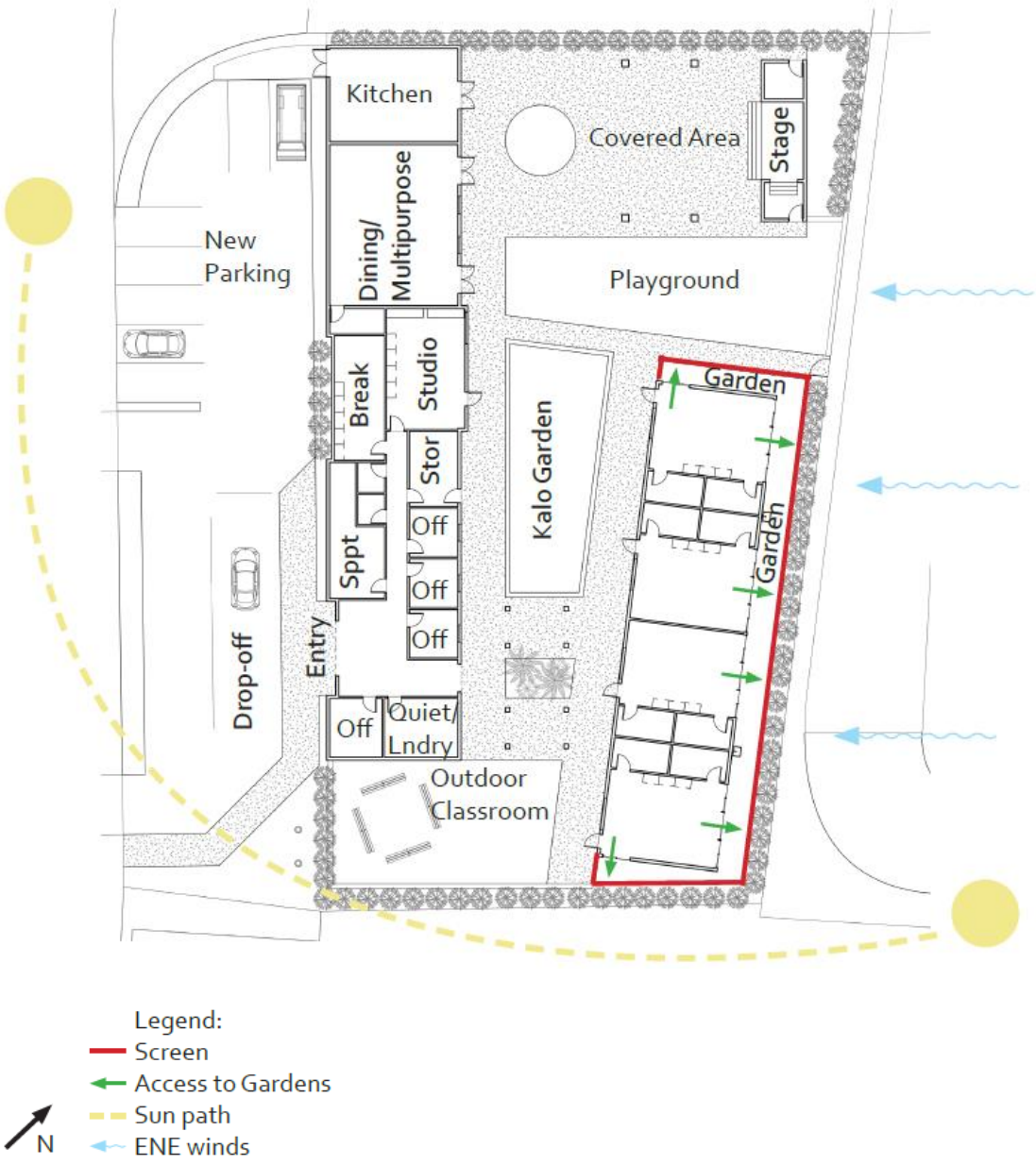
Shared program spaces are also a part of the Community prototype design. The covered stage area, the dining and multipurpose room, and the kitchen can be shared with

[120] (Ulukau Hawaiian Electronic Library 2004) (Winds and Rains of Hawaii n.d.)

the community. These spaces are grouped together on the Liliha Street side of the facility and can be accessed from the Liliha Public Library entry to the facility. Including shared spaces like this can encourage community involvement in the school.

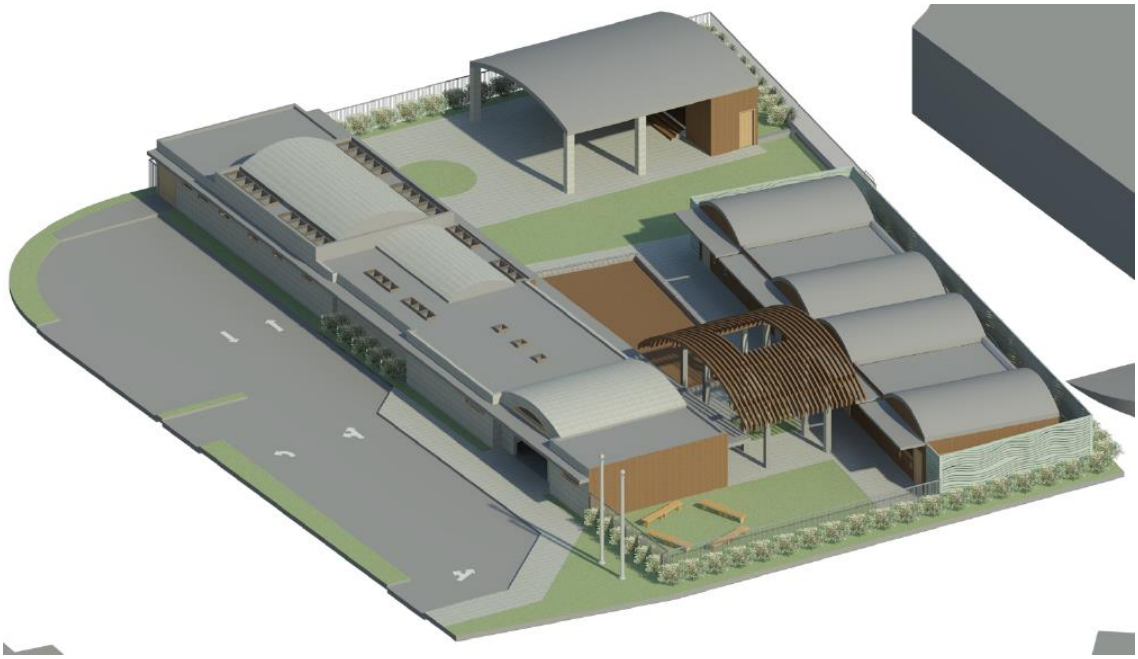
Figure 5.15 Final Design for the Community prototype

Site Plan: Access to the facility is from Kauluwela Place into the drop-off area or from the Liliha Public Library where parking in located on the roof, accessed from Liliha Street, and stairs leads to the ground floor and the playground side entry to the facility. There is also an existing parking area behind the bus stop along Liliha Street.

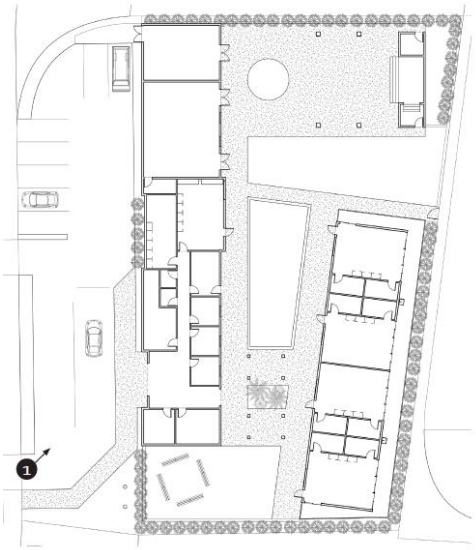


The final floor plan for the Community prototype. The location of the patterned screen and the access to the gardens from the classrooms are highlighted.

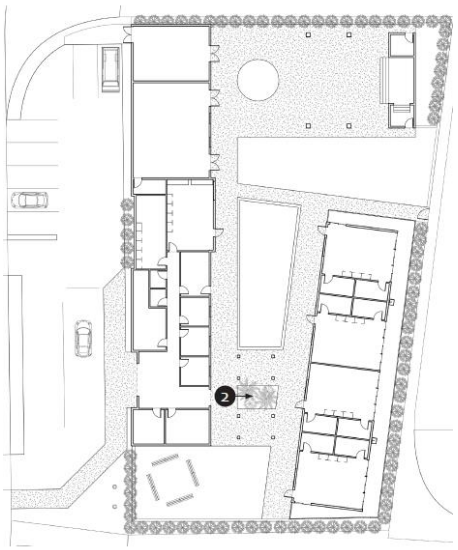
Figure 5.16 Images of the Community prototype



Aerial view of the Community prototype. The curved roofs signify the entry to the school and the student spaces while also adding a softer element to the rectilinear shapes of the buildings. Skylights are provided for the dining and multipurpose room, the art and music studio, the teacher's break room, and the hallway between the administration spaces. The wood curved trellis is used to highlight the courtyard type space between the entry and the classrooms and serves as the observation program space. Following are a series of images of the prototype (right) and the location of these images on the floor plan (left).

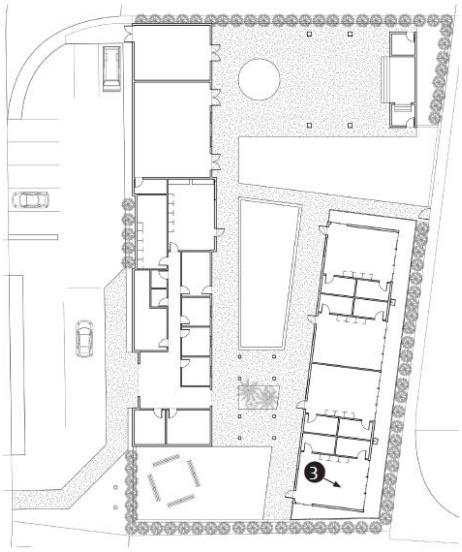


View of the drop-off and entry to the Community prototype from Kauluwela Place.



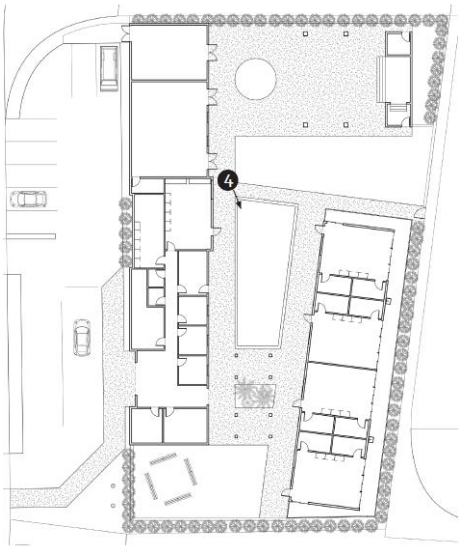
Classrooms

View of the courtyard and observation space before the classrooms.



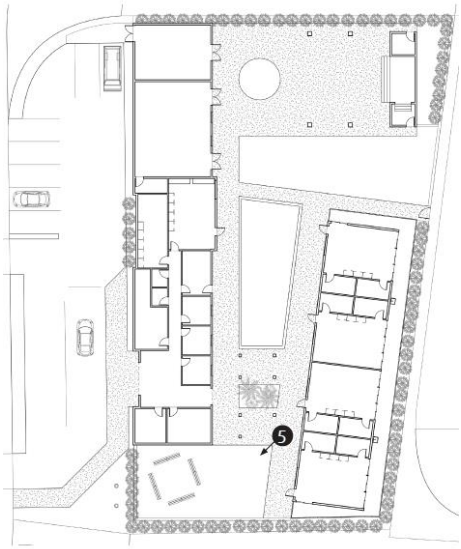
Classrooms

View of the interior of the classrooms showing a vaulted ceiling and a series of sliding doors on the garden side of the room. This provides full access to the garden, allows for natural ventilation, and admits sunlight into the classrooms. Beyond the sliding doors is the patterned screen representing the wind which acts as a boundary around the classrooms while still allowing wind to pass through.



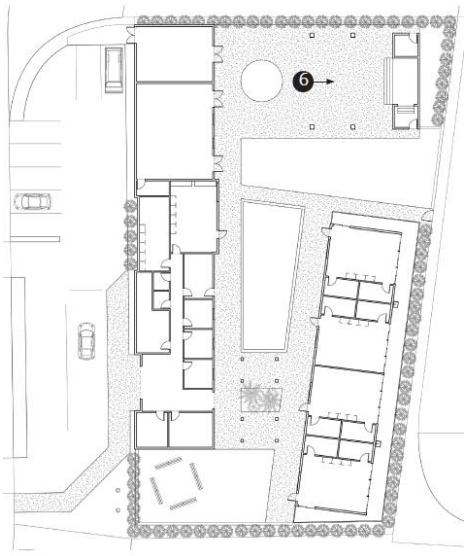
Classrooms

View of the kalo garden between the administration spaces and the classrooms. The kalo garden becomes the center of the Community prototype.



Outdoor Classroom

View of the outdoor classroom adjacent to the Kauluwela Elementary school and the Community park. The outdoor classroom and playground area are surrounded by a rock wall element layered with a six-foot-tall fence.



Stage and Covered Area

View of the covered outdoor stage with the Liliha Public Library in the background. This area can be used for outdoor play, performances, or various cultural activities that require more room than what is provided in the classrooms.

Financial Models

School Prototype

The cost of the School prototype was determined based on the cost of converting elementary school classrooms into a functional preschool space. According to the "Hawai'i Educational Specifications for Elementary Schools," a typical classroom size is about 980 square feet.[121] The estimated cost per classroom ranges from $80,000 to $104,000 depending on the location of the facility.[122] This gives a range of about $80 to $100 per square foot.

The minimum program School prototype has a total area of about 2,250 square feet and occupies two existing classrooms. The cost to convert these classrooms is estimated to be between $180,000 and $225,000. Figure 5.17 shows a comparison of cost and number of elementary school classrooms needed for a preschool program.

[121] (Educational Specifications (EDSPECS) For Elementary Schools 2008)
[122] (Hawaii State Department of Education 2008)

Figure 5.17 Financial Model for the School prototype

Type of Facility	**Area (sf)**	**No. Existing Classrooms Needed**	**Estimated Total Cost ($80/sf - $100/sf)**
Large Group Area Small Group Area Homeliving/ Food Prep Area Technology Area Restrooms (2) Shower/ Changing Room Laundry Teacher Station	500 400 200 60 140 60 80 120		
Total	1,560	1.5	$124,800-$156,000
Small fully self-contained classroom	1,240	1.2	$99,200-$124,000
Large fully self-contained classroom	1,880	2	$150,400-$188,000
School prototype	2,250	2.2	$180,000-$225,000

Data from the Hawai'i State Department of Education, *Educational Specifications (EDSPECS) For Elementary Schools*. The row entitled School prototype indicates the program spaces used for the prototype shown in figure 5.9.

Urban Prototype

To determine the cost of the Urban prototype, the tenant improvement cost financial model was used. The total area of the Urban prototype is about 6,000 square feet after eliminating some program spaces, making adjustments to others, and adding the café. Using the dollar-per-square-foot range of $80 to $120, the estimated total possible cost of the Urban prototype falls between $480,000 and $720,000. However, this does not include the monthly rental cost for occupying a tenant space in an existing office building.

Community Prototype

To determine the cost of the Community prototype, the new construction financial model was used. The total area of the Community prototype is about 17,300 square feet which includes the additional outdoor program spaces and other space adjustments. Using the dollar-per-square-foot range of $400 to $510, the estimated total possible cost of the Community prototype falls between $6,920,000 and $8,823,000. Figure 5.18 compares this prototype cost to the projects that the dollar-per-square-foot range was based on.

Figure 5.18 Financial Model for the Community prototype

Type of Facility	**Total Area (sf)**	**Estimated Total Cost**
2 portables for preschool[123]	1,520	$600,000
8-classroom elementary school building[124]	13,000	$6,000,000
Full elementary school[125]	78,404	$40,000,000
Community prototype	17,300	$6,920,000-$8,823,000

The row entitled Community prototype indicates the program spaces used for the prototype shown in figure 5.13.

[123] (Waikiki Elementary School Mindful Learning Center n.d.)
[124] (Belt Collins Hawaii LLC 2013)
[125] (Hawaii State Department of Education 2015)

CHAPTER 6. EVALUATION

The facility design guidelines (see Appendix) are intended to be used throughout the design process, including at the end for the evaluation of the facility design to ensure its quality. It is also important to review the original goals set at the beginning of the process to ensure they were met and were not lost in the process.

Were these goals met? Do the program spaces reflect the goals? Do the chosen sites match the goals? These are all questions to consider. If a design aspect does not reflect the goals, then it should be reviewed and possibly adjusted.

Figure 6.0 is a summary of the design methodology applied to the three prototypes and the results of each design methodology section. It states the goals for each prototype and the number of students and age group designed for. Ideal program spaces (with consideration for the setting of each prototype) are listed before the program layout and the final design section lists the program spaces that were included. Cultural aspects from the site analysis and aspects used in the final design are also listed in the summary.

Figure 6.0 Detailed summary of prototypes

Methodology Process	**School Prototype**	**Urban Prototype**	**Community Prototype**
Goals	To fit within the existing state public school system, to expand on a state-funded preschool program, and to encourage interaction between grade levels.	For the benefit of working families in terms of convenience and accessibility and to anticipate the increased urbanization of certain areas.	Community setting prototype: For the benefit of the community, to bring together community organizations and to incorporate existing resources, and to improve education levels as a state.
Age group	3-4 years	3-4 years	3-4 years
No. of Classes	4	4	2
Students per classroom	12	12	12
Student to teacher ratio	1:7	1:7	1:7
Program Activities	(See corresponding program activities list)	(See corresponding program activities list)	(See corresponding program activities list)
Program Spaces	• Classroom • General Indoor	• Classroom • General Indoor	• Classroom • General Indoor

	• Non-Assignable Space • Observation • Entry • Quiet Room/ First Aid • Classroom Storage • Classroom Toilet • Laundry/ Shower Room • Staff Support/ Storage • Administration Office • General Outdoor	• Indoor Multipurpose Room • Media Lab • Observation • Entry • Quiet Room/ First Aid • General Facility Storage • Classroom Storage • Classroom Toilet • Laundry/ Shower Room • Serving Kitchen • Serving/ Dining Area • Café • Staff Support/ Storage • Reception • Administration Office • Director's Office • Staff Break/ Toilet • Conference Room • Maintenance Room • General Outdoor	• Non-Assignable Space • Indoor Multipurpose Room • Media Lab • Observation • Entry • Quiet Room/ First Aid • General Facility Storage • Classroom Storage • Classroom Toilet • Laundry/ Shower Room • Serving Kitchen • Serving/ Dining Area • Staff Support/ Storage • Reception • Administration Office • Director's Office • Staff Break/ Toilet • Conference Room • Maintenance Room • General Outdoor • Playground • Covered Playcourt • Stage, Storage, and Toilets • Open Play Field • Outdoor Multipurpose Room
Program Layout	Space Syntax program layout	Space Syntax program layout	Space Syntax program layout
Site Considerations: Site Analysis	• Urban Land Use • Existing and potential elementary schools • Views and Orientation • Natural Features • Climate Analysis • Community Assets	• Urban Land Use • Demographic Study • Views and Orientation • Natural Features • Climate Analysis • Zoning • Community Assets	• Urban Land Use • Demographic Study • Views and Orientation • Natural Features • Climate Analysis • Zoning • Community Assets
Site Considerations: Cultural Landscape Analysis	• Waikīkī ahupuaʻa • Waikīkī area as former marshland • Near Māmala Bay and Diamondhead • Kūkalahale wind	• Honolulu ahupuaʻa • Near Honolulu Harbor, Punchbowl, and Nuʻuanu stream • Kūkalahale wind	• Kapālama and Kalihi ahupuaʻas • Kalihi site near Kalihi stream and Honolulu Forest Reserve • Kapālama site near Honolulu Harbor, Nuʻuanu stream, and Kapālama stream • Kalihi site: Haupeʻepeʻe wind and Ua Poʻo Lipilipi rain • Kapālama site: ʻaoʻaoa wind and ʻōlauniu wind

Site Considerations: Site Evaluation	• Waikīkī Elementary school site chosen for the prototype facility	• Downtown site in an existing office building chosen for the prototype facility	• Kalihi site total score: 58% fulfillment for an ideal site • Kapālama site: 72% fulfillment for an ideal site • Kapālama site chosen for the prototype facility
Final Design: Program Spaces	• Classroom • Observation • Quiet Room/ First Aid • Classroom Storage • Laundry/ Shower Room • Staff Support/ Storage • Administration Office	• Classroom • General Indoor: Art Studio • Indoor Multipurpose Room • Entry • Quiet Room/ First Aid • Classroom Storage • Classroom Toilet • Laundry/ Shower Room • Serving Kitchen • Serving/ Dining Area • Café • Staff Support/ Storage • Administration Office • Director's Office • Staff Break/ Toilet • Maintenance Room	• Classroom • General Indoor: Art/ Music Studio • Indoor Multipurpose Room • Observation • Entry • Quiet Room/ First Aid • General Facility Storage • Classroom Storage • Classroom Toilet • Laundry/ Shower Room • Serving Kitchen • Serving/ Dining Area • Staff Support/ Storage • Administration Office • Director's Office • Staff Break/ Toilet • Maintenance Room • General Outdoor • Playground • Covered Playcourt • Stage, Storage, and Toilets • Outdoor Multipurpose Room • Kalo Garden • Classroom Gardens
Final Design: Program Layout	Space Syntax program layout applied to existing building A site: • Use of existing toilets, observation space, and janitor closet • Dividing existing classrooms into new classrooms with shared spaces in between • Existing access to outside from classroom allows for classroom garden opportunities	Space Syntax program layout applied to existing tenant space: • Revised program layout to reflect three ahupua'a zones • Administration spaces to move to the makai (ocean) side of the facility • Space Syntax program layout revised to show the moved administration spaces • New main entry to facility from the existing elevator lobby	Space Syntax program layout applied to property along Kauluwela Place and Liliha Street: • Revised program layout to better fit the site • Main entry along Kauluwela Place • Secondary entry from the Liliha Public Library • Classrooms rearranged to allow for more natural ventilation and light in the spaces • Community, shared spaces grouped on the Liliha Street side of the facility • Administration spaces grouped on the Kauluwela side of the facility

		• Secondary entry to facility from the street	• Drop-off and some parking incorporated into site design
Final Design: Cultural Aspects	• Consideration for program activities in selection of program spaces • Cultural aspects to relate with theme of elementary school	• Consideration for program activities in selection of program spaces • Program layout to reflect ahupua‘a zones	• Consideration for program activities in selection of program spaces • Legends regarding Haumea and the Kapālama Valley • Connecting to kalo gardens in the surrounding area • Inclusion of gardens, outdoor classroom, and outdoor stage area in program spaces for various outdoor activities • Considerations for wind direction and sun path in selection of window, shading, and openings placement • Opening up classrooms to classroom gardens while allowing for wind and sunlight to enter the space • Dark wood material to represent Kapālama place name meaning, used to highlight student spaces • Screen boundary symbolizes ‘ao‘aoa wind • Layering boundary symbolizes fishponds
Final Design: Community Aspects	• Near various park spaces, historic sites, Kapiolani Community College, Honolulu Zoo, and the Waikīkī Aquarium	• Near various community organizations for youth and families, ‘Iolani Palace, State of Hawai’i Legislature, theaters, and art museums • Inclusion of indoor multipurpose room as a shared space with the community • Secondary entry from the street side for access to facility after school hours	• Near various community organizations for youth and families, Liliha Public Library, Kauluwela Elementary School and community park • Inclusion of kalo garden to connect to Lo‘i Kalo Park and Garden of Niuhelewai • Inclusion of indoor multipurpose space, kitchen, and outdoor stage area as shared spaces with the community • Secondary entrance from the Liliha Public Library side for access to facility after hours

Prototypes

Summary

The School prototype was successful in the application of the minimum suggested program spaces to the existing elementary school site. It was designed to occupy two classrooms and was able to eliminate some costs by making use of existing facilities such as the children's toilets and janitor's closet. The School prototype demonstrates a quick-study method of reviewing existing elementary schools for the possible future implementation of early education classes or programs. The School prototype was unable to integrate new cultural aspects into the design because it relies on the existing building shell and has too few program spaces to arrange in any significant way. The cultural aspects integrated into the design of a prototype in this kind of setting will most likely rely on the existing school's selection of interior materials and finishes and general theme in order for the program to fit within the school.

The Urban prototype was successful in the application of the minimum suggested program spaces to a site located in a high-density, urban environment. The prototype was designed for an office building, convenient for parents who work in or within walking distance of the building. The prototype was successful in providing a variety of program spaces for an early education facility including classrooms, a dining space, a kitchen, studio space, and different spaces for teachers. This prototype also demonstrated how to apply cultural aspects to the design through program space and program layout. While the School prototype could only accommodate culture-related activities in the classrooms, the Urban prototype demonstrated that culture can also play a role in the layout of the program spaces. This was accomplished by researching aspects of Hawaiian culture related to the ahupua‘a system and translating these into activities and design elements that could represent or symbolize various aspects of the ahupua‘a zones. In this case, certain program spaces and their related activities were designated to each zone and arranged appropriately.

One of the goals for the Urban prototype was to anticipate the increasing urbanization of certain areas. This prototype demonstrates that the design methodology can be used to study early education facilities in high-density environments or within

high-rise buildings. If more school facilities are planned for environments such as downtown O‘ahu, it would be beneficial to conduct further research to determine limitations and possibilities for such programs. For the Urban prototype, there was no available outdoor space. The importance of incorporating outdoor facilities was discussed in chapter three, not only from the standpoint of educational facility design but also from the perspective of Hawaiian culture. For future studies, it would be beneficial to find ways of providing outdoor spaces for urban settings, perhaps by repurposing parking lots or the rooftops of parking structures.

The Community prototype was a successful design for a new standalone facility that used the minimum suggested program spaces. This prototype had a greater number of program spaces and larger program space sizes than the other prototypes, but was still able to meet the facility design guideline recommendations with the assistance of the space syntax program. The program layout needed to be adjusted when applied to the site, which displayed an understanding of site conditions, climate analysis, and facility circulation. The design process for the Community prototype also exhibited ways of eliminating certain program spaces that could be replaced with existing community assets as well as ways of incorporating shared multi-use spaces for community programs.

The Community prototype was used to demonstrate several ways of applying cultural aspects to the design. Site research was organized in a design idea chart, divided into the three categories (building symbolism, connection to the land, and program space), and then applied to the design. Since the Community prototype is a new facility, design ideas relating to building symbolism were able to be applied. There was also a greater flexibility for application of methods that maintain a physical and cultural connection to the land; these methods include aspects such as building orientation for ventilation and sunlight, facility openings onto outdoor spaces and gardens, and placement of certain elements that reflect the culture. The Community prototype, as new construction, was able to be much more responsive to the environment and integrate cultural aspects than the Urban and School prototypes, which were renovation or interior-alteration projects.

Cost Comparison

A cost comparison of the three prototypes is shown in figure 6.1. The total estimated building cost of the School prototype fell between $180,000 and $225,000. The build that is most similar in design and cost is the first "2 Portables for preschool" project, which cost about $600,000 to build. The portables are part of a new separate building on an elementary school campus. They include two classrooms, a full kitchen, office space, a meeting room, storage space, and a janitor's closet and shower. The School prototype was applied to an existing building with no changes made to the exterior and consists of two classrooms, an office, staff support and storage spaces, a quiet room with a shower, and an observation space. The School prototype does not include a kitchen but makes use of the existing janitor's closet and toilets for children, which were not included in the cost. Therefore, the School prototype demonstrates the cost savings of incorporating an early education program into an existing elementary school building.

The estimated building cost of the Urban prototype fell between $480,000 and $720,000. The build that is most similar is again the "2 Portables for preschool" project even though they differ in types of program spaces provided. The Urban prototype was able to include the same program spaces as the School prototype as well as additional spaces such as a dining and multipurpose room, a kitchen, four offices, and other staff support spaces. In addition, the Urban prototype was designed to accommodate four classes of twelve students each while the School prototype was designed for only two classes of twelve students each. The estimated cost of the Urban prototype is almost the same as the two portables project but includes more program spaces. This could be due to the same reason the School prototype costs significantly less than the portables project—namely, interior alteration projects generally cost less than new construction projects. It is important to note, however, that monthly rental costs are not included in the estimate for the Urban prototype. This is an example of a situation where additional costs, beyond the estimated building cost from the financial models, should be considered.

The estimated building cost of the Community prototype fell between $6,920,000 and $8,823,000. The build that is most similar is the "8-Classroom elementary school building" project, which cost about $6,000,000 to build. This elementary school building includes the eight classrooms, a conference room, a science room, and a special education room. While the Community prototype only has four classrooms, it also includes an art and music studio, an indoor multipurpose space, a kitchen, an outdoor stage, a playground, gardens, and several administration spaces. The Community prototype may not have as many classrooms, but includes more program spaces for students and teachers. The Community prototype could also be a fully functioning standalone school while the eight-classroom elementary school building is a part of a school and uses existing school resources. In comparison to the cost of building a full elementary or preschool, the Community prototype's estimated cost is lower. This could be because certain program spaces were eliminated in order to make use of community assets or because the number of students it provides for is lower than the schools being compared. The Community prototype shows that a fully functioning early education facility can be provided at a lower cost than other facilities by taking into consideration number of students and existing community assets.

Figure 6.1 Cost Comparison for all prototypes

Type of Facility	**Total Area**	**Estimated Building Cost**
2 portables for preschool[126]	1,520 sf	$600,000
8-classroom elementary school building[127]	13,000 sf	$6,000,000
Full elementary school[128]	78,404 sf	$40,000,000
School prototype	**2,250 sf**	**$180,000-$225,000**
Urban prototype	**6,000 sf**	**$480,000-$720,000**
Community prototype	**17,300 sf**	**$6,920,000-$8,823,000**

The total size and estimated cost for the three prototypes are shown here. Total size and estimated costs of also recent projects are also listed for comparison.

[126] (Waikiki Elementary School Mindful Learning Center n.d.)
[127] (Belt Collins Hawaii LLC 2013)
[128] (Hawaii State Department of Education 2015)

Methodology

The design methodology provided by this dissertation can be used effectively for both quick studies of early education programs in existing buildings and for more in-depth studies of new, standalone facilities, as demonstrated with the three prototype designs. One of the advantages of this methodology is its flexibility of application in different settings and for different facility types. At the base of this methodology is the list of program activities and spaces, which is intended to be continually updated. The list allows the designer or client to choose from a variety of activities and add any that would fit an early education program. Another advantage of this methodology is that it emphasizes research of the specific project site. Site selection and cultural elements depend on site research; the research, in turn, can help in creating a physical and spiritual connection between the school and the site. These types of considerations for early education facilities in Hawai‘i are not emphasized enough. As seen in this dissertation and the precedent studies in chapter three, high quality and successful early education facilities are the result of thorough research on design standards, the project site, and an understanding of the needs of the potential occupants.

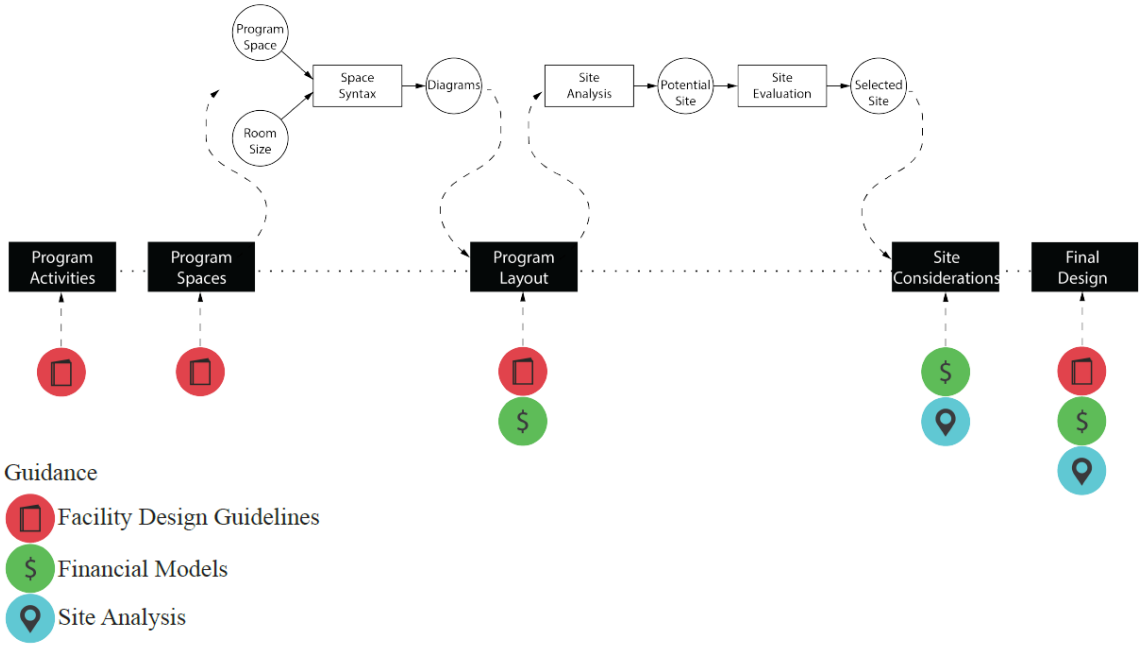
This design methodology also provides a process for integrating cultural aspects into the design of early education facilities. This starts at the beginning of the process with the creation of the list of program activities, which includes culture-related activities, and spaces, as mentioned above, which is one way in which culture can be rooted in the design. Another way is through cultural landscape research which considers climate, current surroundings, and history of the land. The cultural ideas chart lays out many ways in which cultural aspects can be implemented in the design. However, continued research should be conducted to further explore ways to appropriately integrate culture and design. This is especially important for the School and Urban prototypes in which outdoor spaces and changes to the exterior of existing buildings were limited. The Urban prototype did, however, demonstrate a way to create a cultural connection by arranging program spaces to reflect the ahupua‘a system. The integration of culture in the design of early education facilities has two purposes: to create culturally-sensitive schools and to affect and connect the learning experiences of the students to the place.

The design of a building can be an educational tool, a starting point from which students can learn about the history and culture of Hawai‘i.

The purpose of this dissertation was to provide an early education program design methodology that creates an ideal learning environment, establishes connections between the school and the community, and emphasizes the importance of establishing a strong learning foundation for Hawai‘i's youth. The prototypes have shown that this methodology can lead to early education facility designs for a variety of settings. The site analysis section and list of program activities and spaces together offer methods of connecting the school with the surrounding community through elements such as the inclusion of shared spaces for community use, the implementation of design aspects that reflect an understanding of the history and culture of the site and surrounding area, and the selection of a site near existing community assets that can be used by the school. Studies reviewed in chapter one show that participation in early education can lead to higher rates of success later in life. If early education can be considered the foundation of learning and future success, then special care must be taken to ensure the quality and accessibility of such facilities. As Hawai‘i continues to evolve, education should evolve with it to fit the needs of the youth in the present and the future.

APPENDIX

Design Methodology for Early Education Facilities



Design Methodology for Early Education Facilities

Early Education Facility Guidelines[129]

Design guidelines are based on general concepts and requirements from several references for the design and improvement of early education facilities. Concepts and design aspects are organized by occupant type perspectives and fall under certain program spaces. The Facility Design Guidelines, listed in the chart below, are for application in future early education projects. This is not a complete list and should be added to and updated over time.

[129] (American Academy of Pediatrics 2011) (Educational Specifications (EDSPECS) For Elementary Schools 2008) (Hawaii State Department of Education 2016) (Perkins and Bordwell 2010) (Ka Hei 2016) (Tanner, The influence of school architecture on academic achievement 2000) (Barrett, Zhang and Barett, A child's eye view of primary school built environment 2011) (Uline and Tshchannen-Moran 2008) (Woolner, et al. 2007) (NYC Department of Health and Mental Hygiene 2009) (Evans 2006) (Playthings 2016) (Marilyn A. Read 2009) (NCES National Center for Education Statistics 2006)

Facility Design Guidelines

Perspective	General Concepts	Classroom Facilities	Office Facilities	Special Use Facilities	General Use Facilities	Circulation Area
Designer	Occupants: Include faculty, students, and the community in the design of the school.	• Program spaces: (NHSPS) ○ General indoor classroom = 42sf/ child, 50sf/ child preferred ○ Activity Spaces within Classroom (for 2-5 children and 1 instructor) = 40-60sf each • Program spaces: (Building Basics) ○ Activity/ Classroom = 42sf/child ○ Nonassignable space = 20sf/child ○ Classroom restrooms for children = 80sf ○ General indoor classroom = 35sf/ child minimum ○ General outdoor space = 75sf/ child • No. of toilets and sinks per classroom per group size: (NHSPS) ○ Ages 13-35 mo. with <10 per class = 1 sink and 1 toilet	• Program spaces: (Building Basics) ○ Staff support/ storage = 38sf/child ○ Administration Office = 120 sf ○ Director's office = 160sf ○ Conference room = 200sf	• Program spaces: (DOE) ○ Media Lab = 1,200sf • Program spaces: (Building Basics) ○ Art Studio with kiln = 500sf ○ Art Storage = 60sf	• Program spaces: (DOE) ○ Serving kitchen = 905sf ○ Serving/ dining area = 975sf ○ Indoor Multipurpose room = 1,000sf ○ Covered playcourt = 6,912sf ○ Stage, storage, and toilets = 1,240sf ○ Playground = 2,000sf • Program spaces: (Building Basics) ○ Kitchen/ Food Storage = 600sf ○ Central Activity/ Dining = 1,500sf ○ General facility storage = 200sf ○ Quiet room/ first aid = 100sf ○ Staff break/ toilet = 350sf	• Program spaces: (Building Basics) (for an early education facility of 100 children) ○ Observation = 9sf/child ○ Entry = 200sf ○ Reception = 120sf

		○ Ages 36-59 mo. with <10 per class = 1 sink and 1 toilet ○ Ages 36-59 mo. with 10-16 per class = 2 sinks and 2 toilets • No. of children per facility type: (NHSPS) ○ Small family home = 1 - 6 children ○ Large family home = 7-12 children ○ Center = any number of children • Teacher to child ratio and age group per classroom for small family home type: (NHSPS) ○ Ages 2+ years = 1:6 = 6 max • Teacher to child ratio and age group per classroom for large family home and center types: (NHSPS) ○ Ages <12 mo. = 1:2 = 6 max ○ Ages 13-23 mo. = 1:2 = 8 max ○ Ages 24-36 mo. = 1:3 = 12 max				

		○ Ages 3 yr. = 1:7 = 12 max ○ Ages 4-5 yr. = 1:8 = 12 max				
	Safety: Safety and security of students and faculty.	• Furniture that can withstand constant use • Size and height appropriate furniture and equipment • Chair seat height per age group: ○ 1 year = 5”-6.5” ○ 2 years = 6”-10” ○ 3 years = 10” ○ 4 years = 12” ○ 5 years = 12” • Table height per chair seat height: ○ 5” chair = 12” table ○ 6” chair = 13” table ○ 6.5” chair = 14” table ○ 8” chair = 16” table ○ 10” chair = 18” table ○ 12” chair = 20” table or 22” desk height (to allow for storage) • Size and height appropriate toilet and sink fixtures • Toilet seat height per age group:	• Adequate systems for doors and windows to prevent break-ins • Security cameras	• Adequate systems for doors and windows to prevent break-ins	• Adequate systems for doors and windows to prevent break-ins • Climb-proof boundaries around school and play spaces: ○ Fence height minimum on ground floor: 5 ft. ○ Fence height minimum on roof: 10 ft. with additional 45° inward angled panel • Outdoor equipment approved by the US Consumer Product Safety Commission • Outdoor lighting to illuminate school and deter break-ins	• Climb-proof boundaries around school and play spaces: ○ Fence height minimum on ground floor: 5 ft. ○ Fence height minimum on roof: 10 ft with additional 45° inward angled panel

	○ 3-4 years = 11-12” ○ 5-8 years = 12-15” • Grab bar mounting height per age group: ○ 3-4 years = 18-20” ○ 5-8 years = 20-25”				
Comfort: Air quality, ventilation, passive cooling strategies, building orientation, etc.	• Building orientation • Use Hawai’i’s north-east winds for cross ventilation • Horizontal exterior shading devices for north and south faces • Vertical exterior shading devices for east and west faces • Operable windows • Operable window shades • Low VOC emitting materials and finishes • Fresh air in classrooms: (NHSPS) 15-60 cfm/p • Indoor temperatures: (NHSPS) 74°F - 82°F at 30-50% relative humidity during the summer ○ *Hawai’i average relative humidity =	• Use Hawai’i’s north-east winds for cross ventilation • Horizontal exterior shading devices for north and south faces • Vertical exterior shading devices for east and west faces • Operable windows • Operable window shades • Low VOC emitting materials and finishes	• Use Hawai’i’s north-east winds for cross ventilation • Horizontal exterior shading devices for north and south faces • Vertical exterior shading devices for east and west faces • Operable windows • Operable window shades • Low VOC emitting materials and finishes	• Provide shaded areas or covered play spaces • Vegetation • Use Hawai’i’s north-east winds for cross ventilation • Horizontal exterior shading devices for north and south faces • Vertical exterior shading devices for east and west faces • Operable windows • Operable window shades • Low VOC emitting materials and finishes	• Use Hawai’i’s north-east winds for cross ventilation • Horizontal exterior shading devices for north and south faces • Vertical exterior shading devices for east and west faces • Operable windows • Operable window shades • Low VOC emitting materials and finishes

	60-70%, dehumidifiers may be needed for classrooms				
Pathways: Width of corridors, proximity of spaces, signage, minimal use of corridors.	• Classroom spaces should be located near other student spaces such as general use facilities and special use facilities • Child toilet facilities within classrooms and activity rooms	• Office spaces should be located near the entrance for accessibility of parents • Separate adult toilet facilities	• Location of special use spaces depends on the type of activity and if it is designated as a shared space with the community	• Location of general use spaces depends on the type of activity and if it is designated as a shared space with the community • Child toilet facilities located near outdoor activity areas	• Minimum 4 foot corridors for wheelchair accessibility
Light: Use of light fixtures, optimization of natural light in all spaces, building orientation.	• Footcandles per room: (NYC) ○ Classrooms = 30-50 footcandles • Footcandles per room: (Building Basics) ○ General Classrooms = 20-50 footcandles ○ Toilets and Washrooms = 20-50 footcandles • Footcandles per room: (NYC) ○ Sleeping areas, bathrooms, and exit paths = 5 footcandles	• Footcandles per room: (Building Basics) ○ Offices, meeting rooms, conference rooms = 20-50 footcandles ○ Toilets and Washrooms = 20-50 footcandles		• Footcandles per room: (NYC) ○ Recreation Rooms = 20 footcandles ○ Auditoriums, cafeterias, and washrooms = 10 footcandles ○ Open corridors and store rooms = 5 footcandles • Footcandles per room: (Building Basics) ○ Auditoriums = 10-20 footcandles	• Footcandles per room: (NYC) ○ Open corridors and store rooms = 5 footcandles ○ Sleeping areas, bathrooms, and exit paths = 5 footcandles • Footcandles per room: (Building Basics) ○ Corridors and stairs = 20-50 footcandles

Technology: Technology is incorporated into the design of the classrooms and other facilities	• Provide for use of technology within classrooms like projectors, teacher's computer, etc. • Outlets for projectors, televisions, etc. located 54" above finished floor to be out of reach of children • Tamper resistant or "child-proof" outlets for student occupied rooms	• Provide for computer use in offices, projectors and audio equipment in meeting or conference rooms, etc.	• Outlets for projectors, televisions, etc. located 54" above finished floor to be out of reach of children • Tamper resistant or "child-proof" outlets for student occupied rooms • Considerations for on-site energy generations; solar panels on covered parking or school roof • Opportunities for Technology labs • Create opportunities to learn about the building's energy use	• Outlets for projectors, televisions, etc. located 54" above finished floor to be out of reach of children • Tamper resistant or "child-proof" outlets for student occupied rooms	• Provide for use of wall mounted monitors in hallways to display school information • Communication system considered for circulation areas
Community: Spaces are provided for community-use, but does not conflict with school program	• Community use within classrooms is not recommended unless designated as a shared space	• Could provide office and meeting rooms for community involvement in the school	• Recommended to have limited community use within special use spaces	• Recommended to have limited community use within general use spaces, for example: ○ Multipurpose rooms/ shared spaces for after school programs)	• Paths designed to direct public to shared spaces without interfering with students

	Colors	• Use of colors that are stimulating and playful for furniture and finishes • Generally cooler hues used to enhance concentration • Incorporate variation of colors • Opportunity to create themed colored rooms	• Generally cooler hues used to enhance concentration and promote relaxation • Opportunity to create themed colored room	• Use of colors that are stimulating and playful for furniture and finishes • Generally cooler hues used to enhance concentration • Incorporate variation of colors • Opportunity to create themed colored room	• Use of colors that are stimulating and playful for furniture and finishes • Generally cooler hues used to enhance concentration • Incorporate variation of colors • Opportunity to create themed colored room	• Color coordination to identify certain areas or rooms
Faculty	Impression: The school looks fun and welcoming for all occupants and parents	• Fun, welcoming, academic environment that would be appealing to parents • Organized and easy to manage classroom layout	• Professional environment with all necessary provisions • Clean and organized	• Organized and easy to manage learning and playing environment	• Organized and easy to manage learning and playing environment	• Clear organization of school • Easy to navigate pathways
	Space: Adequate size of classrooms both indoors and outdoors to support teaching. Cl assrooms don't feel crowded	• Using recommended space requirements per number of students • Ensure there is extra space (nonassignable space) to allow for a growing number of students • Adequate amount of storage provided for	• Storage provided within office spaces • Spaces provided for individual teacher work and for group work • Leisure spaces provided for staff to create	• Adequate amount of storage provided for all teaching materials, toys, etc.	• Adequate amount of storage provided for all teaching materials, toys, etc.	• Pathways that are wide enough to avoid feeling crowded • Gathering spots considered near classrooms and activity areas

	all teaching materials, toys, etc. • Space provided for a teacher's desk within classrooms	ideal working conditions • Meeting and conference rooms considered for parent meetings			
Safety	• Storage in classrooms only accessible by teachers • Considerations for fire hazards • Evacuation routes assessed for classrooms	• Locked offices to protect personal files of children or other school related information • Considerations for fire hazards • Evacuation routes assessed for office spaces	• Storage in classrooms only accessible by teachers • Considerations for fire hazards • Evacuation routes	• Storage in classrooms only accessible by teachers • Considerations for fire hazards • Evacuation routes	• Considerations for fire hazards • Evacuation routes
Comfort: The space feels cool and comfortable, operable windows, conditioned spaces	• Easy to operate windows to allow for natural ventilation • Easy to operate window shades if needed for napping areas • Considerations for conditioned classroom spaces if natural ventilation is not adequate	• Conditioned spaces for computer use or other heat generating equipment	• Conditioned spaces for computer use or other heat generating equipment	• Conditioned spaces for computer use or other heat generating equipment	• Open-air corridors recommended for tropical climates • Covered pathways for rain or shading from the sun

	Light: There is plenty of natural light, but also different options for lighting in each room	• Large open windows for natural light in classrooms, but window shades also provided • Consider options for light dimming in certain activity areas	• Adequate lighting provided for reading, writing, work areas	• Consider options for light dimming in certain activity areas	• Consider options for light dimming in certain activity areas • Outdoor lighting provided if facility is used by community after school hours	• Adequate lighting provided for circulation areas • Special lighting for student work displays in hallways • Outdoor lighting provided if facility is used by community after school hours
	Displays	• Space is provided to display student work • Space is provided to display information for parents to encourage involvement in child's education	• Space is provided to display information for parents to encourage involvement in child's education	• Space is provided to display student work	• Space is provided to display student work	• Space is provided to display student work • Space is provided to display information for parents to encourage involvement in child's education
	Technology: Appropriate technology is provided for teachers	Example teaching tools: smartboards, computer use at teacher's desk in classrooms, projectors Communication system throughout school	• Computer use in offices and meeting/ conference rooms, projectors in meeting/ conference rooms	• Example teaching tools: smartboards, computer use at teacher's desk in classrooms, projectors • Communication system throughout school	• Example teaching tools: smartboards, computer use at teacher's desk in classrooms, projectors • Communication system throughout school	• Digital display of school information • Communication system throughout school

	Condition: Quality and condition of classroom equipment and furniture	• Furniture and equipment that can easily be moved for convenience or to rearrange activity spaces if needed • Furniture and finishes that can easily be replaced, cleaned, or refinished	• Adequate furniture or office furniture configurations for staff	• Furniture and equipment that can easily be moved for convenience or to rearrange activity spaces if needed • Furniture and finishes that can easily be replaced, cleaned, or refinished	• Furniture and equipment that can easily be moved for convenience or to rearrange activity spaces if needed • Furniture and finishes that can easily be replaced, cleaned, or refinished • Adequate outdoor equipment and considerations for outdoor furniture in gathering spaces	• Considerations for seating in circulation areas and parent observation spaces
	Boundaries	• Distractions can be cut down with fixed or operable boundaries between activity spaces and classrooms • There are options to keep noise levels down in specified areas • School location considerations for (noise pollution) traffic, construction, community events, etc.	• Closed offices, meeting rooms, and other administration spaces for noise reduction with limited views into room for privacy	• School location considerations for (noise pollution) traffic, construction, community events, etc. • There are options to keep noise levels down in specified areas	• School location considerations for (noise pollution) traffic, construction, community events, etc. • There are options to keep noise levels down in specified areas	• School location considerations for (noise pollution) traffic, construction, community events, etc. • Opportunities to see into classrooms from observation spaces without distracting students
Student	Impression: The school looks fun	• Fun, welcoming environment	• Office spaces that feel comfortable for	• Fun, welcoming environment	• Fun, welcoming environment	• Opportunities to create interesting, playful pathways

	and welcoming for all children	• Classrooms have a similar feeling to home for an easy transition from the home environment to the school environment	children if expecting to work with children one-on-one or if having meetings with the whole family			
	Space: Size of activity spaces, outdoor play areas, etc. Students don't feel crowded.	• Classroom spaces are sized properly for the number of students • Opportunities created for individual play and group play		• Spaces are sized properly for the number of students • Opportunities created for individual work/ play and group work/ play	• Spaces are sized properly for the number of students • Opportunities created for individual work/ play and group work/ play • There is an adequate amount of outdoor play area and inclusion of outdoor classrooms	• Gathering spaces provided near activity rooms
	Safety: The school feels familiar and furniture and equipment meant safety requirements for use by younger children	• Considerations for tamper resistant or "child-proof" outlets • Appropriate child sized furniture that won't easily fall over when used by students • Classrooms designed to allow for staff to have a clear view of children at all times	• Offices and other administration spaces are not easily accessible by students	• Considerations for tamper resistant or "child-proof" outlets • Appropriate child sized furniture that won't easily fall over when used by students • Activity spaces designed to allow for staff to have a	• Considerations for tamper resistant or "child-proof" outlets • Appropriate child sized furniture that won't easily fall over when used by students • Activity spaces designed to allow for staff to have a clear	• Pathways deter interaction between students and non-school members • Circulation allows for clear views to student areas for staff to be able to monitor from other spaces

			clear view of children at all times	view of children at all times • Proper boundaries provided to separate outdoor facilities from surrounding areas and to ensure children are not able to wander away from the school • Kitchen equipment appropriate for use by children if necessary for learning activities	
Comfort: The space feels cool and comfortable, conditioned spaces for better concentration	• Classrooms feel cool and comfortable for children to play freely and to also be able to concentrate on activities requiring more focus • Conditioned classrooms considered if natural ventilation is not adequate • Teachers are able to provide students with water and snacks if necessary for their comfort		• Activity spaces feel cool and comfortable for children to play freely and to also be able to concentrate on activities requiring more focus • Conditioned activity spaces considered if natural ventilation is not adequate	• Activity spaces feel cool and comfortable for children to play freely and to also be able to concentrate on activities requiring more focus • Conditioned activity spaces considered if natural ventilation is not adequate • If necessary, provide shading for outdoor play and learning areas to shade from the sun and rain	

Light: There is adequate lighting where needed	• Adequate lighting provided for learning and play areas • Large open windows for natural light and with window shades (operable by staff only) • Options to dim lights for certain activity areas or if napping is within the classroom • Lighting switches out of reach of children		• Options to dim lights for certain activity areas • Lighting switches out of reach of children • Large open windows for natural light and with window shades (operable by staff only)	• Options to dim lights for certain activity areas • Lighting switches out of reach of children • Large open windows for natural light and with window shades (operable by staff only)	
Displays: Students feel good about their progress in school and are encouraged to do better and to participate more	• Display of student work in classrooms and is within view or reach of students to encourage participation		• Display of student work in activity areas and is within view or reach of students to encourage participation	• Display of student work in activity areas and is within view or reach of students to encourage participation	• Displays for student work provided throughout the school so that they feel the school is 'their' place
Technology: Age-appropriate technology is provided for students	• Consider use of appropriate electronic games or other teaching tools in classrooms • No media viewing and computer use for		• Consider use of appropriate electronic games or other teaching tools inactivity areas	• Consider use of appropriate electronic games or other teaching tools in activity areas • No media viewing and computer use for	

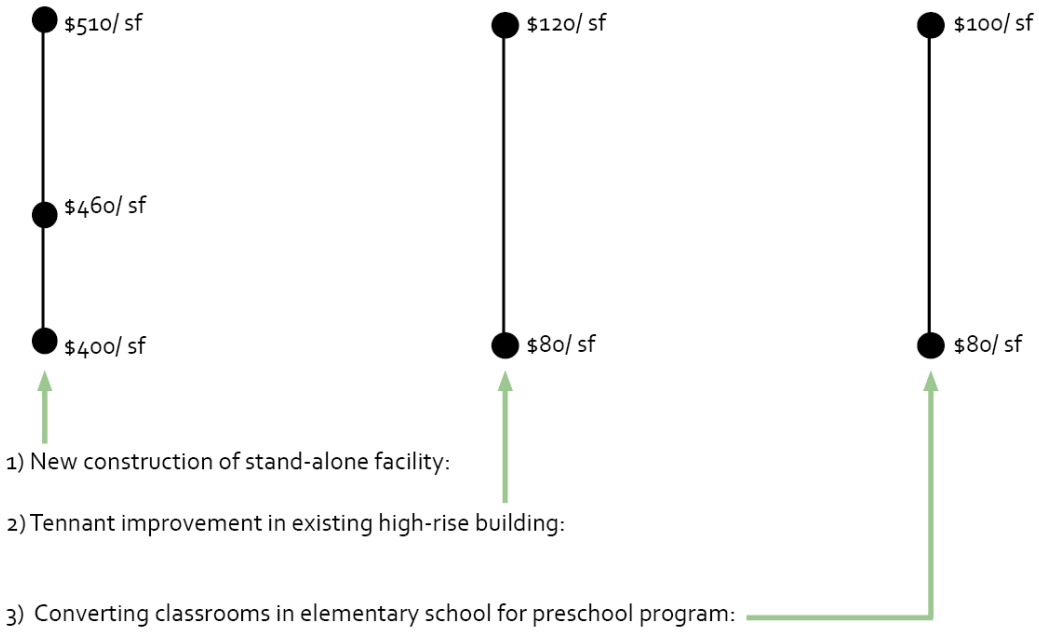
	children younger than 2 years • For children 2+ years, media viewing and computer not to exceed 30min once per week, computer use not to exceed 15 min increments		• Opportunities for Computer labs, media rooms, technology labs, etc. • No media viewing and computer use for children younger than 2 years • For children 2+ years, media viewing and computer not to exceed 30min once per week, computer use not to exceed 15 min increments	children younger than 2 years • For children 2+ years, media viewing and computer not to exceed 30min once per week, computer use not to exceed 15 min increments	
Personal Space	• Examples: Individual desks, personal storage, classrooms provide areas for quiet individual work/ play • Adequate space provided for personal storage: home lunches, extra clothes, medications, outdoor wear, etc.		• Opportunities for quiet individual work/ play	• Opportunities for quiet individual work/ play • Personal storage provided for outdoor facilities • Room provided in the school for children that need time to themselves, away from other children: first aid room, quiet room, nap room, etc.	

	Surfaces: Minimal use of hard surfaces	• Soft flooring in classrooms, no concrete floors • Variation in surfaces that feels more playful • Variation in flooring to indicate different activity areas • Avoid use of hard, sharp-edge surfaces		• Appropriate flooring for certain activities: Soft flooring and furnishings in libraries and multimedia rooms if reading or other activities take place on the ground • Variation in surfaces that feels more playful • Avoid use of hard, sharp-edge surface	• Appropriate flooring for certain activities: water resistant flooring for art rooms and food areas, etc. • Soft flooring in activity spaces, no concrete floors • Variation in surfaces that feels more playful • Avoid use of hard, sharp-edge surfaces • Playgrounds have rubber flooring	
	Colors	• Most preferred colors by children: 1. Red 2. Purple 3. Blue 4. Green 5. Yellow. • Least preferred colors by children: 1. Grey 2. Orange		• Most preferred colors by children: 1. Red 2. Purple 3. Blue 4. Green 5. Yellow. • Least preferred colors by children: 1. Grey 2. Orange	• Most preferred colors by children: 1. Red 2. Purple 3. Blue 4. Green 5. Yellow. • Least preferred colors by children: 1. Grey 2. Orange	• Most preferred colors by children: 1. Red 2. Purple 3. Blue 4. Green 5. Yellow. • Least preferred colors by children: 1. Grey 2. Orange

Financial Models

Following is an example assessment of cost to build for different types of early education facilities. The financial models are based on existing project and use estimated values.

Financial Models



The financial models are based on the following projects:

1) New construction of stand-alone facility:
    a. Two portable facilities on an elementary school campus for a preschool program[130]
        i. $600,000 total cost
        ii. 1,520 square feet
        iii. About $400 per square foot

[130] (Waikiki Elementary School Mindful Learning Center n.d.)

b. Eight classroom buildings on an elementary school campus for elementary grades[131]
    i. $6,000,000 total cost
    ii. 13,000 square feet
    iii. About $460 per square foot
c. New full elementary school campus including preschool program and elementary grade levels[132]
    i. $40,000,000
    ii. 78,404 square feet
    iii. About $510 per square foot

2) Tennant improvement in existing high-rise building
    a. $80-$120 per square foot[133]
    b. $2.30 per square foot equals estimated monthly rental cost[134]
3) Conversion of classrooms in an elementary school for a preschool program
    a. Typical elementary classroom size of 980 square feet[135]
    b. $80,000-$104,000 cost per classroom to convert to preschool program[136]
    c. About $80-$100 per square foot

[131] (Belt Collins Hawaii LLC 2013)
[132] (Hawaii State Department of Education 2015)
[133] (Conversation with Architect on Typical Office Renovation Projects 2016)
[134] (Conversation with Architect on Typical Office Renovation Projects 2016)
[135] (Educational Specifications (EDSPECS) For Elementary Schools 2008)
[136] (Hawaii State Department of Education 2008)

Program Activities[137]

Following is a list of program activities based on existing early education standards and research from precedent studies. Each program activity is first associated with appropriate early education program philosophies and then with the program spaces that fit the needs of the activities. More than one program space may be considered appropriate for each activity. This is not a complete list and should be added to and updated over time.

[137] (American Academy of Pediatrics 2011) (Ka Hei 2016) (Hawaii State Department of Education 2016) (Educational Specifications (EDSPECS) For Elementary Schools 2008) (Perkins and Bordwell 2010) (Freitas 2015) (Freitas 2015)

Activity	Philosophy	Office	Admin Storage	Small Meeting R	Large Conferenc	Break Room	Admin Toilets	Indoor Multipurp	Outdoor Multipur	Individual Desks	Small Group Tat	Large Group Tat	Quiet Room
Free Play	Play-based									✔	✔	✔	
60 min of physical acitvity	Play-based, Community							✔	✔				
Individual concentration	Montessori, Reggio Emilia, High/ Scope									✔			✔
Group concentration	Reggio Emilia, Project-based, High/ Scope										✔	✔	✔
Reading/ Working	Montessori, Waldorf, Reggio Emilia, High/ Scope									✔	✔	✔	✔
Art	Waldorf, Reggio Emilia, Play-based, High/ Scope									✔	✔	✔	
Team sports	Community												
Nap time	All												✔
Opportunities to seek comfort	All	✔								✔			✔
Community Involvement	Community, Project-based	✔	✔	✔	✔			✔	✔				
Parent Involvement	Culture, Cooperative			✔	✔								
Performances	Culture, Language							✔	✔				
General cultural activities	Culture, Community, Language							✔	✔	✔	✔	✔	
Observation of on-site energy generation	Self-sufficiency												
Water collection station	Self-sufficiency												
Building energy monitoring	Self-sufficiency											✔	
Sustainable studies hands-on activities	Self-sufficiency									✔	✔	✔	
Gardening	Culture, Self-sufficiency, Language												
Food preparation	Culture, Self-sufficiency, Language												
Scouts	Community, Project-based	✔						✔	✔	✔	✔	✔	
Club activities	Community, Project-based	✔						✔	✔	✔	✔	✔	
Science	High/ Scope, Montessori, Reggio Emilia									✔	✔	✔	
Social Studies	High/ Scope, Montessori, Reggio Emilia									✔	✔	✔	
Problem Solving	High/ Scope, Montessori, Reggio Emilia									✔	✔	✔	
Bird/ insect observation	Culture, Language												
Dramatic play	Waldorf, Play-based												
Hula/ dance	Culture, Waldorf, Language							✔	✔				
Singing	Culture, Waldorf, Language							✔					
Storytelling	Culture, Waldorf, Language												✔
Sensory play	Culture, Waldorf, Language									✔	✔	✔	
Instrumental music play	Waldorf							✔					
Learning through technology	High/ Scope									✔	✔	✔	
Martial arts	Community, Culture							✔	✔				
Tumbling	Community, Play-based							✔					
Piko, Wehe, Wehena	Culture, Language								✔				
Stream cleanup	Culture, Community												
Water quality testing	Culture, Community												
Plant inventory	Culture, Language												
Observation of aquatic life cycles	Culture, Language												
Reforestation	Culture, Community, Language												

Activity	Philosophy	Media Lab	Kitchen	Children's Dining	Food Lab	Children's Toilets	General Activity	General Activity	Outdoor Class S	Playground	Water Play Area	Classroom Stora	Outdoor Storage
Free Play	Play-based					✔	✔	✔		✔	✔	✔	✔
60 min of physical acitvity	Play-based, Community					✔			✔	✔			✔
Individual concentration	Montessori, Reggio Emilia, High/ Scope					✔						✔	
Group concentration	Reggio Emilia, Project-based, High/ Scope					✔	✔	✔				✔	
Reading/ Working	Montessori, Waldorf, Reggio Emilia, High/ Scope	✔				✔		✔				✔	
Art	Waldorf, Reggio Emilia, Play-based, High/ Scope					✔	✔					✔	
Team sports	Community					✔							✔
Nap time	All											✔	
Opportunities to seek comfort	All												
Community Involvement	Community, Project-based					✔			✔			✔	✔
Parent Involvement	Culture, Cooperative		✔	✔									
Performances	Culture, Language					✔						✔	✔
General cultural activities	Culture, Community, Language	✔			✔	✔	✔	✔	✔		✔	✔	✔
Observation of on-site energy generation	Self-sufficiency					✔			✔				✔
Water collection station	Self-sufficiency					✔	✔		✔		✔	✔	✔
Building energy monitoring	Self-sufficiency	✔				✔		✔					
Sustainable studies hands-on activities	Self-sufficiency	✔				✔	✔		✔		✔	✔	✔
Gardening	Culture, Self-sufficiency, Language					✔							
Food preparation	Culture, Self-sufficiency, Language		✔	✔	✔	✔	✔					✔	
Scouts	Community, Project-based					✔	✔	✔	✔			✔	✔
Club activities	Community, Project-based					✔	✔	✔	✔			✔	✔
Science	High/ Scope, Montessori, Reggio Emilia	✔			✔	✔	✔	✔	✔		✔	✔	✔
Social Studies	High/ Scope, Montessori, Reggio Emilia	✔				✔		✔				✔	
Problem Solving	High/ Scope, Montessori, Reggio Emilia					✔		✔	✔			✔	✔
Bird/ insect observation	Culture, Language					✔			✔		✔		✔
Dramatic play	Waldorf, Play-based					✔		✔				✔	
Hula/ dance	Culture, Waldorf, Language					✔						✔	✔
Singing	Culture, Waldorf, Language					✔		✔					
Storytelling	Culture, Waldorf, Language					✔		✔					
Sensory play	Culture, Waldorf, Language				✔	✔	✔	✔	✔		✔	✔	✔
Instrumental music play	Waldorf					✔		✔				✔	
Learning through technology	High/ Scope	✔				✔		✔	✔		✔	✔	✔
Martial arts	Community, Culture					✔							
Tumbling	Community, Play-based					✔						✔	
Piko, Wehe, Wehena	Culture, Language					✔			✔				
Stream cleanup	Culture, Community					✔					✔		✔
Water quality testing	Culture, Community					✔	✔		✔		✔	✔	✔
Plant inventory	Culture, Language	✔				✔			✔			✔	✔
Observation of aquatic life cycles	Culture, Language	✔				✔			✔		✔	✔	✔
Reforestation	Culture, Community, Language					✔							✔

Activity	Philosophy	Off-Campus (Lo	Cafe	Observation Spa	Outdoor Small G	Outdoor Large G	Indoor Stage	Outdoor Stage	Music Room	Adult Multipurpo	Adult Toilet	Open Play Field	Maintenance Ro
Free Play	Play-based				✔	✔						✔	
60 min of physical acitvity	Play-based, Community						✔	✔				✔	
Individual concentration	Montessori, Reggio Emilia, High/ Scope												
Group concentration	Reggio Emilia, Project-based, High/ Scope				✔	✔							
Reading/ Working	Montessori, Waldorf, Reggio Emilia, High/ Scope				✔	✔							
Art	Waldorf, Reggio Emilia, Play-based, High/ Scope												
Team sports	Community											✔	
Nap time	All												
Opportunities to seek comfort	All				✔								
Community Involvement	Community, Project-based	✔					✔	✔			✔	✔	
Parent Involvement	Culture, Cooperative	✔	✔	✔			✔	✔		✔	✔		
Performances	Culture, Language						✔	✔	✔		✔		
General cultural activities	Culture, Community, Language	✔			✔	✔	✔	✔	✔			✔	
Observation of on-site energy generation	Self-sufficiency	✔											✔
Water collection station	Self-sufficiency	✔			✔	✔							
Building energy monitoring	Self-sufficiency			✔									✔
Sustainable studies hands-on activities	Self-sufficiency	✔			✔	✔						✔	
Gardening	Culture, Self-sufficiency, Language											✔	
Food preparation	Culture, Self-sufficiency, Language												
Scouts	Community, Project-based	✔			✔	✔				✔		✔	
Club activities	Community, Project-based	✔			✔	✔				✔		✔	
Science	High/ Scope, Montessori, Reggio Emilia				✔	✔						✔	
Social Studies	High/ Scope, Montessori, Reggio Emilia												
Problem Solving	High/ Scope, Montessori, Reggio Emilia				✔	✔							
Bird/ insect observation	Culture, Language				✔	✔						✔	
Dramatic play	Waldorf, Play-based						✔	✔					
Hula/ dance	Culture, Waldorf, Language						✔	✔	✔	✔		✔	
Singing	Culture, Waldorf, Language						✔		✔				
Storytelling	Culture, Waldorf, Language												
Sensory play	Culture, Waldorf, Language				✔	✔							
Instrumental music play	Waldorf						✔		✔				
Learning through technology	High/ Scope	✔			✔	✔							
Martial arts	Community, Culture						✔	✔		✔			
Tumbling	Community, Play-based									✔			
Piko, Wehe, Wehena	Culture, Language							✔				✔	
Stream cleanup	Culture, Community	✔											
Water quality testing	Culture, Community	✔			✔	✔							✔
Plant inventory	Culture, Language	✔			✔	✔						✔	
Observation of aquatic life cycles	Culture, Language	✔											
Reforestation	Culture, Community, Language	✔											

Program Spaces

Program spaces refer to the spaces listed in the program activities chart. Program spaces are organized by program type using Space Use Codes. Each program space has an ideal size which is either given as a set square-foot area or a size based on number of students per classroom. This list can be used to select program spaces for the start of the design of a new facility. This is not a complete list and should be added to and updated over time.

Program Spaces

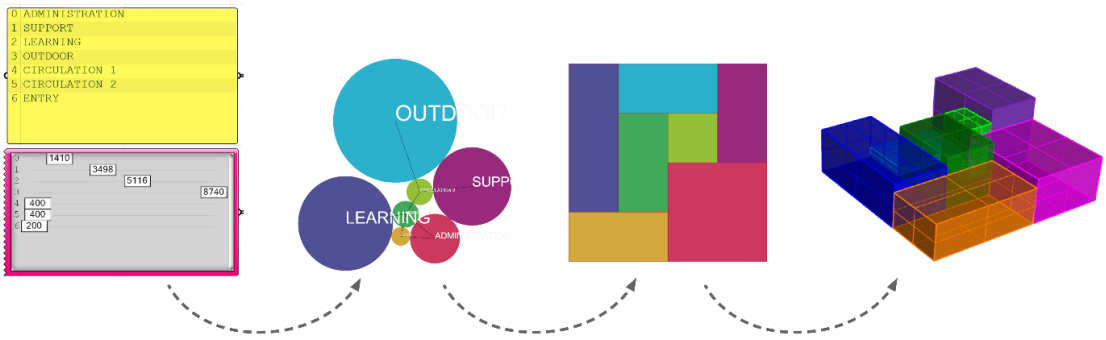
Activities to Spaces	Program Type[138]	Space Use Codes[139]	Program Space[140]	Size of Space [141]
- Individual desks - Small group desks - Large group desks - General activity with sink - General activity without sink	100: Classroom Facilities	110	Activity/ Classroom	42 sf/ child
- Quiet Room - Food Lab - Water play area - Music room		110	General Indoor	35 sf/ child
- Outdoor class setting - Small group tables - Large group tables - Water play area		110	General Outdoor	75 sf/ child
		115	Non-Assignable Space	20 sf/ child
		115	Classroom Storage	80 sf
		115	Classroom Toilet	80 sf
- Small meeting room	300: Office Facilities	310	Administration Office	120 sf

[138] (NCES National Center for Education Statistics 2006)
[139] (NCES National Center for Education Statistics 2006)
[140] (Perkins and Bordwell 2010) (American Academy of Pediatrics 2011) (Educational Specifications (EDSPECS) For Elementary Schools 2008)
[141] (Perkins and Bordwell 2010) (American Academy of Pediatrics 2011) (Educational Specifications (EDSPECS) For Elementary Schools 2008)

		310	Director's Office	160 sf
- Admin storage		315	Staff Support/ Storage	380 sf
- Large conference room		350	Conference Room	200 sf
- Media Lab	500: Special Use Facilities	590	Media Lab	1,200
- Indoor Multipurpose room - Adult Multipurpose room - Stage	600: General Use Facilities	610	Indoor Multipurpose Room	1000 sf
- Outdoor Multipurpose room		610	Outdoor Multipurpose Room	1000 sf
- Kitchen - Food Lab		630	Serving Kitchen	600 - 905 sf
- Children's Dining		630	Serving/ Dining Area	975 - 1500 sf
		630	Cafe	350 sf
- Quiet room		645	Quiet Room/ First Aid	100 sf
		645	General Facility Storage	200 sf
		645	Laundry/ Shower Room	100 sf
- Staff break room - Staff toilets - Staff workroom		650	Staff Break/ Toilet	350 sf
		670	Playground	2,000 sf
		670	Covered Playcourt	75 sf/ child
		670	Open Play Field	75 sf/ child
		675	Outdoor Storage	80 sf
		675	Stage, Storage, and Toilets	1240 sf
	WWW: Circulation	W05	Observation	9 sf/ child
		W05	Entry	200 sf
		W05	Reception	120 sf
	XXX: Building Service	X02	Maintenance Room	80 sf

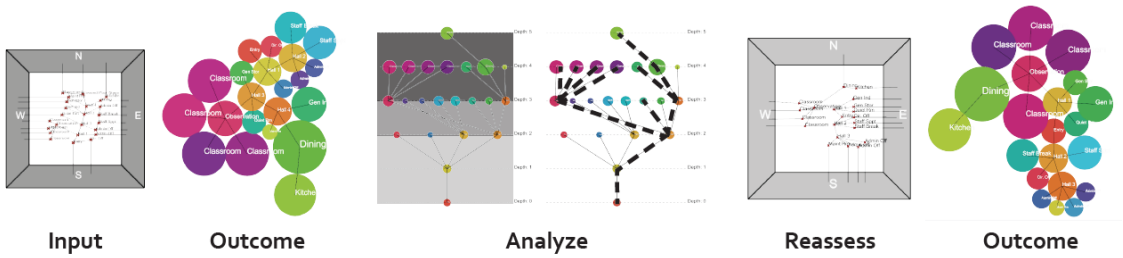
Program Layout

The program layout section of the design process uses the Space Syntax Grasshopper file that can be accessed on the Rhinoceros 3D modeling program.[142] The program spaces and the ideal sizes shown in the previous section are used as the data input for the Space Syntax file. The outcome of the data input is displayed as several different diagrams in order to show the most efficient layout of spaces. The Space Syntax file is used to find quick solutions for laying out the spaces of a future facility and can be easily modified to change the size or quantity of spaces while updating the diagrams in real time.[143] The diagrams can be used to analyze the layout to assess if it fit the needs of future projects. The figure below shows a suggested use of the Space Syntax file using an example facility program list.

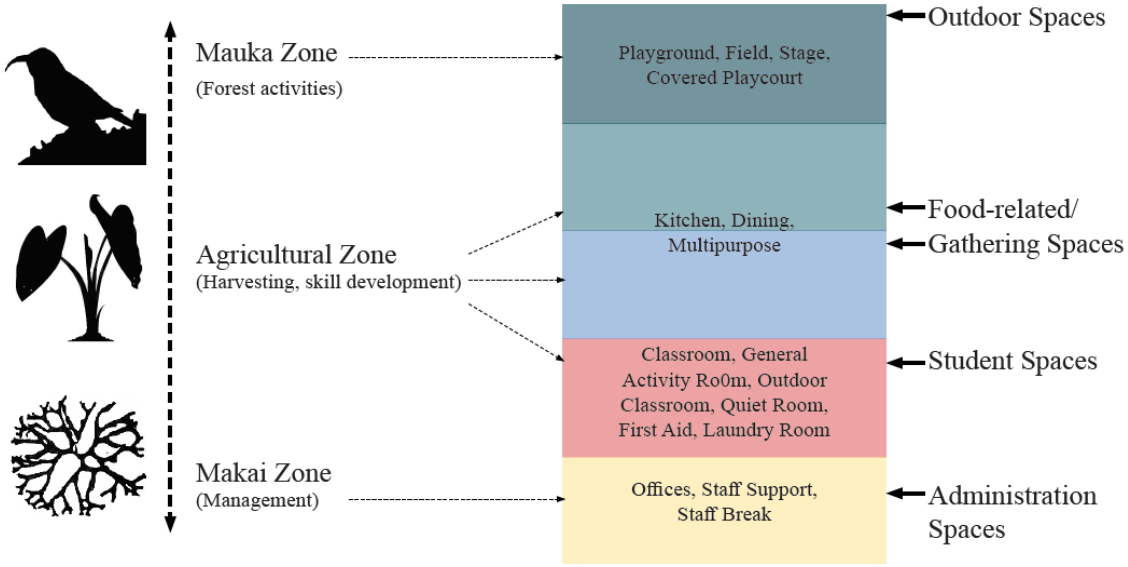


Once program spaces and sizes are inputted, the outcome is a series of diagrams that represent the facility layout. These diagrams can be used to create massings of the spaces in the Rhinoceros program. These massings can then be imported into other programs such as Revit in order to further develop the design and to start the architectural drawings.

[142] (Grasshopper 2016)
[143] (Nourian 2016)



The diagrams created by the Space Syntax file can be used to analyze the layout and, if need be, reassess the layout or inputted data to create a new layout.



There are many different methods for creating a layout of program spaces. These may focus more on the needs of the future project, configured to fit the project site, or arranged to reflect certain cultural aspects extracted from research on the project site. The figures above show examples of program layouts based on cultural aspects.[144]

[144] (Minerbi 1996)

Design Methodology for Early Education Facilities

Site Considerations

Site considerations consists of two sections: site analysis and site evaluation. Both are necessary in order to identify the most appropriate and ideal site for an early education facility. These can also be used to develop design ideas for the facility's overall design. The site evaluation section can be used to assess more than one potential site. The scoring set for the site evaluation helps to eliminate unfit sites and to reveal the most ideal site.

Site Analysis

- Urban Land Use: Identify urban areas for implementation. Agricultural and conservation sites are not suitable for a school facility.[145]
- Traditional Hawaiian Land Division: Identify the *mokupuni* (island), *moku* (district) and ahupua'a of potential sites.[146]
- History and Legends: Seek an understanding of the history and legends associated with the site.[147]
- Existing and Potential Elementary Schools: Identify schools that already offer a preschool program and are in need of renovation or an addition. Also, look for schools that anticipate including preschool classes but do not have a preschool program.[148]
- Demographic Studies: Could include various studies such as density by determining population per square mile in order to identify areas with a high population that may need a new school facility.[149] Other studies could include academic or financial attainment in relation to the studies in chapter one that

[145] (City and County of Honolulu 2016), (Hawaii State Data Center 2013)
[146] (AVA Konohiki Website Team 2016), (Kamehameha Schools/ Bernice Pauahi Bishop Estate 1987)
[147] (Internet Sacred Text Archive 2011), (University of Hawai'i at Manoa n.d.)
[148] (Hawaii State Department of Education 2016)
[149] (State of Hawaii Office of Planning 2016)

highlight participation in early education programs show higher rates of academic and financial achievement later in the participant's life.[150,151]

- Zoning and Building Type: Identify areas and buildings appropriate for an educational or child care program. These include zoning type AG-2, C, R-20, R-10, R-7.5, R-5, R-3.5, A-3, AMX-3, B-1, B-2, BMX-3, BMX-4, IMX-1, and the Kaka'ako Community Development District.[152]
- Infrastructure: Identify site-specific water, utilities, and transportation elements, including water and sewage pipes, flood zones, and public transportation.

Site Evaluation

- Community Assets [score of 0-5, weight value 30% of total score]:
    - The community has child service organizations, family service organizations, club organizations, religious sites, recreational facilities, existing schools in the given area, government and public safety places, art and theatrical places, museums, and retail services.[153]
    - Existing community resources are available for use by early education program.
    - Existing community resources are lacking, which means implementation of an early education program would bring resources to the area.
- Site Access [score of 0-5, weight value 20% of total score]:
    - Site has clear and easy access to facility for students, parents, and guardians.
    - Site has opportunities for drop-off area and parking.
    - Site has clear and easy access to facility for emergency vehicles.
- Site Surroundings [score of 0-5, weight value 20% of total score]:
    - Appropriate barriers surround school.
    - Pollution and noise can be controlled and minimized.

[150] (Jones, Greenberg and Crowley 2015)
[151] (Schweinhart, et al. 2005)
[152] (City and County of Honolulu n.d.), (City and County of Honolulu 2016)
[153] (U.S. Department of Education 2016), (Office of Innovation and Improvement 2014)

    - The functions of surrounding properties will not negatively affect the facility; this includes but is not limited to safety, circulation, and conflict of functions.

- Cultural Landscapes:
    - Climate Analysis [score of 0-5, weight value 10% of total score]:
        - Note types, names, and cultural significance of local rain and winds.
        - Site design use of sun path, types of rain, wind direction, etc.[154]
    - Natural Features [score of 0-5, weight value 10% of total score]:
        - Includes mountain range, valley ridge, streams, coastal areas, vegetation, etc.[155]
        - Note the names and significance of the natural features.
        - Identify the on-site native plant and animal species and their significance.
        - Site has proximity to natural features for use in early education program.
    - Views and Orientation [score of 0-5, weight value 10% of total score]:
        - Identify primary and secondary views from the site.
        - Understand orientation of the site in cultural terms in order to understand the site's place on the land and proximity to key areas.

[154] (State of Hawaii Office of Planning 2016), (Alameida 1997), (Alvarado, Index of Winds 2005), (Alvarado, Index of Rains 2005)
[155] (Map Data 2016), (USGS 2016)

Below is the evaluation chart to assess potential sites:

Site(s)	Community Assets $W_1 = 30\%$	Site Access $W_2 = 20\%$	Site Surrounds $W_3 = 20\%$	Views and Orientation $W_4 = 10\%$	Natural Features $W_5 = 10\%$	Climate Analysis $W_6 = 10\%$	Total Score
Potential Site 1	$S_1 = x$	$S_2 = x$	$S_3 = x$	$S_4 = x$	$S_5 = x$	$S_6 = x$	
	$C_1 = x\%$	$C_2 = x\%$	$C_3 = x\%$	$C_4 = x\%$	$C_5 = x\%$	$C_6 = x\%$	$D = x\%$
Potential Site 2	$S_1 = x$	$S_2 = x$	$S_3 = x$	$S_4 = x$	$S_5 = x$	$S_6 = x$	
	$C_1 = x\%$	$C_2 = x\%$	$C_3 = x\%$	$C_4 = x\%$	$C_5 = x\%$	$C_6 = x\%$	$D = x\%$

i = Categories 1-6

S_i = Score of 0-5

W_i = Weight value of each category

C_i = Category score; ($S_i \div 5 \times W_i = C_i$)

D = Decision factor;

Represents the percentage of criteria met for an ideal early education facility site; ($\sum C_i = D$)

$S_i = 0$ in any category disqualifies the potential site
$S_i = 1$ It is unfit for an early education facility site
$S_i = 2$ Needs improvement for an early education facility site
$S_i = 3$ Meets expectations for an early education facility site
$S_i = 4$ Exceeds expectations for an early education facility site
$S_i = 5$ Exceptional quality for an early education facility site

The site evaluation process includes a scoring system with a range from zero to five and includes a chart for identifying cultural landscape aspects and possible ways to translate this information into the design of the building. A percentage score is determined by dividing the given score by the total possible score of five for each category ($S_i \div 5$). This percentage is multiplied by the weight value percentage for each category in order to get the total category score ($S_i \div 5 \times W_i = C_i$). The sum of each category score gives the total percentage of criteria met for potential sites.

Final Design

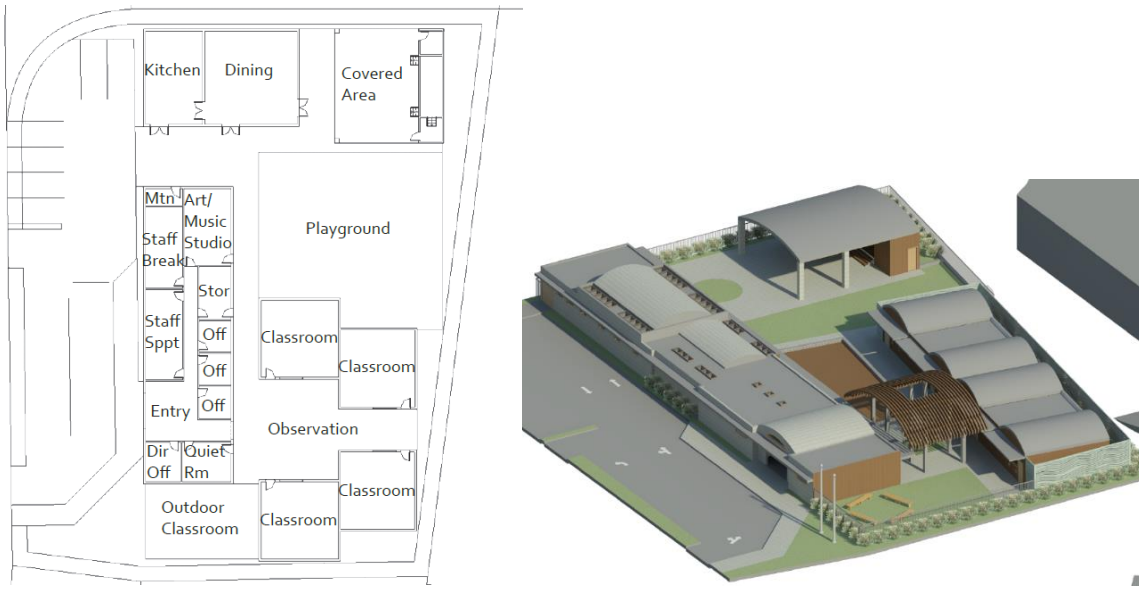
It is important to include facility design guidelines, financial models, and site considerations in the development of the facility. The cultural research conducted for the site can be translated into design ideas for the facility. The culture-related design ideas are organized into three categories: building symbolism, creating a connection to the land, and considerations for program spaces. As mentioned in the program layout phase, the massings created in the Rhinoceros program can be imported into other architectural programs such as Revit to further develop the design and to create architectural drawings. The result of the design phase depends on the needs and the vision of the client or the surrounding community. This final design phase also involves two traditional architectural phases: schematic design and design development. If the process moves forward, the next phases are construction document, bidding, and actual construction phases, the completion of which brings the project to its end; these final phases are not included in this design methodology for early education facilities.

For cultural elements to be implemented into the design, the following steps should be employed:

1. State the scope of the cultural analysis.
2. Research on the history of the culture and existing examples frameworks and studies on methods of integrating culture in design.
3. Research on the specific project location.
4. Organize the information using an existing method researched in step two or organize by the three categories: building symbolism, a connection to the land, and program spaces. Use this information to generate design ideas for the project.
5. Present the information to the client and/or community.
6. Implement appropriate design ideas.

Below is an example design idea chart for cultural aspects of a site. This chart can be presented to the client or community in order to determine design ideas most appropriate for implementation in the early education facility.

Cultural Landscape Aspects	**Building Symbolism**	**Connection to Land**	**Program Spaces**
Views and Orientation			
Natural Features			
Climate Analysis			
History and Legends			



The figure above shows an example facility program created in Revit by importing a Rhinoceros massing of a program layout. The floor plan and perspective image show a transition from the schematic design phase to the design development phase.

GLOSSARY

‘āina – Land.

‘ao‘aoa – A sea breeze.

‘ōlauniu – A wind on Hawai‘i and at Kapālama, Honolulu. Coconut-leaf piercing.

ahupua‘a – Land division usually extending from the mountains to the sea.

haupe‘epe‘e – To play hide-and-seek.

kalo – Taro, a type of aroid plant cultivated since for food.

Kapālama – Wood enclosure.

kūkalahale – A rain and wind famous at Honolulu

lo‘i – Irrigated terrace.

makai – Ocean.

mauka – Inland.

ua po‘o lipilipi – rain at Kalihi. Adze-like heavy rain.

Waikīkī – Spouting water.

Resource for Hawaiian words was taken from the Nā Puke Wehewehe ‘Olelo Hawai‘i (Ulukau Hawaiian Electronic Library: 2017)

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