TRANSPARENCY

OF ARCHITECTURE

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A Design Thesis Submitted to the
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By

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Primary Thesis Advisor

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Thesis Abstract

How can architecture be created to accentuate its surroundings, rather than itself? How can architecture be created to protect the natural environment around it? These are the two important questions I explored in this thesis document. Architecture that both preserves and respects, or even goes as far as enhancing the natural surroundings, creates a transparency that is becoming increasingly necessary over time. The design project following the research portion is my proposed example solution to the above questions. Located in central Arizona, the city of Sedona is surrounded by red rock monoliths and wilderness for miles. The following document analyzes the research and design of a transportation facility meant for air travel. I have researched topics in sustainability and site integration to determine the most progressive ways to design a structure for this non-environmentally friendly function that will both accentuate and protect the airport's natural environment.

Narrative of the Theoretical Aspect of the Thesis

"What are the ways in which the environment is affected by air travel facilities, both ecologically and perceptually (visually)?"

The question above is not an easy one to answer, but one I believe needs to be addressed. There are two main parts to the question, with two keywords: ecologically and perceptually. In this thesis, I will study not only the physical environmental effects of airport facilities, but also effects that alter our visual perception of it.

Every piece of architecture has a site - a specific location in which it is meant to exist. Or if it is temporary, it may have many locations for which it is designed. None the less, real, physical, tangible architecture has a home, a site, a position, a point - whatever you'd like to call it. But how much of the architecture in our world truly acknowledges its surroundings? Sure, architects are trained to make entries easily accessible, to maximize glazing on the south elevation (in the northern hemisphere), to make the structure accessible by automobile by placing curb cuts on nearby streets, but how much of this is actually acknowledging the building's greater surroundings?

Only a small percentage of Earth's built environment truly recognizes the location in which it is placed. Airports, specifically, have a very bad reputation in this realm. In fact, Cerver states the following in his book "The architecture of stations and terminals":

> *"Airports often have more in common with each other than with the cities they are meant to serve."*

What so many architects fail to recognize is not only a need for visual connection to a structure's surroundings, but also the need for architecture to respect those surroundings. Whoever decided good architecture is that which stands out and makes a bold statement was missing another angle of the puzzle. I believe great architecture is that which recognizes and is considerate of its environment. Integration with the site is a primary idea of which I will explore through this thesis. Farther into this thesis document, I will define exact parameters which I believe should be followed in order to achieve a successfully integrated design.

By analyzing the existing environment and ways in which architecture can enhance the views rather than detract from them, we are discovering ways in which to protect the environment and preserve the existing views of nature. This brings me to my next main idea: protection of the surrounding environment. Not only do the pristine views of the environment need to be preserved, but also the physical health of that environment. Climate change is threatening to destroy the wonders of our planet, and our natural function of living. We cannot continue to design in the same ways we used to. In a changing world, we need to adapt as well. In my opinion, the air travel industry is one which needs strong influence.

Air travel has continued to be a growing industry, with little regard to sustainable practices in both the industry itself, and the architecture that makes air travel a possibility. Architects are obviously not all qualified to engineer solutions to the environmental problems of the airplanes, themselves, but we are able to use our knowledge of building systems and new technology to influence the built environment of the airport. In this thesis, I would like to examine some ways in which the operation of airport terminals contribute to negative environmental effects, and how those effects may be offset by smart design.

The discussion of environmental responsibility is finally occurring in the airline industry, as the sector agreed upon a set of global CO2 emissions-reduction targets. These include the goal of carbon neutral growth from 2020 onward, and a 50% reduction in net CO2 emissions by 2050, compared to those of 2005. This is great news, especially considering how quickly the industry is growing. A recent forecast revealed an estimated 31% increase in passenger numbers between 2012 and 2017. That's more than 930 million more passengers (IATA, 2013). According to another source, Eric Henckels of Columbia University, the global market of the airline industry has increased steadily at approximately 5% per year over the past 30 years, but is actually expected to double in the next 10-15 years. Clearly if ever there were a time to initiate environmental saving strategies, it would be now.

So why focus on a small, regional airport in this thesis? Well, in recent years, the use and overcrowding of airports has skyrocketed. Studies show that air travel will only continue to increase, and airports in smaller cities will become more popular due to overcrowding of large hubs, as well as the more recent competitive price of smaller alternative options (Quick, 2012).

I have always had a fascination with the three main ideas colliding in this thesis – airplanes, nature and sustainability. I had my first airplane ride at the age of two, in my dad's Aeronca Champ, and have been slightly obsessed with flying ever since. As I got older, I got my private pilot's license and decided I wanted to be an architect. It was the process of earning my pilot's license during which I began to realize the disconnect between operations of air travel facilities and green living and architecture.

Project Typology

This thesis will result in not only the research of multiple premises to determine possible solutions, but it will also use those ideas to create an architectural design demonstrating the feasibility of the reached solutions. The architectural design will be that of an airport which exhibits the theoretical solutions and presents contemporary design elements.

The next few pages present a number of case studies that will assist in the analysis of the theoretical aspect and the design of this thesis project. Different projects have been chosen for different reasons. Not all of the case studies in this document are airports. The ones that are airports are directly related to my thesis mainly through general typology and the characteristics specific to airports. However, I have also chosen to include a museum and two churches. These relate to my project through the theoretical aspect, with regards to site integration and other such ideas.

Typological Research

STN

LONDON STANSTED AIRPORT

Figure 1 - London Stansted

London, UK // 1990 // Foster Associates

Main Elements of Focus: daylighting, energy efficiency

Stansted is a large airport, serving more than 17 million passengers last year, making it the fourth busiest airport in the UK. Its architecture has been praised for its modern and efficient design, with basic geometry and simplicity. Although the structure has wonderful passive systems, and logically environmentally friendly elements, it lacks any sort of architectural connection to its surrounding environment.

Beginning on a positive note, Stansted's layout is all about efficiency. A huge truss system allows larger areas between each column, resulting in more square footage for airport customers. All air-conditioning, water, telecommunications and electrical outlets are contained to the pillars at the base of each truss, again eliminating the need for additional elements that take up floor space. Its 36-foot ceiling gives the space an airy, yet slightly overwhelming feeling.

Energy efficiency is one element that Norman Foster implemented quite well with passive systems such as utilizing glazing and roof-lighting to lower heating and lighting demands. Heat is provided by solar and casual gains, and artificial light essentially becomes unnecessary in the day-lit hours. This feature is an important one, especially when we know that artificial lighting makes up about 40% of a typical terminal's energy budget. For Stansted, that's about half a million kilowatts per year. And not only does this strategy save energy, but it also becomes an aesthetic element in the space. (Edwards, 1998)

Although, while Stansted is quite energy efficient, it lacks many things as well. I had the opportunity to visit this airport, for a flight from London to Naples. I must say, it is one of the more pleasing airports I've been to, in terms of efficiency and daylighting. However, I remember feeling overwhelmed by the scale of the lobby and the feeling that I was walking through little more than a factory that re-fabricated humans into efficient, mindless beings. I wandered through the space with an obvious knowledge of where I was going, due to circulation design and clear signage, but I didn't feel as though I could relax, take my time, and enjoy the space.

In his defense, Norman Foster designed the terminal to be much different than it is now. Originally designed as a pavilion-style, transparent terminal, in which the airplanes could be seen from the opposite landside, the airport was quickly cluttered with barriers as the result of safety concerns and the need for retail spaces. Looking back on my experience at Stansted, the experience would have been much different had Foster's design carried through to completion. However, technology of security methods will evolve, and perhaps one day we will be able to inhabit the kind of space in which the architect intended. Edwards states the following in his book "The Modern Terminal":

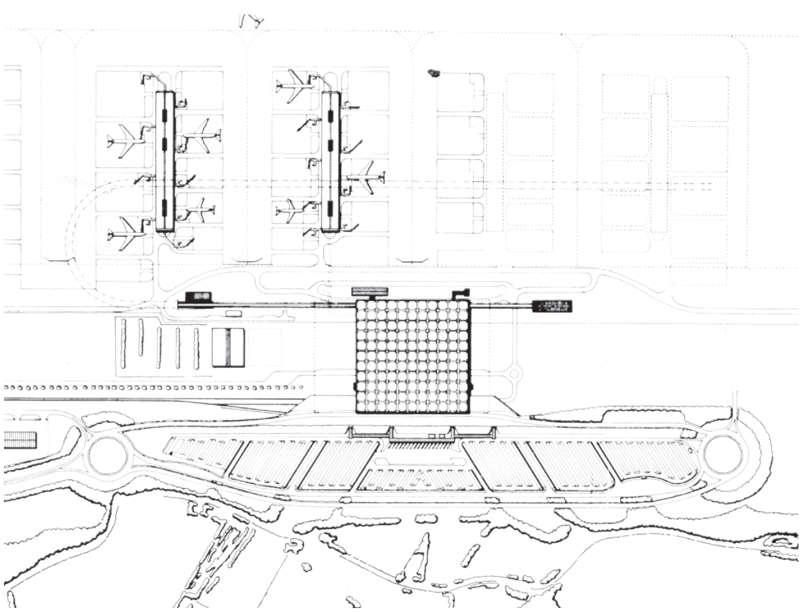


Figure 2 - Stansted Site Plan

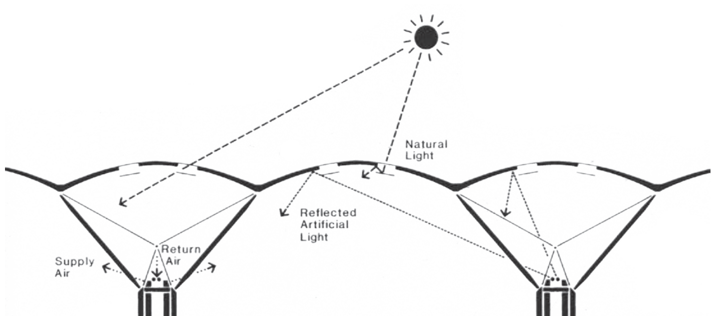


Figure 3 - Stansted Light Diagram

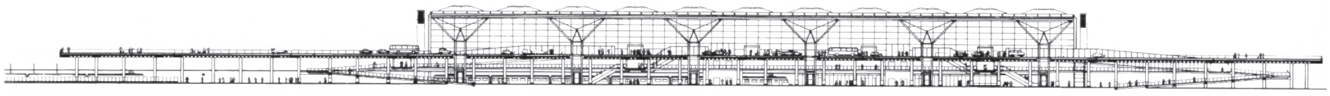


Figure 5 - Stansted Landside Elevation

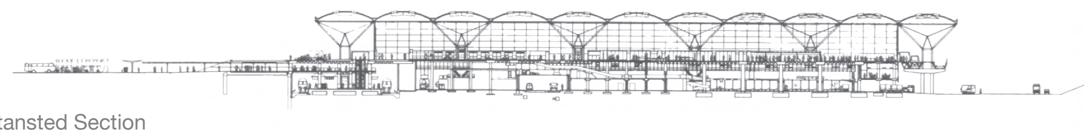


Figure 6 - Stansted Section

"With hindsight, perhaps the controlling hand of one designer cannot determine every detail, and should not attempt to do so within an industry noted for its flux. Perhaps all the terminal architect can expect to shape are the essentials of good architecture – space, structure and light – leaving many details to be determined by others and freely altered on short timescales. If there is a single lesson to be learned from Stansted, it is the need to split the signature spaces and architectural elements from the lesser details, allowing the former to have lasting qualities and the latter to adapt more readily to market needs." (Edwards, The Modern Terminal, 1998, pg. 172)

Perhaps my biggest problem with this design is that it shows little or no regard for the site. It could be placed anywhere in the world, and the meaning of the design would not change. It has been said that the pillars resemble trees, with the wide expanse of ceiling representing the tree canopy. I acknowledge and respect Foster's use of biophilia, but even that does not connect it to the site in which it sits.

This is precisely the problem in which this thesis is focusing.

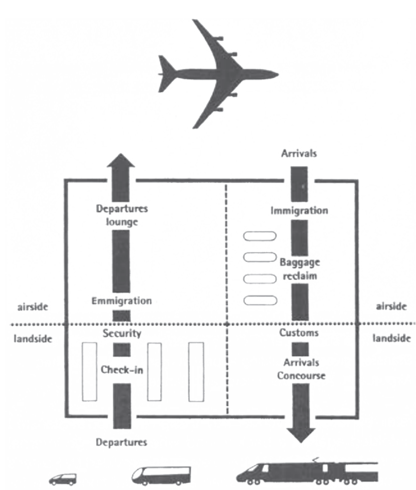


Figure 7 - Stansted Concept Plan

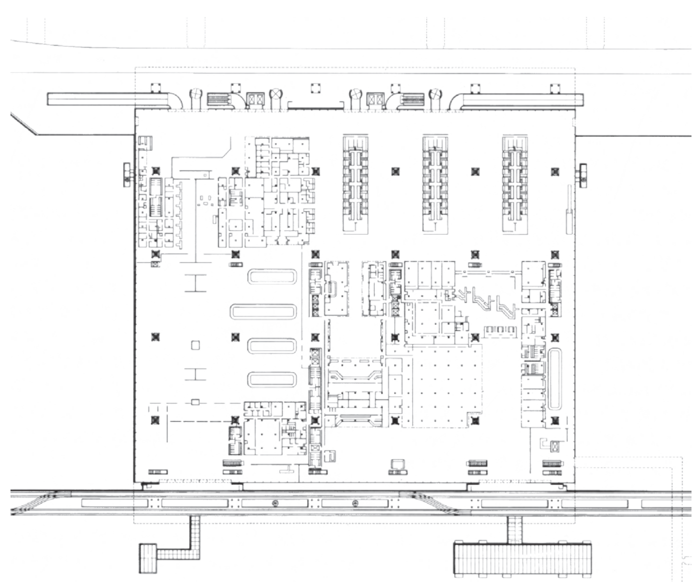


Figure 4 - Stansted Concourse Plan

FAR

HECTOR INTERNATIONAL AIRPORT

Figure 8 - Hector International Interior

Fargo, ND // 1986 & 2008 // Foss Associates & TL Stroh

Main Elements of Focus: designed for the human scale

With 78,186 flights in 2012, Hector International is closest in size to my thesis design project, of all of the case studies analyzed here. It serves five airlines, with the busiest route being Fargo to Minneapolis/St Paul, via Delta Airlines. Minneapolis is a major hub and connection point for many small airports in the area, so it is likely that many of the passengers on the Fargo-to-Minneapolis flights are truly on their way to somewhere else. This is characteristic of many flights these days, as there becomes more and more regional or small airports that allow passengers to connect to huge hubs and proceed to their destinations from there. In my exploratory thesis design project, I will be designing an airport of similar size with similar technical characteristics, so statistical information about this airport will be very similar. Although I am going to be designing a small airport, it is my belief that design is not categorized by size, but rather quality.

I have personally utilized the Fargo airport dozens of times, and still find it to be one of the best in terms of simplicity of circulation and designing for the human scale. The exterior is nothing special, with a simple form and structure. However, the interior main lobby was designed with a slanted exterior wall with diffused daylight and exposed structural trusses that continue onto the ceiling. The main draw of the diagonal wall is that it allows for maximum square footage, but creates a smaller seeming space, as the wall slants inward at the ceiling of the lobby. This is a smart and efficient way to design a space more suited for the human scale, which many large airport designs seem to overlook, or rather disregard. The interior space of Hector International is vastly different of that of London Stansted. Stansted is one level, and was intended to be essentially a large open cube. Hector, however, has been designed as a two-story building, with an open and airy large lobby, and then increasingly smaller spaces as one moves through the building. From the lobby, passengers ride the escalator upward to the open second floor. At the top is a restaurant, convenience store, and the airport security line. Once through security, passengers filter into a comfortable space with normal one-story ceilings, and go to their gates. Passenger circulation at Hector International seems to be efficient and clear.

The use of natural daylighting is decent, with the lobby's main exterior wall facing south. There are clerestories all along the wall, with panels built into the trusses on the interior side to diffuse the light. Still, most photos available show the space as being rather dark. Additionally, it seems as though the amount of daylight is too low to provide much passive heating effects. Overall, the use of natural daylighting could be improved, in comparison to Stansted.

Figure 9 - Hector International Exterior 1

Figure 10 - Hector International Exterior 2

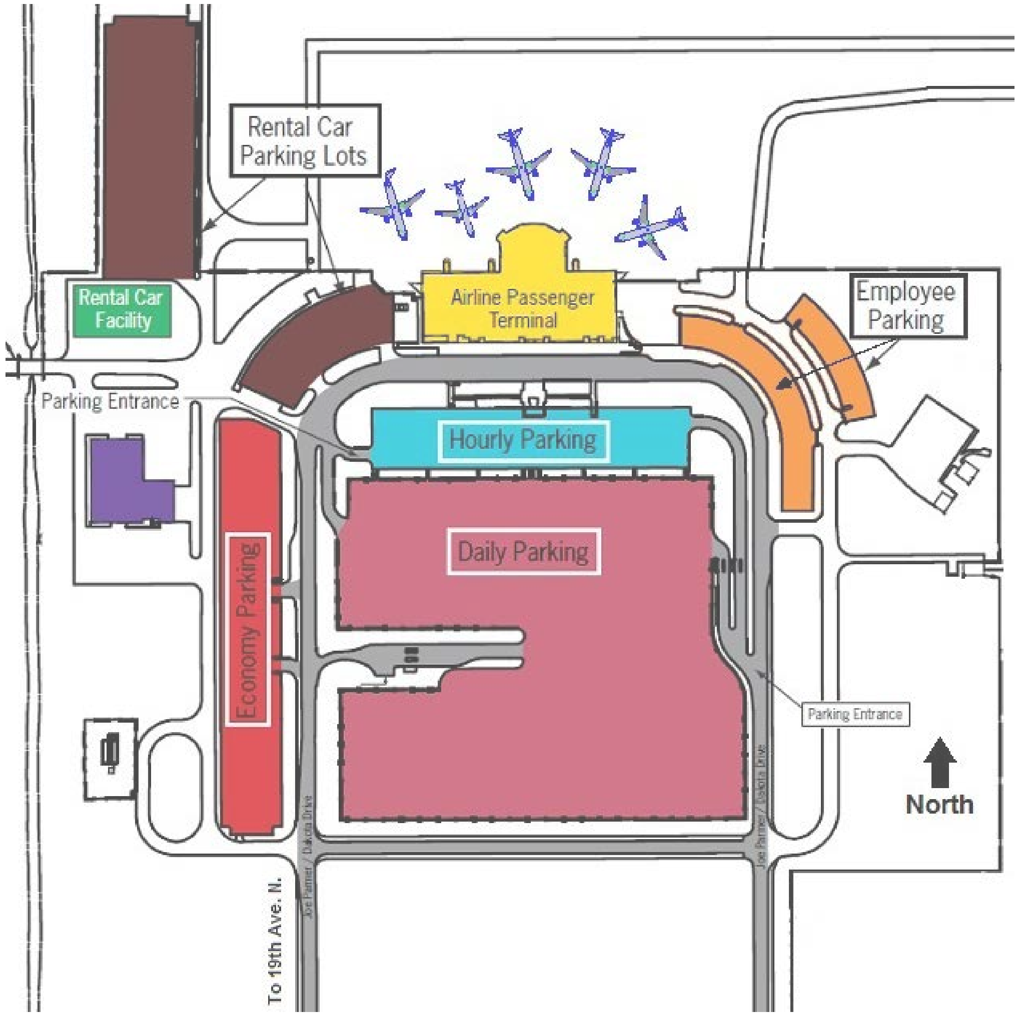


Figure 11 - Hector International Site Map

The main question here is: Does Hector International either protect or accentuate its surroundings? There is very little information to prove either is true. The shape of the building in plan is a standard rectangle with a curved addition on the back. It is two levels, but very wide, creating a large square footage but low volume. One could say this low, wide expanse of building is much like the flat plains on which the airport is located. However, I'm not convinced this was the intent of the architect.

Hector International's design presents with a lack of general acknowledgment of the site, to a point where this airport, like Stansted, could essentially be placed anywhere in the world and nothing about it would need to change or seem disconnected, because the airport in its entirety seems to be disconnected from its surroundings. It seems as though these two airports, although thousands of miles apart and vastly different sizes, have quite a bit in common in relation to my thesis emphasis - accentuation of the surrounding environment. However, they do differ in terms of the other thesis emphasis - protection of the surrounding environment. There is no evidence to assume that Hector is an environmentally friendly building, in the slightest, but Foster at least made an attempt to design an energy efficient structure.

DIA
DENVER INTERNATIONAL AIRPORT


Figure 12 - DIA Mountains

Denver, CO // 1994 // Curtis W. Fentress

Main Element of Focus: connection to landscape, innovative materials, ISO 14001

The Denver Airport, located in North-Central Colorado, is the largest airport in the United States, with a total area of 54 square miles. This, obviously, refers to the entire amount of land owned by the airport authority, and does not mean that Denver has the largest airport terminal in the United States. Denver's is in fact about 2 million square feet. The Jeppesen terminal is a long narrow structure, symmetrical along its transverse axis, with two rows of columns and a giant tensile structure above. (Cerver, 1997)

Along with the unique geometry created by the tensile structure also comes a unique daylight pattern. At the tops of the pillars, where the tensile structure forms points, there are clear spaces that bring in direct sunlight. There are also clerestory windows at the peaks formed at the bottom of the tensile structure that allow for direct sunlight in and views of the sky. However, the most interesting of all of these is the ability of the fabric to allow refracted light to enter the inside of the terminal. This, in my opinion, is one of the best examples of unique application of natural daylighting.

Energy efficiency has become a priority at the Denver Airport in the recent future. In 2008, an expansive solar park made up of 9,200 solar panels was added on the airport grounds, and produces about 6% of the facility's total energy usage. The airport is also the first airport to have ever implemented an ISO 14001 certified environmental management system of the entire facility. This standard sets out broad guidelines that any business can follow, with the basic steps being Plan, Do, Check, and Act. These refer to the stages of planning energy efficient programs, implementing them, measuring results, and then acting on improving performance based on those results. Simply the fact that the Denver Airport has implemented this standard shows great dedication to the health and of our environment.

Unlike most airports, and unlike some other case studies in this document, the Denver Airport was designed with much regard to its specific site and natural surroundings. The white tensile structure that makes up the roof of the Jeppesen Terminal is reminiscent of the snow-capped Rocky Mountains in the distance. But the question is, even with this architectural reference to the surroundings, does the structure enhance its natural environment or rather detract from it? Taking a look at materiality, the fabric tensile material seems to be an elegant choice to represent the mountains, but the color is questionable. Fentress' connection to white snow makes sense, but it accentuates the building rather than its environment. I'm sure Fentress knew this, and an eye-catching design was his intention; it just doesn't agree with the intent of this thesis investigation.

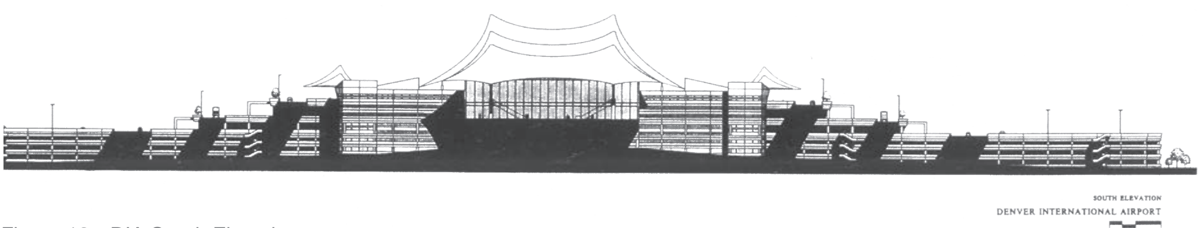


Figure 13 - DIA South Elevation

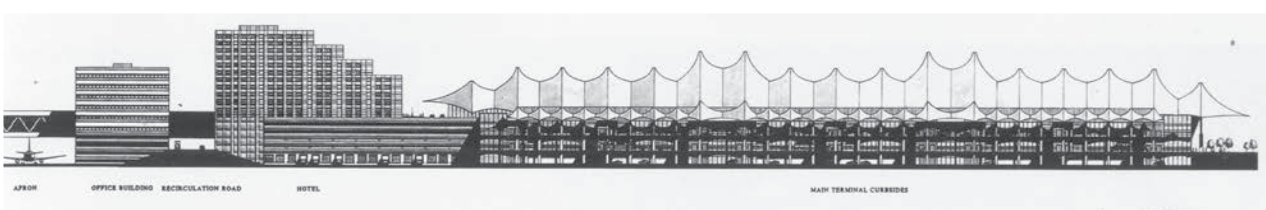


Figure 14 - DIA West Elevation

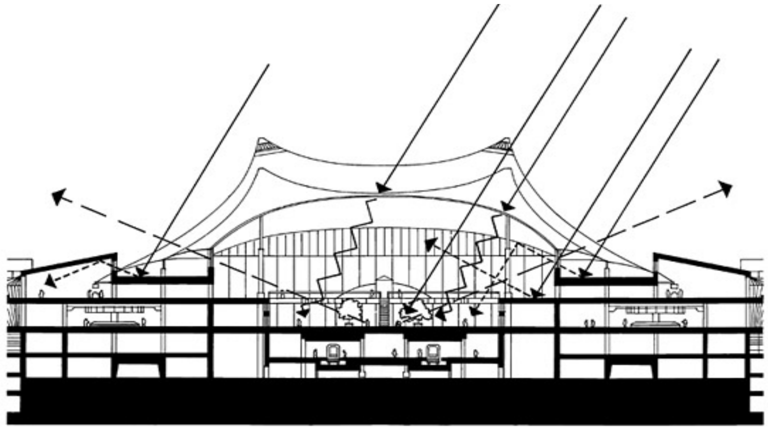


Figure 15 - DIA Light Diagram

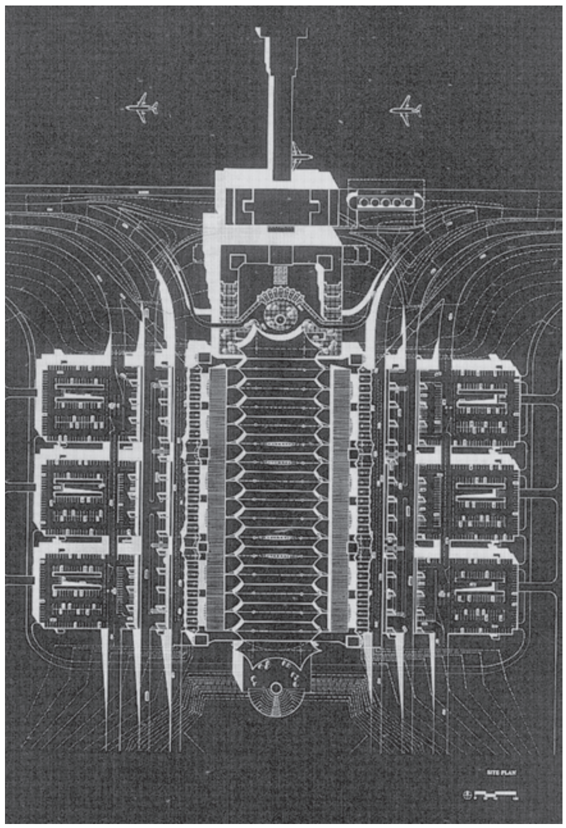


Figure 16 - DIA Site Map


Figure 17 - DIA Clerestory

I believe that half the battle comes from acknowledging the natural aspects of the site, and using those to create a design specific to that certain place. Fentress gave much concern where many architects of airports never would have. This airport is meant for Denver – it would not make sense anywhere else. That, in my opinion, is very important to this thesis. However, the design does take away from the visual integrity of the surrounding nature.

All in all, of the three major case studies shown here, Denver International Airport's design has done the best of correlating with my project emphasis and general direction of my thesis. It connects with its surrounding environment, although not necessarily to the extent I wish to accomplish, and it has recently incorporated sustainable features which enable it to protect its environment to a certain extent.

Additional Typological Research

Even with the knowledge gained from the previous three case studies, it seems as though there needs to be more exploration of the emphasis of site integration. Here, there are studies of buildings with various typologies that seem to be examples beneficial to this thesis.

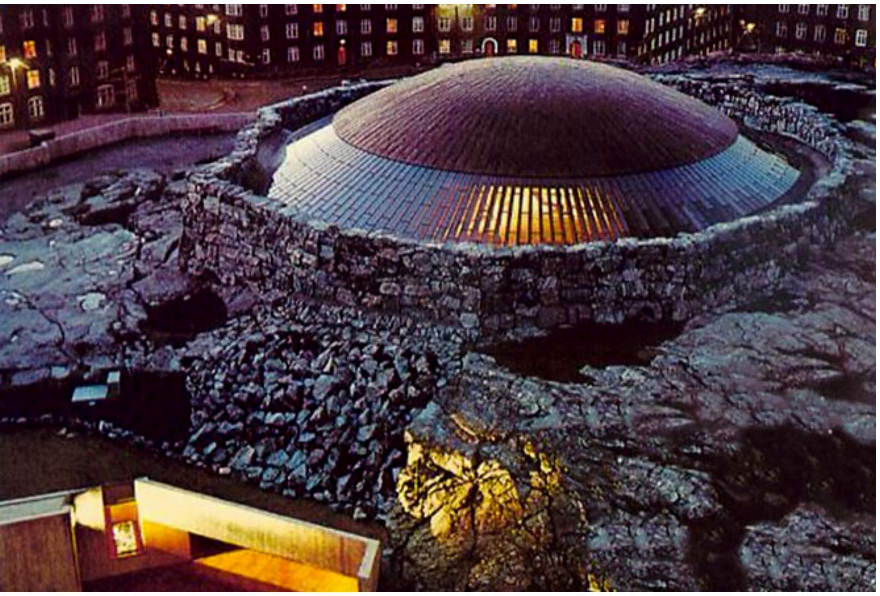


Figure 18 - Temppeliaukio Exterior


Figure 19 - Temppeliaukio Interior

Temppeliaukio Church "Church of the Rock"
Helsinki, Sweden // 1969 // Timo & Tuomo Suomalainen

The name of this structure perfectly describes this building, as it is quite literally carved out of the rock. Interior walls are left naturally jagged, and the roof is a copper dome with a ribbon of skylight around the edge. This case study is one of the best examples of site integration in the world. It offers the phenomenon of being *in* the landscape, and takes that perception farther than ever could be imagined. With natural daylight flooding the space, natural stone walls, views to the natural surroundings, and the copper dome reflecting colors of the natural environment, who could not feel completely immersed in nature in a place like this?

And it seems as though nature-loving architects are not the only ones who find this structure fascinating. More than half a million people visit each year to see this church's magnificent form and unique connection with its natural environment.

Kolumba Museum
Cologne, Germany // 2007 // Peter Zumthor

Another beautiful example of site integration, Peter Zumthor designed the Kolumba Museum to sit atop the remains of the former Church of St. Columba. The Gothic church had been destroyed in World War II. I had the opportunity to visit the Kolumba recently, and it is truly a breathtaking work of architecture.

While this design isn't necessarily acknowledging its broader ***natural*** environment, it does recognize and enhance the man made wonder that once existed there. Zumthor kept as much of the ruins as possible, while also adding a simple, modern second and third stories which house some of the Archdiocese's most incredible art and artifacts.

With a successful integration of the new modern building with the existing site, this case study will likely have a powerful effect on the thesis design process and raise important questions related to the ability of using contrasting architectural styles together to create an impactful, yet respectful design.

Figure 20 - Kolumba Exterior
Figure 21 - Kolumba Detail
Figure 22 - Kolumba Interior


Figure 23 - Chapel of the Holy Cross Sunset


Figure 24 - Chapel of the Holy Cross Exterior

Chapel of the Holy Cross
Sedona, Arizona // 1955 // Anshen & Allen

Located only a few miles from the site of focus in this thesis, is the Chapel of the Holy Cross. It is a 250-foot-high structure that emerges from a 1000-foot cliff, which was oddly enough inspired by the Empire State Building. Unlike its inspiration, the Chapel of the Holy Cross appears to be one with the mountain on which it sits. The elegant, simplistic cross on the front facade, the purpose of the building is evident, but the design does not take away from its natural surroundings. Unlike the Denver International Airport, which relates to its surroundings in its design, the Chapel of the Holy Cross attempts to blend in with material and color, while still making an architectural statement. It causes one to look twice, and really investigate the unique design.

Overall, this building truly does accentuate the colorful rock monoliths on which it rests. It creates a unique experience in which one is able to be immersed in the surrounding nature and in a significant piece of architecture all at once.

Summary of Typological Research

In summary, six architectural projects were analyzed in the preceding section, however only three of these were airports. It is important to acquire a base of knowledge about previous works of the specific typology in which this thesis will focus, but restricting research to only one typology stifles creativity and theoretical exploration.

Overall, it is very obvious to see the differences between the architectural priorities of even the most environmentally-friendly airports, and those of other typologies. While Denver International and London Stansted both seem to be teetering on the edge of sustainability, they still don't quite acknowledge their environments in the ways of the Kolumba, Temppeliaukio and Chapel of the Holy Cross. And Hector International doesn't show any signs of sustainable tactics or site integration.

I realize that my analysis of the first three case studies, London Stansted, Hector International and Denver International, are more negative than anything. This isn't because they aren't incredible designs; it's simply because they don't correlate well with my thesis emphasis. I chose Denver and Sansted because they are the most sustainable airports I could find, and yet they still lack fundamental environmentally-friendly systems and elements. Hector was chosen because of its size, easily relatable to this thesis project, and my extensive experience of using the small airport.

It was reassuring to come across information about a few sustainable practices being implemented in existing airports, as I hadn't been aware of these developments. Denver International Airport has become a leader in sustainable efforts, and seems to be continually progressing. However, airport design is still far behind the rest of the architecture realm where sustainability is concerned.

Also, I have yet to come across an airport that is integrated into its site as much as the Chapel of the Holy Cross, or the other two additional case studies. Is this because of the need for an airport to be visible from the sky? No. Pilots don't look for terminals when they're landing an airplane; they look for big white numbers on runways. So then, maybe modern and flashy terminals are a cultural norm. It's likely the case that many people associate airplanes with futuristic design, but I'd like to make the argument that futuristic isn't always appropriate. In a location like Sedona, site integration is very important, and I plan to prove it through my design project at the end of this thesis.

Major Project Elements

Figure 25 - Elements / Users Diagram

There are many activities that happen within the boundaries of airports. Some of these major elements are:

Ticket Sales Lobby: The main entrance, and first impression of the interior space. Airline employees, passengers, greeters/senders, and general maintenance staff will all occupy the lobby. The space should have plenty of natural lighting, and views to the outdoors to ease the transition of the user from exterior to interior.

Airline Staff Offices / Workspaces / Conference Rooms: Located near the lobby, these private spaces will be used by Airline Staff and Airport Staff.

Security Checkpoint(s): The security checkpoint will be used by passengers, TSA Employees, as well as specific Airline Employees (pilots, stewards/stewardesses). The space will need to be efficiently laid out.

Gate Waiting Areas: These will be used primarily by passengers, but also select airport employees and airline employees (pilots, stewards/stewardesses).

Retail / Restaurant(s): Restaurants and retail spaces will be occupied by their respective employees, as well as passengers and airline employees (pilots, stewards/stewardesses).

Wide Circulation Spaces: Although perhaps obvious, wide circulation spaces are incredibly important to the typical airport program. The actual need for these spaces will be investigated more in the program and design portions of this thesis.
Tarmac (Airplane Loading Area): The Tarmac itself will be used by airline and airport employees (operations and maintenance) loading and unloading baggage, etc.

Baggage Processing and Loading: Again, airline and airport employees will be the only ones using the baggage processing and loading areas. These spaces will have conveyor belts and open floor plans to allow for easy access with small airport vehicles.

Baggage Claim Area: The baggage claim will be occupied by passengers, greeters, and a few airport employees (such as rental car agencies, etc.)

Pick-up / Drop-off Area: This exterior space is typically directly in front of the main entrance, and needs to accommodate passengers, greeters/senders, as well as many vehicles.

Parking: long term and short term: Parking doesn't need much of a description. Long term will be farther away from the lobby doors, and short term will be close.

*Other elements such as taxiways, runways, ATC, general aviation hangars, etc. are on the Airport Authority grounds, but are spaces which will not be used directly by passengers or employees of the terminal. Passengers, pilots/stewards/stewardesses, and others will all utilize these spaces in some way, but they are guided through and will not wander around them via their own free will.

User / Client Description

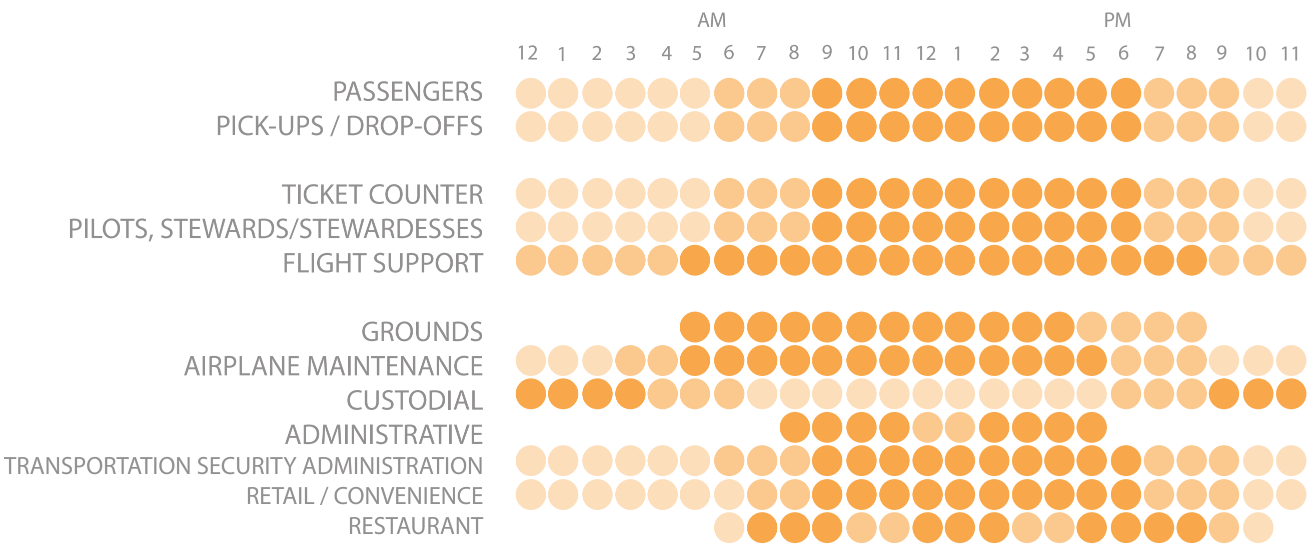


Figure 26 - Users Diagram

The building's user groups can be broken down into three main categories: passengers and their "guests", airline employees, and airport employees.

Passengers: a guest at the airport. They are the paying customers, and receive priority like any customer would. Based on statistics of Hector International, a similarly sized airport, there will be an average of about 12 flights per day, each carrying around 150. This would put this project's total estimated passengers at 1,800 per day. There will need to be long-term parking near the entrance of the airport to accommodate this number of passengers. A thorough study will be conducted in the programming section of this thesis to determine the required number of parking spots.

Also included in this category are the passengers' pick-ups / drop-offs. In other words, family or friends who bring passengers to and from the airport. These people often wait inside the terminal for the passengers to arrive, and space needs to be allocated inside the building, as well as plenty of short-term parking closest to the entrance.

Airline Employees: all employees hired by the airline, directly, including ticket counter employees, pilots and stewards/ stewardesses, etc. These people would have parking separate from that of the passengers.

Airport Employees: all employees hired by the airport authority. This would include grounds, airplane maintenance, custodial, administrative, TSA, and retail / restaurant employees. Also, the board of directors. These people would also park in a staff lot separate from that of the passengers. Total employees of airline and airport combined will be an estimated one fourth of the amount of daily passengers. This equals out to about 450 total employees.

*These categories and numbers do not take into account employees or other passengers / pilots that may use the airport grounds, but not the terminal. These may include air traffic control, flight instructors, student pilots, etc.

Site Information

The site is located in Sedona, Arizona - a town nestled in wilderness and majestic soaring red rock monoliths. Arizona varies vastly from the northern part of the state to the southern. In the north, you are likely to find snow-capped mountains and the Grand Canyon, and in the south, vast dry deserts are more common. Sedona lies right in the middle of these two areas, creating a beautiful mesh of each.

I have chosen this site because of its unique landscape, and because of the political controversy of the protection of nature in the area. The Coconino National Forest, a 1.8-million acre US National Forest located in Northern Arizona, surrounds Sedona, and there has been controversy over the negative environmental effects of the existing airport just outside the town. I would like this thesis project to provide a solution that would allow both sides to compromise, by keeping the airport and designing a structure that will be environmentally friendly and not distract from the natural beauty of the surrounding Coconino National Forrest.

Figure 27 - Sedona Aerial

The two maps on this page reference the Southwest region of the United States, and the border of Coconino and Yavapai Counties, where Sedona lies. The following page presents an illustrated map that better defines the line between these two counties, as well as distances to major cities and the Grand Canyon. The illustration also shows major roads, nearby landmarks and views. Also, notice that letter "D" in the legend is labeled as "Chapel of the Holy Cross", which was already analyzed in the typological research section.

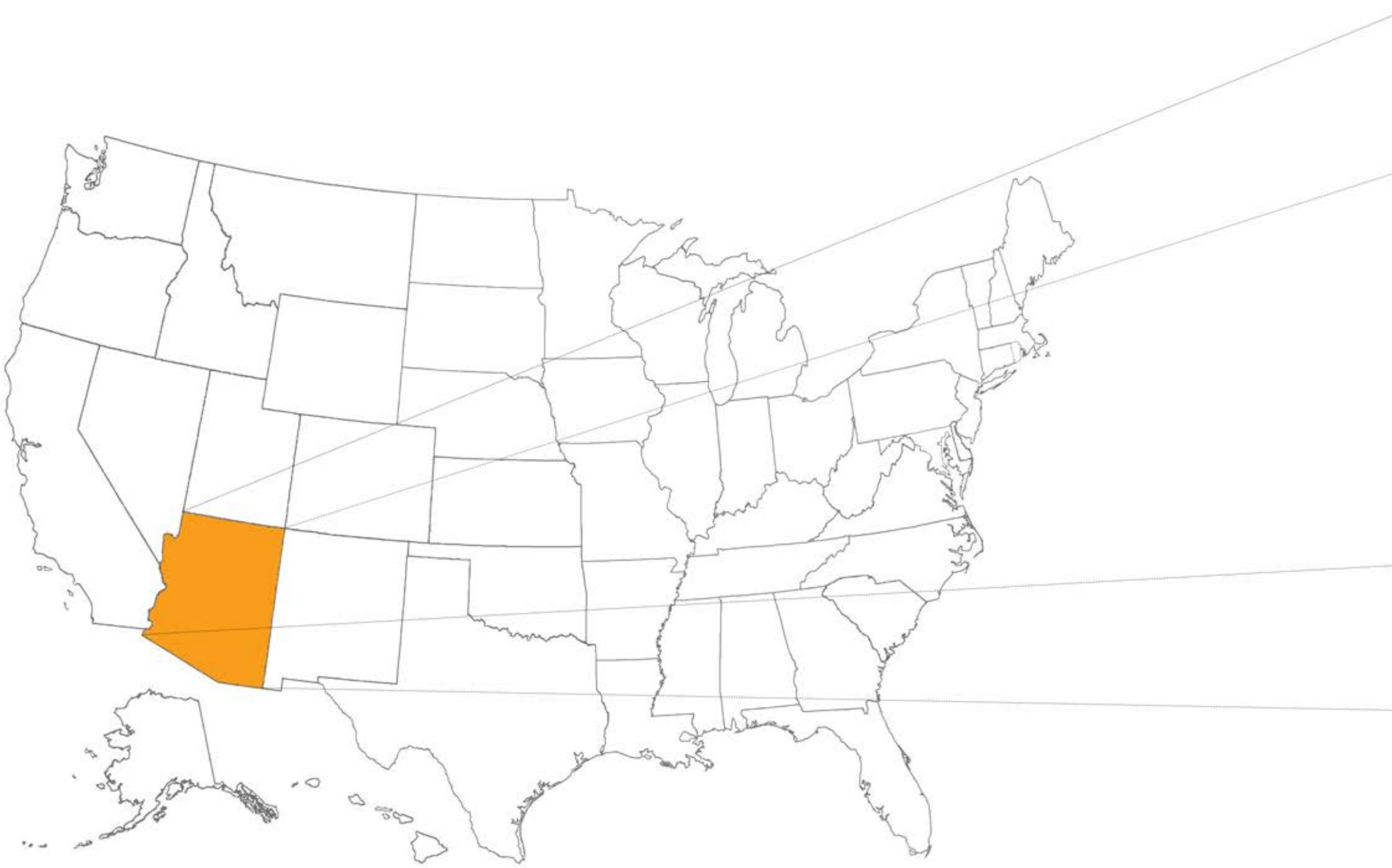
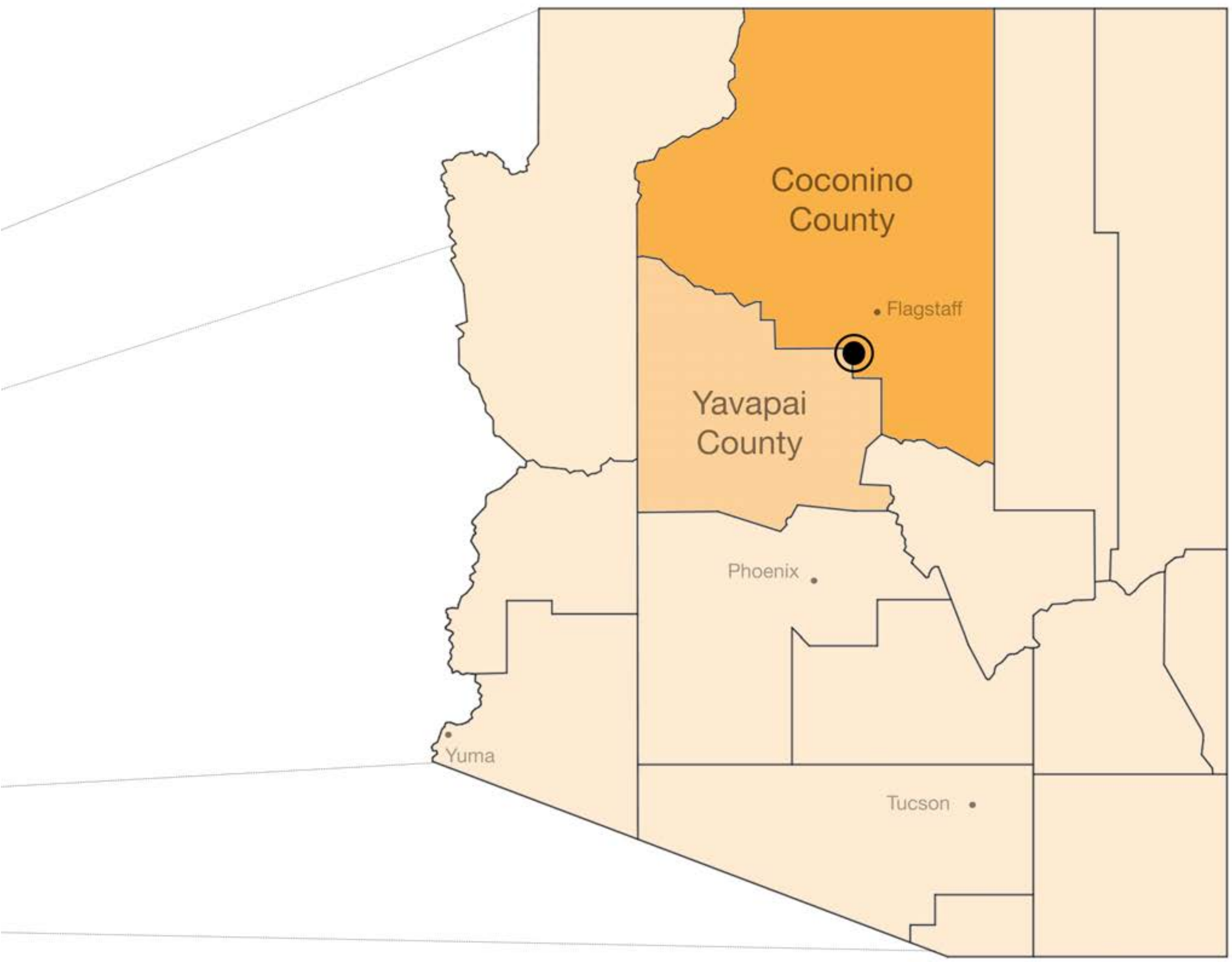


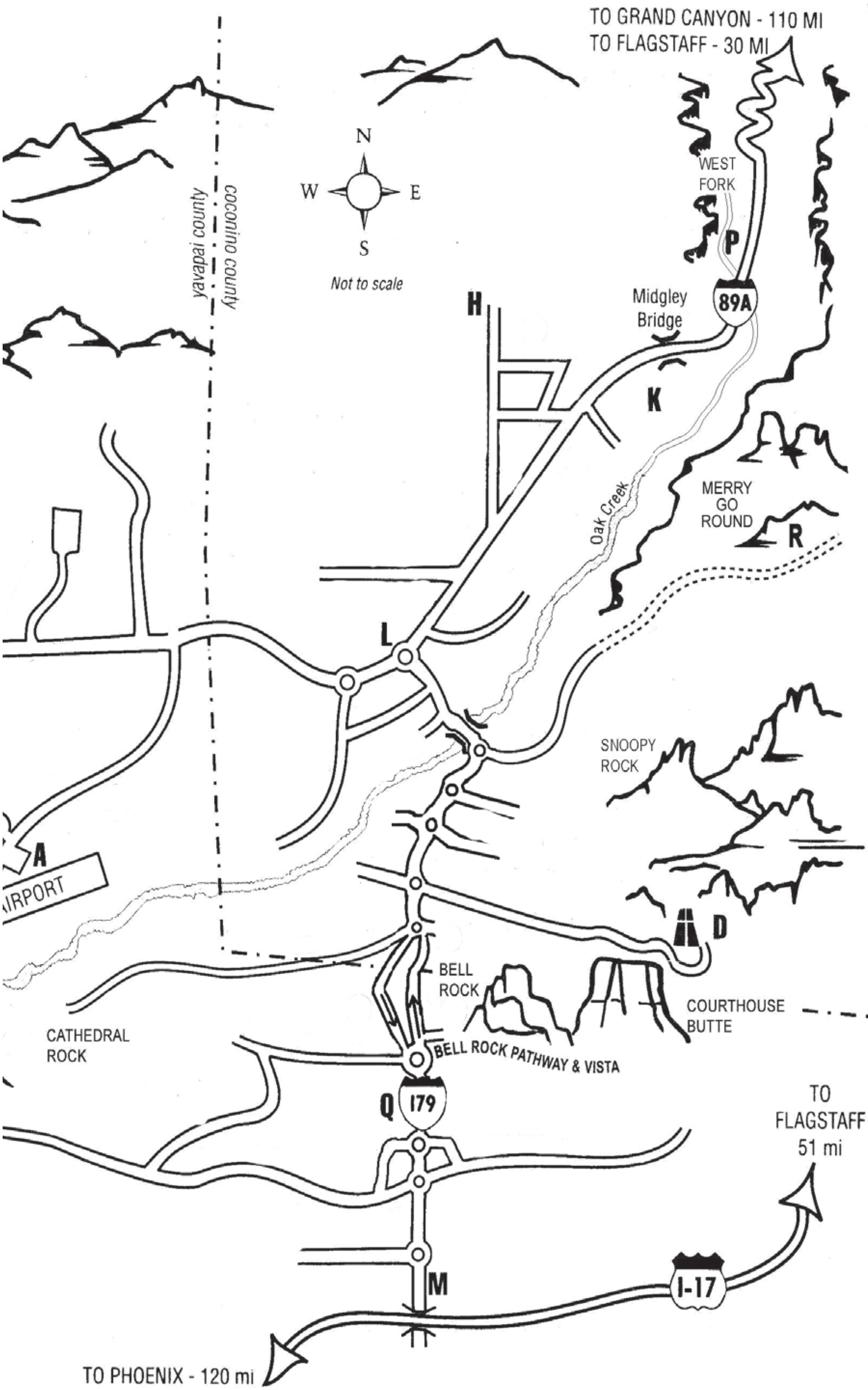
Figure 28 - Map: Regional, State, County


Coconino
County
Flagstaff
Yavapai
County
Phoenix
Yuma
Tucson

LEGEND

A. AIRPORT MESA
B. BOYNTON CANYON
C. CHAMBER OF COMMERCE
D. CHAPEL OF THE HOLY CROSS
E. CITY HALL and POLICE STATION
F. CRESCENT MOON RANCH / RED ROCK CROSSING
G. FIRE DEPARTMENT
H. JORDAN HISTORICAL PARK
I. LIBRARY
J. MEDICAL CENTER
K. OAK CREEK CANYON
L. POST OFFICE
M. RANGER STATION
N. RED ROCK STATE PARK
O. SCENIC OVERLOOK
P. SLIDE ROCK STATE PARK
Q. VILLAGE OF OAK CREEK
R. SCENIC OVERLOOK

Figure 29 - Sedona Map Illustration


TO GRAND CANYON - 110 MI
TO FLAGSTAFF - 30 MI
N
W
E
S
Not to scale
yavapai county
coconino county
WEST FORK
P
89A
Midgley Bridge
H
K
MERRY GO ROUND
R
Oak Creek
L
SNOOPY ROCK
A
AIRPORT
D
BELL ROCK
COURTHOUSE BUTTE
CATHEDRAL ROCK
BELL ROCK PATHWAY & VISTA
Q
179
TO FLAGSTAFF 51 mi
I-17
M
TO PHOENIX - 120 mi

Project Emphasis

To **accentuate** the surrounding environment by conducting research on the visual disturbance of buildings in the landscape, and the ever present conflict between architecture and the natural world. The design project will attempt to propose a balanced compromise that will allow onlookers to not be distracted from their surroundings.

To **protect** the surrounding environment by conducting research on environmental effects of airport operations, and possible solutions to eliminate these effects, and potentially even provide not only neutrality, but a positive impact on the environment.

Goals of the Project

Academic

There are many tasks that I plan to accomplish in my final year as an architecture student. However, these many of these tasks are ones in which I have limited knowledge, and so it is for this reason that I have also listed skills necessary to learn.

- Conduct a building lifetime cost analysis
- Determine a budget, and stick with it
- Research innovative sustainable active and passive systems
- Research visual perception, and its relation to architecture
- Use creative problem-solving methods to implement sustainable strategies
- Gain a better understanding of the construction of a building, specifically the building's envelope
- Experiment with the use of different digital design softwares to enhance the discovery and presentation phases of the design process
- Research ISO 14001 standard
- Research Passivehaus design standard
- Comply to LEED guidelines, and design a Platinum Certified project

Professional

Through the completion of this thesis, I hope to gain both knowledge and physical showpieces which can be used as a marketing tool as I go out into the profession. Every unique skill should be evident in my final presentation and/or design process of the thesis.

- Produce a cohesively graphic thesis document that records every step of the design process
- Produce accurate, readable and graphically pleasing floor plans, sections, elevations, etc.
- Produce logical and accurate details, some of which may be innovative due to the use of ground breaking sustainable strategies
- Produce exceptional renderings that express the true vision of the project
- Contact the architects of some buildings, which are similar in typology and size or theoretical aspect to my project, to discuss these buildings and what can be learned from them

Personal

This thesis the last piece of work to come from my college career, and I will do all I can to make it a worthwhile endeavor which explores the theoretical aspect and typology to completion. I have a great deal of passion for the three major topics being discussed, and expanding my knowledge base on any or all of these will be of great personal benefit to me. Here are the personal goals which I have set for myself in the completion of this thesis.

- Learn technicalities of how airports work
- Fly into the airport which I have chosen for my site
- Learn about new technologies in the air travel industry
- Use this thesis to affect both the architecture profession and the air industry in a positive way
- Expand my overall knowledge on the topic of flying
- Use this thesis project to experience the views of new landscapes from an airplane.

Plan for Proceeding

Definitions of research direction

Research will be conducted on site analysis, history of natural context, programmatic requirements, negative environmental and visual effects of the current facility, sustainable systems and materials, and the integration of architecture with site.

A plan for your design methodology

The research for this thesis project will utilize a mixed method, quantitative/qualitative approach. Both statistical and scientific data will be gathered through archival research, and qualitative data will be gathered through direct observation, archival search, direct interviews, and perhaps local surveys.

A plan for documenting the design process

The documentation of the thesis will be compiled in writing with accompanying illustrations throughout the design process, as well as presented in physical graphic form with presentation boards and physical models at the completion of the project. Following completion, this thesis book and images of presentation boards and models will be available via the North Dakota State University's institutional repository.

Schedule

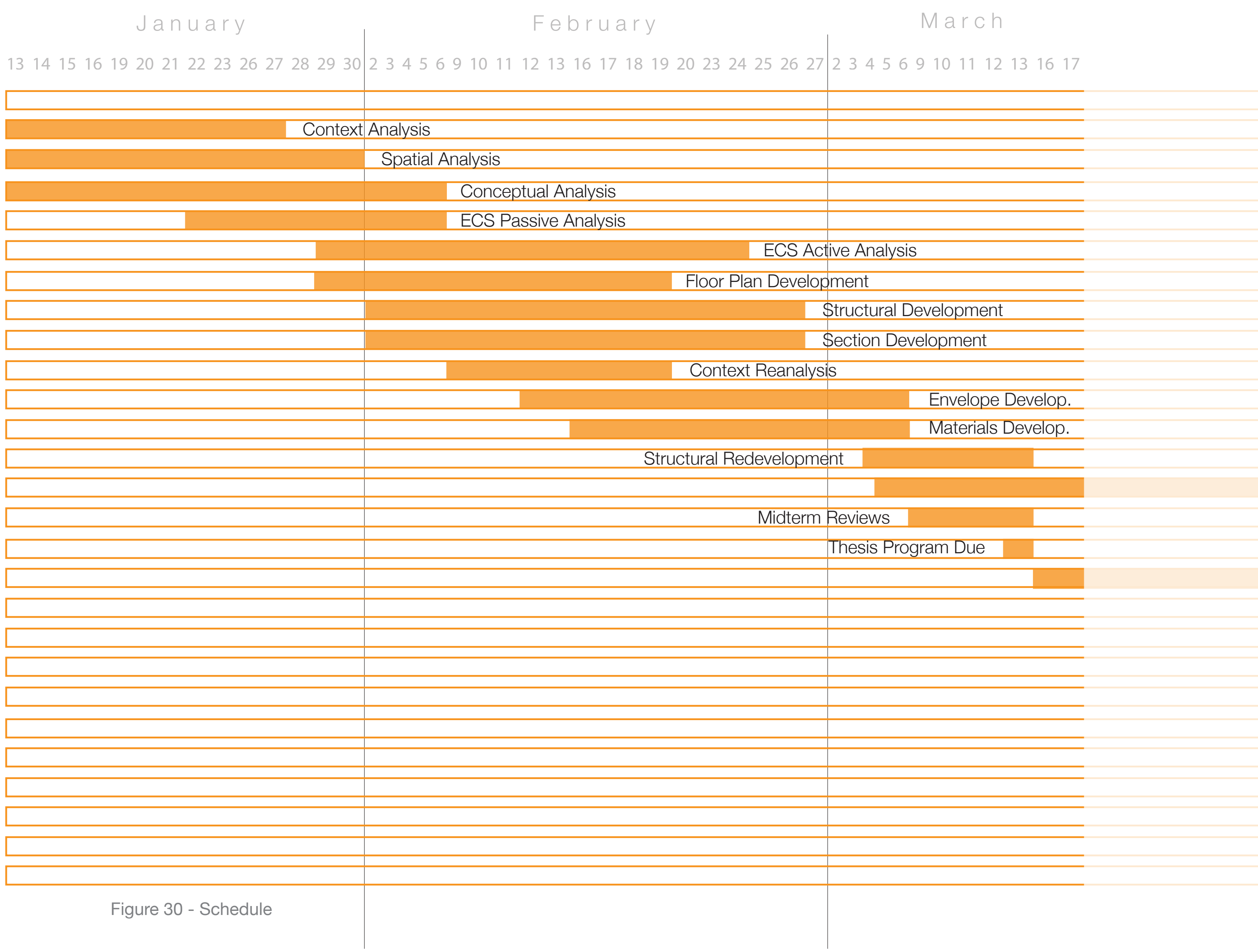
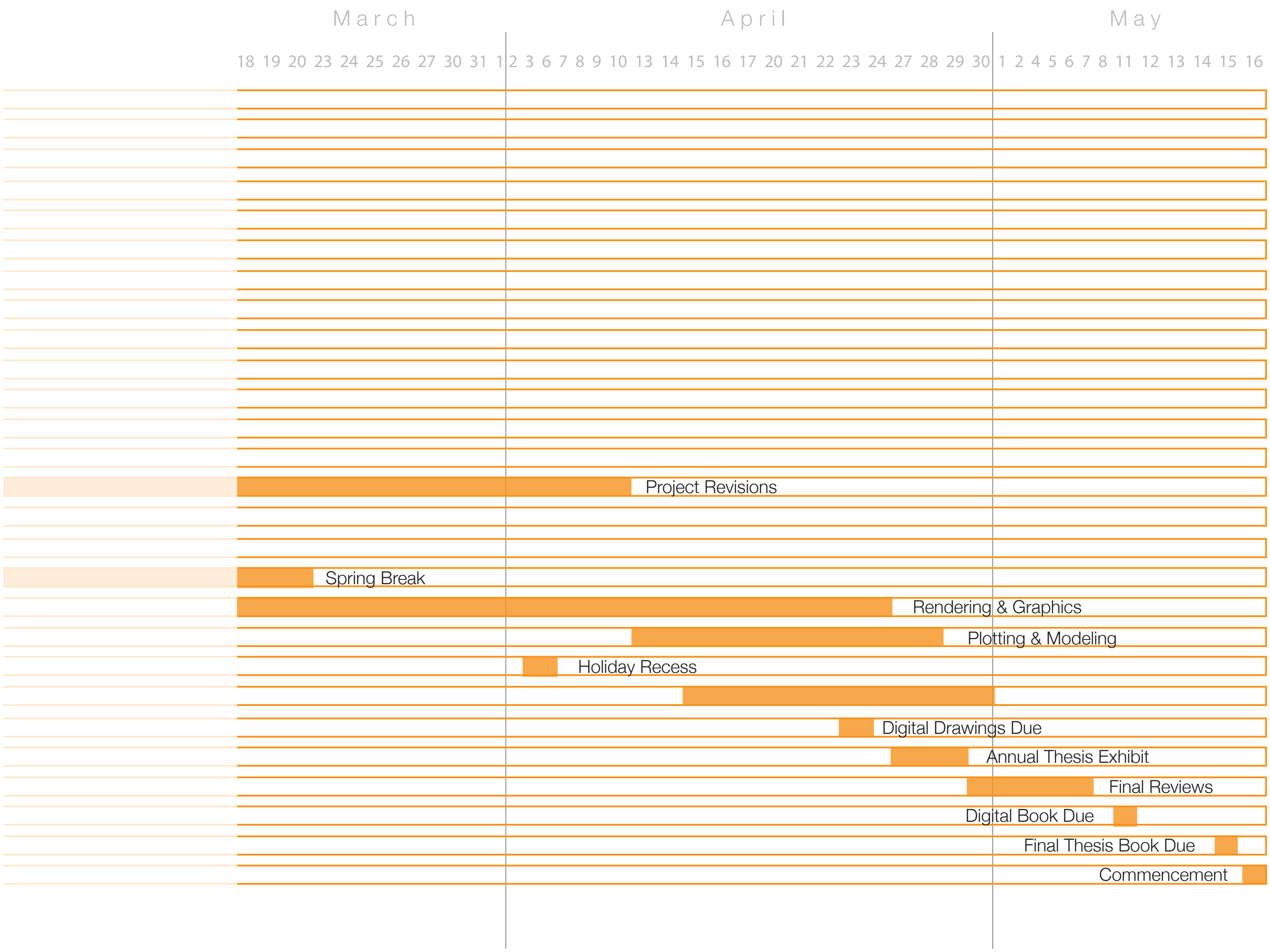


Figure 30 - Schedule


March
April
May
18 19 20 23 24 25 26 27 30 31 1 2 3 6 7 8 9 10 13 14 15 16 17 20 21 22 23 24 27 28 29 30 1 2 4 5 6 7 8 11 12 13 14 15 16
Project Revisions
Spring Break
Rendering & Graphics
Plotting & Modeling
Holiday Recess
Digital Drawings Due
Annual Thesis Exhibit
Final Reviews
Digital Book Due
Final Thesis Book Due
Commencement

THESIS **PROGRAM**

Research of the Theoretical Aspect

Beginning with research on the topic of site integration and the relation of architecture to the land that it inhabits, and ending with research on the topic of sustainable practices and their importance, this part of the thesis document strives to bring together these two similar but historically detached topics.

"Buildings replace the land. That is architecture's original sin."
–Aaron Betsky

What is site integration? It is likely that many may confuse the term "site integration" with "site analysis" or "site incorporation" methods that most architects use in their design process.

Site integration is a vague term that many architects and designers interpret at a minimal level. However, according to Merriam-Webster, to integrate is "to form, coordinate, or blend into a functioning or unified whole". It is likely that many may confuse the term "site integration" with "site analysis" or "site incorporation" methods that most architects use in their design process. Many designers only consider strategies such as building orientation to connect their architecture to the land, but the definition above implies that this is not enough. Simply making use of the general laws of orientation and making the best views visible from a structure is not integration, but rather just the basic principles that architecture is based on. These are important principles, but in order to truly integrate a structure into its site, it needs to become one with the site - "a unified whole". There are ways in which to do this, and just like everything in the art and design realm, the success or failure of certain strategies is subject to opinion. However, when one sees a well-integrated structure, its intention is obvious, and that cannot be denied. Buildings such as the Church of the Rock and the Chapel of the Holy Cross are quite literally integrated into their sites. In his book titled Landscrapers, Aaron Betsky describes site integration as "buildings that seek to restore the land and architects that see their work as unfolding the land rather than hiding it."

Many architects have attempted to do this, and many seem successful. But the biggest struggle of designing a building that is integrated into the site is knowing how to measure the success or to determine the qualifications of a fully integrated project. In this thesis, I will be setting my own measurable requirements of what makes a building integrated into its surroundings. I will break down the requirements into the following categories: land form, ecosystem and micro-climate. But before discussing specific requirements that create a successfully site-integrated building, we must first understand the importance of site integration in the architecture profession and acknowledge the historic struggle between the essence of architecture and respect for the land on which it sits.

Modern Day Technology and the Land

In a world constantly morphing with the development of new technologies, acknowledgment of the land on which we live has become scarce. To most, it has become little more than ordinary – an entity that has always been visible but is rarely truly seen. Currently, the profession of architecture has become a competition of who can build the tallest tower, or the shiniest new stadium. The largest and most influential architecture firms in the world are designing with new technology and leaving traditional methods behind. New methods are a great advantage of the times, as they enable architects to better understand the mechanics of their buildings, but these methods often cloud one's perception of a design during the design process.

Martin Heidegger takes these ideas even further in his essay "The Question Concerning Technology" where he compares man made forms to those in nature that humans are attempting to recreate. One example of this is a dam, which is a near perfect solution that humans recreate artificially. Nature is the all-knowing source, and we learn from it everyday. We develop new technologies based on structures and ideas that have eluded us for centuries, but when will we realize that the very ideas found in nature that we try to replicate and improve are separating us from the very essence of humanity and our connection with the natural world around us. He seems almost positive that technology will one day take over the world, and therefor also take over us. Heidegger then implies that maintaining an artful and poetic mind in a world transforming with new technology will allow us to resist the change ourselves and see the harmful effects of the invasion of technology on our society. (Heidegger, 1977).

Architecture's History with the Land

Architecture's battle with the land originated with the very establishment of architecture itself. However, the first cases of blatant disregard for the land on which architecture rests was likely during the Roman times, when walls and a roof became necessary to claim one's piece of land, to protect it. This is when the existence of "land" began to transform into "territories" – quantifiable and given value. Since then, land has likely become the most valuable entity in the world. Countries fight wars over it, and it contains our most precious metals, gems, and natural resources. As living beings, we cannot foresee any possible way of surviving without it, and yet our society gives so little credit and value to land in our everyday lives.

In ancient times, architecture was often purposefully defiant of its surroundings. Tall temples were constructed to mark civilization in an expansive world with comparatively very few humans. Now, on a planet of which most land is covered with the built environment, glimpses of nature are few and far between. It's almost as if human civilization has created too much of a good thing, and realized the end result is not as we had anticipated.

Human Existence and the Land

Martin Heidegger, in his works Early Greek Thinking and Being and Time, pays cautious consideration to the purpose of human existence and what it is that makes us human beings. Heidegger claims that the act of "gathering" is one element that distinguishes human existence from that of non-human, such as land. (Heidegger, 1985 and 1977, respectively). Aaron Betsky explains Heidegger's opinion on the topic and says, "This is the mark of human existence, setting us apart from the earth and establishing an alternative, artificial ground. All building can only be an elaboration of that original condition of emulation, establishment and essential separation." (Betsky, 2002, p. 9). He does not, however, appear to be agreeing with Heidegger's thoughts. Betsky acknowledges the historical separation between humans and the land, and tries to explain why this came about. Betsky maintains the opinion, throughout his book, that humans and nature should work together as one. Or rather that humans should integrate with nature, in that nature already gives us everything we need to survive.

Guy Debord took a different approach than Heidegger, claiming that the way in which we perceive the landscape is a result of human civilization. Any space in nature has memories and experiences associated with it "that only need to be articulated or named to generate new forms". In my experience as an architecture student, this is how I have been taught. The history and personal experiences with a space are what shape the art and design of a form. But certainly not all architects think this way. Debord conducted an experiment in which he attempted to recreate a city simply by wandering through it and reconnecting small, forgotten elements with far-away monuments in a collage-like manner. He essentially provided a collected image of the essence of the city – an essence that was much unlike the popular belief. He didn't so much create a new city, as rediscover what was already there. Betsky describes Debord's findings in these words, "It was an act of naming that gave significance to the very contour lines of daily existence." (Andreotti, Costa, 1996)

Essence of the Land

The French philosopher, Michel Foucault, lent the name "heterotopias" to spaces that seem somehow unreal, and are not what they seem or what we think they should be. One example that I found especially interesting was a library, and its ability to separate us from current time due to its nature of accumulating time in a space. A library holds hundreds, even thousands of years of information, creating a contradiction of time within an existent space. But how does the heterotopia relate to the question of defining the role and essence of land? Well, Foucault's heterotopia and Debord's theories of human civilization are similar in that they imply that the ideal space is not something that can be built as we build buildings today. The heterotopia is a space that can only be realized, not created, only if we have the ability to uncover what is already there.

"Many architects and designers have attempted to build such spaces. Raised on the teachings of Derrida, Debord, Lefebvre and Foucault, wary of the over-arching ambitions of their elders, and aware of the necessity to build with the land and not merely on it, they are drawing on the secret history of architecture to make a new kind of building: structures that are underground, on the ground, or barely above it. Their forms are not shaped by the niceties of classical or modernist styles, but rather mimic or respond to the specific site on which they are constructed. Torn from the earth or sinking into it, slipping away as it always does into the enigma of the earth." – Aaron Betsky in his book Landscrapers

"Its purpose is to re-write and re-right the uses of the land so that we understand the land and elaborate on it at the same time. It is a tortured yet exuberant architecture that seeks to reveal our origins, our base and our dreams of a new earth." – Aaron Betsky

As many architects and theorists believe, architecture is not created out of thin air, nor is it magically created in the minds of architects. It is an accumulation of existing ideas, materials, and forms that come together to make visible what has always remained hidden. Architect and author, Mark Wigley struggled with this theory, and claimed that it undermined the previously existing notion that architecture is "the building of rational structures on a neutral or abstract ground". (Betsky, 2002, p. 9) (Wigley, 1993). It comes down to the definition of what architecture truly is, and it seems as though that very definition has been changing in recent years. For example, it has long been said that architecture should protect the health, safety and welfare of society. The increasing popularity of sustainable design proves a change in the way architects perceive health, safety and welfare.

Sustaining Site Integration

The question of whether or not humans are a significant cause of climate change is a controversial one. Many believe that this planet goes through natural cycles, in which we are currently on a downward slope. Either way, it is a proven fact that the earth's climate is changing, and all of its inhabitants have the choice to either actively fight back to maintain Earth's livable conditions for as long as possible or to simply let the inevitable happen. It is my opinion that architects have a commitment to the health, safety and welfare of today's and future society.

Many believe that the architect's role in improving sustainability is so minuscule that it will not make a difference in the grand scheme of things, but statistics do not lie. Construction and operation of buildings represent 47.6% of the annual energy and emissions in the U.S. and three-quarters of its electricity. The building sector consumes more energy than almost double that of all industry in America and almost double of America's transportation sector. Now, statistics on energy consumption do not necessarily translate directly to carbon footprint, which is the main concern contributing to climate change, but buildings are also the leaders in carbon emissions. In 2010, the building sector accounted for 44.6% of CO_2 emissions in the U.S., compared to transportation, which was responsible for 34.3%. (architecture2030) These statistics are shocking, given the recent attention surrounding the transportation industry and its "excessive" CO_2 emissions. It's clear that architects, designers, developers and builders are all at fault, and a drastic change needs to be made.

Additionally, the U.S. building stock increases by about 3 billion square feet every year (Hosey, 2013), and it is predicted that by 2035 approximately 75% of the built environment will either be new or renovated. (architecture2030). This presents an opportunity for architects and builders to fight back against the threats of climate change, and create a cleaner environment for the future.

All of these are reasons to ensure that architects become more aware of what they are designing and how it is being built. The following few pages describe general requirements that I believe would result in a work of architecture successfully being integrated into its site. The requirements have been separated into three main categories: land form, micro-climate, and ecosystem.

Land Form

1. The physical built structure of the building must be partially (at least 50%) burrowed into the land itself, or must use exterior materials natural to the environment or colors that blend to the site (70% of the exterior surface area).

2. Must maintain as many physical attributes of the site as possible. For example, the topography of the site (except for that underneath the structure) must remain almost exactly as it was before construction of the new structure. Essentially, from outside the building it should appear as though the construction of the structure has not changed its surrounding.

3. The building's interior should connect to the nature outside using glazing and appropriate interior finish colors and textures.

Figure 31 - Naoshima Contemporary Art Museum
Figure 32 - Chapel of the Holy Cross Sunset
Figure 33 - House in Wales

Figure 34 - Permeable Pavement 1

Figure 35 - Permeable Pavement 2

Figure 36 - Permeable Pavement 3

Micro-climate

1. The heat island effect should be avoided by using materials that reflect more sunlight and absorb less heat. Overall, it is best to use materials that absorb similar amounts of heat as the natural existing materials that are replaced with the building. The goal is to maintain the same amount of absorbed heat from before construction of the building.

2. Attempt to only minimally affect wind patterns and circulation of the site. Any built structure protruding from the land will inevitably affect wind, but it is important to do this as minimally as possible. Wind patterns can affect flora and fauna of the area, and also nearby sites.

3. Be conscious of the use of non-permeable surfaces, and wherever possible use permeable materials to allow rainwater to penetrate the land. Using more non-permeable surfaces than already exist on the site could affect the site's existing water table characteristics, which could in turn affect surrounding sites, flora and fauna.

Ecosystem

1. Any component taken away by the construction of a new building that is essential to animal life should be replaced or substituted to the same magnitude in which it existed previously to the building's existence.

2. Noise is a major deterrent to fauna. Any components of the building design that will cause more noise than what existed previously should be masked or remedied. Some strategies include vegetative buffers, or just simply using a different material or system to eliminate the problem.

3. Attention should be paid to the attraction of unwanted fauna or flora. If they did not exist on the site before, a new building should not be the reason they are there after.

4. Maintain as much of the existing flora as possible. Trees are homes to many animals, affect wind patterns and also provide protection from sunlight and the heat island effect. Also, flowering plants are important to the survival of many insects.

5. It is also important for designers to take responsibility for effects that happen on a larger scale. The amount of carbon released into the atmosphere by human interference is astronomical. A building design should include innovative solutions that work to minimize or eliminate the release of carbon into the atmosphere, but only in situations where humans are the main cause.

Overall, the most important thing to keep in mind is to be aware of the characteristics of the site before and anticipate the effects of every design decision. However, this is assuming the site is a greenfield or clean site. Brownfield sites should be restored to their natural state before construction, if possible.

We know that the planet we live on is a self-sustaining environment, and we should not assume that we are smarter than millions of years of evolutionary change. The natural environment does not need our help, but rather our respect. It is important to not attempt to improve the ecosystem of the site, using sustainable strategies, farther than how it would exist in a normal state. For example, by using materials that absorb almost no sunlight, in an area in which the land itself would normally absorb a substantial amount, compromises the integrity of the micro-climate. Sustainable strategies are beneficial tools, but it is essential that one knows how to properly use them to their ideal extent.

Summary: Research of the Theoretical Aspect

In the previous pages, much has been discussed. It is important to understand the history of the topic and the underlying forces that created the separation of humans and land that we see today. As mentioned before, Aaron Betsky said in his book, Landscrapers, "Buildings replace the land. That is architecture's original sin." The research that was conducted sought to understand why this phenomenon has happened, and what can be done to reverse, as much as possible, the harm inflicted on the environment by human existence.

Figure 37 - Sedona Panorama

It is clear that the relationship between human existence and the land that it occupies is not a new topic of theoretical investigation. Well-known architects and philosophers such as Martin Heidegger, Guy Debord, Michel Foucault, and Mark Wigley all contributed important information to allow an understanding of the relationship between land and humans. Aaron Betsky was also a major source of insightful information. The research has provided a basis of information on which continuing questions and a few conclusions can be drawn.

A set of guidelines has been established that will aid in the design process, and provide absolute means of measurement of the project's success. These guidelines are divided into three categories: land form, micro-climate, and ecosystem.

Overall, the purpose of this thesis is to provide an example of extensive site integration, and provide steps of how the same idea can be implemented for other projects. As designers, we need to stop thinking of the land as just the surface we walk on, but rather respect it as the single entity that provides us with the means for survival. Nature, itself, provides us with all of the answers, and it is now our job to discover them.

Project Justification

Sedona, Arizona is a sacred place to those who live there and to many people who visit the town. With a reputation of being a healthy and spiritual community, many locals believe that the existing airport should not be allowed to continue operation. There is an entire website devoted to describing the health risks and the airport's overall effect of a decreased quality of life. The air travel industry isn't exactly known for its consideration to the environment.

This is the very reason I chose to pursue a thesis project related to air travel in an environmentally rich area such as Sedona. It is about time that the operation of airports starts respecting the environment in which it exists. While I do not have the expertise to solve problems related directly to the airplanes themselves, I do have the ability to investigate and implement strategies to make an airport terminal as respectful as possible to the site. I plan to integrate this challenging typology both physically into the landscape as well as environmentally. The finished design should not shed harmful chemicals into the atmosphere and it should not distract from the beauty of Sedona's natural environment.

The project will test my skills as a problem-solver and designer. I will need to investigate many new ideas and technologies, and use my previous design training to integrate them into a cohesive architectural design.

Historical, Social and Cultural Context

Sedona is a city bursting with unique historical context that includes thousands of years of ancient peoples and settlers, devastating fires, and a long cinematic legacy.

Humans in Sedona

The first documented human presence in Sedona was between 11,500 and 9000 B.C. when the Paleo-Indians inhabited the region. This was not even discovered until 1995 when evidence was found near the Honanki Heritage Site, 15 miles west of Sedona. The Honanki is a cliff dwelling and rock art site in the Coconino National Forest, and it was once home to the Sinagua people of the Ancient Pueblo Peoples, and ancestors of the Hopi People. There is also another heritage site nearby, called the Palatki.

Cinema

Sedona hosted more than sixty Hollywood productions from the very earliest motion pictures up until the 1970s. The gorgeous, untouched landscape proved to be the ideal background for Hollywood productions including Johnny Guitar, Angel and the Badman, Desert Fury, and Blood on the Moon.

Brins Fire

In the summer of 2006, the Brins fire began about one mile north of Sedona. Reportedly started by campers, the fire covered 4,317 acres before it was fully contained ten days later. Evidence of this incredible disaster still exists north of Sedona. Fires seem to be somewhat a continual issue near Sedona. The dry climate breeds fire, and there have been multiple fires in 2014.

Figure 38 - Paleo Indians

Figure 39 - Sedona Cinema

Figure 40 - Brins Fire

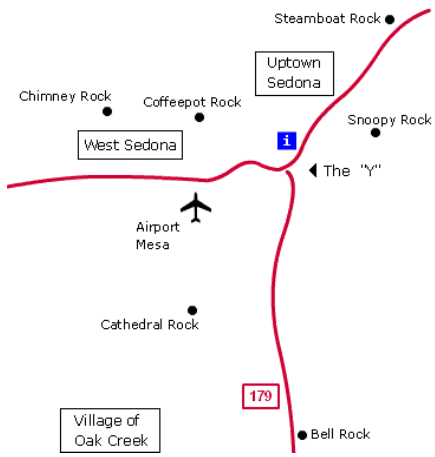


Figure 41 - Rock Formations Map

Coconino National Forest and Red Rocks

The land surrounding Sedona is likely one of the most untouched areas in all of America. Somehow, it has evaded the destruction which humankind has brought upon the earth. The Coconino National Forest has one of the most diverse landscapes of any National Forest in the country. The Red Rocks of Sedona are only one part of this huge forest that extends onward to provide Ponderosa Pine Forests, huge canyons and alpine tundra.

The Red Rock formations that surround the town are named the Schnebly Hill Formation after the town's first postmaster, and the town itself is named after his wife, Sedona. These historic formations have become the town's most treasured landmarks.

Figure 42 - Cathedral Rock

Cathedral Rock

One of the most-photographed sights in Arizona, Cathedral Rock is a unique formation carved over millions of years by the ancient Pedregosa Sea. The redbed sandstone was part of the coastal sand dunes on the Sea's shoreline. There are three hiking trails leading to the three main saddle points, or low points between the large rocks. As believed by New Age adherents, Cathedral Rock is said to contain a power vortex, which contains feminine or magnetic energy that supposedly encourages relaxation.

Figure 43 - Courthouse Butte

Courthouse Butte

According to legend, Courthouse Butte was originally supposed to be called Church Rock because of its location near Bell Rock, and Cathedral Rock was supposed to be called Courthouse Butte. The names were confused by a mapmaker in the 1800's who mislabeled the formations.

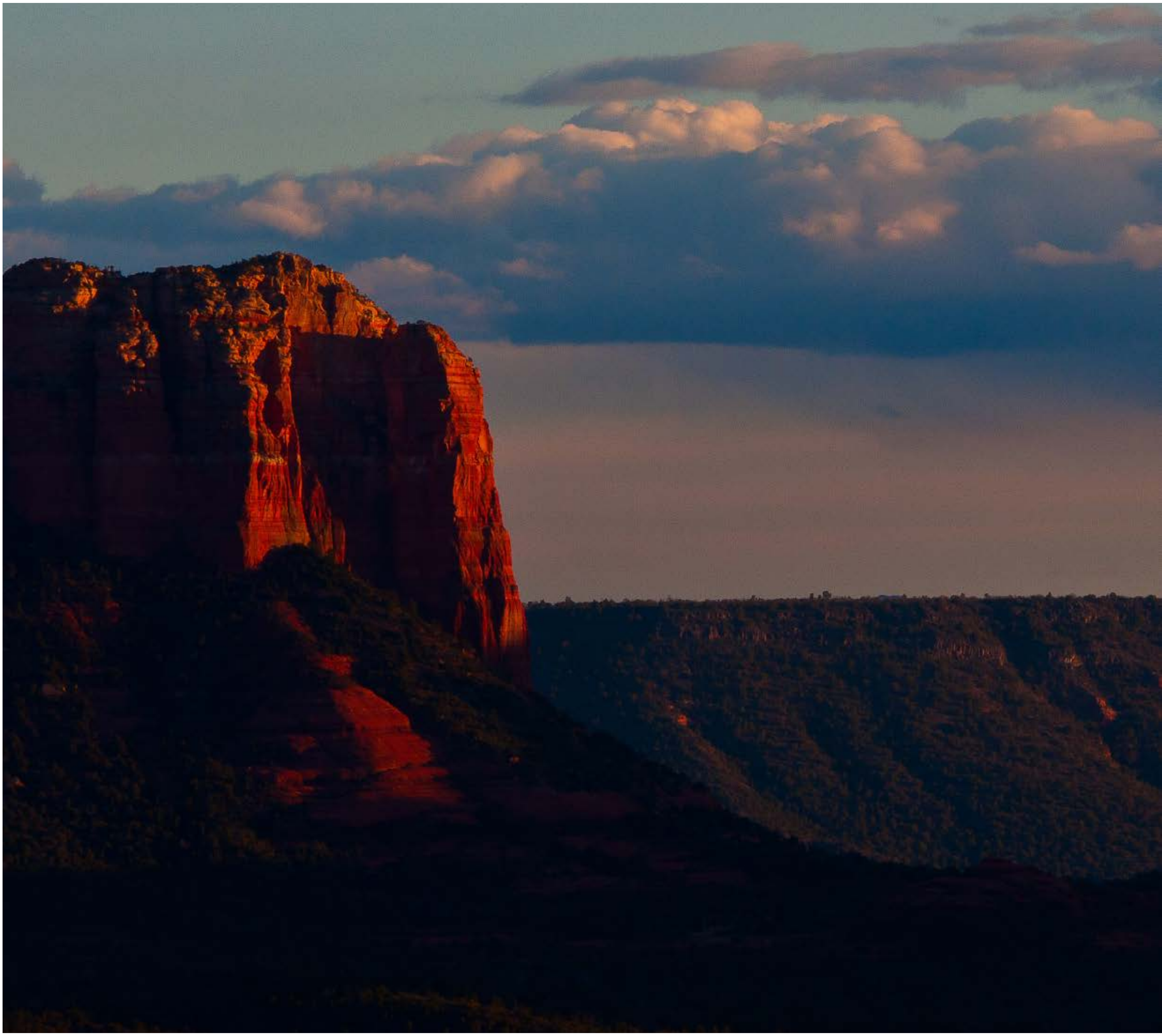


Figure 44 - Bell Rock Panorama

Bell Rock

Getting its name because of its church bell shape, Bell Rock is likely one of the best examples in Sedona of visible geological rock layers. The formation has obvious striations through the entire rock. Visitors are also often amazed by the human profile on the top of the rock that is said to be a woman looking up at the sky. Bell Rock is also said to be one of the famous vortex sites of Sedona.

The image above shows Bell Rock on the right and part of Courthouse Butte on the left hand side.


Figure 45 - Airport Mesa

Figure 46 - Protest

Airport Mesa

Believed to contain one of Sedona's famed power vortices, Airport Mesa is said to contain masculine power, like Bell Rock.

The Sedona Airport itself was inaugurated in 1955, with only a non-paved runway, but quickly acquired pavement in 1960. The airport was, and still is, not a towered airport, and could only be used by small airplanes. However, in 1990 the airport began services with a few small airlines, including Air Sedona, which served nearby places like Phoenix, Las Vegas and the Grand Canyon airport. Although, due to the topography surrounding the airport, the runway is unable to be expanded any farther than it currently is, so modern day Boeing 727s or larger airplanes cannot land here. The airport is currently used by many personal aircrafts and private business jets.

Social Trends & Societal Developments

In the last 200 years, there have been many social movements that involve respecting the environment, such as the Back to the Land Movement and the most recent Go Green Movement. The overall environmental movement began with concerns related to high levels of smoke pollution during the Industrial Revolution. As time went on, philosophers such as John Muir and Henry David Thoreau made contributions of knowledge to the cause, and eventually led to great successes for conservationists, like the preservation of Yosemite National Park by Abraham Lincoln.

Today, environmentalism is better known than ever. It is deeply embedded in American politics, and is taught in many schools. Today's environmentalists believe that the planet and human existence is at risk, and that for the sake of all human life, interference with nature should be restricted or minimized.

Relation to Similar Projects

Throughout history, there have been a few airports that attempt to acknowledge the site, such as a case study previously described in this document, Denver International Airport. The design is meant to mimic the snow-capped mountains located near the site, and the architect executed this quite beautifully. However, this solution does not fully cover the entire topic of site integration. Fentress visually and logically connects the building form to the broader site, but does not attempt to create a connection between the building and the ground on which it is physically touching.

Throughout my research, I have not yet come across an airport that attempts to unify the building and the site as one. There are, however, many examples of site integration that can be taken from other typological categories. Some previously stated examples are the Church of the Rock and the Chapel of the Holy Cross.

Another interesting example of a work of architecture being integrated into its site is the Deer Valley Rock Art Center by William Bruder. The building is a visitor's center for an archaeological site known as the Hedgpeth Hills Petroglyph Site. The structure utilizes a small dam and the major material used is concrete encrusted with shale, which is a waste product of Arizona's mining industry. The color of the materials blend well with the landscape, and maintaining a low height helps to keep this building incognito.

Figure 47 - Rock Art Center

Figure 48 - Rock Art Center 2

Figure 49 - Rock Art Center 3

Figure 50 - Native American Culture

Figure 51 - People at the Creek

Demographics

Sedona is not incredibly diverse, with 87% of the population being white, followed with 9.6% being Hispanic. It was surprising to learn that only 1.5% are American Indian, since the city is so rich with Native American culture.

The town is 44% men and 56% women. One of the more interesting statistics is this: the median resident age is 56.1 years old, compared to Arizona's overall median age of 33.8 years old. Unfortunately, this is not a good sign for the future growth of Sedona. There will need to be other forces driving the growth that will encourage younger families to move to the area. The New Age movement alone is an asset for Sedona's future growth, as environmental awareness and the appreciation for nature are characteristics of the new generation. The citizens of Sedona are well-educated, with nearly 94% of the population over the age of 25 having earned a high school diploma or higher education. 48% earned a Bachelor's degree, and 24% earned a graduate or professional degree.

The population density is 540 people per square mile, which is considered low on a national average, and the average household size is 2 people. The nearest city with a population of more than 50,000 is Flagstaff, Arizona, 25 miles northeast of Sedona. The nearest city with a population of more than 1,000,000 people is Phoenix, Arizona, which is nearly 95 miles southwest.

Sedona has four elementary/middle schools and two high schools.

Site Analysis

Figure 52 - Sedona Aerial Panorama

Qualitative Data and Analysis

Sedona, Arizona is considered my many to be one of the most beautiful landscapes in the world. Its soaring red rocks with gorgeous striations all different shades of red and orange, its unique mix of vegetation covering much of the Oak Creek Valley, and the incredible shadows cast by the formations all create an environment that has inspired artists, writers, film-makers, and many more throughout its existence.

Those who follow the New Age way of life believe that certain formations possess vorticies of spiritual energy, but could it be possible that spiritual energy can be a result of the overwhelming quality of a place? I believe so.

Views or Vistas

In other architectural projects, views from above are typically not nearly as important as views of standing on the site. However, since many of the people who will the visiting the site arrive by air, it's only logical that immense attention be payed to the importance of these views.

From plan view, above, it seems as though a grid was envisioned for the residential areas nearby, but the organic nature of the place took over. On the site itself, the airplane hangars all seem to be lined up perfectly, perpendicular to the runway and taxiway. It's obvious that the airport has accepted an orderly existence compared to the spaces around it.

The most noticeable texture from above is that of the mesa on which the airport sits. The natural valleys and high points create an interesting network of shadows and lines that are reminiscent of veins in the human body. This ties in interestingly with the well-known Bell Rock nearby, on which the formation's peak can be perceived as a human face looking up toward the sky. It could be possible that both of these abstract ideas are part of New Age knowledge, and are believed to be spiritual aspects and not simply rock formations.

The other main textural element is the speckled vegetation layer. Shrubs and desert plants grow in spotty clumps and create interesting density variations that almost look like velvet from above.

Nicholas Mann, a British visitor to Sedona, believed in the sacred nature of Sedona, and went as far as to connect the land formations with lines that began to form patterns. He called them geometric landscape temples. It is also interesting to study the geometries of just one formation, such as the Airport Mesa. The creases and lines in the rock form uniquely shaped geometries.

The shade and shadows are what give the geometries contrasting forms in the morning versus the evening. The feeling of a place can drastically change in this region because of the tall rocks and the shadows that circulate every day. In plan view, the "veins" previously mentioned completely change depending on the time of day and the intensity of the shadows (time of year).

While standing on the airport site, large rock formations can be seen in all directions, but the site is on a high elevation, so the formations do not seem as huge as they really are. However, it truly does feel like one is on a mountain top, while looking over the city.

In section or elevation view, the shadows perform similarly to when viewed in plan, but the effects are far more impactful. The biggest difference from a quantitative standpoint is the amount of viewable surface area covered in shadows. In section view, shadows are much more obvious, covering entire sides of mountains, and are more recognizable to the human brain as a place of refuge from the sun. But in my opinion, the most magnificent effect that shadows have in section view is to make visible the texture of the rocks. As shown in the image to the right, the geological layers and imperfections of the rock are accentuated and invite the viewer to use senses of sight and touch to explore these phenomenons.

Built Features

Of course, the most important built feature of an airport is the runway, which luckily does not obstruct views unless an airplane is currently landing. Other built features on the site include ten long narrow metal buildings that serve either as airplane hangars, maintenance, or general storage for the airport. There is also a small existing airport terminal building that will be documented and analyzed during the coming site visit in December. The materials currently being used on the site seem to ignore their context. Metal buildings make economical airplane hangars, but they certainly do not add to the aesthetics or experience of the site.

Figure 53 - Airport Aerial


Figure 54 - Rock Shadows Panorama

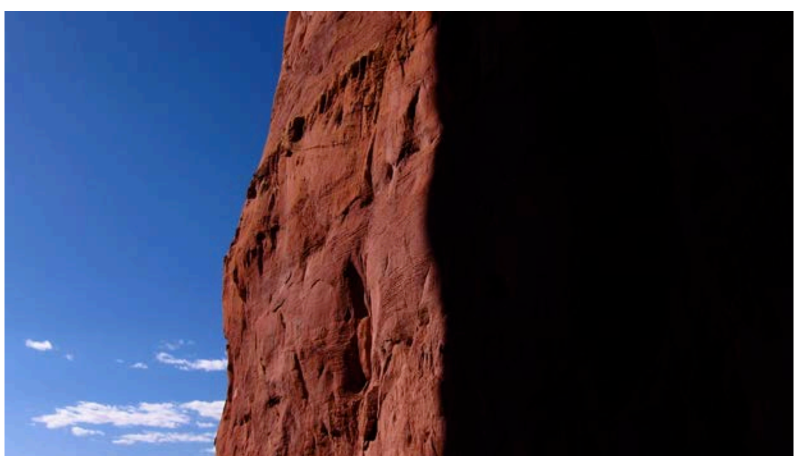


Figure 55 - Rock Shadows

Figure 56 - Sedona Sunset

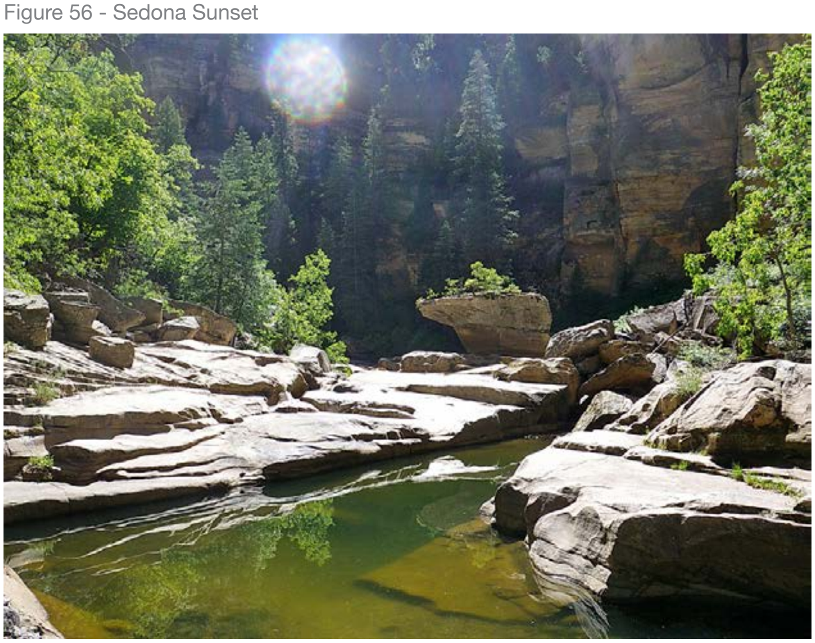


Figure 57 - Sedona Pools

Light

The site and its surroundings have an incredible quality of lighting. The abundance of sunlight is what makes the red rock monoliths glow in incredibly breathtaking shades of orange and red. The warm hued light from the evening sunsets creates likely one of the most enchanting experiences a person could have.

Wind

Sedona often has very little wind, if any at all. This is partially because of the nature of Arizona's climate, but also because of the protection provided by the surrounding rock formations. A breeze can often be felt after hiking to the top of one of these mountains, but seldom at the bottom of them.

The lack of wind only adds to the peacefulness and spiritual feelings that Sedona provides. It allows one to sit in silence, to reflect on one's own self. Perhaps this is another factor that plays into the theories of the New Age vorticies. Maybe nature itself, in all of its calm and peaceful essence, provides such a contrast to our loud, busy lives that simply a lack of noise and busyness becomes a spiritual experience.

Human Characteristics

By viewing the site, it is fairly obvious that there is human interaction and intervention, judging by the giant slab of asphalt running the length of it. The site's main purpose is to welcome pilots and their passengers via aircraft to Sedona, but it has hidden purposes as well. The site also is host to a family-owned restaurant, where visitors and locals can eat while they watch the airplanes and the beautiful views of the Red Rocks. There is also a small hotel situated on the north side of the site, that consists of multiple individual cabins for rent. So not only do people use the site as a means of travel, but also as a place to sleep and eat.

Distress

The elements of distress on the site consist of a lack of vegetation due to aeronautic activity, and a struggle between the cold, man-made steel buildings with the glowing, natural Red Rocks surrounding the site.

*Note: an addition will be made to this narrative after a site visit has been completed in late December.

Soil Compositions

The scientific soil classification for the area of Sedona is as follows: Typic Cryoboralfs-Rock outcrop-Eutric Glossoboralfs (s407). The dominant soil order is known as Alfisol.

Alfisols are found in semiarid to humid climates, and are moderately leached soils that have relatively high native fertility. These soils have mainly formed under forests and have a subsurface horizon in which clays have accumulated. They have a typically non-plastic clay composition, and are also found in the Midwest.

Alfisols occupy approximately 10% of the global ice-free land area. In the US, they account for about 14% of the land area. Alfisols support about 17% of the world's population.

The combination of generally favorable climate and high native fertility allows alfisols to be very productive soils for both agriculture and silvicultural use.

Alfisols are divided into 5 suborders: Aqualfs, Cryalfs, Udalfs, Ustalfs, and Xeralfs. The dominant suborder in the Sedona area is Cryalfs.

There are also rock formations on beginning Northwest of Sedona and wrapping around the town clockwise to the Southeast. These formations do not have a soil order, as they are absent of soil.

(via University of Idaho College of Agricultural and Life Sciences)

Below is a map of Sedona and its immediate surrounding area. The variety of soil classifications, as well as the rock formation can be easily seen.

Other nearby soil classifications include Aridisols and Inceptisols.

Aridisols (from Latin aridus, "dry") are CaCO3-containing soils of arid regions that exhibit at least some subsurface horizon development. They are characterized by being dry most of the year and limited leaching. Aridisols contain subsurface horizons in which clays, calcium carbonate, silica, salts, and/or gypsum have accumulated. Materials such as soluble salts, gypsum, and CaCO3 tend to be leached from soils of moister climates. Aridisols occupy approximately 12% of the Earth's ice-free land area and about 8.3% of the US.

Inceptisols (from Latin inceptum, "beginning") are soils that exhibit minimal horizon development. They are widely distributed and occur across a wide range of ecological settings. They are often found on fairly steep slopes, young geomorphic surfaces, and on resistant parent materials. A large amount of Inceptisols are found in mountainous areas and are used for forestry, recreation, and watershed. They occupy about 15% of the global ice-free land area, and almost 10% of the US. It's also notable that inceptisols support about 20% of the world's population, the largest of any of the soil orders.

(via University of Idaho College of Agricultural and Life Sciences)

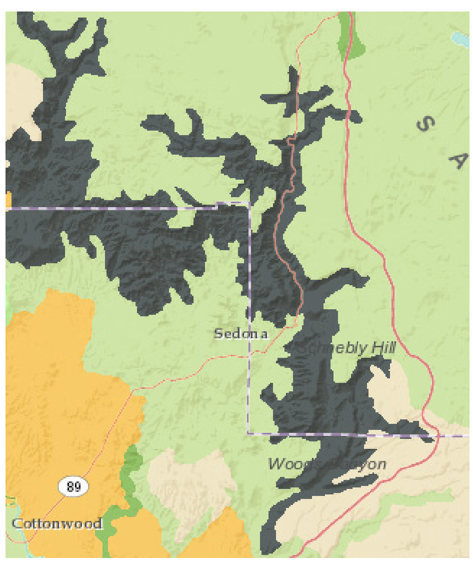


Figure 58 - Soil Composition Map

Water Table

In Arizona Water Atlas Volume 5: Central Highlands Planning Area, the most recent water data for this section of the state is explained. Digging deeper, there is data specific to the Verde River Basin. The basin, itself, is 5,661 square miles. According to the Arizona Department of Water Resources, the area around Sedona has no change data available from between 1990-1991 and 2003-2004. Nearby areas had a negative change between -15 and -1 feet. Water table depth varies greatly, due to huge changes in elevation in the Sedona area. The two measurements taken closet to the city show as 9 feet and 79 feet below the surface in the years 2003-2004. The groundwater beneath Sedona is part of the “Carbonate” Aquifer.

Considering how many different elevations, water depths, and soil types, Sedona may prove to be a difficult site to work with. Although, the water table does not seem to have a history of fluctuation, as -15 to -1 feet is fairly normal. Also, the soil in the area is non-plastic, and won’t erode or saturate too easily.

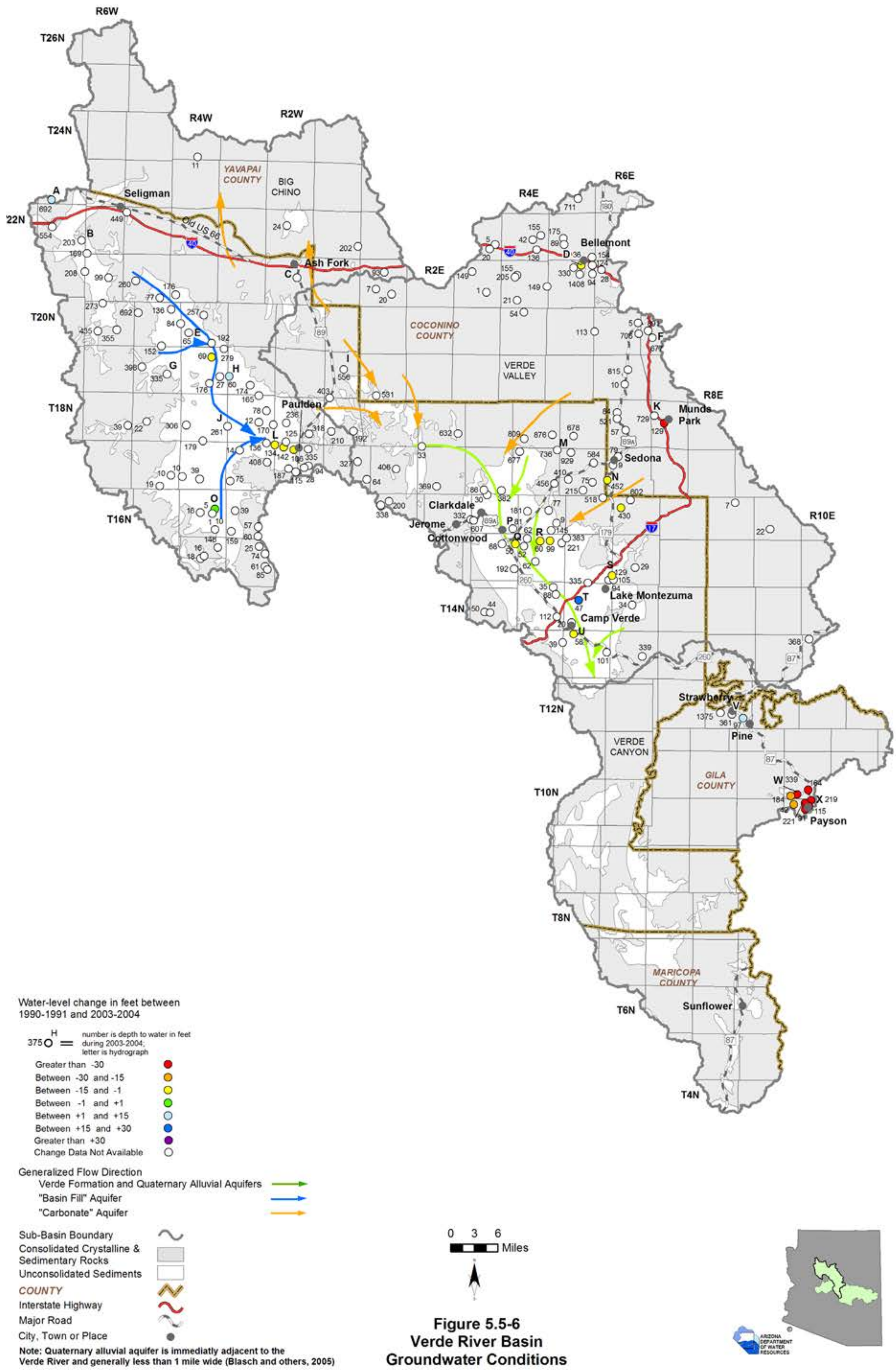


Figure 59 - Verde River Groundwater Conditions

Pedestrian and Vehicular Traffic

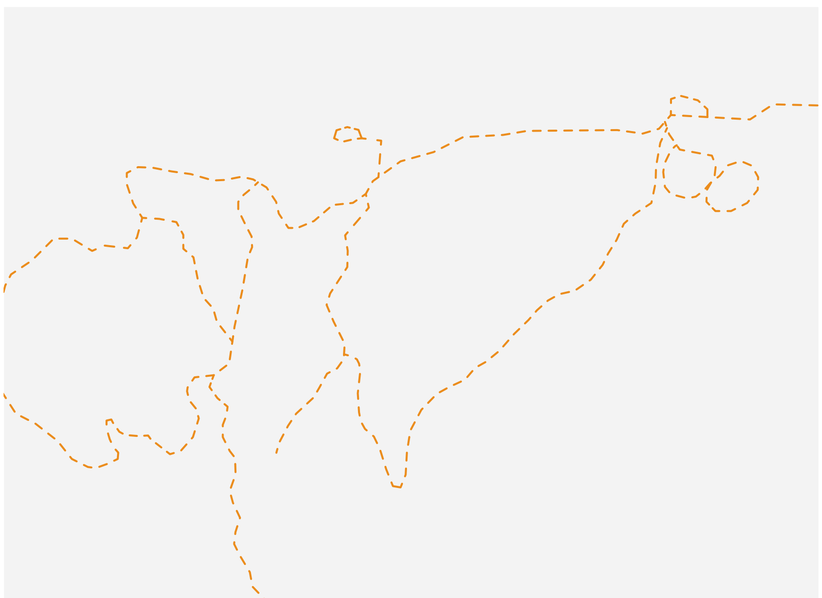


Figure 60 - Pedestrian Traffic Map

Hiking is likely the most popular outdoor activity in Sedona. The city is surrounded by a large number of trails, as shown in the graphic to the right. With over 120 trails in just 20 square miles, there are plenty of options in the immediate vicinity of the city.

On the site of the airport itself, there isn't much pedestrian traffic. People walk from their parked cars to the airport terminal building, and to and from their airplanes.

Figure 61 - Vehicular Traffic Map

Vehicular traffic is heaviest on the US Interstates 179 and 89A, running north/south on the east side of the airport and running east/west on the north side, respectively. Sedona is fairly small, only 18.6 square miles, and the average commute time is between 5-15 minutes. Traffic is not a major issue. On the site itself, the only automotive traffic is to and from the parking lots, and maintenance and fueling trucks around the entire site. There is one other unique type of traffic, however. Airplanes land and take off on the one existing runway, they use the taxiways to enter the general aviation ramps and finally park their aircrafts there.

Topographic Survey

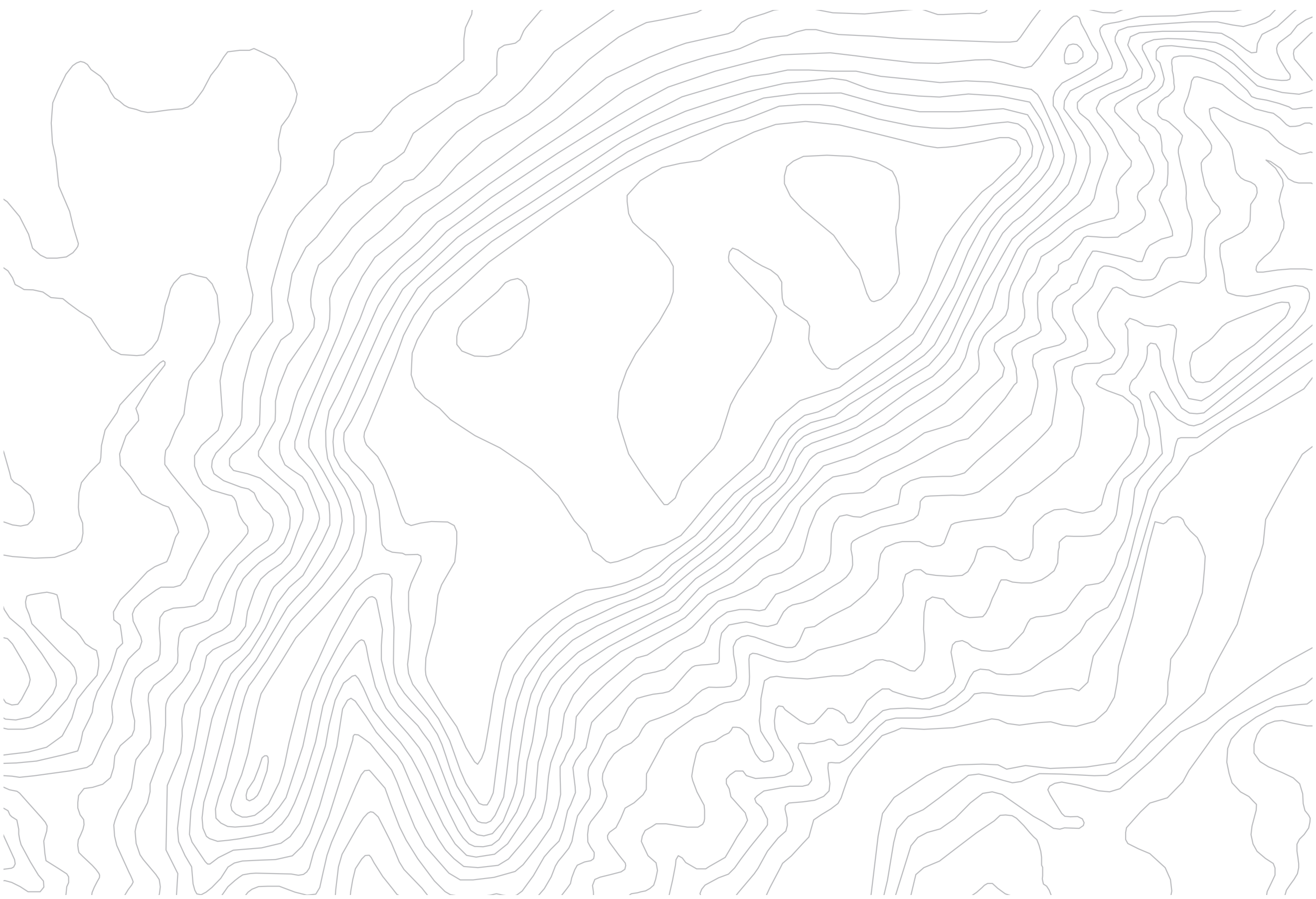


Figure 62 - Topographic Map

Topography:

The slope of the land surrounding the site is quite drastic, as it sits on top of a rock formation, much like a plateau. Much of the site's surrounding has a slope greater than 20%, which is the typical limit for pedestrians. This is why there are hiking trails that switch-back, making the walk longer but more manageable. The elevation change on the build-able site, itself, is minuscule. The ground must be very level in order for airplanes to takeoff and land.

The image below was created to better illustrate the slopes involved in the site. In areas where the lines of color are unclear or look smudgy is where the slope is the greatest. The darkest colors represent the highest points, and the lighter colors represent the low ones.

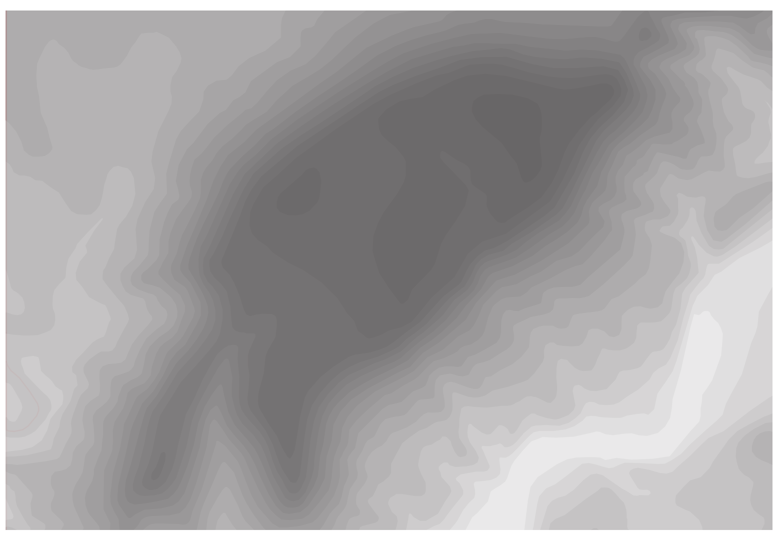


Figure 63 - Topographic Map 2

Vegetation

Figure 64 - Vegetation Map

Vegetation:

The vegetation of Sedona is diverse as a result of its location and the mixing of the drastically varying plants of the south compared to those in the north of Arizona. Trees of the area consist of both conifers, such as the Arizona Cypress, and deciduous, such as the Arizona Ash. The area also is host to shrubs, desert cactus and succulents, and wildflowers of bright colors.

Most of the macro-site is covered in natural vegetation. The airport grounds, however, are fairly free of plants. Possibly, this was a conscious choice in response to the correlation between vegetation and the presence of birds, which can cause dangerous situations when coming into contact with airplanes. However, its more likely that the barren ground is a result of wind disturbance due to air traffic in the area.

Additional Analysis

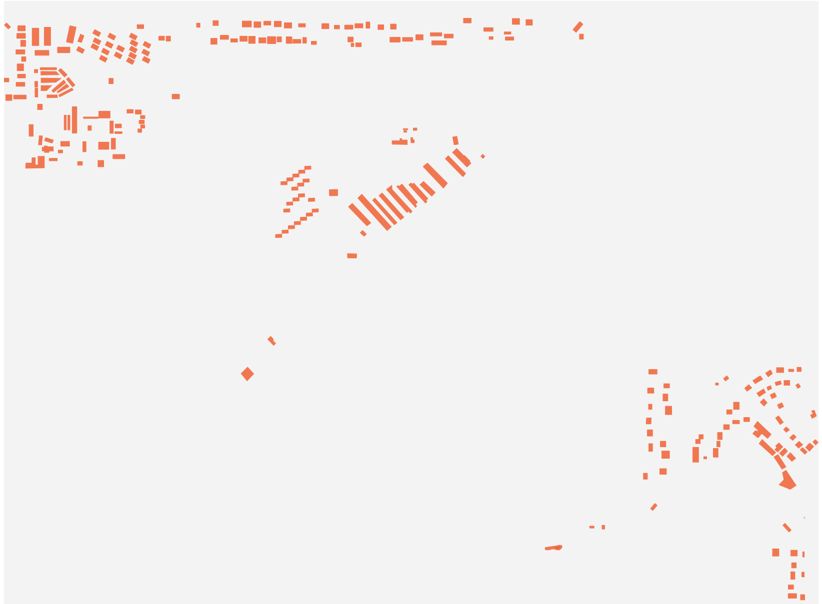


Figure 65 - Surrounding Buildings Map

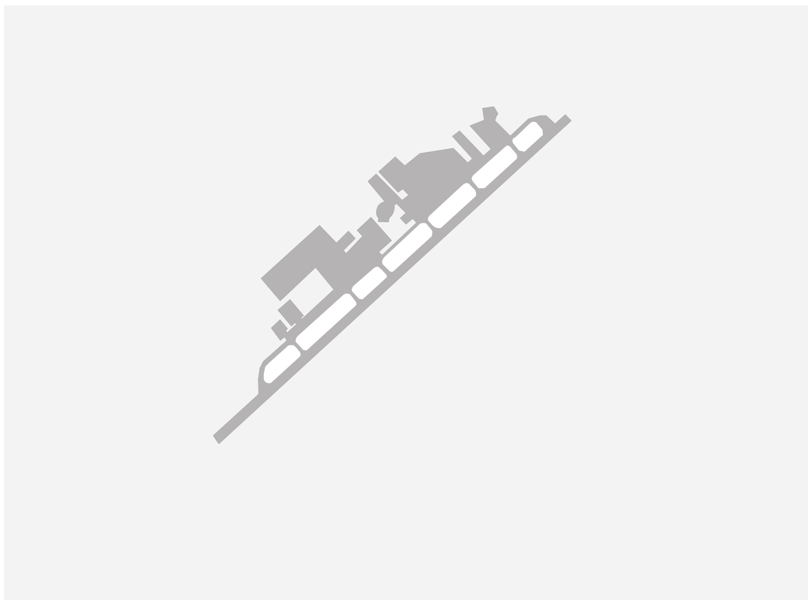


Figure 66 - Pavement Map

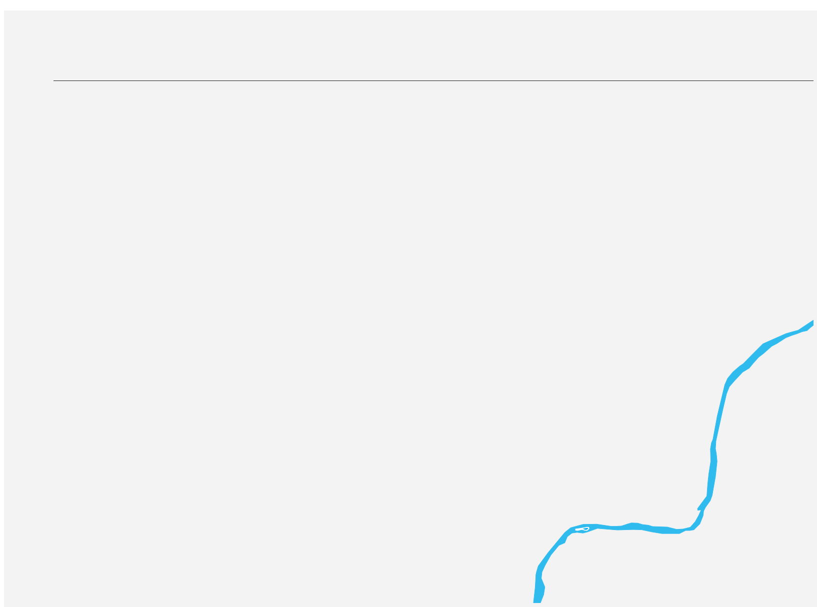


Figure 67 - Site Water Map

Surrounding Buildings:

The macro-site has a large variety of building sizes and types. There are residential areas directly to the north and to the east of the airport, and to the northwest there is an industrial area.

The site itself consists of many long, narrow buildings that house airplanes, provide spaces for maintenance, and act as storage spaces for equipment necessary to the airport's operation.

Airport Facility Pavement:

The runway alone is more than 380,000 square feet of asphalt, and the airport facility contains many ramps where airplanes are tied down, and aircraft hangars. There are about 100 aircraft based in Sedona.

Pavement is a standard necessity for all airports, but it creates unforeseen effects, such as the heat island effect. Investigations will be made into the viability of permeable pavement options for the thesis project's design phase.

Presence of Swamps, Streams, Other Bodies of Water:

The only visible water in the area is Oak Creek, which is a 50-mile thread that weaves its way through central Arizona to eventually connect to the Verde River. There aren't any swampy areas, given the non-plasticity of the soil in the region.

Site Character:

There does not seem to be much physical change in the area. One would think that with such steep slopes, erosion would be a major issue, but the formation on which the site sits has existed for millions of years in its same geological state. There are also not many dying trees or vegetation, as the soil is rich and many of the plant species are desert plants.

Base Map

This map shows natural aspects of the site such as topography, vegetation, and waterways. There are also man-made elements such as roads, existing buildings, and the pavement necessary to operate an air travel facility servicing jets. The importance of this graphic is to analyze the interaction between the many different elements of the site, such as the topography and the pavement of the airport. The top, flat plateau is just long enough to perfectly fit the airport's runway. It's also important to note the relationship between the topography and the road that leads to the site in order to properly anticipate the experience a visitor would have on their way to the site.

Figure 68 - Airport Aerial

*Note: existing utilities and legal boundaries will be added after the site visit in late December.

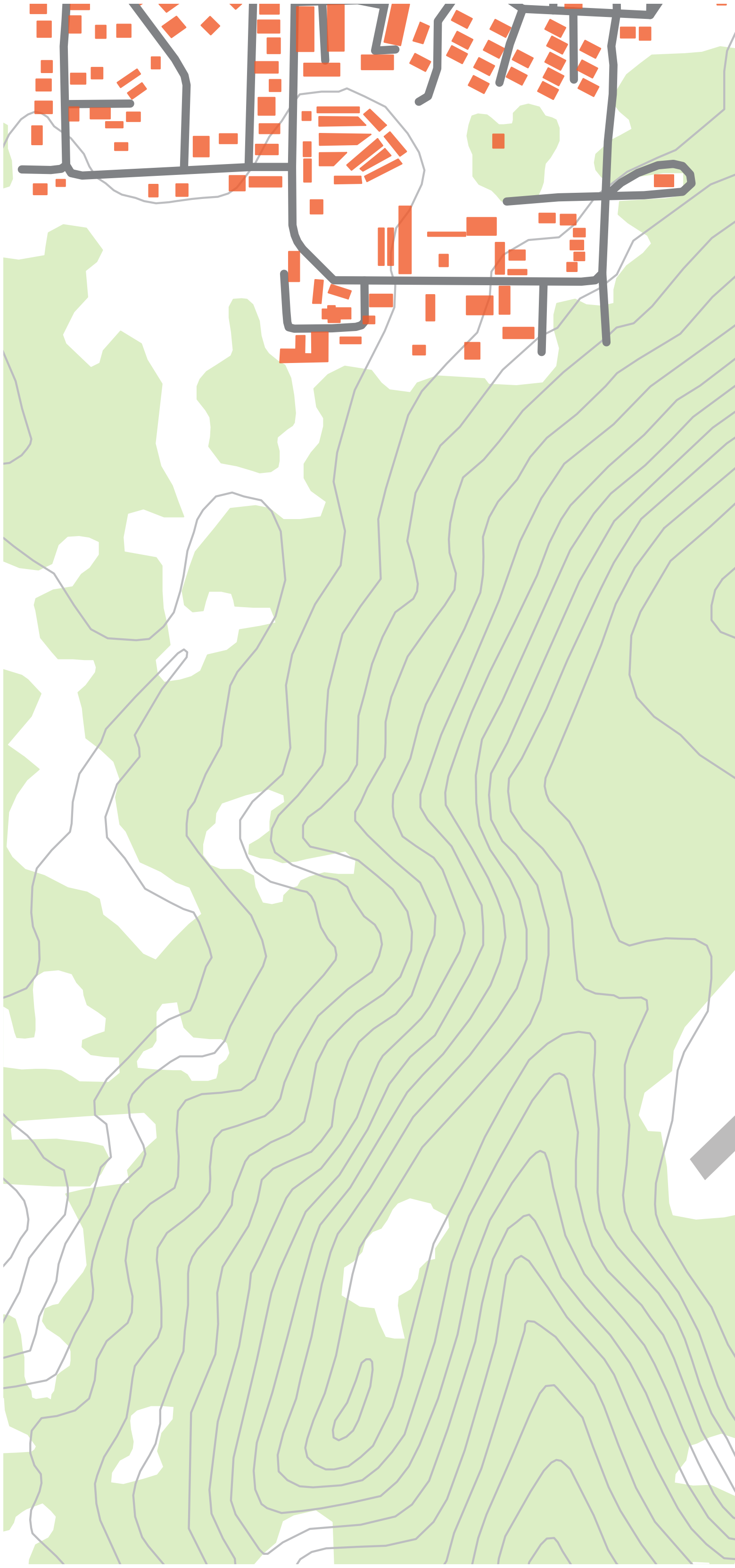


Figure 69 - Site Map

Figure 70 - Sedona Aerial 2

Site Reconnaissance

Figure 71 - Site Reconnaissance North

Figure 72 - Site Reconnaissance East

Figure 73 - Site Reconnaissance South

Figure 74 - Site Reconnaissance West

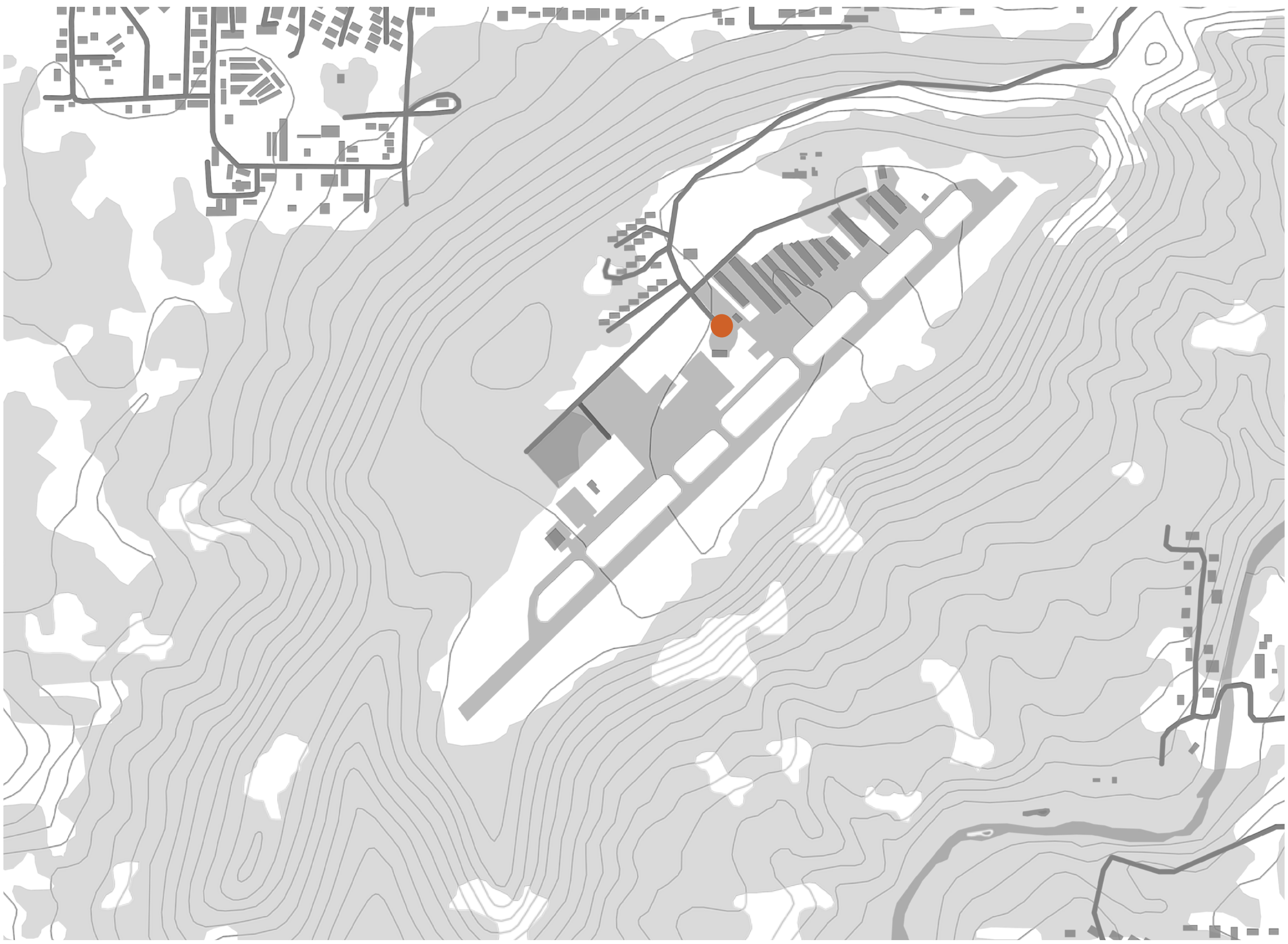


Figure 75 - Site Reconnaissance Site Map

Climate Data

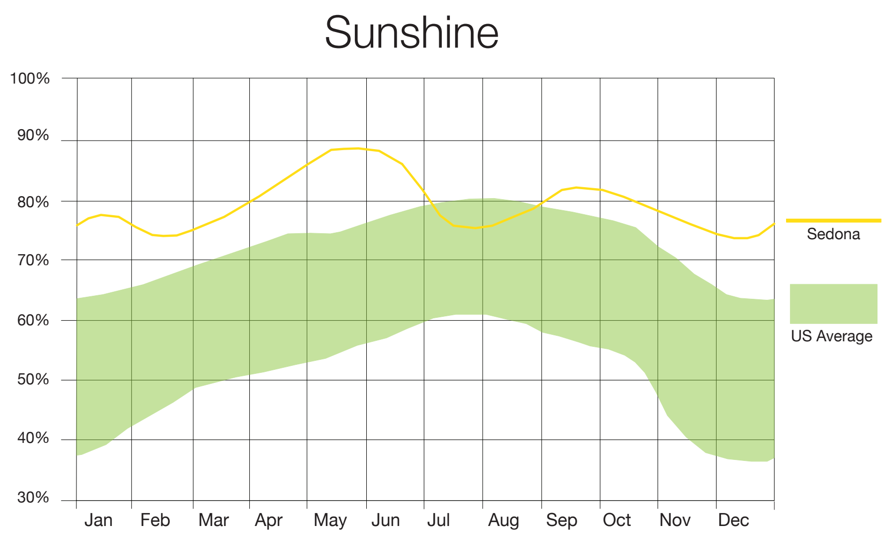


Figure 76 - Climate - Sunshine

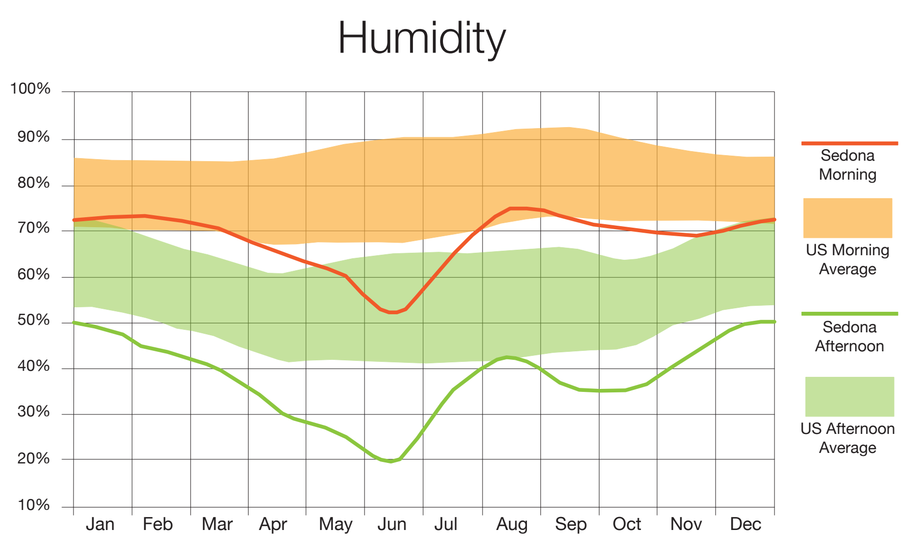


Figure 77 - Climate - Humidity

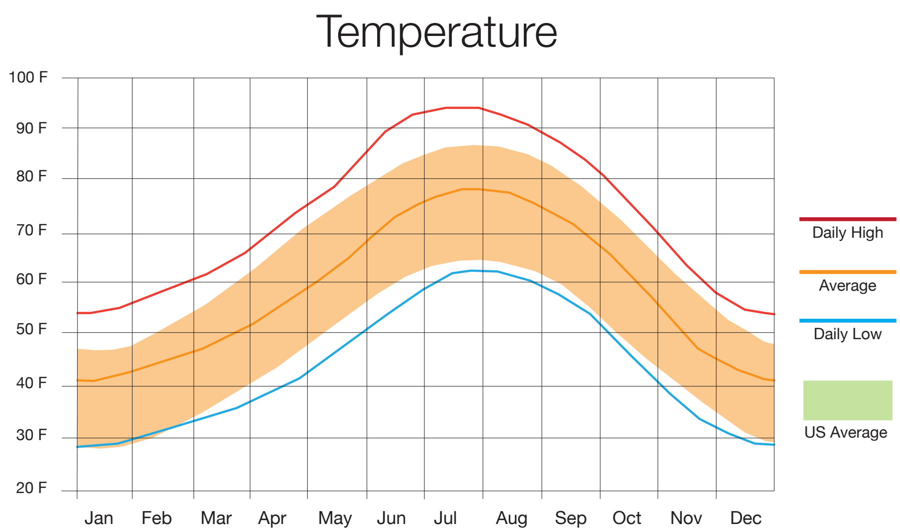


Figure 78 - Climate - Temperature

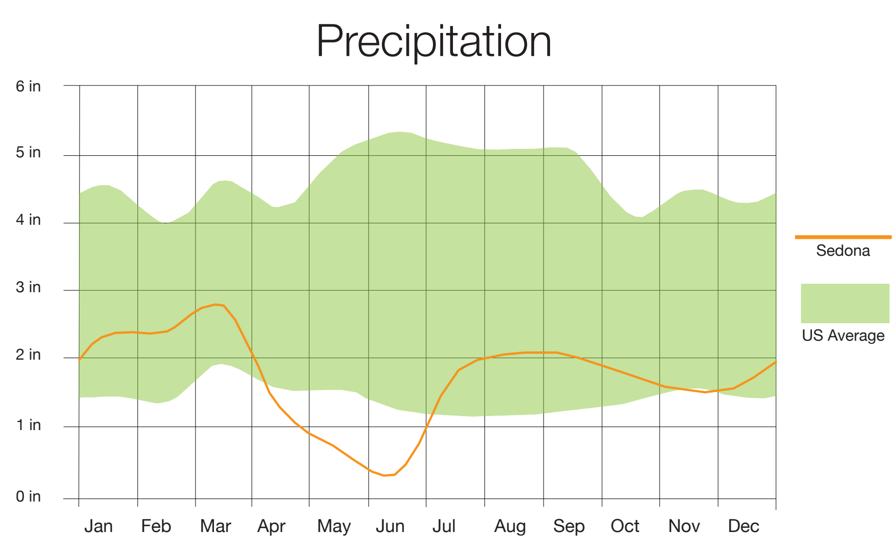


Figure 79 - Climate - Precipitation

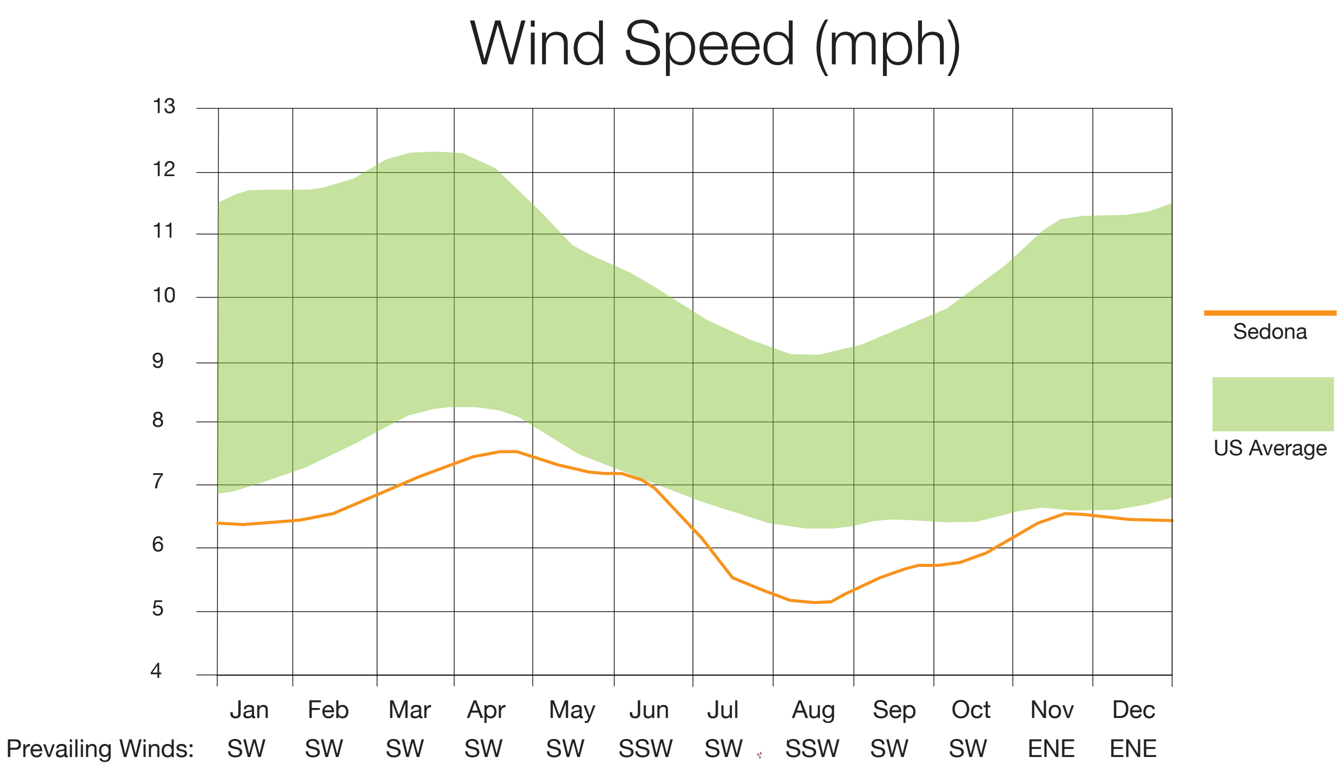


Figure 80 - Climate - Wind

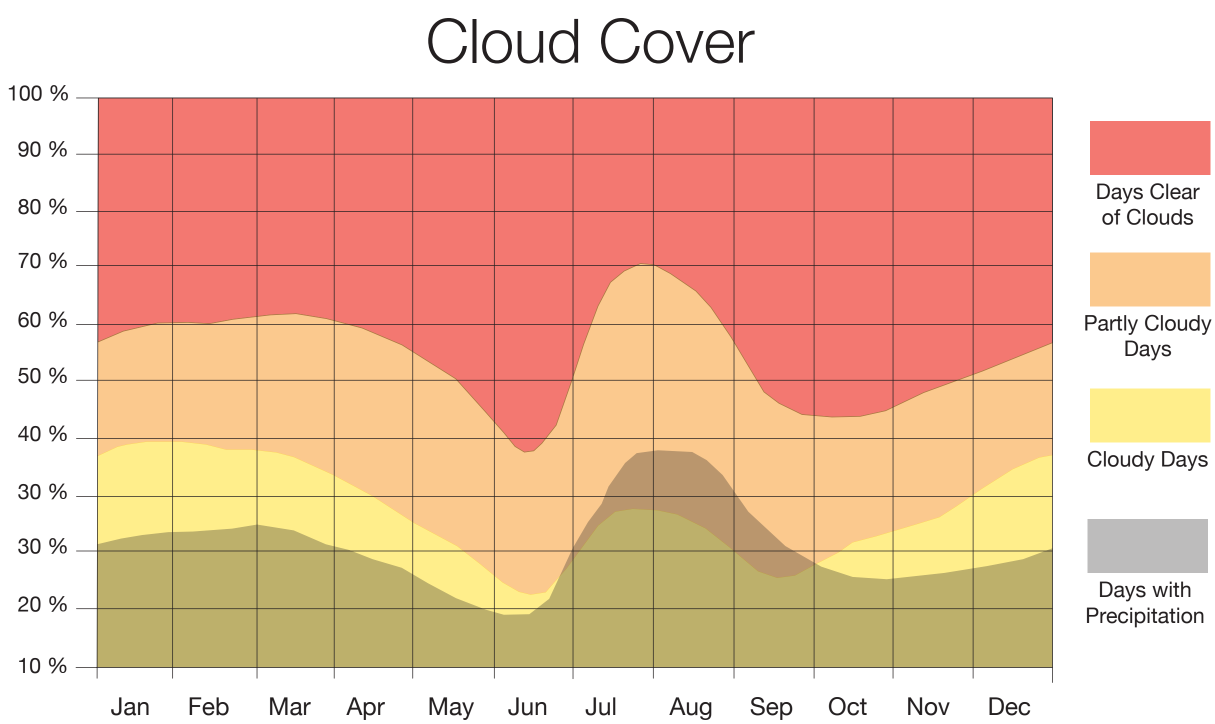


Figure 81 - Climate - Cloud Cover

Space Allocation

Pick-Up / Drop-Off Area

General

Total Square Footage: 11,250

Square Footage per Occupant: 30

Maximum Number of Occupants: 375

Adjacent Spaces: Restrooms

Connected Spaces: Baggage Claim, Lobby

HVAC ●●●○○

20 CFM/person = 6,000 CFM

Desired Summer Temperature: 70 degrees

Desired Winter Temperature: 67 degrees

Lighting ●●○○○

Lighting Levels Required in Space: 10 fc

Acoustics ●●●●●

Sound Level Desired in Space: 50 db

Not Important ●○○○○
Low Importance ●●○○○
Average Importance ●●●○○
Somewhat Important ●●●●○
Very Important ●●●●●

Figure 82 - Interaction Net 1

Ticket Sales Lobby

General

Total Square Footage: 9,000

Square Footage per Occupant: 30

Maximum Number of Occupants: 300

Adjacent Spaces: Restrooms, Baggage Processing and Handling

Connected Spaces: Baggage Claim, Pick-up / Drop-Off

HVAC

20 CFM/person = 6,000 CFM

Desired Summer Temperature: 70 degrees

Desired Winter Temperature: 67 degrees

Lighting

Lighting Levels Required in Space: 10 fc

Acoustics

Sound Level Desired in Space: 50 db

Not Important
Low Importance
Average Importance
Somewhat Important
Very Important

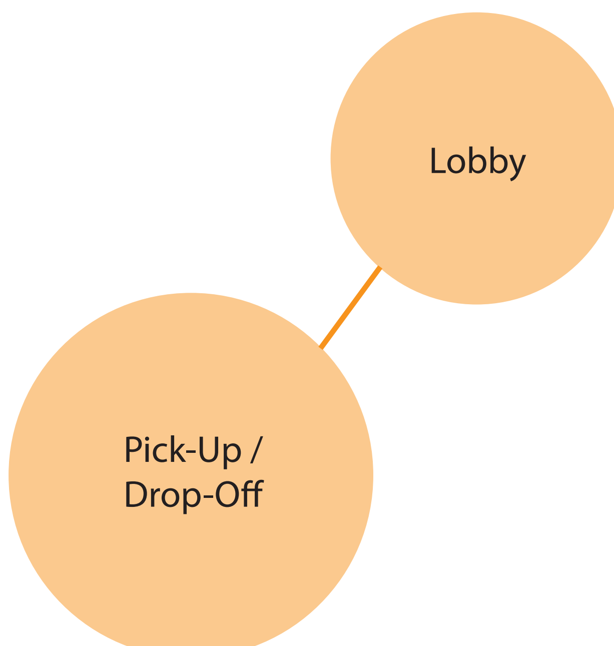


Figure 83 - Interaction Net 2

Security

General

Total Square Footage: 750 (+ 150 sq ft per screening station)

Square Footage per Occupant: 5 (standing)

Maximum Number of Occupants: 150

Adjacent Spaces: Ticket Sales Lobby, Concourse

Connected Spaces: -

HVAC

20 CFM/person = 3,000 CFM

Desired Summer Temperature: 70 degrees

Desired Winter Temperature: 67 degrees

Lighting

Lighting Levels Required in Space: 40 fc

Acoustics

Sound Level Desired in Space: 60 db

Not Important
Low Importance
Average Importance
Somewhat Important
Very Important

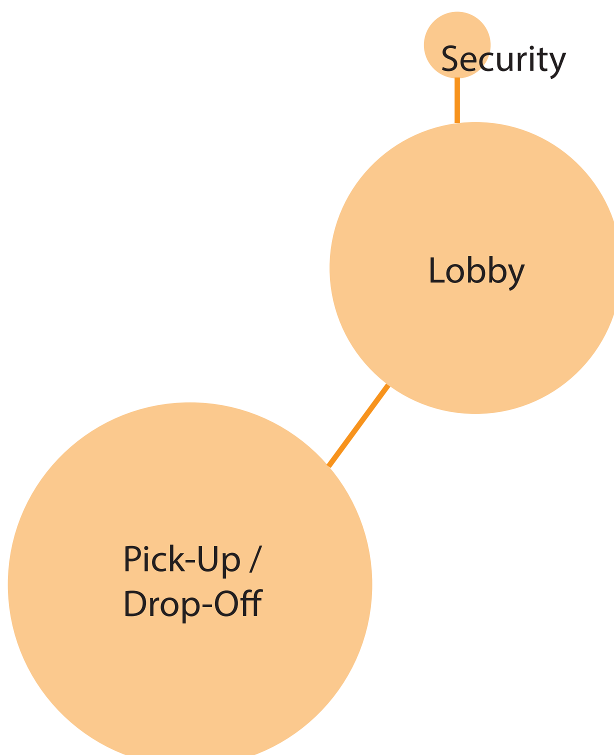


Figure 84 - Interaction Net 3

Concourse (Wide Circulation Spaces)

General

Total Square Footage: 30,000

Square Footage per Occupant: 100

Maximum Number of Occupants: 300

Adjacent Spaces: Restrooms, Retail / Restaurant, Security

Connected Spaces: Gate Waiting Areas

HVAC

20 CFM/person = 6,000 CFM

Desired Summer Temperature: 70 degrees

Desired Winter Temperature: 67 degrees

Lighting

Lighting Levels Required in Space: 10 fc

Acoustics

Sound Level Desired in Space: 50 db

*Note: Gate Waiting Areas and Retail Spaces can be included within the total square footage.

Not Important
Low Importance
Average Importance
Somewhat Important
Very Important

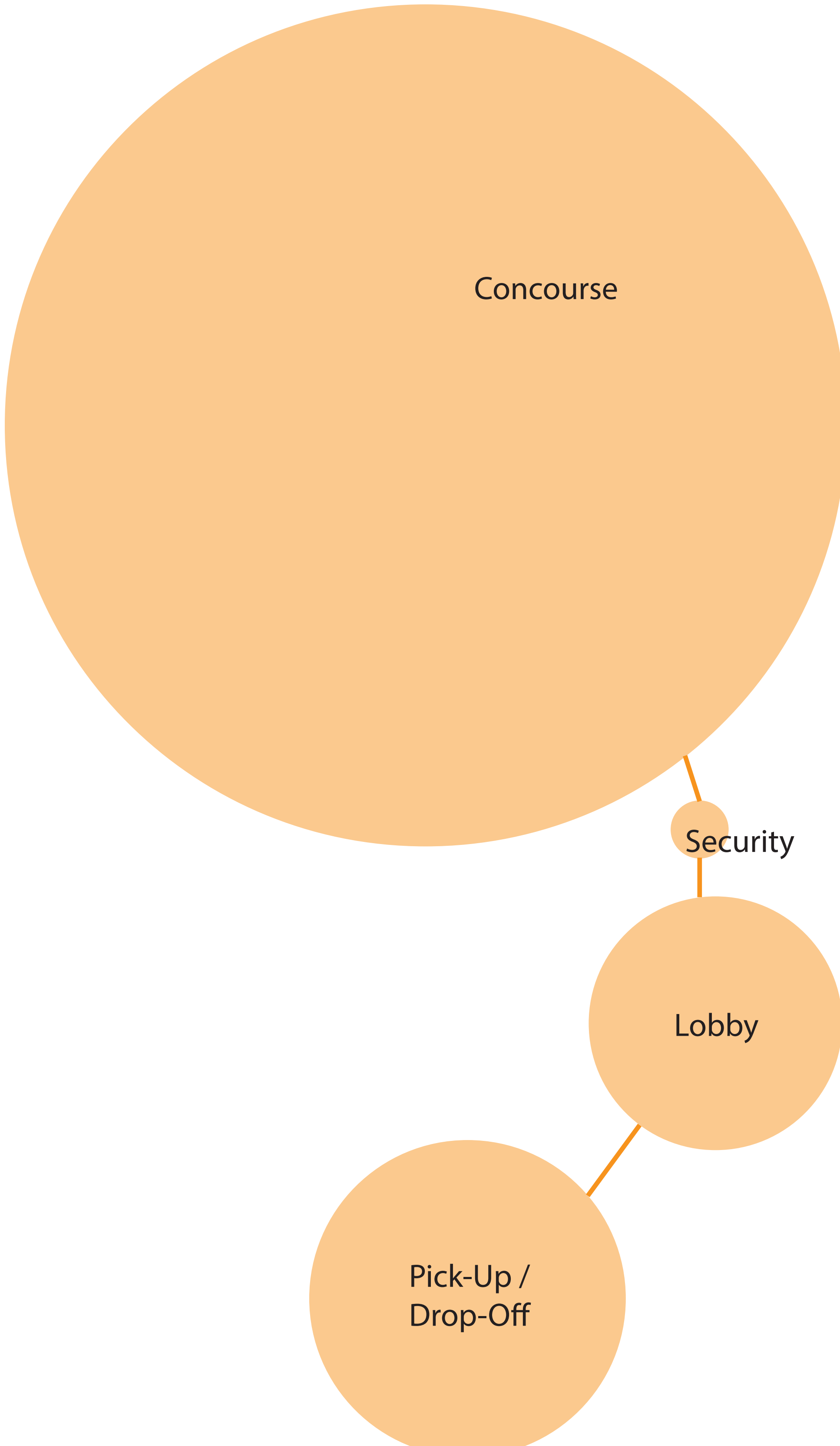


Figure 85 - Interaction Net 4

Retail / Restaurant

General

Total Square Footage: 2,250 + 800 for Kitchen

Square Footage per Occupant: 15

Maximum Number of Occupants: 150

Adjacent Spaces: Restrooms, Concourse, Gate Waiting Areas

Connected Spaces: Kitchen

HVAC ●●●○○

20 CFM/person = 3,000 CFM

Desired Summer Temperature: 70 degrees

Desired Winter Temperature: 67 degrees

Lighting ●●●○○

Lighting Levels Required in Space: 10 fc (50 for kitchen)

Acoustics ●●●●○

Sound Level Desired in Space: 60 db

Not Important ●○○○○
Low Importance ●●○○○
Average Importance ●●●○○
Somewhat Important ●●●●○
Very Important ●●●●●

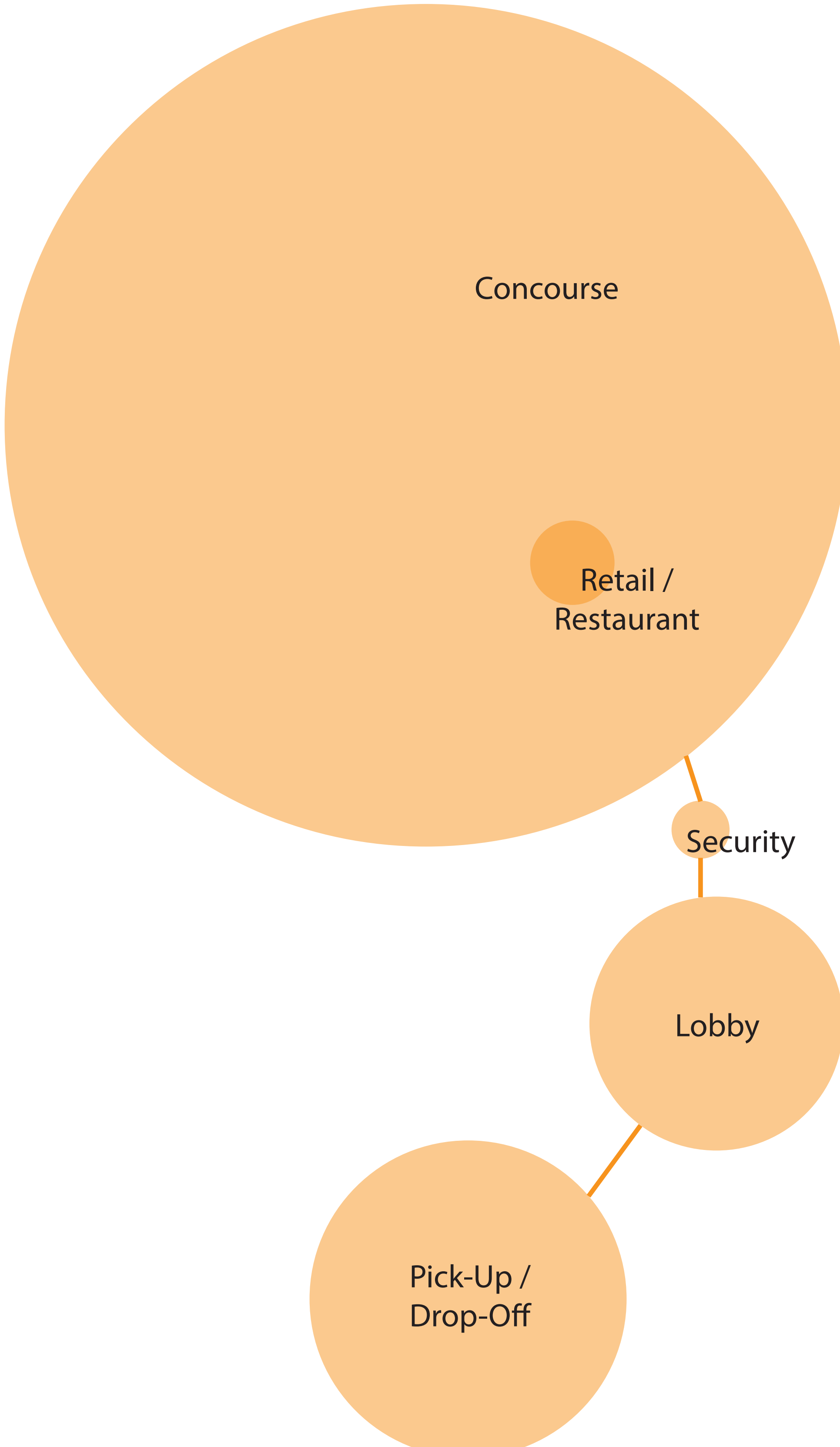


Figure 86 - Interaction Net 5

Gate Waiting Areas

General

Total Square Footage: 4,500

Square Footage per Occupant: 15

Maximum Number of Occupants: 300

Adjacent Spaces: Restrooms, Security

Connected Spaces: Concourse

HVAC ●●●●○

20 CFM/person = 6,000 CFM

Desired Summer Temperature: 70 degrees

Desired Winter Temperature: 67 degrees

Lighting ●●●●●

Lighting Levels Required in Space: 30 fc

Acoustics ●●●●●

Sound Level Desired in Space: 30-40 db

Not Important ●○○○○
Low Importance ●●○○○
Average Importance ●●●○○
Somewhat Important ●●●●○
Very Important ●●●●●

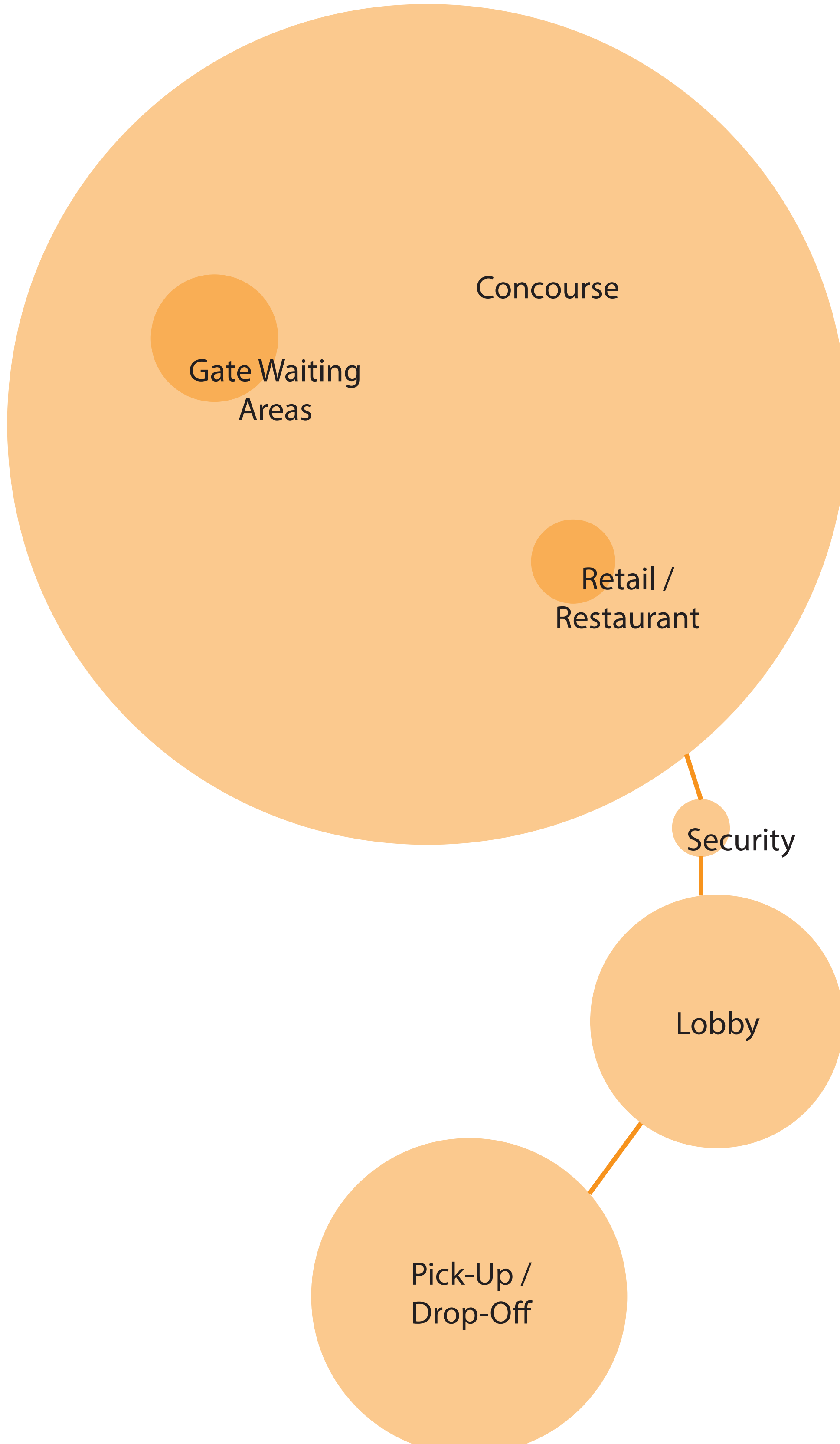


Figure 87 - Interaction Net 6

Baggage Processing and Handling

General

Total Square Footage: 6,000

Square Footage per Occupant: 300

Maximum Number of Occupants: 20

Adjacent Spaces: Ticket Sales Lobby, Baggage Claim

Connected Spaces: -

HVAC ●●●○○

15 CFM/person = 300 CFM

Desired Summer Temperature: 70 degrees

Desired Winter Temperature: 67 degrees

Lighting ●●●○○

Lighting Levels Required in Space: 30 fc

Acoustics ●●●●○

Sound Level Desired in Space: 60 db

Not Important ●○○○○
Low Importance ●●○○○
Average Importance ●●●○○
Somewhat Important ●●●●○
Very Important ●●●●●

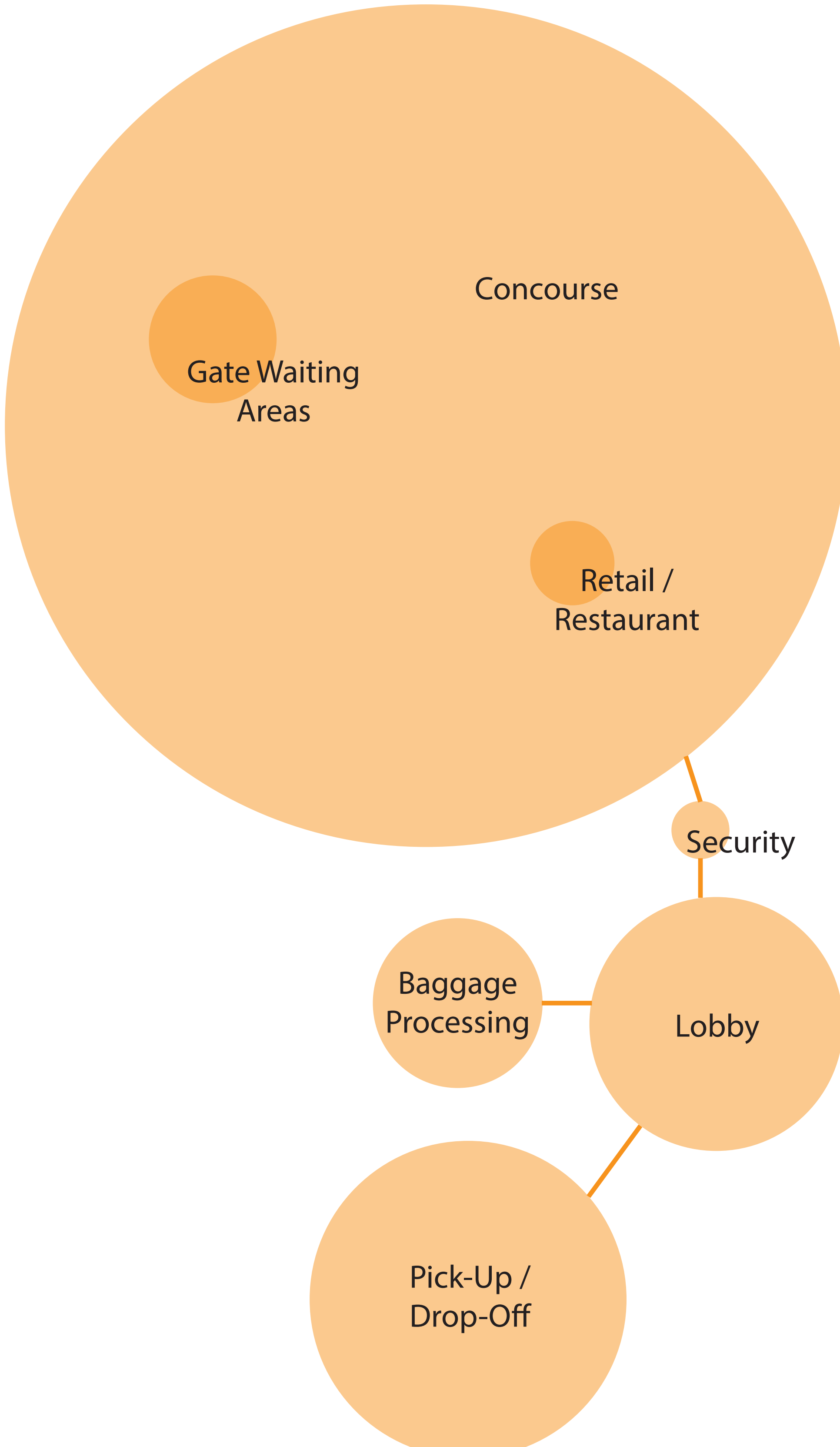


Figure 88 - Interaction Net 7

Baggage Claim

General

Total Square Footage: 7,500

Square Footage per Occupant: 20

Maximum Number of Occupants: 375

Adjacent Spaces: Restrooms, Baggage Processing and Handling

Connected Spaces: Lobby / Ticket Counters, Pick-up / Drop-Off

HVAC

20 CFM/person = 7,500 CFM

Desired Summer Temperature: 70 degrees

Desired Winter Temperature: 67 degrees

Lighting

Lighting Levels Required in Space: 10 fc

Acoustics

Sound Level Desired in Space: 50 db

Not Important
Low Importance
Average Importance
Somewhat Important
Very Important

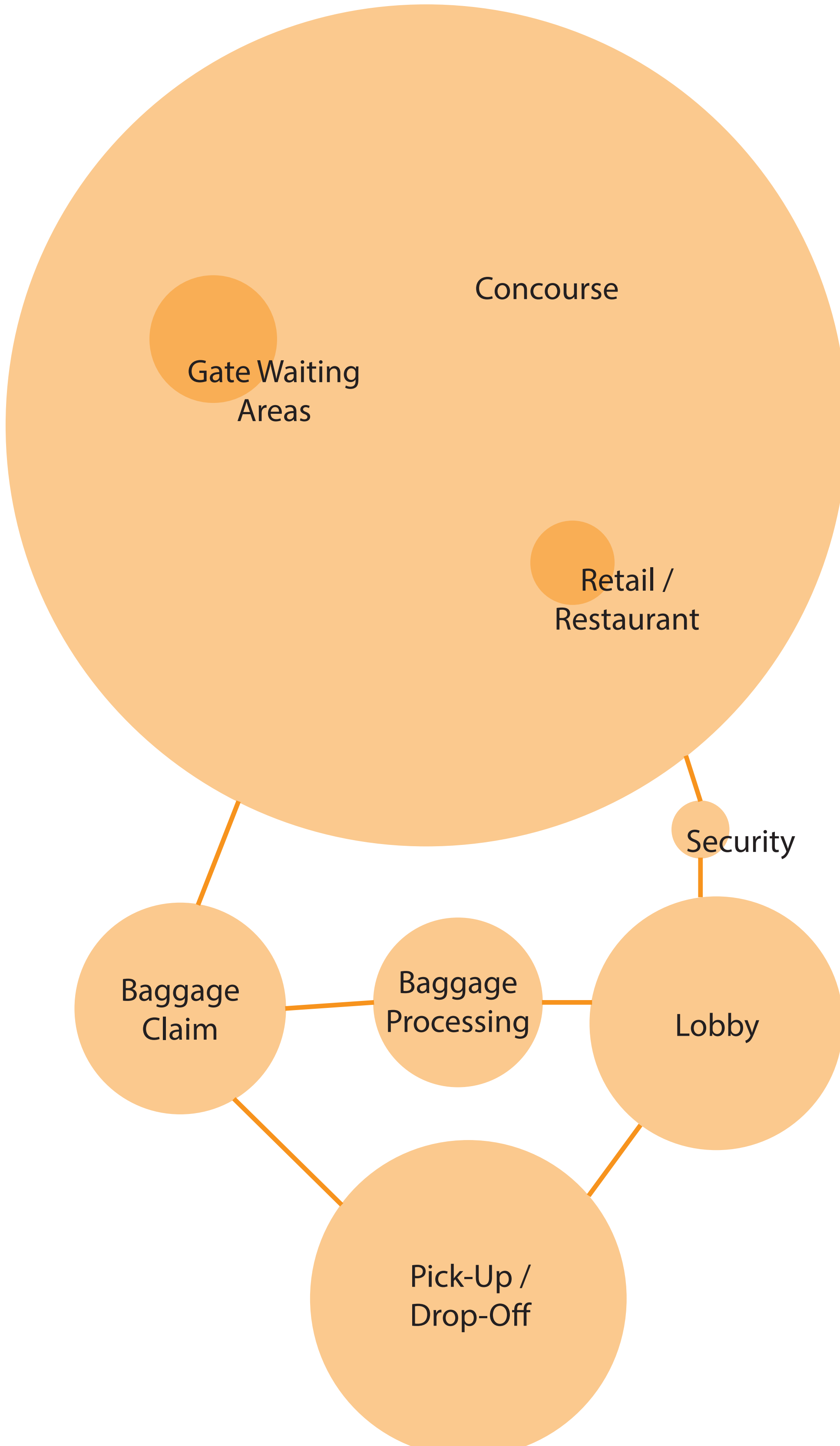


Figure 89 - Interaction Net 8

Staff Offices / Conference Rooms

General

Total Square Footage: 4,000

Square Footage per Occupant: 100

Maximum Number of Occupants: 40

Adjacent Spaces: Restrooms, Ticket Sales Lobby

Connected Spaces: -

HVAC ●●●●○

20 CFM/person = 800 CFM

Desired Summer Temperature: 70 degrees

Desired Winter Temperature: 67 degrees

Lighting ●●●●●

Lighting Levels Required in Space: 50 fc

Acoustics ●●●●●

Sound Level Desired in Space: 30 - 60 db

Not Important	●○○○○
Low Importance	●●○○○
Average Importance	●●●○○
Somewhat Important	●●●●○
Very Important	●●●●●

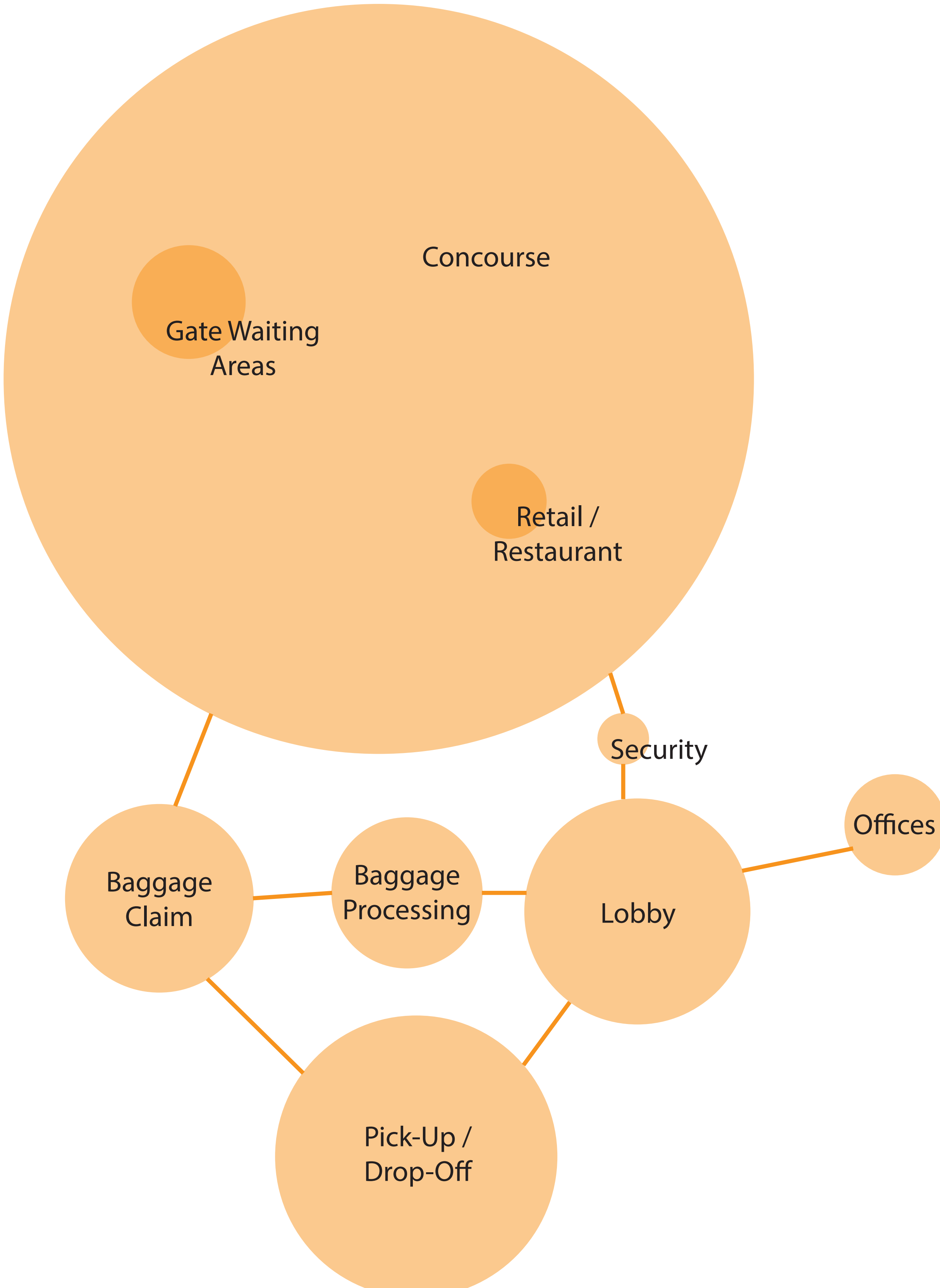


Figure 90 - Interaction Net 9 - Complete

Interaction Matrix

Figure 91 - Interaction Matrix

THESIS **DESIGN**

Design Process

This project has progressed through many stages of development.

Form

The form of the building was inspired by the idea of burying into the land, like Aaron Betsky discussed in his research. In the program section of this thesis document, I created a set of requirements that my project would follow. The form is related to many of the requirements, but most notably the two following:

> *1. The physical built structure of the building must be partially (at least 50%) burrowed into the land itself, or must use exterior materials natural to the environment or colors that blend to the site (70% of the exterior surface area).*
>
> *2. Attempt to only minimally affect wind patterns and circulation of the site. Any built structure protruding from the land will inevitably affect wind, but it is important to do this as minimally as possible. Wind patterns can affect flora and fauna of the area, and also nearby sites.`*

The rendered image on the right shows how well the form blends into the landscape, from glass to bio-plastic panels to the ground. I wanted to create a seamless transition, which left the viewer wondering where the ground stops and the building begins. By allowing the building form to continue the contours of the existing land, I was able to also reduce a change in wind and drainage patterns on the site.

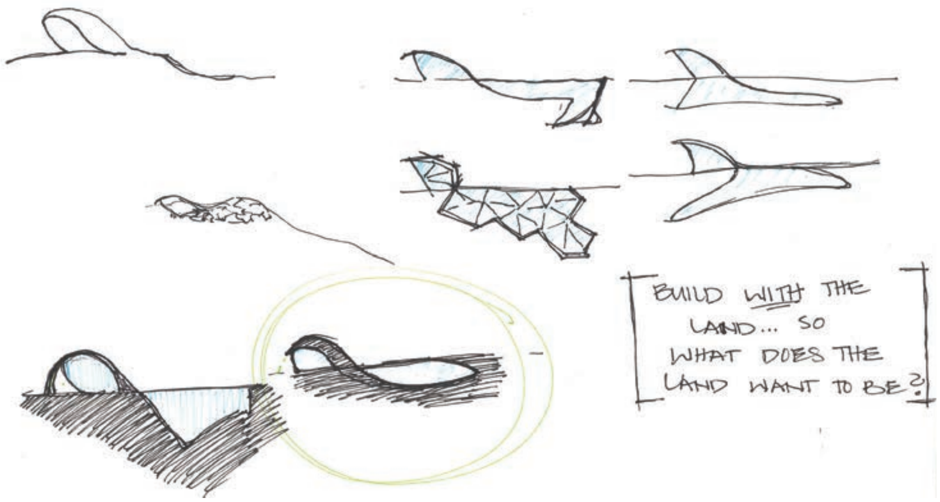


Figure 92 - Process Sketches

Figure 93 - Exterior Close-Up

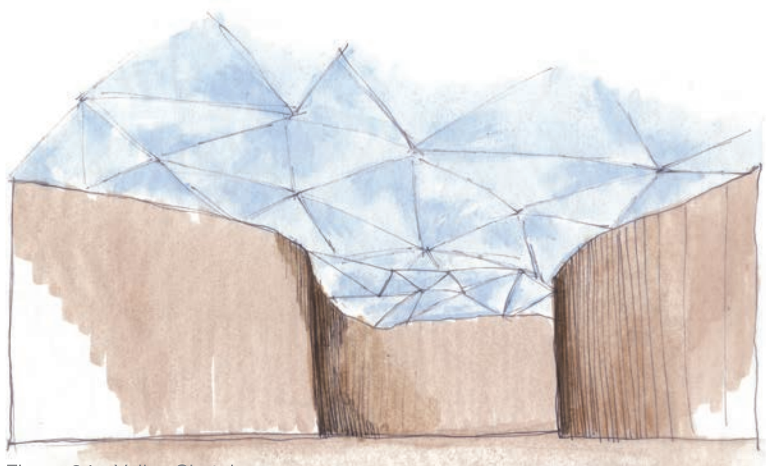


Figure 94 - Valley Sketch

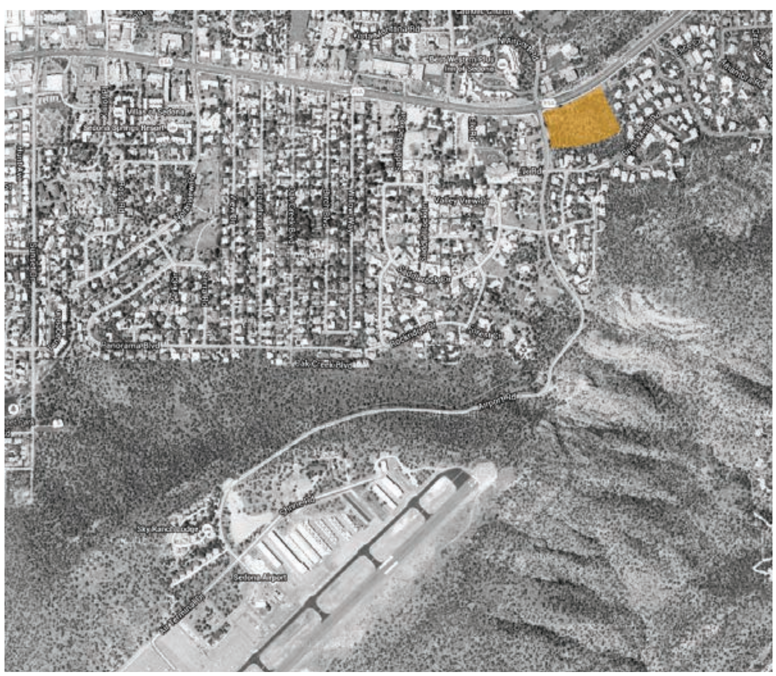


Figure 95 - Parking Diagram

Early on, in the schematic design phase, I had wanted the entire building to follow the curvature of the land. However, that request is a pretty steep one when we consider the typology of the project. How would passengers reach the ground level above if the form followed the land? I decided to place only the three gates on ground level, and all of the other programmatic elements below grade.

Valley

It was clear that there needed to be a road of some sort branching off of the existing Airport Road in order to get passengers, visitors and employees to the new terminal. The final design opted for a valley cut into the rock, with glass panels that continue the contours on top of the valley, just like the building form.

Parking

The first idea was to create a parking structure that followed the same general form as the terminal, itself. The parking garage would have been cut into the mountain, and the facade would have appeared to be the side of the mountain, just as it exists now, but with a few hidden openings to allow for ample daylighting into the structure. The realization quickly came that for a terminal this large, the parking structure would have to be even larger than the square footage of the building itself.

In order to preserve the integrity of the site, the decision was made to distribute the impact of construction by placing an underground parking structure at the base of the butte and providing a shuttle service to the terminal. The parking requirements for a facility of this size are very large, and better suited for a site at the bottom of the butte that has been already developed.

Spatial Configuration

As I began to dig deeper into space planning, I realized that there were some major changes that needed to be made. First, the concourse square footage discussed in the program section of this document was far larger than necessary. I decided to think of the spaces more as pieces that can work together and share square footage, rather than separating them completely.

Structure

The concept for the building's structure stemmed from the need to address the land form requirement of the theoretical premise. It needed to be a rigid structure that could follow the curvature of the land without putting pressure laterally on the exposed rock walls inside.

The solution is a steel frame structure, in which the framework beams are 2 feet in height. There are 13 major beams running from NW to SE. These beams are 4 feet in height, and connect with the framework. Load is transfered from these beams to 12-inch round concrete columns, which use a pin and epoxy connection to stabilize into the bedrock below. The bedrock in this area is sandstone, which is considered an intermediate rock according to the International Building Code.

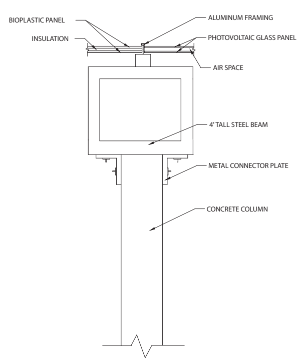


Figure 96 - Structural Detail

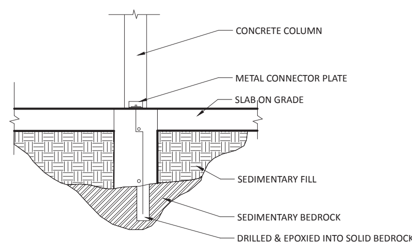


Figure 97 - Column Foundation Detail

Many different iterations were made of this structural system, as shown in the images to the left. I used a software called Form Z to model my structural framework and beams in the digital modeling environment. Some iterations were almost fully triangulated, which created an incredibly accurate mesh that followed the topography exactly. However, this direction was not necessarily realistic. I realized that rectangular panels were much more plausible as a real-life solution, and I used this idea to make further iterations.

The building envelope is composed of photo-voltaic glass and bio-plastic panels that are custom-made to resemble the ground on the site.


Figure 98 - Structure Process - Ticket Lobby

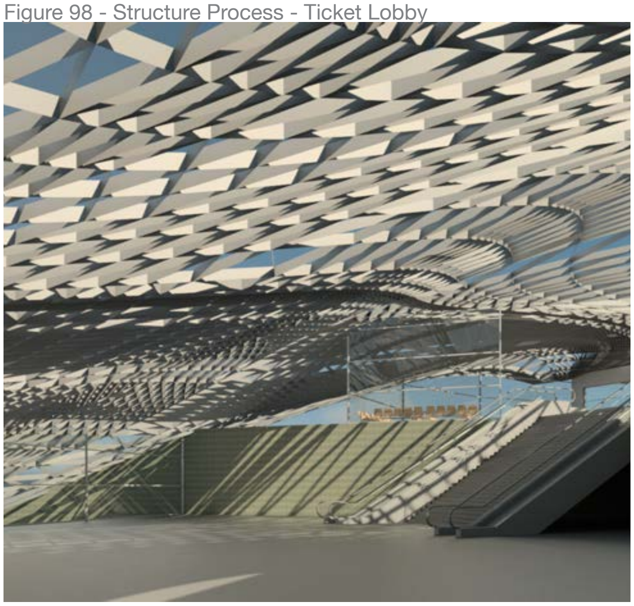


Figure 99 - Structure Progress - Concourse

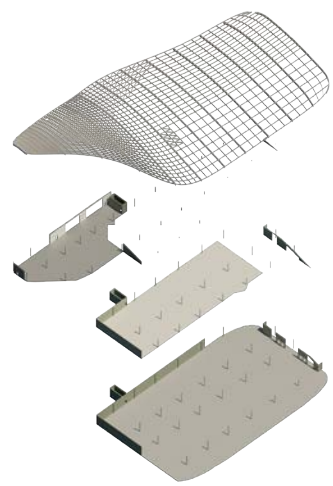


Figure 100 - Final Structural Isometric

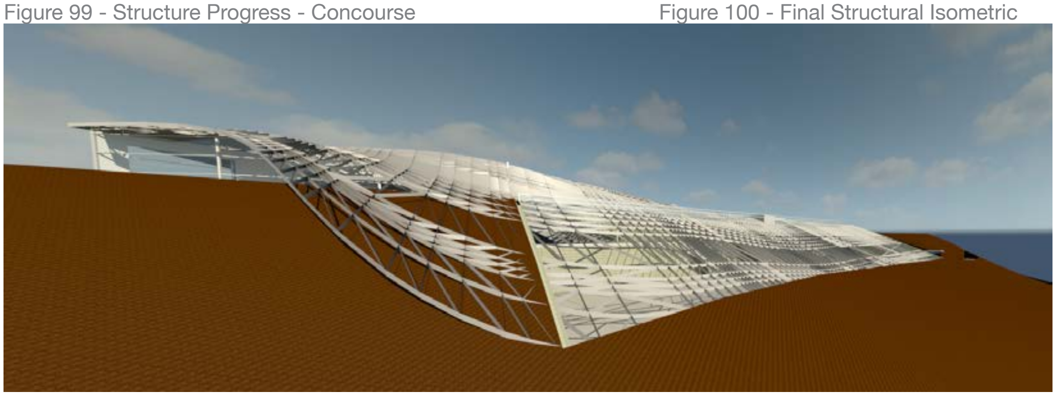


Figure 101 - Structure Progress - Exterior

Solution Documentation

Figure 102 - Final Exterior Perspective

FIRST FLOOR

2 FLOORS BELOW GRADE

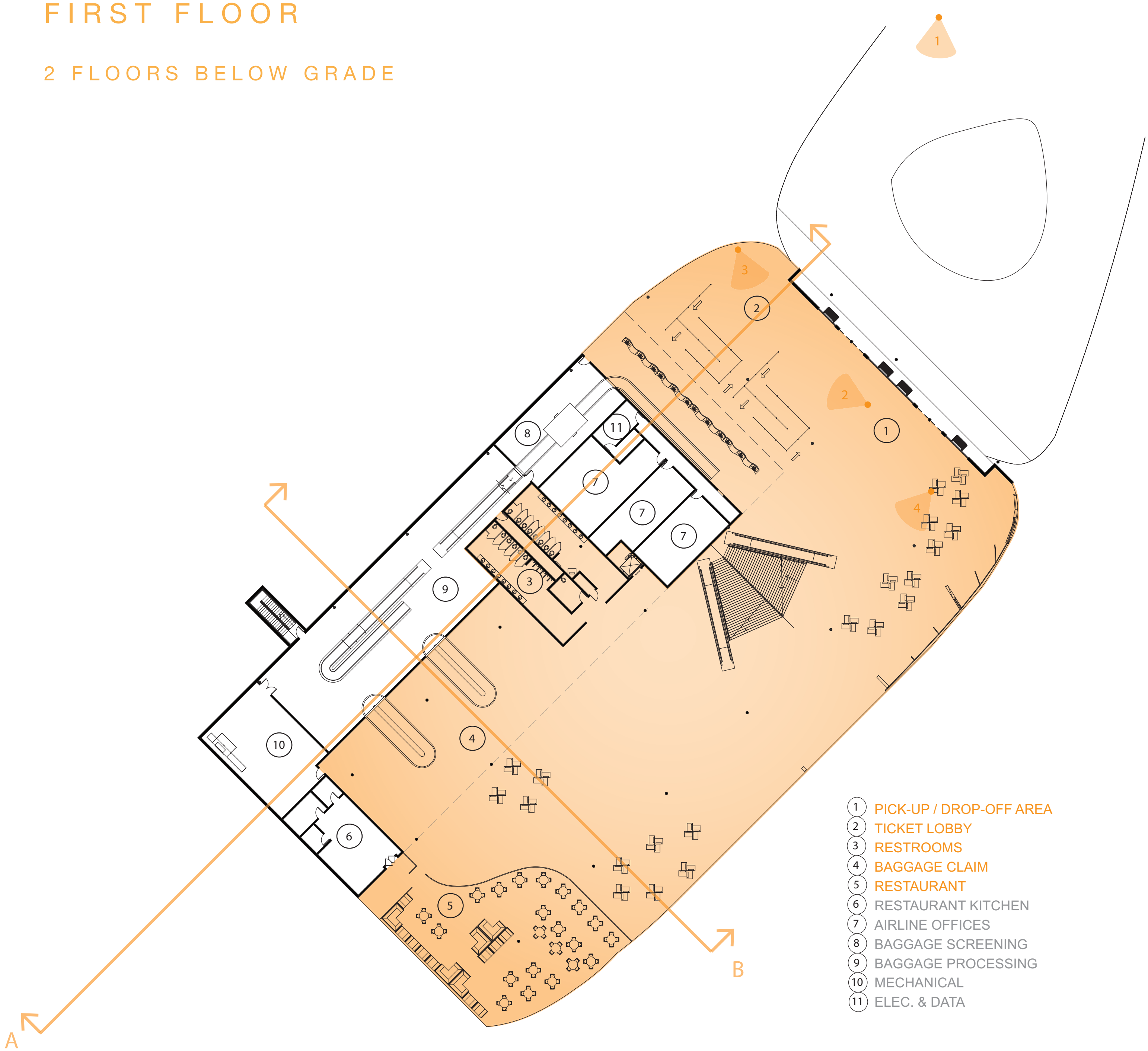


Figure 103 - Floor Plan 1

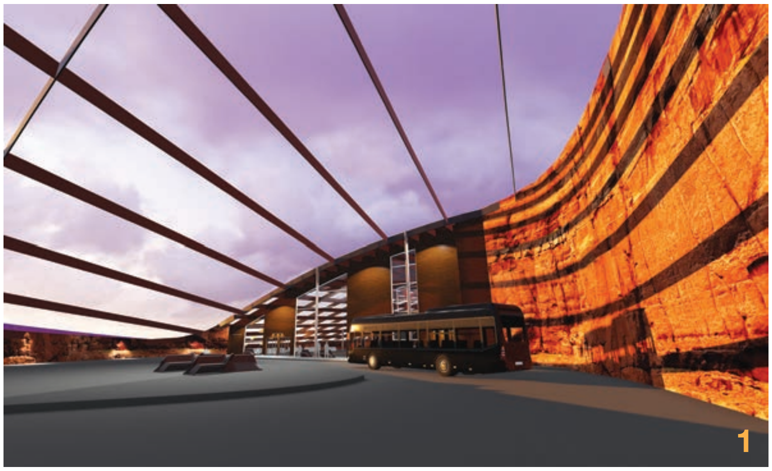


Figure 104 - Valley Entrance

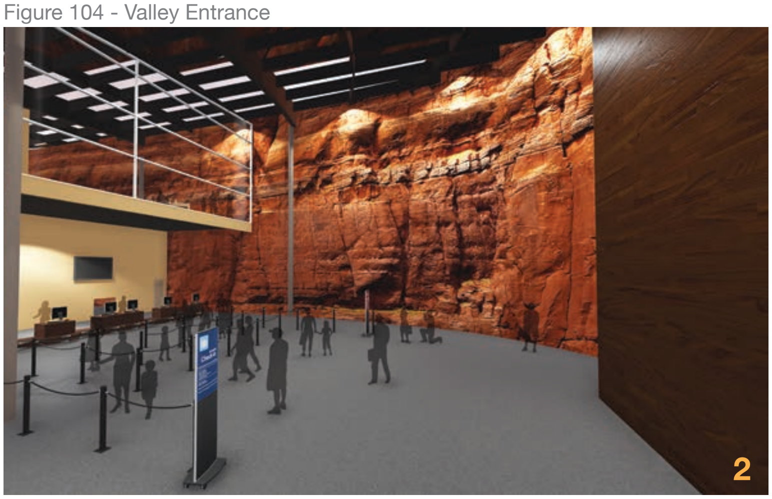


Figure 105 - Ticketing Lobby 1

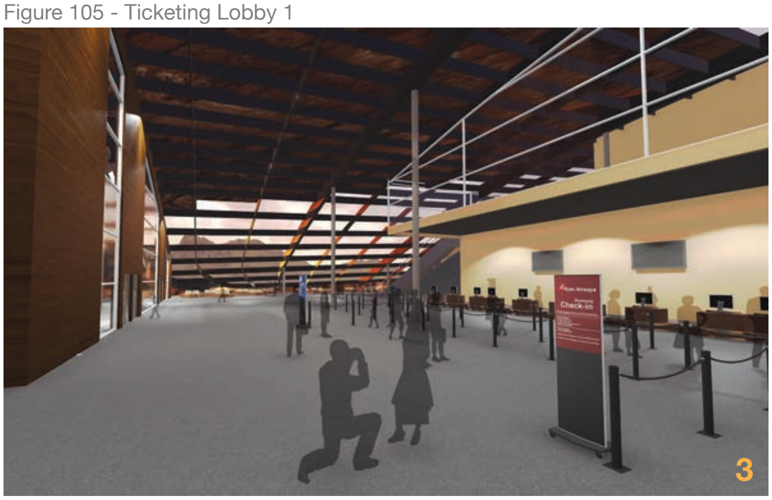


Figure 106 - Ticketing Lobby 2

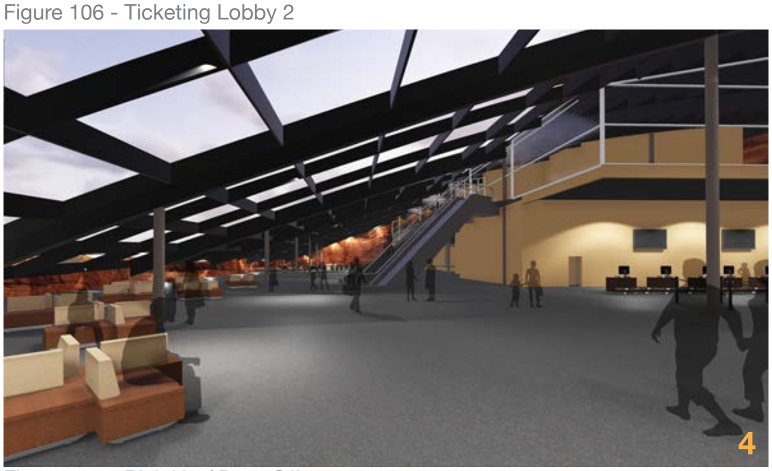


Figure 107 - Pick Up / Drop Off

SECOND FLOOR

1 FLOOR BELOW GRADE

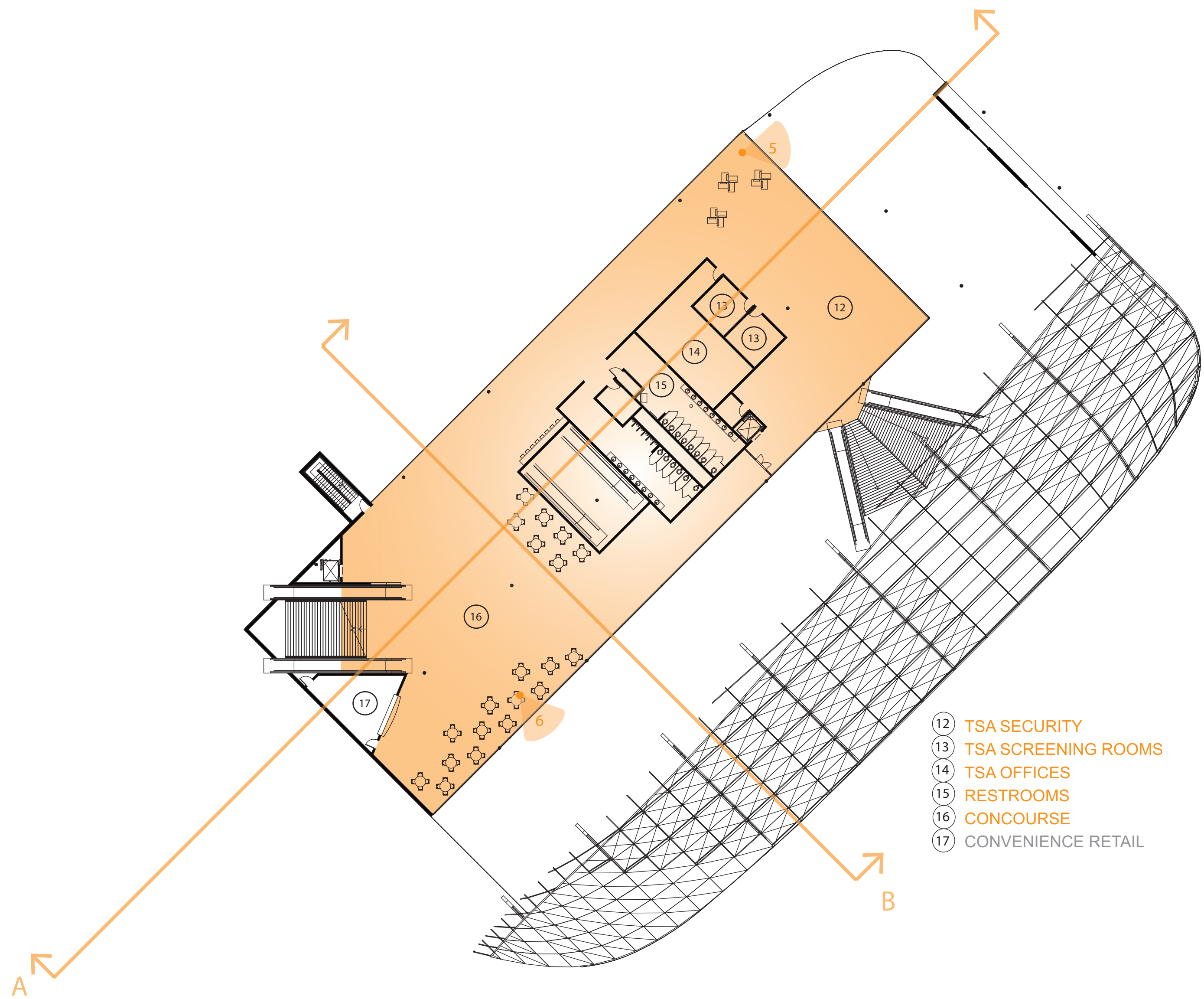


Figure 108 - Floor Plan 2

Figure 109 - TSA

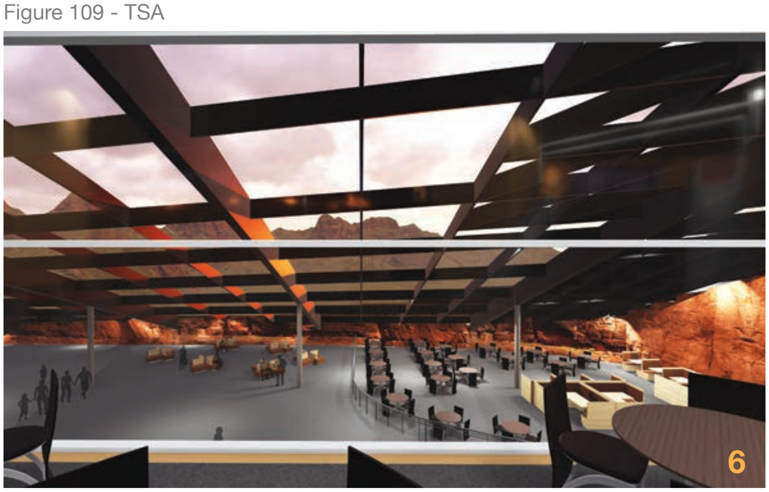


Figure 110 - Concessions/Concourse

THIRD FLOOR

GROUND LEVEL

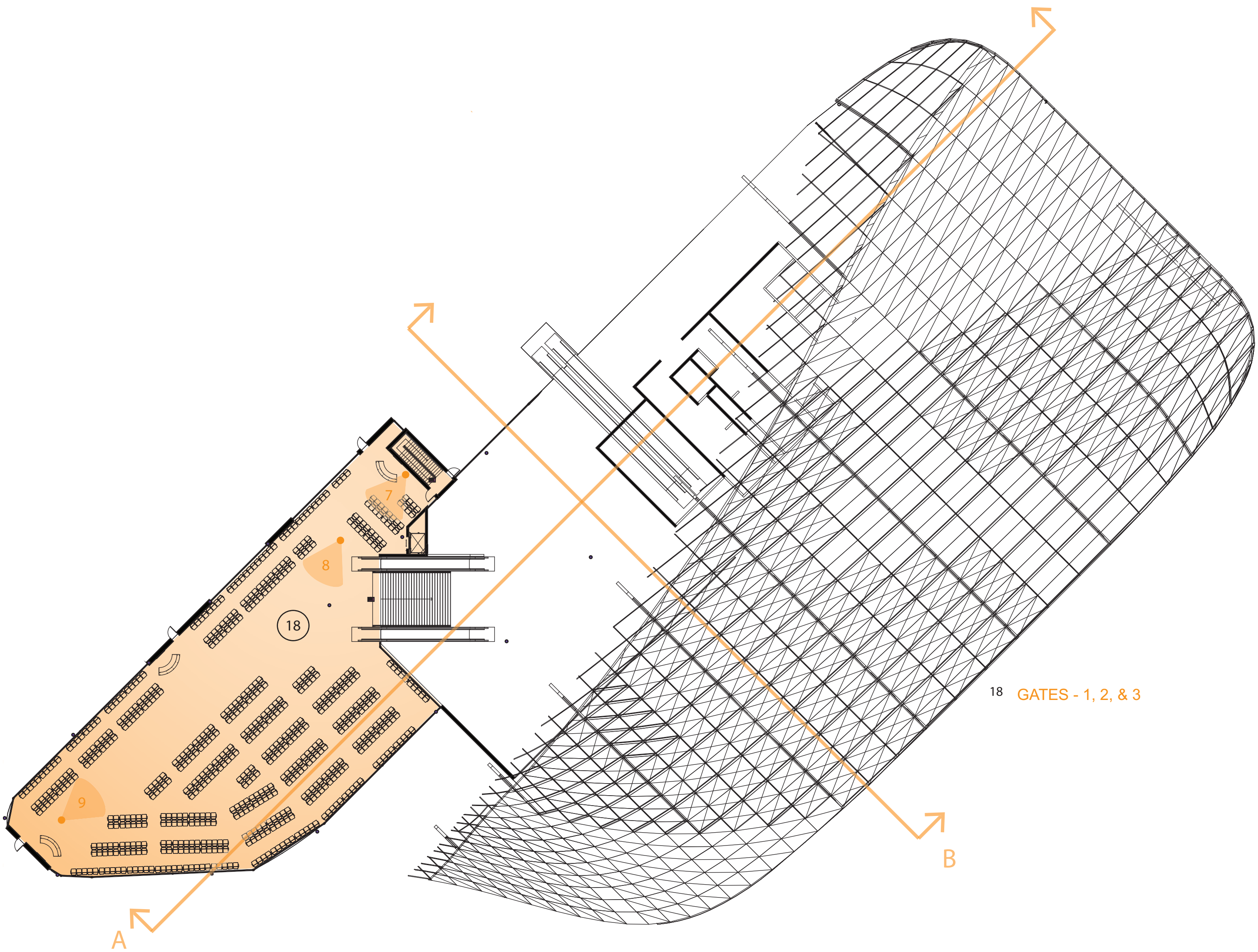


Figure 111 - Floor Plan 3

Figure 112 - Gate 1

Figure 113 - Gate 2

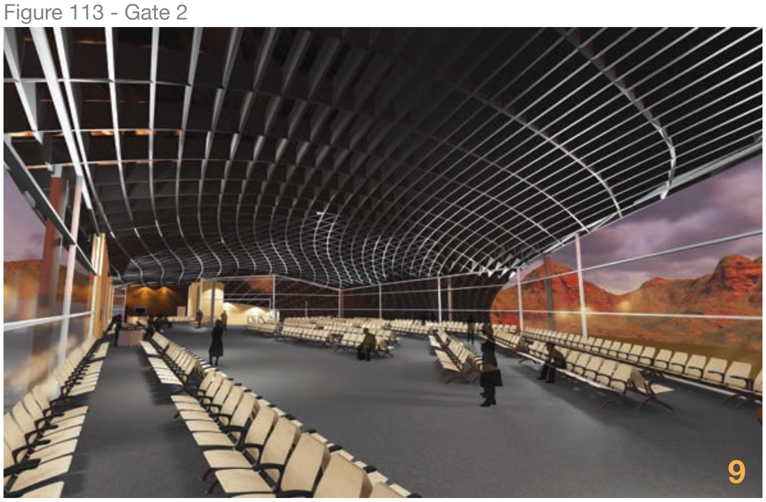


Figure 114 - Gate 3

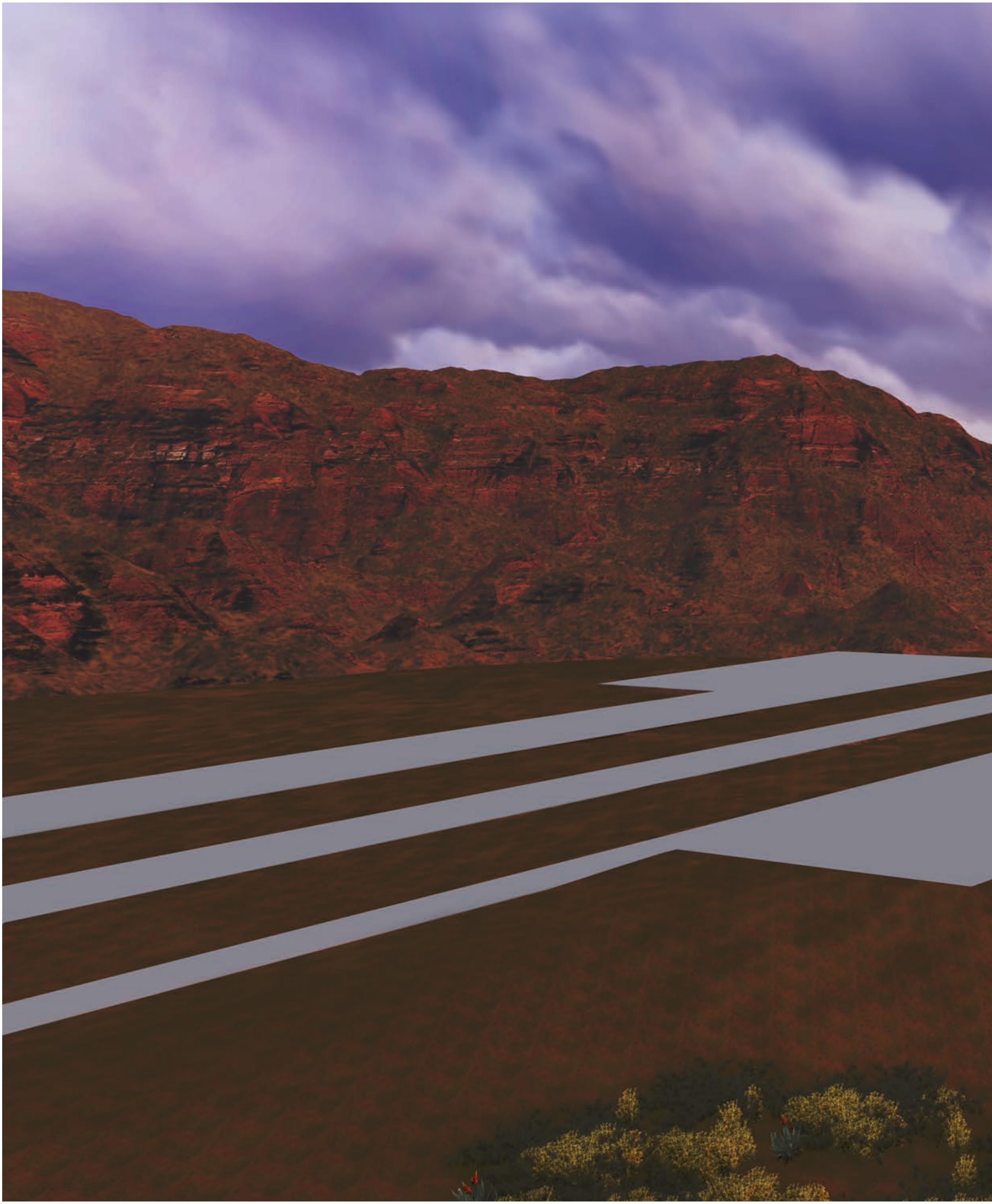
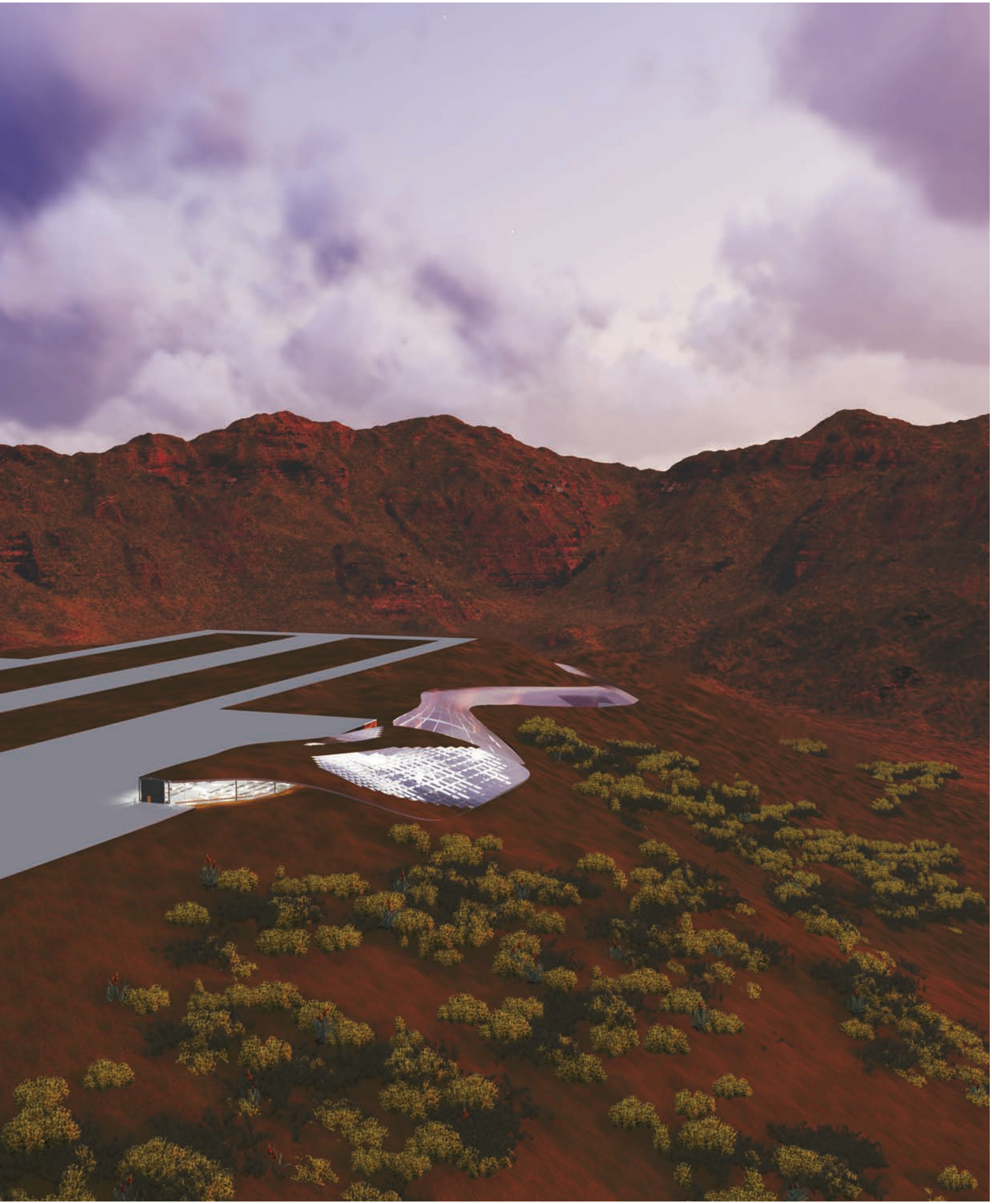


Figure 115 - Aerial Perspective



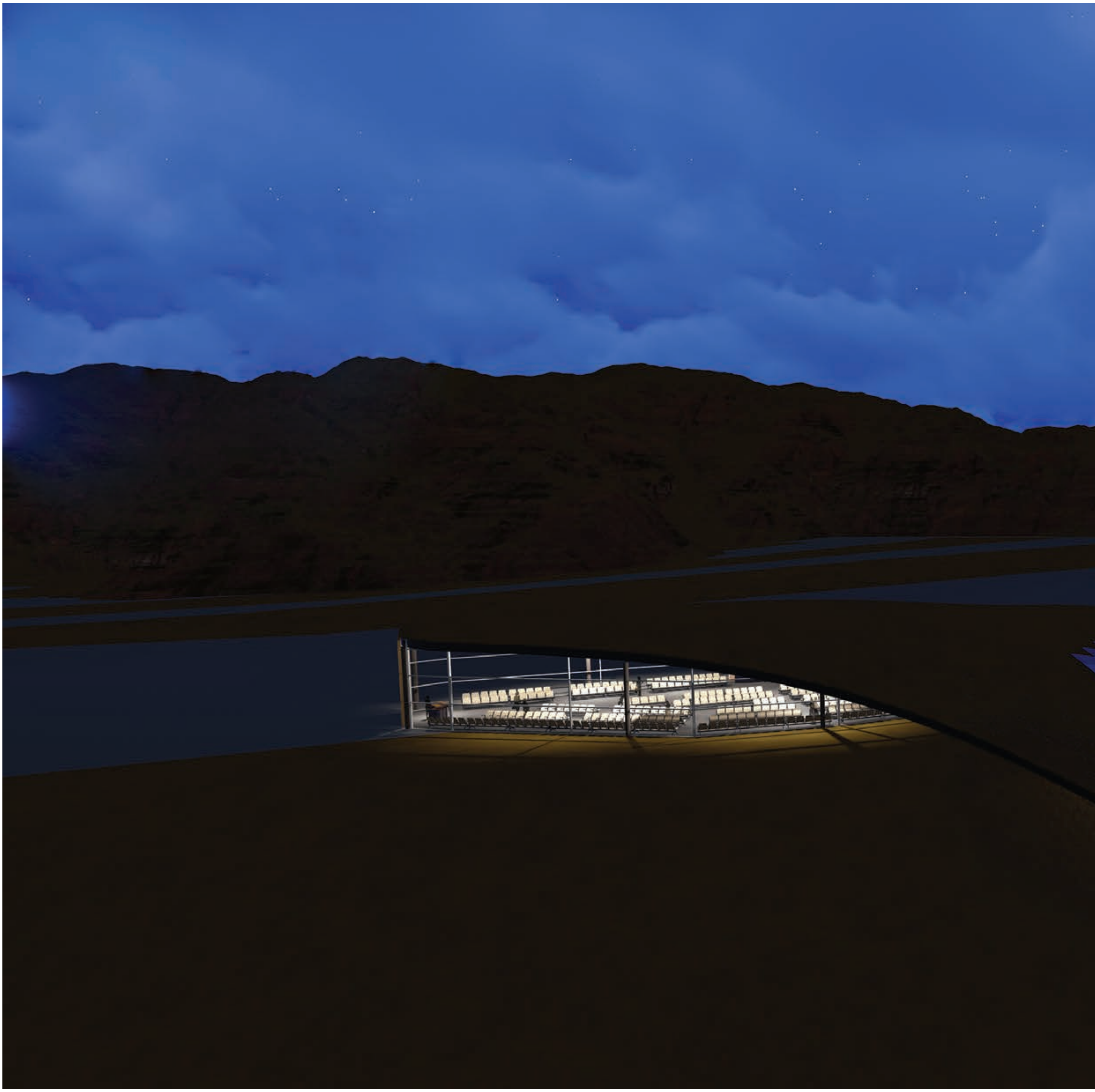


Figure 116 - Night Perspective

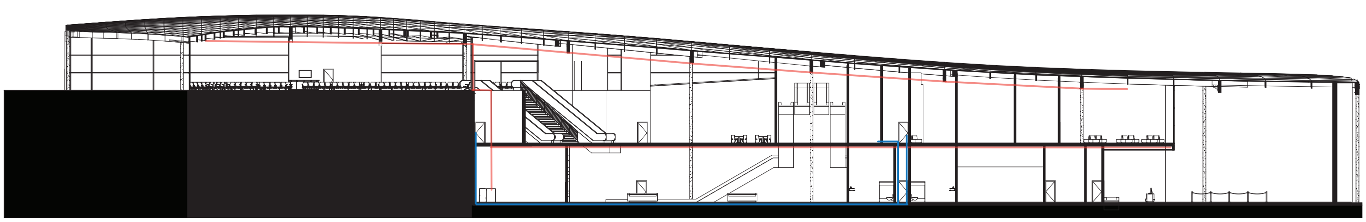
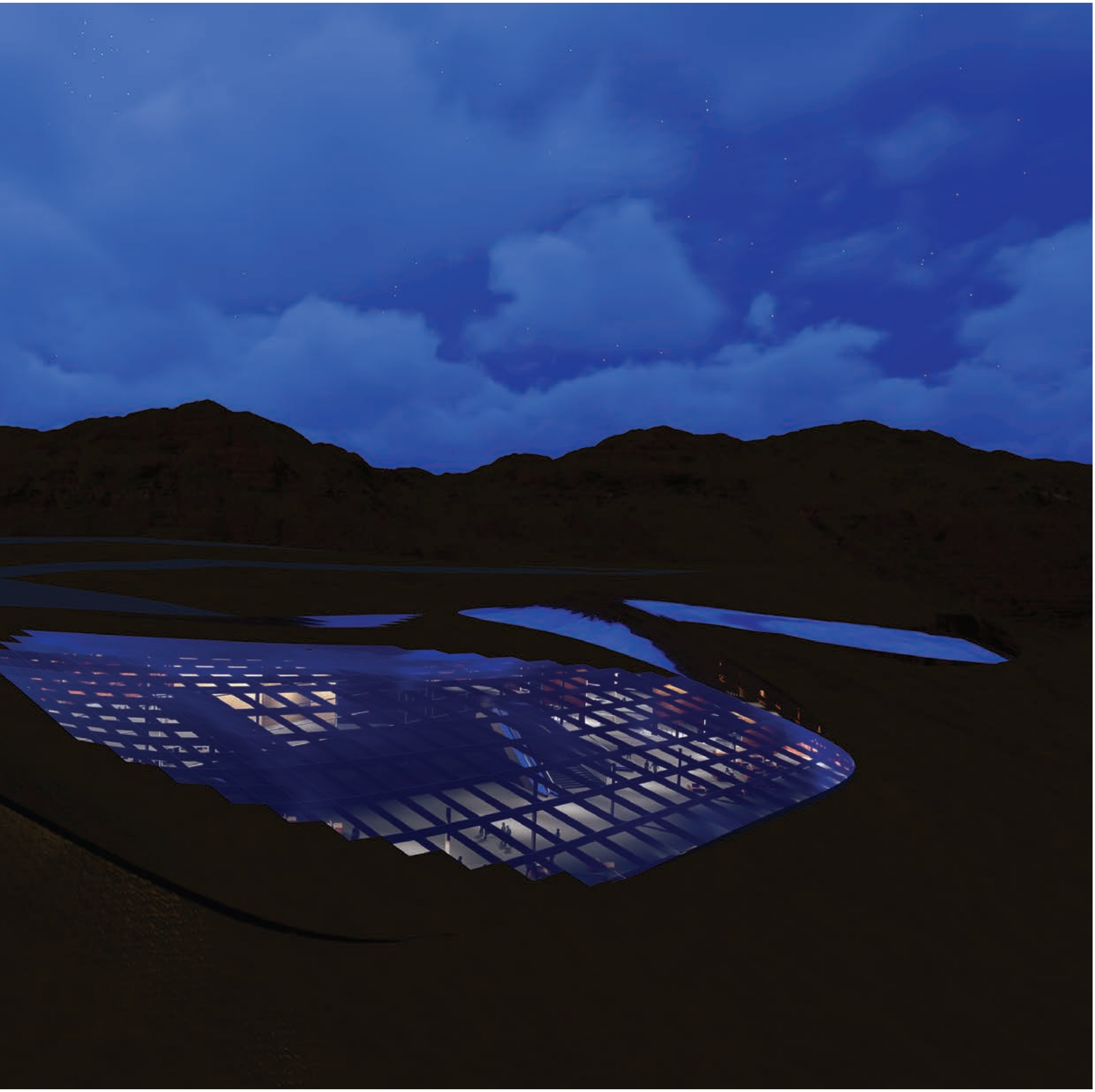


Figure 117 - Section AA



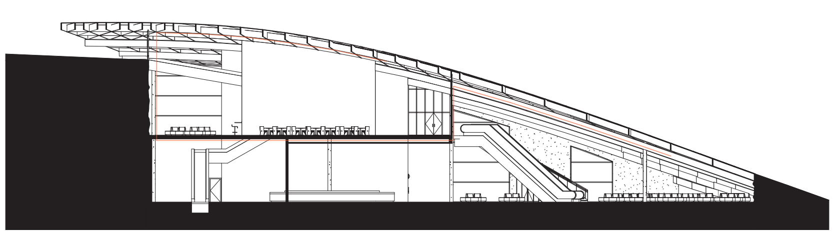


Figure 118 - Section BB

Figure 119 - Section Perspective

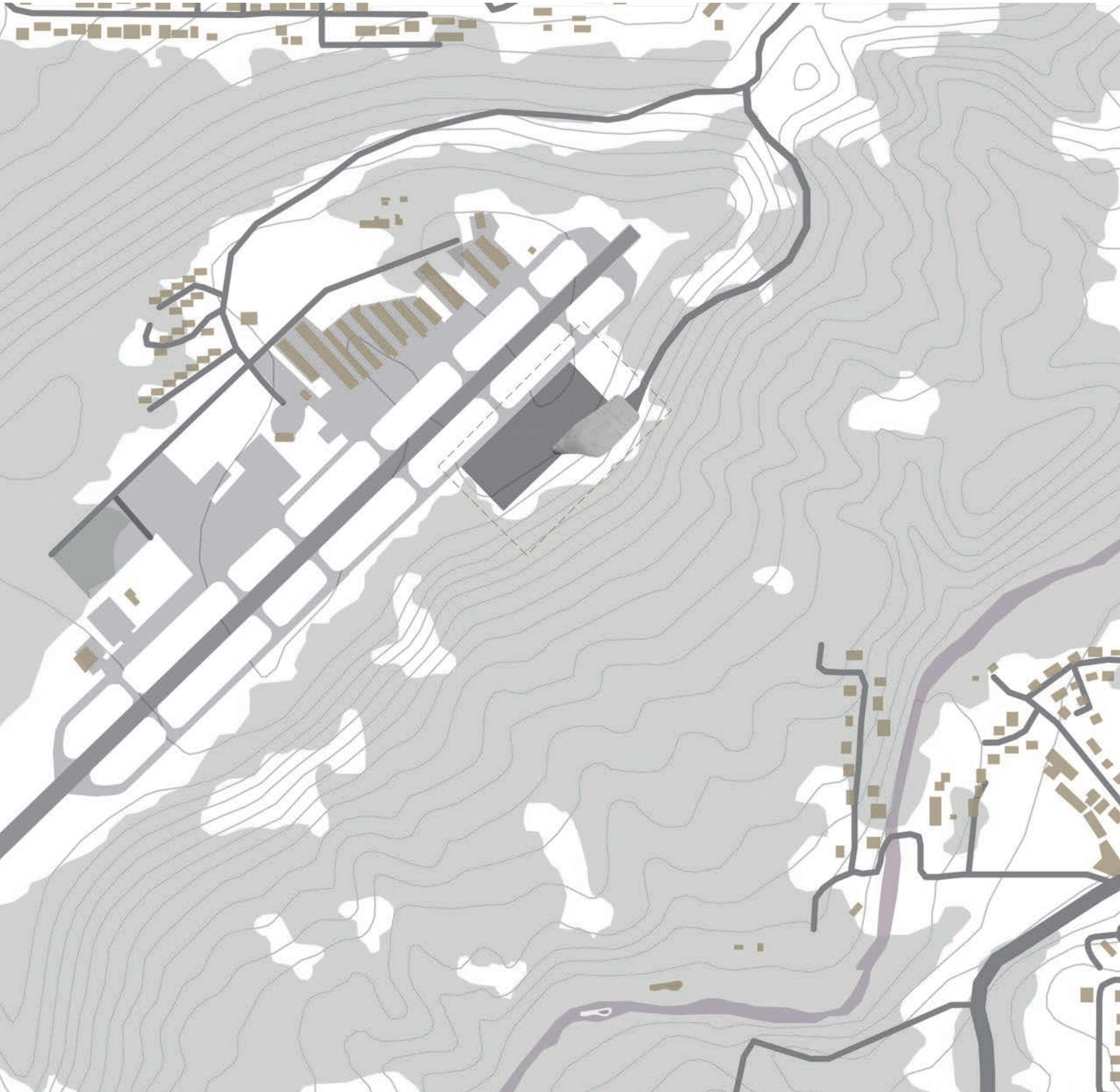
Response to the Site

I believe that my design truly acknowledges the site to the level in which I wanted to achieve. Most of the building, as well as the valley, follows the contours of the site, allowing for only a minimal change in wind and drainage patterns. This also allows for minimal intrusion on views of the site. From the city below, the terminal is not visible at all, which preserves the gorgeous sunset views that the people of Sedona treasure so much.

The bio-plastic panels are designed to look like the ground, which creates an effect of transparency. Viewers of the building will not be sure necessarily where the building begins or ends.

I do believe that the design accentuates the natural environment around it, and also protects the site on which it sits.

Figure 120 - Final Site Plan



I was lucky enough to have the opportunity to fly to Sedona, Arizona to conduct a site visit. In March, my dad and I flew our red RV-8 from Falcon Field in Phoenix to the legendary Sedona Airport. I can quite confidently say that it was the most beautiful flight I have ever experienced. When we landed, we took a taxi to explore the base of the Airport Mesa to determine the views from the city below. The landscape is even more incredible than I had realized, and it provided me with the inspiration to really showcase the scenery in my project.

Figure 121 - Site Visit - Sedona Aerial


Figure 122 - Site Visit - Site Aerial


Figure 123 - Site Visit - Landing


Figure 124 - Site Visit - Airplane RV8


Figure 126 - Site Visit - View From Below


Figure 125 - Site Visit - View From Runway

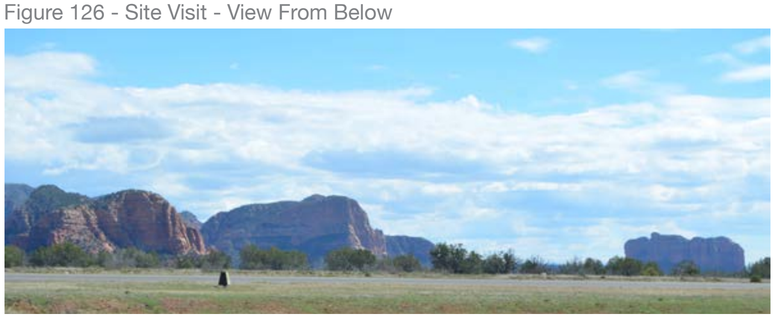


Figure 127 - Site Visit - View From Takeoff

Response to the Typological Research and Program

The typological research has not once been forgotten throughout the design process. The case studies of the theoretical premise have continued to be inspirational, and many parallels can be seen between my design and those studies. I have also kept in mind the typological case studies, as they helped me to figure out space planning, circulation, and the overall logistics of designing an air terminal facility.

As I stated before, the program changed slightly in that the concourse space was decreased and spread out among the different floors. There was also a restaurant added on the first floor to allow visitors, and families and friends of passengers to share a meal before departure or after arrival. I realized that a space like this is necessary, and encourages people to sit and enjoy the space on the first floor, rather than rushing through the motions to the gates above. Also, the conference spaces for airport employees was eliminated. Due to the small size of this facility, that particular space wasn't necessary.

Circulation was a major element in the programming of the building. Airports have a very set progression of spaces, due to security needs, but organizing the spaces was more difficult than I had originally imagined. Below are some diagrams of passenger circulation in the space.

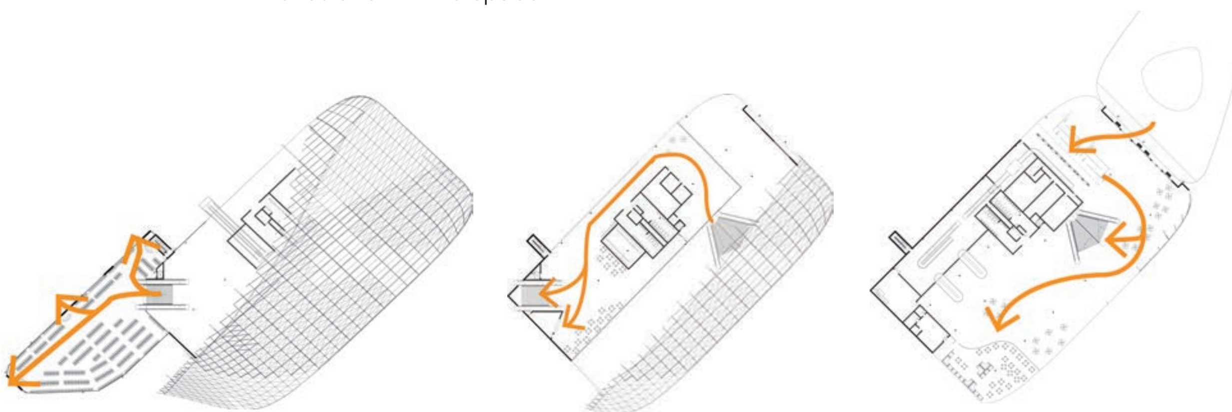


Figure 128 - Passenger Circulation

Baggage circulation was another tough issue to overcome. How can baggage make its way from two floors below grade to the ground floor? I decided on a system of conveyor belts which would bring the baggage up from the ticketing counter to the tarmac, and arriving baggage from the tarmac to the baggage claim. The diagrams below define the path of the baggage in this design.

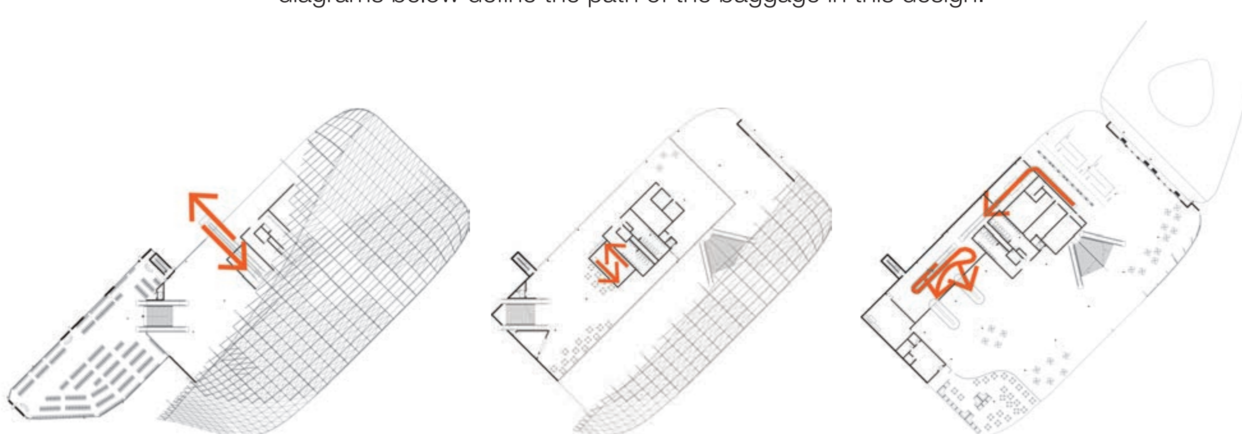


Figure 129 - Baggage Circulation

Response to Goals and Project Emphasis

I had a number of goals listed for this project in the proposal section of this document. Many of the goals simply weren't achievable with the time given to complete this project. However, I am proud of the goals that I did achieve, and I believe that I have grown exponentially as a designer and problem-solver during this project.

Some goals that I didn't achieve and wish I would have been able to are conducting a building lifetime cost analysis, researching and implementing Passivehaus design standards, and completing a LEED checklist.

However, the list of goals which I did indeed accomplish is much longer than the previous. Here are the goals that I believe I achieved:

- Research innovative sustainable active and passive systems
- Research visual perception, and its relation to architecture
- Gain a better understanding of the construction of a building, specifically the building's envelope
- Experiment with the use of different digital design softwares to enhance the discovery and presentation phases of the design process
- Produce accurate, readable and graphically pleasing floor plans, sections, etc.
- Produce logical and accurate details,
- Produce exceptional renderings that express the true vision of the project
- Learn technicalities of how airports work
- Fly into the airport which I have chosen for my site
- Learn about new technologies in the air travel industry
- Use this thesis to affect both the architecture profession and the air industry in a positive way
- Expand my overall knowledge on the topic of flying
- Use this thesis project to experience the views of new landscapes from an airplane.

As this semester draws to an end, and I reflect on the success of the project, I am reminded of all of the things I was able to accomplish. I was pushed to try new softwares, implement new ideas, and I have found that I'm very proud of the end result. I am now much more confident working in Revit, Form Z, and Lumion. More importantly, I have much more knowledge on the topic of site integration, which truly is a passion of mine, and will benefit me in the years to come. This project has triggered even more interest on the topic, and I am hoping to pursue more projects similar to this one when I work in the profession.

Final Project Installation

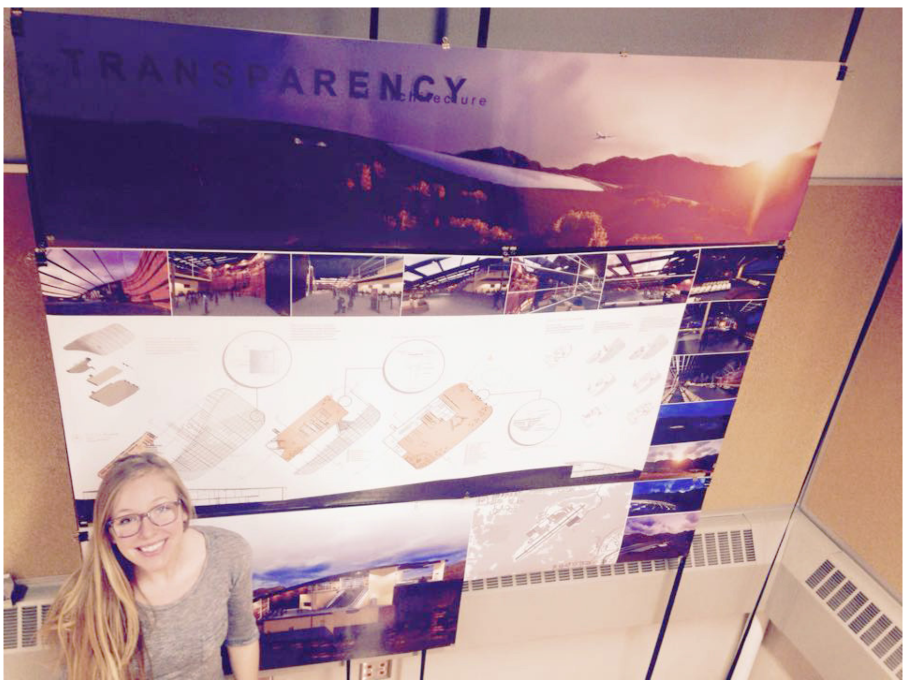


Figure 130 - Display Boards and I

The final project installation was comprised of three boards and a computer set up with a looped animation. The three boards included fourteen renderings created in Revit and Lumion, three floor plans, two sections, one section perspective, three details, one structural exploded isometric, three sets of circulation diagrams, and one site plan.

Figure 131 - Final Display

THESIS **APPENDIX**

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Previous Studio Experience

2nd Year

Fall : 2011 : Joan Vorderbruggen
Tea House
Boathouse

Spring : 2012 : Darryl Booker
Dance Studio
Pritzker “For the Birds”

3rd Year

Fall : 2012 : Mike Christiansen
Askanase Hall

Spring : 2013 : Steve Martens
Fargo City Hall

4th Year

Fall : 2013 : David Crutchfield
High Rise

Spring : 2014 : Paul Gleye
“Urbanism” Study Abroad in Brussels

5th Year

Fall : 2014 : Regin Schwaen
International Competition


Figure 132 - Personal Identification Headshot

Personal Identification

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I'm currently a student at North Dakota State University, pursuing my Master's Degree in Architecture. I grew up in a small town in North Dakota called Hatton, and have always known that my calling is architecture.

Last semester I studied abroad in Brussels, Belgium for three months at UCL, Université catholique de Louvain. The experience was such an amazing one, and I was able to see so much beautiful architecture, it's hard to keep it all straight. Traveling is such a passion of mine. I love to experience new places and cultures. My other hobbies include musical instruments (piano mostly), reading, cooking, and flying (I earned my private pilot license in 2013).

I haven't yet decided which direction to take in the architecture profession. There are so many specialties and I just want to be able to experience working on at least a few different types of projects before settling on just one. I'm enthusiastic about all kinds of architecture, and I think that even in buildings meant to be completely functional, there is always a way to incorporate the beauty of design.

"What I'm challenging myself to accomplish as an architecture student is to gain the most knowledge possible of the world around me and to translate that into something tangible, and to never stop discovering."