

THANK YOU

This thesis work is only a small expression of years of passion, encouragement and support from my parents, grandparents, wife, dear friends, faculty and colleagues over the years. I am grateful for their support, time and sacrifice. You trusted me and let me try new ideas, see new places and pursue my dreams. This publication would not be complete without including this sincere expression of my utmost gratitude. Thank you for investing in and believing in me. This is just the beginning, and I owe my success to each of you.

Matthew R. Dunham

Kinetic Morphology of Performance Spaces



Thematic Introduction

One word that encompasses the entire thematic idea is morphology. This is the study of how spaces can change from one use and typology into a completely different one. In a simple analogy, this thesis takes your average plastic, zip-lock bag and morphs it into a wine glass. Both containers have similar uses; they can hold a liquid. Both items can separately come in many forms and shapes but morphology happens when one takes on the form and shape of the other.

The main typological category of this thesis is performance spaces. A project of this nature has immense requirements which demand a plethora of contingencies and technologies. Now for a more nominal example of this thematic idea. The building can accommodate within one space a multitude of performance spaces: opera and conferences, dance and orchestra, rock concerts and chamber music. This accommodation requires a large number

Figure 0.1. Photo by: Matthew Dunham, Wyle Theater, Dallas, Texas

Morphology: the study of how things, spaces, items and environments change from one use to another. This embodies the entire premise for this research and thesis. A space which is ever evolving and changing as the public needs and uses change.



v

of kinetic elements which assist in transforming each space specific to its needs. It involves an advanced level of automation, resulting in less physical labor. It is a building that not only can facilitate high energy, loud and dynamic concerts, but also technologically morph into a seductively dramatic and powerful space for evening theatrical shows and opera. The facility will be able to accommodate multiple typologies at one time, under one roof, in sub divided spaces which allow visitors the full experience of entertainment.

Before humans utilized design there was craft, which entailed making useful items for specific needs. As man progressed, design was introduced which allowed items and environments to be shaped

for anthropometric ease and enjoyment. There have been continual advancements in all spheres of technology and manufacturing as inventors try to produce items, solving more refined and specific tasks. This later birthed the possibility for adornment and classical-renaissance embellishment, which was not nearly as practical as it was strictly aesthetic. Architecture is now re-emerging to be more practical and useful after a half-century of being reduced to an embellishment and elitist-material.

In this design, all components, other than structural members, must serve multiple purposes and play a role in the morphology of space. The project combines technology integrated architecture with practical solutions and clear design.



Figure 0.2. [Right] Photo by: Matthew Dunham, Show: La Reve, Las Vegas, Nevada
Figure 0.3. [Left] Photo by: Matthew Dunham, The Guthrie Theater, Minneapolis, Minnesota

Previous Studio Work

Fall 2010

JOAN VORDERBRUGGEN

Tea House, Fargo, ND

Boat House, Minneapolis MN

Spring 2011

DARRYL BOOKER

Montessori School, Fargo, ND

Bird Habitat, Bird House

Residential Dwelling, Marfa, TX

Fall 2011

STEVE C. MARTENS

Granite Gallery, St. Cloud, MN

Beaver Research Facility, Kansas City, KS

Spring 2012

MILTON YERGENS

Cotton Research Facility, Mobile, AL

Cooking School and Restaurant, Fargo, ND

Fall 2012

CINDY URNESS

250 Main; Highrise, San Francisco, CA

Spring 2013

FRANK KRATKY

School in Ghana, Africa

Art Installation Project, Fargo, ND

Figure 0.5. Photo by: Matthew Dunham, Masdar City, Abu Dhabi, UAE
Photo taken during Matthew's 3rd group of 20 students which he led to the United Arab Emirates in March 2014. Study Abroad Courses began in 2013 taking NDSU Engineering, Architecture, Interior Design and Landscape majors, both graduate and undergraduate.





Contents

I	Dedication
III	Thematic Introduction
IX	Previous Studio Work

CHAPTER ONE

03	Signature
05	Abstract
07	Problem Statement
09	Project Emphasis
10	Proceedings

CHAPTER TWO

13	Client Description
15	Project Elements
17	Thesis Goals
19	Narrative

CHAPTER THREE

25	Site Information
29	Demographic Context
31	Economic Context
33	Infrastructure Context
35	Climate

CHAPTER FOUR

42	Research
57	Historical Context: Dallas Texas
60	Case Studies
62	<i>Wyly Theater, Performing Arts Center, Dallas.</i>
68	<i>Winspear Opera House, Dallas TX</i>
74	<i>Target Field, Minneapolis, MN</i>
79	Interaction Matrix and Net
81	Space Planning
83	Program

CHAPTER FIVE

91	Building Structure
93	Building Kinetic Elements
95	Exterior Street View
96	Exterior Colonnade
97	Night View Main Door
98	Sun Slats and Cantilevers
99	Main Lobby
100	Administrative Office
101	Palm Court
102	Lounges and Restaurants
103	Concert Hall Configuration
104	Theater Configuration
105	Half Arena Configuration
106	Full Arena Configuration
107	Substage Lifts
108	Security
109	Kinetic Transformation
112	Kinetic Transformation

FLOOR PLANS

115	Level One
117	Level Two
121	Level Three
122	Level Four
123	Level Five and Seven
124	Level Six
125	Level Roof
127	Thesis Display
129	References
131	About the Author

Tables and Figures

Cover: Renders by: Matthew Dunham, of Thesis Design Project, (See Chapter 5)

I	Dedication
III	Thematic Introduction
IX	Previous Studio Work

CHAPTER 1

Figure 1.0. Guthrie Theater
Figure 1.1. The Orpheum Theater

CHAPTER 2

Figure 2.0. Wylly Theater
Figure 2.2 Target Field
Figure 2.3. Thesis Performance Render
Figure 2.4. Guthrie Theater

CHAPTER 3

Figure 3.0. Dallas
Figure 3.1. US Map
Figure 3.2-3.7 Satellite Images of Texas
Figure 3.8. Fair Park
Figure 3.9. Fair Park
Figure 3.10. View of Site and Downtown Dallas
Figure 3.11. View of Site
Figure 3.12. View of Site
Table 3.13. Population Pie Chart
Table 3.14 Population Age Distribution
Table 3.15 Population Annual Income
Table 3.16 Population Income City
Table 3.17 Income Neighborhood
Table 3.18 Top Area Employers
Table 3.19 Means of Transportation
Figure 3.20 Dallas High Way
Figure 3.21 Dart Train
Figure 3.22 Climate
Figure 3.23 Climate
Figure 3.24 Wind Diagram
Figure 3.25 Sun Angle
Figure 3.26 Sun Angle Summer and Winter
Figure 3.27 Sun Diagram

CHAPTER 4

Figure 4.0 Target Field
Table 4.1 Orpheum Stage
Table 4.2. La Reve Las Vegas
Table 4.3. Willow Creek Church
Figure 4.4. Willow Creek Church
Figure 4.5. La Reve Las Vegas
Table 4.6. Winspear Opera House
Table 4.7. Winspear Opera House
Figure 4.8. Winspear Opera House
Figure 4.9. La Reve Las Vegas
Table 4.10. Chicago Millennium Park
Figure 4.11. Target Field
Figure 4.12. Target Field
Figure 4.13. Chicago Millennium Park
Figure 4.14. Target Field
Table 4.42 Interaction Matrix
Table 4.43 Interaction Net

CHAPTER 5

Figure 5.0 Performance Arena
Figure 5.1 Concert Hall Configuration
Figure 5.2 Exterior Facade
Figure 5.3 Lobby
Figure 5.4 Entrance Night View
Figure 5.5 Standard Waffle Slab
Figure 5.6 Waffle Slab Roof
Figure 5.7 Precast Floor Element
Figure 5.8-5.11 Kinetic Components
Figure 5.12 Door 4 Front View
Figure 5.13 Exterior Colonnade
Figure 5.14 Door 3 at Night
Figure 5.15 Sun Slats and Cantilever
Figure 5.16 Lobby Main Concourse
Figure 5.17 Administration
Figure 5.18 Palm Court Cafe
Figure 5.19 Restaurant and Cafe
Figure 5.20 Concert Hall
Figure 5.21 Theater

Figure 5.22 Half Arena
Figure 5.23 Full Arena
Figure 5.24 Substage Lifts
Figure 5.25 Security
Figure 5.26 Kinetic View
Figure 5.27 Kinetic Process

APPENDIX: FLOOR PLANS

Figure 6.0 Digital Process Model
Figure 6.1 Level 1
Figure 6.2 Level 2
Figure 6.3 Level 2
Figure 6.4 Level 3
Figure 6.5 Level 4
Figure 6.6 Level 5 and 7
Figure 6.7 Roof

About the Author

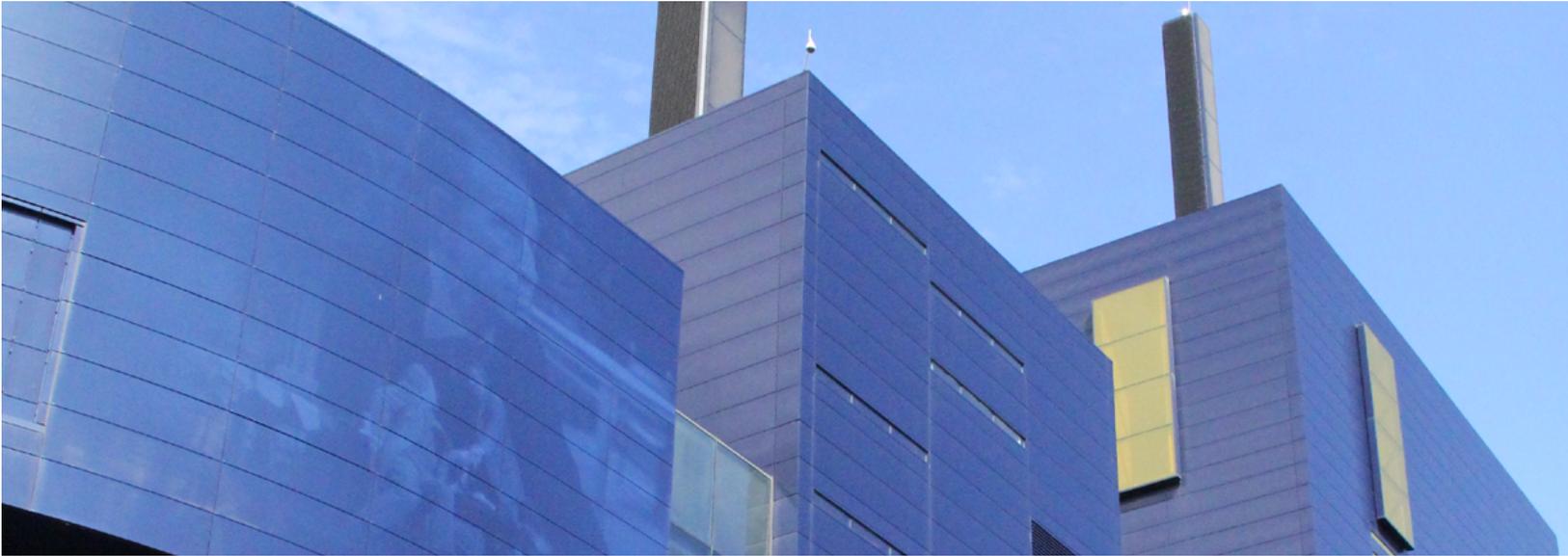
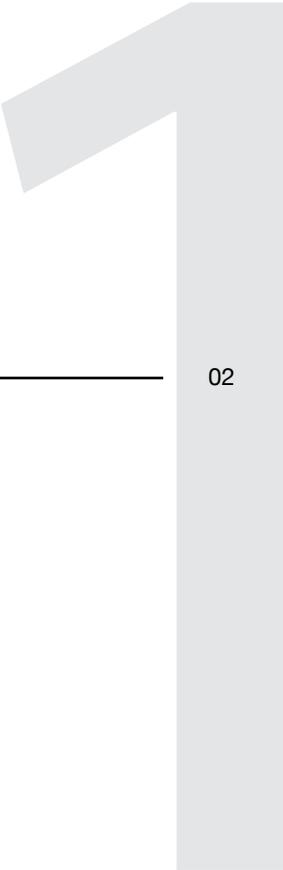
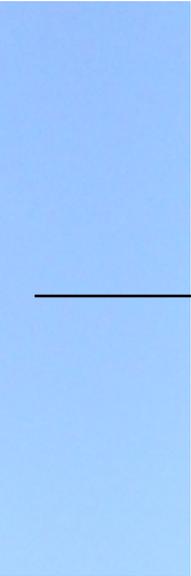


Figure 1.0. Photo by:Matthew Dunham, The Guthrie Theater, Minneapolis, Minnesota



Intent

CHAPTER ONE

02

Signature Page

Morphology of Performance Venue

 MAY 12, 2014
PRIMARY THESIS ADVISOR

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

By

 MAY 12, 2014
MATTHEW ROBERT DUNHAM
THESIS COMMITTEE CHAIR

In partial fulfilment of the requirements for
the degree of Masters of Architecture

December, 2013
Fargo, North Dakota

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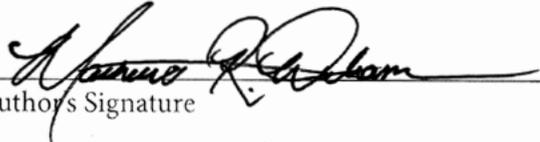
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5/12/14
Date

Abstract

Title: Kinetic Morphology of Performance Spaces

Typology: Performance Space

Site: Dallas, Texas USA.

This is a study of how spaces change from one typology into a completely opposite one. The main typology is stage performance with immense requirements which demand the use of advanced technology and automation. The project combines all stage performance types into one facility, or space. The building accommodates dance, opera, orchestras, rock concerts, conventions, lectures, chamber music, theatrical productions, and intimate recitals, hosting audiences as few as 250 people or as large as 38,000-52,000 people. State of the art technology

integrated architecture will facilitate the complex transition from one space to another. Spaces will be able to accommodate large, dynamic athletic events yet technologically morph into a seductively dramatic space for an evening theatrical show, orchestra or opera. The space needs to be able to accommodate all typologies at one time, under one roof, in subdivided spaces, allowing visitors the full experience of light, sound, and video, regardless of the event.

Project Size: 2.1 Million Square Feet.

Key Words: Flexibility, Technology, Kinetic, Morphology, Theater.



Figure 1.1. Photo by: Matthew Dunham, The Orpheum Theater, Minneapolis, Minnesota

Thesis Problem Statement

Technology-integrated architecture in the morphology of high-profile performance venues for maximum flexibility.

*To clarify terminology used in this research proposal, the term performance space denotes all artistic and stage related performance venues with capacities of 500-30,000 observers.

Typology

Multiuse performance Arena

Claim

A venue which transforms to accommodate *all* conceivable event typologies will have a longer life span, facilitate more events and visitors, and be a prototype for future buildings.

Premise

Transforming performance venues demands high end technology integrated architecture to maximize full potential flexibility. (T. Landis, personal communication, August 13th, 2013)

Unifying Idea

One space which can be used to host gatherings of 250-30,000 people. A single space which morphs to create separate spaces within the whole, bringing all arts together to share one space.

Need

One large performance venue which has multiple artistic typologies where it is digitally flexible to accommodate acoustics, lighting, pedestrian circulation, and service needs.

Justification

These existing large venues have a high cost and energy consumption. However, by combining multiple typologies under one roof, it becomes a one-stop-shop destination, minimizing costs, consolidating resources and compounding income.

Project Emphasis

The concept is to create a multi-use performance facility which can modulate using Technology-integrated architecture to morph into customizable spaces for athletics and artistic events. The goal is to reduce man hours and achieve a minimum of 82% digital control for event change over. This will maximize the number of events in the facility annually while reducing overall costs through consolidating resources, trained professionals, and security.

Plan for Proceeding

Research

This is a typology which has not been precisely done before on such a scale. Therefore, much of the research pertains to studying valid case studies which share foundational elements with this project, learning what has been done in various unrelated typologies and applying it to the architecture of this performance venue. On-site analysis was conducted in August of 2013, accompanied by a national U.S. tour of 11 facilities to explore and meet with staff at these facilities. This information was then used to program and design this project.

Methodology

First, visit and research case studies which have similar facets and morphing spaces. This will consist of interviews, taking photographs and gathering literature. Second, narrow down precise goals to achieve for this design and develop a unifying idea. Third, study systems through statistical data, online and library archives for technology and other applications of kinetics in architecture and design. Fourth, apply knowledge of case studies and technology to create a solution for the design problem.

Documentation

On-site documentation, in the form of site analysis and case studies, will be recorded on digital recording devices, through photography, hand sketching and online research. Further, documentation of the design process will be executed using hand drawings on paper, analysis of computer files and using the computer for designing the final architectural space. This will be presented in the end, using both print and digital media, having screens showing fly-throughs while a model and printed images bring all elements into clarity.

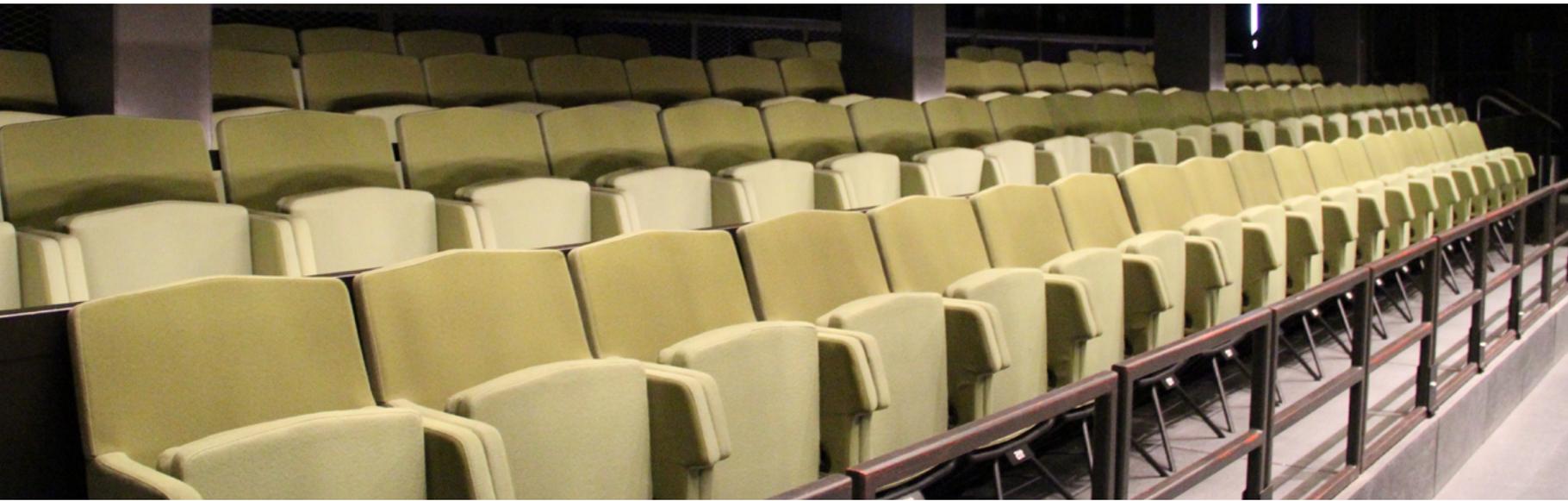


Figure 2.0. Photo by: Matthew Dunham, The Wily Theater, Dallas, Texas.

Proposal

CHAPTER TWO



Client Description

There are two main clients in this project; the End User and the Public. It is imperative due to the complexity and morphological nature that the End User and the Public function unanimously well for a large calendar of high-tech high-indoor events and outdoor spaces. The venue will have the capacity to host upwards of 118 athletic and artistic event typologies, as well as be versatile enough to allow for conventions, large conferences and trade shows.

End User: The End User refers to any personnel who work inside the facility. This includes, but is not limited to, management,

custodians, mechanics, security, production, cooks, receptionists, grounds keepers, engineers and volunteers. Each role is specific and the facility needs to be designed to accommodate the users needs while maximizing realistic flexibility and safety.

The End Users will require upwards of 150 full time daily employees, and in all likelihood over 800 volunteers for larger events. The building needs to satisfy the End User's ability to easily manage, navigate and function during any event. But primarily the process of architecturally-morphing (rolling over) the venue from one event to another must be at least 85% hands free.

To facilitate this transformation as quickly and safely as possible for the End User, integrated technology and automated building systems must be incorporated in the design to transform spaces.

Public: The Public references anyone attending an event, show, reception or dinner within the facility. Events will range from 250 guests in intimate receptions to 60,000 guests at full capacity. The navigation, parking, hospitality and experience must function seamlessly regardless of event. Furthermore, guests will range from black-tie attendees to casually-dressed concert goers so the design of the building must stylistically and architecturally reflect both groups.

Beyond the perimeter of the venue, a large master plan for the re-development of the site has been proposed. This master plan will be referenced to indicated where future growth is already apparent and how the construction of this performance venue can improve the entire community.



Figure 2.2. Photo by: Matthew Dunham, Target Field, Minneapolis, Minnesota

Spaces should not be boring. There is power within the design of a space to control the environment and emotions of its users. Spaces become boundaries, shaping peoples' imaginations and dreams.

Project Elements

Dynamic Facade
As the building is used for both athletic and artistic events the facade needs to reflect the varying event typologies.

Parking
The main users for the lots will be event attendees and should be easily accessible to entrances and well marked.

Arrival
The way the public approaches the building either on foot or by vehicle needs to be easy. Signage needs to be clear and adaptable for all events.

Performance Space
As the main, practical feature of the facility, it needs to be versatile and function at maximum capability for both the performances and audience(fans).

Restaurants
To accommodate guests the facility will have upwards of 30 concession stands and 8 diverse restaurants (open not just for events).

Pedestrian Flow
Movement around the exterior and interior needs to be clearly labled. The environment should be inviting, comfortable and flexible.

Sustainable
The building's energy consumption rate will be high when it is at full capacity. The building will need to manage its own systems and adapt to save energy and electricity.

Rest Rooms
These are essential and should accommodate a capacity of 38-60,000 visitors while maintaining ample water supply and pressure.

Event Space

Capable of holding a gathering of 250 people or upwards of 60,000. Each space needs to be outfitted with all appropriate needs for hosting public events and provide adequate storage.

High-tech

The venue morphs to accommodate varying event types; Adapting audio, lights, projection and signage. This demands state-of-the-art, automated, technology management systems.

Flexibly

The venue can host upwards to 200 different events each year. Everything should be able to adapt and change as the event needs present, whether it is trade show or musical.

Security

Bag check and metal detectors will be at each entrance, including underground parking. Maximum security is required for high profile venue. It should be designed to ease response to crisis situations.

Outdoor Spaces

While the indoor spaces are large, the outdoor spaces must easily accommodate vast parking and contain relaxing spaces, lots of landscaping and provide shade.

Service Level

Accessible to all elevator shafts and all stair wells, this full-circle corridor allows access to all major mechanical and security systems and easy access to the loading dock.

Acoustics

Each event typology demands precise acoustic and amplified sound. As the space adapts its physical shape, the auditory functions will also need to adapt for every event.

Lighting

Each function requires precise stage lighting and event lighting. As the main space adapts its physical shape the lighting layout and design will also adapt for each event.

Loading

For daily use and loading in an event, a large underground loading dock capable of fitting 5 semi trucks and 8 medium trucks is needed.

Thesis Goals

The scope of this thesis project aims not only to design the central performance venue, but also design a building which can become a catalyst for the redevelopment of the entire Fair Park area, which is in the lower east side of Dallas, Texas. The building would be the first element needed to bring about positive redevelopment of the entire lower east side and attention should be given to this matter.

The goal is to create an exceptionally powerful and dynamically functional facility which demonstrates not only five years worth of academic learning but also embodies a lifetime of interest in the typology. Creativity is not the primary goal, but rather functionality, usage, accessibility, and system

integration. Overall cohesive design and form are dictated by the building's natural form and circulation rather than an inspirational artifact or iconic form. This thesis directs attention to spatial arrangement, circulation, theater systems and integrated building systems as they pertain to the typology.

The final presentation goal for this thesis revolves around the complexity within the kinetic transformation of space. To best capture this morphological concept, it will be best to present using 3D animation, clear simple models and sequencing captured in still renders.

Lastly, and more importantly, this thesis aims to bridge the gap between traditional, repetitive typologies and expanding their possibilities through using available technology integrated

design with modern resources. Design in the 21st century should be geared towards flexibility and adaptation, so this thesis strives to do just that. Such a design adapts to change and even forecasts changes in the function of the building. Moreover, this thesis presents explorative research in large scale kinetic systems and well-articulated circulation spaces, more so than a generic structure.

In the end the thesis demonstrates a pool of competently learned knowledge through the research and final work. It is to create an exceptionally powerful and dynamically functional facility typology.



Figure 2.3. Computer Render by: Matthew Dunham, Thesis Project. View of kinetic elements within performance space in motion.

Narrative

Performance spaces have long been a passion of mine. Even as an adolescent, I found these spaces to be magnificent; An ethereal experience of beauty and refined elegance. From their acoustic formations and lighting systems, to orchestra pits, back stages and lofty fly shafts, I was mesmerized. This thesis at its core is an expression of this life-long interest in state-of-the-art performance spaces. My childhood gave me the unique opportunity to both travel the world and grow up in a theatrically interested and musically attracted home.

I have been on stages and working behind them, in every capacity. Moreover, I have had irreplaceable chances to manage some significant and talented ensembles, and to be apart of many. These moments in life have each played a role in not only shaping me, but shaping how I design projects and buildings.

Concert halls and theaters have been designed with increasingly high-tech systems. While the use of them remains primarily the same, and has for centuries, they are becoming more architecturally driven and versatile, including

sprawling atriums and labyrinth-like back stages.

Having studied and examined performance spaces for years, I was set on challenging myself to re-invent versatility within the realm, but abstract, of these high-tech show spaces. In designing my proposed thesis project I do not want to sacrifice intimacy, experience or quality. While guests and visitors should be enticed by a facility's capability to host events and performances, too often architects design for one reason, one purpose. But what if that purpose

changes over time? What if how the audience interacts with performers changes over time? Designers today are trying to imbed versatility and multi-use facets into their projects as a means of using resources and finances wisely. What if everything we owned and bought could be used in a multiple of ways? Think about it, how many uses does the average toaster have? While I want my space to feel nearly the same as any other, I desire its versatility to attract artists from around the globe and to inspire a generation to furiously pursue the arts and

performance spaces in a new way.

Over a decade ago, when I was a young teenager and studying piano, my teacher once asked if I knew the word “ineffable”, to which I replied, “No, I don’t”. She proceeded to explain its meaning... “it means something which is so great that it cannot be expressed by words, but with music alone”. From that moment ineffable was carved in my mind. The Oxford English Dictionary more accurately defines the word with the exemption of the last part, where my teacher added

“but music alone”. While the dictionary exempts that form of the definition the word still embodies the essence of what music can accomplish; that is, something which words have a limitation in trying to capture. The word could be substituted or further defined as indescribable, overwhelming, inexpressible, and deep; things I know even if I try explaining, people will never understand. For each of us, ineffable can be something different.

For me, performance venues have this air about them and often take my breath away; they are ineffable. This

could be attributed to the encompassing talent, art, and creativity that is expressed within their walls. Or the idea that theater and music have the capacity to facilitate an escape from the world, leaving pain at the door while retreating to an imaginative place. A place to forget your worries, and allow the chance to laugh, smile or cry. Likewise, there are architectural sites around the world that have left me ineffable; some have been museums, cathedrals, historical icons, and theaters.

I have been privileged to see some of these places first hand. I find these spaces brilliant and alluring. From seeing the opera house in Venice, Italy, with its intimate capacity and classical-semi circular shape, or the roofless-scale of the Herodes Atticus Theatre in Athens, Greece to the modern statement of the Walt Disney Concert Hall by Frank Gehry or the unique Guthrie Theater in Minneapolis Minnesota.

It is my upmost desire in this project to design a space detached from time but

rooted in significance, sitting on the earth but as if it is in the clouds. Taking modern spaces and morphing them into sanctuaries where the arts become timeless, and the grandeur of the past become alive again. A place where all ages and people can interact; through rock concerts and opera, theater and dance, musicals and quartet music. Where everyone leaves more inspired, with greater knowledge, and more aware of the beauty of the ineffable.

”



Figure 2.4. Photo by: <http://images.industryclick.com>, The Guthrie Theater, Minneapolis Minnesota

“Find the one thing you enjoy doing the most, and pursue it with everything in you. Then if at the end of the day if you get paid for doing it, consider the paycheck a blessing. Do what excites you regardless of if you get paid or not”

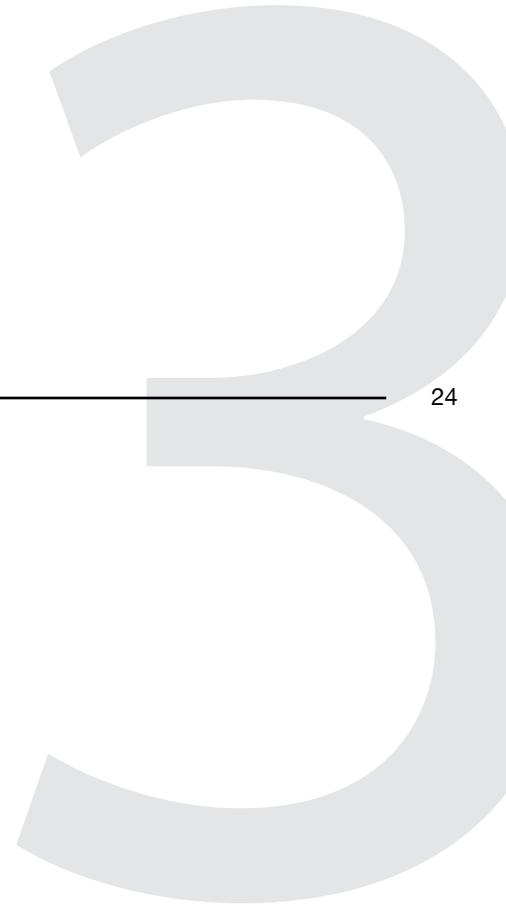
-Dale P. Dunham, Grandfather, Actor of stage and TV. 1931-2004.



Figure 3.0. Photo by: Matthew Dunham. Dallas Texas.

The Site

CHAPTER THREE



Site Information

An overall survey of multiple cities was conducted to see what city would best support this large performing arts typology. The cities studied were Dallas, Minneapolis, Phoenix and Las Vegas. In the end, Dallas was chosen because of multiple criteria. First, its current economic growth; second, its recent creation of a new Arts District and Cultural Center with modern museums and theaters; third, an ideal site for urban redevelopment; and lastly, the growing population that embrace athletic and arts events in Dallas and the Metroplex. As a result, Dallas is one of the few places a facility of this scale would be fully utilized. Once the city was selected, the site was chosen. Just east of downtown by several miles, the site is located on what is called Fair Park. The entire residential area around Fair Park is classified in the lowest income bracket in the United States, as most residents make less than \$16,000 per year. This also reflects high rates of unemployment. Choosing this location for a new mega facility is intentional because it will bring more businesses and redevelopment to the entire east side community. As the facility will demand an increase in hotels, restaurants, parking and other short stay entities. This will boost economic activity in the entire east side community, while improving the utilization of Fair Park, which is currently used once a year for the Texas State Fair.

25

Dallas, Texas, USA

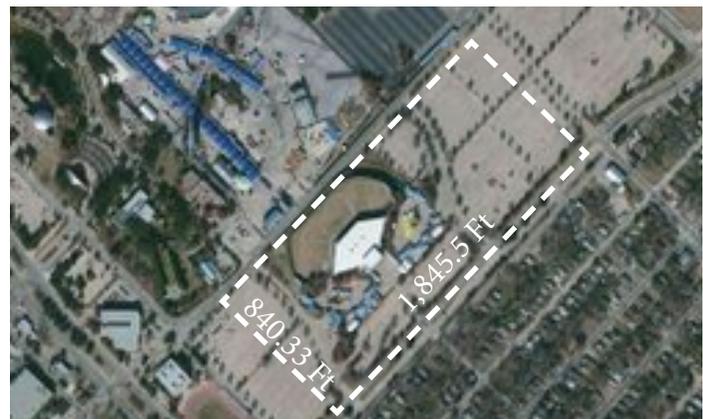
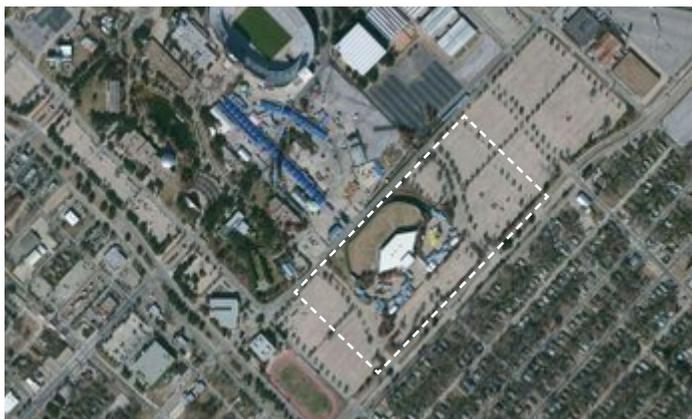
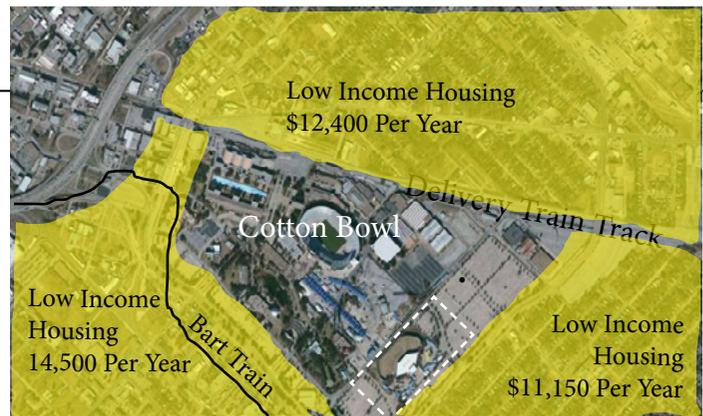
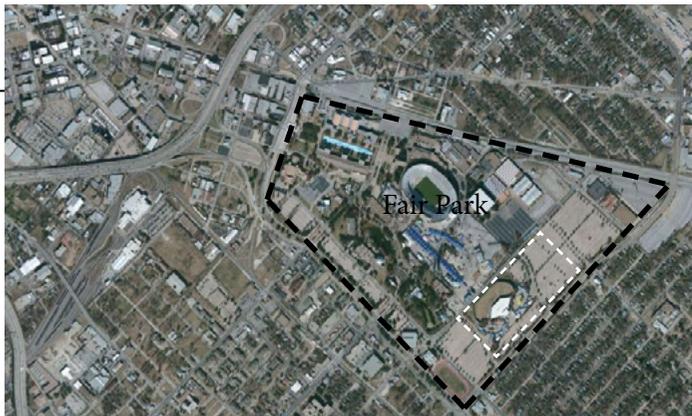
Longitude -96.75

Latitude 32.77

Population 1,241,162



Figure 3.1. US Map
<http://www.clker.com>



• Situated 2.3 miles due east of downtown Dallas, Texas. The site selected is currently a large vacant parking lot which is used only several times a year for varying events. The dimensions are 840.33' x 1845.5'.

Figure 3.2-3.7 By Google Earth: Satellite Images.

Site Information and Fair Park



Figure 3.8. and Figure 3.9.
Photo by: Matthew Dunham, Fair Park, Dallas

The site started as fair grounds dating back to 1886 and was used as the site for the Texas Centennial 1936 Exposition (Dallas City Hall, Fair Park, 2013). Architect George Dahl designed all 30 formal 1930's Art Deco show buildings. There is 749,000 square feet of indoor event space all situated on 277 acres of land. At the center of the park is the old Cotton Bowl Stadium which is still valued in the community for its past use for football and athletic events. After seven decades of use, the entire site has become dilapidated. Currently, it is only fully used for the annual Texas State Fair; most of the aforementioned Art Deco exhibit halls sit empty the entire year. The nearly 40 buildings need massive renovation so this project can bring revitalization to the park and community beyond.

27

Overview of Site

Sun

The maximum height of the sun is 80.2 degrees. The annual lowest sun is 30.1 degrees. While the average high temperature is 105 degrees Fahrenheit in summer, the winter can be as low as 30 degrees Fahrenheit (Dallas City Hall, 2012).

Economy

The area surrounding the park is classified by the United States as being in the lowest income bracket with local residents making \$16,100 a year which indicates an area of high unemployment (U.S. Census Bureau, Dallas, 2010). To the West and towards downtown Dallas, the income increases to an average of \$150,000 per year.

Soil and Vegetation

The deep soil is Ozan Marl clay (Austin chalk) which is hard to keep plants growing. Bedrock is at a depth of 20' (Granite Foundation Repair Inc., 2012) across Dallas and the surrounding area. The Fair Grounds site has been used for decades so there are about 60 varieties of thriving vegetation, including at least 20 kinds of mature trees.



Figure 3.10. [Above] Photo by: Matthew Dunham. View of Downtown Dallas, located 2.3 miles away, from site. View looking from site due east.



Figure 3.11. [Left] Photo by: Matthew Dunham. View looking down on site, 30 acres of parking lot space, on the north-east corner of Fair Park. The site has a freight train track just to the north, used for the State Fair once a year, where large deliveries and construction elements can be received.

Figure 3.12. [Bottom Sequence] Photos by: Matthew Dunham. Details from around the site; parking lot, vegetation and mature trees, water's edge soil from the nearby lagoon, dilapidated housing and tree in clay soil.



Demographic Context

To narrow the scope regarding population, this context is going to focus on the city of Dallas and only reference the surrounding metroplex. Current statistics released in 2013 from the recent national census states that the metroplex; Dallas, Fort Worth, Denton, McKinney and

Rockwall now is home to 6.7 million people. Dallas alone has 1.25 million residents and Fort Worth has 778,000 residents. While Dallas does contain high rise buildings, the majority of the structures are sprawled across the city limits in low rise structures.

Between 2010 and 2012 the population rose by 3.6% which was in line with the national prediction. This changed the population from 2.3 million to 2.5 million in two years.

Diagrams have been included in the research

illustrating the population of Dallas and its breakdown according to race and age [In succeeding pages economic and financial data is supplied]. The statistics and demographics are provided by the United States Census Bureau in conjunction with Dallas Visitors Bureau.

The 2013 population statistics indicate 68.7% are White, 38.9% Hispanic, 22.9% Black African, 6% Asian with a remaining 3.4% made up of Native America, Alaskan, Hawaiian and European

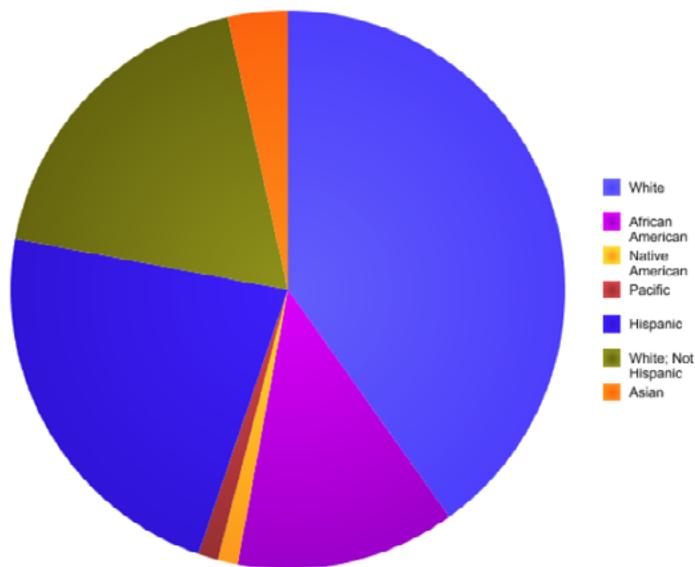


Figure 3.13. Ethnicity Percentages of Population (2013)

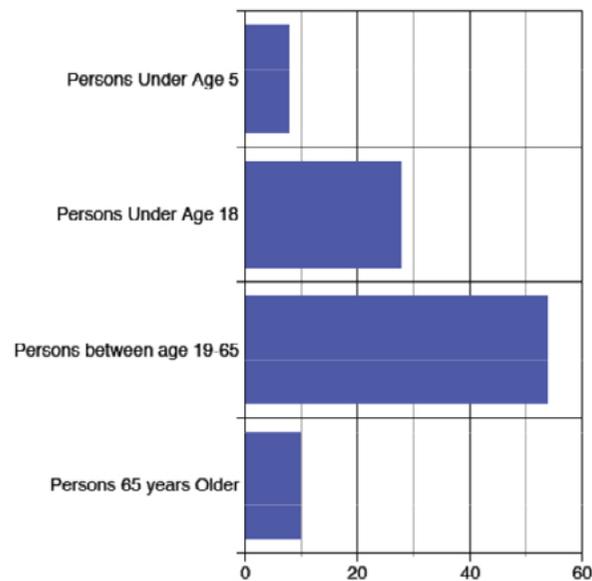


Figure 3.14. Population Age Distribution (2012)

racers. The percentages are not calculated on a 100% system; it is based on the overall percentage of the population for that race, including where some can be a combination of two races.

The largest age bracket falls between 19-65 years old. Within this age bracket the most prevalent percentage is the 25-34 year olds which make up 19.84% of the total Dallas population.

Continued research finds 39.5% of Dallas residents speak a language other than English at home, which primarily is

Hispanic.

Regarding education, 28.1% of the population has had higher education in the form of a bachelor's degree or higher, while the nearly 72% remaining have a high school degree or incomplete college coursework.

In the Dallas area, 38% of businesses are primarily owned by White males, 28% are owned by White females and 13.6% owned by African Americans.

Economic Context

The economic context of Dallas, Texas is best explained by breaking it down into several economic categories. One added category that is not often found within the economic industry is Culture and Arts. This fourth category has been added for the interest of this research and thesis project.

In an overview of the workforce of Dallas, Texas a statement released by the Workforce Commission stated that over 200,000 jobs were created in 2011 and continued to steadily increase. More recently. Areas of job growth have been in business services, hospitality, leisure, trade, transportation and utilities, adding a combined total of 140,300 jobs in 2012. Moreover, unemployment declined in 2013 from 6.3% to 5.9%.

The increase in jobs has brought more people to Dallas

from around the world. The housing sector has had a slight decline in the last six months but is over all up 6.2 percent from a year ago; the decline is reasoned to be the “upward pressure on prices” caused by demand and not enough supply. One local contractor stated that the price increases which caused a momentary lull in the housing was seen as a positive thing for contractors to catch up and get ahead after several seasons of declines. Texas overall has continued to



Figure 3.15. Population Annual Income Region (2012)



Figure 3.16 Population Income City (2012)

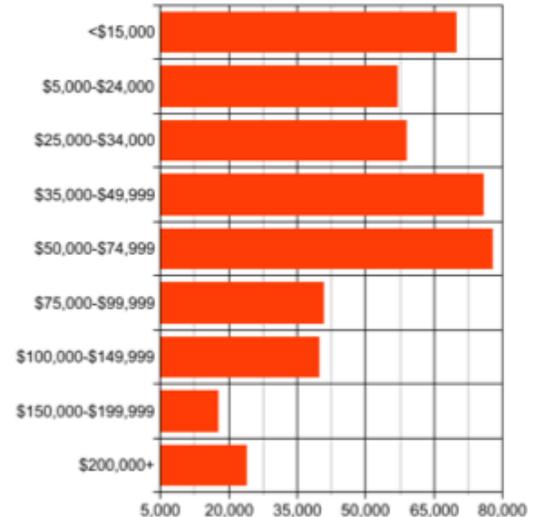


Figure 3.17 Population Income Neighborhood (2012)

outperform the entire nation in manufacturing and the sales of luxury goods. Sources say that the outlook is positive for the manufacturing and sales sectors for the remainder of 2013 and into early 2014. The local Dallas government published that “demand for oil-field services was steady despite the slight decline in the rig count as the number of wells drilled per rig continued to improve. Activity in Texas was particularly strong, both inland and offshore, according to respondents. Oil and gas extraction firms expect further growth in 2014” (p. 7).

Furthermore, the economic outlook for Dallas is strong because of the major Fortune 500 companies that are headquartered in Dallas. Companies such as American Airlines, Lockheed Martin, Citigroup, AT&T, and Texas Instruments are vital to the local economy as they employ tens of thousands of professionals as shown in Fig.3.18.

Lastly, the Dallas Arts District has been a focal point for the arts in Dallas, the Metroplex, and throughout the Southwest

United States since opening in 1983. Measuring well over 60 acres, and covering a 17-block area, the Dallas Arts District is the largest of its kind in the country containing more than 10 major theaters and museums located in one central urban area. Furthermore, the Arts District has remained financially stable and continues to host world renowned events. The Arts District is governed by a board that oversees all the facilities and supports 16 of the approximately 22 eligible nonprofit arts and culture organizations in the Dallas area. The total industry expenditures for the Dallas Arts District in 2010 were \$128,628,528. Total event related expenses were \$52,309,107 which utilizes 100% of ticket sales with a total attendance of 1,574,549 visitors and guests.

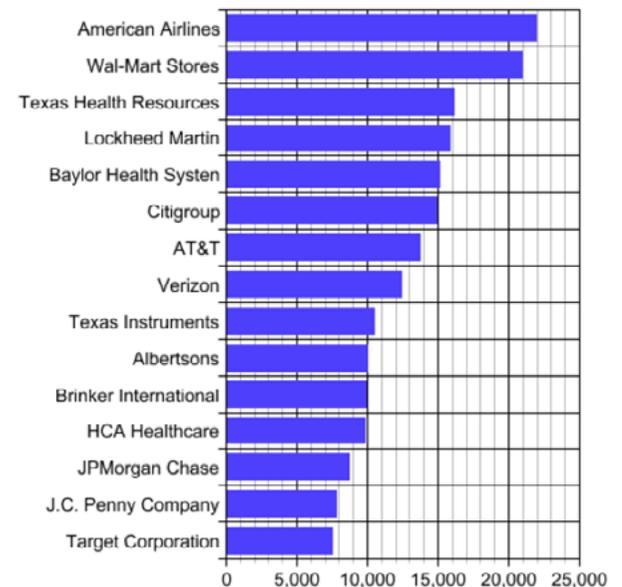
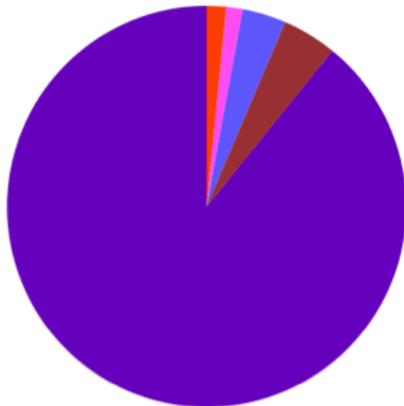


Figure 3.18. Top Area Employers Dallas Area

Infrastructure Context

The Metroplex, made up of the Dallas-Fort Worth area, had a combined population of 6,700,991 as reported in 2013, a 2% increase from the previous year. This 2% increase accounted for an additional 131,8792 people moving into the area, positively affecting the housing market, job market and local transportation systems.

On a macro level of transportation connecting Dallas to the rest of the nation and the World is the Dallas Fort-



Worth (DFW) Airport. A total of 5,204,566 passengers traveled through the airport in 2013, which was up about half a million from 2012. The main carrier, American Airways, where DFW is its hub, is at the top serving 2,066,520, making up almost half of all flights in and out of DFW. Other airlines include Delta, Alaska Air, United and other non hub providers, such as Frontier, JetBlue, Spirit, Virgin America as well as 11 international carriers such as Emirates, KLM and Lufthansa.

On a more micro level, Texas is well known for its interstate and highway systems. These are best displayed in and around Dallas with their multi-level tiers of highways and overpasses, which is where we get the common phrase “spaghetti junction” in referencing large on and off ramps used in road planning. According to the U.S. Census Bureau of 2010, about 507,397 cars and trucks access the roads and highways in Dallas. Moreover, public transportation systems such as light rail and city buses carry thousands to work in

Dallas every day. This is in contrast to 173,836 driving outside of Dallas to work in the suburbs. The average commute in the Metroplex ranges from thirty minutes to travel 15 miles to thirty minutes to travel 25 miles using the highway system. According to the Dallas News “Nationally, 27.4 percent of workers commute outside the county where they live. But for Collin and Denton counties, the numbers are sharply higher, with 37.8 percent of Collin workers commuting to jobs in another county, and 33.7 percent from Denton” (B4). Compared with other large cities, this is slightly longer but it is still lower than cities like New York and Los Angeles. The entire area is well connected by a network of Interstates and highway systems such as Interstate 35E connecting Dallas directly to Oklahoma, Missouri, Iowa and Minnesota. There is also Interstate 20, which connects Dallas to neighboring states while Interstate 40, just north of Dallas crosses the nation from east to west directly connecting to California and the East Coast.

Corresponding to the site, Interstate 35E passes within

Figure 3.19. Means of Transport to Job

two miles of the site (Fair Park). Commuters on Interstate 35 need to exit onto Highway 30, which will connect visitors directly to the site on the North West side. For those arriving from the south, they can access the site off of Highway 40 or Highway 175. The average commute is about 34 minutes in the Dallas area; which includes the surrounding suburbs of Irving, Duncanville, Grand Prairie, Desoto, Mesquite, Garland, Richardson and Carrollton. The largest gridlock of traffic happens on Interstate 35E and Highway 77 in Dallas during

rush hour.

On a further micro level, the local light rail transit system is called the DART; which stands for Dallas Area Rapid Transit. This references their light-rail train but can also include bike, bus and Vanpool services. The idea of the DART first began in 1980 and was to be a large transit network, which has now become the largest light rail system in the United States, servicing upwards of 220,000 from an area as large as 700 square miles. Dallas has also invented a new bike lid system where when someone

uses a bike and locks it up, cyclists can cover their bikes with an egg-like covering, which keeps the bike from overheating when the rider returns and for weather related protection. The DART also offers Vanpooling which allows up to 15 people to share a ride to work and pay a flat fee.



Figure 3.20. Photo by: Dallas News



Figure 3.21. Photo By: DART

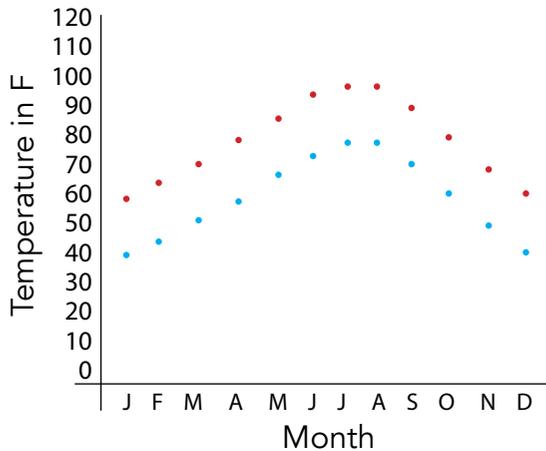


Figure 3.22. Average Local Temperature

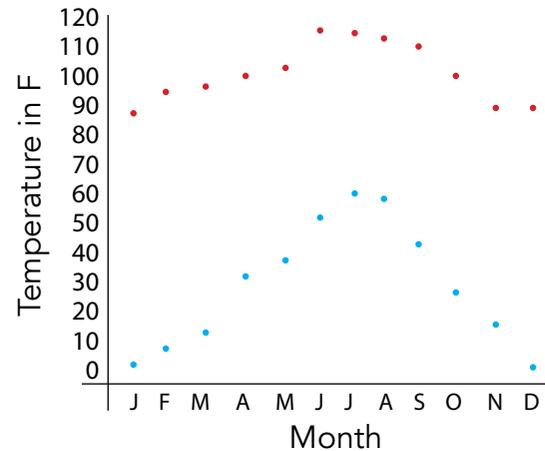


Figure 3.23. Record Local Temperature

Climate Context

Situated between 500 and 800 feet above sea level, the Metroplex occupies 342.54 square miles and is surrounded by 60 lakes and over 50,000 acres of public parks. While Dallas has occasional snowfall, it is not much and melts within a day. Rainfall can be limited with an average monthly rate of 1". The rainy season

is considered to be April and May with May getting upwards of 4.9" of rainfall, totaling an annual average of 35.77 inches per year of precipitation. The average temperature over the entire year is 65 degrees with the daily mean departure being 85 degrees. Even as a majority of the days in Dallas are hot and often muggy, the average

wind speed is 10.3 miles per hour, which is the same as Minneapolis, Minnesota, and Detroit, Michigan.

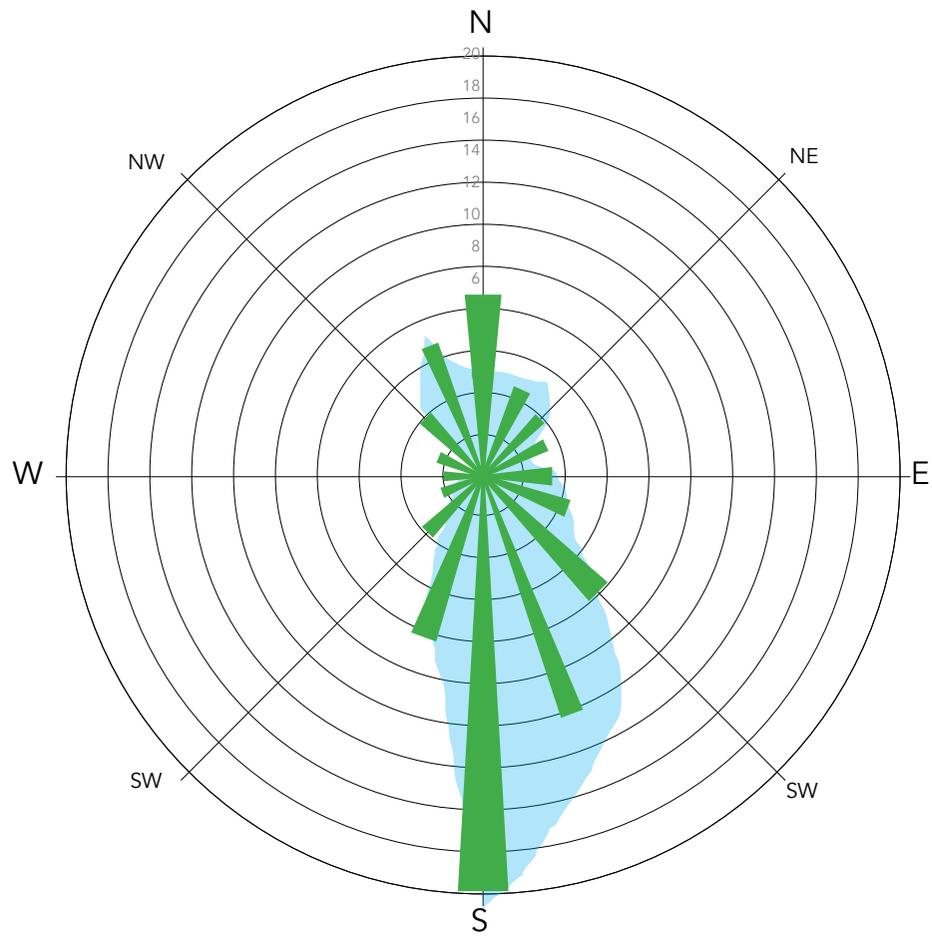


Figure 3.24. Annual Wind Diagram

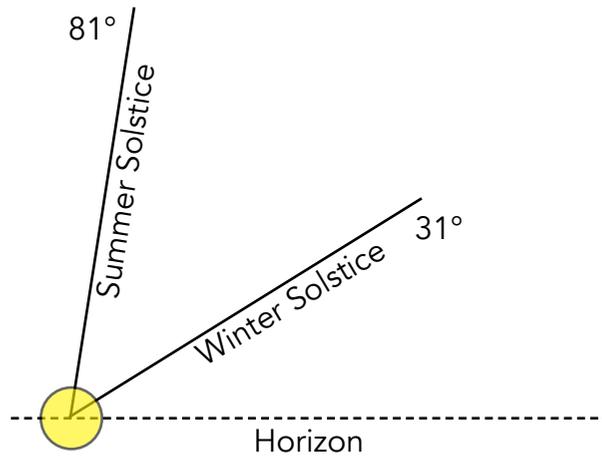


Figure 3.25. Sun Angle: Summer and Winter

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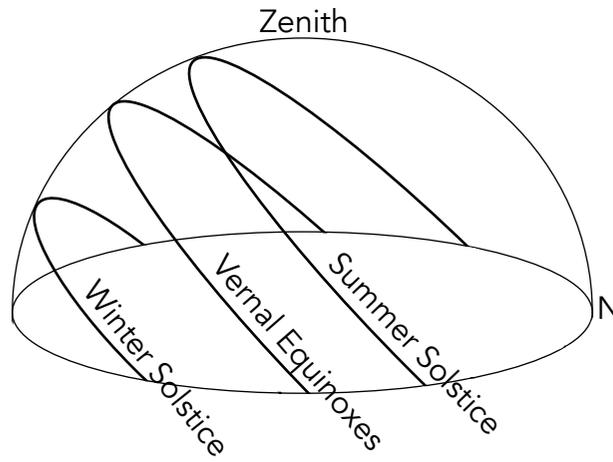


Figure 3.26 Sun Angle: Equator Summer and Winter

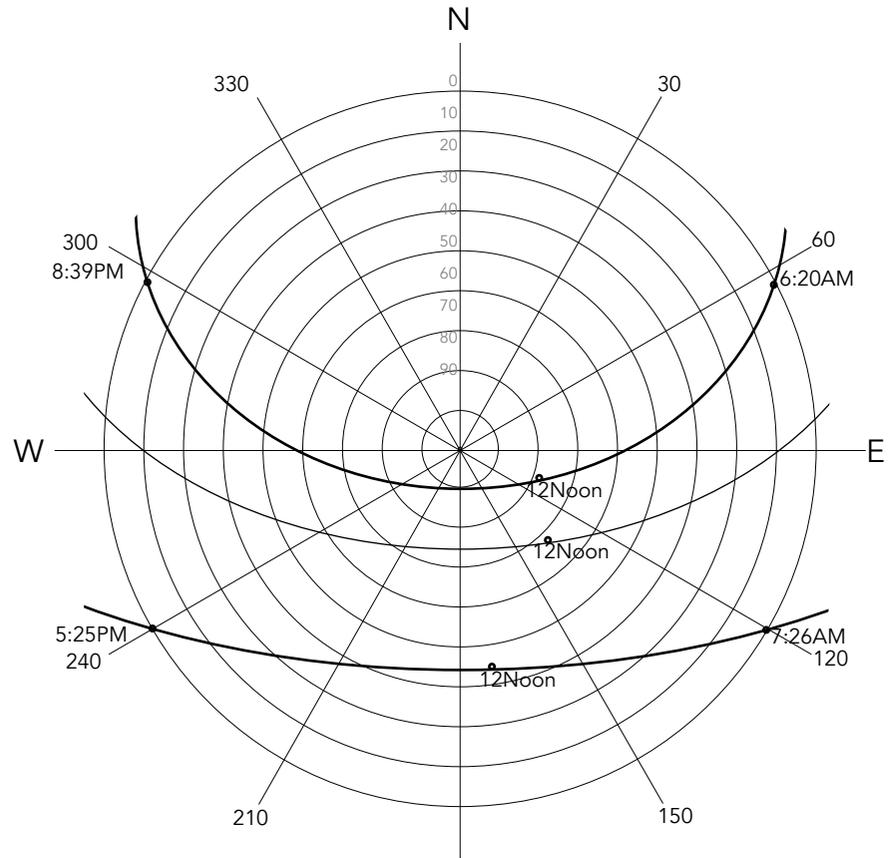


Figure 3.27. Sun Diagram



Figure 4.0. Photo by: Matthew Dunham, Restaurant at Target Field, Minneapolis, Minnesota

Program Document

CHAPTER FOUR

40

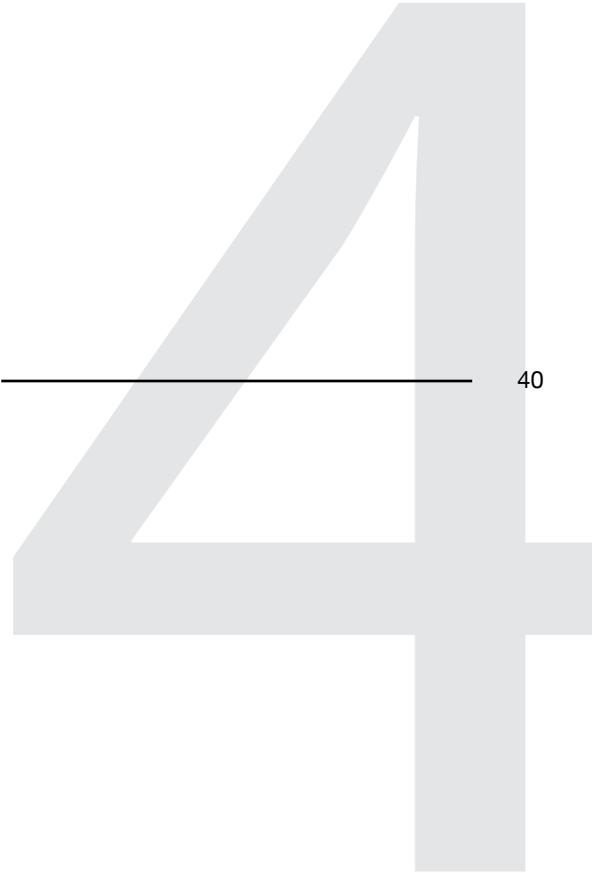




Figure 4.1. Photo by: Matthew Dunham, The Orpheum Theater, Minneapolis, Minnesota

Research

The research draws on my interest in designing performing arts spaces at an advanced level, which utilizes integrated technology and automated building systems in the morphology of space to maximize flexibility in performance typologies through kinetic architecture. As modern technology has developed and become more utilized in entertainment and the arts, performance spaces have likewise become meccas of advanced technology and engineering to advance the audiences' experience. These high-tech spaces as a whole encompass a plethora of elements and contingencies to just merely function. These elements include high-tech well-designed fly systems, acoustics, lighting systems and placement, stage-floor drops and pits, advanced pedestrian

traffic mapping and flow, thoughtful rehearsal space, loading, and back-stage preparation spaces. Advancing our basic thought of performance spaces, this research aims to develop a strategic morphological performance space to maximize annual use through more flexible spaces. The research looks at current performance space case studies, on-site tours and evaluations of spaces in order to help create a feasible foundation for such a proposal to exist.

As this research aims to redefine and support a more advanced model for morphological performance space, it demands further clarification of terms. To clarify terminology the Oxford English Diction defined performance space as: "Noun. Space where drama, music, etc., may be performed; an area in which a performance takes place, a venue; spec. the area in a theatre, concert hall, etc. in which the performers act, play instruments, etc., as opposed to the area where the audience sits".

This definition is far too micro for this research as it limits the definition to merely the stage or performance surface, not the entire macro spaces such as the auditorium, lobbies, back stage, arrival, support spaces and the spectator experience. Therefore when performance space(s) are referenced in this research, it will speak to the whole than the partial, and reference entire venues rather than the singular inner sanctum and the boundaries of a stage. Other terms needing clarification are morphology and kinetic architecture. Defined by the Merriam Webster dictionary morphology is "...a study of structure or form...the form and structure of an organism..." and kinetic is "relating to the motion of material bodies and the forces and energy associated with them." These terms are translated into the design of the performance venue as moving pieces which facilitate transforming the space on a large scale. Moving



Figure 4.2. Photo by: Matthew Dunham, La Reve Theater at the Wynn Hotel, Las Vegas, Nevada.





elements can be combined to create a concert hall, which can also morph into needed elements for a theater, recital hall or large opera auditorium while addressing adequate sound and lighting for each space.

Research was conducted in three different ways to explore this new design concept because there are no case studies to facilitate a comprehensive understanding of the morphology of performance space. First, research was done through a comprehensive literature search using books, online media and websites covering such topics as history of performance space, design, engineering, flow,

and usages as well as theater technologies. Major books providing beneficial concepts to this design thesis include: *The Acoustics of Performance Halls, Spaces for Music from Carnegie Hall to the Hollywood Bowl* by J. Christopher Jaffe; *Site and Sound; The Architecture and Acoustics of New Opera Houses and Concert Halls* by architectural author and historian Victoria Newhouse; and *Geometry and Atmosphere: Theater buildings from Vision to Reality* by Cambridge Research Professors C. Alan Short and Alistair Fair. In addition to these leading books, other journals and books were consulted. Second, a research tour

was organized to arrange on-site tours of applicable facilities. Twelve total facilities were toured in the following five major cities; Chicago, Dallas, Minneapolis, Las Vegas, and Phoenix. A private tour with technical production personnel was arranged at each of the sites to obtain insight into the daily needs and necessities of each facility. These tours often contained unpublished details. Each of the twelve facilities were chosen for a specific applicable element, which would enhance and benefit the overall research. The information gathered from the on-site visits was beneficial in providing valuable real life



Figure 4.3: [Above] Photo: Matthew Dunham, Willow Creek Community Church, South Barrington, Illinois.

Figure 4.4: [Opposite] Photo: Matthew Dunham, Willow Creek Community Church, South Barrington, Illinois.



Figure 4.5. Photo: Matthew Dunham, Show: La Reve, Wynn Hotel, Las Vegas, Nevada.

experiences and understanding of these spaces. Third, graphic analysis of performance spaces and of engineered mechanical systems needed for morphology and kinetic maneuvering of wall and acoustical segments was researched. This has been accomplished through analysis of existing performance spaces and current industry-standard technologies with the thought to combine them with other non-industry standard technologies to advance current performance design through research exploration. These diagrams and plans proved vital in understanding the minute details needed to execute high-level kinetic morphology.

The research tour conducted in mid 2013 gave great insight into the experiential needs of performance spaces. Having the opportunity to meet first hand to discuss the space with key staff about how their facilities worked informed this research on multiple levels; articulating the building and the design process immensely

through their comments and resources. As performance spaces are meticulously designed typologies containing many details, the End Users working in the spaces are often found more valuable to talk to than the designers and architects, as they know how the facility functions well and where there was design oversight. Furthermore, walking through these spaces is vastly more beneficial than only studying drawings, floor plans and published resources. Over the next several pages several main attributes about performance spaces will be discussed that was learned from the tours and literature.

Perhaps the most definable characteristic of any performance space is the auditorium. Auditorium space must be designed with intention in mind. This large area serves the purpose of housing the audience or spectators during a performance. The details of comfort, viewing angle and acoustics are dramatic. A space for a chamber orchestra

ensemble is different than a live theater performance both in sound quality, space and lighting needs. The needs for a large-scale Broadway production verses modern contemporary productions, which require an audience no larger than 1,200, are quite different from that which works for a grand opera house that could seat up to 4,500 people. These larger performance spaces demand more authority and quality than if the same space was utilized for a piano recital.

The nature of performance space auditoria is found in the articulation and details. The particular details to consider when designing such spaces are varied and numerous. It is essential to include the specifics of lighting placement, acoustic treatments, flexible acoustic systems, stage height, stage width, aisle spacing and row spaces, seat dimensions, sight lines, quiet ventilation (pumped in from remote mechanical rooms for noise suppression), orchestra slope angle, balcony angle, sound booth placement, light booth

placement, fire exit illumination, wall and floor materials, ADA accessibility, and access to the stage and back stage. Ultimately within each one of these areas there are a subset of countless more details. Regardless of capacity these above elements are found in all performance typologies, and may vary based on quality, desired user experience and budget.

It is common that within medium scaled auditoria, ranging from 900-2,000 seats, spaces need to be highly kinetic allowing a variant of performance typologies. For example, the average high school auditorium which is used for a plethora of typologies such as lectures, graduation, theater performances, musicals, choir concerts, orchestra and band concerts and talent shows. Due to slight detail miscalculations, some auditorium spaces over the years have turned a beautiful space intended for live theater or orchestra into dance, by not having good enough acoustics for live performance; This was the case

at Northrop Auditorium located at the University of Minnesota. While the space and lobbies are well-articulated and designed the acoustical function does not enhance the performance as it should. Therefore the intended functionality was a failure and needed amplified sound for anyone to be heard (recently Northrop Auditorium as undergone a complete restoration).

Moreover, the lesser public spaces support the greater primary reason for the facility which is ultimately the stage. In all reality the stage does not function alone. It demands a well-organized system of back stage support spaces. These spaces and technologies are fly systems and fly grid (either computer operated mechanical winches or traditional weighed rope systems), pit or mechanical lifts, electric batons (light bars), stage draperies, floor materials, prop or workshops, loading dock, assortment of dressing rooms, possible costume rooms, green room and rehearsal spaces. This list is not exhaustive

and the variations in each one of these is dictated by the needs of the performance typology.

Typically theater consultants in each area for sound, lighting, draperies and fly shafts are called in during project design processes for input on best practices. Theater technologies must be well-integrated into the building environment to avoid oversights that can cost near millions to correct. Many spaces where theater technologies are an after thought are in high schools, large contemporary mega churches, auditoriums not intended for performance and low budget projects.

To advance our basic thought of performance spaces, this research aims to develop a strategic morphological performance space to maximize annual use through more flexible spaces. Utilizing modern technologies to incorporate the details to the boundaries of theater spaces has never been more plausible. Many theaters often push the limits of architects to design more dynamic spaces,



50



Figure 4.6: [Top] Photo: Matthew Dunham, Winspear Opera House, Dallas, Texas.

Figure 4.7: [Bottom] Photo: Matthew Dunham, The Wylie Theater, Dallas, Texas.



which still function. There are multiple projects around the globe that can morph from large concert halls into smaller capacities by modifying their acoustic tiles to section off balconies, sides or lowering the ceiling. The limitations exist in that they still have four walls and a stage that can not move and limited ability to adjust or accommodate. It is because of these inherent limitations that this thesis concept came about. Advancements in cross disciplinary technologies have made it possible to bridge the gap between engineering and architecture. Furthermore, the concept transforms rigid, formulaic

performance spaces to highly adaptable programmable kinetic performance spaces. It is possible to utilize the advancements in engineering and mechanical lift systems, often used in mega bridges and skyscrapers, to move large elements within the performance space. This technology can be combined with highly articulated engendered systems which is used in the port industry for loading and unloading cargo containers as well as large aircraft designs. Likewise, technology integrated architecture can be used in the morphology of performance spaces to create maximum flexibility. This includes

the adapting of stage dimensions, height of the auditorium ceiling, capacity of the auditorium and acoustic treatment modification for varying typologies. Utilizing this advanced integration of technology would provide the entire performance space, acoustics, ventilation, egress and fly shaft to be within a greater fly grid.



Figure 4.8: [Above] Photo: Matthew Dunham, Winspear Opera House, Dallas, Texas..
Figure 4.9: [Opposite] Matthew Dunham, Show: La Reve, Wynn Hotel, Las Vegas, Nevada.



Figure 4.10. Photo: Matthew Dunham, Millennium Park, Chicago, Illinois

Summary

Research was conducted in three different ways to facilitate this exploratory new design concept, as there is no single case study which facilitates the comprehensiveness on a parallel level. The research draws on the interest of designing performing arts spaces at an advanced level, utilizing technology integrated architecture and morphology of space to maximize flexibility in performance typologies and capacities through kinetic architecture. "Performance space" is most broadly defined as the entire theater and all entities within it; however, this requires clear articulation as the actual performance space is also considered to be strictly the stage.

As modern technology has developed and become more

implemented, entertainment and arts performance spaces have likewise become meccas of advanced technology and engineering which in turn advance the audience experience. These high-tech spaces as a whole encompass a plethora of elements and contingencies to function smoothly. These technologies include, high-tech well designed fly systems, acoustics, lighting systems and placement, stage-floor drops and pits, advanced pedestrian traffic mapping and flow for arrival, thoughtful rehearsal space, loading and back-stage preparation spaces. The research tour conducted in mid 2013 provide helpful insight into the experiential needs of performance spaces. Having the opportunity to meet first hand and discuss with technical staff how their facilities function informed this research on multiple levels, articulating the building and the design process immensely through their comments and resources. Performance spaces are

principally all about the details pertaining to acoustics, sight lines, scale, flexibility, community integration and support services. Perhaps the most observable characteristic of any performance space is the auditorium, as it is in many ways the home of the performance space, where guests are made to feel at home and comfortable. Meanwhile, the lesser public spaces, which facilitate the greater primary reason for the facility, are naturally the stage, encompassing the backstage areas and technologies. These two elements as a whole have remained practically the same over the last century and only modified to incorporate advancements in modern technology. Advancements in cross disciplinary development such as the port industry, aviation, and manufacturing have developed systems which can be incorporated into performance spaces at a mega scale, and, while not jeopardizing the atmosphere and experience, provide pivotal



55



flexibility in staging and event typologies. While understanding that the advanced level of technology within the building will become outdated eventually, the primary bones of the space and its fundamental kinetic operations can be updated to maintain functionality. Of course, the surfaces, veneers and finished areas can be overhauled as the decades and elements require.

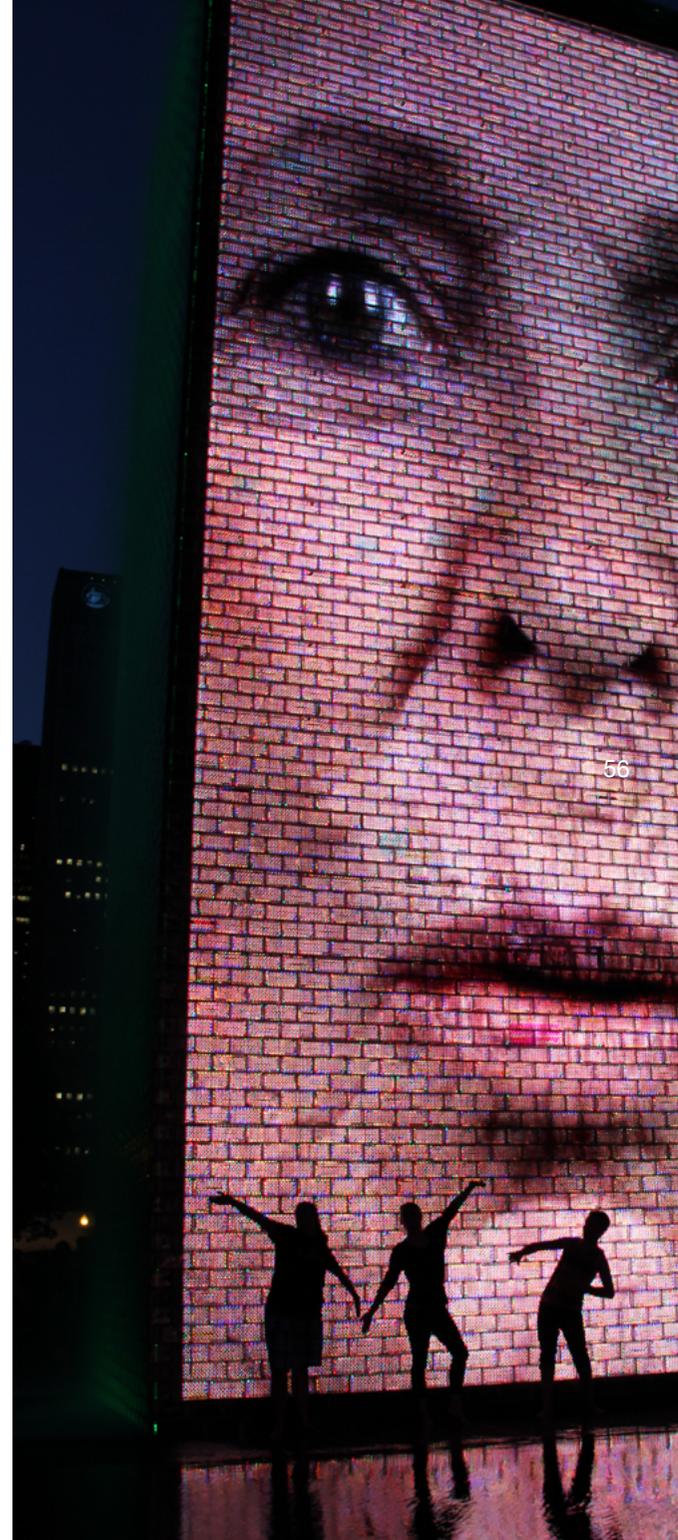
To conclude, a changing morphology has the capacity to increase the quality of the performances it accommodates, combined with immense articulation in creating a space, allowing the best results for any given performance. Vast differences exist between the needs for a Broadway musical and a modern contemporary play. This concept would allow both the stage and audience to be closer, to draw each other in and modify the space to enhance the essence of the art. There is power

embodied in great design. Spaces, which are designed and modified for user and performance needs, provide a foundation for collaborative exploration. This exploration within the field of architecture brings together otherwise separate, yet similar, typologies and creates the capacity to develop and advance the field even further. The performance of events is critical and the creative mind is endless; therefore, this space would allow ideas to flourish and the elements of the special layout to be modified, within limits, to accommodate new expressions and new developments. Furthermore, the morphology of performance space, which utilizes advanced technologies, will allow the building to adapt over time to acclimate more smoothly to changing societal demands and architectural developments.

Figure 4.11. [Opposite Top] Photo by: Matthew Dunham, Target Field

Figure 4.12. [Opposite Bottom] Photo by: Matthew Dunham, Target Field

Figure 4.13. [Opposite Bottom] Photo by: Matthew Dunham, Millennium Park, Chicago Illinois



Historical Context: Dallas, Texas

The history of Texas begins far before the territory joined the United States of America, or the settling of Dallas began at the splitting of the Trinity River.

The land which Texas occupies has a vivid history, but to be brief, this report will start with the fifteenth century. Like much of the south it was occupied by France, Spain and Mexico before it was taken over by the United States. For a brief period Texas was one of the Confederate States of America.[Jacobs, 4].

The first settlers to claim the territory date back to the French in 1682 near Matagorda Bay [Dallas City Hall, 2012]. The arrival of the French ignited Spanish interest in the region and within half a decade the

territory became occupied by Spain, which has taken control of large parts Latin and South America. Over the next few centuries Spaniards continued to pioneer new settlements and missions across the region of Texas. This ended in 1821 with the independence of Mexico from Spain [Beck, 84]. Texas was considered within the territory and jurisdiction of Mexico. For the next fifteen years, after fighting between the Mexican army and American settlers, on April 21, 1836 the Republic of Texas defeated the Mexican Army at San Jacinto [Jacobs, 8].

The site where the city of Dallas stands today was originally founded by an American surveyor who was looking for a prime location to establish a new outpost. In the year 1845, with a growing population, but still under four hundred people, Dallas conducted the first election to decide whether or not the territory of Texas

should join the United States. With a dramatic majority, Texas became a state. Within a year the city became a county and then a permanent county seat [U.S. Census Bureau, 2013]. While the city of Dallas was young, the Gold Rush brought many families, visitors and men through as they headed to California. Some of these people became local residents as they saw new opportunities. Dallas remained a settlement and outpost until 1856 when it was declared a town and the first mayor, Samuel Pryor, was elected.

By 1860 the city of Dallas was now home to over two thousand people, some of them slaves as Texas was a slave state. Texas joined the Confederate States of America, but with every year, commodities become costly and hardships increased. Coinciding with the end of the Civil War, slavery was abolished. This brought dramatic changes to the economy and business.

For example, some White Southerners, who once owned large amounts of land, had to surrender their plantations and move into the city of Dallas.

Dallas was already a booming metropolis, but the 1870's brought greater opportunities for businesses as the passenger train line, Texas Central and Pacific, was extended through Dallas. This exponentially doubled the population from three thousand to seven thousand in under a year [Dallas City Hall, 2012]. "Dallas was now a concentration point for raw materials, such as grain and cotton, shipped to the South and East. It was a last chance for people traveling farther west to get supplies" [Jacobs, 11].

After a Federal Reserve bank was established in Dallas in 1911, it secured its financial epicenter. The onset of WW I brought about many advancements in aviation and military manufacturing. The

site of Love Field was build for flight training and Fair Park became the location of Camp Dick. While the war brought prosperity, knowledge and industry, the Great depression of the 1930's left upwards of twenty thousand people unemployed. However, Dallas did not suffer as much as other cities because of the discovery of oil. But even in the shadow of the depression, Dallas was chosen, after a long competitive race, for the site of the Texas Centennial celebrations in 1936. The site of the centennial was Fair Park, and in preparation for the games, over fifty buildings were build and \$25 million was spent. That year alone a record attendance for visitors reached 10 million, which came to participate in the exposition.

In the decades following, Dallas evolved in the areas of the arts and professional athletics. Over the next half century, major companies chose Dallas as their headquarters such as American

Airways, AT&T, Texas Instruments and the Meyerson Symphony Center.

Within the last decade, Dallas suffered from the same economic downturn as the rest of the United States. In 2009 Dallas opened the first of what would be the most dynamic cultural changes to the downtown landscape. This consisted of creating an Arts District around the Symphony Center. The opening of the Winspear Opera house by Foster+Partners, the Wyly Theater by Rem Koolhaas, Perot Museum of Nature and Science, and the Omni Hotel has transformed the area.

Dallas is advancing faster than even ever before and continues to propose and build new mega structures, transit systems, and cultural centers for its growing population. This is evidence that Dallas is ripe for a world-class performing arts center.



Case Studies

There have been twelve on-site visits conducted to meet with local technical or production staff. This has allowed for first hand photographs, experiences and more importantly questions to be answered from staff utilizing and maintaining these facilities. Each site was chosen specifically for being an extraordinary performance venue, which exhorts flexibility, state of the art technology and ingenious engineering. For priority reasons only three of these site visits has been included as case studies in this thesis project. Predominantly the most important task in these case studies is documenting what works best, what could have been improved and what was forgotten about in the design.

Figure 4.14. Photo by: Matthew Dunham, Target Field

Thank you to each venue for devoting hours to giving a private tour of your facility. To each of you for your gracious hospitality and willingness to discuss the highlights and realities of your jobs and facility. But most importunately, for devoting your lives and endless hours, to bringing the world flawless and world-changing events and productions.



Case Study: Wyly Theater, Dallas

The Dee and Charles Wyly Theater, or more commonly known as simply the Wyly Theater, is located in Dallas, Texas and is one of the four venues which comprise the AT&T Performing Arts Center. When it opened in 2009 it was considered one of the most experimental theaters ever designed and remains that way still today, especially because it is considered to be theater in the vertical or stacked theater. This audaciously modern and dynamic building was designed by internationally renowned, Pritzker Prize winner architect Rem Koolhaas. The firm which worked with Koolhaas was REX located in Brooklyn, New York. A vertical theater means the performance space

is not designed in the standard, sprawling manner, but in a vertical manner with very small square footage per level and the building services separated by levels not just walls.

The 80,300 square foot theater is 12 stories high and sits on a small square piece of land. Within the building there are two performance spaces; One primarily being a black-box rehearsal and large gathering space on the 9th level and the other being their main morphological stage space. The main, “multi-form” theater space seats a maximum capacity of 575 people in its standard U-shape proscenium arrangement, but can also transform into thrust, traverse, and flat floor stage

Figure 4.15. [Left] Photo: Matthew Dunham, The Wyly Theater, Dallas, Texas.
Figure 4.16. [Right] Photo: Matthew Dunham, The Wyly Theater, Dallas, Texas.



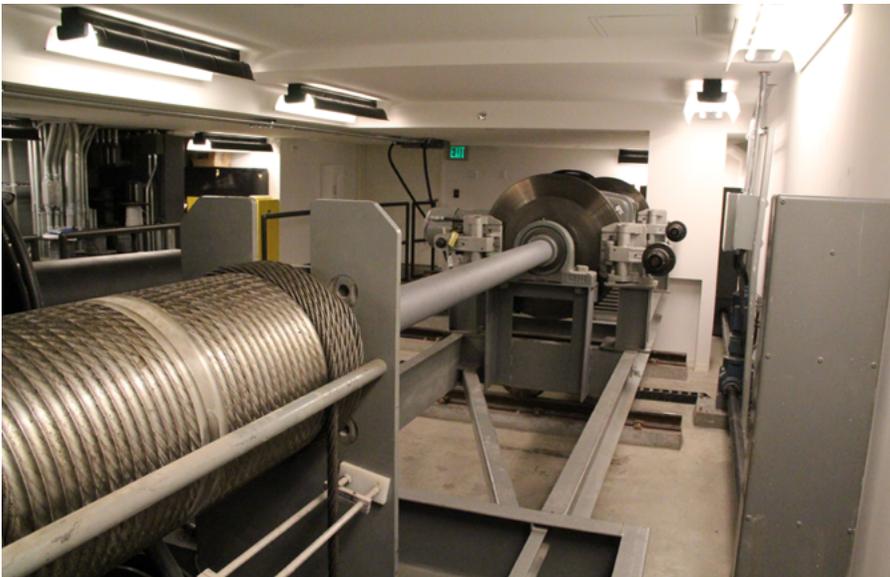


Figure 4.17. [Top] Photo: Matthew Dunham, The Wyly Theater, Dallas, Texas.

Figure 4.18. [Bottom Left] Photo: Matthew Dunham, The Wyly Theater, Dallas, Texas.

Figure 4.19. [Bottom Right] Image from *Sight and Sound*.

Figure 4.20. [Opposite Page] Photo: Matthew Dunham, The Wyly Theater, Dallas, Texas.

configurations. The design choice to do a vertical theater allows for immense flexibility and creativity, but at the same time requires users to continually travel up and down stairs between various building utilities.

Arrival

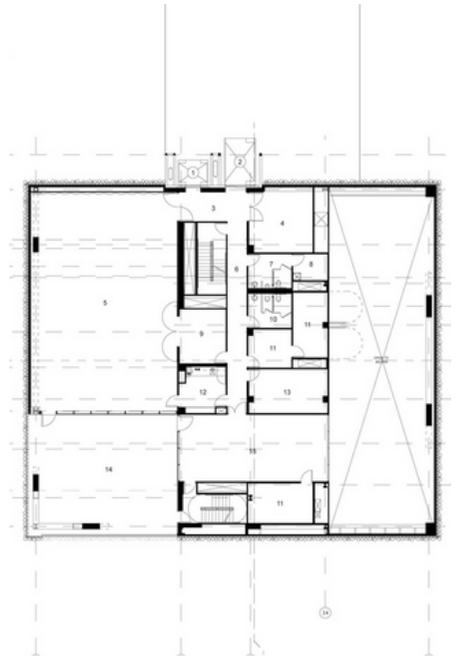
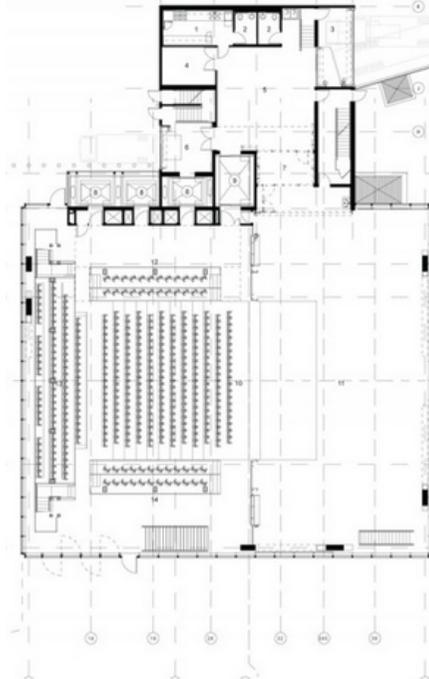
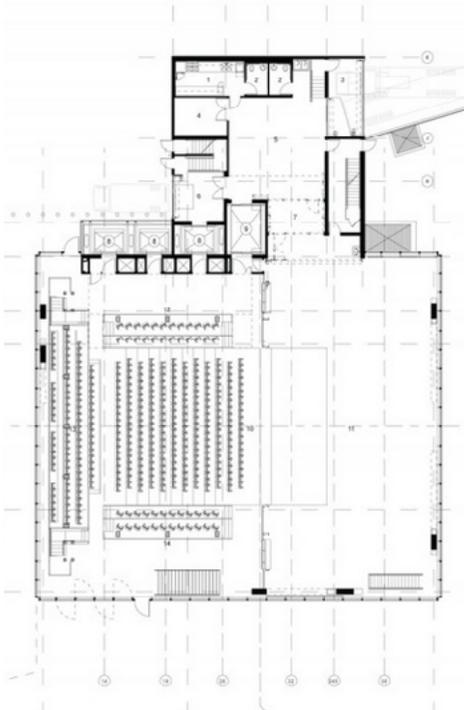
The entrance to the theater is actually two levels below ground and is accessible by a steep

sloping cascade of stairs and ramps which wind between and around trees. There is no public entrance on the ground level for those who are guests to the facility, including those who are disabled; One must descend the steps or ramp to enter. The only entrance on ground level is for service staff and loading. This unusual public entrance is due to the main performance space

being at ground level where people can walk by outside and look in on rehearsals and performances. This is both creative and an issue as a majority of performance spaces demand low lit spaces to highlight the performers on stage.

Auditorium Space

Perhaps the most flexible space in the United States, this 575



seat auditorium has three banks of balconies, all which can hydraulically lift completely up into the ceiling and be tucked away. The strength to stabilize these six, mammoth winches, which raise these sections of seats, required the building to be built and enclosed around them. Not only are the 3-tier levels of balconies dynamic, but the center of the main auditorium flooring is divided into 9 squares. Each of these squares allows for them to become a step(row) of theater seating and pivot 180 degrees; Accommodating a thrust style stage or all 9 grids facing one direction and making a proscenium stage on one end. While the house is highly flexible and can be entirely cleared to be a solid flat floor, the stage space is highly rigid. As seen in the

diagram, the stage fly system is higher than the lighting catwalks above the auditorium space while the mechanical spaces which house the winches for the seating are above all of it.

Support Spaces

The dressing rooms and the green rooms are located one level below the stage on level 2 (Actually the 1st basement level). Meanwhile the lighting and technical storage spaces are located on level 8 above the stage. Elements of the entire program are scattered throughout the building in and around the void of fly systems and stage technologies. The main level (ground level) also houses the loading docks which consist of one 12' semi bay. The Wyly does not contain administrative offices as the offices are all located in the

AT&T Performing Arts Center headquarters.

Conclusion

On-site research with the Center's Technical Director said the vertical space lacked all practical storage. The architect created a simple iconic façade, but completely forgot key elements such as the light booth. At the last minute a cantilevered, light booth was created by puncturing through the outer wall, still deeming it useless as it sits one story too high without visibility of the stage. Overall the flexibility truly pushed the limits of stage and theater auditorium design, but the functionality of the theater spaces are poorly articulated which caused multiple post-occupancy challenges and changes.



Figure 4.21 Photo: Matthew Dunham, The Wyly Theater, Dallas, Texas.

Figure 4.22. [Above] Photo: Matthew Dunham, The Wyly Theater, Dallas, Texas.

67



Case Study 2

The Winspear Opera House

Named after Margot and Bill Winspear, the modernly stylish new Dallas Opera house is called the Winspear Opera House. It is an opera house located in the Arts District of downtown Dallas, Texas. It has a strikingly modern exterior wall that is solid glass from ceiling to floor. The inner wall of the auditorium (opera house) is bright red which at night can be seen through the glass from quite a distance away. The Winspear Opera House was designed by Foster and Partners' lead architect, Spencer de Grey. The facility is the home of The Dallas Opera and also shares the stage with the Texas Ballet. The AT&T

Performing Arts Center invests a lot into developing their shows, music compositions and cultural performances. Not only does the Winspear host opera but also music, dance, Broadway shows, concerts and lectures. The Winspear Opera House includes an education center and recital hall which can be used for special events and small concerts seating up to 200, as well as a space for classes, rehearsals, meetings and events. The Winspear is designed like a standard theater and it sprawls across the city block and on one level houses all the stage functions, dressing rooms, loading dock and lobby.

Figure 4.23. [Left] Photo: Matthew Dunham; The Winspear Opera House, Dallas, Texas.
Figure 4.24. [Right] Photo: Matthew Dunham; The Winspear Opera House, Dallas, Texas.

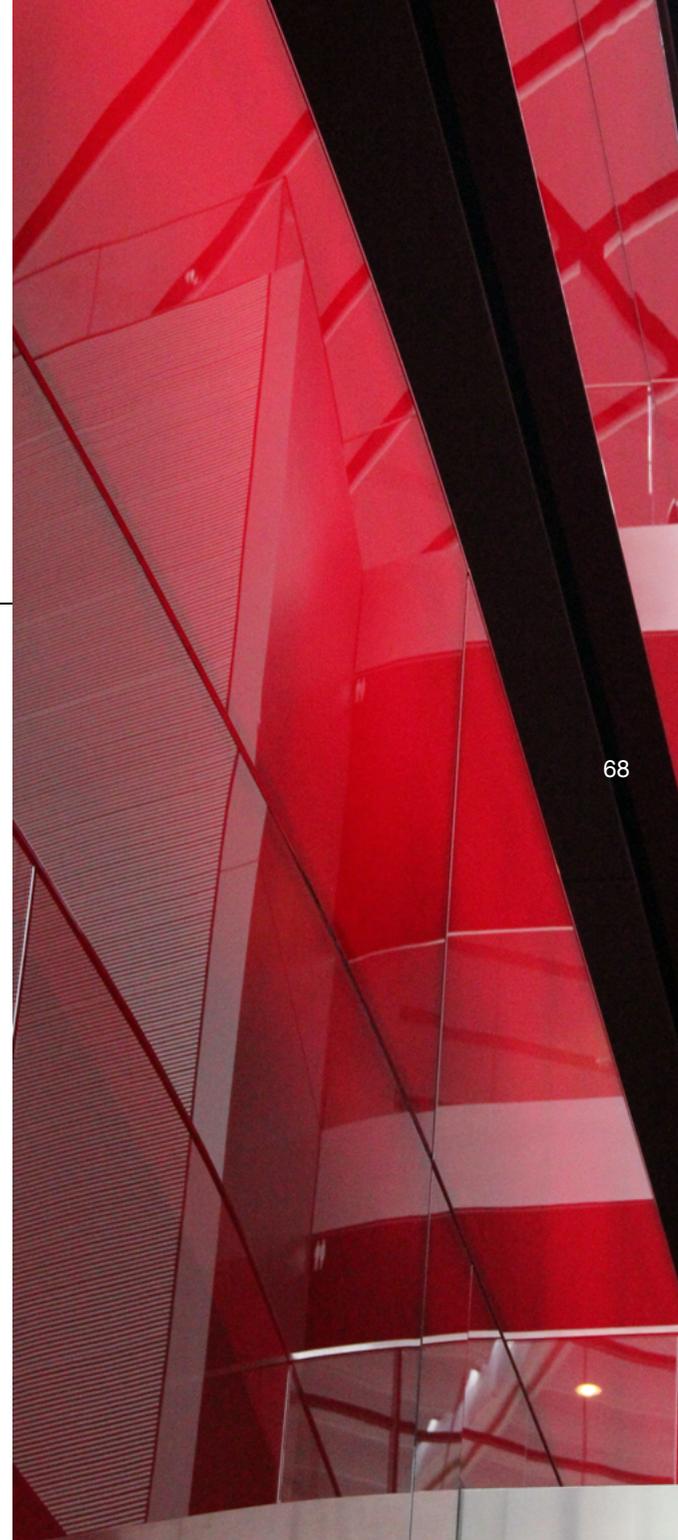




Figure 4.25. [Top] Photo: Matthew Dunham, The Winspear Opera House, Dallas, Texas.

Figure 4.26. [Bottom Left] Photo: Matthew Dunham, The Winspear Opera House, Dallas, Texas.

Figure 4.27. [Bottom Right] Photo: Matthew Dunham, The Winspear Opera House, Dallas, Texas.

Figure 4.28. [Opposite Page] Image from Book: Sight and Sound,

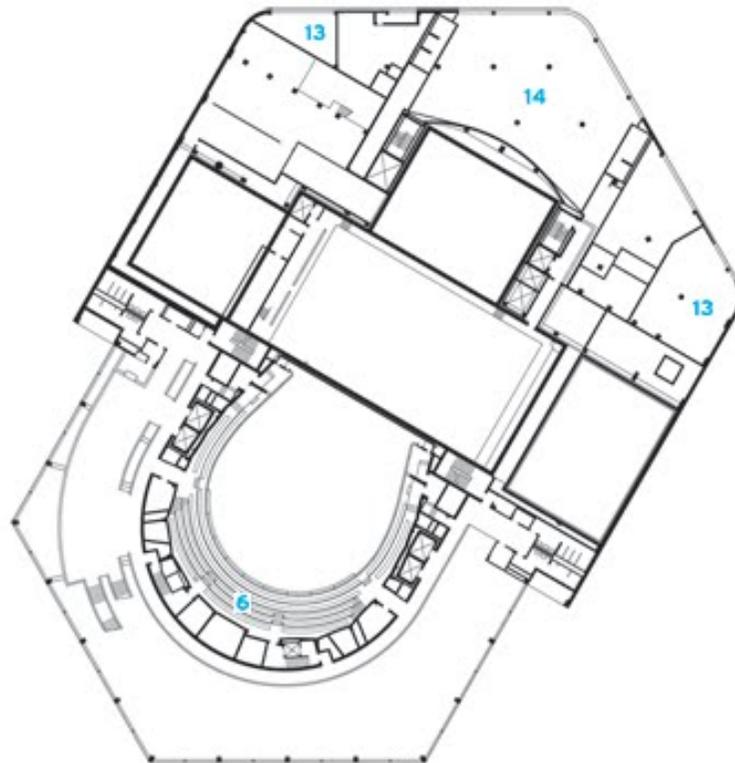
Arrival

As you approach the building, a person is drawn in by the all-encompassing glass façade, which wraps around the building to create a transparency between the opera house and the surrounding Performance Park. An 84 foot wide section of the glass façade is retractable to a height of 23 feet opening up the vast red-dominated lobby to the newly added visitors' cafe and box office. The portico radiating from the opera house on all sides provides shade to over 3 acres of the Performance Park. The solar canopy's louvers are arranged at fixed angles following the path of the sun. By eliminating most direct sunlight on the façade and by creating a cooler micro-climate around the building, the canopy reduces the energy requirements of the Winspear Opera House.

Auditorium Space

This space is a 21st Century reinterpretation of an early 14th century opera house designed in a horseshoe shape. The Winspear seats 2,300 on four balconies and a lower orchestra seating level. In the center of the auditorium there is a 318-rod chandelier located inside the performance hall.

The chandelier hangs 50 feet below the ceiling. Before shows begin, it can be retracted into the ceiling. The acrylic rods are illuminated by three primary color LEDs. Sound Space Design, a London firm, designed and engineered the acoustics specifically for performances of opera and musical theater. Furthermore, the stages are equipped with appropriate



Site Information



Figure 4.29. [Top] Photo: Matthew Dunham, The Winspear Opera House, Dallas, Texas.

Figure 4.30. [Left] Photo: Matthew Dunham, The Winspear Opera House, Dallas, Texas.

flooring for performances of ballet and other forms of dance. The stage contains the world's largest lift which can be lowered to become the world's largest orchestra pit that is able to comfortably seat 80-110 musicians. The Pit spans across the front of the stage and bridges the space between the proscenium and the front row of seats.

Support Spaces

The backstage space is considered one of the largest in the United States outside of the Metropolitan Opera in New York. It has two full-size bays which allow for full scenic changes to come on, off and rotate out. Furthermore,

advanced crane systems can maneuver items, boxes, set pieces and technology to make scene changes and prepare for events and. The support spaces are also well-designed for easy traffic flow to and from the stage and contain an array of costume rooms, dressing rooms and a post-event green room for meeting with the stars.

Conclusion

The Winspear Opera House is an impressively, well-designed performance space which utilizes the high-tech, 91-battion fly grid above the stage, the 30' high loading doors and crane maneuvering system to its advantage to maximize space and production quality. The exterior is 21st century modern and dramatic, but the design is traditional with world-renowned acoustic quality for high-quality performances.

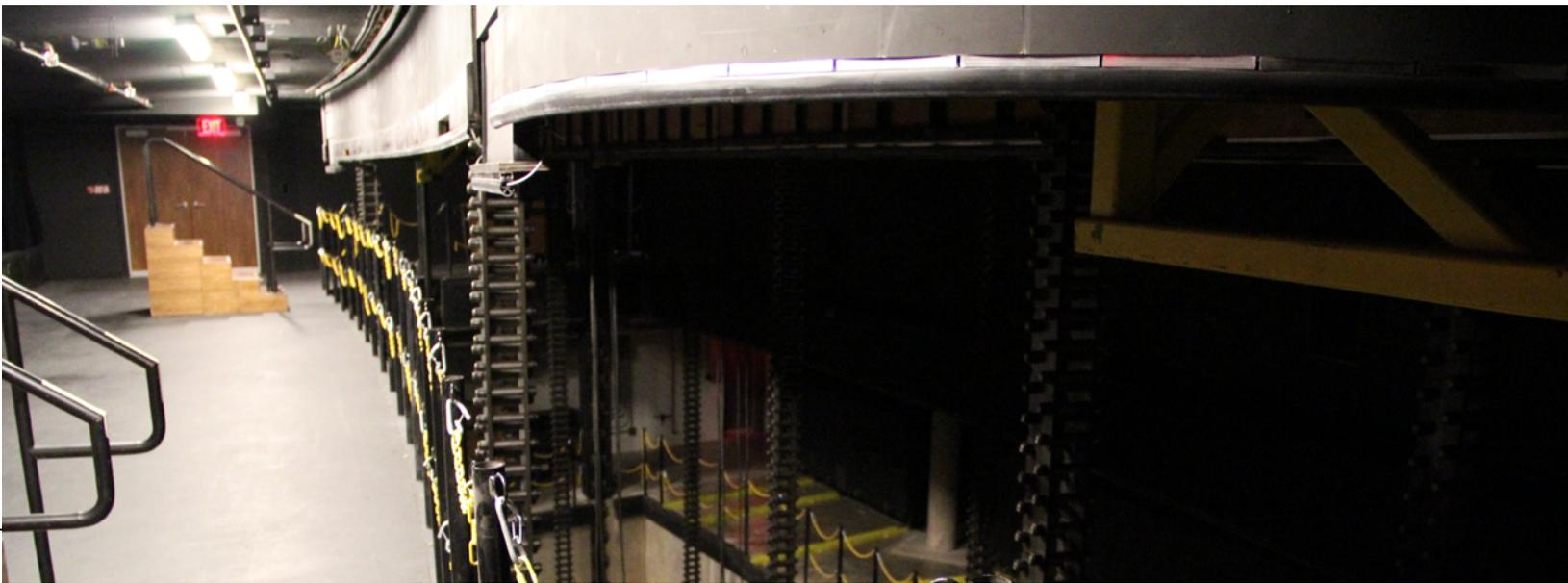


Figure 4.31. [Top] Photo: Matthew Dunham, The Winspear Opera House, Dallas, Texas.



Figure 4.32. [Left] Photo: Matthew Dunham, The Winspear Opera House, Dallas, Texas.

Figure 4.33. [Bottom] Photo: Matthew Dunham, The Winspear Opera House, Dallas, Texas.





Case Study 3

Target Field, Minneapolis

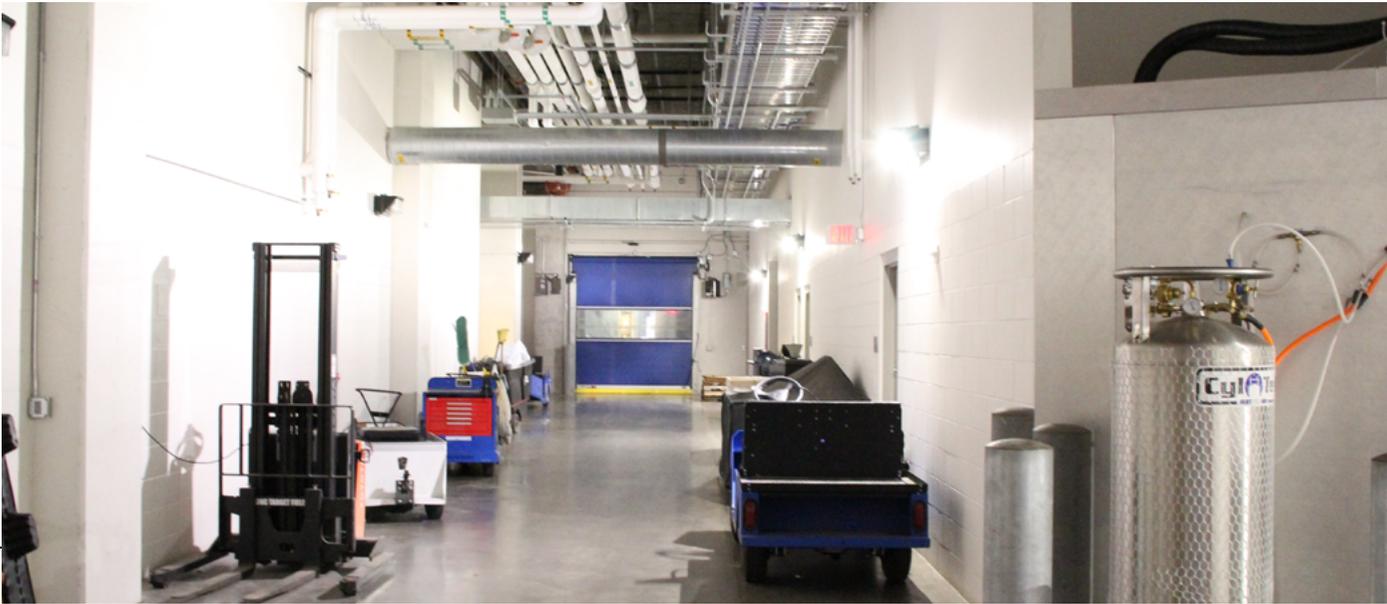
Named after the Target Corporation, whose headquarters are located several blocks away in downtown Minneapolis, Minnesota. Target Field is a state-of-the-art venue for hosting events. Its interior design details, engineering, service production, building circulation and sustainability ranking makes this a trend setting facility. The is evidently not a theater or opera house, but the large-scale system management, support system, circulation patterns and collaboration nodes are well-designed for large events. These things are vastly applicable to a large-scale performance space as it needs to primarily function on

a high level for the end user staffing the facility and the public attending sports, educational or creative events held at the site.

Designed by a break away from HOK sport, Populous, the lead architectural design firm, was tasked with creating a 21st century venue which not only attracted guests for the event, but to partake in one of its many high-class restaurants, clubs and lounges. Target Field was awarded LEED Silver Certification by the U.S. Green Building Council, only the second LEED-certified professional in the United States after National Parks.

*Figure 4.34. [Left] Photo: Matthew Dunham Target Field, Minneapolis Minnesota.
Figure 4.35. [Right] Photo: Matthew Dunham Target Field, Minneapolis Minnesota.*





75

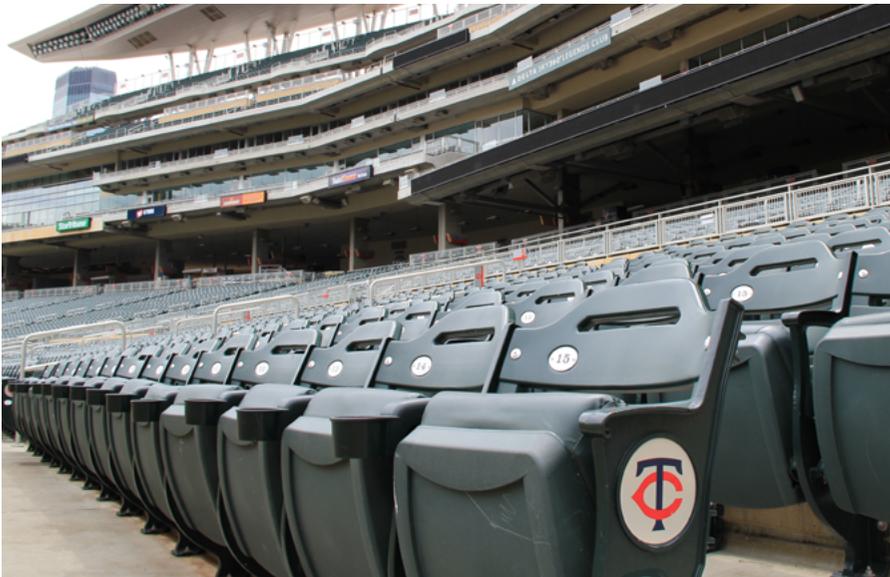


Figure 4.36. [Top] Photo: Matthew Dunham, Photo: Matthew Dunham Target Field, Minneapolis Minnesota.

Figure 4.37. [Bottom Left] Photo: Matthew Dunham, Photo: Matthew Dunham Target Field, Minneapolis Minnesota.

Figure 4.38. [Bottom Right] Photo: Matthew Dunham, Photo: Matthew Dunham Target Field, Minneapolis Minnesota.

Arrival

Seating upwards of 41,000 people, all entrances and exits are clearly marked. The majority of all visitors arrive from three distinct directions; on foot from downtown along an easily-accessible, landscaped ramp, by the light rail train which stops at the venue and

lastly, from the parking garage. The venue is well-connected to the city's transit network and is immediately bordering several parking ramps off of Interstate 94. Over 8,600 people typically arrive at every event via the light rail which terminates at Target Field Station. In a venue this size navigation is critical which is why Target Field has a simple crescent shape layout

and one primary vertical center of circulation by the main entrance. This provides easy access for all visitors and clear navigation.

Support Space

To keep a building of this scale running and operating easily, the ground level has a continuous service level loop. This

allows maintenance and staff to access all elevator shafts that vertically connect them to 4 separate elevator cores spaced around the venue. As a large element of the visitor experience involves food, man-hours were decreased by designing four large refrigeration rooms in the Service Level (basement) to dispense food, pop, beer wine, water and other beverages to all 50 + restaurants, cafes, bars and lounges.



Figure 4.39. [Left] Photo: Matthew Dunham Target Field, Minneapolis Minnesota.

Conclusion

Target Field implores modern technology, strong design decisions, dynamic and easy circulation and inventive heating and cooling strategies to facilitate a smooth sustainable operation. Directing, supplying, entertaining, hosting and welcoming 41,000 guests for each event requires strict organization and circulation. Target Field utilizes the latest technology to maximize flexibility and cut down on man-hours by distribution centers from their lower service level corridor. Furthermore, it is a solid study

on how to utilize resources to decrease energy consumption. Lastly, the level of quality found in the interior design of the venue speaks to a high level of sophistication while still maintaining and servicing thousands of people.



Figure 4.40. [Top] Photo: Matthew Dunham Target Field, Minneapolis Minnesota.



Figure 4.41. [Left] Photo: Matthew Dunham Target Field, Minneapolis Minnesota.

Space Planning: Interaction Matrix and Net

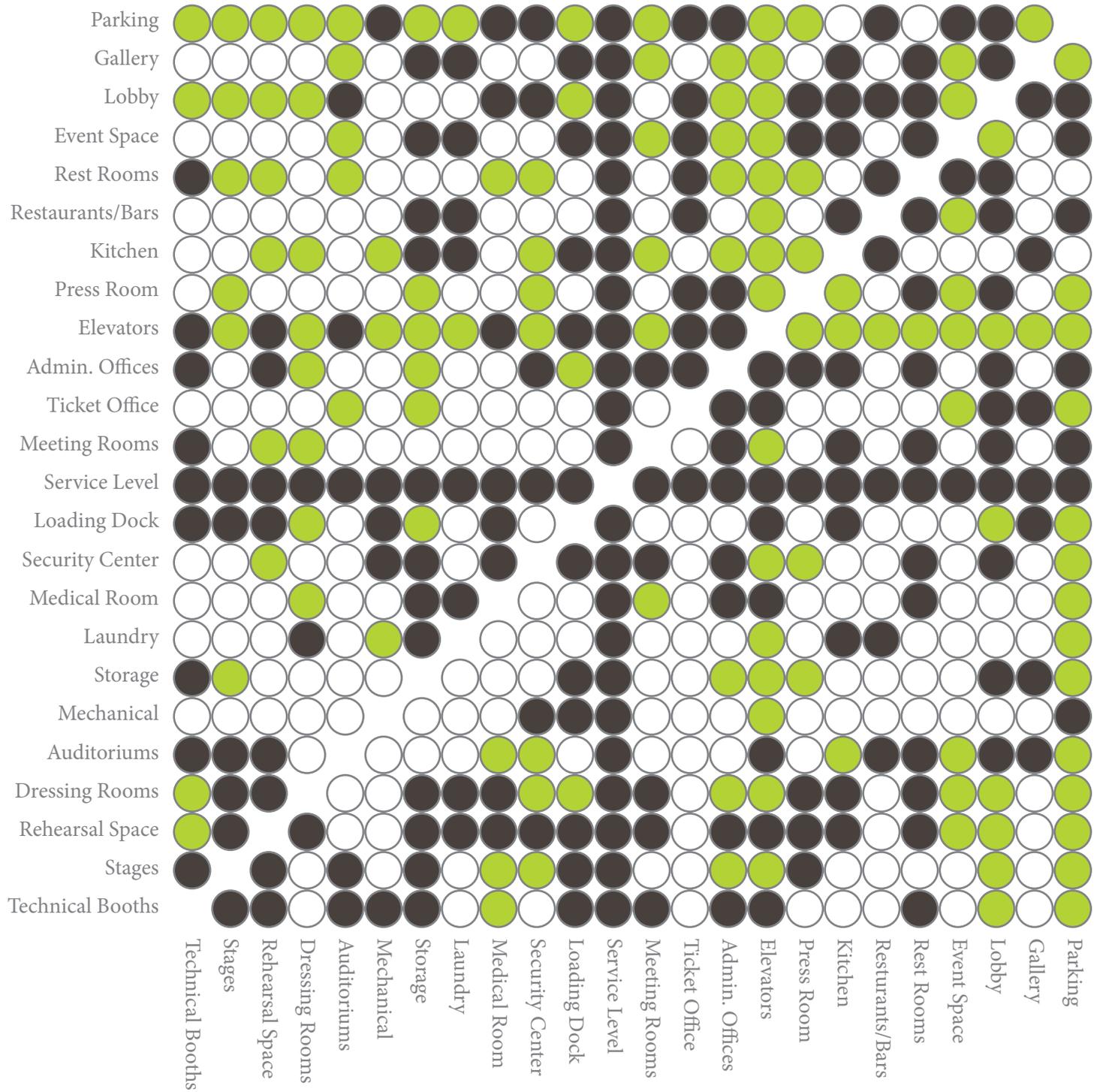
Programmatic space planning is critical in designing and arranging spaces on any building but more so at a building of this large scale and complex practical-oriented performance typology. There are three main spaces within this project: First, the lobby space where guests arrive to access desired entities; Second, the multi-use and dynamic performance auditorium space; and third, the service level which provides private service access to all areas of the building for employees, security, staff and stage performers. The service level, as clearly indicated on the figure on the right, needs to be well-connected to the entire building. This is an entity which becomes the backbone for facility management and functional circulation; not only for the staff but special events which may use rehearsal spaces, green rooms, stage level and kitchen.

79

Interaction Matrix



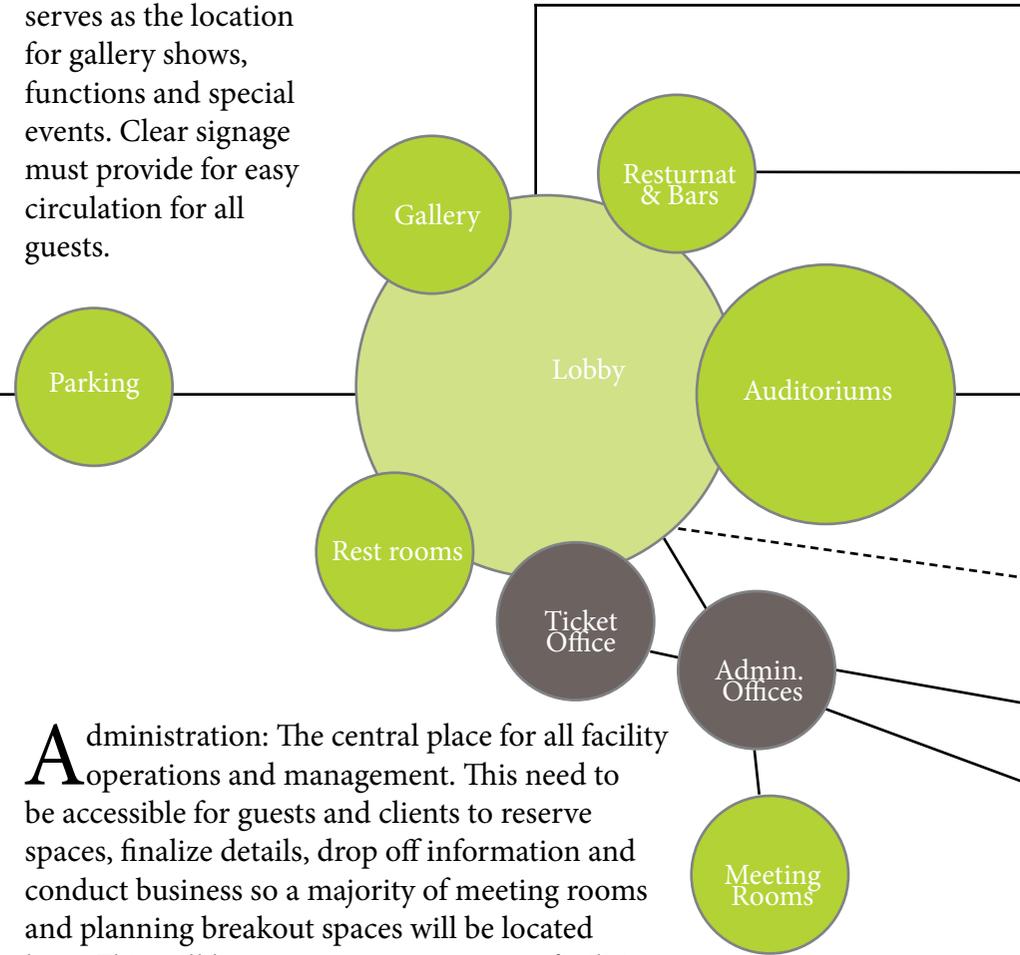
Figure 4.42. [Opposite] Interaction Matrix.



Space Planning

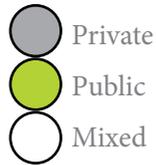
The square footage of the project is large and sprawling so to maintain easy circulation through the building there are two main thoroughfares: One being the lobby space and the second being the service level. Both of these areas are interconnected and from them all other spaces can be accessed.

Lobby: The lobby will be mixed use space where arrival and departure happens and serves as the location for gallery shows, functions and special events. Clear signage must provide for easy circulation for all guests.



81

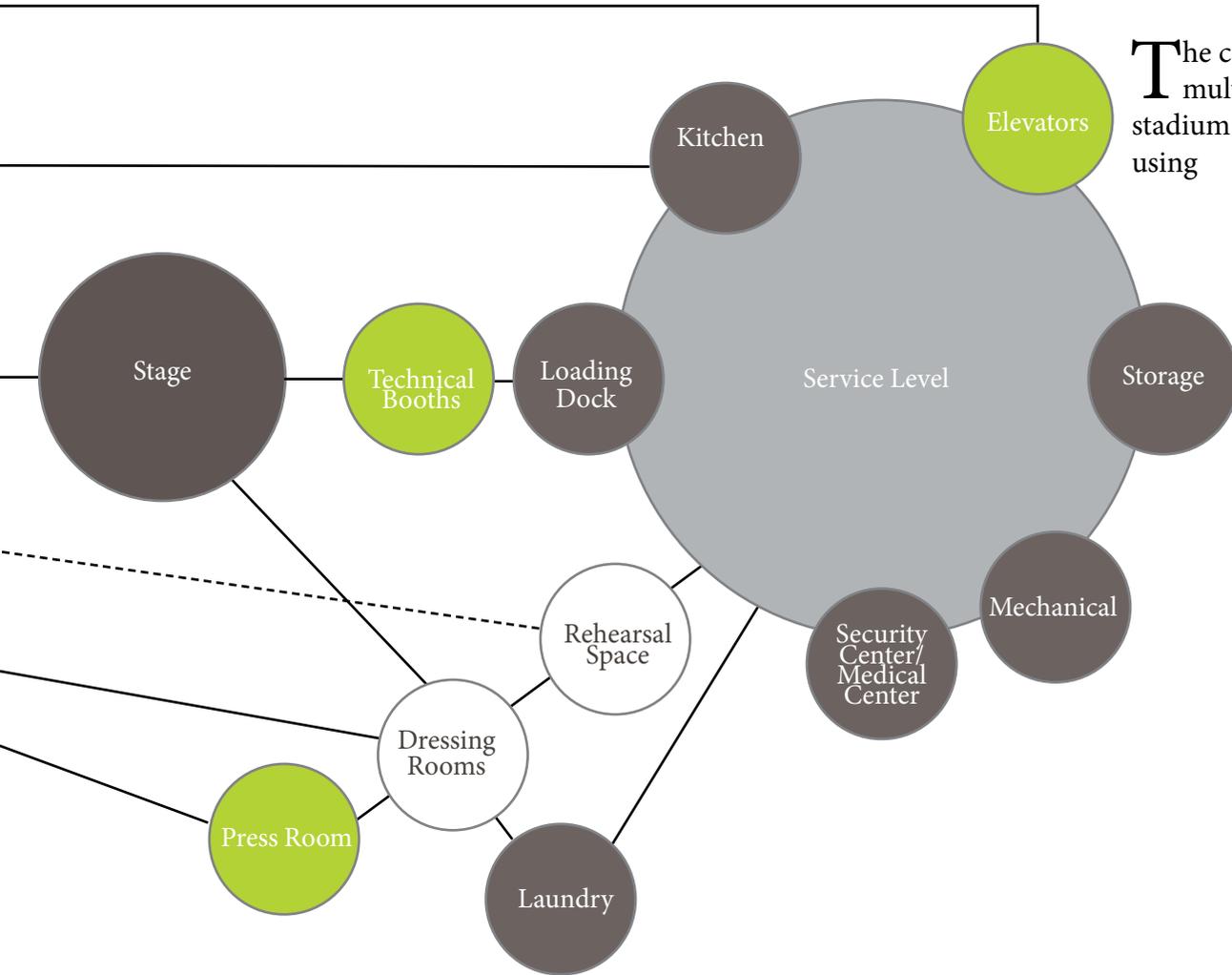
Interaction Net



Administration: The central place for all facility operations and management. This need to be accessible for guests and clients to reserve spaces, finalize details, drop off information and conduct business so a majority of meeting rooms and planning breakout spaces will be located here. This will house event management, facilities management, production, stage development, ticketing and rental. There will be both a public and private entrance for this space so that staff can still access the building after hours.

Figure 4.43. Interaction Net.

Every elevator will have secure access to the lower service level. This allows staff and management circulation at high traffic times to be more easily conducted through the lower levels than through high traffic lobbies. This also helps maintenance and security staff to respond and access to areas of need very quickly.



The concept is to create a multi use performance stadium which can modulate using

Service Level: The service level is located in the lower level or basement. The level houses, and provides access to, all major entities within the facility. Connecting the stage level, dressing rooms, mechanical, shop, and storage, on lower levels to lobbies, administration, club rooms, galleries, and technical booths on upper levels. This is the single most practical arrangement for a building of this scale and dynamic typology.

Space Planning

The scale of this project is vast and contains multiple levels of interconnecting spaces and circulation patterns. The space requirements listed below have been developed based on information and advice obtained through case studies and 12 on-site visits to applicable buildings.

Service Level and Sub Level Total:
83 Pitch: 160,000 sq. ft.
Emergency Health Center: 1,500 sq. ft.
Exam Room (3): 300 sq. ft.
Surgery Space: 500 sq. ft.
Storage: 500 sq. ft.
Office (2): 200 sq. ft.
Security Center 3: 400 sq. ft.
Locker Room (2): 1,000 sq. ft.
Command Room: 450 sq. ft.
Surveillance Room: 1,200 sq. ft.
Maintenance Shop: 1,000 sq. ft.
Maintenance Office: 600 sq. ft.
LL General Management: 800 sq. ft.
Employee Locker Room: 1,400 sq. ft.
LL Storage N 5: 500 sq. ft.
LL Storage S 3: 100 sq. ft.

Production Room: 900 sq. ft.
Press Conference Room: 3,000 sq. ft.
LL Banquet Hall: 6,200 sq. ft.
LL Press Hall: 4,200 sq. ft.
Large Rehearsal Room: 2,500 sq. ft.
Mechanical HVAC 30: 500 sq. ft.
Loading Dock Enclosed: 5,000 sq. ft.
2 sunken bays, space for 5 semi- trucks, 5 vans and 5 cars: 4,800 sq. ft.
Trash Compactor: 1,350 sq. ft.
Executive Entrance (3) : 2,700 sq. ft.
Kitchen: 1,400 sq. ft.
Food Storage: 1,300 sq. ft.
Beverage Storage: 1,000 sq. ft.
Beverage pump room (4): 900 sq. ft.
Dressing Room 1: 2,400 sq. ft.
Dressing Room 2: 2,400 sq. ft.

Dressing Room 3: 2,400 sq. ft.
Dressing Room A: 1,350 sq. ft.
Dressing Room B: 1,350 sq. ft.
Dressing Room C: 1,050 sq. ft.
Dressing Room D: 1,050 sq. ft.

Green Room 1: 3,500 sq. ft.
Green Room 2: 3,500 sq. ft.
Green Room 3: 3,500 sq. ft.
Warm up Space 1: 1,500 sq. ft.
Warm up Space 2: 1,000 sq. ft.
Warm up Space 3: 900 sq. ft.
Large Rehearsal Room A: 2,500 sq. ft.
Large Rehearsal Room B: 2,500 sq. ft.
Dance Rehearsal Room C: 2,500 sq. ft.
Private Music Rooms (25): 1,600 sq. ft.

Main Concourse Level
Lobby: 98,900 sq. ft.
Concessions/Bars (8): 5,400 sq. ft.
Box Office: 900 sq. ft.
Staff Security Entrance: 800 sq. ft.
Gift Shop: 1,600 sq. ft.
Guest Retail Spot: 3,000 sq. ft.
Security Office: 200 sq. ft.
Janitorial Storage: 600 sq. ft.

Restaurant/Lounge A: 3,800 sq. ft.
Restaurant/Lounge B: 3,800 sq. ft.
Restaurant/Lounge C: 3,000 sq. ft.

Bar A: 2,000 sq. ft.

Bar B: 2,100 sq. ft.

Level 2

Restaurant/Lounge A: 3,800 sq. ft.

Restaurant/Lounge B: 3,800 sq. ft.

Restaurant/Lounge C: 3,000 sq. ft.

Bar A: 2,000 sq. ft.

Bar B: 2,100 sq. ft.

Lounge A: 2,000 sq. ft.

Lounge B: 1,000 sq. ft.

Administration

Private Offices (20): 2,400 sq. ft.

Open Offices (35): 1,950 sq. ft.

Meeting Space: 1,440 sq. ft.

Board Room: 2,000 sq. ft.

Circulation: 60,000 sq. ft.

Janitorial Storage: 600 sq. ft.

Conference Room A: 375 sq. ft.

Conference Room B: 375 sq. ft.

Conference Room C: 400 sq. ft.

Conference Room D: 500 sq. ft.

Exhibit Space: 2,000 sq. ft.

Exhibit Space: 2,500 sq. ft.

Exhibit Space: 3,300 sq. ft.

Level 3

Tech Production Room: 1,200 sq. ft.

Mechanical: 200 sq. ft.

Press Suite Room: 4,000 sq. ft.

Boxes (8): 1,120 sq. ft.

Dining: 500 sq. ft.

Mechanical: 200 sq. ft.

Janitorial Storage: 600 sq. ft.

Restaurant\Lounge A: 3,800 sq. ft.

Restaurant A: 1,800 sq. ft.

Restaurant B: 1,200 sq. ft.

Bar A: 2,000 sq. ft.

Bar B: 2,100 sq. ft.

Level 4

Restaurant/Lounge A: 3,800 sq. ft.

Restaurant B: 3,800 sq. ft.

Restaurant C: 3,000 sq. ft.

Bar A: 2,000 sq. ft.

Bar B: 2,100 sq. ft.

Level 5 Loft Level

Restaurant/Lounge A: 3,800 sq. ft.

Restaurant B: 3,800 sq. ft.

Restaurant C: 3,000 sq. ft.

Bar A: 2,000 sq. ft.

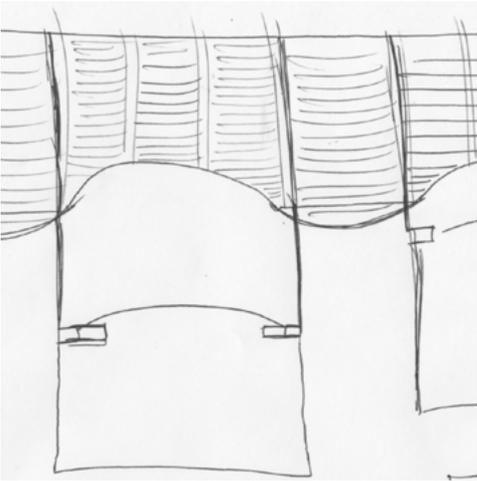
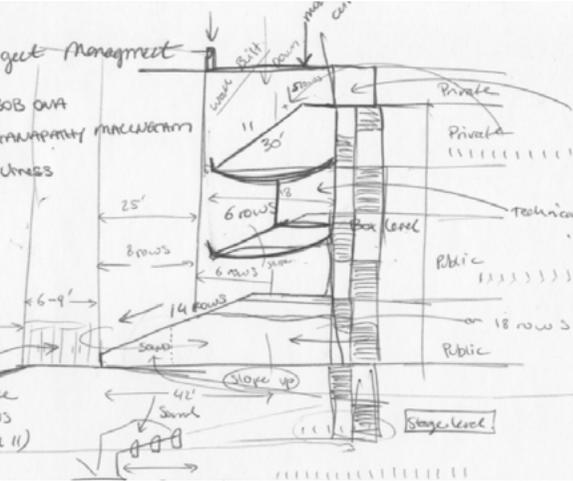
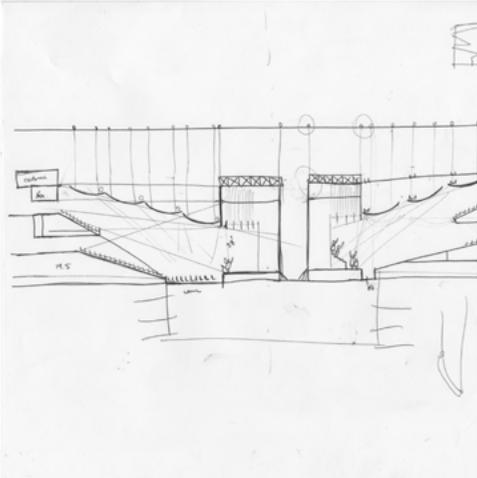
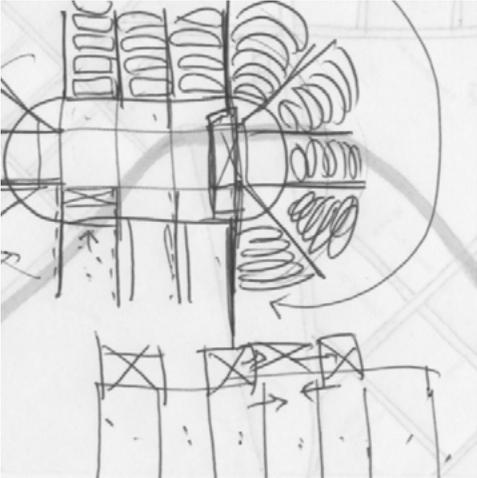
Bar B: 2,100 sq. ft.

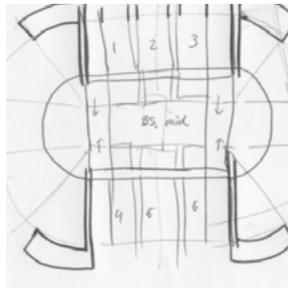
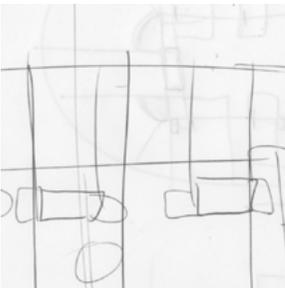
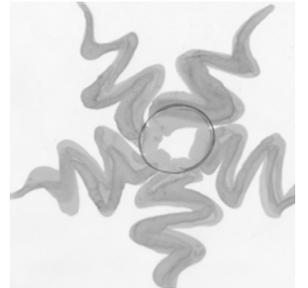
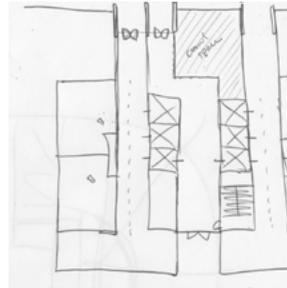
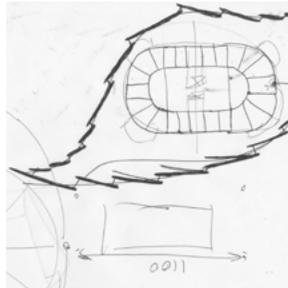
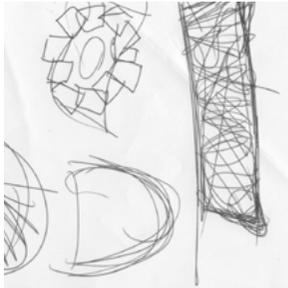
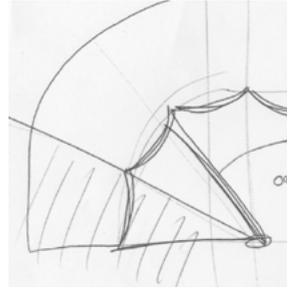
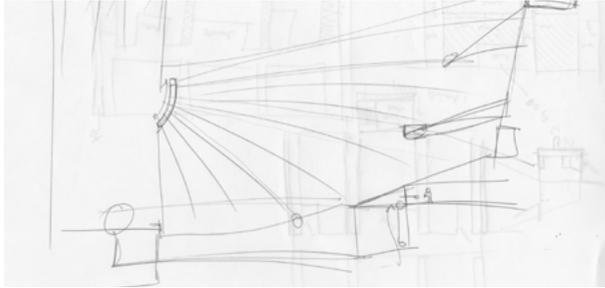
Executive Suite A: 3,200 sq. ft.

Executive Suite B: 3,200 sq. ft.

Executive Suite C: 3,200 sq. ft.

Process Sketches





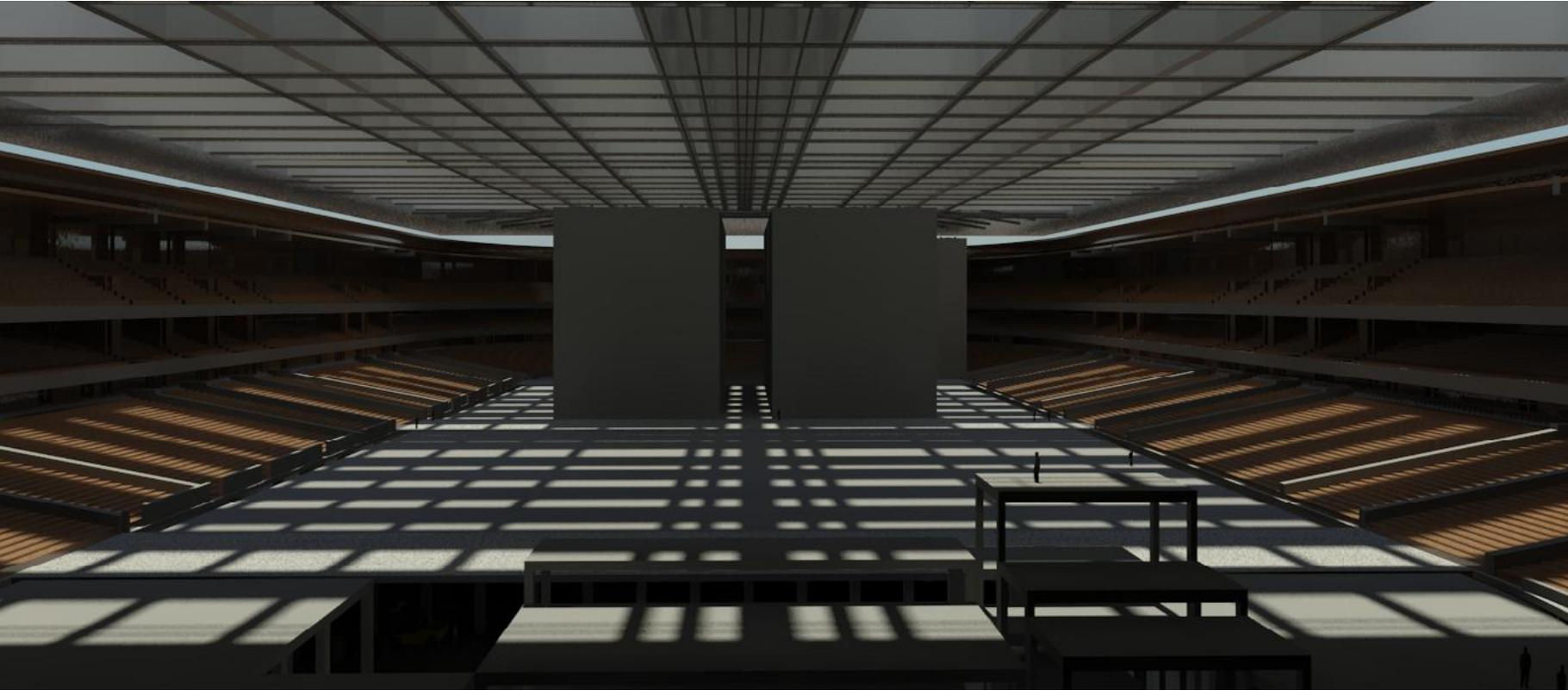


Figure 5.0. Computer Render by: Matthew Dunham, Thesis view of inside of arena with kinetic elements visible.

Design Solution

CHAPTER FIVE

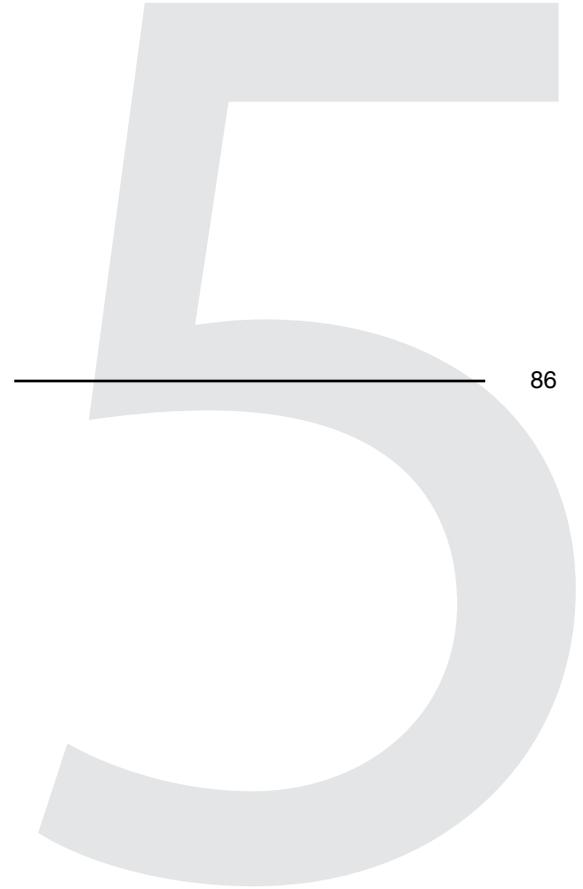




Figure 5.1. Computer Render by: Matthew Dunham, View of corner showing the concert hall, seating 4,400 people.



The Builing

This project has been designed in every single detail to be a monument to performance space design, a landmark and a destination in the community, and milestone in modern development of performance space architecture. The structure had to seamlessly blend both architecture and interior design together to create a large scale event space that could offer a wide variety of performance typologies. A significant design goal of the project has been to enhance the visitor experience in every possible way. To accomplish this goal, the design of the building combines structural engineering capabilities with traditional theatrical performance requirements; blending them both to create a state-of-the-art building which maximizes flexibility

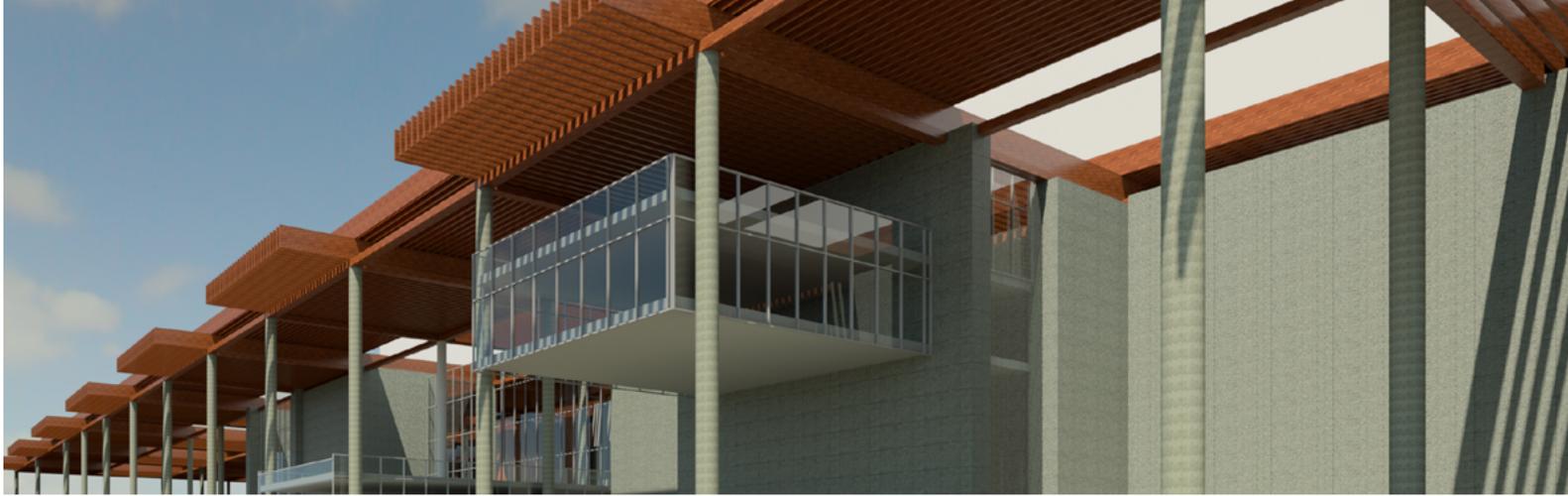
to enhance, not detract from, the overall quality of the experience.

The large side cast walls, which create a powerful perimeter around the building, stand 87 feet tall. These walls are designed on such a large scale to display electronic LED screens which provide dynamic instantaneous motion graphics and real-time potential broadcasting of events LIVE from inside the building. Incorporating these large LED screens around the perimeter of the building will also make it the largest project on earth to utilize this square footage of LED screens on any one permanent structure. This design element was chosen as the interior of the building to provide uninterrupted, and almost unnoticed, kinetic transformations. The building's exterior had to dynamically change as well in order to better promote each performance event on the inside.

The exterior of this project is rather minimal. This design decision was made to focus most of the buildings energy, cost and kinetic on the parts that significantly matter within the performance space. This said, the lobby spaces and public spaces throughout the concourse level, the balcony levels, cantilevers, the exterior colonnade and plaza are designed to frame views for visitors on the inside, and provide sprawling vistas for visitors outside.

The horizontal sun slats which create a lofty, soft ceiling and roof are also design strategies for shading the building from summer heat. The nearly 800 anodized aluminum sun slats rest on rolled steel and site cast concrete columns. These slender columns rise from the ground to the sunshade canopy to soften the monolithic lines of the rigid concrete cast walls and LED signage screens.

Figure 5.2-5.4. Computer Renders by: Matthew Dunham.
5.2: Initial basic exterior facade with sunshades.
5.3; large art installation and acoustic wall in the main lobbies.
5.4; Monumental number outside each main door.



Structural Building Systems

This project pushes the limits of structure to solve the design problem of creating a highly automated kinetic system. The design demanded a structural roof which would span 480 feet, allow light to permeate inside and provide a 100% accurate flat base. Industry standard long span trusses were bypassed as they do not guarantee a flat bottom rail.

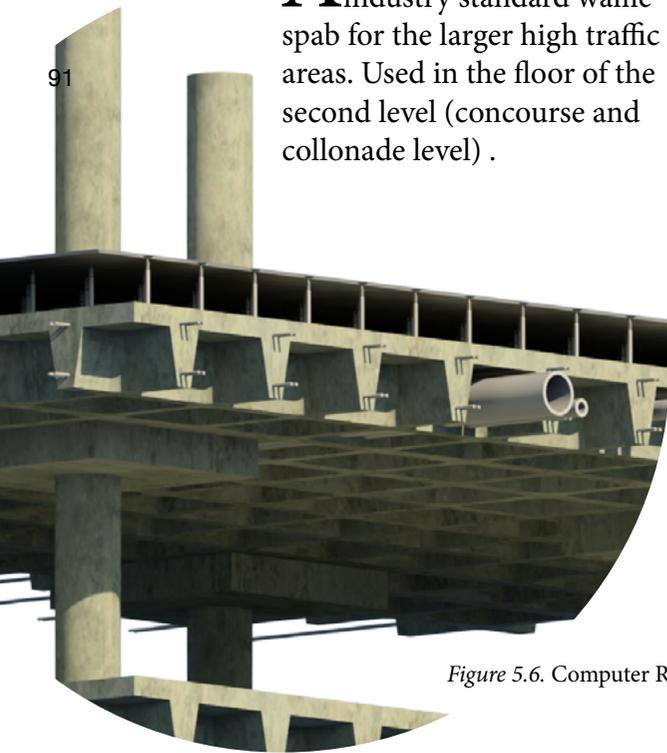
Above: the site cast industry standard waffle slab for the larger high traffic areas. Used in the floor of the second level (concourse and collonade level).

The building is divided into five main structural segments. The first is a large site cast concrete base, which helps create the plaza on level 2. Secondly, out of this level rise the monolithic walls which surround the lobby and provide dynamic surfaces for LED displays and event signage. Third are the precast elements which make up the interior floors and large walls. Fourth is the roof, a site cast monumental waffle slab, made on site, which is 48' thick and spans the main performance space. Lastly is the anodized aluminum light frame structure which creates the sprawling horizontal sun slats designed to shade the public plaza and colonnade.

Site Cast Elements: These elements of the structure are cast in place on site. Primarily these refer to the exterior monolithic walls that surround the lobby and the roof which is a large waffle slab.

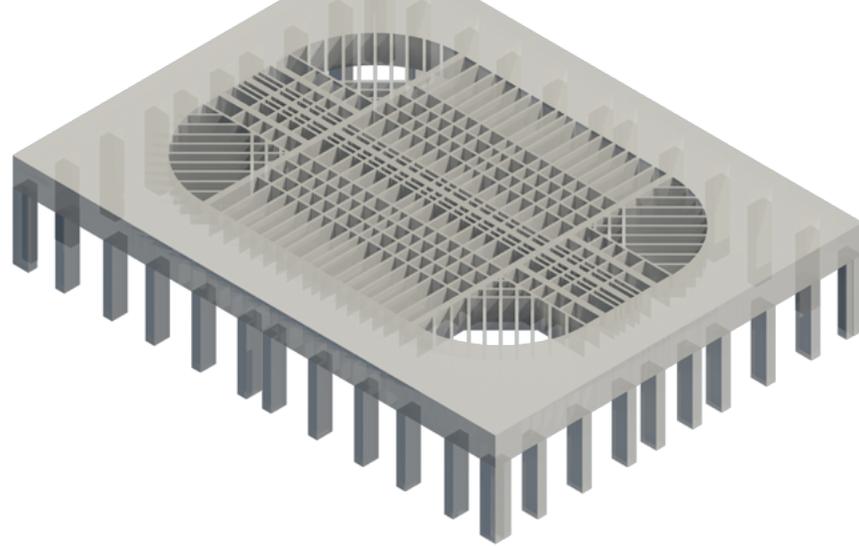
Precast Elements: These are concrete elements (walls, floor spans, columns, steps, and details) which are mass produced off site at another location and shipped to the site and assembled onsite. Most of the arenas stepped seating levels are precast.

Figure 5.6. Computer Renders by: Matthew Dunham.



The roof structure waffle slab is visible here on the right. Note the table like quality as the waffle slab sits 118 feet above the ground and is supported by a series of solid, site-cast pylons grounded on bedrock.

Figure 5.6. Computer Renders by: Matthew Dunham.



Conventional stadium roofs are made out of heavy-duty steel, which is light weight enough to span long distances, allowing for most long-span roofs to easily reach 700 feet or more while showcasing great slender designs and forms. However, in this case, it was critical that the bottom rail of the structural roof be perfectly flat to provide a solid surface in which a track can be mounted to assist in the automated kinetic moving of elements. To solve this challenge, a waffle was chosen to be the ideal type of roof. A waffle slab provides a lighter and stiffer slab than an equivalent flat slab and less mass. In this design, a waffle

slab of this scale, depth and span has never been done. This process allows the reinforcement of the two-way roof, thereby providing more rigidity. Using post-tensioned concrete allows for a more accurate final result. Furthermore, this monumental roof would be supported by massive pylons; similar to a bridge support. The pre-tensioning would be done while the structure is in the air, and the rest of the building elements would rise around it. The rest of the building would be comprised of light frame and precast concrete elements, making for easy assembly on site.

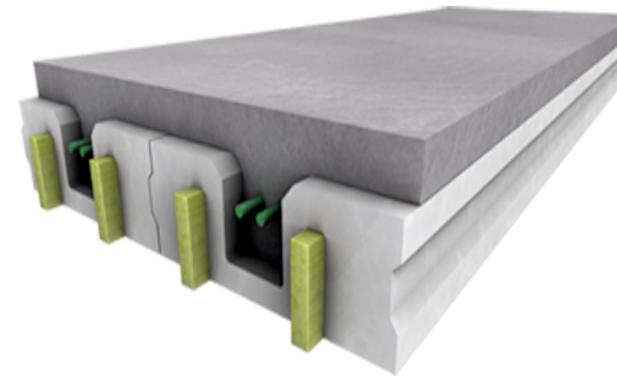
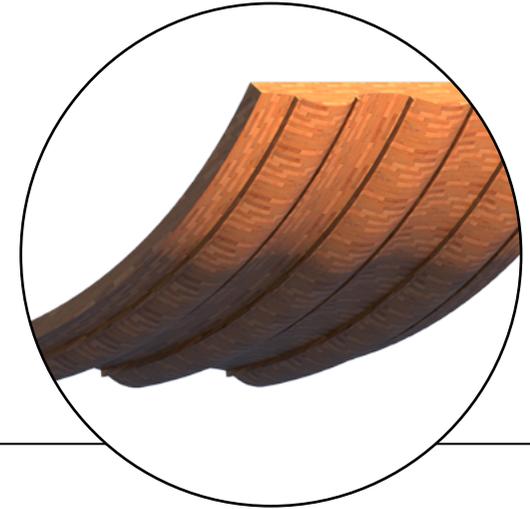
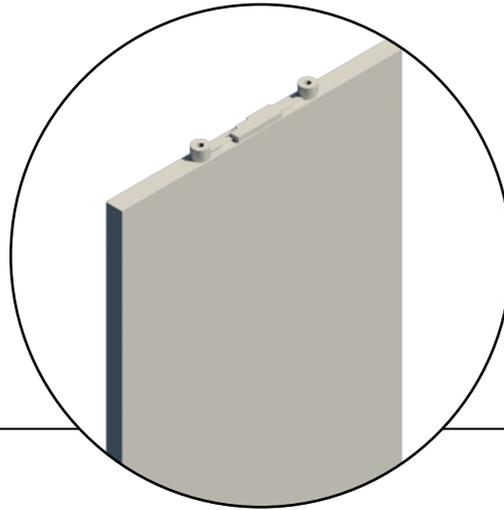


Figure 5.7. Computer Renders by: Matthew Dunham.

Above: The site cast industry standard waffle slab for the larger high traffic areas. Used in the floor of the second level (concourse and colonnade level).

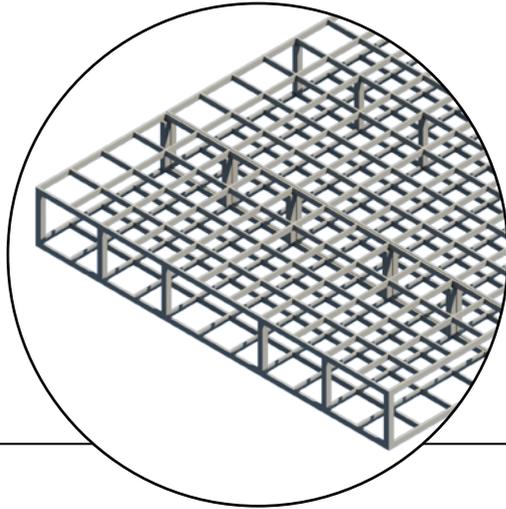
Kinetic Performance Components

There are 586 kinetic components which work together to dynamically transform the space from one event typology into another. This kinetic morphology happens through the use of hydraulic lifts, push chains, spiral lifts, suspended track systems and electric winches. The entire system, other than the floor, is ceiling suspended and retracts into large loft-level garages. Meanwhile the floor is divided into 208 segments and can be raised and lowered 24 feet as needed. The system is designed to be exclusively automated therefore requiring less man hours and intensive labor. Through a inferred and motion detector system kinetic objects will not engage if people or objects are in the way or in danger.

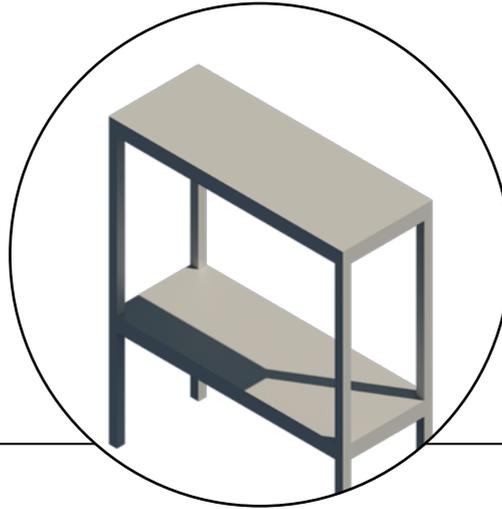


Walls: There are 214 kinetic walls which work together to sub-divide the performance arena into 10 acoustically sound separate auditoriums. Some walls are not square and because of the seating, a gentle-slope, the walls must lineup perfectly. Each wall is 18”, layered much like a fiberglass exterior door which is created for air flow resiliency, acoustic barrier and its light weight mass. On top of these walls is an “intelligent node”, using a computerized automation system these nodes control the walls precise speed of movement, and locking mechanism.

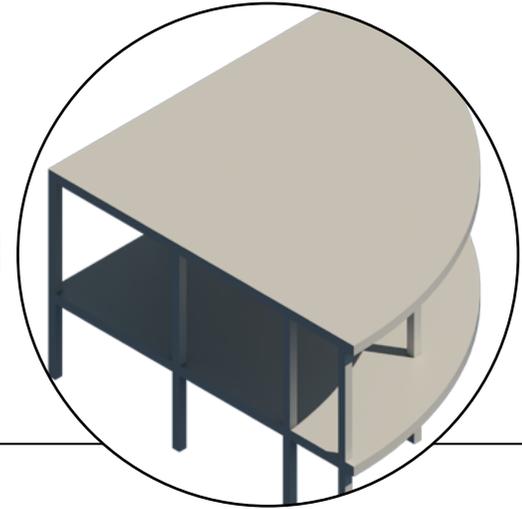
Shells: There are two types of acoustically treated kinetic wall elements period. The first our ceiling suspended acoustic clouds which have it on 2 fly points. These acoustic clouds can have it from the horizontal position in which they are used to a fully vertical orientation and Paul the upwards into the ceiling, and back into the vertical Loft storage spaces around the upper perimeter of the arena. Furthermore these sound clouds can be lowered attend any ideal height, even the ability to close off the balconies of the arena and make much more intimate Theatre venues.



Grids: There are ten, large fly-grid decks which are self-contained, under hung systems that contain the winches for 100 battens or 100 line sets, electric bars for lights and draperies. These as seen above can fly out over the desired stage location and be set to any height necessary for the production (most commonly no higher than 85')



Floors: These hydraulic floor lifts were first invented and utilized in Washington, D.C. for the Metropolitan Opera. Here that similar design concept has been maximized by strategically placing these hydraulic lifts throughout the entire spacious floor area. These lifts can be lowered 24 feet into the basement or these floor pieces can be raised as high as 24 feet in the air, allowing each separate area or section of the performance space to customize the precise height of the stage and allow for orchestra tiers or set changes.



Security: Absolute security and safety of all personnel and visitors must be a priority in the space of a high-tech animated system. Utilizing infrared camera motion detectors and the lock down procedure the kinetic functions of the building will only move based on a high-tech computer program. If any element or motion is sensed within the entirety of the arena all movement will automatically cease. The ceiling ball of the arena and all sub spaces can be completely locked down so that no transformation can take place.



Exterior From Street

Location: Ground Level

Primary Use: View from street

The main building is raised 24 feet above street level as the bedrock in Dallas and the surrounding area is relatively shallow. This height creates a monumental facade along the street and elevates the main concourse to maximize the views of downtown and Fair Park. These large walls act as billboards for events and are covered in LED panels allowing the facade to be as kinetic and dynamic as the events being housed inside. The perimeter of the building fills the site and is surrounded by palm trees, landscaping, and benches. In the foreground the lower level car drop-off located on ground level at each of the four doors allows easy accessibility for vehicles to drop passengers off before parking. This lower level lobby then directs guests immediately up to the main concourse level.



Exterior Colonnade

Location: Level 2 (Lobby Level)

Primary Use: Casual arrival, dining,

This sprawling 50 feet wide colonnade is a natural extension of the main concourse, allowing a visually seamless extension of gathering, social, dining, gallery, and performance spaces. This raised level allows great views of downtown and Fair Park. The exterior sun slats are made of anodized aluminum rectilinear slats, each standing 5 feet tall and spanning 54 feet. Visible here are two horizontal bridges which each act as an extension of the interior enclosed event space, restaurant space below, and open-air rooftop space for dining or gathering above. This allows for more rentable space for trade shows, special events, and wedding receptions.



Door 3 (Doors 1-4)

Location: Level 3

Primary Use: Arrival, Billboard, Statement

Standing boldly to announce each door are 55 feet tall numbers at each of the main entrances. Each of the 4 main doors, located on the corners and each have a ground level car-arrival. The elevated main concourse level provides easy access and signage for event attendees and guests to navigate the building. Meanwhile, the large monolithic walls act as modern LED lit billboards dynamically announcing upcoming events. To help cool the air and provide soothing sounds, each entrance has large reflecting pools. These pools are located at the base of the walls to act as infinity pools blurring the line between objects and soften the hard lines of the building.



Sun Slats and Cantilevers

Location: 5 and 7

Primary Use: Shade and Social

A subtle shading device, made from anodized aluminum and coated to look like wood, spans the entire building. These slats are 5 feet tall and are more heavily concentrated on the southern sides providing even more shade where necessary. These sun spats seamlessly transition between the ceiling of the concourse space and the open air colonnade, the only difference is the gaps between slats on the interior spaces are filled with glass and create air tight skylights. The cantilever; also pictured above is one of 8 which provide enclosed space on the lower level and open rooftop space on top of them. Many of these are restaurants providing thrilling views of the skyline and the buildings own scale, and other ones can be rented events, while most roofs are visitor lounges.



Lobby and Main Concourse

Location: Level 5

Primary Use: Arrival

Perhaps the most dynamic element of the concourse and lobby is the “acoustic art wall”, a four story wood wall which drapes like a curtain. This powerful form announces each of the four entrances to the main concourse. This level has four cafes and four bars, six concession stands, rest rooms, four ticket offices, information kiosks, access to all performance spaces (maximum of 10), and is connected to all vertical and horizontal circulation paths. On the right side of the image are the circulation paths connecting people to the venue’s two balcony levels; meanwhile bypassing levels three and five which are administration and conference rooms. On the left of the image are large doors which span the width of the concourse and allow the four sections of the arena to be separated, allowing guests with ticketed exclusive access entry to those theater spaces.

Figure 5.16. Computer Renders by: Matthew Dunham.



100

Administration

Location: Level 4

Primary Use: Support

Providing office space for over 150 administrative people is primarily consolidated on level 4. This administrative level provides office space for managers, directors, promotions, accounting, event planners, ground and facilities, reservations, ticketing, designers and other necessary management. The only departments which do not have office space on level 4 is maintenance, security, medical, technical production, and kinetic control which are located on levels 1 and 2 closer to their daily functions. However, they are easily connected as these one elevator vertically brings you between the two office spaces.



Palm Court

Location: Level 2

Primary Use: social

One of four cafes located on the main concourse is the Palm Court Cafe. This is a monumental space providing exterior views as well as dynamic views from all upper balcony levels. Visible in this view on the bottom left is the entrance to one of the four corner seating sections, most commonly capable of becoming a concert hall seating between 2,600 and 4,400 people. Visible here is also level four which provides access to the arena's first balcony level, and is not separated by a glass wall like the floors above and below it. Visible here are the large 6 feet high doors which can pivot and section off the concourse spaces into four separate sections if necessary, each accessing a maximum of three performance spaces. When these doors are closed each section must accommodate upwards of 9,000 guests.

Figure 5.18. Computer Renders by: Matthew Dunham.



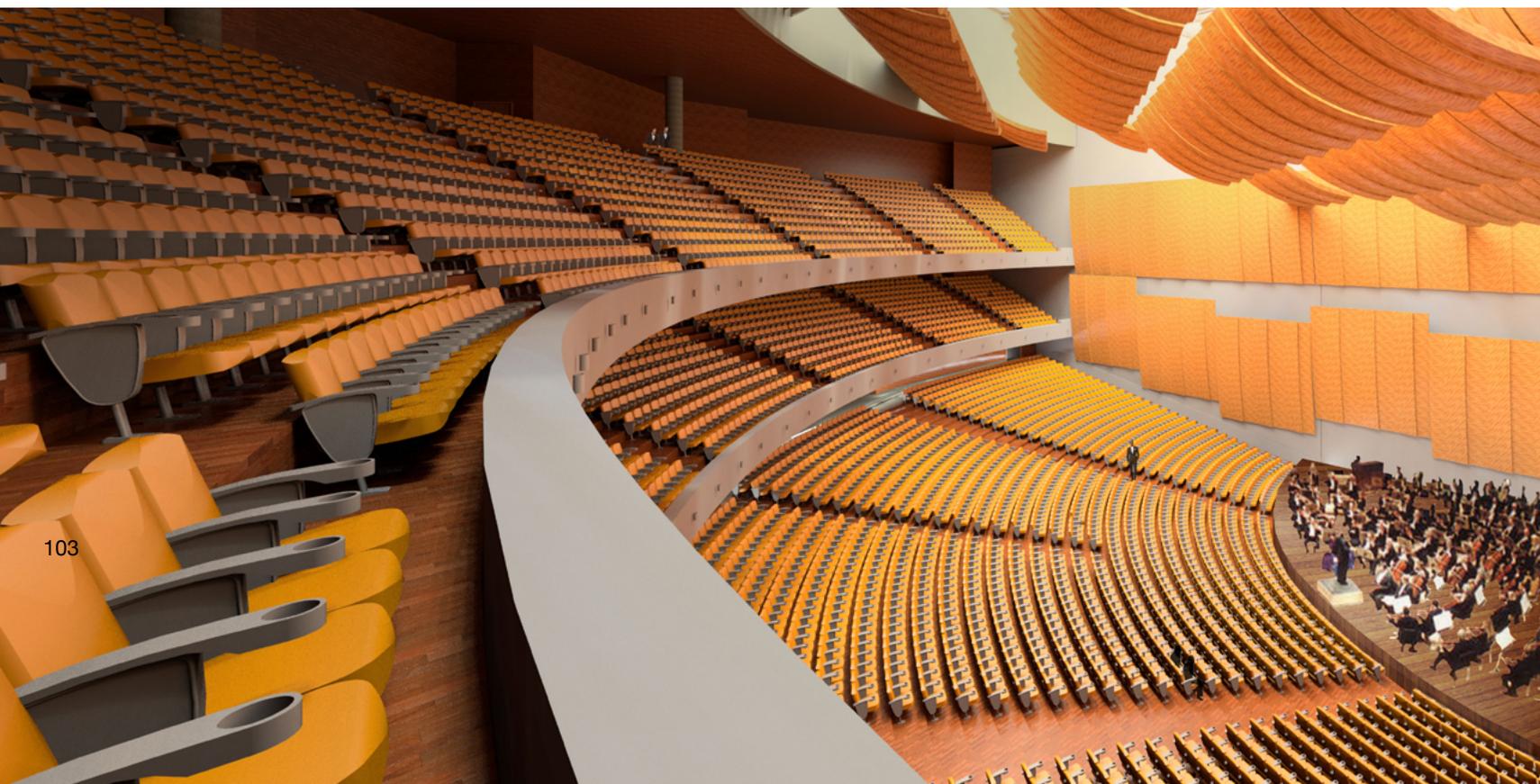
Restaurants and Cafes

Location: Level 2

Primary Use: social, dining

To attract guests to pre-show dinner and lunch, as well as post show cocktail and dessert, the facility has twelve different sit down dining options, each in a varying style. Each balcony level (levels four and six) has concession/bars as well as access to some of the sit down restaurant venues. The main concourse level has four cafes and four bars, six concession stands while the remaining eight restaurants are on the ground level with walk-by street access. With the exception of the eight self-contained ground level restaurants, all other bars, cafes, and restaurants are supplied by small on site prep kitchens with most of the food preparation and food supply from the kitchen located on the ground level.

Figure 5.19. Computer Renders by: Matthew Dunham.



103

Concert Hall

Location: Level 3-5-7

Primary Use: Events

When the arena is in its maximum subdivided state it holds 10 separate stages, 4 of which are concert halls and located on the arenas corners. Based on the needs and acoustic cloud configuration, these concert hall spaces can seat between 2,600 and 4,400 people when both balconies are in use. As the back wall of a concert hall should not be curved, while the balcony rail is, the back walls are irregular and create right angles as to not direct sound back at the stage. The structural waffle slab roof allows for light to penetrate the space during the day for rehearsals and mid-afternoon performances or conferences. These skylights can be closed off to create a performance grade blackout space even during mid day, while not affecting the light quality in performance spaces on either side.



104

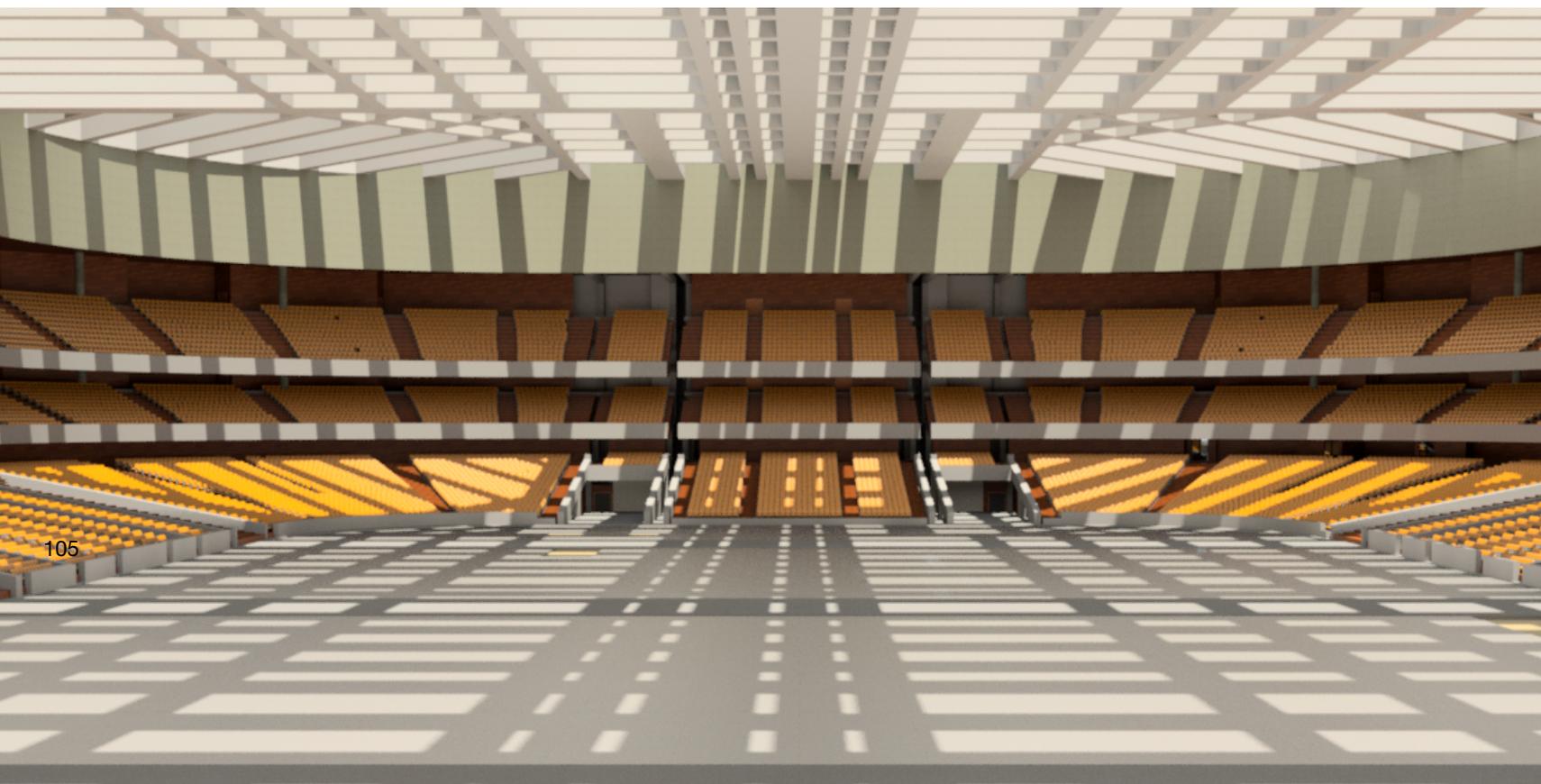
Theater

Location: Level 3-5-7

Primary Use: Events

In addition to the four concert halls there are six theaters. Four of them are identical and two of them on the ends of the arena are smaller and those are identical. These theaters seat between 1,100 and 1,900 with the proscenium arch close up to the front row. With orchestra seating the capacity can increase to 2,400 each. The larger four, pictured above, have stages built to hold Broadway level productions with a proscenium arch width of 54 feet, customized height of the arch between 32 feet and 65 feet. The stage's wings span 140 feet wide and the stage depth is 80 feet. The entire stage floor can lower 24 feet into the “underworld,” a massive pit/trap room where loading and unloading of sets can take place. The fly grid can also be customized and set to the most ideal height for the tour's needs.

Figure 5.21. Computer Renders by: Matthew Dunham.



105

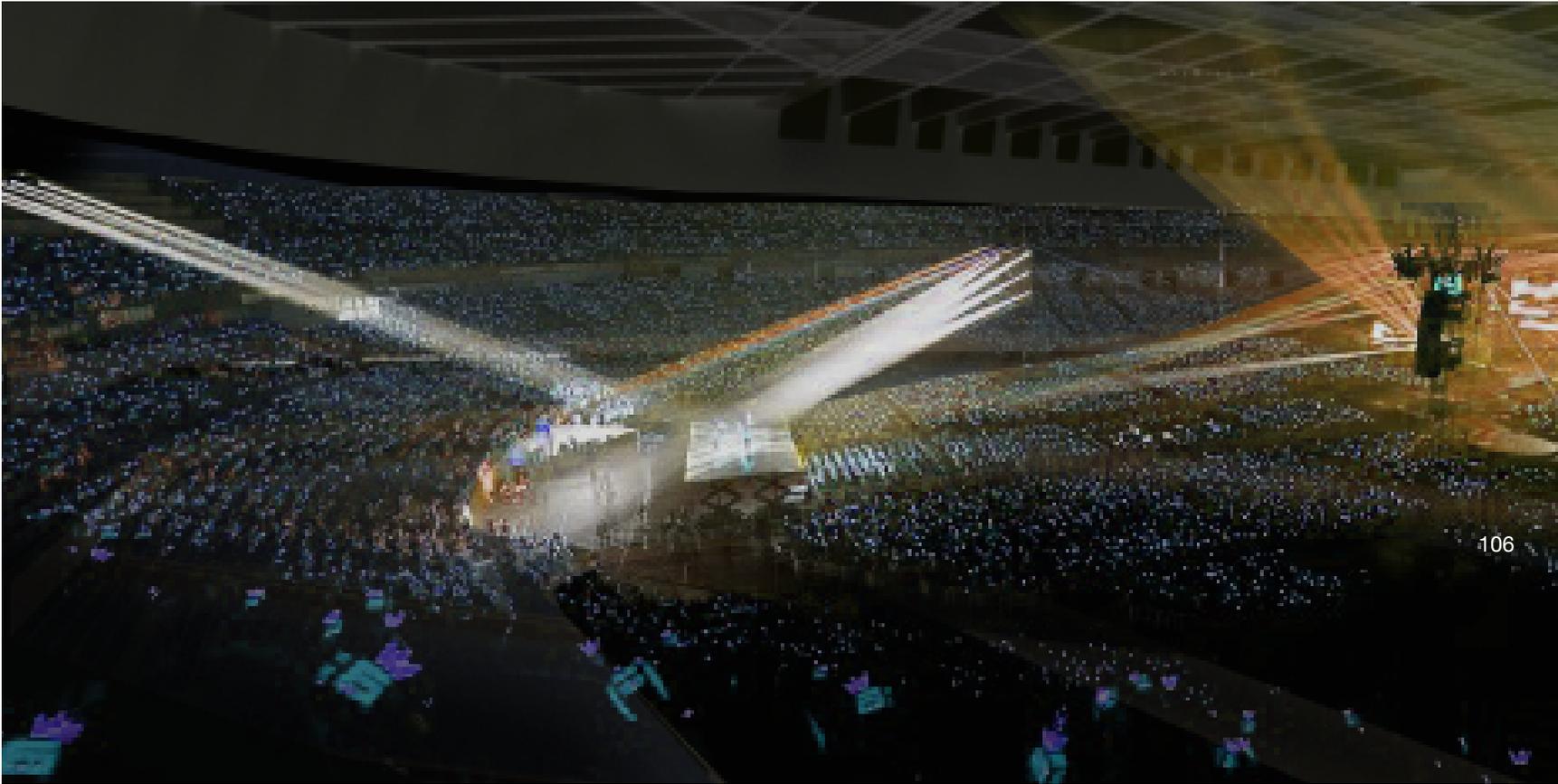
Half Arena Concert

Location: Level 2-4-6

Primary Use: Events

To maximize flexibility of productions with various typologies and sizes, the arena can be subdivided into an array of different spaces: Ranging from the full 38,000-55,000 seat arena during concerts to identical halves as shown above or to smaller sections. When the arena is divided into two halves, its uses are still highly flexible, allowing for trade shows, concerts, expos, road shows, and other large events. The waffle slab roof allows this space to be naturally lit while the one on the other side of the wall can be further divided and blacked out for entirely different events. As the waffle slab roof has electro glazing, the room can go from naturally lit to blackout in under three seconds. The fly grids used above each of the stages can be brought together to create a larger fly grid in the middle and raised or lowered to any desired height.

Figure 5.22. Computer Renders by: Matthew Dunham.



106

Full Arena Concert

Location: Level 3-5-7

Primary Use: Events

Literally a stadium, seating upwards of 38,000 seated or 55,000 with seats placed on the floor, this venue has the capacity to host all ranges of performance typologies such as opera, concerts, orchestras, dance, and theater as well as if necessary a soccer field with running track. This mega flexible venue was designed to assure extraordinary flexibility in hosting events while maintaining a nearly hands-free automated system. A drawback with traditional kinetic spaces is the need for time intensive labor to change over spaces: whereas in this design, the space can theoretically transform on its own from ten theaters to one stadium for a rock concert. Providing a flat bottom waffle slab roof gave the ability to track in all walls like a ballroom partition, but on a massive scale.

Figure 5.23. Computer Renders by: Matthew Dunham.



107

Substage Hydraulic Lifts: “Underworld” Location: Level 1 Primary Use: Production

The sub stage area is larger than the size of a football field and located on the ground floor, tucked deep inside at the center of the building where only select staff and technicians would be allowed. The entire arena floor is subdivided into 202 hydraulic lifts, which use guide rails and bracing to raise 24 feet above the main floor or lower 24 feet below. This allows any segment of the arena floor to raise and become a stage, simultaneously lower to load new sets or create any desired levels. Each floor segment has a top deck and bottom deck, allowing the pieces to fully raise the 24 feet while maintaining a solid floor (image on left). The idea comes from a similar floor at the New York Metropolitan Opera on a smaller scale.

Figure 5.24. Computer Renders by: Matthew Dunham.



108

Security

Location: Level 2

Primary Use: Security

In a building this size the security center is a critical space which needs to function for preventative measures, as well as a situation room and command center for emergencies or high profile events and conferences. The building is designed with zones, sectors, and levels in mind, all which can be locked down and access granted or restricted. This room is adjacent to the security offices, a conference room, two holding rooms, and dressing rooms for security personnel. This room should not get confused as the control room for the sub stage hydraulic lifts or kinetic arena transformations. One level below is a separate control center for all kinetic components and moving pieces which looks similar but allows window views to the sub stage.

Figure 5.25. Computer Renders by: Matthew Dunham.



109

Kinetic Transformation

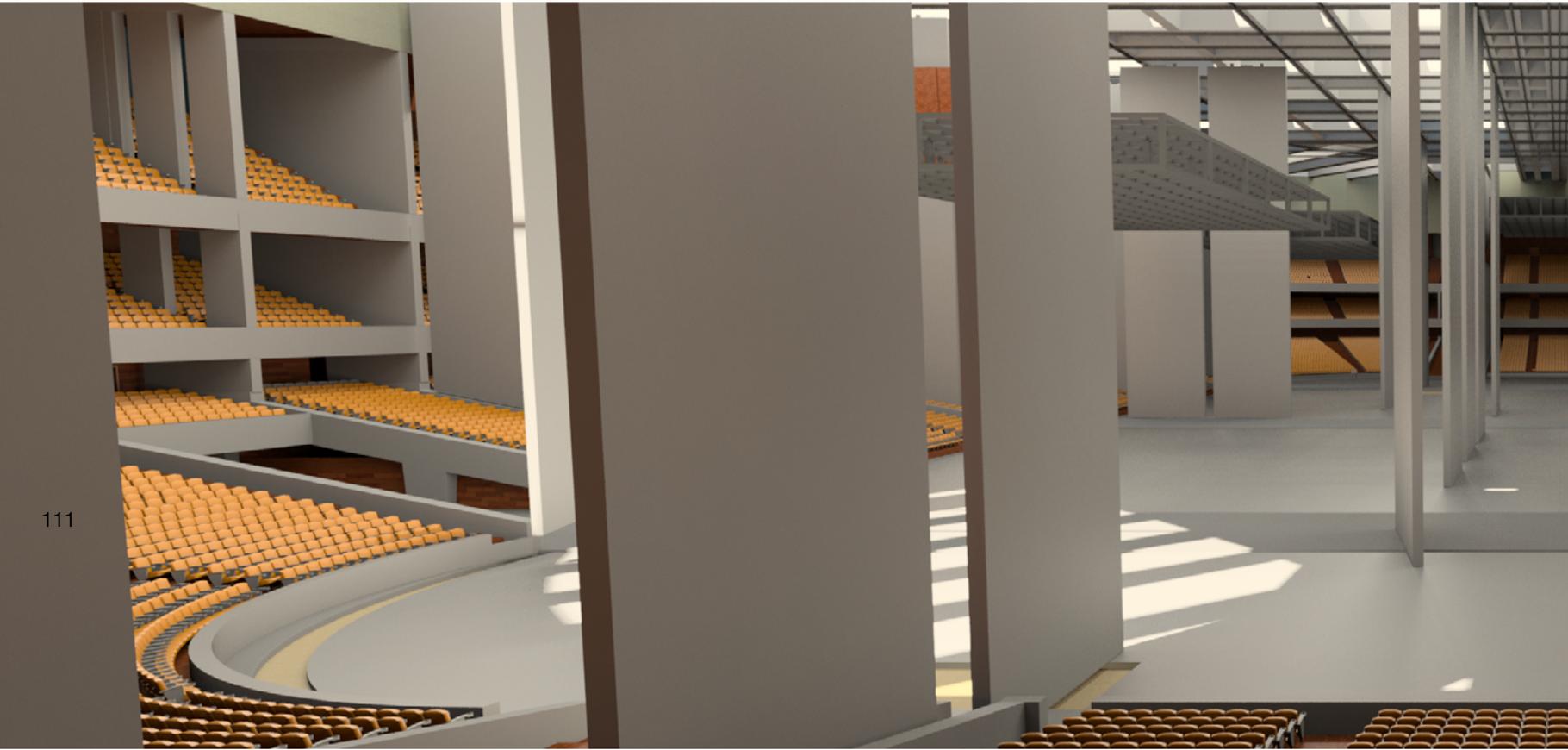
Location: Main Performance Arena

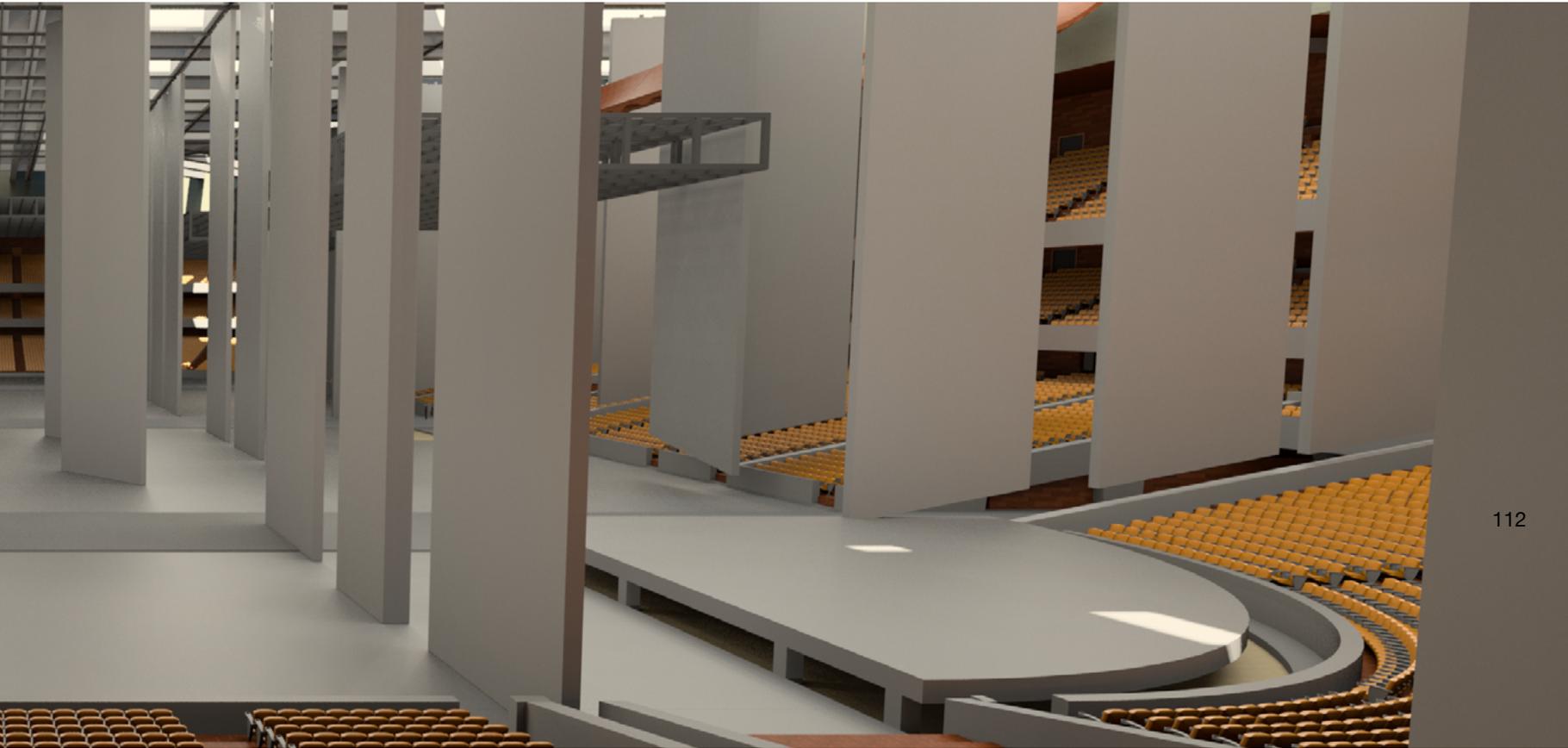
Primary Use: Events

There are 586 kinetic components which work together to dynamically transform the space from one event typology into another. Through the use of hydraulic lifts, push chains, spiral lifts, as well as suspended and track systems such as electric winches. The entire system, other than the floor, is ceiling suspended and retracts into large loft-level garages. All acoustic ceiling shells/clouds, fold up and are hoisted upwards and into their storage space. There are ten large fly-grid decks which are self-contained, under hung systems, which contain the winches for 100 battens or 100 line sets, electric bars for lights, and draperies. These, as seen above, fly out over where ever the desired stage location is and can be set to any height necessary for the production (most commonly no higher than 85 feet).

Figure 5.26. Computer Renders by: Matthew Dunham.







Kinetic Transformation

Location: Main Performance Arena

Primary Use: Events

Perhaps the simplest kinetic elements are the walls, while also being the most intelligent elements. There are 5 different sizes of walls plus 3 bottom-cut-angled wall types which close off the perimeter. Other than these three bottom-cut walls, the others are 118 feet tall, 18 inches thick and have one intelligent brain mounted on top. This brain, through an automated system, controls the movement horizontally. This mono-mount system allows the wall to pivot on a central point and swing out much like a revolving door. The longest track a wall needs to travel is upwards of 280 feet. This mono-mount system also allows the multiple 90 degree turns each wall must do to navigate around other walls.

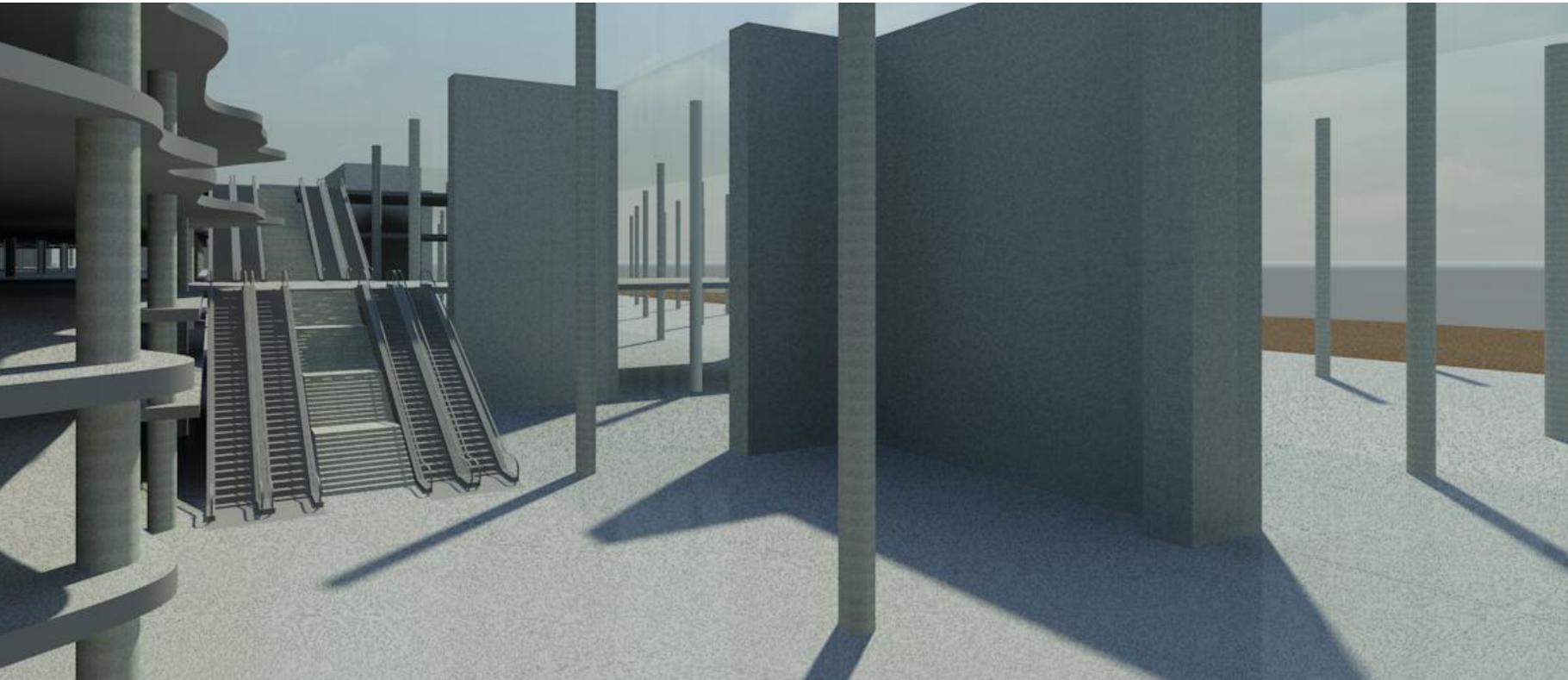


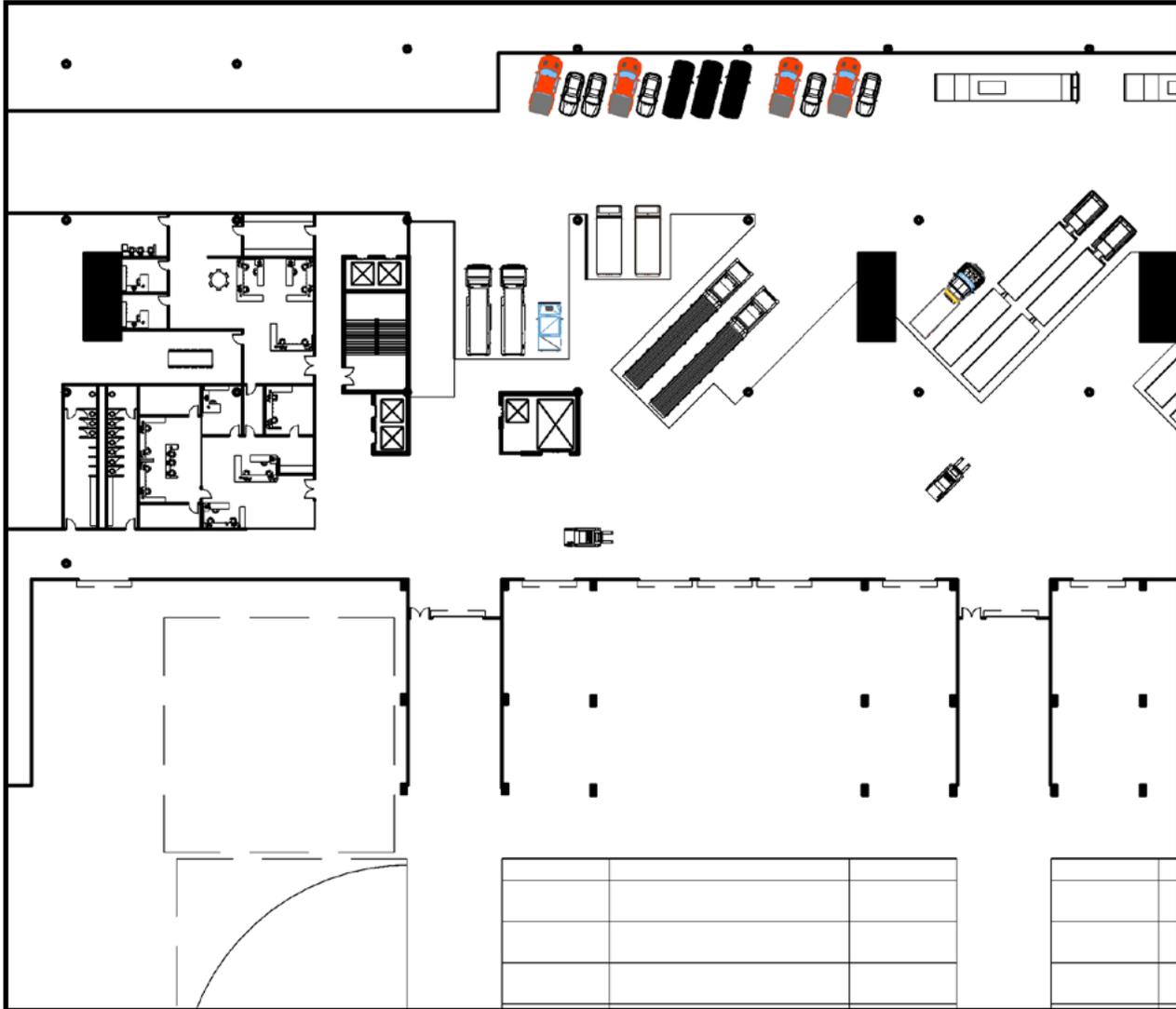
Figure 6.0. Photo by: Matthew Dunham. Project in Progress

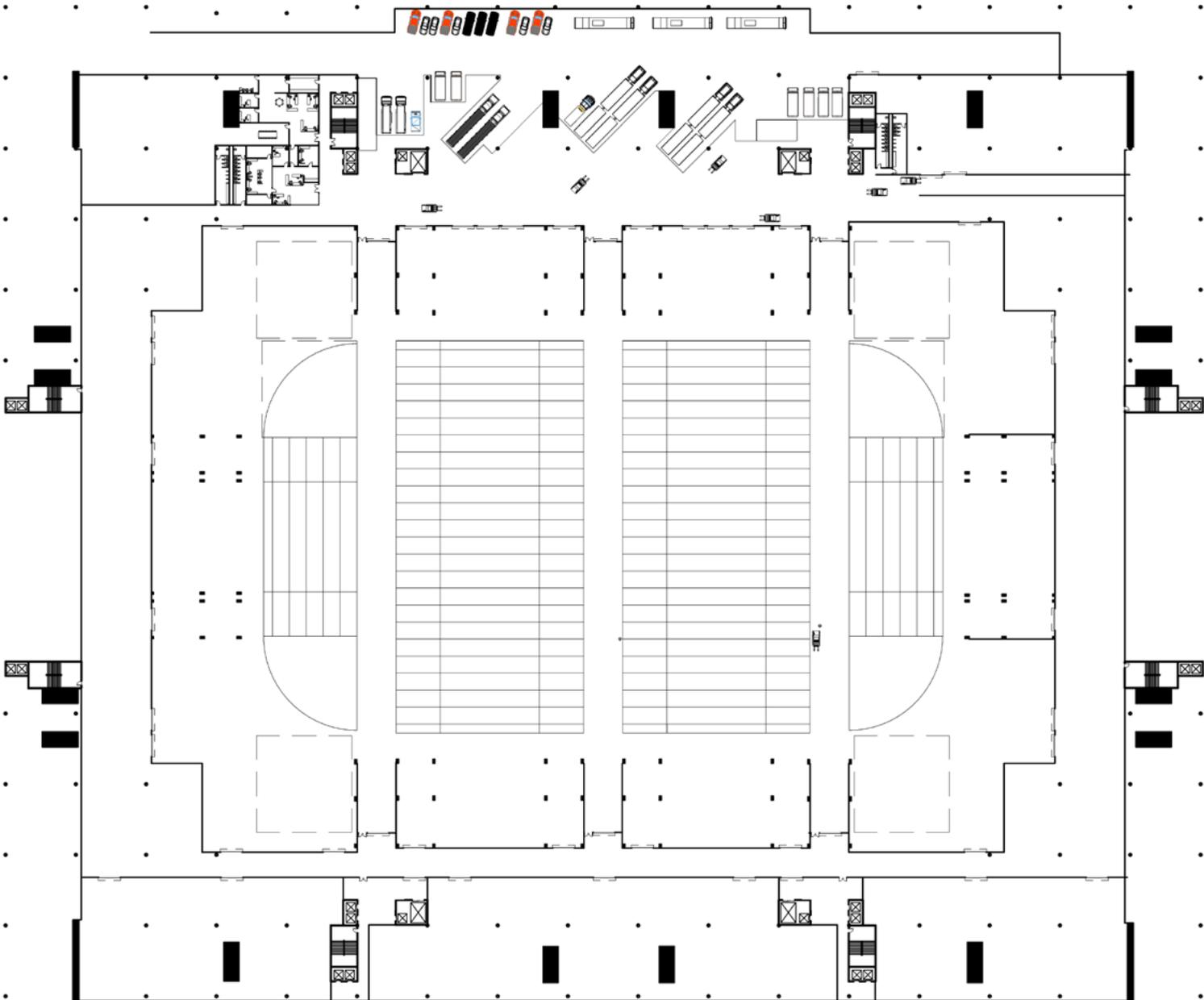
Floor Plans

APPENDIX

Floor Plan: LEVEL 1
Enlarged:

This enlarged image below is taken from the plan on the right and shows the loading dock and Kinetic Management office on the left of the image. These offices control, through cameras and monitors all the kinetic transformations of the building.

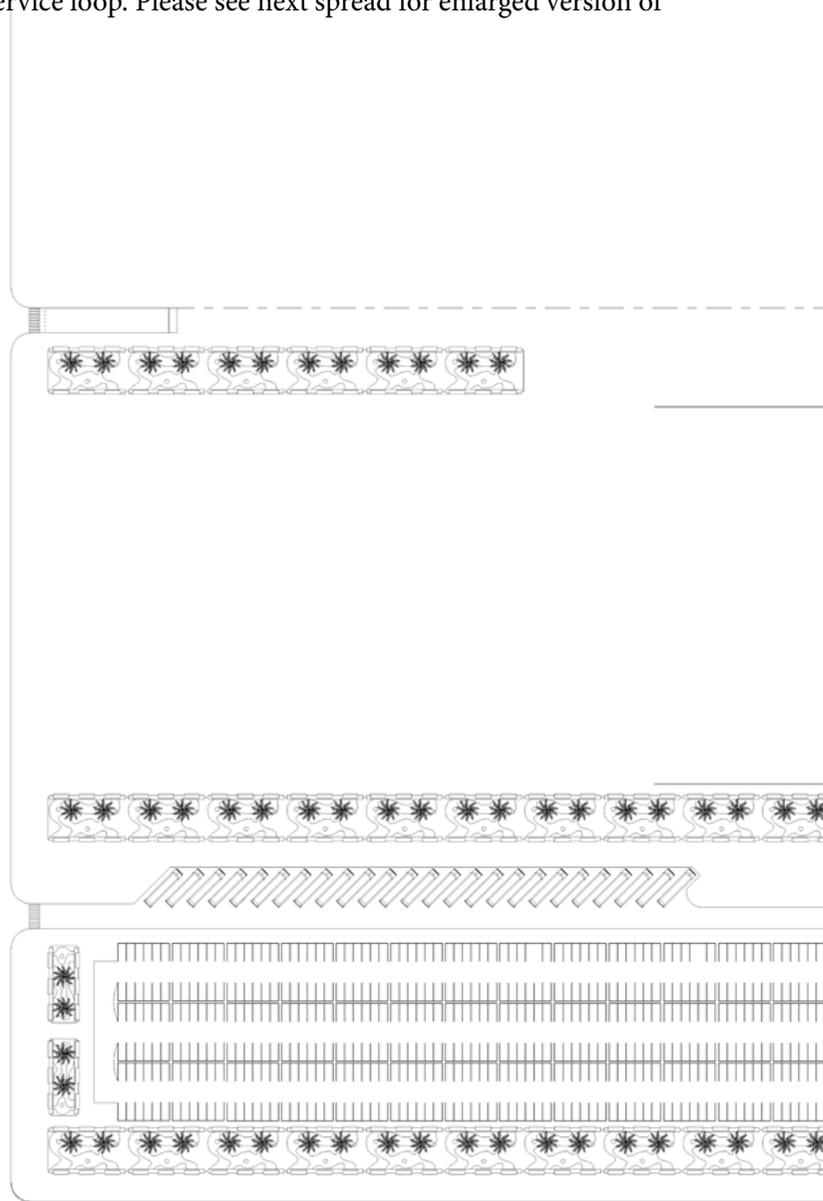


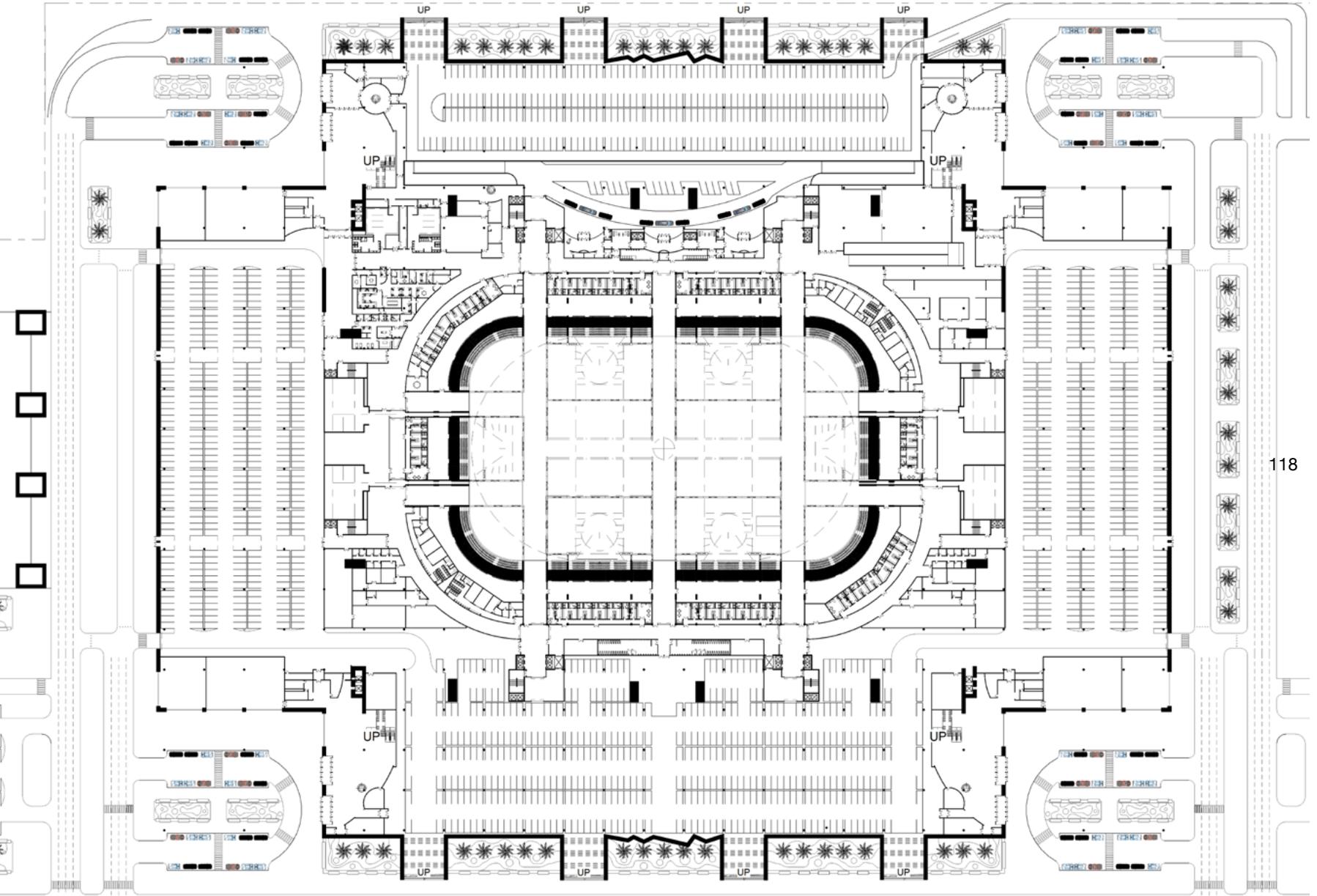


Floor Plan: LEVEL 2

MAIN ELEMENTS:

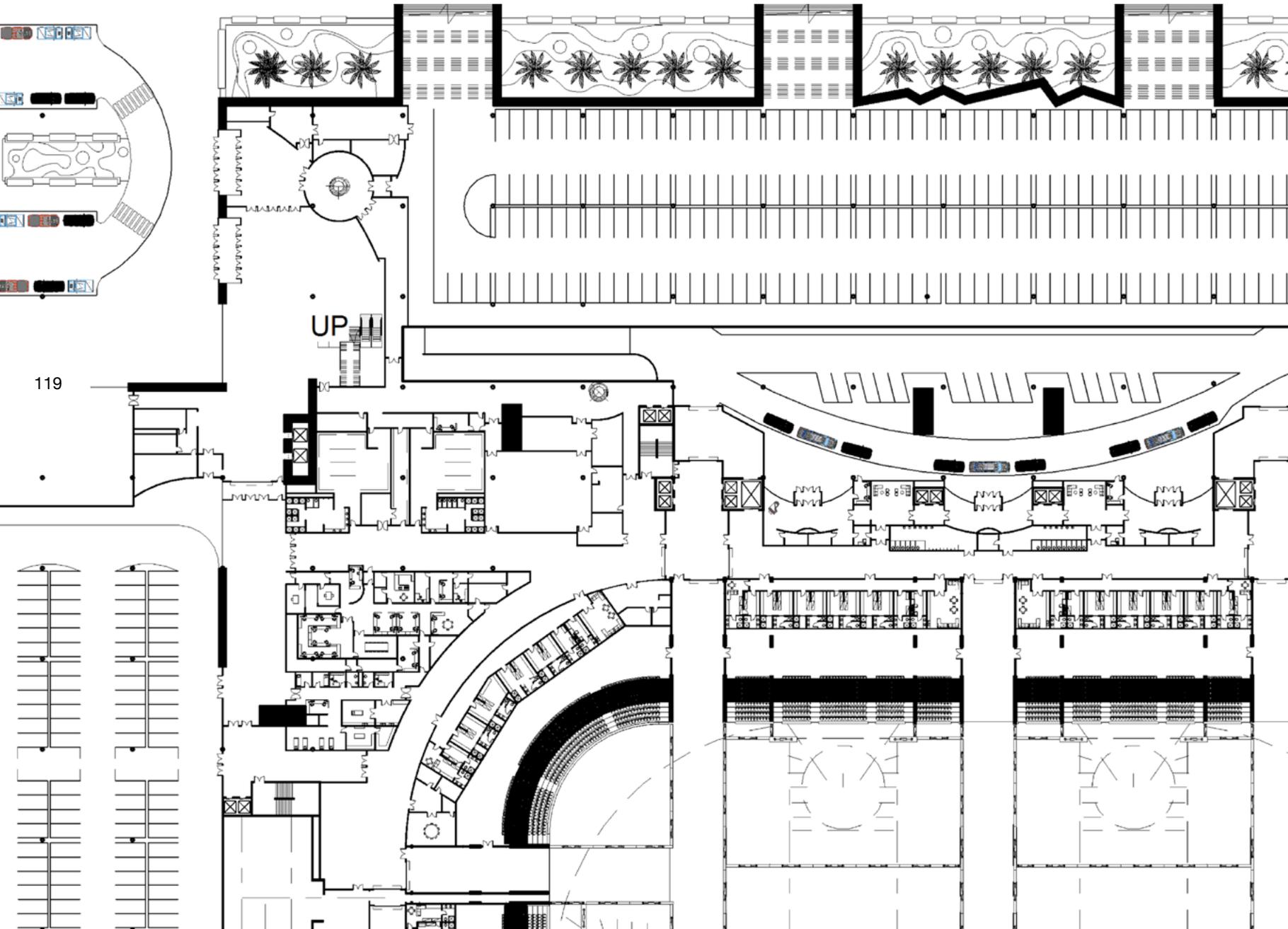
This is the main level for all arrival as it is street level. This level serves all service functions of the building and is connected to the vertical circulation cores around the service loop. Please see next spread for enlarged version of this plan.

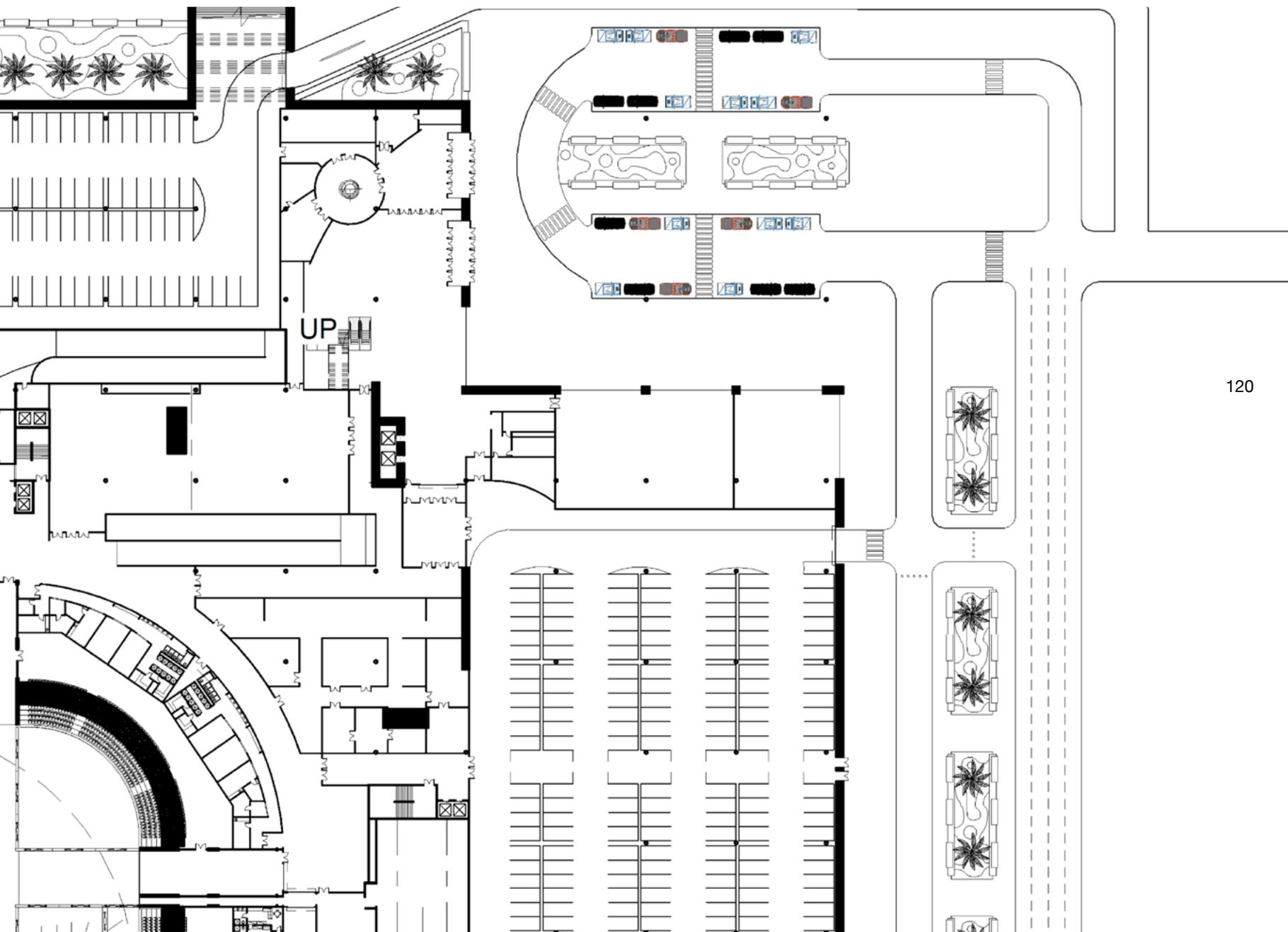




Floor Plan: LEVEL 2 [Enlarged]

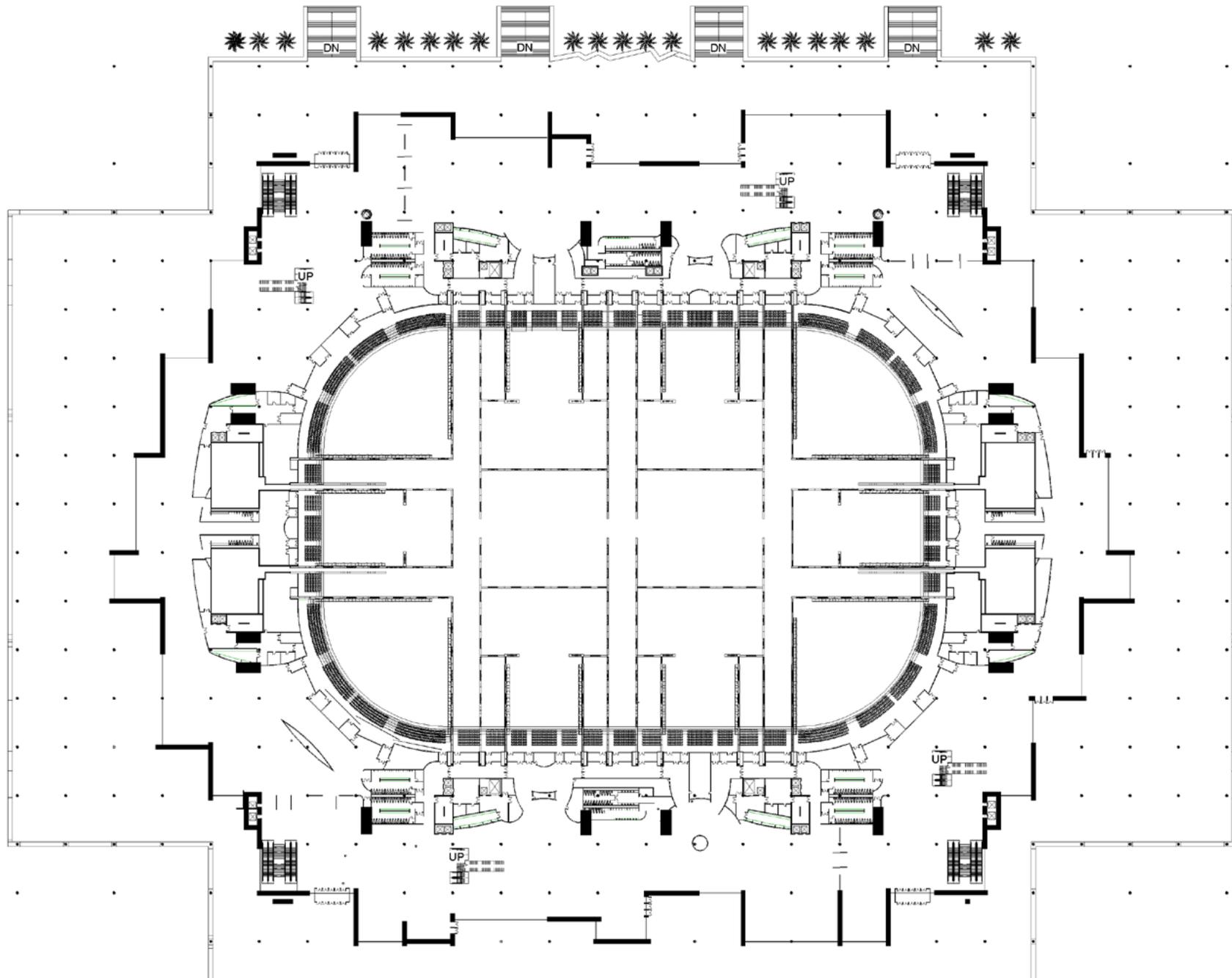
Main elements within this view is the staff parking, staff entrance, volunteer lockers, security headquarters, medical, dressing rooms, Locker Rooms and Ground Level visitor drop off, Performer, VIP Arrival, Central Dispatch Kitchen.





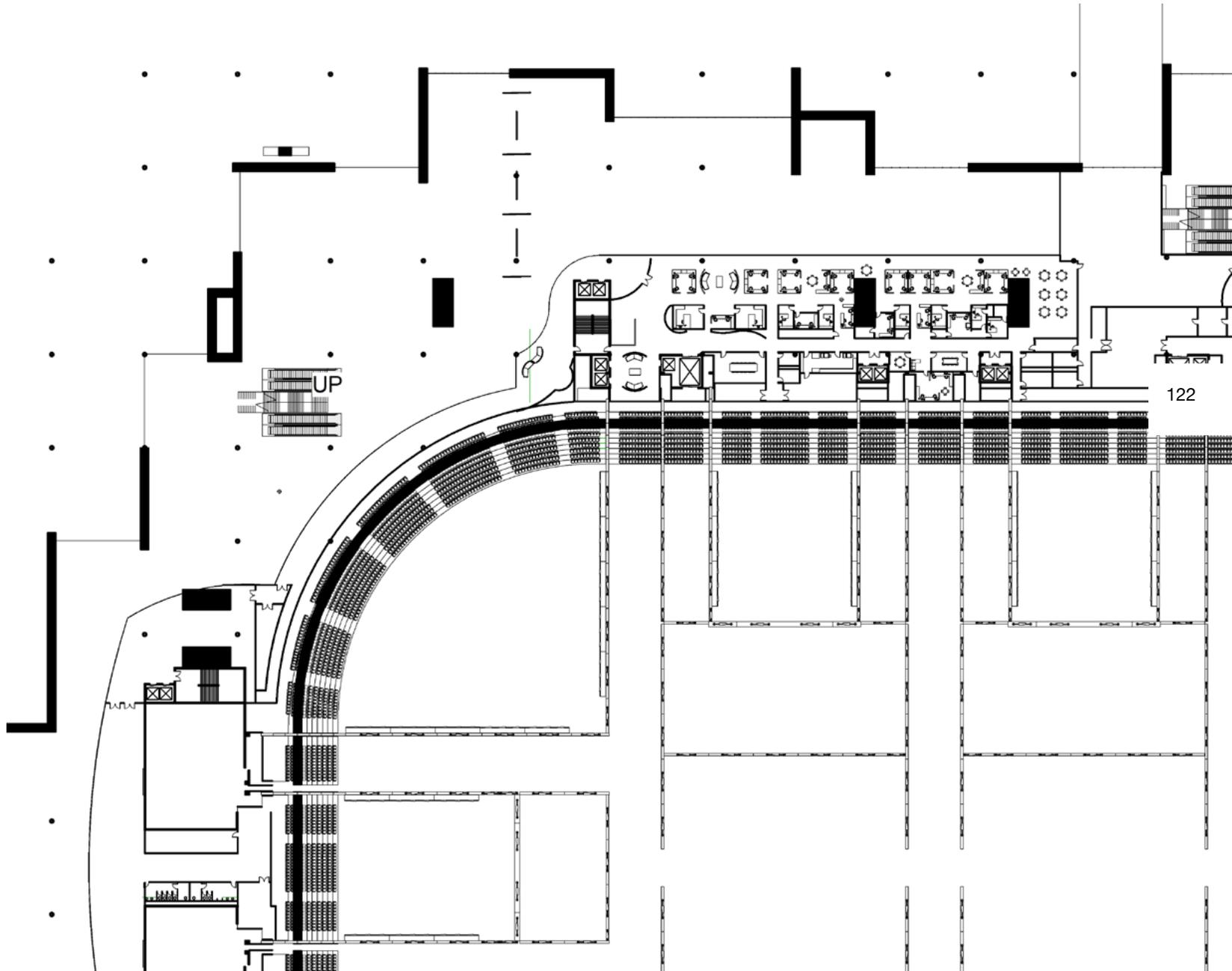
Floor Plan: LEVEL 3 MAIN ELEMENTS:

This is the main lobby level of the entire building. It is raised off ground level by 24 feet and is encompassed by a large 50 foot wide colonnade. Once inside one of the 4 main doors, the lobby and all levels are assessable.



Floor Plan: LEVEL 4 Partial View

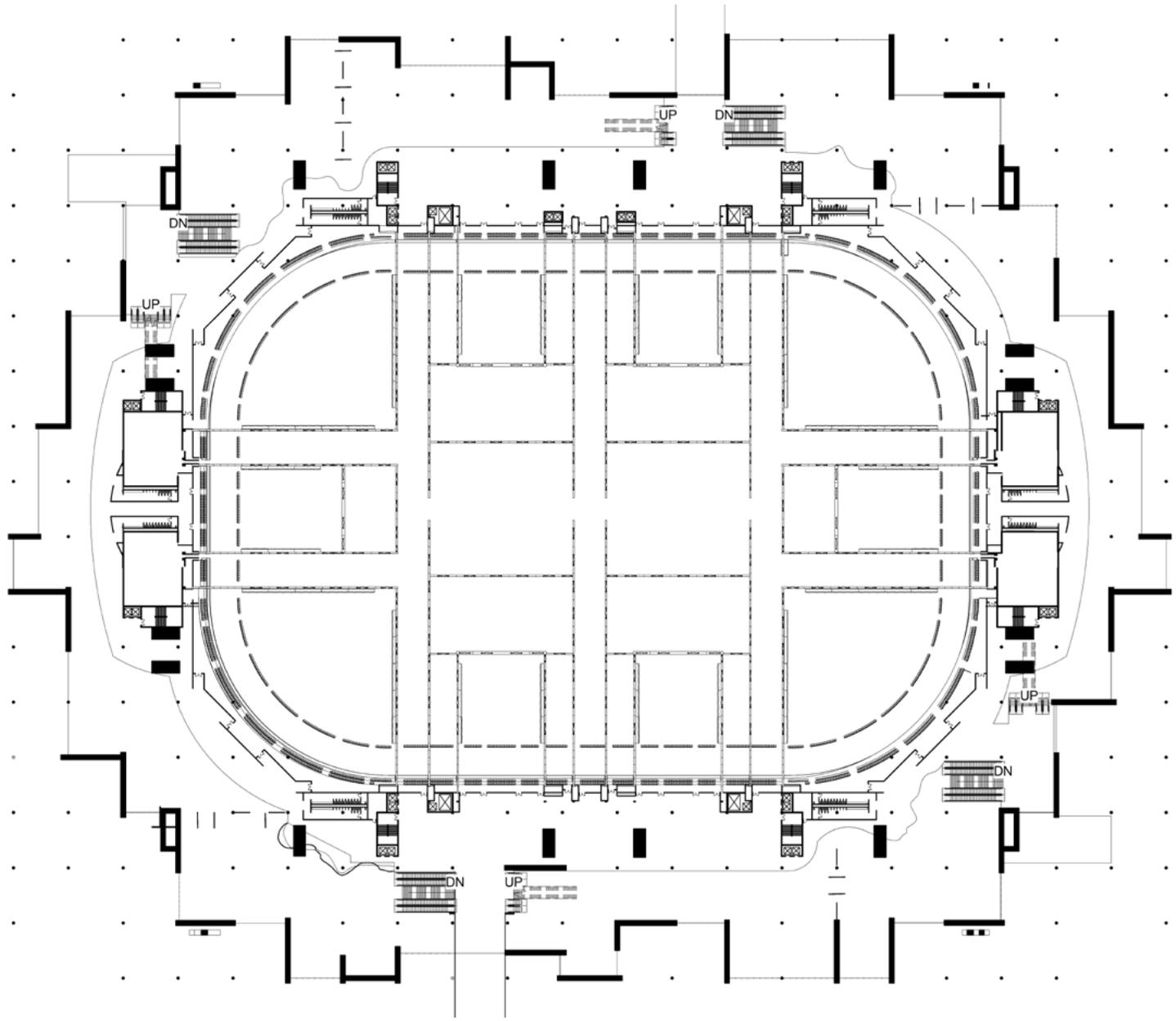
This level is primarily circulation as it fills a vertical void between theater balconies. On this level is the administrative office as well as meeting and conference rooms.



Floor Plan: LEVEL 5 and 7
MAIN ELEMENTS:

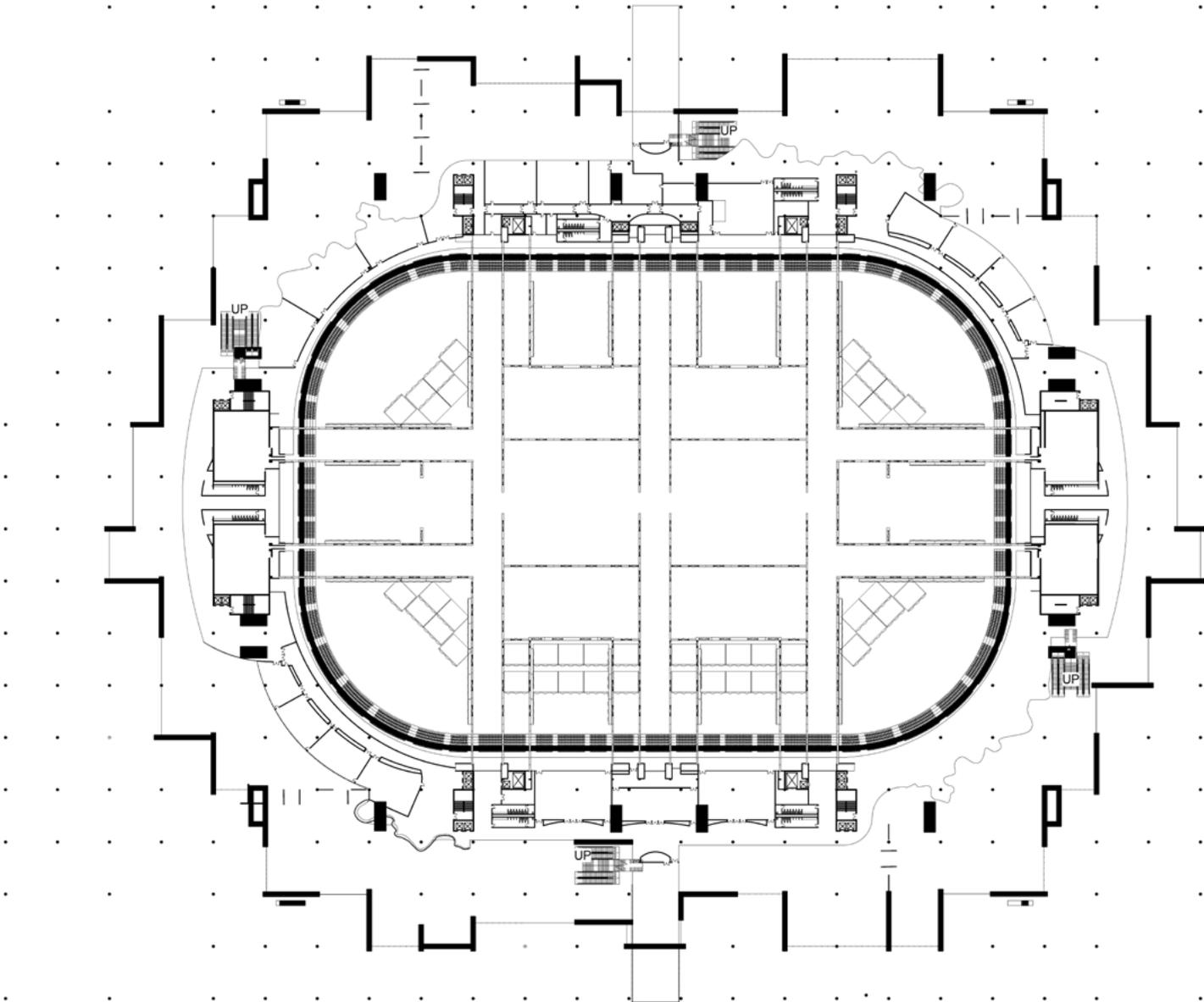
This is lower of the two main balcony levels; providing access, rest rooms, lounges, and restaurants to those guests on this level.

123



Floor Plan: LEVEL 6 MAIN ELEMENTS:

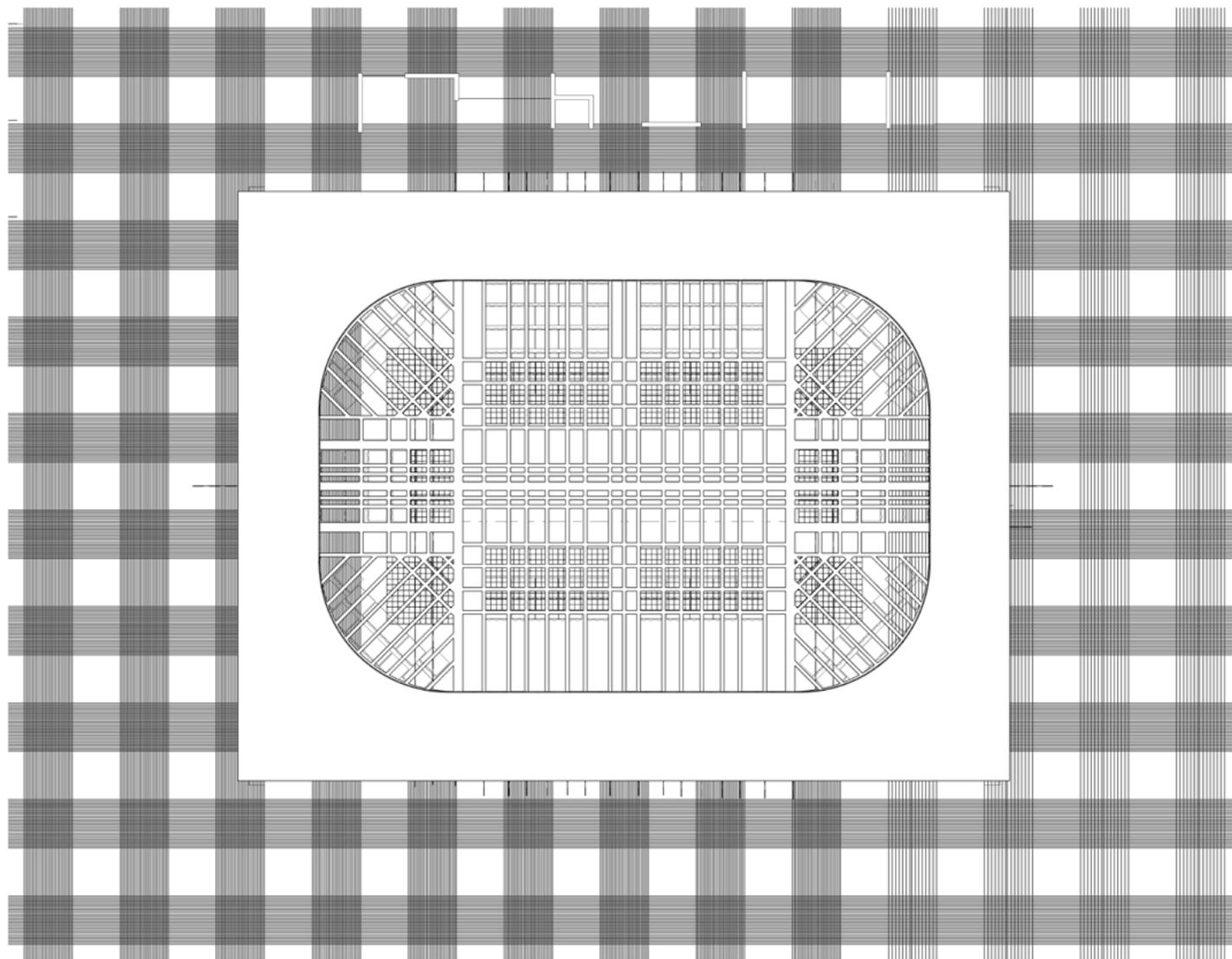
This level is a continuation of conference space and meeting rooms, as well as a collection of cantilevered restaurants and the VIP green room suites.



Floor Plan: Roof

On this level are visible the sun slat shading roof and the monolithic site cast Waffle Slab which covers the roof.

125



Thesis Display Photographs



127



As a McKenzie Finalist the display was moved to the main gallery along with the other four finalists.



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- 129
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About the Author

Matthew Robert Dunham

His personal style leans toward clean modern spaces with elements of historic charm that are rich in local materials and speaks to culture. Matthew's international travels have developed a preference for highly commercial spaces with a focus on performing arts venues. Large-scale event spaces are his passion as he focuses on performance

space design. His design process is very hands-on and attentive to detail, often starting with floor plans, section drawings, and creative perspectives.

Born in Kunming, Yunan, the People's Republic of China, Matthew has visited over twenty five counties, lived in Taiwan and the United Arab Emirates for a decade. He attended a

British private school in the U.A.E. before returning to the United States with his parents. In recent years, Matthew studied at St. Cloud State University and continued his education in Architecture at North Dakota State University. He currently works as Production Director at a church. He has made plans to pursue a PhD in Architecture to continue this topic.

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