Urban Stadia: Integrating Stadium Design with Mixed-Use Building Tactics to Rejuvenate an Urban Neighborhood

Thesis Book

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Sections

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Thesis Proposal

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Project Title and Signature Page

Urban Stadia: Integrating Stadium Design with Mixed-Use Building Tactics to Rejuvenate an Urban Neighborhood

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 Master of Architecture

Primary Thesis Advisor

Thesis Committee Chair

Figure 01 - View of Minneapolis skyline from site

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Thesis Abstract

Sporting stadiums impact the socio-economic capabilities in all of the areas in which they exist. Some have a good impact, they are able to fully integrate into the urban environment and benefit the area through areas such as economics, walkability, transportation, etc. But there are many that do not accomplish this. They essentially become ginormous concrete structures that are surrounded by thousands of asphalt-laden parking spaces and they only end up serving the community on the days in which the sporting team plays, usually once or twice a week. What if the same tactics we are using to rejuvenate our downtown areas can serve a bigger part in getting one of the most expensive typologies in this world back on track? With this thesis, I look to delve into just what type of impact a stadium will have on an urban environment, when combined with mixed-use building tactics.

The Narrative of the Theoretical Aspect of the Thesis

Sporting stadiums have a large impact on the area in which they are built. Not only do they affect the economy of the area, they affect circulation of pedestrians and other forms of transportation. They affect the environment, the very land on which they are built. Some inspire progress in the area of urban design and some do not. Although I do believe that as a whole stadiums are being more effectively designed, there is still much progress to be made with fully integrating stadiums into an urban environment.

I think we have learned over the years that although stadiums are much larger projects than those in other typologies like residential, they still require the same type of design elements in order to be successful. Many stadiums constructed in the past, like the Angels Baseball Stadium in Los Angeles, look like large monuments to acres and acres of parking spaces, with more of a connection to asphalt than any of the surrounding city life. As our knowledge of how to successfully create urban environments has grown, so has our ability as designers to make stadiums a part of the cities in which they reside.

Figure 02 - Anaheim Angels Baseball Stadium in California

Figure 03 - Kansas City's Arrowhead and Kauffman Stadiums, showing the area of impact that two stadiums can have together, when not integrated into the urban environment

A design typology that has a lot of success in creating lively and functional urban environments is mixed-use buildings. They are able to fulfill many of the needs around them such as residential spaces, office spaces, and retail spaces, so the building is always being used and that is all being accomplished with one building's worth of space, which is very beneficial to dense, urban environments. Mixed-use buildings also combine old and new design tactics to create very walkable areas. What if these mixed-use design elements were to be infused with the design of an urban soccer stadium?

Sports teams and stadiums have always been staples of the city and states in which they reside. Our country has always put a lot of stock into sporting teams and us as citizens derive a lot of our identity by how our sports teams are doing. If sports are so important to us and we are willing to invest so much into them, why don't we design the structures in which they reside to serve more purposes that to house sporting events once or twice a week?

Figure 04 - San Francisco Giants AT&T Stadium, a good example of stadium design integration into its site

I believe that stadiums can be fully integrated into their urban environments using mixed-use building strategies. The west loop neighborhood of Minneapolis next to the International Market square is an appropriate location for which to study the effects of molding two different typologies together in a declining urban neighborhood.

The west loop neighborhood is a declining urban environment surrounded with newly developing areas. On the east side, Target field has induced much development around it. On the other side, rich buildings like the International Market Building have spurred on many residential developments. In the middle of these two areas, the west loop is filled with abandoned warehouses, office buildings and truck depots. This site is begging to be renovated to coalesce with the emerging energy around it. The west loop neighborhood also needs to be rejuvenated in order to reflect the culture and rich environment created by the daily international Farmer's Market. Soccer stadiums have often been facilitators of cultural integrity around the world and I believe it would be a good building typology to reflect this unique part of the Twin Cities.

A soccer stadium is needed in the area to house the brand new Minnesota soccer team FC United. The new U.S. Bank stadium that is being constructed for the Vikings is not an effective stadium option for the team as it houses three times more than the team is looking to have for a capacity (18,500). FC United wants a more intimate venue for both themselves and their growing fan base to enjoy.

Stadium design has gone through a lot of stages of evolution, and I look to continue this process by using mixed-use properties and lessons from successful designs in the past while renewing an area's socio-economic status effectively connecting it to its surroundings.

Figure 05 - A proposed mixed-use stadium design for the AC Milan soccer

The Building Typology

The building typology used in this design investigation is a mixed-used soccer stadium, designed for the new FC United soccer team in Minnesota. The team is looking for a more intimate venue to play soccer in than the new U. S. Bank stadium that is being constructed for the Minnesota Vikings. The approximate capacity needed for seating in the stadium is 18,500, less than a third that is planned for the U.S. Bank stadium. The smaller amount of seating that is needed will allow for the mixed-use design elements to be infused with the stadium area. Along with the progression of soccer in the United States and Minnesota, the mixed-use stadium typology needs to keep progressing in order fully realize the potential of stadium integration into an urban neighborhood.

Typological Research

Figure 06 - Parken Stadium, Copenhagen, Denmark

Olympic Stadium
GMP (Gerkan, Marg und Partner)
Kiev, Ukraine

Figure 07 - Olympic Stadium at night in Kiev

Typology: Mixed-Use Olympic Soccer Stadium (Renovated)
Year Built: 2011
Size: 1.6 million
Seating Capacity: 68,000
Cost: $380 million

Olympic Stadium

GMP (Gerkan, Marg und Partner)
Kiev, Ukraine

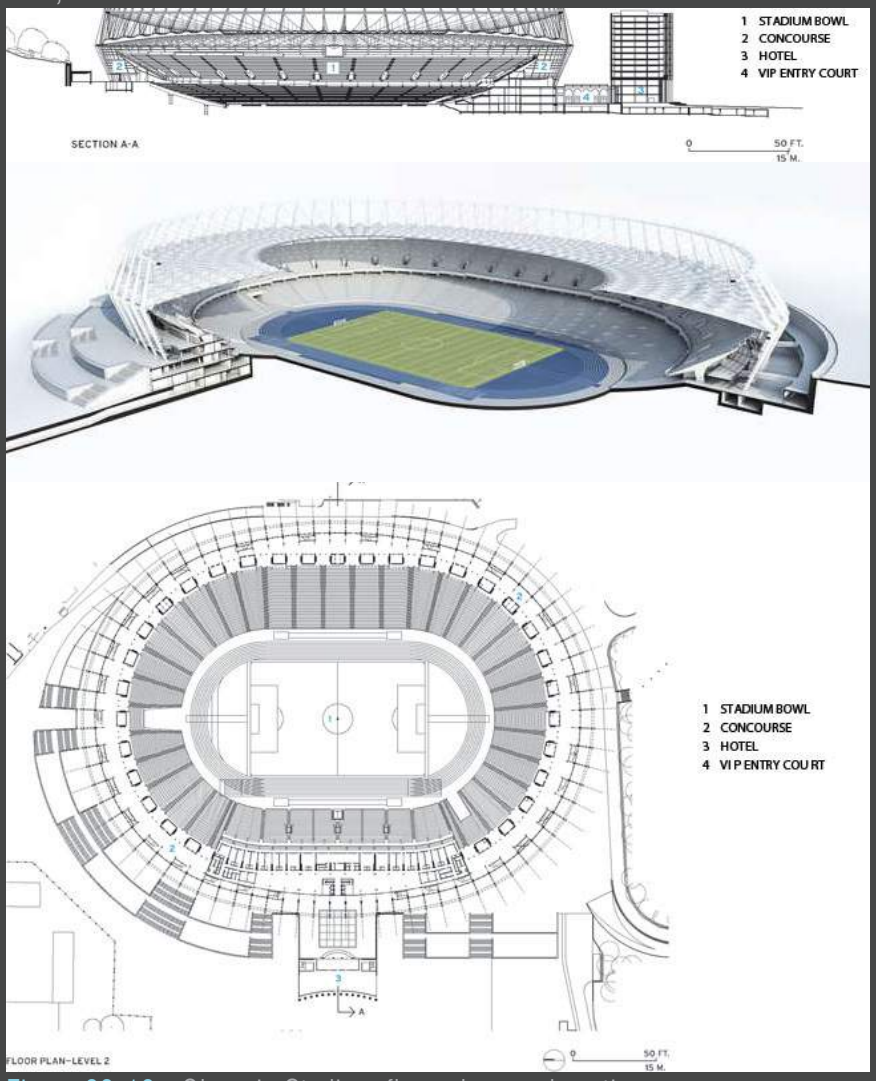


Figure 08-10 - Olympic Stadium floor plans and sections

An Olympic-Sized Mixed-Use Stadium:

After its renovations, the Olympic Stadium in Kiev is 1,015 ft. by 722 ft. The large stadium still manages to blend somewhat into the urban skyline because of the adjacent buildings and the topography. Sixty steps separate the sidewalk from the terrace that surrounds the stadium. 40 gates allow the 68,000 possible spectators to enter into the primarily glass and steel structure. This stadium has a seating arrangement that is much different than other stadiums in this typological study. The seating areas are placed further from the pitch than many other fields in order to accomodate the olympic-sized track around the soccer pitch. With the renovation, box seats were brought into the design on the west stand, a plaza to the west of the stadium, a garage below it, and a park that has been landscaped. The entrance for VIP's is served through the lobby of a hotel that is adjacent to the structure.

Olympic Stadium

GMP (Gerkan, Marg und Partner)
Kiev, Ukraine

Innovative Structure:

Olympic Stadium looks similar to a crown that is encased in a glass and steel enclosure. This structure sits on top of a plinth that is clad of granite that reaches around the lower bowl of the stadium and extends to the hotel. The upper section of seats is surrounded by an exoskeleton created by 80 slim columns made of steel. These columns stand 42 feet high above the concrete and support the roof of the stadium that is designed like a bike wheel, where the spokes tie a tension ring in the center of the roof to a couple of rings on the perimeter of the stadium that serve as compression agents. There are screens made of glass that give the circulation spaces shelter and tie all of the structural elements together into one cohesive unit. The new structure is pretty much in-line with the concrete of the structure, but there are some parts that aren't in order to make the roof cable system symmetrical. The tops of the columns are leaned in towards the middle of the stadium to support the parts of the canopy that are furthest towards the middle. The roof is made of PFTE (glass-coated textile) material that is reinforced by panels that are star-shaped at the locations of the skylights. Flying masts support the domed skylights. The roof contains 640 of these skylights.

Figure 11-13 - Olympic Stadium structure

Olympic Stadium

GMP (Gerkan, Marg und Partner)
Kiev, Ukraine

Figure 14 & 15 - Olympic Stadium and hotel interiors

Mixed-Use Combining Styles:

The court in the hotel that serves as the VIP entrance to the stadium, is an italian style of architecture and was built in the 1950s. This court serves as the link to a stadium space that is of a much different style as you can see in the picture above on the right. The glass walls that allow the citizens outside of the arena to see its structure are 50 feet tall. These glass walls also protect galleries on the 2nd tier of the stadium that came with the renovation. The top tier of the olympic stadium can be accessed not only by the stadard path up the circulation stairs from the lower tier but also from bridges that are from a park that resides behind the stadium.

Telenor Arena

HRTB

Fornebu, Bærum, Norway

Typology: Mixed-Use Indoor Arena

Year Built: 2009

Size: 124,861 sq. ft.

Seating Capacity: 15,000 for soccer, 23,000 for concerts

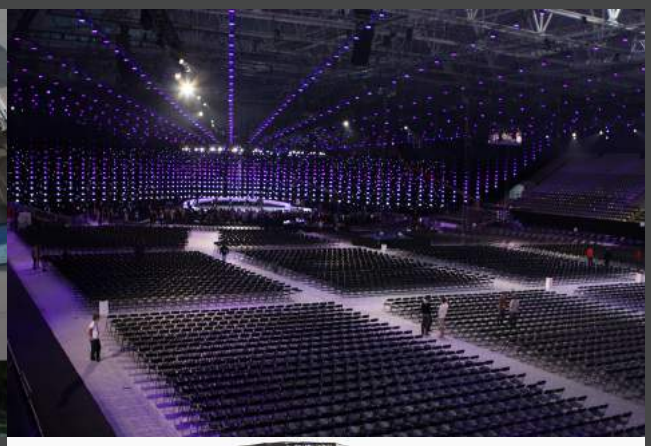
Cost: 585 million Norwegian Kroner or $72,039,913

Figure 16 - Telenor Arena with view of offices

Telenor Arena

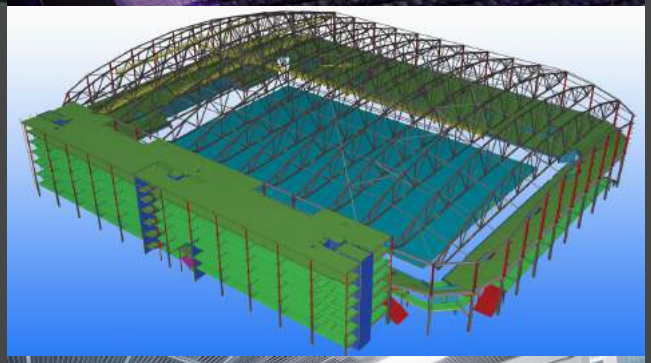
HRTB

Fornebu, Bærum, Norway



Mixed Use Arena:

Telenor Arena serves as a multi-purpose arena that has been home to a variety of events that include concerts, exhibitions, action shows, and soccer. It has seating possibilities for a 23,000 capacity. It has a permanent roof structure made up of long-span trusses and a textile roof membrane. The floor of the arena is made of asphalt which allows for a variety of uses.



Modern Office Spaces:

Scandinavia's largest indoor stadium has offices, a conference center, restaurants, bars, dressing rooms, press rooms, VIP lounges, a fitness center and high-end modern offices.

Figure 17-20 - Arena concert usage, structure and office interiors

California Memorial Stadium and Simpson Center for Student-Athlete High Performance

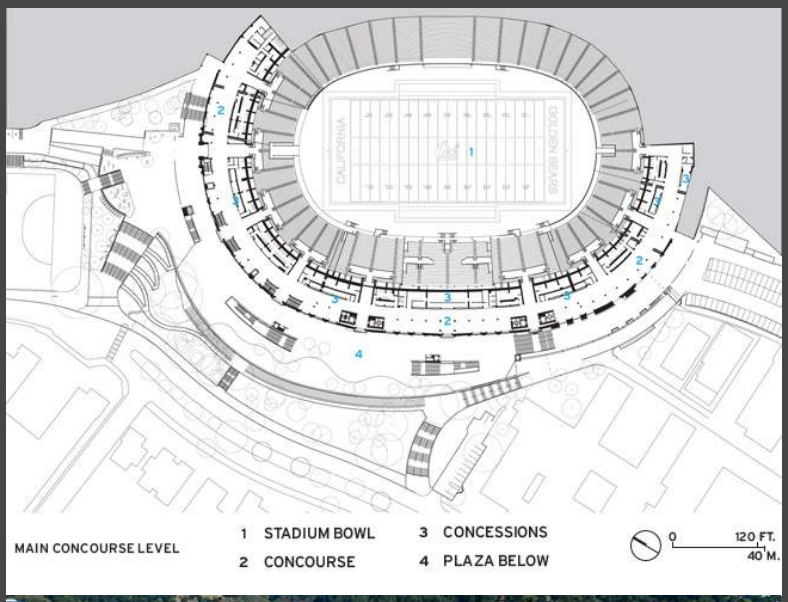
HNTB Architecture and STUDIOS Architecture
Berkeley, California

Typology: College Football Stadium Renovation
Year Built: 2012
Size: 454,000 sq. ft.
Seating Capacity: 63,000
Cost: $474 million

Figure 21 - California memorial stadium exterior

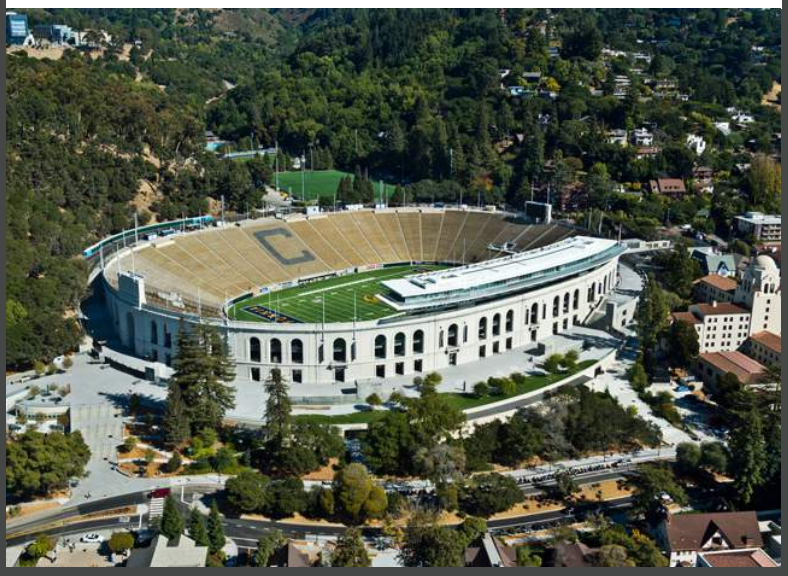
California Memorial Stadium and Simpson Center for Student-Athlete High Performance

HNTB Architecture and STUDIOS Architecture
Berkeley, California



Redesigning a Floor Plan:

The floor plan of the stadium was renovated for accessiblity and structural reasons as well as to increase the stadium's square footage by 50%. A lot of the extra space they were looking for was found underground within the slope of the site the stadium was on. The feature that attracted the fans the most to the renovation was the area they have to congregate before the games on the acre-and-a-half plaza.



Design Integration with the Site:

The original memorial stadium was built at the base of the foothills of Berkeley, California right on the Hayward Fault. Even with the stadium's size of over 450,000 sq. ft., the stadium nestles nicely into the university's campus, running right along one of the school's main streets, Piedmont Avenue. The stadium has incredible views of San Francisco to the west.

Figure 22 & 23 - Memorial stadium floor plan and site

California Memorial Stadium and Simpson Center for Student-Athlete High Performance

HNTB Architecture and STUDIOS Architecture
Berkeley, California

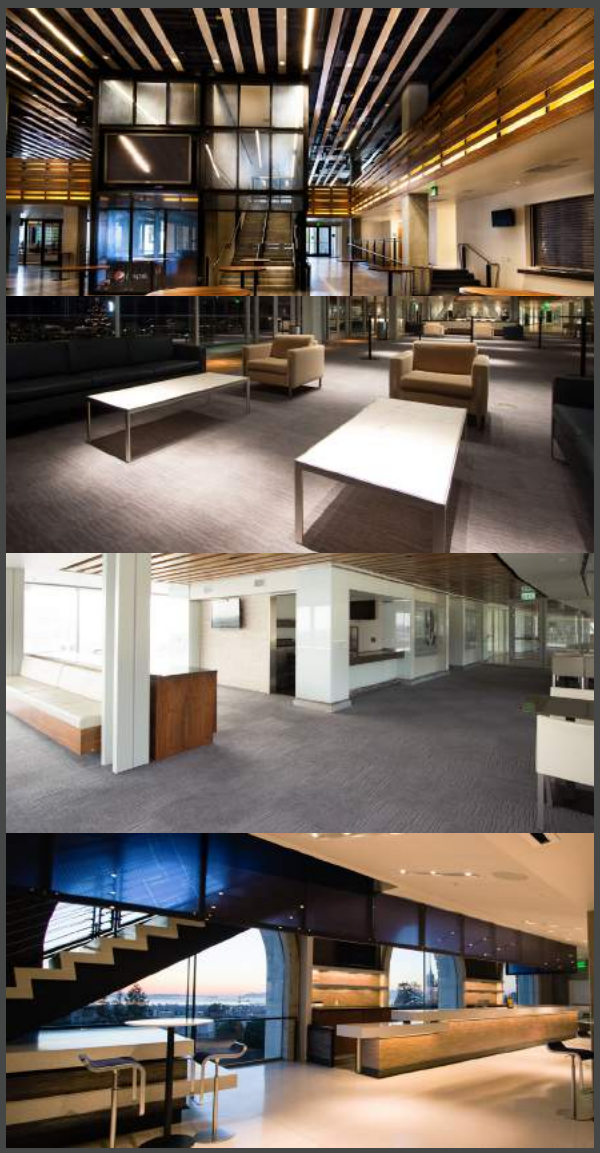
Renovating for Mixed-Use:

The concrete structure of the stadium borrows heavily from past coliseum and ampitheater designs. The renovation wasn't easy as they were tasked to better the structural design of the facility for protection against any seismic activity from the fault on which it is located, without changing the board-formed-concrete facade. As you can see on the three pictures to the right, they designed an eight story building into the front hill of the site after demolishing much of the previously existing structure (excluding the hillside and the facade). The seating bowl does have some features as well. As you can see in the top picture to the right, a 2-story canopy made of glass and steel was designed to house the press box and a club for donors. This structure that divides the old stadium from the new addition is supported by two elevators that are one of the structural features to prevent seismic activity from harming the stadium. One of the largest features that is included in the portion of the stadium underground was the Simpson Center for student-athlete performance, whose entrance was located between two substantial walls made of concrete and limestone. The 145,000 sq. ft. center sky-lit training center has an amazingly open feel to it.

Figure 24-26 - Memorial stadium section, gym entrance and interior

California Memorial Stadium and Simpson Center for Student-Athlete High Performance

HNTB Architecture and STUDIOS Architecture
Berkeley, California



Modern Interiors for the Fans and Alumni:

While the design of the renovated stadium fully respects the ancient stylings of the coliseum-esque exterior, many lush and modern interior spaces were designed to bring the stadium into the 21st century. These spaces were part of the eight-story insertion previously mentioned. 3 of these new spaces are donor clubs, those spaces are pictured in the top 2 images and bottom image to the left. These spaces were designed to hold banquets and other special events. The top picture is the field club, which specializes in holding larger award ceremonies or banquet functions. The bottom photo to the right shows the stadium club, which offers great views of the whole bay area as well as a bar and lounge seating. This space is best for hosting receptions or networking events. The picture 2nd from the top to the left shows the university club that is located above the new press box. This space is considered the 'penthouse' of the stadium and has access to a glass-deck balcony. This exclusive area is perfectly designed for corporate-related events or fundraisers. The picture 3rd down from the right shows the Chancellor's Box which is a more intimate space for small dinners or gatherings. These spaces and this stadium are great case studies showing all stadium designers that even traditional-looking stadiums can mix many modern elements effectively into the architecture.

Figure 27-30 - Memorial stadium club and chancellor's box interiors

Parken Stadium

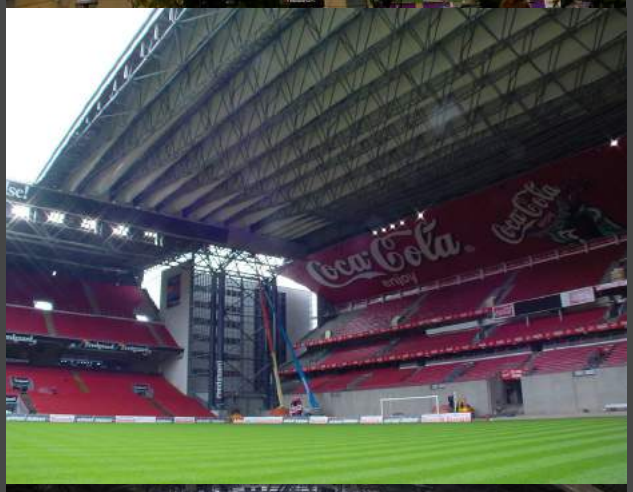
Gert Andersson
Copenhagen, Denmark

Typology: Mixed-Use Soccer Stadium
Year Built: 1992
Seating Capacity: 38,065 for soccer, 50,000 with end-stage setup and 55,000 for middle-stage setup
Cost: 640,000,000 Danish Kroner or $97,641,357

Figure 31 - Parken stadium interior

Parken Stadium

Gert Andersson
Copenhagen, Denmark



Mixed Usage:

Parken Stadium is the home field of the FC Copenhagen and the national soccer team of Denmark. It is a mixed-use stadium that houses the F.C. Kobenhavn MegaStore, which is a club store, as well as pubs like Lions & Barrels, and a reception area. The exterior of the stadium represents a mixed-use typology, and the corners of the building bring a modern office style and intersects it with the stadium bowl area.

Rectractable Roof Structure:

PVC architectural fabric is the material that makes up the movable roof at Parken Stadium. The roof is made up of 12 membrane cushions made of textiles. Each of these cushions are 92 meters long and 7 meters wide and are filled with air by special blowers when the roof is closed. This system is supported by 13 four-boom traveling trusses and two gantry girders that run parallel to each other down the lengths of the stadium roof. The roof is rated as a permanent structure as it can withstand the weight of snow along with other elements. The roof takes 30 min. to completely close or open.

Field Viewability:

Parken Stadium has two seating decks on three sides of the field that contribute to most of the stadium's 38,065 seating capacity. The upper decks are angled greater than the field seating in order to be able to see the entire field from any seat. You can see evidence of this from the photo to the left showing the view of an upper deck seat.

Figure 32-34 - Parken stadium exteior, roof structure and upper deck view

AC Milan Stadium Design (Not Built)

ARUP Architects
Milan, Italy

Mixed-Usage and Sustainability:

This innovative design for the AC Milan soccer team was going to include many things besides the soccer stadium housing more than 40,000 fans. Plans included a hotel, a sports college, restaurants, a children's playground, green areas, and public spaces that could've been used by the city.

Innovative Technology:

Sight lines for each fan in their seat were analyzed by Arup's parametric tool and designed so that everyone would have the best possible view of the soccer action. VIP areas and spectator areas were designed to have many high tech resources. VIP areas were designed to have special lounge spaces with views to the mixed-zone and the athletes area that was connected to the pitch. The roof was also designed to be movable in order to lessen the noise impact it had on its surroundings.

Modern Exterior:

The modern exterior design of the building that makes it look like a high-end office complex allows the large stadium design to nestle perfectly into its urban surroundings.

Figure 35-37 - AC Milan exterior and interior renderings and site placement

Summary of Typological Research

Sporting stadiums are designed to be all different shapes and sizes. There are many innovative and responsible decisions made everyday in the sporting stadium field and that is how we get some of the designs that you just saw. There are a lot of design and structural solutions that were brought up in this research but they may not all be beneficial or smart for the type of stadium that is planned to come from this thesis study. Not all solutions work for every climate and for every site, and that is the beauty of stadium architecture. When designing stadiums you have a chance to be innovative creatively as well as design something that fully represents the area in which it is built.

The California Memorial Stadium showed how a stadium can be fully integrated into the site in which it sits. Not only did it do this by featuring renovations that react when the earth it sits on is unstable but it also used the excavation of that earth to make way for a revolutionary student-athlete space and fitness center. The California Stadium was intriguing as well because most of the seating around the field was contained within just one bowl of seating and was still able to have 68,000 guests. When looking at the possible capacity of MN United's stadium of around three times less than that, the new soccer club's stadium may have a variety of seating arrangement possiblities.

The Parken Stadium showed a great example of a seating arrangement that hugs the field on everyside and an example of exterior space designing that fits in with an urban environment. The Parken stadium features the use of an upper deck of seating around the field and has to raise the inclination of the seating in these areas so fans can still see all the soccer action. The Parken Stadium also shows an example of retractable roofing, something that may be involved in the MN United project seeing as the MLS season schedule they will have has games from early March to late October.

Telenor Arena was a great example of a stadium with a fixed roof structure and modern office spaces. It also showed what type of materials are very useful to us on an arena floor in order to have quick transitions from athletic events to concerts or business conferences. The fixed-roof structure on this stadium might be a possibility for the MN United stadium as well.

Olympic Stadium's inclusion of an olympic-sized track showed what impact that has on the arrangement and location of seats around the soccer field and how that impacts the shape of the design around it. It was also a great example of pedestrian access from unique locations such as a city park. Olympic Stadium also shows a very innovative use of structure that ties the whole design together. This is an element that will be very important to the MN United design, the structural design should be innovative and well-planned to fit with the new Twins and Vikings stadiums that are now in the downtown Minneapolis area.

The AC Milan design showed a progressive version of how a soccer stadium can be designed to completely fit in with a modern urban neighborhood without skipping a beat. It also showed how a modern soccer complex can integrate sustainability measures not usually found in stadiums such as accessible green roofs.

All of these stadium typology studies will be able to have an impact on the MN United design as they have made innovations in exterior design, interior design, mixed-usage, structural design, transportation integration, and pedestrian circulation.

Major Project Elements

- Major league soccer regulation field
- Spectator seating (approx. 17,500 to 20,000 seats)
- Specialty seating and press box space for both owners and managers of the soccer team and for spectators
- Team areas / locker rooms
- Concession spaces
- Service / mechanical areas
- Parking spaces for the soccer organization, the fans, the users of the mixed-use typologies of the design
- Ticket booths
- Multiple entry gates
- Mixed-use spaces
    - Commercial
    - Offices
    - Restaurants / bars
    - Coffee Shop
- Retractable roof
- Bathrooms
- Circulation space
- Connection to lightrail station and other forms of vehicular circulation

User / Client Description

Who is this project designed for?

Minnesota FC United Soccer Team

Figure 38 - Minnesota FC United soccer team logo

Who else will use the stadium?

Retail Stores

Businesses (Office Spaces)

Minneapolis Farmers Market

Restaurants / Bars

Coffee Shop

Minnesota FC United Soccer Team

Peak Usage: Game days, practices
Parking Requirements: 3,500 cars, 175 buses
Other Requirements: 17,500-20,000 spectator seats, locker rooms for both the home and away teams, box seating for owners, reception areas for team events and fitness area, maintenance/storage area, controllable lighting

Farmers Market Grocery (Organic Food Store)

Peak Usage: 8am-8pm, everyday
Parking Requirements: 15-20 spaces
Other Requirements: Food display areas, worker break area, check-out area, area for farmer's market foods

Small Retail Store #1: MN FC Team Clothing Store

Peak Usage: 8am-8pm, everyday
Parking Requirements: 15-20 spaces
Other Requirements: employee spaces, team clothing areas, check-out space, offices

Small Retail Store #2: Downtown 401 Clothing

Peak Usage: 8am-8pm, everyday
Parking Requirements: 15-20 spaces
Other Requirements: employee spaces, team clothing areas, check-out space, offices

Coffee Shop: Beans United

Peak Usage: 6am-8pm, everyday
Parking Requirements: 15-20 spaces
Other Requirements: Seating/lounge spaces, coffee brewing area, bar/serving area, office space

Twin Cities Bike Rental / Repair

Peak Usage: 6am-6pm
Parking Requirements: 10 spaces
Other Requirements: Bike maintenance station, new bike display area, employee area, and bike tire fillup station

Minneapolis Farmers Market

Peak Usage: Once a month in summer
Parking Requirements: 50-60 spaces
Other Requirements: Food truck access, field convertability to walkable surface for large market gatherings

Restaurant / Bar #1: Sammy's Sandwich Shop

Peak Usage: 8am-8pm, everyday
Parking Requirements: 15-20 Spaces
Other Requirements: Dining Area, kitchen, staff area

Restaurant / Bar #2: Marioti's Restaurant

Peak Usage: 4-12pm, Thurs-Sun.
Parking Requirements: 25-30 spaces
Other Requirements: Large dining area, modern state of the art culinary kitchen, full-sized bar, staff area

Restaurant / Bar #3: Barney's Pub

Peak Usage: 4-12pm, Thurs-Sun.
Parking Requirements: 25-30 spaces
Other Requirements: Large seating area, full-sized bar, full industrial kitchen, waiting area, office

Office Space #1 : United Noodle Wholesale

Peak Usage: 8-6pm, weekdays
Parking Requirements: 15-20 spaces
Other Requirements: office spaces, conference rooms, storage for stock

Office Space #2 : Accent Store Fixtures

Peak Usage: 8-6pm, weekdays
Parking Requirements: 15-20 spaces
Other Requirements: office spaces, conference rooms, reception, retail space

Office Space # 3 : American Office Products

Peak Usage: 8am-6pm, weekdays
Parking Requirements: 15-20 spaces
Other Requirements: Office spaces, retail space

Office Space #4 : Stark Electronics

Peak Usage: 8am-6pm, weekdays
Parking Requirements: 15-20 spaces
Other Requirements: Office spaces, storage for stock, technology maintenance space

Office Space #5 : Ameritrust Bank

Peak Usage: 8am-5pm, weekdays
Parking Requirements: 15-20 spaces
Other Requirements: Office spaces, teller desks, lobby/refreshment area, meeting areas, conference rooms

Office Space #6 : FHC Architects

Peak Usage: 8am-5pm, weekdays
Parking Requirements: 15-20 spaces
Other Requirements: Open office area, conference rooms, reception area, kitchen area, printing/ scanning area, plotting area

Site Information

County Map

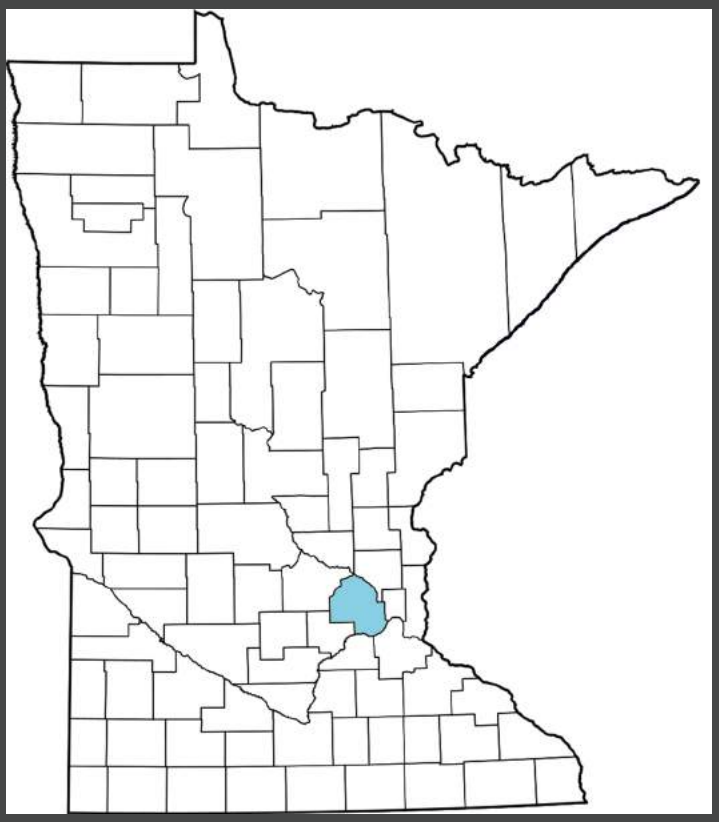


Figure 39 - Hennepin County, Minnesota

City Map

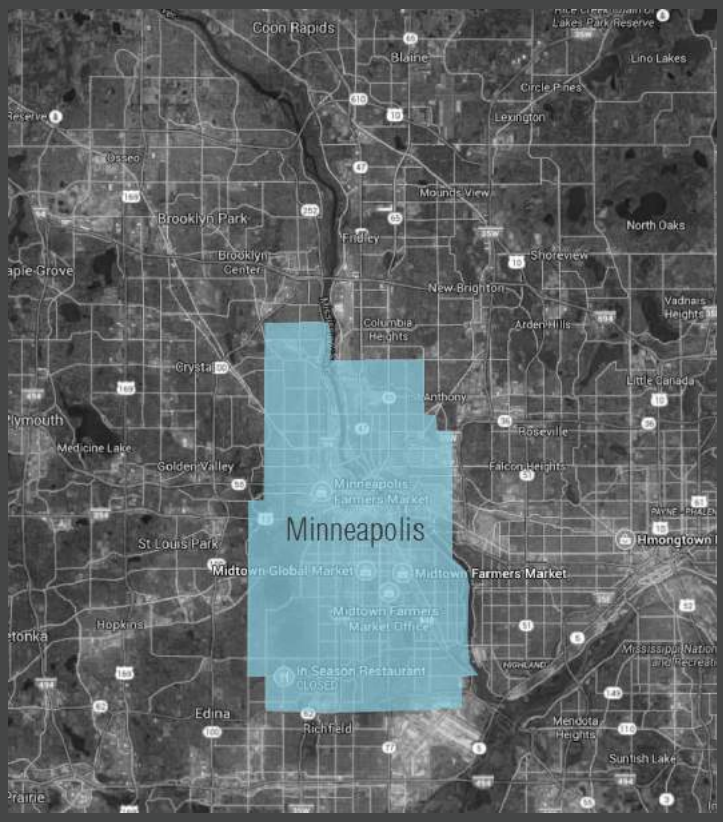


Figure 40 - Minneapolis, Minnesota

Neighborhood Map

Figure 41 - Farmers Market neighborhood

Site Map

Figure 42 - Possible stadium site area

Reason for Site Selection

The west loop of the Minneapolis Farmers Market neighborhood would be a great site for the new FC United soccer stadium. As previously explained, the Farmers Market would be able to infuse the stadium's site with a rich culture and the lightrail that runs through the Twin Cities is not far from the site and a small addition to the rail could be built to run north along Royalston Ave next to the possible stadium site. The existing site is occupied with many old office buildings and truck delivery stations that are now being put up for lease. The suggested area for the stadium is 853,125 square feet. The extra area that could be used for further development is approximately 467,500 square feet. The addition of the soccer stadium on this site would fully connect all of the new housing developments to the west and the new developments to the east spurred on by Target Field.

Pictures From Around the Site Location

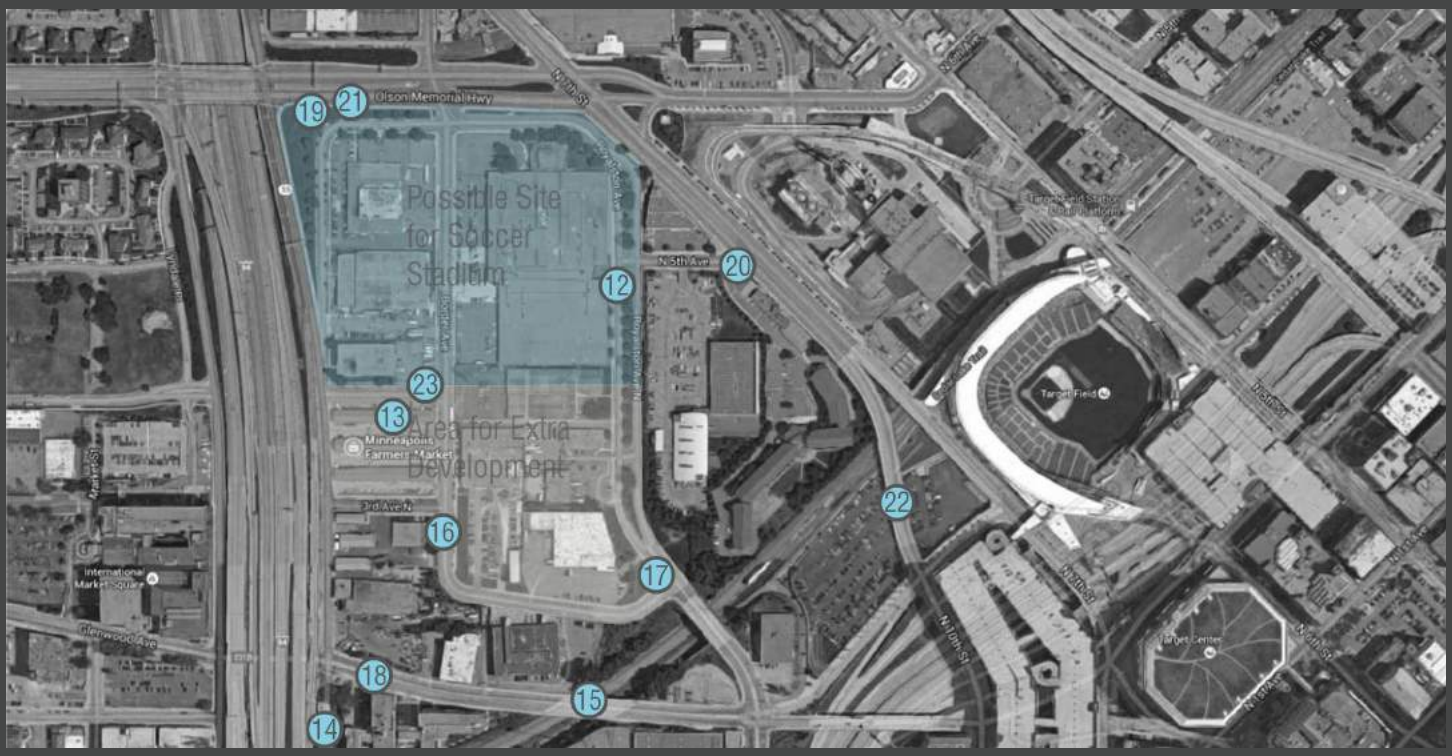


Figure 43 - Map of site pictures

Figure 44 - One of the office buildings up for lease on the possible soccer stadum site

Figure 45 - Minneapolis Farmers Market, these shelters where they sell the produce is west of the proposed soccer stadium site

Figure 46 - View of the industrial district to the south of the of the proposed stadium site

Figure 47 - View of the lightrail that runs to the south and east of the proposed stadium site

Figure 48 - View of the stretch along the west side of the proposed site, next to the Farmers Market shelters

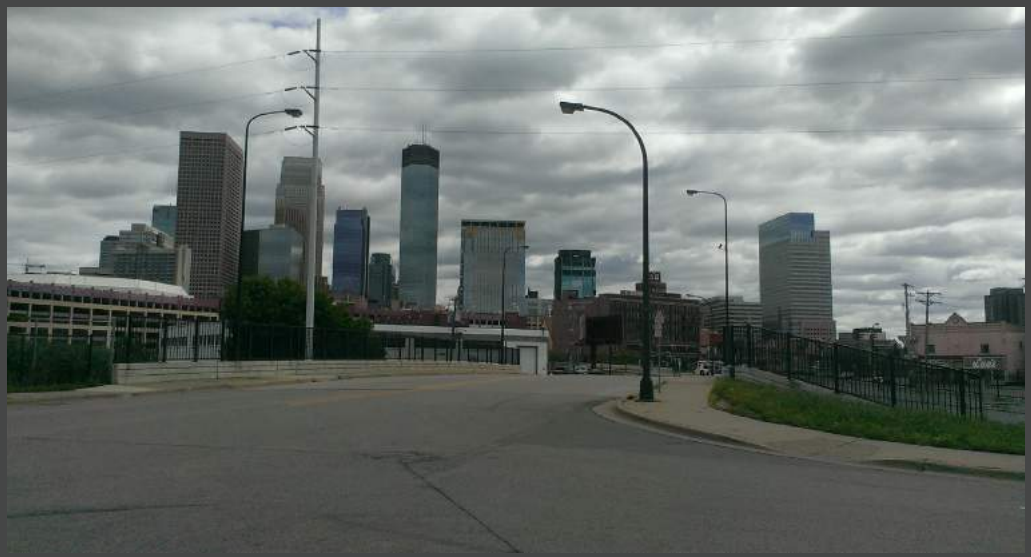


Figure 49 - View of the Minneapolis skyline from the southeast corner of the proposed site

Figure 50 - View of the new and redeveloped apartment buildings to the south of the proposed site

Figure 51 - View from the intersection of Olson Memorial Highway (off of I-94) and East Lydale Ave N

Figure 52 - West approach to Target Field on N 7th St

Figure 53 - View of Olson Memorial Highway on the north side of the proposed site

Figure 54 - View of lightrail and parking lot for commuters southeast of the proposed site

Figure 55 - Parking lot on proposed site, severe elevation change to take into consideration

Project Emphasis

1. Studying impact of different sporting stadiums on different area's economies, in order to inform design for FC United Stadium and better benefit the Twin Cities and Minnesota economies

Tactic: Showing data graphs and diagrams of stadium impact on area economies

2. Studying stadium transportation system integration into neighborhood aesthetic in order to better understand how to full mesh the FC United stadium with the existing transportation systems in Minneapolis, such as the lightrail system

Tactic: Creating a transportation map to study how neighborhood transportation tactics can mesh with the tactics used in stadium design

3. Studying the integration of stadium structure with that of mixed-use buildings in order to create an iconic, but effective structural system that will inform the rest of the design

Tactic: Creating a 3-d model showing the interaction of stadium and mixed-use building structure and its integration with the rest of the design

4. Studying the integration of spatial and circulation planning in order to effectively integrate the spaces and circulation needs of the mixed-use typology and the stadium typology

Tactic: Creating different 3-d model iterations of stadium and mixed-use spaces and circulation and evaluating which solution is most effective

Goals of the Thesis Project

With this thesis project, there are many goals that are set out to be achieved. The theoretical goal is to find the answer to the question, "What is the impact of sporting stadiums on an urban neighborhood environment, when combined with mixed-use building tactics?" There are three environments in which this goal exists: the academic, the professional, and the personal. The academic environment that the goal of answering this question is that it will take both the knowledge of all the things I have learned in the NDSU College of Architecture so far as well as my enjoyment, knowledge and constant studying of stadium design in order to answer a question such as this. From the steel structure design of my high rise project, to the long-span steel structure and roofing system of the border crossing that I designed for Otay Mesa in San Diego, I have the previous experience to understand the enormity of the structure that will be required to get a project like the one described in this thesis accomplished. The professional environment associated with this theoretical goal is as follows: With my thesis project, I hope that it is not merely a solution for the FC United soccer club in Minnesota, I hope that the solution that is derived from this project can have a lasting impact on many stadium designs. I hope that the research derived from this project with form a blueprint from which future stadium designs can use to be more effective in their integration of mixed-use building tactics in order to better fit their environments.

A physical goal I have associated with this project is that I want to learn as many of the facets of stadium design as I can so that I am able to design one in the future and have it built. Academically this goal will take me lots of research to accomplish, from learning how stadium structure works to learning how to design an effective place for tens of thousands of people to watch sports. Personally, it has always been my goal to design sporting stadiums one day. Their designs have been a passion of mine for a long time. Whenever I have a lunch break at work, I watch YouTube videos of the latest stadium designs. It doesn't matter

whether it is soccer, football, baseball or basketball, I have always had a passion for beautiful and innovative designs that make going to sporting events a special time for the fans. I enjoy that each stadium is unique in its own nature and each design has the chance to say something about the city and the environment in which it represents. My professional goal as a student is to finish school, get licensed and work in a stadium design firm such as HOK Sport, HKS, etc. I have received much advice on how to approach the thesis project, but the most important advice that I think I have gotten is to work on a project or typology that you would like to work on in the future and that is exactly what I am doing.

Lastly, the social goal that I have for this project is to learn how to create a space that protects what we all love about sports and the stadium experience, while also bringing new design tactics that make the stadiums better fit the environment that we live in and reflect the growth of intelligence in our decisions and the way we live. When I was younger I started drawing very rough sketches of baseball stadium designs while in church services. Usually I would only change up the design of the outfield fence or the shape of the first level of seating or the foul ball areas, but I would draw many different iterations. To this day I still believe that little things like that only fueled my interest in the stadium design profession and I am still drawing stadiums in church services. One of my personal goals was and is to design a real sporting stadium one day, to be able to prove to my younger self that all those sketches weren't a pipe dream, that they led to a real-life stadium design that hundreds of thousands of people get to experience every year and cheer on their favorite teams in. As a child, I lived in Peoria, Illinois cheering on Michael Jordan and the Bulls. I also lived in St. Louis and got to cheer on Mark McGwire as he set the then single-season home run record of 70. I still have a picture of my dad and I both wearing the 1991 world series sweaters when the Minnesota Twins won when I was only a month or two old. Sports have had an impact in my life and have given

me many special memories and I know that many others can say the same. Whether it is going to a ball game with your dad, or doing a group cheer at a soccer game, sports are a very human experience. And this is an experience that I would love to facilitate through my designs. This project may be a small step in the direction of achieving my ultimate career goals, but it is a step in the right direction. The reason that I chose to go into architecture wasn't because of the professional prestige, or the money, it was because I enjoyed designing things, having the opportunity to use my creativity in a new way every day. And I feel that if I got into this profession while chasing something that I enjoy, might as well let that chasing continue to see what experiences I get to enjoy next.

Plan for Proceeding

Definition of Research Direction

Theoretical Premise / Unifying Idea :

Sporting Stadiums can combine the multi-use aspect of mixed-use typologies to create a stadium design that blends in with the urban neighborhood around while also creating a space that can be used for multiple functions instead of just sporting events, making it more economical for the city and more active for its citizens. How do they do this?

Tools: Future visits to stadiums that impact their surrounding environment and drawing from previous experiences, studying existing economic impact from consumer price reports.

Expected Conclusions / Outcomes: Stadiums that have a positive impact on their surroundings do so because they are integrated into their environment not only architecturally but economically and socially as well.

Typology :

How can mixed-use building techniques combine with stadium design to have a positive socio-economic impact on a neglected urban neighborhood?

Secondary Questions:

1. How to define a process on how to design a stadium with integrated mixed-use.
2. How to define a process to assess how the design works or is effective.

Tools: Computer programs for spatial planning, structural integration analysis and consumer price reports with which to study economic impact

Expected Conclusions / Outcomes: I believe that these processes will help create stadium designs that are fully integrated with mixed-use design techniques and that they will enhance the socio-economic capabilities of the area in which they are built. I believe that a process can be defined to these 2 steps:

1. Design a stadium with integrated mixed-use.
2. Assess how the design works or is effective.

Historical Context :

How have stadiums in the past been successful at benefitting their surroundings on a socio-economic level?

Tools: Average attendance studies, square footage studies, typology studies, study of events held besides sports, revenue studies

Expected Conclusions / Outcomes: Reasons for why stadiums in the past have been successful, able to use things that did work for stadiums in MN United stadium design

Definition of Research Direction

Site Analysis :

What orientation of the field would be best on the site?
How extensive would the excavation be to place the lower bowl seating of the stadium beneath ground level?
Which corner of the building should the main entance be located?
How should the site design be handled so that transportation circulation is at its most efficient?
Tools: Programs like Anylogic can be used to study circulation patterns, studies of the soil on the site and what buildings previously inhabited the site will give clues as to how stable the ground would be during an excavation, and sun, wind, and light studies would inform how the field should be oriented and which corner the entrance should be placed
Expected Conclusions / Outcomes: Information that tells how to place the building on the site and how to integrate transportation around it

Program Requirements :

How are spaces, circulation and structure of a stadium brought into cohesion with that of a mixed-use building?
Tools: Experience reports from stadium architects, previously stated research findings
Expected Conclusions / Outcomes: Getting useful tactics and lessons learned while trying to mix a stadium design with a typology so urban as mixed-use

Design Methodology

1. Create space planning alternatives for the soccer stadium using *Sketchup* including the following areas :
    - Total sq. ft.
    - Parking configurations and layouts
    - Square footage for different spatial areas
        - Restaurants/bars
        - Stadium seating and circulation
        - Apartments
        - Business areas
        - Coffee shop

2. Measure the transportation and economic impacts of each space planning alternative
    - Creating a transportation map to study how neighborhood transportation tactics can be integrated into those used with stadium design (including vehicles, light rail, pedestrian and biking)
        - Using *AnyLogic 7.03* for transportation studies
    - Showing data of the following two areas for each design iteration:
        - Rental Values per Sq.Ft. *(Quantitative Research)*
        - Cost of Construction *(Quantitative Research)*
            - Get info from using RS Means online program

Design Methodology

3. Creating a 3-d model showing the interaction of stadium and mixed-use building structure

   - Using Autodesk Revit for structural integration studies

   - Studying stadiums that have integrated mixed-use structure and design strategies in the past using the book *Sports Architecture* by Rod Sheard

   - Studying different long-span structural elements that could be incorporated into the stadium and mixed-use design strategies using the book *Tragsysteme* by Heino Engel and the NDSU link to the Architectural Records site with stadium designs that includes drawings of their plans and sections:
   http://archrecord.construction.com/projects/building_types_study/TypeIndex.aspx?bts=SSF

4. Develop a design strategy for a mixed-use soccer stadium based on an analysis of the impacts

   - Use following info beforehand:
   Assess the meaning of the economic data by synthesizing that info with Consumer Price Index reports while using the economic data graphs provided with different stadium designs in the book *Developing Sports, Convention and Performing Arts Centers* by David C. Petersen

Design Documentation

Design Software Used :

- Autodesk AutoCAD
- Autodesk Revit
- Sketchup 2015

Presentation Software Used :

- Adobe Illustrator
- Adobe In-Design
- Adobe Photoshop

Design Methods :

- Conduct thesis research project in fall studio semester
    - Building 3-D model iterations for studio circulation and spatial planning
    - Review work weekly with studio professor
    - Adjust project based on review
    - When research project is done, save findings and integrate into spring semester's schedule of work
- Back-up all info with hard drive
- Update thesis book as soon as something is added
- Update works cited of thesis book as soon as new resources are discovered

Thesis Book Publication :

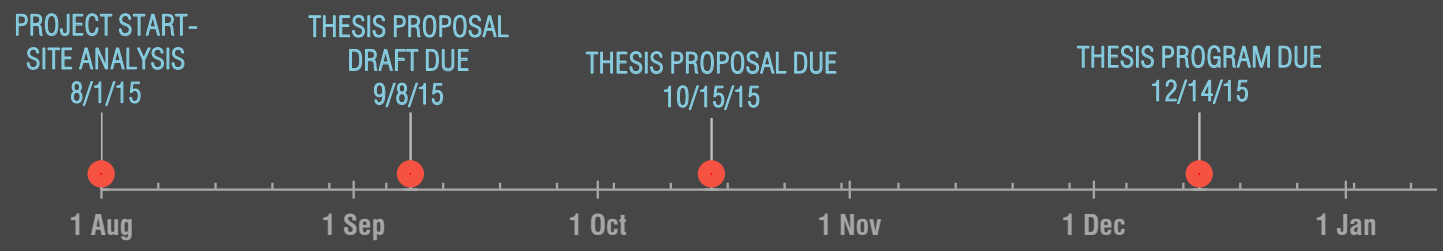
All material from studio research project and other pertinent info to this thesis will be made available in book format and at the NDSU Institutional Repository

Thesis Schedule / Deliverables

Thesis Program Work: Oct. 15th - Dec. 14th

- Results from theoretical premise research
- Project justification
- Historical, social and cultural context of the thesis
- Site analysis
- Final building program (space allocation)

Thesis Proposal Work: Aug. 20th - Oct. 15th



Thesis Schedule / Deliverables

Development of Presentation: Apr. 1st - May 9th
-Presentation drawings
-Models
-Thesis book development
-Reviews

Design Development: Feb. 15th - Apr. 21st
- Taking spatial organization determined to be most effective from research and developing rest of design
- Structural design, both building and roofing
- Elevation studies, integration of mixed-use design techniques
- Intergration of materials typically used in mixed-use typology
- Developing sections and studying seating arrangement and angle of viewing towards soccer field
- Systems
- Assemblies/details

Schematic Design: Jan. 15th - Feb. 15th
- Analysis of site context, spatial organization and masses, study of sun, wind and light patterns
- Integration of thesis research project results
- Environmental impact studies

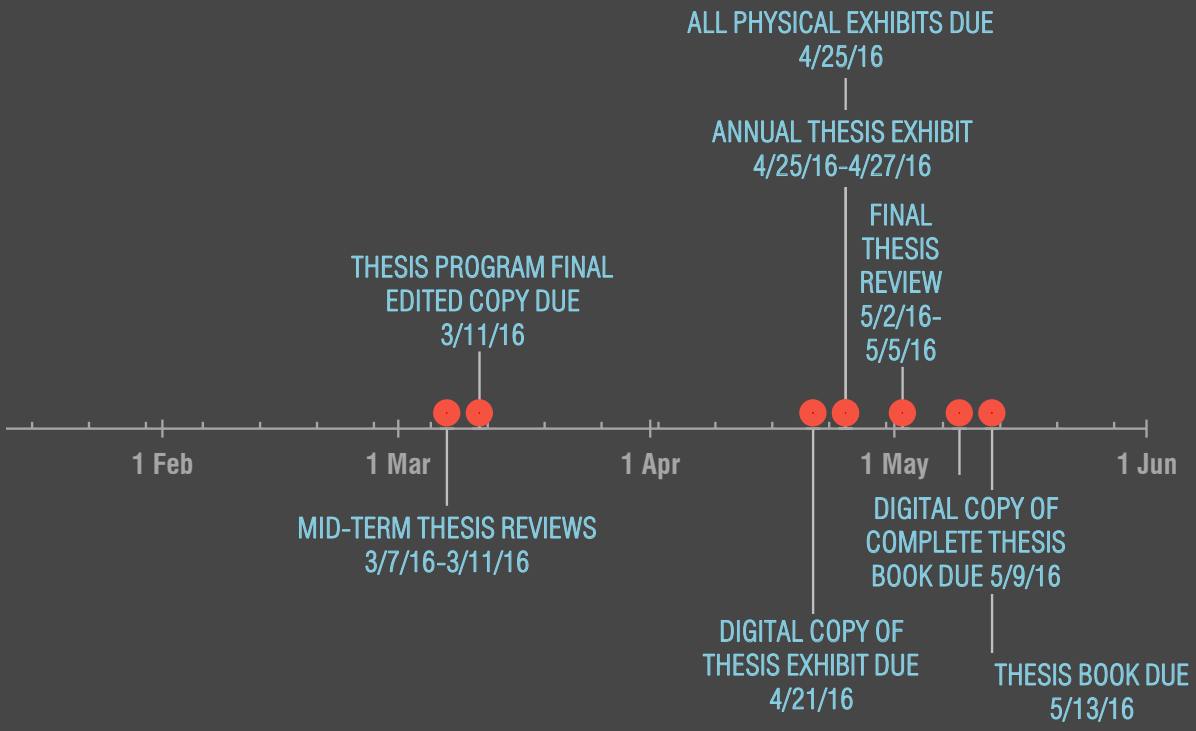


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Figure 25 California entrance to gym area. (n.d.). Retrieved October 13, 2015, from http://archrecord.construction.com/projects/Building_Types_Study/stadiums/2013/images/1310-California-Memorial-Stadium-and-Simpson-Center-for-Student-Athlete-High-performance-HNTB-Architecture-and-STUDIOS-Architecture_main.jpg

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Appendix : Previous Studio Experience

2nd Year

Fall : Joan Vorderbruggen

Tea House - Fargo, ND

Minneapolis Boat House - Minneapolis, MN

Spring : Stephen Wischer

Twin House - Fargo, ND

Center for Baroque Music Appreciation - Fargo, ND

3rd Year

Fall : Milt Yergens

Guitar Center - Healdsburg, CA

Mixed-Use Urban Building - Glasgow, Scotland

Spring : Bakr Aly Ahmed

Culinary School / Institute - Fargo, ND

Border Crossing Station - Otay Mesa, San Diego

4th Year

Fall : David Crutchfield

Urban High Rise – San Francisco, CA

Spring : Steve Martens

Adaptive Reuse of Ada Village Hall – Ada, MN

Appendix : Personal Identification

Mitchell Clark Borgen

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Email – mitchell.borgen@ndsu.edu

"My experience at NDSU has made it possible for me to achieve my dreams someday and design sporting stadiums. I used to draw plans for sporting fields on church service programs with no hope of making those designs come to life, and that has all changed."

Urban Stadia: Integrating Stadium Design with Mixed-Use Building Tactics to Rejuvenate an Urban Neighborhood

Thesis Program

Mitchell Clark Borgen
North Dakota State University
Department of Architecture and Landscape Architecture

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Theoretical Premise / Unifying Idea Research

A soccer stadium is needed to house the brand new Minnesota soccer team FC United. The new U.S. Bank stadium that is being constructed for the Vikings is not an effective stadium option for the team as it houses three times more than the team is looking to have for a capacity (20,000). FC United wants a more intimate venue for both themselves and their growing fan base to enjoy. Stadium design has gone through a lot of stages of evolution, and I look to continue this process by developing a process on how to design a stadium with integrated mixed-use and a process with which to assess how the design works or is effective.

There are three texts and five online texts that will help me with the developing of these processes. A couple will allow me to pull ideas from past stadium designs when designing a structure that incorporates both mixed-use and stadium design techniques. Another book will allow me to study different stadium designs while looking at some of the economic statistics of each design and what each one is used for.

One book titled Sports Architecture by Rod Sheard includes features many different stadium designs that are for many different sports and it also includes many of the facts about the capacity of each stadium, the location of each stadium as well as the cost of each stadium. There are also floor plans and sections in the book which will give me many clues into which structural designs would be most appropriate for the mixed-use design that I am planning for the Minnesota FC United Soccer Team. Rod Sheard is one of the principals of Populous Architects who has done the majority of major sporting stadiums in the United States and around the world and the book includes many of the lessons that Rod and his staff learned with each of the projects which is a valuable resource for me as I try to define a revolutionary process to designing urban stadia.

Even when this book was published in the year 2000, Rod Sheard and his staff at Populous architects are at the leading edge of transforming stadium design in order to bring it into the next century. They understand that stadiums and their design are not only important to the economic success of their own venue but that they can also be lightning rods of commercial and economic success to the areas of the city around it. In the book there is mention of economic

studies that were conducted in Britain and America showing that for "every pound or dollar spent inside a stadium, between five and ten are spent outside, in the city itself". They also have drawn comparisons between the evolution of airports and what stadiums are trying to evolve into. The studies they have derived from airports show that "40 per cent of the total revenue generated at airports derives from merchandising- a figure which is increasingly being met by leading sports clubs and stadium operators." The reason why this research is so important to stadium development is the fact that people often spend the same amount of time in both types of buildings, usually 2-4 hours. This comparison shows that stadiums, if they want to evolve in how economical they can be, they will take a page from the airports playbook and design their buildings to include many more ways that people can be spending their money. That's why so many airports now look like shopping malls with airports attached to them, there is a large amount of time that a lot of people spend in those buildings and they are now designing them to take economic advantage of that fact.

There are also many other areas of stadium design that can be learned from Rod Sheard and his staff. There are chapters that are designed to teach how to design for the comfort of the fans by allowing appropriate dimensions to each spectators seat (between 475mm to 500mm wide) and depths of the tread that they sit on (between 760mm and 800mm deep). They also state some of the requirements they have in certain countries for how many spectator seats can be placed in a row before there needs to be an aisle. Sheard lists the range of 24-32 seats being the right range of seats per row, but he also states that some countries allow up to 40 seats to be placed in a row while the UK only allows up to 28. Rod and his staff also have an equation they use to see whether or not the viewing angle for all of the spectators in the stadium are adequate or not.

Rod's book also describes the needs of both the participants in the sports that the spectators watch and the required spaces for officials and all of the other spaces needed to make a stadium operate successfully. I think perhaps though the most important thing that I have learned

from studying this book is that the reason Rod states for his and his co-workers primary involvement in stadium design is that was what their clients needed. They first created a relationship with clients who were as passionate about their companies and teams as Rod and his staff were about their design firm. These clients just happened to be owners of different sports teams. This approach to running a firm, putting the client's needs first and above all, gave Rod and his firm the start and continuing success they needed to become one of the world leaders in sporting stadium design.

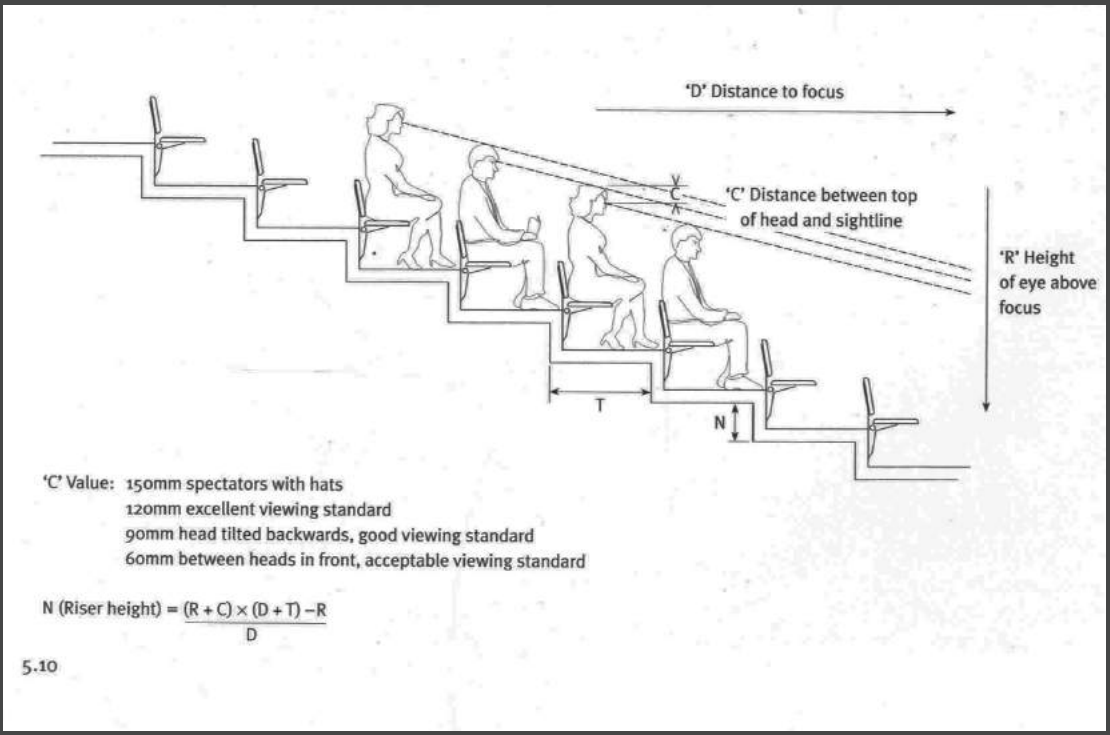


Figure 56 - Diagram with seating height and viewing calculations

A book titled Tragsysteme by Heino Engel will also prove a great resource for my research as the book takes large structural systems of every type and strips them down into pieces so that they are easier to understand. The resources provided in this book will allow my structural research to retain its validity as I will be able to design stadium structure that would work in the real world. This book shows examples of structure using many different types of materials as well which will be really useful to myself because combining mixed-use building techniques and stadium techniques will more than likely include the use of many different materials both for aesthetic purposes and structural purposes. Engel's book will be a good one to look at to understand how different structural materials can be combined safely and beautifully.

With the help of Engel's book I will be able to figure out all the formulas and configurations of geometrical shapes to make sure that however I design the roof of the mixed-use soccer stadium and whether or not it has a retractable roof, I will be able to know that the design is safe and effective. I will be able to reference Engel's book for any structural load formula I need whether it has to do with force, loads, gravitational force, moment, stress, resistance, or equilibrium. There is examples of how to solve all of the previously stated for the structural system that you decide to employ and there is also diagrams for each of them showing what physics the mathematical equations are solving so that you can have a better understanding of your structure. There are also many diagrams showing various different types of structures, including pneumatic, cable, tent, arch, flat trusses, transmitted flat trusses, curved trusses, space trusses, and many others. The diagrams that I will more intently be focusing on are the "wide-span roof enclosures". These diagrams show possible structural solutions for a soccer stadium designed to fit 20,000 spectators. The book mainly focuses on singular structural systems, so it will remain to be seen if further expertise and research is required to effectively integrate the structural system of the stadium area of the building and the structure covering the mixed-use area of the building.

Another book that I will be using in my research is titled Developing Sports, Convention,

and Performing Arts Centers by David C. Petersen. This book also looks at many different types of stadiums and designs, but instead focuses on the economic impact of the stadium designs and also looks at the differences that mixed-usage has on their integration into the city's activity. This book includes sections showing data from stadiums that include different sports and other things like entertainment venues and how that brings in a greater volume of both people and revenue for the city in which the stadium is located. The book also includes sections that help estimate future use or occupancy of stadiums which will be very useful to me as I try to develop a process with which to assess how the design works or is effective (one of my two secondary goals).

Unlike the previous two books described, David's book focuses on the economics of stadiums. This shows in many different studies shown throughout the book. The book reiterates what I state in other areas of this program that stadium design has gotten away from the design of multi-sport stadiums. They list the same reason as I have, when one large space tries to accommodate space for different sports that require such different seating arrangements for all, instead of making many different great ways to enjoy sports in one building, you are creating many different sub-par ways to enjoy sports in one building. Another way that this book shows its dedication to sport stadium economics is the discussion on things like stadium parking. In the book it states that "stadiums and large arenas typically require a parking space for every two to four attendees. If mass transit is not available or is not used by fans, parking lots or structures must be provided to accommodate as many as 7,000 cars for a 23,000-seat arena and 20,000 or more cars for a 70,000-seat arena." The book also discusses how any stadium should be placed nearby other amenities that the surrounding area has to offer like convention centers, hotels, restaurants, etc. and it also gives charts that help evaluate a potential site to see how economical placing a stadium there would be.

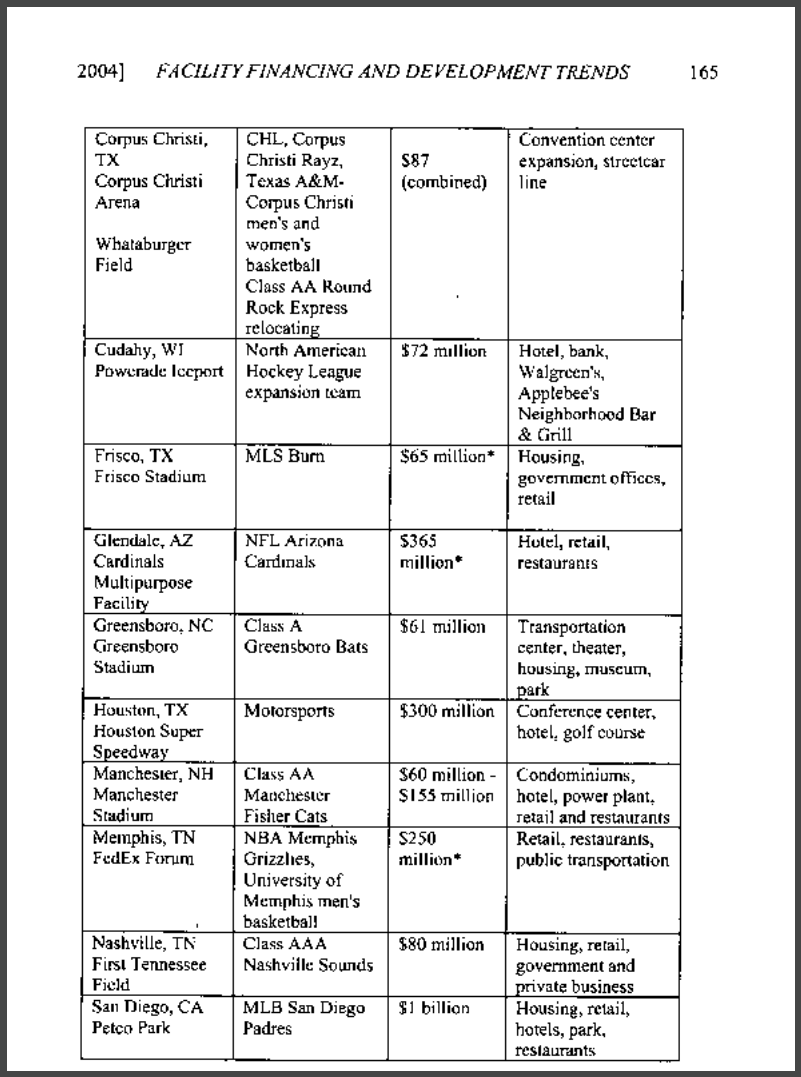
There is also many other economic lessons to be gleaned from David's book such as the prices of construction cost of convention/sports centers which at the time of the publication

of this book (2001) was "$250 to $400 per square foot." This will have to be synthesized with current cost data, but it will still be effective in allowing me to understand whether or not the cost calculations done for the mixed-use soccer design are accurate. Extra means of revenue are also discussed within the book which include the designing and offering of premium seating options and permanent seat licenses which are also discussed later in this program. These options can be costlier to include in the design of the stadium, but with individual seat licenses now worth in the $1000s of dollars, this can be a very effective way to offset the economic cost of building a stadium that costs hundreds of millions of dollars.

The first online book that I will be using information from in order to design a successful stadium for the MN United soccer team is an online thesis titled "It Takes a Ballpark Village: Stadiums, Coalitions, and Growth in Two Cities" by Anna O. Bently. This thesis studies the story of a city looking to "spark revitalization, provide new jobs and industry, and increase civic pride" with the development of a sporting stadium. Anna's thesis suggests that instead of developing a stadium with those goals in mind, guiding the stadium development process with "growth and general development as the outcome" might be more effective. Anna uses case studies from San Diego and St. Louis and studies their "stadium planning process, groups involved, motives for participation and the outcomes of the projects" in each state along with an element that is growing in popularity with stadium projects, the "ballpark village" development. This is a great resource to use because it is a thesis about community development much like mine and it will better inform what goals to have in mind when designing the stadium. It also is a great study on the development around stadiums and how that is becoming more and more popular with stadiums even being built today like the new Atlanta Braves stadium.

The "Marquette Sports Law Review Book" that is in an online format has provided great case study information for this thesis project. As you can see below, it contains lists of stadiums of all uses and sizes, what their overall costs were, and how much and what type of commercial and mixed-use developments was spurred on near the stadium after it was built. With this

information, I will be able to look up the stadiums included in that list, find the ones that most fit the characteristics of the stadium being designed in this thesis and see how they were able to integrate mixed-usage with their stadium or connect them by other means such as landscaping, skyways, or other modes of transportation.



2004] *FACILITY FINANCING AND DEVELOPMENT TRENDS* 165

Corpus Christi, TX Corpus Christi Arena Whataburger Field	CHL, Corpus Christi Rayz, Texas A&M-Corpus Christi men's and women's basketball Class AA Round Rock Express relocating	$87 (combined)	Convention center expansion, streetcar line
Cudahy, WI Powerade Iceport	North American Hockey League expansion team	$72 million	Hotel, bank, Walgreen's, Applebee's Neighborhood Bar & Grill
Frisco, TX Frisco Stadium	MLS Burn	$65 million*	Housing, government offices, retail
Glendale, AZ Cardinals Multipurpose Facility	NFL Arizona Cardinals	$365 million*	Hotel, retail, restaurants
Greensboro, NC Greensboro Stadium	Class A Greensboro Bats	$61 million	Transportation center, theater, housing, museum, park
Houston, TX Houston Super Speedway	Motorsports	$300 million	Conference center, hotel, golf course
Manchester, NH Manchester Stadium	Class AA Manchester Fisher Cats	$60 million - $155 million	Condominiums, hotel, power plant, retail and restaurants
Memphis, TN FedEx Forum	NBA Memphis Grizzlies, University of Memphis men's basketball	$250 million*	Retail, restaurants, public transportation
Nashville, TN First Tennessee Field	Class AAA Nashville Sounds	$80 million	Housing, retail, government and private business
San Diego, CA Petco Park	MLB San Diego Padres	$1 billion	Housing, retail, hotels, park, restaurants

Figure 57 - Chart showing different sized stadiums and their development trends

Beyond the Scoreboard is a book written by Rick Horrow who used to work as the official facilities consultant for the NFL. The whole book is about the business of sports and it sheds light on some great tips that I can use in the design of a mixed-use sporting stadium to make it that much more effective economically. One big thing to generating revenue in a stadium is holding "mega-events". Rick states in the book that every community that hosts a SuperBowl, the championship game in the NFL, generates about $300-$400 million dollars of economic activity. Now while the stadium being designed in this thesis is not designed for an NFL team nor will it be big enough, there is a lesson to be learned here. In order for the stadium designed in this thesis to produce a healthy amount of revenue, then the stadium must be designed to effectively host many different types of events like concerts. This will also ensure that the stadium area of the building is used on days other than when a sporting events is being held.

One of the online sources is a study on the sustainable development for professional sports stadiums by Brianna Ridge, who works at the School of City & Regional Planning at the Georgia Institute of Technology College of Architecture. The most important part of this resource that I will be able to use in this thesis is in the conclusion, where Brianna lists four recommendations that would "improve the sustainability of professional athletic stadium sites within the United States." The following are those four recommendations that will be surely integrated into the design process for the mixed-use stadium in this thesis:

- Locate stadium adjacent to the eight prime land uses (office, hotels, dining, commercial, transit, nearby residential, limited parking, other points of interest)
- Stadium's site located in the core or at the central edge of a city
- Locate the stadium by a transit station or establish a new transit station at the stadium
- Form an aesthetically pleasing atmosphere of local retailers that turns the stadium inside-out

Another one of the online books that will certainly help with this thesis study is called "A Blueprint for Successful Stadium development" by KPMH. This book guides the reader through

every process of stadium design, from giving charts that document the key phases, milestones, timings, and the main professionals that are involved through all of those steps in the development process to showing the phases that every successful stadium design process goes through to study the marketing and financial feasibility of the stadium. This online book also has many graphs and charts showing that trends in stadium design like premium seating and city locations that are growing in popularity in the United States are also true in many other countries around the world. This means that the information and lessons learned from this thesis will be able to be used worldwide. As you can see in the picture below, this book with blueprint in its title is also a "blueprint" for understanding all of the different spaces and people that interact with the building on a daily basis. This information will help me be able to design a soccer stadium that works excellent for everyone involved.

Figure 58 - Organizational diagram showing functional aspects of a stadium design

Stadium design has been around for centuries and there has been many developments over the years. I am looking to create processes that designers can use to help them fully integrate their stadium designs into the urban neighborhoods that surround them. The books that I am looking at will provide information to me about how different stadiums integrate long-span structure into their designs, how those structural systems really work and how they can be integrated with the structural systems and materials used in mixed-use buildings. These resources will also collectively help me further understand the different impacts a stadium can have and how to estimate a stadium's role in a city's socio-economic capabilities.

Designing a mixed-use soccer stadium complex that is hundreds of thousand of square feet can be a huge undertaking, but this is another way that I will be able to use the resources previously described, many of the books have case studies of stadiums provided with floor plans and sections. Combining these with the helpful master lists provided in the texts that state all of the different spaces that need to be included in a stadium will make sure that I not only design for all of the needs of the stadium, but that they are placed in an effective way.

Stadium design is a typology where it is essential that you design through looking at floor plans *and* sections. This is due to many factors, but one main one is that stadium seating takes up a large portion of the area of a stadium's space and it is placed at an angle, creating underneath spaces that need to be utilized in order for the stadium to be effeicient. Using the mathematical formulas that I have found in the previous texts will help me in designing a stadium that features a cohesion between stadium seating space, circulation space, and mixed-usage areas.

Many of the texts previously described will be an asset to this thesis as they always keep in perspective the goals of their studies. Whether the content of the books is about structure, or economic impact, or sustainable design, they always refer back to what the main goal of their studies was. This may be the most important lesson that I learn from all of these guides. In order for me to accomplish the goals of my thesis, I am going to have to keep my eyes on the goal,

which is to determine a process or methodology that designers can use to create urban stadiums that rejuventate neighborhoods. I can't get stuck on all of the little details like the placement of seats one-by-one in a digital model if I want this project to mean something on a larger scale. Stadiums are huge projects and that means when done right, they can have a big impact. This thesis will provide the MN United soccer team a blueprint on how to do just that.

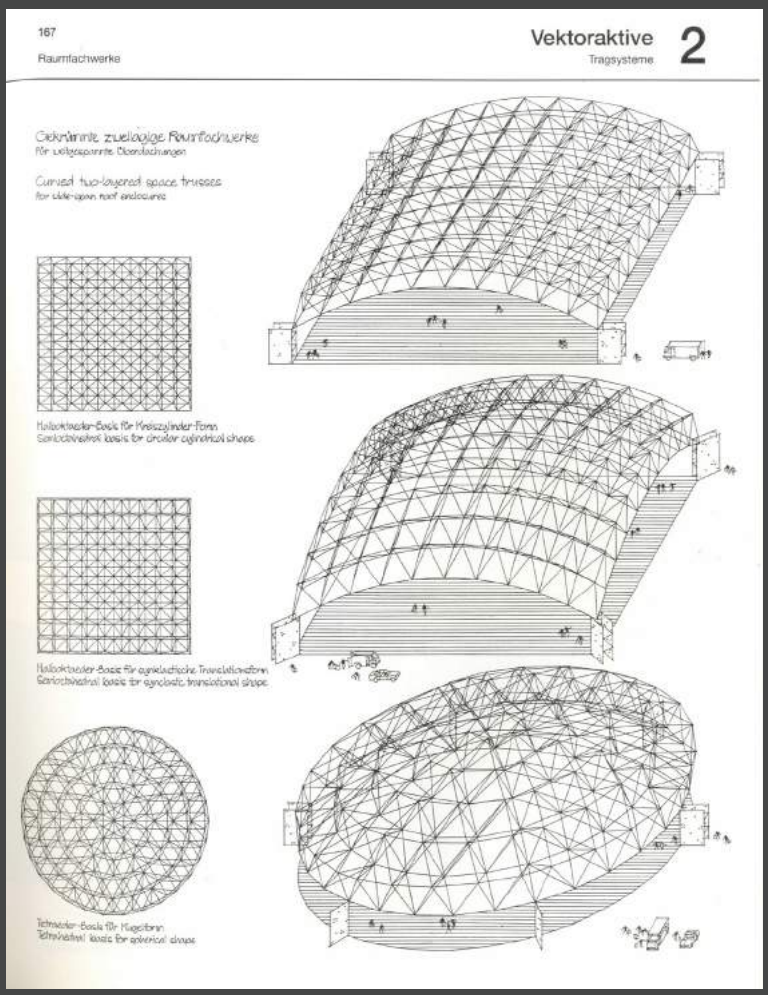


Figure 59 - Different structural designs for long-spanning systems

Project Justification

According to Plunkett Research, the sporting industry in the United States is worth $498.4 million and throughout the world it is worth $1.5 trillion. The industry has been around for decades and sports have become part of many country's identities. Instead of trying to take down the industry and prevent spending on the sporting stadiums, I think we should study how to design stadiums so that they fit in with the cities around them and perform several functions. If we can learn to design stadiums to have a mixed-use element with them like office or retail spaces for example, the stadium is able to more easily recover the cost of the its construction and it is also able to save the city money that would've been spent constructing the spaces that are now a part of the stadium.

Plunkett Research states that the MLS (Major League Soccer) industry is worth $600 million in the U.S., showing that although it may not be the most popular sport in the country, its fan base is steadily growing. The Minnesota United soccer team is an expansion team of the MLS looking to create a home for themselves in the Twin Cities area of Minnesota. A large stadium for the Minnesota Vikings is being constructed, but the MN United team is looking to play in a stadium that has a seating capacity that is about one-third the size of the Vikings stadium to create a more intimate venue for their fans.

Stadium design has become more advanced over the years, becoming more tech-savvy and environmentally friendly. Stadium designs still leave much to be desired when it comes to truly fitting into an urban streetscape and feeling like a building that you could as easily walk into off the sidewalk and enjoy a cup of coffee as you could watch a sporting event in. With this thesis project, my goal is to create a process that allows stadium designers to more fully integrate their stadium ideas into the surrounding cities while designing a state-of-the-art mixed usage soccer stadium for the MN United team in Minneapolis, MN.

This thesis project will take all of the knowledge that I have learned during my duration of architecture school at North Dakota State University. The stadium will require all of the information that I have learned about long-span structure as the stadium will require just that to

house both the soccer stadium and mixed-usage spaces. I will also have to employ my knowledge of spatial planning and integration in order to make the mixed-usage spaces mix effectively with the surrounding sporting stadium. Urban planning and streetscape design lessons that I have learned will help me out in designing a stadium that is both large enough to fit the program that I have planned, but also be intimate enough to make pedestrians want to use the mixed-usage spaces even when a sporting event is not going on. This project will require a lot of site analysis to understand what measure will have to be taken to make the west market loop neighborhood in Minneapolis a place where a 18,500 seat, mixed-usage stadium can be built.

Transportation studies will be key in fully integrating the stadium into the Minneapolis site, and the need to create flexible modes of travel for both urban dwellers and people living outside the city will be hugely important to the success of the project. As said before, stadiums are starting to employ cutting-edge tactics of environmental sustainability and in order to integrate these into the MN United stadium, my knowledge of HVAC and mechanical systems will be tested. Landscape and parking design will be essential to completely transform the ones used by truck depots and failed office spaces into an exciting urban node and to make-sure the site is accommodating to the all of the building occupants needs.

One of the goals of this project is to effectively integrate the existing farmers market that has been such a rich part of the area for so long into the stadium experience. Designing the stadium site in order to fit with the market and make it a part of the MN United experience will require my knowledge of site design as well as spatial planning. In order to create a stadium that mixes well with the urban landscape of Minneapolis will also test my knowledge of materiality. Stadiums in the area like Target Field (home of the Minnesota Twins) used limestone, a product found heavily in MN, as one of the main components of the exterior stadium cladding. With the MN United Stadium, I am looking to use a cladding system on the stadium that both reflects the area that it resides in as well as fit in with its urban context. With all of the usages that I plan on including in this stadium design, I want to design the materiality of the stadium so that it looks

like a building that can fit an office building, a coffee shop and a soccer stadium all under one roof.

I believe that although the amount spent on stadiums on a world scale is staggering, we can create a process for designers to make their stadium designs work more for the city around them and also look more like the city around them. If this process can effectively change the way we design our stadiums, then a huge impact will have been made on one of the largest and most expensive typologies exisiting. Stadiums will become urban nodes of activity and not just on the days that a sporting event is taking place, it will be one everyday, just like the rest of the city.

Figure 60 - Proposed Detroit Events Center

Historical,Social and Cultural Context of the Thesis

Historically, sporting events have drawn the attention of millions. Sports are something that can rally a whole city together for one cause. They are so engrained into the fabric of our world's culture. The first stadium ever designed was in the 8th century BC in Greece and there have been 1,000s of stadium designed and built since then. Some have taken steps back in stadium design and some have introduced elements that change the typology forever. Many have been successful from a safety standpoint, but some have failed in that regard. When a stadium design truly works, it can be a symbol of pride for the city and country/state for which it is in. When a design goes wrong, the result can be catastrophic because of how many lives occupy the space of a stadiums. Stadiums can have the power to drastically change its surroundings in good ways and bad. Stadiums and their designers are starting to evolve with the world around them. There are now many stadiums with retractable roof systems, mixed-use spaces, green roofs and other state-of-the-art technology featuring video screens that are thousands of square feet large. Some stadiums have been able to integrate into their environments, but stadiums still have yet to fully fit into the urban streetscape around it and blend in. Buildings that are thousands of square feet large are hard to blend into the environment around them, and it may take many advances in the typology in order to accomplish this, but I believe it can be done.

There are currently just over 60 stadiums being constructed at this moment with many of them costing millions of dollars. There has been much controversy over the massive amount of money that is put into stadiums and where is comes from. There has also been controversy about the construction techniques of stadiums in countries like Qatar and Brazil where many workers are migrants who come to those countries looking for work and get treated and paid very poorly and many die due to the grueling conditions they are put under. There are many reasons why people are against the building of stadiums, about as many as there are for their building. My argument is this, as long as stadiums are going to continue being built at the rate they are today and there is little we can do to slow them down, then why don't we work to reform the way that they are built? Let's work to make sporting stadiums work for our cities once again.

Let's create a methodology for designers that helps them create spaces that aren't large empty reminders of mis-spent money or mis-managed construction, let's take what we have learned from stadiums in the past, combine it with what we have learned about them in the modern era and form a new era of stadium design where large stadiums are large for a reason. Let us make that reason be that they are constantly brimming with activity due to successful integration of the stadium into the urban landscape of our cities. Let us make sure that all future stadiums are accomplishing this through successful integration of mixed-use spaces in the stadium to bring constant traffic throughout the building. Effective integration of multiple modes of transportation with a stadium can help. Site placement can also be a big difference in whether a stadium is economically viable because stadiums can have as much mixed-usage incorporated into its design as the client wants, but if the stadium is placed in an area where there is no foot traffic, then those business' might not make any financial impact for the stadium whatsoever. There are many other factors that go into designing a stadium that has a beneficial impact on the neighborhood or city around it. In order to study all of these factors more closely and see whether different design choices worked or didn't work for the financial feasibility of different stadiums, we need to delve deeper into the history of stadiums and how they evolved into mixed-use stadiums and what things along that creative path worked or didn't.

In the 70's and 80's in America there was a large number of stadiums built in the cookie-cutter style. These were coliseum-type stadiums that weren't designed for any sport in specific, they instead were designed in a mostly circular shape in order to house many different configurations of seating. Some examples of this type of stadium was the Coliseum in Oakland, Candlestick Park in San Francisco and the Metrodome that was located in the same city as the one my MN United design iteration is meant for. All of these coliseum-type stadiums were able to house many different sports because of their simple shape, but because of this design there was much lacking from the spectators experience in whichever arrangement the stadium was in at the time. Instead of these stadiums being purely designed for one sport with one config-

Figure 61 - Oakland Coliseum during a Raiders football game

uration, they made the necessary concessions to house all of the sporting field configurations turning a possibly great experience into more sub-par experiences. Over time, all of these cookie-cutter style stadiums started to wear down with age and stadium styles started changing. In the years of the late 90's and early 2000's stadium design in America started to transform into more sport-specific stadiums and some even started to integrate more mixed-usage into their buildings. A good example of this is Ford Field, an NFL football stadium that was built in 2002. This 1.5 million square foot stadium was built in the warehouse district in Detroit. It was the first NFL stadium to integrate mixed-use commercial development that leverages the stadium structure for year-round use. This stadium was a critical piece in rejuvenating downtown Detroit. From 2002 to 2015 more stadiums have been built and some integrated the mixed-use tactics of Ford Field into their plans and some didn't, but one thing was becoming clear, with more and more stadiums being designed for a single sporting use like they were in first half of the century,

more stadiums needed to be built to house all of the sporting teams. With more stadiums needing to be built, that meant cities and states with sporting teams in need of stadiums had to spend that much more money. Even in the late 90s and early 2000s little had still been proven that stadiums could be economically-viable ventures for the cities that they are in. This is where the location of the stadiums and inclusion of mixed-use can be so important for stadiums. If there is going to be more and more money spent on stadiums in the future, then we need to find a way to design these coliseums smarter so that they can give back to the city that is supporting them financially.

Figure 62 - Old Picture of Manchester United fans

Figure 63 - Century Link Field, home to the Seattle Seahawks NFL team and the Sounders MLS team

Socially, sports are also a juggernaut. The most popular sport in the world is soccer with approximately 3.5 billion estimated fans and even though it is not the most popular in America, it is growing in popularity every year. With this project I am looking to design a stadium that if built would cause as much positive change in the popularity of soccer in Minneapolis, MN as the design would cause for the stadia typology. The millennial generation are now adults and the social preferences of that generation is changing the world. Many of us prefer living in urban areas with lots of mixed-usage buildings. Those areas best fit our style of living, they are high energy and are connected to so many different outlets of entertainment. Stadiums are a part of those urban environments that the millenials are populating and they need to adapt to the changes that they are bringing with them. One of the biggest ways that stadiums can integrate into the urban neighborhoods around them is to study the social trends of the people in that neighborhood. In Minneapolis there is a growing number of millenials as mentioned before. If that is the group of people that will be buying tickets to see soccer games and concerts in a new stadium that is being designed, then the smartest thing to do economically-speaking is to design it around their lifestyle. Ford Field, the football stadium for the Detroit Lions football team features a team store, a nightclub/restaurant, 200-room hotel, office spaces and various retail areas. This is the level of mixed-use that needs to start being adapted into all new stadiums that hope to successfully inte-

Figure 64 - Entry elevation of Ford Field in Detroit, home of the NFL team the Detroit Lions

grate into their urban landscapes. Before the inclusion of mixed-usage to pull in people off the street and into the stadium, the stadium also needs to be placed in an urban location that is in close vicinity to a large number of people and walkable areas. The more walkable the area surrounding a stadium, the more foot traffic that stadium is going to get inside it. Kauffman stadium (MLB) and the Chiefs stadium (NFL) are both very beautiful stadiums for their respective sports, but they provide little extra earning possibilities for the city of Kansas City because they are only designed to house sporting events. And even if they were designed with mixed-usage, it wouldn't matter because both stadiums are placed in the middle of nothing in the city, they are very far away from the urban areas of the city and are surrounded by 19,000 parking spaces.

The next generation of sporting event attenders want to see the design of sporting stadi-

ums fit their lifestyle in the form of mixed-uses and cities want to see the mixed-usage revenue to help offset the costs that building a stadium incurs. Unfortunately, getting a mixed-use stadi um approved is hard when there are more potential owners of the stadium involved, and that can become true with mixed-usage. Trying to balance the legislation, the public and private funding, and the sporting associations when trying to get a stadium built for a single tenant is hard enough, but with mixed-use there are many more tenants and much more to juggle on the political side of getting a stadium approved. There are many stadiums in the present day that are including mixed-uses within their stadium or are spurring it on in the form of development outside the stadium walls. The new San Francisco 49ers stadium, the new Vikings stadium in Minneapolis, MN and the planned Braves baseball stadium all have plans for mixed-use residential (hotels and apartments) and retail developments (shopping centers) nearby the stadiums. This is showing that even if mixed-use isn't built within the stadium, a stadium that is expertly placed in the middle of a bustling urban area will have mixed-use developments follow. With thoughtful design, no longer do stadiums have to be located on the coasts with storied franchises to be financially successful like in the past.

Culturally, soccer has always had great influence. It is the one sport that the whole world plays. Every four years the World Cup is held and teams from all around the world compete to win the honor of being called the best soccer team in the world for the following four years. Wherever the World Cup has been held, it has always been a way for that country to show itself off to the rest of the world including the people, the architecture, the food, etc. The best stadiums around the world are able to represent the country and culture around them through their designs. With this soccer stadium design for the MN United team, I am looking to represent the city of Minneapolis and the state of Minnesota around it. The fact that the building of a soccer-specific stadium for Minnesota is even in the works is a product of cultural change in the state of Minnesota and the country of the United States. Since the modern era of American football started in 1932, that sport has steadily grown into the most popular sport in the United States by a wide

margin. Soccer was widely regarded as the least popular of the main sports in America, but that has been changing over the last 15 years or so. Even before the latest World Cup in which team U.S.A.'s participation garnered much greater soccer viewership, there has been a surge in television ratings for the games played in the Premier League with ratings nearly doubling from 2012 to 2013. Not only that but MLS teams have been noticing a greater success at the local level as well, with attendance increasing consistently over the past 14 years despite the great increase in MLS teams. Total attendance topped 6 million in the 2013 and 2014 seasons, with the 2015 season bringing in a total attendance of just over 7.3 million. Whether it is due to there being a wider cultural range of people now living in the U.S. and bringing their love of soccer with, the greatly increasing knowledge of the danger present in the popular sport of American football, the increased televising of soccer in the U.S., or the possibility of the millennial generation liking soccer more than the past generations, overall attendance and viewership of soccer is rising and the growing amount of soccer stadiums being built in the United States is showing that.

The progression of mixed-usage in stadium design and the growing popularity of soccer in the United States (12 soccer-specific stadiums have been built in the past 12 years), this is the perfect time to be capitalizing and designing a mixed-use stadium for an excellent fanbase in the Twin Cities of Minnesota. Combining the lessons learned about stadium history, the social changes that the millennial generation has brought and the ever growing culture of soccer in the United States, the MN United stadium will be designed for the team, for the fans, for the city.

Site Analysis

Views

The MN United stadium design will need to incorporate views of the Minneapolis skyline around it by keeping views from inside the stadium to the outside open on the south-eastern corner of the proposed site.

Built Features

Most of the built features that are represented on the site are the office/retail buildings on the site. The other features include the berm mentioned before that runs north-soutth through the middle of the site and the built concrete platforms that support the roofing structures used by the Farmers Market.

Light Quality

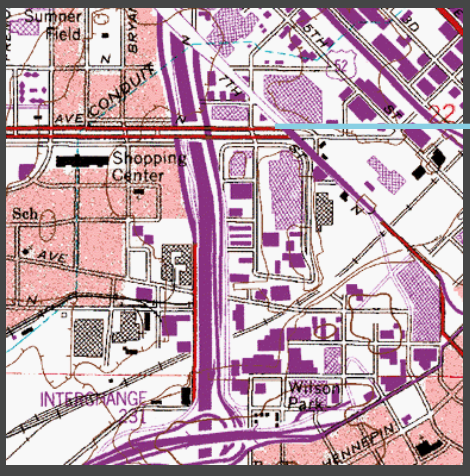
The light quality on the site is very generous as it is not surrounded by many of the tall skyscrapers that are to the east of the site that would block out the sunlight. This works very well for the stadium project if there is going to be a retractable roof with the sunlight then able to fall through the roof onto the field. The regular season in MLS goes from March to October, which is when Minneapolis and the rest of the state of Minnesota has more of its sunny days, which will also help there be plenty of sunshine onto the soccer field during play. Unlike many of the soccer-specific stadiums located in the southern states in the U.S., the changing seasons in Minneapolis mean a large swing in the location and timing of sunlight. This will have to be taken into account with planning the artificial light system and the orientation of the stadium on the site.

Utilities

There are electrical systems present on the site in the form of transformers. there are also telephone wires. The benefit this site provides to the furture usage of a stadium is that the areas has been inhabited by so many different businesses which means that many of the necessities the stadium will need in electrical connections have already been started. Sure there will have to be much expansion on these systems in order to support the much larger needs of a stadium housing 20,000 soccer fans, but at least the site isn't starting from square one.

Existing Topography

There is a large berm that is running through middle of the proposed stadium site along the north-south axis. This change in topography would need to be leveled before the construction of a stadium on the site, or that feature would simply have to be worked into the stadium site design. Maybe the stadium rests on the east side of the proposed site with a large plaza staircase leading up to the stadium from the west side to counteract the change in elevation the berm presents. The 93.8% of the site that has the U4A classification of soil is described as urban land-udipsamments (cut and fill land), it is also described as complex which explains the many different possible soils it could be (described in the soils section) and that it has a 0 to 2 % slope. This means that this area has some spaces that have a slope of under 1% which means it does not drain well unless it is paved and carefully finished. The part of that area that is between 1 & 2% will seem flat and are usable for all kinds of activity. The part of the site that has a U3B soil classification is also described as unorthodents (cut and full land), and that the area this soil inhabits can have anywhere from a 0 to 6% slope. That means it includes the two classifications of slope found with the area that the U4A soil inhabits, but with the extra slope category of 4 to 10% with are defined as easy grades, and are suitable for movement and informal activity.



Site Location

The elevation above sea level that the Farmers Market (just south of the site) is listed at is 826 ft. The rest of the site is at a higher elevation, but due to the fact there is little change in topography, the rest of the site should not be more than 10-15 feet higher that.

Figure 65 - Topographic map of the north/west loop of Minneapolis

Existing Vegetation

There isn't a large amount of vegetation on the proposed site as the site is occupied mostly of office buildings for lease or truck depots. The line of trees that follows the east border of the proposed site would allow for a great processional type feeling as you drive up towards the southeastern corner of the site. Maybe this would be a great corner to feature the main entrance of the stadium with much of that part of the elevation being glass to allow views to the skyscraper skyline of Minneapolis?

Wind

The main landform that affects the flow of the wind is the berm that runs north-south just to the east of Border Ave. The berm is large enough that when on the west side of it, the lower side, you are protected by most any wind movement. You can tell in the image below that the berm is about as tall as a the delivery truck next to it so the height of that berm could be as tall as 12-14 ft. None of the buildings prevent too much airflow because they are 2 stories tall or shorter. As mentioned later, there is few instances of vegetation found on the site except for on the outskirts so there is little wind cover provided by that.

Figure 66 - Side view of the berm and Stark Electronics

Human Characteristics

One of the most significant features on the site is the large berm that has been built to keep one of the business' parking lots level throughout the downward slope experienced when going west on Holden St N. There is people present on the site, mostly people that work at the various businesses that are still open.

Figure 67 & 68 - One of the street parking payment recepticles on the site and the store Accent Store Fixtures

Vehicular and Pedestrian Traffic

The only business that has much of a retail function is the Accent Store Fixture business and Party Value business that is on the west side of the site, located right off of Lakeside Ave. This is the only business on the site that receives much commercial traffic. All of the traffic that occurs on the site seems to be vehicular because the neighborhood is not very close to any residential areas. The Farmers Market that is located on the south end of the site brings quite a few people to the area. By far the most active area of the entire site is on the west side of the sight between Accent Store Fixtures, the Farmers Market, and I-94. On the east side there is a decent amount of both pedestrian traffic and vehicular traffic with roads to the nearby Target Field and access to the lightrail. There is also a pay and park system located on the site that has various machines that collect payment for street parking during the weekdays.

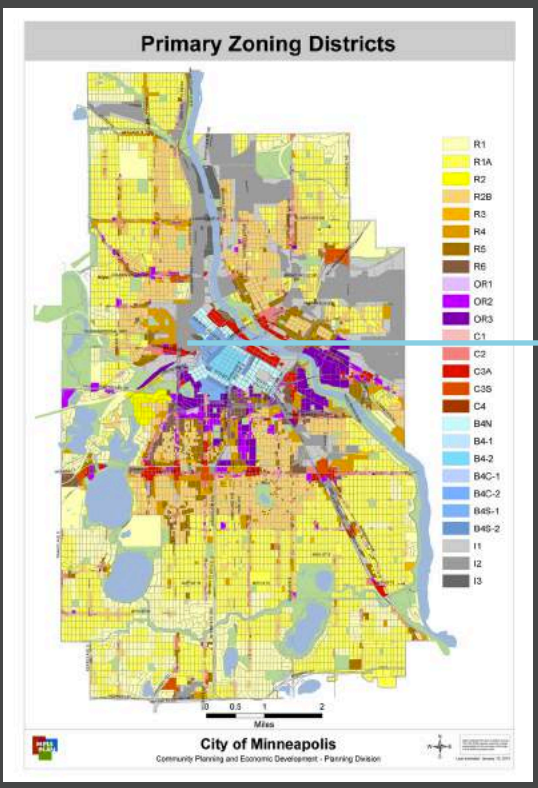
Soils

The majority of the site that the stadium will be located on has soil that has a classification number of 4A. This soil takes up 93.8% of the site. This means the soil on the site could be any combination of the following: loose to medium dense sands; firm to stiff clays and silts; or alluvial fills. The allowable soil bearing pressure associated with this type of soil is 1500 psf, the blow count is 18-23 and the torque probe value (inch-pounds) is 276-350. The minority soil type that is found on the southeast corner of the site has a classification number U3B. This soil type takes up 6.1% of the site. The soil in this part of the site could be made of any combination of the following: sand, silty sand, clayey sand, silty gravel, medium dense course sands, sandy gravel, very stiff silt, and/or sand clays. This type of soil has an allowable soil bearing pressure of 1500, a blow count of 18-23 and a torque probe (inch-pounds) of 351-550. The soils on the proposed site may have to be tested as there may be a chance of soil contamination with the large amounf of office parking and truck depots that have inhabited the site in its history. The foundation and structural techniques used by the other stadiums that share this soil (ex. Target Field) will be studied to determine how to best approach the same for this stadium.

Figure 69 - Soil classification map of the site

Distress and Site Character

The distress that I found on the site is of a human variety. The neighborhood that surrounds the site is classified as an I2 or "medium industrial district". This is shown in some of the many of industrial businesses that call the land between Lakeside Ave and Royalston Ave N their home. Because of this, there is a lot of asphalt and concrete paving for delivery trucks like the ones seen at G&K Services. This is leaves little space for green space in the neighborhood. I didn't notice any dying trees when I visited the site, but I did notice that some of the businesses that call that neighborhood their home are already vacated and are looking for tenants. I didn't see much erosion or other damage to the land, but the buildings that inhabit the neighborhood are all older and most are not well kept. The distress in general and is on a macro level, affecting the entire site.



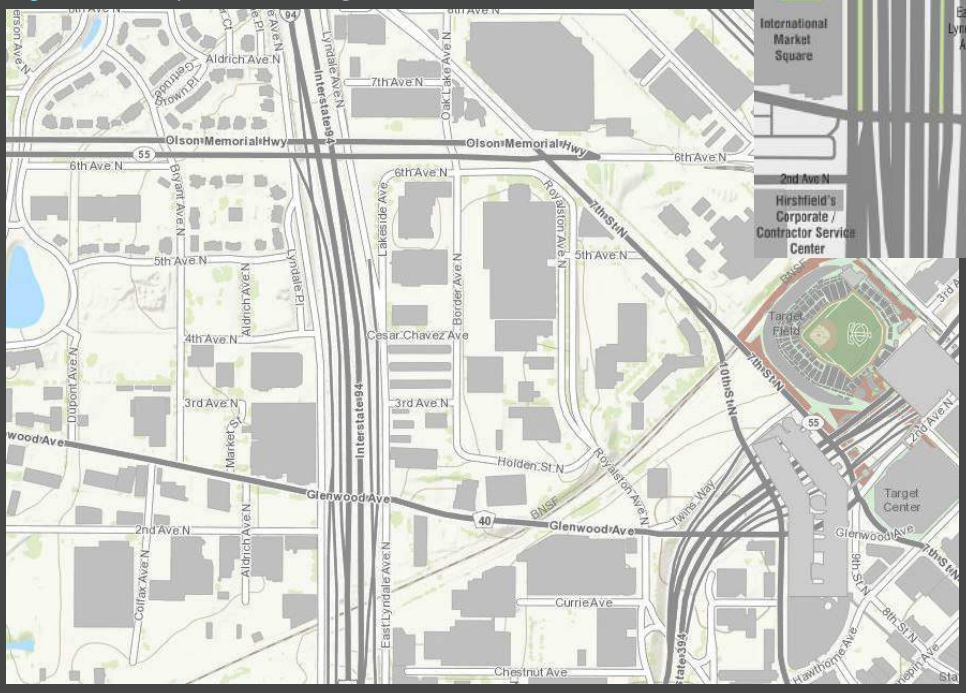
Site Location

Figure 70 & 71- Zoning district map of Minneapolis and picture of G&K services and their trucking parking lot

Base Maps

In Map B, the light green color represents grassy areas, while the light grey represents paved areas. The dark grey color shows roads, the middle grey color represents buildings outside of the site boundaries and the buildings in blue are the buildings within the site boundaries.

Figure 72 - Map A : tree & vegetative cover, water, contours



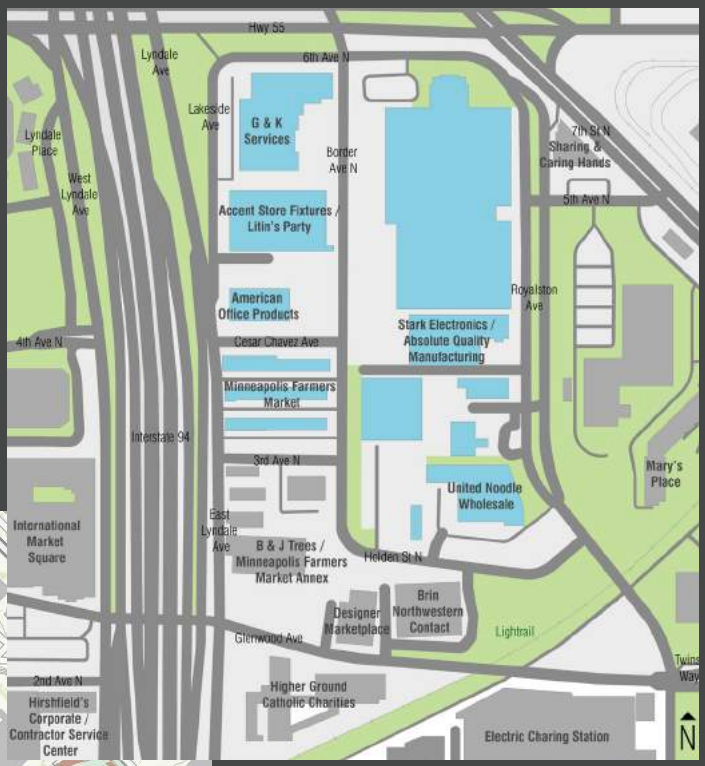


Figure 73 - Map B : road, bridges, buildings

Map A is the Urban Tree Canopy (UTC) map for Minneapolis.

Photo Grid

Figure 74 - Photo grid map of site

Figure 75 - Picture of west side of site

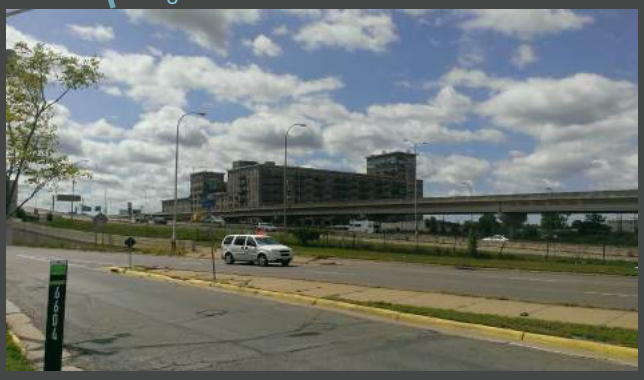


Figure 76 - Picture of north side of site

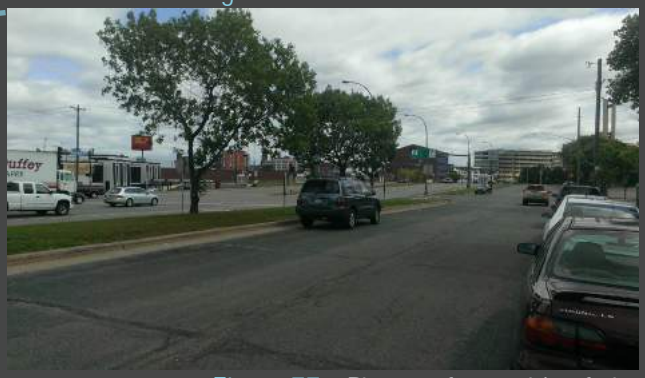
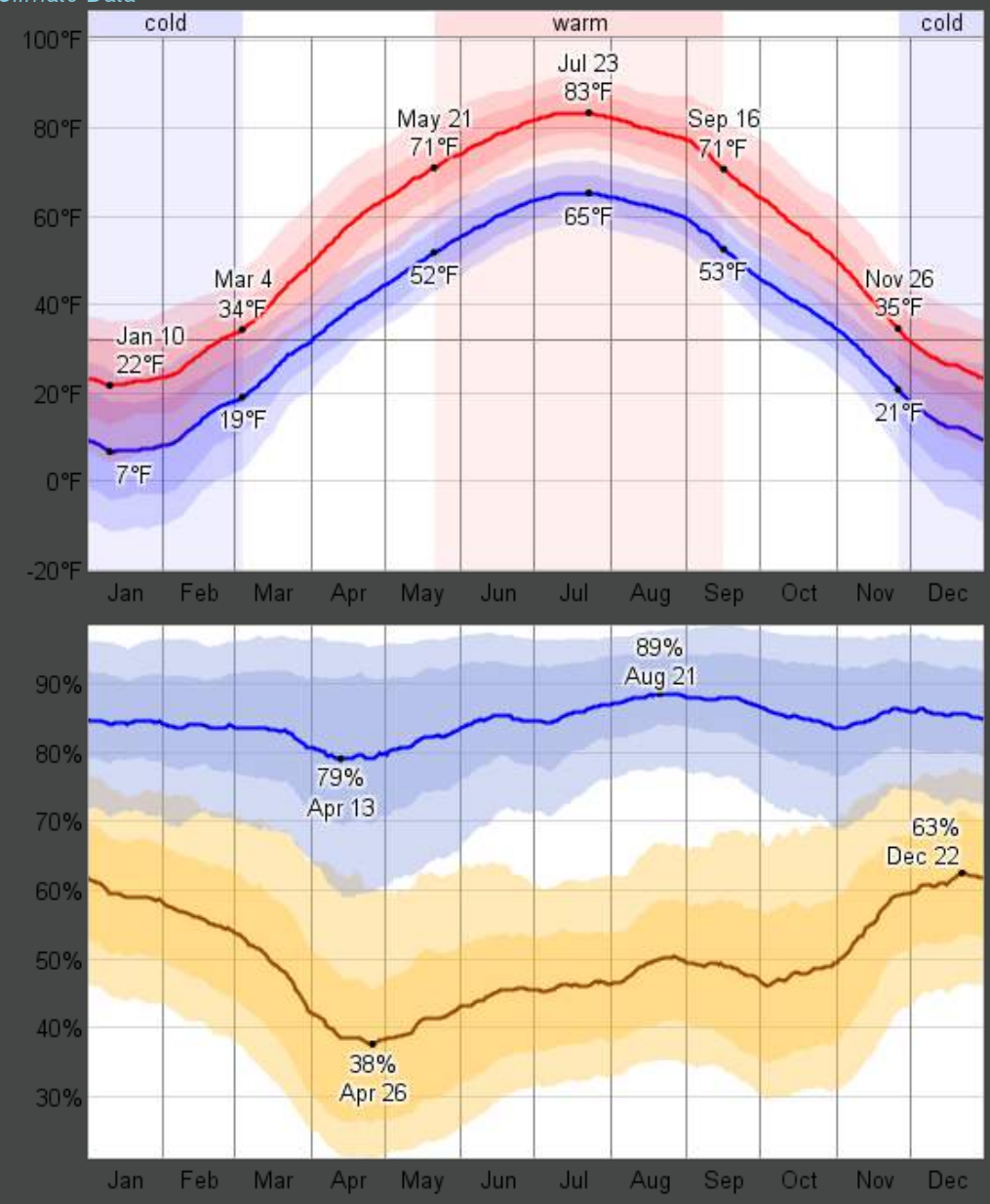


Figure 77 - Picture of east side of site

Figure 78 - Picture of south side of site



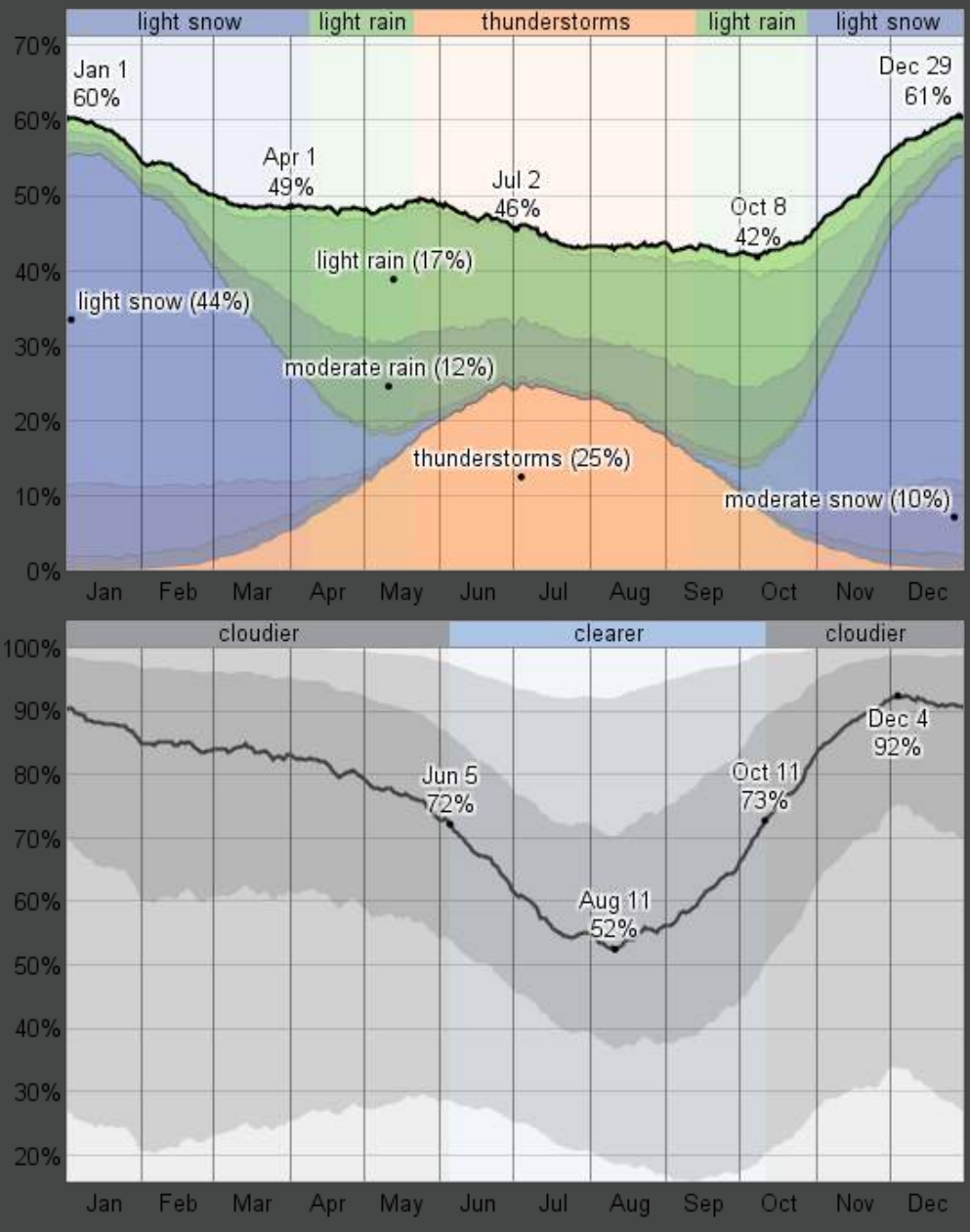
Daily High and Low Temperature

The coldest part of the year lasts from Novermber 26th until March 4th. The average temperature during this time is 34 degrees Fahrenheit. The warmest part of the year lasts from May 21st to September 16th. The average temperature during this time is 71 degrees Fahrenheit.

Relative Humidity

The humidity in Minneapolis greatly varies based on what season it is in, with the highest humidity being found in late August, and the least humid or driest days being found in late April.

Figure 79 & 80 - Temperature and relative humidity charts for Minneapolis, MN



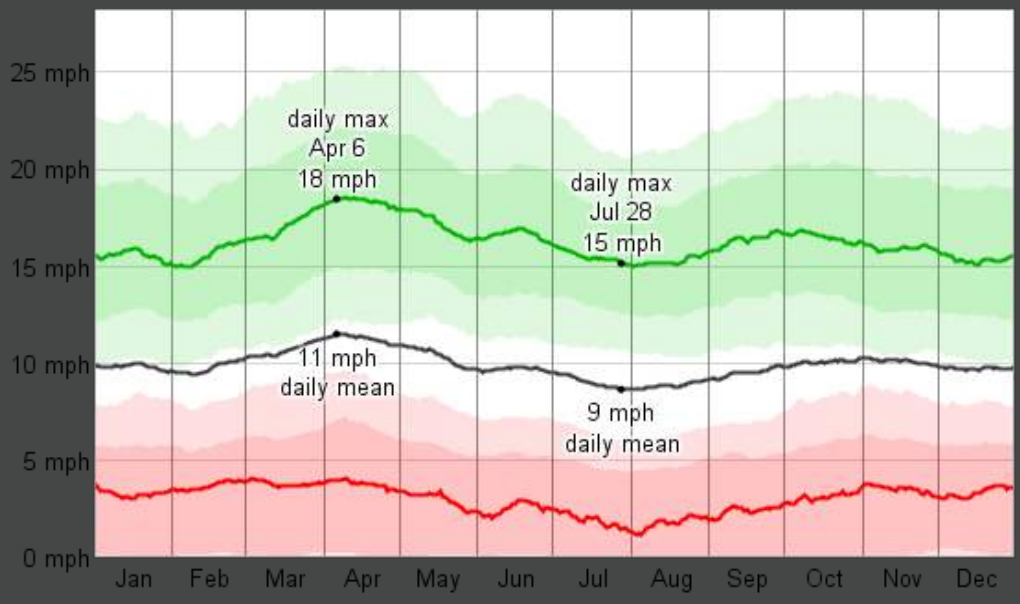
Daily Chances of Precipitation

On the days that have recorded precipitation over the year light snow happened on 32% of those days, light rain happened on 20% of those days, thunderstorms happened 20% of the time, and moderate rain happened 12% of the time.

Median Cloud Cover

The part of the year that is the clearest from cloud cover starts around June 5th. the part of the year that is cloudier starts around October 5th.

Figure 81 & 82 - Precipitation and cloud cover charts for Minneapolis, MN



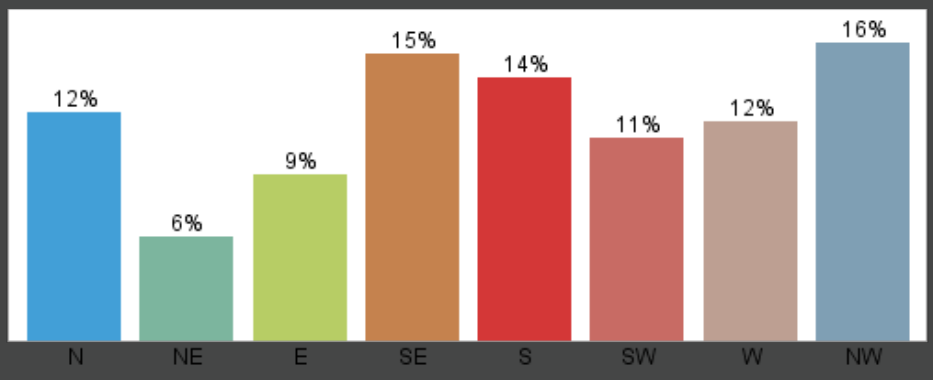


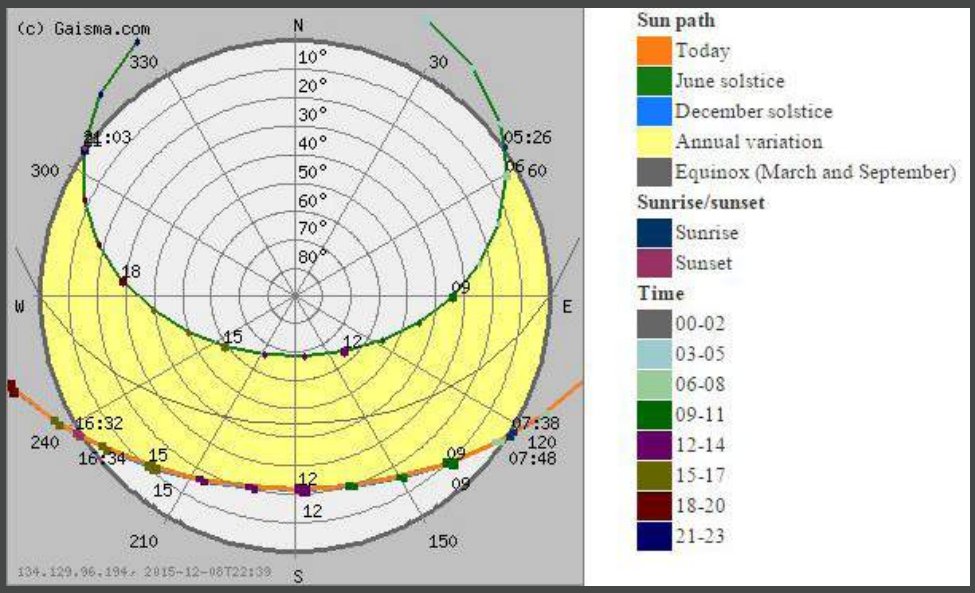
Figure 83 & 84 - Wind speed and wind direction charts for Minneapolis, MN

Wind Speed

In Minneapolis, wind speeds can vary from 1 mph to 19 mph, but very few times is the wind speed greater than 25 mph. The time of year when the average wind speed is greatest can be found in early April and the time of year when the average wind speed is lowest is in late July.

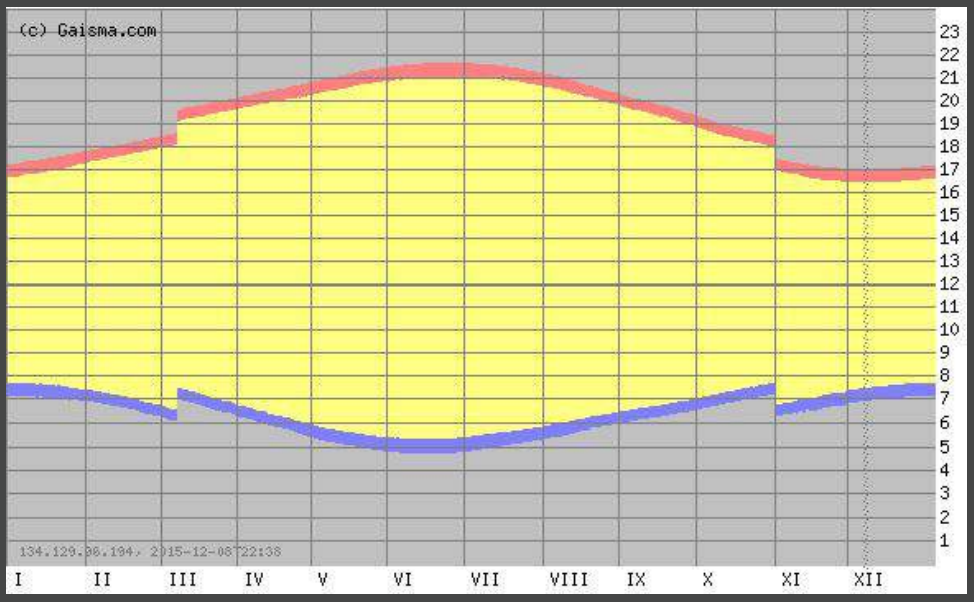
Yearly Wind Direction Percentages

As you can tell from the chart to the left, the wind in Minneapolis comes most from the Northwest, but there are many times of the year when it is coming from any other direction.



Sun Path

As you can tell from the sun path chart, the summer days in Minneapolis are very long and the winter days are very short.



Sunrise, Sunset, Dawn and Dusk Times Graph

Key:

Yellow - Sunshine

Grey - Darkness

Pink - Dusk

Blue - Dawn

Figure 85 & 86 - Sun path and sunrise, sunset, dawn and dusk times for Minneapolis, MN

Climate Summary

As proven by the climate graphs, the most temperate time for climate in Minneapolis is found from late spring to late fall. The soccer season starts in March, which means the first month or so of the season will be met with pretty cold temperatures. It will be useful to feature a retractable roof on the soccer stadium so that it can be closed during the beginning of the soccer season, open during the nice summer months that are less cloudy and daylight lasts long into the evening, and then closed again late in the season and during the winter months so that the stadium can be protected from snow and be a venue for other events like concerts. Having a rectractable roof during the peak summer days with the most humidity will also allow for the building to be enclosed and better block out those dangerous conditions to the athletes and fans.

Site Analysis Conclusions

The analysis of the selected site for the mixed-use soccer stadium for the MN United MLS team has provided evidence that although there will have to be some work done on the site in order to get it ready to house the stadium, the potential difference that this stadium can make for the west loop neighborhood of Minneapolis is great.

While there are many things that need to change about the site, there are elements of the site that can be integrated into the stadium design. The part of Royalston Ave that runs north and south on the east side of the site can be used as the main road to the plaza and main entrance of the stadium and also act as the main entrance to the stadium from the lightrail extension that would allow it to run along the east side of Royalston Ave and connect right back up with the existing part of the light rail track that wraps around the north end of Target field. The northwest corner of the stadium site at the intersection of Olson Memorial Hwy and East Lyndale Ave N could also allow for a great secondary entrance for mostly pedestrians as there are nice side-walks running along Olson and East Lyndale. There is a nice green space at this corner of the site with a few trees and a sidewalk headed towards the middle of the site that could be expanded upon to create a secondary plaza/entrance path to the stadium.

There are also many parts of the site that would need to be changed in order to make a

soccer stadium work on the site. There are a lot of buildings on the site that would need to be removed in order for a 17,500 – 20,000 seat stadium to fit on the site. This project is all about rejuvenating this west loop neighborhood of Minneapolis and I feel that in order for the site to become something new, its needs to wipe its hands clean of the run-down poorly-designed retail, truck depot, offices, and storage buildings that exist on the site and start fresh. Thankfully some the buildings on the site are already up for rent as they no longer have any owners. Once the buildings were removed, the stadium would have to be designed to work around the berm that runs down the middle of the site or the berm would have to be leveled with the rest of the site.

The shelters of the Minneapolis Farmers market that are located to the south of the site, could be renovated in order to fit more with the eventual design of the soccer stadium and left where they are at. In order for this to work and the farmer's market still be integrated successfully into the plaza of the stadium, the plaza might have to move to the west and be located more on the south-southwest side of the stadium. The other option is to relocate the Farmers Market to the southeast corner of the site, which would work better with the idea of having the main entrance/glass façade of the stadium be located at this corner in order for the fans in the stadium to have a nice view of the Minneapolis skyline.

One thing that was noticed during the site analysis was that although the site didn't have a lot of pedestrian or vehicle traffic for a Twin Cities area, there were some bright spots of activity at the Farmers Market and at some of the retail stores along East Lyndale Ave., showing that the site is in a great location being next to I-94 to the west. There are many reasons to expect a great increase of foot and vehicle traffic on the site if it were to have a soccer stadium with nice access to the site from I-94 using East Lyndale Ave N along with nice access to the site from Olson Memorial Hwy, which connects to a nicely developing residential area to the west of the site. There are also many nice bike paths and a nearby lightrail that is close enough to bring people near the stadium even if an extension along Royalston Ave wasn't possible. Although there is some park

ing lots near the site, most of them are privately owned so there may need to be some parking designed for the stadium on the site, especially to accommodate for team buses. The visibility of the stadium should be good from about any location around the site which will help the mixed-use spaces be successful along with the stadium. The climate and weather of Minneapolis will more than likely dictate that this stadium have a fixed or retractable roof in order for the stadium to be effective economically and be used year-round. It would be preferable for the roof to be retractable or see-through in order for fans to enjoy the long summer days of Minnesota.

Some testing of the soils on the site would more than likely have to be done to determine whether or not the area has been contaminated enough by the use of diesel trucks in order to classify it as a brownfield site. If this site is indeed a brownfield area, then measures would have to be taken in order to rectify the soils and get it ready for a large complex to be designed on it. There may be LEED points for the taking if the brownfield soils can be rectified.

All in all, the site between Royalston Ave N and East Lyndale Ave N in the west loop neighborhood of Minneapolis has a lot of potential to be a successful site for a mixed-use soccer stadium.

Figure 87 - Picture of apartment buildings on Glenwood Ave and the International Market Square

Final Building Program (Space Allocation)

Soccer Stadium

Users: Minnesota FC United Soccer Team

Square Footage:

Major league soccer regulation field

115 x 74 yards = 8,510 sq. yds. or 76,590 sq. ft.

Spectator seating (approx. 17,500 to 20,000 seats)

= 110,000 sq. ft.*

Specialty seating and press box space for both owners and managers of the soccer team and for spectators

= 16,350 sq. ft.*

Team areas / locker rooms

10,000 sq. ft. (locker rooms) + 20,000 sq. ft. (training areas and weight rooms) = 30,000 sq. ft.

Coaches Areas

2 spaces x 2,700 sq. ft. / space= 5,400 sq. ft.

Kitchen Areas

2 spaces x 6,000 sq. ft. / space= 12,000 sq. ft.

Concession spaces (including space for Famer's Market vendors and other concessions)

= 20,000 sq. ft.

Ticket booths / entry gates

= 36,000 sq. ft.

Circulation space / bathrooms

= 300,000 sq. ft.

TOTAL (Soccer Stadium)

= 606,340 sq. ft.

* Square footages based off of estimates (sq.ft. / seat) for the new 18,000 seat soccer stadium design approved for the Orlando City SC soccer team - http://www.mlssoccer.com/post/2014/03/31/orlando-city-council-approves-plan-18000-seat-soccer-stadium-orlando-city-sc

Mixed-Use

Minnesota FC United Soccer Team Offices
Square Footage: 6,000 sq. ft.
Farmers Market Grocery (Organic Food Store)
Square Footage: 2,700 sq. ft.
Small Retail Store #1: MN FC Team Clothing Store
Square Footage: 2,700 sq. ft.
Small Retail Store #2: Downtown 401 Clothing
Square Footage: 2,700 sq. ft.
Coffee Shop: Beans United
Square Footage: 2,700 sq. ft.
Office Space #1 : United Noodle Wholesale
Square Footage: 6,000 sq. ft.
Office Space # 3 : American Office Products
Square Footage: 6,000 sq. ft.
Office Space #5 : Ameritrust Bank
Square Footage: 6,000 sq. ft.

Twin Cities Bike Rental / Repair
Square Footage: 3,700 sq. ft.
Event Space
Square Footage: 6,000 sq. ft.
Restaurant / Bar #1: Sammy's Sandwich Shop
Square Footage: 3,700 sq. ft.
Restaurant / Bar #2: Marioti's Restaurant
Square Footage: 3,700 sq. ft.
Restaurant / Bar #3: Barney's Pub
Square Footage: 3,700 sq. ft.
Office Space #2 : Accent Store Fixtures
Square Footage: 6,000 sq. ft.
Office Space #4 : Stark Electronics
Square Footage: 6,000 sq. ft.
Office Space #6 : FHC Architects
Square Footage: 6,000 sq. ft.

TOTAL (Mixed-Usage)
= 73,600 sq. ft.
TOTAL (Mixed-Usage + Soccer Stadium)
= 679,940 sq. ft.
Service / Mechanical areas
= Approx. 10% of total building sq. ft. = 67,994 sq. ft.
TOTAL (Mixed-Usage + Soccer Stadium + Service / Mechanical area + Storage (55,000 sq. ft.) =
= 802,934 sq. ft.

Parking

Users: MN United, the fans, the users of the mixed-use typologies of the design

Square Footage: 3,000 car spaces + 75 bus spaces = 500,000 sq. ft.

TOTAL (Mixed-Usage + Soccer Stadium + Service / Mechanical area + Storage (55,000 sq. ft.) + Parking) =
= 1,302,934 sq. ft.

Final Building Program Summary

With the spatial allocation of the stadium I wanted to include enough different mixed-use spaces to show a full integration of the sporting stadium typology and the mixed-use typology. For many of the stadium-related spatial allocations, a stadium proposal for the Orlando City SC team which includes a very similar number of seats as the MN United team wants was used for fan seating and circulation square footages. When determining the size of spaces for the mixed-usage areas, I used the approximate square footages of mixed-use spaces in the downtown Fargo area like Kittsona (approx. 100 ft. x 20 ft.) for the retail spaces and pub spaces like the Toasted Frog (approx. 100 ft. x 30 ft.) to approximate the size of an urban pub space. My experience at the Grand Forks, ND branch of JLG architects which is around 8,000 sq. ft. gave me something to refer to when allocating spaces for modern banking and architecture office spaces. Downtown Fargo is a great example of an urban area that has been revitalized through mixed-usage and effective spatial allocation, and those are goals of mine when designing this mixed-use soccer stadium.

Appendix : Extra Programmatic Elements

Inclusion of the Farmer's Market Into the Urban Fabric of the Mixed-Use Stadium

With the design of this mixed-use stadium, I am looking to bring both the urban feel of downtown Minneapolis to the west loop neighborhood of the market square and also inject some of the worldly culture that only the world's #1 sport (soccer) can bring. One way that I am going to prove this through my design is to incorporate the existing vendors of the nearby farmer's market into the stadium concessions area. Adopting organic alternatives for part of the concessions area of the stadium will strengthen the diverse culture of the stadium that the soccer games will bring. The main goal of this thesis is to rejuvenate how stadium design is done and help mesh the stadium typology with the mixed-use designs of downtown areas, and only having the regular concessions of hot dogs and pretzels does not reiterate that. In order to bring stadium design fully into the 21st century and fully adapt them to fit into the urban contexts around them, we need to pay attention to the details and the proposal above is doing just that. Food from the farmer's market will also be regularly featured in the organic foods store included in the mixed-use stadium, *Downtown 401*.

Figure 88 - Picture of the Minneapolis Farmers Market logo

Southwest Light Rail Transit Project Update

The Southwest Light Rail Transit project is an extension of the METRO Green Line in Minneapolis. This route will connect with the METRO Blue Line, the Northstar Commuter Rail Line, bus routes, and future transitways. This extension will also pass through the communities of Eden Prairie, Minnetonka, St. Louis Park, Hopkins and it will also pass close to Edina. This route will also be able to connect with Target Field Station as well as the U of Minnesota, downtown St. Paul and the State Capitol area. More importantly to this project, this extension of the Light Rail is going to pass along Royalston Ave N which is on the east side of the proposed site for the mixed-use soccer stadium for MN United. There is even a station planned for Royalston Ave N, which means that any fans traveling to the stadium can use this METRO Green Line extension and get off the Light Rail right at the stadium. The development in transportation around the site is further confirming that this site is deserving of an MLS stadium.

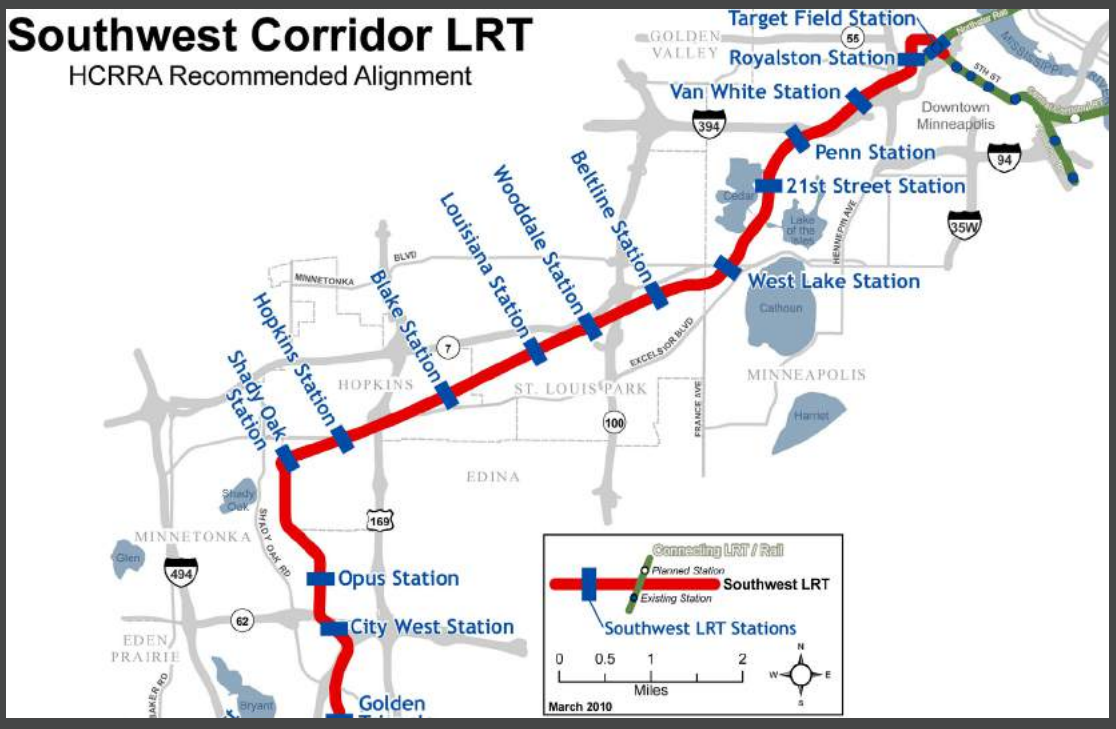


Figure 89 - Map showing the path of the southwest Light Rail transit project

Facts About North Loop/West Loop Minneapolis

The site of the proposed mixed-use stadium is in a location that can often be referred to as the "west loop" or "north loop" of Minneapolis because of its northwest location in relation to the downtown area. Much of the history of this warehouse district often refers to the area as the "north loop" however. The north loop/west loop of Minneapolis is proving to be an excellent place to put a mixed-use soccer stadium and the following facts only reiterate that :

- the title of the fastest growing neighborhood currently goes to the north loop as it has grown from 1,500 residents in 2000 to 4300 residents in 2010 and the population is still growing at an exponential pace

- the age groups of the population were found to be at these percentages:
    - 37% for the age group of 25-34
    - 17% for the age group of 35-44
    - 13% for the age group of 45-54
    - 9% for the age group of 55-64

- The north loop has continued to gain accolades from various publications including the *Mpls. / St. Paul Magazine* and *City Pages* who have given it the award of "Best Neighborhood", *Forbes* which has declared north loop the "12th Hippest Neighborhood", *Fast Company* which gave north loop the distinction of "Favorite Neighborhood" and *Thrillist*, which has called area the "Coolest Neighborhood of America".
The biking in north loop has been declared as "best biking city" by *Bike Score* and the "#3 bicycling city" by *Bicycling Magazine*

- The Station at Target Field serves as a multi-modal transportation hub and is close to the site for the proposed soccer stadium. There is also an adjacent public plaza and ampitheater that attract people to hold special events year round near the site as well.

What these facts mean is that although they represent an area that is mostly north of the site where the soccer stadium is planned, there is a large amount of the millenial generation that is living near where the stadium site is located. And because of the highly praised urban area that is around them and it being one that caters to their interests, they more than likely will continue to live in that area and recommend it to others. This means that there is a large, young population (one that enjoys watching soccer more than any past generation) nearby the stadium site location. This also means that the stadium should have success being located at the site next to Royalston Ave and with all of its young attendees, it should have that success for quite some time. After further understanding the history of the site and seeing that it was part of this industrial district from the early 1900s and it got left behind when all of the other areas of Minneapolis were being renovated and redeveloped in the 80s after hard times in the 60s and 70s, I believe I have found the perfect site for a rejuvenation project of this magnitude. The proposed site is one of the few areas left in this thriving North Loop that has yet to realize its potential with the great city and citizens around it and a mixed-use building that features the newly popular social event of going to soccer games, should catch this area up to fit in with its urban environment, further fulfilling the goal of this entire thesis.

Appendix : Research Journal Article

Urban Stadia: Integrating Stadium Design with Mixed-Use Building Tactics to Rejuvenate an Urban Neighborhood

Introduction and Background

Principal Investigator - Mitch Borgen

Theory - Sporting Stadiums can combine the multi-use aspect of mixed-use typologies to create a stadium design that blends in with the urban neighborhood around while also creating a space that can be used for multiple functions instead of just sporting events, making it more economical for the city and more active and exciting for its citizens.

Potential Impact - To give all sports stadium designers a process by which they can fully integrate their stadium designs with mixed-use building techniques and then define a process by which they can determine whether the design will be effective in increasing the socio-economic capabilities of the neighborhood containing the mixed-use stadium.

Main Question - How can mixed-use building techniques combine with stadium design to have a positive socio-economic impact on a neglected urban neighborhood?

Secondary Questions -

1. How to design a stadium with integrated mixed-use.
2. How to define a process to assess how the design works or is effective.

Motivation - As a designer and a sports fan, sports stadium design has always been a passion of mine. I want to develop a process that helps other sporting stadium designers fully integrate their stadium designs in with the urban landscape around them by combining them with mixed-use design techniques.

Methodology

Through the initial spatial planning models of the stadium, I started to realize one of the most prevalent ways that spatial planning can impact the economic activity of a stadium is through the simple allocation of square footages. The more square footage that the stadium seating arrangements take up, the less space there will be for the mixed-use areas to be able to use to generate their revenue. Now the direct impact that the stadium square footage is having on the mixed-usage square footage is particular to some constants that have been determined by me, the researcher. One constant is the overall footprint size of the building, I wanted to keep this the same throughout all of my iterations in order to more effectively study the impact that the size of the sporting or mixed-use spaces will have on the other. Keeping the iteration's footprints the same will allow the price of the building to remain closer to constant so this study can more clearly focus on the underlying concern of the economic impact of the spatial allowance and organization of mixed-use and stadium areas. The stadium's circulation space will be kept the same for each iteration because the stadium seating capacity of each iteration is staying the same. This decision will only further specify the results gathered from this report as being due to the spatial planning of the mixed-use and stadium seating spaces. The stadium seating capacity was kept the same so that any differences in economic activity that each iteration causes will truly be able to be tied back to the spatial planning and allocation and not just changed by the number of ticket buyers that are allowed to watch each game when the stadium is at full capacity. As you can see through the new methodology below, the main purpose of this research has transformed into its most simple form by merely studying the impact that the spatial planning of the two most important typologies in this research (sporting and mixed-use) have on each other and how that impact effects the stadium's ability to economically rejuventate the area around it.

Methodology Cont.

1. Create space planning alternatives for the soccer stadium using Sketchup including measurements of the following areas:
    a. Total Sq. Ft.
        i. Sq. Ft. of Stadium Area
        ii. Sq. Ft. of Mixed-Use Area
2. Measure the economic impacts of each space planning alternative
    a. Determine how much the sq.ft. of the mixed-use area will cost to construct (using RS Means) and compare that to how much revenue the mixed-use space of each design iteration will generate by determining the revenue generated by each of the following mixed-use spaces. Percentages that each mixed-use space will take of the overall mixed-use area allowance is as follows:
        - Retail Stores (Clothing and Organic Food) - 8.3% ^
        - Coffee Shop – 3.5% ^
        - Restaurants/Bars - 21.7% ^
        - Business/Office Space – 24.5% ^
        - Apartments – 42% ^
            *Using RS Means
            ^ Percentages of each mixed-use space are calculated from the spatial requirement of each space divided by the total square footage of the mixed-use typology; this is described in the Thesis Program Draft
    b. Determine how much the sq. ft. of the stadium area will cost and compare that to how much revenue will be brought into the stadium through those seats
        * Using RS Means

Methodology Cont.

c. Determine the net gain of the two different typologies (sports area and mixed-use) and which iteration contains the spatial planning that maximizes the economic gain of the stadium

*Using RS Means

3. Determine which, if any, of the stadium design iterations most exemplify a stadium that is designed with both spatial planning and economic impacts in mind

These numbers were kept the same in all of the iterations in order to keep consistency of the factors that are besides those being studied:

Soccer Field- 225 ft. x 345 ft.
Entire Stadium Footprint- 615 ft. x 695 ft.
Stadium Seating Capacity- 18,236
Square Footage of Circulation Space- 150,000 sq. ft. (gathered from research done for thesis program)
Total Square Footage of Stadium Seating and Mixed-Usage Areas- 427,425 sq. ft. (area of entire stadium footprint, used as arbitrary constant for this study)

Research Results

Iteration #1

Total Sq. Ft. of Stadium Seating Area- 154,013 sq. ft.
Total Sq. Ft. of Mixed-Use Area- 123,412 sq. ft. (Total Square Footage of Stadium Seating and Mixed-Usage Area and Circulation Area- Square Footage of Circulation Space-Total Square Footage of Stadium Seating)
- Retail Stores (Clothing and Organic Food)- 10,243 sq. ft. at $171.94/sq. ft. = $1,761,152.91
- Coffee Shop- 4,319 sq. ft. at $232.28/sq. ft. = $1,003,236.96
- Restaurants/Bars- 26,780 sq. ft. at $191.23/sq. ft. = $5,121,052.26
- Business Office Space- 30,236 sq. ft. at $177.65/sq. ft. = $5,371,491.85
- Apartments- 51,834 sq. ft. at $178.14/sq. ft. = $9,233,659.68

Cost of Stadium Seating Area- 154,013 sq. ft. at $145.92/sq. ft. = $22,473,882.00
Profit of Stadium Seating Area- $14,328,754.64 per year
Cost of Mixed-Use Area- $22,490,593.66 ($182.24/sq. ft.)
Profit of Mixed-Use Area- $9,084,208.80 per year
- Retail Stores (Clothing and Organic Food)- $30.60 per square foot (rent) = $313,435.80/year
- Coffee Shop- $30.60 per square foot (rent) = $132,161.40/year
- Restaurants/Bars- $30.60 per square foot (rent) = $819,468/year
- Business Office Space- $30.60 per square foot (rent) = $925,221.60/year
- Apartments- 51,834 sq. ft. x $133 per square foot (rent) = $6,893,922/year

Cost of Both Stadium Seating Area and Mixed-Use Area- $44,964,475.66
Yearly Profit of Both Stadium Seating Area and Mixed-Use Area- $23,412,963.44

Research Results Cont.

Iteration #1

Figure 90 - Top view of stadium iteration #1

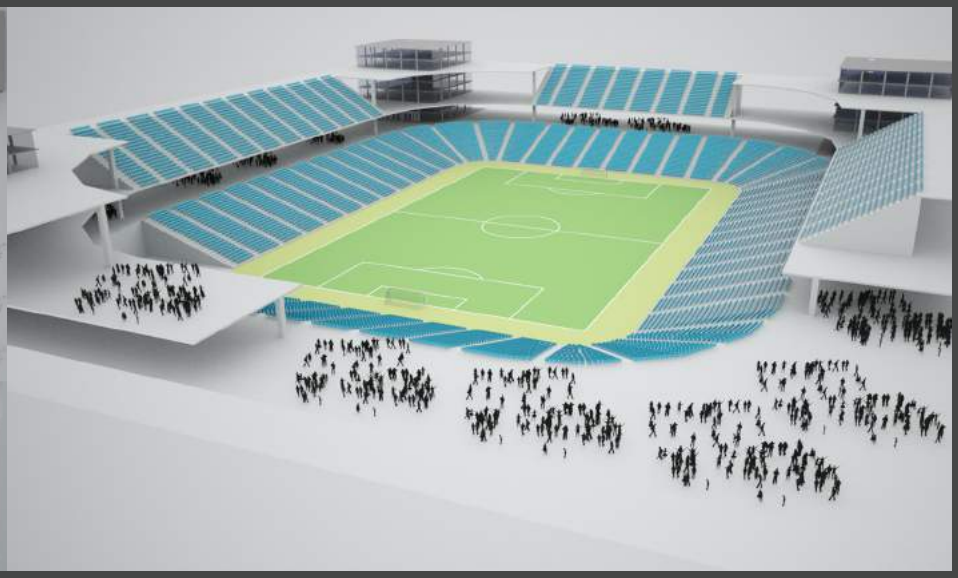


Figure 91 - Perspective of stadium iteration #1

Research Results Cont.

Iteration #2

Total Sq. Ft. of Stadium Seating Area- 155,946 sq. ft.
Total Sq. Ft. of Mixed-Use Area- 121,479 sq. ft. (Total Square Footage of Stadium Seating and Mixed-Usage Area and Circulation Area- Square Footage of Circulation Space-Total Square Footage of Stadium Seating)
- Retail Stores (Clothing and Organic Food)- 10,083 sq. ft. at $173.02/sq. ft. = $1,744,533.88
- Coffee Shop- 4,252 sq. ft. at $234.31/sq. ft. = $996,277.47
- Restaurants/Bars- 26,361 sq. ft. at $191.40/sq. ft. = $5,045,492.15
- Business Office Space- 29,762 sq. ft. at $178.25/sq. ft. = $5,305,206.88
- Apartments- 51,021 sq. ft. at $178.53/sq. ft. = $9,108,651.22

Cost of Stadium Seating Area- 155,946 sq. ft. at $145.80/sq. ft. = $22,736,707.41
Profit of Stadium Seating Area- $14,328,754.64 per year
Cost of Mixed-Use Area- $22,200,161.60 ($182.75/sq. ft.)
Profit of Mixed-Use Area- $8,941,807.80 per year
- Retail Stores (Clothing and Organic Food)- $30.60 per square foot (rent) = $308,539.80/year
- Coffee Shop- $30.60 per square foot (rent) = $130,111.20/year
- Restaurants/Bars- $30.60 per square foot (rent) = $806,646.60/year
- Business Office Space- $30.60 per square foot (rent) = $910,717.20/year
- Apartments- 51,021 sq. ft. x $133 per square foot = $6,785,793/year

Cost of Both Stadium Seating Area and Mixed-Use Area- $44,936,869.01
Yearly Profit of Both Stadium Seating Area and Mixed-Use Area- $23,270,562.44

Iteration #2

Figure 92 - Top view of stadium iteration #2

Figure 93 - Perspective of stadium iteration #2

Research Results Cont.

Iteration #3

Total Sq. Ft. of Stadium Seating Area- 175,410 sq. ft.
Total Sq. Ft. of Mixed-Use Area- 102,015 sq. ft. (Total Square Footage of Stadium Seating and Mixed-Usage Area and Circulation Area- Square Footage of Circulation Space-Total Square Footage of Stadium Seating)
- Retail Stores (Clothing and Organic Food)- 8,467 sq. ft. at $181.16/sq. ft. = $1,533,902.78
- Coffee Shop- 3,571 sq. ft. at $227.24/ sq. ft. = $811,464.89
- Restaurants/Bars- 22,137 sq. ft. at $191.36/sq. ft. = $4,236,047.45
- Business Office Space- 24,994 sq. ft. at $185.58/sq. ft. = $4,638,440.92
- Apartments- 42,846 sq. ft. at $183.25/sq. ft. = $7,851,640.34

Cost of Stadium Seating Area- 175,410 sq. ft. at $144.71/sq. ft. = $25,383,221.92
Profit of Stadium Seating Area- $14,328,754.64 per year
Cost of Mixed-Use Area- $19,071,496.38 (or $186.95/sq. ft.)
Profit of Mixed-Use Area- $7,509,089.40 per year
- Retail Stores (Clothing and Organic Food)- $30.60 per square foot (rent) = $259,090.20/year
- Coffee Shop- $30.60 per square foot (rent) = $109,272.60/year
- Restaurants/Bars- $30.60 per square foot (rent) = $677,392.20/year
- Business Office Space- $30.60 per square foot (rent) = $764,816.40/year
- Apartments- 42,846 sq. ft. x $133 per square foot = $5,698,518/year

Cost of Both Stadium Seating Area and Mixed-Use Area- $44,454,718.30
Yearly Profit of Both Stadium Seating Area and Mixed-Use Area- $21,837,844.04

Iteration #3

Figure 94 - Top view of stadium iteration #3

Figure 95 - Perspective of stadium iteration #3

Research Results Cont.

Constants

RS Means Constants

In order to keep the integrity of the study, there were multiple constants that I kept when studying the construction costs of the different typologies present in this study. Here is a list of the constants that I kept for each typology:

Stadium seating area

- Material: Concrete block/steel frame
- Stories: 2
- Story Height: 20 ft.

Apartments

- Material: Face brick w/concrete block/steel joists
- Stories: 3
- Story Height: 10 ft.

Offices

- Material: Face brick w/concrete block/steel joists
- Stories: 2
- Story Height: 12 ft.

Restaurant

- Material: Face brick w/concrete block/steel joists
- Stories: 1
- Story Height: 15 ft.

Research Results Cont.

Retail Stores (Clothing and Organic Food)

Material: Face brick w/concrete block/steel joists

Stories: 1

Story Height: 15 ft.

Coffee

Material: Face brick w/concrete block/steel joists

Stories: 1

Story Height: 15 ft.

Contractor Fees: 25%

Architectural Fees: 7%

Location: Minneapolis, MN

Other Pricing Constants-

Average Retail Rent in Minneapolis, MN: $30.60/sq. ft.

Average Apartment Rent in Minneapolis, MN: $133/sq. ft.

Average American MLS Ticket Price ($46.22) x Total Number of Home Games in MLS Season (17) x Maximum Stadium Seating Capacity (18,236): $14,328,754.64 (Maximum Stadium Seating Profit/Year)

Research Results Cont.

Results

Iteration #1

Square Footage of the Stadium Seating Area- 154,013 sq. ft.

Square Footage of the Mixed-Use Area- 123,412 sq. ft.

Cost of Both the Stadium Seating Area and Mixed-Use Area- $44,964,475.66 ($162.08/sq. ft.)

Profit of Both the Stadium Seating Area and Mixed-Use Area- $23,412,963.44/year ($84.39/sq. ft.)

Iteration #2

Square Footage of the Stadium Seating Area- 155,946 sq. ft.

Square Footage of the Mixed-Use Area- 121,479 sq. ft.

Cost of Both the Stadium Seating Area and Mixed-Use Area- $44,936,869.01 ($161.98/sq. ft.)

Profit of Both the Stadium Seating Area and Mixed-Use Area- $23,270,562.44/year ($83.88/sq. ft.)

Iteration #3

Square Footage of the Stadium Seating Area- 175,410 sq. ft.

Square Footage of the Mixed-Use Area- 102,015 sq. ft.

Cost of Both the Stadium Seating Area and Mixed-Use Area- $44,454,718.30 ($160.24/sq. ft.)

Profit of Both the Stadium Seating Area and Mixed-Use Area- $21,837,844.04/year ($78.72/sq. ft.)

Conclusions and Projections

Conclusion

Iteration #1 and #2 have 25 rows of seats on the main concourse. These iterations that have more rows of seating on the main concourse take up less square footage for the same amount of seats as iteration 3, which has only 20 rows in its main concourse. This allows for both iteration #1 and #2 to have more space for the mixed-usage typology. My theory was that the stadium designs that allow for more mixed-use square footage will generate more revenue through that typology and will be the better stadium design choices, economically speaking. The results of this study confirm my theory as both iteration 1 and 2, the iterations with more space for mixed-use areas, averaged about $1.5 million more dollars in profit per year than iteration #3 according to the above calculations. The total square footages were kept the same for all of the stadium iterations so the main thing that was changing between each iteration was the percentage of the overall stadium square footage that the mixed-use and stadium seating areas took up. We can see that in iteration #1 and #2 when the mixed-use area made up just over 120,000 sq. ft. the combined cost of both the mixed-use and seating spaces was more than $500,000 greater than in iteration #3. When studying the net profit however, the case for iteration #1 and #2 can be made over #3. The net profit combines both the cost of the stadium seating and mixed-use areas and combines them with the profits they are able to garner. With iteration #1 and #2 both costing around $500,000 more than iteration #3 but able to make much more profit ($1.5 million/year), the spatial planning present in iteration #1 and #2 are clearly more cost-effective than in #3. Now to study the economic difference between #1 and #2. The spatial planning found in iteration #1 is a little under $30,000 more costly than in iteration #2, but in iteration #1 yearly profits are over $140,000 more/year than in iteration #2. This makes iteration #1 the most economical spatial planning out of all three that were studied.

Conclusions and Projections Cont.

Spatial planning is an essential part of designing a successful stadium that integrates mixed-use and there are a lot of items to consider when picking out the best plan, but the relationship between seating arrangement and mixed-use spaces in a stadium and how much square footage they take up of the total stadium square footage clearly makes a difference as shown through this study. We have determined that the most economical spatial plan was found in iteration #1 that features a rectangular seating arrangement, curved seating at the corners of the soccer field, 25 seat-rows on the first level and 20-seat rows on the second level of seating. With this study, step #1 of the design methodology has mostly been completed which was stated as : create space planning alternatives for the soccer stadium using *Sketchup.*

That being said there are still other factors that will need to go into the study of this spatial planning iteration to get it ready to use in the MN United stadium design, including the planning of club and other luxury seat options that are more and more becoming a great means of revenue for the stadium and its owners. The planning of parking around the different stadium iterations will also cause an economic affect as will the planning of different modes of transportation. This research though is an essential start to designing an effective *Urban Stadia* for the MN United soccer club.

Three different seating iterations were studied for effectiveness in material and space used to save on construction costs. Using RS Means, it was determined that the center and bottom iteration with more seats in the first bowl cost less to construct. They also took up less space from the mixed-use areas, allowing those spaces to generate more revenue. The seating design in the final stadium is most similar to the one on the bottom. Luxury suites have been added between the lower and upper decks on the east and west sides of the stadium. The stadium seats 20,000 fans, including 19,889 general seats and 111 handicap accessible spaces.

Conclusions and Projections Cont.

This spatial planning study factored apartment spaces. Apartment spaces did not end up being included in the final design of the stadium. This was decided due to a few factors. One was that I wanted to design the building to have office spaces for the buildings and businesses that would lose their existing space because of the stadium design. It made the most sense in the eventual design to include these spaces on the second floor of the stadium, where the apartments would have existed. The other reason that apartments weren't included in the final design was that I couldn't justify putting apartment rooms next to a stadium of 20,000 screaming soccer fans, with only a wall or two between. I have been to many North Dakota State Bison football games, where the seating capacity is very similar to the 20,000 in this design and if the soccer stadium in this design got even close to producing the noise level that is present in the Bison games, then I feel it would be very hard to sell those spaces. One opportunity that I derived from the discussion I had with the thesis presentation critics after my presentation was that living spaces could be offered near the stadium if I were to build mixed-usage above the 2-level premium parking ramp on the east side of the stadium design.

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Urban Stadia: Integrating Stadium Design with Mixed-Use Building Tactics to Rejuvenate an Urban Neighborhood

Final Design

Mitchell Clark Borgen
North Dakota State University
Department of Architecture and Landscape Architecture

Figure 96 - South elevation render

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List of Tables and Figures

Other Stadiums, Good and Bad Summary

Figure 97 - Olympic Stadium, built in 1908

The first rudimentary athletics tracks were designed in VIII century B.C. and the first stadium with rectilinear stands was introduced in Great Britain as a soccer (futbol) facility. Even with all of those years of stadium building experience, good and bad examples still exist. Because of their complexity, there are many opportunities for innovation, but there are also many ways to fail. Studying the history of stadium design, I looked at a lot of different stadium's and started to ask myself questions. The answers to these questions helped inform my design decisions such as my site selection and eventual seating design.

Figure 98 - Kansas City's Arrowhead and Kauffman Stadiums

Figure 99 - San Francisco Giant's AT&T Stadium

Which stadium design is most effectively integrated into their urban landscape?

Other Stadiums, Good and Bad Summary

Would you rather watch a game in a stadium designed to fairly support the seating organization for a bunch or sports or watch a game in a stadium designed for an enhanced experience in a few select sports?

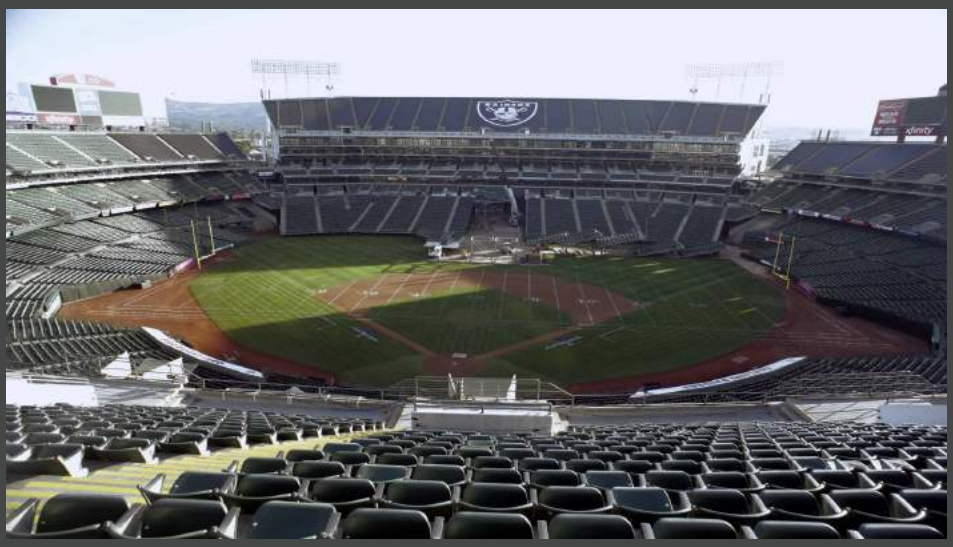


Figure 100 - Oakland Coliseum

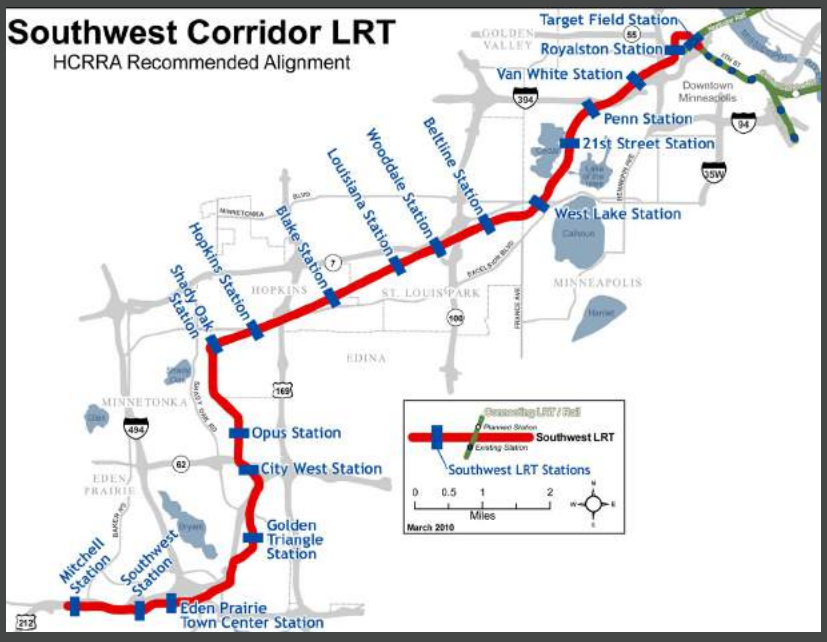
Figure 101 - Century Link Stadium during football

Figure 102 - Century Link Stadium during soccer

Site Selection Summary

Figure 103 - Proposed stadium site

Figure 104 - Light Rail Green Line extension



Reason for choosing North Loop site for stadium:

- Neighborhood was left behind when most of the surrounding areas were renovated in the 1970s, leaving this site presently with many aging or un-maintained office buildings of which some are currently vacant.

- Many existing modes of transportation to the site including the Metro bus system and the lightrail that serves neighboring Target Field.

- The site is close to Minneapolis and an emerging millenial population, which features a growing soccer fan population.

- The site is right next to where the Light Rail Green Line extension will be constructed from 2017 to 2019 and opened in 2020. Planned Royalston station is right across the street from the stadium's proposed patio / tailgating area.

Existing Site / **Demo / Rejuvenation**

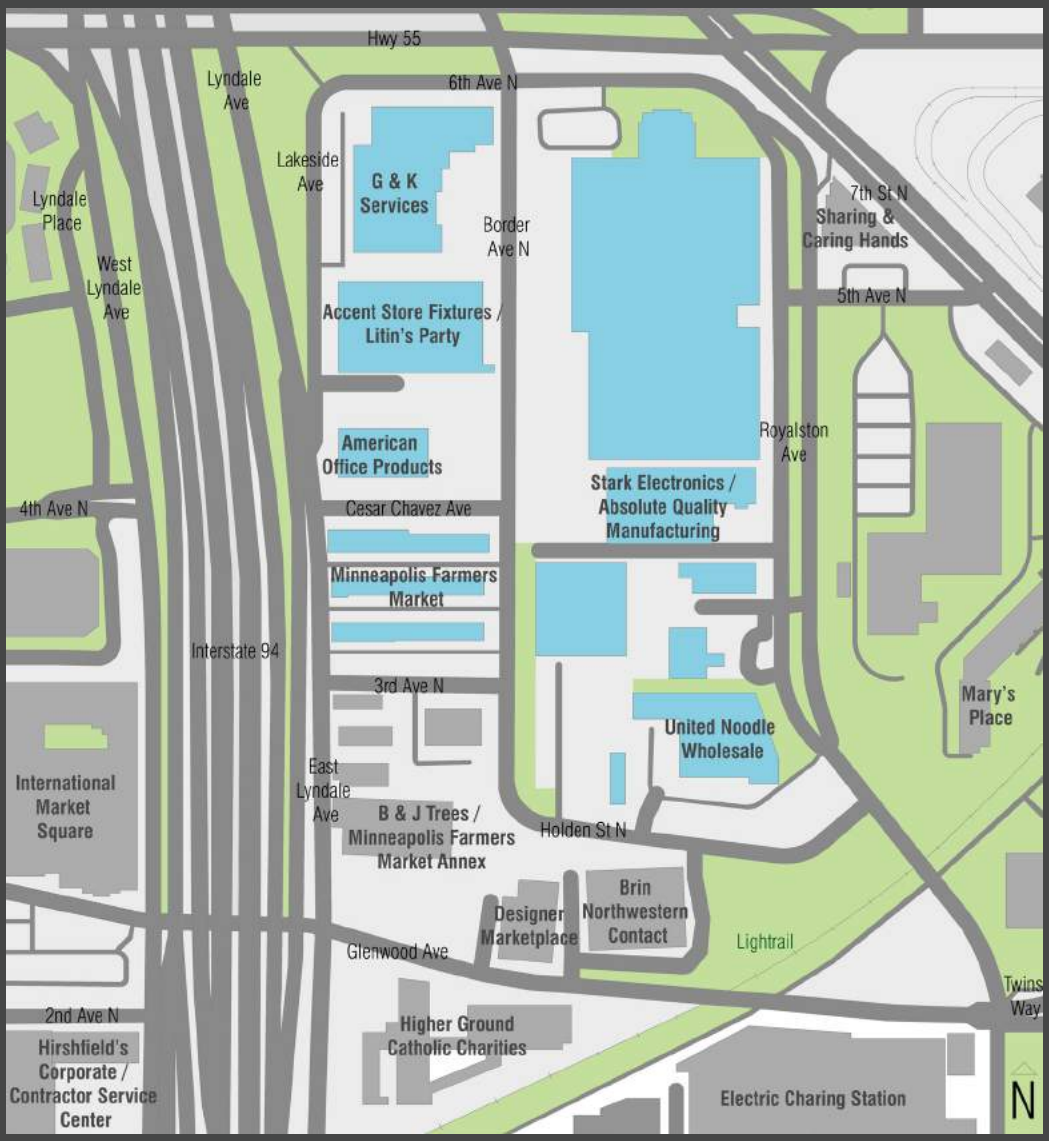


Figure 105 - Site Map of existing site

The existing site is in a prime location between I-94, Target Field and the International Market Square. The buildings in blue are the ones located on the site where the stadium and auxiliary spaces would be located.

Existing Site / *Demo* / Rejuvenation

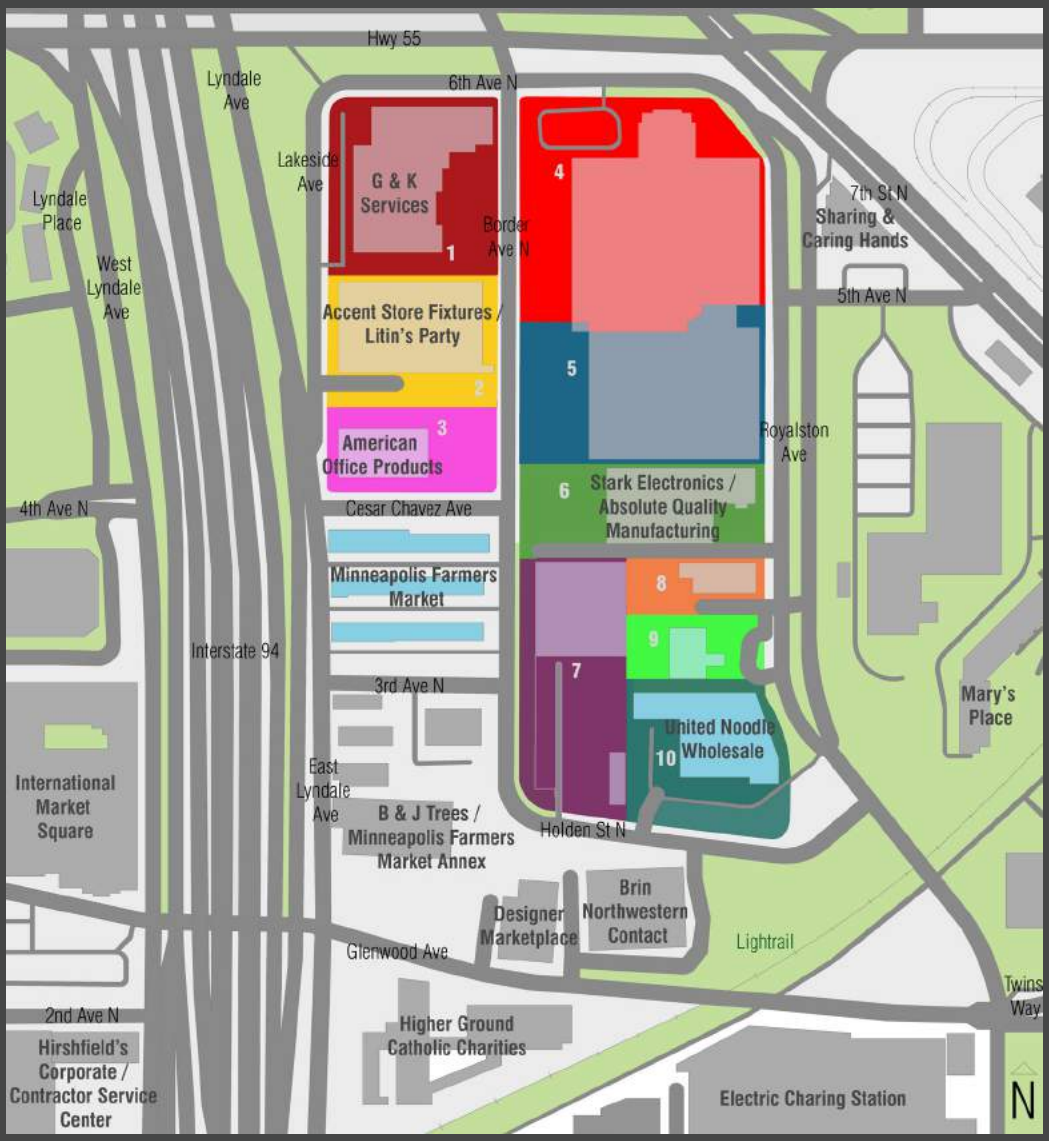


Figure 106 - Demolition Plan Map

The construction of the stadium would include demolishing of 10 different property zones, though the stadium I have designed has spaces allocated for many of the businesses as replacement.

Existing Site / Demo / *Rejuvenation*

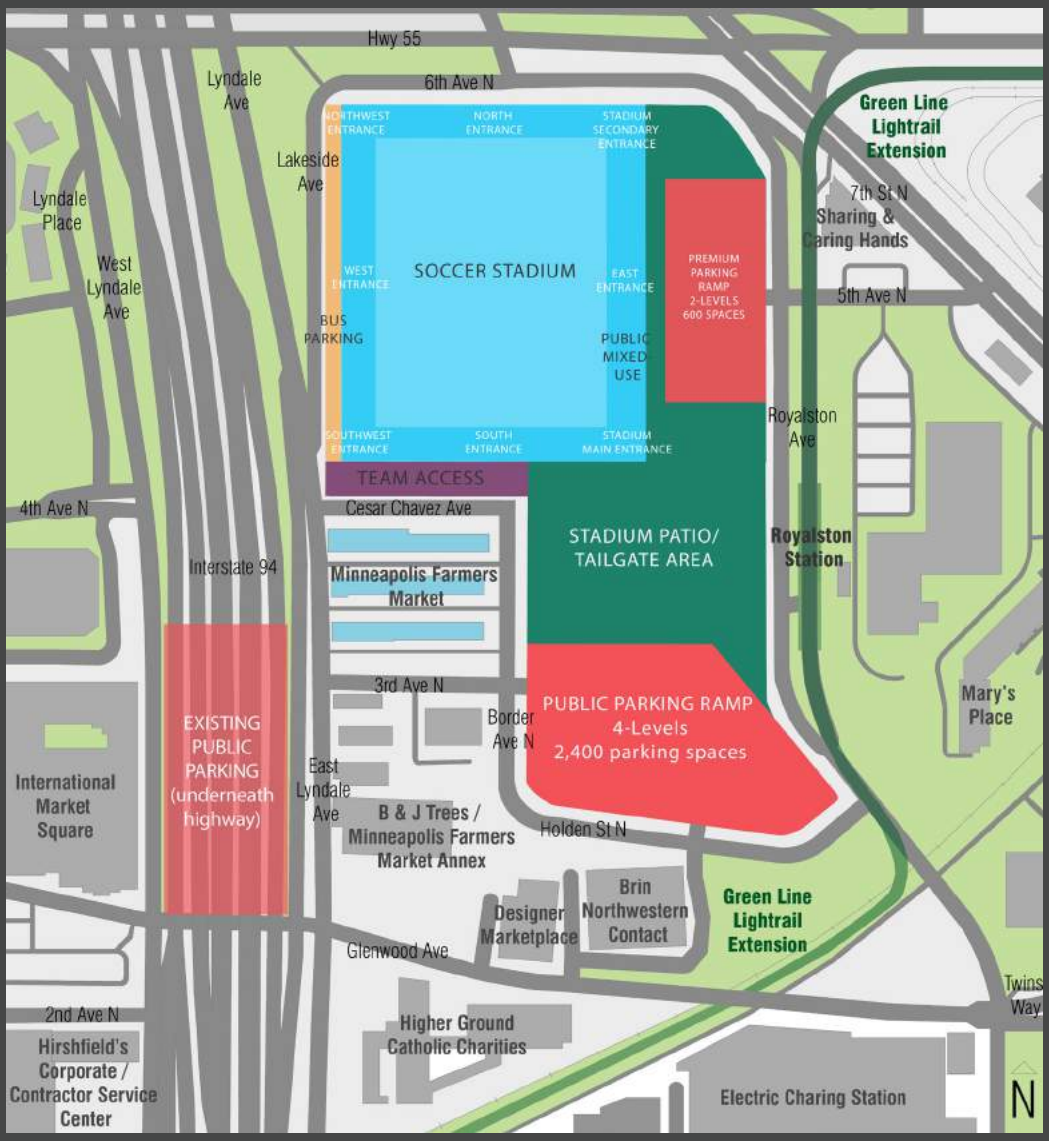


Figure 107 - Site Map after insertion of stadium design

Between new parking ramps providing 3,000 new parking spaces and a tailgate area located between the existing Farmer's Market and a future Light Rail station, this stadium is immersed in its site through many means of transportation.

Design Process / Inspiration Summary

Facade Inspiration

Figure 108 - Colonial Warehouse

Figure 109 - Else Warehouse

The Else Warehouse and the Colonial Warehouse are a couple of the buildings that are nearby the proposed site in the Warehouse District of Minneapolis.

Figure 110 - Ibrox Stadium

Ibrox Stadium in Glasgow, Scotland has a distinct warehouse style about it which was inspiration for the facade of the Minnesota FC Stadium. I feel the brick and glass facade represents strength and tradition, signaling that soccer will trive in that stadium and hopefully this proposal's design for many years.

Design Process / Inspiration Summary

Facade Design

Figure 111 - South / North Elevation Render

Locally-produced Kasota Limestone is used with brick in the masonry exterior walls, connecting the stadium with many of the area's buildings utilizing the same material, including Target Field. The brick material provides a timeless traditional style for the stadium as well as creates a downtown feel for the mixed-use spaces.

Figure 112 - East / West Elevation Render

Design Process / Inspiration Summary

Structural System Inspiration

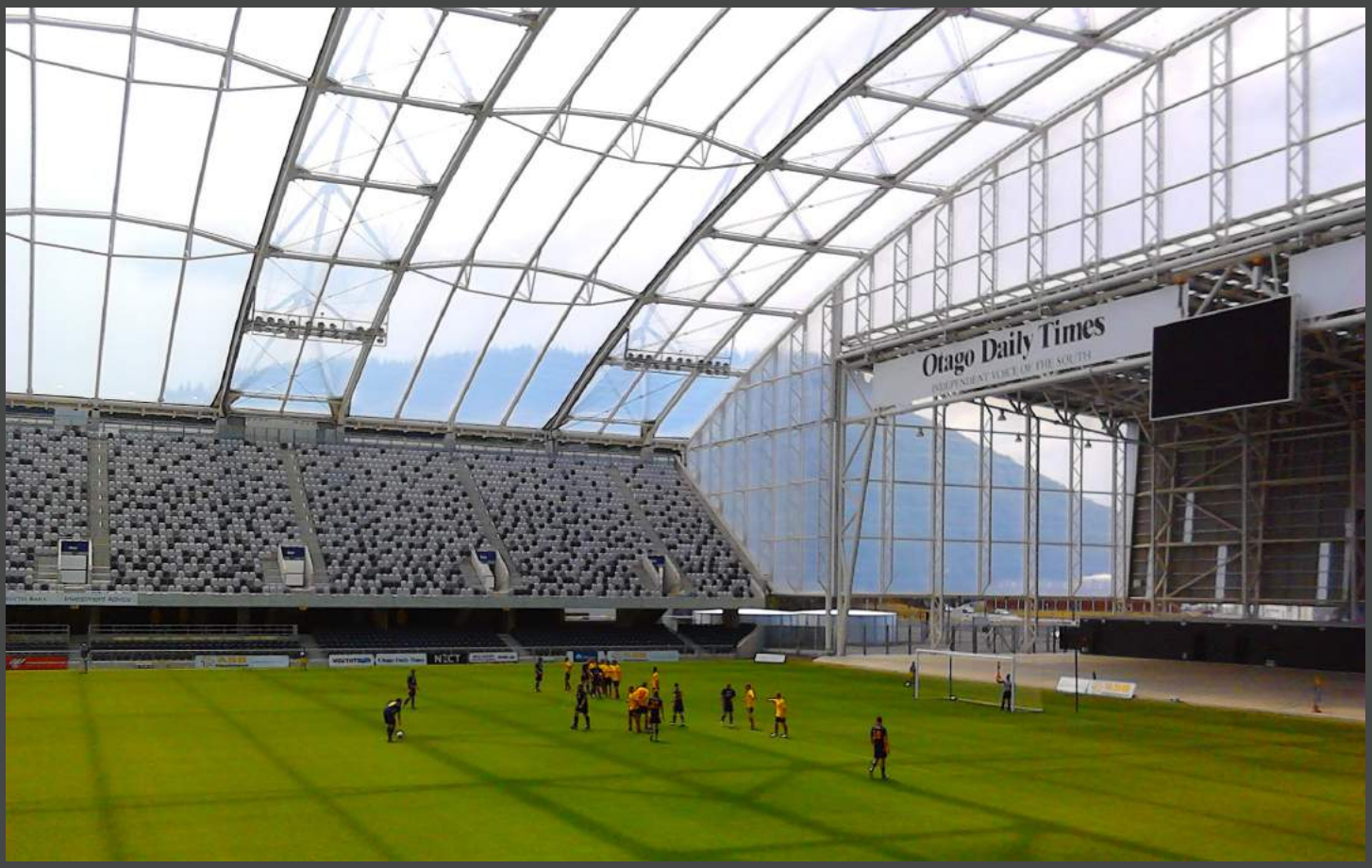


Figure 113 - Forsyth Barr Stadium

The Forsyth Barr Stadium in New Zealand features a steel structural system of curved I-beams and Tri-chord trusses that this stadium proposal borrows elements from. It also includes the use of an EFTE roofing system which allows the stadium to be fully enclosed while still letting in plenty of diffused daylight for games.

Design Process / Inspiration Summary

Structural System Design

Figure 114 - Structural system render

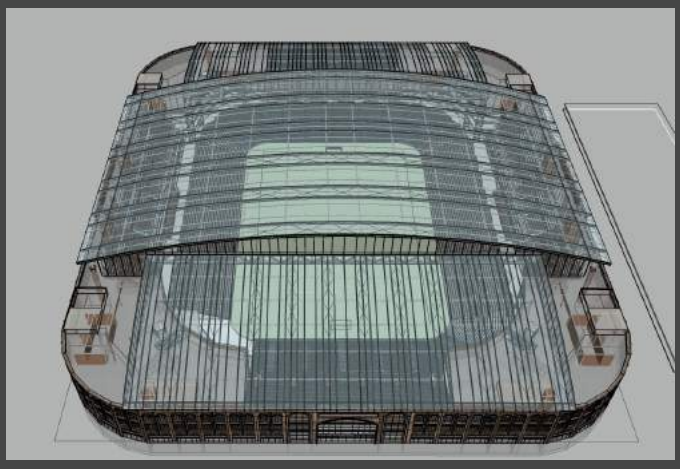


Figure 115 - Structural system top view

Figure 116 - 1st level fan balcony

Design Process / Inspiration Summary

Structural System Detail A

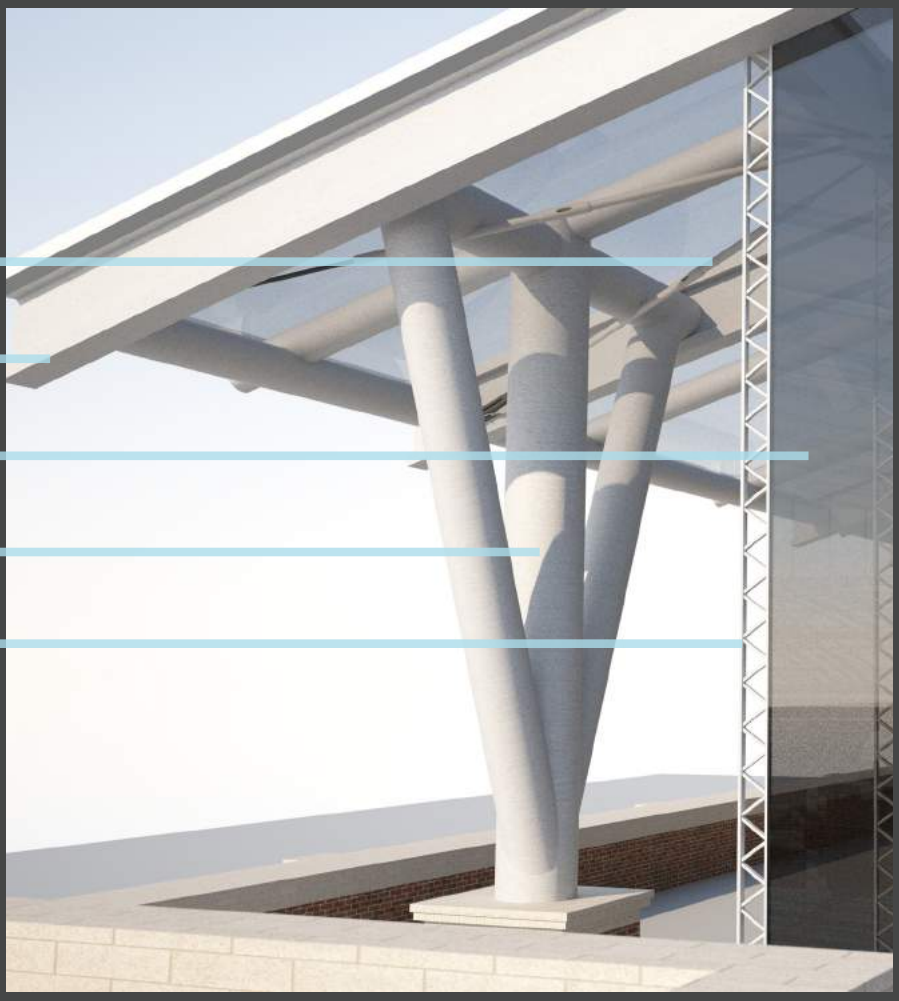


Figure 117 - Structural system detail A

The structural steel pipes run down into masonry columns at the same height as the brick parapet wall, the transition from steel at the roof level to brick in the interior levels allows for warmth and continuation of the facade design language into the interior spaces.

Design Process / Inspiration Summary

Structural System Detail B

Trichord Steel Truss

Steel Truss with Steel Plate Connection

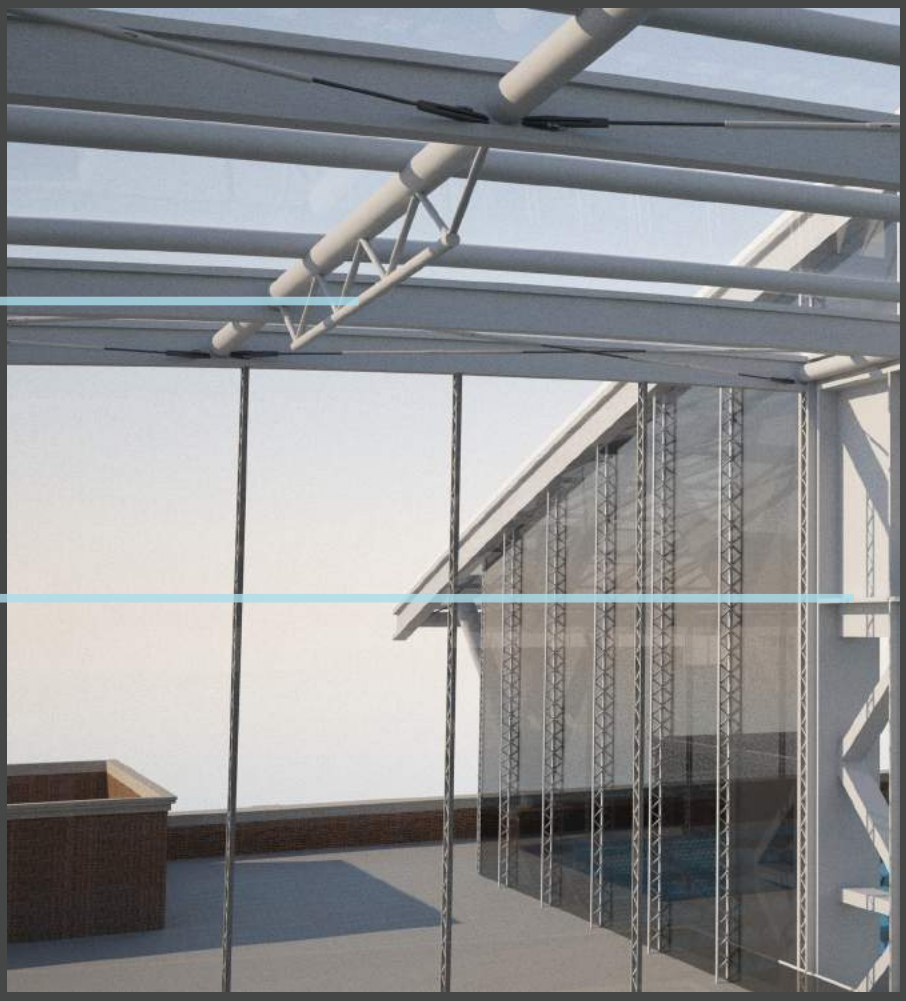


Figure 118 - Structural system detail B

Design Process / Inspiration Summary

HVAC System Design

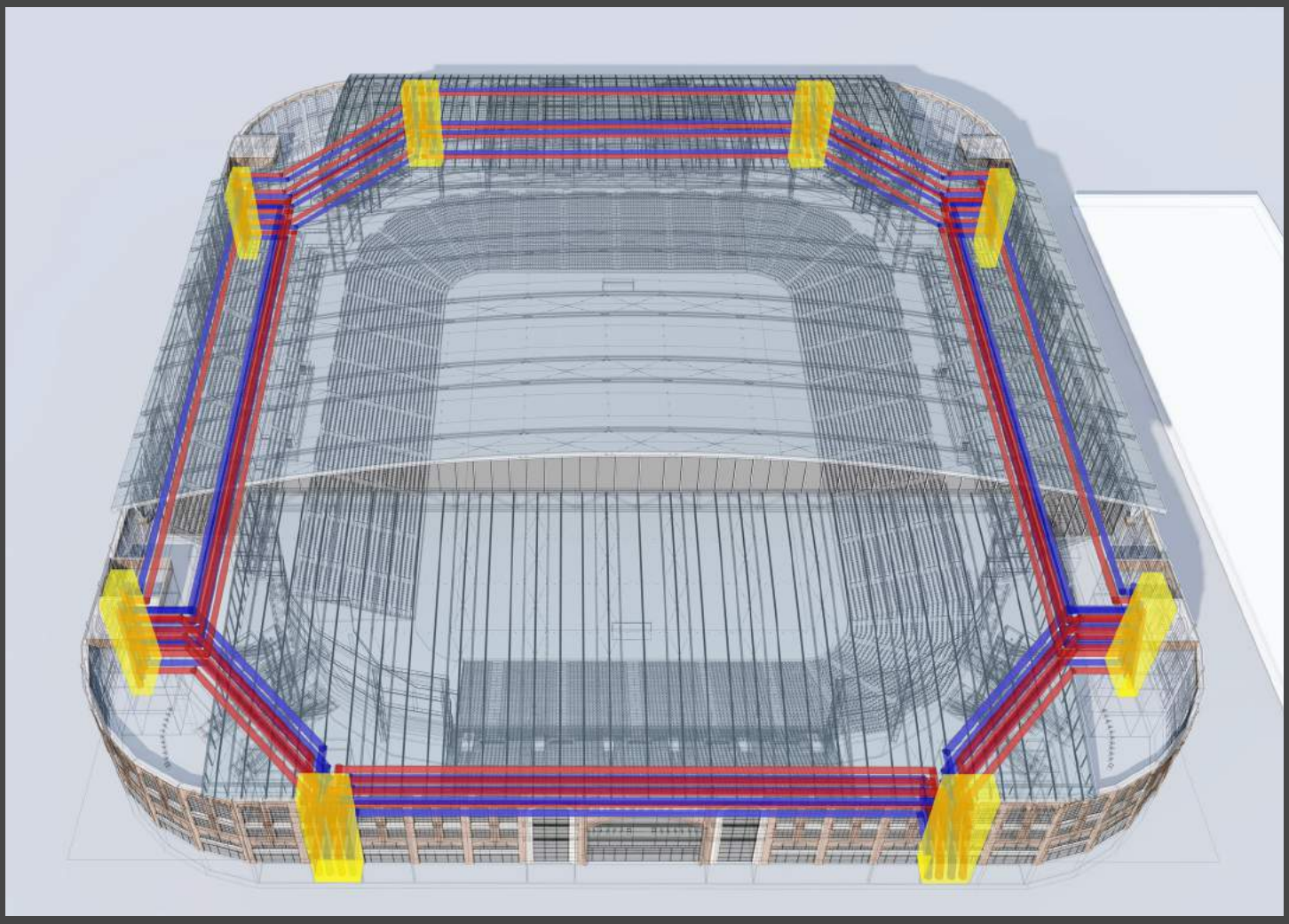


Figure 119 - HVAC design

Cooling Ducts Heating Ducts Air Intake

Design Process / Inspiration Summary

Excavation Study

The majority of the site that the stadium will be located on has soil that has a classification number of 4A. 93.8% of the site and 100% of the area the stadium would be built on has this soil and its the same type as what is beneath U.S. Bank Stadium, the new home of the Minnesota Vikings. Consequently I was able to design the first bowl of the stadium 25 ft. into the earth to allow for easier access from the sidewalk to the mixed-use and stadium area. The stadium feels fully integrated into the site.

Figure 120 - U.S. Bank stadium section cut

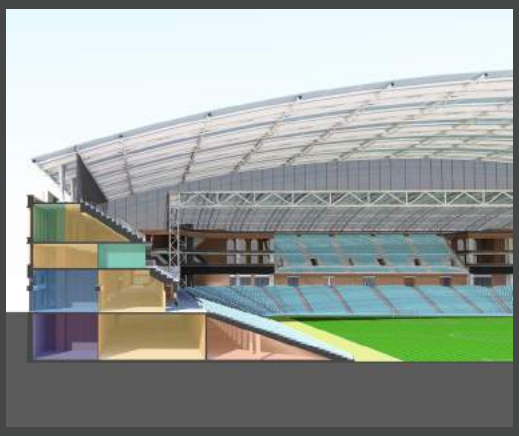


Figure 121 - Section cut B (small)

Design Process / Inspiration Summary

Seating Design Summary

Figure 122 - Seating iteration #1

Figure 123 - Seating iteration #2

Figure 124 - Seating iteration #3

Three different seating iterations were studied for effectiveness in material and space used to save on construction costs. Using RS Means, it was determined that the center and bottom iteration with more seats in the first bowl cost less to construct. They also took up less space from the mixed-use areas, allowing those spaces to generate more revenue. The seating design in the final stadium is most similar to the one on the bottom. Luxury suites have been added between the lower and upper decks on the east and west sides of the stadium. The stadium seats 20,000 fans, including 19,889 general seats and 111 handicap accessible spaces. More in-depth calculations and results from this study are available starting on page 110.

Design Process / Inspiration Summary

Seating Design Summary

Figure 125 - Stadium seating rendering

Stadiums are very complex structures. And adding as many additional spaces as I have in this program can run the risk of making it even more complex. That is why I designed the floor plans and seating areas as simply as possible. The simplicity of the wayfinding in the building allows for inhabitants to free their minds of being lost and allows them to focus on the game, or the shopping, the eating, or the fact that they can do all of these in one building.

Final Design Images

Stadium Section Cuts

Figure 126 - Section cut A

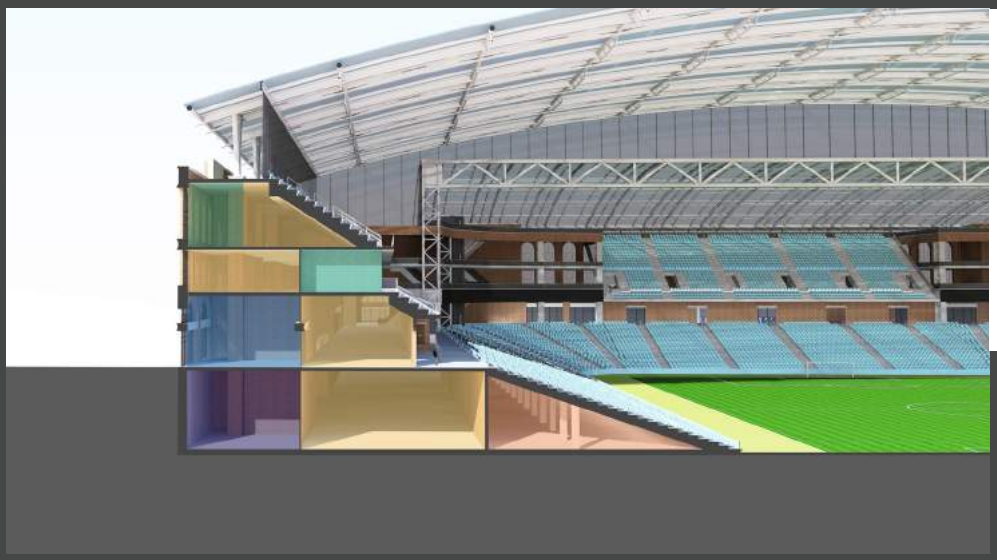


Figure 127 - Section cut B

Final Design Images

Basement Floor Plan

Figure 128 - Basement floor plan

The basement offers home and away locker rooms, a kitchen for both the players and catering events in the 3rd floor event space, exercise areas, and trainer spaces. The basement is only accessible from the elevators and stairs using key access, this keeps the public from the designated team areas. The teams access the playing field by entering from the tunnel underneath the fan balcony in the southwest corner.

Final Design Images

Basement Floor Plan Key

Figure 129 - Basement floor plan key

Final Design Images

First Floor Plan

Figure 130 - First floor plan

The Outer rim of the first-floor is dedicated for mixed-use spaces that are used at least 5 days a week. Access to mixed-use spaces and circulation to 2nd and 3rd floor office spaces are located before entering stadium area, preventing confusion between ticket holders and non-ticket holders. There is also a space for the Farmer's Market to set up an organic grocery store. I saw this as an opportunity to give them an indoor space to sell during the winter. I also see food from the Farmer's Market being sold with the regular concessions food during the games as well. I aimed to rejuvenate many of the aspects of a stadium experience, including the types of food offered.

Final Design Images

First Floor Plan Key

Figure 131 - First floor plan key

R - Replacement Space for Existing Office On Site

E - Space Used Every Day

Final Design Images

First Floor Mixed-Use Area: Barney's Pub

Figure 132 - Barney's Pub render

Final Design Images

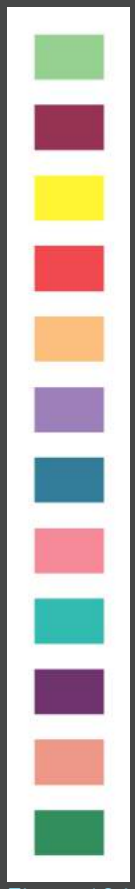
Second Floor Plan

Figure 133 - Second floor plan

Office spaces created for businesses involved in demolition area. There are 34 luxury suites available. Luxury suites are becoming more and more an essential part of stadium design. The ticket prices are higher, generate more revenue, and help pay for stadiums.

Works Cited

Second Floor Plan Key



Stairs / Elevators
Women's Restroom
Men's Restroom
Mechanical / HVAC Rooms
R E Office Space - United Noodle Wholesale
R E Office Space - Accent Store Fixtures
R E Office Space - American Office Products
R E Office Space - Stark Electronics
Standard Suites
Premium Suites
VIP Suites
Concessions Areas

Figure 134 - Second floor plan key

R - Replacement Space for Existing Office On Site

E - Space Used Every Day

Final Design Images

VIP Stadium Suite

Figure 135 - VIP stadium suite render

Final Design Images

Third Floor Plan

Figure 136 - Third floor plan

3rd floor corner office spaces designated for high-profile clients like an architecture firm or bank, one of the corners is designated for special events.

Final Design Images

Third Floor Plan Key

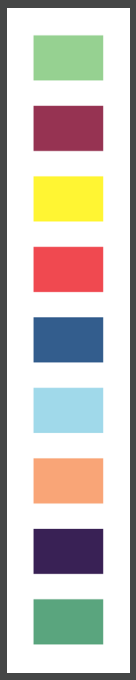


Figure 137 - Third floor plan key

R - Replacement Space for Existing Office On Site

E - Space Used Every Day

Final Design Images

Third Floor Plan Office Space: FHC Architects

Figure 138 - FHC Architects office render

Final Design Images

Fourth Floor / Roof Deck Plan

Figure 139 - Fourth floor plan

Final Design Images

Fourth Floor / Roof Deck Plan Key

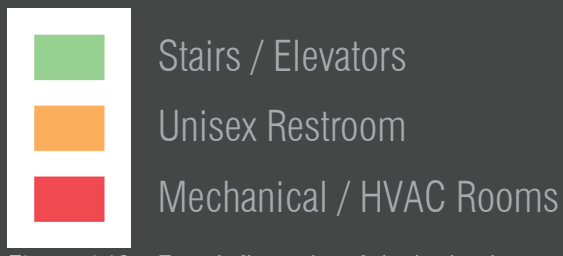


Figure 140 - Fourth floor / roof deck plan key

Final Design Images

Roof Balcony

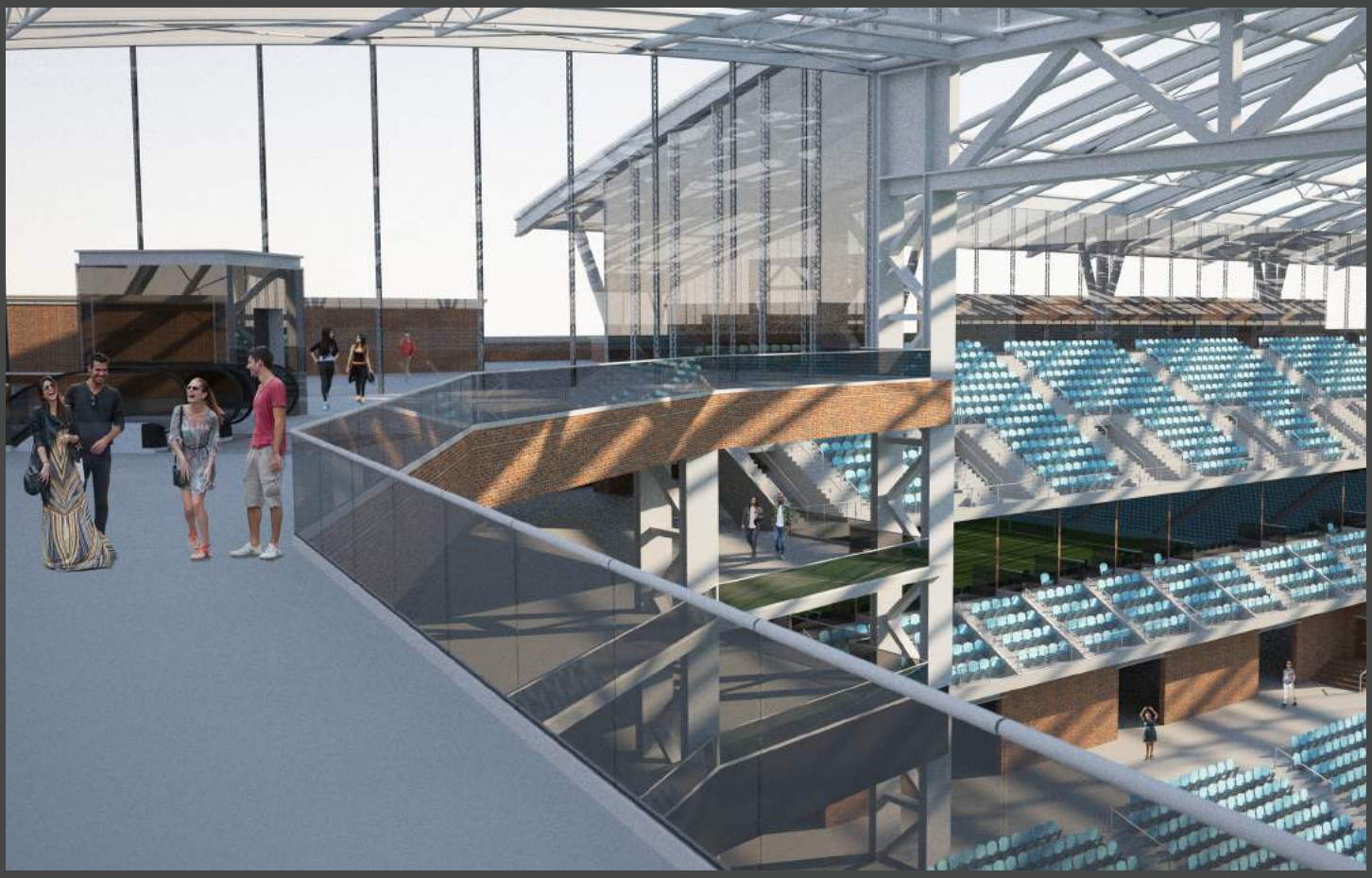


Figure 141 - Roof balcony render

The fourth floor shows the design's goals to make a walkable space as the east and west sides of the 4th floor include an accessible space for pedestrians to enjoy the outdoors while being able to watch the game through the EFTE panels.

Lessons Learned

Stadium design is changing, for the better - There are many stadiums now incorporating mixed-use in their design plans. Stadiums are getting more and more expensive and the inclusion of mixed-usage in the designs can help convince the owners and taxpayers that paying for a stadium is worth it when it can be used daily instead of a couple times each week.

Spatial planning and organization is crucial to mixed-use stadium design - I wanted to include a lot of mixed-use in this project, to create an urban neighborhood within one building. I wanted all of these spaces to be accessible right off the streets surrounding the stadium, but I had to also make sure that the inhabitants of the mixed-use spaces didn't also have instant access to the stadium. So while I was bringing stadium and mixed-use spaces together in one building, for many reasons I still had to be keep them separate for many reasons.

Combining the stadium and mixed-use aesthetic is a sensitive design process - Designing a facade that fit the stadium typology and mixed-use spaces took some balancing. I ended up going with a brick facade that gives the stadium a warehouse/industrial feel, which also creates a nice, inviting streetscape for the mixed-use spaces on the ground floor.

Technology is advancing along our design techniques - The growing use of EFTE roofing (the same used at U.S. Bank Stadium, the new home of the Vikings), allows stadiums to have most of the benefits of an open-air stadium while still allowing the building to be fully enclosed and used year round, further giving stadium investors a return on their investment.

Lessons Learned

A stadium's integration into its site is critical - Designing the stadium's first bowl of stadium seating and the field to be 25 ft. underneath the ground level allowed for the stadium to be fully immersed into its site as well as further strengthen the walkable quality that the design possesses as many of the stadium occupants will be able to walk in right off the street and down into their seats. This also helps with accessibility, an area stadium designs can always improve on. Also placing the site so that it both incorporates the existing Farmer's Market and the future Light Rail extension shows that this design was flexible enough to incorporate what worked on the site previous to the building of the stadium and what will help it in the future and combined it into one cohesive design solution. This design respects its urban context while looking to improve upon it.

To improve stadium design, we must learn from lessons in the past as well as utilize new building technology- The style of this stadium is a combination of new and old tactics of stadium building and this relates to the sport of soccer in a sense that it is also new and old. It is a sport with much history and tradition but a sport that is newly emerging in popularity in America and into the Twin Cities. My hope is that like the growing popularity of soccer, smarter stadium design keeps growing in popularity as well.

Appendix : Reference List

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