

THE FUTURE OF ALOHA STADIUM:
21ST CENTURY STADIUM DESIGN PARAMETERS

A D.ARCH PROJECT SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAI'I AT MĀNOA IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF ARCHITECTURE

MAY 2015

BY

Michael L. Feo

D.Arch Project Committee:
Clark Llewellyn, Chairperson
Panos Prevedouros
John Meyers

Keywords: Aloha Stadium, Stadium Design, Football Stadium, NFL Stadium,
College Stadium

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To my parents, for providing inspiration and support, the building blocks to accomplish great things.

Acknowledgements

To the University of Hawai‘i’s School of Architecture’s faculty and staff, my sincerest gratitude for supporting me while I am pursuing an architecture degree.

To my committee members for providing the guidance necessary to make this project applicable to the problems that are facing the citizens of the City and County of Honolulu. Their guidance was pivotal in providing solutions for the island of Oahu and state of Hawai‘i.

To Clark Llewellyn and the Global Track staff for establishing and fostering the University’s relationship with Tongji University. I would not have developed a deep appreciation for the importance of stadium architecture, if not for the year spent at Tongji University, completing my master’s thesis

Abstract

The design of stadiums in the near future will focus on incorporating programming to make stadiums more functional for the urban communities they serve. Stadium scale, both in its physical size and radius of influence, makes the stadium an important urban entity that has an effect beyond the delineated space in which it is constructed.

Stadiums are a public structure because their funding is drawn from public sources, notably taxes and land; thus a stadium's true "client" is the general public. Integrating programming that supports multiple functions, such as malls, restaurants and even commercial space, benefits the general population, and not just those that use the stadium as an entertainment venue. This thesis explores and evaluates architectural issues, extending stadium use beyond sporting events, resulting in a site fully integrated in the city, providing a higher return on investment for the citizens.

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Preface

This D.Arch project addresses the current stadium situation that is facing, the state of Hawaii, and the City and County of Honolulu in regards to Aloha Stadium. Aloha Stadium is at the end of its lifecycle. The stadium requires major repairs or must be torn down and replaced with a new facility. In either case the new stadium will need to be built to fit the needs of the City and County of Honolulu, and regionally, benefit the entire state of Hawaii. In order to understand these requirements, this D.Arch project explores architectural issues culminating in design relationships that can be used by elected officials of the state of Hawaii and City and County of Honolulu to evaluate different choices in replacing Aloha Stadium.

Chapter 1. Introduction

Stadiums built in the United States are funded by both public and private funds. The use of public funds has been criticized as a public subsidy to the entertainment industry, specifically, for professional sports teams. How much has the public paid to build stadiums? 2007 Sports Facility Report, quoted Sarah Wilhelm, estimates that 5 billion of the 9 billion dollars spent on stadiums construction between 2000 and 2008 was public money. The report shows that stadiums are built primarily by public funds.

To the contrary to the aforementioned argument, David Swindell's and Mark S Rosentraub's article, "Who Benefits from the Presence of Professional Sports Teams?," argues that the incentives that sports teams receive from governments, including stadium funds, and tax breaks to the team members, are greater than the economic benefits returned to the community. The article concludes that stadiums should be a private endeavor because the benefits are to the people that use the service, such as the fans of the sports teams, and not to the public as a whole. While the authors imply that there are intangible benefits, they do not quantify the value of those benefits. Understanding their value and proposing ways to increase them are goals of this thesis.

An example of a non-conventional, public use of a stadium is the 1988 Florida law states that sports teams that accept public funds to build their venue are required to shelter homeless on off nights. Using the law passed in 1988 as a precedent, an argument can be made that the inclusion of additional public oriented programming gives greater purpose for the public funds invested in the stadium.

With over fifty percent of the funds for the stadium coming from the public, stadiums are public building. As current stadiums are not providing adequate justification for the public funds invested, the design of future stadiums must focus on creating structures that benefit the city that it serves, beyond the services provided on game day.

Creating stadiums that are designed to provide value to the public legitimizes the expenditure of public funds.

How does one incorporate additional value into a stadium to further benefit the city's citizens? This thesis answers that question by considering the following more limited questions:

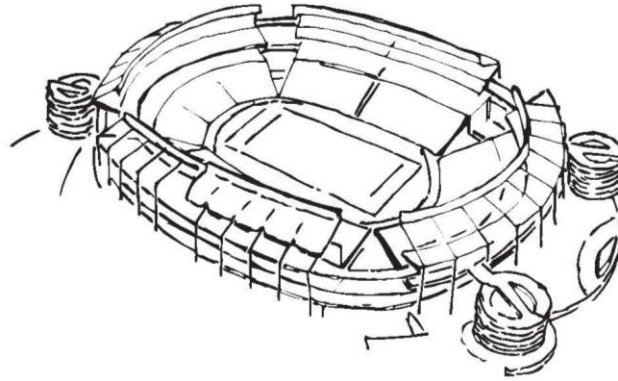
- 1) What motivates a city to construct a new stadium?
- 2) How does a city choose the location of a new stadium?
- 3) How does a city decide the architectural definition of the stadium in terms of program?
- 4) What are the current problems faced by contemporary stadiums in terms of finished solutions?
- 5) What design parameters can we propose to increase the benefits of a stadium?
- 6) How much greater is the stadium's value to the general public when incorporating these parameters?

Chapter 2. Aloha Stadium – “The Case Study”

Chapter two begins by understanding the context in which the current stadium, Aloha Stadium, was built and what needs the stadium intended to solve for the City of Honolulu, and ultimately the island of Oahu. This chapter makes two important points: the first point is review what questions politicians asked to determine the need for the stadium, and the second point is to understand the process for how the stadium was financed.

Reviewing the questions that were asked when the stadium was conceived provides a set of precedent questions that, when answered in the context of the stadium’s current situation, can help determine if Aloha Stadium needs to be torn down and rebuilt, renovated, or left alone. The chapter’s second goal is important because without understanding a project’s financing, it is difficult to choose the optimal number and types of features to maximize the return on investment.

Aloha Stadium [Figure 1, 2 and 3] is an important structure for Honolulu and the island of Oahu because it serves as an important cultural identity. When events are televised from Aloha Stadium, the structure presents to those not located in the area a view of the Hawaiian region. Before Aloha Stadium there was Honolulu Stadium, which represented the city’s identity. Upon destruction of Honolulu Stadium the local newspaper opined that the demolition of Honolulu Stadium represented the destruction of Oahu’s past. The paper was referring to the Oahu that was plantations and agriculture. With Aloha Stadium near the end of its lifecycle, Oahu is again at a transition from one time period to another.



Date Opened	September 12, 1975
Ownership (Management)	State of Hawaii (State of Hawaii)
Surface	FieldTurf
Cost of Construction	\$37 million
Stadium Architect	The Luckman Partnership, Inc.
Capacity	50,000
Luxury Suites	None
Club Seats	None
Cost:	\$37 million
Parking:	7,800 spaces for cars, 140 stalls for buses
Seating:	Individual theater-style seats, complete with backs and arm rests, are included throughout the 50,000-seat complex. The distance from the first row of seats to the sidelines varies between 22 and 40 feet, and from 25 to 60 feet at the end zones.
Playing surface:	Monsanto Astroturf.
Lights:	Mercury Vapor
Orientation:	The Aloha Stadium surface lies in a North-South direction.

Figure 1 – Aloha Stadium Fact Sheet

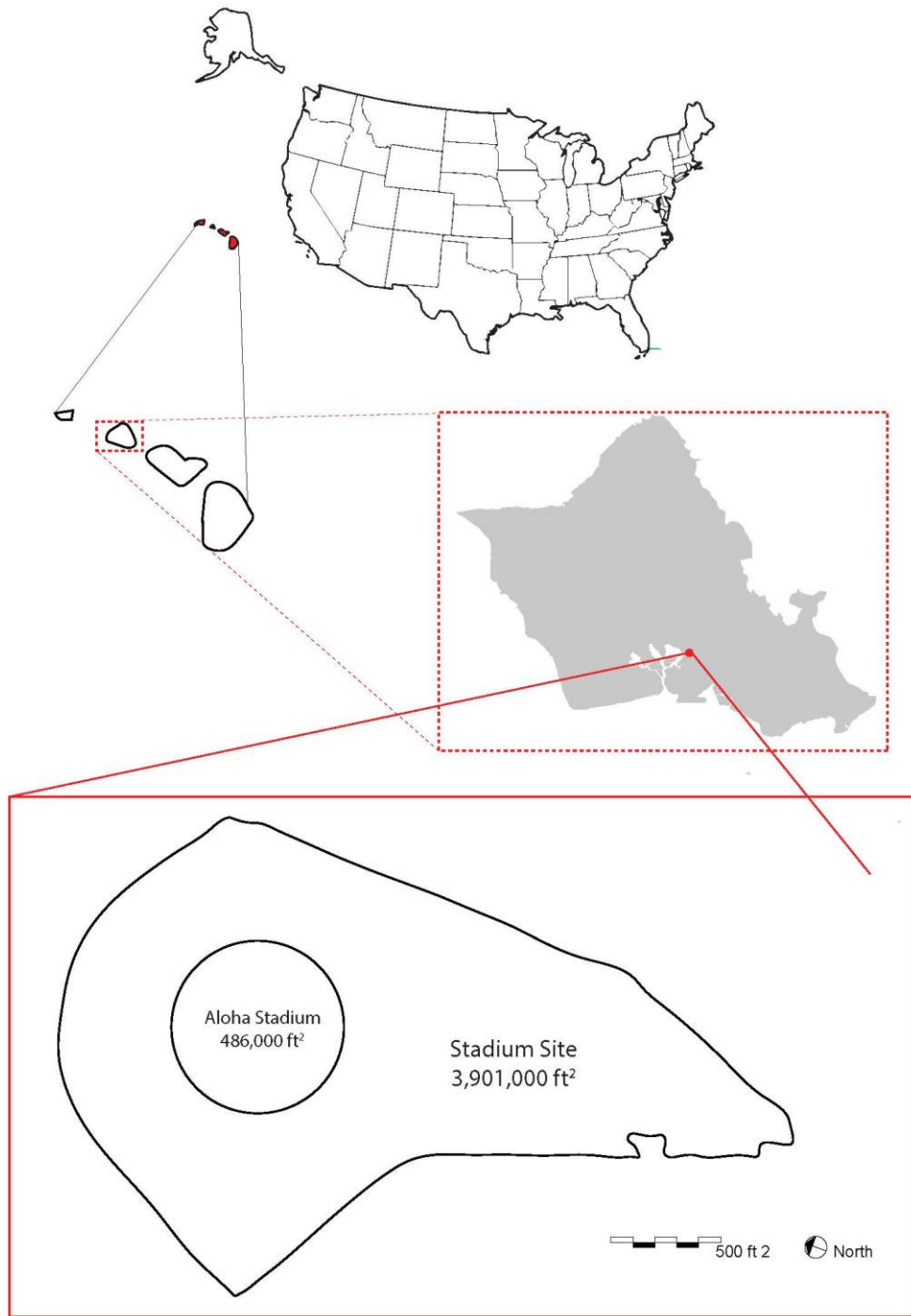


Figure 2 - Aloha Stadium Location & Site

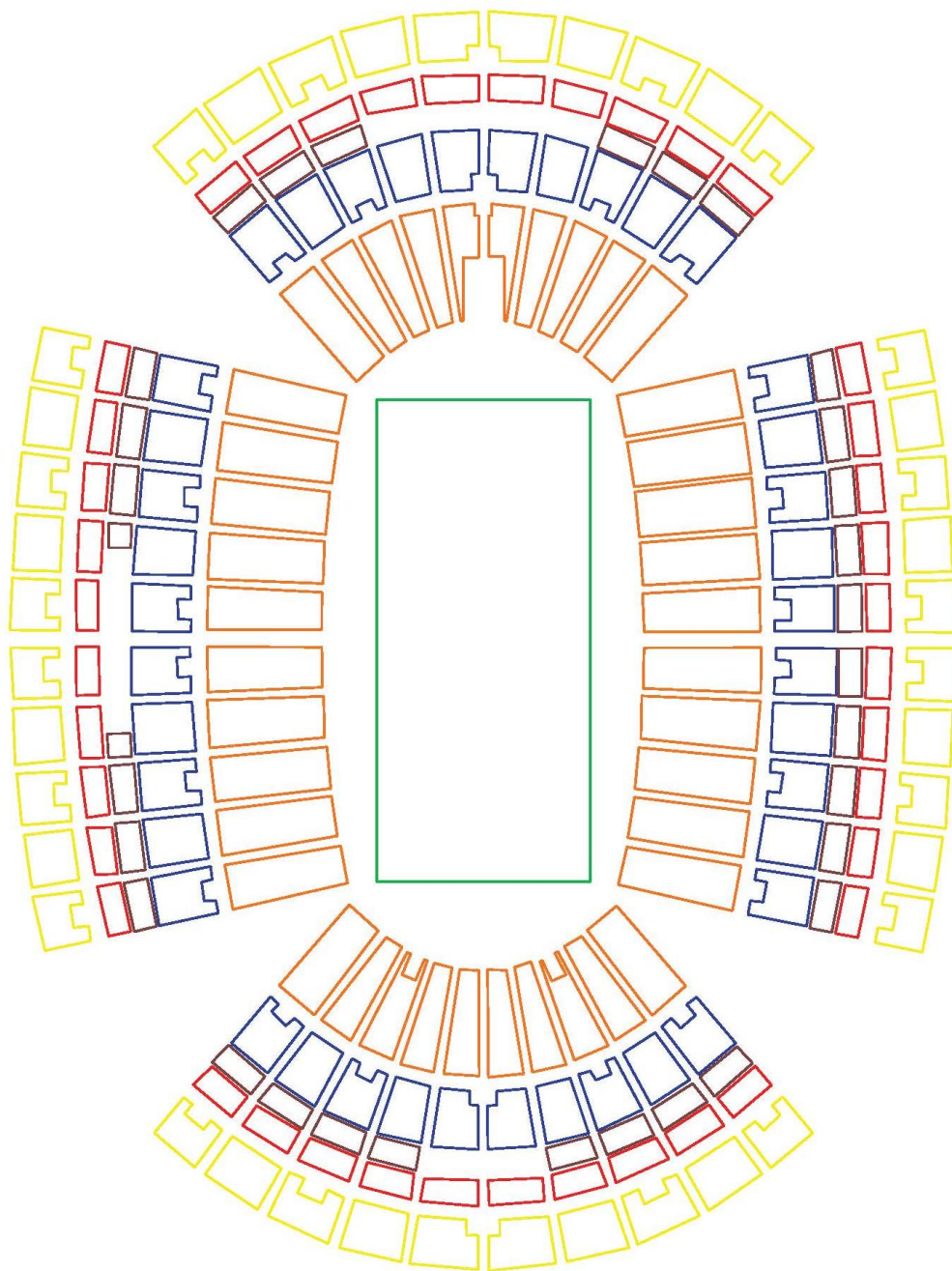


Figure 3 - Aloha Stadium Seating Diagram

2.1: History of Aloha Stadium

Aloha Stadium finished construction in 1975, with the purpose to replace the outdated Honolulu Stadium, located on King Street. According to “Report and Recommendations,” prepared by the Mayor’s Stadium Advisory Committee, the Honolulu Stadium was beyond its prime years; the report states “It may seem academic to have posed this question, [The need for a new stadium], especially to anyone who has attended an athletic event at the present structure on King Street”. As displayed in the confident underlying tone of the committee’s writing, Honolulu Stadium was reaching the end of its life and in dire need of a replacement.

The 1970’s, at the time the state was closing out its first decade in the Union, was a prosperous decade for the City of Honolulu, as highlighted by a construction boom. When constructed in 1926, Honolulu Stadium was surrounded by duck ponds; but by 1970, the stadium was surrounded by housing. Development of Waikiki, with new glamorous buildings made Honolulu Stadium look old and dilapidated. The big joke around town was the one about “how quickly the Stadium would crumble if the termites ever stopped holding hands.” The termite problem was so bad that the faculty of University of Hawai‘i conducted studies at Honolulu Stadium to research termites. The termite problem was so bad that local’s nicknamed Honolulu Stadium the “termite palace.”

In fact, at the writing of the report, it was known to the authors that Honolulu Stadium was condemned by the Stadium’s Board of Directors; who stated that the structure would not be able to meet current and future needs. As a result the Board decided to demolish the stadium by the end of 1972.

Prior to the report written for the Mayor’s Office, the city commissioned Western Management Consultants, Incorporated to conduct an economic feasibility analysis for a new multi-purpose stadium for the City and County of Honolulu.

The report title “Economic Analysis of the Proposed Honolulu Stadium,” produced by Western Management Consultants, Inc., included six specific areas of analysis. The six areas were;

- 1) market potential for a new 30,000 seat stadium,
- 2) site specific (Halawa Site) design concepts to perform cost estimates,
- 3) project probable financial performance of a new stadium,
- 4) recommendations for operating agencies and financial methods,
- 5) community cost and benefits, and
- 6) implement a construction program with a time table.

These six areas are important for a designer of a stadium because they contain the information to initiate legislation for the construction of the structure. A skillful designer should review economic reports to have a better understanding of the context in which the decision to build the building was made.

To paraphrase the conclusion of the report, the existing facilities in Honolulu will not meet the growing and increasingly wealthy populace of Honolulu. Therefore, there is need of a new stadium for Honolulu as a prerequisite for the participation of amateur and professional sports enjoyed by the aforementioned populace. The building of the new stadium from the initial report in 1970 to the completion took five years. On September 12, 1975, Aloha Stadium was open to the public, replacing Honolulu Stadium and contributing to Honolulu’s transition from an agricultural town to a growing urban community.

2.2: Location of Aloha Stadium and Oahu's Circulation

Through the analysis conducted by Western Management Consultants, Inc., the Halawa neighborhood became the best available location for the stadium and was eventually the site in which Aloha stadium was constructed. The Halawa Housing Area lies at the junction of Kamehameha Highway and Moanalua Road, situated between the downtown Honolulu area and Pearl City, just northwest of Honolulu's International Airport.

The criteria to determine an adequate site to construct a stadium was as followed; the site's ability to benefit the surrounding location's development, the ease to construct upon the site (grading, drainage and foundation), the appearance of the stadium from points around the site, accessibility to the site, and climatic conditions.

The new location of Oahu's stadium was beneficial as the population considered it to be easily accessible. Oahu's urban fabric developed in an urban sprawl, in which the primary mode of transportation is the automobile. The adjacency of Aloha Stadium to Kamehameha highway and the H-1 at construction made the location of the stadium central to the major roads of the island of Oahu.

As Oahu developed from the 1970's to present day, additional roadways were constructed. Even with the further development of roadways over the last forty years, Aloha Stadium is still in an ideal location when considering accessibility for the island. [Figure 4]

The Island of Oahu is currently investing in a light rail system: Honolulu Area Rapid Transit, or HART for short. By investing in HART, the island is promoting alternative modes of transportation, apart from driving personal automobiles. The shift from automobiles to pedestrians will also facilitate a shift in the urban makeup. The shift will

also transition Oahu from an automobile-oriented sprawling development to a transit-oriented urban development. The areas surrounding the HART stations will be opportunities to create new nodes within the urban context of Oahu. Aloha Stadium will have its own station on the line, providing additional transportation alternatives for patrons to access the venue.



Figure 4 - Aloha Stadium Oahu Circulation Diagram

With the city investing in increasing transportation infrastructure to access Aloha Stadium, the city is showing that the stadium has been historically, and will in the future, be an important venue for the island.

When constructed, Aloha Stadium had a life expectancy of fifty years: in 2015, the stadium is forty years old. What is to become of Aloha Stadium? The location of the stadium is ideal as it is easily accessible. Consequently the stadium has enormous money-making potential in Oahu's urban development. Rebuilding a new stadium on site is a reasonable choice in replacing the aging Aloha Stadium.

The critical question is then how can the new stadium be designed to maximize its benefits to the local community? By creating programming that draws people to the stadium at times other than during game days or using the facilities for other purposes can help to increase the stadium's usability. One of the unique cultural phenomenon of Aloha Stadium is the flea market held in the parking lot of the structure. The market creates a pleasant, pedestrian mall for people to enjoy. Knowing that the stadium will have its own public transportation with the HART, further development of pedestrian friendly spaces would be beneficial. This will make Aloha Stadium a destination on non-game days, for both locals and island visitors. By strengthening the development around Aloha Stadium, the HART station will increase the importance of the stadium within the urban framework of the Island of Oahu.

Additionally, Aloha Stadium can be useful by sharing its parking lot with the HART station. Park-and-Ride is a program in which people leave their automobiles, and board public transportation in order to get to their final destination. As the parking lot for Aloha Stadium is empty when major events are not being held, utilizing the parking spaces would reduce the necessity of building a parking structure for HART. Since parking fees collected on game days would more than pay for the parking facilities, HART riders could enjoy free parking further incentivizing commuters to use the light rail systems, and decreasing significantly automobile congestion on the area's overburdened freeways.

2.3: Current Function of Aloha Stadium

This section discusses how Aloha Stadium functions currently; the focus is on the events that currently are held in the stadium, and the surrounding area that make up the site of Aloha Stadium. This section illustrates the programming uses of the stadium as it depends on day's usage.

Aloha Stadium when constructed was a prime example of performance architecture because of its ability to change form by shifting its grandstands. The grandstands of Aloha Stadium were designed and constructed to be movable by using an Air-film system. Air-film works by providing a thin film of air less than a sixty-fourth of an inch thick, which acts like a lubricant, creating an almost frictionless surface. Once the frictionless surface is achieved the stands are moved along curved rails set in concrete. At the end of the rails are built in footings that can support the load from the stands.

The purpose of the performance architecture was to allow Aloha Stadium to have appropriate seating orientation for either football or baseball games. At the time of construction of the Aloha Stadium, Honolulu had neither a professional football nor baseball team. Given the continued lack of a professional team, Aloha Stadium was built for an intended user that never materialized.

2.4: The Financing of Aloha Stadium

This section deals with proposals of what to do with Aloha Stadium, as well as, introduce other potential uses of the stadium, for instances incorporation with University of Hawai'i's football needs. The stadium goes beyond just a venue for the UH football team and becomes a place for the larger community to enjoy. The state of Hawaii used public funds because the stadium enhances the community by being able to provide additional entertainment options.

When local businesses like Hawaiian Airlines provides financial support for the stadium, they give back to the community. In 2011 Hawaiian Airlines paid for a new field for the stadium, and the naming rights of the field were given to them. The name of the stadium changed to the Hawaiian Airlines Field at Aloha Stadium. The new field results in the increased quality of the venue. The new field increased the quality of the venue benefitting the locale's uses such as college sports, high school sports, and high school graduations. The benefit of supporting local culture through a stadium remakes it

from a purely physical entity to the embodiment of the Hawaiian word Oahu, “the gathering place.”

Being a cultural icon for an area comes at a large expense. Can the aesthetics of a building justify the use of funds to construct a very large structure? Just because a stadium’s appearance and primary function is important culturally to the city does not mean that the locale should not benefit in other ways. Aloha Stadium currently provides for the community in which it resides as “a gathering place,” a term much beloved among the inhabitants. As the structure is in need of being rebuilt, future manifestations of Aloha Stadium should continue the trend that the current stadium established. This can be added to with additional design decisions, reinforcing the concept of a local indicator, specifically of “a gathering place” that is unique to Honolulu.

How can an architect justify the extravagance of the stadium that is demanded for in this mass communicative age? Zaha Hadid’s initial stadium design for Tokyo’s 2020 main Olympic Stadium has become a controversial architectural project because of its extravagance. Responding to the criticism the Japanese Olympic committee rewrote the brief for the project, resulting in a resubmission of the stadium’s design from Zaha Hadid. The new design has resulted in continued critique,

“Arata Isozaki has warned the latest, scaled-down vision for the Games centerpiece could be a ‘monumental mistake’ and a ‘disgrace to future generations’. The 83-year-old called on the arena’s client – the Japan Sports Council – to invite Zaha Hadid to redesign the stadium from scratch in light of the revised brief. In a letter to the organization, he said: ‘Two years ago, I felt that the Zaha Hadid proposal... was a design that presented an excellent image of a 21st century urban architecture.’ He continued: ‘However, when I saw the revised proposal... I was shocked to see that the dynamism presented in the

original had gone. What remains is a dull, slow form, like a turtle waiting for Japan to sink so that it can swim away.”¹

Isozaki’s observation is that the stadium’s new design has lost the spirit of hope for the future of Japan. The critique by Isozaki is that the stadium is not just a functional building to house the Olympics, but also a global iconic symbol for the country of Japan.

The main stadium of the 2020 Japanese Olympics will become a sign signifying the national aspirations of Japan for the rest of the world to see during the 2020 Olympic Games. How do stadiums become aspirational national symbol? To answer that question: first, there needs to be an understanding of the context of sports as an entertainment purpose in the modern world.

A stadium is a sign that represents the local and national interest of a locale, the stadiums physical form creates similarity on the national level by being a specific type of building and also providing uniqueness through the individual components of the form that differentiate one stadium from another.

The affinity of a fan to a particular team of a given sport is commonly based around the location of the team's home field. Figure 5 shows the extent of prominent territories for the National Football League. Within each there is a star, signifying a stadium. The map illustrates a region similar to a nation state in which the star represents the capitol. Since in the nation of a sport team the home stadium is the most important area within the fan base community, the stadium becomes the capitol building of the nation.

¹ Fulcher, Merlin. "Hadid's Revised Tokyo Stadium Branded 'turtle' in Latest Attack." Architects' Journal. Accessed November 16, 2014.
http://www.architectsjournal.co.uk/8672172.article?WT.tsrc=email&WT.mc_id=Newsletter2.

Stadiums provide a city with an identity outside typical geographical or political defined boundaries. What the stadium does is project the boundaries of the city beyond the typical geopolitical limits. The culture of the city spreads beyond its geopolitical border, creating a broader area of control through cultural influence. The stadium in essence allows the city to extend its reach through cultural influence.



Figure 5 - NFL Team Influential Reach
Source: Accessed November 16, 2014.

http://assets.sbnation.com/assets/710910/UnitedStatesofFootball_4e2058904ebdb.png

2.5: Conclusion

While stadiums are expensive and in many cases are economically not justified, stadiums like Aloha Stadium in Honolulu are important structures for American cities. Stadiums are an edifice to American culture, supporting the nation's love of sports and entertainment. For an American city, the stadium is a connection to not only the nation but to a location's cultural identity. In some sense, they are the American equivalent of Europe's iconic cathedrals.

Understanding that economically stadiums are poor investment, there must be other justifications for the cost. As stadiums are local indicators, the cultural worth is justification for the cost. Cultural value for a local is an issue that is becoming important in a globalized atmosphere, because it allows for the area to be unique. With hopes to be unique, future stadium design must continue to increase in quality, to outdo the stadium that has come before. As long as this type of competition exists, future stadiums will become bigger, better, and more spectacular.

Chapter 3. Understanding Stadiums – “When is a Stadium a Stadium”

To understand what an architecture type of building like a stadium is, the characteristics of a stadium need to be defined. But how does one define a building's characteristics? Is it by the activity that the building is built for? In the case of the stadium the activity did define the building. For the meaning of the word stadium used today is derived from the ancient Greek word stadion.

Stadiums were an important structure for the ancient Greeks. The stadium was a type of temple to their Gods. The Greeks believed that showing physical prowess, was a way to show their appreciation to the Gods for the blessing the Gods bestowed upon them. Games were important to the Ancient Greeks, so much the point that peace was declared when events like the ancient Olympics occurred.

Stadiums continue to advance in contemporary time as they have throughout history. Until the Modern Era stadiums were focused on having a seating area and an area for the action to occur. As time progressed stadiums began to differentiate to draw a larger assortment of people to be entertained.

Stadiums in the modern era represent more than just a place of entertainment and revelry to the gods. Contemporary time stadiums have become local indicators, representing the characteristics of the surrounding area, providing program and function.

3.1: History of Stadiums

Stadiums have been an important component of human society. By going through the history of stadiums, one will understand the transformation of purposes beyond the events held. This section will expand upon the research presents in my Master's thesis conducted at Tongji University, framed appropriately for this thesis.

The oldest stadium on record is the “Stadium at Olympia” found in Greece in the town of Olympia. The Stadium of Olympia is an example of stereotomic construction, which is defined in the architectural academic lexicon as “to stack upon”. An example of stereotomic construction is stacked masonry. The site for the stadium chosen at the side of a hill, and the hill was excavated to an appropriate slope to form the sides of the stadium. The slope formed one side of the stadium’s seating, while the playing area was then excavated to continue the slope of the seating area. The removed earth was used to construct an additional seating area facing the initial seating area. [Figure 6] The stereotomic architectural structure of the stadium began with a negative and additive process created by the excavation process.

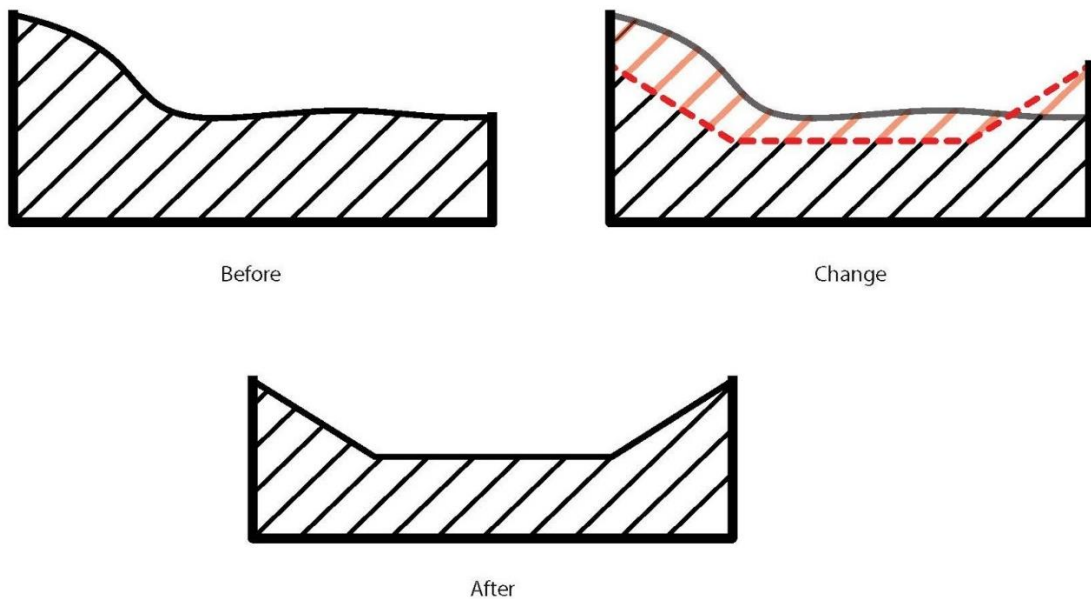


Figure 6 - Stadium at Olympia Construction Diagram
Source – Feo, “Structure as Architecture” Style: Stadiums as the turn of the 21st Century.

Stadium at Olympia was built for the purpose of foot races. Which as mentioned earlier, the name stadion evolved as a result of the function of the building. An important fact to know is that the meaning for the word stadium comes from the Greek word stadion. A stadion is a unit of measurement for length, the “Playing area” of the Stadium at Olympic measures the length of approximately six hundred stadion, or about 176 meters. The Stadium at Olympia was also used for the events of the ancient Olympic Games.

The oldest stadiums consisted of similar components of modern day stadiums. There was the playing field, seating area for the general population, VIP seating, and advertisement areas. The programming [Figure 7] of Stadium at Olympia is composed of a track surrounded by banks. Located in the banks are a stone platform and an altar. The stone platform called the exedra was seating for the judges, who were picked from the elite members of society in order to ensure the integrity of the games. The judges’ seating area was similar to the owner’s boxes of today as the judge in these events were decided based on how notable the person was in the society. In a sense, the alter was an ancient form of advertising. As the events were held in hopes of appeasing the Gods, the alter was dedicated to the locals favorite deity, and therefore, served as an endorsement of the power of that God.

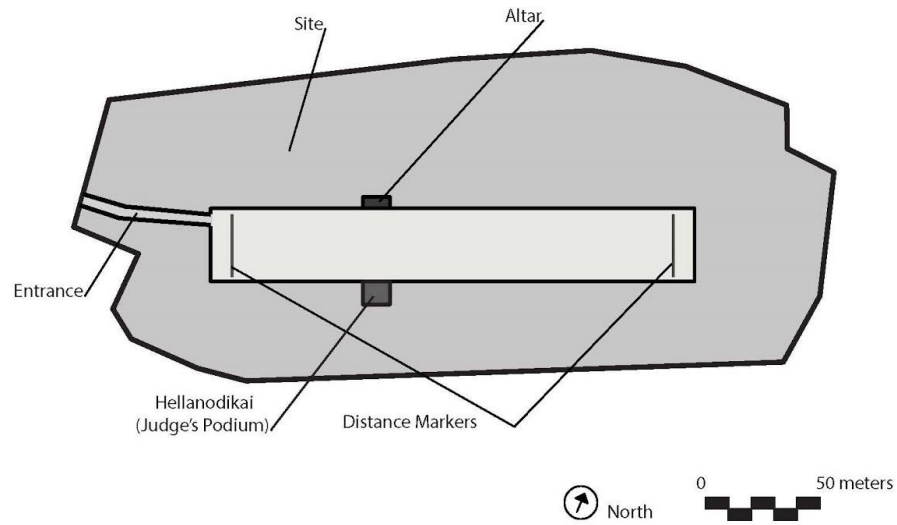


Figure 7 - Stadium at Olympia Site Diagram

Source – Feo, “Structure as Architecture” Style: Stadiums as the turn of the 21st Century.

Though the Stadium of Olympus was constructed for foot races, it eventually incorporated other forms of racing, particular chariot racing as a result of the evolving tastes in entertainment. The other form of stadium that appeared during ancient Greece was the Hippodrome. The Hippodrome was constructed in a similar fashion to the Stadium at Olympia, by excavating a hillside. Using the dirt from the excavation of the hill, a new hill was constructed on the other side, creating seating that surrounded the track.

Following the Greeks, the Romans did their version of the Hippodrome called the Circus. The largest difference between the Greek and the Roman construction is that the Romans began to make buildings that did not need to be constructed out of the landscape. The Roman’s construction method was stacking of stones to make the form of the stadium. The stadiums were still cut from the earth, but instead of being terrestrial architecture, the architecture became terrestrial stacking architecture.

During the Roman Empire, communities constructed multiple theatres and stadiums to entertain their population. The development of the arch allowed the Romans to construct large structures that enclosed larger amounts of volume, enabling the construction of one of the Empire's largest stadiums the Flavian Amphitheatre [Figure 8], commonly referred to as the Coliseum, which resides in the current city of Rome, in Italy.

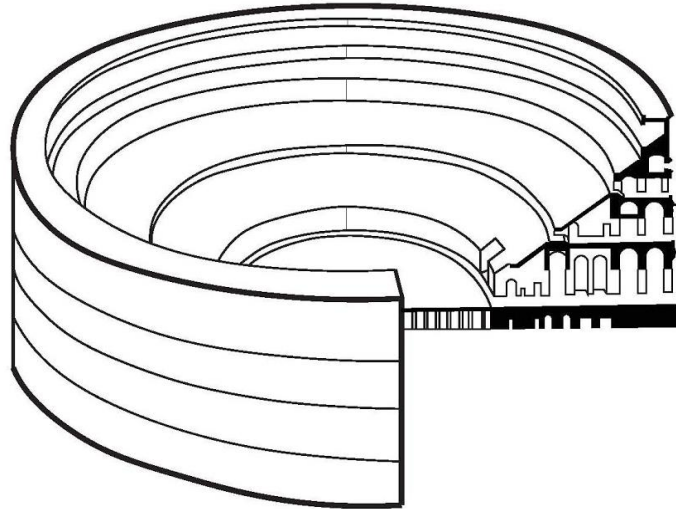


Figure 8 – Flavian Amphitheatre Section Axon Diagram
Source – Feo, “Structure as Architecture” Style: Stadiums as the turn of the 21st Century.

Stadium historians believe that the construction of stadiums was suspended between the 4th Century and the 19th Century in the western world, because of the desire to construct different types of building, including: churches, cathedrals, fortifications, towers, and palaces. The need for sport entertainment was lost until the Renaissance period, when sport entertainment became popular again. At the time, sport entertainment did not have a need for building, as the sporting events were conducted in any open space. A famous example of using an open space to hold a sporting event is the Piazza Del Campo in Siena, where horse racing still occurs today.

Though the square does not have the typical form of a stadium, a use of the square is the same as the programming for a stadium. It was quite common for public squares to be the place of gathering for the town, making it the ideal location for public entertainment

to be conducted. To provide for the spectators in these events, temporary structures were erected for their comfort. Knowing precisely the form of these structures is difficult, as the materials used for construction was wood, leaving us to speculate on their form and construction.

At one time, it was believed that stadium construction did not occur between the fourth and the 19th century, in actuality, stadium construction was prevalent during the 16th Century, A recorded form of stadium was built, appearing within the construction of English castles. For example, Henry VIII redesigned Whitehall Palace in 1540 to include a tiltyard for jousting with an estimated seating capacity of 10,000 – 12,000 seats.

Note that the tiltyard stadium type was found typically within castles, raising an interesting question: Is the tiltyard a stadium type, given that it is part of the programming of another building type? For the purpose of architectural research, a tiltyard should be considered a stadium type. Thus, a component of a building can be a type of stadium, as long as its primary function is as a place for a spectator to view a sport. The tiltyard location is shown in the diagram of Kenilworth Castle. [Figure 9]

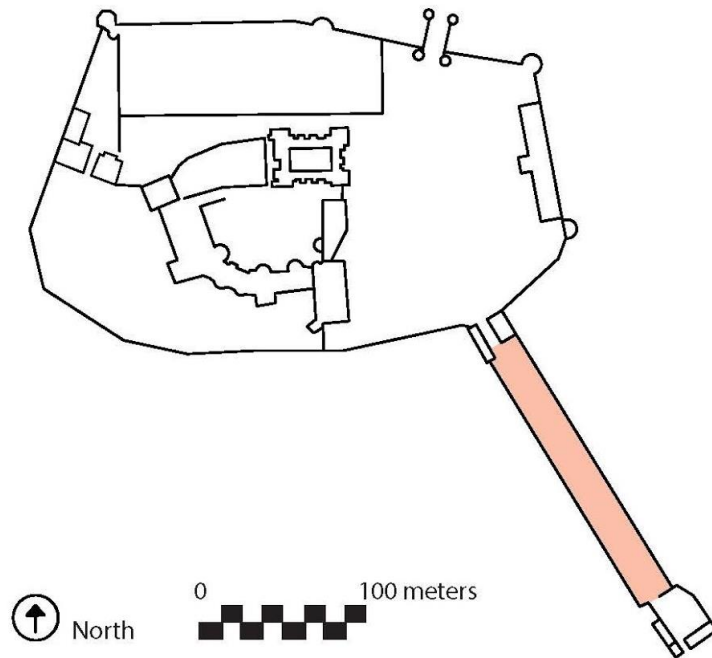


Figure 9 - Kenilworth Castle's Tiltyard Diagram

Source – Feo, “Structure as Architecture” Style: Stadiums as the turn of the 21st Century.

The tiltyard was used to host gladiator battles as well as jousting. Additionally, the tiltyard of the Hampton Court Palace has a tower designed specifically for the use of viewing the tournament. In essence, the tiltyard was the castle’s entertainment area, similar to the room where the television set is today.

The current versions of stadium history are not a fully inclusive picture of the stadium type. As the research of this thesis cannot extend into every inadequacy of historians’ definition of stadiums, it can only address and admit to the fact that the entire discourse of history is not fully comprehensive.

Stadiums began to be constructed again in the 19th Century, with the emergence of organized sports, seen in the football (soccer) leagues that formed in Europe. While the football leagues were gaining notoriety, the revival of the Olympics, in 1884 is pointed to by stadium historians as the beginning of the importance of sport in the modern era.

“Technical Recommendations for Grandstand in Modern Stadium – Stadium Atlas,” by Rod Sheard, documents the types of stadiums in the modern era based on programmatic design drivers. Sheard explains the five generational types of the Modern Era Stadium. To categorize the types of stadiums, Sheard broke them up into generations. In each generation, the primary design drivers are explained. The next generation of stadium occurs when the primary design drivers change.

“First Generation Stadia - Emphasis was placed on large audience capacity with minimal concern for quality of facilities as well as comfort for the spectator.

Second Generation Stadia - Greater emphasis on comfort of the spectators and improving support facilities in the venue. Stadia were largely concrete bowls and a great many of the world’s sporting venues are second generation stadia.

Third Generation Stadia - The family stadia emerged in the early 1990's, developing facilities to lure the entire family to the events. Sports were the focus but not the only attraction. It is important to note that the principle source of income shifted from turnstile receipts towards merchandise and television rights. This caused the incorporating of bars, food outlets and shops to infiltrate the stadium.

Fourth Generation Stadia - Integration of design, funding and management. Look at the Telstra Dome as an example. Look for opening roof, moving seating tiers and a below-pitch car park. This is a blueprint for the city of the future.

Fifth Generation Stadia: Urban Regeneration - Stadia have come of age. They have grown into buildings that can be used as catalysts for the planned and strategic growth of our culture, our aspirations and, sometimes, our failures. We need to learn how to use them wisely.”

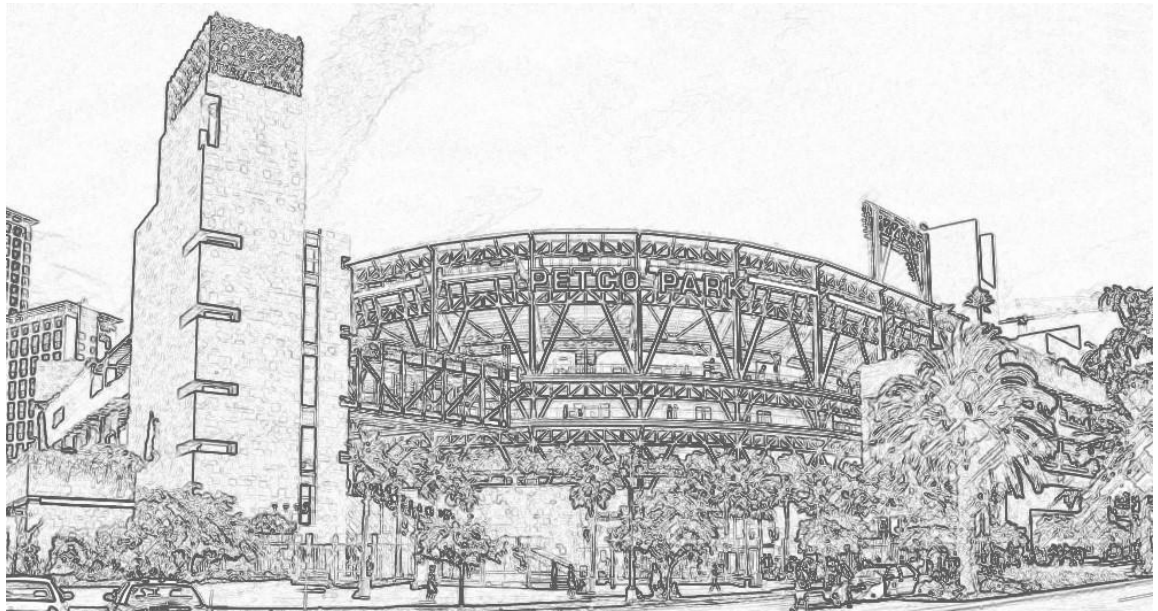


Figure 10 - San Diego's Petco Park an Urban Regeneration Stadium
Source – Feo, “Structure as Architecture” Style: Stadiums as the turn of the 21st Century.

Petco Park is a baseball stadium located in southern California, in the town of San Diego. The stadium is home to the Padres, a Major League Baseball team. The intention of the project was to revitalize San Diego’s decaying downtown district. The area it is built in borders the city’s Bay and the Gaslamp District, an area redeveloped at the same time to assist the city in revitalizing its downtown area. The theme of revival carried through to the style of Petco Park, and is best described as “retro,” as the stadium was designed to bring back the glory days of baseball stadiums of earlier generations. Petco Park shows that entertainment venues are a cohesive package that can reach into community enhancing the quality of life.

The fifth generation of stadiums is a focused on the building being used as a catalyst for the growth of culture. With the emergence of the fifth generations of stadiums, architecture is becoming a prominent influence in the design of the stadiums.

Incorporating architecture with sports entertainment, a stadium becomes an iconic esthetic for the city. When one thinks of Rome, a common image for many is of the

Coliseum (Flavian Amphitheatre), demonstrating the iconic image stadiums bring to an area. With the architecture of the stadium being a symbol of national importance, stadiums have become an important architectural canvas for nations.

The difference between the Roman version, and the fifth generation stadium described by Sheared, is that the Roman stadium design is constrained to the building ability of the Romans. In other words, the Roman stadium exists the way it does because the Coliseum was constructed with the methods understood by the Romans. The result is a stadium that becomes not only a place of entertainment, but also an indicator of the culture. As the arch was a technology mastered by the Romans, the stadium was constructed as a result of the development of the arch. Since no other immediate culture around had similar technology, the arch became a symbol of Roman ingenuity. In a way, the Roman Coliseum is, at the very least, a precursor of the fifth generation of stadium; and at most the very first fifth generation stadium in existence.

3.2: The American City and Her Stadiums

The crowd roars over the organ's hum as they chant "Take Me Out to the Ball Game," during the middle of the seventh inning. The chanting of the crowd at an American Baseball game is a modern ritual developed from the transformation of sport entertainment. The ritual is not for a religious or a solemn occasion, but the celebration of human physical triumph through sports.

Sports in contemporary United States have evolved into a cultural experience. Sports have been a form of entertainment dating back to antiquity, but the formalization of teams became effective in part because of the underlying acceptance of nationalism. The formalization of teams begat national professional sports, as seen with the proliferation of Major League Baseball, at the turn of the twenty-first century. National professional sports throughout the country have become a pivotal component of the United States' culture.

The design of the corresponding sports buildings had to respond to the resulting increased demand that developed as a result of the new cultural experience of the nation. Throughout U.S.'s stadium history, stadiums have had to become more advanced and multifaceted facilities, because of the stadiums becoming a representation of not only the team but also the locality of the area. Unlike in Europe, where the most prominent buildings for the region were churches and castles, for the towns and cities of the United States the stadium is a major architectural indicator of a region.

Having a local indicator in a city comes with a significant monetary cost. This demand for individual identity within a larger movement has increased the cost of stadiums. Towns compete to have the best facilities, where the architecture of stadiums is now being compared to historical architecture monuments; as seen in the opening of the Dallas Cowboys' Stadium, which was presented alongside pictures of the Pyramids, Parthenon, Coliseum, and Taj Mahal. From an architectural perspective: Is the Cowboy's stadium worthy of being in league with some of the greatest buildings constructed? In my opinion, this is not as important an argument as the point that stadiums for the United States are the local indicator. In crafting the local indicator the expense in some minds, for example the owner of the Dallas Cowboys, is a worthy use of capitol resulting in the construction budgets increasing.

The large amount of money to construct the stadium has become the burden of the public, since it is the taxpayers' money that pays for the stadium. How is this justified? This burden has been thoroughly analyzed by economists, with the conclusion that it is not economically beneficial for stadiums to be constructed with the public picking up the tab. On one side, *Pro-Stadium* minded people, such as professional sports teams, are concerned with image, sparing no expense; while the other, *Anti-Stadium* minded people, including fiscally concerned citizens, are concerned with seeing a return on investment.

Despite the financial and economic burden, stadiums are an important structure for American cities because stadiums have potential to be the catalysts for urban renewal projects, as well as providing a town with an identity outside typical geographical or political defined boundaries. Additionally, stadiums are gathering places that provide entertainment, which is an important human need. The architect of the stadium must consider the contradictions in the implications of developing a stadium for an area. Thus, architects must investigate the important considerations through the lens of financing, construction, and lifecycle, in order to provide a design that will mediate the paradoxes. On the one hand, stadiums are a demand for extravagance; but on the other hand, the stadium needs to be built in a way that does not bankrupt the city. Aloha Stadium in Honolulu, being the venue for the National Football League's Pro Bowl, is one example of the stadium being an important structure for an American city. In this case, the stadium gives the isolated state of Hawaii the ability to connect with the nation's cultural experience of sport entertainment, without the need of having a team of their own.

3.3: Stadiums Cost Benefit Analysis

This section deals with the problem of funding large-scale projects. The expense of the stadium is generally passed onto the citizens through taxation, this makes the construction of the stadium a semi-public project. The section will look at the arguments of the benefit, as well as, the detraction of the construction through political and monetary parameters.

Creating a sense of place is an important component when constructing stadiums. Towns hire architects to design stadiums to embody the genius loci of the town and the region. Constructing those stadiums has become a monetary burden for the area for which they serve, causing the public to question the choice of spending public funds for private business, such as sports teams. Some critics call the development of extravagant stadiums government subsidies for the professional sports teams. To deal with this concern, most

proposals for the use of public funds for building stadiums are accompanied by an economic impact study.

Economic impact studies look at the cost and the benefits of constructing a new stadium. The cost and benefits can be broken down into four categories: direct benefits, indirect benefits, construction costs, and operating expenses. Proponents of the stadium project, the professional team or the local stadium authority, adulterate the process, typically by funding these studies. The results of these studies overestimate the benefits of the stadium. When studies are conducted and funded by third parties, the resulting conclusion is that stadiums are a poor return on investment.

If stadiums are not a good financial investment, then why in the last twelve years have ten new National Football League stadiums been constructed? In the book *Cities and Sports Stadium: A Planning Handbook* edited by Roger L. Kemp, the author combines essays that present case studies, explaining the value and limitations of stadiums. One of the case studies quotes a Minnesota County commissioner, Mike Opat, who says,

“No one argues for a new museum and theatres: No one argues for a new museum on the grounds that it will create jobs or revitalize a neighborhood. But people enjoy museums, vibrant communities have them, and citizens come to expect them... I can't put a dollar value on the number of seniors or young people who follow the team, there are just a host of intangibles.”

The argument that is being made is that the construction of a new stadium is an important factor in a professional team's decision to stay or leave a city. The decision impacts a much larger percentage of the population, young and old, than that which may actually use the stadium.

The idea that sports increases the quality of life is quite obvious in the United States, when one looks at the integration of sports in high schools, colleges, and other places which have the primary purpose to provide education. In the United States, there appears to be a fundamental belief that sports reveal and enhance a person's character. Those personal characteristics are important, because they make up a culture's value system. This adds an important moral component that supports the cultural importance of stadiums.

What a professional stadium represents is the value of sports to a location. Stadiums are the pinnacle embodiment of the United States' fundamental belief that sports are beneficial to a person because they enhance the participants' character. The stadium becomes a physical icon of the morals that define the culture. Stadiums have the ability to uplift a society, which justifies the cost of constructing such a costly structure.

Chapter 4. Stadium Design Case Studies

By looking at other stadiums being constructed for professional sports, a catalog of proposed, implemented, and successful structures delineates what designers of the future stadium, that replaces Aloha Stadium, should adopt or avoid. With the stadium not being constructed for another ten years, the likelihood of a National Football Team increases. Thus the initial focus of the case studies is drawn from professional stadiums.

Knowing that a new stadium for Honolulu would not begin construction until 2020, at the earliest, the ability for the city of Honolulu to begin the discussion of a National Football League to expanding the number of teams should begin. The expansion of the NFL is likely, as the League continues to host games in London, with last year seeing three games being played in Wimberley Stadium. The football commissioner Robert Goodell has stated that he sees a football team in London very soon. If that were to mean expansion of the League, then a new expansion team in Hawai‘i would make a lot of sense. It would allow the NFL to begin expanding towards the Asian Market, without having to leave U.S. soil.

The first part of this section, titled Professional Football Team for Hawai‘i, will outline the chances of Oahu hosting a professional football team. The section will then: look at professional football stadiums that have been constructed recently, enumerate important programming elements, and describe construction methods that a future Oahu Stadium might consider. This section will introduce case studies of contemporary stadiums, defined as stadiums constructed in the past fifty years (1965 to 2015), the layout will begin with the most recent, and work its way backwards.

The latest expansion team to the NFL was the Houston Texans in 2002, the addition of the team allowed for the franchise to have an even amount of teams, totaling 32. This allowed for easy schedules, as the 32 teams are divided into two conferences, with those sixteen teams divided into 4 divisions. To make scheduling easy, if the league were to be expanded, an equal amount of teams needs to be added to each conference by creating a new division, which contains four teams for each division or eight new teams in total. Adding two new divisions would make no difference to the regular season, with a new post season structure figured out.

If the NFL were to expand, where are the most likely places that the new teams would call their hometown and why? Nate Silver conducted a study that located the most likely places in which the NFL would expand to. Silver's study was conducted by reviewing the popularity of the NFL in a given market, by asserting that popularity is proportional to the number of Google Searches for NFL-related topics. The average saturation of NFL fans in any given United States city is 28%. Using that number as a multiplier to the population of Oahu - 953,207 gives a probable NFL fan base of 266,898. Silver's study determined that the approximate amount of NFL fans on Oahu was approximately 230,000.

Domestically, Honolulu has the fourth largest concentration of unallocated fans for the NFL. Domestically and internationally, Honolulu would be the eighth largest unallocated fan concentration location in Silver's chart (Table 1).² With Honolulu's County median family income from 2009-2013, \$81,370³ would easily support a National Football Team in spirit and financially.

² <http://fivethirtyeight.com/features/the-nfl-should-expand-to-london-but-first-canada-mexico-and-la/#fn-10>

³ <http://quickfacts.census.gov/qfd/states/15/15003.html>

Table 1 – NFL Fans Up For Grabs

Source: <http://fivethirtyeight.com/features/the-nfl-should-expand-to-london-but-first-canada-mexico-and-la/#fn-10>

Where There Are NFL Fans Up For Grabs			
Estimated fans by metro area, expansion and relocation markets			
METRO	TOTAL NFL FAN BASE	FANS FOR MOST POPULAR EXISTING TEAMS (IN THOUSANDS)	UNALLOCATED FANS
Los Angeles	3,660,000	OAK (590), SD (590), DAL (490)	1,990,000
Mexico City	1,490,000	DAL (130), PIT (130), DEN (80)	1,150,000
Toronto	990,000	DAL (90), BUF (50), DET (40)	810,000
Las Vegas	630,000	DAL (90), OAK (50), SF (50)	440,000
London	410,000	PIT (30), NE (30), DAL (30)	320,000
Orlando	490,000	MIA (80), TB (60), DAL (50)	300,000
Montreal	280,000	NE (30), BUF (10), DAL (10)	230,000
Honolulu	230,000	SF (20), DAL (20), SEA (20)	170,000
Virginia Beach	440,000	WAS (130), DAL (80), PIT (70)	160,000
Portland	310,000	SEA (100), SF (30), DEN (30)	150,000
Vancouver	270,000	SEA (100), NE (30), DAL (10)	130,000
Memphis	220,000	DAL (50), TEN (30), PIT (20)	120,000
Oklahoma City	270,000	DAL (120), NO (30), DEN (30)	90,000
Paris	100,000	NO (10), DAL (10), NYG (<10)	80,000
San Juan	80,000	NYG (<10), GB (<10), DAL (<10)	80,000
San Antonio	440,000	DAL (270), HOU (60), NO (50)	60,000
Sacramento	460,000	SF (210), OAK (130), DAL (60)	60,000
Essen-Dusseldorf	60,000	DAL (<10), NYG (<10), NE (<10)	60,000
Madrid	50,000	MIA (<10), DAL (<10), NE (<10)	50,000
Austin	360,000	DAL (200), HOU (80), NO (40)	40,000
Manchester	70,000	PIT (10), NE (10), DAL (10)	40,000
Columbus	330,000	CLE (130), PIT (90), CIN (80)	30,000
International market without NFL team			

As 87% of NFL fans have an income above fifty thousand, the higher income populace of Honolulu has the potential to be a good market for NFL fans. Since the average size of a typical professional football stadium is 67,000, only a third of the Honolulu fan base would be needed to fill an average size stadium. A stadium with a seat for every fourth fan would have only 57,500.

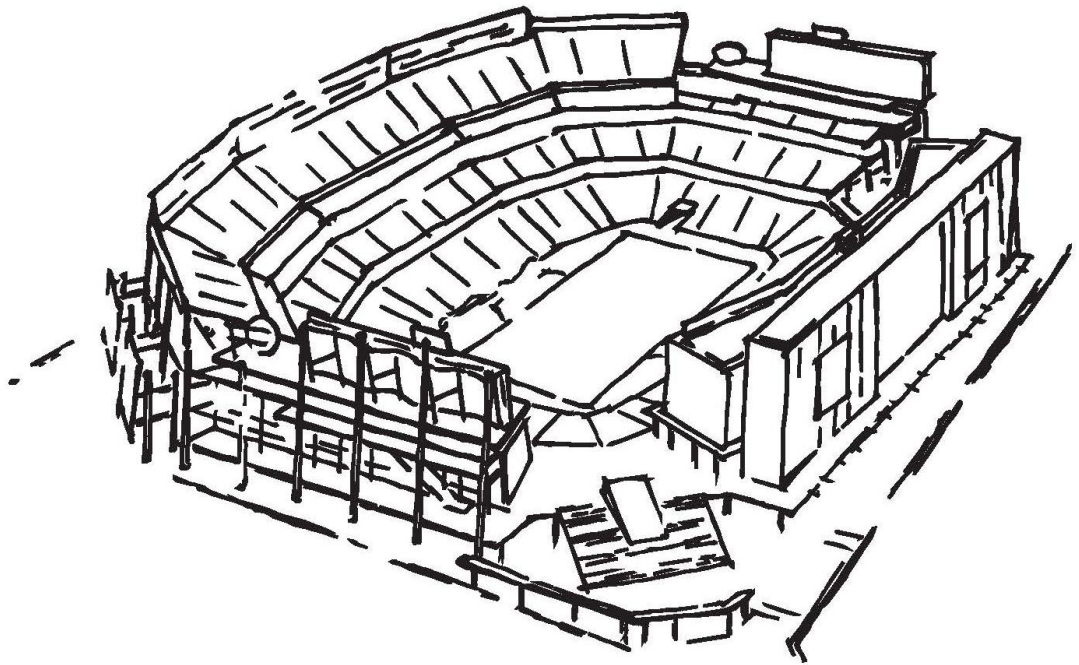
4.2: Levi’s Stadium

Levi’s Stadium constructed in Santa Clara, California, is an example of a stadium addressing the current automobile urban context. The stadium was constructed for the San Francisco 49ers home field. Levi’s Stadium is within the urban development of the San Francisco Bay Area. The stadium was constructed for the San Francisco 49ers, yet

the location of the stadium is forty-five miles south of downtown San Francisco, in the city of Santa Clara.

The duration from the initial agreement to the completion of the structure is five years. The construction process began on June 4th, 2009, when the San Francisco 49ers and Santa Clara reached an agreement on the stadium that would be named Levi's Stadium. Three years later, the construction of the stadium officially broke ground on April 19th, 2012. The construction of the stadium took about two years, being completed on July 17th, 2014.

Levi's Stadium was chosen to highlight how this stadium tackles two problems that a future stadium for the island of Oahu will face: (1) How will the stadium that replaces Aloha Stadium be environmentally friendly? (2) How will the new stadium fit within the greater region? These two problems must be considered in the design of the replacement to Aloha Stadium. The Levi's Stadium design addresses these two problems and provides solutions. Levi's Stadium success in green design, by achieving LEED Gold, should be inspirational for the future.



Date Opened	2015
Ownership (Management)	City of Santa Clara (City of Santa Clara)
Surface	Grass
Cost of Construction	\$1.2 Billion
Stadium Financing	\$330 Million Subsidy, Remainder by the Team.
Naming Rights	Levi Strauss paid \$220.3 million for 20 years.
Stadium Architect	HNTB
Capacity	68,500
Luxury Suites	162 Suites
Club Seats	9,000
Orientation	North - South

Figure 11 – Levi's Stadium Fact Sheet

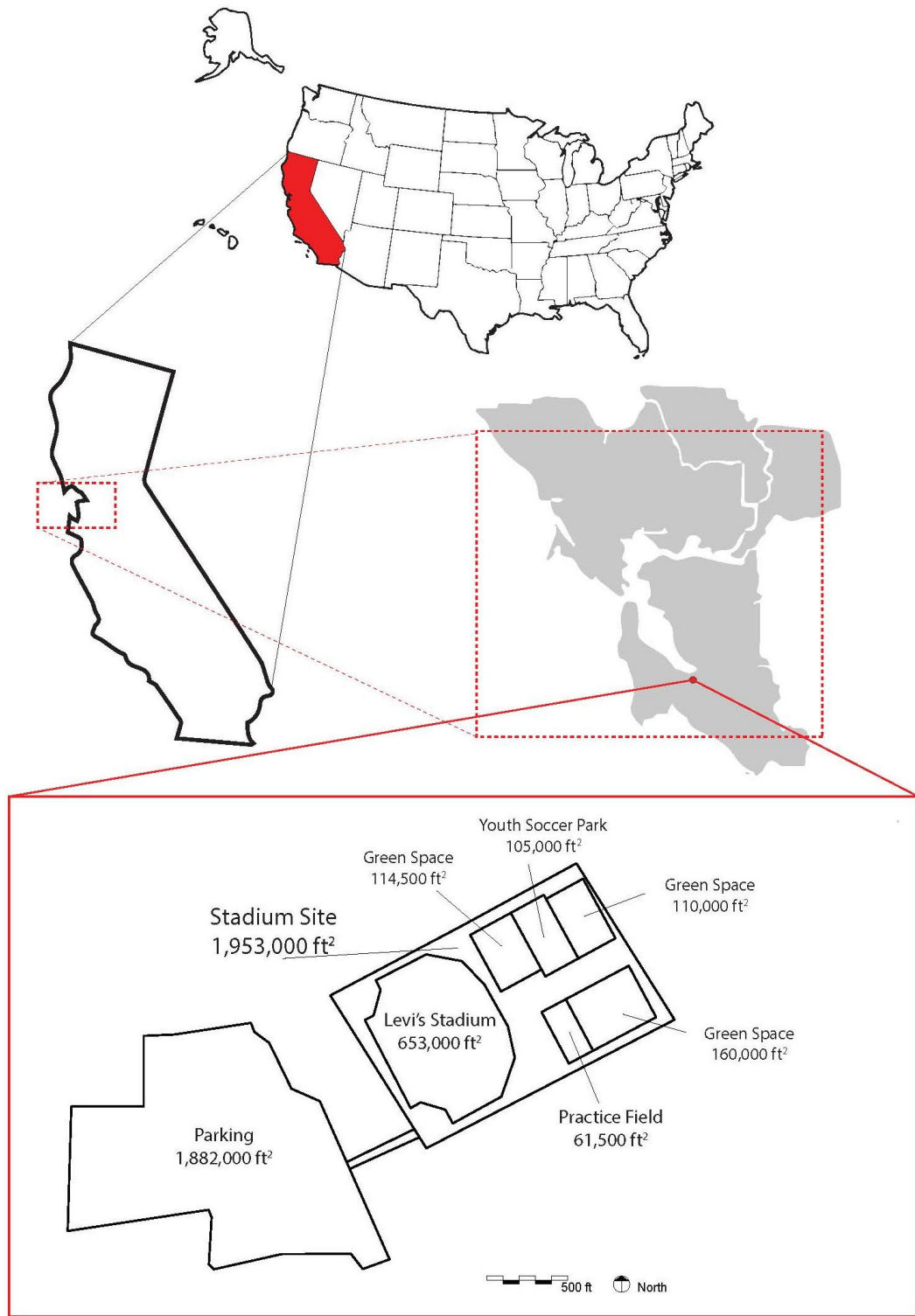


Figure 12 – Levi's Stadium Location and Site

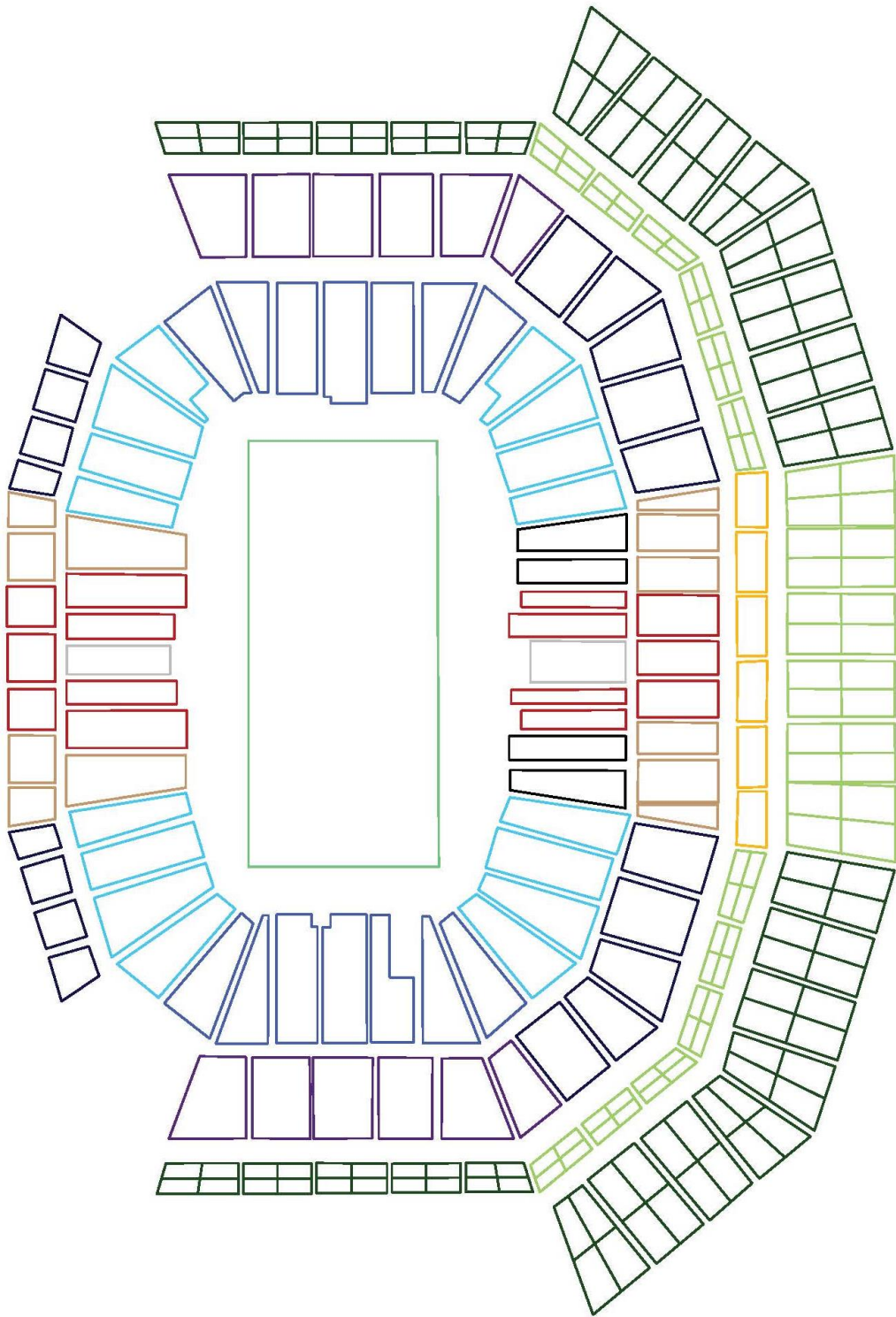


Figure 13 – Levi's Stadium Seating Diagram

How will the stadium that replaces Aloha Stadium be environmentally friendly?

Levi's Stadium boosts LEED Gold certification by being built with sustainable materials, as well as supporting sustainable practices: providing renewable energy, area specific planting, reducing water usage through low-flow plumbing fixtures, etc. The shift of environmentally conscious buildings becoming important in the United States is clearly illustrated by Levi's Stadium, with public and private money justified and being put towards Levi's Stadium's environmentally conscious design components.

Levi's Stadium shows a stadium's potential to be beneficial to its environmental surroundings. As stadiums are public facilities, the immediate surroundings of stadiums have potential to become parks for the region in which they reside. By reducing its impact on the immediate ecology, the stadium becomes a champion for increasing the local environmental supportive infrastructure.

By creating a stadium with LEED certification, expectations change. As people become familiar with LEED and are educated on the benefits of this type of design, the desire to have that type of building becomes less of an exception and more of an expectation. As mentioned earlier, stadiums are culturally important structures that embody the culture and cultural values of a locale. Incorporating environmentally friendly and ecologically minded designs, such as in the case of Levi's Stadium, ties that thread of the locale's buildings into the greater tapestry of its region's culture.

Regarding the replacement of Aloha Stadium, the stadium's designers and builders need to be conscious of the environment in which it is built. The average temperature of Hawai'i is an agreeable 72 degree Fahrenheit, but being below the Tropics of Cancer, the direct sunlight is uncomfortable, and can lead to fans getting sunburns. To address this climatic specific problem, there must be plans for a shading device or for enclosing the stadium, to reduce the direct sunlight. This makes ecological sense.

As electricity is expensive, solar panels should be implemented in the design to not only benefit the surrounding area with renewable energy, but to also create an agreeable climate within the stadium. Levi's Stadium provides renewable energy to its immediate area by having three NRG Energy solar-paneled pedestrian bridges and a solar-paneled roof deck. The replacement Aloha Stadium could implement similar solutions to the design, by creating a solar-paneled covered walkway from the proposed HART station to the stadium. This would increase the amount of solar panels by incorporating them into the immediately surrounding infrastructure. As the stadium will need to have energy workers, potentially provided by Hawaiian Electric Company (HECO), they would be responsible for managing and servicing the solar array.

How will the new stadium fit within the greater region?

Levi's Stadium is a perfect example of how stadiums become an important structure for the region. The San Francisco Bay Area urban development has occurred with heavy influence of the automobile. When walking around downtown of San Francisco, the distance between important sites is short, because many of the sites pre-date the automobile. As time progressed, the automobile become increasingly prevalent in daily life, allowing for people to cover greater distance, which in turn resulted in suburban sprawl. As most of California's growth has occurred in the last fifty years, it has developed into regions of dense urban population centers interconnected by suburban areas. The greater San Francisco area has turned into a larger regional city that is locally referred to as The Bay Area.

Development on the island of Oahu is having an effect on quality of life, as density in the southern part of the Island increases. Like the Bay Area, Oahu has expanded with a strong influence of the automobile. This has resulted in an inefficient transportation infrastructure that the county officials of Honolulu are trying to remedy by implementing the Honolulu Area Rapid Transportation (HART). Transportation is

shifting to be more efficient and to allowing a greater volume of people movement per each means of transport.

Levi's Stadium is not really centrally located within the Bay Area, as it is located in the southern portion of the Bay Area in a portion that is not serviced by the regional train service. This resulted in the need for of greater parking infrastructure. In figure 12, the area of the parking that is provided for the stadium is almost equal to that of the necessary site for the stadium. Levi's Stadium location is an example of poor site selection for the design of future stadiums.

The location of Aloha Stadium is extremely beneficial to the island of Oahu because the location is in the middle of the heavily developed south portion of the island. Moreover, the location is convenient for people in west and east Oahu. Building the replacement for Aloha Stadium in the same location is imperative in order to continue to reap the benefits of a centrally located stadium, which is easily accessible to the entire island of Oahu.

Levi's Stadium is a good example of what a stadium can do beneficially, as well as the problems that may arise from the building the structure. The location of Levi's Stadium was most likely do to the common occurrence of cheaper land being in less prime location. The out of the way location of Levi's Stadium, one could argue, is increasing the attractiveness of the area. The problem is that an immense area of asphalt becomes a barrier, like an ocean, in the urban context making Levi's Stadium cut-off from its surroundings, which would in turn could possibly stifle development.

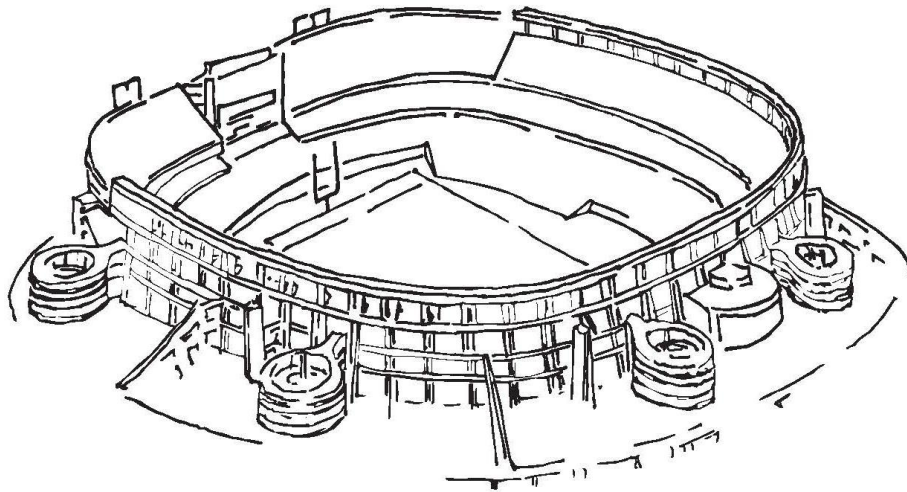
4.3: Qualcomm Stadium

Qualcomm Stadium hosted its first football game on August, 20th, 1967. The stadium broke ground on December 24th, 1965 with construction lasting one and a half years. Qualcomm Stadium contributed significantly in the transformation of San Diego from a sleepy Navy outpost to a major metropolitan city. During that transition, Qualcomm stadium grew from an initial seating capacity of 50,000 seats to capacity of 70,561. During the stadium's lifetime, it hosted a Major League Baseball (MLB) World Series (1984) and three NFL Super Bowls (1988, 1998, and 2003). Qualcomm Stadium has had three names during its lifetime: San Diego Stadium, Jack Murphy Stadium in 1981 to honor the San Diego Union sportswriter responsible for moving the Chargers from Los Angeles to San Diego, and Qualcomm Stadium.

Despite its contribution to San Diego's transformation, it is difficult to consider the stadium a successful public project, as even today, the city of San Diego owes money on the stadium. In 2012, American Broadcast Company affiliate 10 News reported that San Diego still owes more than \$54 million dollars on Qualcomm Stadium.⁴ With an initial construction cost of \$27.75 million in 1967, equivalent to \$196 million dollars in 2015,⁵ the stadium has become a huge financial burden for the city, and is the poster child of large cities failing to manage debt.

⁴ <http://www.10news.com/sports/chargers/qualcomm-stadium-debt-remains-if-chargers-leave-town>

⁵ <https://www.minneapolisfed.org/community/teaching-aids/cpi-calculator-information>



Date Opened	1968
Ownership	City of San Diego
Management	City of San Diego
Surface	Grass
Cost of Construction	\$27 million
Stadium Financing	\$78 million renovation completed in 1997.
Naming Rights	997 renovation; \$18 million from naming rights;
Capacity	\$60 million from sale of bonds.
Luxury Suites	Qualcomm Corp. paid \$18 million cash for 20-year naming rights in 1997.
Club Seats	71,294
Orientation:	113 Suites
	7,882
	East - West

Figure 14 – Qualcomm Stadium Fact Sheet

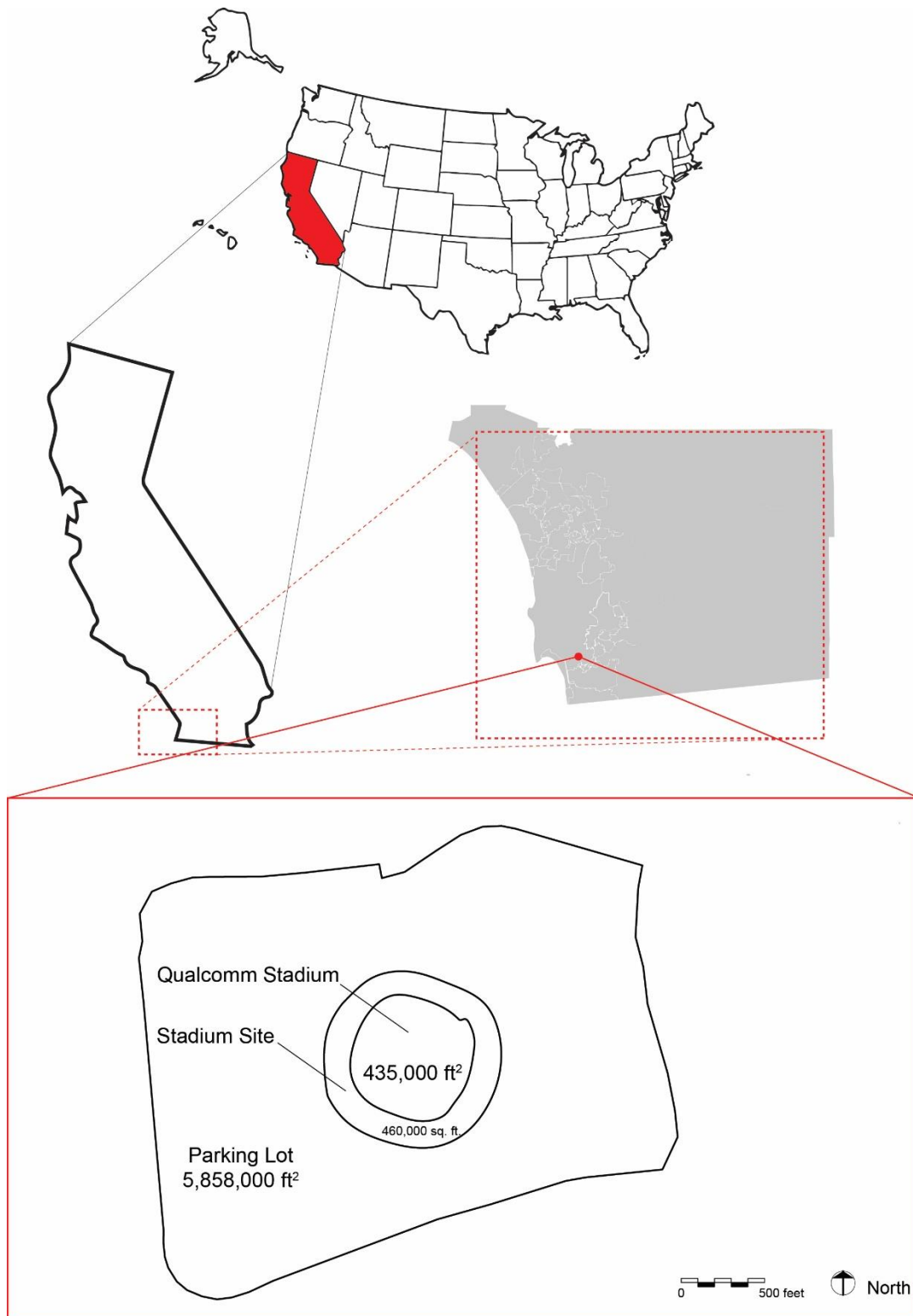


Figure 15 – Qualcomm Location and Site

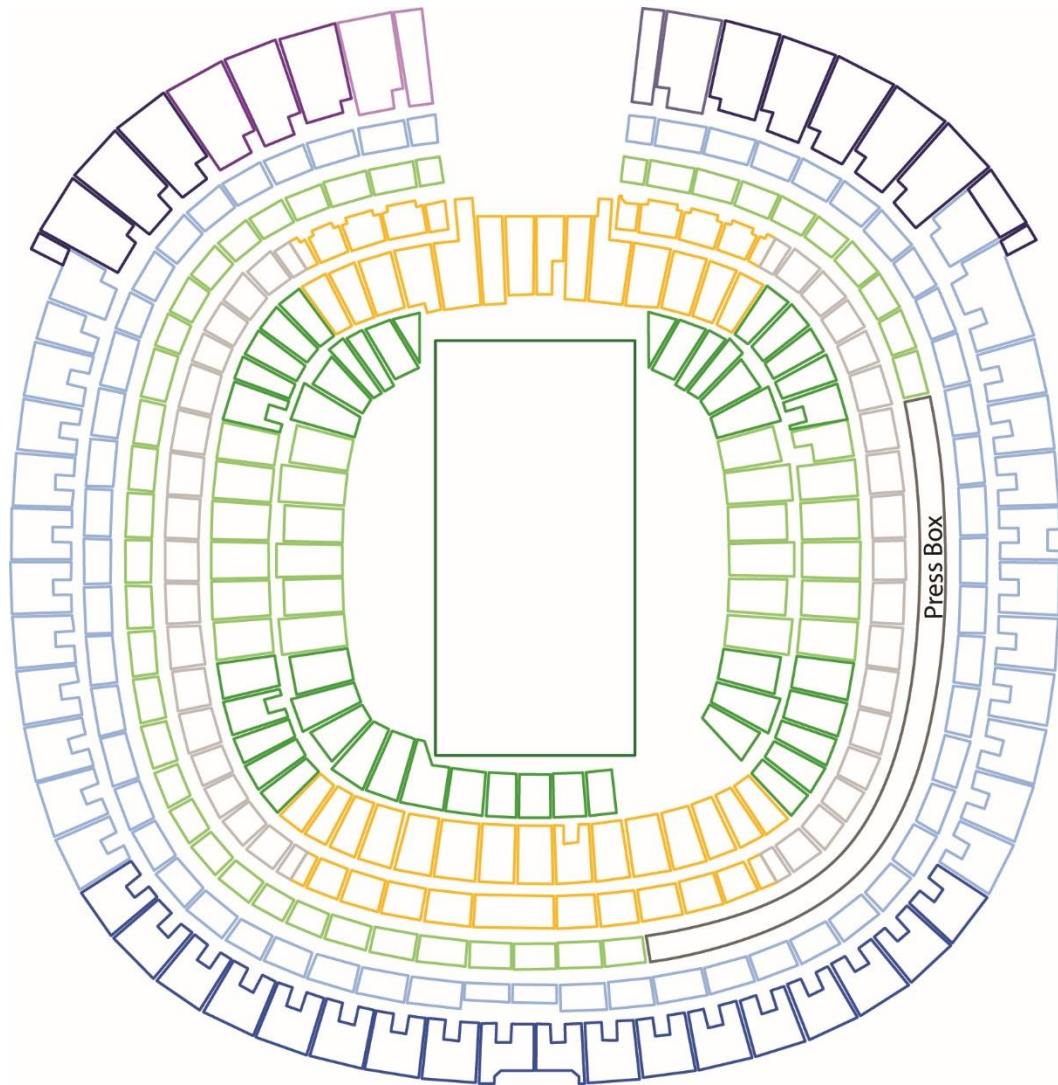


Figure 16 – Qualcomm Seating Diagram

Even with two professional sports teams and multiple series-ending games, the financial success of a stadium is not guaranteed. For the future replacement of Aloha stadium, the stadium needs to be designed to ensure that the stadium built justifies the expense, to insure that repayment of stadium costs does not exceed the usable life of the stadium, as in the case of Qualcomm Stadium.

When Qualcomm stadium was built, it was the most advanced stadium of its time. This allowed the stadium to be host to the Super Bowl and the World Series. Could the replacement to Aloha Stadium be built to be able to hold these events? As this research is focused towards a football stadium, what would be the requirements for the replacement of Aloha stadium be to host a Super Bowl?

Bryan Rose, an author for Sports Illustrated, reported on a 153 – page document leaked in 2014 outlining the features and amenities the NFL requires of stadiums and their local community to host a Super Bowl. The selected requirements relevant to this study, dictated by the NFL from the report are as followed:

Stadium Configuration:

- Seating Capacity: minimum 70,000 fixed seating capacity
- Seats must be a minimum off 19 inches wide with seat backs and arm rests
- American Disabilities Act (ADA) Compliant
- 35,000 Parking (within one mile from stadium)
- 3,000 Staff parking (within half a mile)
- 14,000 sq. ft. media work room
- 14,000 Post-Game Interview Room
- 200 press seats (1 press seat 24”w x 20”d)
- 70 minimum suites for NFL

Weather Requirements

- Average daily temperature over ten years to be above 50 degrees

Team Facilities

- Locker rooms for 65 players
- Separate training areas for teams
- Separate equipment rooms
- Separate Head couch locker room
- Assistant Couch Locker room 20 person capacity

Hotel Requirements

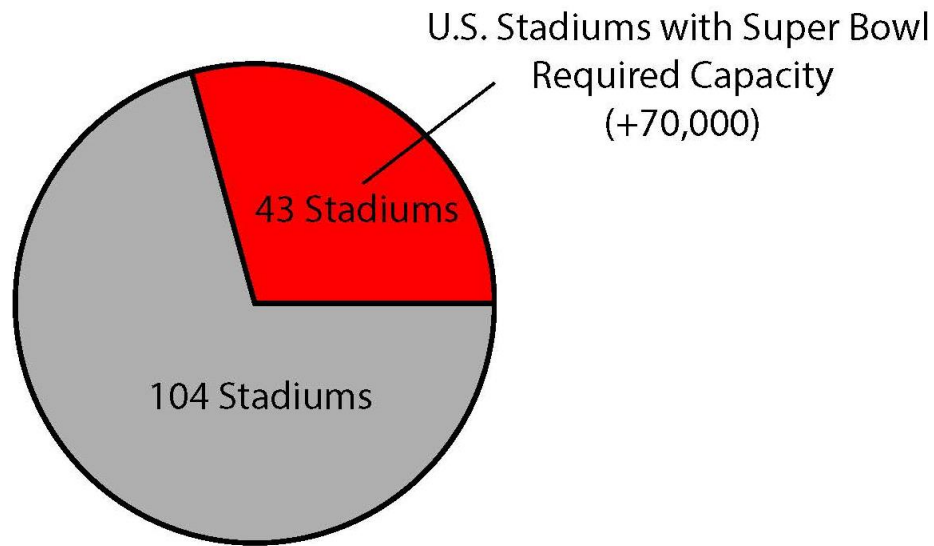
- 27,000 Hotel Room within 60 minutes
- Separate training areas for teams
- Separate equipment rooms
- Separate Head couch locker room
- Assistant Couch Locker room 20 person capacity

The requirements outlined were submitted to cities competing for the 2015 Super Bowl. Rose's report suggests that the requirements are in force until 2018. For the City of Honolulu to construct a stadium capable of attracting a Super Bowl requires it to at least match, if not exceed, these requirements, as these requirements will be outdated in a few years. Under the assumption that the City of Honolulu will finish construction of a new stadium around 2025, it will need a +70,000 seating capacity. Knowing that the capacity needs to increase is an important design driver.

Continuing investigation of Qualcomm Stadium illustrates the effect of the demands for larger stadium capacity from the NFL for Super Bowl events. Qualcomm's first renovation was finished in 1984, bringing the seating capacity to 60,794.⁶ The second major renovation, in preparation for Super Bowl XXXII increased the seating capacity to 71,450. This increase was beneficial for San Diego because it allowed Qualcomm to be the venue for a second Super Bowl in 2003. From the initial capacity of 50,000 to 71,459, the stadium had to increase its seating capacity by ~70% from initial construction at significant extra cost above what would have been incurred at original design.

For Honolulu to be a location for a future Super Bowl, the replacement stadium would need a capacity of at least 70,000 seats—40% larger than the existing Aloha Stadium. Even then, it would be but 1 of 43 stadiums in the United States large enough to host a Super Bowl.

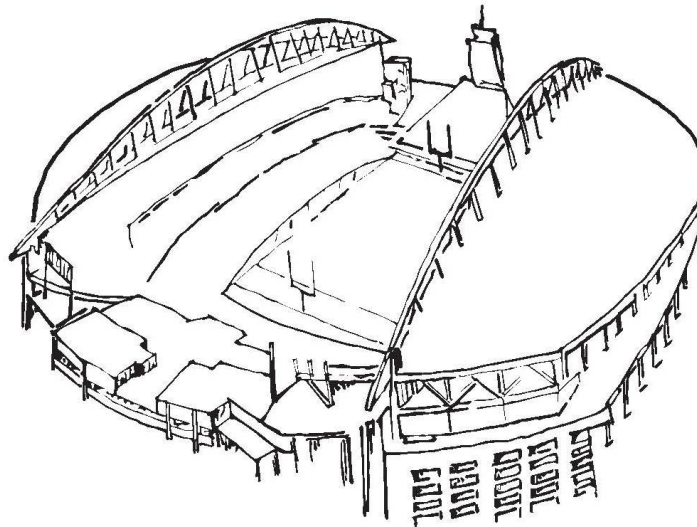
⁶ <http://football.ballparks.com/NFL/SanDiegoChargers/index.htm>



4.4: Century-Link Field

Four years after breaking ground for construction in 1998, CenturyLink Field held its first event on July 19, 2002. The stadium was designed by Ellerbe Becket, LMN Architects and Streeeter & Associates. The stadium had a construction cost of \$430 million, which incorporated both a stadium as well as an adjacent event center, a theater, and a parking garage.

The design of the stadium was followed closely by Paul Allen, the owner of the Seattle Seahawks. Allen was looking to design a stadium that would be open-air, but with an intimate atmosphere. The architectural inspiration for the stadium came from the University of Washington's Husky Stadium. Husky Stadium is an open-air stadium with covering for the spectator area, shielding most from the very wet environment commonly found in that area of the Pacific Northwest. CenturyLink Field designers borrowed the open/covered roof idea creating a stadium that allows cover for 70% of the spectators.



Date Opened	July 19, 2002
Ownership	Washington State Public Stadium Authority
Management)	First & Goal, Inc.
Surface	Field Turf
Cost of Construction	\$360 million
Stadium Financing	Extension of county issued bonds serviced by car rental and hotel tax to raise \$75 million; 6 additional lottery games to raise \$91 million; Paul Allen to provide \$100 million.
Naming Rights	Telecommunications corporation Qwest \$75 million over 15 years.
Stadium Architect	Ellerbe Becket and First and Goal, Inc
Capacity	67,000
Luxury Suites	100 Suites
Orientation	North - South

Figure 17 – Century-Link Field Fact Sheet

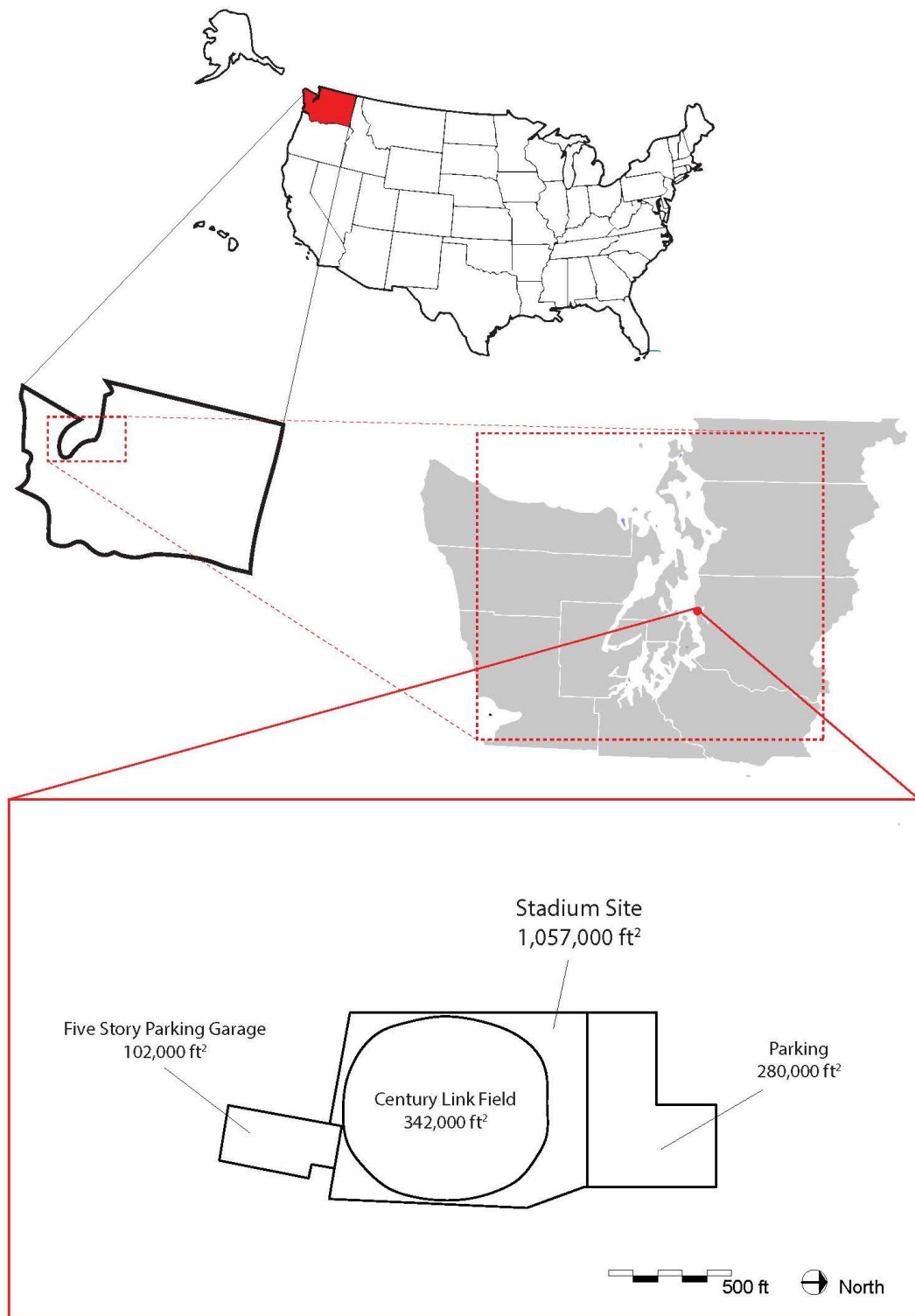


Figure 18 – Century-Link Location & Site

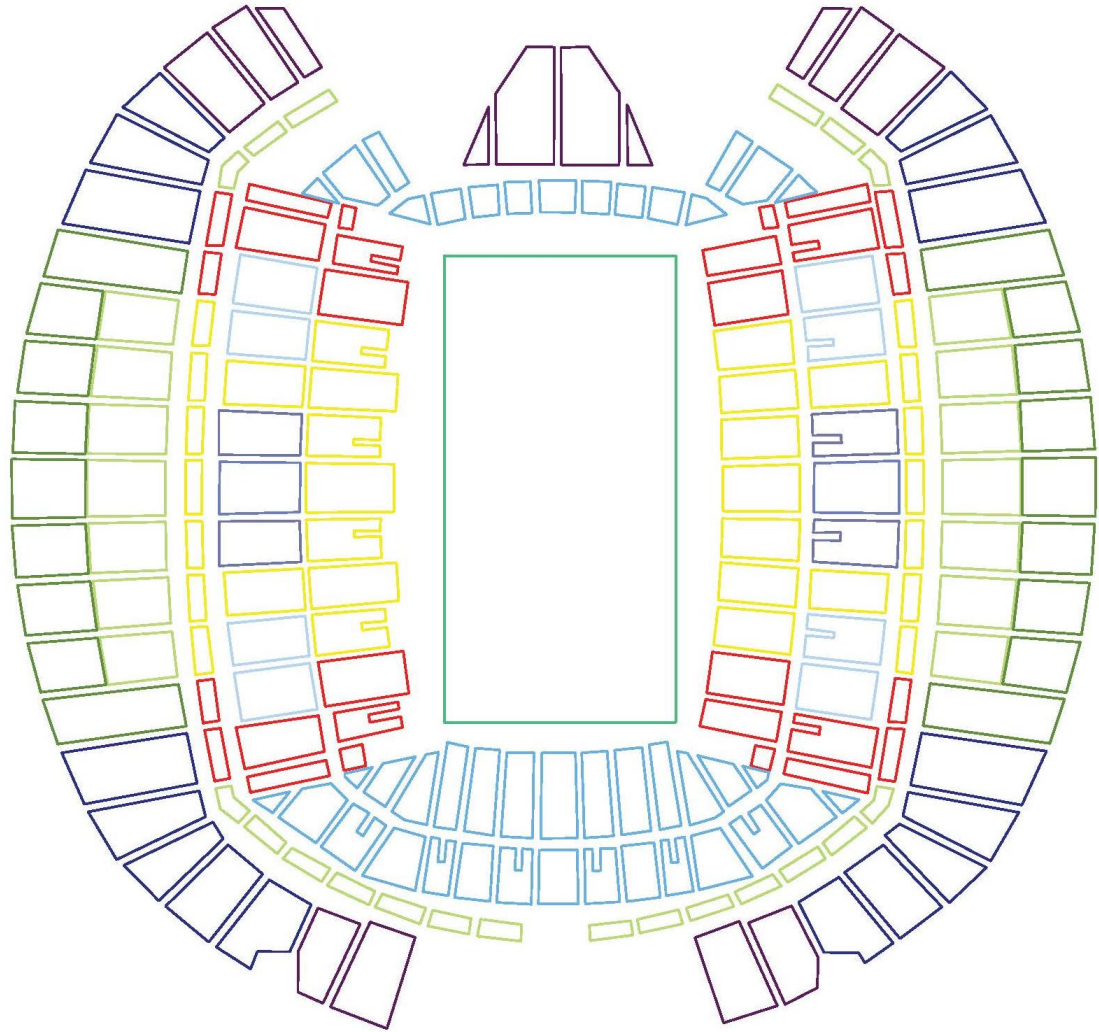


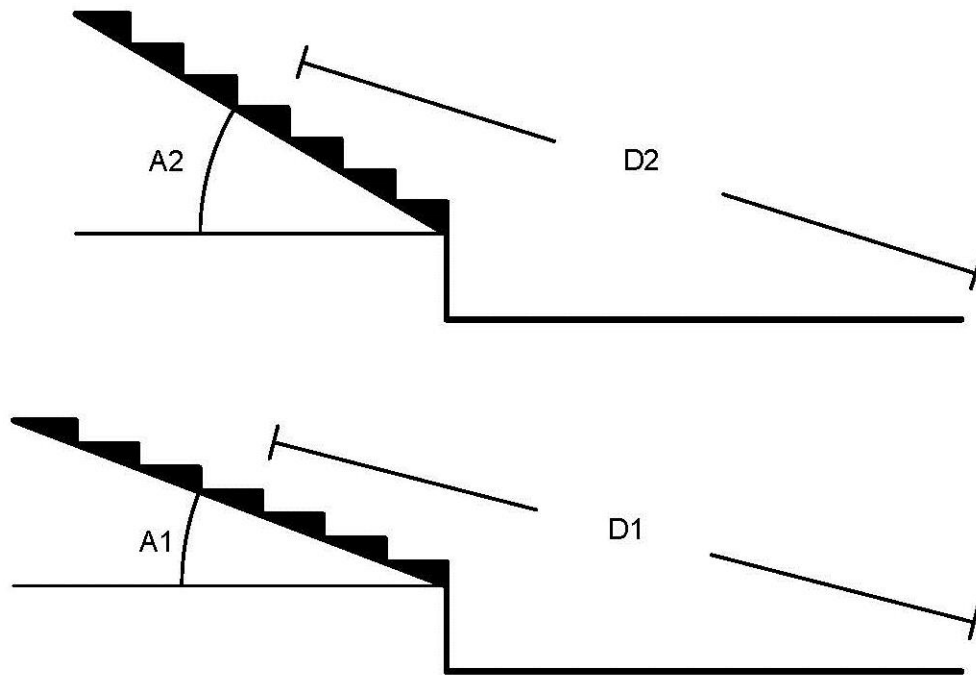
Figure 19 - CenturyLink Field Seating Diagram

CenturyLink Field has the smallest footprints of any NFL stadium⁷. Since CenturyLink Field is constructed on the site of the previous Seattle Seahawk stadium, the Kingdome, and within the urban core of Seattle, the stadium's footprint was constrained. With the constraints imposed by the site and the demand of seating capacity that was desired by the owner, allowing for potential Super Bowl games to be played at the stadium, the design solution of making the seats in the stadium have a large slope was utilized. By making the seats steeper within the design CenturyLink Field accomplished the required seating 72,000 if expanded. Normal football games have a seating capacity of about 67,000 seats. Having a high pitch reduces the distance of the seats from the field while expanding spectator's field of view [Figure 16]. The closer the seats are to the center of the field a more intimate atmosphere results. This intimate atmosphere adds to the appeal for the patrons of CenturyLink Field.

Modeling CenturyLink Field after Husky Stadium had additional unintended benefits, namely, the amplification of the crowd's noise. On Saturday, September 14th, 2013 Seattle broke the Guinness World Record for the highest peak decibel level of 136.6 decibels. Seattle's record was beaten by Arrowhead Stadium in Kansas City on October 13th, and then recaptured on December 2nd at 137.7 decibels. To put that into perspective, firing a shotgun produces 140 decibels that can result in hearing damage or loss. The deafening crowd sound can reduce a visiting offense's ability to communicate resulting in false starts. A false start is a penalty in football in which an offensive line player moves after taking or simulating a three-point stance and prior to the ball being snapped.⁸ In fact, CenturyLink Field has one of the highest number of false starts in the League.

⁷ <http://blogs.aecom.com/connectedcities/centurylink-fields-design-advantage/>

⁸ <http://www.nfl.com/rulebook/positionofplayers>



A = pitch of the stadium seats,
 D = distance from the stands to the field,
 If $A_1 < A_2$, then $D_1 > D_2$

Figure 20 – Stand Pitch Diagram

Achieving the magnitude of sound is a result of the effort of the fans as much as the architecture of the stadium. The roof of CenturyLink Field is parabolic, which allows for the sound produced by the fans to be redirected towards the center of the field.

As shown in Figure 17, the red arrows indicate the redirection of the sound. The redirection results in the amplification of the noise on the field. That noise results in the aforementioned false starts. The effect of the architecture on the game of football is skillfully achieved in Ellerbe Beckett's architecture.

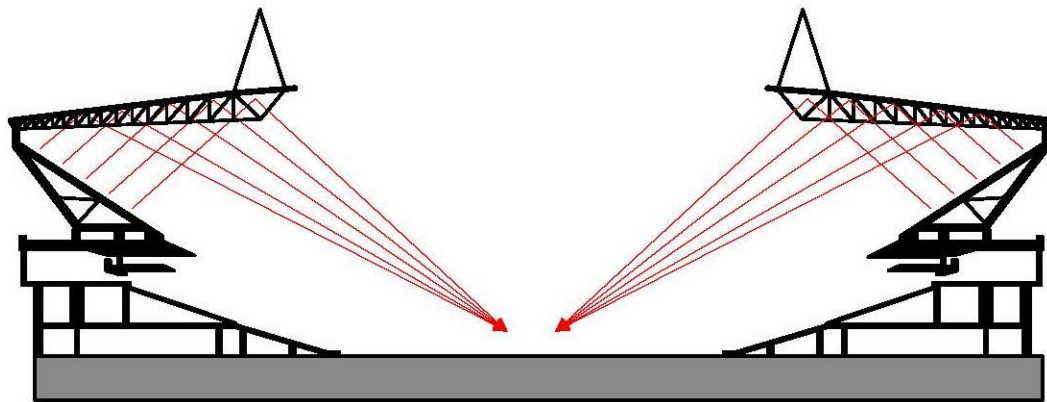


Figure 21 – CenturyLink Field Sound Diagram

4.5: Edward Jones Dome

The Edward Jones Dome constructed in St. Louis, broke ground in July 13th, 1992 and took a little over three years of time to complete construction with an opening occurring on November 12th, 1995. The total cost of the project was \$280 million. The architect for the project was HOK Sport, headquartered in Kansas City. HOK Sport was rebranded in 2008 and now operates under the title of Populous.

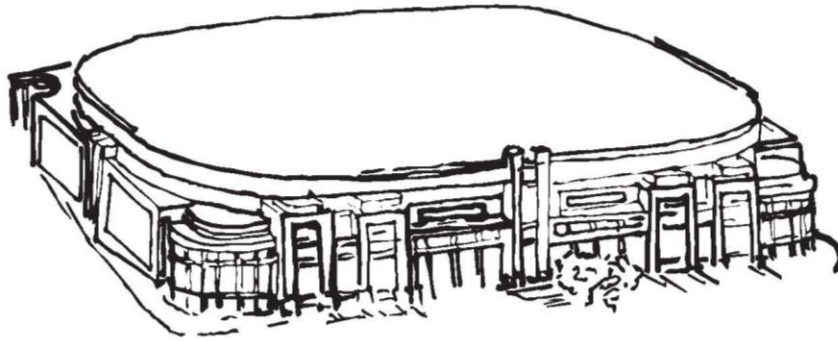
The city of St. Louis decided to build the Edwards Jones Dome to attract a professional football team. The city of St. Louis had a professional football team from 1960 to 1987, when the Cardinals moved from Chicago to St. Louis. The owner of the team, Bill Bidwell, desired a new stadium for the Cardinals. The city of St. Louis responded by proposing a 100 acres of land along the Missouri river to construct a new 70,000 seat stadium. The construction of the new stadium was delayed by political gridlock, resulting in Bidwell moving the Cardinals to Arizona. After St. Louis lost their professional football team, the government officials began to seek a replacement team. In order to do so, they used their plans to construct a new stadium to entice a team to move to St. Louis.

The NFL announced they would be expanding the league by two teams in 1991. Five cities were in the competition to host those expansions team. St. Louis became the frontrunner, when the city announced plans to start constructing the stadium that we

know today as the Edward Jones Dome. Unfortunately for St. Louis, the expansions teams went to Charlotte and Jacksonville. This turn of events did not end St. Louis' hopes to attract a professional football team, the city changed their focus to teams looking to move. The teams that were looking for a new home were the New England Patriots, Cincinnati Bengals, and Los Angeles Rams. The Rams decided to move to St. Louis because of the new facilities the city was constructing.

Stealing another's lover tells a person two things about their newly acquired love; one they are willing to do anything for love, and two they will not hesitate to look for green pastures when things get rough. An NFL team moving to a new city is the same as stealing someone else's lover. NFL teams have extreme leverage in the city that they call home. The teams bring a prestige to the city. As there are a limited number of professional football teams, they become a symbol of a city making it among its peers. Every Sunday during the season, the city's name associated with the team is announced on the national stage, to the envy of all of the other cities without representation of a professional team.

Just as gold's rarity creates scarcity and greater monetary value, professional teams uses their rarity as leverage to get everything they want, including costly, new facilities. The high costs result in substantial use of public funds, possibly exceeding what the city can afford. This situation is observed with the St. Louis Rams and the city of St. Louis. In the initial negotiation with the city, the Rams put a condition in the contract stating that "the stadium must rank in among the top eight highest quality NFL Stadium by 2015 or they'll start looking for a new city to call home." This is a problem for St. Louis, because in 2008, *Sport Illustrated* conducted a reader's poll that ranks the Edwards Jones Dome as one of the worst stadiums in the NFL.



Date Opened	November 12, 1995
Ownership (Management)	St. Louis Regional Sports Authority St. Louis Convention/Visitors Bureau
Surface	AstroTurf (1995-2004) Field Turf (2005-Present)
Cost of Construction	\$280 million
Stadium Financing	Debt issued by City, State and County; annual debt service paid by City (\$6 million from tax revenue); State (\$12 million from tax revenue); County (\$6 million from hotel/motel tax).
Naming Rights	Edward Jones will pay the Rams an average of \$2.65 million per year over the course of the 12-year agreement.
Stadium Architect	Populous
Capacity	65,321
Luxury Suites	124 Suites
Club Seats	6,500
Playing Surface	'Magic Carpet' turf system. With this system, forced-air jets in the floor create a 'cushion' that allows the turf to be rolled into place in about an hour. For storage, the turf retracts into a chamber beneath the event floor.
Lights	
Orientation	N/A

Figure 22 – Edward Jones Dome Fact Sheet

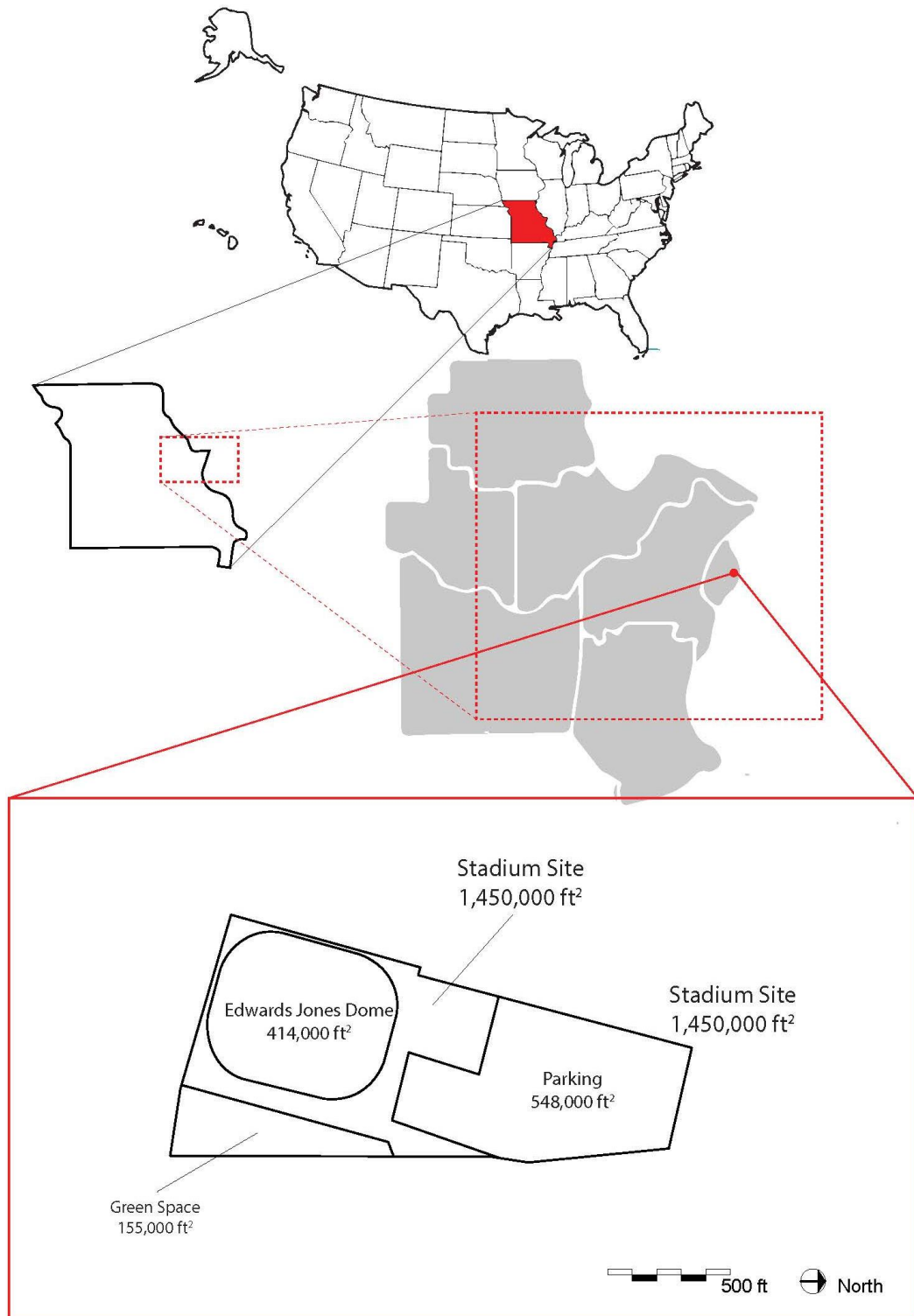


Figure 23 – Edwards Jones Dome Location

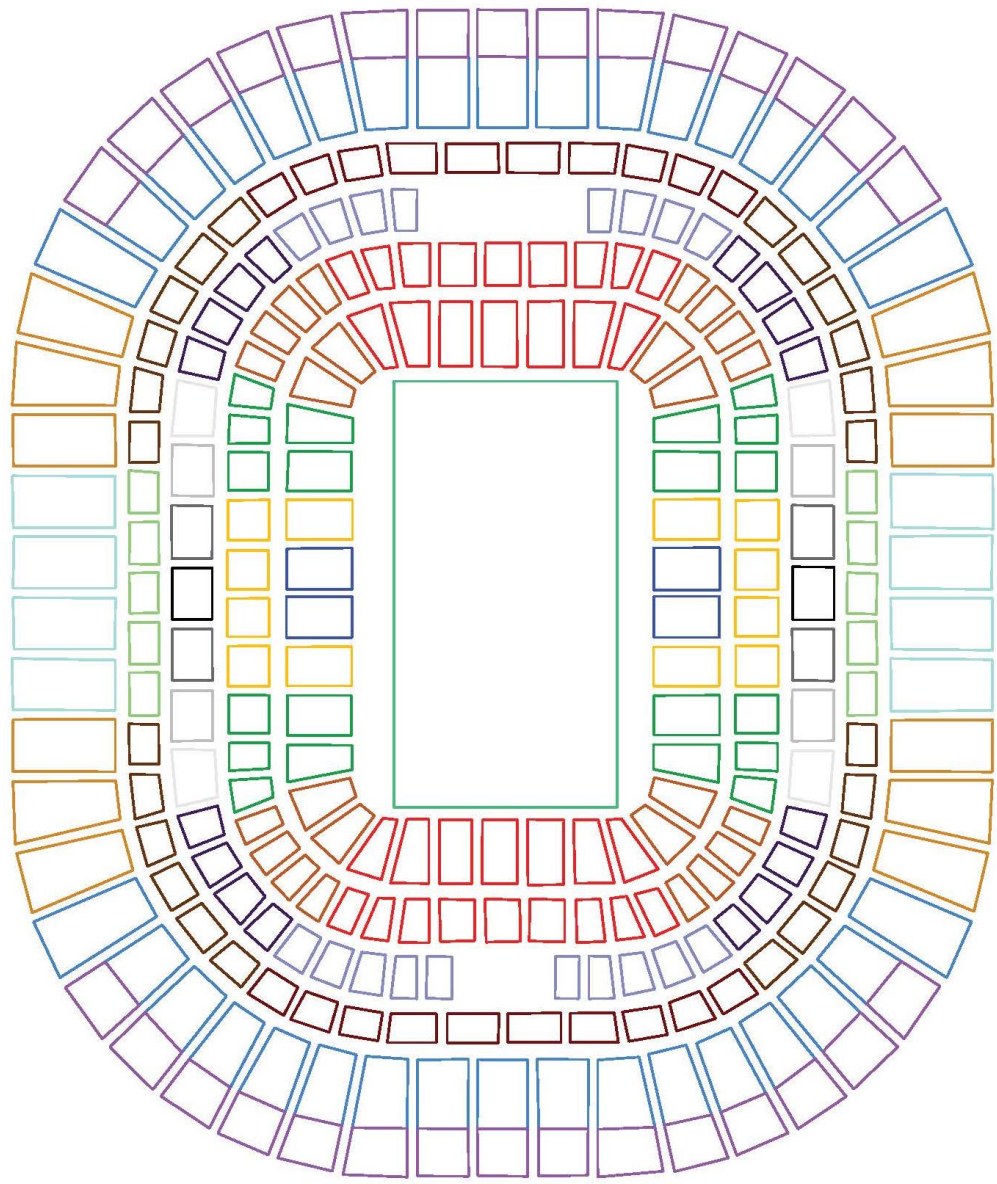


Figure 24 – Edward Jones Dome Seating Chart

In 2015, the Edward Jones Dome is only twenty years old. For a stadium to go from brand new to the worst stadium in the NFL in just twenty years implies that stadium age may not be a good indicator of stadium value. As seen in the data in Appendix C, there is not a clear distinction that age directly affects the quality of the stadium. The average age in the lowest third of stadium rank is 28 years, the average of the middle third is 20 years, and the average age for the highest ranked third is 28 years. The average age of the thirty-one stadiums is 25 years, and there is not a clear correlation between a stadium's age and its rank in the list. It is important to note the anomaly that Lambeau Fields, the number one stadium, has an age three times the average age of all stadiums, and may be due to nostalgia of its fans rather than the its facilities.

As age is not the reason for the poor ranking of the Edward Jones Dome, what are the reasons fans have turned against the building that houses one of the city's most precious asset? A potential answer to that question is that the stadium just loses the preferences of the market. The loss of market preference shows that markets are not static, resulting in a fluctuation of what the market demands. As stadiums continue to be built, the newer stadium provide additional amenities. These newer amenities, over time, become expectations. As time continues, those expectations are not in the stadiums constructed before, thus placing pressure on older stadiums to renovate, or make way for new stadiums.

The St. Louis Rams argued for what the city of St. Louis estimates as \$700 million dollars in renovation costs, to make the stadium appealing for future Super Bowl bids. As the Edward Jones Dome was constructed initially with public funds, the question of what to do with the stadium at this point is a public concern because the stadium is a public building. Bigger and better stadiums with larger construction budgets are looking towards private fund in order to satisfy the demand, this has a profound impact on stadium design, because the building will shift from a public one to a private entity changing the client for which the architect is working.

4.6: Conclusion

The choice to build an NFL Stadium is difficult for Honolulu. The area is not ideal for football games as the state is approximately a minimum of a six hour plan ride from a major secondary markets. The city of Honolulu and entire state of Hawai‘i would have to spend a considerable amount of money to build a new professional quality stadium to even attract a professional team. Looking at the cost, of the last ten constructed stadiums, one can see that the expense is growing.

Table 2 – Stadium Cost

Stadium	City (State)	Year Built	Cost of Construction (\$)	Cost of Construction (2015) (\$)
Levi’s	Santa Clara (CA)	2014	1.3 billion	-
MetLife	East Rutherford (NJ)	2010	1.6 billion	1.73 billion
AT&T	Arlington (TX)	2009	1.3 billion	1.43 billion
TCF Bank	Minneapolis (MN)	2009	303 million	334 million
Lucas Oil	Indianapolis (IN)	2008	720 million	789 million
University of Phoenix	Glendale (AZ)	2006	455 million	532 million
Lincoln Financial Field	Philadelphia (PA)	2003	512 million	656 million
Ford Field	Detroit (MI)	2002	430 million	564 million
NRG	Houston (TX)	2002	352 million	462 million
Gillette	Foxborough (MA)	2002	430 million	564 million

At an average cost of approximately \$780M dollars to construct a new stadium, the decision to commence with a project is a huge decision. The problem with investing in that size of a stadium for the state of Hawaii is that the state still would need to, and be able to, attract an NFL team to the location.

With an uncertainty of the stadium being used during construction, Honolulu should look at a replacement stadium that incorporates options of the events that do occur at the current Aloha Stadium to ensure that a stadium is being designed at an appropriate size. Aloha Stadium is the venue for a few football events: Pro Bowl, Hawai‘i Bowl, UH Warriors, and a field for local high school players. Checking the attendance records for the Pro Bowl, informs if the capacity of Aloha Stadium is adequate for the event.

Table 3 – Pro Bowl Attendance⁹

Year	Location	Attendance
2014	University of Phoenix Stadium	63,225
2013	Aloha Stadium	47,270
2012	Aloha Stadium	47,134
2011	Aloha Stadium	48,423
2010	Aloha Stadium	49,338
2009	Sun Life Stadium	70,697
2008	Aloha Stadium	49,958
2007	Aloha Stadium	50,044
2006	Aloha Stadium	50,410
2005	Aloha Stadium	50,190
2004	Aloha Stadium	50,225

The attendance of the Pro Bowl shows that a replacement stadium should be at least at the same size as the current stadium, as the event of the Pro Bowl has the attendance that utilizes the entire stadium.

⁹ http://en.wikipedia.org/wiki/Pro_Bowl

Chapter 5. The Future Oahu Stadium Design Parameters

The purpose of this chapter is to provide a reference, in ascertaining the required program for a stadium, for stadium designers. By creating an outline of the spaces that are necessary for a working stadium, the guide will facilitate quick determination of spaces needed in the project. The outline will include references and suggestions of what adequate space is needed for each section. This is not to say that the section can estimate exactly the precise needs of every stadium design.

There are a multitude of factors that are necessary in order to determine the correct sizing of a stadium that is necessary for each individual project. Thus, this section attempts to provide areas of investigation, in the context of a replacement to Aloha Stadium, which will facilitate the design of the stadium. Having a site to create references is necessary to have context. Not having a chosen site before a stadium is designed creates too many unknowns. Without limitation, the project becomes too speculative to provide guidance. Thus, the necessity of the site already being chosen is important in order to explore the type of design solutions that are beneficial or not. Knowing the site provides stadium designers avenues of explorations that can result in points of departures, resulting in stadiums that are cohesively explored. If cohesively explored, the resulting stadium designs will have greater amounts of merit.

This section will show the relationship between the components of stadium design, as design does not have a right or wrong answer, but instead options. Knowing the relationship of the options facilitates the decision of choosing one option over another. For instance, the chair size has a relationship with: the circulation of the stadium, the stadium's footprint, and the capacity of the stadium. Each choice has its benefits, as well as its consequences. Those benefits and consequences are not realized until that choice is placed in context with other choices that are made. By putting choices together, those relationships produce their own unique set of benefits and consequences.

For ease of understanding the stadium, the stadium has been separated into three areas of reference: “Event Space”, “Supporting Space,” and “Site,” each of the areas has been made as a separate section within the chapter. These three areas of a stadium do have relationships among themselves, but the effect of an individual member of a section for instance seat size, in “Event Space” section, on a member of another section is peripheral rather than defining.

In addition, there is a fourth area that is designated for the stadium and that is the context in which it resides. As stated previously in the abstract, the stadium is a large publically funded building that becomes a space that is utilized by the surrounding community. In this thesis, with the focus of Aloha Stadium and the island of Oahu, the context that was ascertained as the largest and guaranteed user of the stadium was the University of Hawai‘i at Mānoa’s football team. When designing stadiums, the context of the surrounding area must be understood, to allow for an appropriately designed stadium. In conclusion, in order to understand the stadium design, one first must understand the four components that directly influence the design of the stadium. In summary, the four components discussed below are: Event Space, Supporting Space, Site and Urban Context.

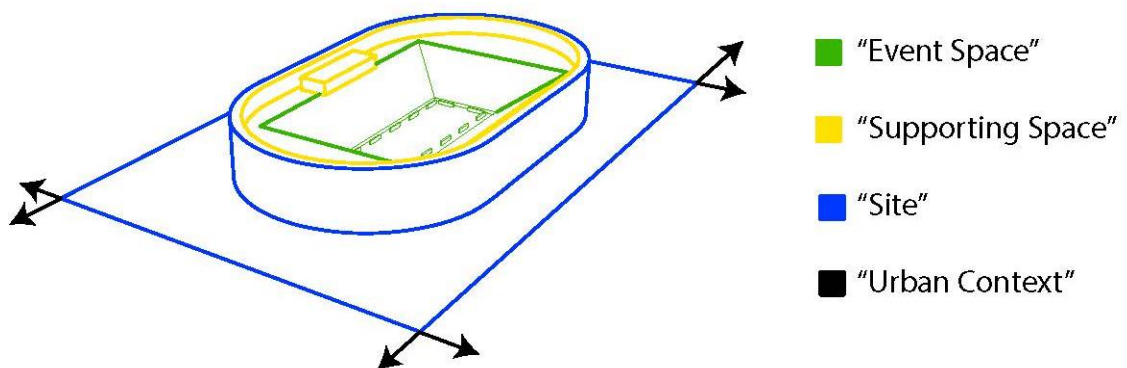


Figure 25 – Stadium Subsection Diagram

Applying the components of a stadium to Aloha Stadium site shows how these components should be applied to any stadium design.

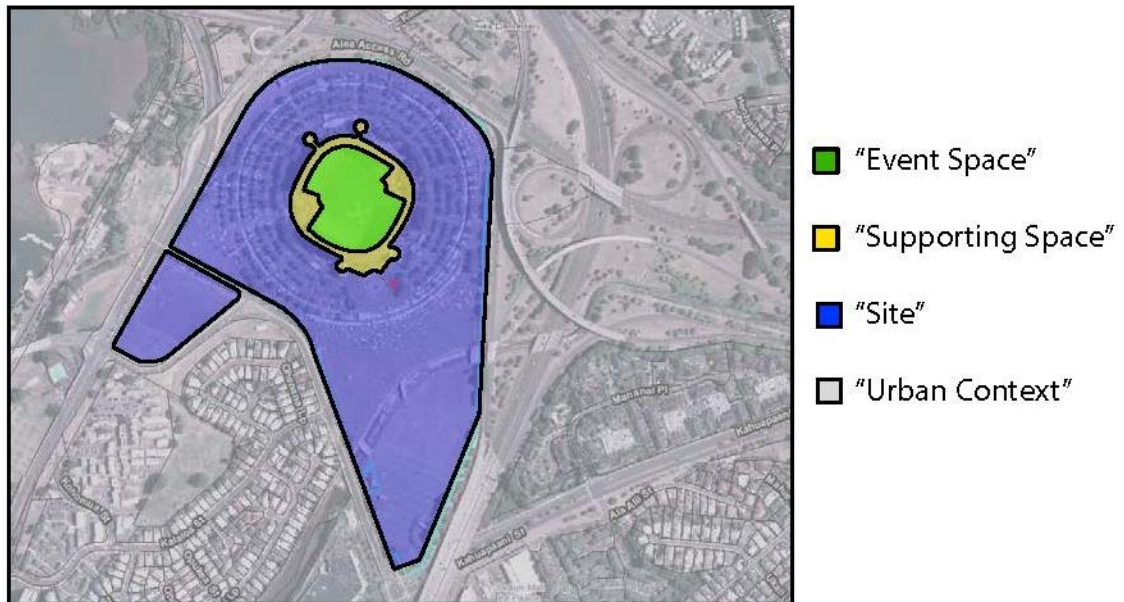


Figure 26 - Aloha Stadium Subsection Diagram

By applying the stadium subsection to previously constructed stadiums, the designer has the ability to easily categorize the pre-existing components. Through analysis of the existing components, the designer will be able to decipher what the society expects of a newly-designed and constructed stadium.

For an architectural designer, the relationships that are outlined in this section, when followed, will expedite the design process. As a starting point, the information that proceeds will give the architect the ability to conduct a comprehensive predesign. The section also allows for a thorough development of the schematic design of a stadium. As this paper addresses generic design concerns for stadiums, completing each portion would not constitute full completion of the schematic design phase, as the unique factors for a specific stadium, would have to be discovered and addressed on a case by case basis.

5.1: Stadium Design: Programming & Seat Capacity

Determining programming for a stadium initiates the design of the stadium. Knowing the purpose of the stadium: baseball, American football, soccer, auto racing or horse racing has huge influential consequences to the outcome of the stadium build. Changing the event for which the stadium is being built, for instance auto racing or baseball, drastically changes the size and scope of the project. Understanding the programming of this stadium being primarily for American Football provides a scale for the stadium.

Programming was important in the initial design of Aloha stadium. Designing the stadium to be multifunctional, to be a place for both baseball and football games to be played, was a parameter guiding Aloha Stadium designers to create design solutions that would satisfy both sporting events. The design solution that was proposed for Aloha Stadium was having the stands being moveable, transforming the stadium from a football configuration to/from a baseball configuration. Movable stands were the design solution to accommodate the intended program of a multiuse space. Programming was pivotal in design for Aloha Stadium. In the larger generic context, stadium architecture truly subscribes to the rule of form following function.

Whether or not the moveable stands for Aloha Stadium was a good thing or a bad thing is irrelevant when discussing design; but instead the focus should be on the benefits and the consequences. The moveable stands allowed for the stadium to be used more frequently by having the ability to host both baseball and football games, more than if the stadium was built for only a single purpose. The consequence of the stands is that the stadium relied on the mechanism that allowed the stand to be moved. Over the years, the upkeep of the mechanism became problematic. Aloha Stadium's stands eventually became stationary, resulting in Aloha Stadium having a single use. Looking back, the benefit of multiuse becomes over time, a consequence. Currently, Aloha Stadium is fixed into a football configuration, yet the stadium's programming dictated a design for both

football and baseball. In order to accommodate both events, sacrifices had to be made in order to appease both. Thus, when Aloha stadium was set in a football configuration, the implementation works, in the sense that it provides the right stand orientation for the specific sport. However, the design solution is not to the same degree because the compromises that were necessary to accommodate baseball adversely affected the football stadium configuration of Aloha Stadium. In summation, the lesson can be learned that a stadium that is built for multiple events cannot be designed to the same degree of quality as a space designed for a specific sporting event.

Looking at the program of a stadium that would replace Aloha Stadium, it is important to understand the potential uses of the stadium. As discussed in the previous chapter, professional football has a potential of coming to the Island and thus is a potential user. The largest guaranteed user of the stadium would be the University of Hawai'i's football team the Warriors. By looking at ticket sales of the UH Warriors, one can get an idea of what is required for the UH Warriors. The table on the following page shows the attendance of the UH Warriors games since 2001.

Table 4 – UH Warrior Game Attendance

Home Game #	Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
1		39,058	36,411	31,442	37,001	44,204	33,298	39,446	40,252	32,008	50,000	39,390	42,996	39,958	35,443					
2		28,755	29,050	31,417	30,756	30,300	38,566	40,571	37,723	29,358	31,695	44,429	40,040	36,096	34,128					
3		27,146	24,999	31,632	30,568	29,469	37,928	40,246	36,360	33,761	29,002	35,078	41,153	39,616	37,900					
4		20,495	20,495	29,752	29,471	42,031	31,499	40,225	41,218	34,051	28,196	36,264	40,136	34,098	36,566					
5		28,530	27,061	28,359	28,907	37,446	32,628	39,014	49,047	32,083	27,892	32,879	41,668	36,784	45,012					
6		32,690	19,799	27,865	27,411	30,011	40,643	42,312	50,000	33,622	34,031	30,864	43,477	36,851	33,148					
7		-	25,604	-	34,446	37,820	40,069	40,549	50,000	47,825	28,326	33,846	39,685	50,000	41,148					
8		-	-	-	-	46,231	-	45,718	-	50,000	-	41,654	29,005	36,671	50,000					
9		-	-	-	-	-	-	-	-	43,435	-	39,754	-	35,513	-					
Total Attendance		183,419	185,931	180,186	219,390	297,512	254,631	328,081	304,600	336,143	229,142	334,158	277,007	345,587	313,345					
Average		26,203	30,989	30,031	31,341	37,189	36,376	41,010	43,514	37,349	32,735	37,129	34,626	38,399	39,168					
% of Average Attendance		52%	62%	60%	63%	74%	73%	82%	87%	75%	65%	74%	69%	77%	78%					
Capacity		50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000					
Over 75% Capacity		45	45	45	45	45	45	45	45	45	45	45	45	45	45					
75% > Capacity > 50%		58	58	58	58	58	58	58	58	58	58	58	58	58	58					
Under 50% Capacity		3	3	3	3	3	3	3	3	3	3	3	3	3	3					
Highest Attendance		50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000					
Lowest Attendance		19,799	19,799	19,799	19,799	19,799	19,799	19,799	19,799	19,799	19,799	19,799	19,799	19,799	19,799					
Mean Attendance		35,747	35,747	35,747	35,747	35,747	35,747	35,747	35,747	35,747	35,747	35,747	35,747	35,747	35,747					
Median Attendance		36,312	36,312	36,312	36,312	36,312	36,312	36,312	36,312	36,312	36,312	36,312	36,312	36,312	36,312					
Total Attendance		3,789,132	3,789,132	3,789,132	3,789,132	3,789,132	3,789,132	3,789,132	3,789,132	3,789,132	3,789,132	3,789,132	3,789,132	3,789,132	3,789,132					
Total Events		106	106	106	106	106	106	106	106	106	106	106	106	106	106					

With the average attendance of UH Warrior games being 36,000 or about seventy percent of Aloha Stadiums capacity, the size of the stadium is quite close to the appropriate size of a needed stadium. Knowing the size of the attendance of the games allows a designer to suggest that maybe shrinking the new proposed facility by ten percent would be beneficial, as the stadium current size is a bit large for its use.

If one looks at the data even closer, during some years the stadium attendance for the games is over 75% of capacity, and has sold-out in some situations. As football is a sport, having a team that wins increases the demand for people to want to go to the football game. Constructing a stadium at average capacity may become problematic when the team is having a winning season and the demand for attendance increases. If the stadium design could not accommodate additional seating, as needed, valuable revenue would be lost. This example illustrates how crucial the power of programming in the design of stadiums is. The replacement for Aloha Stadium should address that growth potential of the sport and the attendance. Having the program incorporate the ability to increase and decrease capacity easily allows for the stadium to grow and shrink according to its uses. Recalling Qualcomm Stadium from the case study, the stadium was the same size as Aloha stadium at conception, yet has been able to grow its seating capacity as the use of the stadium expanded. Where should the initial capacity of the new stadium begin? Looking at the same table, but reducing the size of the capacity of the stadium, gives a good indication of what the ideal seating capacity for Aloha Stadium should have been.

Table 5 - Reduce Seating Capacity to 45,000 Seating

Home Game #	Year	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001
1		36,411	39,058	31,442	37,001	44,204	33,298	39,446	40,252	32,008	50,000	39,390	42,996	39,958	35,443
2		29,050	28,755	31,417	30,756	30,300	38,566	40,571	37,723	29,358	31,695	44,429	40,040	36,096	34,128
3		24,999	27,146	31,632	30,568	29,469	37,928	40,246	36,360	33,761	29,002	35,078	41,153	39,616	37,900
4		20,495	29,752	29,471	30,301	42,031	31,499	40,225	41,218	34,051	28,196	36,264	40,136	34,098	36,566
5		27,061	28,530	28,359	28,907	37,446	32,628	39,014	49,047	32,083	27,892	32,879	41,668	36,784	45,012
6		19,799	32,690	27,865	27,411	30,011	40,643	42,312	50,000	33,622	34,031	30,864	43,477	36,851	33,148
7		25,604	-	-	34,446	37,820	40,069	40,549	50,000	47,825	28,326	33,846	39,685	50,000	41,148
8		-	-	-	-	46,231	-	45,718	-	50,000	-	41,654	29,005	36,671	50,000
9		-	-	-	-	-	-	-	-	43,435	-	39,754	-	35,513	-
Total Attendance		183,419	185,931	180,186	219,390	297,512	254,631	328,081	304,600	336,143	229,142	334,158	277,007	345,587	313,345
Average		26,203	30,989	30,031	31,341	37,189	36,376	41,010	43,514	37,349	32,735	37,129	34,626	38,399	39,168
% of Average Attendance		58%	69%	67%	70%	83%	81%	91%	97%	83%	73%	83%	77%	85%	87%
Capacity		45,000													
Over 75% Capacity		69													
75% > Capacity > 50%		35													
Under 50% Capacity		2													
#															
Highest Attendance		50,000													
Lowest Attendance		19,799													
Mean Attendance		35,747													
Median Attendance		36,312													
Total Attendance		3,789,132													
Total Events		106													

Table 6 - Reduce Capacity to 40,000

Home Game #	Year	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001
1		36,411	39,058	31,442	37,001	44,204	33,298	39,446	40,252	32,008	50,000	39,390	42,996	39,958	35,443
2		29,050	28,755	31,417	30,756	30,300	38,566	40,571	37,723	29,358	31,695	44,429	40,040	36,096	34,128
3		24,999	27,146	31,632	30,568	29,469	37,928	40,246	36,360	33,761	29,002	35,078	41,153	39,616	37,900
4		20,495	25,732	29,471	30,301	42,031	31,499	40,225	41,218	34,051	28,196	36,264	40,136	34,098	36,566
5		27,061	28,530	28,359	28,907	37,446	32,628	39,014	49,047	32,083	27,892	32,879	41,668	36,784	45,012
6		19,799	32,690	27,865	27,411	30,011	40,643	42,312	50,000	33,622	34,031	30,864	43,477	36,851	33,148
7		25,604	-	-	34,446	37,820	40,069	40,549	50,000	47,825	28,326	33,846	39,685	50,000	41,148
8		-	-	-	-	46,231	-	4,5718	-	50,000	-	41,654	29,005	36,671	50,000
9		-	-	-	-	-	-	-	-	43,435	-	39,754	-	35,513	-
Total Attendance		183,419	185,931	180,186	219,390	297,512	254,631	328,081	304,600	336,143	229,142	334,158	277,007	345,587	313,345
Average		26,203	30,989	30,031	31,341	37,189	36,376	41,010	43,514	37,349	32,735	37,129	34,626	38,399	39,168
% of Average Attendance		66%	77%	75%	78%	99%	91%	103%	109%	93%	82%	95%	87%	96%	98%
Capacity		40,000													
Over 75% Capacity		84													
75% > Capacity > 50%		21													
Under 50% Capacity		1													
#															
Highest Attendance		50,000													
Lowest Attendance		19,799													
Mean Attendance		35,747													
Median Attendance		36,312													
Total Attendance		3,789,132													
Total Events		106													

By reducing the seating capacity at the initial completed construction of the replacement stadium, the size of the project will be ideal for the use of the guaranteed tenant of the UH Warriors. This may limit the use of the Pro Bowl as the capacity would be diminished, but the project would be appropriate for the significant use of the structure.

The strong relationship of the stadium capacity and its intended programming in the case presented in this thesis introduces a new method of design implementation for stadiums. Stadium designers should think less like architects, in which the finished construction occurs and the project is complete, and more like a city planner in which the long term intention of the area will be considered. This translates into the architecture by having a multiphase construction process. The general framework for the project would have to be designed to ensure the ability of the structure to be easily converted and expanded upon. This requires a new type of design process for the architect, in which multiple uses are set into place that dictate the next move, like chess players looking at potential moves that their opponent would make, stadium design should incorporate similar tactics.

Programming and seating capacity are of the utmost importance when it comes to stadium design. If either situation is not thoroughly thought through then the design of the stadium will not be beneficial over the lifespan of the structure. Stadium design should shift to not only a finished product but towards a multiphase project that can be adjusted for the potential problems that will arise, as the stadium use evolves over its lifecycle. In the case of Aloha Stadium's replacement, the implication of what the replacement stadium will be is just as important as how the stadium will react to the changing demands of professional sports teams. The success of Qualcomm Stadium was in its ability to grow in size. The importance of having a stadium design that can easily accommodate the ability to grow and shrink is seen through the investigation conducted in the case study portion of the thesis; and the requirements of what is necessary for the guaranteed tenants UH Warriors is pivotal for Aloha Stadium successor's success.

5.2: Stadium Programming – “Event Space”

The Core of a stadium’s programming deals with the components of the stadium that are needed to actually view the events of the stadium, as well as the actual area in which the event is to occur. The elements that are included in these components are: the field, seating area, advertisement or signage, and the replay screen. For the designer deciphering the area for which the event will occur is the first step in determining the size of the stadium.

As this thesis has shown, the current purpose of Aloha Stadium is for the viewing of American Football games. The first thing a designer must find out is the answer to the question: What is the actual size of a football field? The playing dimension of an American football field is 53.3 yards (~160 feet) wide by 120 yards long (360 feet). This dimension accounts for the playable area. The area does not account for the total area necessary for the game to occur. Besides the playable area, a surrounding area must be incorporated for reserve players, coaches, trainers, and other support staff like referees, cameramen, photographers, etc. – all of whom need to be adjacent to the playing surface. This area in football is called the sidelines. The sidelines add an additional thirty feet surrounding all sides of the playing area. The total dimension of the area of action for football is 190 feet wide by 390 feet long.

The dimensions for the area of action for American football is close to the dimensions for soccer. The soccer field as determined by Fédération International de Football Association, FIFA, has a playing dimension of a length “between 100 yards and 130 yards and the width between 50 and 100 yard”¹⁰. The fact that the dimensions of a soccer field are not drastically different than a football field, makes it easy for the stadium to accommodate both sports by using the maximum field dimensions of the twos

¹⁰ http://worldsoccer.about.com/od/soccer101/a/101_Field.htm

sports. This works for soccer and football because the action of events occurs in the same direction, along the long side of the fields.

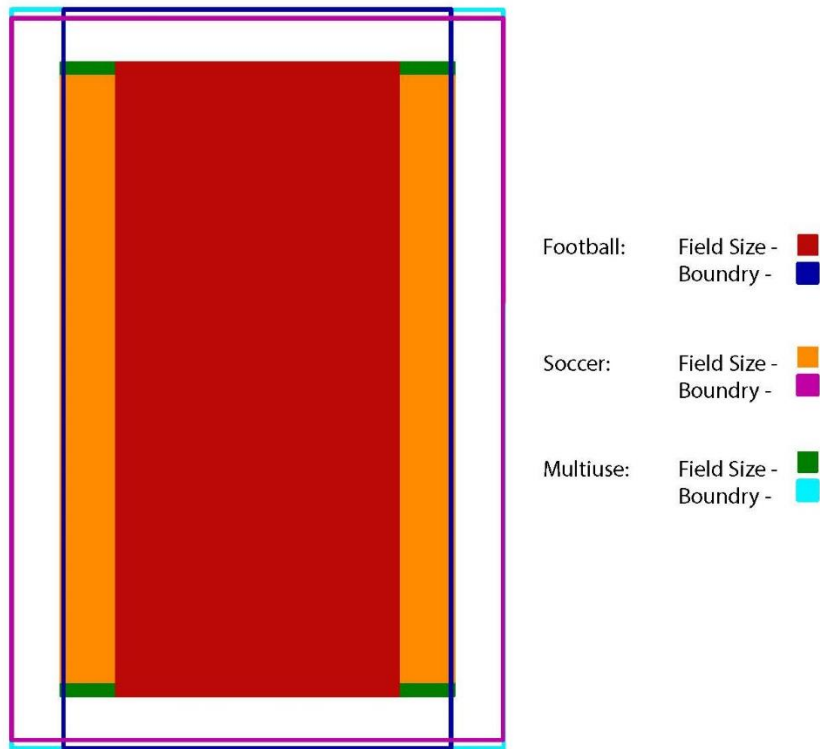


Figure 27 - Field Size

With the size of the field known for the event, determining the size of stands is the next step. FIFA, in 2007, published guidelines for the optimal distance and the maximum distance the spectators should be from the field. The optimal distance is determined by drawing a circle with a radius of 90 meters, centering the optimal distance circle in the center of the field. The maximum distance is calculated by drawing circles with a 190m radius from each corner of the field. The area inside of all of the circles is the area in which the stands should be limited to, in order to ensure the spectators are not too far away from the event.

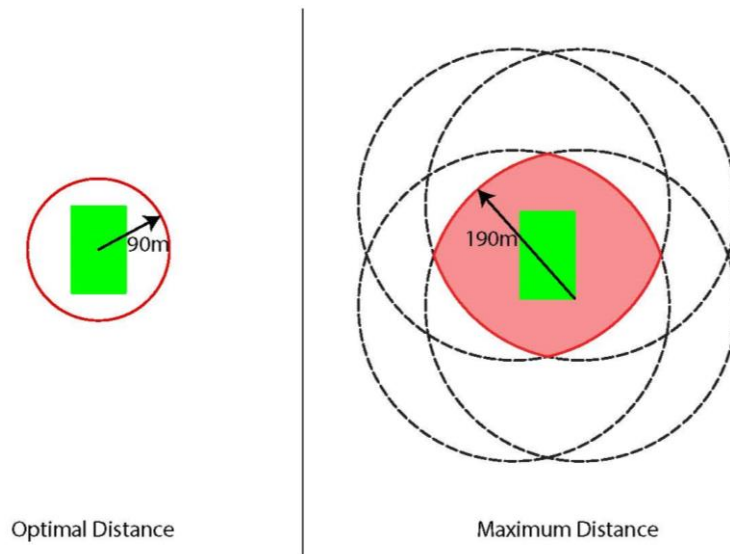


Figure 28 - Optimal and Maximum Spectator Distance

The radius shown in the above image does not only apply to the 2-dimensional plan view. Expanding that limitation into the third dimension means that the radiuses used for the optimal and maximum distance would then make a sphere in 3-dimensional space, with the same radiuses presented in the plan view above.

The acceptable area for the spectators is over 400,000 square feet. Determining how that space is used is controlled by a few factors: the size of the seats, the dimension of the seat risers (the area in which the seats are located), and the steps necessary to allow spectators to get to their sets, referred to as seat circulation.

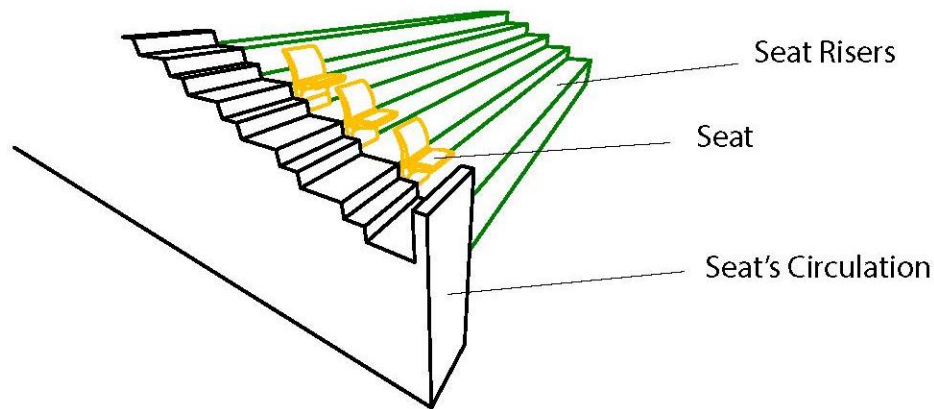


Figure 29 - Event Space Components

The three primary components that make up the Event space are: Seat Risers, Seats, and Seat Circulation. Again, the components are dependent upon each other.

The interdependence is a function of the programming, the amount of seats that are desired, and the spacing that is necessary between the seats. For safety reasons, the number of seats are limited to circulation that provides adequate egress in an emergency situation. This requirement is extremely important, to allow for proper evacuation of the stadium in times of emergency. Thus, having a seat too far from circulation would result in a design that would endanger the health and safety of the patrons of the building.

Typically, there are laws that prescribe the necessary evacuation time. Building requirements in the United States use a version of the International Building Code. The International Building Code, 2006, Chapter 10 Egress is a good reference to understand the multitude of requirements to satisfy the safety requirements when designing a stadium. As this thesis cannot cover every occurrence, it notes that when designing stadiums, the architect must give utmost importance to the health and safety of the intended user, and ensure that the finished designed stadium satisfies all prescribed safety measures of the locality in which it exists. Thus, the designer needs to locate the required

building code dictated by law, possibly a version of the International Building Code, and follow all requirements.

Another important relationship between the components of the event space comes from the relationships of the three components. As the seats are placed on the risers, the seats take up space. Although the space taken up of the seats is a barricade to seat circulation, it provides a design opportunity. By aligning the area in which the seats mount to the risers with a step in the seating circulation, distance between each seat is reduced. Overall, this allows for seats to be closer to the action of the event.

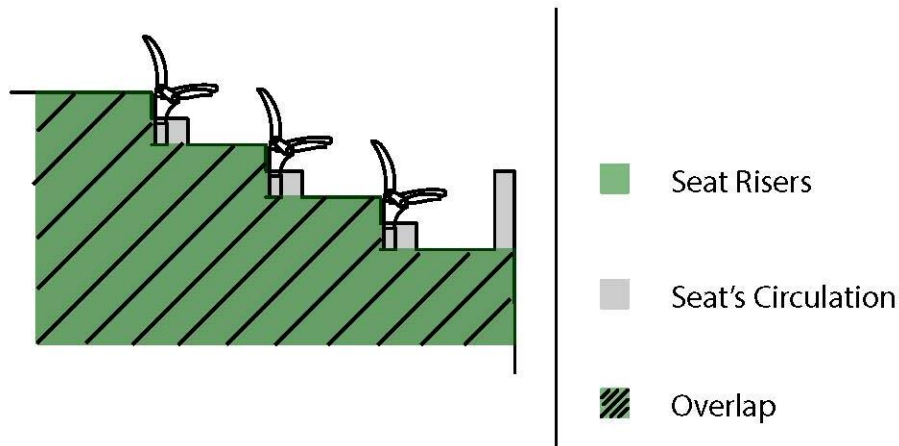


Figure 30 - Event Space Relationship Diagram One

The relationship between the three components in this section gives the designer the control to determine the distance in which the spectators are from the action. By changing the slope of the seat risers, the audience is moved closer to the action.

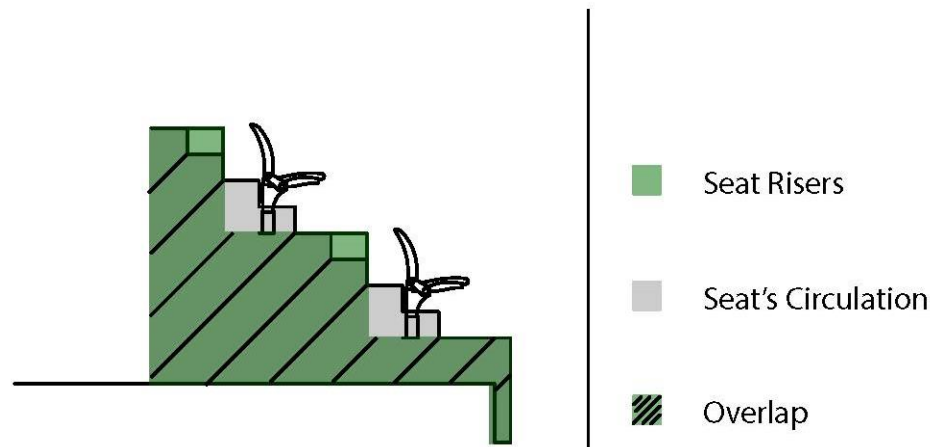


Figure 31 - Event Space Relationship Diagram Two

This results in stadiums that are taller, but the footprint of the stadium becomes smaller. This is how CenturyLink Field in Seattle was able to have so many seats, at a capacity that would be able to hold a Super Bowl, yet have a footprint that is smaller than stadiums that do not have that capacity.

Other components that occur in the event space are: the press box and the box seat. The Press Box and box seats are best located at the optimal viewing distance from the action, for different and unique reasons.

The Press Box is the location reserved for the users that generate the media to report on the events that occur in the stadium. In the early days of American sports, this location was necessary for the news people to prepare their stories about the events of the games. As technology advanced the Press Box began to incorporate first radio announcers and now TV announcers. Most stadiums place the Press Box at the fifty-yard line and at the optimal distance to the field, providing announcers the best seats in the stadium. The economic justification is that enhancing the presentation provided by the announcer attracts a bigger external audience, increasing the value of advertisements and thus the price that can be charged for them.

The box seats are for the spectators willing to pay for a premium experience. The box seats appear on the club level of the stadium. They are preferred seating because they are located in the ideal distance from the field. Box seats typically have better chairs, full backs, a greater degree of reclining and more legroom than other sections of the stadium. In addition, the box seats have access to separate facilities: restrooms, dining options, and stores not shared with the other sections of the stadium.

The box seats also include the luxury suites, another tier of premium seating, further differentiating the box seat section of the stadium. The suites at the stadium have similar amenities to a hotel suite. Stadium suites usually have a private bar and restroom for the fans. The suites are typically not owned by a single fan and are usually a perk that companies offer to their executives, to be able to enjoy the game themselves and with friends, family, or important business clients.

Designing the primary layout of the “Event Area” requires a look at the stadium in sections. From the previous presented information, below is a diagram showing a way to design the stands in a stadium. The lower section has a less steep angle to push the box seat section far enough away to be near the optimal viewing zone. The highest section has a steeper slope to keep the majority of the stands within the maximum viewing area line.

The “Event Area” once resolved provides the base form of the stadium. Each solution to satisfy the necessity of the stadium once again has benefits and consequences. Two forms that can result from a resolved “Event Area” are provided to illustrate the benefits and consequences of the resulting forms.

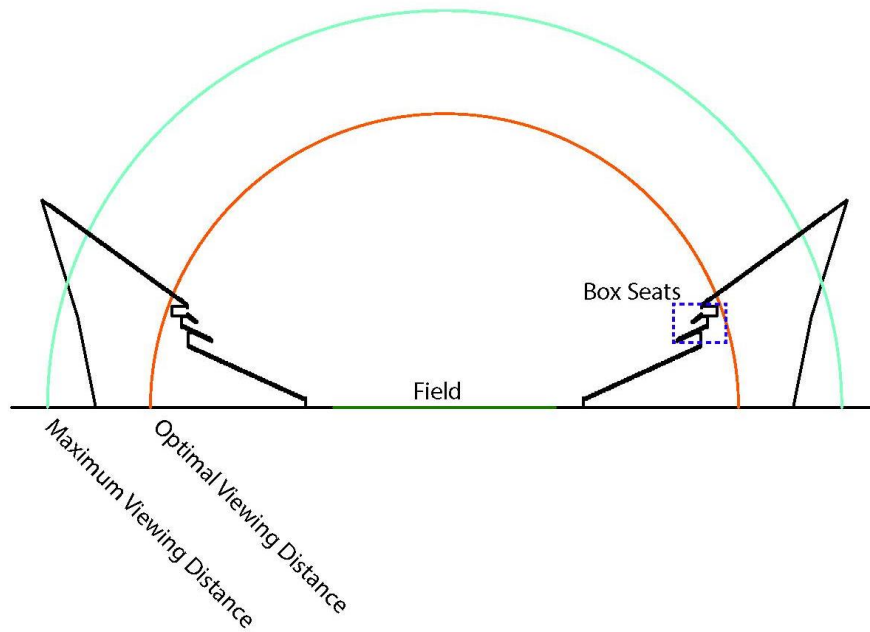


Figure 32 - "Event Area" Section

Form A presents the stands located only on the sides of the field, where Form B the stands are fully surrounding the field. Form A results in have a smaller footprint, but a taller resulting structure. Form B is a shorter structure, but takes up a larger footprint. When looking at construction cost Form A would be a more expensive option then Form B, because of the additional foundation work that would be required as structure gain in height.

The stadium should be constructed in the Form A as the design provides better sightlines. Even though Form B is more cost-effective, having the stands circulate the entirety of the field does not add much for the user when they are experiencing the stadium. Since the action of both football and soccer move along the length of the stadium it is better to have the seats along the length of the field.

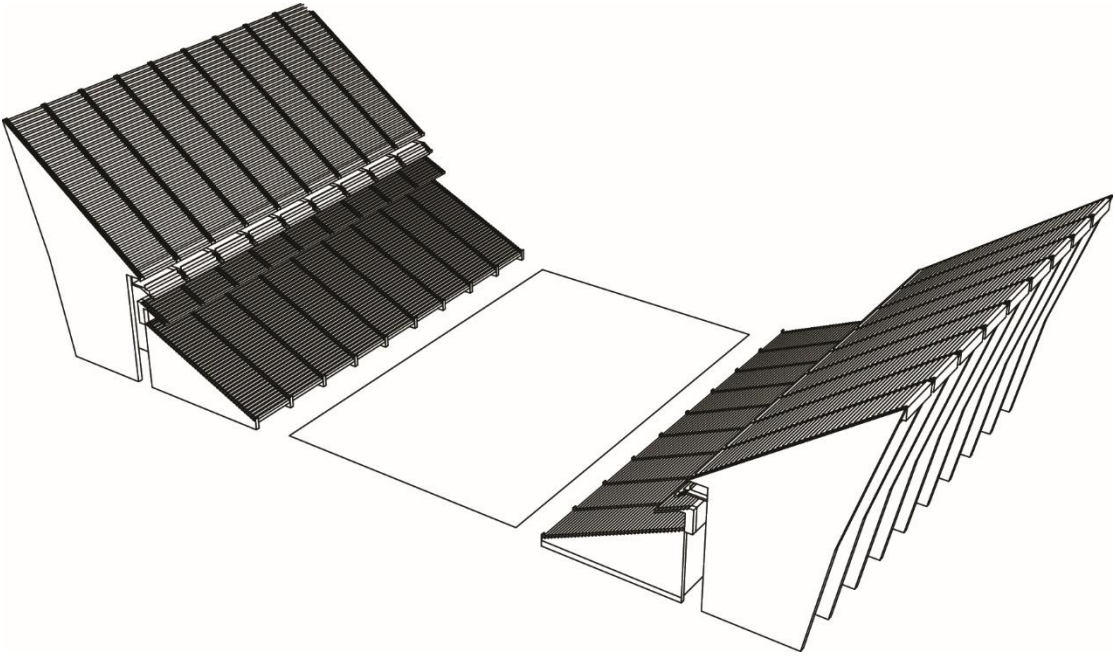


Figure 33 – Form A

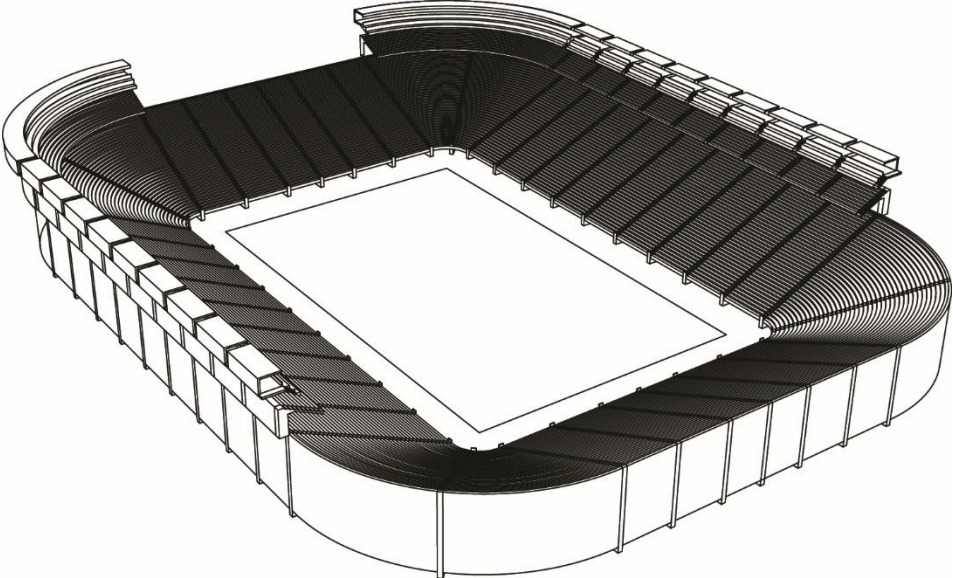


Figure 34 – Form B

5.3: Stadium Programming – “Supporting Space”

The “Supporting Space” of the stadium is the area of the stadium that gives support to users of the stadium. The support areas are unique to the user of the stadium. The typical users of the stadium are:

- 1) the fans – patrons of the stadium that came to view the event,
- 2) the athletes – the people who are active in the event that will be spectated, and
- 3) event staff – the people who provide the amenities for fans and ensuring the space is utilized appropriately.

Requirements for the “Supporting Space” for fans are just basic human requirements, such as: food, water, restrooms and maybe souvenirs. Thus, a stadium must provide those necessities. For the fans, the “supporting spaces” that are needed are: concession stands to provide the food and drink, restrooms, and memorabilia stores. The degree of quality for each of the spaces for the spectators may not necessarily be similar. When discussing the box seats in the previous section, we noted they might have facilities of better quality than the general admission seats. This may seem to be discriminatory; but remember, the stadium’s purpose is to showcase an event for a multitude of social and economic levels. For the fan that pays a greater amount to view the event, the amenities that they are provided should be of a comparable quality.

Athletics is an entertainment vocation. In order for the athletes to be able to perform their entertainment, they are in need of facilities that allow them to be prepared for the event in which they are going to participate in. The athletes’ supporting area consists of: coach’s locker rooms, player’s locker rooms, referee’s locker rooms, separate medical facilities for each team, equipment rooms, laundry facilities, and interview areas. The supporting area allows the athletes to be able to prepare to perform to the best of their ability.

To be able to hold an event for a large number of people, the area needs to be able to support the needs of everyone using the stadium. To be able to provide those needs, a multitude of staff needs to have working space to adequately provide those needs. Thus, the staff area's supporting space would be: security, turnstiles, ticket booths, janitorial services, grounds-keeping, turnstiles, management offices, and other spaces necessary to ensure the stadium can work as a functioning building that is safe and clean for the users of the space.

When designing, for the “supporting space”, the area of the stadium that can be used is much larger than the necessary programming that needs to be incorporated into the stadium. Even when stadiums provide the luxurious amenities, the volumetric space that is used is only a fraction of the volumetric space delineated by the stands. Thus for the designer, at the beginning phases of designing the stadium, the focus should be on what types of support spaces are necessary for the design. Having the location of those spaces would be reserved for a future design phase.

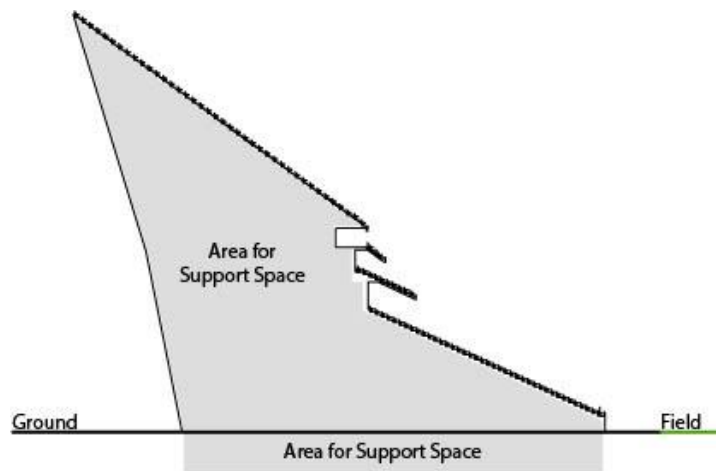


Figure 35 - Support Space Location Diagram

5.4: Stadium Programming – “Site”

The Site of the stadium encompasses all of the area that surrounds the stadium that is not actually a part of the stadium with the exception of the component of the stadium that is considered “the look”. Parking dominates most stadium sites as automobiles constitute are the major transportation means in the United States.

As “the look” of the stadium is viewed as a person approaches the structure, “the look” is also a part of the experience when a person is within the area of the site. Thus, “the look” is a component of “the site”. We emphasize “the look” for the purpose of this thesis, as it forms so much of the fans’ and the community’s perception of the stadium.

With the scale of the stadium being so large, its look is visible in the “Urban Context”. As explained in the creation of these categories, “the look” would have to be a subsection of the site, because it interacts with the both the “Supporting Space” in that it is a physical demarcation of the end of the site, and the beginning of the “Supporting Space”. The “Urban Context” is also involved because the form of the stadium becomes ingrained into the skyline of the urban community.

When dealing with “the look” for the replacement of Aloha Stadium, it should include the type of roof structure that will be built. The location of Oahu within the tropics makes the possibility of generating solar power a viable consideration. With the Clean Energy Initiative proposing that the state should achieve 70% clean energy by 2030¹¹, incorporating a solar panel array would be helpful in achieving that goal. If solar panels were decided to be a part of the design then they would affect “the look”.

¹¹ <http://www.hawaiicleanenergyinitiative.org/>

Stadiums in more northern latitudes have successfully integrated solar panels in their roofs. Kaohsiung National Stadium in Taiwan is an example of a stadium that utilizes solar panels in its structure.

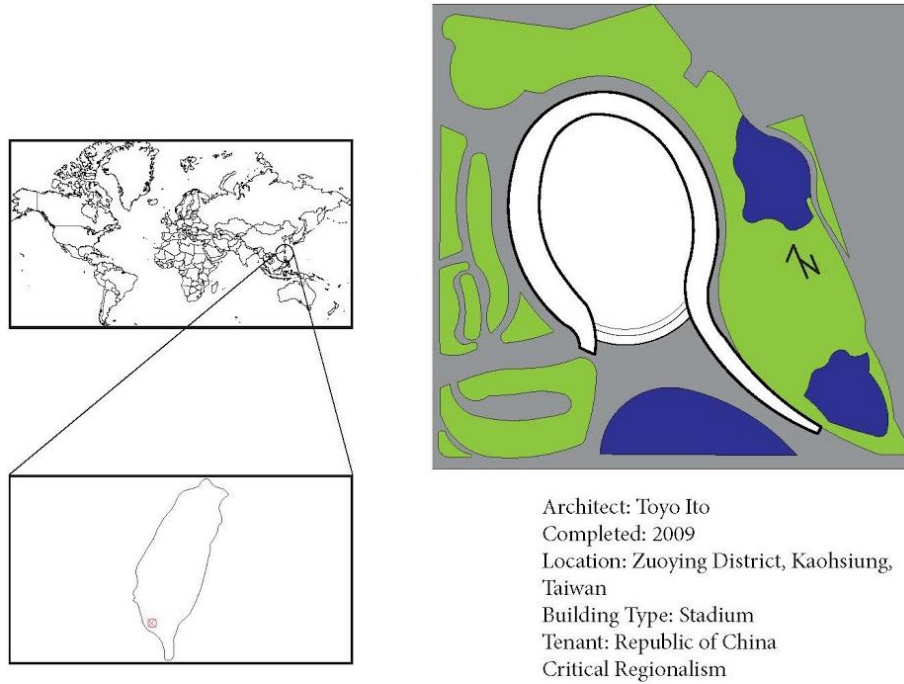


Figure 36 - Location of Kaohsiung Stadium

Source – Feo, “Structure as Architecture” Style: Stadiums as the turn of the 21st Century.

Environment Integration

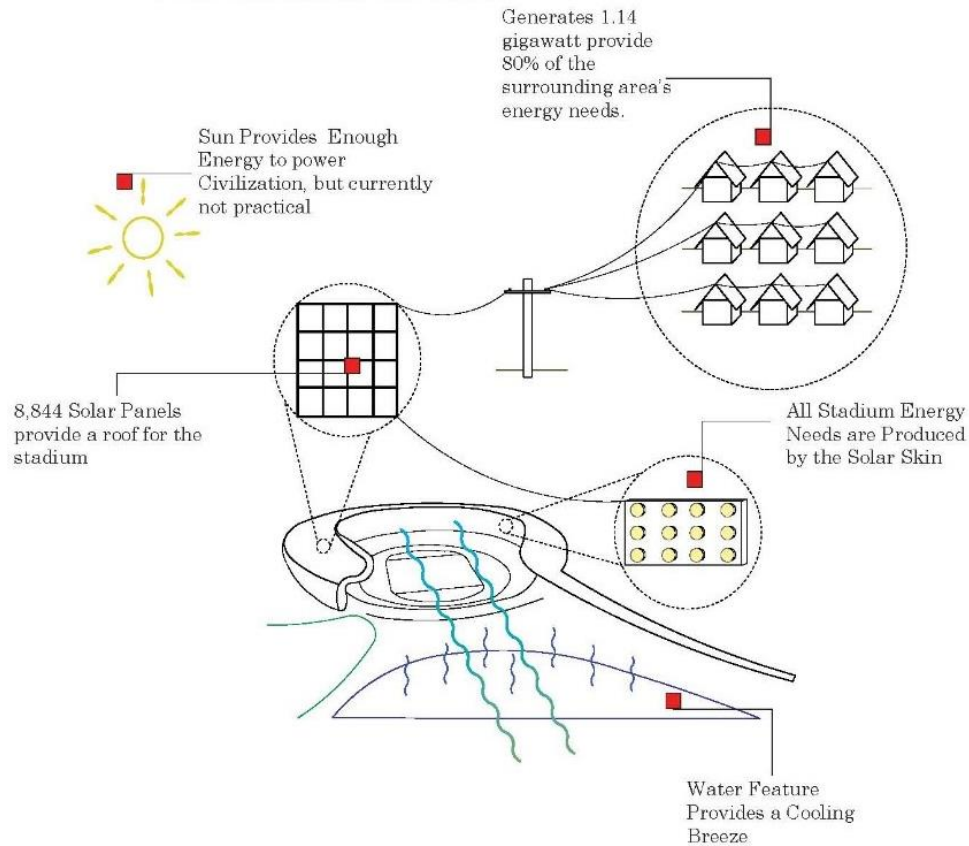


Figure 37 – Kaohsiung Diagram

Source – Feo, "Structure as Architecture" Style: Stadiums as the turn of the 21st Century.

For a newly-designed stadium to replace Aloha Stadium, the form of the stadium should heavily consider the incorporation of solar panels upon the façade and roof structure. One such form that would accommodate solar panels well, in addition to being synonymous with Hawaii, is volcanoes. The southern area of the roof could be covered with solar panels to produce electricity for the stadium, as well as the surrounding community. In addition, the roof structure would have the additional benefit of providing shade for the spectators, making the experience at the event more enjoyable for those in attendance. Continuing the volcano concept, the other side of the stadium roof might incorporate tinted glass of similar black color to the solar panel- resembling the color of obsidian produced by volcanoes. Esthetically, the form of the volcano resonates with the

project because the stadium could be a physical manifestation to the Hawaiian volcano goddess Pele. Whatever the form of the newly designed stadium, the incorporation of solar panels into the façade and southern facing walls should be heavily considered.

With “Site” component of the stadium design starting out dealing with the façade of the stadium, the manual now moves outwards to the question of how people get to the stadium. The primary circulation employed by Honolulu is that of the personal automobile. The primary circulation will be further investigated in the “Urban Context”, but knowing the primary circulation of the city is important in this section, to ensure that the site provides the necessary infrastructure needed for circulation, which in this case is providing parking spaces for patrons coming to use the stadium.

The current parking provided by Aloha Stadium is about 7,000 parking spots. For a NFL Super Bowl, the stadium would require 35,000 parking spaces. To provide that much parking would require a five-story structure build over the existing space.

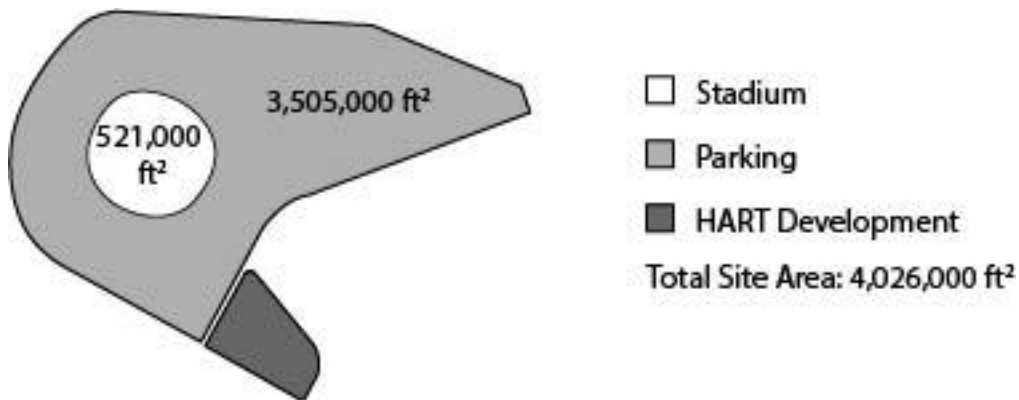


Figure 38 - Aloha Stadium Site Diagram

Seen in the diagram, the site of Aloha Stadium as it exists today is beginning to shrink. The HART Development is using the small parking lot across the street from the main portion of the site. This further shrinks the site of Aloha Stadium, decreasing the ability of the site to be sufficient for future stadium design.

For a future Aloha Stadium, a parking garage structure would take up less area of the site. This would allow for additional development for the newly gained space. To accomplish that goal, the new stadium should incorporate a multi-story garage over the site.

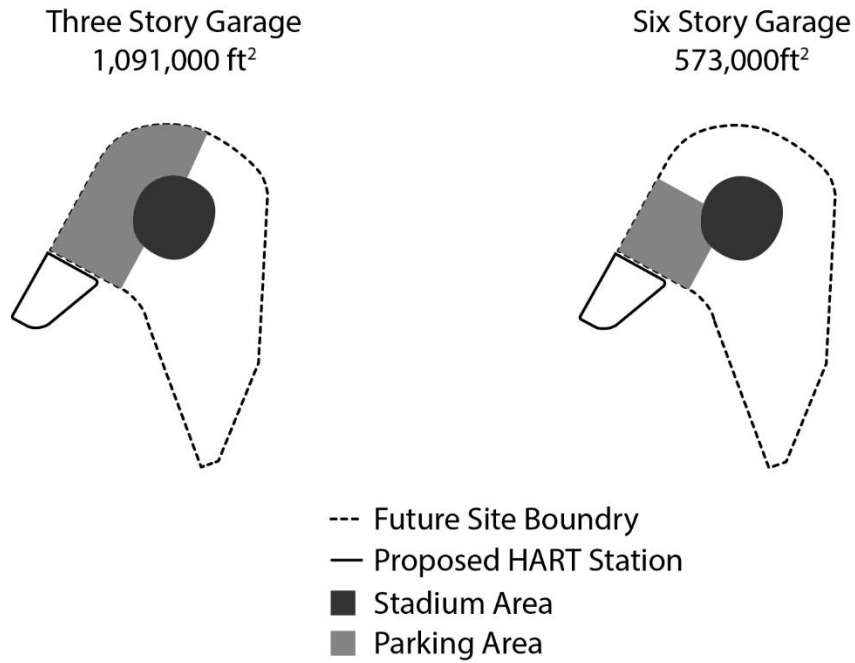


Figure 39 - Parking Garage Diagram

The potential of freeing up additional space would have huge benefits, as it enables incorporation of new types of programming into the space. One option is to repurpose the space to a green space, for the city to enjoy. Making the space into an athletic inspired park would bring much needed green space into the urban area. Another sporting related use of the freed space might be as a Formula One race course.

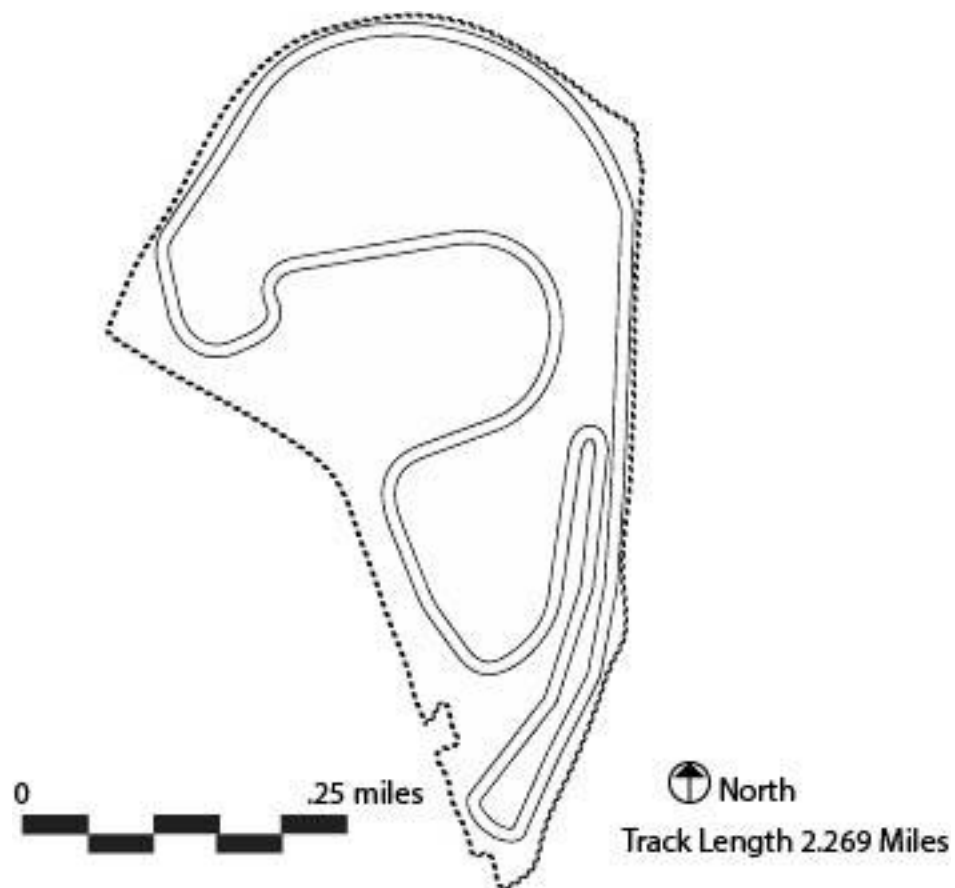


Figure 40 - Racetrack Diagram

By having the racetrack run through the stands of the newly designed stadium, the venue would realize greater functionality. This would also be an appreciated addition to motorsport aficionados, because the island of Oahu lacks proper motorsport facilities. The island of Oahu did have a raceway park in west Oahu called Kalaeloa Raceway Park; but it was lost when the owner redeveloped the property for other uses. Due to the owner deciding to redevelop the land for other uses the raceway has not been in operation. By incorporating a racetrack in a portion of the free space of the parking lot due to parking spaces in the garage, the usability of the newly designed stadium increases. Increasing usability would make the justification of such a large project easier to accomplish, because the benefits would be greater.

Another method of utilizing the Aloha Stadium site is to incorporate a commercial area, with a sport or entertainment theme. With the location of the HART station adjacent to the site another benefit could be realized. Commuters would be able to utilize the stadium's parking lot as a park and ride, when the stadium is not in use. The additional usage could make the expense of the parking structure have even greater justification. As the parking lot becomes taller, the available space to provide additional commercial programming offsets the costs.

Commercial space adjacent to the stadium, as well as a HART station, provides activity benefiting both. For the HART station, the benefit of having the commercial apron, the commercial adjacent area, allows for people to have something to do while they are waiting for a train. This activity provides a desirable filter for people that are taking advantage of the park and ride. When the park and ride user comes to the station to park their car they begin by leaving their car in the parking structure. Once parked, the user moves from the parking structure to a pedestrian oriented commercial apron. This allows the user to transition from a sparse suburban area towards a denser urban area.

With the HART being built, the area becomes accessible by more types of transportation beyond the personal automobile. This benefit results in an ideal environment for commercial development. One example of how regional trains create commercial aprons around the station can be seen with the Bay Area Regional Train's (BART) Emeryville station.

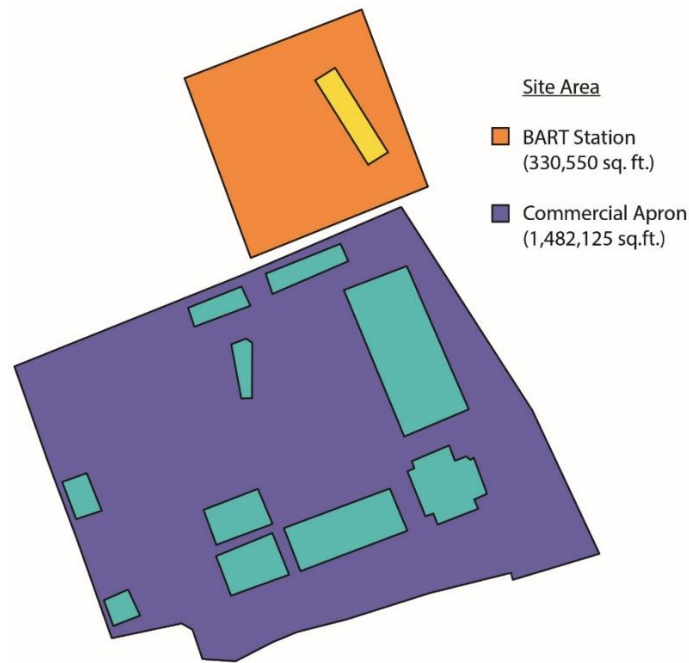


Figure 41 – Emeryville BART Station

The Emeryville BART Station is an important case study for the future development of Aloha Stadium, because the area of the BART station is similar to the area of the HART station. With the construction of parking structures, the resulting freed area can become a commercial apron for the HART station.

For stadium users, the commercial space provides for post-event activities. The post-event activities alleviate the pressure that results from the mass exodus that usually occurs after an event. Without something to do readily available around the stadium after the event, the fans are left with the only option being to leave the stadium. This results in a large amount of circulation to handle the fans leaving. Providing additional activities for the patrons of the stadium adjacent to the game provides a type of traffic metering. Instead of everyone leaving the area at once, some patrons can go, for example, to a restaurant to have a meal. This lowers the demand upon the provided circulation. It is thus recommended that the site plane of the replacement to Aloha Stadium incorporates commercial space. A diagram of a site plan, incorporating commercial development, is shown.

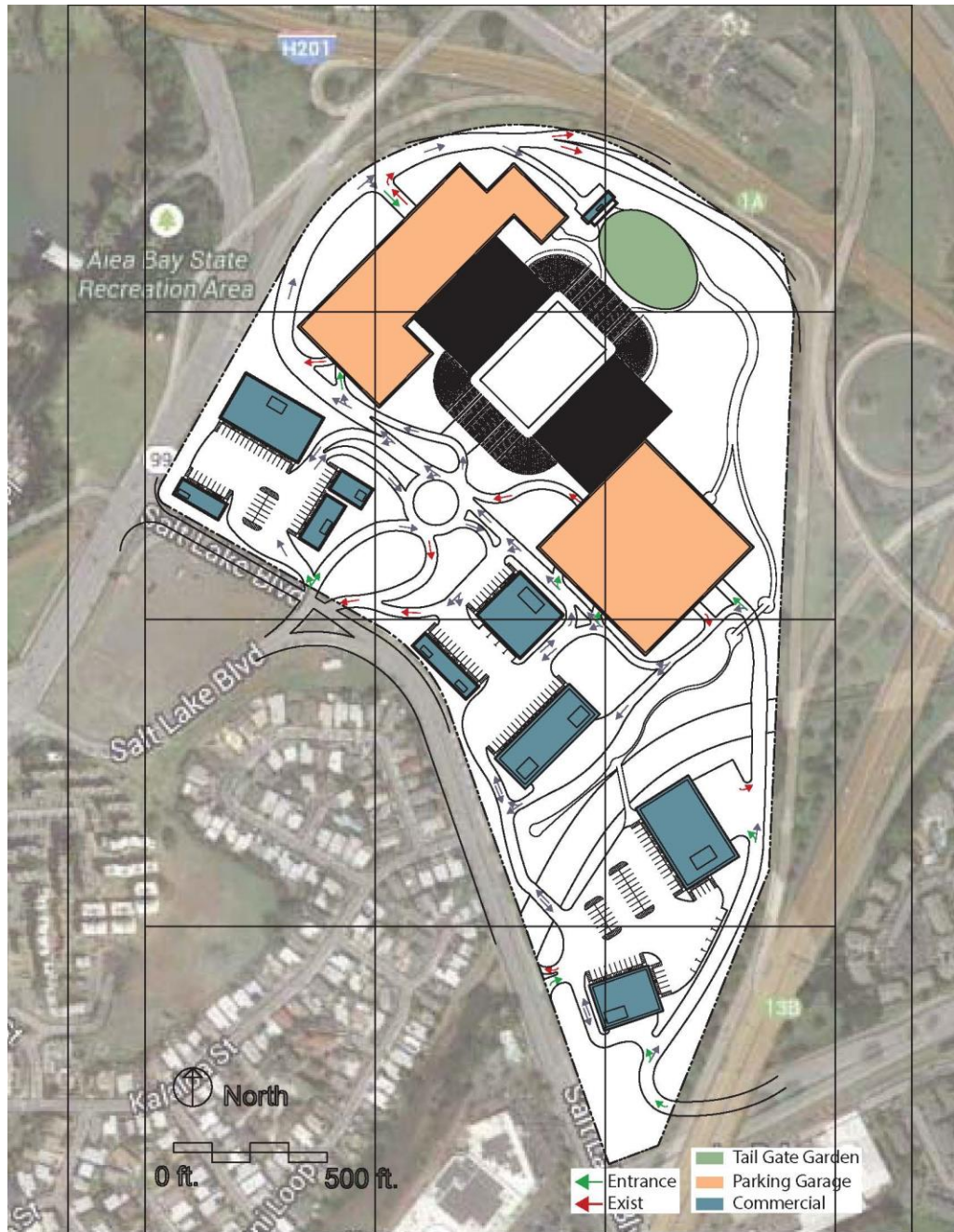


Figure 42 – Site Diagram

This diagram shows the overall use that can be incorporated into the site development. As shown the commercial space fronts Salt Lak Boulevard. What this results in is a commercial area that becomes the middle space between the parking structure and the HART station.



Figure 43 – Master Plan

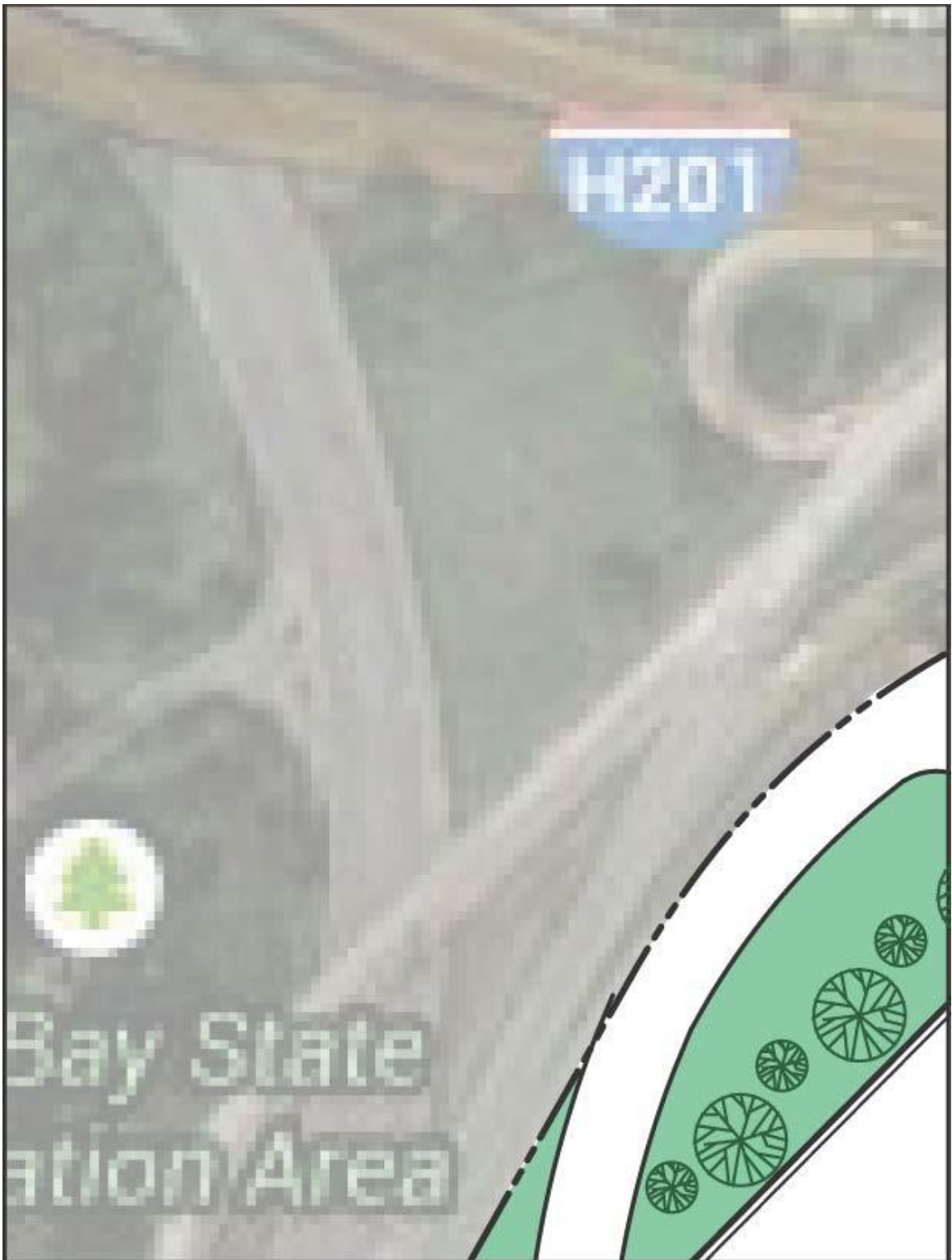


Figure 44 – Master Plan A - 1

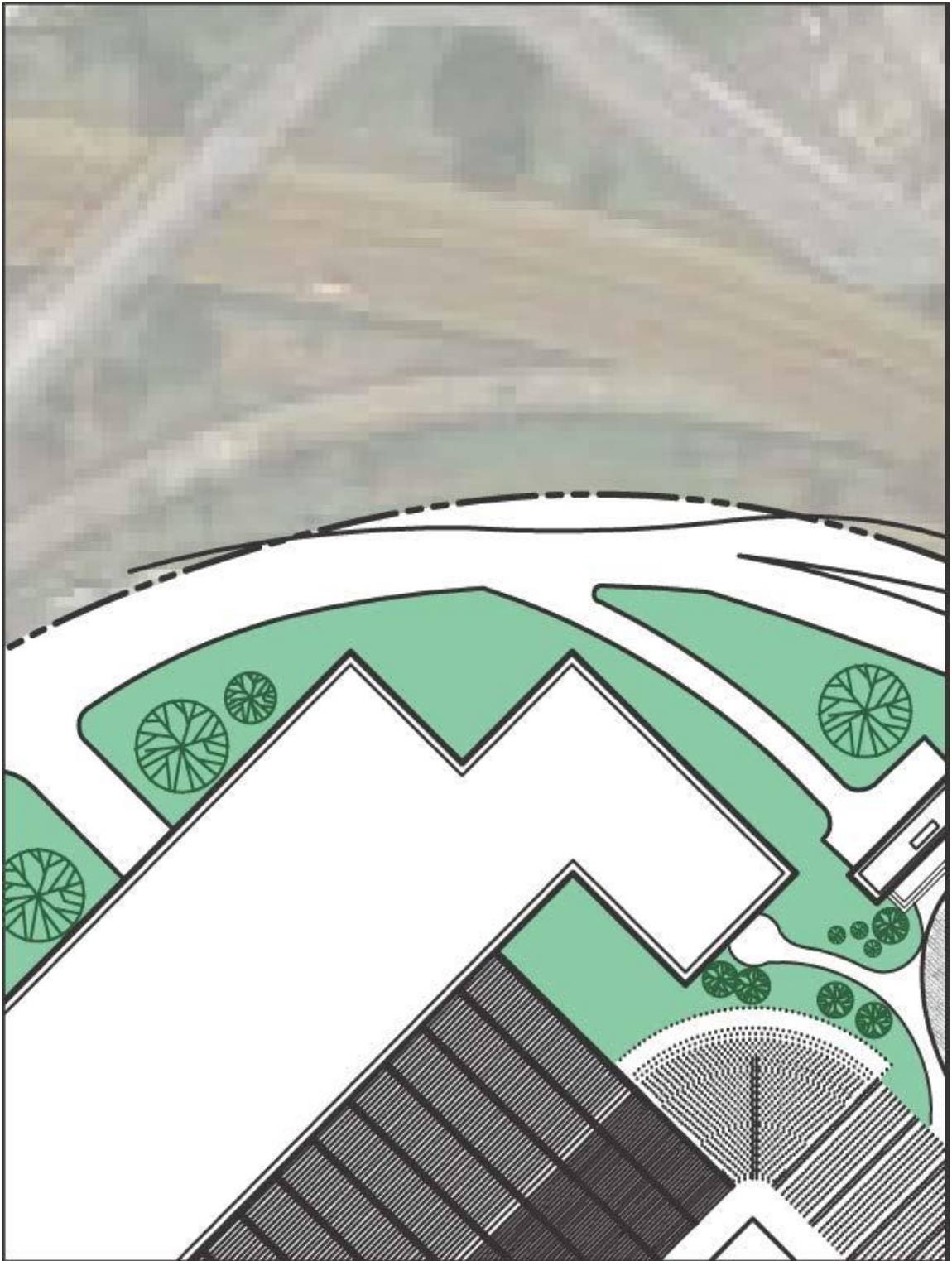


Figure 45 – Master Plan B - 1

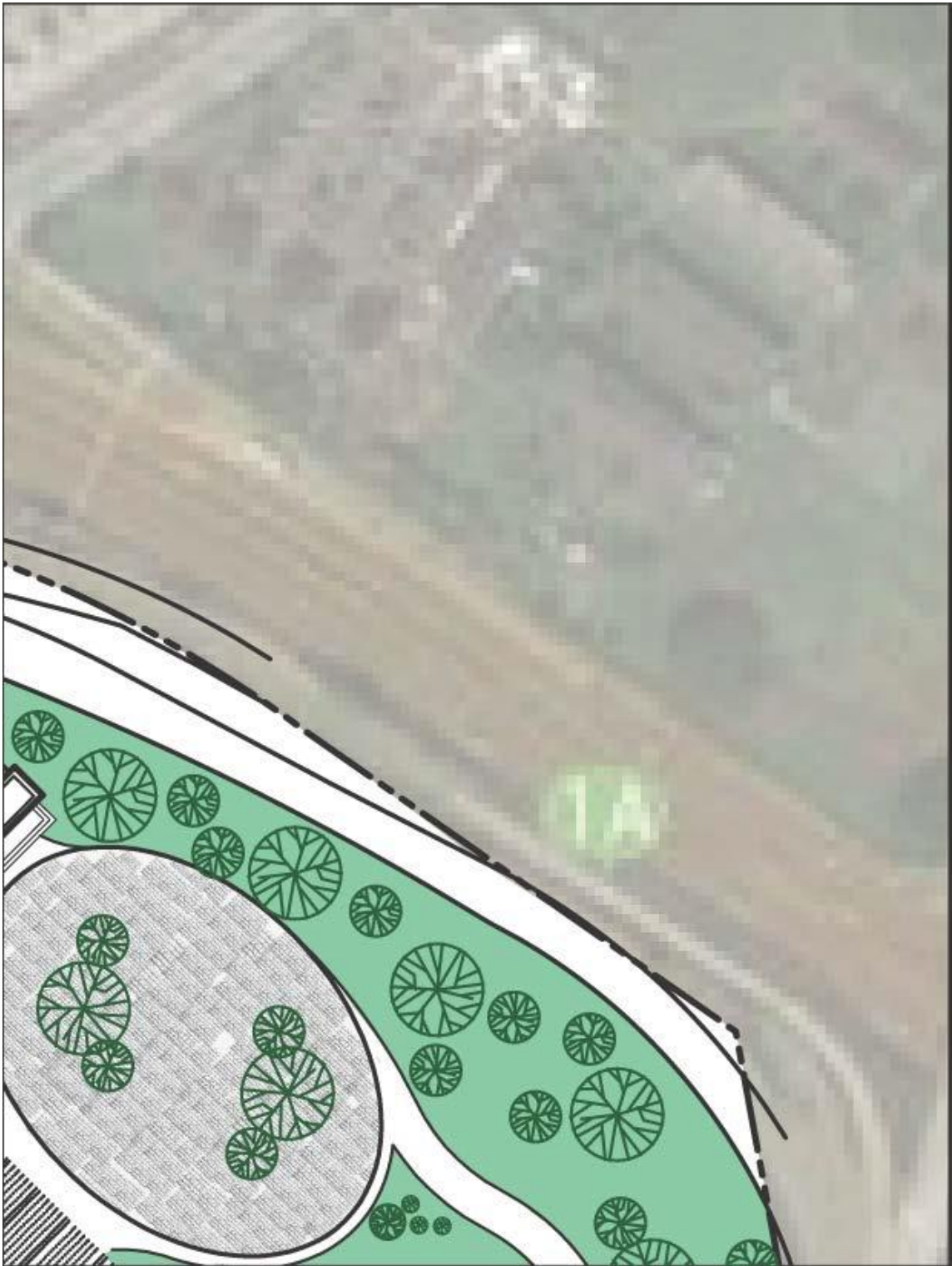


Figure 46 – Master Plan C - 1

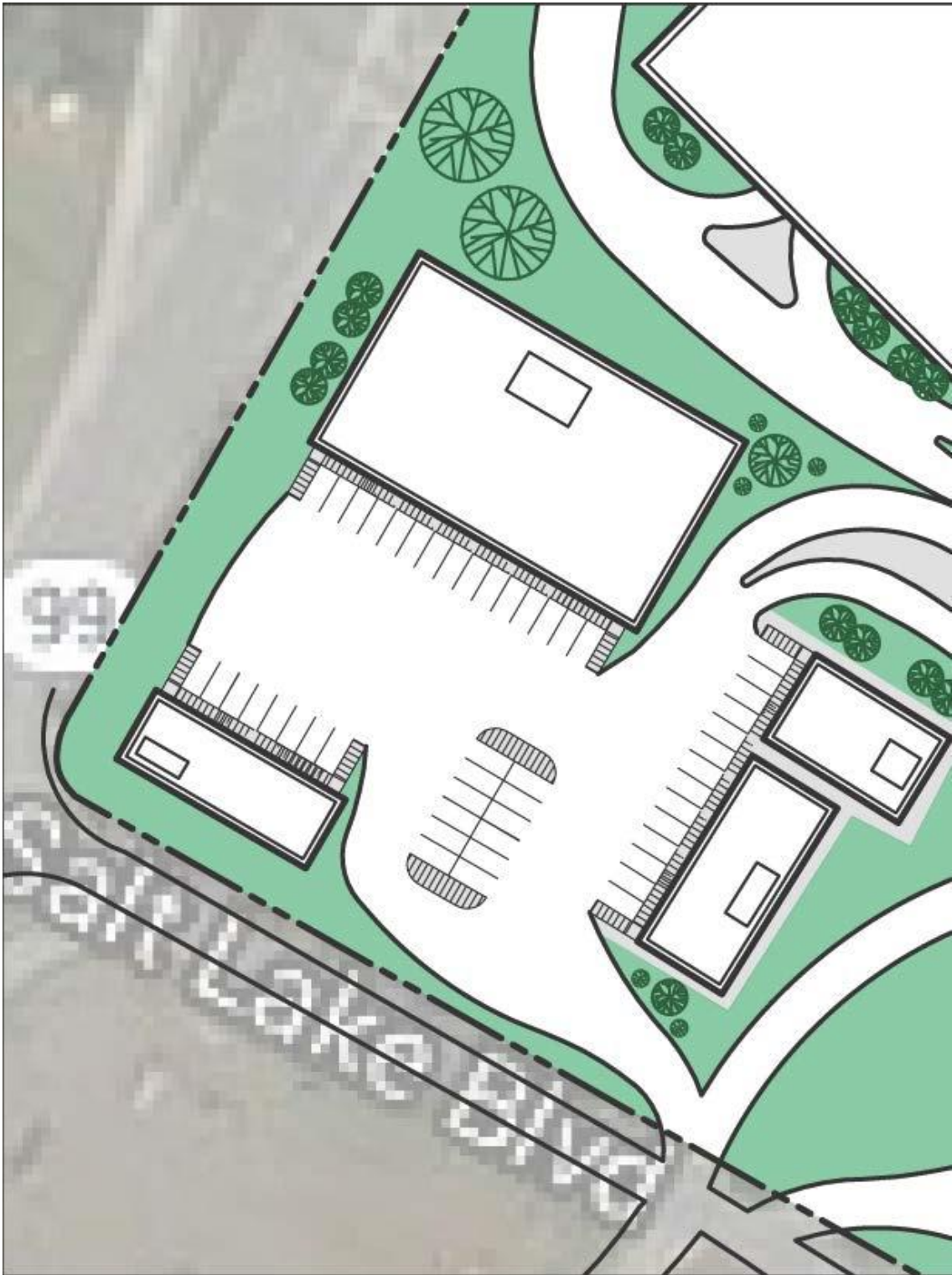


Figure 47 – Master Plan A - 2

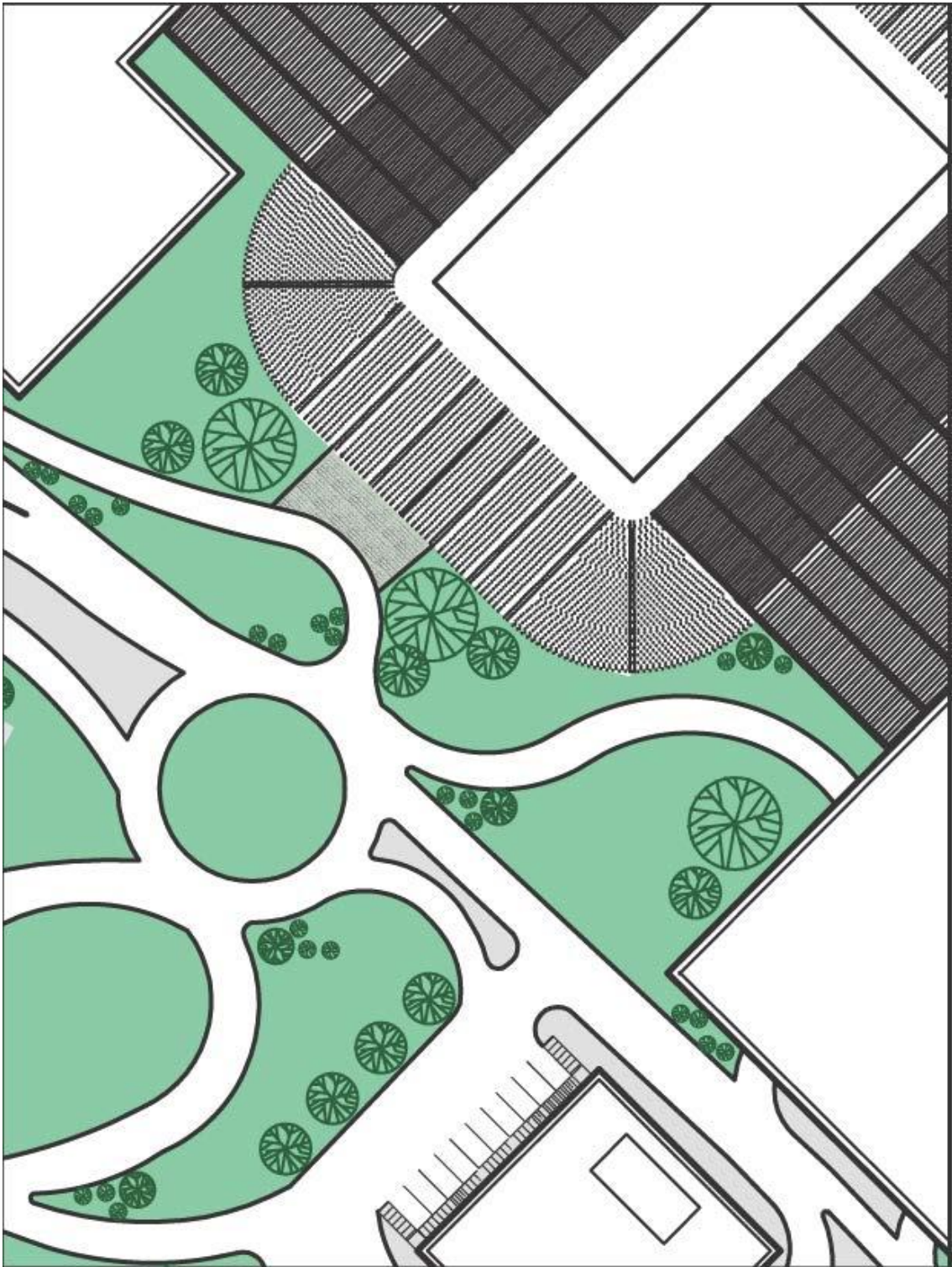


Figure 48 – Master Plan B - 2

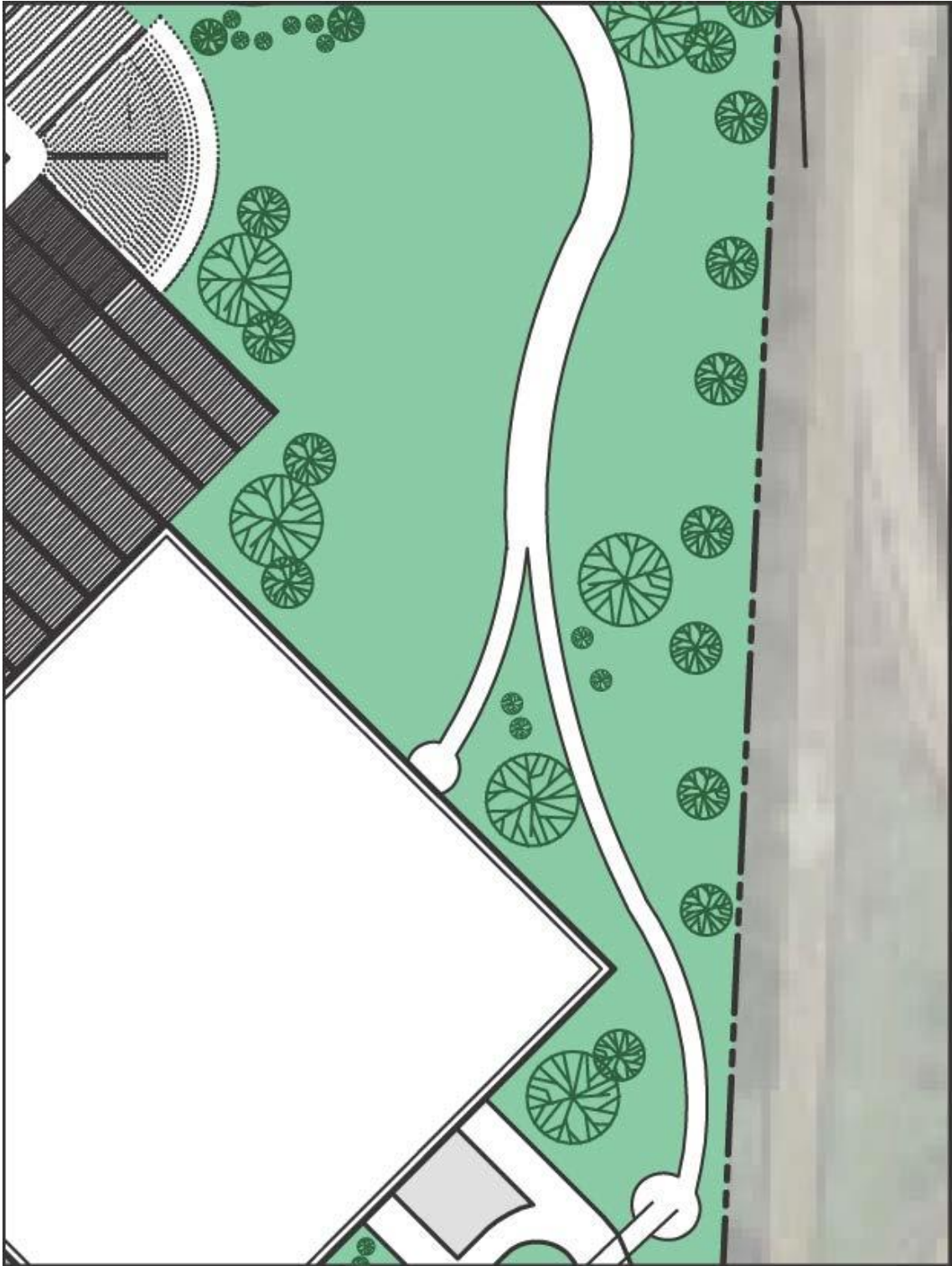


Figure 49 – Master Plan C - 2

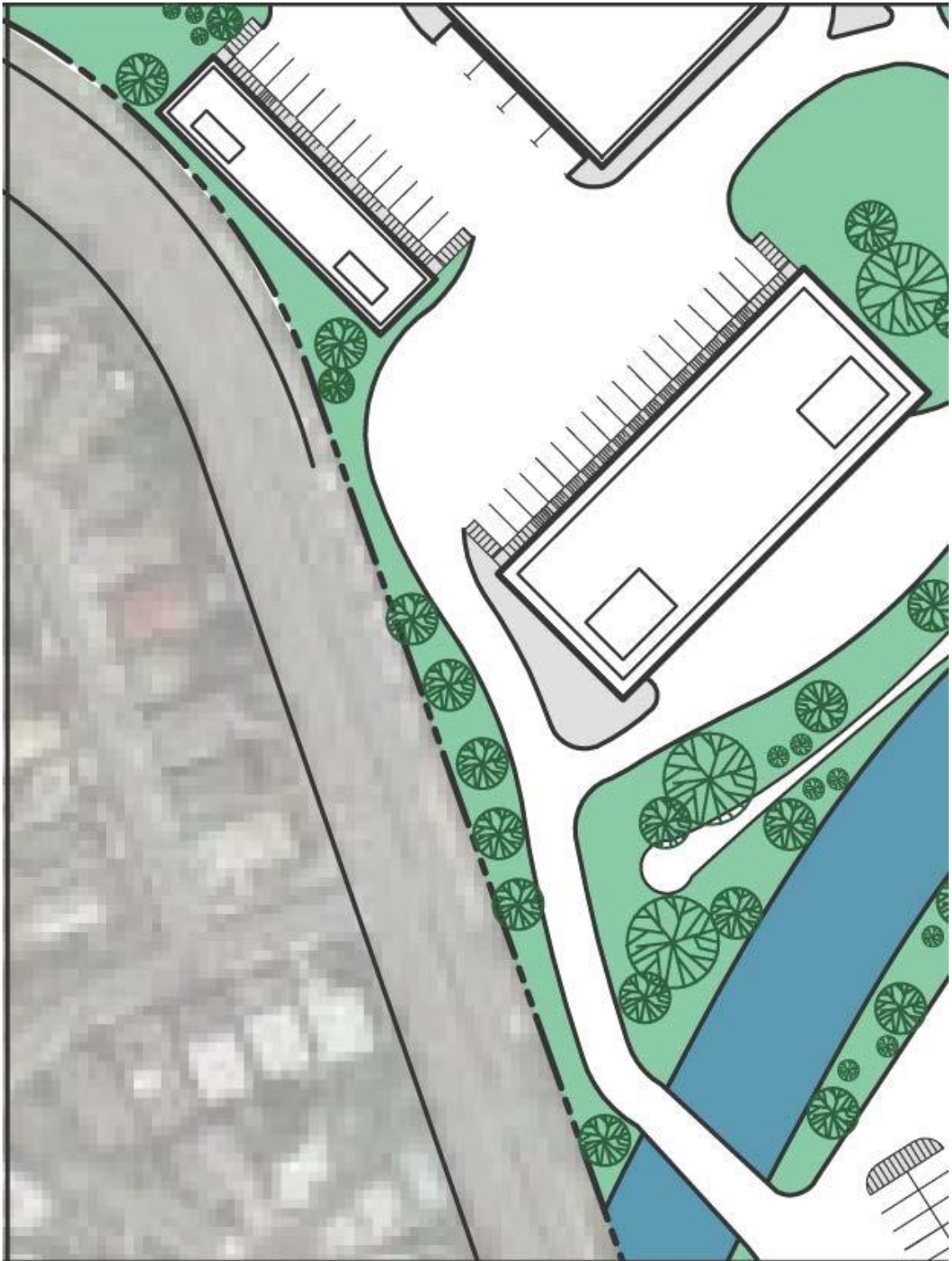


Figure 50 – Master Plan B - 3



Figure 51 – Master Plan C - 3



Figure 52 – Master Plan B - 4



Figure 53 – Master Plan C - 4

5.5: Stadium Programming – “Urban Context”

The inaccessibility of Aloha Stadium for pedestrians does not impede the spectators from enjoying the events; but it does indicate a larger problem with Honolulu’s urban fabric. As a city that was largely constructed after the 1950’s, Honolulu was not designed for pedestrians, but rather for the automobile scale. As Honolulu consists of a population that is wealthier than the average American city, where the median Honolulu county family’s income is \$72,764¹² and the US family income is \$51,900¹³, the ability to afford a personal automobile has been in the reach of the middle class household. This resulted in a proliferation of automobiles on the island. As a result, there has been an increase in traffic, to which the city responded by further developing the infrastructure. As Oahu continues to grow and develop, the ability to continue the path of constructing infrastructure for automobiles is becoming unsustainable.

Honolulu is transitioning from a suburban context to an urban one. This transition is a problem that has plagued many post automobile cities. The larger issue that is presented to urban environments that are established with the car is that there is no central location for the urban fabric.

In cities that were created before the car, the limit of the city was determined by the distance a person could walk. This results in a central location that becomes heavily developed. A primarily pedestrian urban circulation results in a very dense, very compact area, much like a nucleus in a human cell.

For cities that were created post personal automobile, the distance between entities shifted from being adjacent to each other to being further away. This distance change occurred because the automobile allowed people to live farther away from the

¹² "United States Census Bureau." Honolulu County QuickFacts from the US Census Bureau. Accessed March 16, 2015.

¹³ "Five Years Of Recovery Haven't Boosted The Median Household Income." DataLab. September 16, 2014. Accessed March 16, 2015.

places they needed to go, such as: stores, offices, and banks. Thus, the first expansion of the city occurred.

The second expansion of the city came with the enlarging of space for the automobiles' needs, in order for the car ride to be enjoyable. With larger cars, people were able to carry more people and things. Having the ability to carry more things increased the size of the homes, which in turn increased the demand for the production of things. Since having space is desirable, suburban environment became popular, in which the primary mode of transportation became the automobile, resulting in larger streets, buildings, and parking lots. These components all demand greater space, thus increasing the distance between destinations.

Eventually the space necessary for the infrastructure required by personal automobiles becomes too big, or the infrastructure becomes limited by the development, resulting in circulation congestion, traffic. This problem has manifested itself in Honolulu. Responding to that problem, the citizens of Honolulu voted to fund the establishment of a regional train, called the HART. The system is similar to the San Francisco regional train, known as the BART, on the routes of which the stations allow for the quick movement of people from the suburban areas to the urban core. The hope is that the HART will provide relief from the traffic occurring by the overuse of the highway system. At the writing of this thesis, Honolulu is billed at number three for the worst traffic in the United States¹⁴, higher than New York City despite it having the largest population in the United States. As the traffic problem for Honolulu is moving people east and west along the southern portion of the island, the Hart line follows the same path as the H-1 interstate. [Figure 54]

¹⁴ Terrigno, Phil. "10 U.S. Cities with the Worst Traffic." *The Fiscal Times*. June 6, 2014. Accessed February 24, 2015. <http://www.thefiscaltimes.com/Articles/2014/06/06/10-US-Cities-Worst-Traffic>.



Figure 54 – HART Line Diagram

Source Accessed December 10, 2014.

<http://www.honolulustransit.org/media/21086/bg-map.jpg>

The future of the current Aloha Stadium as a structure, ending its expected lifecycle in 2025, does not mean that its replacement should be located on a new site. With the inclusion of the HART, and with the current accessing of the stadium by automobile, the site is ideal for a future stadium. The HART station will be established in one of the southern overflow parking lots of the stadium. Due to the circulation needs of the site and the centrality of the site for the island, the existing site of Aloha stadium is still the ideal site for a new stadium to be constructed.



Figure 55 – HART Planned Station
 Accessed December 11, 2014. <http://www.honolulutransit.org/rail-system-guide/interactive-route-map.aspx>.

Urban Renewal

The distance between the Honolulu stadium and Pearl Harbor base station is 1.7 miles or 2.8 kilometers. Both the proposed HART stations are quite far to the Pearl Harbor national park; however, the stadium station is closest at 0.7 miles or 1.1 Kilometers, whereas the Pearl Harbor base station is 1 mile or 1.6 kilometers. In order to create a pedestrian space, the environment must be suitable for pedestrians. To create such an environment the implication of particular design elements should be implemented. This section will discuss types of designs that would be beneficial to creating a pedestrian oriented development.

Having the ability to access Pearl Harbor National Monument by foot would be ideal, as it allows for better access for visitors and tourists. Creating multiple points of interest along the way to the site would draw more people to the location. Connecting the two attractions, with pedestrian oriented strips, would generate a walkable path in which the visitors could take to explore the landmarks of Oahu. Developments along that path would strengthen the appeal of the location, drawing even more visitors to the location.

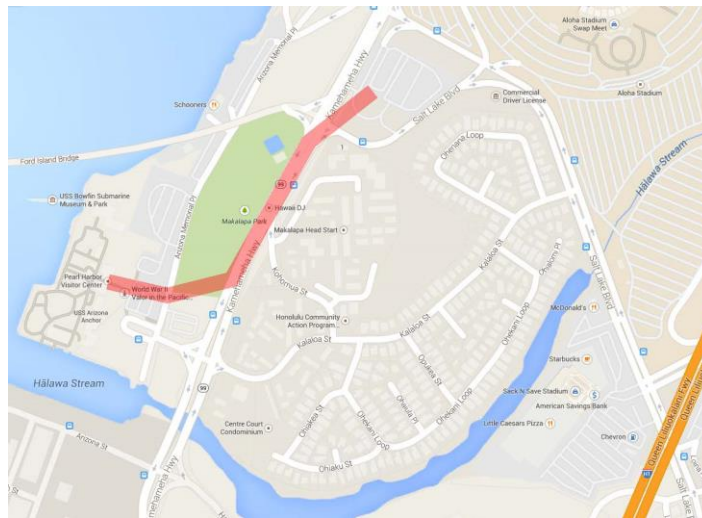


Figure 56 – Aloha Stadium Urban Development Opportunity

One method to create an environment that would appeal to pedestrians, would be to create multi-functioning structures. The use of a building must be varied to ensure that the site is usable during all hours of the day. For the future of the Aloha Stadium Pedestrian Oriented Development (ASPOD), the morning would be bringing in people to catch the train into the downtown area of the city. Thus, having an area where people could grab breakfast, or drop young children off at daycare would make for suitable programming choices for the area. The storefronts for those entities should be at the street level; accessing the front of the store should be planned to address the scale of someone walking by.

To achieve that goal, removing the ability to park around the stores would force the users to leave their cars and use the intended circulation of the area. Mixed-use and

commercial buildings with entries and windows on pedestrian-oriented streets provide interesting walking environments. The shops should have no parking allowed.

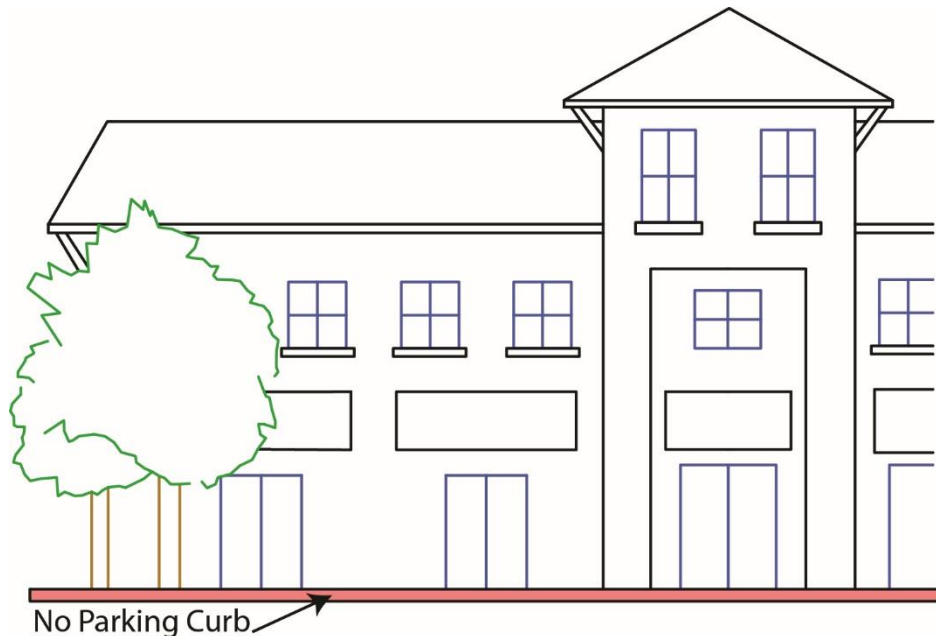


Figure 57 –Commercial with No Parking in Front

Once the area attracts people to the location, the area must be a place in which people would like to spend their time. The weather in Oahu is a pleasant temperature and sunny for most of the year, with periodic showers. When outside, the sun becomes a deterrent as too much time will result in sunburns and possible heat exhaustion. This problem can be seen in other areas that are extremely warm, like Las Vegas’ Freemont Street.

Freemont Street in Las Vegas has been enclosed with a roof, allowing the space to be inside and outside, and ultimately making the area pedestrian friendly by removing the harsh heat of the sun. When crafting a new inside/outside space: awning, arcades, and trellises can help protect pedestrians from the elements, making the space enjoyable. If the space protects the pedestrians, then more people would be willing to stay in the location. Higher foot traffic results in better opportunities for businesses to receive customers, resulting in a sustainable pedestrian commercial area for the urban fabric.

Shelters such as awnings, arcades, and trellises, can help protect pedestrians from the sun and rain.

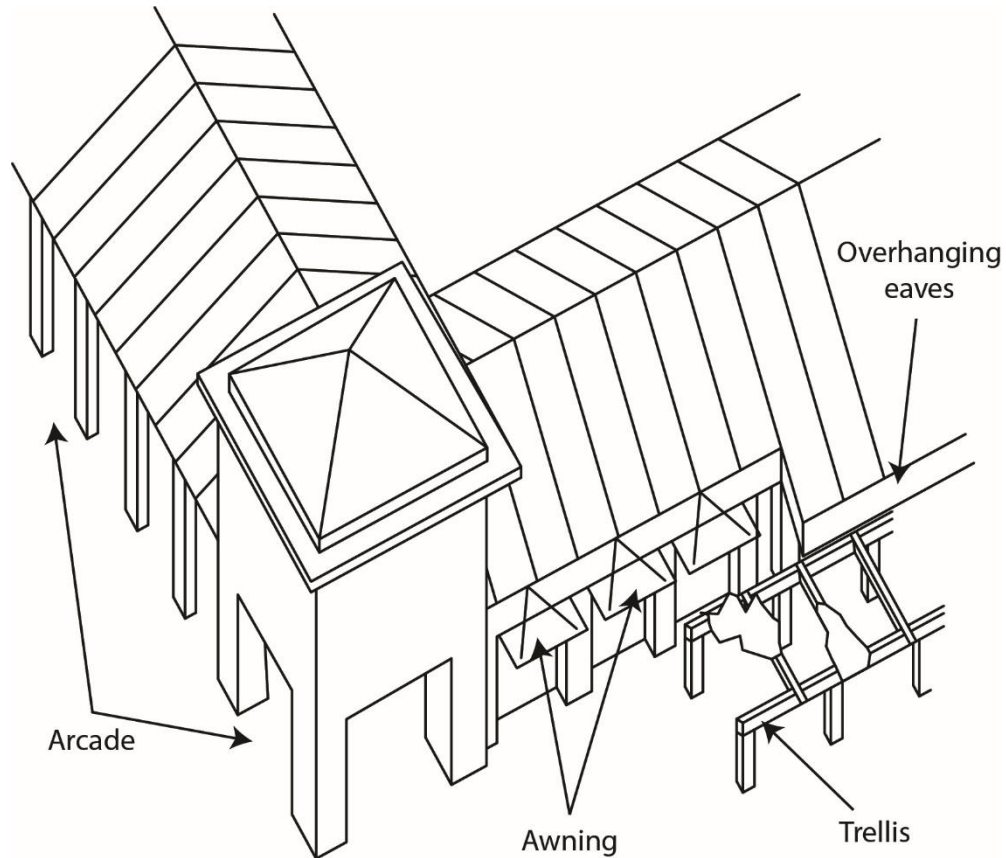


Figure 58 – Pedestrian Shelters

Pedestrian Oriented Development is the idea that the pedestrian circulation trumps all other forms of circulation. In creating a pedestrian oriented development, continuous sidewalks reinforce that the area of the urban fabric is for pedestrians, and not intended for automobiles. Continuous sidewalks with trees are appropriate in separating automobiles and pedestrians, providing greater sense of safety for the pedestrian users.

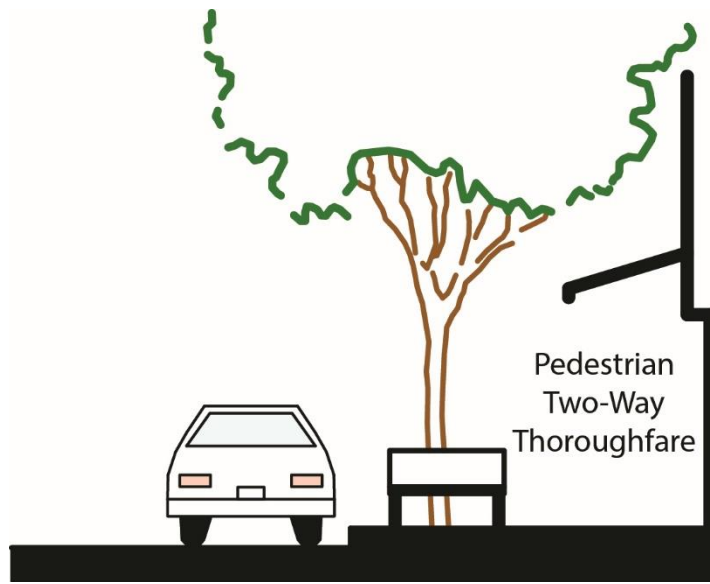


Figure 59 – Continuous Pedestrian Separated Sidewalk

Completely removing buildings from automobile access is not a viable option, since commercial buildings still need to receive shipments of the good that they are selling. Thus, a secondary circulation must be established, while not dominating the pedestrian oriented scheme. By placing the parking structures behind the buildings, aligned along pedestrian oriented streets, the two forms of circulation are separated. This allows for businesses to receive deliveries on one side of the building and having their storefronts on the pedestrian side. This type of scheme is beneficial, as it allows support for the commercial business, without sacrificing the safety of the customers. An ideal transit oriented development design allows the storefronts to face the pedestrian-oriented streets.

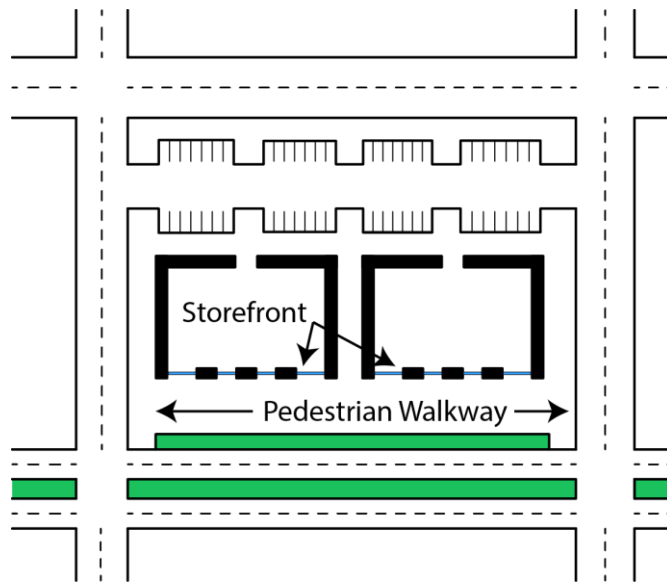


Figure 60 – Pedestrian Oriented Street

Knowing that the site of Aloha Stadium will be a station on the first line of HART shows that the State of Hawaii is investing in the location of the stadium. As the stadium will end its intended lifecycle around 2025, a replacement will most likely be located on the same site. To help with the transition from a sparse suburban development to one of a dense urban development, the area around the stadium should incorporate pedestrian oriented development, which would result in a denser development around the HART stations.

Focusing development around HART stations to be more pedestrian friendly will strengthen the shift from automobile centric urban fabric to one of a mass transit oriented urban fabric. With the continued development of the island of Oahu, the need to efficiently move the population increases. With a mass transit oriented urban fabric, the quantity of people the urban environment can support would be greater than the quantity based solely on personal automobiles

Chapter 6. Sounds Great but Who Can Pay?

The cost of construction for a new professional football stadium is estimated to be around a half a billion to a billion dollars. In smaller markets like Honolulu, the burden to construct the stadium typically falls as a public expense. Thus, generally, governments issue bonds to raise the capital necessary to construct a stadium. This method of financing becomes difficult because the building truly is a public building. With the user of the new Honolulu Stadium primarily being the University of Hawaii football team, opponents of the project could make the argument that the government is subsidizing a form of entertainment.

Fortunately, the University of Hawaii is a public school, so the argument does not have as much merit as if the stadium was being built for a professional football team. In the case of a stadium being built exclusively for the use of a professional football team, the argument that public money should not be subsidizing a private industry that makes billions of dollars a year is difficult to counter, as the argument has merit. This section discusses methods of payment for the process of building a new stadium. These methods should be implemented with the initial design of a new stadium. Before concept renderings can move to further development, the financing has to be agreeable for the public financing the building. With a consensus to move forward, the concept renderings can be further developed towards a finished building.

Why should an architect be concerned with the financing of the project that they are working on? Architects already have established that they are in service to the public with regards to the safety of the building they design. With a stadium the design goes beyond just the safety of the building, as it is one of the most expensive projects that a city can spend its money on. With the massive amounts of money necessary for the project, multiple entities become involved: politicians, community leaders, news agencies, and the average citizen. All have a vested interest in the project that the chosen architect has the power to shape. Knowledge of different types of financing is important,

because the financing has impacts on the design. When the architect understands the financing, he or she can develop and provide innovative solutions to incorporate space that agrees with financiers' visions and desires.

6.1 Personal Seat License

A Personal Seat License (PSL) is a fee paid to allow a person the right to buy season ticket for a certain seat in the stadium. The holder is allowed to sell this privilege to others if they choose. Selling preferred seats brings community money into the project. The preferred seat purchase gives the owner the exclusive ability to purchase event tickets before anyone else.

According to an article, written on Forbes website, by Dan Alexander, this method of financing has allowed the construction of the NFL's most expensive stadium in the history of the NFL.¹⁵ This type of financing has spurred a secondary market for the owners of these PSLs. The PSL buyer hopes to purchase this license at the initial offering in hopes that the value of the license will go up over time. The NFL in recent occasions, aware of this secondary market, has begun to increase the initial price of the PSL. How can a PSL affect the actual design of the stadium?

One way that design can be implemented to facilitate PSL financing can be in having the right to name the seats at the initial purchase. Given that some buyers are purchasing the seats licenses in the hopes of reselling and making a profit at a future point of time, the option of naming the seat gives additional incentive, as the name immortalizes the initial buyer. Whether they can keep the seat license or not, the first

¹⁵ Alexander, Dan. "NFL PSLs Have Become Very Risky Investments." Forbes. September 12, 2012. Accessed February 24, 2015. <http://www.forbes.com/sites/danalexander/2012/09/05/nfl-psls-have-become-very-risky-investments/>.

buyer's name would appear on the seat during the life of the stadium. With Aloha Stadium needing over 45,000 seats, selling only ten percent of the seats at two thousand dollars results in nine million additional dollars of revenue to offset the purchase price of the stadium. For a stadium with a cost of half a billion dollars, this method of financing is just under two percent of the cost of the stadium.

6.2 NFL

Moving a professional football team to Hawaii has benefits for the NFL and also to the surrounding urban development. The presence of an NFL team in Honolulu geographically brings the franchise closer towards Asian markets. China has seen its fan base double in the last three years, causing the NFL to see if they can conduct exhibition games in China.¹⁶ This track record of expanding in foreign markets is similar to the expansion of the league into the United Kingdom, in which the league first played exhibition games in London, and now plays two regular season games. Locating an NFL team to play in Honolulu has the potential to extend the NFL fan base across the entire Pacific Region. This bolsters the viewership of the NFL, resulting in larger client bases.

Additional viewers are not the only benefit of bringing the NFL to a city like Honolulu. The construction of stadiums is beginning to shift from just the stadium to extensive real estate development projects. On Tuesday, February 24th, 2015, the city officials of Inglewood California unanimously approved zoning changes of the old Hollywood Park racetrack. The change in zoning allows for the construction of an 80,000 person capacity stadium. The racetrack is in initial development talks with proposals from Hollywood Park Land Co. stating the scope of the project to include homes, office

¹⁶ Wan, Allen. "NFL Sees Strong China Growth as Joe Montana Rallies Asian Fans." Bloomberg.com. November 14, 2011. Accessed February 26, 2015. <http://www.bloomberg.com/news/articles/2013-11-15/nfl-sees-strong-china-growth-as-joe-montana-rallies-asian-fans>.

buildings and shopping malls; and with the current change in the zoning can now include a massive stadium.

Tim Logan, an author of the *L.A. Times*, commented on the change writing that “profits from modern-day stadiums come from more than just the stadium”¹⁷. NFL owners are billionaires that make money by investing their capital into various projects. A favorite investment among the owners is that of real estate. This shift of real estate development releases the stadiums from the dependency of public funds opening up the possibility provided by private money. What affect will it have on the architecture of the stadium and even the programming?

The design of Hollywood Park shows a new shift in stadiums. In the mid-nineties, stadiums were places on the outskirts of town located on cheap land to reduce the cost. The primary goal was to have it on main thoroughways like highways. Near the late nineties, stadiums became urban rejuvenation projects. Now, in the early 2000’s, stadiums have transformed once again into entertainment district developments for cities. With Kaka’ako being the urban rejuvenation site of Honolulu today, could a stadium placed in the neighborhood provide much needed entertainment? Perhaps having the future stadium of Oahu still in the same site will allow the strengthening of the connection, through an entertainment urban development, between Oahu’s major urban areas, Pearl City and Downtown Honolulu.

With the construction of a stadium to replace Aloha Stadium, the City and County of Honolulu and the island state of Hawaii should seriously consider, the benefits and consequences, of bringing an NFL team to the islands. By being provided plans to build a new stadium, the NFL would see that Honolulu was interested in having a professional

¹⁷ Logan, Tim. "Stadium Economics: How Building a Venue in Inglewood Makes Financial Sense." *Los Angeles Times*. February 25, 2015. Accessed February 27, 2015. <http://www.latimes.com/business/la-fi-stadium-economics-20150226-story.html#page=1>.

football team. With the demand for at least one, if not two, NFL teams in Los Angeles, as well as the expansion of the NFL to the United Kingdom, there are signs that Oahu might stand a chance as a new NFL football venue. Also, since the NFL and the city of Honolulu having a preexisting relationship with the playing of the Pro Bowl at the current Aloha Stadium, informing the NFL that Honolulu would be interested in having their own NFL team may be convincing enough for the NFL to consider expanding the numbers of teams in the league. Constructing a project like this would entice international financial investment opportunities for the state of Hawaii, resulting in a modern city that will flourish in the coming years.

6.3 University of Hawai‘i

The University of Hawai‘i Warriors football team makes substantial amounts of revenue. ESPN has provided the expenses and revenues for a 120 collegiate level football teams and in the United States. The Warrior football team is 66th in revenue with a total of \$37,427,263.¹⁸ For expenses, the Warriors are 68th with a total expense of \$35,133,798.¹⁹ This leaves the Warriors with a surplus of 2.3 million dollars. This not a large amount of money, in terms of the cost to build a new stadium, but this money could contribute a significant amount of the financial resources necessary to build a new stadium. In fact, the rent UH pays to use the stadium covers only the overhead costs to hold the event.²⁰

Creating a stadium for just the Warriors would require a less demanding design lowering the construction costs, perhaps by as much as a billion dollars. Even if the UH Warriors were to use their profit from the event over the course of a typical stadium’s life

¹⁸ "College Athletics Revenues and Expenses - 2008." ESPN. Accessed February 27, 2015. http://espn.go.com/ncaa/revenue/_/page/1.

¹⁹ "College Athletics Revenues and Expenses - 2008." ESPN. Accessed February 27, 2015. http://espn.go.com/ncaa/revenue/_/type/expenses/page/1.

²⁰ "How Much Does UH Pay to Use Aloha Stadium?" - Hawaii News Now. November 24, 2014. Accessed March 16, 2015.

span, about 50 years, the amount of money, using the 2008 profit, would only be 115 million dollars. With the initial construction cost of Aloha Stadium being 37 million dollars and then adjusting that cost to account for inflation²¹, the present day cost to build a similar stadium would be 152 million dollars. The Warriors are quite close to being able to afford such a purchase, but would still need financial assistance.

UH Warriors would not be able to outright afford the cost of constructing their own stadium, because the amount they can generate over fifty years is less than the construction cost of the building. Financing for stadiums typically occurs in the form of loans that are paid off over time; and the cost of the stadium does not reflect the additional capital necessary to pay off the interest of the loan. Thus, UH Warriors would not be able to afford a stadium the same size as Aloha Stadium.

The athletic director Ben Jay is not looking for a stadium the size of Aloha Stadium. In the summer of 2014, the athletic department of UH commissioned Gensler Design in Los Angeles to create concept rendering of a stadium for the athletic department, with money given from a generous donor. The athletic department asked for a stadium with a capacity of only 30,000 to 35,000. That size of a stadium is 40% - 42% of Aloha Stadium.

The state of Hawaii commissioned a New York consulting firm, to determine what the cost for a new facility would be, and the results was \$192 million²² for a facility with a roof covering.

²¹ Inflation calculations were conducted using the US Inflation Calculator at the URL: <http://www.usinflationcalculator.com/>. Accessed February 2nd, 2015.

²² Shimogawa, Duane. "New Stadium Recommended to Replace Aloha Stadium, Report Says - Pacific Business News." Pacific Business News. June 26, 2014. Accessed February 27, 2015. <http://www.bizjournals.com/pacific/news/2014/06/26/new-stadium-recommended-to-replace-aloha-stadium.html?page=all>.

With a three percent interest rate on the stadium, the annual cost to the athletic department to pay off the stadium in fifty years would result in only half of the money needed, thus, the other fifty percent would have to be provided by the State of Hawaii and the City and County of Honolulu, in order for the stadium to be affordable, in terms of a monthly payment for UH. If money is provided from other sources, UH would only be a fifty percent shareholder; the State, City, and County being additional shareholders.

Table 7 – UH Warrior New Stadium Payment Breakdown

Construction Cost	\$192 million
City and County of Honolulu Share	\$96 million
UH Athletic Department Share	\$96 million
Term of Loan	50 years
Interest Rate	2.5%
Monthly Payment of Each Owner	\$280,000
Annual Amount Paid by Each Owner	\$3.36 million

Considering the revenue and profit generated by the Warriors football team, going in on a stadium deal with the city makes fiscal sense. Currently the team would not be able to afford the stadium by itself; but splitting the cost with the City and County of Honolulu would allow for a new stadium that fits the University’s needs. A new stadium could become a large venue amenity that could be a semi-public structure with benefits to the general population.

6.4 HECO

By creating the stadium with a solar array, HECO can have a space to place a solar generator on the Island, reaching their goal as a green energy supplier as well as being a financier toward a new stadium. HECO has ambitions to lower the dependency on fossil fuels, to provide the island of Oahu with the necessary energy that has become an expectation. Utilizing the stadium’s roof space as a platform for solar panels would result in the following benefits: clean renewable energy, and a portion or all of the new stadium being enclosed.

The energy rates of the Hawaiian Island are three times that of Mainland cities. At the writing of this thesis, there has been a surplus of oil, driving the price of gasoline down, lowering the cost to produce power. But, even still, the price per kilowatt paid for by the average consumer is 32.8 cents. This is three times the national average of the United States electrical price over all sectors in 2013 – 10.08 cents per kilowatt hour.²³

The average modern photovoltaic solar panel will produce 8 – 10 watts per square foot²⁴.

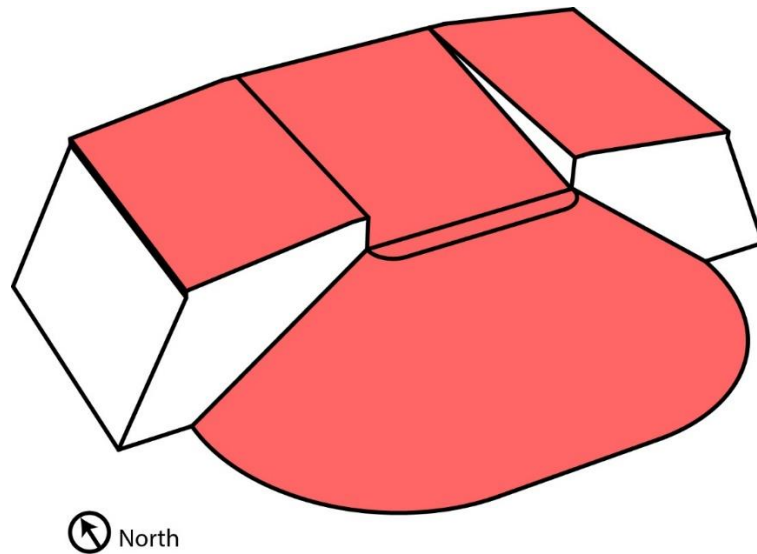


Figure 61 – Stadium Roof Solar Panel Potential Placement

The area indicated in red on the diagram is approximately 543 thousand square feet. Covering that entire area would result in about 5,400 kW of electrical power. With a production time of about five hours per day, the power generated per day would be

²³ "U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." EIA. January 27, 2015. Accessed February 27, 2015.

http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_3.

²⁴ "Get a Free Solar Estimate to See Solar Costs from Top Rated Solar Companies." Solar Installers. Accessed February 27, 2015. <http://www.solar-estimate.org/?page=solar-calculations><http://www.solar-estimate.org/?page=solar-calculations>.

27,000 kW of electrical power before reduction through inefficiencies. The reduction due to real world conditions would be 78% of projected solar gain. That results in a daily generation of 21,000 kW or 21 MW. The current peak demand of Oahu's energy needs are 1216 MW²⁵, thus, incorporating a solar array as part of the roof of Aloha Stadium would produce 1.7% of Oahu's peak necessary demand for energy. This number could be expanded upon further, if the entire area of the site – twenty times the surface area of the proposed stadium – was fitted for solar panel. Having a solar array over the entire site would provide shading for the parking structure, as well as a substantial push towards Oahu in adopting clean energy onto the grid.

With the cost of construction for a professional stadium, being beyond the means of the island of Oahu, there are methods for being able to afford such a structure. If the NFL can be convinced to bring a team to Hawaii, the resulting urban development could be a catalyst creating construction jobs. The new construction would give portions of Oahu's urban fabric an updated look. Additionally, the City and County of Honolulu would have more amenities. Having a new entertainment district would provide even greater amounts of things to do, and would bolster the major economic driver in Oahu, which is tourism.

Whether or not the pursuit of a professional football stadium is necessary, the need for a new stadium is real, and will occur in the near future. The University of Hawai'i Warriors football team is in need of a better home field. Alone, the football team would not be able to finance its own stadium. The limited amount of space on the Island of Oahu makes the location of a replacement stadium more likely to be on the site of the current Aloha Stadium. Potential doubling of the use of a stadium by the public, as well as the UH Warriors, makes the most sense for the urban fabric of Oahu.

²⁵ "Hawaii Energy Facts and Figures." State of Hawaii Department of Business, Economic Development and Tourism. January 1, 2013. Accessed February 27, 2015. http://energy.hawaii.gov/wp-content/uploads/2011/10/EnergyFactsFigures_Jan2013.pdf.

Chapter 7: Conclusion – Stadium Recommendations

Unlike in Middle Ages in Europe where the most prominent buildings were churches and castles, the contemporary American city favors the stadium. The American cities' stadium is the status symbol that is on display every time the stadium is hosting an event that draws attention from the rest of the nation. In the case of Super Bowls, World Cups, and Olympics, the stadium draws international attention, becoming a symbol for millions, for which the stadium identifies the place. The United States has drastically changed stadiums from just a place to view a sporting event, to a building that encompasses things to do for any and every type of user. Like the American shopping mall, contemporary stadiums try to offer something for everybody. This has resulted in stadiums' construction budgets ballooning to over a billion dollars.

For the island of Oahu, in the State of Hawaii, Aloha Stadium has been the region's sporting entertainment venue. As Aloha Stadium's lifecycle is fifty years, by the year 2020 Aloha Stadium will have come to the end of its life. Knowing the datedness of Aloha Stadium, many have begun to ponder what should replace Aloha Stadium? The aim of this thesis is to observe the possible users for the stadium that shall replace Aloha Stadium. After an investigation of the users, design parameters are discussed, resulting in a discussion of what type of design drivers should be adopted for the future replacement stadium. Lastly, the financing was brought under investigation to understand potential effects that the future stadium could have, if certain design drivers were implemented. In culmination, a recommendation was presented to give a starting point for policy makers, community members, and anyone else who is interested in the construction of one of America's truly prominent structures, the stadium.

The recommendation for Honolulu is to demolish Aloha Stadium and construct a new stadium. As the only guaranteed tenant is the University of Hawai'i Rainbow Warriors, constructing the field to support the collegiate team first and foremost is a

logical conclusion. Having a professional football team could be possible in Oahu, but the most likely scenario would have to be an expansion team. As there is no guarantee at the writing of this document that the NFL will be expanding the league, it is important to create design solutions for what is known to be a guaranteed user of the stadium, and not one of speculations or hope.

The capacity of the replacement stadium should be 45,000 seats. This number is larger than what is recommended by the UH athletic department. The reason for choosing to go larger is based on the fact that fan attendance is influenced by the winning and losing record of the UH Warriors. Winning games puts fans in the seats, as shown in the tables of UH Warrior game attendance - the better the team is doing, the more fans show up to the game.

Replacement stadium forms were presented in the future design portion of the document, listing the benefits and consequences that result from each form. The stadium should be constructed in the form A, as the design provides better sightlines. Even though form B is more cost effective, having the stands circulate the entirety of the field does not add much for the user when they are experiencing the stadium. Since the action of both football and soccer move along the length of the stadium, it is better to have the seats along the length of the field.

Even though designing the stadium specifically for a professional sports team has been ruled out, the future designed stadium, should still consider the hope of attracting a Professional Football team. As the amount of home games for professional football is less than ten, the remote location of Honolulu is not as problematic as for other sports with much longer seasons. Thus, Honolulu is still a viable and attractive option for the NFL. In the project brief, the stadium should be designed with expansion in mind. By being able to add additional capacity to the stadium easily through modular design techniques, the newly designed stadium will be able to expand if need be. If the NFL does decide to

create an expansion team, the replacement stadium has the ability to be converted into a larger venue.

When looking for financing for the stadium, a partnership between the University of Hawai‘i and the City and County of Honolulu should be formed. UH will be one of the primary users of the stadium and a guaranteed client since the space to construct a stadium is limited to only a few locations on the land-starved island of Oahu. The UH should be willing to split the cost with the city.

To reduce costs further the stadium should look to employ the use of a solar array by bringing HECO into the partnership. The stadium should be willing to rent out their parking structure to HART as an additional garage for Park and Ride. Lastly the stadium should have a roof. This allows for a greater amount of events to occur, without the need to worry about the weather. This would add to the functionality of the stadium, increasing the likelihood that the stadium would be attractive to perspective event planners.

The important message to take away from this document is that design has benefits and consequences. Those benefits and consequences are linked to one another in which if one thing is changed the benefits and consequences also change. The designs outlined in this document are to further develop the talk of what type of stadium should replace Aloha Stadium. They are specific to the time in which the document is written and may not hold up to the test of time. What does hold up in design is logical thinking that creates opportunities and solutions that are unique, providing the greatest amounts of benefits and the least amount of consequences.

Appendix A²⁶

Table 8 – United States of America’s Stadiums

-	Stadium	City	State/Province
1	Michigan Stadium	109,901	Ann Arbor Michigan
2	Ohio Stadium	104,944	Columbus Ohio
3	Kyle Field	102,512	College Station Texas
4	Tiger Stadium	102,321	Baton Rouge Louisiana
5	Bryant–Denny Stadium	101,821	Tuscaloosa Alabama
6	Darrell K Royal–Texas Memorial Stadium	100,119	Austin Texas
7	Los Angeles Memorial Coliseum	93,607	Los Angeles California
8	Sanford Stadium	92,746	Athens Georgia
9	Rose Bowl	92,542	Pasadena California
10	Cotton Bowl	92,100	Dallas Texas
11	Ben Hill Griffin Stadium	88,548	Gainesville Florida
12	Jordan–Hare Stadium	87,451	Auburn Alabama
13	Memorial Stadium	87,000	Lincoln Nebraska
14	MetLife Stadium	82,566	East Rutherford New Jersey
15	Bobby Bowden Field at Doak Campbell Stadium	82,300	Tallahassee Florida
16	Gaylord Family Oklahoma Memorial Stadium	82,112	Norman Oklahoma
17	Frank Howard Field at Memorial Stadium	80,200	Clemson South Carolina
18	Notre Dame Stadium	80,795	South Bend Indiana
19	Lambeau Field	80,735	Green Bay Wisconsin
20	Camp Randall Stadium	80,321	Madison Wisconsin
21	Williams-Brice Stadium	80,250	Columbia South Carolina
22	AT&T Stadium	80,000	Arlington Texas
23	Arrowhead Stadium	79,451	Kansas City Missouri
24	FedExField	79,000	Landover Maryland
25	EverBank Field	76,867	Jacksonville Florida
26	Mercedes-Benz Superdome	76,468	New Orleans Louisiana
27	Sports Authority Field at Mile High	76,125	Denver Colorado
28	Sun Life Stadium	75,540	Miami Gardens Florida
29	Spartan Stadium	75,005	East Lansing Michigan
30	Bank of America Stadium	73,778	Charlotte North Carolina

²⁶ "List of American Football Stadiums by Capacity." Wikipedia. Accessed January 26, 2015. http://en.wikipedia.org/wiki/List_of_American_football_stadiums_by_capacity.

31	FirstEnergy Stadium	73,200	Cleveland	Ohio
32	Ralph Wilson Stadium	73,079	Orchard Park	New York
33	Husky Stadium	72,500	Seattle	Washington
34	Donald W. Reynolds Razorback Stadium	72,000	Fayetteville	Arkansas
35	Sun Devil Stadium	71,706	Tempe	Arizona
36	Legion Field	71,594	Birmingham	Alabama
37	Georgia Dome	71,228	Atlanta	Georgia
38	Faurot Field	71,168	Columbia	Missouri
39	NRG Stadium	71,054	Houston	Texas
40	M&T Bank Stadium	71,008	Baltimore	Maryland
41	Kinnick Stadium	70,585	Iowa City	Iowa
42	Qualcomm Stadium	70,561	San Diego	California
43	Rice Stadium	70,000	Houston	Texas
44	Lincoln Financial Field	69,172	Philadelphia	Pennsylvania
45	LP Field	68,804	Nashville	Tennessee
46	Gillette Stadium	68,756	Foxborough	Massachusetts
47	Levi's Stadium	68,500	Santa Clara	California
48	Commonwealth Stadium	67,606	Lexington	Kentucky
49	CenturyLink Field	67,000	Seattle	Washington
50	Edward Jones Dome	66,965	St. Louis	Missouri
51	Lane Stadium	66,233	Blacksburg	Virginia
52	Raymond James Stadium	65,647	Tampa	Florida
53	Paul Brown Stadium	65,535	Cincinnati	Ohio
54	Heinz Field	65,500	Pittsburgh	Pennsylvania
55	Citrus Bowl	65,000	Orlando	Florida
56	Alamodome	65,000	San Antonio	Texas
57	Ford Field	65,000	Detroit	Michigan
58	LaVell Edwards Stadium	63,725	Provo	Utah
59	University of Phoenix Stadium	63,400	Glendale	Arizona
60	O.co Coliseum	63,026	Oakland	California
61	Lucas Oil Stadium	63,000	Indianapolis	Indiana
62	Kenan Memorial Stadium	62,980	Chapel Hill	North Carolina
63	California Memorial Stadium	62,717	Berkeley	California
64	Ross–Ade Stadium	62,500	West Lafayette	Indiana
65	Liberty Bowl Memorial Stadium	62,380	Memphis	Tennessee
66	Scott Stadium	61,500	Charlottesville	Virginia
67	Soldier Field	61,500	Chicago	Illinois
68	Yale Bowl	61,446	New Haven	Connecticut
69	Davis Wade Stadium	61,337	Starkville	Mississippi
70	Memorial Stadium	60,670	Champaign	Illinois
71	Vaught–Hemingway Stadium	60,580	Oxford	Mississippi
72	Mountaineer Field at Milan Puskar Stadium	60,540	Morgantown	West Virginia
73	Mississippi Veterans Memorial Stadium	60,492	Jackson	Mississippi
74	Jones AT&T Stadium	60,454	Lubbock	Texas

75	Boone Pickens Stadium	60,218	Stillwater	Oklahoma
76	Arizona Stadium	57,803	Tucson	Arizona
77	Carter–Finley Stadium	57,583	Raleigh	North Carolina
78	Papa John's Cardinal Stadium	56,000	Louisville	Kentucky
79	Jack Trice Stadium	55,000	Ames	Iowa
80	Bobby Dodd Stadium	55,000	Atlanta	Georgia
81	Autzen Stadium	53,800	Eugene	Oregon
82	Folsom Field	53,750	Boulder	Colorado
83	War Memorial Stadium	53,727	Little Rock	Arkansas
84	Memorial Stadium	52,929	Bloomington	Indiana
85	Franklin Field	52,593	Philadelphia	Pennsylvania
86	Falcon Stadium	52,480	Colorado Springs	Colorado
87	High Point Solutions Stadium	52,454	Piscataway	New Jersey
88	Byrd Stadium	51,802	College Park	Maryland
89	Sun Bowl Stadium	51,500	El Paso	Texas
90	Independence Stadium	50,832	Shreveport	Louisiana
91	TCF Bank Stadium	50,805	Minneapolis	Minnesota
92	University of Kansas Memorial Stadium	50,071	Lawrence	Kansas
93	Aloha Stadium	50,000	Honolulu	Hawai'i
94	Bill Snyder Family Football Stadium	50,000	Manhattan	Kansas
95	Dowdy–Ficklen Stadium	50,000	Greenville	North Carolina
96	Floyd Casey Stadium	50,000	Waco	Texas
97	Stanford Stadium	50,000	Stanford	California
98	Carrier Dome	49,262	Syracuse	New York
99	Ryan Field	49,256	Evanston	Illinois
100	Reser Stadium	45,674	Corvallis	Oregon
101	Rice-Eccles Stadium	45,634	Salt Lake City	Utah
102	Robert F. Kennedy Memorial Stadium	45,423	Washington, D.C.	N/A
103	Bright House Networks Stadium	45,323	Orlando	Florida
104	McLane Stadium	45,140	Waco	Texas
105	Amon G. Carter Stadium	45,000	Fort Worth	Texas
106	Alumni Stadium	44,500	Chestnut Hill	Massachusetts
107	Bulldog Stadium	41,031	Fresno	California
108	Ladd Peebles Stadium	40,646	Mobile	Alabama
109	University Stadium	40,094	Albuquerque	New Mexico
110	Rentschler Field	40,000	East Hartford	Connecticut
111	Michie Stadium	40,000	West Point	New York
112	Vanderbilt Stadium	39,790	Nashville	Tennessee
113	Joan C. Edwards Stadium	38,016	Huntington	West Virginia
114	Bronco Stadium	37,000	Boise	Idaho
115	Sam Boyd Stadium	36,800	Whitney	Nevada
116	M. M. Roberts Stadium	36,000	Hattiesburg	Mississippi
117	Skelly Field at H.A. Chapman Stadium	35,542	Tulsa	Oklahoma
118	Martin Stadium	35,117	Pullman	Washington
119	Nippert Stadium	35,000	Cincinnati	Ohio
120	Sonny Lubick Field at Hughes Stadium	34,400	Fort Collins	Colorado
121	Navy–Marine Corps Memorial Stadium	34,000	Annapolis	Maryland
122	Wallace Wade Stadium	33,941	Durham	North Carolina

123	War Memorial Stadium	32,580	Laramie	Wyoming
124	Gerald J. Ford Stadium	32,000	University Park	Texas
125	BB&T Field	31,500	Winston-Salem	North Carolina
126	Johnny "Red" Floyd Stadium	31,000	Murfreesboro	Tennessee
127	Cajun Field	31,000	Lafayette	Louisiana
128	Rubber Bowl	31,000	Akron	Ohio
129	Huskie Stadium	30,998	DeKalb	Illinois
130	Liberty Bank Stadium	30,964	Jonesboro	Arkansas
131	Apogee Stadium	30,850	Denton	Texas
132	Joe Aillet Stadium	30,600	Ruston	Louisiana
133	Dix Stadium	30,520	Kent	Ohio
134	Spartan Stadium	30,456	San Jose	California
135	Malone Stadium	30,427	Monroe	Louisiana
136	Aggie Memorial Stadium	30,343	Las Cruces	New Mexico
137	Harvard Stadium	30,323	Boston	Massachusetts
138	Rynearson Stadium	30,200	Ypsilanti	Michigan
139	Kelly/Shorts Stadium	30,199	Mount Pleasant	Michigan
140	Waldo Stadium	30,100	Kalamazoo	Michigan
141	FAU Stadium	30,000	Boca Raton	Florida
142	Jim Wacker Field at Bobcat Stadium	30,000	San Marcos	Texas
143	Veterans Memorial Stadium	30,000	Troy	Alabama
144	InfoCision Stadium–Summa Field	30,000	Akron	Ohio
145	William "Dick" Price Stadium	30,000	Norfolk	Virginia
146	Cessna Stadium	30,000	Wichita	Kansas
147	Benson Field at Yulman Stadium	30,000	New Orleans	Louisiana

Appendix B²⁷

Table 9 – NFL Stadiums

-	Stadium	Capacity (Seats)	Roof type	Team(s)	Opened
1	MetLife Stadium	82,566	Open	New York Giants New York Jets	2010
2	Lambeau Field	80,735	Open	Green Bay Packers	1957
3	AT&T Stadium	80,000	Retractable	Dallas Cowboys	2009
4	Arrowhead Stadium	79,541	Open	Kansas City Chiefs	1972
5	FedExField	79,000	Open	Washington Redskins	1997
6	Sports Authority Field at Mile High	76,125	Open	Denver Broncos	2001
7	Sun Life Stadium	65,326	Open	Miami Dolphins	1987
8	Bank of America Stadium	73,779	Open	Carolina Panthers	1996
9	Mercedes-Benz Superdome	73,208	Domed	New Orleans Saints	1975
10	FirstEnergy Stadium	73,204	Open	Cleveland Browns	1999
11	Ralph Wilson Stadium	73,089	Open	Buffalo Bills	1973
12	Qualcomm Stadium	71,283	Open	San Diego Chargers	1967
13	Georgia Dome	71,228	Domed	Atlanta Falcons	1992
14	NRG Stadium	71,054	Retractable	Houston Texans	2002
15	M&T Bank Stadium	71,008	Open	Baltimore Ravens	1998
16	Lincoln Financial Field	70,000	Open	Philadelphia Eagles	2003
17	LP Field	69,143	Open	Tennessee Titans	1999
18	Gillette Stadium	68,756	Open	New England Patriots	2002
19	Levi's Stadium	68,500	Open	San Francisco 49ers	2014
20	EverBank Field	67,246	Open	Jacksonville Jaguars	1995
21	CenturyLink Field	67,135	Open	Seattle Seahawks	2002
22	Raymond James Stadium	65,890	Open	Tampa Bay Buccaneers	1998
23	Paul Brown Stadium	65,484	Open	Cincinnati Bengals	2000
24	Edward Jones Dome	65,309	Domed	St. Louis Rams	1995
25	Heinz Field	65,050	Open	Pittsburgh Steelers	2001
26	Ford Field	65,000	Domed	Detroit Lions	2002
27	University of Phoenix Stadium	63,400	Retractable	Arizona Cardinals	2006
28	O.co Coliseum	63,132	Open	Oakland Raiders	1966
29	Lucas Oil Stadium	63,024	Retractable	Indianapolis Colts	2008
30	Soldier Field	61,500	Open	Chicago Bears	1924
31	TCF Bank Stadium	50,805	Open	Minnesota Vikings	2009

²⁷ "List of American Football Stadiums by Capacity." Wikipedia. Accessed January 26, 2015. http://en.wikipedia.org/wiki/List_of_American_football_stadiums_by_capacity.

Appendix C²⁸

Table 10 – NFL Stadiums' Age

Rank	Stadium Ranking	Age (Opening Year)
1	Lambeau Field	58 (1957)
2	CenturyLink Field	13 (2002)
3	AT&T Stadium	6 (2009)
4	Arrowhead Stadium	43 (1972)
5	Soldiers Field	91 (1924)
6	Lucas Oil Stadium	7 (2008)
7	Heinz Field	14 (2001)
8	Gillette Stadium	13 (2002)
9	University of Phoenix Stadium	9 (2006)
10	Reliant Stadium	13 (2002)
11	MetLife Stadium	5 (2010)
12	Mercedes-Benz Superdome	35 (1975)
13	Sports Authority Field	14 (2001)
14	M&T Bank Stadium	17 (1998)
15	Paul Brown Stadium	15 (2000)
16	CandleStick Park	55 (1960)
17	Lincoln Financial Field	12 (2003)
18	Ford Field	13 (2002)
19	Georgia Dome	23 (1992)
20	Ralph Wilson Stadium	42 (1973)
21	FedEx Field	18 (1997)
22	Raymond James Stadium	17 (1998)
23	FirstEnergy Stadium	16 (1999)
24	LP Field	16 (1999)
25	Bank of America Stadium	19 (1996)
26	EverBank Field	20 (1995)
27	Sun Life Stadium	33 (1987)
28	Mall of America	38 (1982)
29	Edward Jones Dome	20 (1995)
30	Qualcomm	48 (1967)
31	Oakland	49 (1966)

²⁸ "List of American Football Stadiums by Capacity." Wikipedia. Accessed January 26, 2015. http://en.wikipedia.org/wiki/List_of_American_football_stadiums_by_capacity.

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