THESIS PROPOSAL

ICE IN THE DESERT

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North Dakota State University
ALA Masters Program

Signature Page

A Design Thesis Submitted to the Department of Architecture and Landscape Architecture of North Dakota State University

By
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In Partial Fulfillment of the Requirements for the Degree of Masters of Architecture

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Stephen A. Wischer Thesis Committee Chair	May 12, 2023 Date

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Abstract

Sports have the ability to bring a whole city together, especially in a time of such division in this world, sports can bridge those differences, even if it is for just a few hours. For many, sports are a source for passion in one's life. Growing up, playing sports gave me an outlet to escape from the normal world.

Arena's have some of the most unique design options in the entire world. *This thesis proposal shows how these buildings can be built for sustainability, and made for all athletes at different stages in their careers.* These spaces provide a community with multiple purposes, from hosting games, to concerts, to even holding farmer's markets on days where the team isn't playing.

Narrative

Creating an environment that encourages athletes to continue and enhance their skills in a sport is a huge factor in determining the growth of sports in a community. Today, it is seen all to often that the top tier players receive the most resources in hockey associations. Giving college and youth players an encouraging complex to grow as a player helps create a larger liking for the sport, leading to more fans and popularity for the building.

Architects play a crucial role in the overall success of an arena. From designing a structure whose roof can span the width and length of the bowl of the arena to allow unobstructed views for viewers to providing passive systems for cooling and green energy use. The main issue with rinks today is the lack of space for training and including all age groups. With hockey being such a growing sport in America, ice has become hard to come by allowing the players to practice.

Tuscon, Arizona is a prime location for these issues. As stated earlier, hockey is a rapidly growing sport in the United States. In the last 20 years, the amount of youth hockey players in America has risen by over 230%, making it one of the fastest growing sports in the country. With these surplus of players, a space is needed for these players to continue playing the sport they love.

Club sports are a huge way to give students a chance to play their respective sports. With this in mind, a hockey complex for a college club hockey team will be the main group I want to design for. This also gives opportunity for youth hockey groups to use this space as well.

Project Typology

This project's typology is a sustainable hockey rink to serve as the home of a college club sport hockey team, and provide opportunities for youth teams to skate on it as well. The building typology for this will be commercial. The design of the arena will be centered through sustainability, and creating off-ice training spaces for the athletes.

The design will contain a single bowl for seating, and contain suites for those that wish. With hockey rapidly growing in the South West, this design will solve the problem of there being a lack of ice rinks for all ages to skate on.

Case Studies

1 Climate Pledge Arena

2 T-Mobile Arena

3 Ralph Engelstad Arena

Climate Pledge Arena

Figure 1

Location: Seattle, Washington

Use: Used for concerts
- Renovated to become home of Seattle Kraken

Cost: has exceeded $1 billion over the course of its history

Background

Climate Pledge Arena is home to the Seattle Kraken on the National Hockey League. This arena is the most progressive and sustainable arena in the world. Primarily used as a concert venue, Climate Pledge Arena underwent renovations to house the Seattle Kraken, who became a part of the NHL in 2021.

Climate Pledge Arena became the world's first carbon net-zero arena. This case study gives many different options for sustainable design in the stadium genre of buildings.

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

Water Conservation

With 198 days of expected rainfall per year, this gave Climate Pledge Arena a golden opportunity for water tanks. These tanks are placed at various spots on the roof, and collect rainwater to use throughout the arena. The water flows through a series of gutters and pipes into an underground tank that holds 15,000 gallons.

All bathrooms in the arena have waterless toilets to preserve as much water as possible. Similarly, additional water tanks are placed throughout the site to collect water and reduce water runoff, this water helps fulfill the needs for the arena as well as the rain tanks on the roof.

Figure 8

Figure 9

Figure 10

Zero | Pledge | Conservation

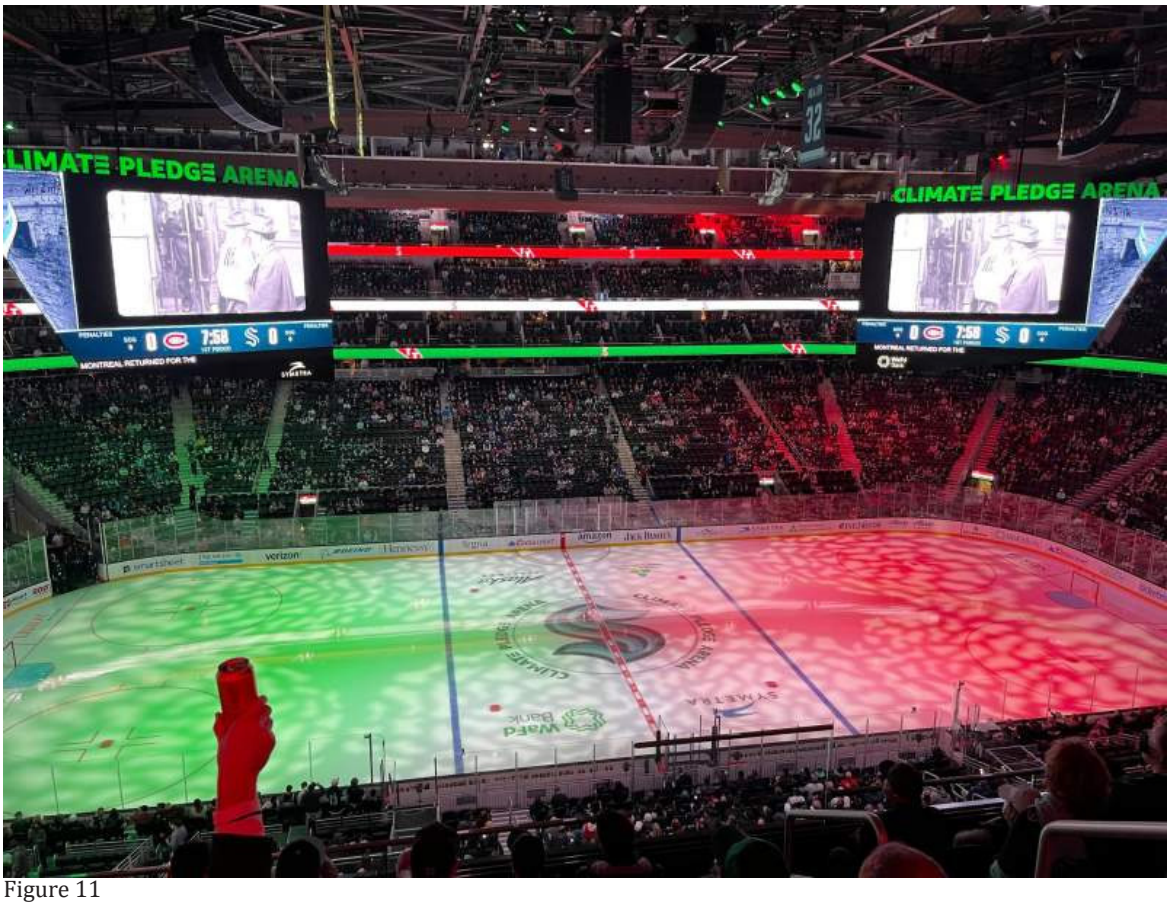


Figure 11

Zero Single-Use Plastic

Single-use plastic almost never gets recycled. These plastics end up in landfills where they don't biodegrade

Climate Pledge Arena is the first arena to announce an intention to eliminate single-use plastics. They are committed to being 100% free by 2024

Figure 12

Figure 13

Zero Waste

Climate Pledge Arena has a target range of 95% + diversion rate, which is considered 'zero waste'. A diversion rate is the amount of material (trash) a business deflect, or sends, to the landfill.

This is achieved through simple info graphics for consumer education, and on-site sorting. Composting of the waste and extensive recycling is done throughout the arena as well.

Solar Energy

The Seattle Kraken's home has been converted to 100% electric. Solar panels were installed on the roof to cover most of the buildings energy needs.

Offset renewable energy plants will funnel the rest of the building's power needs.

Figure 14

Findings

Climate Pledge Arena sure does live up to it's name. The extents of conservation observed throughout the arena have changed the way arena can be built for the future. The beautiful glass walls at the ends of the rink create stunning views. Putting views aside, the biggest reason for a case study on this arena was the outstanding job at conservation.

From water tanks to solar panels, this arena has it all. Built in the 1960s, Climate Pledge Arena has proven that a new arena or stadium doesn't need to be built to be sustainable.

Figure 15

Conclusion

Climate Pledge Arena proves that arenas can encourage and thrive with sustainability. Each climate will have different ways of being sustainable. Their success in solar energy is a tactic most arenas can use in taking the next step in sustainability. Views of the exterior, similar to the Ralph, are utilized throughout the arena, this rink, however, shows directly outside looking in to the rink instead of the concourse. All of these features can be applied in the proposed arena design.

Figure 16


Figure 17

T-Mobile Arena

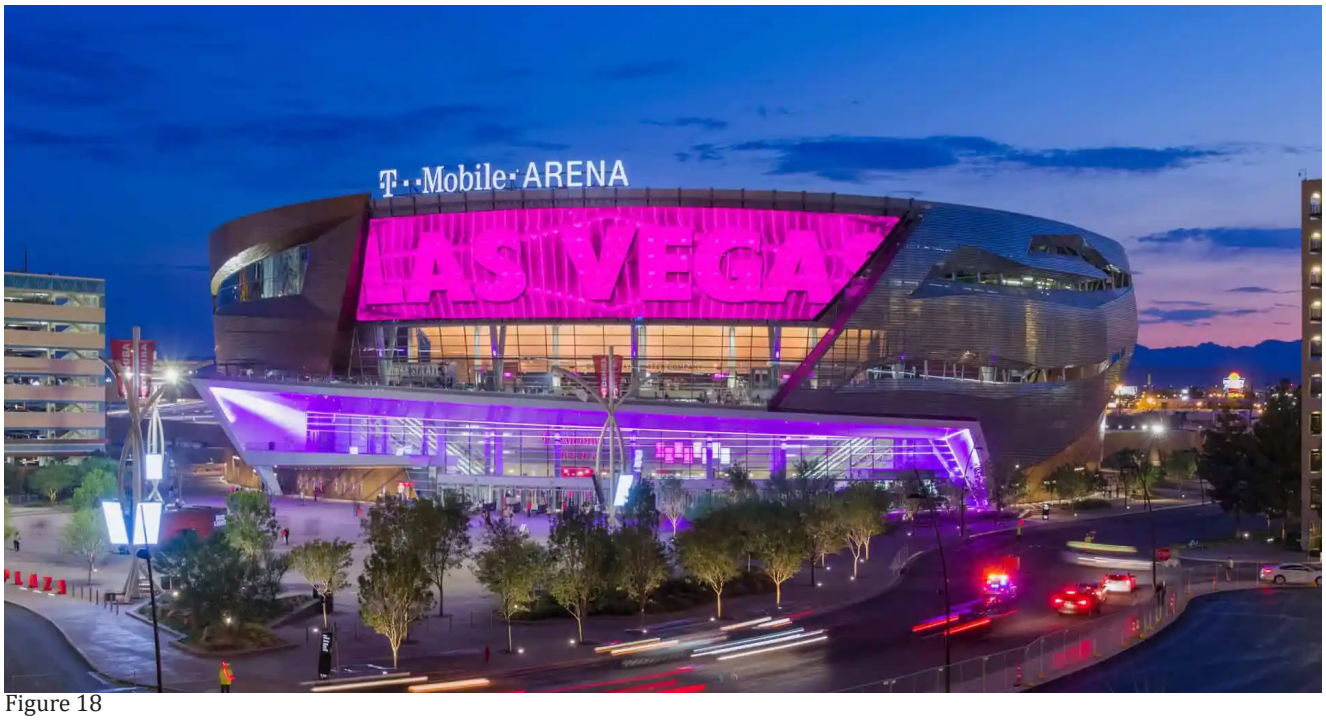


Figure 18

Location: Las Vegas, Nevada

Use: Home of the Vegas Golden Knights
- Home of USC

Cost: has exceeded $375,000,000

Background

T-Mobile Arena, located in Las Vegas, holds over 20,000 fans. Located just off the strip, this arena is as flashy as you'd expect coming out of Vegas. This rink is constructed of a expansive glass facade, and highlighted by a 9,000 square foot LED screen glowing magenta encasing itself to capture the glamour of Las Vegas.

T-Mobile Arena is home to the Las Vegas Golden Knights, an NHL franchise that found its home in the league in 2018. The arena is composed of over 7,000 individual metal beams, totaling to over 7,100 tons of material.

Figure 19

“CHALLENGE. Two environments come to mind when we think of Las Vegas. One is the glitz and glamour of The Strip. The other is a spectacular surrounding landscape highlighted by the Spring Mountains to the west. The design for T-Mobile Arena, an AEG and MGM Resorts International joint venture, needed to speak to both in a way that felt authentic to locals and tourists alike.

INNOVATION. To capture the excitement of Las Vegas Boulevard sitting just a block away, the arena opens with an expansive glass facade and sweeping 9,000-square-foot LED screen. An outdoor performance stage and sweeping balconies also radiate energy outward into The Park, a winding landscaped space that weaves the arena together with its neighbors.

Meanwhile, the south and west facades of the arena reflect desert and mountain influences and feature a solid skin that protects against the intense desert sun. This “of the desert” skin wraps the arena with rolling bands of metal that evoke the color and sedimentary layering of the desert mountains.” - populus.com

Figure 20

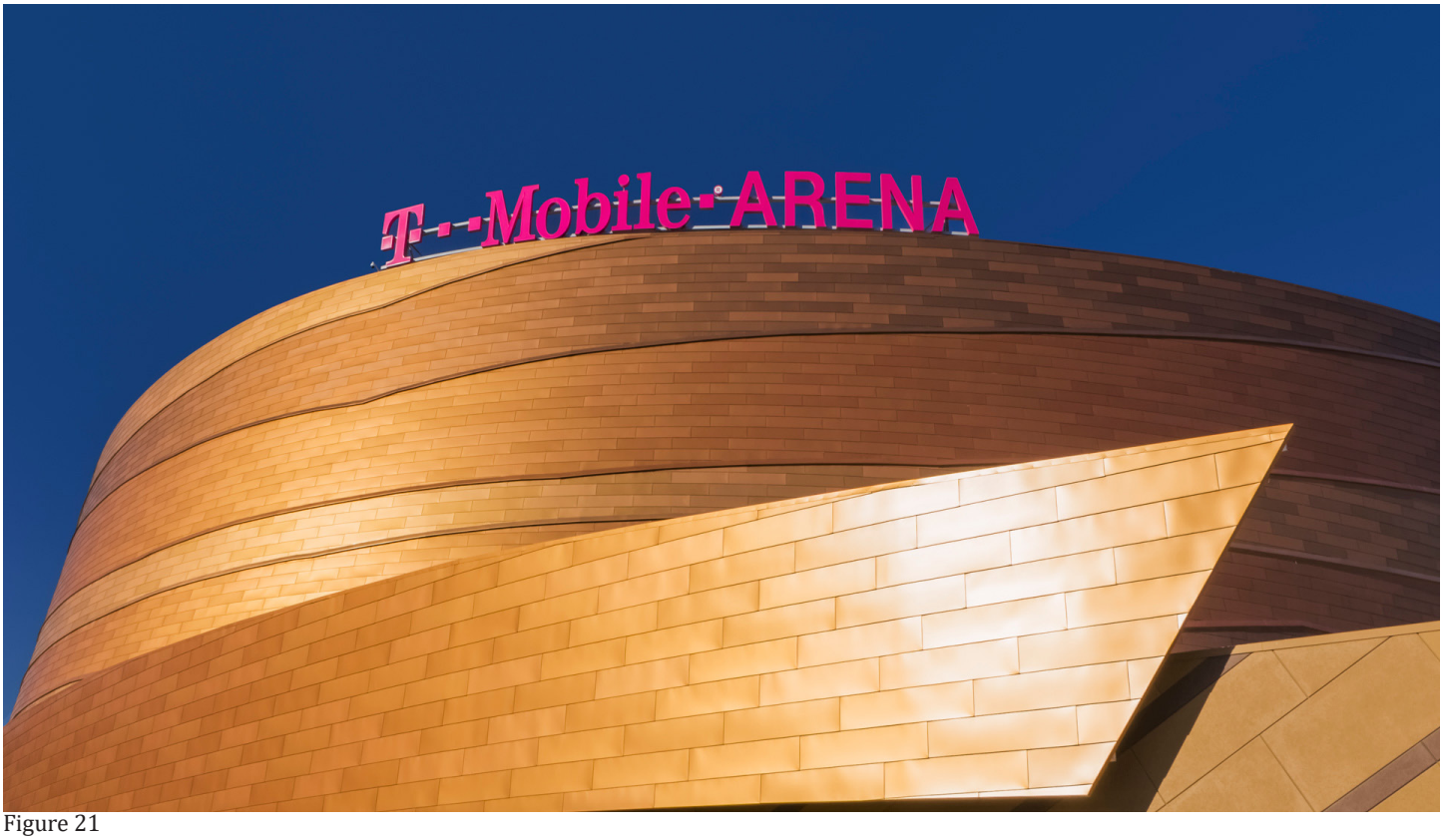


Figure 21

Glamour | Impact | Innovation


Figure 22

Primarily, T-Mobile Arena is constructed of structural steel with composite concrete floors. This design features a long span roof which covers the 350 foot by 450 foot seating bowl with no help from columns giving spectators unobstructed views. An expansive rigging grid is capable of supporting 2 Boeing 737 airplanes, or 180,000 pounds.

In the 82 foot atrium, custom Y shaped columns were installed to support three things, the enclosure, the structure above, and the cantilevered exterior balcony.

The South and West facades of the building were built and designed to be solid, to help keep out the sun's intense desert heat from penetrating the building's interior.

T-Mobile Arena has also achieved LEED gold standard rating for their eco friendly design. LEED, which is a preeminent rating system for design, construction, and operation of high performance green buildings, gave this arena the title due to their reduced energy consumption using high efficiency LED lighting, an on-site well, and low-flow fixtures to reduce water consumption. This building also recycled over 80% of construction waste throughout the construction process.

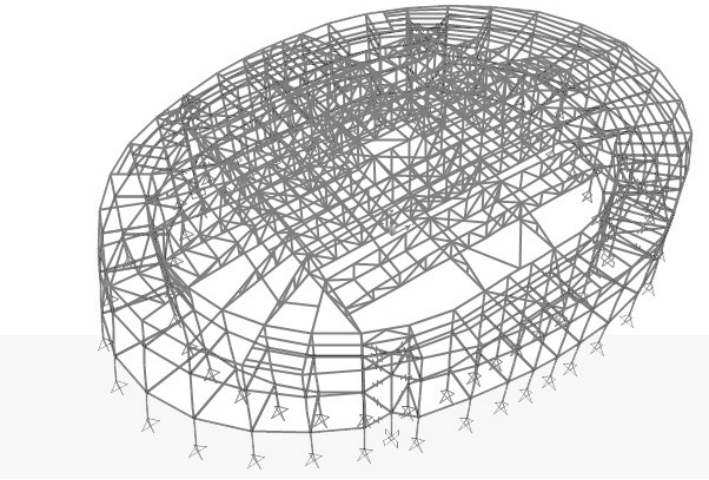


Figure 23

Figure 24

Figure 25

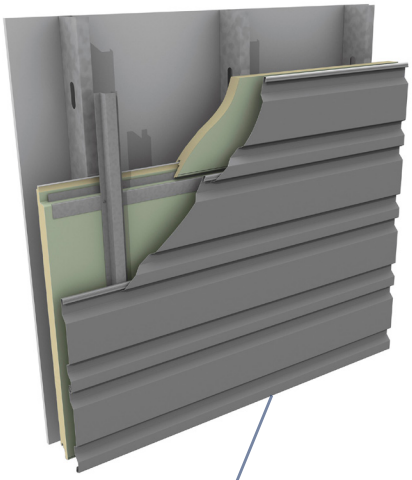


Figure 26

Figure 27

T-Mobile Arena is composed of over 217,000 square feet of Centria metal products.

MetalWrap long span series insulated composite backup panels feature a single component design that replaces multi component assembly for back up wall design. This system provides thermal, air, water, and vapor barriers in a composite assembly to maintain a comfortable atmosphere within the arena.

Along with these MetalWraps, 27,000 square feet of Centria brand perforated Eco screen wall system helps control the amount of light passing through the curtain wall on the exterior of the building.

Not only do these structural pieces keep provide multiple barriers, but they also create beautiful exterior material options for the building.

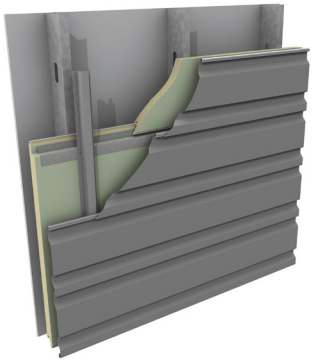


Figure 28 MetalWrap MR-100

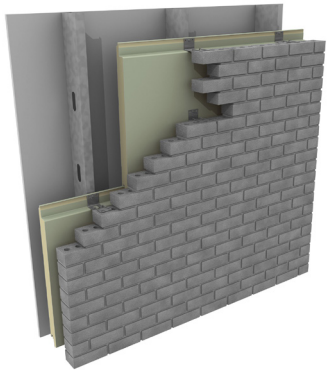


Figure 29 MetalWrap Masonry

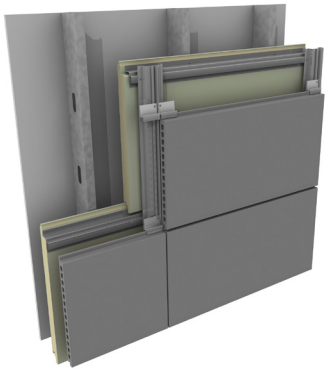


Figure 30 MetalWrap MR-300

Drainable Louvers are installed throughout the exterior of the building. These louvers help minimize water penetration into the building, and add a sleek look to the design.

These louvers can also help control air flow into the building, this helps architects help control the airflow without sacrificing the performance of the building.

These are products of CS (construction specialties), there are many options for the louvers. These options vary from drainable, to acoustical louvers. Using these help give architects the option of creating outdoor spaces and help control the environment as much as possible.

Figure 31

Figure 32

Findings

T-Mobile Arena is a prime example of designing to blend in to the environment. The facade design contains deeper meaning for each material, with the gold hue of the metal panels representing the desert landscape, and the 9,000 square foot LED screen capturing the glamour and pizzazz of the strip in Las Vegas, located just a few blocks away.

The metal structure mixed in with a concrete flooring is a very efficient design option for the desert climate of Southern Nevada. The MetalWrap facade design gives the architects so many options for both looks and colors of the panels. These help create beautiful exterior scenes while providing highly efficient thermal barriers.

The drainable louvers protecting the cantilevered outdoor balconies are another facade design method that mixes well with the MetalWrap system. The combination of these perforated systems and exterior glazing helps bring in natural light without it being overwhelming for the space.

Figure 33

Conclusion

The hidden intent through each process of T-Mobile Arena gives the building so much more character. Each facade choice mimics the site's surroundings whether it be through the Las Vegas reputation, or the landscape in the distance outside of city limits.

The metal structural components give the arena more opportunities for open space, especially in the main arena space, giving fans un obstructed views no matter the seat. This structural option creates opportunities outside the rink space, and can help design larger atrium spaces for a grand main entrance to the arena.

Figure 34

Ralph Engelstad Arena

Figure 35

Location: Grand Forks, North Dakota

Use: Home of University of North Dakota Men's Hockey Team
- Used for concerts and events throughout the year

Cost: $104,000,000

Background

The Ralph Engelstad Arena, located in Grand Forks North Dakota, is home to the University of North Dakota men's hockey team. With it's inaugural season in 2001, the Ralph has been considered 'the Taj Mahal of college venues', Sport's Illustrated 2012, for over 20 years. The concourse level consists of all granite flooring, while the seats in the arena are all leather.

The 400,000 square foot arena seats 11,643 spectators, and includes 48 full luxury suites, along with 2 club spaces containing the largest standing bar in North Dakota. The exterior, consisting of precast panels and inlaid brick matching the rest of the UND campus, provides fans on the outside a taste of the action on the inside with large curtain walls.

The roof of the Ralph was constructed using large structural steel fabricated trusses that span the width of the arena. The roof structure was designed to hold the score board for the arena, which in 2019, was updated with a $6,000,000 jumbo screen. The roof also hold the rigging loads for concerts held at the rink.

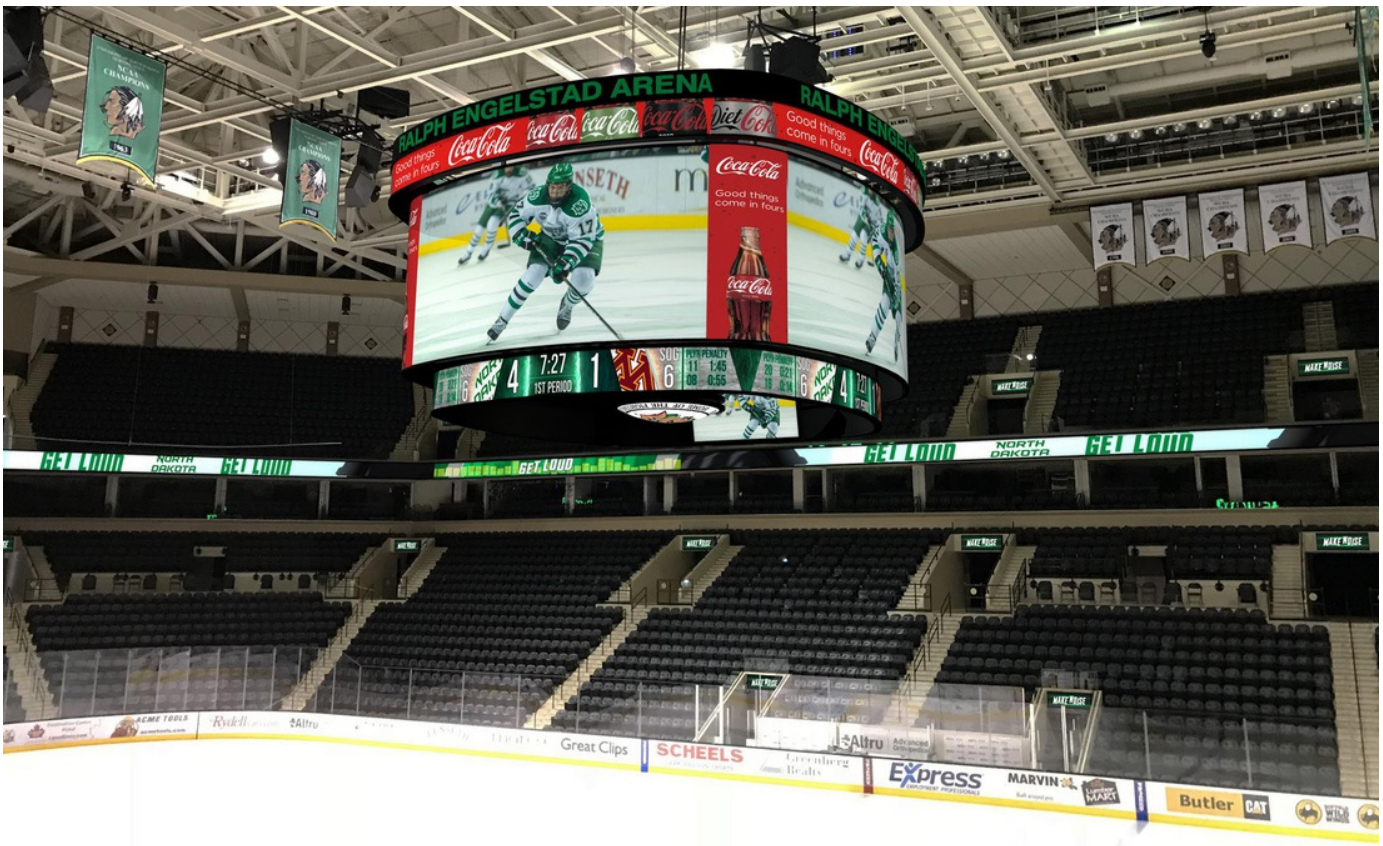


Figure 36

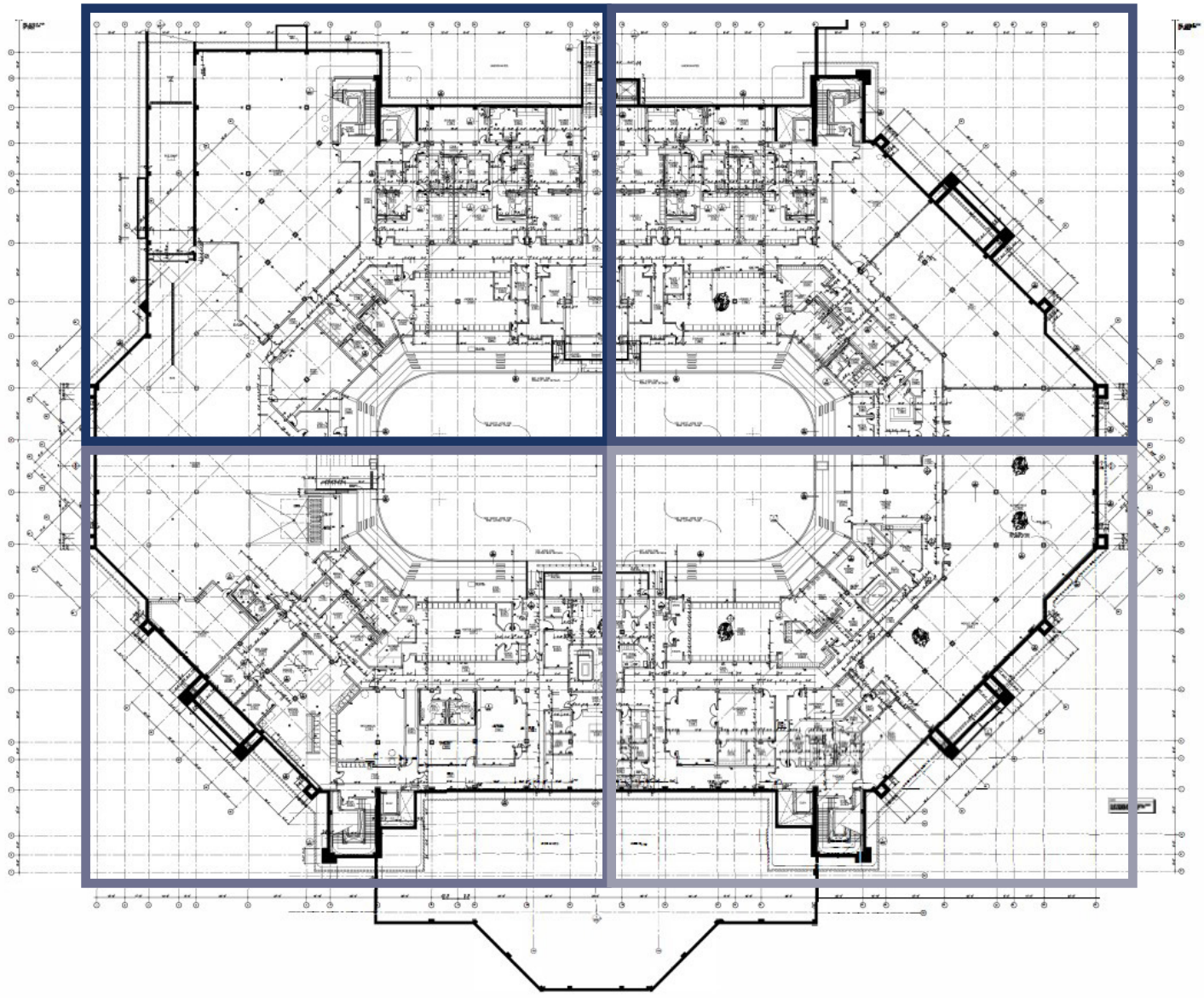


Figure 37

Ice Level- Segment A

Ice Level- Segment B

Ice Level- Segment C

Ice Level- Segment D

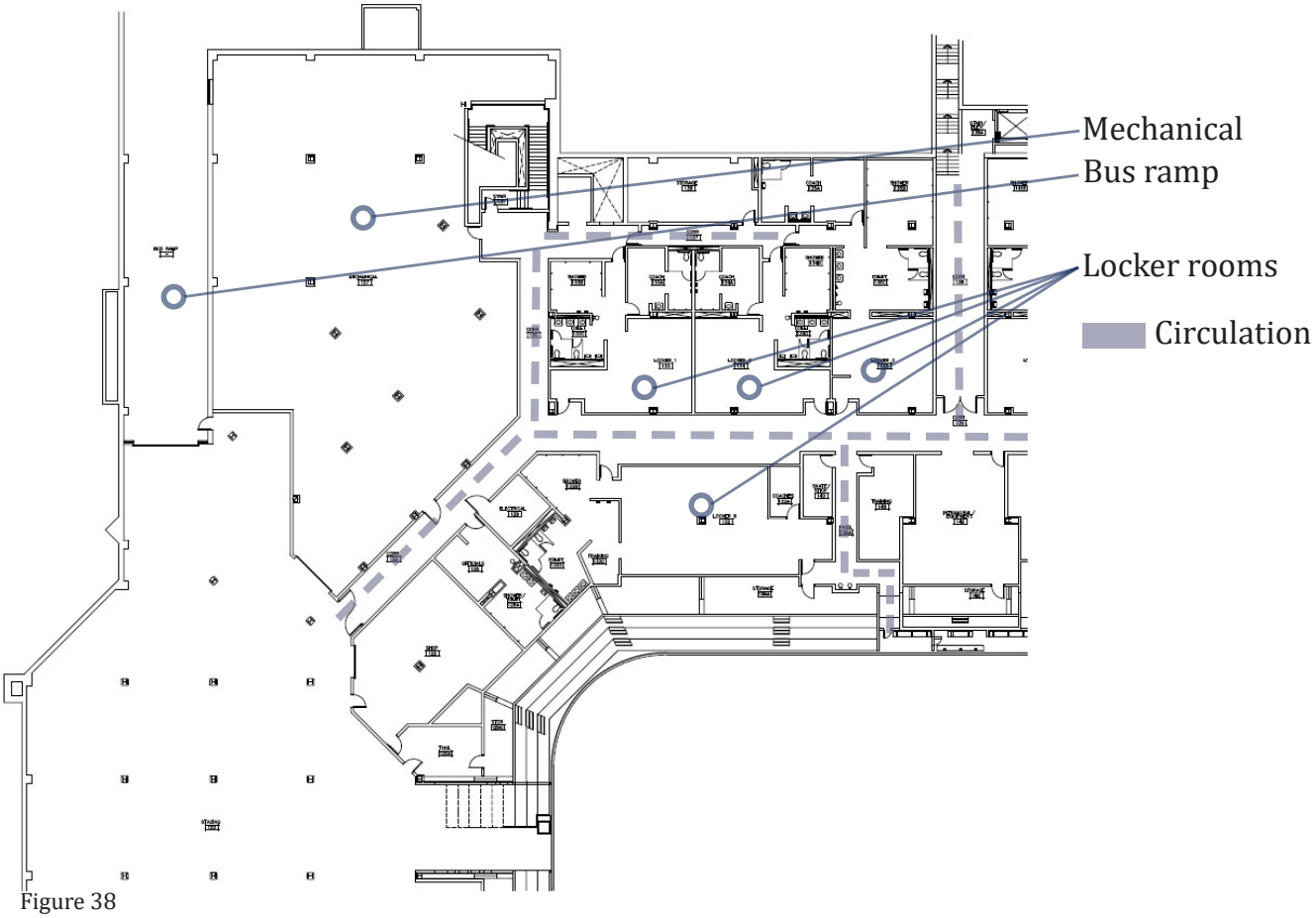


Figure 38

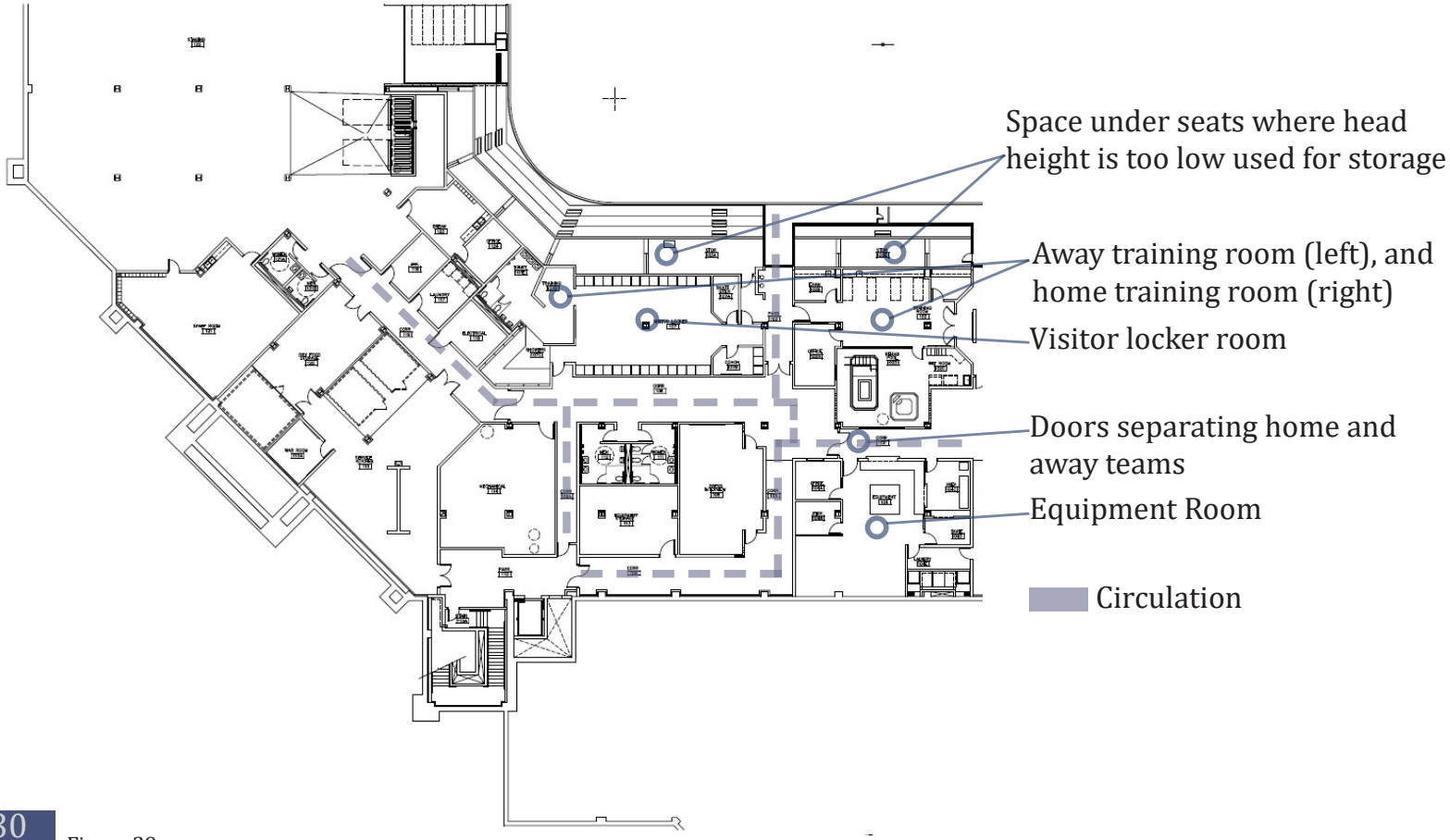


Figure 39

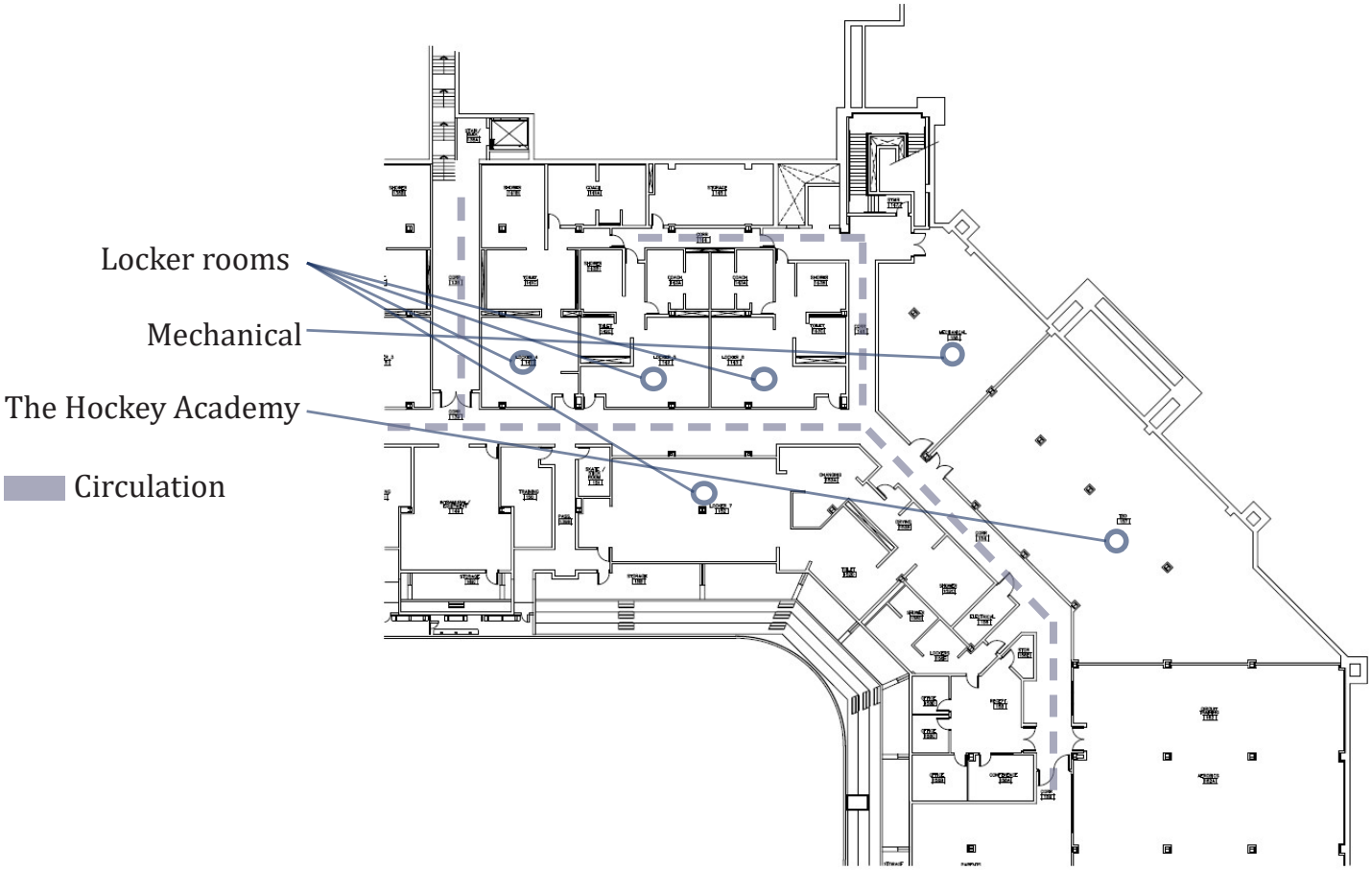


Figure 40

Figure 41

Figure 42

Passion | Energy

Figure 43

History | Luxury

Figure 44

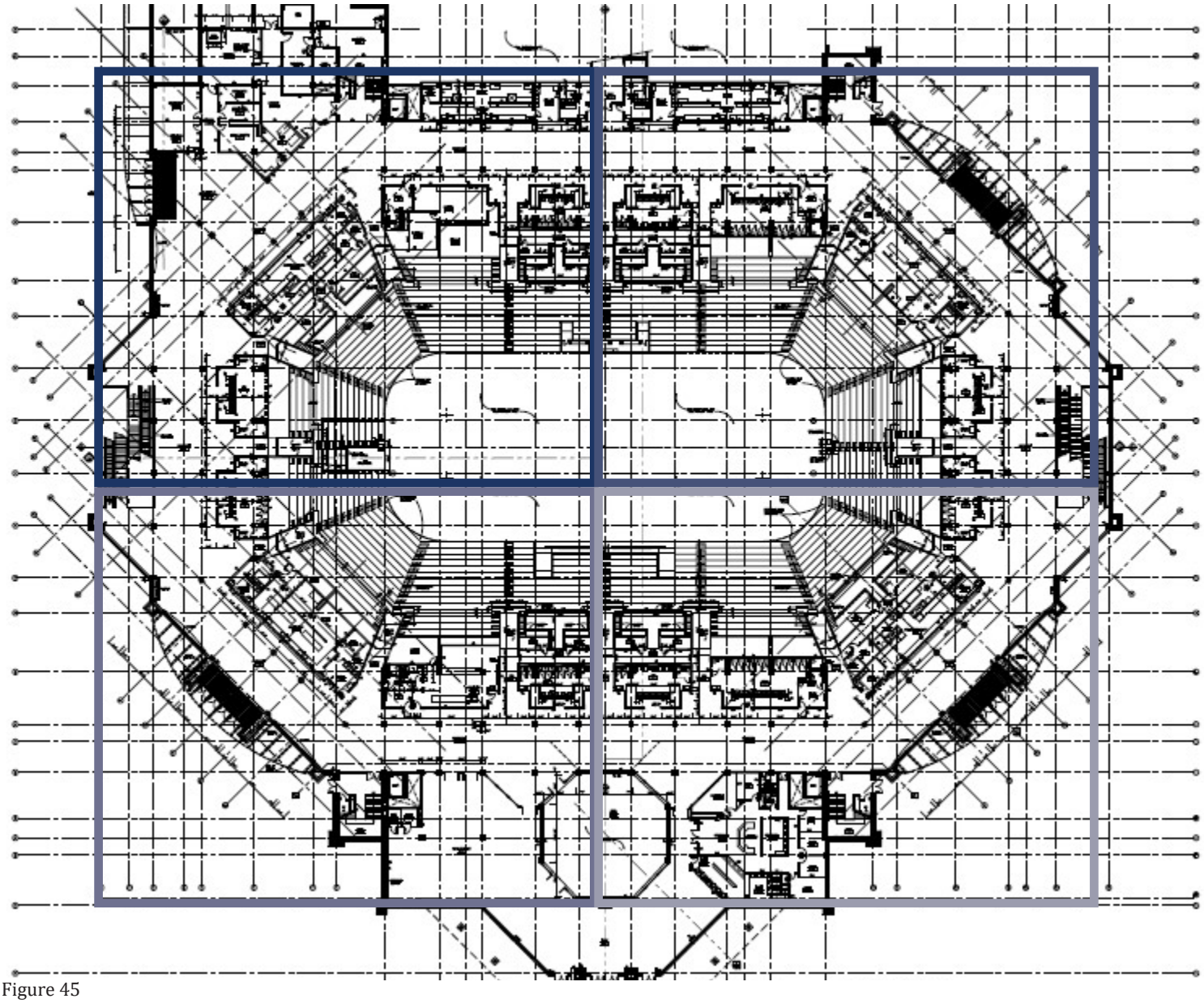


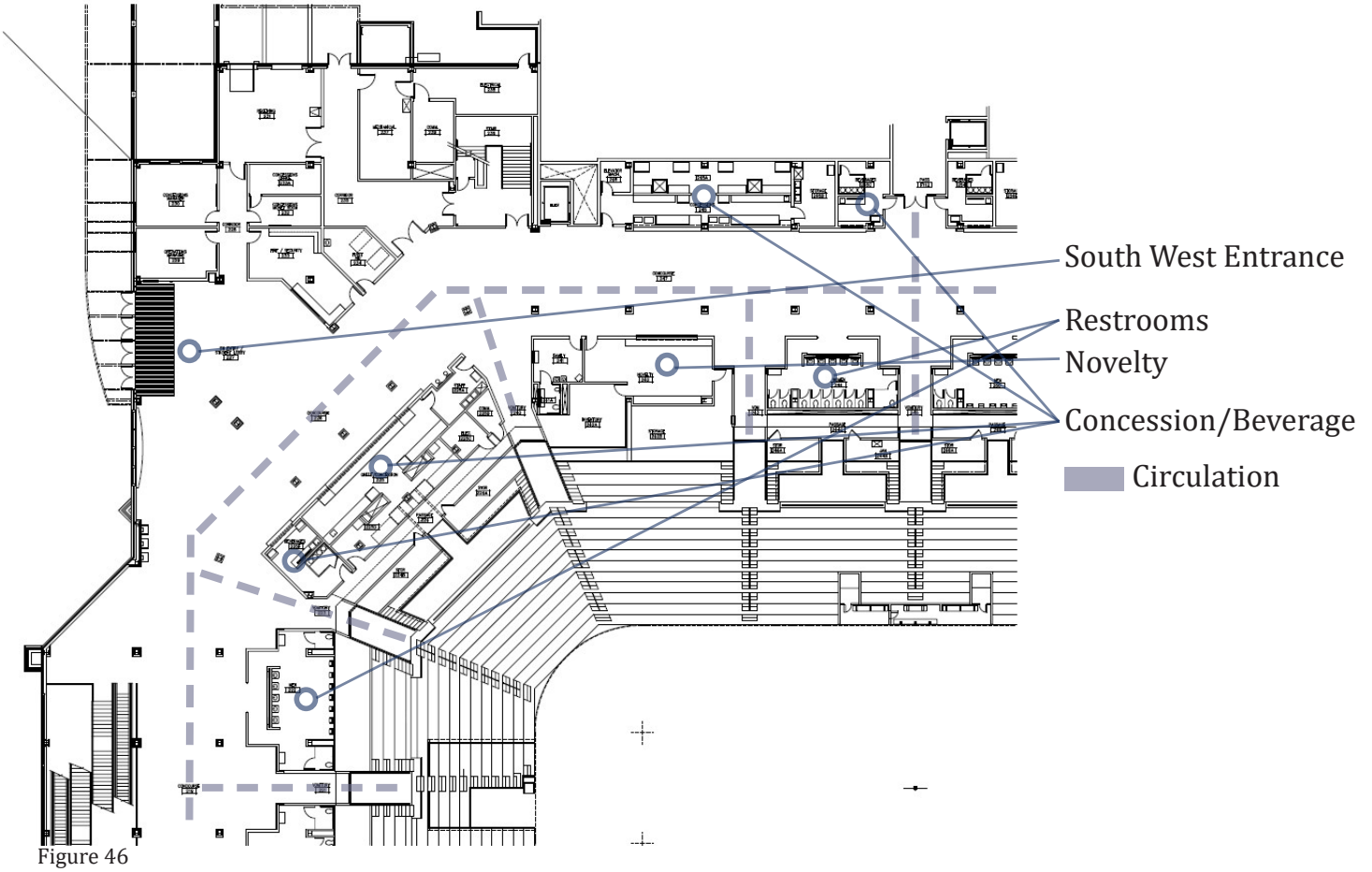
Figure 45

Main Concourse- Segment A

Main Concourse- Segment B

Main Concourse- Segment C

Main Concourse- Segment D



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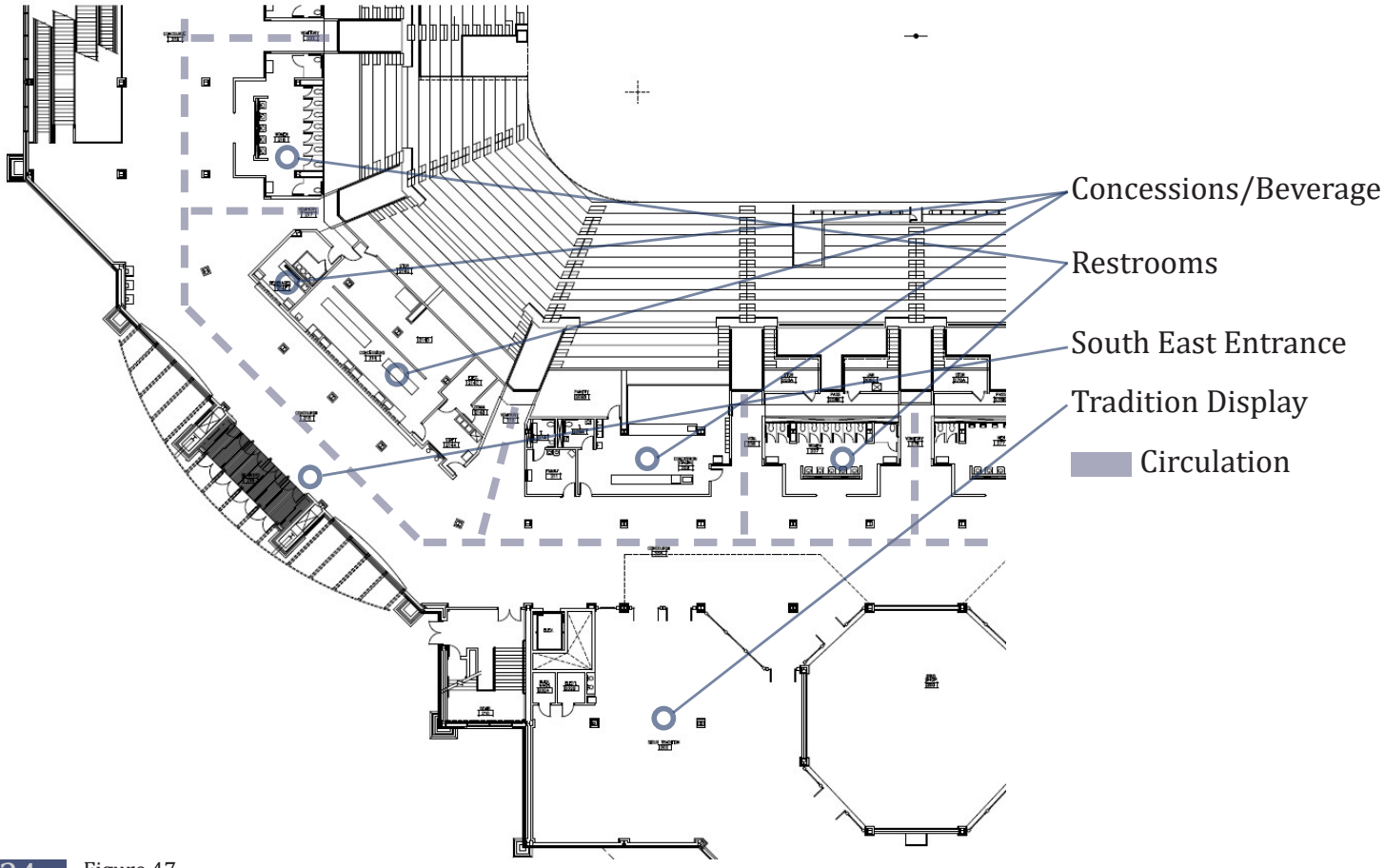

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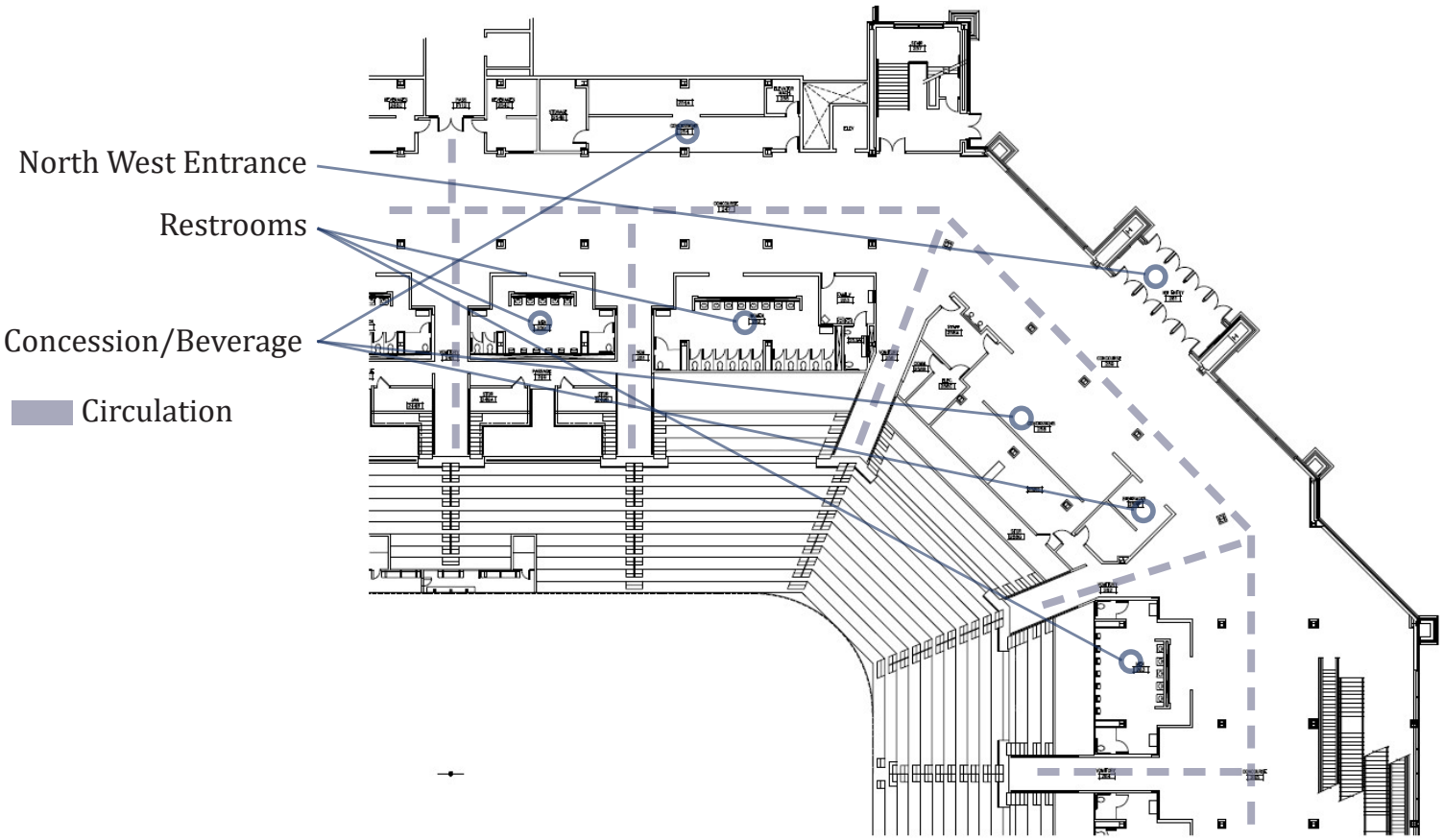

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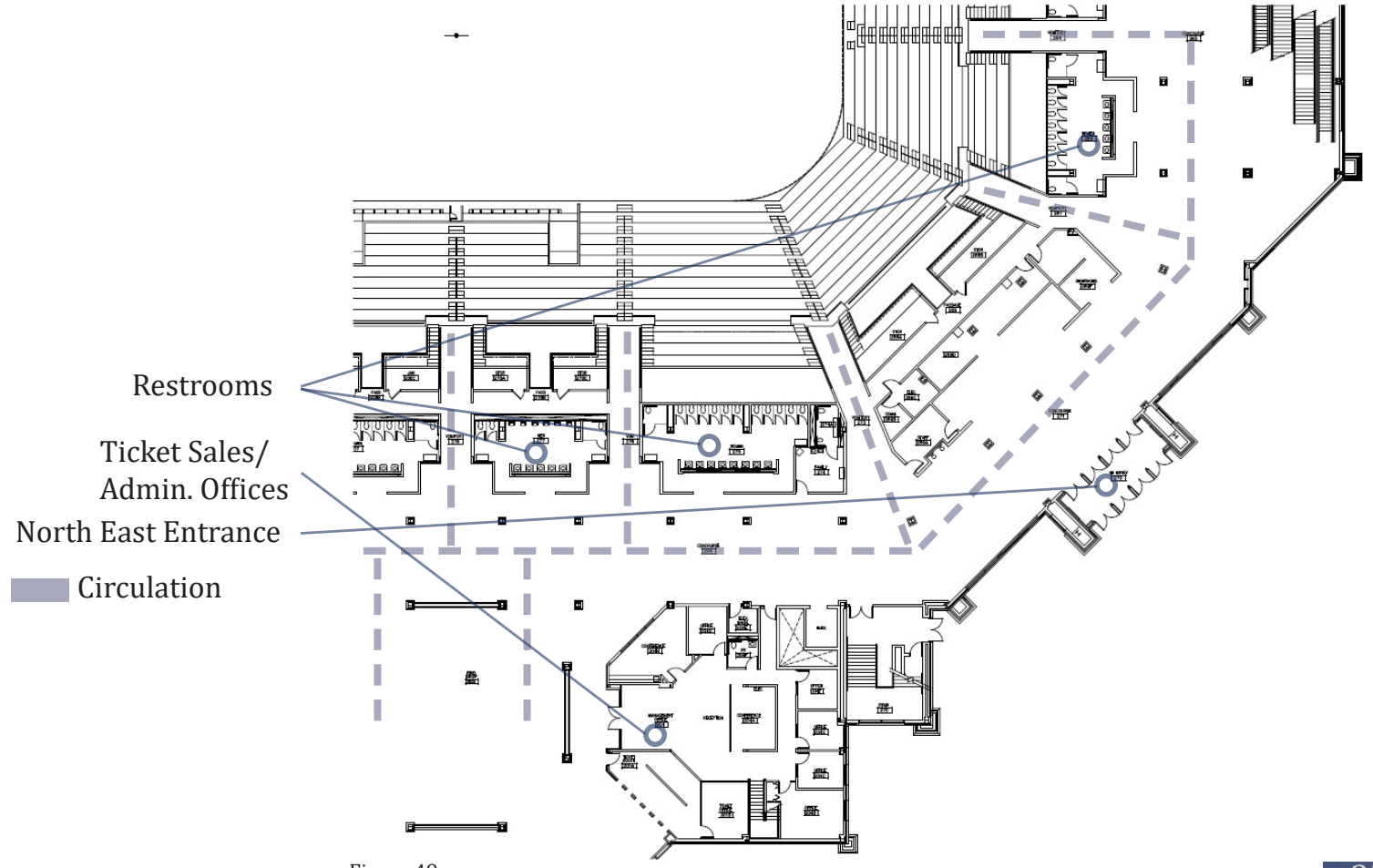


Figure 49

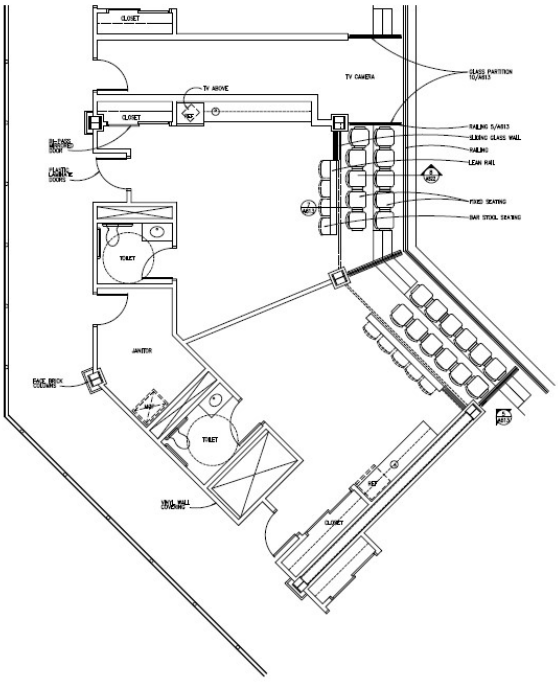


Figure 50

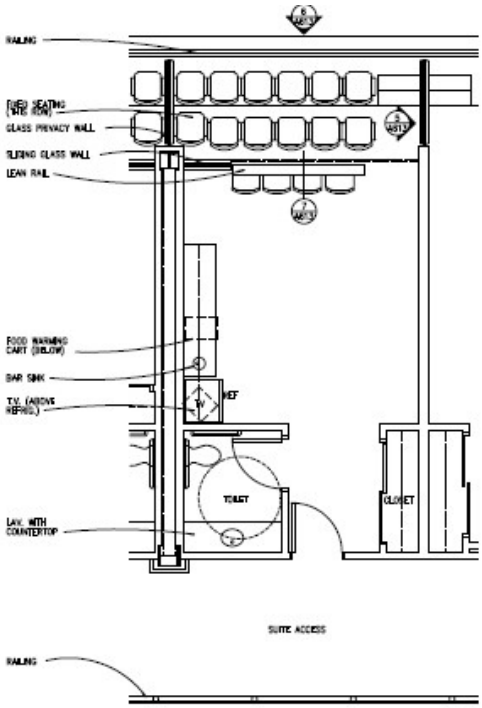


Figure 51

Findings

The Ralph has shown why it is the center of the college hockey world, with its luxurious seating to marble concourse floors. The circulation of the arena is fairly simple, but affective. The main concourse is very open and easy to follow, with larger corridors, is efficiently moves the fans around the arena to their seats and the various concessions.

Ice level is where a majority of the storage for the arena is held. The equipment for concerts is held in the large Zamboni access space, along with truck access for players leaving the rink and for items to be imported into the arena. A main corridor gives the youth athletes that attend The Hockey Academy an easy route to the space. Smaller hallways give workers and players better access to the locker room and players lounge spaces.

Growing up in Grand Forks, UND hockey was a weekly event for my family in the winter time. From the pregame light show, to the fire works after a win, fans are kept engaged with the action for the whole 60 minute time period. Concession stands and vendor cart are placed throughout the arena, giving off aromas that bring fans in to the stands. Restroom access is very good as well, with multiple bathrooms at either side of the rink for both men and women.

Conclusion

The Ralph Engelstad shows how college sports can bring a whole city together. From large concourse walkways to beautiful scenes from and seat in the arena, The Ralph has earned the title of being 'The Taj Mahal of college hockey'. Looking at the floor plans of the arena, the best method moving forward regarding floor plans would be placing the rink on the site, and building out around the ice. This helps ensure each seat will have a great view of the game, and exterior possible views can be achieved as well.

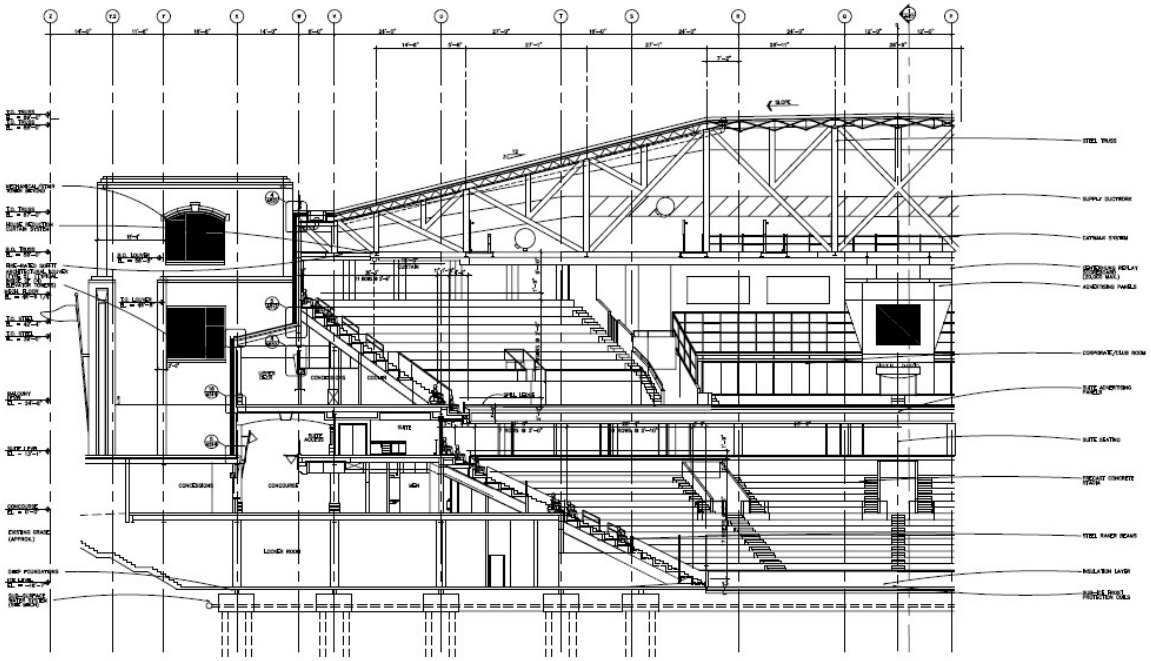


Figure 52

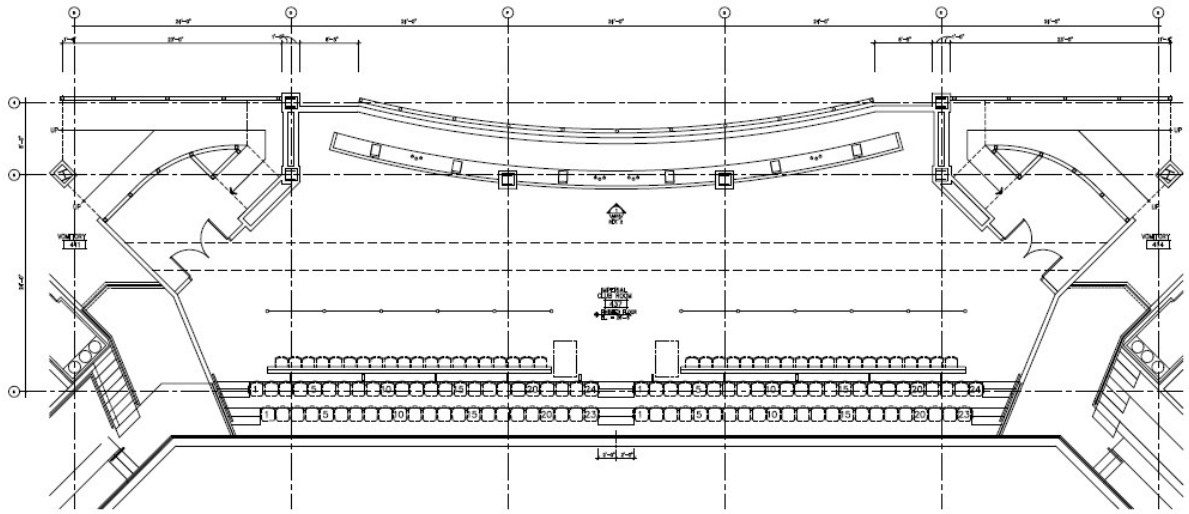


Figure 53

Overall Findings

Throughout the process of learning about each of these 3 buildings, I found a few similarities. The first, and most important, is a large atrium or main entrance for the space. Each arena had a grand main entrance setting the tone and taking people's breath away as they walk in. This was done through different methods, for the Ralph, they went with showcasing the history of the team and what they have accomplished, while T-Mobile arena features an 80' tall entry space to give a grand entrance feel. Large curtain wall systems are implemented in each design as well. These window walls create a dynamic facade, giving exterior views of the action happening within. Sustainable design was the driving factor for the two NHL rinks. In their respective climate, Climate Pledge Arena and T-Mobile Arena both proved how a large scale arena can be sustainable.

Each study was focused on different topics, the Ralph was studied for it's floor plans and how a rink can help facilitate youth hockey players that want to train off ice. Climate Pledge Arena helped go into depth on just how sustainable a hockey rink can be. With water catching tanks for a climate that has wet days almost 200 days out of the year, to solar panels to harness the sun's energy on the days it doesn't rain, this building has it's eyes on a greener future. Finally, T-Mobile Arena. This Las Vegas gem helped understand the structural components of building in the desert. The structural steel used to span large distances to ensure all fans have beautiful angles of the game is a clear take away. As well as the shading and water protection Centria products which help make the building perform at a higher level.

Project Emphasis

1 Sustainable Design

With the environment so dependent on human consumption, creating a design that can minimize it's footprint on the world is highly important.

2 Community Connection

Connecting the building with the community is a big factor for this design. Creating a space where the whole community can come together and cheer on the same side is a way to achieve this. Also, designing a space that gives youth athletes the opportunity to train and use this facility is also important for this project.

3 Health and Wellness

With this being a sports related project, this project will have to encourage people to be active. Whether it be on the ice, or through a workout facility, there are many ways this design can help get people active.

Major Project Elements

The main project elements will be creating 1-3 sheets of ice to supply maximum ice availability for the city the design is located in.

Designing space for off ice training, such as weight rooms, and turf for running and exercising on will be included as well.

Client Description

1

Athletes

With this being a hockey complex, the main clients the design is for the athletes that will use it. Creating a memorable experience through circulation and rink features will be top priority.

2

Fans

The fans are also a huge part of a rink design. Fans make the game a more enjoyable atmosphere for the players to compete in. So pleasing the fans will also help the athletes and create a competitive atmosphere for games.

3

Students

They are, in fact, called **student** athletes, right? The amount of time athletes can spend on the field or ice every day can take a lot of time away from studying for school. Providing spaces where these students can expand their knowledge and keep up with school work will be important in this process.

4

Workers

Giving concession stand worker adequate space to provide food and beverages for fans. Along with providing janitorial space and storage, and adding a break room to let workers rest as well.

The Site

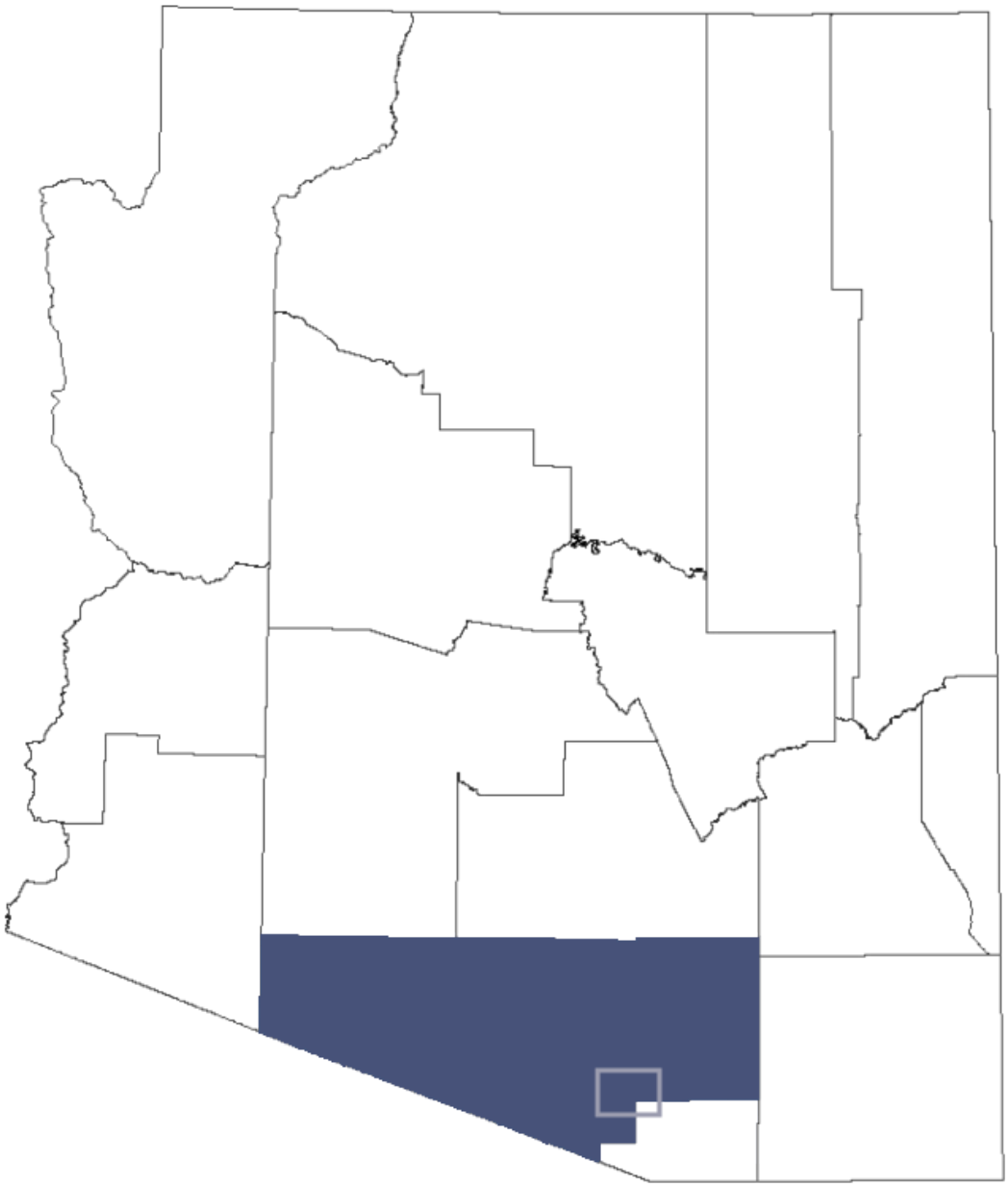


Figure 54

Figure 55

Figure 56

Figure 57

The Site

Tuscan, Arizona
University of Arizona

This state, city, and college made the most sense for this project. With Arizona State University forming a Division I hockey team a few years back, I can only imagine the University of Arizona wishes to follow suit. Southern Arizona is in need of more ice sheets, giving the building more revenue opportunity for community use.

This new site, situated between 6th Street and 7th Street, brings the action closer to the Wildcat's campus, drawing more students in to watch these games.

Figure 58

Project Goals

The number one goal is creating a unique and efficient design to help bring the sport of hockey to communities in the Western United States. This project will be guided by using the research from this Fall semester to guide my design.

Designing for my clients will need to be taken into consideration at every point in the design process. Circulation of the space will determine how this complex performs. Creating an experience for both players and fans is a challenging yet reachable goal.

Sustainable design will also be a goal of mine. Architects need to keep finding ways to produce the most environmentally sound buildings possible. Ways this can be achieved will be solar panels, and possible natural lighting in the public spaces of the arena.

Lastly, I want this to be a project I feel proud of. I want to leave NDSU knowing my best project was my last project, and I gave it all I had in the process of finishing this thesis.

Plan for Proceeding

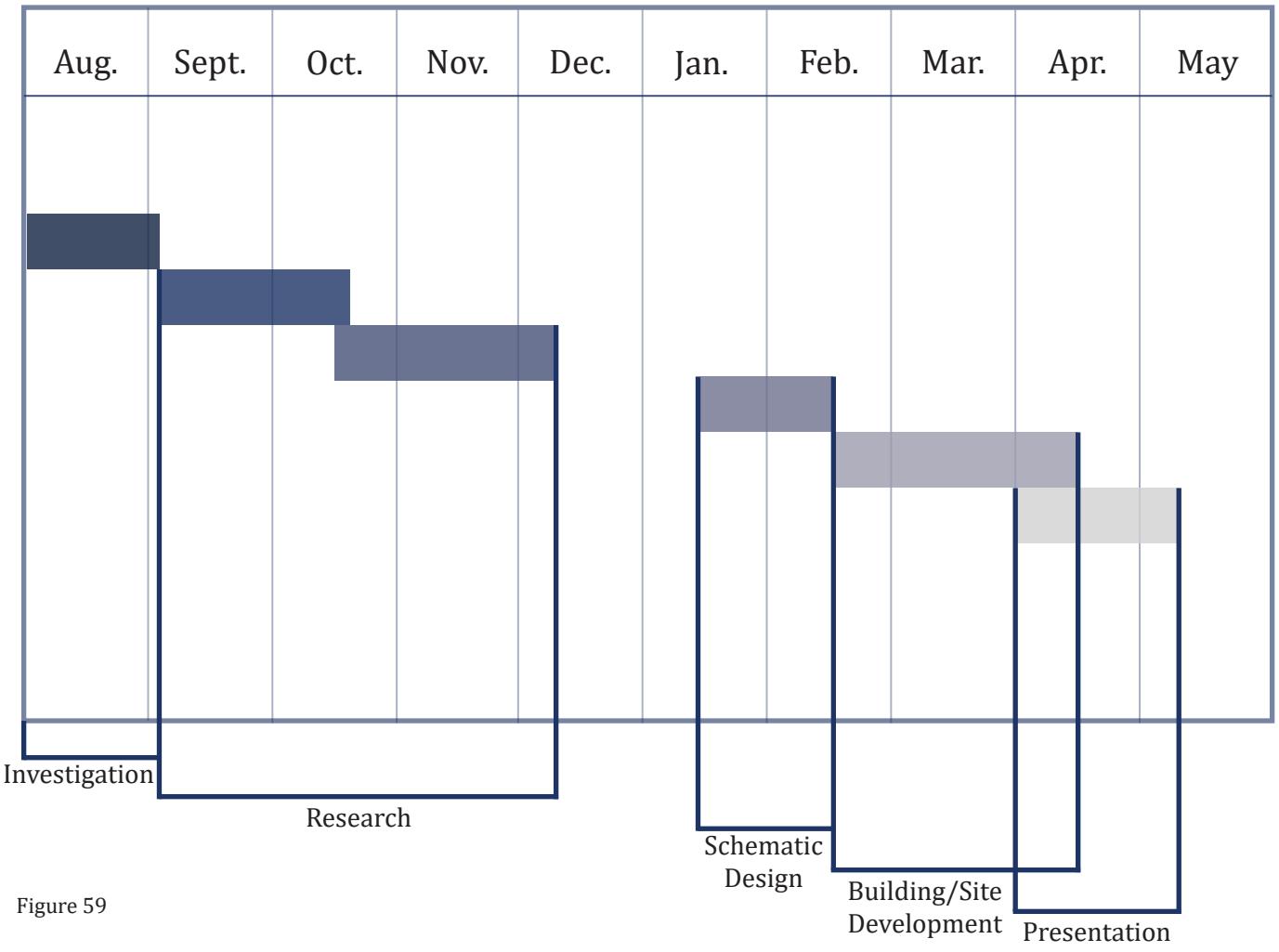


Figure 59

Proposal

Site analysis/Spatial program

Sketching/Massing of building/site

Floor plans/Evelations/Structure/Materials

Building/Site Development

Renderings/Presentation Board/Final critiques

THESIS RESEARCH DOCUMENT

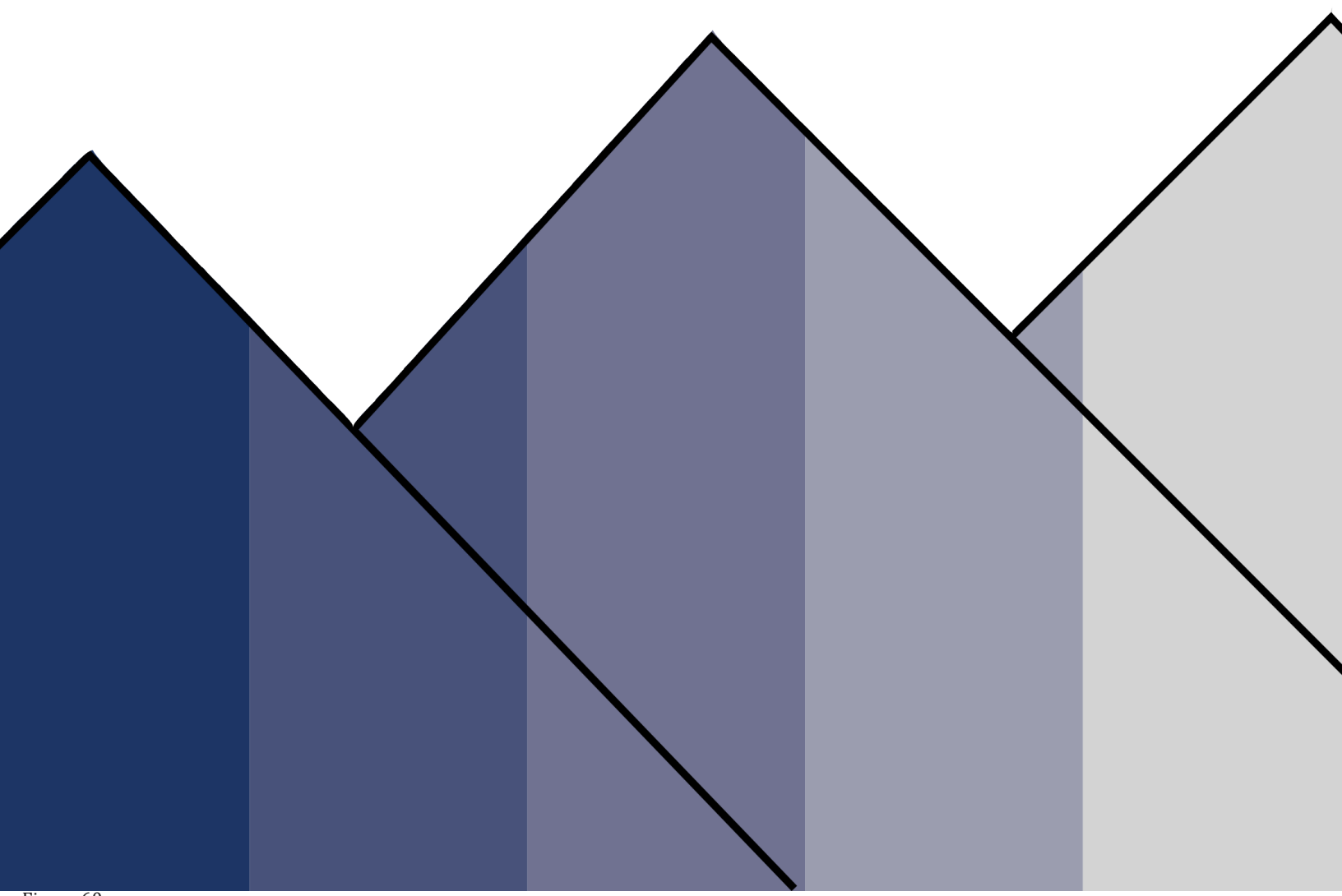


Figure 60

Social, Cultural, and Historical Context

Social Context

A college hockey arena is a great way to unite the community, and the student body of the University of Arizona. Bringing the UofA hockey team closer to the main campus will give the students more of a reason to attend these games. Adding another ice rink to the growing hockey population in Tuscon gives youth players an opportunity to train like a college athlete at a young age. Growing up in Grand Forks, playing at the Ralph, home of UND men's hockey, was always the highlight of the year, win or lose.

Cultural Context

A new arena changes the current culture of the U of A hockey team. A state of the art hockey complex gives the University of Arizona hockey program the tools it needs to make a jump to Division I hockey in the future.

Historical Context

This proposed hockey complex adds to the future of hockey in the desert by creating a space for college and youth hockey players, for decades to come. Stadiums have been the focal point of the architecture of a city for the longest time, and this arena can help be a highlight of architecture in the city of Tuscon.

Site Analysis

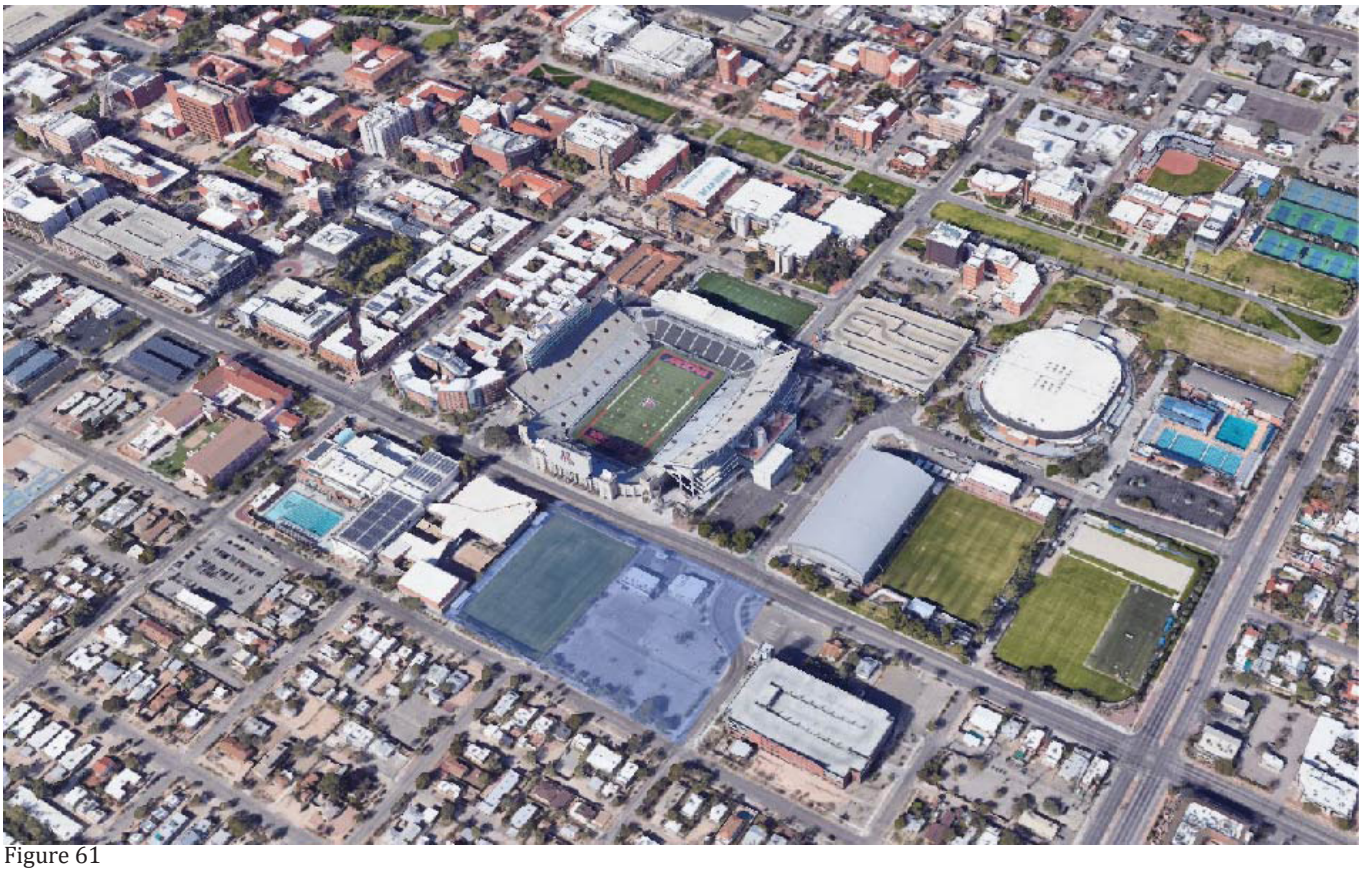


Figure 61

Parcel: 12408241D

Owner: University of Arizona

Area: 215,800 square feet

Latitude: 32.2271

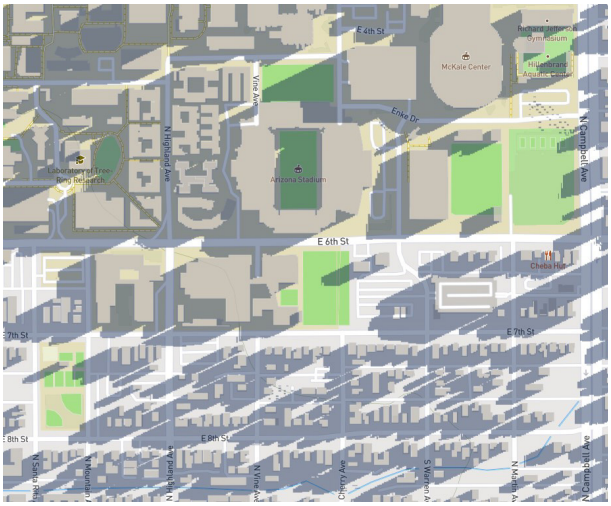
Longitude: -110.9496

Current Zone: R2/C1

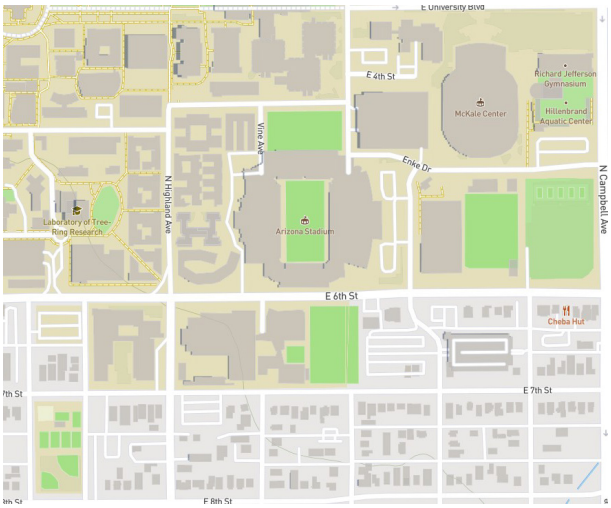
Sun Study

Summer Solstice

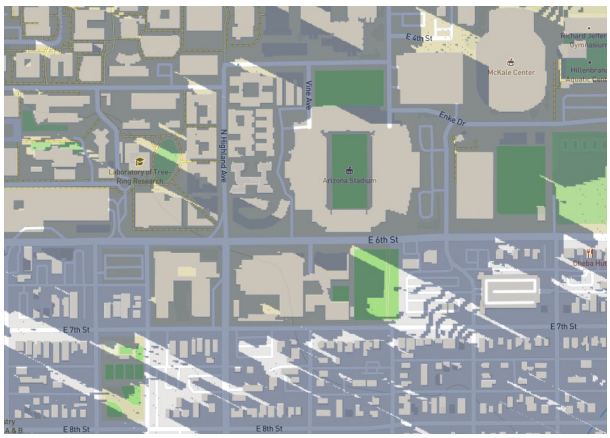
Dawn



Noon

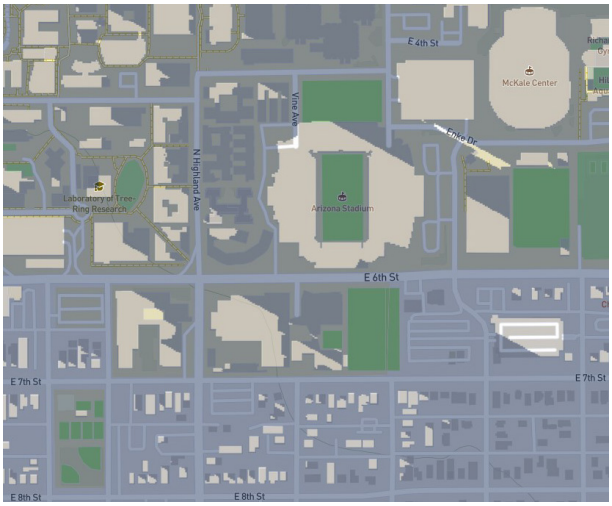


Sunset

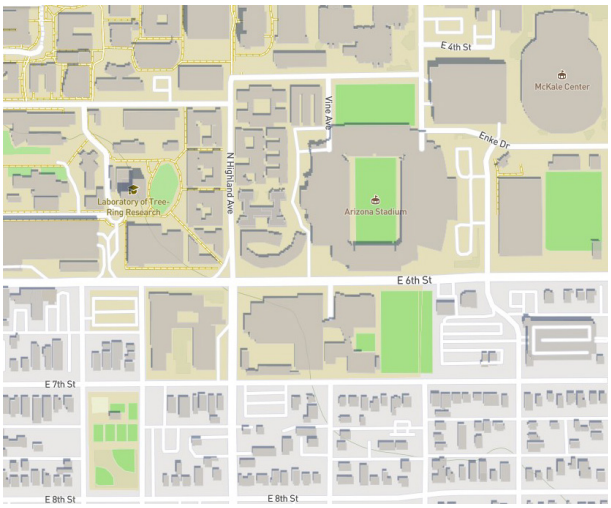


Winter Solstice

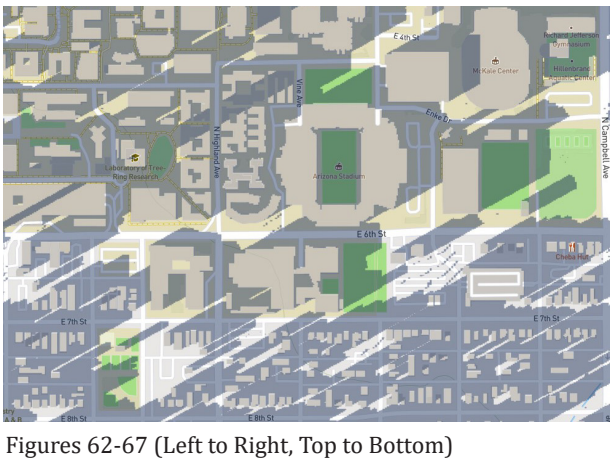
Dawn



Noon



Sunset



Figures 62-67 (Left to Right, Top to Bottom)

Average Daily Sunshine in Tuscon

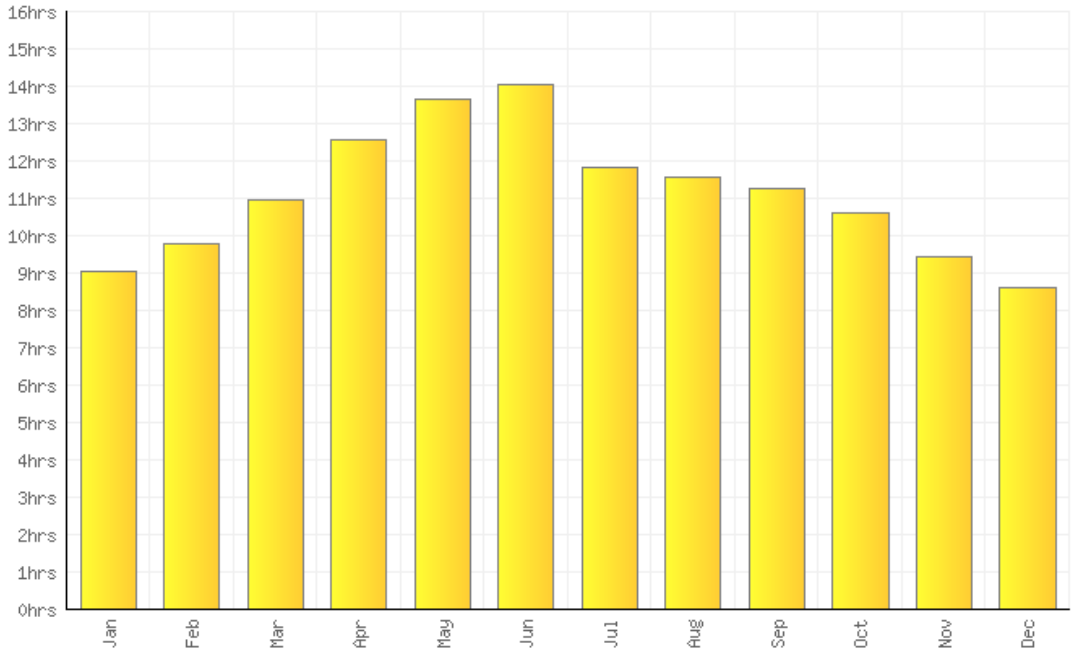


Figure 68

The chart above shows the average amount of daily sunshine Tuscon receives throughout the year. The image to the right displays a 2D sun path journey in relation to the site.

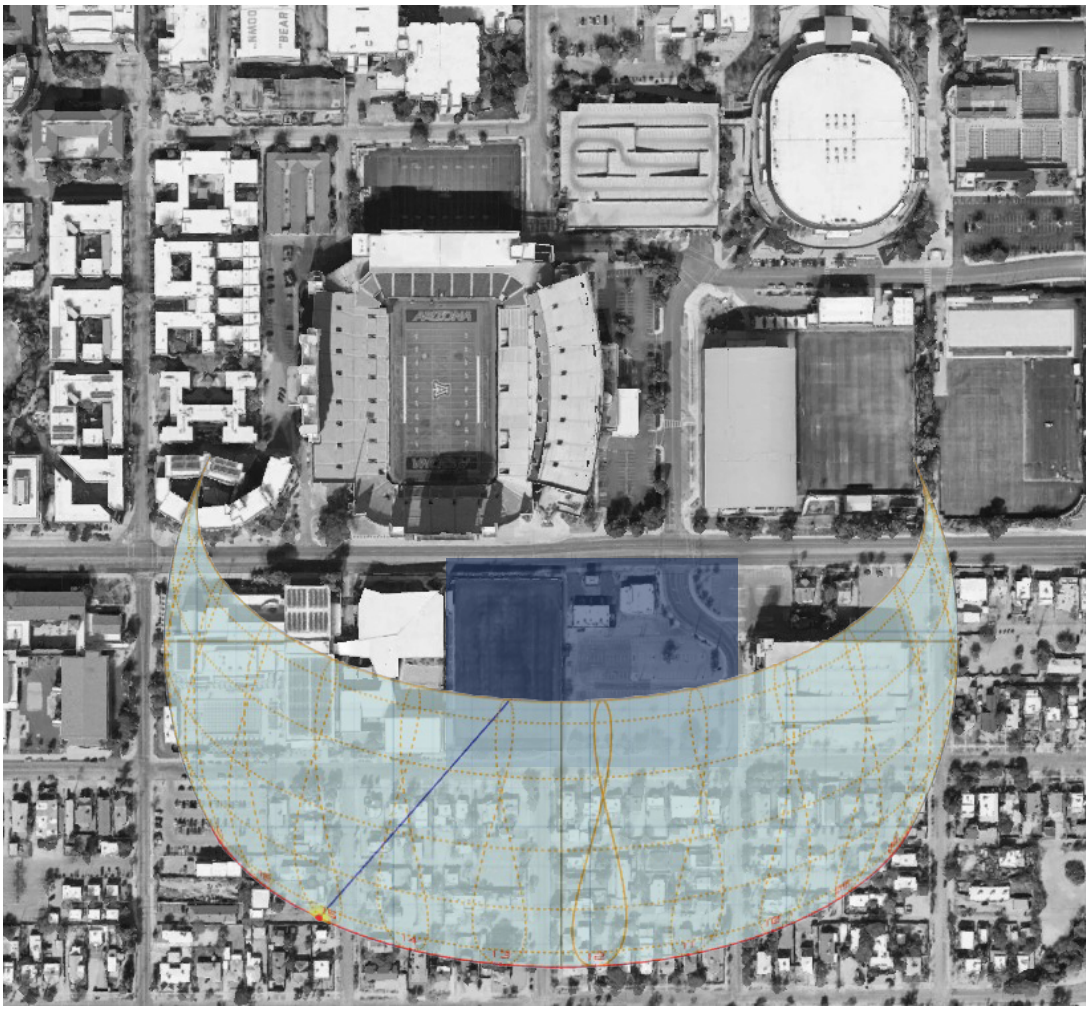


Figure 69

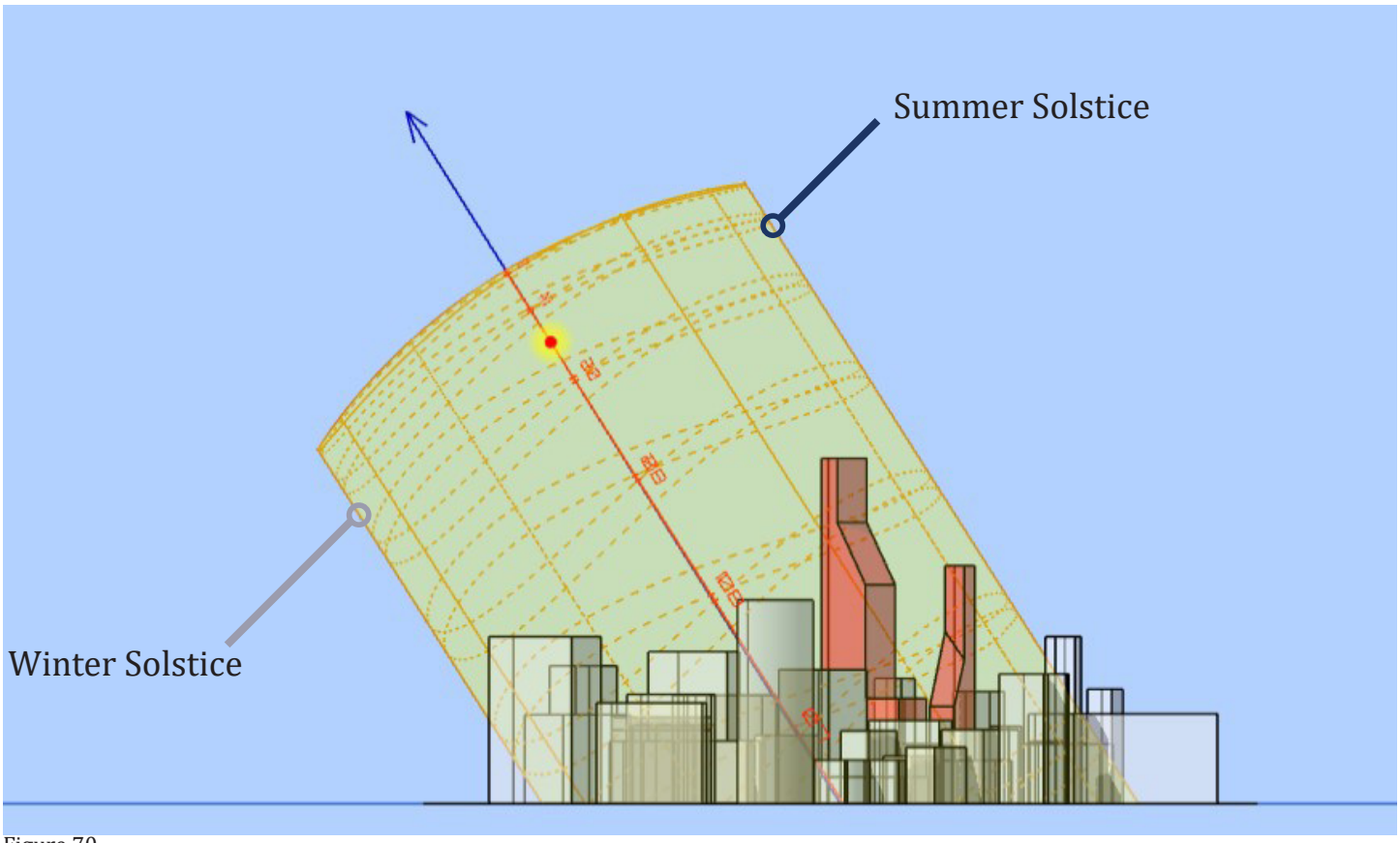


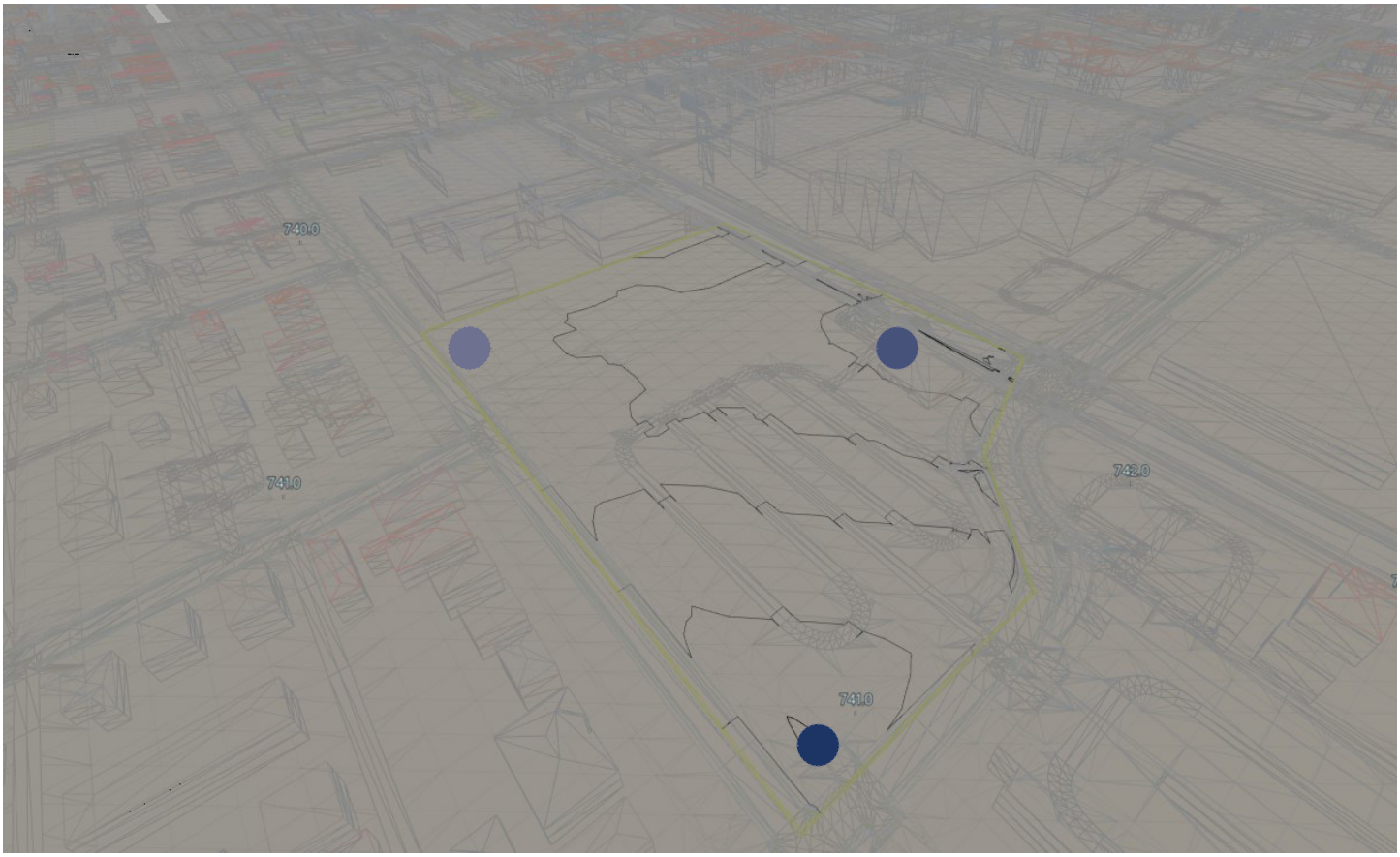
Figure 70

The graphic above shows a side view of the sunpath moving across the site. This helps showcase the angle difference of the sun from summer to winter, and everything in between.

The site, located on East 6th Street, is the perfect location for this thesis. This site puts the University of Arizona Hockey team at the heart of the school's athletics. With the football stadium just North, and the basketball complex just a little further North-East, the proposed arena will be much easier for students to attend games.

As anticipated, sunshine is abundant on this site. Early mornings and late evenings provide the site with the most shade. These sun patterns show great opportunity for solar panel usage set on top of the design. It is also worth noting shading outdoor spaces will need to be a priority for possible mid day usage.

Topography



Highest Elevation Lowest Elevation Proposed Loading Dock

The image above shows a basic contour map of the site, with each line representing 1/3 meters, or roughly 1 foot. The image to the right displays a 2D topography map of the site. Overall, the site is fairly flat, which can be anticipated, as one piece of the site is used as a rugby field, while the other piece is a parking lot. But it is fairly certain that water run off will be moving to the South-East of the site.

Figure 71-72, Top to Bottom

This map is crucial in identifying water run-off. With a loading being needed to load and unload equipment at ice level, this means that ramp will need to be located on the West side of the site.

Soil Composition

Ochric epipedon - The zone from 0 to 14 inches (Ap horizon)

Argillic horizon - The zone from 14 to 36 inches (Btk1, Btk2, Btk3 horizons)

Calcic horizon - The zone from 14 to 60 inches (Btk1, Btk2, Btk3, Bk horizons

The Tuscon series contains very deep, well drained soils formed in fan and stream alluvium (a deposit of clay, silt, sand left by flowing streams).

Mean annual precipitation: 7 inches
Mean annual air temperature: 75 degrees F

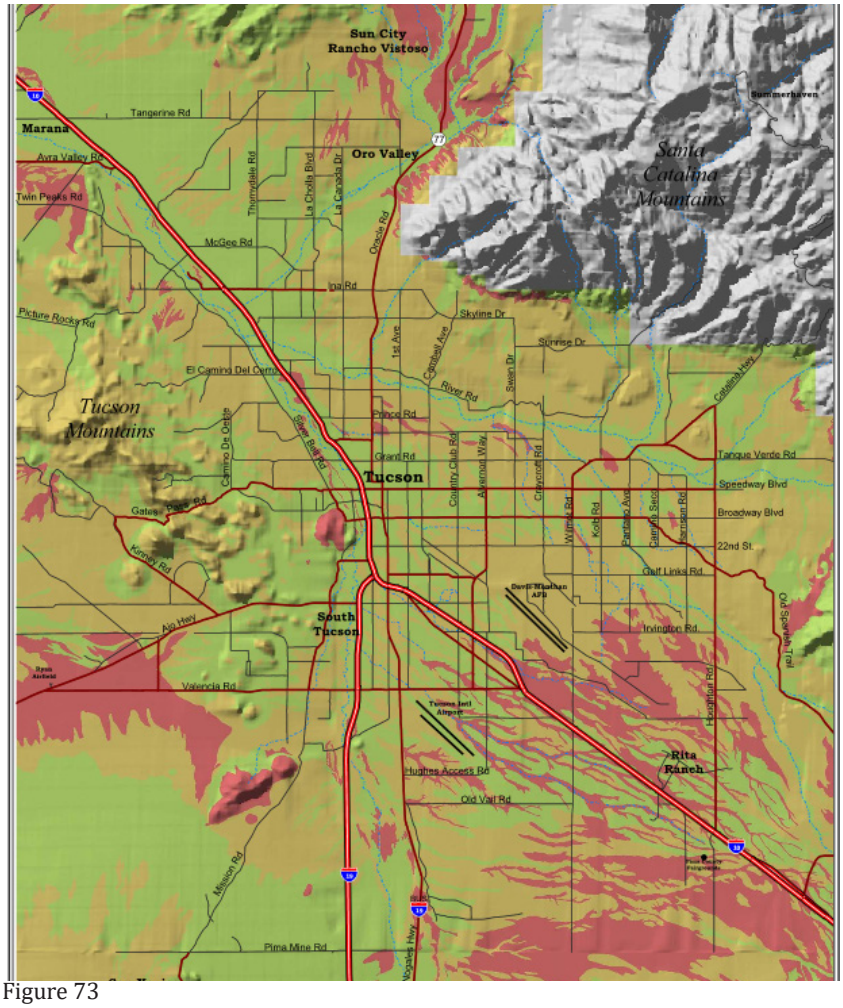


Figure 73

This map shows the shrink/swell potential for the soil in the Tuscon area. Shrink/swelling of the soil is when wind and ephemeral streams deposit loose and under saturated sediments that are prone to collapse.

Vegetation

The lack of trees can be due to the fact that this site is being used for parking and a rugby pitch. This leaves great opportunities to add trees as needed around the site, providing shade for the users throughout the day. These trees will be needed to make this site usable during the hot summer months in Arizona.

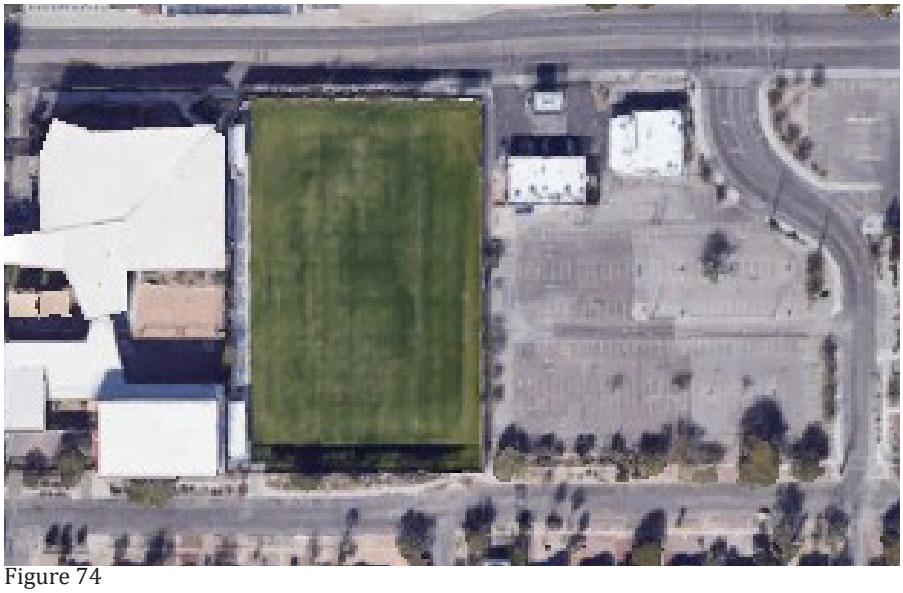


Figure 74

Plants

Due to the harsh summer months, growing plants in Tuscon can be difficult. But it doesn't mean its not possible. These plants: The Mexican Sunflower, Moss Rose, Opium Poppy, Blanket Flower, and Red Amaranth (Left to Right, Top to Bottom) are plants that thrive in the desert with minimal water. They range in size from 12 inches tall (Moss Rose), to 6 feet tall (Mexican Sunflower).

Figure 75-79, Left to Right, Top to Bottom

Trees

(From Top to Bottom, Right to Left) The Chilean mesquite, Desert Willow, Texas Mountain Laurel, and Cacti are some tree species that grow well in the desert climate.

With minimal space allowed on the site for vegetation, due to the buidling itself, and parking regulations, efficient landscape needs to be applied to make the exterior pop. These trees provide shade without over-growing the site (range from 10-30 feet in height), and bring in beautiful color onto the site's landscape.

Figures 80-83, Top to Bottom, Left to Right

Zoning

Figure 84

Zone C-1 Zone R-2

The image above shows the zoning parameters of the site, with one side being commercial, and the other being residential. A code variance will be needed to move along with the proposed project typology.

The land to the North of the site contains a high density zone, that being the University of arizona. The land to the South contains low and high density housing, many being college students.

This project will be completed following the guidelines from the International Building Code, along with the city ordinances the city of Tuscon has.

City Ordinance

Tuscon has implemented city ordinances to guide designs along with the International Building Code. These ordinances support sustainable practices relating to water and energy conservation. Water and Energy conservation pertain to requirements for solar readiness, meaning buildings under construction must have inserts available for solar panel installation. Along with this, residential gray water, commercial water harvesting, and electric vehicle charging also are required with the design.

Tuscon has supported designs with a water harvesting guidance manual. This includes micro basins, gabions, water tanks, and more for techniques on harvesting rainwater.

Water tanks can be used as an individual tank, or constructed as a series of tanks, with the overflow from one tank filling the next, or a connection pipe at the bottom of the tanks, keeping the water level the same in each tank.

Figure 85

Figure 86

Tuscon is really playing to their strengths in adding a solar panel readiness ordinance. With an average of almost 12 hours of sunlight a day throughout the year, solar panels can be a crucial energy form for building use.

Circulation

Figure 87

Residential Streets

High Density Traffic

Campus Roads

The image above shows the road system around the site. Heavy traffic runs through East 6th Street, which is directly North and adjacent to the site, and North Campbell Avenue, which is just East.

Foot traffic is also very high in this area. With students walking and biking to class throughout the day, adding both bike racks and seating along the North side of the site might be appropriate. This allows the building to shade the seating area, and allow students to sit and enjoy the weather.

With the site being near campus, foot and car traffic are very high in this area. East 6th Street will have the biggest impact on the site. The prominent facade of my design should be facing East 6th Street (or North), this will catch the eyes of the pedestrians and draw the most attention to the design. It also allows more glazing to be used, which can help bring in sunlight in the early mornings, and block out the sun throughout the mid day hours.

Below is an image showing the bike and pedestrian friendly routes around the site, and in the University of Arizona campus.

Figure 88

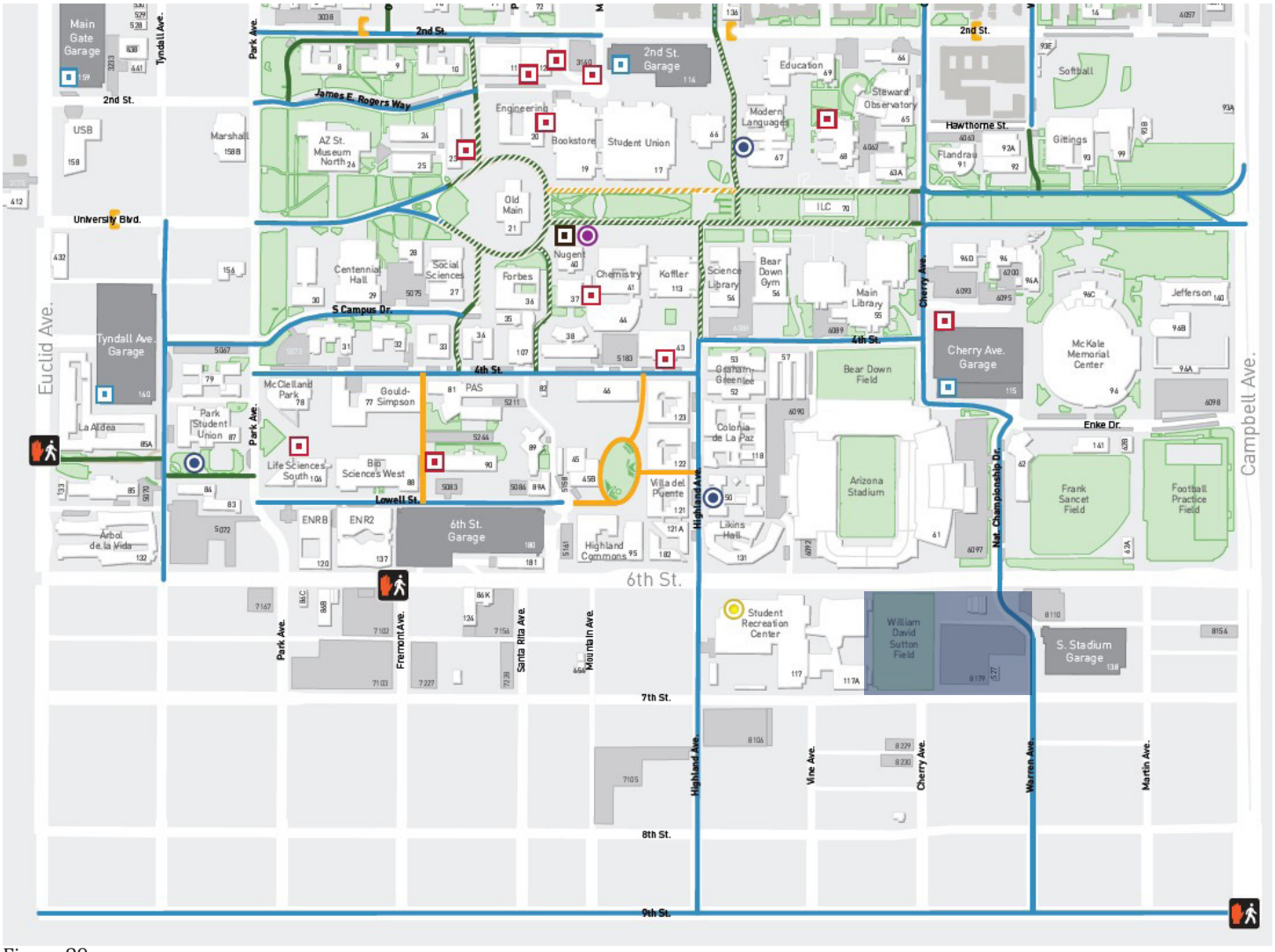


Figure 89

Nearby Buildings

Figure 90

- Arizona Stadium
- Univ. Of Arizona Rec. Center
- Parking Ramps
- McKale Memorial Center
- Thesis Site

Arizona Stadium, located across the street from the site, is the heart of the University of Arizona campus, and the home of their football program.

Figure 91

Figure 92

The McKale Memorial Center is the home for the men's and women's basketball programs, hosting highly energetic games night in and night out.

Along with the practice facilities for track and field and the football team, these two stadiums make up a very athletic portion of campus. This thesis adds to the history of sports for the University of Arizona, creating an even richer sporting environment for the campus.

The University of Arizona recreation center sits adjacent to the site. The new addition to the rec center includes a cardio mezzanine, a multi court gym, and outdoor volleyball and other outdoor activities.

Figure 93

2 parking ramps are located just minutes away from the site, which can greatly help the over flow of parked cars when games are going on at the site.

Figure 94

A big aspect of design is making sure the building being built doesn't affect neighboring buildings in a negative way. The biggest thing to keep in mind is making sure the University of Arizona's recreation center doesn't get blocked out of sunlight opportunities for the outdoor volleyball courts, along with their other numerous outdoor activity spaces.

Views

Figure 95

View Looking North-East

Figure 96

View Looking North

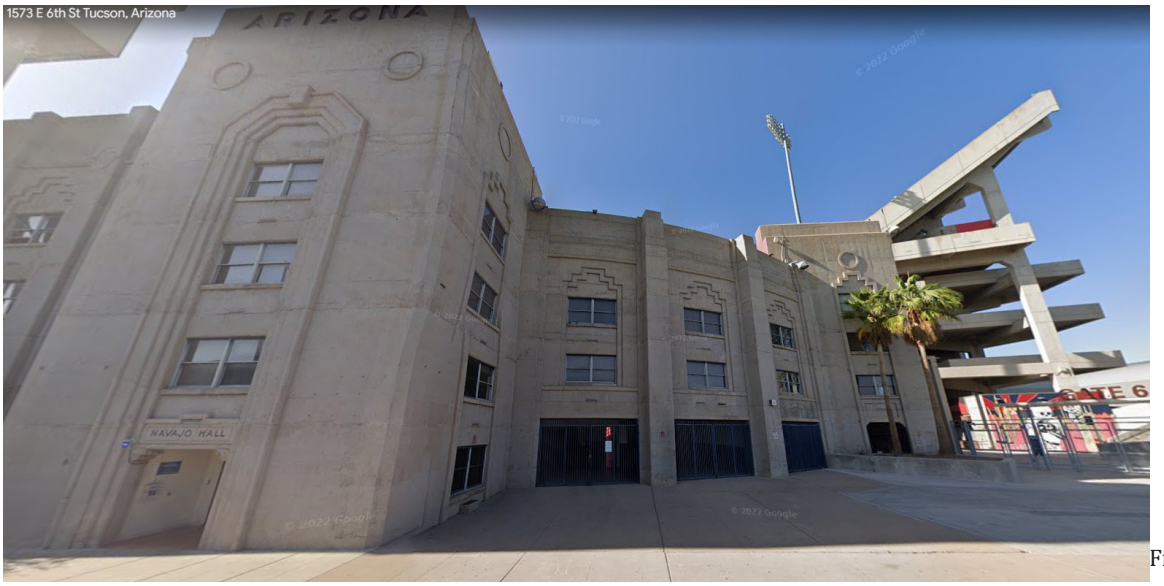


Figure 97

View Looking South-East

Figure 98

View Looking South

Figure 99

Site Analysis Takeaway

This site is located in a prime spot on the University of Arizona's campus. The proximity to both Arizona Stadium and McKale Memorial Center strengthens the bond of athletics with the school. The distance to multiple parking ramps also plays a big factor into this site, as they can be used for games, alleviating some of the parking needs of this design.

A unique aspect of the site is the curved road branching off of National Championship Drive. This gives an opportunity for cars passing by to see into the building through a glazing system, creating a link between the interior and exterior of the building.

Overall, the site does not hold much plant life. The University of Arizona's campus contains a fair amount of vegetation, this is an aspect I want to bring to the site, connecting it to the campus. Sunlight also plays a role into the vegetation selection, as this site could be used on weekdays and weekends at various times throughout the day. Canopy shading will need to be implemented to make the exterior of the site bearable in the summer months of the year.

The University wellness center is a place many students use to relieve the stress of school through physical activity. Creating a structure as to minimize the affect on the wellness center will be a big priority as well. The outdoor sand volleyball courts will be the biggest priority as to not interfere with the natural sunlight that reaches the space.

With a pretty flat site and views of the campus attractions, this site will work great for a hockey arena. Following the cities building ordinance for green design will help the environment, and the thesis goal of creating an eco-friendly arena for the city of Tuscon. Creating a well scaled design that works to not overshadow the surrounding buildings, but join them in creating a strong athletic community.

Performance Criteria

Space Allocation

Performance Measure

The aspect measured in my design is space usage, and circulation throughout the building. Designing a building that is both family friendly, but held to a professional standard needed for a college hockey rink.

Performance Measure Source

The performance measure can be found throughout extensive research of current hockey rinks, and finding what works, and what doesn't in a floor plan layout.

Performance Analysis

Drawings, such as bubble diagrams and eventually scaled drawings comparing distances to different spaces. (i.e. bathrooms distances, entrance locations, concession locations etc)

Performance Judgment

Judgment for space allocation will be done through the research completed in this document. Using case studies to construct a floor plan as efficient as possible, and making sure every user of the arena has needs met.

Code

Performance Measure

The aspect of the code criteria is making sure all the check marks supplied by the IBC and city ordinances are met.

Performance Measure Source

Using the IBC will be the source for this criteria.

Performance Analysis

The analysis for the code criteria will be reading the respective section my site is in for the IBC and following the standards stated in the book.

Performance Judgment

Judgment for this will be making sure the building follows code through bathroom design, fire escapes etc.

Energy Consumption

Performance Measure

Aspects measured in the design will be energy usage through either on site solar panels, or energy from the grid. Units of data will be kWh for the building

Performance Measure Source

Using different sources from previous designs to decide how much energy should/will be used for a rink in Arizona will be a source for this criteria.

Performance Analysis

Different forms of computer programs, specifically Auto desk Insight will be used to calculate the thermal performance of the exterior walls and glazing of the design.

Performance Judgment

Judgment for this criteria will be used through insight, which tells how much energy per square foot is used throughout the year, along with how much money will be spent per square foot.

Environmental

Performance Measure

Looking and measuring the light intensity for both the interior and exterior of the design. And using the city ordinances for green design through solar energy and water harvesting systems.

Performance Measure Source

The green energy usage can be found through the cities building ordinances, requiring new designs to have solar panel readiness, and water harvesting systems incorporated into the design.

Performance Analysis

Insight will be used to calculate the lighting intensity throughout the building, ensuring the space is adequately lit, and making sure there are no spaces left dark.

Performance Judgment

Judgment for the environmental criteria will be through following the city building ordinance and following codes, along with producing good lighting results in insight.

Behavioral

Performance Measure

The performance measure for the behavioral criteria will be through circulation patterns and placement of high usage spaces, such as concessions, and bathrooms, throughout the concourse.

Performance Measure Source

A source for this criteria is following the case study research done in this document, and enhancing on the good aspects of the floor plans, and finding solutions on the aspects it struggle in.

Performance Analysis

Again, studying the floor plans will be the analysis task for this criteria.

Performance Judgment

Judging this criteria is particularly difficult, considering it will be hard to study a usage pattern of a building that hasn't been constructed and used yet. But just trusting in my past research, and judging off that, will be the best judgment of this criteria.

Space Allocation

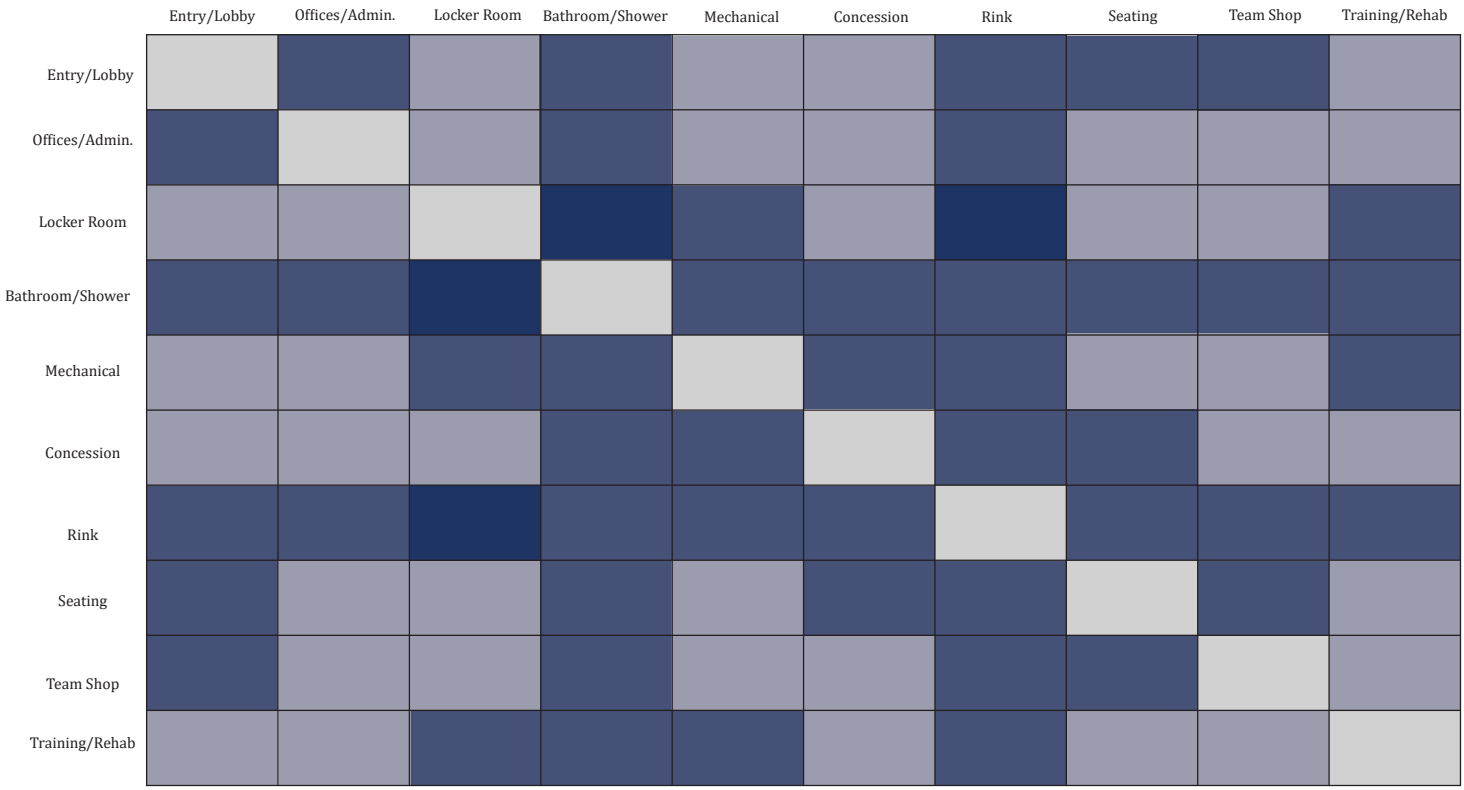


Figure 100

The spaces throughout the design will primarily revolve around the centralized hockey rink. The lobby will be the primary link for fans entering the space, giving direction to seating sections and nearby bathrooms/concessions. Locker rooms and bathrooms will be linked at ice level, as to give the players direct access to showers and toilets.

Concessions and bathrooms will also be linked at the concourse level, while both spaces will also be as close to the seating as possible.

Bubble Diagrams

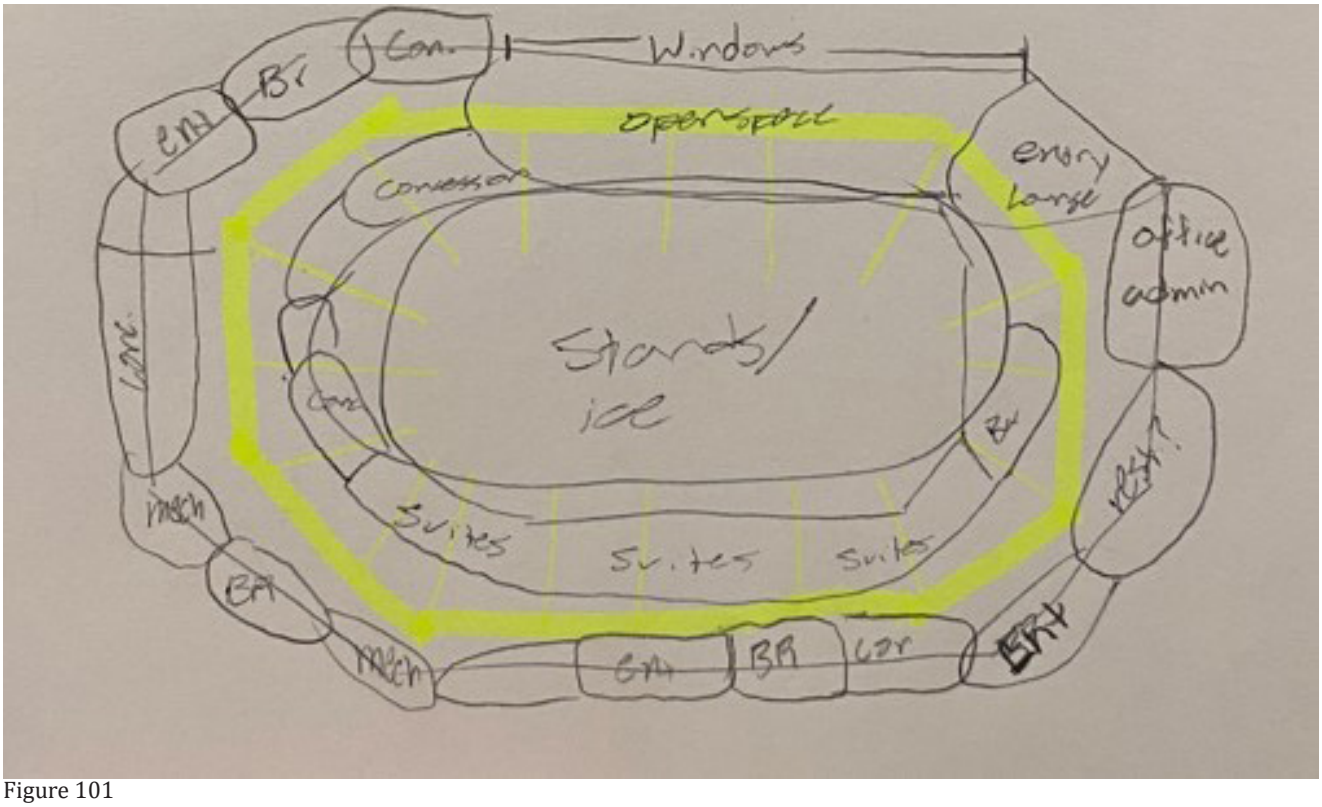


Figure 101

Above is a bubble diagram spacing out the layout for the concourse level of the building. For the floor plan, everything on this level revolves around the ice sheet and seating. Bathrooms need to be located at various spots throughout the building, making it as easy/simple as possible to use the restrooms from any given seat in the arena. Concessions also need to be placed in a similar style to the bathrooms. The highlight shows the circulation throughout the space, with plenty of entry points to the seating for fans.

The main entry to the arena plays 2 roles. The first, providing location services showing where seating sections are located, making it easier for first time visitors to find their seats. The second role is providing an entrance for youth players to reach the ice level, where the locker rooms are located. Other entrances are located at each corner of the building, providing fans from all directions with an in to the arena. A private entrance for the University players is also added for a more direct route to their locker room.

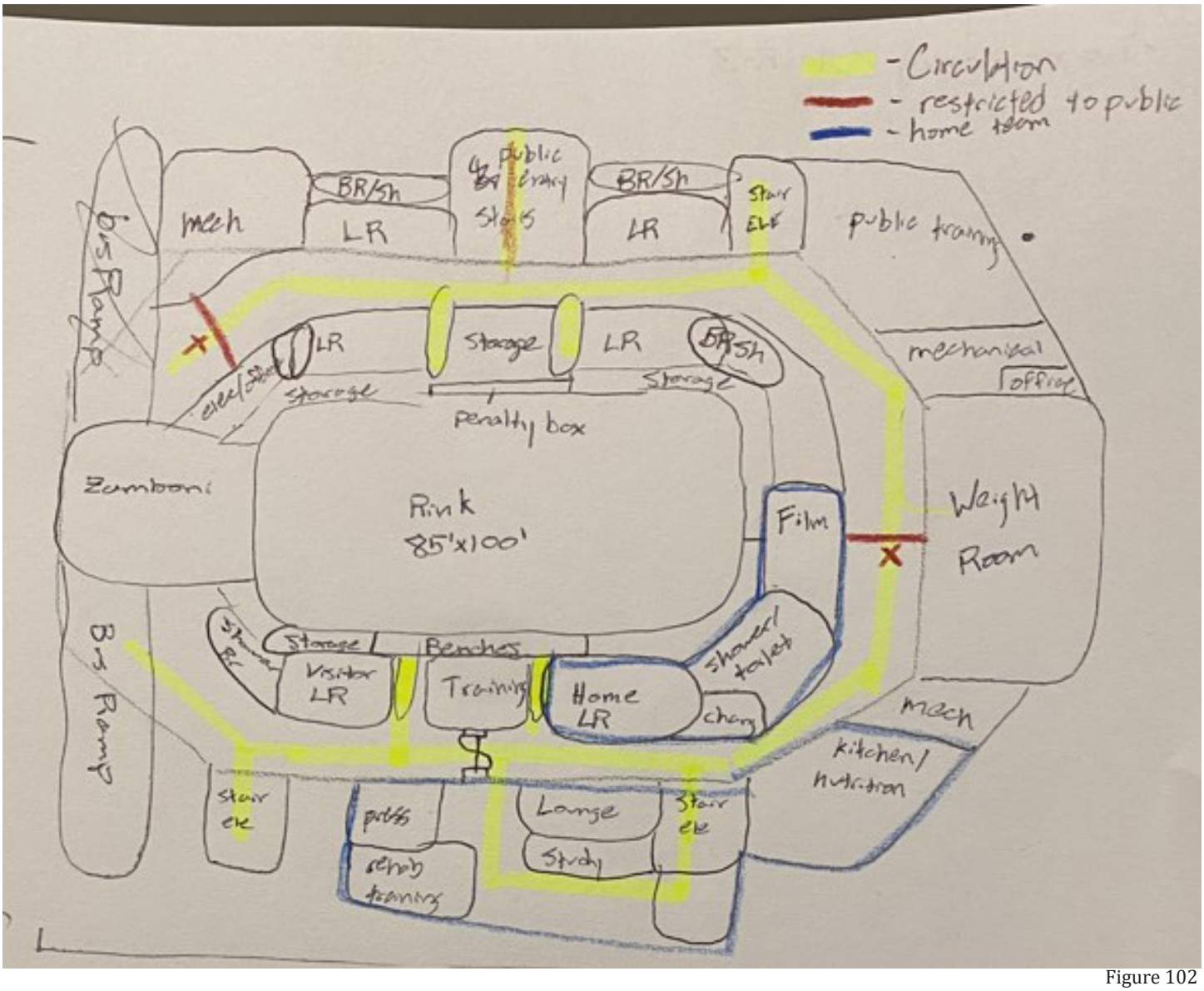
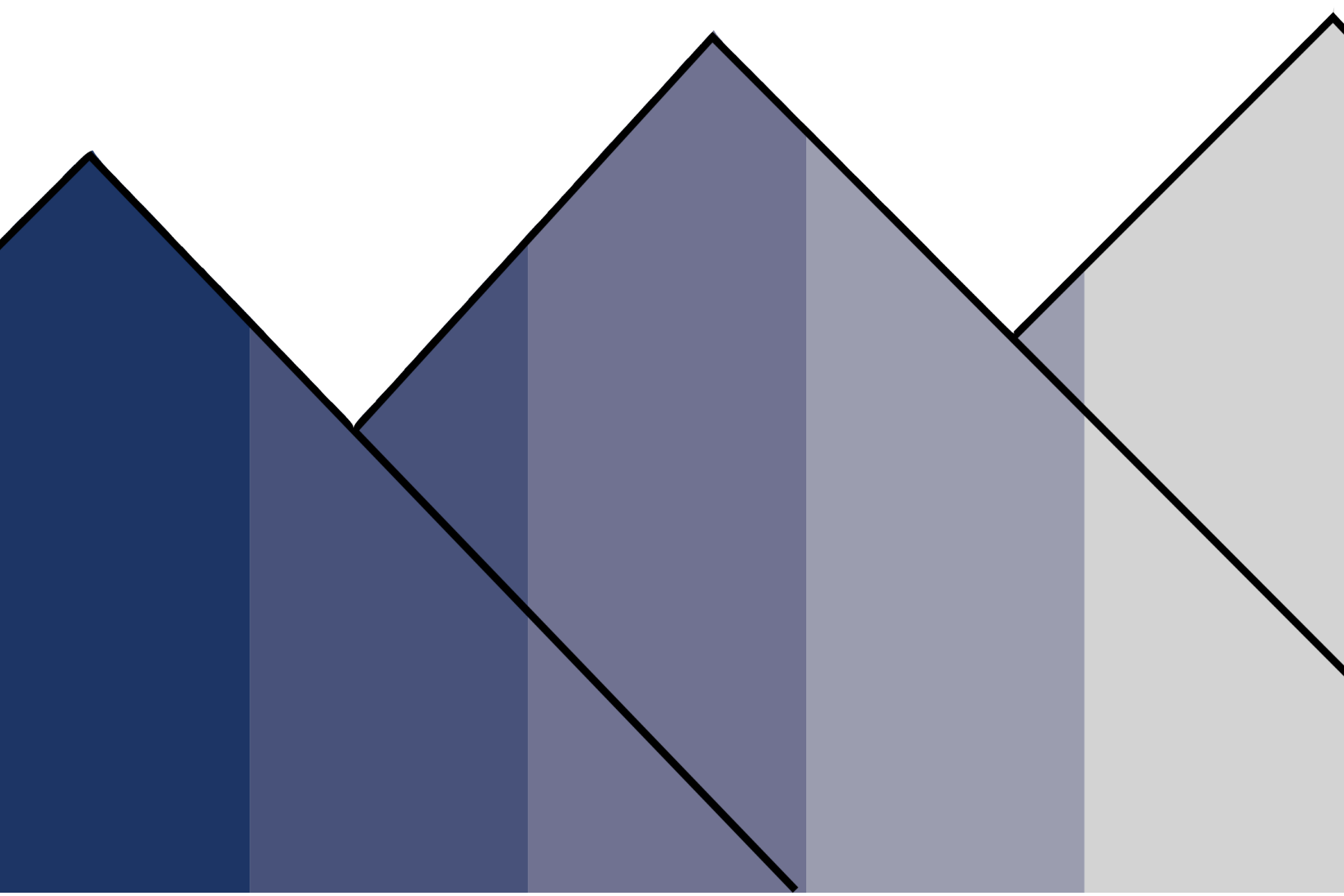


Figure 102

The lower level, or ice level, is where the bulk of the building's mechanical and electrical are located. The best location for this is next to the bus/loading ramp. This provides easy access for machinery to move in and out, and easy access for service repairs. The tricky part of the ice level design is keeping the public spaces public, and the private spaces private. Simple doors can be used with key card access to keep youth players from the college team spaces. Along with separating the visitor locker room from the home team, a similar approach with a key card access door will be implemented.

Considering the workout facilities will be used for youth training as well as college, the spacing of the weight room and treadmill space had to be near both youth locker rooms and team locker room. Storage is implemented throughout the perimeter of the rink, where the height from floor to ceiling isn't high enough for common use.

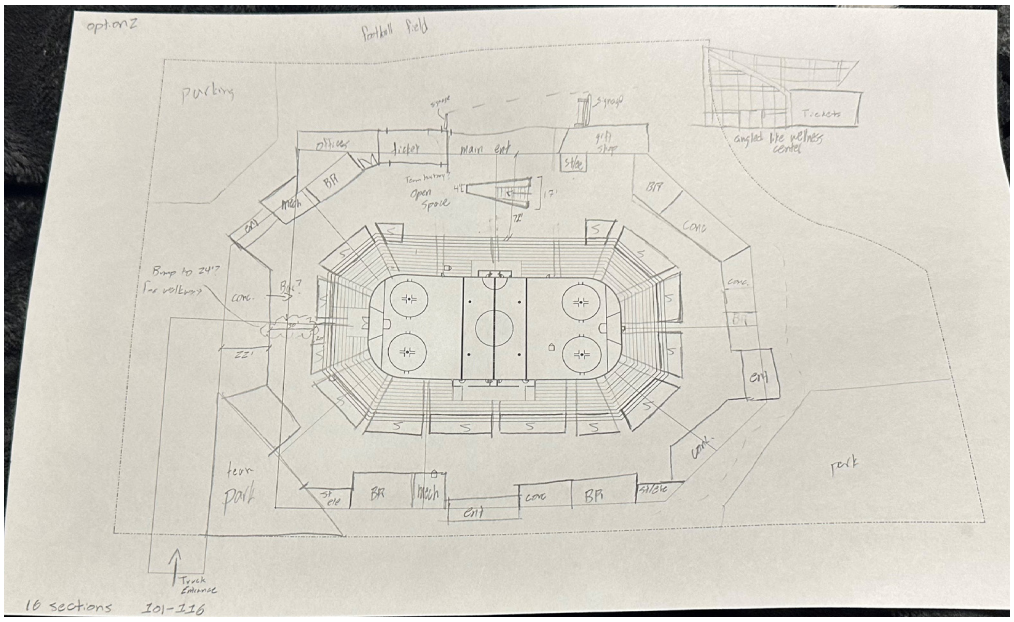
Design Solution
Arizona Arena



Design Process

Moving into the design phase of Arizona Arena, it was important to expand on the bubble diagrams done in the semester earlier. Printing off a scaled image of the rink on the site helped streamline this process. Capturing the views from surrounding site context buildings helped decide certain floor plan spaces' location.

Piecing these spaces together began expanding the ideas for design, and finding ways to cirulate the thousands of people around the building as well.



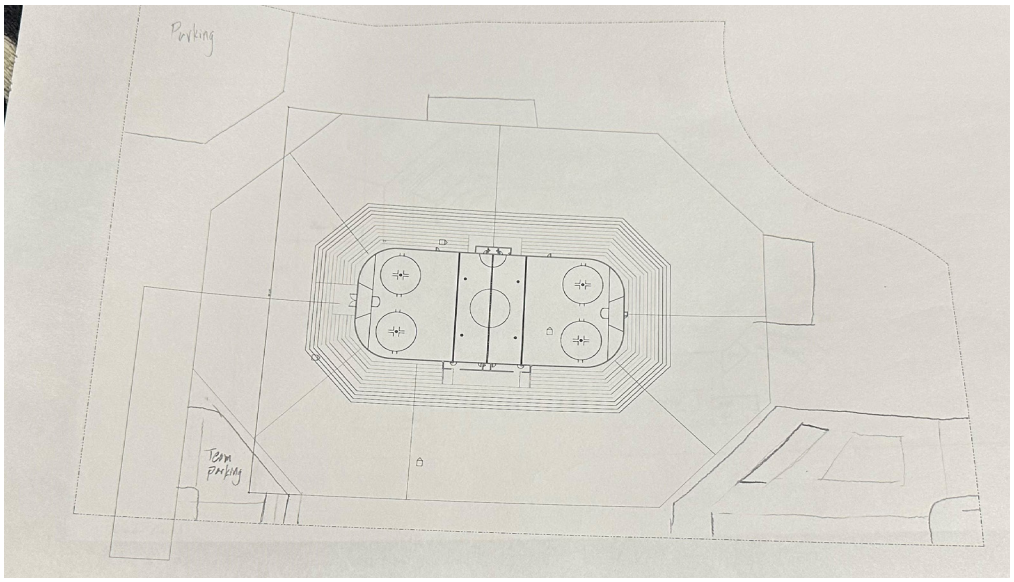
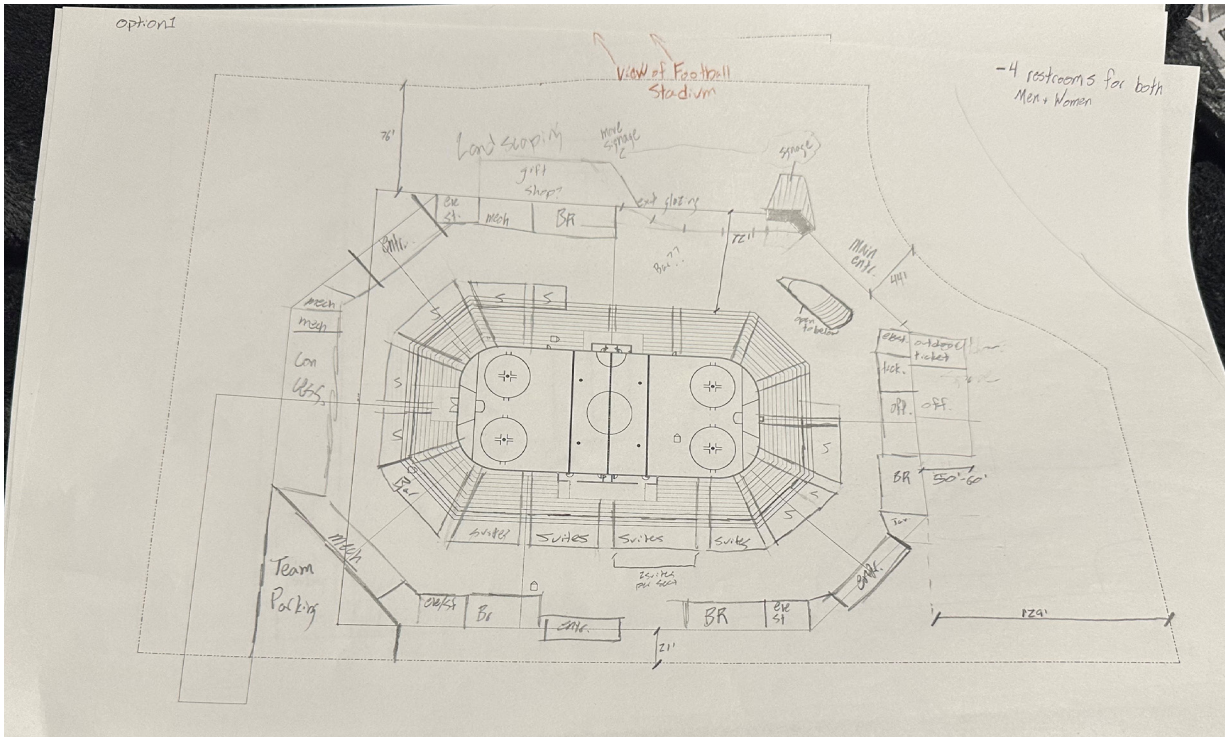


Figure 103-104

Finalized Floor Plan Sketches



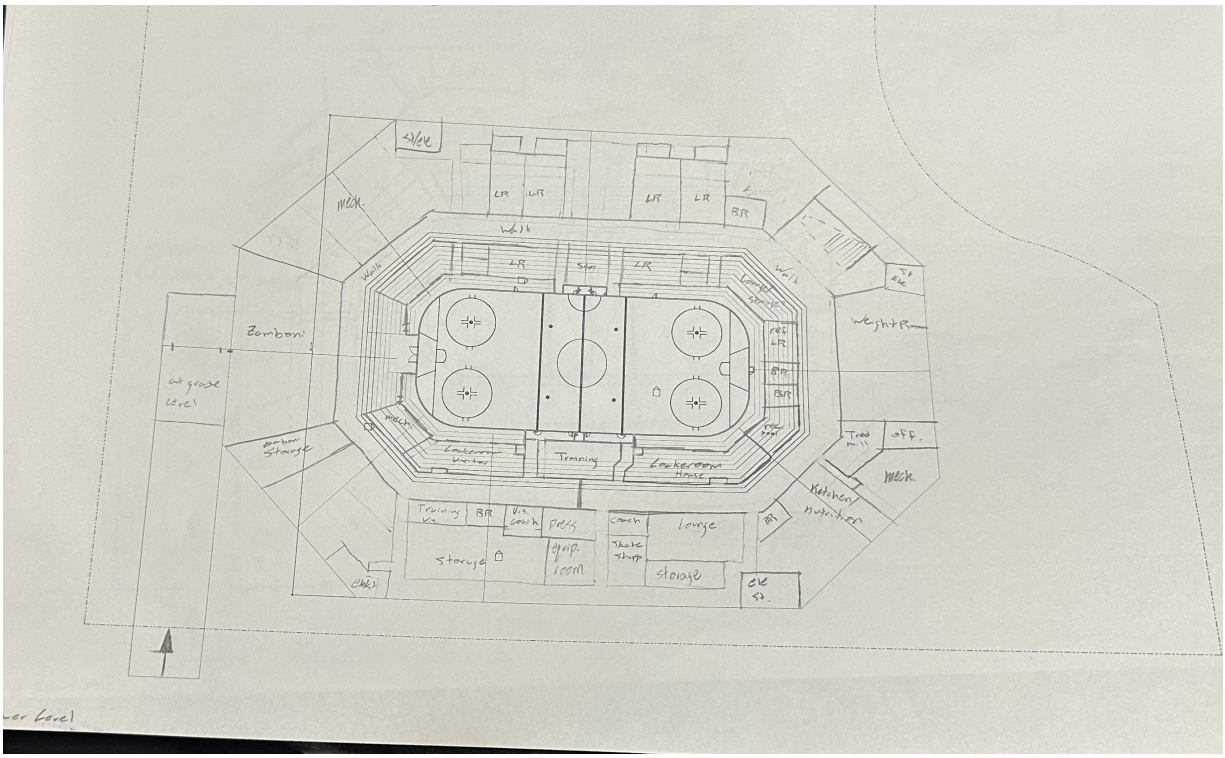


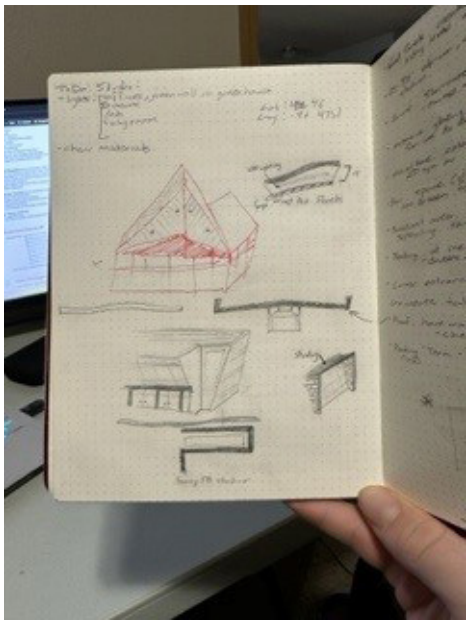
Figure 105-106

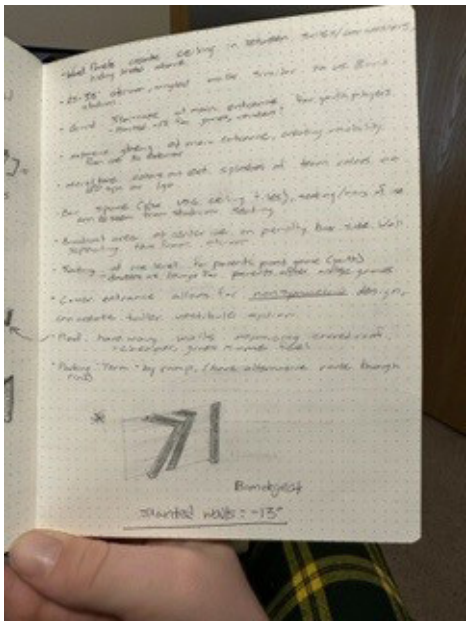
These floor plans were the finalized sketches before moving into the computer. With a large atrium serving as the main entrance, this corner of the building would be the focal point. With large curtain walls capturing Arizona Stadium, and looking out to the campus, this provides the best views, while only capturing the sunlight in the early to late morning, which are typically the cooler part of the day.

Design Sketches

Throughout the whole semester, my sketchbook was crucial in each step. Whether it was drawing, or just writing what I want to design, I was able to capture all of my thoughts, and was able to narrow these thoughts down into what turned into the final product.

Along with these notes and sketches, mini schedules were written out, from a 1 week stretch to a month stretch, making these small scale schedules made an efficient design process.





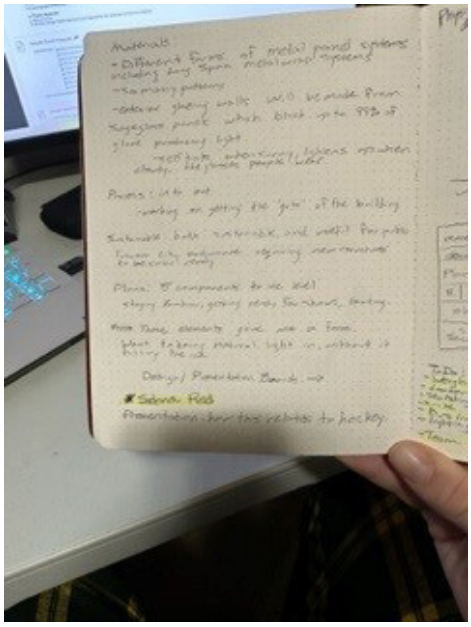
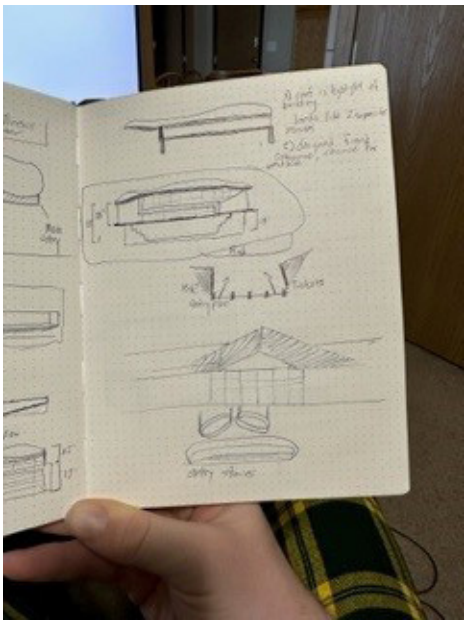
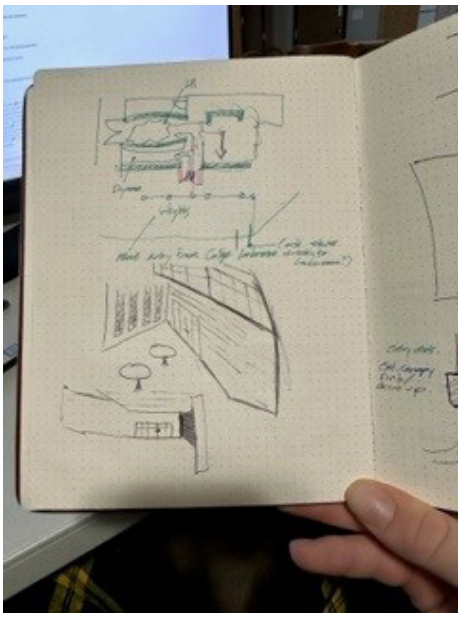
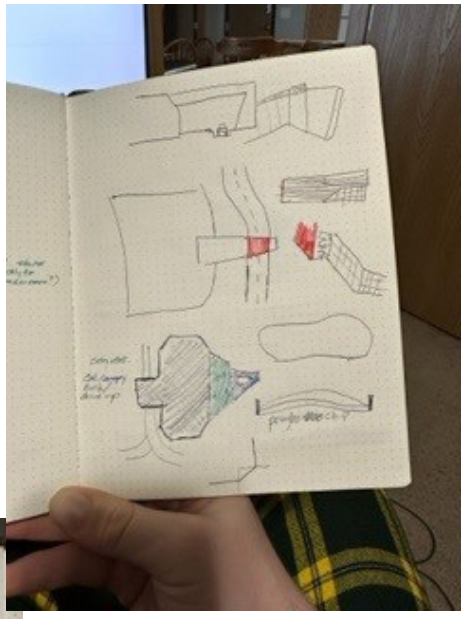


Figure 107-110







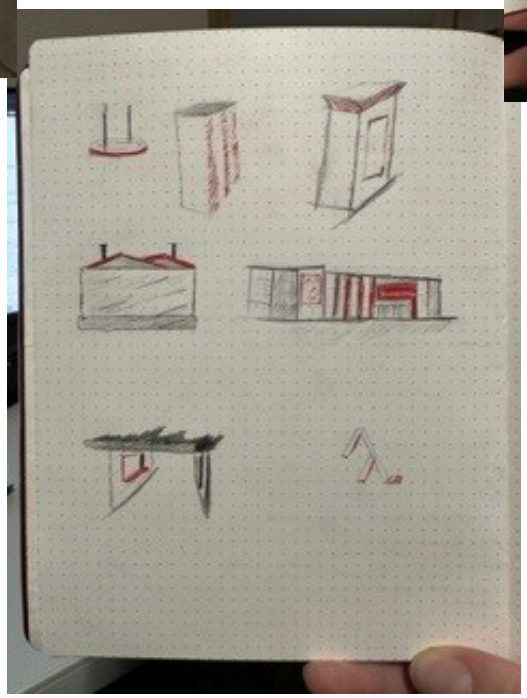


Figure 111-115

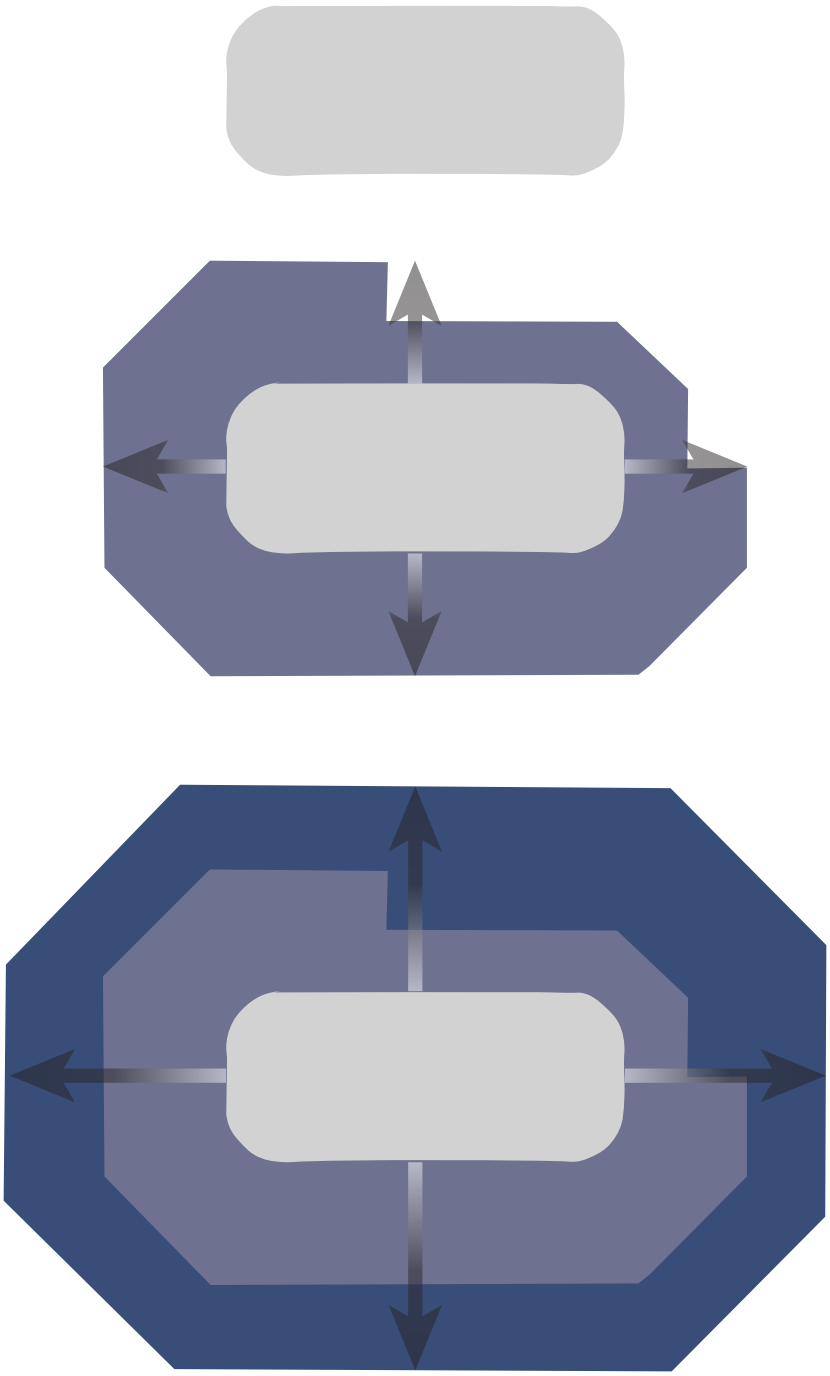


Figure 116

The design process for Arizona Arena was fairly simple. To start, The rink was first placed, the 85’ by 200’ rink dimensions will never change, so designing around the rink was crucial in the development of the building. After the rink is set, the next layer of the design was creating the views, or seating, for the arena. This step was arguably the most important, as this is where the fans will be sitting for the majority of games. Creating unobstructed views from all angles helped guide this part of the process. Finally, circulation and entrances create the final layer of the design process. Finding ways to move people in, out, and around the rink efficiently was the goal of this phase.

Following the In-toOut design process, the 3D form began to come to life. While designing the 3D form, structural componants were constantly kept in mind. Structural columns were spaced out on a 20'x20' grid, with an extensive roof truss system spaning over the ice and atrium. These componants were very important in finalizing spaces for floor plans.

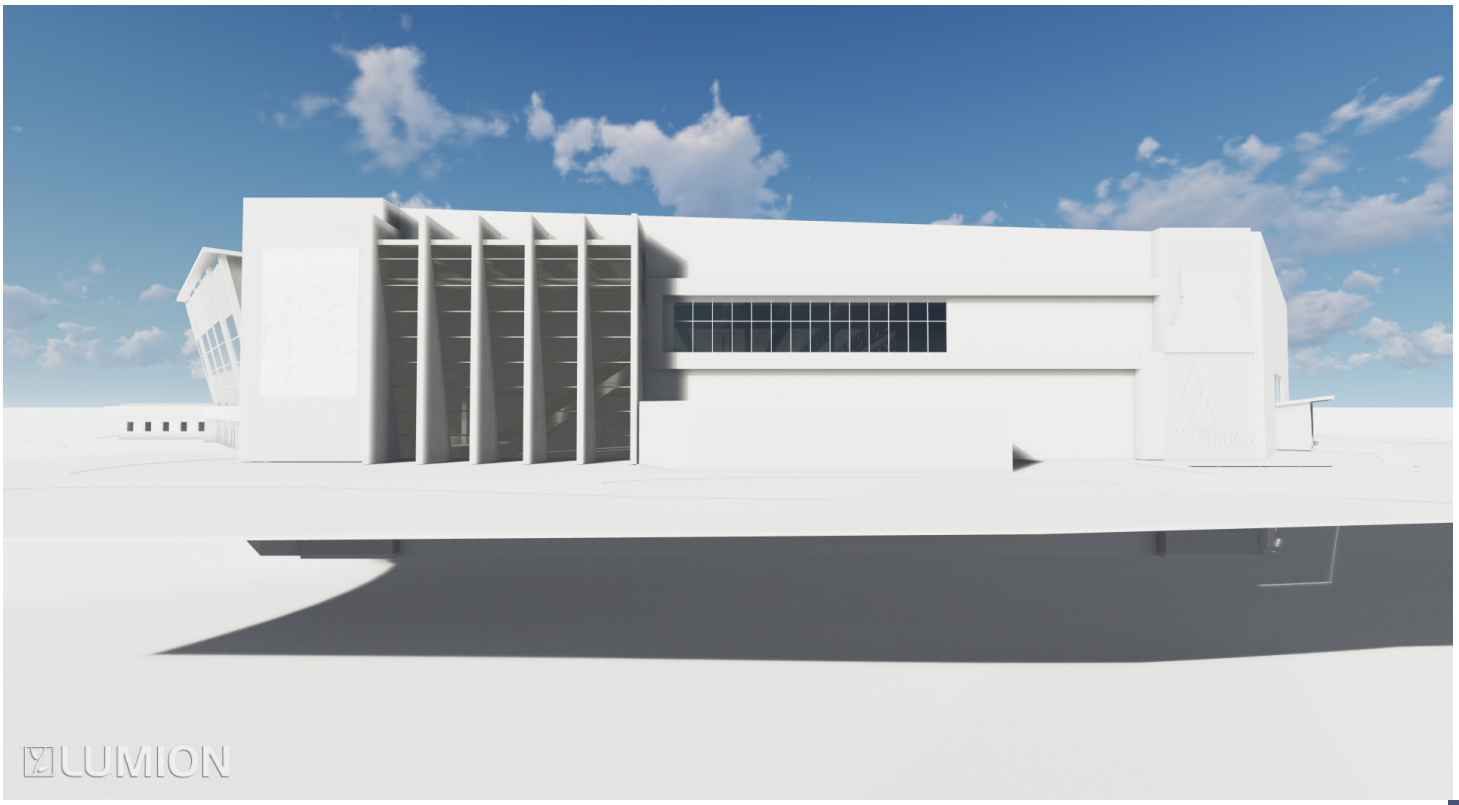
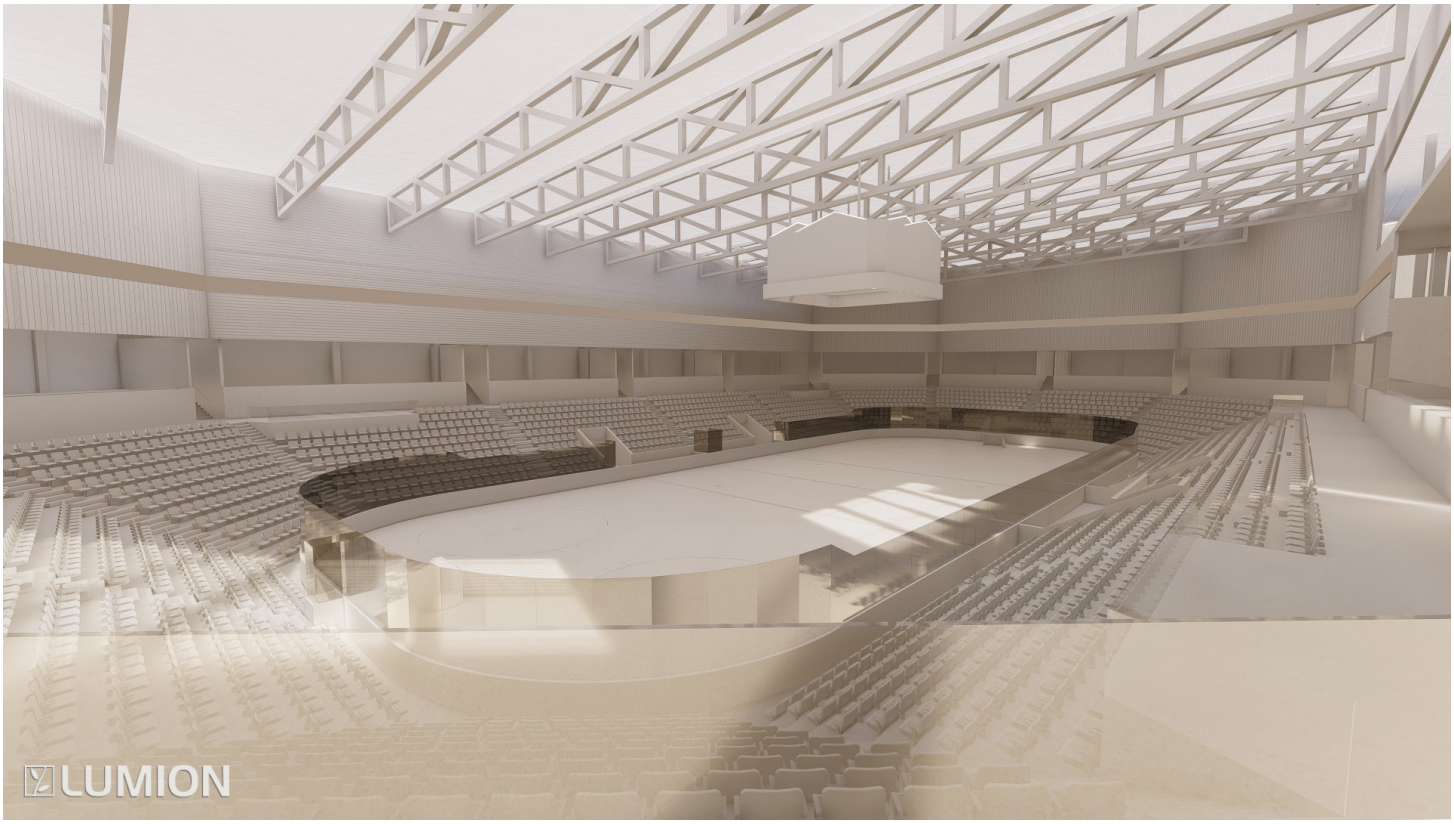


Figure 117-118

This phase of design was able to begin capturing angles for renders, and seeing what works, and what doesnt work in the design. Another aspect of this phase was not worrying about material choices at this point, the made the sole focus on design and circulation.



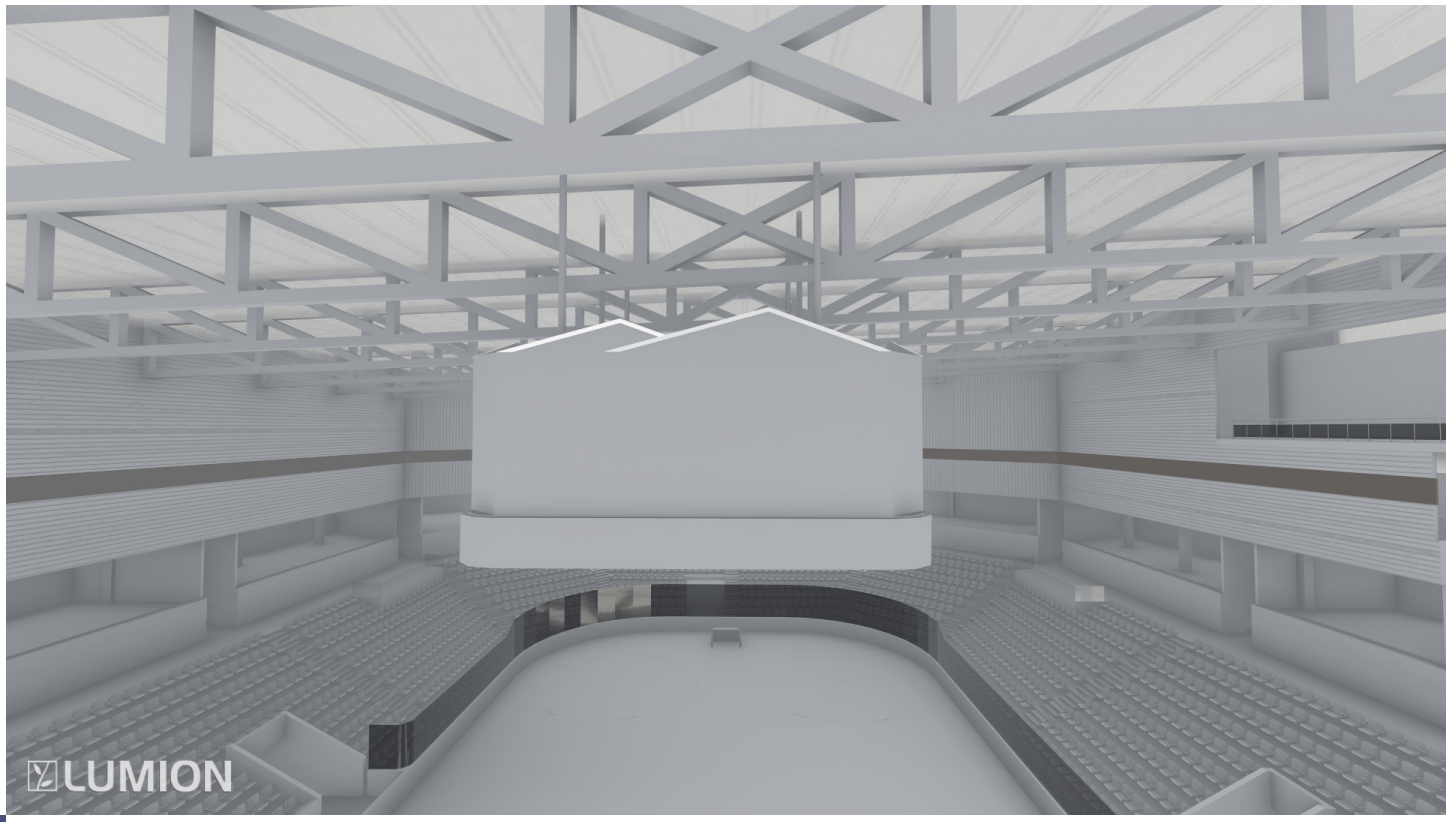


Figure 119-120

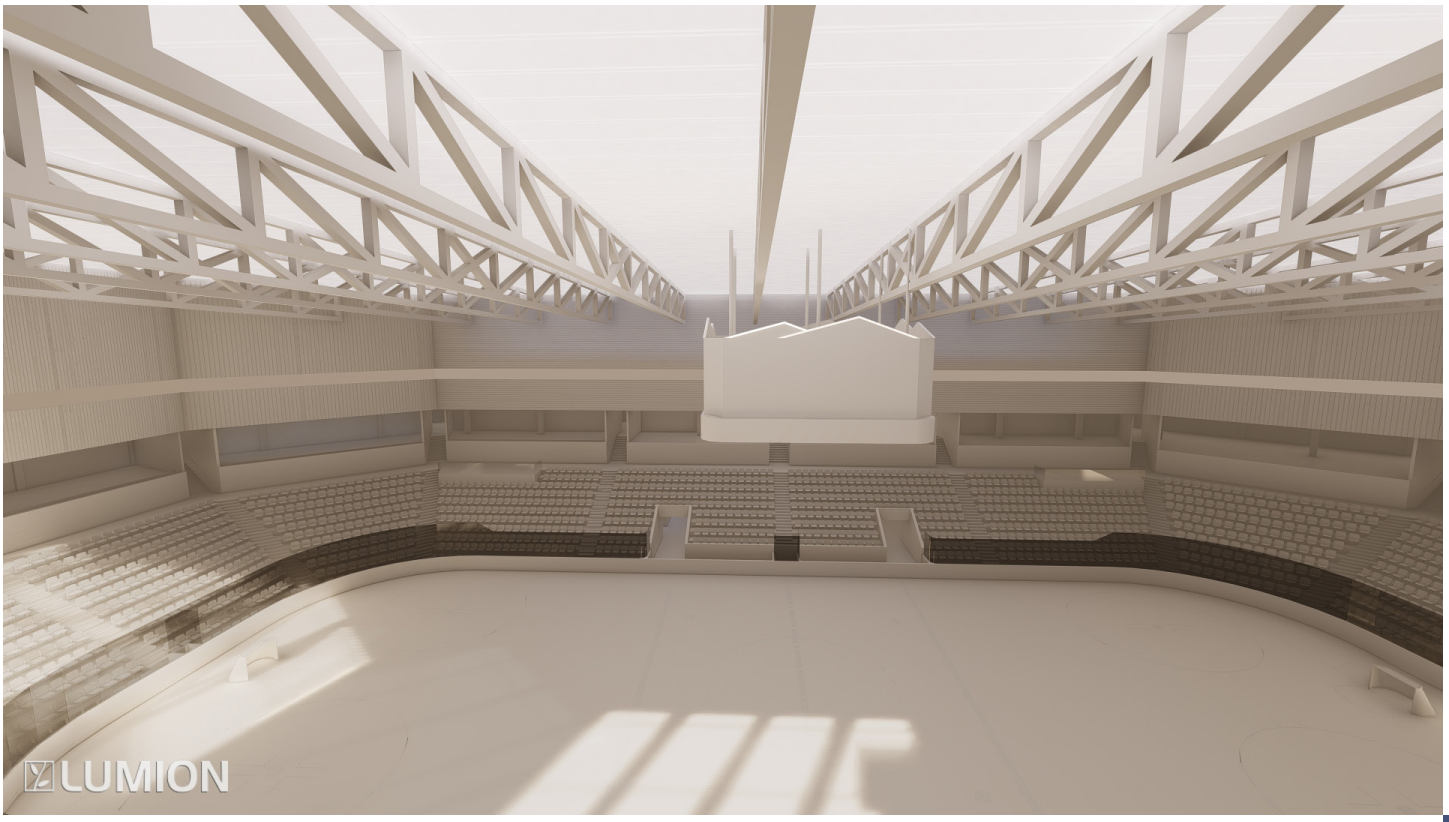


Figure 121-122

Final Design

Figure 123

The solution is Arizona Arena. This 152,000 square feet facility features an NHL size sheet of ice. Located across the street from Arizona Stadium, as well as the U of A campus, this arena is walkable for all students to attend games. A bus stop is also available for student transport. The rink seats 3,600 people in the General Admission seats, with and additional 500 barstool seating along the perimeter of the sections. 22 suites, including a corner bar, can seat another 170 people, with space for another 100 bar stool seats. A standing room bar overlooking the rink holds 200 people giving spectators top notch vies of the action. Designed through sustainability, the rink was made to freeze in the desert heat of Tuscon.

Ice level provides players of all levels with high end training equipment. 6 public locker rooms provide youth teams with ample space to prepare for games. A private lockeroom for the UofA team is also featured, with a team lounge, study space, and cafeteria for nutrition giving the athletes everything they need to succeed on and off the ice. The weight room gives athletes an off ice training space with over 65' of turf for sprints, a synthetic ice station, and a skating treadmill to perfect strides.

Site Plan

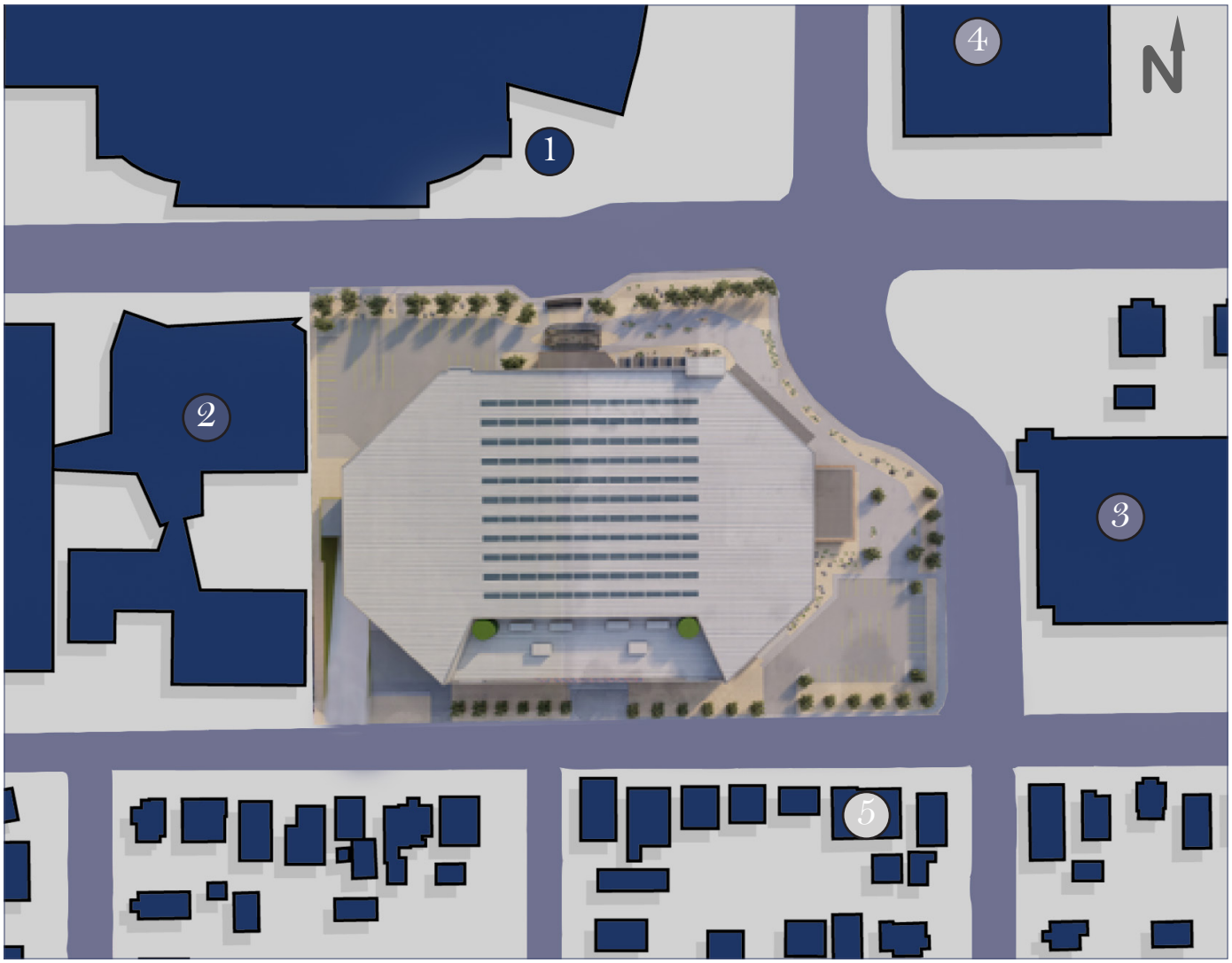


Figure 124

1 Arizona Stadium
2 Rec. Center
3 Parking Ramp
4 ICA Indoor Sports Center
5 Residential Neighborhoods

Keeping the surrounding site in mind, these 5 site context pieces guided the site design, and the overall design. With residential neighborhoods directly south, it was important to limit the amount of windows on the South facade. This helps minimize noise leaving the rink and going into the resdential blocks. With historic Arizona Stadium to the North, this gave the idea for longer spans of curtain walls. This created views for the people inside the building, and allowed people driving or walking by to catch a glimpse of the action inside.

Floor Plan- Main Level Concourse

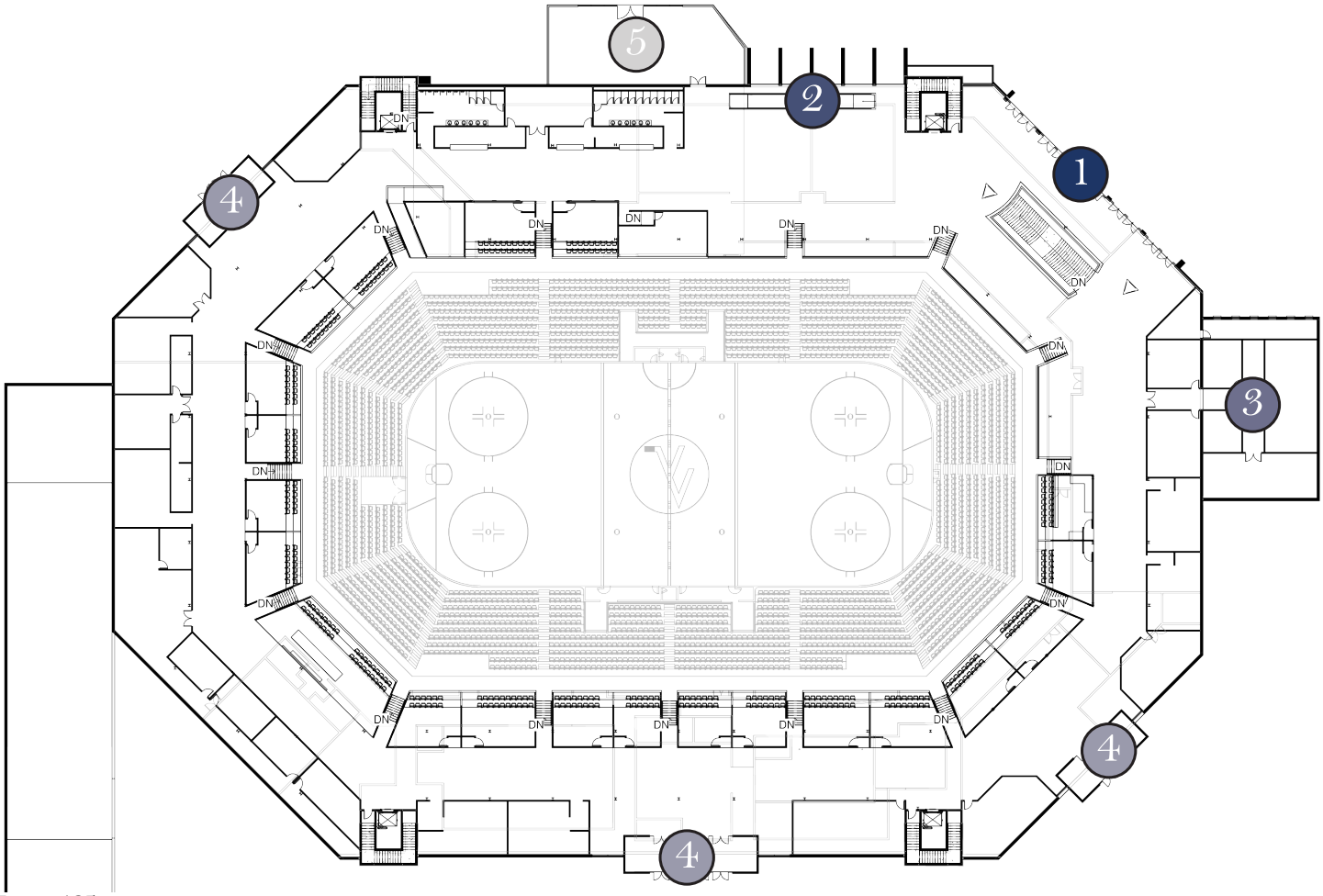


Figure 125

1 Main Entrance

2 Escalator to Standing Bar

3 Admin Offices/ Ticket Sales

4 Building Entrances

5 Team Store

Moving on to the floor plans, the process was pretty simple as well. The concourse had 2 main goals, unobstructed views for all seats, and circulation. To make the 5,000 people moving in a single building more streamline, a second smaller walkway was added in between the suites and the general admission seating. This added another way for people to get to their seats without going through the concourse. It also minimizes the traffic of the concourse which will already be busy with the restrooms and concessions throughout the level.

Floor Plan- Ice Level

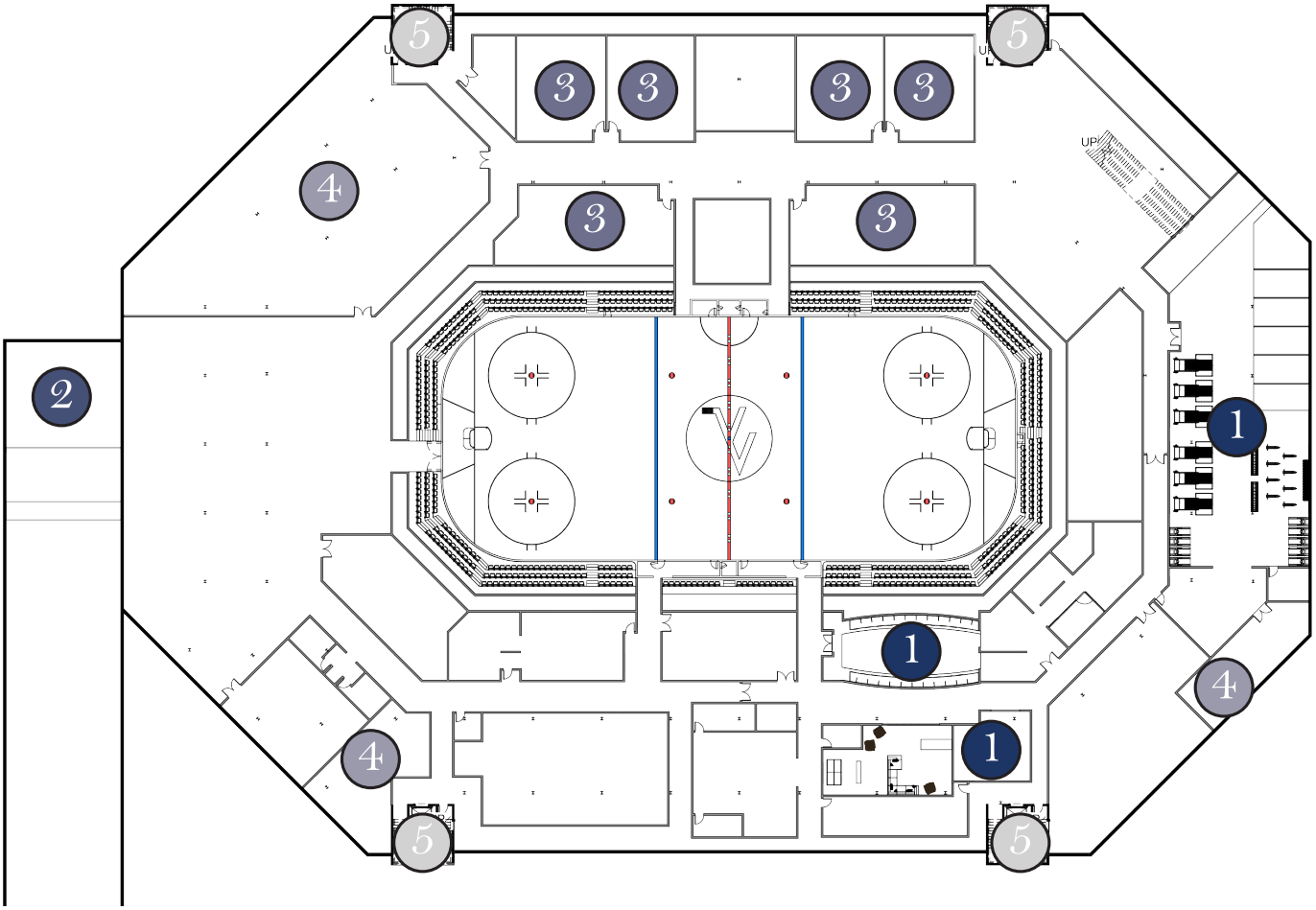


Figure 126

1 Team Spaces

2 Loading Dock

3 Public Locker Rooms

4 Mechanical

5 Egress Stairwells

The ice level, or event level, floor plan contains the 'guts' of the building. With much of the building's mechanical equipment located here. The biggest aspect that needed to be addressed is seperating the UofA locker room and other spaces from the public locker rooms. This privacy was done with adding doors with key card activation locks, this ensures the team has the privacy they need. The weightroom, which is used by the UofA team as well as the youth players, is centrally located between the locker rooms for easy accesss.

Sustainability

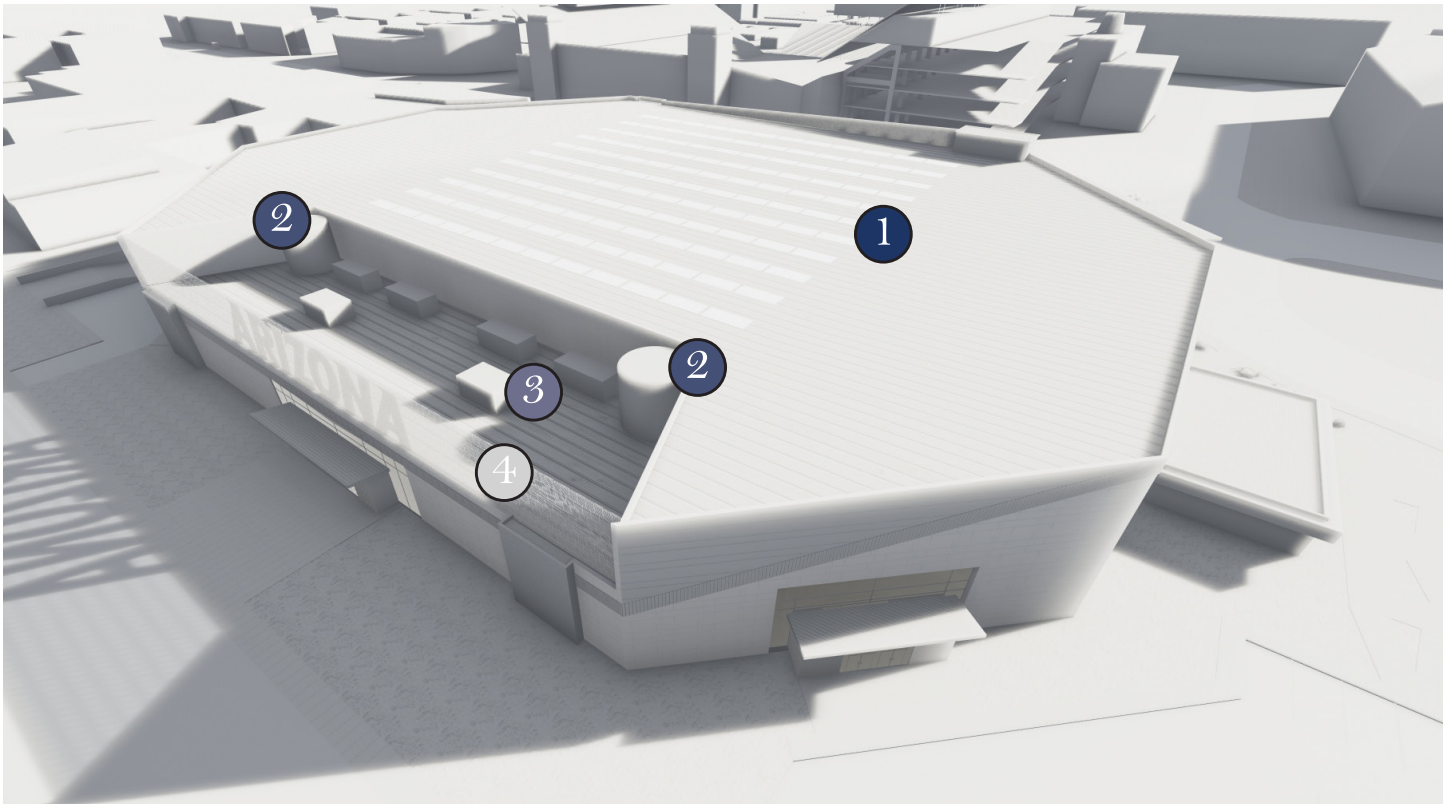


Figure 127

1. Solar Panels
2. Water Cisterns
3. Mechanical Equipment
4. Perforated Metal Panel

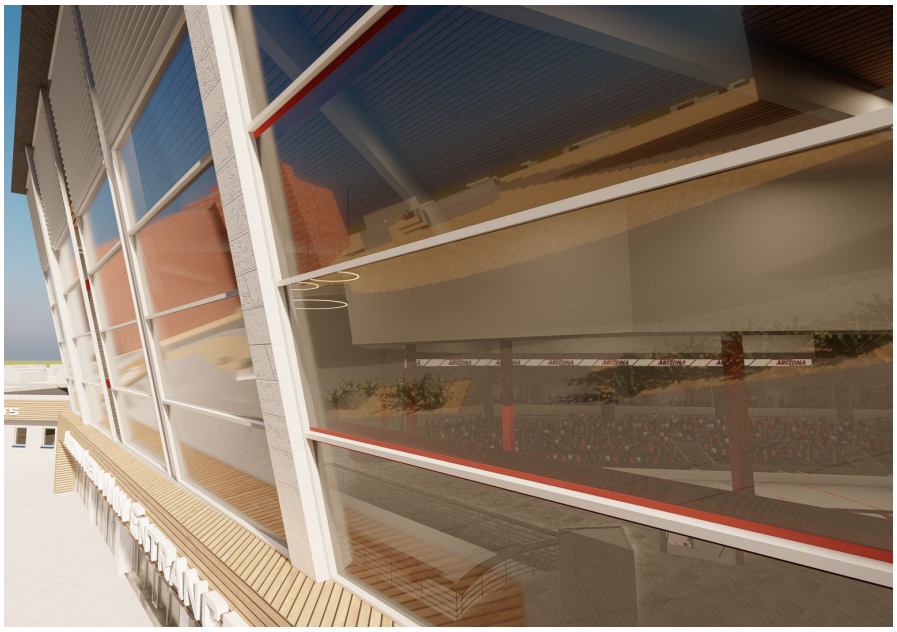
Arizona has amazing potential for solar energy, along with other solar design options to minimize the carbon footprint of the site, while still creating a beautiful building.

Driven by sustainable design, Arizona Arena contains multiple sustainable features. 2 Water cisterns catch rain water funneled in by the roof. This water is distributed to the building's low flow toilets and sinks, preserving as much water as possible.

The roof holds 132 solar panels collecting the 300 days of sunshine Arizona experiences yearly. These solar panels support the energy needed to keep the lights on and the mechanical equipment running.

Any left over energy harnessed by these solar panels can be sent to the Tuscon power grid, and be used for electricity throughout the city.

A perforated metal panel wall helps hide the roof top mechanical equipment from people on the ground.



Sage Glass- Day Time

Sage Glass- Night Time

Figure 128-129

Sage Glass is an electro chromic glass that tints and clears automatically, creating light and thermal comfort in a space. The energy needed to run these panels of glass take very little. 120 square feet of Sage Glass consumed less energy than a 60 watt light bulb.

When the sun is shining, Sage Glass will self tint and block the sun from entering the building. On overcast days, the tint will lighten up and allow the natural light to enter the building. This cuts the energy usage and cost for the building all year.

Structure

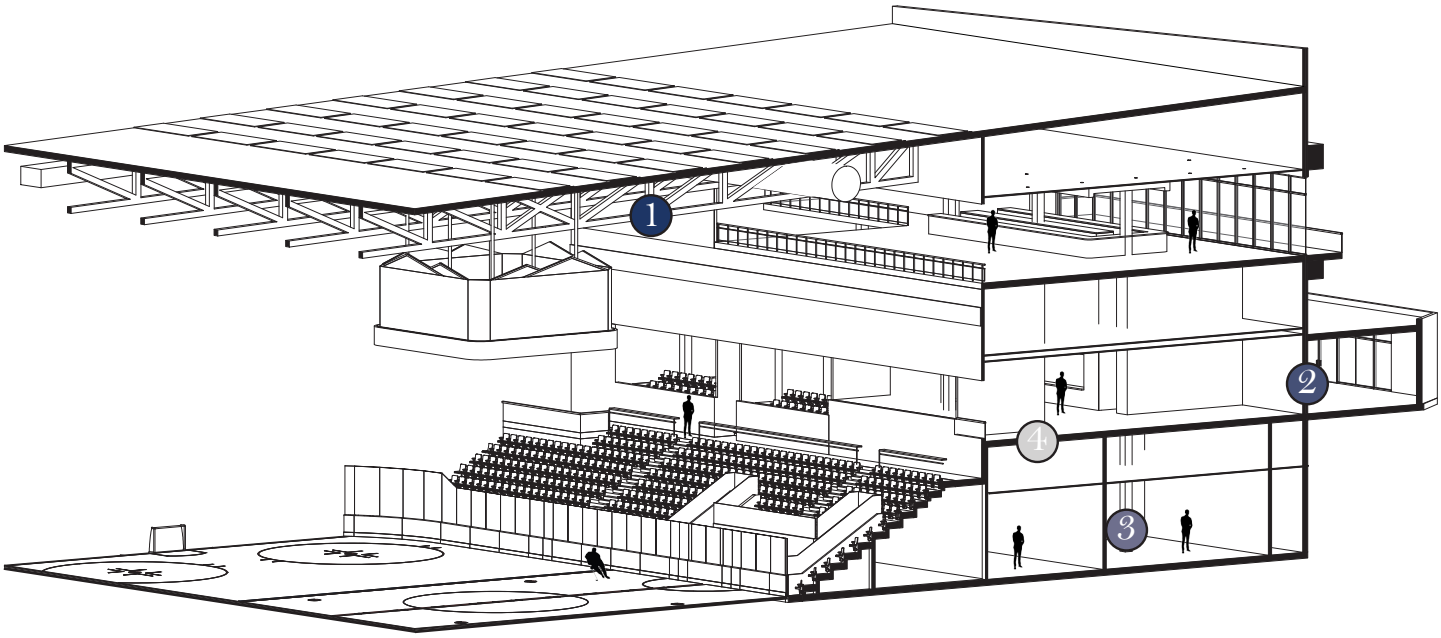


Figure 130

1 Steel Web Truss System

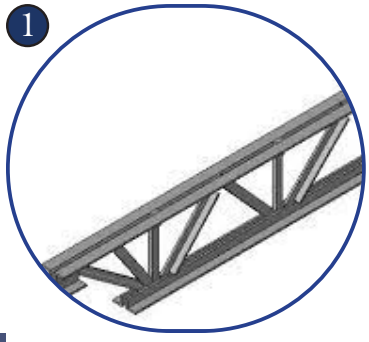
2 Metal Wrap Insulated Wall Panels

3 Steel I Beam Columns

4 Composite Concrete Floors

For any stadium or arena to succeed, heavy structural components are needed to ensure the safety of the users. The roof spanning over the ice is held up with a steel web truss system, which rest 15' apart. A structural column grid, which is a 24' by 24' span locates the I beam steel columns, which meet the truss system, and support the roof. The floors consist of a composite concrete floor system, which is both efficient and stable for this climate. Finally, exterior walls are metal wrap isnulated wall panels. These walls are very efficient at keeping the ice, and the building cool. Interior walls are simple metal stud system walls, finished with gypsum wall board.

1



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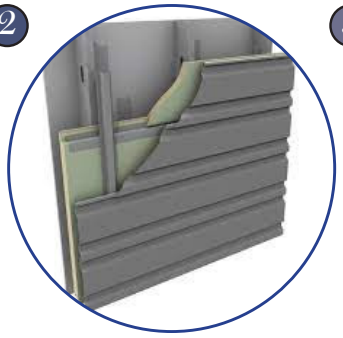

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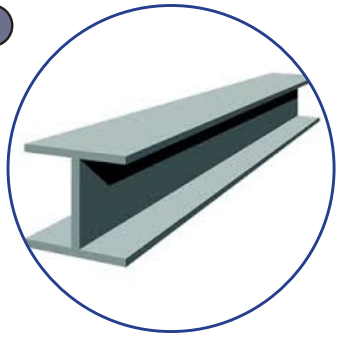

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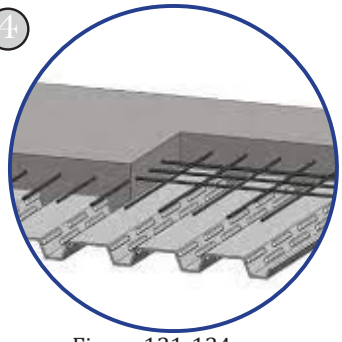

Figure 131-134

Line of Sight

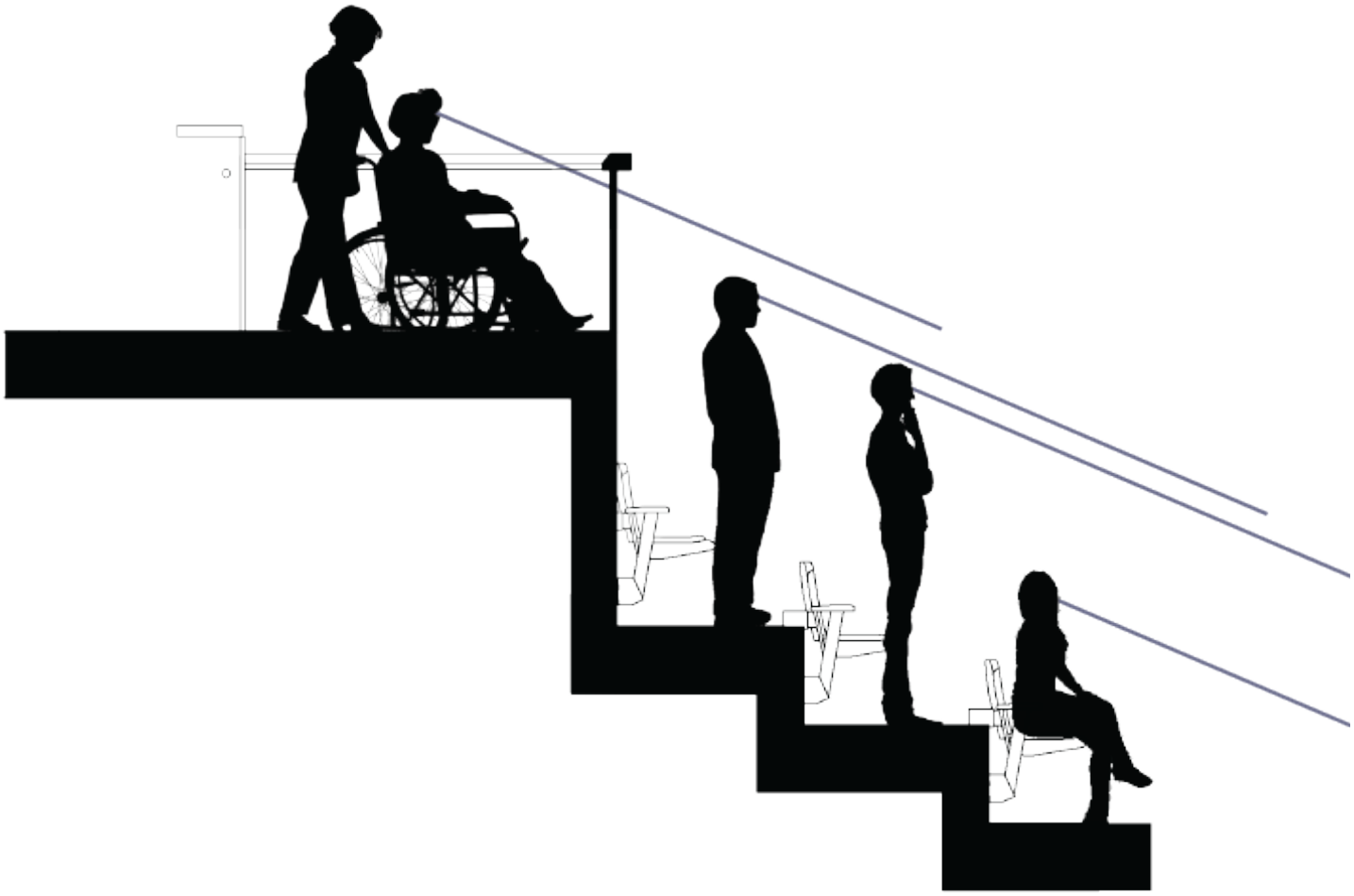

Figure 135

4 wheel chair accessible seating platforms are placed at each corner of the rink. Handicap seating is also available at the North East corner of the arena by the main entrance.

Handicap seating was calculated using the wheelchair platform height calculator. These calculations make sure every spectator has the same line of sight of the ice, ensuring every person has top notch views of the action.

Branding

Figure 136

Branding can be the most useful tool in marketing. Creating a sleek logo for the arena really ties the whole project together. Logos dont have to be full of detail, but the logo should have meaning. With Arizona Stadium across the street for the site, it was only fitting to name the arena 'Arizona Arena'

The logo for Arizona Arena, to no suprise, contains 2 A's. These As form a hockey stick to symbolize the sport it holds events for, with both letters forming an outline of mountains, which surround the city of Tuscon.

Figure 137

Final Renders

Figure 138-139

Figure 140-141

Figure 142-143

Figure 144-145

Figure 146-147

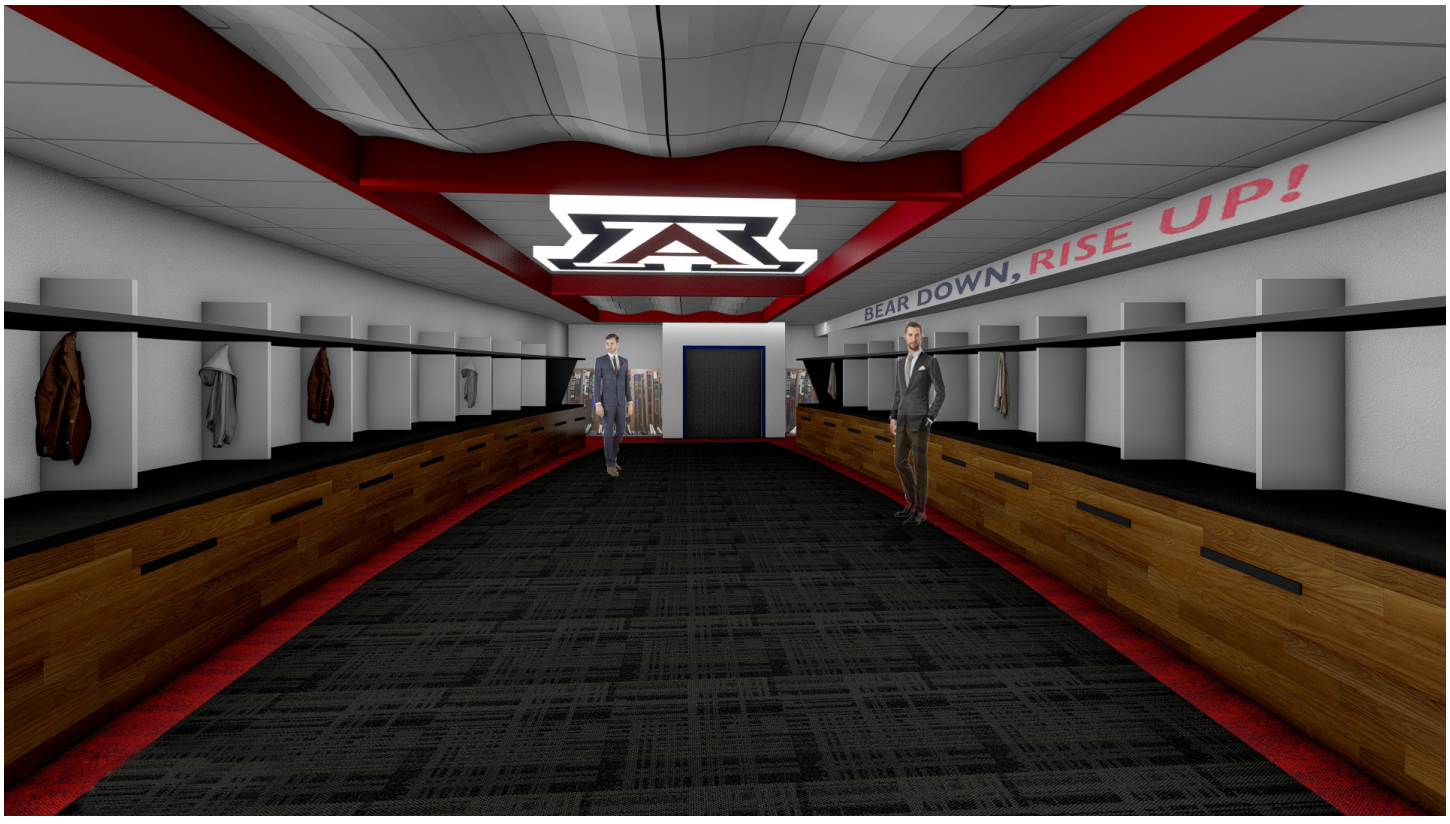

Figure 148-149

Final Thoughts

Throughout this process of a thesis project, a few things have crossed my mind. Firstly, this year has taught me how to micro manage my timeline that my professors give me. With due dates given to us throughout the semester, I found it crucial to break up these due dates into smaller sections. It's sort of like hockey, there are 3 periods, and the goal of each period is to out score your opponent, and make adjustments in between periods. My opponent was completing my thesis project, and instead of 'scoring' more, I set deadlines for certain aspects of my design. Whether it was crating structural components, sustainable design, renders, photo edits in Photoshop, board design and submission, and everything else in between, these goals were set at numerous points throughout the semester and school year. Any adjustments made affected every other goal I had for finishing this project, which made me more motivated to stay on my schedule.

In my research document, I stated that I want this project to be something I was proud of as I embark into the real world. Arizona Arena is something I am so very proud of. Through my research last semester, and my sketches done, it really is crazy how these sketches and research turn into my final design.

With this in mind, I would like to take the last space I have on this paper to say thank you to all my professors throughout my 5 years at North Dakota State University. Freshman year I came into this program not sure if I wanted to be an architect or an engineer, I gambled on my gut feeling and it was the best decision of my life.

Sincerely,

CW

Appendix

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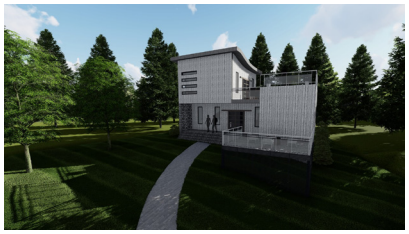
Previous Studio Experience

2nd year

Fall 2019
Instructor: Charlott Greub
Project: Boathouse



Spring 2020
Instructor: Emily Guo
Project: Dwelling 303

3rd year

Fall 2020
Instructor: Paul Gleye
Project: Cultural Center

Spring 2021
Instructor: Cindy Urness
Project: Sanford Same Day Surgery Clinic

4th year

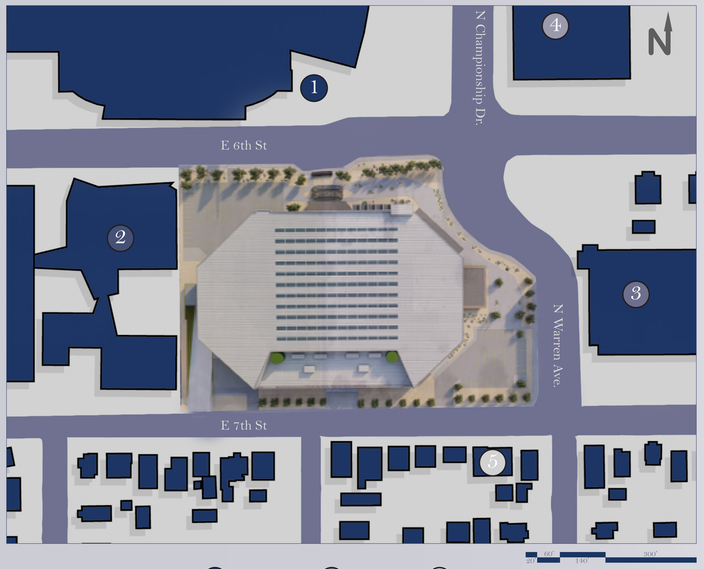
Fall 2021
Instructor: Amar Hussein
Project: Fluctus, Highrise Capstone Project

Spring 2022
Instructor: Amar Hussein
Project: Urban Design

5th year

Fall 2022
Instructor: Cindy Urness
Project: Otte Jacob Wetland Research Center

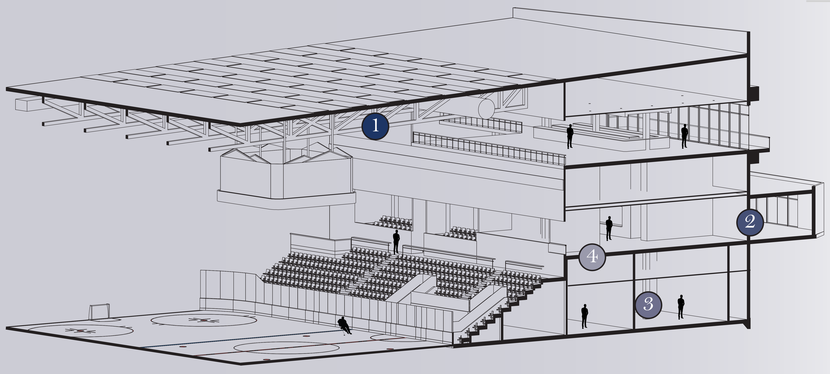
Spring 2023
Instructor: Cindy Urness
Project: Arizona Arena, NDSU Master Thesis



1 Arizona Stadium
2 Rec. Center
3 Parking Ramp
4 ICA Indoor Sports Center
5 Residential Neighborhoods

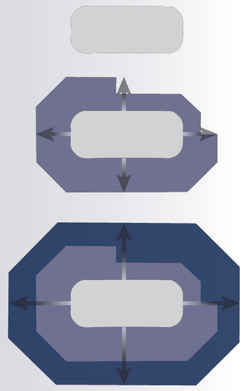
Site Plan

3D Section



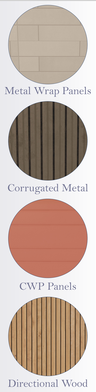
1 Steel Web Truss System
2 Metal Wrap Insulated Wall Panels
3 Steel I Beam Columns
4 Composite Concrete Floors

Design Process



The design process for Arizona Arena was fairly simple. To start, The rink was first placed, the 85' by 200' rink dimensions will never change, so designing around the rink was crucial in the development of the building. After the rink is set, the next layer of the design was creating the views, or seating, for the arena. This step was arguably the most important, as this is where the fans will be sitting for the majority of games. Creating unobstructed views from all angles helped guide this part of the process. Finally, circulation and entrances create the final layer of the design process. Finding ways to move people in, out, and around the rink efficiently was the goal of this phase.

Materials



Arizona Arena

ICE IN THE DESERT

Tuscon, Arizona

Arizona Arena Logo

Video QR Code

Statement

Over the last 20 year, hockey has seen a 230% increase in players throughout the nation, making it one of the fastest growing sports in the United States. Arizona is one of the leading states for this increase. With the increase in players, a facility is needed to provide youth players a space to practice and play on ice with off ice training options as well.

Along with youth players, the University of Arizona hockey team is in need of a new facility. This ACHA division I program has shined, consistently being a top 20 team in their respective division. This success has given them as reason to make a jump to NCAA Division I hockey, the highest level of hockey before the professional level in America. To make this jump, the team needs a new facility that is held to the NCAA division I standards for both players and spectators.

Solution

The solution is Arizona Arena. This 152,000 square feet facility features an NHL size sheet of ice. Located across the street from Arizona Stadium, as well as the U of A campus, this arena is walkable for all students to attend games. A bus stop is also available for student transport. The rink seats 3,600 people in the General Admission seats, with and additional 500 barstool seating along the perimeter of the sections. 22 suites, including a corner bar, can seat another 170 people, with space for another 100 bar stool seats. A standing room bar overlooking the rink holds 200 people giving spectators top notch vies of the action. Designed through sustainability, the rink was made to freeze in the desert heat of Tuscon.

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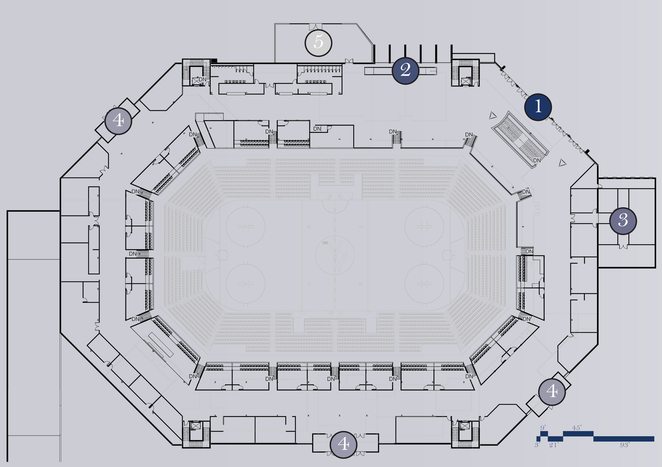
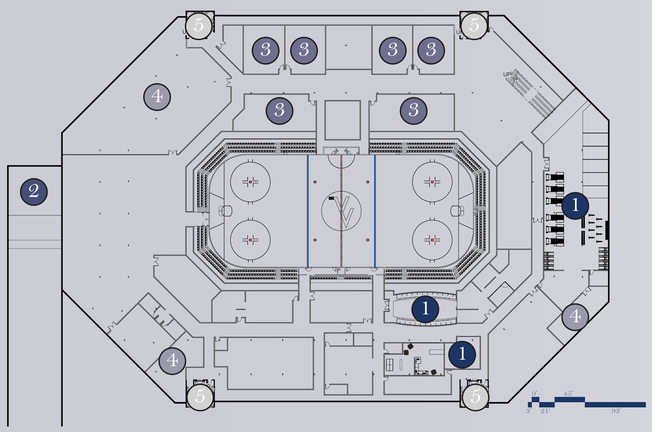


1 Main Entrance
2 Escalator to Standing Bar
3 Admin Offices/ Ticket Sales
4 Building Entrances
5 Team Store

Main Level-Concourse

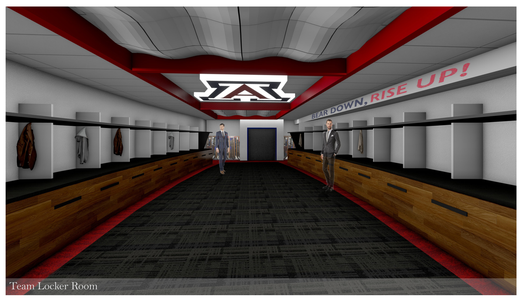
Lower Level- Ice Level



1 Team Spaces
2 Loading Dock
3 Public Locker Rooms
4 Mechanical
5 Egress Stairwells

Ice View

Main Entrance



Team Locker Room

Weight Room

Sustainability

1 Solar Panels
2 Water Cisterns
3 Mechanical Equipment
4 Perforated Metal Panel

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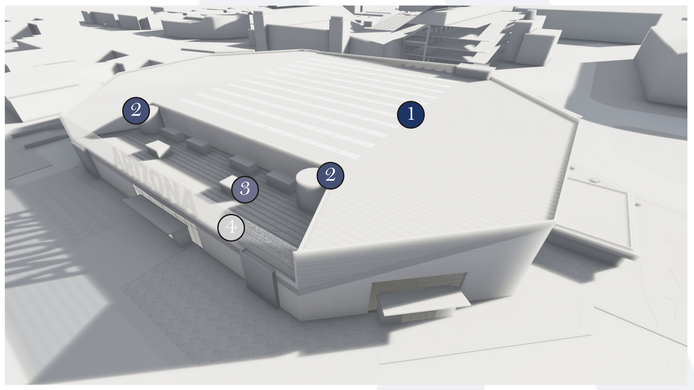
Any left over energy harnessed by these solar panels can be sent to the Tuscon power grid, and be used for electricity throughout the city.

A perforated metal panel wall helps hide the roof top mechanical equipment from people on the ground.



Sage Glass

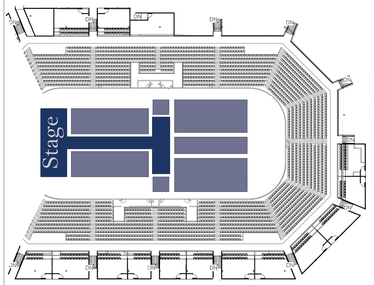
Sage Glass is an electro chromic glass that tints and clears automatically, creating light and thermal comfort in a space. The energy needed to run these panels of glass take very little. 120 square feet of Sage Glass consumed less energy than a 60 watt light bulb.

When the sun is shining, Sage Glass will self tint and block the sun from entering the building. On overcast days, the tint will lighten up and allow the natural light to enter the building. This cuts the energy usage and cost for the building all year.

Sage Glass- Daytime

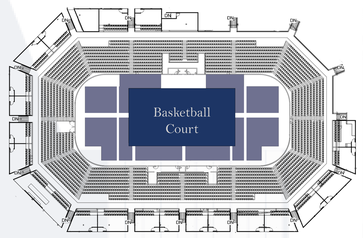
Sage Glass- Night Time

Mixed Use Plans



Concert Plan

Basketball Plan



Additional Seating

Suite

Concourse