ADAPTABILITY

STRUCTURAL EXPRESSION

TECTONIC CONDITION

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"Movement is the last thing we associate with structures, intuition tells us that structures are stationary."

- Santiago Calatrava (1)
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It has been said that great architecture makes a statement. While some statements are open for debate, the basic premise of a building making a valid statement rings true for all good designers. With this initial design criterion in mind, a designer must go beyond the initial requirements and provide a building that is capable of exceeding every requirement requested of it.

Structural expression is one aspect of architecture that has been used throughout history as an inspiration for many of the greatest architectural works. From the Gothic arch to the space frame, many significant examples show the forces at work in a building in a very real and tectonic way. It is this structural expression, coupled with the skin of a building, where a building takes its form.

Detailed tectonic conditions also play a role in architectural expression. For example, when concrete is formed, the form work becomes a part of the final design, not only because of the texture but also because of the voids that are created once the ties are removed. This simple rhythmic pattern of ties plays a large role in the final appearance, even though it doesn't show up in the drawings. Something as simple as the bolts that hold up timbers or steel can also be a means to express the reality of the building. It is then through these details that architecture is made. The phrase "God is in the details" takes on a literal tone as well as making a statement that emphasizes the importance of thorough design. Looking at the way things are actually constructed and how that determines the experience that users will have in the building will in turn develop into a more accurately developed understanding of the final product.

In addition to focusing on the general idea of structural expression, a building structure that can be responsive to changes may provide additional opportunities for the physical reality of the building to be meaningful for its users. Adaptability of the structure will allow for a designer to build a building which can be prepared for countless design criterion. Adaptability will not only allow for future uses but will also have the strength of customizing the space for specific needs on a daily basis. Be it function, users needs, environmental changes or future adaptation, a flexible building makes more sense economically and keeps it relevant to the current time.
"A theatre presents one of the most difficult design tasks for an architect because it combines the need for a technically perfect shape with the necessity of allowing fantasy and dreams to happen."

James Steele (2)
In order to serve the dual goals of the thesis exploration of structural expression and adaptability, it is necessary to select a program type and scale that will allow for these issues to be prominent. One of the more dynamic building types, both in terms of structural expression and adaptability is a theatre. This program presents many challenges to the designer in regard to the structure of the building, acoustics, materiality, layout and countless other design criteria which must be met. In addition, the variability of performance types may allow for specific kinds of adaptability strategies, in addition to those that would be found in any building type (such as adaptations to varying environmental conditions.) With the necessity that the structure have a medium size span, the program of a performing arts center presents itself as a strong design generator for the issue of the poetics of construction. Site also plays a large role in the design of the building and its ability for adaptation. Being that the site will be located on the University of Detroit Mercy campus a small performing arts center will be appropriate for both students and the surrounding community.
The station acts as a threshold between Britain and the Continent. More than that it also becomes a monument of a new railway age, when high-speed trains can compete with air travel. The Waterloo terminal has the capacity to handle 15 million passengers a year, or up to 1500 in four minutes. Grimshaw viewed the terminal as a “heroic railway station with the same function as a 21st century airport”. It is a very busy terminal located on a constrained urban site. The site both limits and provides an opportunity for the magnificent structure Grimshaw created.

The practical considerations of a railway terminal dictate that a span must be made for the canopy to cover the tracks and the platforms. It also dictates that a sufficient amount of natural light be provided at the same time.
precedent analysis
Circulation is the key consideration that ties all these together. The roof in the terminal at Waterloo becomes the focus of the building in response to the site and track. The trusses derive their shape out of necessity of scale and technical expression. They make use of tension and compression members with telescoping circular members which form the truss. The final roof form is a three pin arch with the central pin offset to one side.

The roof structure devises its technical expression from the inversion of structure and skin. At the pivot point the trusses invert the forces from compression to tension. This technical expression of the forces at work is also presented in the way cladding is used both inside and outside of the structure. The skin of the structure also changes here from being outside of the structure on the north-east side to being inside the structure so as to expose the structure to the elements on the south-west side.

The intention of the architect was to use the structure as a clear presentation of the spatial requirements required by the tracks, while at the same time informing people of the direction of travel. Because of the strict site constraints the building became an expression of the site on which it takes place by use curving the trusses along the path of the track. From a pragmatic approach this building is successful in that it clearly directs passengers to their destinations.

To provide year round protection from the elements is not an easy task in a railway terminal due to the amount of movement in the structure caused by the movement of heavy trains. Connections needed to be developed that provided deflection of up to a quarter of an inch. To complicate matters even further the deflections are almost never in one axis but must allow for travel in all three axes. The connections reflect the amount of one-off design that went into not only each detail but the building as a whole. Similarly to the structure and skin the detailed tectonics are the “final stage of a length process, and one informed by an openness to circumstance and a desire to solve problems with grace.”

The precision in the building gives a good intention of the architect’s ability to engage the user in all aspects of the building. It can capture a visitor’s attention beyond the eye-candy of the trusses, through the use of detailed one-off connections. It is here in the tectonics of the building where the machines like qualities come through. In an age where trains need to be seen as a reasonable alternate to air travel, the Waterloo Terminal plays a large role in convincing us that it’s up to the task.

Below the tracks is where the majority of the pedestrian traffic takes place. It is here where the passengers are directed to their
Legend

1 Concourse
2 Escalator
3 Kiosk
proper locations. Because of the high level of weight that is directly above this area concrete column reinforced with rebar is used. Due to the large numbers of travelers traveling through the terminal no partition walls are used just columns supporting the concrete second floor above.

From the lower level there are two rows of columns which are responsible for supporting the weight of the trains above. Because of the weight of the trains and due to the fact that the load isn’t stagnant dictates that special attention needs to be paid to these columns. This is reflected in the bigger diameter of these columns compared with columns which only support the weight of the second floor. On top of these columns a series of wide-flange beams support the track.
Location: Dallas, Texas
Architect: Rem Koolhaas, OMA
Date: Spring 2008
precedent analysis
The Charles and Wyly theatre will be a 11-story facility with one of the most innovative theatre designs in recent history. The theatre designed by Rem Koolhaas, will become part of a theatre district known as the Dallas Arts district in downtown Dallas, Texas. Architect in charge Joshua Prince-Ramus looked for a new and innovative way to address the needs of both classical and experimental theatre performances.

Using an innovative “stacked” design the theatre essentially acts as one large fly-loft with all functions stacked on top of one another. This stacking allows as a way to provide as flexible a space as possible. Support functions are located either above or below the main auditorium. This stacking allows for seating, stage as well as backdrops to be pulled up into the fly-loft for a wide array of theatre configurations. Exterior walls are removable to allow for extremely large objects to be used as props such as airplanes and even large animals.

The greatest strength of this project is the restraint with which the architects showed by keeping the building as simple as possible. By refraining from over complicating the project the theatre maintains its original intention, which is to provide as flexible a building as possible. The ability for this performing arts center to house a multitude of different functions becomes one of
MILWAUKEE ART MUSEUM

Location: Milwaukee, Wisconsin
Architect: Santiago Calatrava
Date: 2001
The Milwaukee Art Museum was Calatrava’s first building built in the United States. It has since become a symbol of the city of Milwaukee itself. The museum sits on the water of Lake Michigan in downtown Milwaukee, Wisconsin. The museum is next door to the Milwaukee Art center designed by Eero Saarinen in the late 1950’s. As the number of visitors grew each year and the number of works acquired by the museum grew it soon became necessary to build a new addition. City officials looked for an architect who would provide a building that made a strong architectural statement with the ability to be very functional at the same time. Santiago Calatrava was chosen as the architect and construction began in 1997 on the Milwaukee Art Museum. The Quadracci Pavilion, opened in 2001 and has been wowing visitors since.

The Remain Bridge, a 250-foot-long suspended pedestrian bridge that connects downtown Milwaukee directly to the lake front and the Museum, acts as a new destination building to the city. The bridge is made up of a 200-foot mast with tension cables supporting the walk. The Bridge reflects Calatrava’s unique approach to bridge design. The Museum’s main entrance leads into a glass Hall at a height of 90 feet. The Burke Brise Soleil, the moveable, wing-like sunscreen comprised of 72 steel fins, rests on top of the reception hall and is raised and lowered to control both temperature and light in the structure.

The approach and goals of the Milwaukee Art Museum similarly follow the same design goals that I am trying to accomplish. The building works well to accomplish the goals that it was originally set out to do. By providing such a unique shape with an operable sunscreen Calatrava provided a destination building for the city of Milwaukee.
KUWAIT PAVILION

Location: Kuwait
Architect: Santiago Calatrava
Date: 1992
precedent analysis
Pavilion architecture has the same feel as amphitheater architecture in the sense that it becomes more than simple architecture but rather a landmark or destination to a city. In this degree the Kuwait Pavilion mechanically expresses this voice. The operable roof opens up to a height of 25 meters. The rational behind this operable roof became an opportunity to distinguish between the different types of crowds during the day and night. More practically the ability to provide shade during the day and an open view of the sky is very beneficial due to its geographic location. The pavilion as a whole provides a voice for the importance of Kuwait on a global scale. Images and videos are projected onto the ends of the building of Kuwait.

The basic premises behind this building in regards to the structural expression are similar to the general theme behind my thesis. The fact that adaptability is presented through the structure makes it even stronger as a precedent for the type of ideas that I will explore. The fundamental ideas of the pavilion are clearly displayed to any visitor or passerby, and because of this the building is successful based on its function.
SITE ANALYSIS

Possible Site Locations
1923 Masterplan

1926 Site Plan
These studies attempted to look at different forms of structural adaptation. The 3D rendering made use of threaded rod that attached to movable glass panels. The panels moved on a track so as to maximize what could be held within the container.

The sketch problem assigned to me was to contain three different objects: a baseball, a vase, and a ladybug. The model below held all three objects through threaded rod that with "fingers" that can be attached to the ends.
"Movement is the last thing one associates with structures. Intuition tells us that structures are stationary." It is with this idea where the basis of structural adaptation takes root. As an idea, structural adaptation stands to provide unexpected results in a building and a building that is best suited for adaptation in order to design more relevant and smart buildings. Structural adaptation leads to a structure that can change to accommodate new uses, provide visual wonderment and allow for the most effective use of a building. Architectural applications for responsive structures arise from issues of spatial efficiency, adaptability, shelter and even transportability. Buildings that can become more efficient through adaptability are better suited to a rapidly changing architectural environment. Performing arts centers more so than other programs provide an opportunity for social gatherings and act like an event similar to a church service. People attend theatres and movies for similar reasons as
a means of losing oneself in a fantasy world. Ultimately, the form of a theatre should provide opportunities to give outside viewers more of a visual cue of what goes on inside. Walking into a theatre should be as exciting as walking into a typical classroom is boring.

Ultimately, the site that was chosen for the best opportunity to achieve a successful project was the University of Detroit Mercy McNichols campus. The University of Detroit Mercy is a catholic university with a student body close to 6,000. A small size university provides the opportunity to create a building with a great deal of carefully planned detail. Although there is a theatre program at the university it has lacked a permanent performing arts center and it makes sense to provide a new building on the campus. The University is located in the center of an urban neighborhood community of Detroit. In accordance with the Mission statement of the school a strong commitment to the community and the ability to house community functions within the theatre becomes one of the means of a performing arts center. In addition to outreach to the community a theatre becomes one of the strongest ways to expand the school into new and innovative areas that will help keep the school continue its expansion of students and programs offered. Additionally a performing arts center could help to strengthen the programs that are currently offered by including the architecture and engineering students to help in construction of stage sets and even construction of the building itself.

Theatre programs at the university have had a record of not staying in one place for very long and ultimately the program has suffered because of its
Lack of a permanent home. In 1972 the University of Detroit Mercy and Marygrove consolidated the two schools fine art programs. Most productions took place at The Theatre on the campus of Marygrove with Theatre 100 housing some of the smaller productions in Shiple Hall. In 1979 performances moved to the Paul Robeson Theater in Detroit’s Northwest Activity Center. 1980 saw the University again leasing space at Marygrove College. The Studio Theater which was housed in the Architecture building opened in 1984. In 1995, The Theatre Company moved to a new location, the McAuley Auditorium on the Outer Drive Campus. In 2000 The Theatre Company developed the On Stage Theatre. With the move of Outer Drive programs to the McNichols campus in 2004, the Theatre Company once again began performing at Marygrove, which is intended as a temporary solution until a dedicated performing arts center is constructed on the McNichols campus.

Historically speaking the fundamental idea of theatre has not changed in thousands of years. It’s only been in modern times where theatres have begun to take a large transformation from typical stage and seating to much more experimental setups. Trends are always difficult to predict and this rings especially true with theatre performances. With ever changing theatre performances and various types of plays a unique approach to theatre design has become the norm. It becomes impossible or difficult at best to make one type of theatre that can effectively house all the various types of performances. Hence, the most effective way to design a theatre is to take an approach that to have the most effective space, special care and attention must be paid to allow for a design which can be adapted to future
uses and requirements both known and unknown. Small universities especially as well as public community theaters with limited resources can only afford to build performing arts centers that maximize flexibility of the space.

From the earliest historical examples such as classical columns that bow out at the bottom in an effort to express the loads on the column. Or, the Gothic arch which effectively becomes a visual cue to the way the loads are transferred from the roof of the building to the base. These structural expressions, is it known to the viewer or not presents a clear definition of how the building works as a system. The Crystal Palace presents itself as an excellent example from a historical context. The result of an architectural competition, Joseph Paxton was asked to simply enclose the space. The end result is a structure which expresses effectively the structural goals of enclosing large, grand spaces. The Pompidou Center another example of clearly presented structural elements demonstrates the structural effectiveness in a way that anyone can understand. These historical structural examples similarly express the simple yet elegant transferring of loads from the roof to the foundation.

Movement in structure has been used since biblical times ranging from the “Hero of Alexandria’s Pneumatic Temple” which features a pneumatic door which opened and closed at certain intervals to coincide with certain rituals. Fast forward to the 20th century and architects have ultimately steered away from movement in architectural design. Santiago Calatrava on the other hand has designed, engineered and built more
adaptable structural elements into his buildings than any other architect. Ranging from the Kuwait Pavilion with a roof of "finger like" beams which open up to reveal the night sky, or the Planetarium building in Valencia Spain which reveals the interior through a folding wall, his buildings are ushering in a new age where structural adaptability will become the norm.

Calatrava provides elegant yet dynamic structural systems which although made of heavy materials look as if poised to take flight. Inherently the most intriguing elements of Calatrava's structures are their imitation of nature. More importantly, a Calatrava building connects with the inhabitants in a deeper more intimate way than can be found in non-adaptable structures. "The images that the moving structures of Calatrava invoke seem to well up out of the unconscious, to tap that yearning, willing, indeed passionate part of life that tends to be slighted
by purely utilitarian and functional, as well as formalist works.”

Whether natural or artificial, structures are the result of movement. They are products of the transportation of materials, and the components of assembly and construction. Indeed, even with regard to those structures which appear to negate movement, without it they would not exist. The creation of structures involves movement of all kinds: transport, raising, rotating and fastening to name a few. Buildings, bridges and trees are constantly moving, albeit with comparatively small amounts of deflection. If deflection weren’t allowed and accounted for structures would ultimately be brittle and break under loads.

Taking the idea of deflection a step further leads architects to buildings that move and flex to shape their own surroundings. Trees that bend are stronger and lighter than trees that don’t bend. The interior of a structure also needs to change responsively. One can’t afford to have spaces that sit unusable for large portions of the day due to a fixed configuration. More specifically a small university needs its performing arts center to stay on the cutting edge and avoid becoming dated in relation to changing theatrical requirements. One of the best ways this can be achieved is through a structure that adapts to various design criteria. Imagine being able to custom fit the theatre to the type of play or performance that is taking place. Or the interior might be able to adapt to better control crowd flow or better control air flow in the summer versus winter. Theatres are unique buildings in that they have a
set of rules which govern them yet at the same time no two theatres are the same in respect to shape, plan, materiality, and design intentions. Theatres present unique opportunities for architects because they provide "the need for a technically perfect shape with the necessity of allowing fantasy and dreams to happen." Theatres structural design needs to stay on the cutting edge of technology in much the same way the advancements in video projection, acoustics and stage design have advanced. Unlike traditional theatres where there is never an inkling of what goes on inside, it becomes one of the goals of this project to provide a certain level of transparency to address the surrounding community but also to provide further expression of the design goals of the theatre. While advances in technology have made interiors more intelligent and comfortable, the idea of a building as a whole changing shape is only just emerging as a possibility because of the complexity of the task. Space, structure and form are the traditional outward expression of a building. However structural adaptability goes beyond this given form and allows for new and innovative forms to be present. There can be two different types of adaptability that can be accounted for. Adaptability that anticipates what types of needs will be coming and those that are unforeseen before and after the building are constructed. A building that mimics a living system would be able to sense and respond appropriately to exterior conditions like varying winds, temperature swings or changing sunlight. Inside, the building might change to accommodate crowd flow or provide for various floor plan conditions. Building skins clad in new generations of energy-making materials could alter their form to track the sun, enable greater shading or
sunlight penetration while also producing energy. A new group of architects are currently working on the notion of “responsive structures” that observe their internal and external environment and change form to suit any situation. Architects such as Tristan d’Estree Sterk and Robert Skeleton at the Office for Robotic Architecture are working on developing shape changing building envelopes which make use of tensegrity structures which can be controlled by pneumatic arms. These unique structures do away with traditional walls and instead allow for a skin which can be moved and adjusted to accommodate an infinite number of building forms. “Shape-changing envelopes offer architects the ability to produce buildings that condition themselves in very simple, natural and sustainable ways.”

Today the technologies available to architects and builders is growing; however architects need to be increasingly savvier about how they incorporate the new technologies. By understanding the faults of today’s architectural systems and enabling new technologies that address these faults one can provide a smarter building which responds in an environmentally responsive manner. Responsive architecture will allow for dynamic environments instead of static buildings. Ultimately, the strength of flexible buildings is the ability to link user needs with architectural form.

2. James Steele. Theatres (pg. 28)
4. www.oramba.com
A Performing Arts Center on the University of Detroit Mercy campus

Due to the site location being on the University of Detroit Mercy McNichols campus the opportunity to respond to the urban setting where students as well as people who live in the neighborhoods near campus can gather becomes one of the goals of the theatre. In addition, the program can allow for various forms of adaptability of the building, which is a central theme of the thesis. With these two concepts in mind, the program can allow for a communicative space that is equally adaptive to different types of performance. Ideally, the program will allow for adaptability both within the building as well as a way to expand the building out into the campus and surrounding community.

A theatre is seen as an expressive building that becomes a landmark for a city. With this type of building, a structure that is very expressive of the goals of the thesis becomes a way to fully explore structural expression. Because of the structural expression of the Fisher Administration building right next to the site, a way that the building could fit into its context would be to follow some of the same cues that are expressed in the Fisher Administration. The very nature of performance, actor, and audience becomes a dynamic program that lends itself to a building that is both technically advanced and visually interesting at the same time. A theatre is seen as an expressive building that acts as a landmark for a city that it is housed in. Because the building is located on the University of Detroit Mercy campus, the way it can integrate pedestrian travel and gathering spaces becomes crucial to its success. The theatre has to allow for future adaptation and avoid the problem of becoming obsolete based on its inability to adapt to changing needs.
Despite the traditional architectural building that we associate with theatres, the performance itself can take place anywhere there is an audience. With this free and open attitude towards the theatre, performance spaces that can be integrated into the community and campus will be another form of adaptation that the building will address.

The locations of these spaces on the site play a crucial role in the success of the project. Within the context of the university the way in which the main theatre space is viewed helps in determining the relationship the building has with both the campus and the surrounding community. As the program is concerned the main theatre space would ideally be seen from Livernois and act as a destination for the University. The outdoor/indoor theatre needs to connect with campus and the surrounding neighborhood. The classrooms and offices are spaces that will be solely accessed by students and teachers so clear access from them becomes an important issue to consider.
Space Requirements

Main Theatre:
- 600 Seat House: 6000 SF
- Proscenium stage: 1000 SF
- Fly-loft: 500 SF
- Total: 7500 GSF

Black-Box Theatre:
- 200 Seat House: 3500 SF
- Platform: 500 SF
- Total: 4000 GSF

Multi-use Space:
- Multi-use: 9500 SF
- Storage: 50 SF
- Toilet/J.C.: 250 SF
- Total: 9800 GSF

Technical Support:
- Lighting Control: 100 SF
- Sound Control: 60 SF
- Tech On-stage: 120 SF
- Stage Crew Lounge: 150 SF
- Total: 430 GSF

Technical Areas:
- Loading/Receiving: 300 SF
- General Storage: 500 SF
- Shop: 1000 SF
- Costumes Storage: 400 SF
### Laundry
- Laundry: 150 SF

### Mechanical
- Mechanical: 300 SF

### Electrical Shop
- Electrical Shop: 120 SF

### Tech Crew Office
- Tech Crew Office: 400 SF

**Total:** 3170 GSF

### Performers Facility
- Group Dressing (2): 500 SF
- Wardrobe: 80 SF
- Make-up: 150 SF
- Toilets/Showers (2): 400 SF
- Artists Lounge: 300 SF
- Assembly On stage (2): 160 SF

**Total:** 1590 GSF

### Classrooms/ Offices/ Administration
- Classrooms (6): 3600 SF
- General Offices (6): 600 SF
- Directors Offices (2): 300 SF
- Storage: 50 SF
- Box Office: 60 SF

**Total:** 4610 GSF

### Rehearsal Spaces
- Rehearsal Stage: 1500 SF
- Storage: 500 SF

**Total:** 2000 GSF
Audience Support:

- Foyer: 5000 SF
- Food/Beverage: 50 SF
- Toilets/J.C.: 350 SF
- Coat Check: 300 SF
- Total: 5700 GSF

Support:

- Back Stage Support: 3000 SF
- Rehearsal: 2000 SF
- Total: 5000 GSF

Outdoor Theatre:

- 300 Seat Space +/-: 7000 SF +/-
- Stage: 1000 SF
- Total: 8000 SF

Total: (7500 GSF + 4000 GSF + 9800 GSF + 430 GSF + 3170 GSF + 1590 GSF + 4610 GSF + 2000 GSF + 5700 GSF + 5000 GSF + 8000 GSF) x 20% (Circulation and Structure) 

(51800) x 20% = 10,360

= 62,160 GSF
Main Theatre Seating

A. Quantities Required

1. Space Capacity  600 Seats
2. Number of Units  1
3. Net Square Feet  6,000 sq./ft.
4. Total Net Area  6,000 sq./ft.

B. Purpose/ Function - The main theatre space will act as a proscenium theatre in a traditional fashion. The floor will be raised to the roof to reveal all the seating a few feet below.

C. Activities - All large theatre performances and auditorium style presentation will be housed here.

D. Spatial Relationships - Sloped seating will provide for better viewing no matter how close the seat. As the floor is raised to reveal the seating, lighting needs to still be provided in the ceiling.

E. Qualitative Considerations - Vertical panels can be raised or lowered to open and close the walls of the theatre, which will also block out daylight.

F. Equipment/ Furnishings - Collapsible seating will allow for the removable floor to be lowered into place.

G. Behavioral Considerations - All movable systems need to be incorporated so as to not get in the way of each other.

H. Structural Systems - Long span to clear the seats and aisles.

I. Mechanical/ Electrical Systems - All mechanical and electrical systems will need to be housed above the theatre space.

J. Site/ Exterior Considerations - The west wall opens up onto Livernois. A water feature that helps to define the outdoor performance space will be housed here.
**Proscenium Stage**

**A. Quantities Required**
1. Space Capacity 75 people  
2. Number of Units 1  
3. Net Square Feet 1,000 sq./ft.  
4. Total Net Area 1,000 sq./ft.

**B. Purpose/Function** - The stage will provide the space required for a wide variety of performances.

**C. Activities** - Actors and actresses will perform here.

**D. Spatial Relationships** - The stage moves up and down in sections on pneumatic cylinders so as to provide various scenery options.

**E. Qualitative Considerations** - Overhead and spot lighting is provided.

**F. Equipment/Furnishings** - A stage curtain will be provided so as to close off and open up the stage.

**G. Behavioral Considerations** - The stage is designed only for the actors and actresses and is raised up a few feet in front of the first row.

**H. Structural Systems** - Typical.

**I. Mechanical/Electrical Systems** - Typical.

**J. Site/Exterior Considerations** - Typical.
Theatre Stage/Support/Fly-loft

A. Quantities Required
   1. Space Capacity: 0
   2. Number of Units: 1
   3. Net Square Feet: 1,000 sq./ft.
   4. Total Net Area: 1,000 sq./ft.

B. Purpose/Function - The stage will be the main focal point within the theatre. Backdrops and scenery are hung from the vertical core (fly-loft).

C. Activities - Where the performances take place as well as the storage for the scenes above the stage.

D. Spatial Relationships - Vertical space with a floor to ceiling height of 55'.

E. Qualitative Considerations - All natural light needs to be blocked out. Stage lights are to be provided so as to fully light the actors and scenery on stage.

F. Equipment/Furnishings - Collapsible seating will allow for the removable floor to be lowered into place.

G. Behavioral Considerations - Stagehands need to have space which can be accessed during a performance without being seen by the audience.

H. Structural Systems - Column free space with enough structural support to support all flying scenery.

I. Mechanical/Electrical Systems - Electrical needs for the sound, lighting, and pulley systems.
Black-Box Theatre

A. Quantities Required
   1. Space Capacity  200 people
   2. Number of Units  1
   3. Net Square Feet  3,500 sq./ft.
   4. Total Net Area  3,500 sq./ft.

B. Purpose/ Function - As flexibility becomes one of the key design issues in this space, providing an open space which can allow for various stage configurations and seating configurations becomes key.

C. Activities - Actors and actresses perform here as well as a place for seating for spectators.

D. Spatial Relationships - East facing walls have the ability to move out into the quad commons.

E. Qualitative Considerations - Because of the nature of black-box theatres a space with limited natural light will work the best.

F. Equipment/ Furnishings - An elevated stage with the ability to be rolled outside on casters.

G. Behavioral Considerations - The stage is designed only for the actors and actresses and is raised up a few feet in front of the first row.

H. Structural Systems - Beams and girders with the ability to house cranes which can lift and move various objects within the space as well as to the outdoors theatre.

I. Mechanical/ Electrical Systems - Typical.

J. Site/ Exterior Considerations - Providing for an outdoor stage becomes integral to the success of the black-box theatre.
Multipurpose Space

A. Quantities Required
   1. Space Capacity 1,000 people
   2. Number of Units 1
   3. Net Square Feet 7,500 sq./ft.
   4. Total Net Area 7,500 sq./ft.

B. Purpose/ Function - The space directly above the
   Main theatre space performs multi-purpose tasks as a
   place for any various degree of functions.

C. Activities - A wide array of activities can be
   performed here ranging from an art exhibit to
   graduation ceremonies.

D. Spatial Relationships - A tall enough vertical space
   so as to accommodate ideal acoustical qualities and
   provide enough head room.

E. Qualitative Considerations - Vertical panels can be
   raised or lowered to open and close the walls of the
   theatre, which will also block out daylight.

F. Equipment/ Furnishings - Collapsible seating will
   allow for the removable floor to be lowered into
   place.

G. Behavioral Considerations - All movable systems need
   to be incorporated so as to not get in the way of each
   other.

H. Structural Systems - Long span to clear the seats
   and aisles.

I. Mechanical/ Electrical Systems - All mechanical and
   electrical systems will need to be housed above the
   theatre space. Proper levels of air circulation need
   to be provided so as to ventilate during performances
   with a full house.

J. Site/ Exterior Considerations - The west wall opens
   up onto Livernois. A water feature that helps to
   define the outdoor performance space will be housed
   here.
Lobby

A. Quantities Required
   1. Space Capacity  600 people
   2. Number of Units  1
   3. Net Square Feet  8,500 sq./ft.
   4. Total Net Area  8,500 sq./ft.

B. Purpose/ Function - Intermediate space between outside and the interior theatre functions.

C. Activities - Gathering space before entering the theatre.

D. Spatial Relationships - Lower ceiling height than proscenium theatre space and black-box theatre.

E. Qualitative Considerations - A glass facade will enclose the entire space as well as offer 4 means of egress.

F. Equipment/ Furnishings - Lounge chairs and benches.

G. Behavioral Considerations - A curtain wall system that can be opened and closed will be important to the design goals of the performing arts center.

H. Structural Systems - Long span to allow for a clear open space. Simple column and roof grid system will be used.

I. Mechanical/ Electrical Systems - Typical.

J. Site/ Exterior Considerations - Typical.
Movement Study #1

Movement Study #2
Movement Study #3

Movement Study #4

Movement Study #5
Black-box Theatre Wall Study

By providing walls which can be rotated a more experimental theatre experience will be provided to the director.
Theatre Floor Study

Looking at a floor system which can be raised and lowered in sections through a pneumatic system will provide an adaptable theatre space with an infinite number of stage and seating arrangements.
Floor Plan Studies

These drawings were meant to designate the areas where adaptation (yellow) takes place and where the fixed support spaces will be housed.
Site Model
Final Model
Black-box Section Model
First Floor Plan
Second Floor Plan
Site Plan
Lower Level Floor Plan
Wall Sections
Lobby Axonometric
The thesis project attempted to provide a real and feasible approach to structural adaptation. With a broad range of adaptation the project made as many attempts as possible to provide scenarios for which adaptation will take place.

After the first semester the project contained three theatres, however it became apparent that if adaptability truly was going to be a part of the project it would only make sense to contain fewer theatres. The final project contained two theatres that made every attempt to be as adaptable as possible, so as to only need two theatres no matter the type of performance that will be taking place.

My initial design agenda attempted to have only a few forms of adaptation. Looking at broader user needs freed up the project and in return allowed for a more diverse and enriched project. Additionally, looking at how the performances can spill out into the landscape provided additional forms of adaptation.

Ultimately, the project failed to address very specific scenarios for adaptation. By looking at how different forms of performances actually take place would have provided a more realistic and more convincing project. For example if a rock concert was to be performed on campus, or the Blue Man group was to perform, how would the theatre adapt to theses very different scenarios? One of the most crucial design aspects in a performing arts center relies on the acoustics. My project failed to truly look at this, although the thought was in the back of my mind, it never truly got the attention it deserves.


