OPTIMIZING COMMUNICATION IN TWENTY-FIRST CENTURY RESIDENTIAL ARCHITECTURE IN HAWAIʻI

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To my family for their unwavering support.

Abstract

Twenty-first century architecture is comprised of highly complex relationships between architects, builders, and a wide range of specialty consultants who are utilized to bring a project full circle. These multifaceted interactions reflect the complexities of today's modern design field. However, this compartmentalized architectural process has distanced many individual specialists from one another, resulting in new modes of interaction, and demanding an increased level of communication between all parties involved.

This dissertation investigates the importance of engaging with, and further developing these modes of communication and interaction. It outlines the history of architecture so as to understand how architecture is organized today, then examines the factors that have led to changes in how entities interact, communicate, and work together. Further, it discusses the nature of current architect, builder, and consultant relationships, the dynamics molding those new relationships, and speculations as to future changes.

Understanding the history of relationships and build models, the different parties involved in the architectural process, the contracts governing the relationships between parties, and the current business models used enables identification of the strengths and weaknesses of present day interactions. Moreover, by gaining a deeper understanding of, and engaging with the many different modes of communication, architects and builders can greatly reduce project inefficiencies and increase overall productivity, project quality, individual profitability, and, most importantly, the design-build process as a whole. Focusing on the communication process throughout the preliminary schematic and evaluation stages can ultimately benefit overall architectural design, building aesthetic, and the functionality of a structure as well. The study concludes by anticipating future changes, and proposing several modes of work and contract

relationship modifications, based on the evaluation and state of operations, build methodologies, entity interaction, and materials today.

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List of Abbreviations and Terms

AIA	The American Institute of Architects
Architect	A person who designs buildings and advises in their construction.
Architekton	Traditional Master Builder
As Built Drawings	Revised set of contract drawings reflecting any changes in the field.
ASID	American Society of Interior Design
ASI	Architects Supplemental Information
BIA	Building Industry Association
BIM	Building Information Modeling
CAD	Computer Aided Design
C&C	City and County of Honolulu
CII	Construction Industry Institute
Clash Detection	Method to identify potential constructability issues prior to arising in the field
Consultant	A professional who provides advice and direction in a particular field of expertise
Contractor	A professional who contracts to erect buildings.
Cost-Plus	Method of pricing in which a fixed profit factor (percentage) is added to the costs
CMU	Concrete Masonry Unit
DB	Design Build
DBB	Design Bid Build
Designer	One who assists the architect in the development of plans for a project.
DPP	Honolulu Department of Planning and Permitting
Engineer	A professional who is certified in a branch of engineering.
Exhibit A	Scope of Work
Fabricator	A professional who manufactures a product to architect specifications.
Greywater	Wastewater from sinks, baths, and appliances without serious contaminants
GMP	Guarantee maximum price
Hawaiian Telcom	Honolulu phone and data provider
Hearth	Central fireplace viewed as the heart of the home.
HECO	Hawaiian Electric Gas Company
HIGas	Honolulu propane and natural gas provider
IPD	Integrated Project Development
Lead Time	Latency between the initiation and execution of a process
LV	Low Voltage
MEP	Mechanical Electrical Plumbing
OAC	Owner Architect Contractor
One-line diagram	Simplified notation for representing a three-phase power system.
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
Procore	Cloud based construction management program
Product Data	Information provided by manufacturers to illustrate a material, product, or system
Revit	Autodesk BIM software
RFI	Request for Information
Shop Drawings	Detailed drawings, diagrams, schedules and other data prepared by contractors.
Spectrum	Alternative Honolulu phone and data provider.
Stipulated-Sum	A fixed price, or lump sum contract. Most common contract in construction.
Subcontractor	Trade partner who performs specialty work as a portion of the completed project.
UNESCO	The United Nations Educational Scientific and Cultural Organization
Value Engineering	Exercise which helps improve/maintain efficiency while decreasing incurred cost
Vendor	Company offering products and materials to builders.
Virtual Construction	Utilizing BIM to model a structure to the extent it would be built in the field.

Chapter 1: Introduction

Twenty-first century architecture consists of many complex relationships between highly specialized designers and builders. Today's architect is, in many ways, much more distanced from those in the field and on site physically building. Without a strong, clear, and directed means of communication between them, the chance for miscommunication (or mistiming of communication) is greatly increased. According to the Construction Industry Institute (CII), this costs the United States construction industry more than US$15 billion dollars a year in rework expenses.[1] The CII defines rework as "extra field work performed to rectify nonconforming work regardless of the source of the nonconformance. This includes design changes and design, fabrication, and construction errors that caused the initial incorrect work."[2] This has a significant impact, accounting for more than 5% of overall construction costs. Clearly, there is a critical need for clearer modes of communication.

Today's complex and compartmentalized architectural process has led to new disconnects between design entities and builders. There are also disconnects in the field among contractor, subcontractor, vendor, and fabricator, further compounding the issue and highlighting the need for clear modes of communication between all involved. Whether it be attributed to the move from basic construction documentation to extremely detailed BIM modeling and shop drawings, ever increasing levels of specialization, or simply a firm's inability to keep up with the times, it all boils down to how we, as architects and builders, communicate. The sheer volume of building

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[1] Construction Industry Institute, RS10-2 - Measuring the Cost of Quality in Design and Construction (Austin: Construction Industry Institute, 1989), accessed October 3, 2017, https://www.construction-institute.org/resources/knowledgebase/more-filter-options/result/topics/rt-010/pubs/rs10-2#.

[2] Construction Industry Institute, "Do It Right the First Time (Best Practice)." CII - Topic-Summary-Details. Accessed October 3, 2017, https://www.construction-institute.org/resources/knowledgebase/best-practices/quality-management/topics/rt-203#.

methods, communication options, and changes over the past century are evidence of the large scale shift in the architecture and construction industry.

To optimize communication, we need to understand it. What accounts for the present state of the industry? What daily factors contribute to mass inefficiencies in the field, and why are they happening? How has the historical context divided up modern-day architecture? How did current relationships come to be? How have AIA contracts molded client, architect, builder, and subcontractor interactions? Which modes of communication are ineffective, and which are successful? Understanding these communication inefficiencies will allow architects and contractors to optimize twenty-first century architecture and construction processes, decrease rework expenses, and facilitate a better finished product. Ultimately, this significantly benefits each and every entity, from client to architect, general contractor, subcontract, vendor, and all others involved.

As Roth and Roth Clarke point out, "unlike painting or poetry, which can be pursued by individual artists on their own, architecture results only when a client or patron calls it into being. Thus, the history of architecture is also a history of the relationship between architect and patron."[3] This thesis will begin by doing just that, examining the historical evolution of architecture and the ever evolving role of the architect in order to gain a better understanding of the current state of affairs. From early humans and the first built structures, through the Industrial Revolution and modern design, studying significant periods on the timeline sets the stage for present day architectural analysis.

[3]Leland M. Roth and Amanda C. R. Clark, *Understanding Architecture: Its Elements, History, and Meaning* (Boulder, CO: Westview Press, 2014), 119.

The complex relationships of twenty-first century architecture are better understood by examining the many different players in the game. All have different modes of communication, levels of experience, and unique specializations that require deep coordination and understanding of their individual and collaborative roles. Identifying these will also allow a clearer perspective on how to cater to the needs of each entity, thereby optimizing the communication process. Understanding the legal documents that have guided the relationships among the parties, and how they (the documents) have changed over time reveal how to set up new and improved relationships. The proceeding research will then examine present day architectural business models, current modes of communication, various project organization methods, and individual case studies directly impacted by communication issues. This will highlight the areas needing greatest attention, the most critical factors at play, and what architects and contractors can do to better communicate their needs and expectations throughout the architectural process.

The aims of this thesis are to identify changing areas of communication and organization, and to create a basis for frameworks that anticipate and promote better design-build systems, as the building and construction methodologies and processes adjust to new technology, liability, and goals. This *sketch* of an improved system of interaction includes amendments and addendums to the existing contracts, maintaining the same level of liability while giving all parties involved room for better communication.

Chapter 2: The Evolution of Architecture and the Role of the Architect

I. Early Humans and the First Built Structures (400,000 B.C.E.)

Although it is nearly impossible to identify the exact point in time when human beings first learned to build, we know with certainty that, as our ancestors evolved, they learned to control and manipulate their environment to improve their wellbeing and chances for survival. Learning to control fire, identifying the human need for social interaction, developing the spoken word and written languages, and creating symbolic images/objects were among the many advances molding humankind. But, perhaps the most important of all was architecture and the built environment. As Read (1965) remarked, "Architecture is shelter, but it is also symbol, and a form of communication. Architecture is the crystallization of ideas, a physical representation of human thought and aspiration, a record of the beliefs and values of the culture that produces it."

Figure 2.1: Terra Amata, Nice, France

Source: Lumley, Henry De. "A Paleolithic Camp at Nice." Scientific American 220 (May 1969).

Such places as Terra Amata in Nice, France are among the first recorded civilizations built by *Homo erectus* (Figure 2.1). Archeologists and historians identify Terra Amata as a springtime campground on which *Homo erectus* produced what is considered the first architecture. Of the twenty-one structures documented by archeologists, eleven were rebuilt on the same footprint every year during the hunting season. Oval in plan, they measured 26-49 feet long and 13-20 feet wide. The side walls were made up of a 3 in. diameter branch cladding, which was pushed into the sand and supported by exterior perimeter rocks, roughly 12 inches in diameter. The roof structure was supported by vertical centerline posts 12 inches in diameter, with a ridge beam reinforcing the side branches which leaned against it. There was a central hearth, with a windbreak of stones on the northwest side (Nice's prevailing wind direction), and adjacent workspaces thought to be used for tool/weapon fabrication.

The hearth itself served as more than just a source of heat and means to cook. It represented the community. As Roth and Roth Clark (2014, 162) argue, "That a group of Homo erectus people returned to Terra Amata year after year suggests a regular hunting cycle, but even more important is the hearth. The fire suggests the gathering of the group, of the establishment of a community…In using fire and building artificial shelters, these human ancestors took control of their environment, shaping it to their own convenience and requirements. The first steps towards architecture – the deliberate shaping of the living environment – had been taken." Terra Amata is an example of the first step in our built environment – small scale architecture as a temporary means of shelter. These simple stick-framed houses were utilized for hundreds of thousands of years right through the Neanderthal and *Homo sapien* phases, and were only slightly modified by the civilization responsible for their design. Neanderthals, for example, had similar wood frames, but used thick animal hides for their exterior cladding rather than branches, and massive animal bones at the base for support, in lieu of exterior perimeter rocks (*Scientific American* 1974). As seen repeatedly throughout history, civilizations used building materials that were readily available, locally abundant, and exemplified their local traditions, creating what is known today as Vernacular Architecture. Thought of as architecture of the common man, it responded to climate, culture, and environment, and was the basis for building throughout the beginning stages of human history.

II. The Emergence of Long-Term Timber Structures (12,800 B.C.E.)

A turn in the evolution of architecture occurred in 12,800 B.C.E. with the emergence of larger, more permanent timber structures, such as those found in Monte Verde, Chile. Submitted to UNESCO as a potential World Heritage Site in 2004, this ancient settlement was preserved when a heavy landslide of clay sealed the remains of the buildings, and prevented oxygen from deteriorating the wood, leather, and fibrous materials used in their construction. Large scale timber was used to erect two different types of structures found at two different locations on the site – a rectangular "tent-like" housing structure, and a U-shaped ceremonial hearth and cooking structure. The base of the housing structure was made of crudely cut logs, with vertical wooden posts roughly every three feet on center supporting a wooden ridge beam and roofing system. It is thought that the vertical support columns would have demarcated individual living areas. The twelve excavated interior rooms were arranged, six per side, with a central circulation corridor. Adjacent to the Monte Verde site, archeologists uncovered an abundance of preserved animal furs, suggesting that leather hides were used for the wall cladding and interior room separation (UNESCO World Heritage Centre, n.d.). This housing structure was thought to function only as such, sheltering multiple families for long periods of time. A very different edifice located on the west end of the site served as both the kitchen and communal space. The kitchen revolved around two large fires, and provided for many members of the community. The footprint of the building was U-shaped, it had a compacted sand and gravel foundation with wooden vertical posts every eighteen inches on center, and it was clad with thick animal hide. Also utilized for the custom of processing kills after the hunt, ritual celebration, and the preparation of cultivated medicinal herbs, this structure was open to the front for community observation and interaction (UNESCO World Heritage Centre, n.d.).

The archeological evidence of burnt and chewed seeds, as well as various medicinal plants suggests some level of agriculture and cultivation to help sustain the community. The shift from smaller scale temporary housing to larger, long term housing necessitated year round nutritional sustenance, hence the emergence of agriculture. These developments led to individualized roles and responsibilities within the community, and hunters and gatherers, agriculturalists, and builders likely emerged during this period. Although the architect profession was not established until Egyptian society nearly ten thousand years later, this earlier period could very well mark the first stages of the architectural profession. A project of this size, with multiple build sites and building programs, would require knowledge of how to site the structures as well as build them properly. This role likely would have been taken on by the alpha of the group, setting the stage for the architect as leader and overseer of the entire process.

III. The Permanently Inhabited Urban City (7,000 B.C.E.)

Located in the Konya Province of present day Turkey, Catalhoyuk was one of the first permanently inhabited urban cities (Figure 2.2). With roughly eight thousand residents concentrated on 32 acres, Catalhoyuk was a farming community and vital link for trade routes throughout the Fertile Crescent. The clustered residences were timber framed with mudbrick infill and plaster finish, and were often painted with elaborate mosaics or murals. The houses were tightly grouped, with no streets or horizontal circulation, with the exception of an occasional courtyard. Entry was by way of a hole in the roof, which also functioned as the vent for the central hearth. This was one of the first recorded communities where people chose to live together in such a fashion.

Figure 2.2: Catalhoyuk, Turkey

Source: Dan Lewandowski in "Çatalhöyük 'Map' Mural May Depict Volcanic Eruption 8,900 Years Ago." Science News January 13, 2014, http://www.sci-news.com/archaeology/science-catalhoyuk-map-mural-volcanic-eruption-01681.html.

According to archeologist Michael Balter (2005), "Nearly everything that came afterward, including organized religion, writing, cities, social inequality, population explosions, traffic jams, mobile phones, and the Internet, has roots in the moment that people decided to live together in communities. And once they did so, the Catalhoyuk work shows, there was no turning back." As this was now a large scale communal structure, essential tasks began to be divided among people within the community. Those tasks included growing food, managing irrigation, producing bread, making clay pots for storage, smelting copper or making bronze and fashioning tools, tending to ritual observances, maintaining shrines, and building houses. This can be thought of as the beginning of specialization.

Here, architecture is a permanent means of shelter on an urban scale, and introduces the complex social system of community living. Although there was still no professional designation, this marks the second stage of the architect insofar as the continued emergence of a designer, builder, and/or carpenter. Due to the sheer scale of building density and the amount of housing required, this would likely have been a well thought out process.

IV. The Emergence of Intensive Agricultural and Mercantile Civilizations (4,000 B.C.E.)

Intensive agricultural civilization in ancient Mesopotamia was centered on a regenerative water source, where carefully controlled irrigation was essential for survival. Located in a relatively flat topography, Mesopotamia (or "land between two rivers") is flanked by the Syrian Desert, the Western Turkish Mountains, and the Zagros Mountains. From the Southwest flows the Tigris and Euphrates Rivers, fed by tributaries from the Zagros Mountains. Wildly unpredictable, these two rivers can experience droughts as well as damaging floods throughout the year. Thus, carefully controlled irrigation for agriculture was vital in the Sumerian, Akkadian, and following eras as large city settlements focusing on political, mercantile, and religious activities and achievements within the region were established. On the heels of these pursuits came the need to record communal decisions and grain tallies, hence, the emergence of Cuneiform (written language).

Major cultural changes molded architecture in the subsequent Sumerian, Akkadian, Babylonian, Hittite, and Assyrian Empires. As Roth and Roth Clark (2014, 162) point out, "The first permanent buildings in Mesopotamia served the most compelling and encompassing public needs, attempting to bridge the gulf between humans and the gods. Even when the individual buildings were sponsored by individual kings, these places were still the embodiment of public communal purpose. Human civilization and its most fundamental architectural expressions had been invented" (Roth and Roth Clark 2014, 162). These Ziggurats were built on artificial platforms to shelter them from damaging seasonal floods, as well as to elevate the temples closer to the gods. They were constructed of Adobe brick dried in the sun and laid with mud mortar. Archeological evidence suggests that each of the oldest Mesopotamian settlements was dedicated to a particular deity, and was, therefore, centered around an important ritual or religious shrine (temple). Each was also surrounded by clustered residential dwellings, and interspersed with community courts and buildings, libraries, archives, and granaries (Roth and Roth Clark 2014, 183).

Ancient Mesopotamia continues to think of architecture as a permanent means of shelter on an urban scale, and also introduces complex large scale religious monuments. This is the first conspicuous example of the ancient connection between architecture and religion, as well as specialization in landscape architecture, as Mesopotamia was known for its urban terraces heavily planted in with trees (such as the Hanging Gardens of Babylon). Still, there was no architect designation.

V. The Priestly Architect (2,750 B.C.E.)

Ancient Egypt was located in a geographical area that received less than 10 inches of rain per year, so it controlled the waters supplied by the Nile River. Running 4,130 miles, the Nile is the longest river in the world and absolutely vital to life in the Nile Delta. It is fed by three tributaries — the Blue Nile and Atbara in the Ethiopian mountains, and the White Nile flowing from the Albert and Victoria lakes in central Africa. The Nile naturally created three seasons: (1) Inundation or seasonal flooding from June to October, which watered and fertilized the soil, (2) Time for planting from November to February, and (3) Drought from February to June, when crops were harvested and stored. This natural river cycle formed the basis of the ancient Egyptian cycle of life.

The Egyptian life cycle was centered on the gods of the land who were thought to control the forces of nature. Egyptians idealized the time when gods inhabited the earth, and set out to recreate that in their everyday life. They believed that life on earth was one part of an eternal journey, and in order to continue that journey after death, one needed to live a life worthy of continuance (Mark 2016). This belief directly influenced ancient Egyptian architecture and the built environment. According to Roth and Roth Clark (2014, 188), "Egypt's greatest architectural remnants are buildings dedicated to funerary practices, its pyramids serving as man-made mountains of burial, its temples lining the Nile with endless repetitions of column after column, of court and chamber leading to yet more courts and chambers. It is an architecture of great mass and monotonous regularity, deliberately and determinedly adhering to established forms and details over a time span equal in length to everything that has followed it up to the present day."

It was this unique culture that gave rise to the concept of the architect. Imhotep, who served under the Pharaoh Zoser between 2635 B.C.E. and 2595 B.C.E., was the first recorded western architect. His other recorded titles were High Priest, Seal-Bearer of the King of Lower Egypt, Chamberlain, Ruler of the Great Mansion, Hereditary Prince, Greatest of Seers, Carpenter, Sculptor, and Physician (Badawy 1982). The initial connection between religion and architecture stemmed from the fact that, in ancient Egypt, all education was provided by the temple priests. This influenced tomb and temple design and construction and, indeed, all the architecture of the period. Imhotep is credited with the introduction of stone construction in Egypt, as well as the invention of the pyramid. Ancient Egyptian culture deeply valued the architect as more than a profession. He was viewed as "Something much more than a designer of buildings – lovely, elegant, charming, and efficient though they may be. His greater role is that of being the delineator, the definer, the engraver of the history of time" (Raskin 1974, 136).

In short, here, architecture is a monumental religious expression, forming a direct connection between the Egyptians, their gods, and ancestors (Figure 2.3). This is the period in which the first architect was introduced as well as connected to the priesthood (i.e., the first documented connection between architecture and religion). Egyptian civilization's strong ties to its dead and its gods, as well as its circle of life directly influenced its architecture. Priests' control of education gave birth to the architect/high priest concept. This period is also the beginning of the hierarchical/skeletal structure in the field of architecture. Working under "priest-architects" were thousands of overseers (foremen) and craftsmen. This mirrors the key players within the architectural field, and it was in this period that the different roles in the field began to take shape. An architect leads an overseer (or foreman), who manages a craftsman (or carpenter). This hierarchy marked the beginning of relationship forms within the field and the establishment of different modes of communication. Also important was the emergence of the first construction documents. Ancient Egyptian architects documented their builds through plan and elevation, often with different colored inks on papyrus to demarcate different elements of the drawing. One of the oldest surviving Egyptian architectural drawings shows front and side elevations of the shrine. They used black ink for the shrine itself, and red ink to create a grid around the image to show dimensions and proportion.

Figure 2.3: Temple of Queen Hatshepsut, Nile, Egypt

Source: https://i.ytimg.com/vi/xu5qmoLDq6U/maxresdefault.jpg

VI. The Architekton (750 B.C.E.)

The Greek word for architect is composed of two parts: *arkhi* or chief, and tekton or builder (Dinsmoor, Spiers, and Anderson 1989, 214). Unlike in Ancient Egypt, the chief builder or master builder was not a religious figure. Greek culture focused on life at hand, and encouraged individual intellectual excellence. It promoted physical superiority and rigorous discipline, and inherently questioned the nature of being and the world around them. Greek architecture, though largely influenced by Egyptian sculpture and post and lintel stone construction, were monuments to their gods and expressions of their culture through the built environment. Greeks identified themselves through their built works. These "sculptural masses set in balanced contrast to the landscape" included palaces, temples, amphitheaters, government buildings, public buildings, mixed use structures, and even military fortifications (Roth and Roth Clark 2014, 247). They are a true exemplification of the fact that architecture was an intricate part of daily Greek life for each and every individual.

Similar to that in Egypt, however, Greek culture and architecture was greatly influenced by the unique geography and climate of the region. Greece's rugged limestone and marble mountain ridges carved both the treacherous topography as well as much of the mentality of the culture. As land travel was extremely difficult, Greeks turned to the ocean as their main means of transportation. Risk taking on the high seas, argue Roth and Roth Clark (2014, 216), "bred in the Greeks an adventurousness of spirit, a love of action, and a readiness to put their strength to the test. The tough, resilient fiber of the Greeks was formed in response to an environment that could change dramatically in an instant, for besides violent thundershowers, the region is prone to earthquakes, dangers seldom encountered by the Egyptian."

The ancient Greeks valued architecture as a monumental expression of its culture and civilization. The shift from heavy direct monarchal religious influence to forward thinking democratic values may have shaped developments in the architectural field at that time. Architects were now specialists entirely in the realm of the built environment. The absence of any documentation of Greek architectural drawings on vellum or parchment suggests that Greek architects worked so closely with stone masons and stone yards on their projects, that there was no need for abstract drawings to further convey what needed to be built. This is the architect as a true master builder, who understands the project and its boundaries and limitations completely. Also evident during this period is the reliance on stone yards or quarries for massive scale projects, thereby expanding the range of architectural relationships to include a third entity, "vendors." Although very different from today, these stone yards were essentially material vendors for Greek construction. At this point, the architectural chain now included architects, overseers, craftsmen, and material vendors, and the relationships were becoming more complex, although the master builder was capable of managing the various players.

VII. The Roman Manipulation of Space: Architecture as a Statement (265 B.C.E.)

Molded by geographic location and the consistent warfare that took place while battling for control over the center of trade and commerce, a unique Roman character developed. Ancient Romans had a "sense of ingrained discipline, patriotic responsibility, and serious purpose that is best described by the Latin term gravitas, a sense of the importance of matters at hand, a propensity for austerity, conservatism, and a deep respect for duty and tradition. A good Roman practiced a strict morality, served the state, maintained unimpeachable honor, and strove for physical and spiritual asceticism" (Roth and Roth Clark 2014, 249). These pragmatic cultural qualities produced a large number of architecture- and engineering-minded individuals. Furthermore, factors such as the distribution of wealth and high population densities in ancient Roman cities forced these individuals to discover new architectural solutions. Roman architects and engineers were able to take on scale in a fashion Greeks and Egyptians never could. They engineered roadways that linked mountain ranges to coastlines, rerouted water hundreds of miles through man made aqueducts to cities for daily use, and built massive detailed structures, many of which still stand and are in use.

Hanz Kahler, architect, historian, and author of *The Art of Rome and Her Empire* (1963), describes Roman architecture as “an architecture of space, enclosed internal space and outdoor space on a grand scale” (Roth and Roth Clark 2014, 246). Ancient Roman construction adopted much of the same architectural language as that of ancient Greek architecture. The use of materials and technologies evolved, however, with new tools for carving/modifying large scale stone and brick, newly introduced materials (namely concrete), and large scale engineering developments such as the dome and the arch. Roman concrete enabled architectural shapes that were free from the traditional confines of stone and brick construction. The concept of the dome resulted in construction of vaulted ceilings without crossbeams and other large scale structural elements. The dome is also the first example of large scale covered public space, which is best portrayed in Hadrian’s Pantheon, a former Roman temple completed in 125 C.E., which still stands and functions as a present day church nearly two thousand years later (Figure 2.4).

Figure 2.4: Pantheon, Rome, Italy

Source: https://static.thousandwonders.net/Pantheon.Rome.original.1785.jpg.

The Pantheon exemplifies Roman building achievement, which required the highest level of organization and building operations, and was one of the first examples of construction management. Constructing the formwork for the ceiling coffers, coordinating the transportation and timely arrival of building materials, and controlling the timing and quality of the placement of concrete are a few examples of the immense level of detail, coordination, and communication that was required to build the Pantheon.

With these advances, ancient Romans were able to construct buildings that were complex, progressive, resilient, and strong. Their construction approach largely shifted from column and lintel, to one based on massive walls integrated with arches and domes. The concept of substructure also became apparent with the construction of roads, aqueducts, bridges, canals, cisterns, and dams. This enabled Romans to achieve exceptional levels of successful public-use infrastructure. They were also responsible for significant developments in housing and public hygiene, including the first public baths and toilets, under-floor heating, glazing, and piped water known to man.

Building typology increased as well, with the creation of amphitheaters, basilicas, circuses, forums, temples, theatres, villas, obelisks, and elaborate gardens. Additionally, there was a large number of Roman public buildings. These generally served a political function, and were designed to demonstrate the power of the state and/or the specific individuals who built them. All this urban development required well thought out organization and planning. The streets were organized into networks of irregular triangles, centered around the forum, or civic open space, and flanked by city offices and civil buildings. These public buildings made up the heart of the city, as the space was enclosed and utilized by thousands of people on a daily basis.

The majority of residential architecture was comprised of apartment houses. They were blocks of three to four floors with centrally landscaped internal atriums. With nearly one million inhabitants in Rome at the time of Augustus, available and affordable housing was in short supply. As dense development ensued, some of the first documented building regulations came into being during the reign of Nero. Some of those regulations included residential height restrictions (70 feet) and fire regulations, specifically requiring the use of non-flammable building materials. There were even provisions in the building codes for elevated brick and concrete pathways circulating residential blocks, which allowed for pedestrian circulation above the congested streets of Rome below (Roth and Roth Clark 2014, 262). Further, the rural city of Pompeii offers insights into the types of country residences that marked the period. When Mount

Vesuvius erupted in 79 C.E., it buried a range of different residential housing types. Modest artisans' residences, larger aristocratic residences, and palatial hillside villas were all preserved in a thick layer of sediment and ash. Like their urban counterparts, country houses were centered around an internal garden or atrium space. In ancient Roman society, architects were no longer religiously affiliated, as was the case with the Egyptians. Romans built from a more political perspective molded by their intensive daily urban lives.

VIII. Medieval Architecture: An Architecture of Religion and Military Prowess (500 C.E.)

As the Roman Empire began its downfall only a few hundred years after the Common Era began, administration and political authority ceased to function, building and development halted, educational institutions collapsed, and the advanced systems of infrastructure and utility fell into complete disrepair. Europe was divided into territories or kingdoms by whichever warring civilization was strong enough to take and control land. The medieval architecture which followed, was represented in three very different periods of the middle ages: (1) The Early Middle Ages (450 C.E. to 1000 C.E.), which consisted of the end of the Roman empire and the ensuing dark ages, (2) the High Middle Ages (1000 C.E. to 1150 C.E.), which established the feudal system and reemergence of cities, and (3) the Late Middle Ages (1150 C.E. to 1500 C.E.), which saw the rise of most Gothic architecture in the form of churches, schools, and private buildings.

The Early Middle Ages, or dark ages, were a time of complex and layered personal contracts. Land holding monarchs gave tenancy of their lands to vassals in exchange for military protection. Vassals, in turn, employed farmers who pledged their crop yields to the vassals, and so on down the line to the lowest peasant. These relationships caused cities to shrink. In many cases, they became obsolete, as the focus shifted to the manors and fortified villas of the countryside, which spawned small rural villages. This is perhaps the first historical example of urban sprawl more than fifteen hundred years ago when castles emerged. Nobles constructed castles, as both offensive and defensive structures, to control the area directly surrounding them. These castles were home base when launching military offensives, and provided protection from potential enemy attacks. Although their military origins are often emphasized in castle studies, the structures also served as centers of administration and symbols of power, as they were used to regulate the public, and monitor/control major travel arteries. They were often located near mills, fertile farmland, and active water sources required for daily life.

Positioned on a natural mound or earth built up for the purpose of strategic defense, the first castles were wood framed structures. The central courtyards, or baileys, contained storage buildings, workshops, and lower class residences surrounded by a wooden site wall or palisade. There was often another layer of defense with perimeter ditches, either wet or dry, and a drawbridge gated entry. Overlooking this, was a wooden tower, or keep, which housed the local monarch or lord (Figure 2.5).

Figure 2.5: Motte and Bailey Castle, England

Source: http://sabreteam.free.fr/Moyen/Motte_and_bailey.jpg

Toward the end of the Early Middle Ages (1000 C.E.), castles began to be constructed of stone. Stone provided much greater protection, and castles could now be built directly on the level ground rather than on a hilltop, although strategic locations were still chosen. The tower or keep was either square or cylindrical in shape, and had walls nearly fifteen feet thick at their base. Stacking four or more floors above, the monarch's residence consisted of living quarters, servant's quarters, workspaces, and storage. Outbuildings in the baileys were still constructed of wood, but they were protected by the thick stone palisade walls. These perimeter walls had towers strategically placed at regular intervals. The intervals were determined by bowman's range to prevent attackers from scaling castle walls during battles. Over time a second perimeter wall, or outer bailey, emerged providing two concentric fortified walls protecting the castle. The cross shaped windows were aesthetic, but also provided a perfect perch for archers to safely target invaders from inside the castle walls. Crenellated walls, or battlements, are similar to modern parapet walls and provided a barrier for archers on the roof to hide behind when not actively engaging enemies.

The transition to the High and Middle Ages was largely marked by the reemergence of the city. As trade throughout Europe began to increase rapidly, towns situated along once abandoned trade routes were re-inhabited, and new developments emerged elsewhere to accommodate those who now lived, worked, and traveled along the routes. The increasing trade in wool, cotton, spices, and other textiles transformed cities into places of personal freedom and opportunity. Rising wealth in urban areas brought back the money economy (no longer a barter economy), and reinvigorated major construction works in the form of large scale cathedrals (Figure 2.6).

Figure 2.6: Beauvais Cathedral, France

Sources: https://upload.wikimedia.org/wikipedia/commons/thumb/1/15/Beauvais_1.JPG/1200px-Beauvais_1.JPG, and http://c8.alamy.com/comp/H49K7D/the-cathedral-of-saint-peter-of-beauvais-france-H49K7D.jpg.

One of the most common architectural footprints of medieval cathedrals is the Latin cross plan, consisting of a nave or central aisle, transepts, or the arms of the cross projecting perpendicular from the nave, and the altar standing at the east end. Unique characteristics of Gothic architecture that evolved were the pointed arch, the ribbed vault, the double wall, the flying buttress, clustered columns, ambulatories, wheel windows, spires, and stained glass windows (Wilson 2005). These characteristics allowed for the iconic height and proportion embraced by Gothic architecture. These vertical feats were achieved to suggest a connection to heaven. When cutting a section through the main body of a Gothic church, the nave is considerably taller than it is wide, with proportions sometimes greater than 2:1.

IX. Modern Architecture: The Machine Age and Specialization (1720 C.E.)

The Industrial Revolution, namely the machine age and specialization, created large scale shifts in how the architectural field functioned. As individuals became more specialized, and materials and technology advanced, architecture and engineering begin to separate. Architects began to concentrate primarily on aesthetic and the humanist or user aspect of the space, often at the expense of functionality and construction. This is exemplified by shifts in architectural education at this time. For example, the Beaux-Arts academy in France emphasized the production of aesthetically beautiful drawings, rather than context and feasibility. As the Industrial Revolution opened the door for mass production and cheaper manufacturing, middle class vernacular architecture became increasingly ornamental as building materials became cheaper under machine production. Regarding architecture and the built environment, the greatest feat of the Industrial Revolution was the large scale shift from hand production methods to machine production, and the production of machine tools in factories.

Since the vast majority of pre-industrial production was fabricated by individual specialty craftsmen, very few could afford metal components in their manufacturing systems. The more affordable wooden components had the disadvantage of changing dimensions as they expanded and contracted with temperature and humidity, and the various joints tended to loosen over time. With more affordable manufacturing processes and rapid industrial progression, machines with metal parts and frames became much more common. As machines became more precise, interchangeability and the standardization of parts followed. Metal parts enabled better working machinery, and machines broke down and required servicing less frequently.

Joseph Aspdins' invention and patenting of Portland cement in 1824 had a huge impact on the build environment (Witt 1966). Although it was a formula scientists had been experimenting with for years, Aspdin was able to balance the proper amounts of calcium silicates, aluminum and iron compounds, with pulverized limestone and clay. As the most important component of concrete, stucco, mortar, and grout, Portland cement was (and still is) a vital building material which could be mass produced and easily transported. All that was needed on site was to mix with sand, aggregate, and pour.

All these new advancements in building and technology issued in the architectural modernist movement. The worldwide shift from monarchal to democratic rule, rapid population growth in the Americas, Europe, and Asia, and modern industrialization led to substantial urbanization, construction of new buildings, and the rise of new cities. Banks, government buildings, police stations, hospitals, railroad terminals, industrial buildings, businesses, schools, and prisons were commonplace (Roth and Roth Clark 2014, 262). Indeed, many scholars consider modern capitalism to be *the* most substantial feat of the Industrial Revolution.

The modern architectural style of the period was avant-garde, of which the architectural community and the public had mixed opinions. Following World War I, modernist architects sought to develop a new style that was unique to the post-war demographic, and that focused on the needs of the middle and working classes. By removing superfluous ornament, modernist architects saw structures in their pure and raw state. Buildings expressed their functional and structural elements, rather than hiding them behind facades. Exposing steel beams, finished concrete surfaces, and structural connections were common in modernist architecture. Architects

Mies van der Rohe and Philip Johnson aimed to design buildings based on the intrinsic qualities of the building materials themselves. They also utilized modern construction techniques and materials, trading the traditional Greek and Roman forms which had been modified by civilizations for centuries, for simple geometric forms. The Industrial Revolution made capable steel-frame construction. This later gave birth to high-rise buildings and superstructures.

Modernism has been criticized by members of the architectural profession. Colquhoun (1981) states that "successful architecture is not a personal, philosophical, or aesthetic pursuit by individualists; rather it has to consider everyday needs of people and use technology to create livable environments, with the design process being informed by studies of behavioral, environmental, and social sciences." Architects further resisted modernism on the grounds that it lacked ornamentation and reference to historical style.

Brutalism followed, with its heavy facades made of raw, unfinished concrete. This architectural style became popular for government and educational buildings, housing blocks, shopping centers, and, at times, even single family residences. Brutalist architecture utilized brick, glass, steel and stone to compliment the raw concrete aesthetic. Other styles, such as Biomorphism and Zoomorphic architecture, literally used nature and natural forms as the primary design inspiration. Examples such as the Lotus Temple in India exemplify the literal translation of natural form into architecture (Figure 2.7).

Figure 2.7: Lotus Temple, New Delhi, India

Source: http://www.orangesmile.com/extreme/img/main/lotus-temple_1.jpg.

Modernism was a time of experimentation and pushing limits as well. With new technology and progressive building materials as a product of the Industrial Revolution, architects and engineers began to design within parameters they had never used before. Some of these progressive designs experienced catastrophic failures. One was the Hyatt Regency Hotel in Kansas City. The aerial atrium walkways were designed to be slender in profile to follow the language of the rest of the building. The live loads, however, were never correctly accounted for, and eventually failed after concert goers at numerous music venues created enough rhythmic load to cause the thin supports to snap. As a result, the elevated walkways pancaked down one on top of the another, eventually killing 114 people and injuring more than 200 on the dance floor below. This was the single worst disaster in the American building industry, and was a direct result of the architecture and engineering of the project (Roth and Roth Clark 2014, 568). Modernist architects were sometimes criticized for their urban renewal planning principles. An example is the Pruitt Igoe housing complex in St. Louis Missouri, which was eventually abandoned and demolished after the town's social collapse in the late 1950s.

X. Twentieth and Twenty-First Century Architecture: The Age of the Architect (1970 C.E.)

In the 1970s and 1980s, as structures, building systems, services, and energy and technology became more complex, the field of architecture continued to separate as individuals became more specialized in their respective disciplines. Architects became experts in particular project types (i.e., single family residential, multifamily, high-rise, commercial, medical, hospitality, etc.), technological programs, project delivery methods, construction management, and much more. Needless to say, this became the age of the architect. Many of the iconic buildings we know today emanated from this period. Drawing inspiration from the late modernists Le Corbusier, architect Richard Meier designed both the Getty Center in Los Angeles (Figure 2.8) and the Barcelona Museum of Contemporary Art in Spain. He was known for his stark white, sleek geometric buildings clad in glass. His designs attempted to reduce the material pallet and refine modernist minimalism. Similarly, Phillip Johnson, drawing inspiration from Mies van der Rohe's twentieth century simplicity, created his archetypal Post Oak Central Towers and Pennzoil Place thickly clad in architectural glazing. Both put their stamp on the urban skyline. Other architects of the time expressed their designs through sculptural form. Landmarks, such as I.M Pei's Grand Louvre in France (Figure 2.9) and Renzo Piano's Centre Georges Pompidou are fabulous examples of architectural innovation and expression through the postmodern era.

Figure 2.8: Getty Center, Los Angeles, California

Source: https://images.adsttc.com/media/images/5037/f9ad/28ba/0d59/9b00/073f/large_jpg/stringio.jpg?1414206602.

Figure 2.9: The Grand Louvre, Paris, France

Source: http://s1.r29static.com//bin/entry/038/0,638,2000,1125/x/1602235/image.png

As governments and their capital cities raced to outdo one another, the international architect was born. Some examples of these include Norman Foster's Shanghai Bank in Hong Kong, Skidmore Owings and Merrill's Jin Mao Tower in Shanghai, Kenzo Tange's Tokyo City Towers in Tokyo, and Kohn Pederson Fox's Shanghai World Financial Center in Shanghai, China (Figure 2.10). World leaders raced to build the tallest buildings by the world's most renowned architects as a statement of power and purpose.

Figure 2.10: Shanghai World Financial Center, China

Source: https://wp-assets.dotproperty-kh.com/wp-content/uploads/sites/2/2016/05/15121641/Shanghai-World-Financial-Center.jpg.

In the last fifty years, the modernist era has significantly advanced how the architectural field designs, constructs, and operates. As concrete, steel, and glass became viable building materials, the range of what was possible opened up, and architects took full advantage. Reaching high into the sky in an attempt to show what human beings are capable of, architects have pushed the limits of construction by creating inhabited structures which tower more than half a mile above the earth’s surface. As materials and technology continue to advance, the architectural field must remain focused on minimizing environmental impact from construction, and understand the complete implications of architectural design and material selection.

Chapter 3: The Different Entities within the Field of Twenty-First Century Residential Architecture

I. Players in the Game and How they Operate

The architectural process involves many players from a wide range of specialties and disciplines (Figure 3.1). These individuals include the client, architect, engineer, consultant, general contractor, subcontractor, utility entity, city and county entity, inspector, and inquisitive neighbor. Each has vastly different responsibilities, collaborative interactions, working methodologies, and levels of project involvement. Identifying these differences can help create a clearer understanding of the lines of communication between and among all those involved, and highlight potential ways to optimize the communication process.

Figure 3.1: Relationships among the Entities

Source: http://ascelibrary.org/cms/attachment/60576/1344166/7.jpg.

II. The Client

There are many different types of clientele seeking custom residential architecture in the twenty-first century. They may be classified according to demographics and financial means. The type of client needs a residential architect may encounter can include anything from large luxury custom homes, to more modest middle-sized homes, to smaller (usually contractor driven) remodel projects. These different clients are often unfamiliar and, sometimes, even intimidated by the architectural process. Hence, there is a need for clear and defined modes of communication. Survey research conducted for the American Institute of Architects (AIA) by the Roper Organization and Gorman Group finds that even though more than 91% of actual clients hold architects in high regard, they are hesitant about hiring them. Architects score high in the areas of professionalism, creativity, knowledge, experience, and concern for quality. However, clients indicated several areas for improvement. When asked to apply adjectives to describe architects, seven out of ten respondents used the terms completely or somewhat “demanding” and “elitist,” while six out of ten referred to them as “arrogant” (The American Institute of Architects 1993, 6).

To establish a positive working relationship with owners, architects must listen and respond to their individual wants and needs, as well as provide resources throughout the architectural process. Regarding the latter, the AIA has produced a range of client resources over the years, such as the booklet, *You and Your Architect*. This booklet is an instructional guide for clients seeking architectural design. It provides guidance on how a project can benefit from positive owner/architect relationships. It states that, “Experience tells us that successful projects…result from informed clients working with skilled architects to form professional, business, and often personal relationships. These relationships are formed early on and are nourished by clear communication, mutually understood expectations, and a willingness of both client and architect to understand and accept their responsibilities for realizing a successful project" (The American Institute of Architects 2001, 1).

Clients' responsibilities are also outlined in this AIA booklet. They include establishing the project site, having visibly defined design aspirations, obtaining a projected budget and construction timetable, clearly expressing overall expectations, being communicative and responsive throughout the design and construction phases, as well as negotiating with and compensating the architect and contractor fairly (The American Institute of Architects 2001, 3). When clients understand what is expected of the architect and of themselves, as well as the resulting implications of potential scope changes, change orders, and the lack of a timely response, they (clients) can help streamline communication, project efficiency, and project success. Ultimately, it is the owner's project, albeit facilitated by the architect. As Haviland (1994, 733) points out, "the owner issues the construction documents for bidding and negotiation, and the owner signs the construction agreements with contractors, construction manager, or design/build entity. It is the owner's project and it is important."

III. The Architect

Arguably, the most important player in the entire process, with the exception of the client who calls the project into being, is the architect. Architects play many different roles, and can specialize in any of the disciplines within the field — residential, commercial, hospitality, healthcare, government, landscape, historical preservation, etc. In each office there is a hierarchy as well, among the firm's principles, business development teams, licensed architects, non-licensed designers, draftsmen, detailers, office administrators, and others. Furthermore, aside from architectural design, the AIA also describes a range of architect services — evaluation and planning, project administration and management, bidding and negotiation, and contract administration (The American Institute of Architects 2001).

The residential architect has a different and unique set of roles and responsibilities, as opposed to other specializations. With a smaller scale and tighter scope, the single family residential architect is fully involved in the comprehensive design and full scale involvement on the project. This means that, unlike other facility types requiring engineer, specialist, and consultant administration and approval, the single family residential architect can oversee the entirety of the project fairly independently. He or she has the ultimate authority or oversight, hence, everyone involved on the project is subcontracted to the architect. As Plato wrote in *Politicus*, "Architects were not workmen but directors of workmen, and consequently, they possessed theoretical knowledge as well as practical skills" (Plato S. I, 1621). This was as true then as it is now. The residential architect has to possess the theoretical understanding of a project's full capacity, the practical skill of how to put a building together, and knowledge of how to lead a project team successfully to fruition. Working with, and overseeing multiple professions throughout the course of the project can be daunting if the full scope of work is not understood by the architect. Engineers, consultants, contractors, vendors, and the various governmental and utility agencies all work in different ways and communicate differently. Architects need to recognize and adapt to each profession's abilities and limitations so as to maximize the potential impact of all involved.

The owner/architect relationship is the primary driver behind the architectural process. According to Article 2 in the AIA's Standard Form of Agreement Between Owner and Architect,

> 2.1. The Architect shall provide professional services as set forth in this Agreement. The Architect represents that it is properly licensed in the jurisdiction where the Project is located to provide the services

> required by this Agreement, or shall cause such services to be performed by appropriately licensed design professionals.
>
> 2.2. The Architect shall perform its services consistent with the professional skill and care ordinarily provided by Architects practicing in the same or similar locality under the same or similar circumstances. The Architect shall perform its services as expeditiously as is consistent with such professional skill and care and the orderly progress of the project (The American Institute of Architects 2017b, 5).

Additionally, Article 3 of the document lays out the architect's responsibilities to the project. These include managing in-house architectural services, communicating with all members of the project team, coordinating with any outside resources provided by owner-contracted consultants, and interfacing with utility and city and county entities in order to follow applicable local building and zoning regulations. The Subsets of Article 3 set up the legal framework and architect responsibilities to the project, homeowner, design, documentation, and construction processes in a clear and organized fashion. The subsets are listed in the following order — schematic design phase services, design development phase services, construction documents phase services, procurement phase services, and construction phase services.

The schematic design phase can be broken down into the first four steps of the "*Scope of Architect's Basic Services*" in AIA's Standard Form of Agreement Between Owner and Architect. Step 1 is the preliminary evaluation, in which the architect reviews the owner's program, expected schedule, design and construction budget, project site, and any other pertinent information needed to understand the requirements of the project. After careful assessment, the architect shares his preliminary evaluation with the client, providing alternatives and collaborating until there is an understanding between the two. Step 2 follows with the preliminary design. This conceptual proposal illustrates building scale and relationships to the surrounding site context which, upon owner approval, translates into Step 3, the schematic design documents. These documents consist of site plans, preliminary building plans, sections, elevations, study models, perspective sketches, renderings, and a potential material pallet (The

American Institute of Architects 2017b, 7). The final part of the schematic phase, Step 4, is an estimated cost of work, followed by the owner's approval prior to shifting into the design development stages.

The design development phase (Step 5) is shorter since it is largely based upon previous architect and owner interaction and approval. Here, the architect works primarily in house to further develop the set of drawings and documents, upon which the eventual construction documents will be based. Again, the AIA's Standard Form of Agreement Between Owner and Architect, states that,

> "The Design Development Documents shall illustrate and describe the development of the Approved Schematic Design documents and shall consist of drawings and other documents including plans, sections, elevations, typical construction details, and diagrammatic layouts of building systems to fix and describe the size and character of the Project as to architectural, structural, mechanical and electrical systems, and other appropriate elements. The Design Development documents shall also include outline specifications that identify major materials and systems and establish, in general, their quality levels." (The American Institute of Architects 2017b, 7).

This is perhaps one of the most important stages of communication between the architect and owner. At this point, it has gone beyond basic conceptual design, and includes physical characteristics with implications which need to be fully understood by all involved. This is the responsibility of the architect, as he or she is most familiar with the design, and has professional knowledge and understanding that the client may not have. As long as the client is clear with regard to his or her ideas and desires, a good architect will be able to translate those ideas into reality. According to the AIA's publication, *You and Your Architect*, an instructional help book for clients seeking Architectural Design, one of the most important qualities of an architect is his or her ability to listen. "Look for a good listener, and you'll find a good Architect" the booklet advises.

Once the client expresses his ideas, and those ideas are captured in the architect's design, as well as mutually approved by all parties, the construction documentation phase begins (Step 6). This is the stage at which concept becomes reality, and the architect must begin to address real world design requirements, such as building codes, utility restrictions, special design requirements, and environmental regulations. At this critical point the design documents should contain the level of detail and information required to physically construct the work. An architect who listens and responds to the client's needs, coupled with a client who, from the start, relays precisely what he or she wants and expects, have the effect of avoiding potential speedbumps as well as reaching project success.

That is not to say there are no complications. The architect's originally estimated cost of work could change due to the inaccuracy of his or her figures versus those of bidding contractors. That would prompt a value engineering exercise in order to bring the client's numbers back down to the original budget. Issues can also compound if the client's mind changes during this stage. Whether it be due to the architect's miscommunication or the owner's lack of understanding, all communication leading up to this point is critical. Any substantial changes from here on could delay the project, or cause the owner to incur significant additional costs. Making sure the owner clearly understands what he or she is getting, from design, to aesthetic, to finish schedules is critical to the success of a project. Once construction documents are complete, they are submitted to the Honolulu Department of Planning and Permitting for review and approval. The DPP process takes anywhere from two to 70 calendar days, depending on the monetary valuation of the build (Honolulu Department of Planning & Permitting n.d.).

During the construction documentation phase, architects also have the responsibility of beginning owner/general contractor interaction. Facilitating this relationship includes

"…assisting the Owner in the development and preparation of (1) procurement information that describes the time, place, and conditions of bidding, including bidding or proposal forms; (2) the form of agreement between the Owner and Contractor; and (3) the Conditions of the Contract for Construction (General, Supplementary and other Conditions)" (The American Institute of Architects 2017b, 7).

Step 7 is the procurement phase. Here, the architect helps the owner compile a list of prospective general contractors, who then submit either competitive bids or negotiated proposals. Often, the type of contract is directly a factor of the complexity and or expense of the design itself. The architect aids in the entire process, from facilitating the distribution of proposal documents, to performing interviews of potential general contractors, answering questions, then compiling a breakdown for owner review. After the successful bid or proposal, the architect awards the winning party and prepares the construction contracts. This is often AIA Document A101-2017, Standard Form of Agreement Between Owner and Contractor.

At this point, the architect has no control over, or liability for, the general contractor's means and methods of construction, sequencing, techniques, procedures, or safety methods. However, he or she should ensure the success of the project through multiple accountabilities during Step 8, the construction phase. Some of those responsibilities include site visits and work quality evaluations, construction inspections to ensure there are no deviations from contract documents or defects in materials or installations, construction timetable assessments, and substantial completions. Ultimately, the architect is a direct representative of the owner on-site, and oversees the entire course of construction. The frequency of the site visits and inspections is part of the contractual agreement, and is laid out in Article 4 of the AIA's Standard Form of Agreement

Between Owner and Architect.[4] Other responsibilities, such as submittals, request for information (RFI), architects supplemental information (ASI), owner, architect, and contractor (OAC) meetings, and general contractor interaction, revolve entirely around communication.

These interactions on the architect's behalf are among some of the most important, and directly influence a project's success. As contractor and subcontractors undoubtedly will raise questions and request clarifications throughout the construction phase, the content of response and clarity of explanation by the architect is of utmost importance. Often, the best way to do this is with simple and clear responses to field-generated submittals and RFI, as explained in Article 3 (3.6.4) of AIA's Standard Form of Agreement Between Owner and Architect (The American Institute of Architects 2017b, 10). When giving supplemental building information in the form of ASI, architects should focus on giving the general contractor enough information to do their job successfully, without being overly detailed, confusing, or vague. This is where the architect serves as the umbrella, overseeing the balancing of information transfer. Balancing different entity involvement and input helps streamline the construction process. While communication itself is critical, facilitating that interaction is even more important. The architect is responsible for controlling entity interaction and the transfer of information in order to filter what each is privy to. The more hands in the pot, the more chance there is for communication error. Upon successful project conclusion, and barring any claims or disputes, the architect conducts inspections, then issues Certificates of Substantial Completion, and final Certificate of Payment.

[4] See Article 4.2.3, Supplemental and Additional Services, in the document (The American Institute of Architects 2017b, 13).

IV. The Engineer

Many different types of engineers may be involved in a residential architecture project. These include geotechnical engineers, soils engineers, environmental engineers, civil engineers, structural engineers, mechanical engineers, electrical engineers, and plumbing engineers. These entities are usually heavily involved in the pre-construction and construction documentation phases, as these are areas where their expertise and input are most valued. For example, geotechnical and soils engineers assess the stability of soils mechanics and subsurface conditions prior to building. Although these engineers have very limited communication with architects, interaction between both prior to construction would likely be of great benefit to the project. For instance, information from the engineer regarding the preexisting conditions of the soil substrate could influence the architect's design, whether it be slab on grade or post and pier. It could even influence the layout of the structure in relationship to the adjacent natural elements of the site and how they will behave during the lifecycle of the building. Haviland (1994) affirms that geotechnical characteristics affect the economics of development. According to him, they "…have an effect on the buildable area of the site. Depth to bedrock, elevation of water table, bearing capacity of the soil, expansive nature of the soil, moisture content, percolation rate…have important implications for engineered fill, building form, foundation and structural design, erosion potential, drainage and runoff" (Haviland 1994, 621).

Other engineers, such as mechanical, electrical, and plumbing (MEP), seemingly play a less collaborative role. It is true that they simply lay out the routing and performance of the utility systems with the structure itself. Yet, the performance of a building is of utmost importance to the owner who will occupy the space. Hence, it is imperative that clear communication from owner to architect, and from architect to engineer regarding the expected performance of the MEP systems in a structure is critical. Lighting, audio visual, plumbing fixture performance (i.e., water pressure, temperature ranges, etc.), appliance type and functionality, and thermal comfort are among the many elements that impact the daily life of the user, but sometimes take a back seat to design aesthetic. Clearly communicating what an owner and architect can expect from the performance of an engineer-designed MEP system, is critical to client satisfaction (i.e., project success).

Civil and structural engineers are more removed from the design process. They are primarily concerned with the method of construction, given the building's design. Although much of their work is never visible in the finished architectural design, they play important behind-the-scenes roles. For example, structure can be one of the key elements of architecture if the architect chooses to be express it. Clear communication from architect to engineer regarding the exposed structural connections he or she wishes to highlight could be of great benefit to an architectural design. Collaboration and clear communication between architect and engineer have led to some of the most intriguing built works in the world, such as Santiago Calatrava's Olympic Sports Complex in Athens, Herzog and de Meuron's National Stadium in Beijing (Figure 3.2), and Norman Foster's 30 St. Mary Axe in London.

Figure 3.2: Herzog and de Meuron's National Stadium in Beijing

Source: https://upload.wikimedia.org/wikipedia/commons/thumb/1/1e/Beijing_national_stadium.jpg/1200px-Beijing_national_stadium.jpg.

This is similarly the case for bioengineers. Although commonly thought of as designers of environmental systems, they can bring great value and aesthetic to architectural as well. Take for example, Kieran Timberlake's Sidwell Friends School in Washington D.C., where constructed sustainable wetlands double as an on-site greywater treatment system. According a study conducted by the University of Maryland, this closed loop system helps prevent over 317,000 gallons of wastewater from entering D.C.'s sewers a year, while also enhancing the character of the building.[5] If these desires are not clearly expressed in the initial collaborative stages, potentially great design opportunities could be lost.

[5] See Landscape Performance Series, October 2012, https://landscapeperformance.org/sites/default/files/Sidwell%20Friends%20Methodology_0.pdf.

As engineers are subcontractors of the architect, this relationship molds interaction and communication with the general contractor or any other build entity. Hence, engineers should relay their needs and expectations unambiguously to the architect, so he or she could transfer that information to other parties. Once the project commences, there is almost no communication between the general contractor and engineer. Communication arises only when there are field-generated questions or discrepancies needing clarification. Again, the architect functions as an intermediary, facilitating communication among the different players. Communication from all parties, then, is critical to answering questions successfully and facilitating appropriate solutions.

V. The Consultant

Consultants are individuals who advise in certain areas of expertise. In an architectural setting, consultants can specialize in lighting, acoustics, environment, historical preservation, low voltage and automation, security, and much more. Architects often assemble their own consulting teams, unless the owner contracts the consultant directly early in the project development stages. The former is beneficial for, as Haviland (1994, 520) argues, "When the architect-consultant relationship is formed early in the project — or before the project begins, in a strategic alliance or a team put together to acquire the project — the consultant can be involved in project planning, and is in a position to commit to services, scope, and schedule before the architect makes these commitments to the owner." Since the architect is the prime contractor, however, he or she assumes all responsibility for the accuracy, completeness, and quality of the consultants' work. This is the case only for in-house consultants; any owner-retained consultants are not the responsibility of the architect.

Owner-retained consultants interact in an entirely different fashion, and can become a hindrance if not managed by the architect. The AIA *Architects' Handbook of Professional Practice* highlights the importance of consultant management in its breakdown of design team agreements (3.43): "The architect is usually in the best position to coordinate the activities of the other design professionals on the project. If the architect is not assigned these responsibilities and the owner is unable to provide them, the architect may want to negotiate to assume these responsibilities and to be compensated for them. When the architect is assigned coordination responsibilities, owner-retained consultants should be required, by contract, to submit to the architects' authority, and to look only to the owner if they have claims with respect to the architect as the owner's agent" (Haviland 1994, 524). In the case where an owner hires a specialty consultant with knowledge and expertise outside the realm of the contracted architect, simple communication and management are key. This often saves the architect time and liability, as he or she does not have to review or assume responsibility for the work. Again, coordination is the key to a successful architect/consultant relationship.

VI. The General Contractor: The Managing Builder

The general contractor, sometimes referred to as the prime contractor, has one of the most critical roles in the entire architectural process. The AIA defines the general contractor as an entity who "works under contract, assembling the labor, materials, and management necessary to construct the complete project" (Haviland 1994, 20). According to the AIA's Standard Form of Agreement Between Contractor and Subcontractor (Document A401-2017), some of those responsibilities include timely communication and decision making, efficient construction scheduling and project proficiency, limiting interference with subcontractor's scope of work and timetables, ensuring health and wellbeing of trades on site, addressing non-conforming work, etc.

Essentially, once the architect has created the construction documents, the general contractor facilitates the total build timeline, from breaking ground through owner turnkey. The clear separation of these entities is visualized in Figure 3.3. Communication is the overarching factor in this process since, while the general contractor is not the one who builds the structure itself, he or she is ultimately responsible for it. It is the specialty contractors or subcontractors who carry out the physical construction at the direction of the general contractor. Clear modes of communication and interaction can facilitate a successful project. The opposite can lead to poor quality of work, negligent means and methods of construction, non-conforming jobsite safety policies, construction rework, increased costs incurred by builders and clients due to rework expenses, and delayed construction timetables.

Figure 3.3: Design-Bid-Build

Source: http://kbc-inc.com/wp-content/uploads/2010/03/design-bid-build.jpg.

In the very first stage of interaction, the request for proposal (RFP) sets up the expectations and relationships between general contractors and subcontractors for the duration of the project. Since subcontractors are responsible only for their portion of the work, project scope needs to be clearly outlined by the general contractor to make sure all facets of the required specialty work are being performed under contract. This is done by way of Exhibit A, Scope of Work. Exhibit A outlines the general conditions of the subcontract, which carry over from trade to trade, as well as the specific scopes of work, which are different for each individual subcontractor. The basis of Exhibit A is the bid tally sheet, which allows the general contractor to compare multiple subcontractor bids. The tally sheet identifies the work included in the subcontractor's bid price, as well as specific exclusions, or items that may require allowances or secondary financial review upon entering into site specific project conditions.

Understanding the construction documents, then communicating exactly what work needs to be done by each subcontractor is a critical responsibility of the general contractor. Most trades work in very different capacities from company to company. Some firms choose to be more involved in the project, taking on more responsibility and liability, and being able to make more money. Other companies prefer the minimal amount of scope, and to get in and out as quickly as possible in order to move on to the next contract. A concrete subcontractor, for example, may choose to come into a project in which all required site work has already been completed. His or her scope of work would then include setting batter boards, pulling string lines, installing below grade vapor barriers, setting formwork, tying steel reinforcement (rebar), and then placing concrete. A more ambitious concrete subcontractor may choose to do all his or her own site work prior to the previously mentioned scope of work. He or she may opt to dig for all the under slab utilities, dig for required footings and slab on grade, install aggregate base coarse, and complete all required compaction prior to placing concrete, etc. This must be thoroughly vetted by a general contractor prior to entering into a contract in order to avoid overlap in scope. If the civil subcontractor also has these items in his bid, the general could potentially be paying two different companies to perform the same work. If there is a lapse in scope, the general contractor could be left scrambling to find someone to perform the missed work at the time of realization, which could delay subsequent trades, ultimately delaying schedule.

Contractors need to communicate clearly on-site. As the general contractor is responsible for the project as a whole, the inevitable unexpected site specific issues, requests for information and clarification, and potential detail discrepancies which arise throughout the course of the project need to be answered clearly and quickly. Furthermore, contractors need to be in touch closely with the architect. Daily activities, construction progress, project milestones, and any unexpected issues which arise need to be relayed as they occur in order to keep all parties informed and collaborative in solving problems. The general contractor is the facilitator between all parties and needs the clearest and most direct forms of communication. Miscommunication impacts multiple entities on the project, and can have huge repercussions to cost and schedule. Ultimately, a general contractor's ability to communicate and understand all the implications of each entity successfully completing his or her work per plan, within budget and within schedule, is what enables the general contractor to take on such large undertakings.

VII. Specialty Trade Contractor or Subcontractor: The Hands on Builder

Specialty trade contractors or subcontractors are trade partners who perform their work as a portion of the completed project. Because they are usually contracted to the general contractor, they are referred to as subcontractors or subs. Contractors and subcontractors are often lumped together, but it is the subcontractors who actually build the structures. The AIA defines the subcontractor as an entity who "has a direct contract with the prime contractor to perform any of the work at the site" (Haviland 1994, 18). These specialty trades include, civil, mechanical, electrical, plumbing, masonry, carpentry, roofing, drywall, painting, glazing and mirrors, low voltage, audio visual, security and landscaping. Each subcontractor provides his or her bids during the RFP phase, and are negotiated with, chosen by, then directly contracted to, the general contractor.

Subcontractor communication is vital as well, and is based primarily on in-house interaction, vendor and fabricator collaboration, and general contractor interface. In-house communication is imperative to facilitating field work, manpower scheduling, material pickups and deliveries, submittals and procurement, and general on-site interaction. A company's ability to communicate internally, and to balance its manpower successfully, while ensuring each team member is utilized to his or her greatest potential, allows that company to carry multiple projects, increasing both company confidence and profitability. Understanding procurement timetables, that is, lead times, increases scheduling efficiency and improves project productivity as well. Submittals also play an important role. Communication between estimators, project managers, and office managers ensure submittals are tendered accurately and in a timely fashion, eliminating the need for resubmittal and added work within the company. Most importantly, however, is on-site interaction. Clear directives and communication on-site between foreman, journeymen, apprentices, and laborers increase daily productivity, quality of work, and employee morale.

Vendor and fabricator collaboration impacts material specifications and ordering, accuracy of custom fabricated components, and shipping and lead times. As nearly all of the building material in Hawai‘i is imported, accurately calculating shipping costs and lead times will have a drastic impact on subcontractor success as well. Making sure material specifications match what is being ordered, ensuring shop drawing dimensions are field verified prior to sending out to fabrication, and taking into account any potential hiccups along the way to the jobsite are critical to any successful business operating in Hawai‘i.

Further, general contractor interface relies heavily on communication between the two parties. In fact, much of the focus of AIA’s Standard Form of Agreement Between Contractor and Subcontractor is on communication. Article four defines subcontractor responsibilities and contractual obligations to the general contractor. Article 4.2.4, for example, states that “The Subcontractor shall furnish to the Contractor periodic progress reports on the Work of this Subcontract as mutually agreed, including information on the status of materials and equipment that may be in the course of preparation, manufacture, or transit” (The American Institute of Architects 2017a, 5). Other clauses focus on quality control of the subcontractor’s work, non-conforming work, protection of the subcontractor’s work from negligent acts on behalf of other trades or the general contractor entity itself, safety and housekeeping throughout the worksite, as well as warranty and indemnification clauses.

VIII. The Utility Entity

Utility company requirements and regulations are a big component in construction nationwide. In Hawai‘i, single entities such as Hawaiian Electric Company (HECO), Board of Water Supply (BWS), and Hawai‘i Gas monopolize the market, and, thus, hinder the construction process if not thoroughly understood by the architect and general contractor, or accounted for in the preconstruction/pre-permitting stages. Other utility companies such as Spectrum and Hawaiian Telcom have less influence, but an impact nonetheless.

HECO, for example, requires its own separate electrical submittals for new construction, in addition to the construction documents submitted to the city and county for the building permit. The required documents include electrical load calculations, electrical site plans, one-line diagrams, meter elevations, as well as civil, structural, and landscape plans. These submittals have implications that are different from those of city and county ordinances or building codes. If an architect's design fails to consider these additional requirements, it could cause field problems down the line. BWS and Hawai'i Gas have their own regulations as well when it comes to water management and gas installation proximities and the required clearances.

More often than not, it is the subcontractor entities who thoroughly understand these regulations, since they have dealt with them directly on many occasions. Electricians are familiar with HECO codes, whereas plumbers are familiar with Hawai'i Gas regulations. Communication with these entities will facilitate a smooth shift from construction project to occupied residence. Ensuring this, whether it be on the architect or general contractor's behalf, is imperative to the project as utility companies rarely communicate their construction requirements to the general public. They leave it up to the parties responsible for facilitating the construction process to do their own leg work and identify what is required by each individual utility entity.

IX. The City and County Entity

The Honolulu Department of Planning and Permitting is responsible for "long-range planning, community planning efforts, administration, and enforcement of ordinances and regulations governing the development and use of land, various codes pertaining to the construction of buildings, and city standards and regulations pertaining to infrastructure requirements" (PBR Hawaii & Associates 2015, 1). Architects often work directly with one or several of DPP’s strategic groups. Most often these interactions occur with the building department, site developments divisions, and the planning and land use permitting departments (as they control planning, zoning, and permit issuance for the city) (Figure 3.4).

Figure 3.4: Department of Planning and Permitting 2017 Organization Chart

Source: https://www.honolulu.gov/rep/site/dpptod/dpptod_docs/DPP-Org-Chart_4-11-17.pdf.

Architects in Honolulu should understand the intricacies and nuances of the local building department, and what to expect throughout the permitting processes. Communication should be proactive, and should stem from the architect in order to move through these steps successfully.

There are many forms of communication with which to interact with DPP; some are more successful than others.

In a survey conducted by PBR Hawaii & Associates in 2015 to assess customer satisfaction, 128 local professionals, including consultants, architects, engineers, and planners, responded to questions about DPP services, staff, and other pertinent information. The results exemplify the optimal modes of communication and establish realistic expectations when assessing permitting time and DPP interaction/response time. Some of the key findings include common modes of interaction with DPP, experience with staff and services, and DPP responsiveness. The results were overwhelmingly sub-par, with mediocre customer satisfaction. The established “satisfied” range was from six (slightly satisfied) to ten (extremely satisfied). The Honolulu Department of Planning and Permitting’s average rating was 5.77, which is mediocre at best. Interestingly, some of the customer ratings were also grouped by type of communication. Individuals who interacted with DPP face-to-face gave a lower average satisfaction rating of 4.93, whereas those who utilized phone, email, or the online database indicated a satisfaction level of 6.0 or higher. This can be attributed to the need for increased staffing. In fact, PBR Hawaii & Associates (2015, 12) noted that, “When asked if additional funding were available to DPP to improve on customer service, the majority of respondents said to hire more staff (30%), simplify regulations (19%), offer more online services (13%), provide more staff training (10%), and provide more educational seminars to the public and building industry (9%).”

What this means is that successful interaction with DPP requires, first, an understanding of the building codes and regulations. This would allow one to realize what can be submitted for permit successfully, versus what may get kicked back for redesign. Second, knowing how best to communicate any questions or concerns, and how to get timely and helpful responses would ultimately benefit the process greatly. This means, knowing what types of questions desk clerks are best suited to answer, versus what a plans inspector, building inspector, or city planner is apt to know. Interfacing with the wrong individuals within DPP can lead nowhere or, on the more extreme end, result in construction document re-review, adding time and money to a project. Additionally, aside from the architect, the general contractor and subcontractors regularly interact with DPP to obtain building permits, noise permits, trenching permits, and street usage permits. All parties should, therefore, grasp how best to communicate with DPP to successfully complete their part of the architectural product.

X. The Inspector

Multiple inspectors are involved in the construction stages, from the city and county building electrical and plumbing inspectors, to utility and special inspectors, and the infamous Occupational Safety and Health Administration (OSHA) inspectors. Communication is critical as these are most often in-person interactions in which requirements need to be clearly defined, and expectations precisely outlined by each party. It falls on the general contractor, however, to secure the necessary information to keep all employees on site safe, and pass all inspections.

Each inspector has unique roles and responsibilities, and assesses jobsites differently in order to identify compliance and/or infractions during the construction phase. The city and county entities, such as building, electrical and plumbing inspectors, ensure that all systems are built per plan and to all applicable local building codes. Much of this is life-safety oriented, making sure than once the house is occupied, there will be no immediate dangers to the residence or homeowner due to the construction work. Similarly, utility inspectors are focused on clearances, meter locations, buried conduit encasement and safety precautions, maintenance and service issues, among other life safety and utility management concerns. Ultimately, direct communication on site, and transparency with current construction work will facilitate successful interaction.

Special inspectors are not involved in all projects as are other inspectors. They represent the owner's interest, evaluating, and ultimately approving or rejecting the quality of the construction work, and ensuring that all architect specifications are being met. Some of these inspections include perimeter ground termite treatment, concrete mix design and slump testing during pours, welding quality control, uplift ties and strapping, shear walls and nailing patterns, and structural design confirmations. As is the case with utility inspectors, as long as work is being performed correctly and according to the architect's specifications, clear communication and transparency of on-site construction will facilitate successful interaction with special inspectors.

OSHA inspectors play an entirely different role in the construction process. Although they are ultimately there to protect human health and safety, they can have drastic impacts on the construction phase if the general contractor does not ensure proper safety protocol and procedure throughout the project site. Outlined in the Occupational Safety and Health Act of 1970, OSHA was created to "assure safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance." (US Department of Labor, 2017). These inspectors conduct random jobsite inspections due to a number of factors (including complaints, random inspections, and scheduled inspections), and search for infractions that endanger workers engaging in construction work onsite. Issues such as fall protection safety, personal protective equipment (PPE), construction management practices and techniques, tool and equipment safety, health code standards (such as being provided adequate facilities and resources to safely operate throughout the course of a workday) as well as life safety precautions will warrant OSHA citation and potential stoppage of work. In this case, although communication must be clear on site, communication in house must be clear as well. Ensuring that the proper company representatives are on site during OSHA inspections, and that all the proper protocols are being followed can better ensure a positive inspection experience. The alternative, tens of thousands of dollars in fines and citations, impact a company's standing, finances, and insurance policies.

XI. The Inquisitive Neighbor

While not often looked upon as a major part of the architectural process, neighbor(hood) communication is vital to maintaining good relationships and a positive image with the community adjacent to the project site. Establishing clear modes of communication creates partnership, rather than opposition. Construction projects, though temporary in nature, can inconvenience surrounding neighbors. General contractors who preempt or take precautions to minimize the inconvenience can build a positive working relationship, which could eventually lead to an increase in the firm's business and positive publicity. Furthermore, architects who involve the neighborhood in projects, soliciting input and gaining direct feedback from them, will be better received. Often, neighborhoods have special design requirements which should be met by the architect and owner. One such neighborhood, the Wailupe Peninsula Community Association (WPCA) in Honolulu, is an excellent example. The association by-laws govern a wide range of architectural design decisions. Design restrictions include regulations on building height, more aggressive setback/side yard distances as compared to DPP, limiting roof typologies for aesthetic reasons, limiting ocean front building proximities, and regulating second story window/view restrictions. For example, Article XVI, Section 2 of the WPCA by-laws focused on second story additions states that, "all second story additions will be considered by the board for approval, subject to the following restrictions and conditions…All flat roof structures shall not be allowed…all second story additions must have a minimum setback of forty-five feet from the rear and front property lines, and fifteen feet from the side property lines…no side windows with views of adjoining side properties will be permitted."[6] As these laws are not requirements of the city or county of Honolulu, owners are not required to abide by them, but are unable to utilize amenities and common facilities if they do not. Since these design restricting by-laws are established by the association board, they likely reflect the perspectives and preferences of the community members themselves. Owners and architects who choose to ignore design requirements are essentially challenging the preferred way of designing and living, and could ultimately be poorly received by the neighborhood.

Combative interactions with neighbors, or the adjacent community could lead to "bad blood" toward the architect and owner, negative publicity for the architectural firm and general contractor, complaints to OSHA or the city or county during construction, prompting inspections and potential infractions, and triggering negative associations with all involved. Ultimately, both the architect's design, and the contractors building it directly represent the owner. If the owner chooses to ignore community concern and interaction, that decision also falls on the rest of the entities throughout the process, and will undoubtedly impact construction and schedule. Being

[6] See By-Laws of Wailupe Peninsula Community Association, http://nebula.wsimg.com/2c9bfe9b6f24545ababf79c86edecdcf?AccessKeyId=E3B5EB6D3F9C8223BB0D&disposition=0.

sensitive to the inquisitive neighbor and knowing how to interact with him or her can be critical to the design and construction processes.

Chapter 4: Legal Drivers of Communication and Relationships

I. The Industry Standard: The AIA Contract

The American Institute of Architects began creating standard forms of agreement for architectural practice in the 1880s. According to the institute, "Since 1887, the AIA has relied upon a committee of experts to help draft and update its contract documents. From the three-man Committee on the Uniform Contract of 1887 to today's 35 design and construction industry leaders, the AIA Documents Committee has always played an integral role in the creation of AIA Contract Documents."[7]

Over the years, these legal documents have been modified and adapted to fit the ever advancing field of architecture. Beginning with the first Uniform Contract in 1888, which was meant for owner and contractor interaction, and in conjunction with the National Association of Builders, they eventually evolved into the first set of Standard AIA Documents in 1911, and America's first Standard Owner-Architect Agreement in 1917. These arrangements have gone through sixteen revisions/iterations over the years, and now constitute nearly 200 different contracts and forms which make up the industry standard for managing relationships in architecture and construction today. Some of the most common standard forms of agreement include the Owner-Contractor Agreement, Owner-Architect Agreement, and Contractor-Subcontractor Agreements. There are many others, however, such as Owner-Construction Manager, Design-Builder-Contractor, and Developer-Builder-Architect. There are also documents that govern the general conditions of a relationship, the required processes for changes to a project, payment and financial interactions, and even programming and value

[7] The American Institute of Architects, "The History of AIA Contract Documents," https://www.aiacontracts.org/contract-doc-pages/21531-the-history-of-aia-contract-documents.

analysis. The AIA contracts are meant to clearly identify individual liability, entity roles and responsibilities, and modes of interaction. Hence, they are widely recognized as the industry standard, and are used by all industry professionals, including architects, contractors, owners, consultants, and attorneys. AIA contract documents fall into two categories: (1) families, based on types of projects or particular project delivery methods, and (2) series, based on the use of the document."[8]

The contracts themselves are collaborative. They are not simply compiled by architects without any outside influence. On the contrary, the AIA has often sought input from various stakeholders within the construction industry, independent legal counsel, builders, architects, and attorneys to further develop its documents. The AIA documents committee is diverse as well. These thirty-five individuals, serving a ten-year voluntary term, come from various backgrounds, and are composed of AIA staff, architects, engineers, consultants, insurance advisors, management teams, and outside legal counsel. Collaboratively, they draft and revise policies establishing the principles of professional interaction in the architecture and construction field. Further, the AIA provides additional training and resources for industry professionals to gain a deeper understanding of AIA contract documents. These include in person or live webinar training in various contract disciplines, as well as digital instructional resources and historical references. Their website offers sample versions of all 200 contacts and forms currently in use, as well as previous editions for comparison.

Since their inception, the AIA contract documents (the contracts themselves, and forms governing financial modes of interaction) have been revised every ten years. The current set of documents released in 2017 contain major changes to both the owner-architect and owner-

[8] The American Institute of Architects, "The AIA: What We Do," https://www.aiacontracts.org/contract-doc-pages/21536-what-we-do.

contractor agreements. The changes almost always reflect the current state of affairs in the architectural field. For example, the 2017 revision reflects an increase in building cost per square foot. As a result, “the Architect is no longer required to re-design for no additional compensation if he or she could not have reasonably anticipated the market conditions [which] caused the bids or proposals to exceed the owner’s budget.”[9] Some of the other changes include the addition of sustainable exhibits into any preceding AIA contract, new agreements aimed at addressing terminations for convenience, clauses differentiating supplemental services versus additional services, and architect compensation guidelines for percentage based contracts. These changes clearly respond to previous issues, that is, inconsistencies or areas that needed to be addressed or clarified. Some addendums even address communication in the architectural process, such as the latest change identifying the “expanded ability for the owner and contractor to directly communicate about the project while maintaining the architect’s ability to remain informed about communications that affect its services.”[10]

These adaptations allow for the identification and response to changes in the field and economy. The time following the release of the revisions is considered a transitional period, where the previous contracts can be used for up to eighteen months after the day of release, at which point they become null and void. During this time, the AIA releases a document comparative, which allows the user to see line items that have been crossed out, original text, and new lines that have been added (Figure 4.1). Users are, therefore, able to compare changes. Such a format enables a visual tracking of the evolution of these contracts over time.

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[9] The American Institute of Architects, "2017 AIA Contract Documents," https://www.aiacontracts.org/contract-doc-pages/67216-2017-document-release.
[10] Ibid.

Figure 4.1: Contract Comparison

The Evolution of AIA Documents: How and Why?

An important point to bear in mind when analyzing the evolution of the AIA contracts is that these documents have evolved to reflect practices in the construction industry, not necessarily the design industry. In fact, the reason that the owner-contractor documents are the A-series, and the owner-architect documents are the B-series is because the AIA started drafting these agreements first. The owner-architect agreement came into being three decades later in 1917, and, although it has lengthened significantly, much of the language remains the same. Thus, the documents have all evolved in a very specific way over the course of 130 years.

Another factor impacting contracts is litigation. This is highlighted by AIA's substantial archive of interpretive case law. The *AIA Legal Citator*, a book published by LexisNexis, has documented every instance since 1974 in which an AIA contract document is cited or interpreted in a court ruling. This reference document "addresses the most essential concern of construction law, the interrelationship between the parties to all major construction projects" (Stein, 2007).

AIA documents are ultimately designed to be the nationwide industry standard for balancing allocation of risk and responsibility between architect contractor, and client. This helps ensure a project's success. To achieve that, AIA documents must be up-to-date with the current issues in the field and relevant court decisions. The 17th edition of the AIA documents, released in April and October of 2017, encompasses many changes relating to the current trends of digital data (BIM) and sustainable design exhibits. Kenneth Cobleigh, Managing Director and Counsel of AIA Contract Documents, maintains that "technological advancements such as Building Information Modeling (BIM) and the evolution of certain social expectations, such as sustainable design and construction, along with changes in the construction insurance market, influenced revisions in the 2017 documents" (Sweeny, 2017). This reflected the digitization of the construction industry, as well as the large scale push for substantial sustainable design initiatives.

Another revision in response to current issues in the field was the new insurance and bonds exhibit, which accompanies owner contractor agreements. According to Colbeigh, this was the "single most significant revision" (cited in Sweeny, 2017), as it allows for flexibility when developing project insurance coverages and requirements. This new exhibit takes into account differentiation between required and option insurance coverages, and also allows the document to respond to changes in the insurance market without revising the owner contractor documents. Other significant changes in the newly released 2017 AIA documents include revisions to site evaluation and project feasibility services, historic preservation services, on-site project representation services, facility support services, commissioning services, certificate and substantial completion, notice of additional services, and an amendment to the professional services agreement. In a recent AIA interview, Cobleigh urged architects to get familiar with the 2017 revisions as "many of them impact the role and responsibilities of the architect directly. Others directly impact the roles and responsibilities of the owner and the contractor, and the architect will need to understand those impacts in order to provide advice to the owner and to adequately perform contract administration services. We hope that all architects, and other industry participants, take advantage of the significant written resources and education programming opportunities available to learn about, and understand, the 2017 revisions and the full portfolio of AIA Contract Documents" (Sweeny, 2017).

While these documents are highly complex, well established, and proven, they present some of the greatest potential communication issues in the field of architecture. The term "industry standard" is defined as "generally accepted requirements followed by the members of an industry" (Business Dictionary, n.d.). Firm lawyers may be familiar with the details of the AIA documents, but not necessarily architects and designers. This can lead to asymmetric knowledge within the field, as the AIA documents literally dictate interaction between all parties involved. There are over two hundred different contract documents available. They may be overwhelming to comprehend or simply thought of as legal jargon, but they are certainly underutilized. Therefore, the evolution of the documents should be subjected to the input and experiences of all those who currently practice in the field. The AIA is an extraordinary reference. It offers sample copies of each and every document online, as well as a multitude of digital journals, reports, virtual document overviews, and online resources.

The second potential communication issue lies in the fact that the AIA Documents are intended to be nationwide standards. For the majority of the mainland U.S. building community, national standards make sense. However, construction in Hawai'i operates very differently. Hawai'i's unique geographic location, distinct climate, cultural demographics, economic diversity, and heavy reliance on imported goods and services prompt the question as to whether Hawai'i and other isolated locations warrant a specific set of documents or potential addendums and articles to better serve the construction industry there.

II. AIA Documents Committee: Member Perspective

The AIA Documents Committee is made up of twenty to thirty AIA members with diverse backgrounds in the construction industry. These ten-year voluntary commitments are served by those representing owners, architects, and a wide variety of individuals within the construction industry spread throughout the mainland United States. The committee meets four times a year, twice at the AIA national office in DC, and twice a year at locations nearer the west coast so individuals from that region do not have to travel to the east coast for all four meetings. The committee drafts the documents, then seeks feedback from industry professionals. These include the American Bar Association's forum on construction law, practicing architects nationwide, as well as a variety of contractors and owners' groups. The goals of the committee are to create standardized contract documents for national use, provide a cheaper alternative to custom drafted documents, equitably allocate risk, conform to common and statutory law, clearly define each party's responsibilities, and reflect current industry practices.

III. Legal Challenges Governing the Conventional Process of Architectural Design

Although the AIA's contractual documents lay out a clearly defined framework for legal interaction, they also create, unintentionally, communication challenges for entity collaboration in the conventional architectural process. The AIA standard forms of agreement are a direct result of the type of architectural interface selected by owner and architect. When referring to the design-bid-build model, the compartmentalized process is exemplified in the resulting contractual documents. Some of the articles and clauses in these documents inherently block interaction which could otherwise be of benefit to the architectural process. Moreover, the resulting absence of certain working relationships and/or entity collaborations from the chosen legal approach is of greater detriment to the process. In the conventional design-bid-build model, where the owner utilizes a fixed price or lump sum contract, the three major contracts entered into are: (1) A101-2017 Standard Form of Agreement Between Owner and Contractor, (2) B101-2017 Standard Form of Agreement Between Owner and Architect, and (3) A401-2017 Standard Form of Agreement Between Contractor and Subcontractor. This results in no contract being entered into between the architect and contractor, perhaps the most important communication line in the entire architectural process. Since the owner ultimately employs both, there is no financial obligation between these two entities, therefore no form of agreement is adopted. Although the owner-architect contract outlines some of the architect's responsibilities in relationship to the contractor, the owner-contractor document is focused on timetable, budget, completion, and payment, not communication. The result is a relationship focused on individual entity liability, rather than project success and accountability between architect and contractor. Another missed communication opportunity in conventional design-bid-build, is a contract between subcontractor and architect. While architects have a tendency to lump contractors and subcontractors together, the subcontractors are the ones who actually build the structure, and have a far greater knowledge of trade nuances and specific requirements as it relates to the type of work being performed. If contracts are entered into between these two entities, the subcontractors could be involved in preconstruction, which would greatly decrease the chances of running into field issues resulting from lack of understanding.

One of the greatest legal challenges governing the conventional design-bid-build process of architectural design is the reliance on the contractor's ability to successfully complete a project, even though his or her contract is most often awarded based on a fixed price bid, not quality of work or capability as a company. This is a direct result of contract typology, the overall cost of the building process, and the inability of most owners to understand that bid cost most often reflects quality and performance. The old adage, "you get what you pay for," could not be any truer than it is in the construction industry. This compounds further, as the lowest bidding contractor will likely look for their lowest bidding subcontractors as well, in order to maximize their potential profit, resulting in a snowballing of poor quality production and installation. Involving the contractor in the design process through design-build or integrated project delivery will cost more upfront, but save money and time, and increase project quality and longevity in the long run.

IV. Communication through the Contractual Drawing Process

Architects use a variety of different methods to communicate the stages of architectural design to an owner. In the pre-construction documentation phases, the chosen style of communication is at the discretion of the architect. Those techniques can include hand sketching, hand rendering, and building information modeling software (such as Revit, Rhinoceros, and other three dimensional modeling programs), all of which produce realistic renderings and virtual walkthroughs, physical models, relationships diagrams, and photographic references from previous projects and completed works. The architect should choose his or her communication technique based on the owner's ideal method of learning, especially since the owner may not be able to visualize ideas in the same manner as the designer. Most owners do express their desires through verbal descriptions and visual references, such as photographs, videos, and material typologies. More often than not, they have some sort of understanding of associated cost, but the architect must clearly communicate all cost implications from the beginning stages to avoid confusion leading to redesign or value engineering down the line. Again, clarity on the owner's behalf regarding design objectives, constraints, and budget are imperative to facilitating a successful project. The AIA, therefore, encourages the architect to challenge the owner. As stated in *You and Your Architect*, the AIA's guide on architect and owner interaction, "A good architect challenges the client's program, schedule, and budget. Even when these have been developed through painstaking effort, it is in the client's best interest to encourage this challenge.

In this way, the architect comes to understand project requirements in detail. The analysis may also reveal the latent problems or opportunities" (The American Institute of Architects 2001, 15).

Although there are no required communication methods in the AIA contractual documents, certain types of drawings are required. Article 3.2.5 of the owner and architect contract indicates that preliminary schematic design drawings include site plans, preliminary building plans, sections, elevations, study models, perspective sketches, and digital representations. These drawings and other design documents are vital communication tools for the parties involved. As the architectural process moves forward, more detailed communication drawings are required. Article 3.3.1 indicates that the design development phase should include additional (typical) construction details, outline specifications, and diagrams of architectural, structural, electrical, and mechanical building systems. These communication documents will help advance the design and project as a whole. Bringing important issues to the fore increases understanding on the part of the owner.

In the stages prior to the construction documentation phase, the majority of design communication is between architect and owner. The end goal of such communication is to create a design that achieves the client's desired results. In the construction documentation phase, the methods of communication change drastically. While owner approval is still required before submitting for permit or sending out for bid, these design communication documents are ultimately created for professionals within the field of architecture and construction. They consist of drawings and details with a much higher level of refinement, and are intended to lay out the quality standards and performance criteria necessary to physically construct the work. Additionally, the DPP requires specific documents in order to submit for permit, as well as specific communication details. Some of these requirements include plot plans, any pertinent information regarding adjacent property proximities and easements, indications of program (i.e., room use, dimensions, locations, and sizes of doors and windows), typical structural details (e.g., framing plans and sections indicating sizing and spacing of beams, floor joists, roof rafters, and ceiling heights), exterior elevations indicating building height envelope, and vertical circulation details (i.e., stairway sections showing treads and risers, handrails, head clearances, and widths).

Owners, city and county plans reviewers, and bidding contractors all require different levels of information and methods of communication. Further, the receiving entities are required to contribute to the architectural and communication processes as well, with clarifying and detail developing documents. These include shop drawings, product data, samples, mockups, and other submittals that clarify design and construction details. Shop drawings, for example, are detailed drawings, diagrams, schedules, and other data prepared by contractors and subcontractors illustrating a portion of the work. The purpose is "to demonstrate the way by which the contractor proposes to conform to the information given and design concept expressed in the contract documents" (The American Institute of Architects n.d.).[11] Shop drawings are critical to the communication process as they not only confirm that both parties are on the same page, but also identify potential nonconforming work. This is the last opportunity to pinpoint potential design conflicts prior to committing to purchasing a particular good or service. These back and forth communications consist of shop drawing submittal on a contractor's behalf, followed by the architect's review and response. They often warrant revision and resubmittal to clarify any potential issues, and to verify that what is to be fabricated and installed conforms to field conditions, design intent, and individual expectations prior to approval. Shops can be tracked

[11] The American Institute of Architects, "Fear of Shop Drawings: What is the Process, Really, and Does it Need Fundamental Change?" AIA Higher Logic, https://network.aia.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=79b7f7cd-28db-466b-a42f-ddf13fa13cef.

through the course of a project by utilizing the AIA Document G712-1972, Shop Drawing and Sample Record.

Other submittals, such as product data, samples, and mockups, also provide important opportunities for communication between all parties. Product data submittals ensure that contractors are installing materials and finishes per the direction of the architect, and achieving the required level of finish as indicated in the contract documents. Samples and mockup submittals help bring specifications to reality; architects and owners can review physical samples of what is to be fabricated and installed. Sample submittals include stone, tile, wood, paint, glazing, mirrors, flooring, electrical and plumbing fixtures, and many more. Mockups are less common, but can identify potential issues since they tend to highlight connection details or items warranting a physical construction prior to purchase. Mockups can include window and door mockups, clear butt glazed corner conditions, exposed structural connections, flashing and trim, waterproofing, custom profile gutters, precast concrete, and more. These are essentially partial full-scale models of what is to be built for functional, visual, and aesthetic analysis.

As submittals occur during the course of construction, timeliness of communication is another factor, especially in Hawaiʻi, where nearly all construction material is imported and has an associated upcharge and lead-time. Establishing deadlines and building in appropriate float time to account for the inevitable delays in manufacturing and import, as well as clearly communicating expectations and requirements serve to streamline the entire process. At this point, all contractor and architect interaction is in the form of a moving target, as nothing is idle in the project. Any change or alteration as a result of vetting shop drawings will likely have implications that reach beyond the item at hand as they can impact both work in progress and previously completed work. For example, appliance changes could impact countertop or cabinet dimensions; window dimension changes will impact the rough opening dimensions warranting reframing; and plumbing or electrical fixture changes could impact MEP rough in and result in opening walls and/or rerouting utilities. Communication between all entities ensures that any adjustment or alteration is done with a full understanding of the resulting implications.

V. Communication through Building Information Modeling

A relatively new technology, building information modeling (BIM) plays an integral role in today's architectural process. Prior to computer-aided design (CAD) which emerged in the late 1980s, architectural communication through drawing was done by applying pen to paper (velum or mylar). These two-dimensional technical documents were hand-drawn and complemented a set of written specifications. Those two items compiled a construction set of drawings and were used to build an architectural design. In today's ever evolving technological world, the introduction of building information modeling capabilities has vastly improved the communication process. According to architect and construction expert Bruce H. Corke (2016),

> BIM is a virtual construction model of a building with the three primary spatial dimensions being width, height and depth. BIM can augment the three primary spatial dimensions with time as the fourth dimension (4D) and cost as the fifth dimension (5D). BIM therefore covers more than just geometry. It also covers spatial relationships, light analysis, geographic information, quantities and the properties of the building components. BIM allows the extraction of different views from a computerized building model for drawing production as well as other uses. BIM has the potential to be linked with construction scheduling software (4D). BIM models can also carry attributes for selecting and ordering materials automatically, providing cost estimates as well as material tracking and ordering (5D).

BIM is an incredible communication tool. Programs such as Revit, Sketch up, Rhinoceros 3D, AutoCAD 3D, and others allow for an enhanced visualization of an architectural design. This allows an architect to create a digital model of a potential design, from which he or she can extract two-dimensional construction drawings, realistic rendered perspectives, virtual walkthroughs, and natural lighting and ventilation analyses. If utilized correctly, BIM also allows for an extremely sophisticated level of construction estimation and project management for contractors. BIM capabilities allow for takeoffs of cubic yardage of concrete, linear footages of dimensional lumber, square footages of interior and exterior wall cladding materials, flooring, roofing, linear footages of utility lines, as well as clash detection coordination. Traditionally performed by an in-firm quality control specialist, clash detection identifies potential constructability issues before they arise in the field. This benefits owner, architect, and contractor as it minimizes requests for information, and helps to streamline the project.

Clash detection coordination is an enormous benefit of BIM, but it can only be utilized if the architect is virtually constructing the building as it would be in the field. Often, BIM programs are used to produce a three-dimensional virtual model for visualization purposes, in addition to perspective renderings, floor plans, elevations and sections. There is an entirely different level of information available, however, if an architect chooses to virtually construct a building. By inputting critical information, such as utility routing, foundation details, framing specifications, and cladding and finish conditions, BIM's semi-automated quality control clash detection software can identify conflicts among building systems. For example, there are two ways to create an exterior wall in BIM programs such as Revit. The first, and more common approach, is to select a wall typology in the Revit family and assign it to a location. The user can select a wall materiality — such as pour in place concrete, CMU, lumber framed — and assign a thickness. The second, more complicated option, is to manually build that wall as it would be in the field. This means placing the curbs; positioning anchor bolt imbeds and hold-downs; selecting the dimensional lumber thicknesses; placing the studs and indicating layout (i.e., 16 inch on center vs. 24 inch on center); placing waste lines, water lines, HVAC ductwork, insulation, plywood shear and load uplift ties, and vapor barriers, as well as both the interior and exterior cladding. This level of information input allows for an exponentially higher level of information output.

The first option gives the user information regarding wall height, width, and thickness, as well as general materiality and surface area. The second option gives a much more comprehensive information breakdown. It identifies previously noted items and produces detailed wall sections, allowing for thorough material takeoffs, and pinpointing potential building system collisions. In this case, clash detection software can pinpoint how plumbing and mechanical systems will interact with the structural makeup. The potential collision areas are identified, then addressed in the design stages, rather than dealing with them as they arise in the field. This process minimizes RFI and change orders. Using virtual construction, the architect essentially builds the project twice, once on a computer screen, and again in the field. However, architects must be sensitive to the time and labor requirements involved in utilizing virtual construction. Firms must find a balance between information that is required and beneficial to the process, and the amount of time needed to create the model as it is much more labor and time intensive on the design end. Ultimately, virtual construction allows both the design and build teams to better coordinate, schedule, and estimate the project.

The depth of information that can be produced by BIM programs when employing virtual construction is of enormous benefit to the architectural and communication processes. BIM can produce correctly annotated and extremely detailed shop drawings, in addition to the construction documents submitted to DPP for permit. Such in-depth drawings and documents can then be utilized for shop drawings, prefabrication, and CNC program coordination. If utilized correctly, these new-age communication tools can help streamline the design and construction processes. The AIA and CII have both recognized the importance of BIM as well. So much so that AIA Document E203–2013, Building Information Modeling and Digital Data Exhibit, is often attached to an existing exhibit to "establish the parties' expectations for the use of digital data and building information modeling on the project and provide a process for developing the detailed protocols and procedures that will govern the development, use, transmission and exchange of digital data and BIM on the project" (The American Institute of Architects, 2017c).

VI. Post Construction Documentation Communication

Once the architect issues the construction documents to the contractor for building, new modes of communication come into play. Some of these modes of interaction include architect initiated communication with the contractor (including build compliance and quality control), contractor initiated communication with the architect, and submittals and verifications. Although each scenario is warranted for a different reason, all will inevitably become apparent throughout the course of a project, and should be addressed individually.

Architect initiated communication with the contractor can come in the form of in-person site visits, phone calls, e-mails, and official Architect's Supplemental Information (ASI). How often an architect conducts in-person site visits, compared to making phone calls or e-mails, depends on many factors. These include location of an architect's firm in relation to the project site, how much an owner requests the architect to monitor the construction process, how the architect personally chooses to monitor his or her project, and the type of relationship the architect and contractor possess on that particular contract. Article 3.6.2 (Evaluations of Work) in the AIA Document B101-2017, Standard Form of Agreement Between Owner and Architect, states that,

> the architect shall visit the site at intervals appropriate to the stage of construction…to become generally familiar with the progress and quality of the portion of work completed, and to determine, in general, if the work observed is being performed in a manner indicating that the work, when fully completed, will be in accordance with the contract documents. However, the architect shall not be required to make exhaustive or

> continuous on-site inspections to check the quality or quantity of the work. On the basis of the site visits, the architect shall keep the owner reasonably informed about the progress and quality of the portion of the work completed, and promptly report to the owner (1) known deviations from the contract documents, (2) known deviations from the most recent construction schedule submitted by the contractor, and (3) defect and deficiencies observed in the work" (The American Institute of Architects 2017b, 9).

The purpose of this article is to find a balance, that is, a quantity that satisfies the owner and architect, but does not hinder the construction process itself through intrusive or too frequent site visits.

Phone calls and e-mails, while still observing that same balance, are good alternatives to in-person site visits. A phone call can clarify a simple question, or simply reinforce the existing personal relationship and available lines of communication between architect and contractor. E-mails can clarify simple questions as well, but function in two different ways. On one hand, they are less personal. Thus, they often require additional individual outreach (unless there is a pre-existing relationship). On the other hand, e-mail communication allows for recording and tracking interaction throughout the course of a project. Such e-mail correspondence can establish timelines of entity interaction, identify individual responsibility in cases needing clarification, track the process of decision making, and even serve as potential evidence during legal litigation. Both e-mails and phone calls, however, are dependent on how a project architect chooses to communicate with his or her team.

ASI is issued when there is a change in the contract documents, which need to be communicated by the architect to the contractor. These are often owner-driven changes, or changes as a result of an unforeseen field condition. Regardless of their origin, these changes should be clearly communicated in order to be successfully implemented in the field. Unlike the preconstruction stage, the project is now a moving target as it is constantly progressing. Any ASI needs to be thoroughly vetted by the architect, then again by the contractor in the field. This is done to ensure that all changes, impacts to the schedule, and cost implications are clearly expressed prior to beginning the work. ASI can be communicated via supplemental construction documents (i.e., plans, elevations, sections, details), product specifications, or specialty contractor recommendations.

Similarly, contractor-initiated communication with the architect comes in the form of e-mails, phone calls, and official RFI. In this case, the contractor represents both himself or herself and all other subcontractors in the field, as well as clarifies any discrepancies or issues within their scope of work. The contractor must effectively communicate subcontractors' concerns to the architect in order to facilitate successful solutions. Miscommunication on the part of either the contractor or subcontractor can lead to schedule delays and potential additional incurred cost. Clarifying field concerns with the architect by phone or e-mail sheds lights on whether or not the discrepancy warrants an official RFI. Compiling and tracking these changes is critical to correctly completing the finished product per plan, and also dictates whether or not a project has an accurate set of built drawings when it is complete. RFI and ASI logs are accurate ways of tracking these changes throughout the course of the construction. Contractor-initiated communication with the architect can also stem from fabricator, supplier, or vendor concerns, and must be treated in the same fashion. Sometimes, building systems or chosen finishes can be either non-compatible, or pose field issues which may or may not be understood by the architect. When brought to the contractor's attention, these issues must be clearly explained in order to resolve them successfully.

Submittals and verifications are communicated through physical documents to effectively track and monitor them throughout the course of the project. Required by the AIA, and outlined in Document A201-2017, General Conditions, a submittal schedule must be assembled by the contractor and submitted for architect approval. This log is coordinated with the construction schedule, gives the architect ample time to review and respond, and should account for the associated lead times with each submittal so as not to delay the project. Verifications, usually relating to shop drawings and their corresponding field dimensions, must be documented as well. This information must also be thoroughly tracked in order to communicate effectively among multiple entities and, ultimately, to receive the correct product on-site for installation.

VII. Design and Management Tools Shaping Communication

The AIA documents provide a variety of legal approaches and contract structures, depending on the particulars of a project. As architects, owners, and contractors interact in many ways, choosing the right contract is very important. The AIA document, Document Synopses by Series, aids this process by breaking down the contracts by purpose, and showing how to determine the most suitable contract, given the architect's particular project. Each contract or form is summarized in one paragraph, and alternative contracts and supplementary documents and exhibits identified to assist architects. The AIA documents are divided into six series, by type:

A-Series: Owner/Contractor Agreements
B-Series: Owner/Architect Agreements
C-Series: Other Agreements
D-Series: Miscellaneous Documents
E-Series: Exhibits
G-Series: Contract Administration and Project Management Forms.

These various legal approaches to builder representation include owner-contractor agreements, owner-construction manager agreements, owner-design builder agreements, and owner contractor integrated project delivery agreements.

The A-Series documents focus on owner-builder agreements and are further broken down by type of financial payment agreement. For example, contracts can be set up with payment being either stipulated sum, cost plus, or guaranteed maximum price. This usually depends on the complexity of the job, namely, the thoroughness of the construction documents being used for pricing purposes, as well as the owner's desired level of involvement and quality of work.

The stipulated sum contract, also known as fixed price or lump sum, is the most common pricing strategy in construction. This type of financial agreement is best utilized when the construction documents, plans, and specifications are thorough enough for a contractor to give an accurate cost estimate. These documents can then be distributed to multiple contractors for competitive bid pricing. Stipulated sum is commonplace in the traditional, and overly compartmentalized, design-bid-build project delivery method. This is often the most appealing to owners, as it limits exposure and liability for cost of construction. Conversely, it can propose potential issues, as the general contractor usually builds a significant contingency into his or her budget for unforeseen circumstances. It can also introduce issues from a design documentation perspective. A report released by Peckar & Abramson, Counsel to the Construction Industry, which seeks to explain the intricacies of contractual pricing arrangements, points out that "the design team may not be sufficiently knowledgeable about constructability issues, current construction costs, or other factors that may require a redesign and/or reduction to the scope of the project. Accordingly, the project may experience delays to the completion of the project as the design team revises the construction documents, preventing the contractor from proceeding with the work" (Handfinger, n.d.).

The cost plus contract is utilized in cases where an owner or architect may be hiring a contractor for his or her experience, ability, and reputation, rather than opting for the lowest bidder. The contractor is paid the actual cost of construction, plus a fee. That fee can either be a stipulated amount, or a percentage of the overall construction cost, depending on the agreement between the owner and contractor. This type of contract is ideal when a builder is involved in the preconstruction and design stages. It allows for the builder's perspective during design and construction documentation, ultimately leading to a smoother building process. However, owners tend to shy away from cost plus agreements, since they have the potential to increase project expenses given that construction costs are not capped. In fact, increasing construction cost could potentially increase contractor profit. Therefore, there is little desire to value engineer or attempt to lower overall project cost on the builder's end. This can be curbed, though not guaranteed, by establishing a stipulated fee for the contractor, rather than a percentage of overall construction cost.

The guaranteed maximum price (GMP) arrangement is essentially a hybrid cost plus agreement. It is structured in the same way. The only difference is that there is a cap on the total liability to the owner for the overall cost of the construction project. If the total construction cost exceeds the agreed upon amount, the contractor is then liable for all additional cost overruns. Often, there is a shared savings clause in a GMP, which states that the parties will split savings incurred if the construction cost end up being less than the agreed upon guaranteed maximum price. This gives the contractor an incentive to decrease costs, while not jeopardizing his or her potential profit on a project. If utilized correctly, the guaranteed maximum price arrangement is ideal for design-build or integrated project delivery models.

The B-Series documents focus on owner-architect agreements, and are divided primarily by the scope of services being requested of the architect. The different typologies include baseline contracts, sustainable development contracts, complex projects, pro-bono services, development ventures, federally funded or insured projects, design build projects, and interior design jobs. Each agreement has corresponding general conditions as well that are meant to be used in conjunction with the contract. An example synopsis for the AIA Standard Form of Agreement Between Owner and Architect, states that

> AIA Document B101™–2017 is a one-part standard form of agreement between owner and architect for building design and construction contract administration. Services are divided into basic, supplemental and additional services. Basic services are performed in five phases: schematic design, design development, construction documents, procurement, and construction. Supplemental services are services that are not included as basic services but are identified as the architect's responsibility at the time the agreement is executed. Additional services are services that may arise as the project proceeds. This agreement may be used with a variety of compensation methods, including percentage of the budget for construction cost and stipulated sum. B101–2017 is intended to be used in conjunction with AIA Document A201™– 2017, General Conditions of the Contract for Construction, which is specifically referenced.[12]

The C-Series documents are identified as *other*, and are primarily used for joint ventures, project management agreements, and a variety of independent consultant arrangements. Some of the residential consultant relationships would include land surveying, geotechnical engineering and soils reporting, project commissioning, digital data licensing, and sustainable services being utilized on a project. Their roles and scopes of services are outlined in the standard form of consultant services specific to each entity, and generally divide consultant services into phases. Some of those phases include explorations and testing, preparing technical reports, design phase services, and construction phase services. Other, more specific items, are identified in the different consultant agreements, for example, the AIA Document C106-2013, Digital Data Licensing Agreement. This document focuses on intellectual property and the transfer/use of digital data (i.e., Building Information Modeling [BIM] between client and consultant entities). Article 2.1, transmission of digital data, states that "the transmitting party grant the receiving party a nonexclusive limited license to use the digital data identified in Article 5 solely and

[12] The American Institute of Architects, "AIA Document Synopses by Series," http://aiad8.prod.acquia-sites.com/sites/default/files/2017-10/AiaDocSynopsesBySeries_101617.pdf.

exclusively to perform services for, or construction of, the project in accordance with the terms and conditions set forth in this agreement."[13]

The D-Series documents are miscellaneous documents that function primarily as reference guides. This section consists of methods of calculating the areas and volumes of buildings, a project checklist for architects for use throughout the entire architectural process, and a guide for sustainable projects. In residential design in Hawai‘i, architects often maximize the allowable square footages permitted by city and county building code. This must be calculated accurately when applying for a building permit in order to gain project approval. Although there is no single standard for calculating floor area, since it varies depending on applicable building code, AIA Document D101-1995 gives several approaches to calculating office areas, retail areas, and residential living areas. Residential living areas are spaces used for habitation, and include "…the sum of the areas of the floors of the building, measured from the exterior faces of exterior walls or from the centerline of walls separating buildings. The architectural area includes basements, mezzanines, intermediate floors and penthouses provided that these areas have a minimum of seven feet headroom height…paved or finished covered areas, such as open porches and similar spaces, shall have the architectural area multiplied by an area factor of 0.50. The architectural area does not include such features as utility chases (less than seven feet to any physical obstruction), exterior terraces, steps or eaves."[14] The two portions of the document, which refer to finished covered surfaces and exterior terraces, are especially

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[13] The American Institute of Architects, "AIA Document C106-2013 Digital Data Licensing Agreement," AIA Contract Documents C Series: Other Agreements, http://aiad8.prod.acquia-sites.com/sites/default/files/2016-09/AIA-C106-2013-Free-Sample-Preview.pdf.

[14] The American Institute of Architects, "AIA Document D101-1995 Methods of Calculating Areas and Volumes of Buildings," AIA Contract Documents D Series: Miscellaneous Documents, http://aiad8.prod.acquia-sites.com/sites/default/files/2017-02/AIA-D101-1995-Free-Sample-Preview.pdf.

important in Hawaiʻi, as a large portion of Hawaiian residential design incorporates interior/exterior living.

Although outdated, the Project Checklist AIA Document D200-1995 could be an excellent reference that allows architects to record and track their processes from predesign to post-construction services (Figure 4.2). Each stage of the architectural process is broken down into multiple checklists, itemizing the critical tasks to be addressed by the architect throughout the scope of the project. Those include pre-design, site analysis, schematic design, design development, construction documentation, bidding or negotiation, construction contract administration, and post construction services. Pre-design, for example, is broken down into project feasibility, project presentation, pre-contract, project administration, and project programming. These five categories are disaggregated further into a virtual explanation as to how to navigate these hurdles successfully by utilizing the AIA designated checklist.

The Project Feasibility Checklist, for example, outlines the decision-making process involved in determining whether or not a project is worth pursuing. It starts with establishing whether or not the owner, or potential client, is financially able and committed to completing the project. Next, the implications of site specific factors — i.e., social and economic, demographic, climate, sun, wind, views, transportation, parking, government support services, and safety/

Figure 4.2: Project Checklist

security — on potential design should be considered. From there, the architect should determine timetables and potential incurred cost for project staffing, project design, cost estimation, construction documentation, permitting, and many other services through to the construction phase.

The E-Series documents are indicated as additional exhibits — i.e., on BIM and digital data, as well as sustainable projects. Supplementary to the previously noted C106-2013 Digital Data Licensing Agreement, the AIA Document E203-2013, Building Information Modeling and Digital Data Exhibit, establishes expectations for the use of digital data and BIM on a project. The Sustainable Projects Exhibit, AIA Document E204-2017, can be used in a variety of sustainable project approaches, and outlines the potential risks, individual entity responsibilities, and opportunities exclusive to projects involving substantial sustainable design and/or construction elements. The document outlines the desired level of sustainability from the owner/client. It then identifies project objectives, sustainability plans, and certifications, in addition to the scope of architect, contractor, and owner responsibilities. Ultimately, it sets the stage for the anticipated level of sustainable intervention, and what can be expected from all parties involved. The resulting sustainability plan describes "the Sustainable Objectives; the targeted Sustainable Measures; implementation strategies selected to achieve the Sustainable Measures; the Owner's, Architect's and Contractor's roles and responsibilities associated with achieving the Sustainable Measures; the specific details about design reviews, testing or metrics to verify achievement of each Sustainable Measure; and the Sustainability Documentation required for the Project."[15]

[15] The American Institute of Architects, "AIA Document E204-2017 Sustainable Projects Exhibit," AIA Contract Documents E Series: Exhibits, http://aiad8.prod.acquia-sites.com/sites/default/files/2017-04/E204_2017%20sample.pdf.

The G-Series documents are Contract Administration and Project Management Forms. These forms include everything from project abstract forms, amendments to previously signed agreements, change order documents, requests for information, applications for certifications of payment, work changes, field reports, contractor's affidavits, and substantial completion certificates. These documents are highly important to the architecture and construction processes in both the preconstruction and construction stages. Preconstruction forms establish project protocols and expectations, individual certifications, and potential liabilities on the parties responsible. Construction forms dictate the process of changes in the field and their implementation, and address field issues requiring clarification (and paper trail for liability purposes). Two construction forms that are utilized often are the AIA Document G716-2004 Request for Information (RFI) (Figure 4.3) and AIA Document G701-2017 Change Order (Figure 4.4).

Figure 4.3: AIA Change Order Document

Figure 4.4: AIA Request for Information Document

Chapter 5: Design Brief

I. Introduction/Purpose

Doc II consists of a mock client and architectural design(s), which further reinforces the previously noted Doc I theories and hypothesis. Designing two custom residential proposals — one based on a design-bid-build business model, and the other based on a design build business model — for the same client allows for a comparison of the two, identification of issues that could potentially arise during the architectural process, and identification of the benefits of one delivery model versus the other. Furthermore, Doc II attempts to prove that design build, when focused on achieving design aesthetic in conjunction with project efficiency, constructability, and performance, is an ideal delivery method for custom single family residential architecture in Hawai‘i.

II. Architekton Design Build, LLC: Firm Statement

We strive to provide value and integrity in architectural design and construction. We deliver elegant, locally responsive tropical modern designs, while ensuring that our clients receive the highest quality workmanship, project management, and customer service through every stage of the architectural process, from conceptual design to owner turnkey.

Architekton Design Build LLC understands that architecture is an extremely complex field with multiple, critical communication pathways. These interactions across a variety of disciplines and professional focuses must be clearly communicated to all parties involved for a project to be successful.

Contrary to the traditional design-bid-build process, where many highly specialized entities work independently with little collaboration, design build involves collaboration among all critical entities/elements. This creates a streamlined design and build process, minimizes miscommunication, and maximizes design, fabrication, and construction efficiency.

We believe that the 21st century design-bid-build architect is, in many ways, much more removed from those in the field and on site physically building than our predecessors were. Without a strong, clear, and directed means of communication among all the highly specialized entities on a project, the chance for miscommunication (or mistiming of communication) is great. According to the Construction Industry Institute (CII), this costs the United States construction industry over $15 billion dollars a year in rework expenses. The CII defines rework as "extra field work performed to rectify nonconforming work regardless of the source of the nonconformance. This includes design changes and design, fabrication, and construction errors that caused the initial incorrect work." The direct cost impact is significant, accounting for more than 5% of overall construction costs incurred nationwide. The need for clearer modes of communication is critical, and the solution (on the single family custom residential scale) is true architect-driven design build. That is what we offer.

III. Firm Values

As a design build team, we make decisions based on five core competencies:

1. ***Client Value and Satisfaction.*** We streamline the residential building process to ensure that clients receive the highest quality design, construction, and project management.

2. ***Client desired Aesthetic***. We give the client the visual appeal and style they desire, and increase satisfaction by further developing those ideas as a team. This includes collaborating with clients during the development phase to ensure their satisfaction with the design.
3. ***Design Functionality.*** We choose materials and finishes that compliment both what is produced/distributed/available locally, and the associated cost of labor for production and installation.
4. ***Building Longevity.*** We determine whether the chosen material pallet can endure the harsh Hawai‘i weather, namely, the aggressive shoreline environment of windward Oahu.
5. ***Environmental Consciousness.*** We evaluate chosen materials in terms of their embodied energy, safety, and health for installers and clients/occupants, and the environmental impact on surrounding microclimate as a result of installation or building lifespan.

IV. Firm Model

1. Architekton is a small design build firm that focuses on custom single family residential in Hawai‘i, as well as the design build delivery method vs. the traditional design-bid-build model. It is a local company with a strong design background, strong understanding of Hawai‘i construction specifics and potential issues, and invaluable construction expertise. Its delivery model proposes locally responsive and environmentally responsible design, improved work flow, streamlined design phase, more efficient and cost effective construction phase, overall financial satisfaction, and a positive impact on overall quality and cost of design.

2. In-house construction management, carpentry, masonry, and labor.
3. Architekton driven. Firm deeply values the importance of a master builder as lead architect.
4. Ten (10) total employees
    a. Two (2) Hawai‘i licensed architects, also directly involved as site superintendents (D.Arch)
    b. Two (2) designers/draftsmen (BEnvD or Higher [Engineering Degree, B.Arch or M.Arch])
    c. One (1) project manager (MBA)
    d. Five (5) office employees (estimator, detailer, accounting/payroll, HR, reception)
5. AIA contract primarily in use – AIA A145-2015 (Standard Form of Agreement Between Owner and Design-Builder for a one or two family residential project), and AIA A441-2014 (Standard Form of Agreement Between Contractor and Subcontractor for a Design-Build Project)
6. Firm works directly with specialists, subcontractors and consultants during pre-construction and design.
7. Firm adaptively responds to the local market, and continuously evolves as the build environment does.
8. Firm understands business and the importance of personal relationships in Hawai‘i (i.e., how things get built in Hawai‘i).

V. Project Specifics: Client

1. High-end custom residential
2. Client construction budget ≥ $5,000,000 (lot purchased prior)
3. Looking for value in architect and general contractor
4. Used to traditional design-bid-build model. Needs design-build process coaching.
5. Initial VE efforts tend to recirculate (i.e., HVAC, casework, materiality, etc.).
6. Values architectural design.
7. Looking for beauty, elegance, and to make a statement.

VI. Project Specifics: Client's Desires

1. Slab on grade
2. Pour in place concrete walls & nonstructural 2"x6" framed partition walls
3. Glass facades with shade elements (depending on directionality/orientation)
4. Open/operable facades with shading/weather separating elements depending on directionality/orientation.
5. Timber/glulam open beams & exposed architectural connections
6. Intensive green roof combined with wood shake or copper roof
7. Minimize superfluous/ornamental design, opting for simple yet elegant, clean, tropical modern design that responds to the site specific factors of the project.

VII. Project Specifics: Budget

Client construction budget ≥ $5,000,000 (lot purchased prior)

Design build cost plus fixed fee contract

VIII. Project Specifics: Site

Kahala, Honolulu, HI. Single family residential (150’x76’ lot size)

IX. Project Specifics: Programming Details

Two story single family residential

7000 square feet

Four-bedroom main house

Two car garage

Separate pool house with second floor guest bedroom

Six bathrooms

Indoor/outdoor living (large operable and sliding façades)

Large operable façade lanais

Separate entertaining/public spaces and family living spaces

Office

Wine room

Large pantry

Open plan

Pool and spa

Yard

Landscape screening

Intensive green roof

Exposed structure and architectural connections

Fine finishes

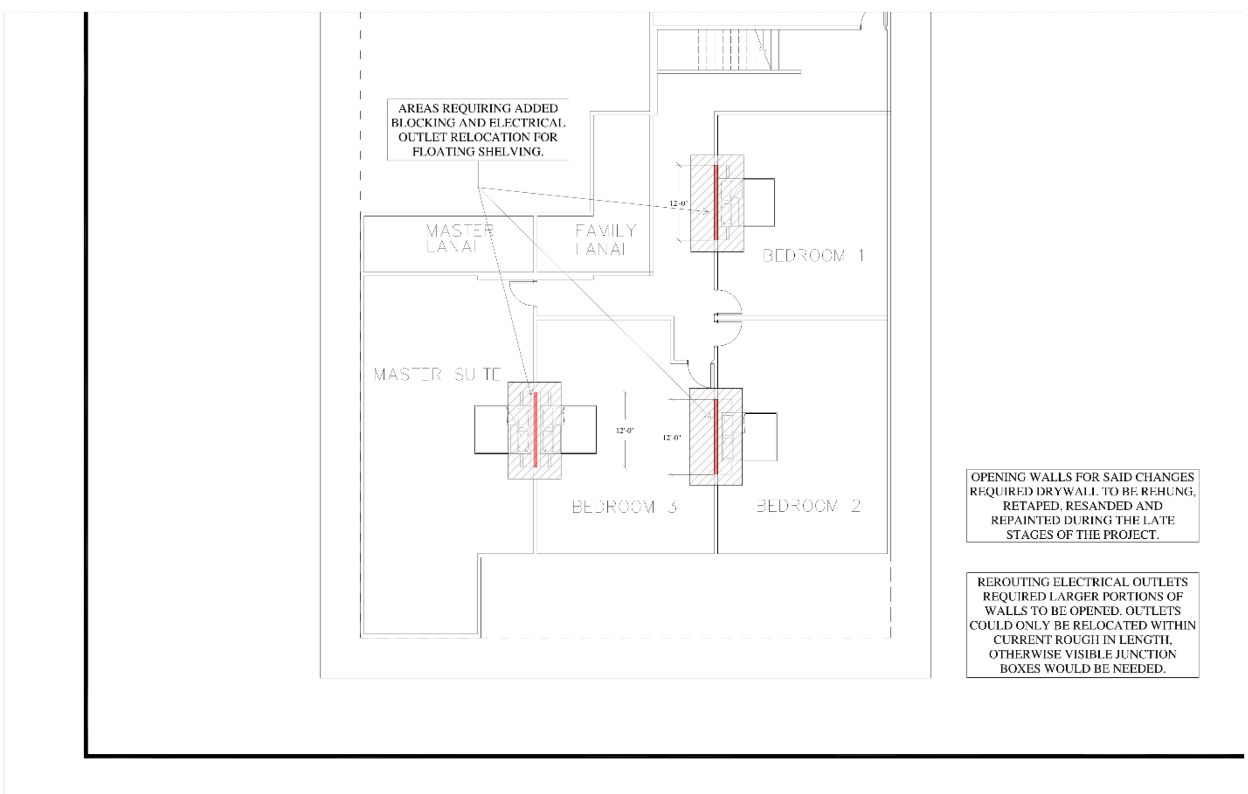
X. Potential Issues when Comparing Design-Bid-Build and Design Build Delivery Models on a Residential Scale

1. Impacts to the project as a result of client-retained designers or specialty subcontractors who were not involved in the original architectural design process

i. Interior Designer Built in Furniture Changes

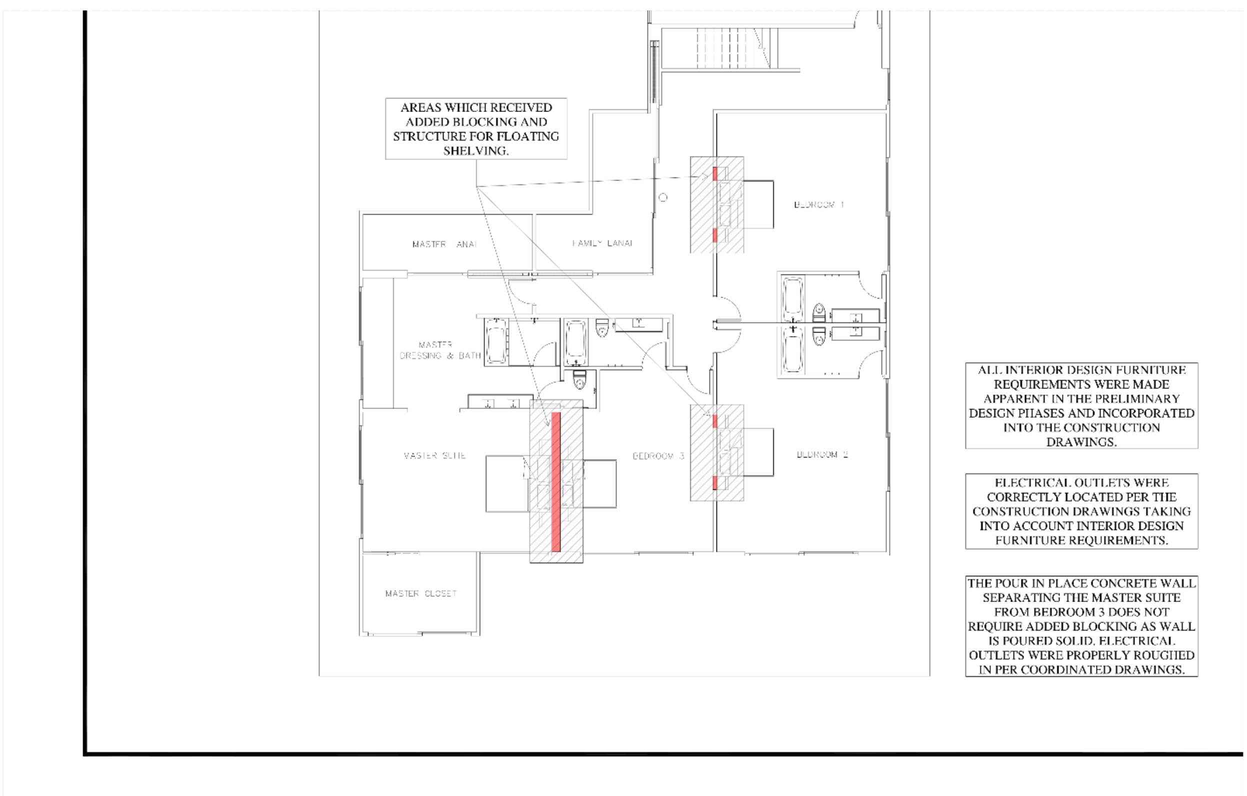
Interior designers added floating shelves and floating vanities in three different rooms. These were not designed until the later stages of construction, and required walls to be opened to install blocking/added structure to support those pieces. The locations of the units also required electric to be rerouted, and outlets relocated. Since the interior designer is directly contracted to the client, there is no communication between the designer and architect until construction documents are issued to the field.

Figure 6.1: Interior Design Furniture Changes



The structural requirements for the furniture changes were vetted in the preliminary design phase, as indicated in Article 4.2 in AIA Document A145-2015 Standard Form of Agreement between Owner and Design-Builder for a One or Two Family Residential Project.[4] This information is vital for an accurate design proposal and cost projection. Moreover, as the interior designer is directly involved in the design processes, these requirements were made apparent and incorporated into the construction drawings long before a problem arose.

Figure 6.2: Interior Design Furniture Adaptations



[4] The American Institute of Architects. Standard Form of Agreement Between Owner and Design-Builder. Report no. A145-2015. Washington, DC: The American Institute of Architects, 2015a.

ii. *Interior Designer Master Closet Changes*

Again, as the interior designer is directly contracted to the client, there is little to no communication between designer and architect. Simultaneously, however, the architect and general contractor are in the process of casework shop drawings. The interior designers significantly changed the master closet layout, size and functionality, thereby negating weeks of shop drawing revisions and in house work. Massive amounts of time have been wasted in the offices of the architect, contractor, and cabinet subcontractor. The shop drawing process (of redlining, revising, and resubmitting) is very time intensive for all involved. When someone introduces new information that negates significant amounts of work that has already been completed by the team, wages and resources are wasted, and a huge problem is created.

The client's expectations and requirements for the master closet were clearly set forth prior to the preliminary design phase, as indicated in Article 4.1 Owner's Criteria in AIA Document A145-2015. This information is vital for an accurate design proposal and cost projection, and, as the interior designer is directly involved in the design processes, they also review all casework shop drawings in contrast to their own in house drawings to ensure accuracy and eliminate rework.

iii. *Interior Designer Master Bath Changes*

As the master bath is a part of the larger master suite, the interior designer made significant changes to the master bathroom as well to match details and aesthetics elsewhere. Rearranging fixtures, reversing shower and tub locations, and adjusting overall room dimensions led to rerouting of electrical, water, and waste lines; adjustments to drop ceiling heights on the first floor to achieve the required slopes for waste line runs; and the ripping out and redoing of large amounts of wood framing, wood backing/ blocking, and waterproofing. This also spurred incurred costs relating to restocking fees, since fixtures were changed and/or deleted.

The master bathroom, more importantly, the plumbing fixtures and locations, were thoroughly vetted in the preliminary design and construction document phases. As the interior designer is directly involved in the design processes, the implications of such changes had been made clear by the design build architect prior to the issuance of the construction documents. AIA Document A145-2015 Article 5.1.1 makes clear that, prior to issuing the construction documents, all information setting forth the requirements for construction of the work needed to be clearly stated.

iv. Smart Home/Security Consultant Driven Electrical Changes

The client contracted directly with the low voltage/smart home and security consultant in an attempt to keep costs down. As the consultant's requests were not part of the original design process, multiple low voltage changes had to be made to accommodate the Lutron smart home system. These changes resulted in added lighting, changing of fixtures and transformers, changes in electrical requirements, added low voltage and electrical panels, etc.

Although it is not ideal for the design process, the smart home/security consultant works directly for the client in an attempt to keep costs down. This is allowable per Article 7.5 of AIA Document A145-2015, which indicates that "the owner reserves the right to award separate contracts in connection with other portions of the project… whereas the design builder shall coordinate and cooperate with separate contractors employed by the owner." The electrical requirements for the smart home and security system were still thoroughly vetted in the construction documentation phase, however. This information is vital for an accurate design proposal and cost projection, and as the smart home/security consultant is directly involved in the design processes, these requirements were made apparent and incorporated into the construction drawings.

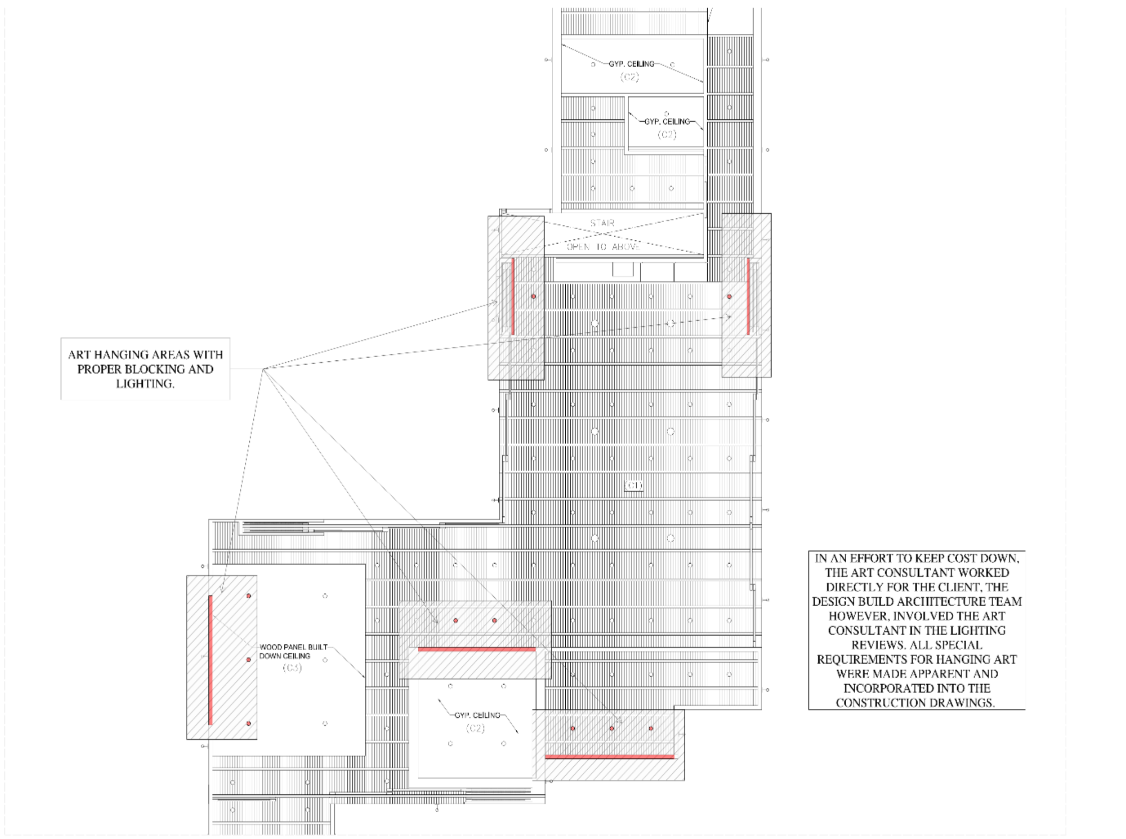
v. *Art Consultant Driven Electrical Changes*

The client hired an art consultant, who strategically located chosen artwork throughout the house. However, these pieces required dedicated lighting, as specified by the consultant. This affected electrical rough in and fixture type, and added electrical locations (post wall finish). In a few cases, due to the stage of construction, artwork had to be relocated as it was too far past rough in to add power, or certain art pieces were removed from the project entirely as they could not be properly illuminated.

The art consultant works directly for the client in an attempt to keep costs down. The electrical requirements for all artwork was thoroughly vetted in the preliminary design phase, and all requirements were made apparent and incorporated into the construction drawings in a timely fashion. Even though Article 7.5 of AIA Document

A145-2015 states that, "the design builder shall coordinate and cooperate with separate contractors employed by the owner," it also says that "any incurred costs shall be borne by the party responsible." The art consultant insured active involvement to avoid incurring any cost associated with misinformation on his end.

Figure 6.3: Art Lighting Adaptations



vi. *Property Manager Driven Garage Casework Changes*

The property manager and client decided late in the project that they would be better off with casework in the garage, rather than surface mounted rack storage as designed by the architect. The original garage finish was stain grade birch plywood with kerfs and reveals/joints to keep with the aesthetic of the rest of the house. This was applied over the one-hour fire rated drywall, and took a significant amount of carpenter's labor to achieve the desired aesthetic. After all that work had been completed, the interior designer added a garage casework package that covered up all the labor intensive carpentry work. If this was communicated previously, the garage drywall would only have needed to be hung and taped to achieve the required fire rating, then left alone until casework installation.

Although there is added cost associated with the garage casework, regardless of timeline, the client was able to recognize the importance of capturing all major changes prior to issuing the design build amendment (which sets forth the terms of the agreement), and consulted the property manager for final comments. The requested casework was added into the construction documents, and the intricate detail work, which would have been covered up by the cabinets, was removed from the project. AIA Document A145-2015 Article 6.1 allows the owner to make additions within the general scope of the contract, but the contract sum and contract time changed accordingly. In this case, as allowed in the contract, the client paid for the cost of the cabinets and installation plus overhead and profit. There was, however, a healthy credit, as the stained birch panels and labor were removed. This helped with the cost of the added casework.

vii. Wine Room Consultant Driven Changes

The architect was instructed by the homeowner to design a wine room shell with the dimensions 15'x15.' The architect designed/specified the wall, ceiling, and floor finishes, as well as the electrical fixture types and locations. The architect also designed the wall and ceiling assemblies, indicating thermal barrier, wall finish, and required insulation R-values. The wine room interior would then be fitted out and finished by a specialty wine cabinet subcontractor. The wine room HVAC system (independent from the main house central air system) would be designed by the wine room cabinet subcontractor's specialty (HVAC/refrigeration) consultant. There is little communication during preliminary and schematic design, other than indicating the square footage required to successfully house the homeowner's collection.

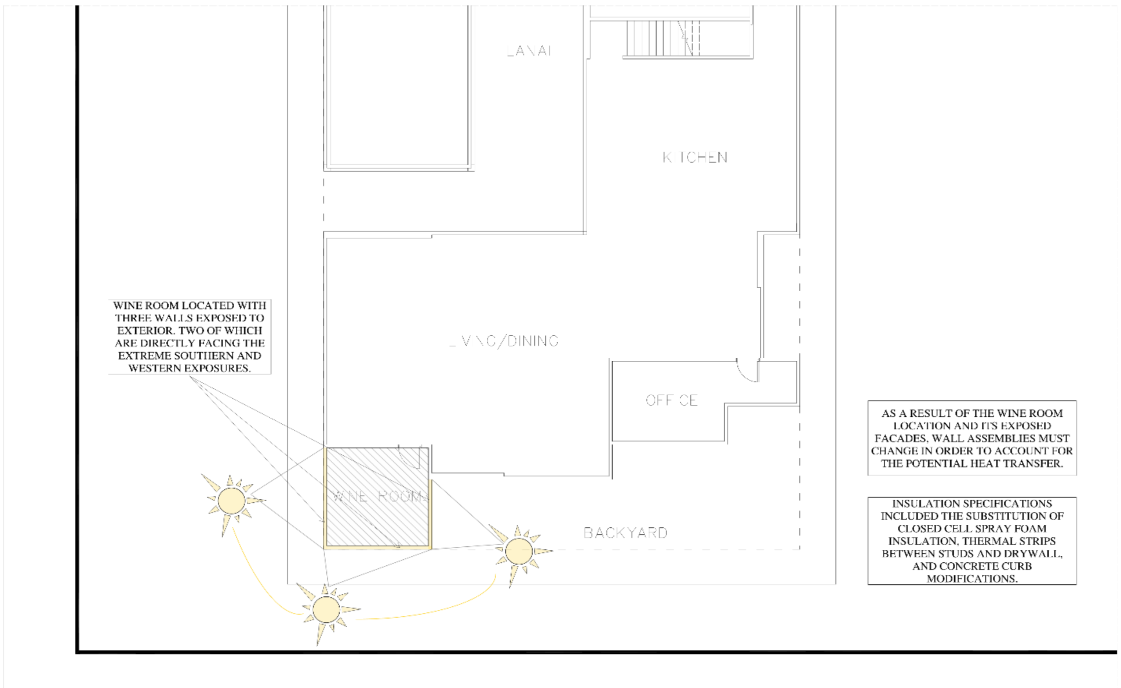
Not knowing the potential problem it would cause, the architect located the wine room with three walls exposed to the exterior. As a result, this required the wall assembly to change to account for the potential heat transfer from the aggressive southern and western sun. The changes included batt insulation changing to closed cell spray foam insulation, stud framing required thermal strips to be installed prior to drywall, and the concrete curb insulation being modified to accommodate the potential heat transfer.

Also, the proximal sliding doors which, when opened, can increase interior temperature and humidity drastically. This can cause large amounts of heat and moisture transfer at the wine room entry door — a temp of 53 degrees in the wine room, and potential temperatures of 75-90 (depending on the time of year) in the living/dining room when sliding doors are opened.

The timetable for both of these, especially the HVAC design, came far too late in the process. This lead to chipping of concrete curbs to accommodate refrigerant line sets as the concrete foundation had already been poured. This also led to change orders incurred by the homeowner for the altered wall assembly, as the closed cell spray foam insulation and thermal strips added a significant cost to the budget.

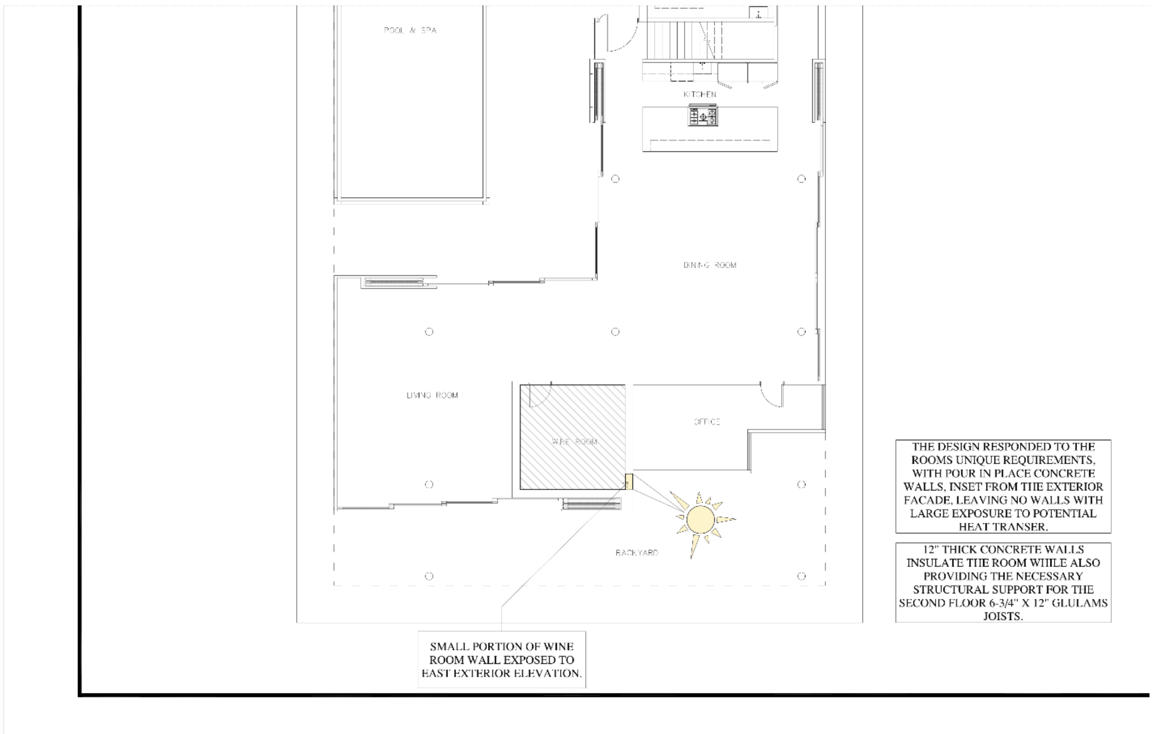
Unbeknownst to the architect, the value of the client’s wine collection required backup support systems for the insurance company to hold the policy. These support systems included a 22K watt emergency natural gas/diesel generator, and a redundant HVAC system. Redundant, in this case means, two completely independent HVAC systems service the same 15’x15’ room; in case one goes down, the other can be engaged to run as long as necessary until the other is repaired.

Figure 6.4: Wine Room Exposure Issues



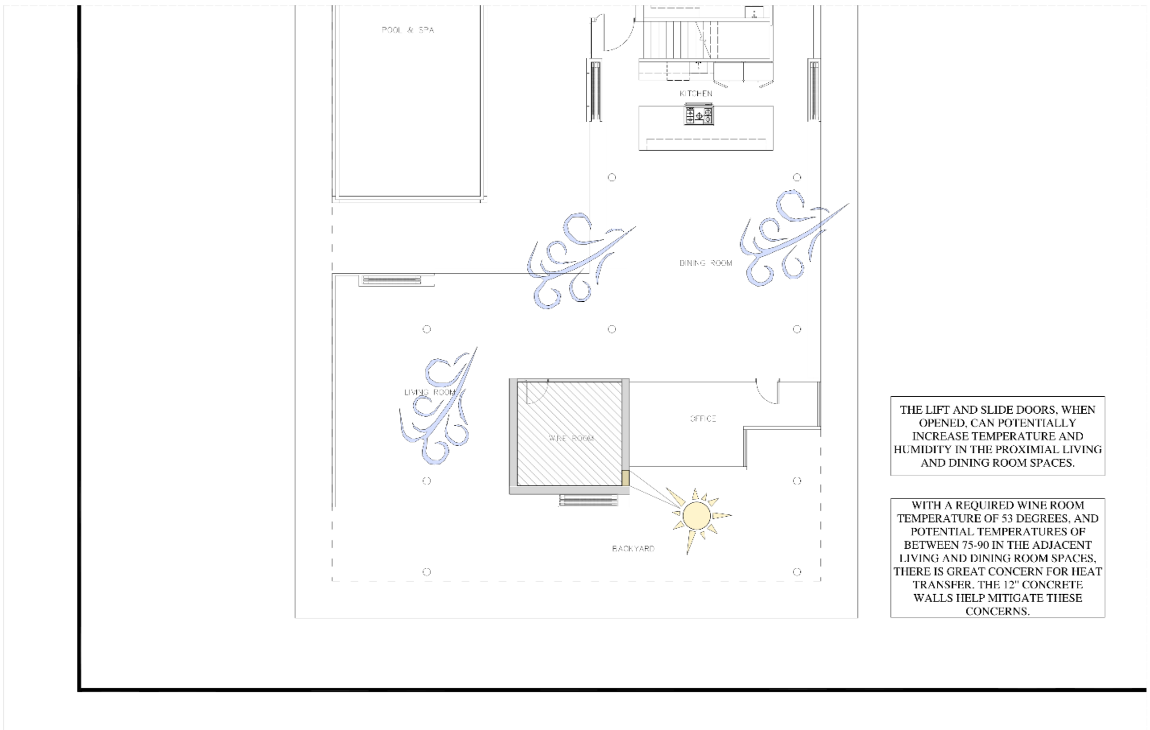
Much attention was paid to the location and wall makeup for the wine room. In order to actively involve his consultant, the client made apparent the importance of the wine room in the predesign, or owner's criteria phase. Article 4.1 of AIA Document A145-2015 allows the client to include detailed design requirements for the project, physical desired characteristics, and budget and projected milestone dates. As a result, the design responded to the room's unique requirements, with pour in place concrete walls and inset from the exterior façade, leaving no walls exposed to large potential heat transfer. The concrete not only insulates, but provides structural support for the 6-3/4"x12" glulam beams supporting the second floor, and creates a unique aesthetic/ focal wall in the living room and master bedroom.

Figure 6.5: Wine Room Exposure Reduction



The backup support systems required by the client's insurance company to hold the policy for his collection was made available early on in the project. This allowed the HVAC design build consultant to work directly with the specialty wine HVAC subcontractor to design compatible whole house and wine room systems.

Figure 6.6: Wine Room Heat Transfer Issues



2. **Impacts to the project as a result of Design-Bid-Build architect's inability to make thoroughly understood constructability decisions, due to a minimal understanding of the associated cost, fabrication, installation, and lead time implications**.

   i. *Terne Coated Stainless Steel (TCS2) Edge Metal Timetable*

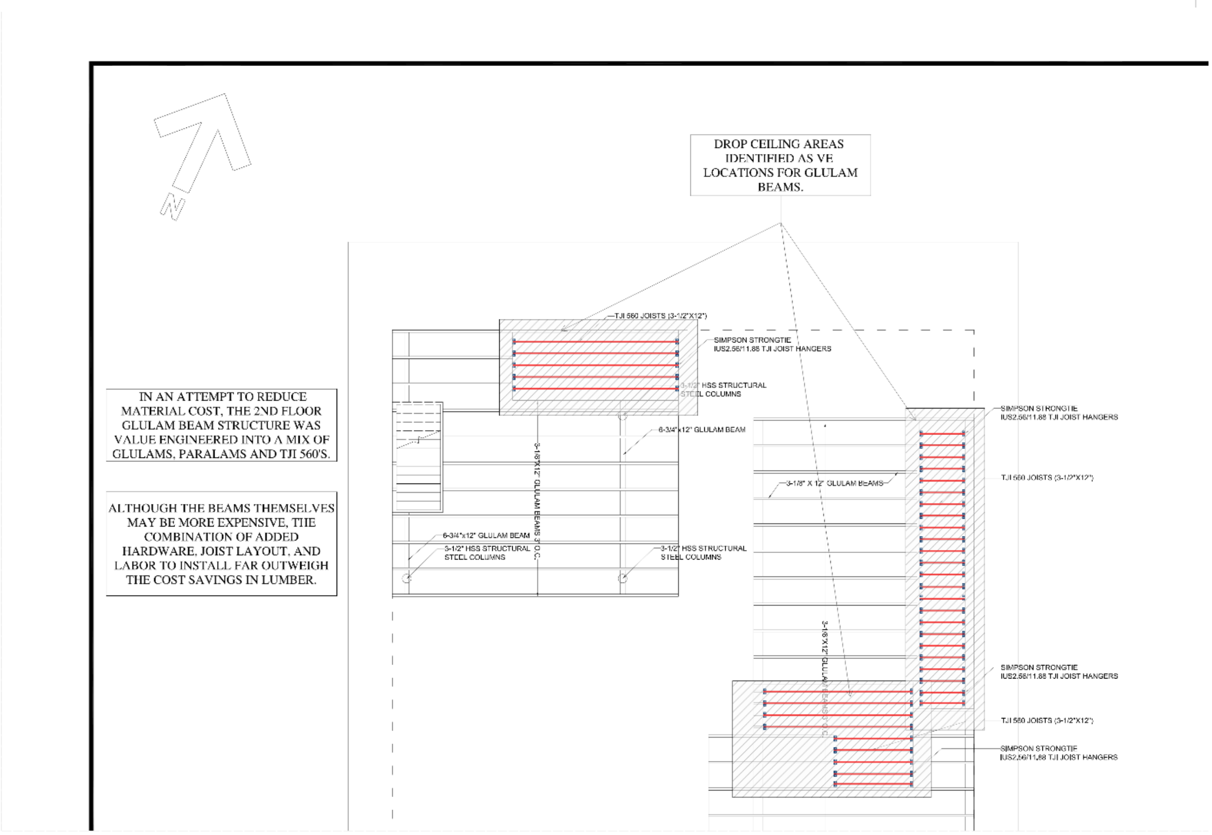
   The architects did not release the flashing and trim specification until late in the project. As their suggested vendor was too expensive, the roofing subcontractor tried to source it cheaper for the client. This process involved product data and physical sample submittals to make sure the correct material was sourced. This timeline stalled window and roof installation, as the window flashing and roof edge metal could not be installed, neither could the doors, windows, or roof sheathing. The final approved sample was sourced from a vendor in France since TCS2 is a rare metal. The lead time was 14-16 weeks via expedited ocean freight. As this would cause the project to stop until the trim arrived, the general contractor ended up air freighting twenty, four by ten sheets, which was enough material to keep the roof and window installations from stalling. The air freight, however, was exorbitantly expensive, and added a substantial cost to the project.

As sequencing is critical to a design build construction project's success, the design build architect released all project specifications when the construction documents were released. The first line item in Article 5 of AIA Document A145-2015 states that, "Upon the execution of the design build amendment, the design builder shall prepare the necessary construction documents, including drawings and specifications." In comparison, the standard design-bid-build contract, AIA Document B101-2017 Standard form of Agreement between Owner and Architect, specifies in Article 3.4.1 Construction Documents Phase Services that the architect must also provide detailed specifications setting forth the quality levels and performance criteria. That being said, these are often preliminary specifications, as detailed specifications are not required for building permit, and often fall to the wayside to make room for adjustments and design changes prior to beginning construction. The design build architect ensured that all specifications, including flashing and trim, were comprehensive enough as to not impact scheduling or sequence of construction negatively.

ii. Unsuccessful Value Engineering

Since the scheme calls for dropped ceilings in the garage and other utility areas, the designer's value engineered the floor structure. The original design called for the use of all 6-3/4"x12" glulam beams for the entire floor structure. In an attempt to lower material cost, the designer's value engineered these areas to a mix of paralam beams and TJIs. Ultimately, although the material is cheaper, the time involved in layout, the required hardware (hangers, straps, uplift ties, etc.), and the labor to install the value engineered system is far more expensive and time intensive than using the glulams themselves.

Figure 6.7: Framing VE Layout



As the design build architect and his team understands the implications of value engineered material changes, there was never any attempted value engineering. This saved significant billable hours in both the architect and subcontractors' offices for the value engineering effort itself, as well as money and time in the installation of the glulam joists. It takes the foresight and understanding of a design build architect to see that the money saved in time involved in layout, the required hardware (hangers, straps, uplift ties, etc.), and the labor to install the value engineered system material far outweighs the amount saved in material.

iii. Photovoltaic & Solar Hot Water Panel Locations on Roof

In the construction documents, the architects arbitrarily located the solar hot water and photovoltaic roof panels in the center of the large main house roof. During the construction phase, the client asked the architect to maximize the allowable panel count to increase the solar energy available for the home. The architect conceded, noting that this would be done as long as the panels were not visible from below, so as to maintain a clean roof edge profile. Although this was communicated to the solar subcontractor, when the field team installed their panels, many were visible from below. This then caused the perimeter panels — 34 in all — to be removed around the entire building. That amounted to a loss of tens of thousands of kilowatt hours per year that could have been supplying the home, or stored on site in the battery backup system.

Prior to installing the finished roofing, the solar subcontractor installed rail stanchions for the photovoltaic and solar hot water panels. This was done to alleviate any roof

penetrations after the finished roof membrane had been installed, maximizing water tightness. These were strategically laid out as a team with the design build architect and solar subcontractor. Taking into account optimal angles for solar gain, the team laid out the panels in order to maximize the available square footage, while maintaining the clean roof edge from below. The solar hot water panels were also strategically located above an electrical and plumbing chase to minimize run length from the panel to the hot water storage heaters. The design team also actively involved Hawaiian Electric Company (HECo) in order to anticipate any design or performance issues, and to keep current with the ever changing local photovoltaic requirements.

3. Impacts to the project as a result of poorly performing designs or specifications.

i. Fixture & Appliance Performance

Plumbing fixtures and certain appliances (dishwasher and washer/dryer) did not perform to client standards. The architect chose them primarily for their aesthetics, rather than their performance. Some of the client's issues with fixtures included unsatisfactory temperature ranges and weak pressure. The dishwasher, for example, presented a problem, as the dishes were still wet after running the dry cycle. The main issue was with the specific fixtures themselves. As previously noted, the fixtures were chosen primarily for modern aesthetic, and was sourced out of Europe. The client was not aware of the different energy requirements in Europe, which require lower flow and lower temperature mixing valves and shower heads. To rectify the problem, the plumbing subcontractor removed all backflow preventers, and manually increased the temperature ranges to appease the client. However, this voided the product warranties, since they were now modified, and caused other performance downsides to the adjustments that were made. This could have been prevented with more active involvement on the client's end, although that is not necessarily encouraged in the traditional design-bid-build delivery model. After preliminary design and client approval, owner involvement in finishes tends to be fairly minimal.

As the client was very particular about personal comfort, the design build architect encouraged the client to personally select fixtures and appliances based on previous experience and suggestions from the specialty plumbing supplier. The design build architect set forth a suggested finish and style of fixture and appliance, but left the choice up the client. The plumbing supplier also actively involved the client with a tour through the showroom, and allowed the client to experience the showroom's mock bathrooms. This allowed the client to try various bathroom fixtures prior to purchasing.

ii. Exterior Siding Stain & Sealer Performance

The architects specified a low strength matte finish for the already fragile cedar siding. This finish performed poorly, allowing staining and marking throughout the course of construction. In fact, it actually required the entire exterior to be refinished a second time before turning over to the client. The product was specified by the architect as they had previously used it, although in a less aggressive environment. In the aggressive coastal environment of windward Oahu, the finish did not stand up to the elements.

The design build team chose a more appropriate finish for the western red cedar siding on the project for two reasons: (1) to provide the client quality and longevity, and (2) as the design build contractor, they are held liable for warranty. Article 5.4 of AIA Document A145-2015 states that, "the design builder warrants to the owner that: (1) materials and equipment furnished under the contract will be new and of good quality; (2) the work will be free from defects not inherent in the quality required or permitted by the design-build documents; (3) the work will conform to the requirements of the design build documents." The design-bid-build model, namely AIA Document B101-2017 Standard form of agreement between Owner and Architect, has no warranty requirements on the architect's behalf, as all warranty is placed on the general contractor and subcontractors. Designing with function and performance in mind is a necessity for a design build architect, whereas a design-bid-build architect is more likely to transfer blame to the subcontracted party.

iii. Lift & Slide Door Water Intrusion Performance

The architect's design required that there be no thresholds/elevated sills at the lift and slide doors. This is for the desired aesthetic of open living/seamless coplanar transition from interior to exterior stone when the doors are in the open position. Without an elevated threshold/sill, however, heavy wind driven rain causes large scale water intrusion at the west façade. Although the door manufacturer indicated in his shop drawings that these doors would not be warrantied for water intrusion, due to the lack of threshold, the client's representative approved the design, since the client valued the architect's design, and figured it would not become a problem. Water intrusion has been an issue on more than ten occasions since the homeowner's occupation. Architect redesign is now happening to solve the problem without replacing the door system.

The design build team brought in the door manufacturer early in the design stages in order to successfully achieve the same desired detail, a coplanar/seamless transition between interior and exterior stone. Since the design build contractor is liable for warranty, per Article 5.4 of AIA Document A145-2015, there had to be a concrete solution in place. Again, the design-bid-build model has no warranty requirements on the architect's behalf; all warranty is placed on the general contractor and subcontractors. The design build architectural team was able to incorporate a linear trench drain the length of the doors, which would not visually disturb the stone, but provide an outlet for pooling water. Designing with function and performance is a necessity for a design build architect, especially when it comes to waterproofing and water intrusion.

Figure 6.8: Water Intrusion Issues

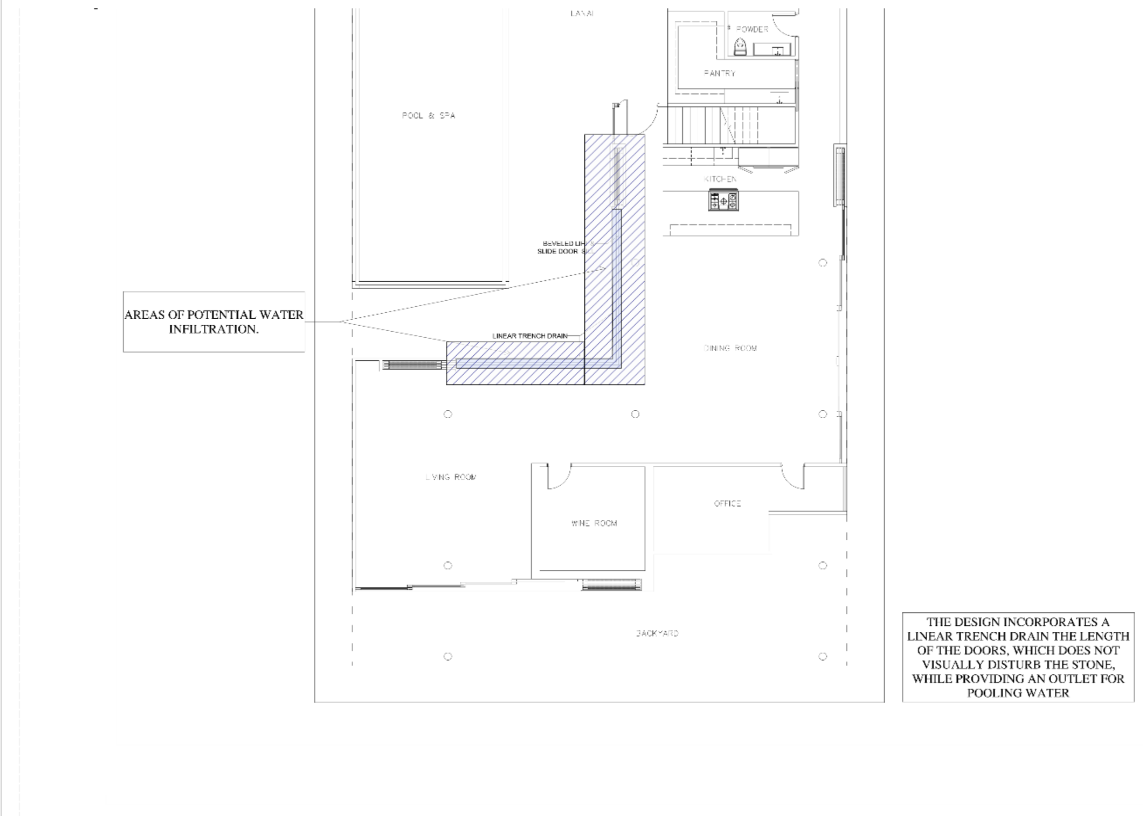
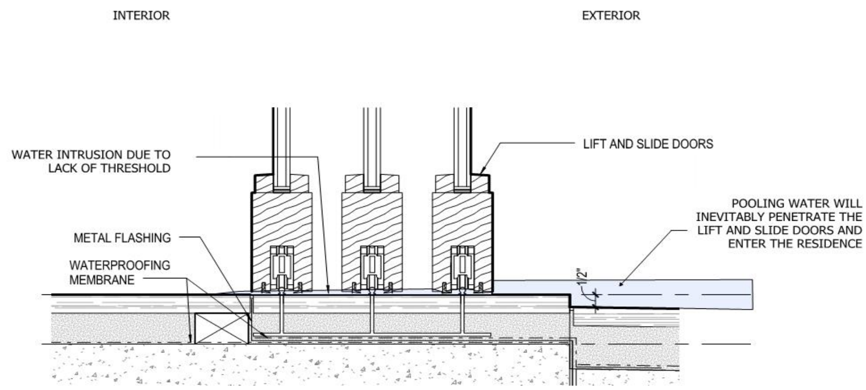


Figure 6.9: Water Intrusion Issue Detail



Appendix

I: Site Analysis

Figure 5.1: Site Location: Kahala, Oahu

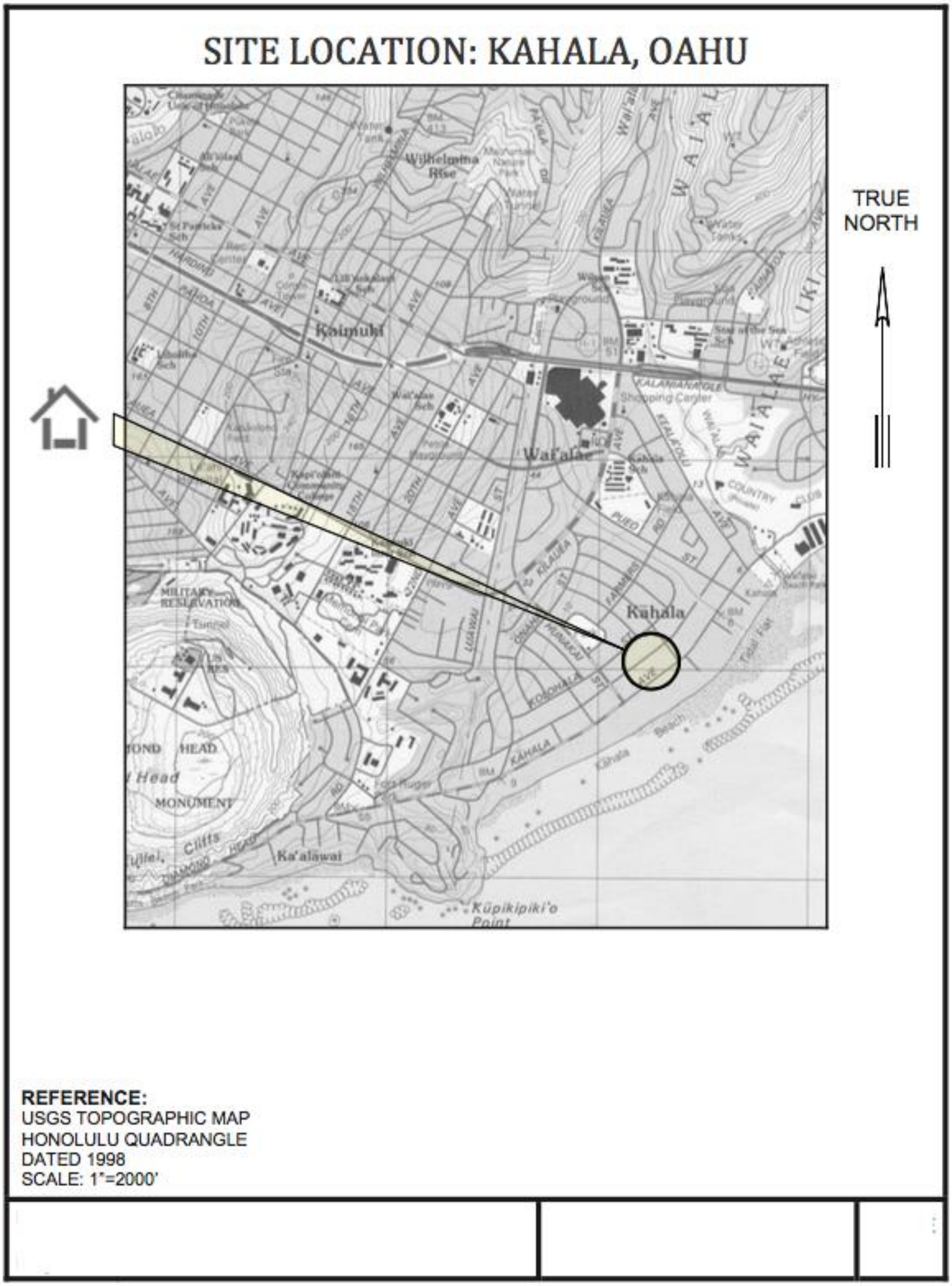


Figure 5.2: Potential View Planes

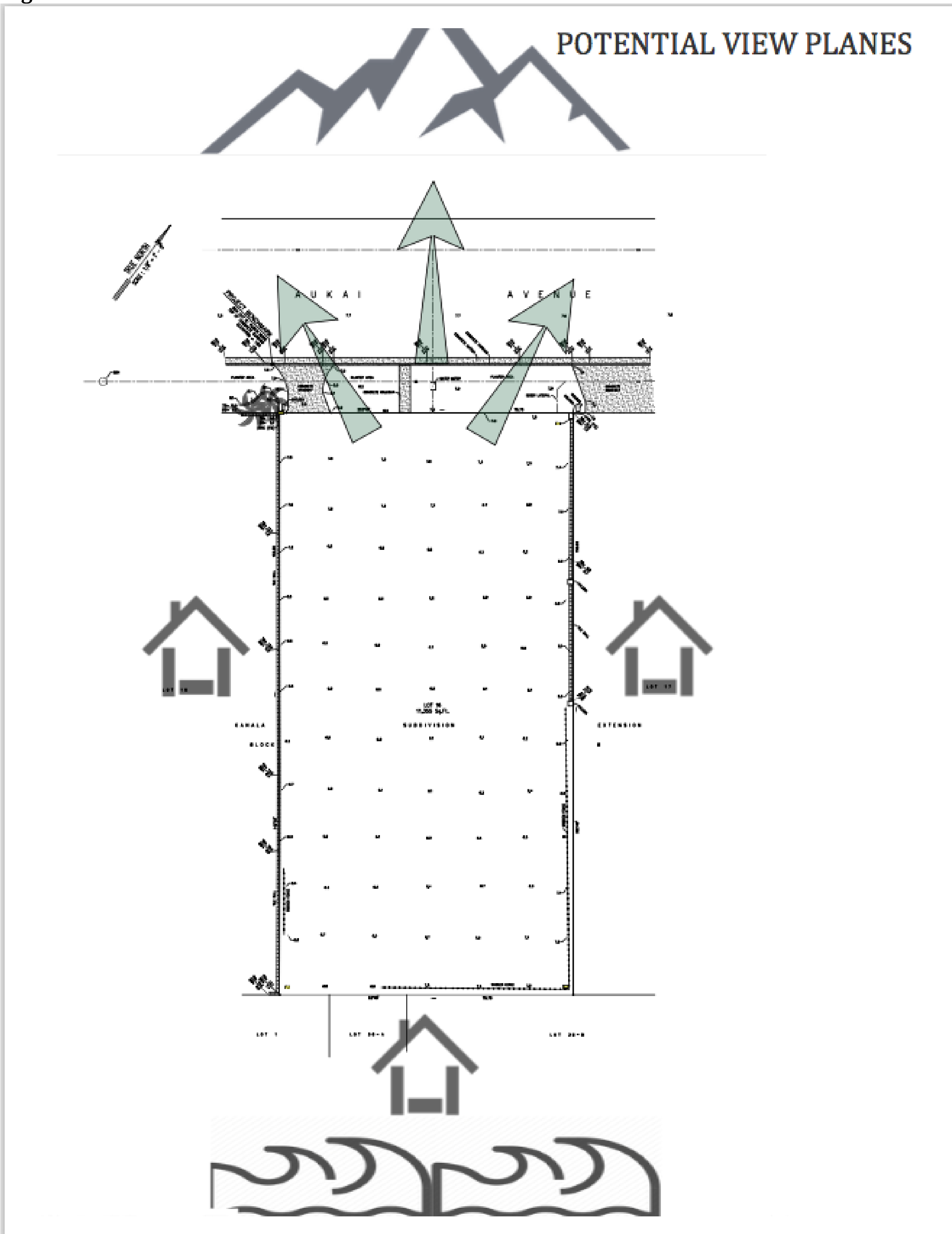


Figure 5.3: Predominant Tradewind Direction

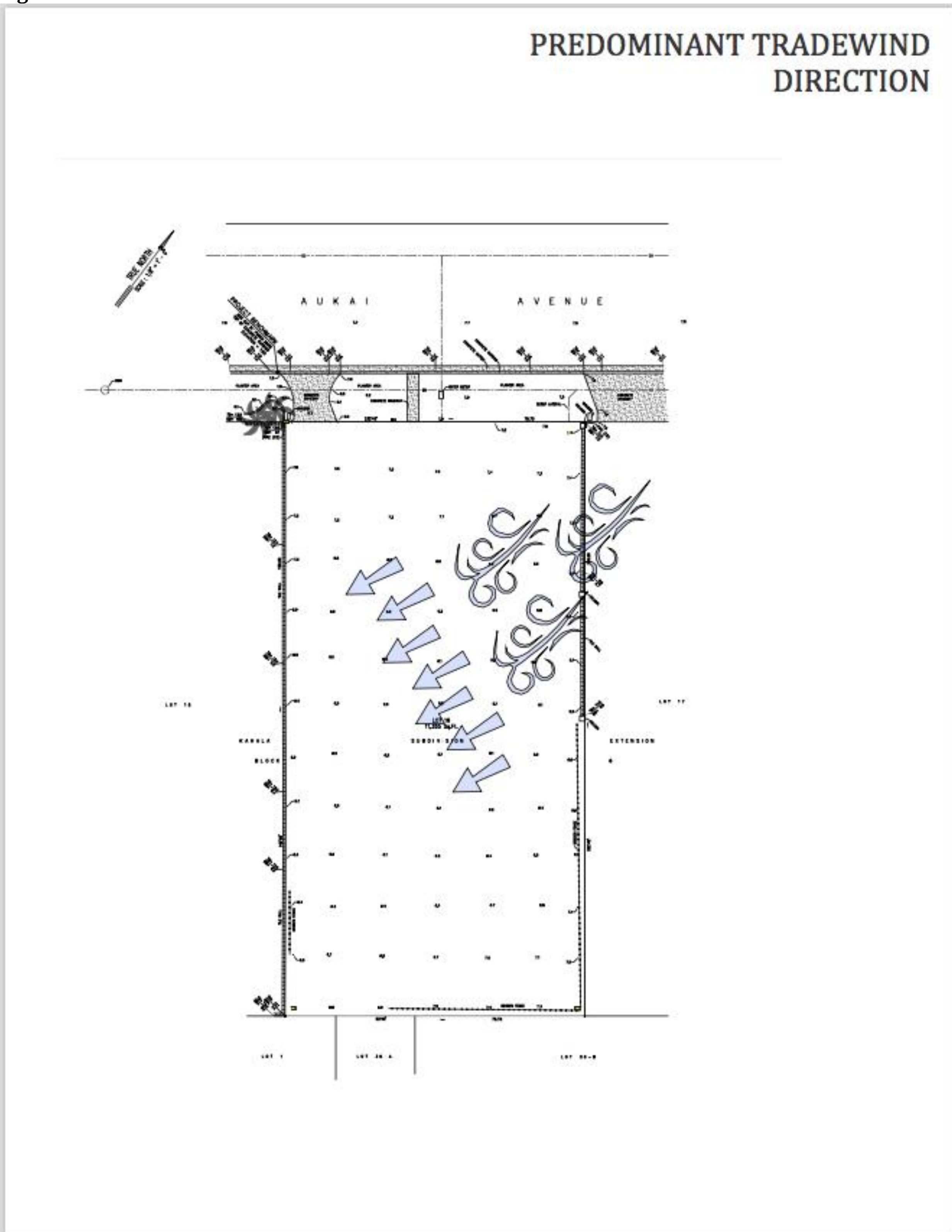


Figure 5.4: Sunpath

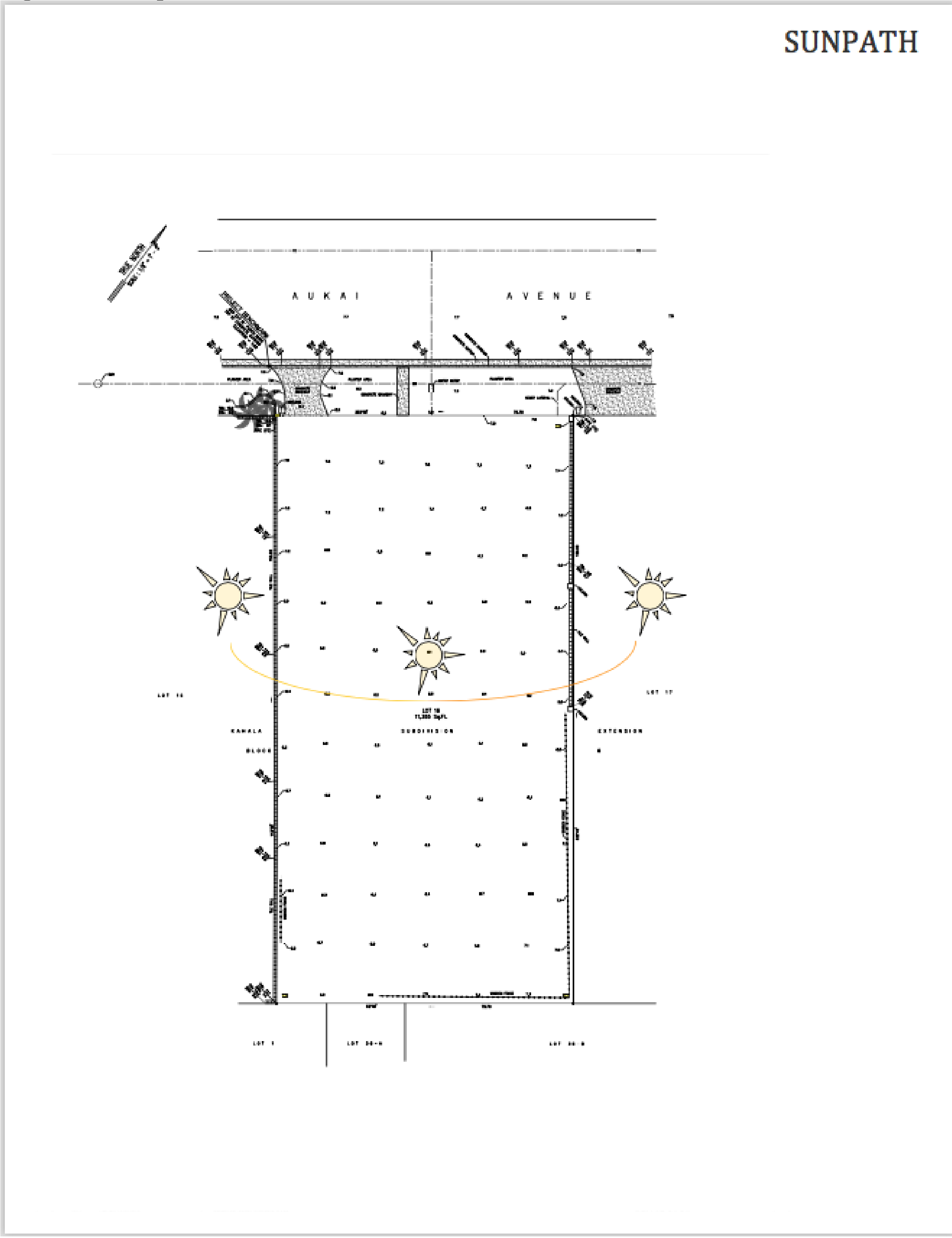


Figure 5.5: Existing Utility: Points of Connection

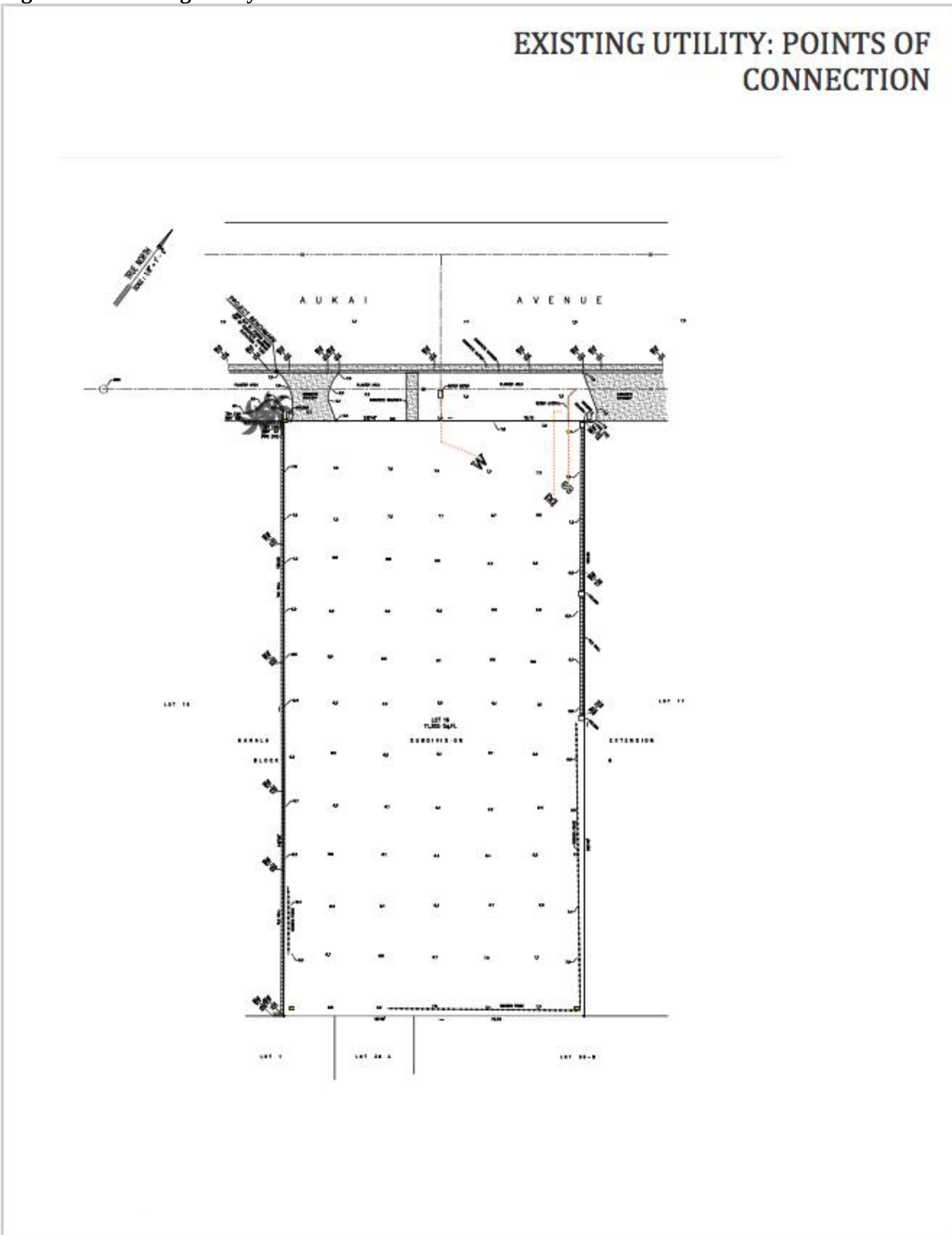


Figure 5.6: Building Setbacks

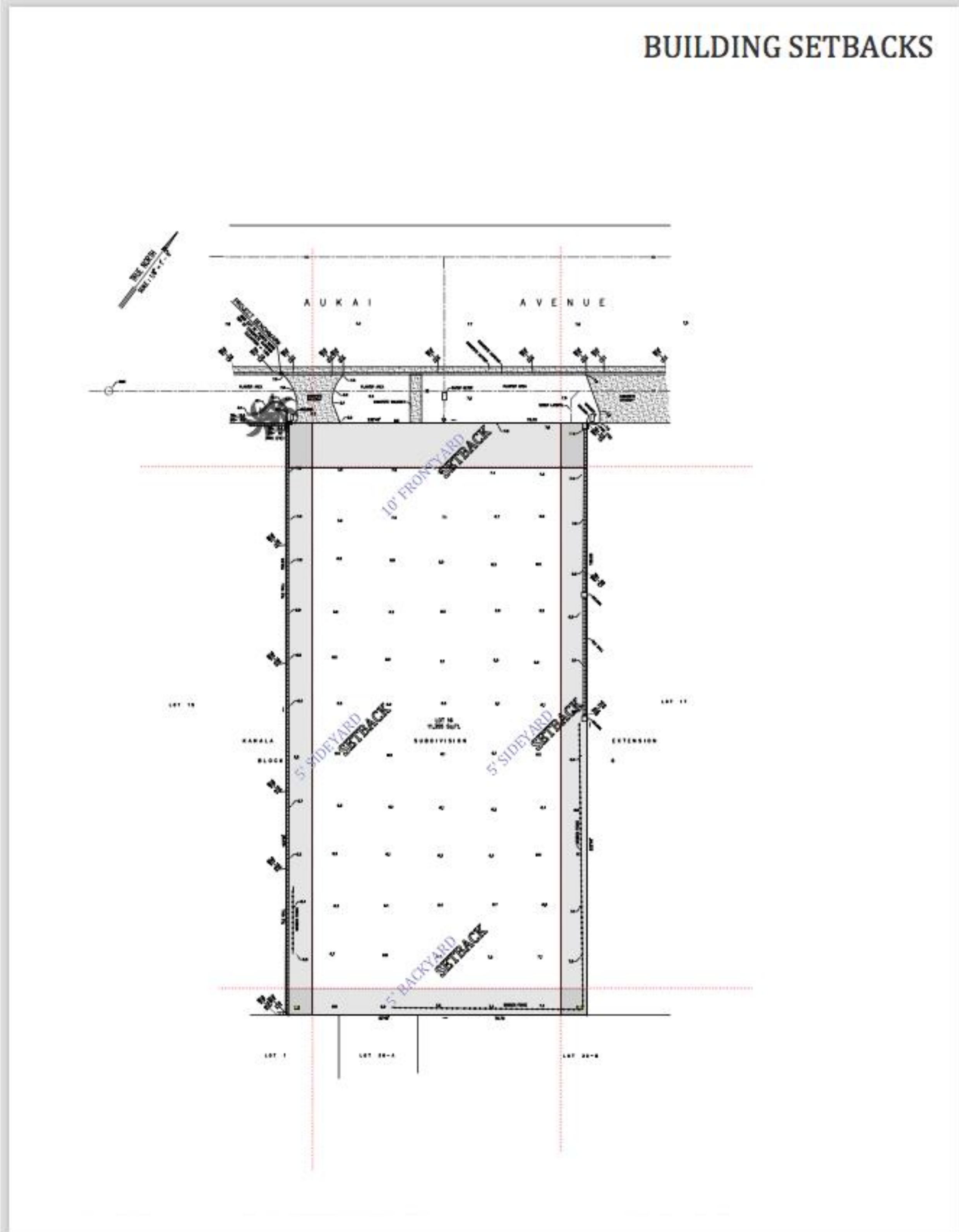


Figure 5.7: Information Overlay

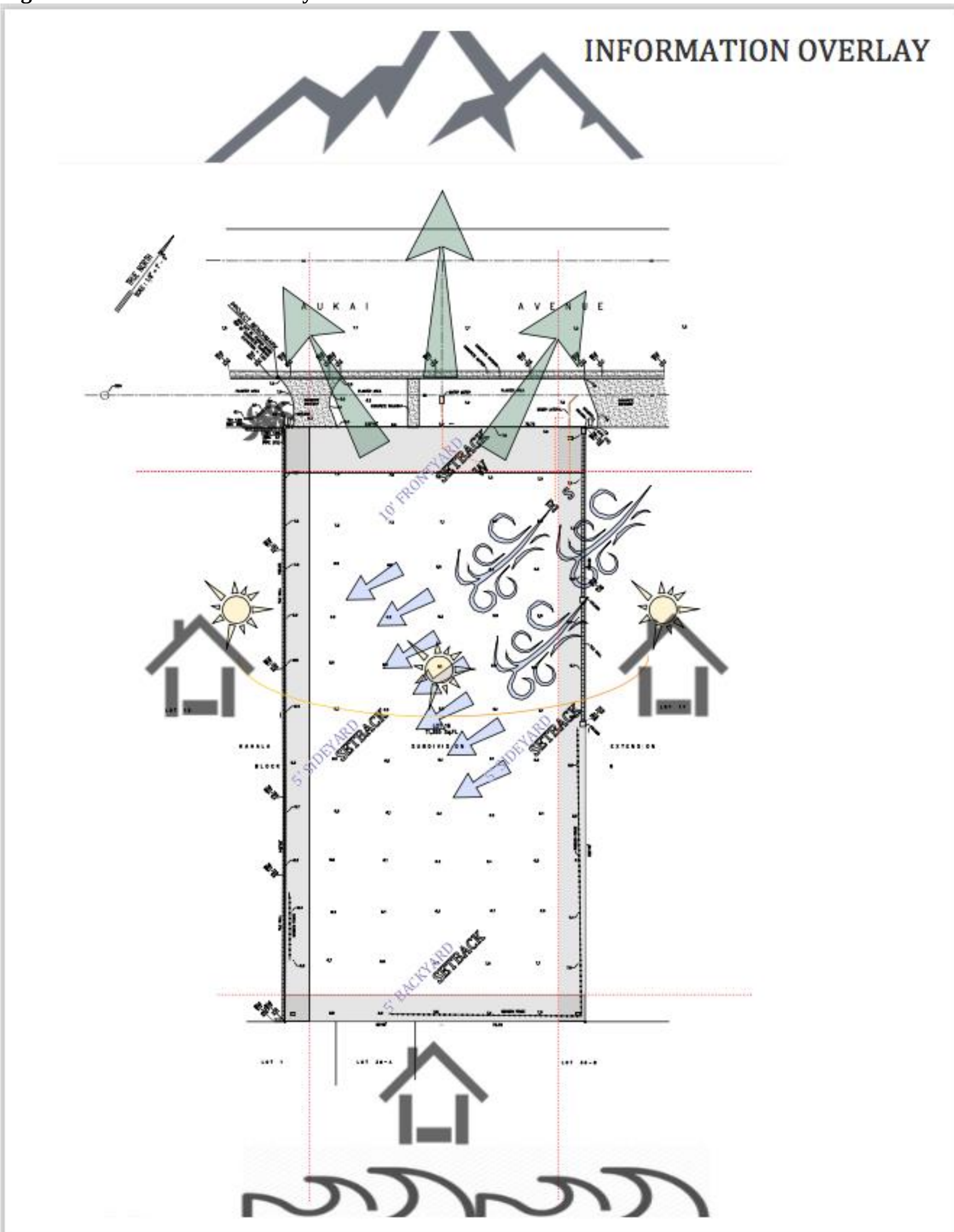


Figure 5.8: LUO: Building Envelope

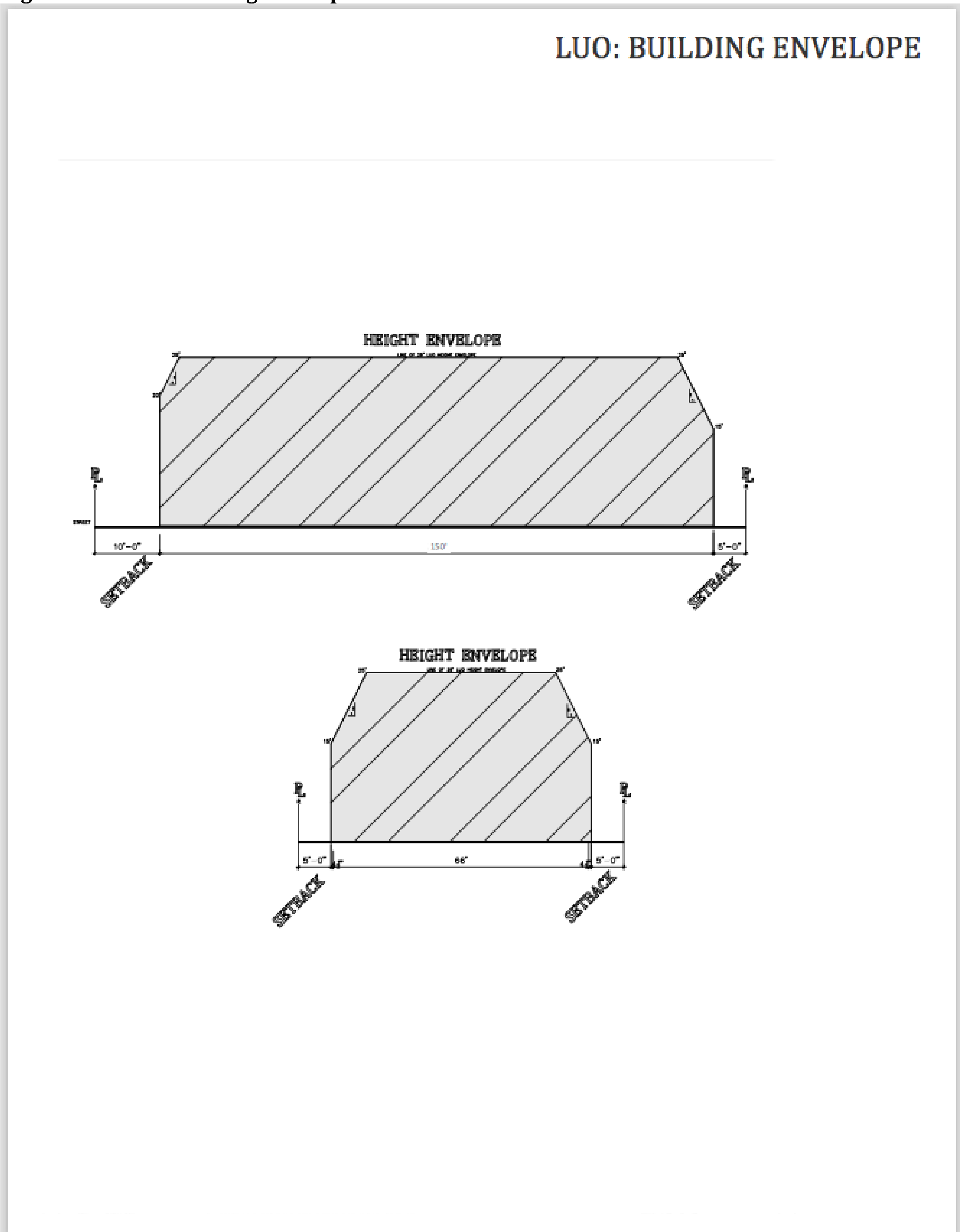


Figure 5.9: The Client's Desires

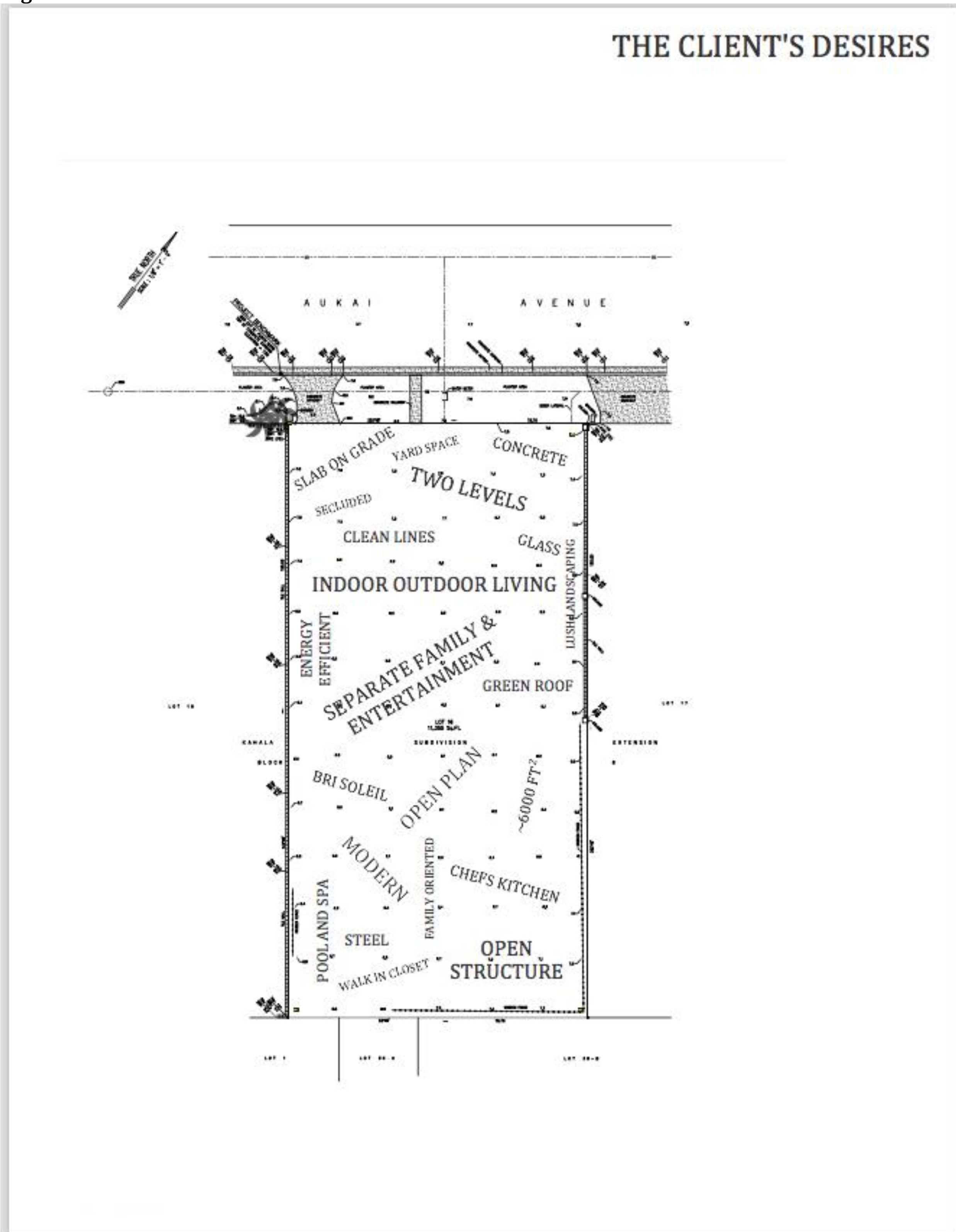


Figure 5.10: Program: First Floor

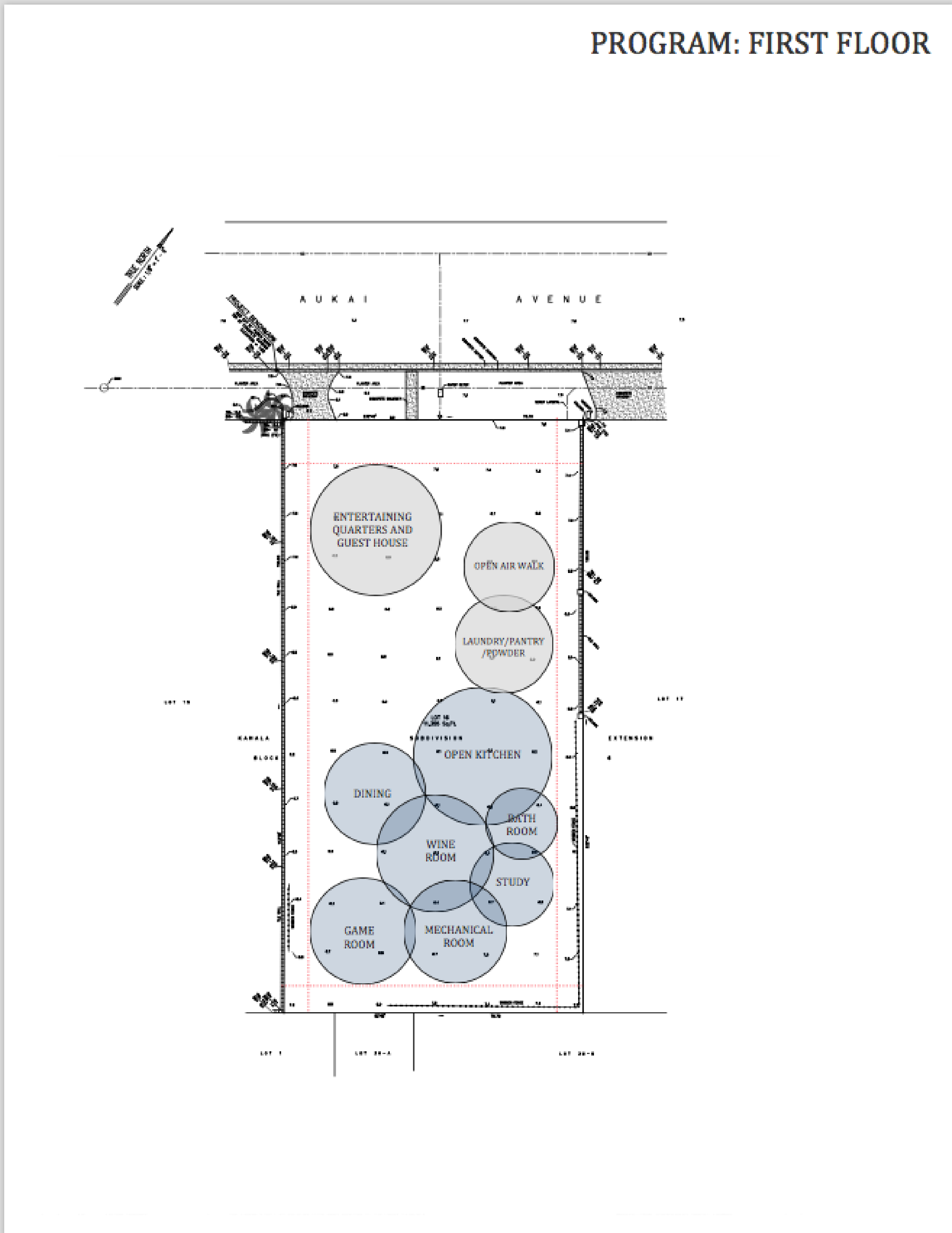


Figure 5.11: Program: Second Floor

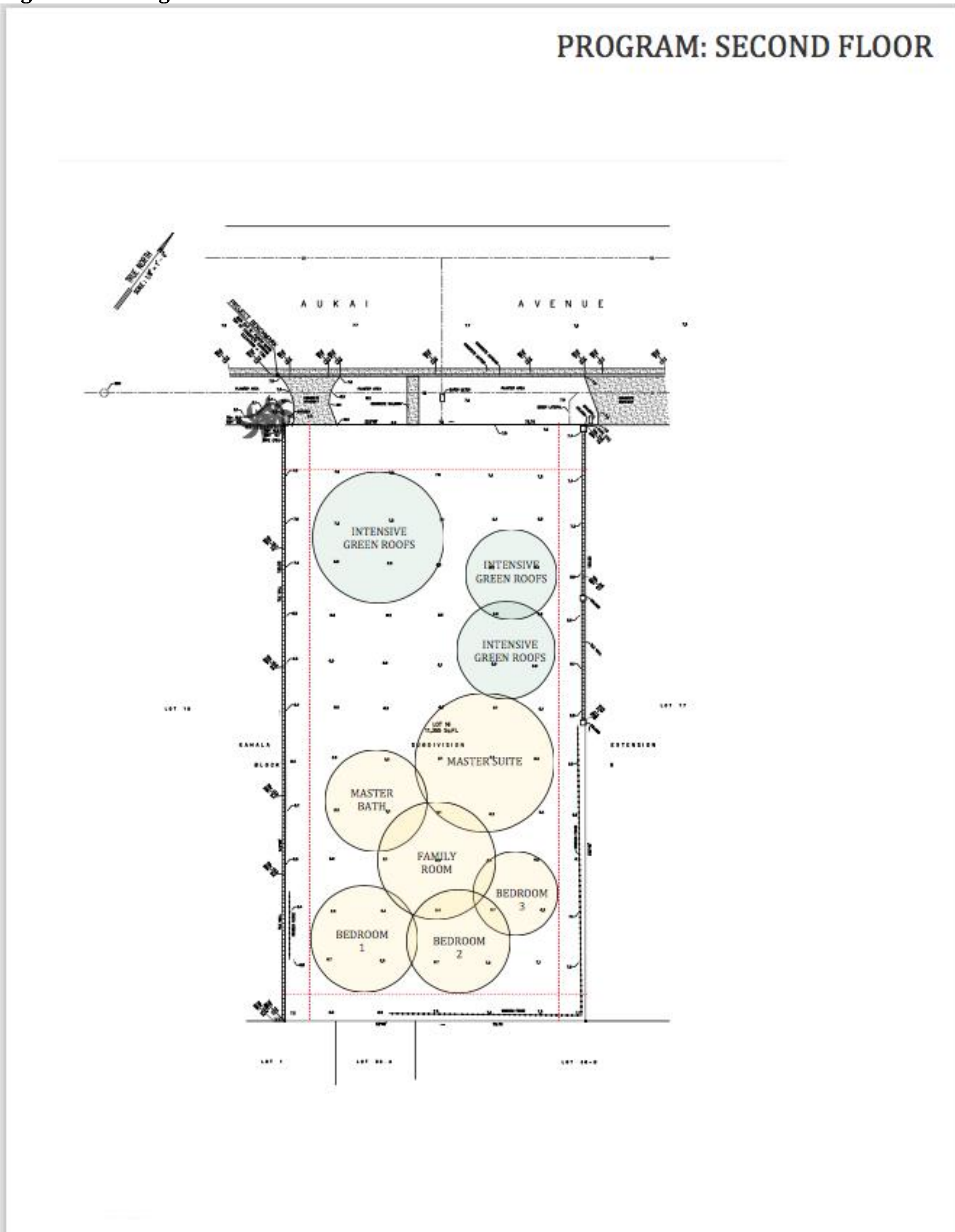


Figure 5.12: Program: Landscape

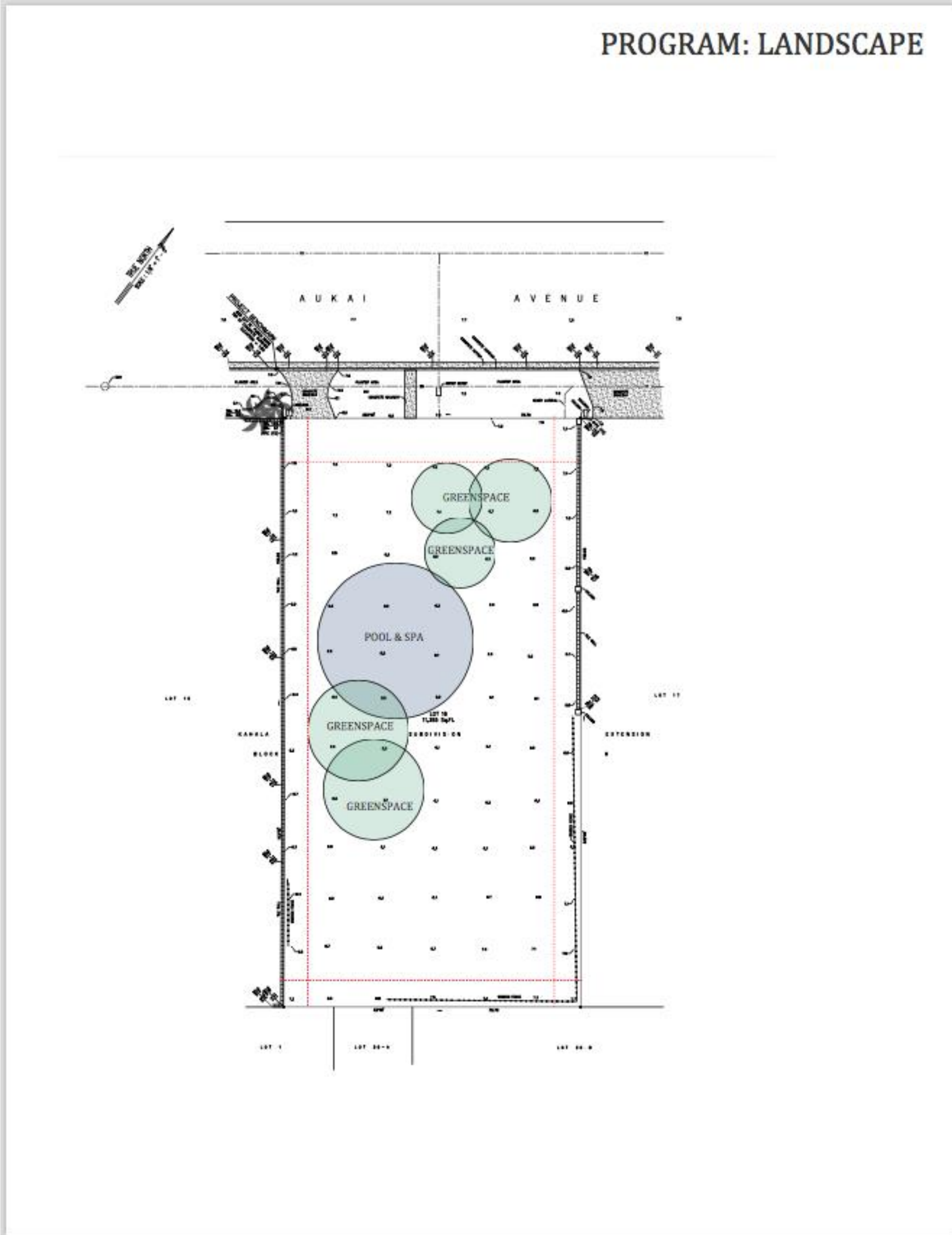


Figure 5.13: Program: Exterior East & North Elevations

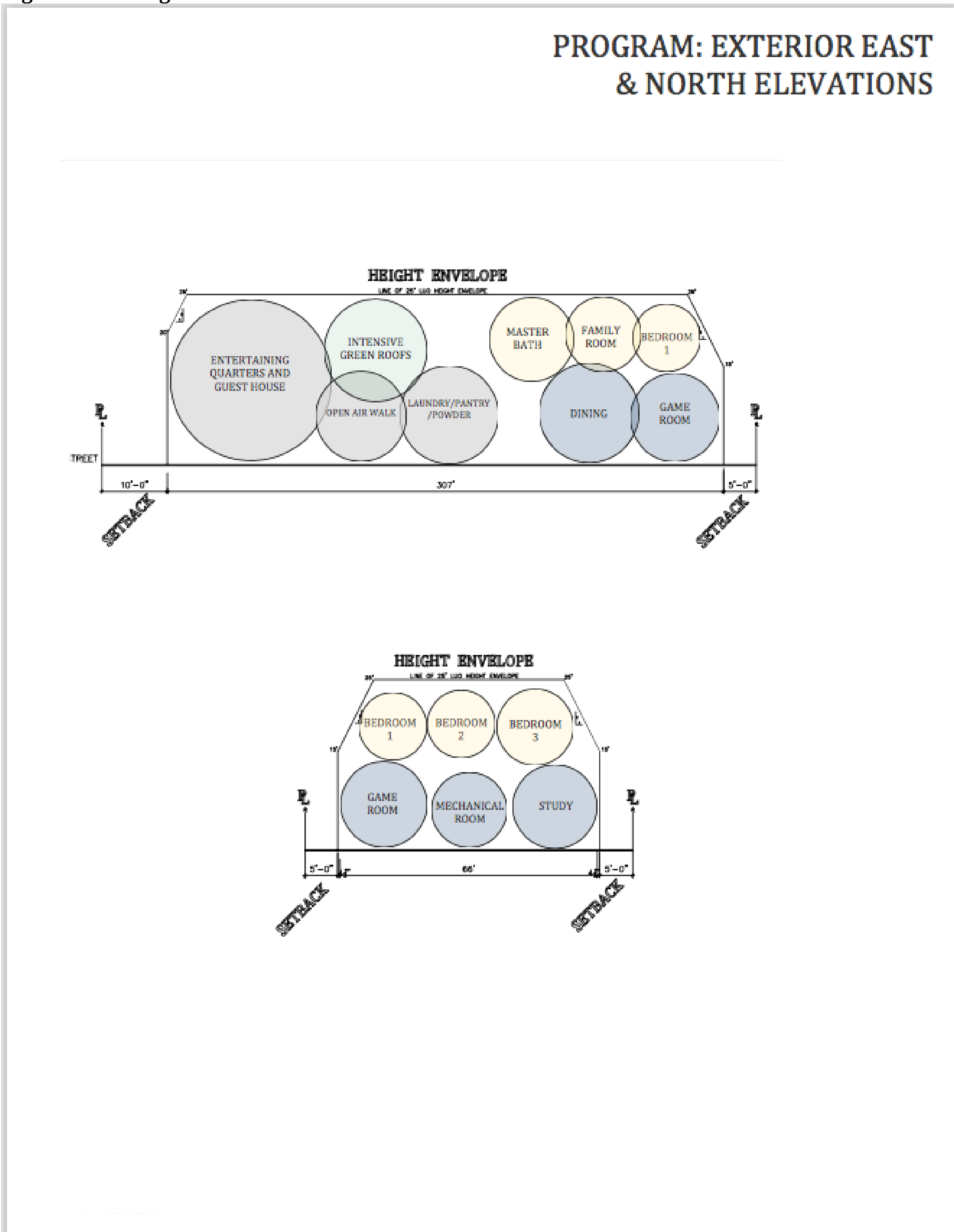
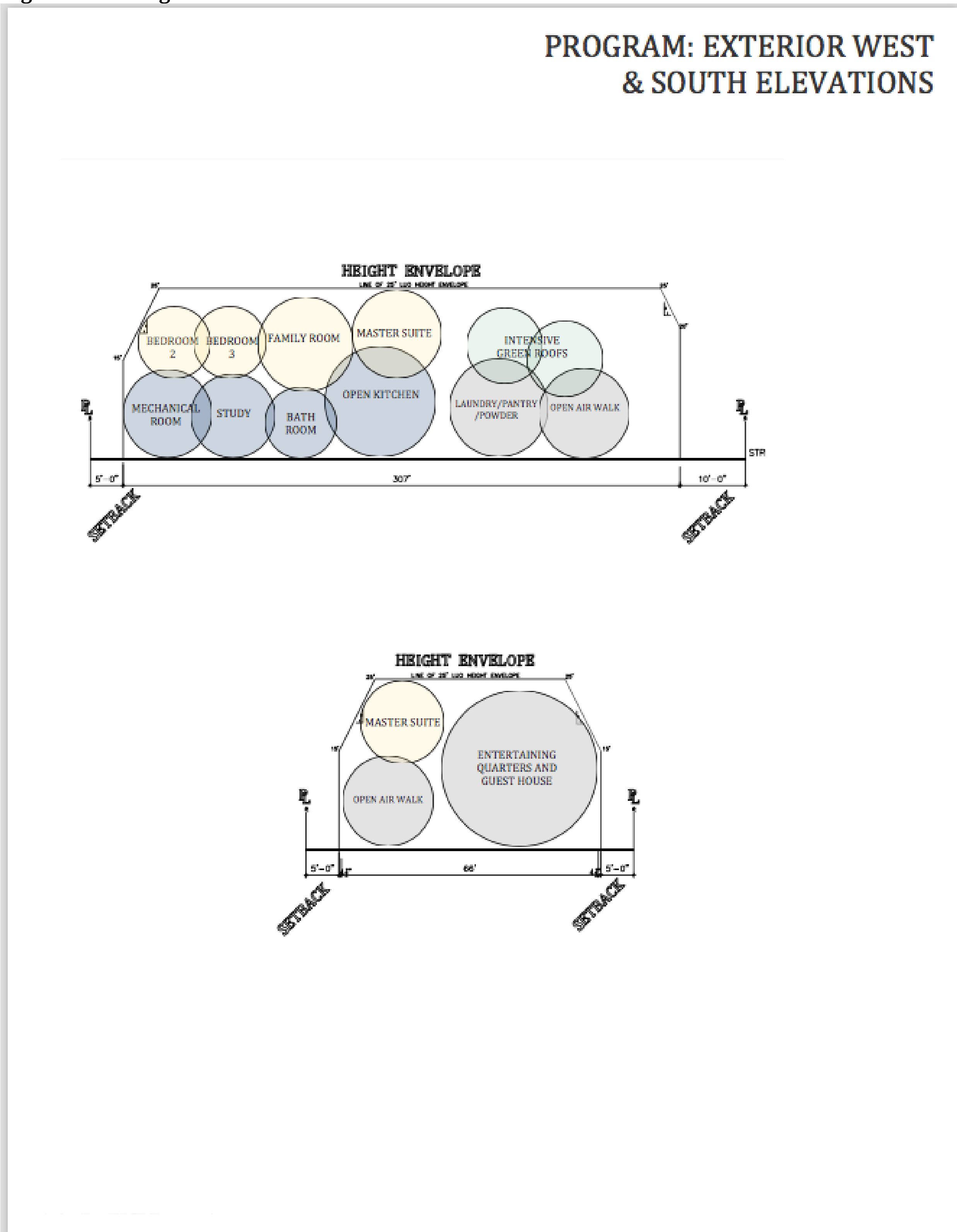


Figure 5.14: Program: Exterior West & South Elevations



II. Design I Proposal

Figure 5.15: Design Proposal I: Site Dimensions

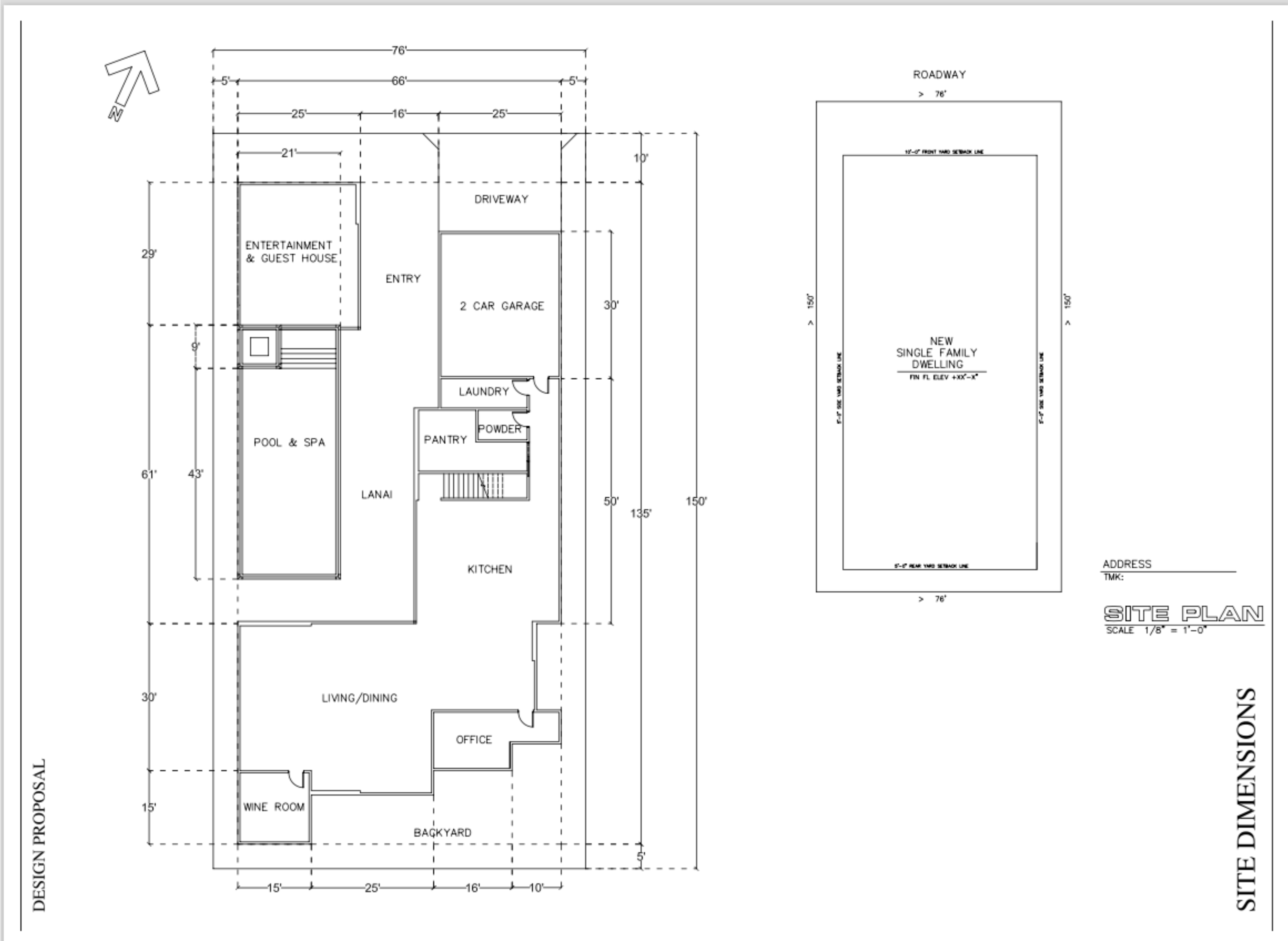


Figure 5.16: Design Proposal I: First Floor Plan

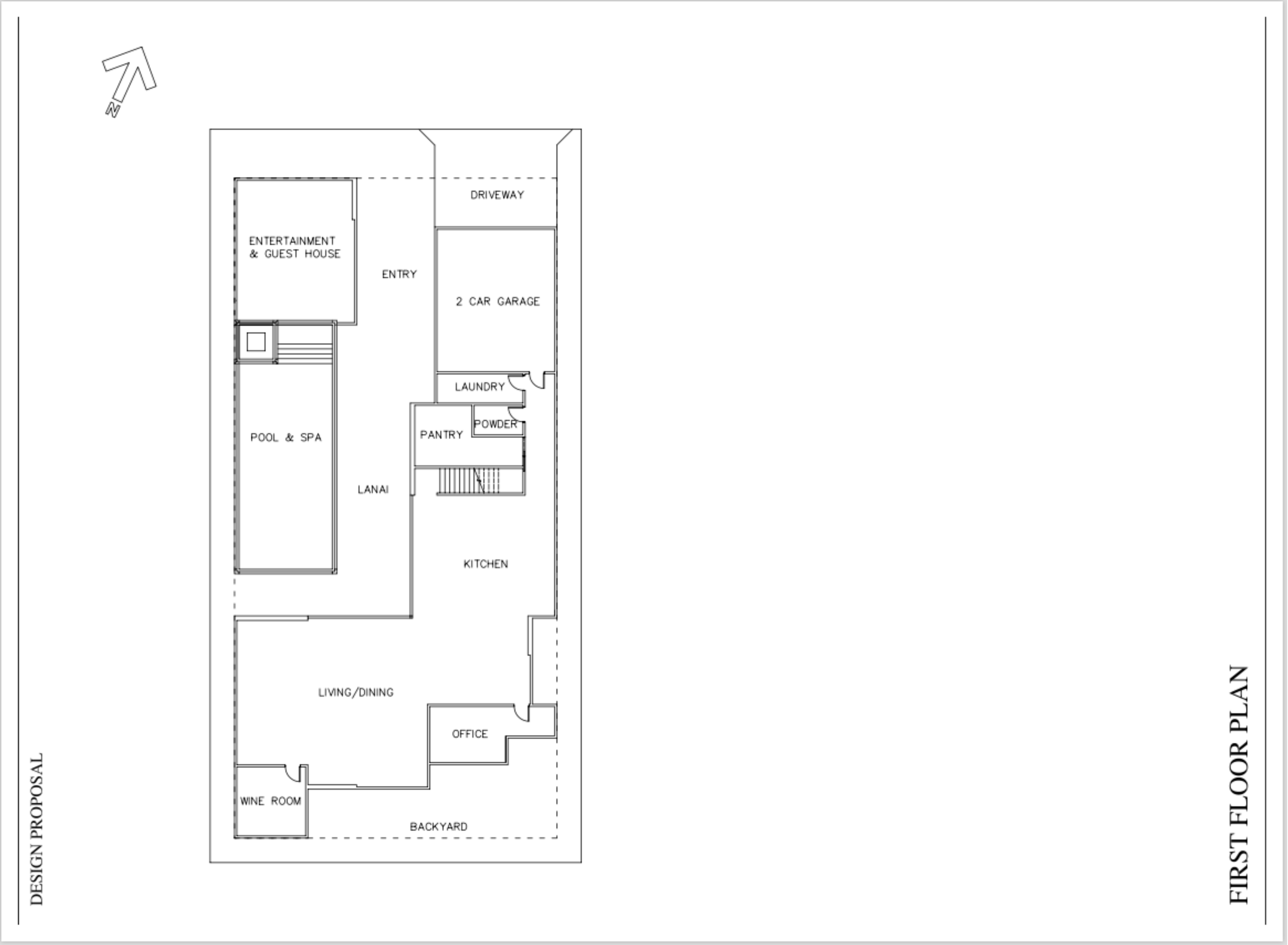


Figure 5.17: Design Proposal I: Second Floor Plan

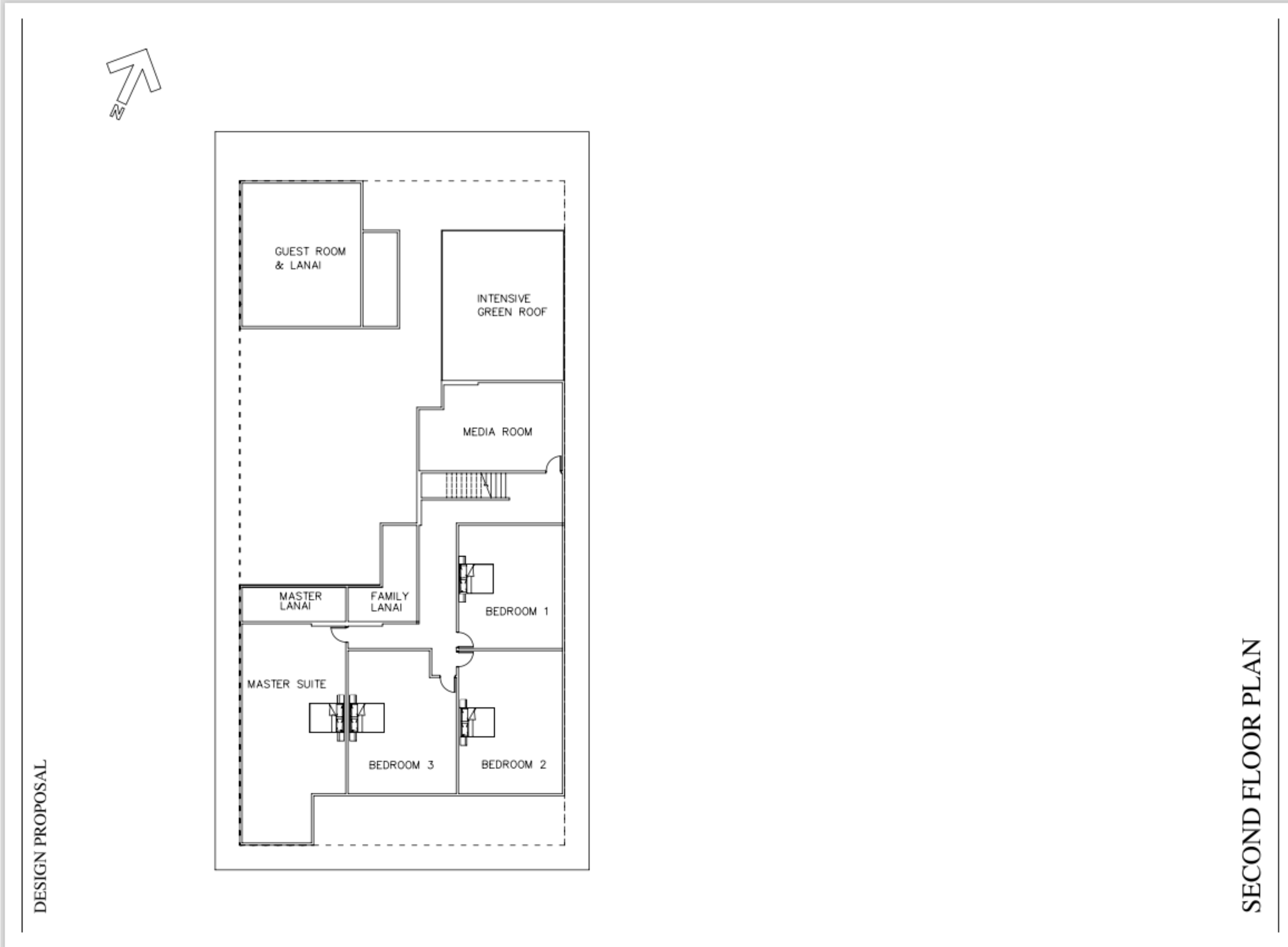


Figure 5.18: Design Proposal I: Second Floor Dimensions

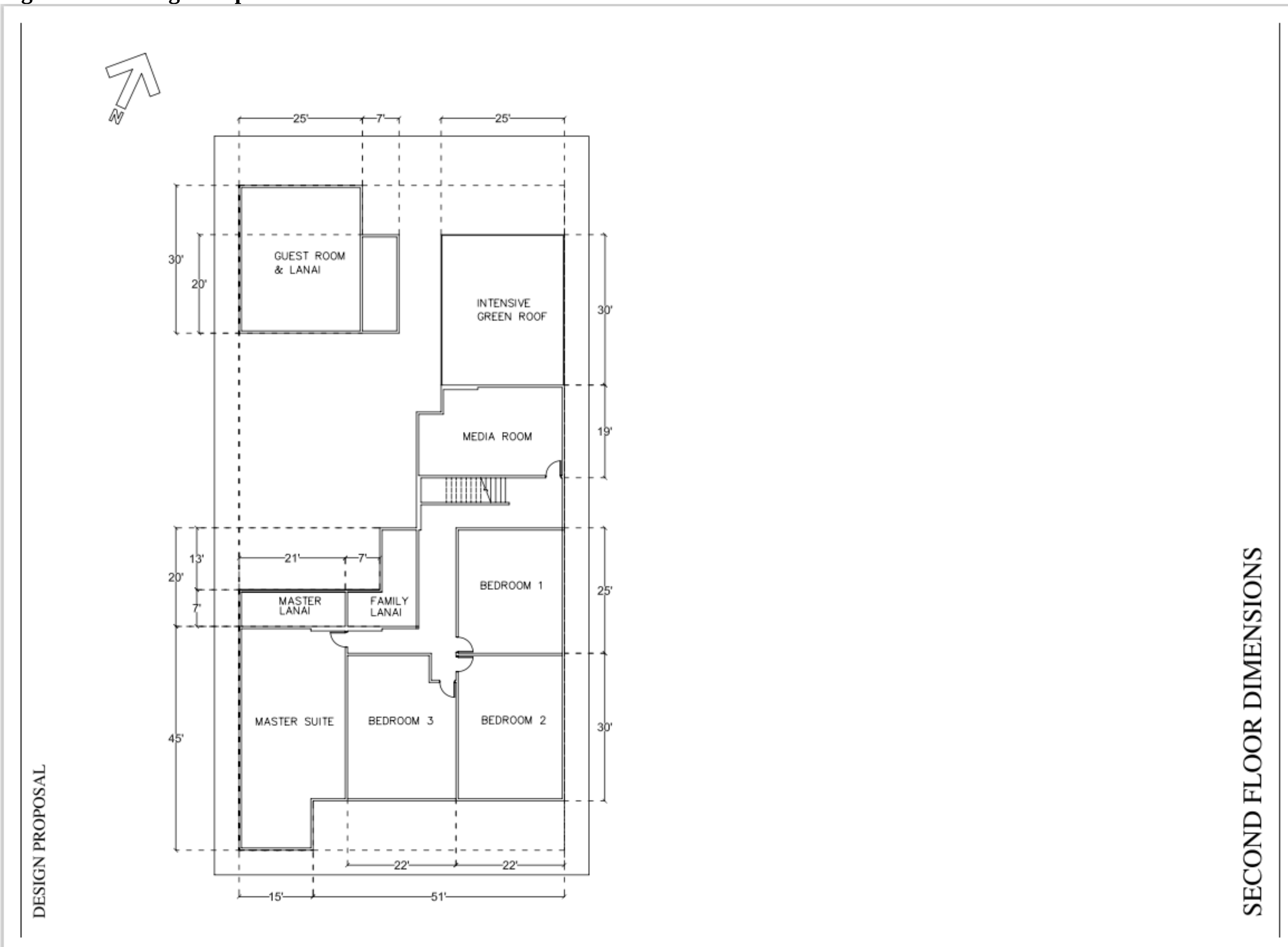
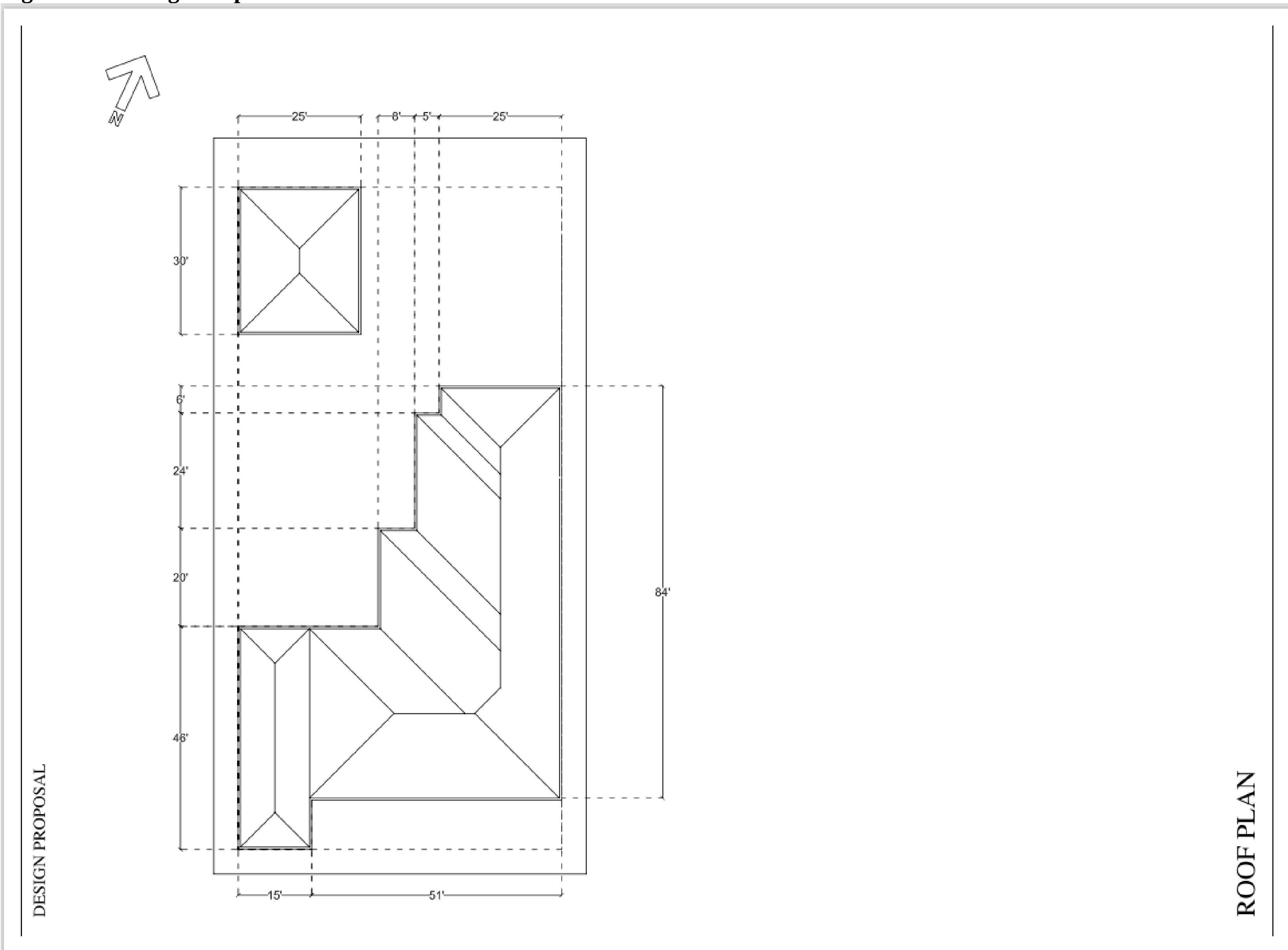


Figure 5.19: Design Proposal I: Roof Plan



III. Design II Proposal

Figure 5.20: Design Proposal II: Perspective Rendering I

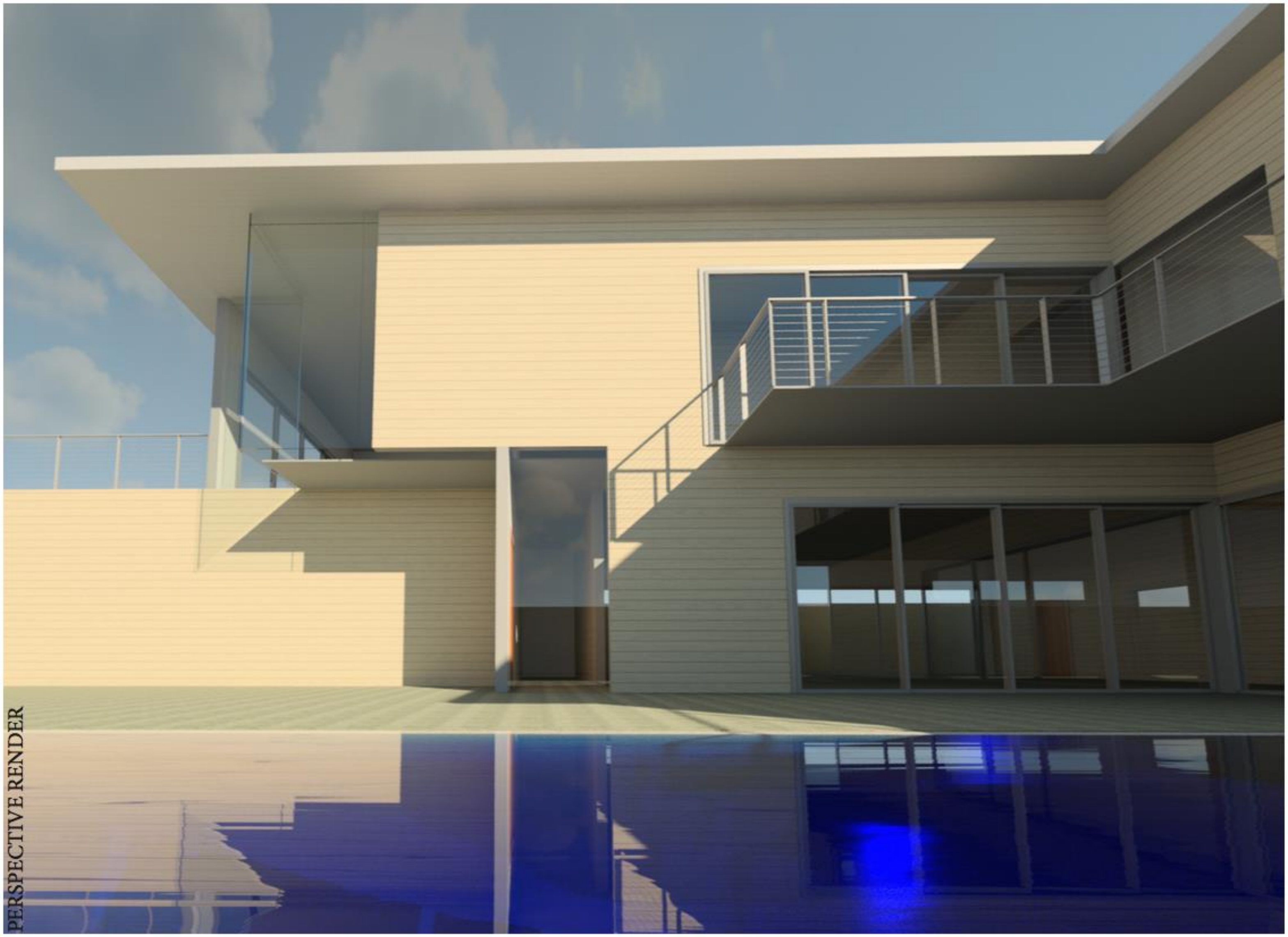


Figure 5.21: Design Proposal II: Perspective Rendering 2

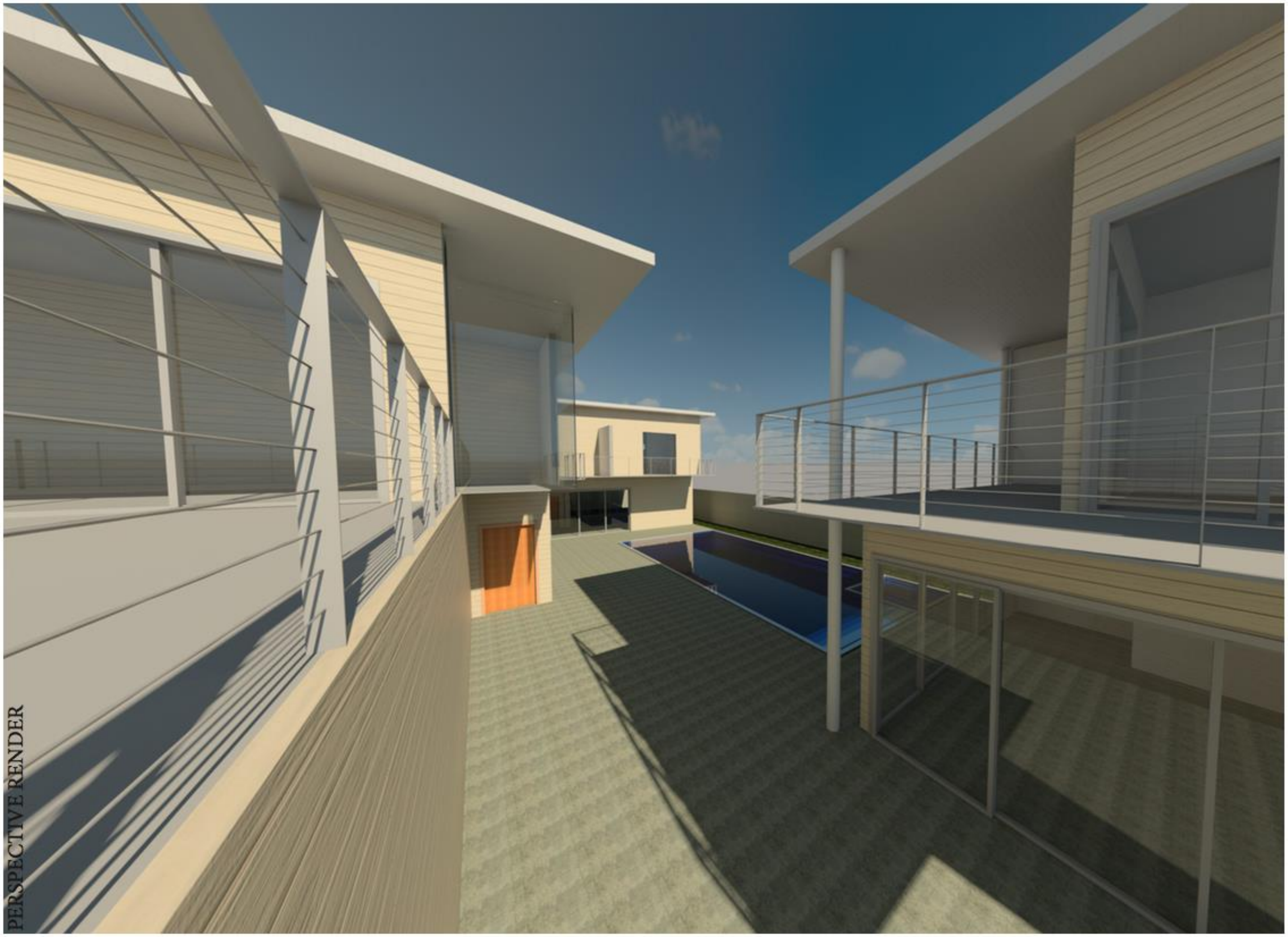


Figure 5.22: Design Proposal II: Perspective Rendering 3

Figure 5.23: Design Proposal II: Perspective Rendering 4

Figure 5.24: Design Proposal II: Perspective Rendering 5

Figure 5.25: Design Proposal II: Perspective Rendering 6

Figure 5.26: Design Proposal II: Perspective Rendering 7

Figure 5.27: Design Proposal II: Perspective Rendering 8

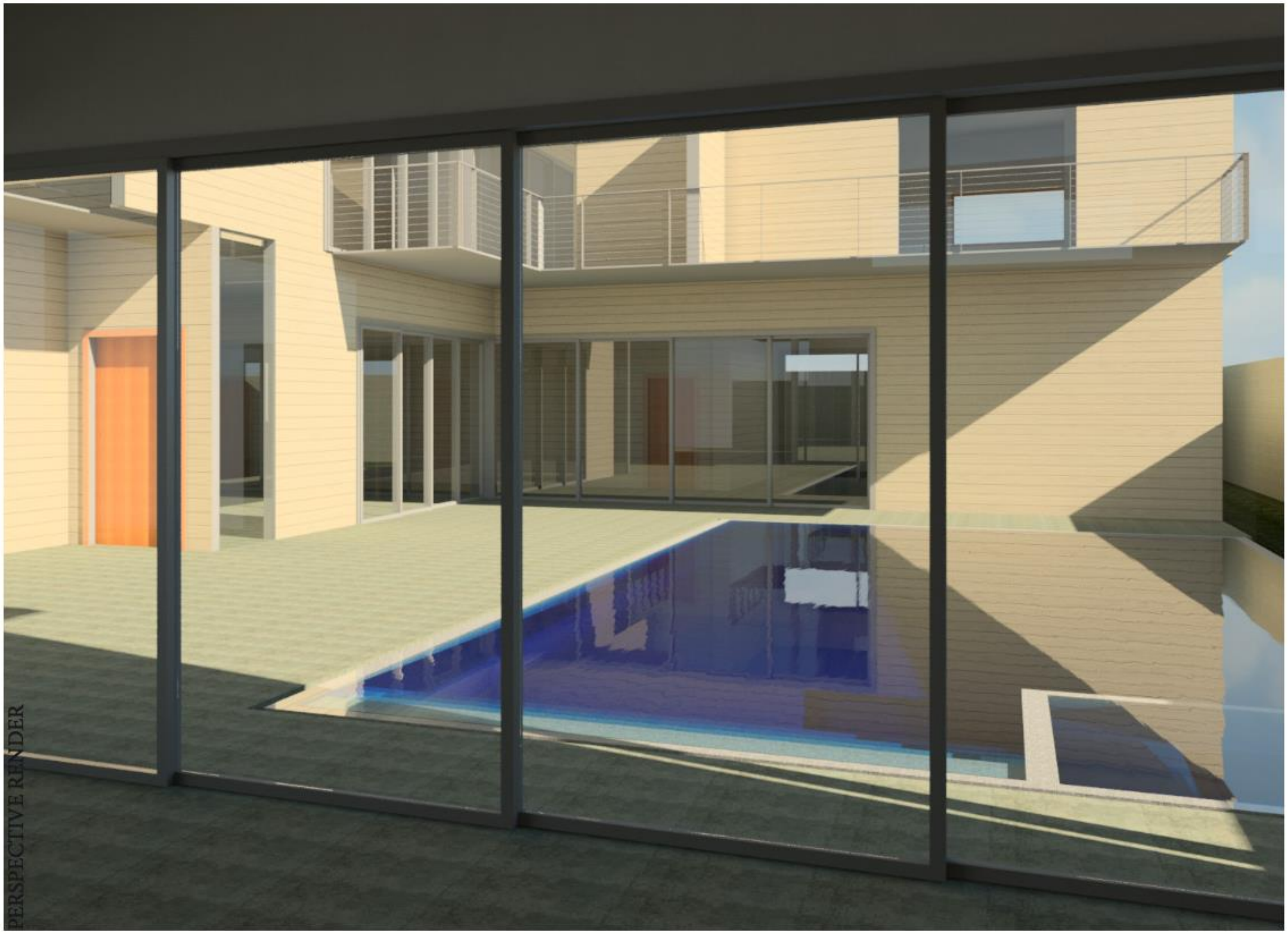


Figure 5.28: Design Proposal II: Perspective Rendering 9

Figure 5.29: Design Proposal II: Site Dimensions

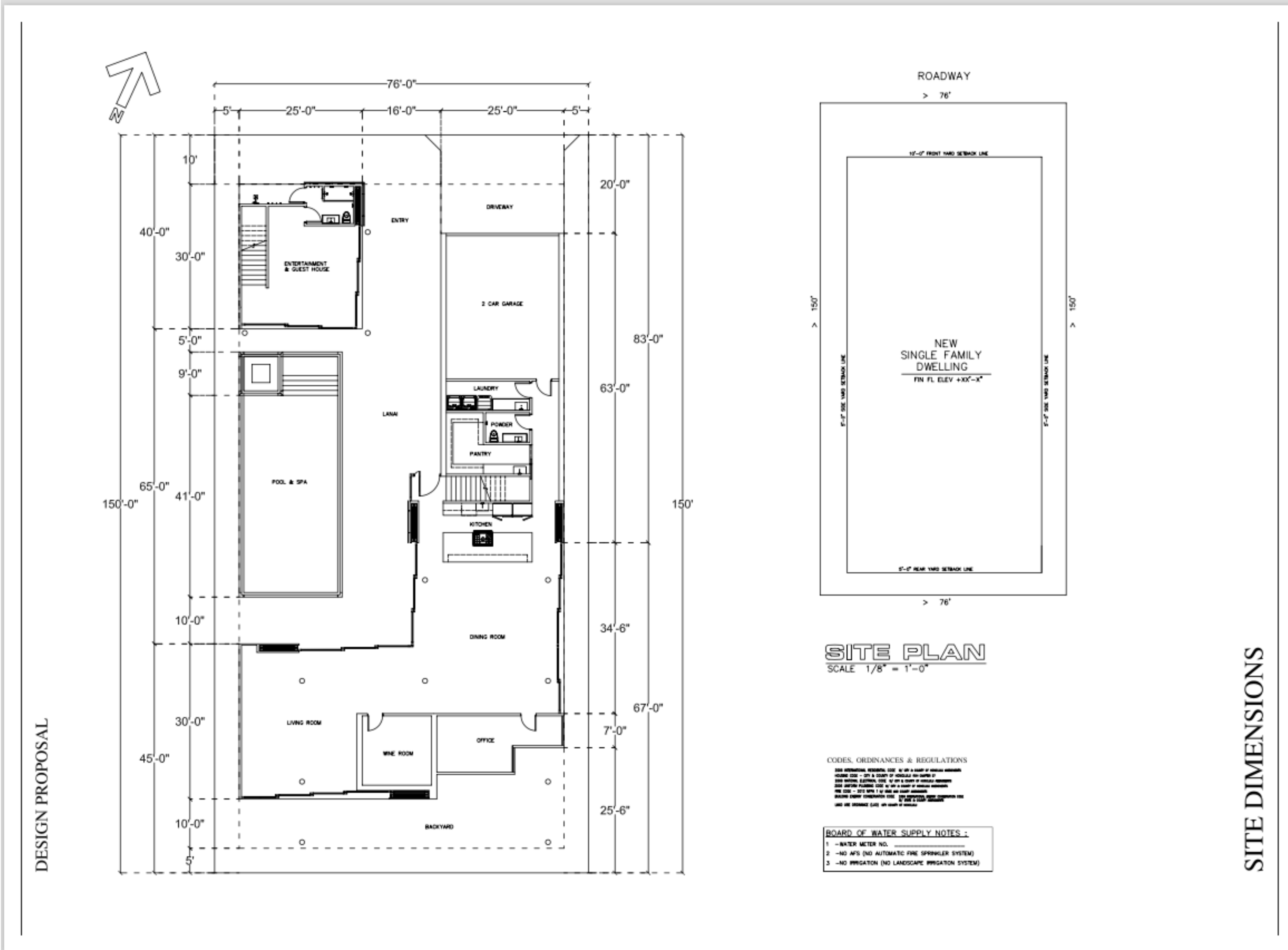


Figure 5.30: Design Proposal II: First Floor Plan

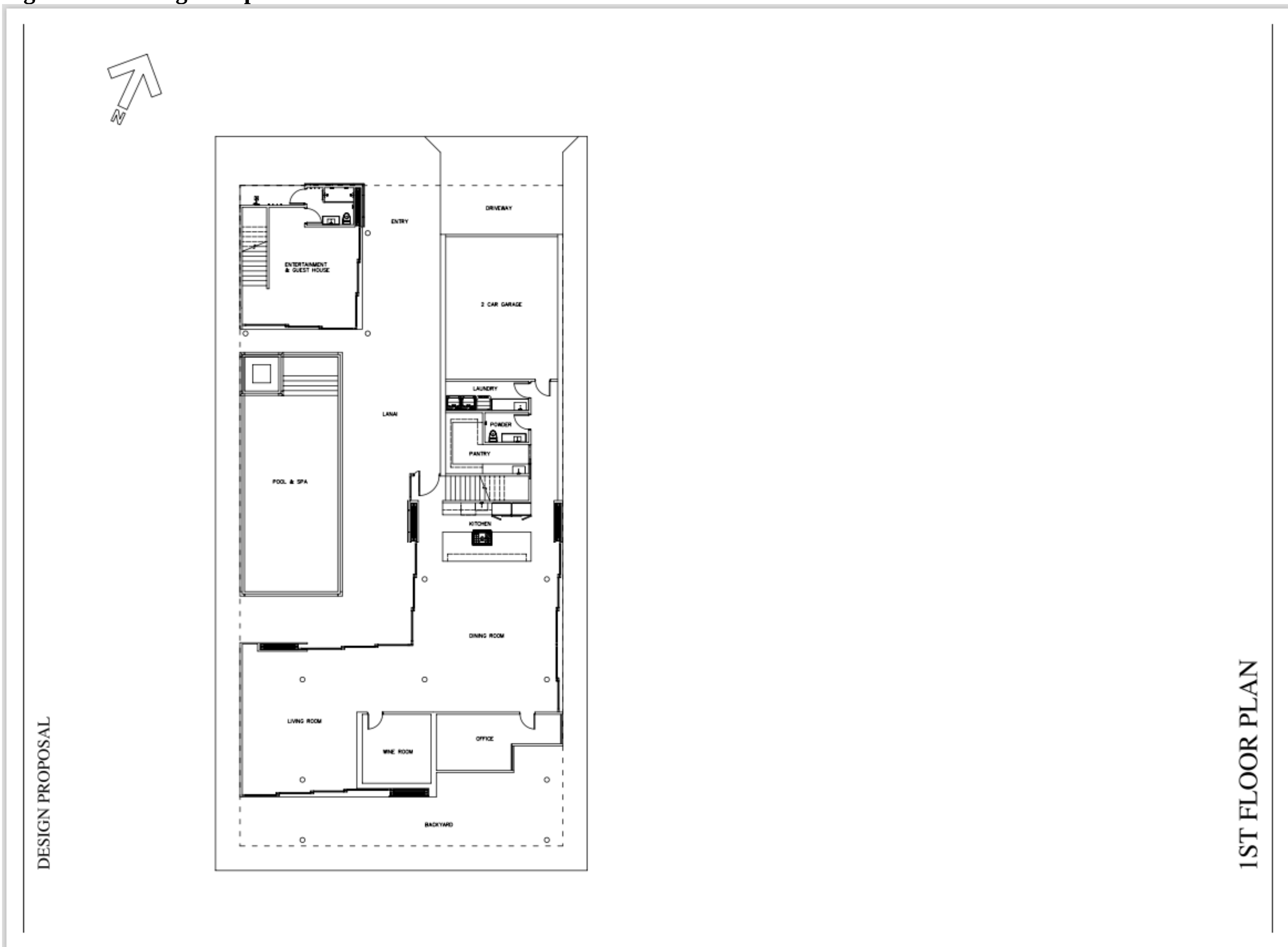


Figure 5.31: Design Proposal II: Second Floor Plan

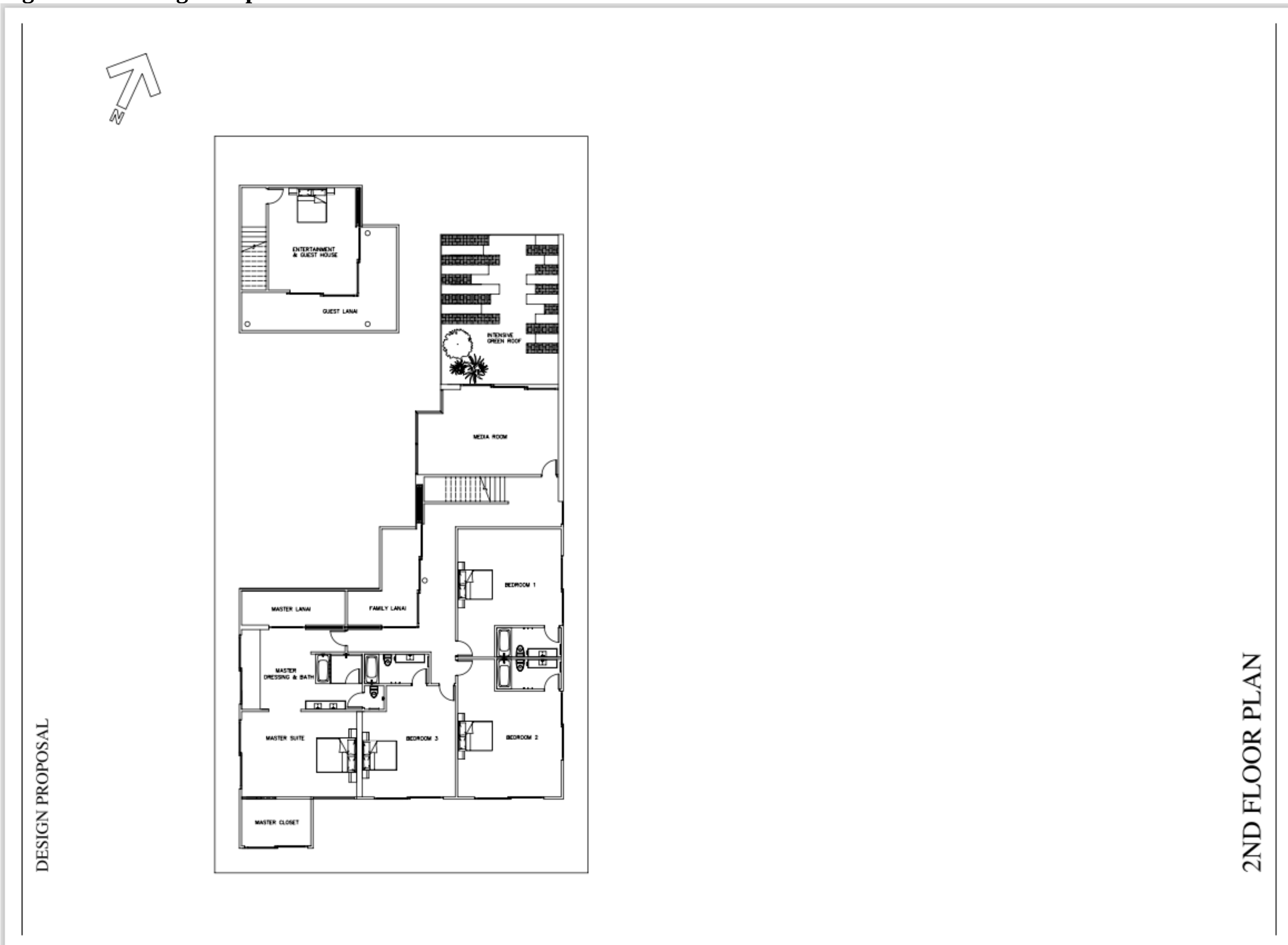


Figure 5.32: Design Proposal II: Second Floor Dimensions

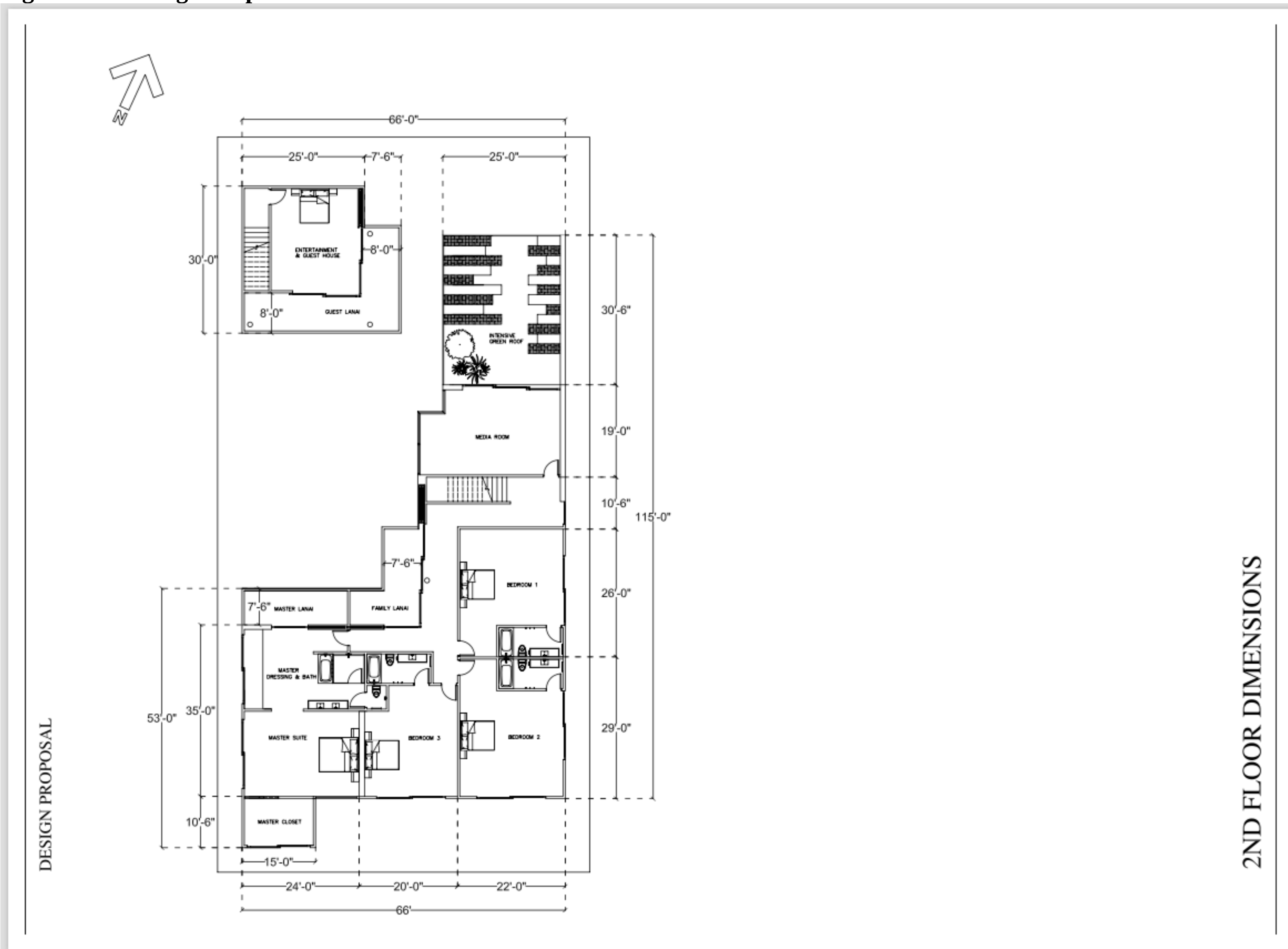


Figure 5.33: Design Proposal II: Floor Area Calculations

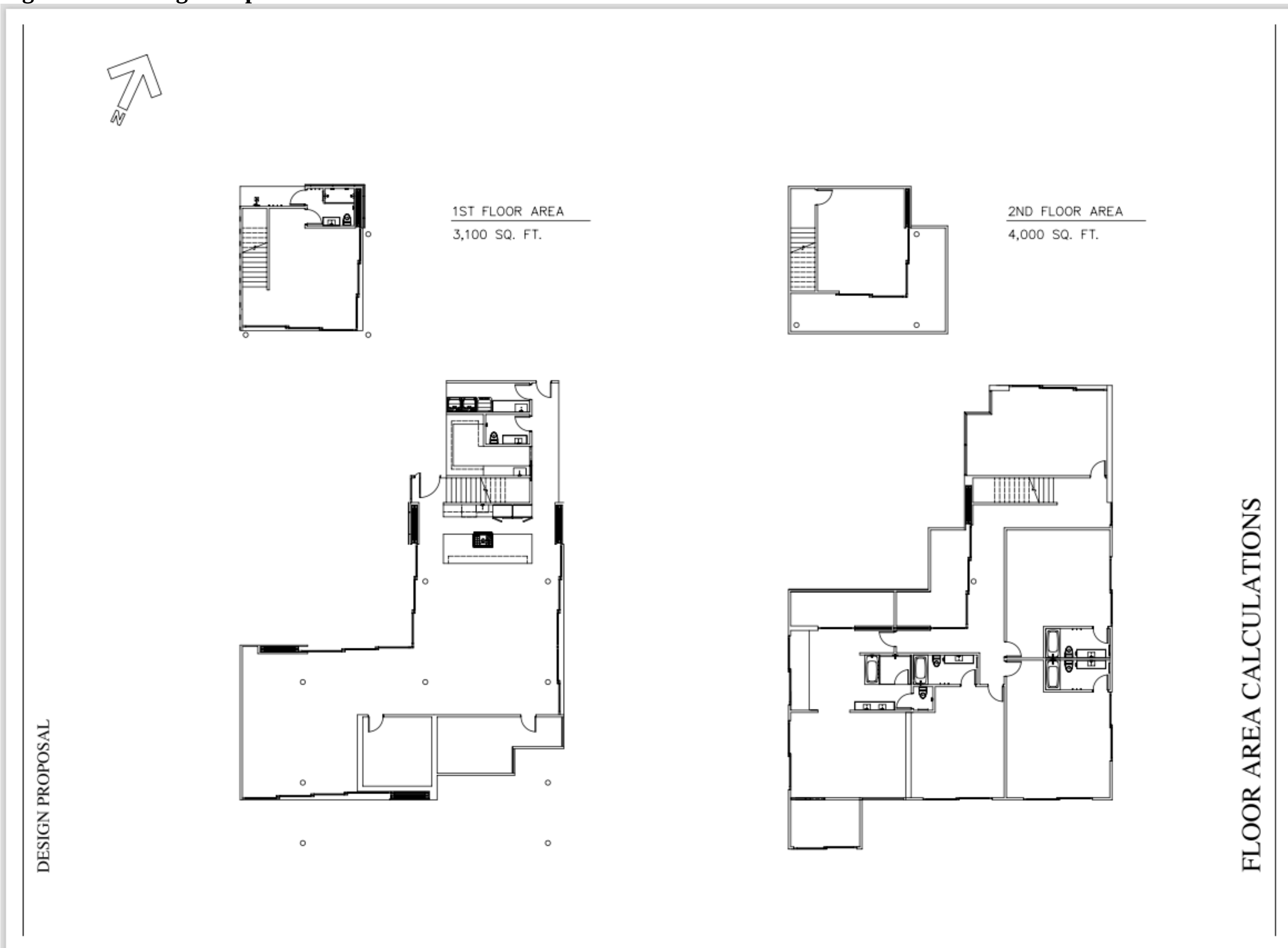


Figure 5.34: Design Proposal II: First Floor RCP

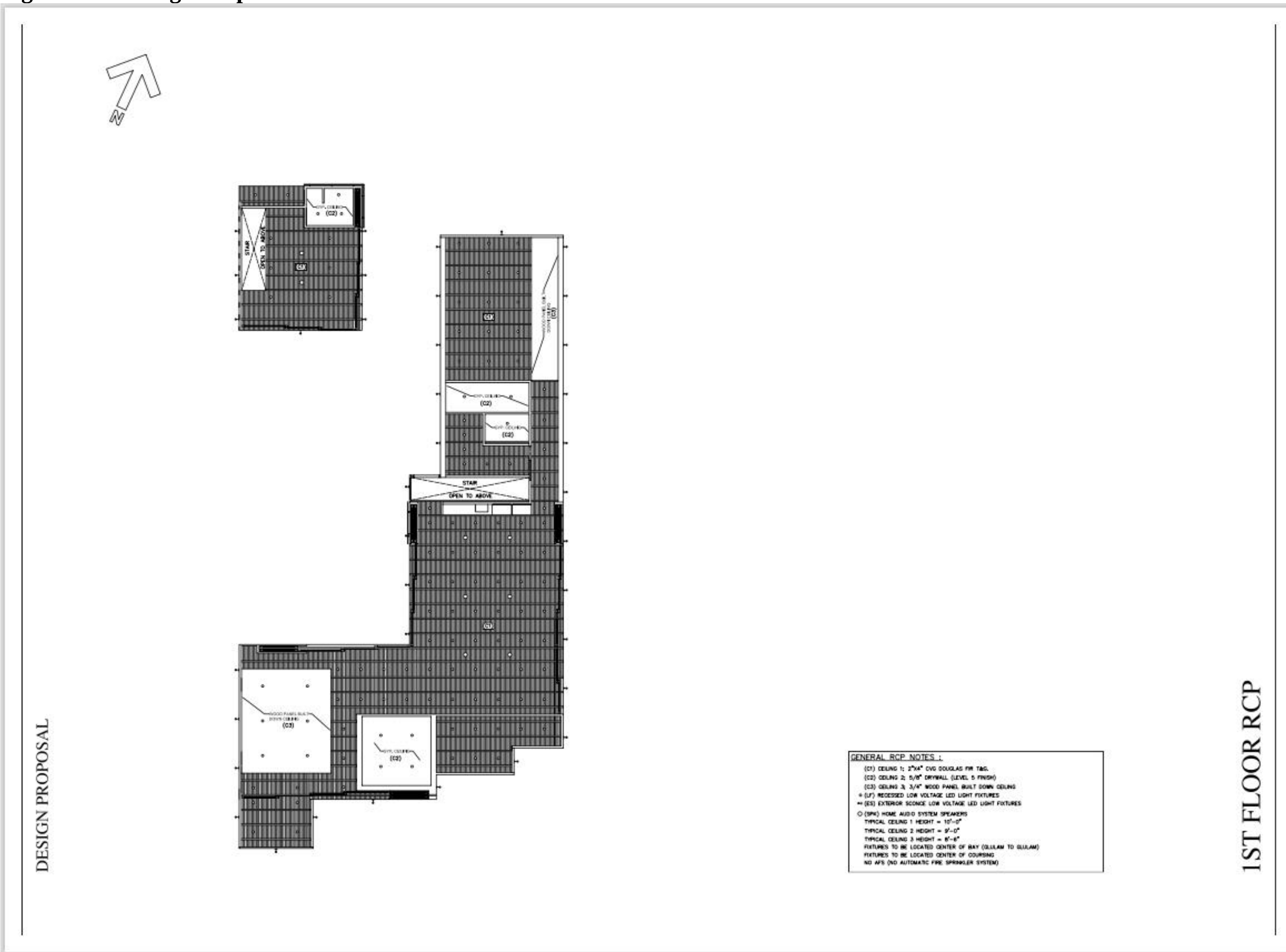


Figure 5.35: Design Proposal II: Second Floor RCP

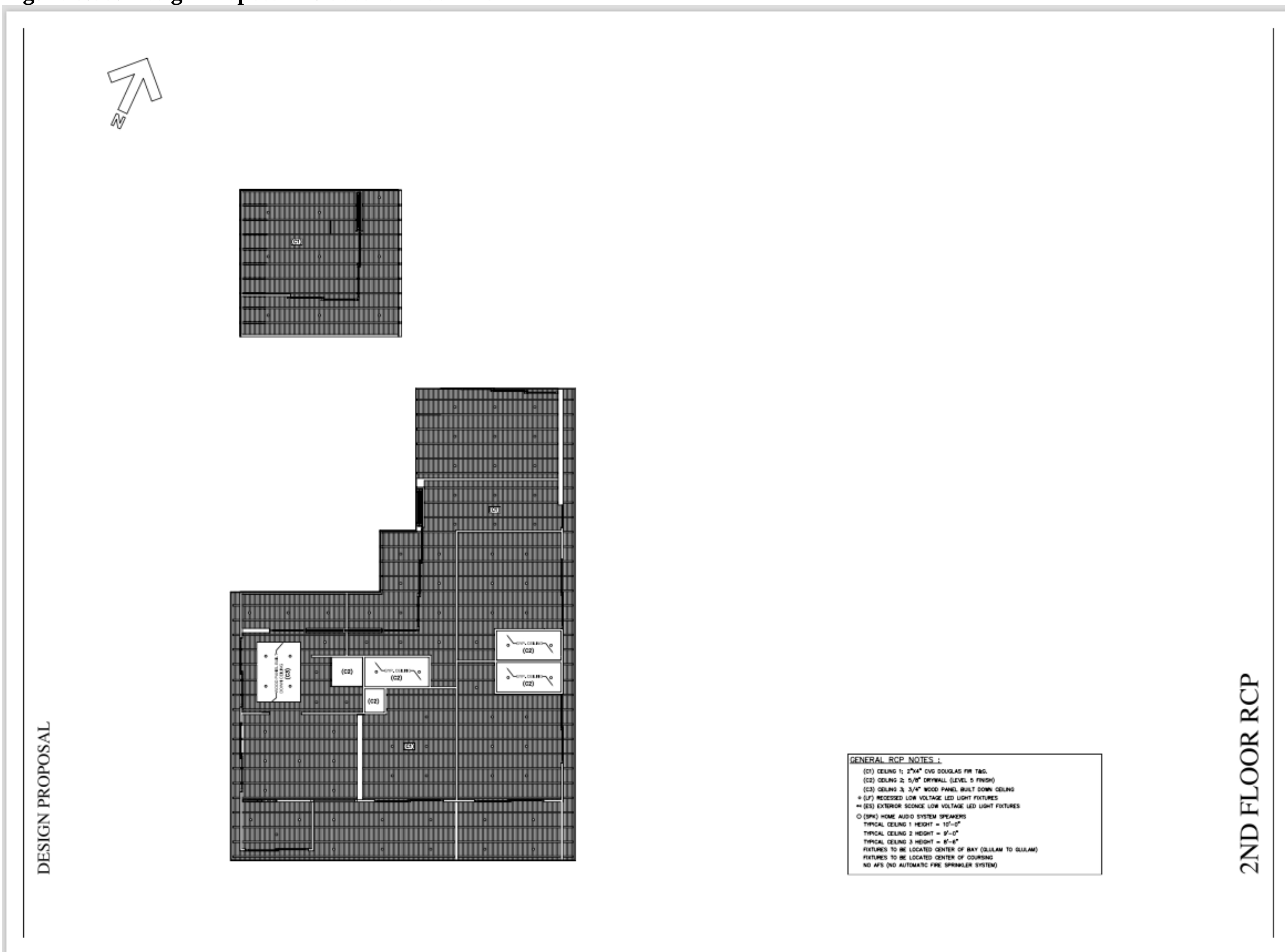


Figure 5.36: Design Proposal II: Roof Plan

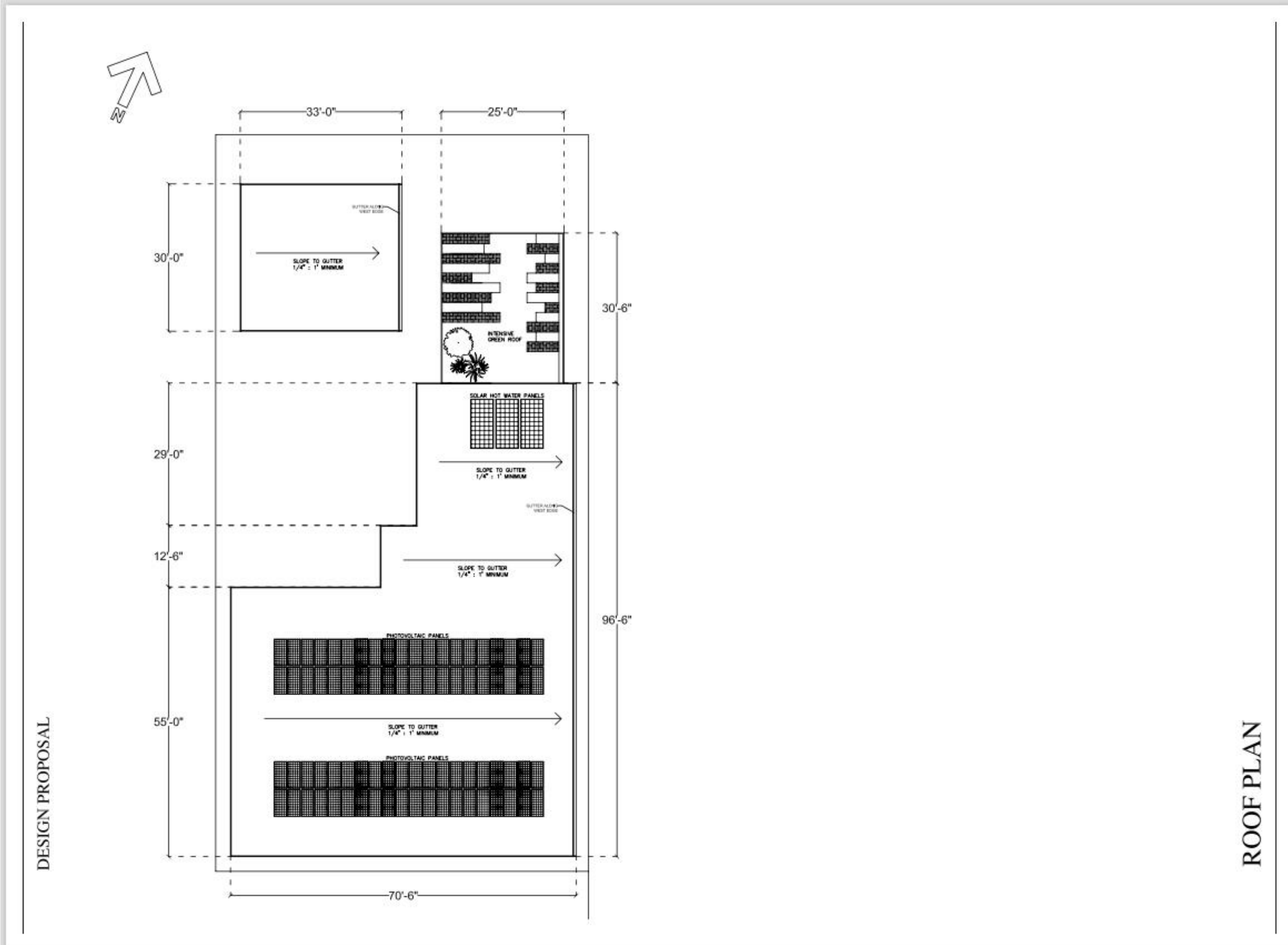


Figure 5.37: Design Proposal II: Exterior Elevations I

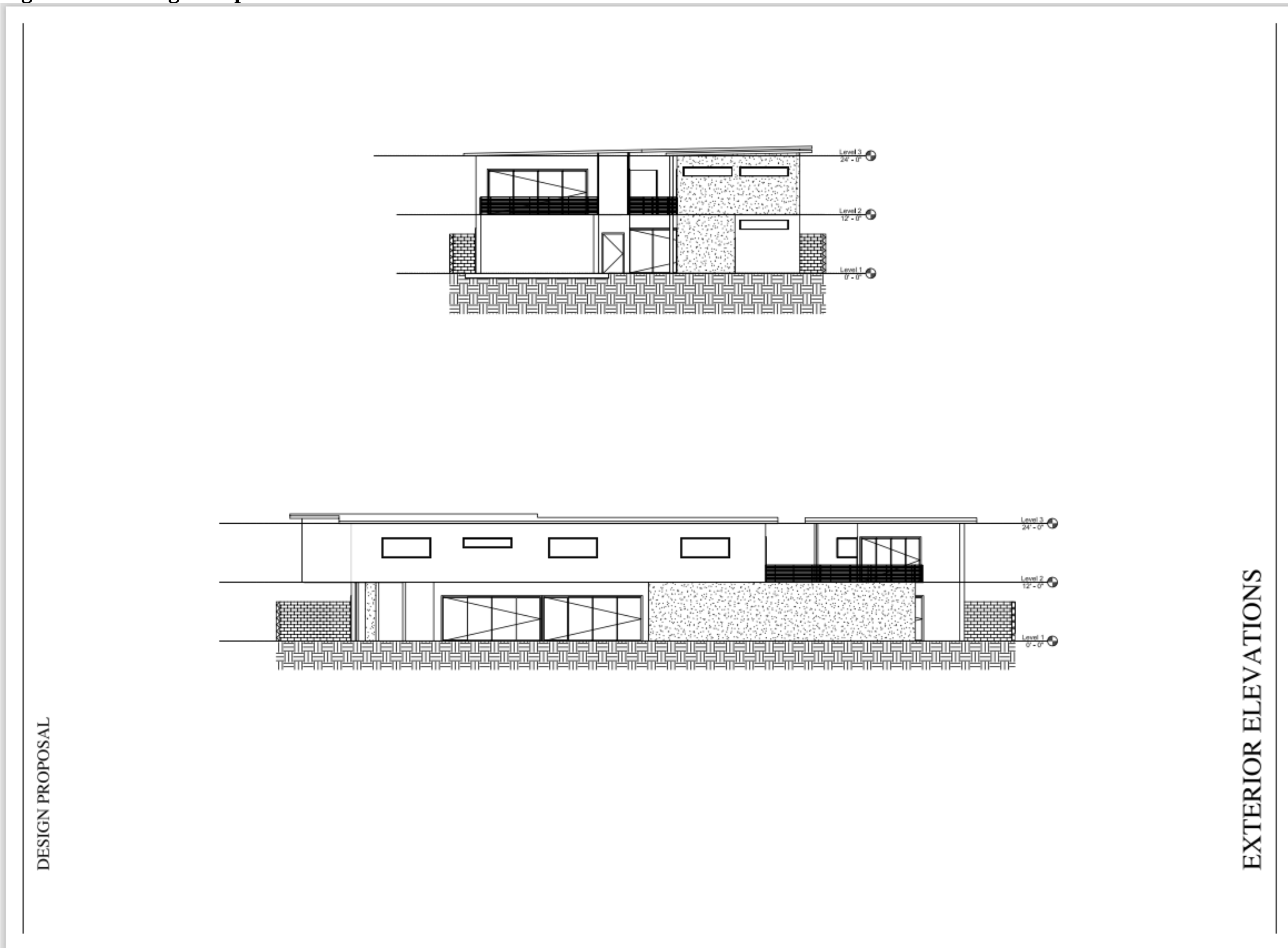


Figure 5.38: Design Proposal II: Exterior Elevations II

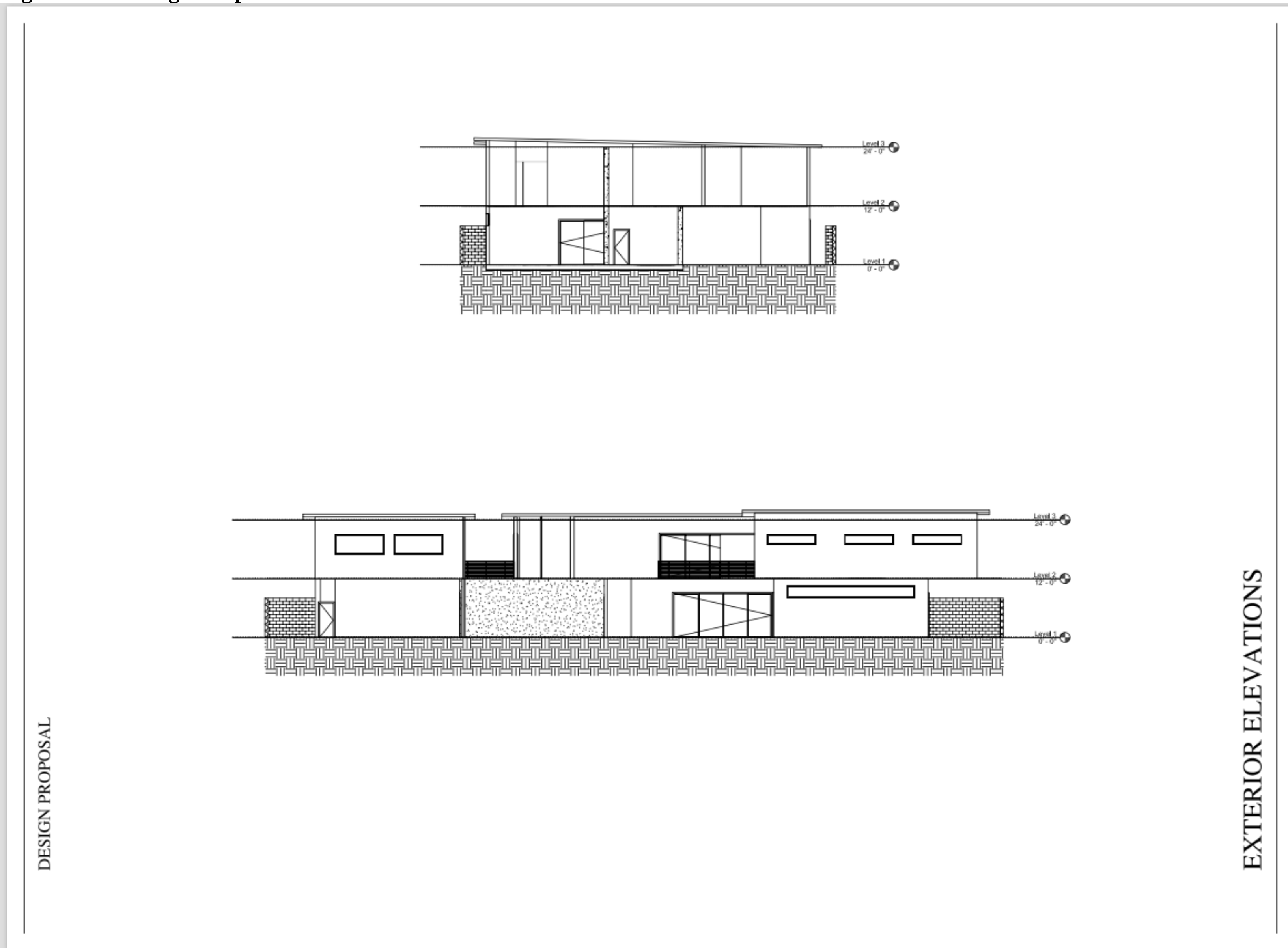


Figure 5.39: Design Proposal II: Building Sections I

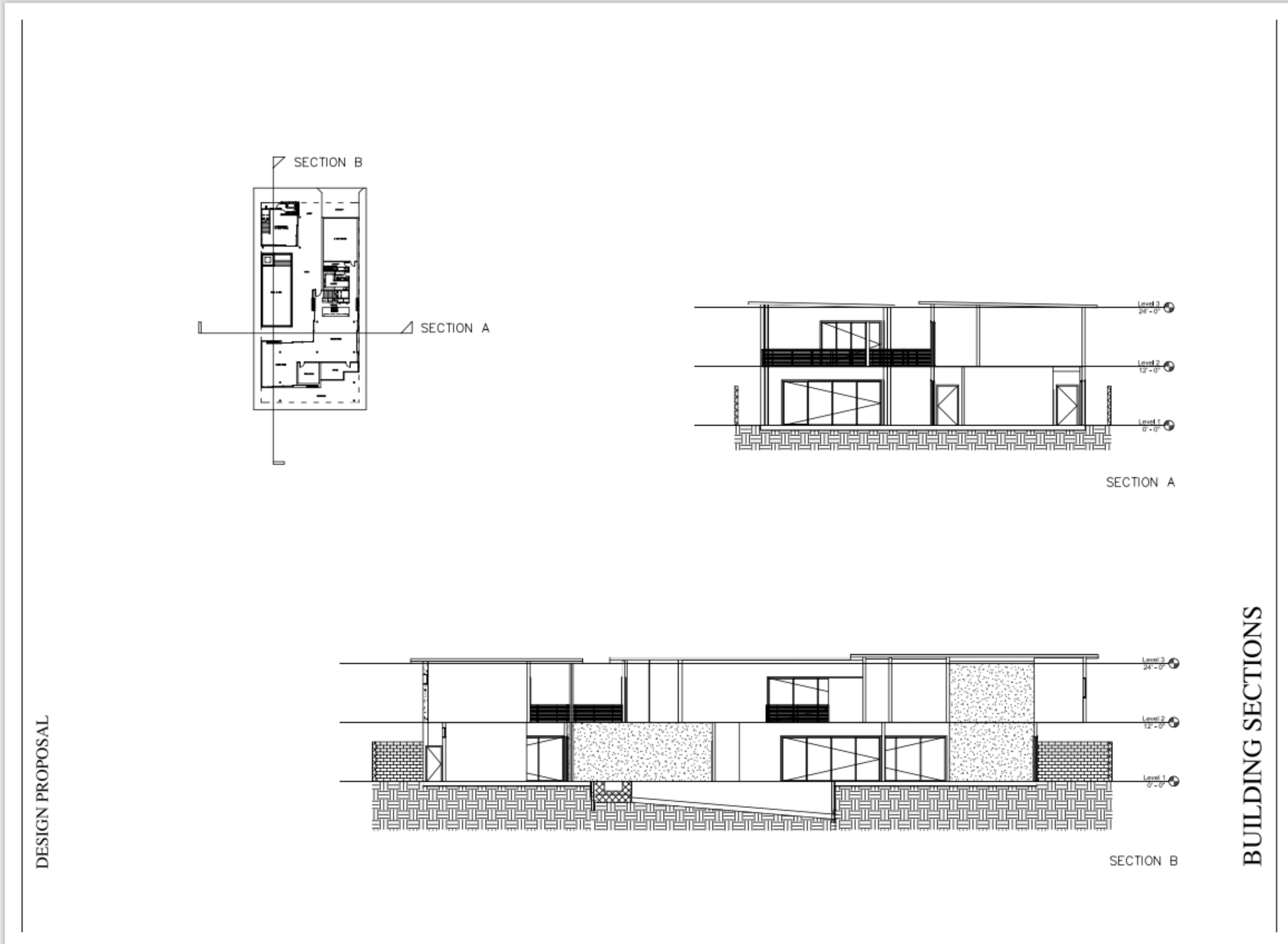


Figure 5.40: Design Proposal II: Building Sections II

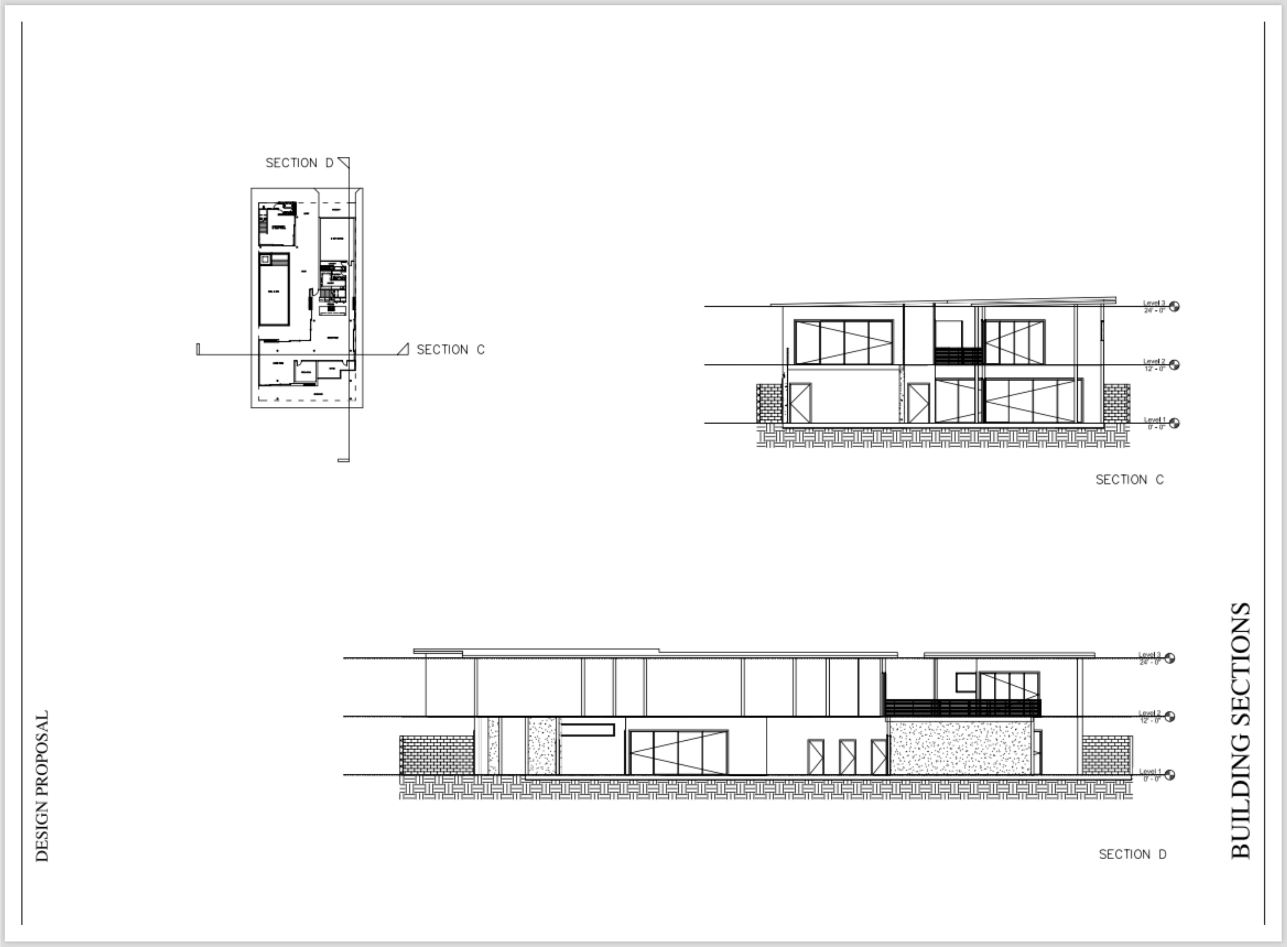


Figure 5.41: Design Proposal II: Foundation and Structural Steel Column Plan

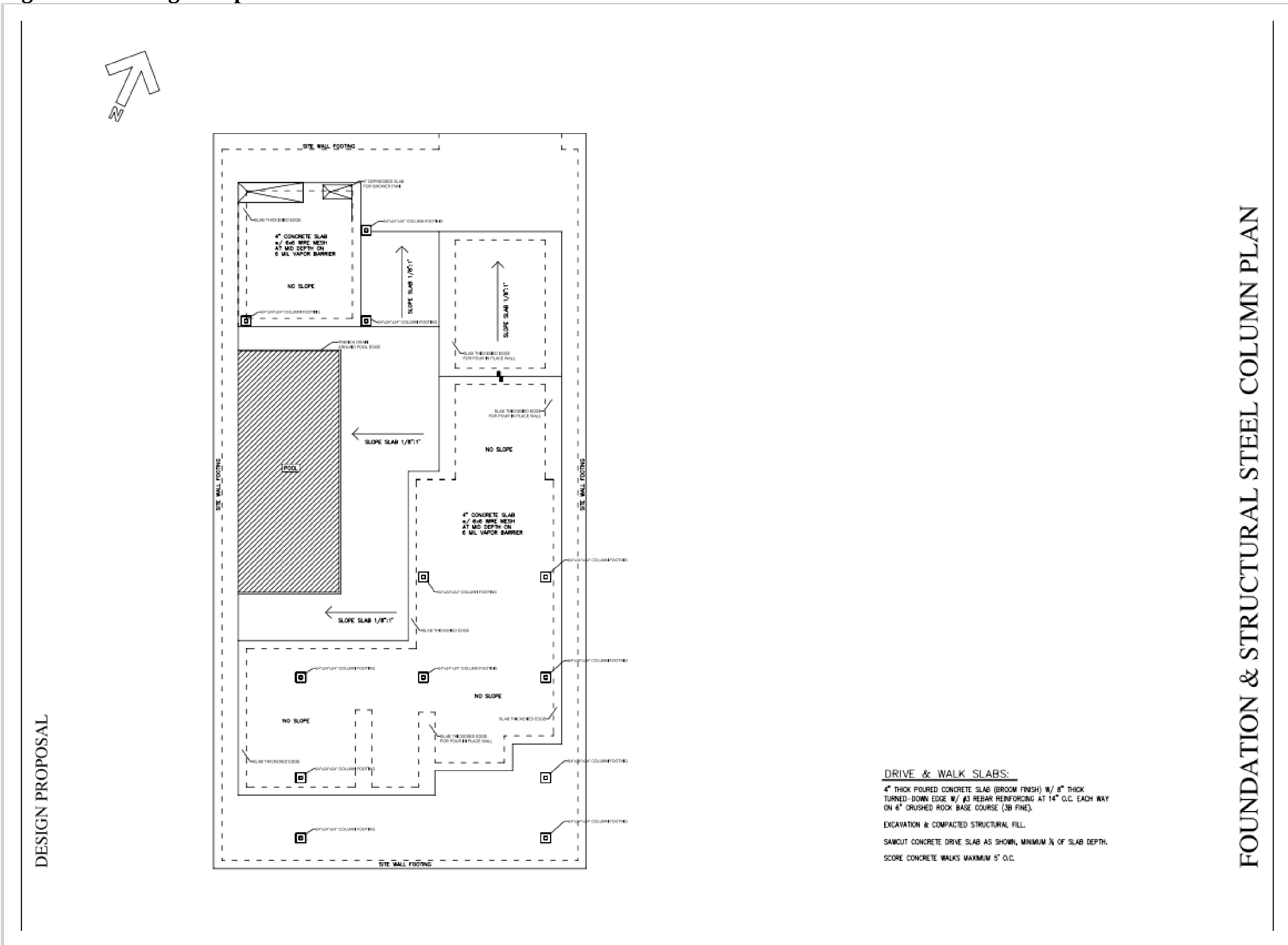


Figure 5.42: Design Proposal II: Second Floor Framing Plan

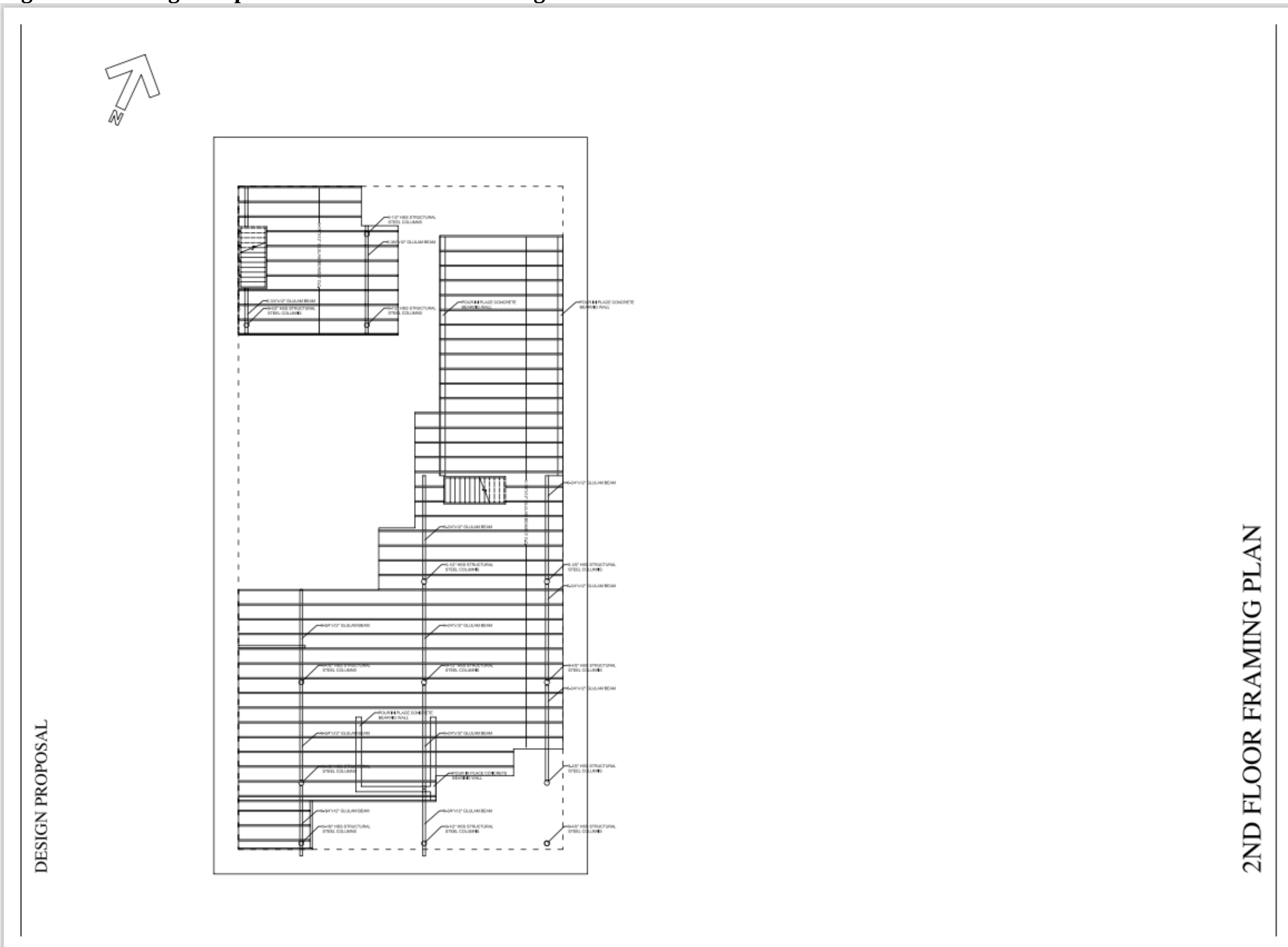
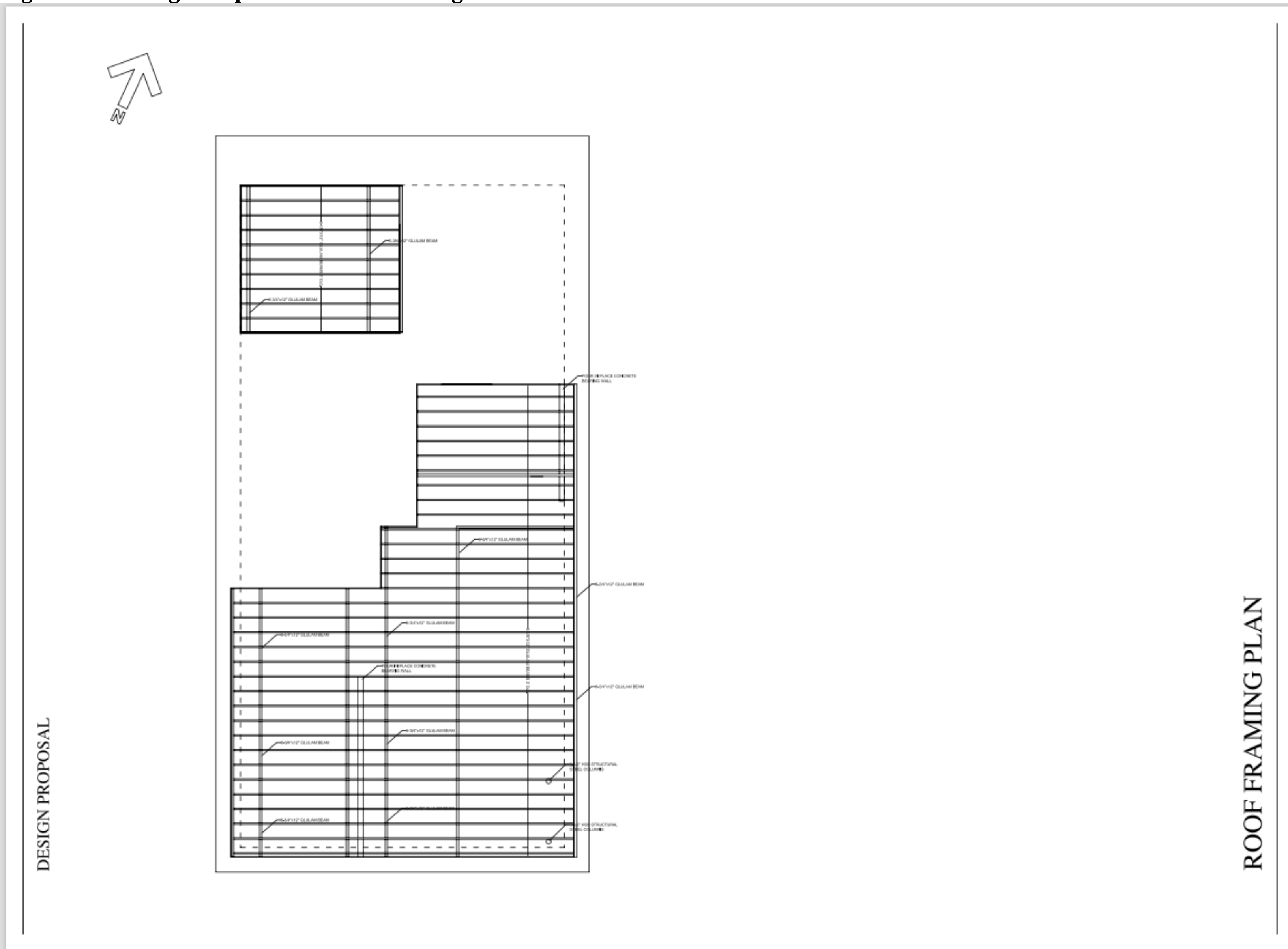


Figure 5.43: Design Proposal II: Roof Framing Plan



Chapter 6: Conclusion — Communication Effectiveness and Efficiency throughout the Architectural Process

This dissertation investigates the importance of engaging with, and further developing today's modes of communication and interaction. An historical analysis of the build environment, and how and why the architect emerged, allows us better understand today's form of architecture. The historical perspective also reveals the factors that have led to changes in how entities interact, communicate, and work together. Next, the dissertation analyzes the current nature of architect, builder, and consultant relationships, the dynamics molding those new relationships, and speculations as to future changes.

There is a long line of architectural relationships, human interactions, and modes of working together that have evolved throughout the centuries. Practicing architects, designers, builders, and tradesmen have worked in very different capacities over time, and will continue to do so. In the process, they will evolve with the times, and adapt to the built environment, tools, and manufacturing processes available, as well as modern-day clients. It is critical that twenty-first century architects are actively involved in this ongoing refinement of the field. This includes having an intimate understanding of today's building materials and methods, being involved in the evolution of building, fire, and life safety codes, actively participating in AIA contract revisions and addendums, and contributing to the education of aspiring designers and builders.

Twenty-first century architecture is comprised of highly complex relationships between architects, builders, and the wide range of specialty consultants who are involved in bringing projects full circle. This compartmentalized architectural process has distanced many individual specialists from one another, straining interaction, and demanding greater communication among all parties involved. The complexities of modern building design have also expanded these specializations. Although they provide great opportunities for the built environment, they also create hurdles, as specialists remove themselves further from vital parts of the architectural process. These multifaceted interactions reflect the complexities of today's modern design field. Miscommunication results in more than $15 billion dollars a year in US construction rework expenses. The need for clearer modes of communication is apparent and critical. A potential solution to the single family custom residential scale is the Architekton-driven design build delivery model. Although this may not be the solution to resolving architectural communication inefficiencies as a whole, due to the way the field operates, and to new technologies and production methods available, Architekton-driven design build provides opportunities for better design, more efficient construction, and improved single family residential architecture.

The design portion of the dissertation, which consists of a mock client and comparative architectural designs, aims to further reinforce this hypothesis. Designing and comparing two custom residential proposals — one based on a design-bid-build business model, and the other on a design build business model for the same client — allows for the identification of issues that could potentially arise during the architectural process, identification of the benefits of one delivery model versus the other, and resolutions to the inherent set of issues that arise from each during the architectural process. In the traditional design-bid-build process, different entities work independently; there is little collaboration with others in the design and construction fields. In the same fashion, today's design-bid-build architect is, in many ways, much more removed from those in the field and on site physically building than were our predecessors. The design build process, however, includes all critical entities/elements in the collaborative design developments. This creates a streamlined design and build process, minimizes miscommunication, and maximizes design, fabrication, and construction efficiency. Fewer independent communication pathways mean less chances for miscommunication. The AIA has recognized the value of the design build process as well, identifying it as a successful project delivery method for residential construction, and providing unique design build contracts for use in the field. This is reinforced by the AIA's evolution of the IPD documents in the 2017 revisions. This is essentially the commercial equivalent of residential design build, validating further that design build is a viable building method. The AIA is now creating (from scratch, and furiously changing) its large scale version.

Design build is sometimes criticized as being contractor led, detracting from architectural design, aesthetic and site specific appropriateness. According to a 2012 AIA firm survey, "less than five percent of AIA members are engaging in architect-led design build, whereas more than 15 percent are engaging in contractor-led design build."[16] These projects are often looked down upon by the architectural community, as it raises the question of design quality. This is due to the fact that design build can sometimes give oversight to the contractor, who has a tendency to focus on budget and constructability, rather than design and aesthetic. Some architects, although they may believe that there is a place for design-build, would prefer to work with owners to achieve their desired aesthetic and design, and then later work with a contractor to meet a budget. This statement embodies the architectural field's current opinion of design build. Although it may often be accurate, evolving the design build delivery model to retain the communication benefits, while heavily focusing on the design itself is an extremely viable delivery method. Some architects think it is difficult to influence the quality of the product, while others who are experienced in the design build delivery method believe the opposite.

[16] American Institute of Architects, "The Business of Architecture: 2012 AIA Survey Report on Firm Characteristics." Washington DC: AIA, 2012.

In fact, according to Chris Cedergreen, president and senior principal of Forum Studio, based in Chicago, "working with contractors from the beginning of a project enables architects to test a design's intentions and systems throughout the design and construction process. That generates immediate feedback, and allows architects to quickly design solutions. It's not a limiting factor at all. It adds to the design process."[17] Identifying potential problems early on limits inefficiency within the field, and minimizes (if not eliminates) change orders. Change orders can occur during the construction phases of a project, when either an architect or homeowner alters a structure, or some unforeseen factors cause additional work that was not outlined in the initial contract. According to the Construction Industry Institute, change orders add, on average, nearly 5% to a project's cost. This, theoretically can be avoided by utilizing the design build delivery method.

By focusing on owner and architect communication and interaction first, a design build architect is able to utilize his or her field understanding, be in touch with the subcontractors who will ultimately perform the work, and bring them to the table early on in the design process to identify potential constructability issues. Design build also removes superfluous steps in the communication process (i.e., the managing builder). No longer does an architect need to communicate with a contractor, who then communicates with a subcontractor. The design-bid-build delivery method essentially becomes a mathematical equation between the multiple entities involved — the skill and knowledge of an architect multiplied by the skill and knowledge of the general contractor and his/her subcontractors, multiplied by their level of communication and working relationship. Design build creates total accountability for the project team. As long as the client chooses the right firm, all multiplication is removed from the equation, since everyone

[17] Joe Gose, "Design-Build Goes Mainstream." National Real Estate Investor, April 1, 2003. http://www.nreionline.com/development/design-build-goes-mainstream.

is on the same team and works toward the same overall goal. When challenges arise in the process — as inevitably, they do — all members of the team work together to solve the problem, instead of pointing fingers or blaming other entities.

According to a study conducted by the Construction Industry Institute in Austin, Texas, and Pennsylvania State University, design-build results in cost savings of at least 6%, compared with the conventional design-bid-build project delivery method. Additionally, design-build projects are completed 33% faster. Firms that see the value in the design build delivery method can potentially increase their contract work and company profitability immensely. In firms such as Hensel Phelps' in Colorado, design build work accounted for more than 36% of the company's $1.9 billion in revenues in 2012. Twenty years ago, while 20 years prior design build work was few and far between. It did not exist at New York's Turner Construction Company twenty years ago; by 2011, it accounted for 10% of its $6 billion in revenue. KMD Architects from San Francisco has seen its design build work increase nearly 25%, from less than 10% twenty years ago to nearly 35% in 2013.

There are similar findings in Hawaiʻi. Established in 1980 by architect Jeffrey Long, Long & Associates began as a design firm specializing in high end custom residential architecture. The firm's vision statement points out that, "Upon recognizing a need to have a single point of responsibility throughout the design and construction processes, the design build services were established to provide a unified workflow thereby minimizing the inherent design and construction challenges typically experienced by mainland and international clientele."[18] In 2016, Long & Associates Architects and Interiors was rebranded as Longhouse Design + Build, thus, representing the firm's goal of a more collaborative design approach. Since then, it has been

[18] About Us - Longhouse Design Build. http://lai-hawaii.com/about-us.

involved in more than 150 custom residences in Hawaii, the West Coast, and Asia. Longhouse Design + Build has also received numerous local and national awards from the AIA, American Society of Interior Design (ASID), and the Building Industry Association (BIA).

Delivery speed plays a large part in design build results. The design build firm of Ryan Cos. U.S. in Minneapolis, for example, completed a $77.4 million, 360,000 sq. ft. structure in 13 months using the design build delivery method. This type of project took half the time it would have if other design methodology were utilized. Expediting the construction timetable also cut in half the number of interest payments paid on its bond financing, saving the client about $1 million. The design build delivery method not only allowed the client to eliminate costs associated with carrying the land for another 13 months, but also allowed him/her to begin tenant buildout/occupation, and to collect rent sooner. These statistics suggest that design build is a potentially viable delivery method for other architectural approaches as well, even though projects vary from client to client, and from site to site.

The twenty-first century design build master architect (Architekton) could be the next phase in the evolution of the design build delivery method. It would bring architects back to a master builder level of understanding, and beyond the current vision of design build, to the new Architekton design build delivery method. Here, the Architekton is in direct contact with all those involved in the project, and eliminates the middlemen who could potentially introduce communication issues into the process. Essentially acting as the steward of the design, the architect ensures a better final product by centering responsibility in one place, and eliminating potential arguments, inefficiencies, and other overhead sometimes associated with the traditional design-bid-build architect and general contractor. It also establishes continuity and the inherent efficiency, resulting in a firm’s involvement from start to finish, and avoiding items being missed or falling through the cracks. It is an opportunity for the architect to ensure that what is important to the client goes through to the project. The Architekton led design build delivery model further creates, potentially, a better designer and architect. Intimate knowledge and understanding of construction, material and labor capabilities, and the architectural process as a whole creates opportunities. These include expressed architectural connections and details, highlighting materiality and structural elements, manipulating material capability, and aesthetic. Ultimately, Architekton driven design build architecture, on the single family residential scale, produces a stronger design by the architect, a more efficient construction management process, and a better final product for the client.

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