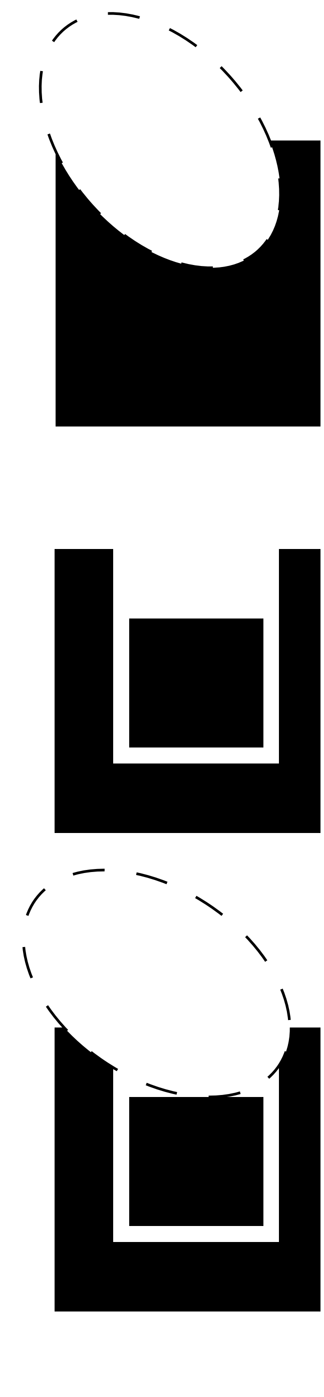
OKLAHOMA SHAKESPEARE THEATRE

HONORS THESIS

SPRING 2016

MORGAN BRUN



Program Requirements

The Oklahoma Shakespeare Theatre (OST) is designed to serve Oklahoma Shakespeare in the Park (OSP) by providing them a theatre of their own. The programmatic requirements of the building were:

interior theater that seats 350

exterior performance space

shop for set production

shop for costume production

rehearsal space

café that could remain open when the theater is closed

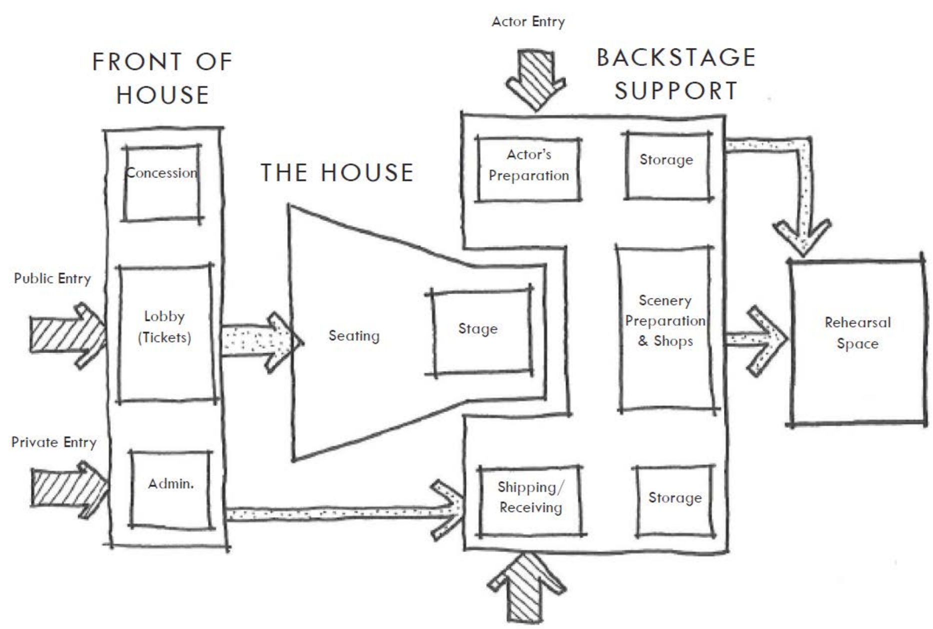
a grand lobby

two dressing rooms

a green room

and support spaces

OSP does several matinee performances for school groups, so the site requires a bus loading/drop-off area. A loading area for lumber and other supplies is also needed.



Functional diagram of large performing arts facilities.

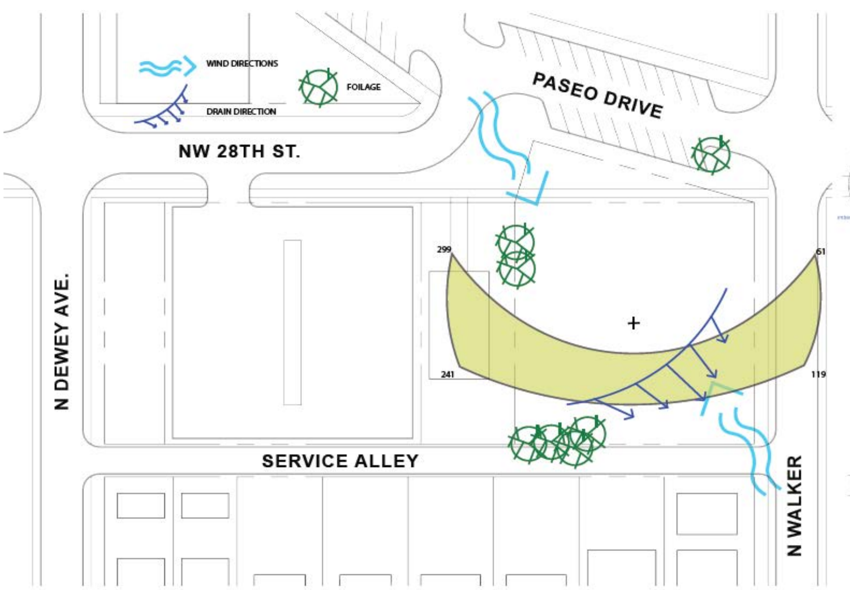
BUBBLE DIAGRAM

Design Issues

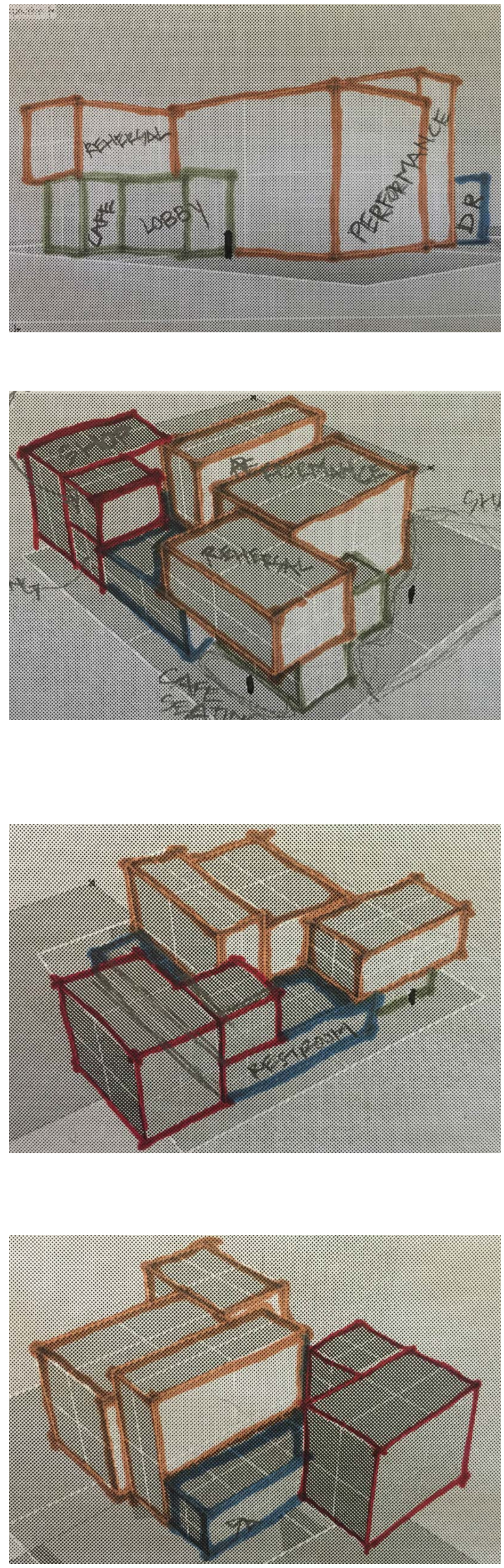
The two main problems addressed in the design of the OST are the development of a relationship between the theater and the Paseo Arts District and the development of a flexible interior performance space.

After analyzing the site I determined one design issue—the theater's relationship and connection to the rest of the Paseo Arts District. Paseo contains many galleries for the visual arts. The Oklahoma Shakespeare Theatre will serve the Paseo district as a gallery of a different kind. A gallery for the performing arts, a place in which the public can learn about the production of theatre, specifically Shakespearean theatre.

The second design issue stemmed from the purpose and goals of Oklahoma Shakespeare in the Park. From those goals the need for a flexible interior performance area was determined. If the building is a gallery for Shakespearean theatre, then the stage is its canvas. The stage was designed to be as versatile as possible, while still allowing for connection between the patron and the actor.



SITE ANALYSIS



MASSING MODELS

Schematic Design

THE SITE ::

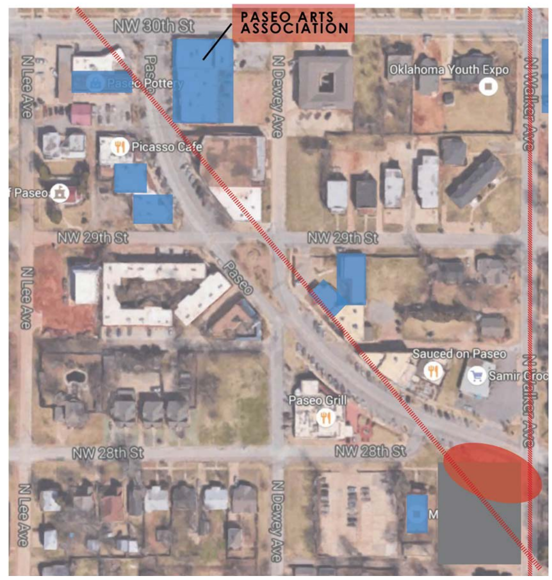
At the corner of Paseo and Walker, the Oklahoma Shakespeare Theatre is in a perfect location to function as a gathering space for the district—acting as a termination point for the axis formed by Paseo and as a billboard grabbing the attention of vehicular traffic on Walker.

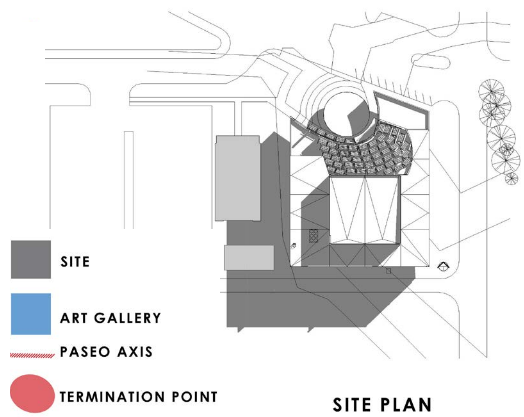
Three pedestrian entries into the site are provided: one leads from the West parking lot, one from the corner of Paseo and 28th street, and the other from the parking spaces in front of the theatre. Adjacent to the parking spaces along Paseo is a bus loading area. On the South side of the site is a loading area for supply trucks. The loading area is directly connected to the set production area to minimize the travel distance for carrying supplies.

The NW corner of the site is terraced down to form the outdoor performance area—allowing for a transition between the scale of Paseo and the scale of the theatre. The exterior performance area provides the Paseo Arts District with an outdoor space for events like art fairs or local music festivals, connecting the Oklahoma Shakespeare Theatre with Paseo. The terracing serves as seating for performances, while also shaping the stage.

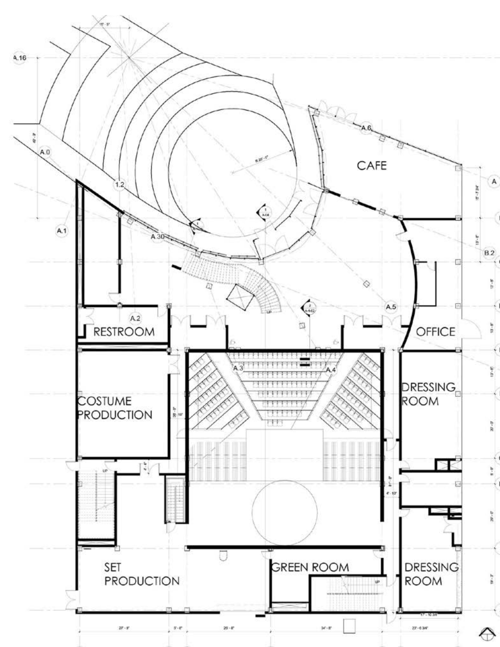
THE LAYOUT ::

From the exterior performance area patrons can enter the café or the lobby. The café completely opens up to the outdoor space allowing theatre goers to watch performances while enjoying drinks or dinner. In the lobby patrons can pick up tickets at the box office, which is distinguished from the other spaces by a curved wall, get a drink from the café, enter the theatre, or go up to the mezzanine. The mezzanine is ac-



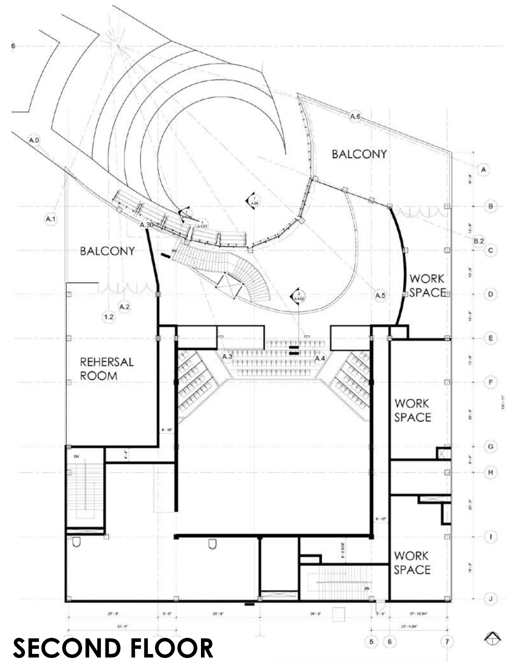


SITE PLAN



GROUND FLOOR

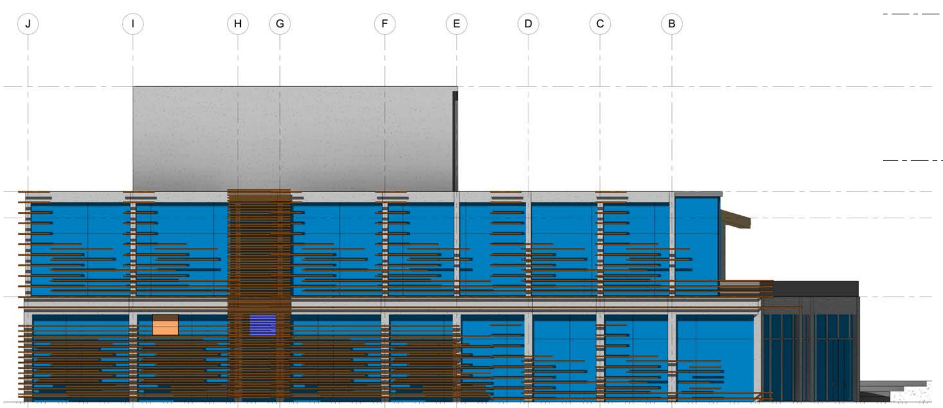
cessible by a grand stair in West portion of the lobby, or by a glass elevator. From the mezzanine, visitors can go to any of the rehearsal rooms, or enter the balcony of the theater box. The program only required one rehearsal room, however the added rehearsal spaces act as areas for the community further connecting the OST with the Paseo District. These workspaces can be used by local artists for gallery exhibitions, workshops, or as practice spaces.



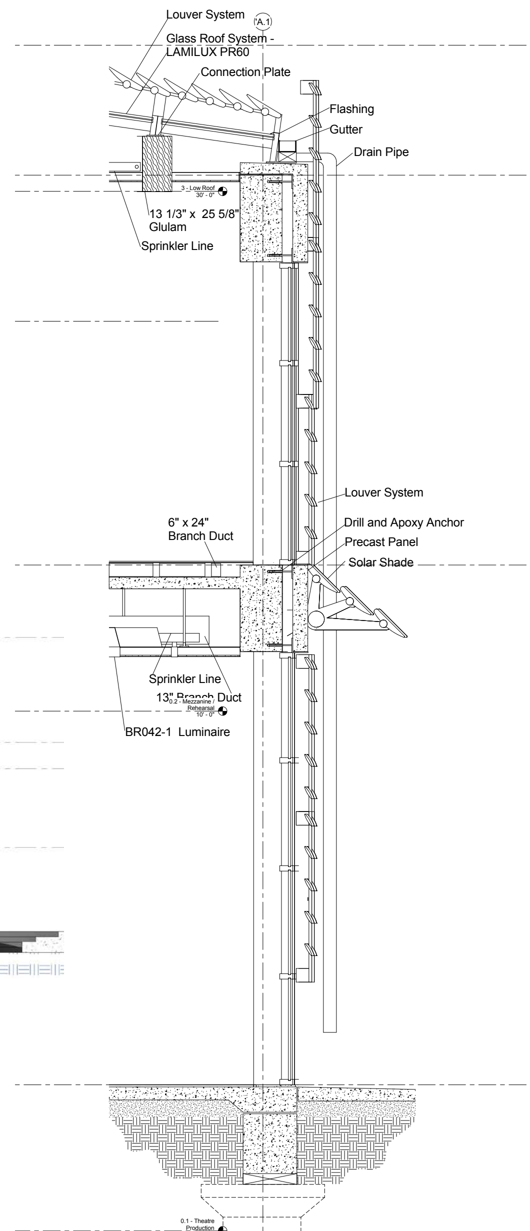
SECOND FLOOR

THE FAÇADE ::

Terracotta and wood louvers provide shading for the building. Terracotta is used to connect the design vocabulary of the Paseo District with the Oklahoma Shakespeare Theatre. The buildings in Paseo are a Spanish/Mission revival style, which have terracotta roofs. The density of the louvers will match the use of the space, with areas like the dressing rooms having a very high density and the café and rehearsal rooms having a lower density. The low density of louvers will allow a greater visual connection with the exterior. This visual connection serves to create interest in drivers passing by. Drivers will pass the theatre on Walker and be able to see people rehearsing which will peak their interest in attending a performance.



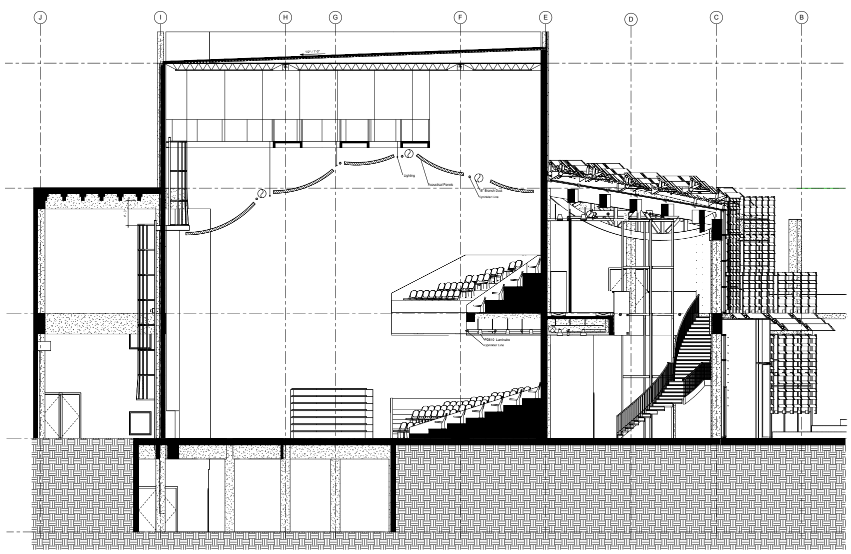
EAST ELEVATION



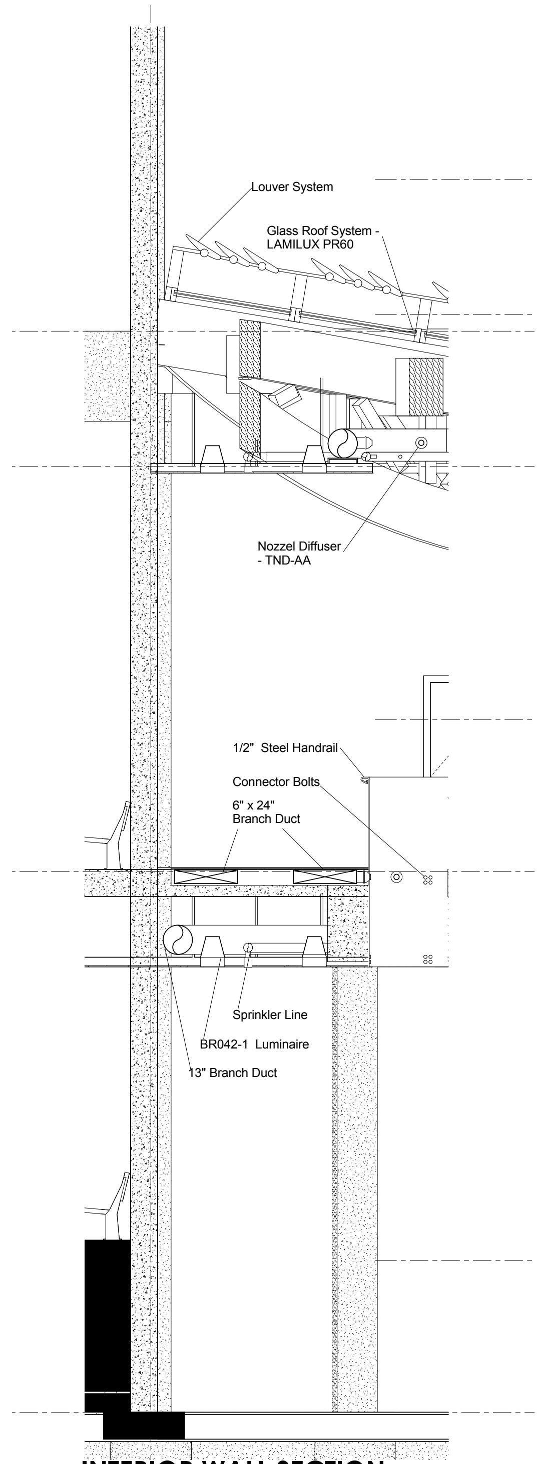
EXTERIOR WALL SECTION

THE LOBBY ::

The roof structure of the lobby helps define the outdoor performing area and separate the lobby from the theatre box. The theatre box is a 60 feet by 60 feet by 60 feet cube. This pure, platonic form recognizes the high art of Shakespearean Theatre. In contrast, the lobby is formed by this more organic roof structure to represent the hectic nature of modern-day life that many people go to theatre to escape from. The structure consists of intermediate glulam members and glulam trusses. The roof is glass with wooden louvers to shade and protect the glass. The wooden louvers are repeated at the level of the second floor to bring the entry down to a human scale.



THEATRE SECTION



INTERIOR WALL SECTION

THE STAGE ::

The theatre box is a versatile space to provide the directors, set designers, and actors a place for their creativity to thrive. There is a hydraulic turntable in the center of the proscenium and the height of the thrust can be adjusted with a hydraulic lift. The two front sections of seats are collapsible benches that can be oriented toward the thrust or the proscenium. They can also be pushed out of the way entirely to allow for special dinner theatre performances or extra-large sets.

An intimate setting is maintained by putting the stage and the entry on the same level. People might have to walk across the thrust of the stage to get to their seats, with no clear distinction between the aisle and the stage the barrier between the audience and the actor is broken down. No seat is further than away 55 feet away, so audiences can clearly see facial expressions. The intimate setting will allow the patrons to better connect with the actors and the performance.

Mechanical

HVAC ::

The HVAC system is a variable air volume system with three air handling units in the basement and 17 thermal zones. The air-cooled chiller sits on the south-west side of the lower roof, and the boiler is in the basement. One AHU services the west side of the building. Intake and exhaust louvers for this AHU are on the west side of the building. Another air handling unit serves the east side of the building, and the third AHU only services the theatre box. Intake and exhaust louvers for both of these AHUs are on the east side of the building. The intake vents sit ten feet above each exhaust vent. The location of louvers for each AHU align with mechanical chases that run from the basement to the second level. These mechanical chases house return and supply ducts. There are three other plumbing chases for the restrooms.

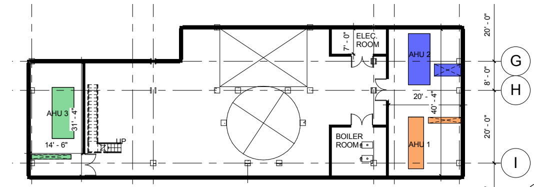
ELECTRICAL ::

The transformer is on the South side of the site. Each floor has two satellite closets, so that no electrical cable needs to run more than 200 feet. The main electrical room is in the basement.

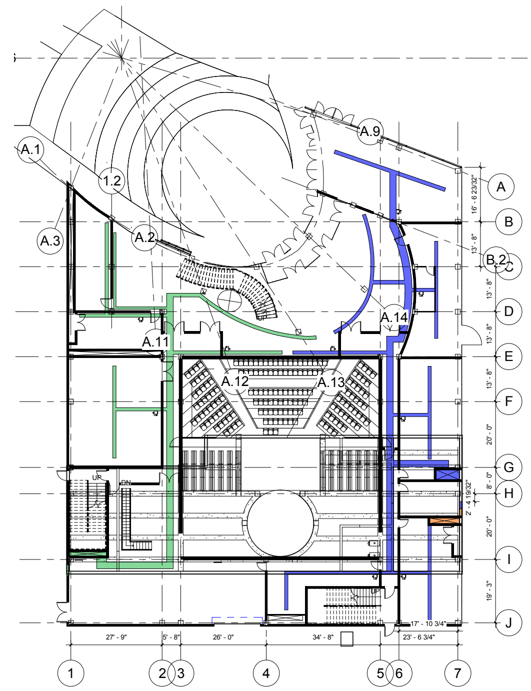
LIGHTING ::

Daylighting in the focus space was modeled using the heliodome. The conditions tested were for an overcast day. The illuminance was constant in each zone of the lobby because of the glass roof. The average illuminace was 2.85 footcandles. The IESNA recommend value for illuminance is 5 footcandles, so additional lighting is needed even for a bright day.

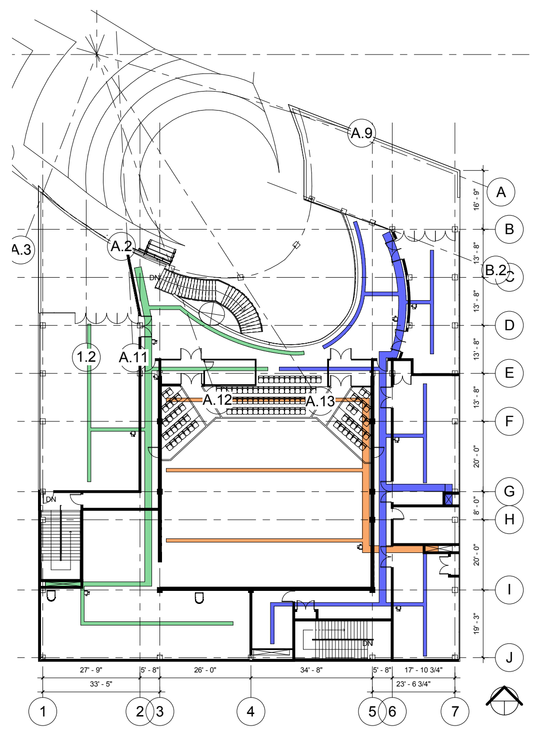
Recessed lighting was selected. The lights were arranged around the mezzanine. They light up the mezzanine and the space below it. Pendent lighting, hung from the trusses, illuminates the rest of the lobby. Lighting calculation were only performed for the recessed lighting.



BASEMENT



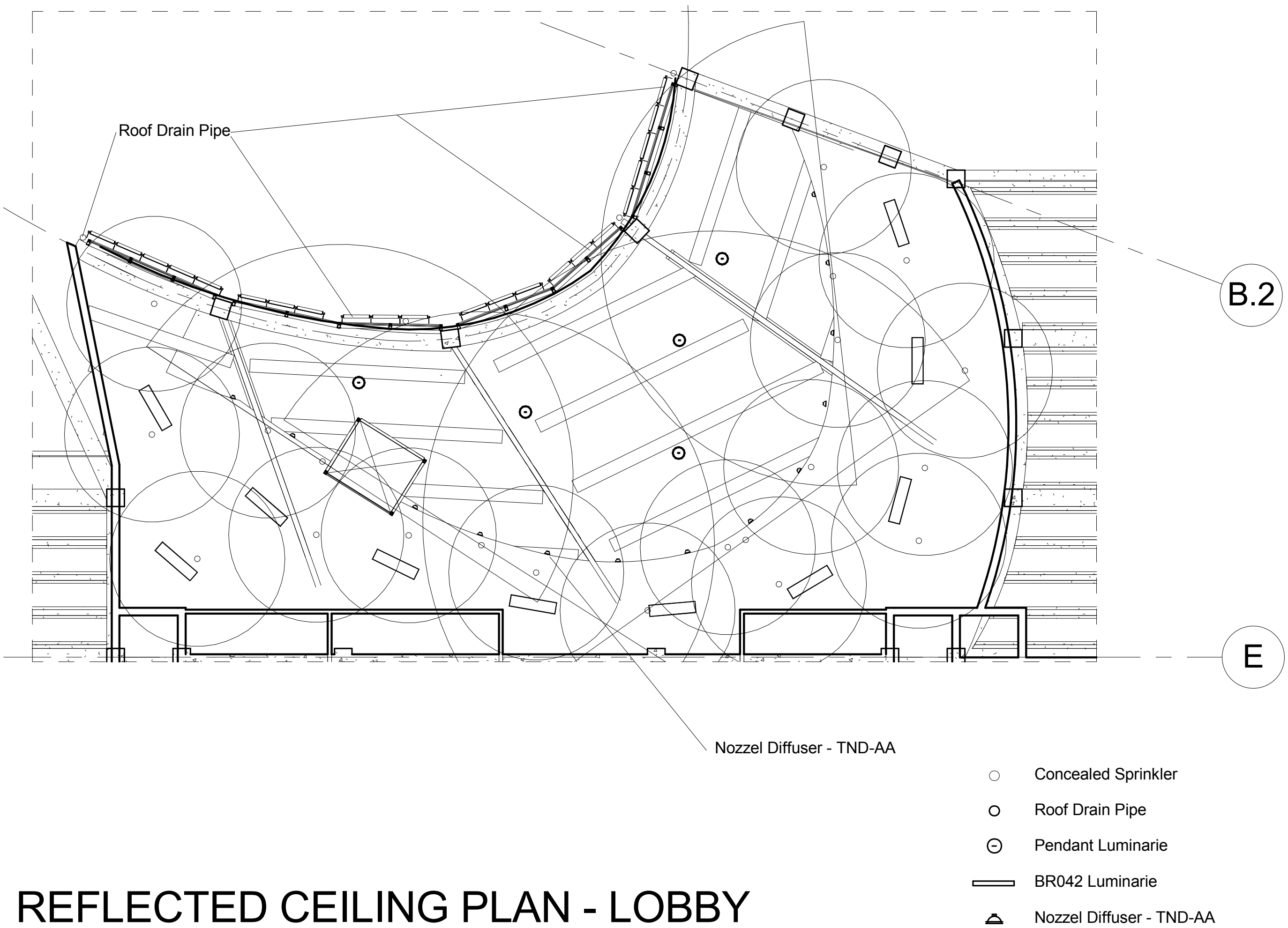
GROUND FLOOR



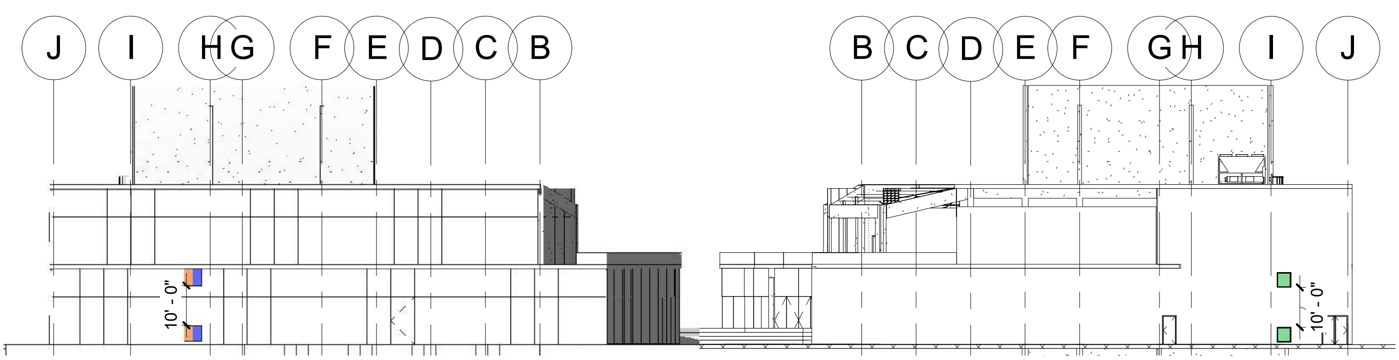
SECOND FLOOR

THE FOCUS SPACE ::

In lobby the mechanical systems were more fully developed. The glass roof and glu-lam structure needed to be exposed, so the mechanical systems could not be concealed by a drop ceiling. To solve this design problem, I ran all of the mechanical systems around the balcony. Air ducts run under the balcony structure, and in a drop floor above, along with sprinkler lines and lighting. Above the balcony there are drop panels that hold lighting and sprinklers. The sprinklers in the drop panels spray up as well as down to protect the wooden structure. Sprinklers with a larger than usual throw radius are used at the edge of the balcony in order to cover the entire lobby.



REFLECTED CEILING PLAN - LOBBY



EAST ELEVATION **WEST ELEVATION**

Structure

GRAVITY ::

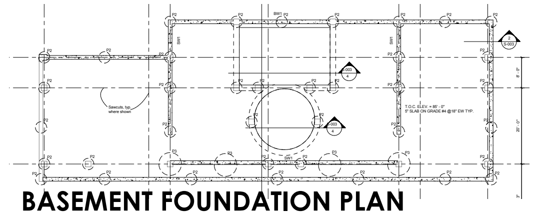
The gravity system is a one-way reinforced concrete system. I selected concrete for the structural system for two reasons: firstly because of the mezzanine and secondly because of the exposed curved beams in the lobby. The balcony of the theatre cantilevers out from the lobby mezzanine and the east and west bays adjacent to the theatre box. Using cantilevers was necessary ensure the theatre box was free of columns. Concrete's inherent stiffness meant calculations for deflection and vibration were unnecessary. (Assuming the depth of the members met ACI 9.5.) If steel had been selected for the structural system, then the size of the members would have been determined by floor vibrations per the AISC Design Guide 11: Floor Vibrations Due to Human Activity.

LATERAL ::

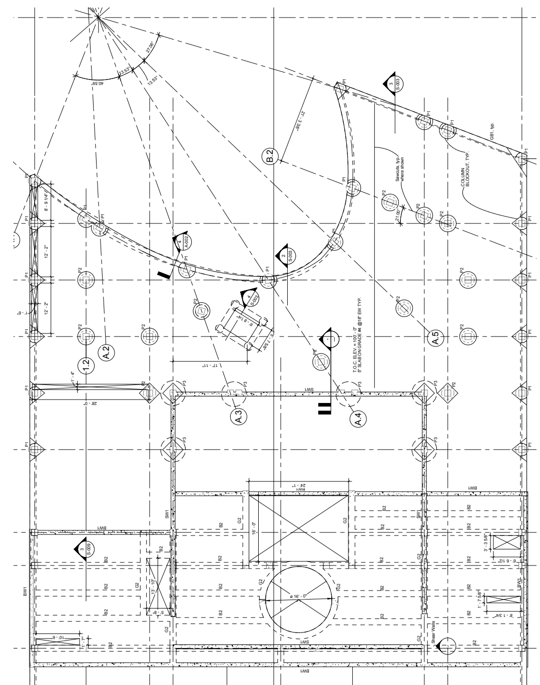
The lateral system is concrete shear walls. The shear walls are the walls that form the theatre box. Vertical and horizontal bracing is provided for the shear walls by columns and beams that are part of the gravity system. The design and analysis I completed for the shear walls was for uniformly distributed reinforcing using the analysis/design software ETABS 2015. If there had been more time available in the course, then I would have done a more thorough analysis of the shear walls. My understanding of shear wall design is still at a superficial level.

FOCUS SPACE ::

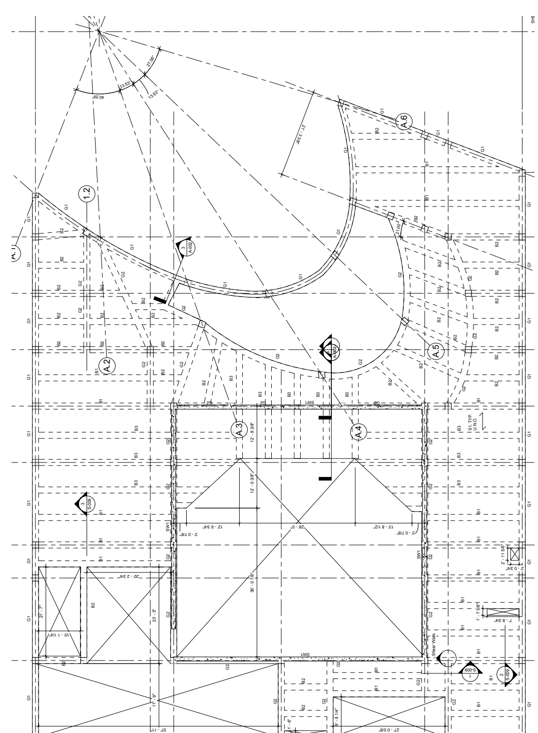
The lobby roof is composed of glulams and three bowstring glulam trusses. Additional depth and thickness was not added to the size of each member because the structure is protected by the sprinkler system. The depth of the framing could have been re-



BASEMENT FOUNDATION PLAN

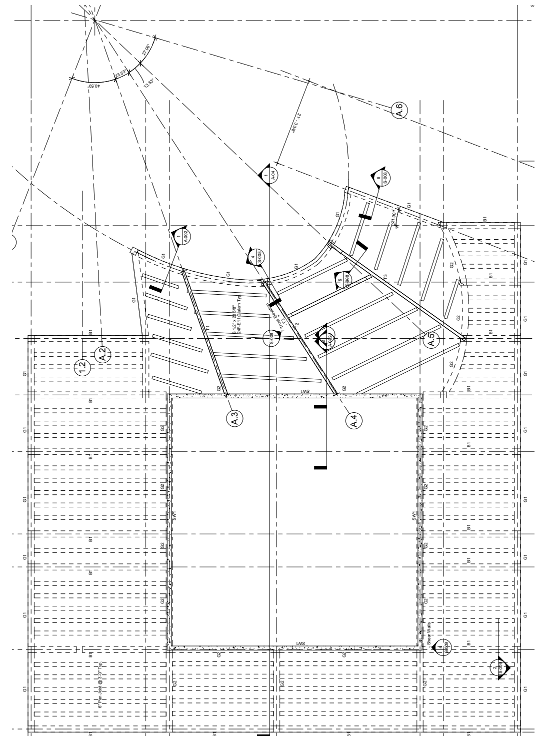


FOUNDATION PLAN



SECOND FLOOR FRAMING

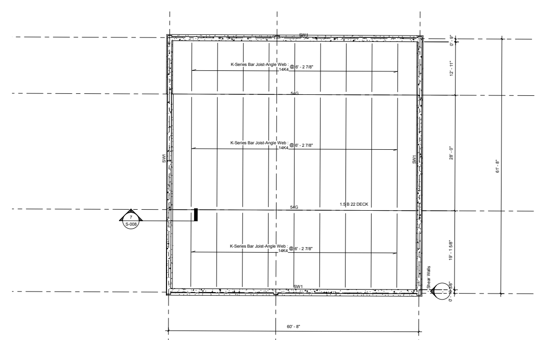
duced with a more thorough analysis. The controlling dimension for all of the framing was the depth of the intermediate glulam beams. The truss chords were then sized so the beams could easily frame into them. This made the trusses larger than was desirable. With further development all of the sizes could be reduced. The beams in the center bay had a larger span and greater tributary width than the rest of the glulams. By decreasing the spacing of these beams the depth could be reduced.



LOW ROOF FRAMING

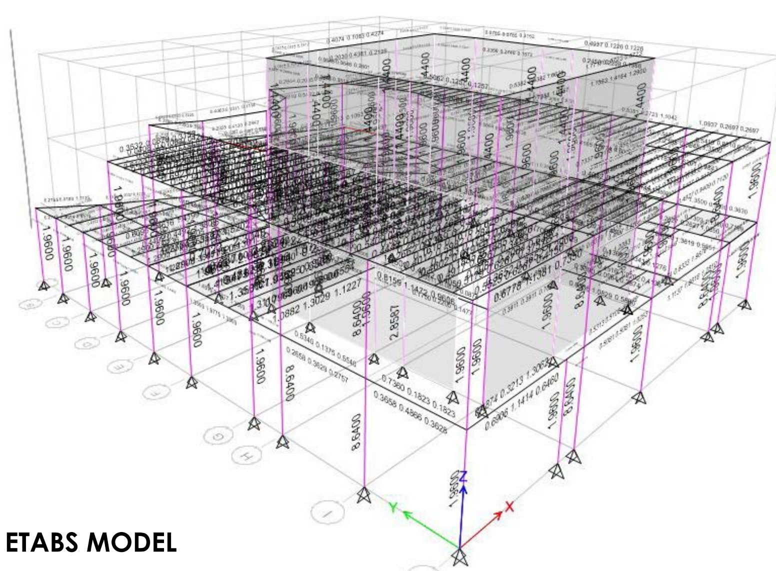
ETABS ::

To analyze and design the structure I used a trial version of ETABS 2015. The limitations of the trial were an inability to print or export files from ETABS and a limit to five load cases. The load case limit was not an issue because I had completed a lateral load comparison by hand and determined that wind, not seismic, controlled. The inability to print and export files was frustrating, but easily overcome by taking screenshots of the required information. The benefit of printing from ETABS is that the program will compile a report containing all of the inputs, design preferences, analysis, and design results that can be sent directly to the printer. I wish I had been able to use the file export function in ETABS, so that I could export analysis results to Excel. Exporting data from ETABS to Excel makes finding minimum and maximum moments or shears much easier.



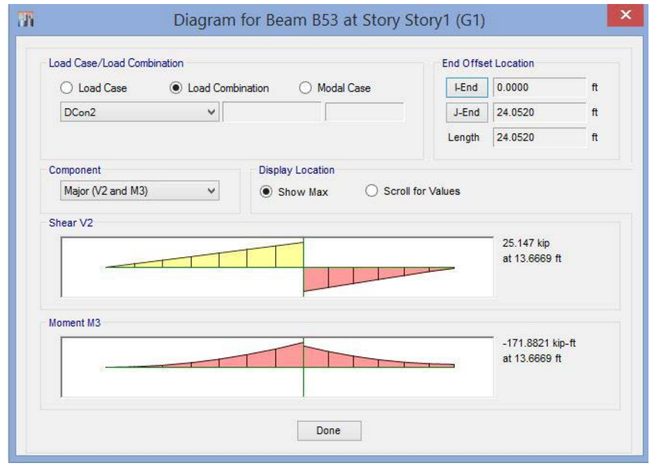
HIGH ROOF FRAMING

ETABS will also automatically calculate wind loads for a building. I tried to use this feature because I thought it would be interesting to compare my hand calculations with the ETABS calculations. Parameters are input, like risk category and pressure coefficients, then ETABS calculates and applies wind pressures



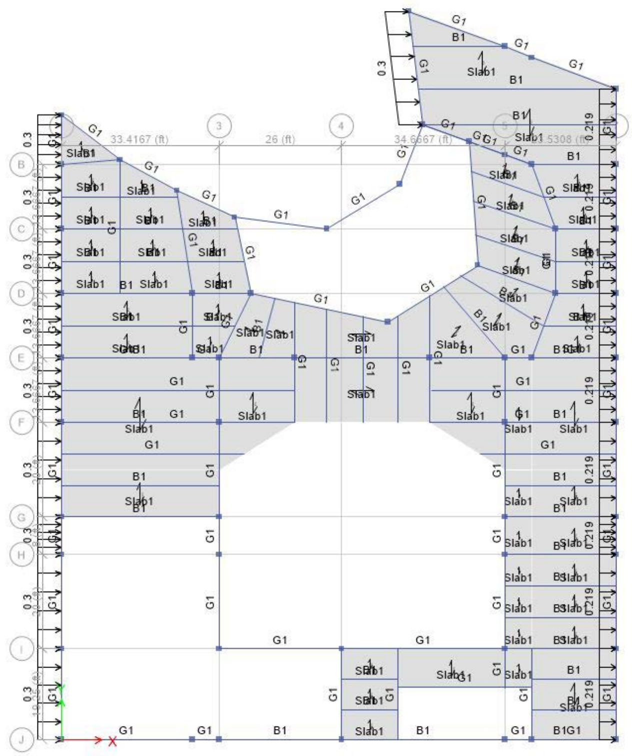
ETABS MODEL

to shell elements. I had only constructed the frame of the structure, and I did not have the time to figure out how to add shell elements that would not be analyzed as part of the structure. Instead I just added the wind loads I had calculated by hand to the model.



BEAM SHEAR AND MOMENT DIAGRAMS

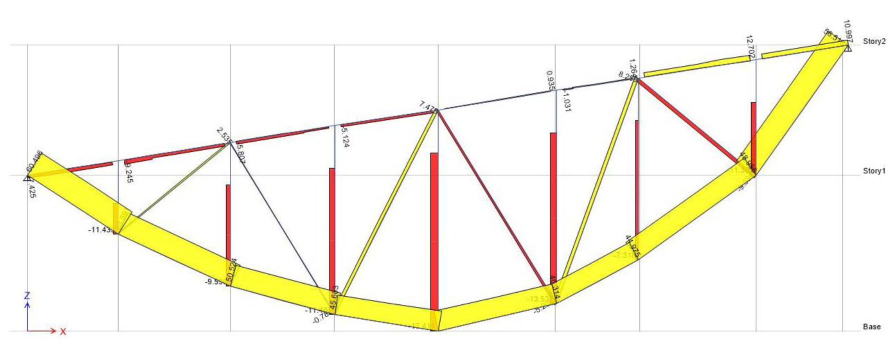
For design in ETABS I ran two separate but identical models: one for concrete frame design and another for concrete shear wall design. Concrete frame design provided the required area of steel for shear and positive and negative moment. This is the point in the design process where organizing the data in Excel is extremely useful. The distance that maximum shear reinforcing is required can be determined by looking at the shear diagram for the member. ETABS has three different options for shear wall design: simplified compression and tension, uniform reinforcing, and general reinforcing. I used uniform reinforcing to determine the area of steel in the edges and center of the wall.



WIND LOADS

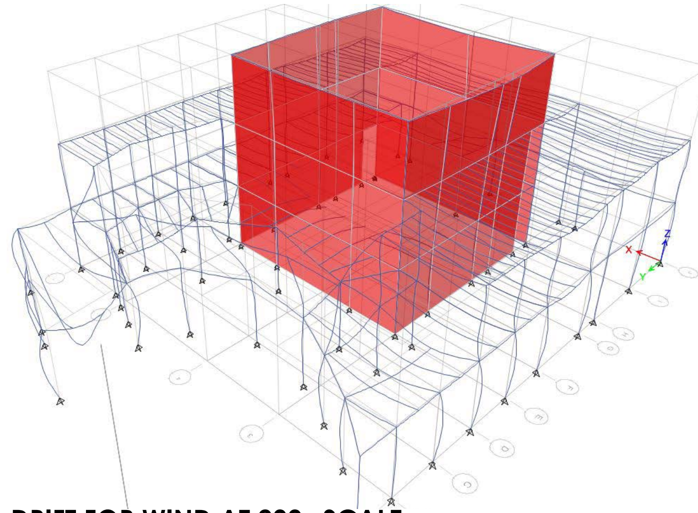
THOUGHTS ::

In reflection, a steel structure would have functioned just as well, if not better, for the majority of the building. Concrete could still be used in the lobby and theatre box, but the rest of the building would be steel framing with composite floors. The aspects of concrete that were necessary for the lobby and theatre box, were not needed for the rest of the theatre. Although I don't know if using three structural materials instead of two would have increased or decreased the cost of structure. There may



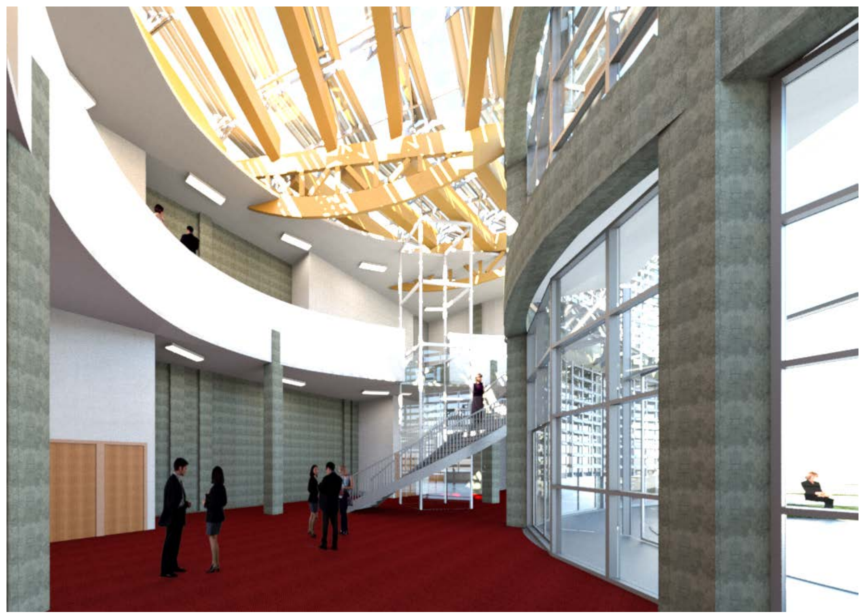
AXIAL FORCE IN LOBBY TRUSS

have been savings on formwork, time and labor, but those savings might have been counter acted by the added expense of connecting the steel and concrete structure together. A comparison of the two systems would have been interesting. I wish there had been time in the course to do such an analysis. Without an in-depth analysis I cannot definitely say whether or not the savings on labor and formwork would make up for the difficulties of have two different structural systems.



DRIFT FOR WIND AT 200x SCALE

The Final Product



Theatre, and more generally the performing arts provide society a necessary escape from the chaos of modern day life. Personally, what I appreciate the most about theatre is the chance to connect with something beyond myself. The Oklahoma Shakespeare Theatre will serve the Oklahoma City community by not only providing performances, but also providing community gathering spaces. The architectural, mechanical, and structural designs were all developed with this goal in mind. The design of the OST balances the need for efficiency in mechanical and structural systems with the architectural vision.