Repetition: A Study of the Structural Bay

The proposal of a concert hall for the Virginia Symphony on Belle Isle, Richmond,Virginia

by

Evelyn Elizabeth Strong

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Approved:

William Brown, Chairman

William Galloway

Mario Cortes

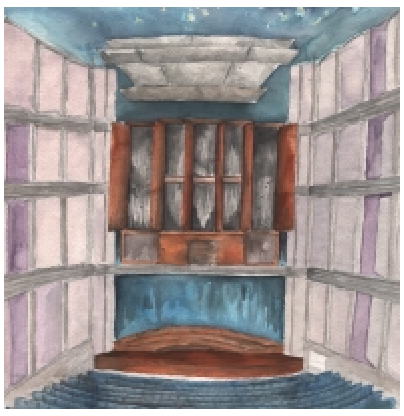
Heinrich Schnoedt

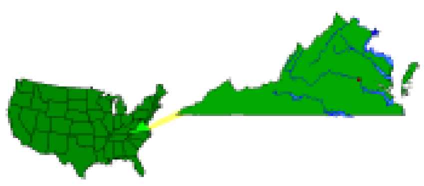
Every architect strives to make architecture, without its occurrence being a guaranteed result. Although often mistakenly used synonymously, a differentiation exists between building and architecture. Architecture offers more than a protective device that shields its occupants from the elements. Architecture defines a place, engages the senses with intention and awareness. It could be a shadow cast across a wall, a tiny beam of light that makes a dark room sparkle, or a sense of quiet stillness.

Theories abound describing the process of architecture. The paths to architecture differ according to the questions posed, permitting explorations from many directions such as the viewpoints of the plastic art of sculpture, the performance art of dance, or the study of material properties. Precedent studies provide a guide in the direction of an investigation, but they must be carefully used. Too often, a building is described by its style. In consequence, our study of architectural history becomes a trap, limiting our investigation to the appearance. Architectural elements such as a Doric column become mere signs applied to a building; their structural function is negated.

The classification of architecture by style encourages the inherent temptation to copy the fashionable outward trappings of a building without understanding the ideas that produced the original architecture. In lieu of visiting and sketching new buildings, in contemporary practice, we experience architecture through glossy magazine photographs. The images are visually exciting, yet the tactile depth is lost, consequentially reducing our perception to the visual qualities of the building. This perceptual limitation allows the possibility of designing buildings that specify the qualities of heat, light, air, durability, and changeability within the buildings and then applying materials as if they were texture maps. We, especially young architects, must thoroughly study the images presented to us whilst questioning the resulting architecture. With understanding of what makes architecture comes the ability to take a position. Otherwise, we drift, following the tides of fashion, and risk never achieving architecture.

Through studies of architectural history, one gains an intuition about structure. This developing knowledge guides the decisions of material and scale, leading me to the opinion that tectonic expression is a fundamental part of architecture.
How the structural interrelationship of materials germinates architecture is the topic of this thesis; with a secondary exploration in the methods of employing construction to relate a building to the site. Through the design of a concert hall for symphonic music, these paths towards architecture are investigated.





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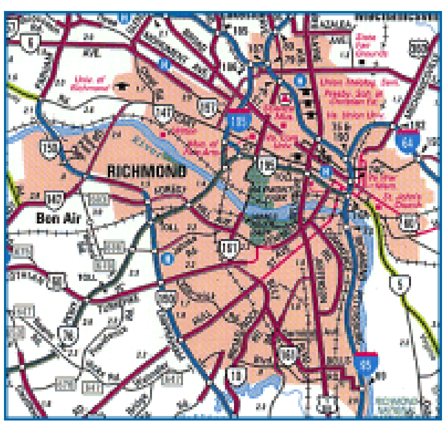

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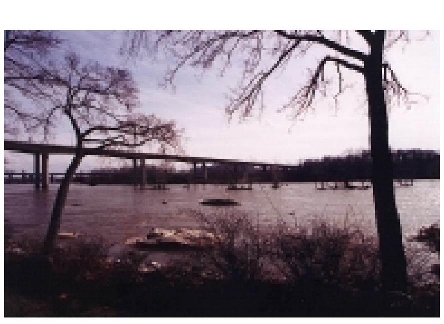

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Site

There is an indivisible connection between a building and its site. Congruent pieces of earth are not the same regardless of where they are located. Factors beyond the property boundaries influence the site. The geography and history of a place provide a context for the inserted building. Belle Isle, an island in the James River, Richmond, Virginia, is the site for the proposed concert hall. Richmond is the capital of the Commonwealth of Virginia, with a long and colorful history dating back to the mid-1600s when English explorers settled along the James River. The fall line separating the Tidewater and Piedmont regions was geographically conducive to settlement, making Richmond the northernmost port city along the James River. Trafficking mostly in tobacco, Richmond was a lethargic southern city until war was declared in 1861.

The Civil War completely transformed the city. Jefferson Davis, the President of the Confederate States of America, chose Richmond, Virginia, as the capital of the Confederacy. No longer an obscure southern port, Richmond was a strategic city for both sides of the conflict.

In the end, General Robert E. Lee was unable to prevent the onslaught of Union soldiers and Richmond fell to the enemy, but not without a final act of defiance. Richmond was nearly destroyed by fire in an effort by the Confederate Army to prevent Union possession of armaments and supplies. Out of rubble and ash, Richmond proudly rebuilt and clings passionately to its memories of its brief position of power.

After the Civil War, the port continued to be a vital part of Richmond. Areas of the city like Shockoe Slip and Shockoe Bottom testify to the rebirth of shipping with their tobacco warehouses now converted into restaurants, shops and apartments. In the late 1990s, Richmond invested in a multi-million dollar revitalization program to increase the leisure and tourism industry. One area developed is the Kanawha Canal that connects Shockoe Bottom to the river above the rapids. The canal was retrenched. Pedestrian ways, outdoor landscaped areas, and placards form the Canal Walk.

1. Location of Richmond, Virginia

2. Map of downtown Richmond

3. View of downtown skyline from Hollywood Cemetery

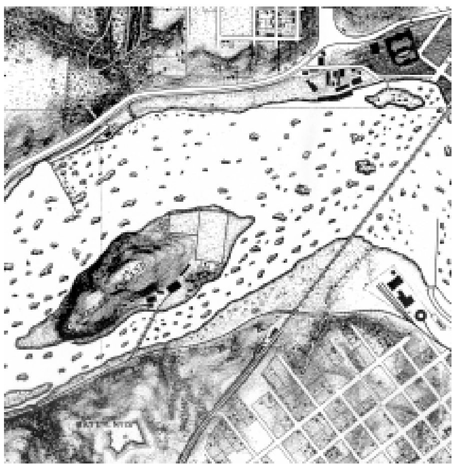
4. View of James River and downtown Richmond looking east.

5. View across the James River towards southside Richmond from Hollywood Cemetery

6. View of Belle Isle and the Robert E. Lee Bridge, one of five bridges connecting downtown Richmond to the southside of the city.

Belle Isle is located across the river from the Canal Walk terminus. It is the northernmost island in a chain of islands located in the James River flowing through downtown Richmond. The park, heavily wooded, with nature trails meandering between remnants of a Civil War prison camp, quarry, power plant, and iron industries, commands a prominent position between the north and south sides of Richmond. Here, as nowhere else, is one presented with the historical development of the city. To the southeast, beyond modern day skyscrapers, towering chimneystacks pay tribute to the era when tobacco warehouses lined the canal and shipping was a major industry. The newly renovated canal walk begins here and guides thousands of visitors along the riverfront, past large corporate headquarters to end at the Tredegar Iron Works. On the cliffs above the canal rests Hollywood Cemetery, a carefully maintained reminder of Virginians' contribution to the shaping of the United States of America with monuments to the two Virginian presidents there interred, as well as the large memorial to the Confederate soldiers lost in the Civil War.

Rocky outcroppings create a series of rapids that make crossing the river difficult. In the Civil War, because of the difficult crossing, Belle Isle was an ideal location for a Union soldier prison camp. The number of soldiers imprisoned on the island varied in thousands during the three years of use. Photographs taken during the Civil War testify to the grim conditions that prevailed. An earthen berm and placards are all that remain. Even the graves have been exhumed when Belle Isle became part of the James River Park System. The rapids, which acted as a fence, are now a stretch of whitewater that entices kayakers to test their ability.



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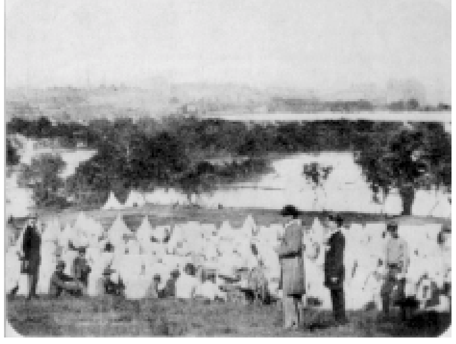

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7. Detail of an 1867 Corps of Engineers Map by Nathaniel Micheler showing Belle Isle

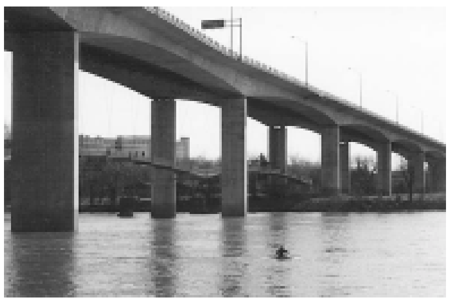
8. History marker locating the site of the Union Soldiers prison camp on Belle Isle.

9. "Belle Isle during the Civil War" Rees, photographer

10. "Graves of Union Soldiers on Belle Isle, Richmond" April 8, 1865, Alexander Gardner, photographer

11. History marker describing Powhatan Indian activities on Belle Isle

12. History marker and ruins of 1816 iron manufacturary on Belle Isle.



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The impressions of the site begin on the north side of the river. Cargo railway trestles criss-cross downtown Richmond. Over-structured steel trestles pass over the parking areas beside the Tredegar Iron Works. The concrete and steel footbridge suspended from the Robert E. Lee Bridge leads from the parking area across the James River to Belle Isle. Four-inch diameter cables supporting the footbridge appear threadlike in comparison to the massive seventy-eight foot high concrete pylons supporting the highway bridge. Triangulated cables securely anchor the footbridge against lateral movement from the wind or vibrations from vehicular traffic above. But psychologically, the footbridge is delicate, poised precariously over the foaming rapids.

On a sunny day, people park their cars and cross the river to picnic, fish, bike, or walk their dogs. Belle Isle is quite different in character from the urban parks. People seek the park as a destination instead of being viewed as green space in transit. The physical quality of leaving the car and walking across the bridge enhances its uniqueness.

16. Footbridge access to island suspended from the Robert E. Lee Bridge

17. Cables support gravitational and lateral loads on footbridge

18. Steel beams support footbridge

19. Connection details

Despite the number of people visiting the island, an atmospheric hush lingers on the grassy plain. Here, the imprint of civilization on the island is most felt. The relic of an early twentieth century Tredegar Iron Works warehouse stands like a skeleton against a wooded backdrop. An earth berm marks the infamous prison camp location. The woods are in the process of reclaiming the other structures, empty shells of an iron milling plant and hydroelectric power plant.

Once on the nature trails, one forgets the grassy plain. The impact of man on the island is gentled. Everything feels fresh, as if newly discovered. The paths are cool, even in the fierce summer heat. Sunlight dapples the ground. The primal energy of nature dominates the senses. Here is a place of dreaming. Certain places have such a compelling attraction to stop, rest, and dream that people make their own benches or picnic tables from the very rocks jutting from the river.

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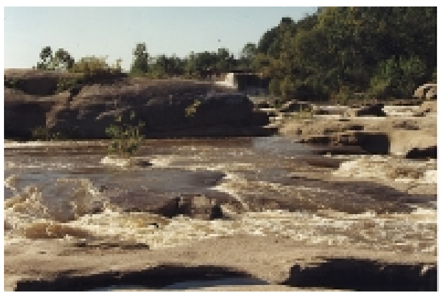

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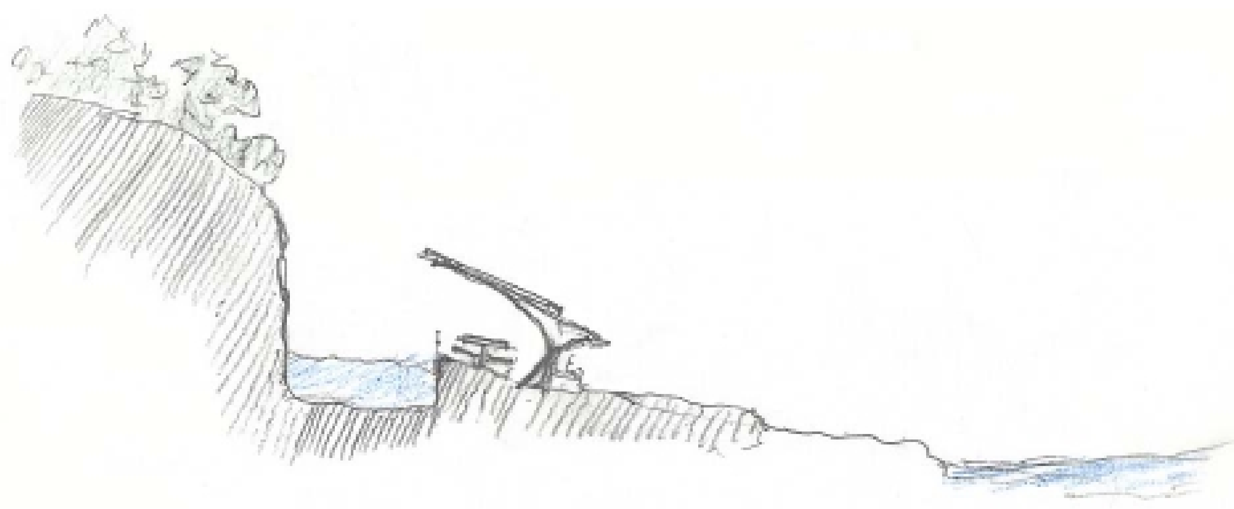
20. Rock outcroppings in river at island shore

21. View north across river to Hollywood Cemetery.

22. Quarry pond

23. View of upriver rapids on south side of Belle Isle

24. Quarry pond



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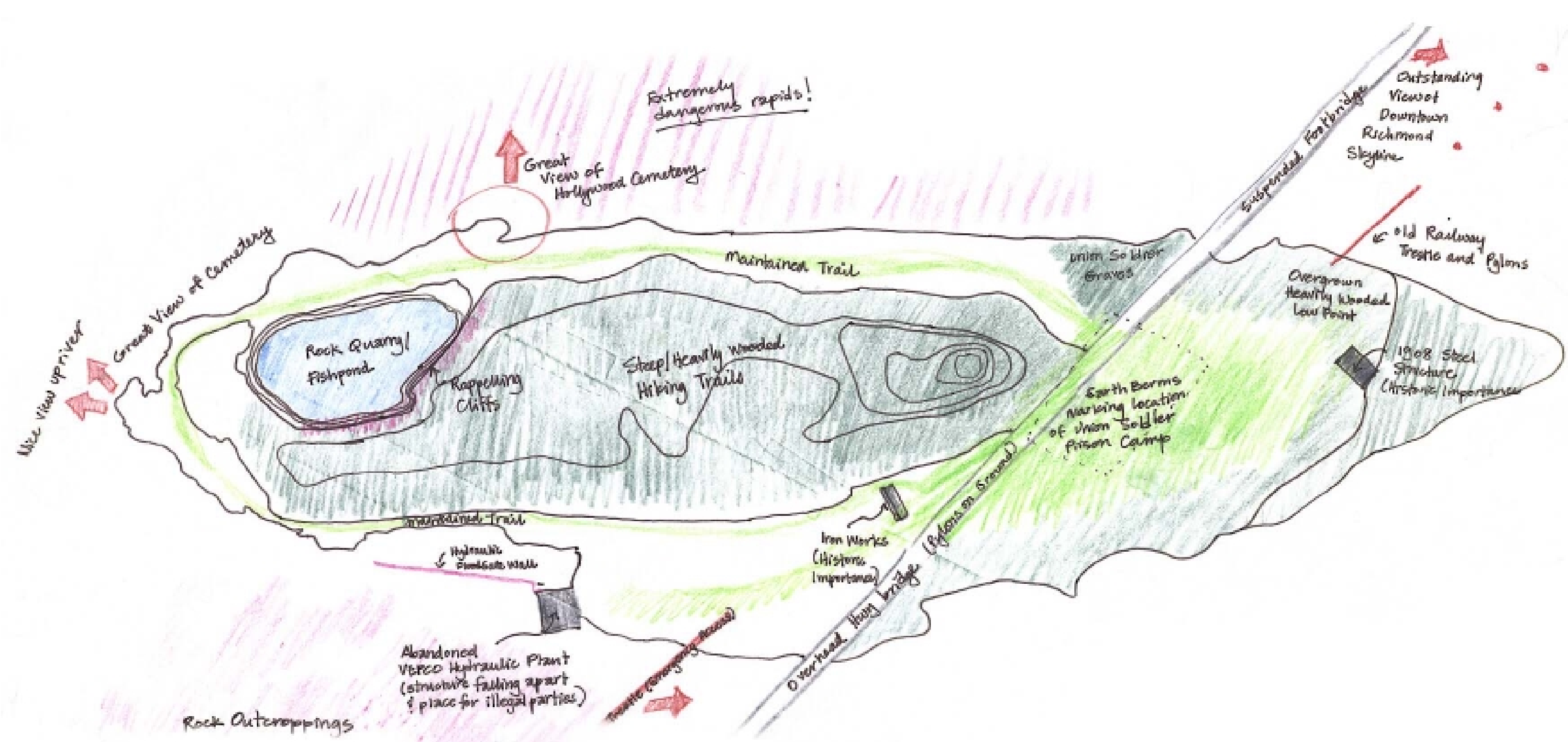
13. Sketch of picnic shelter with views of the rock quarry and rapids upstream

14. Sketch of bench with vines trestled on wires stretched between structural elements overlooking Hollywood Rapids

15. Initial site analysis

The river has a dynamic impact on the site. The very fact that the site is an island presents challenges not apparent on a more structured urban site. Belle Isle is separate from downtown Richmond. The scale of the proposed concert hall is not influenced by the surrounding buildings, rather by the rocks, trees, and river. There is an opportunity for monumentality. The scale of the concert hall must be grand. Anything less makes no impression on the island and the Richmond skyline. A consequence of the scale of the concert hall is the increased emphasis on the integration between the site and the building. The structure cannot sit on the island as if the island were a flat geometric plane. The site must be shaped to fit the concert hall in the same way the design directly relates to the natural formation of Belle Isle. Although modest in relation to the 60-acre island, the concert hall has a significant presence on the grassy plain.



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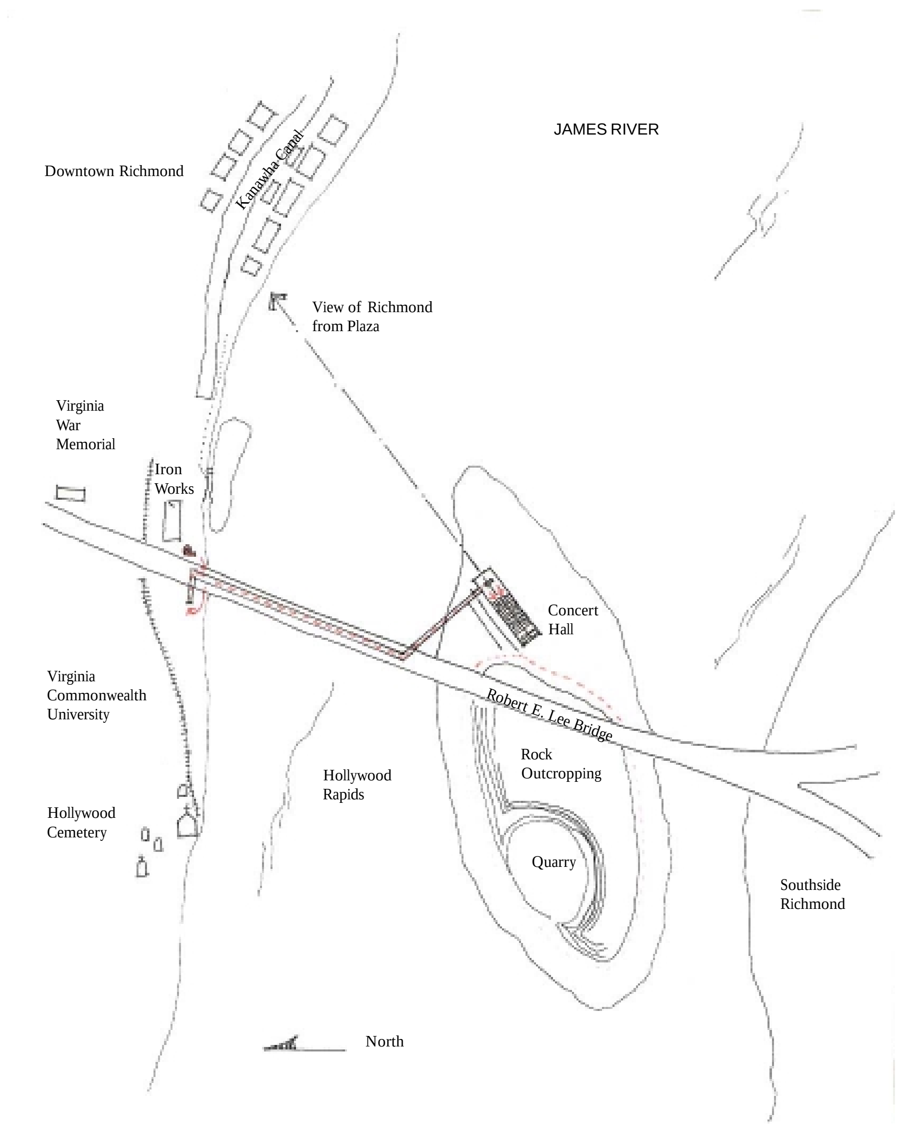
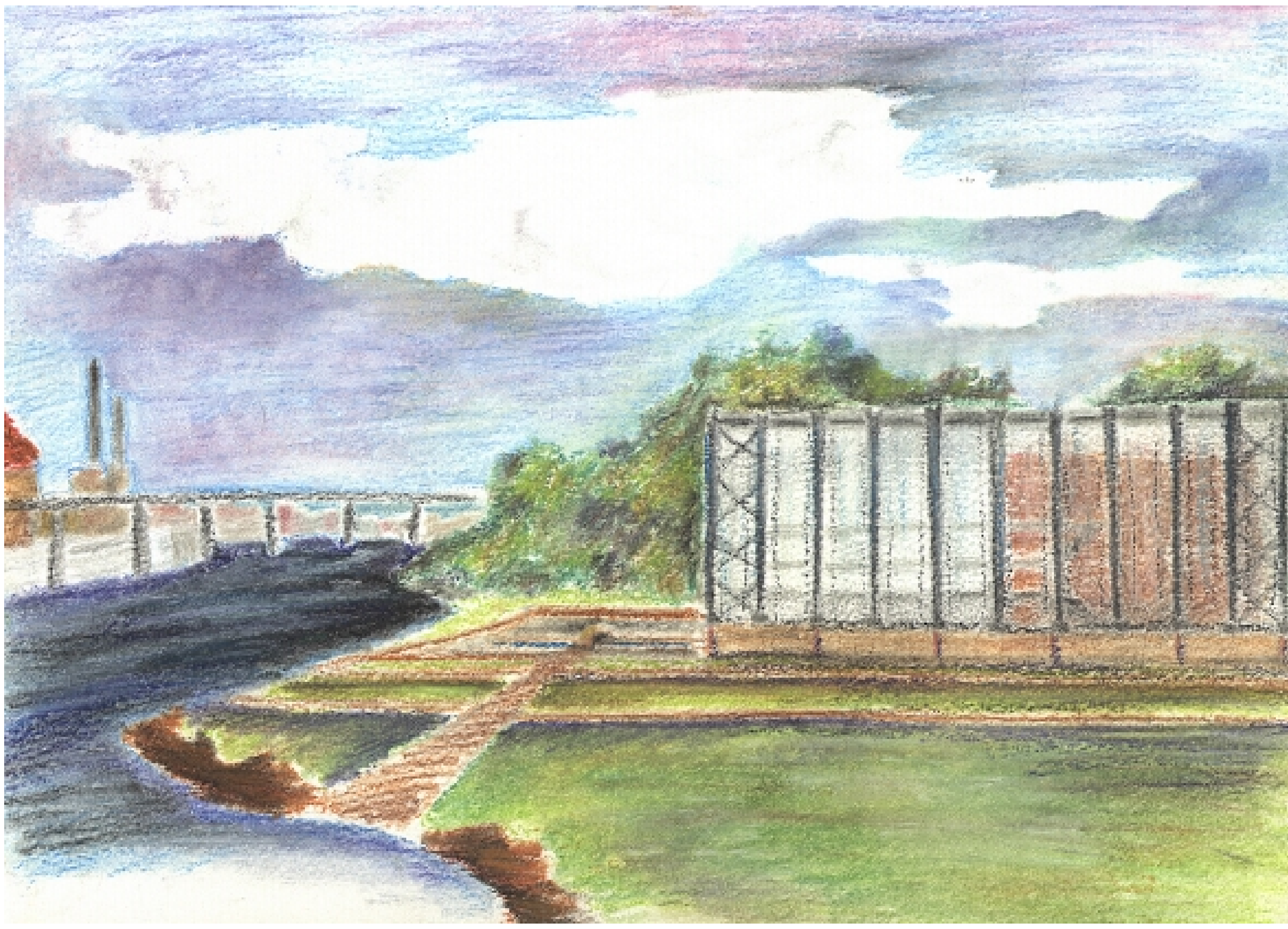


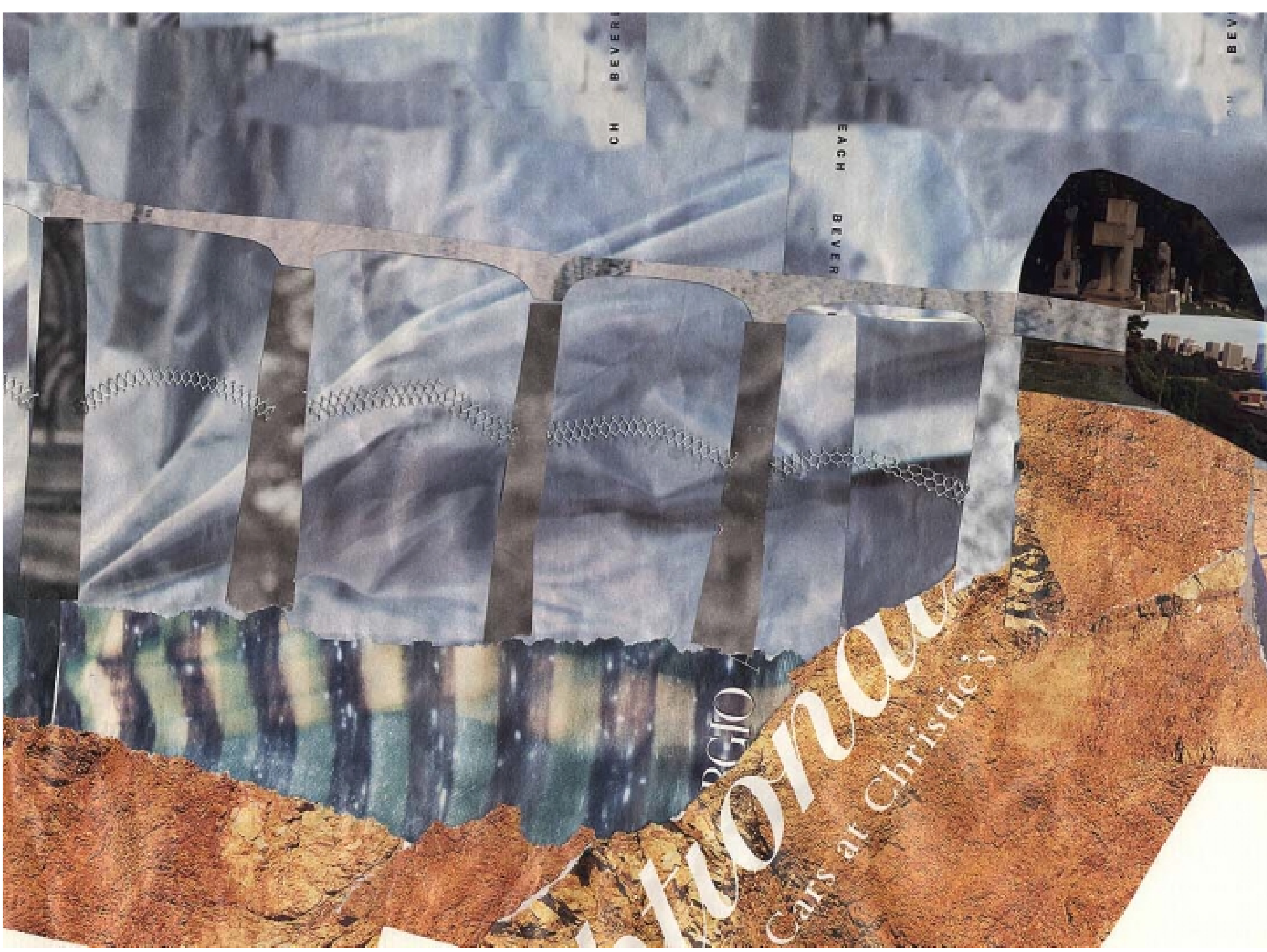
Attending a concert is an event. It has an atmosphere of a party. People make an evening out of the performance. Plans are made for days before the date of the concert – where to go to dinner before the performance and what to do afterwards. They dress up in their best clothes. The heightened anticipation brings energy to the performance. This electricity is vital. The performers translate the energy through their instruments into music.

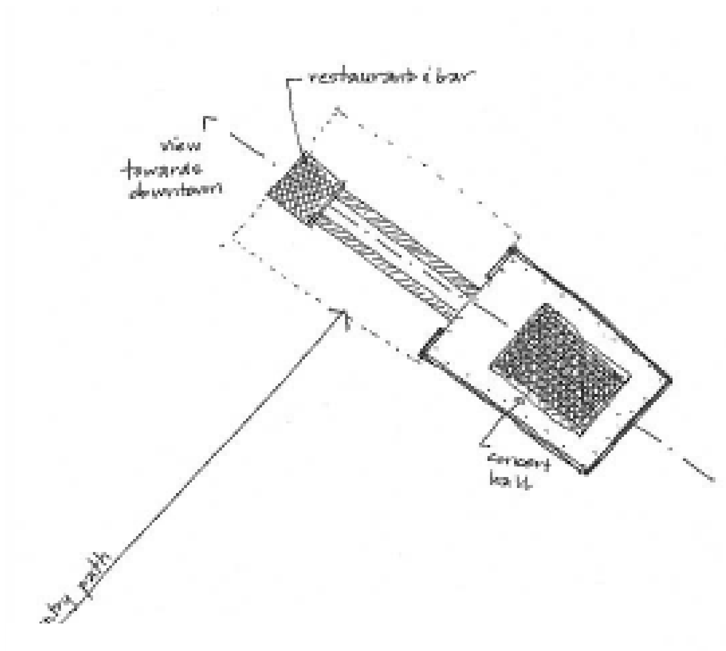
The procession to the concert hall is designed to draw out the experience. The river is a gate to an exciting world that only exists on certain nights of the year. The concert hall glows like a beacon, drawing the audience to it like moths to a flame. The footbridge with its delicate cables transports the guests to the island, setting them down lightly on the ground. The audience traipses on a cut stone path on axis with the plaza. The lights of the city twinkle on the other side of the river. Terraces of shrubbery and groundcover with stone walls prepare the guests for the plaza. Conversations ripple as people meet with friends on the plaza.

Inside the building, a pageantry of people congregates on the stairs. Each level offers a different vantage point from where one can see and be seen. The structure of the stairs and balconies is a filigree setting for the rich life and color of the guests.

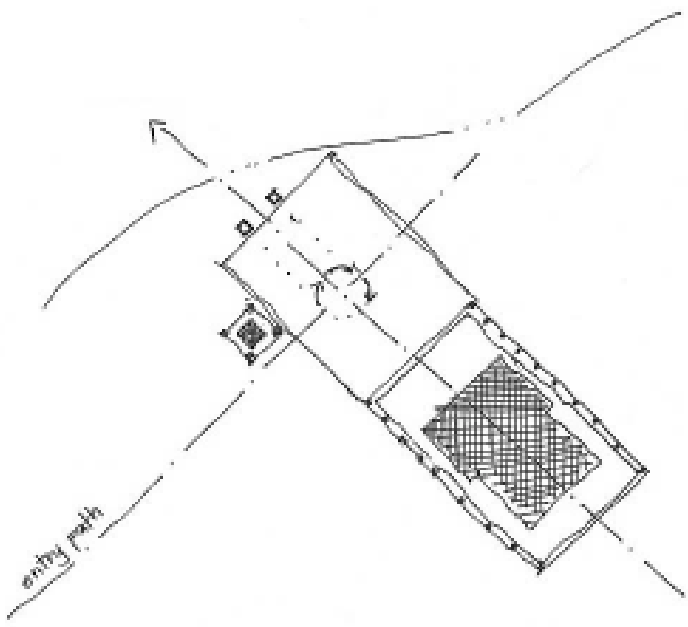


Sketch of procession to concert hall



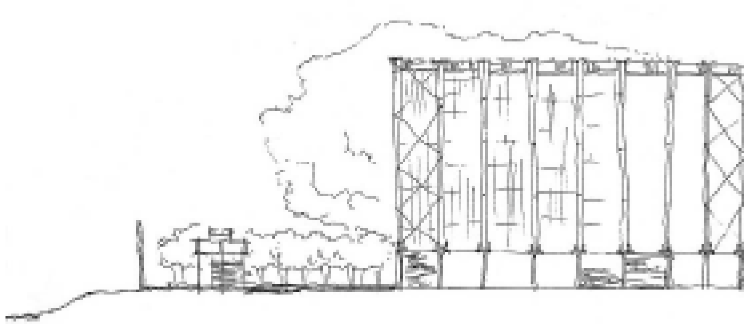


Conceptually the concert hall is like a pavilion with an emphasis on the 360-degree panorama of the site. Yet, the scale of the concert hall prohibits its treatment as a garden folly. The concert hall is so large that it alters the site much the same way a pool's surface alters when a pebble is dropped in the water. The joint between the concert hall and site must be stronger than a line drawn on a piece of paper. The three-hinge frame that comprises the superstructure has an inherent symmetry that influences the entire complex. A stone plaza connects the earth and building, creating a front and back to a uniform enclosure. Three diagrams potentially resolve the axial arrangement of concert hall and site:



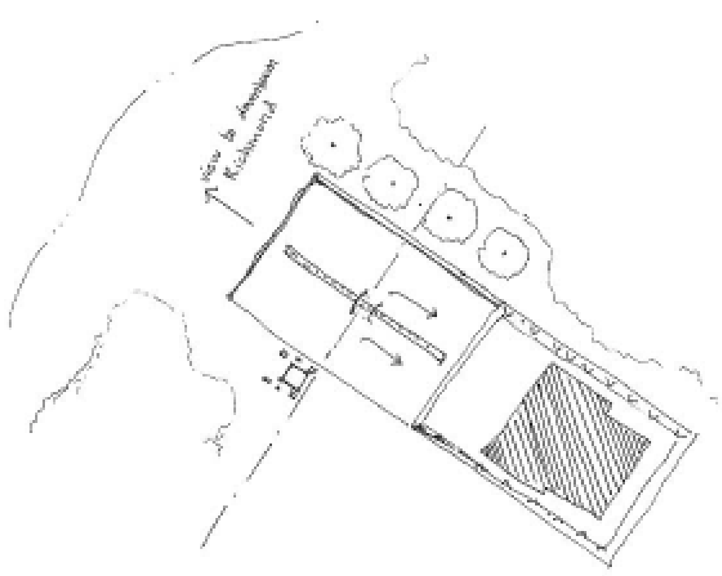
Site Diagram 1

The first study explores the possibility of secondary functions like the restaurant and bar becoming distinct elements outside the structural frame. They create an end for the main axis. A bridge connects the elements to the main structure. The plaza is experienced at ground level as well as from the air. Studied in section, this solution compromises the initial design of a large superstructure supporting interior objects. Instead, the proposed design appears as horizontally connected fragments.



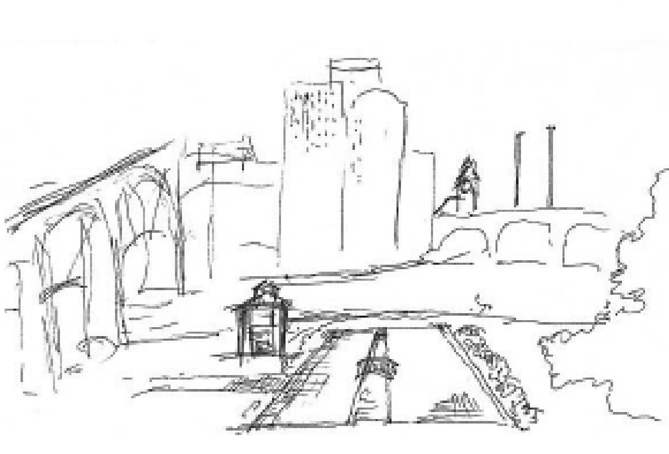
Site Diagram 2

The second proposal is an exploration of how the symmetry and formality of the superstructure and glass enclosure of the concert hall can determine the development of the site. The public space, the joint between earth and structure, is a formal garden that frames the view to downtown Richmond. The skyline becomes the focus for the main axis, extending the site visually. In the garden, there is an important moment of intersection between the main axis and a secondary axis created by the path. The role of the intersection could be developed in a variety of ways. Is the intersection only visual? Does an object placed at the point of intersection force the visitor to rotate around the foci? Or does the intersection provide the potential for human habitation?

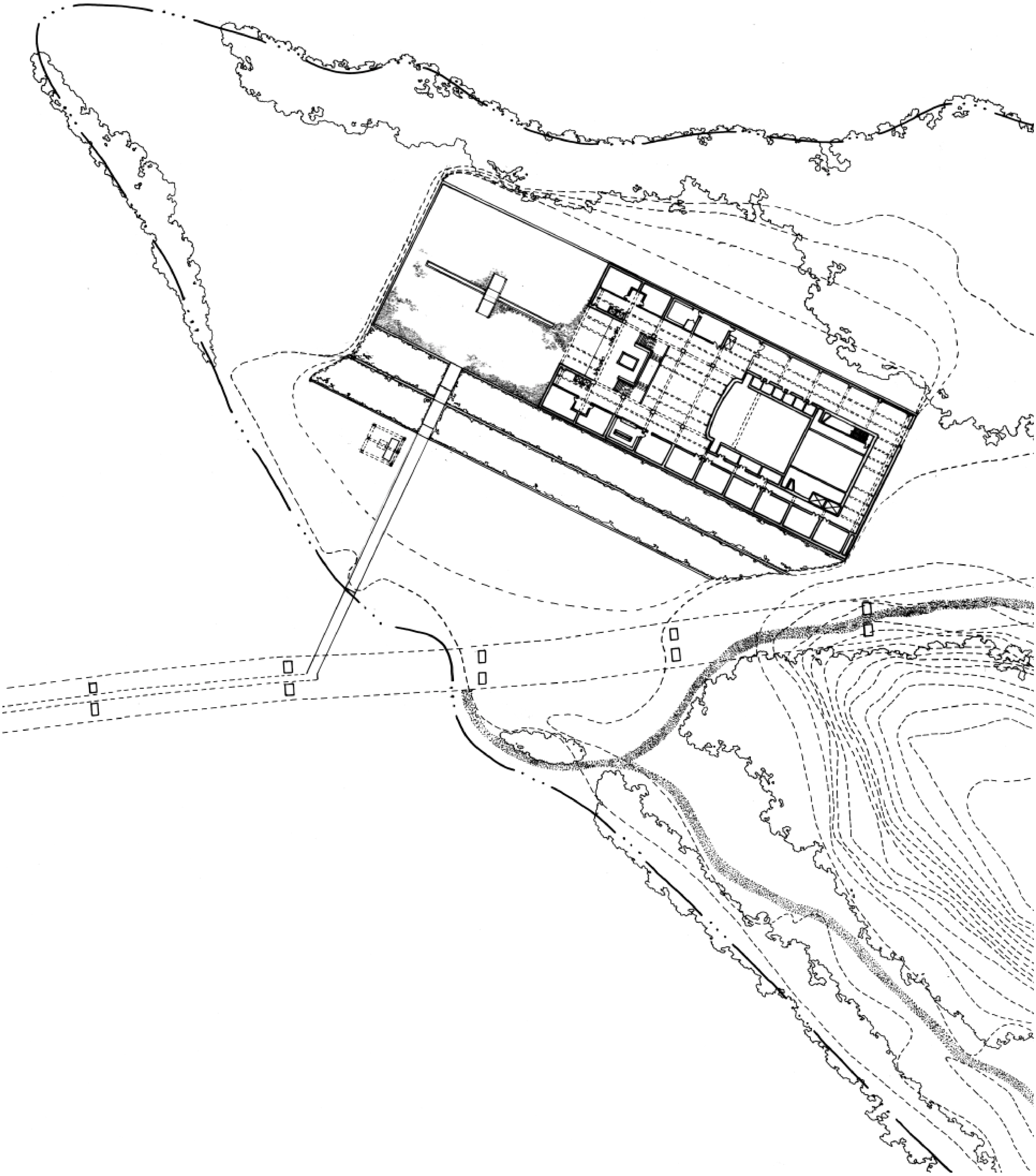


Site Diagram 3

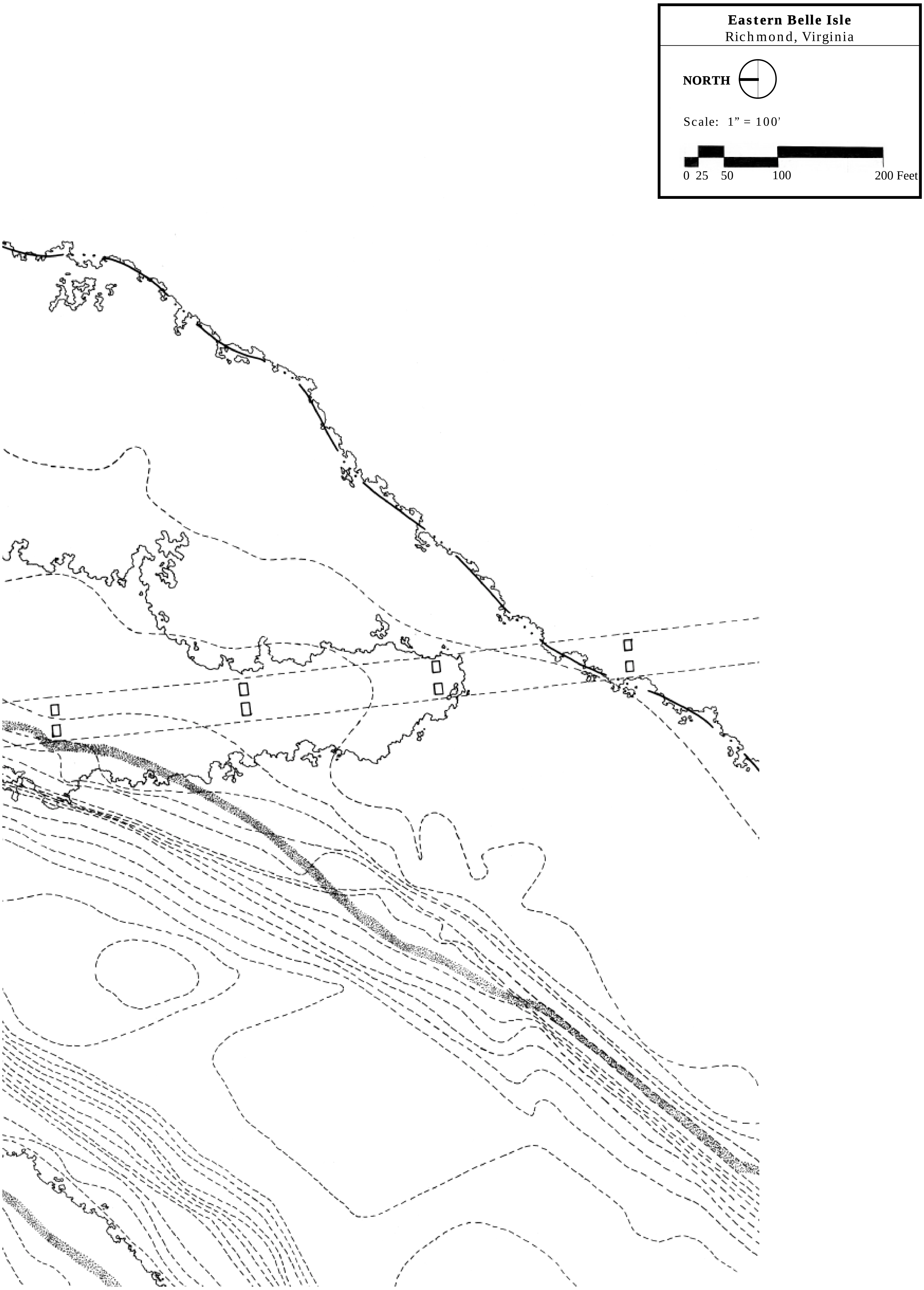
Restricting the palette of materials, the formal gardens become a gravel plaza with a sandstone edging. Changing the topography around the building, the plaza is elevated a few feet above the level of the grassy plain. The change of elevation strengthens the visual connection of a stream of water in a channel that bisects the plaza and the river. Aligned with the secondary axis created by the path, the bridge articulates the moment of intersection, allowing people to occupy the intersection. The bridge should have a generosity to be a place to gather, to sit, as well as cross over the fountain.



Opposite page: Site model



Site Plan


Eastern Belle Isle
Richmond, Virginia
NORTH
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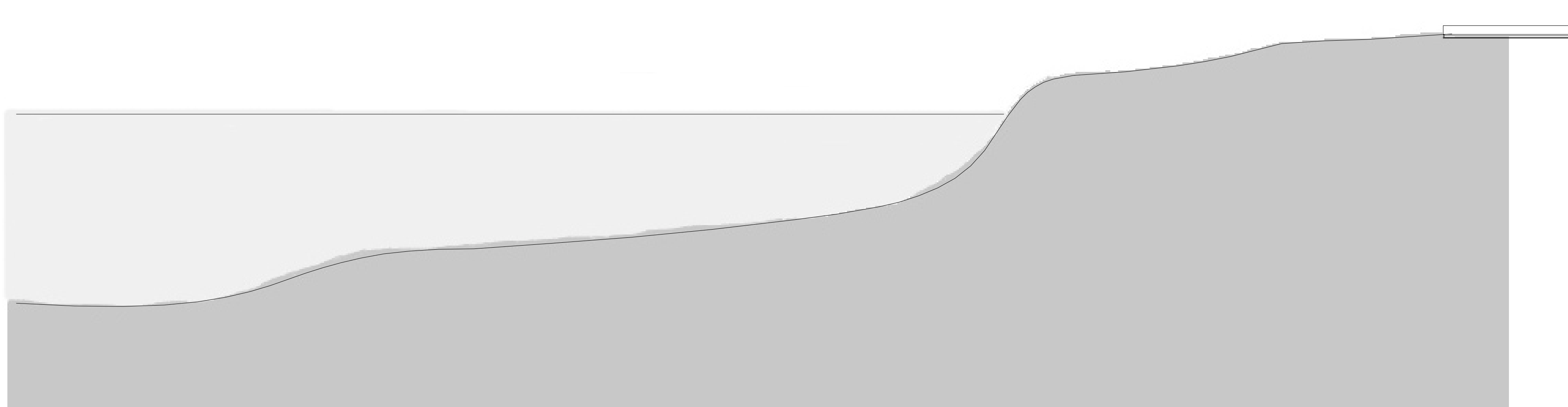
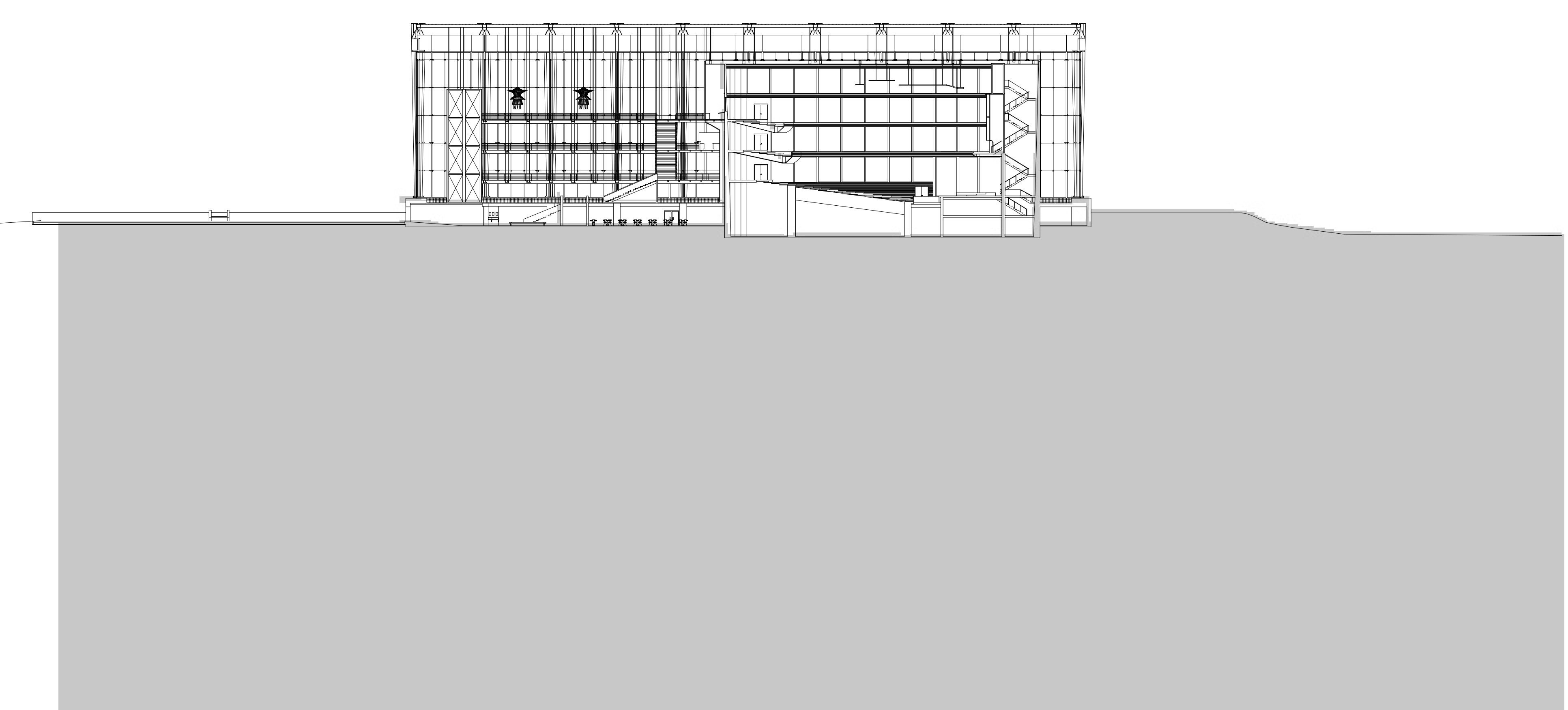
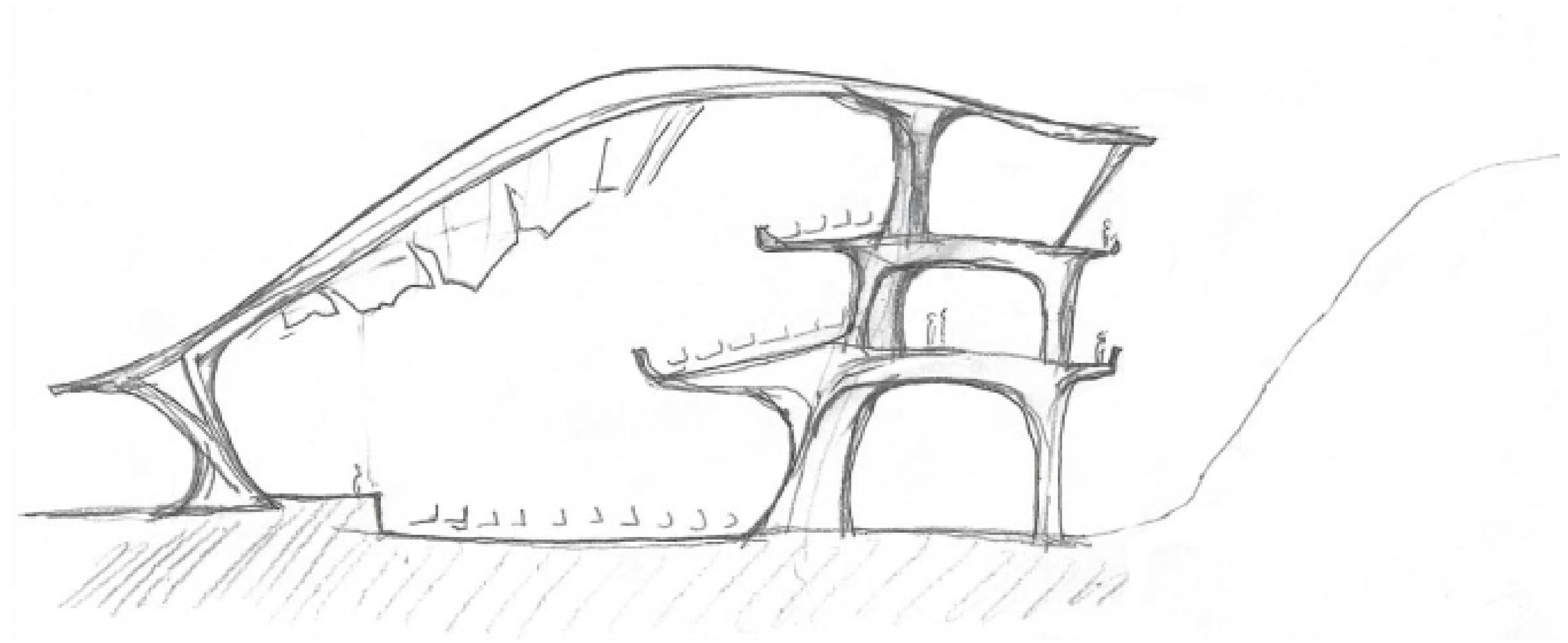


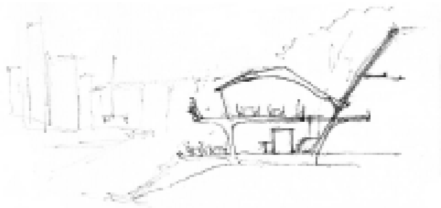


Section looking East



Conceptual section through concert hall

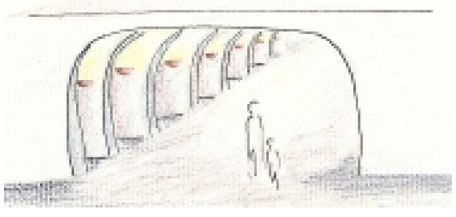
Design



Conceptual section through cafe

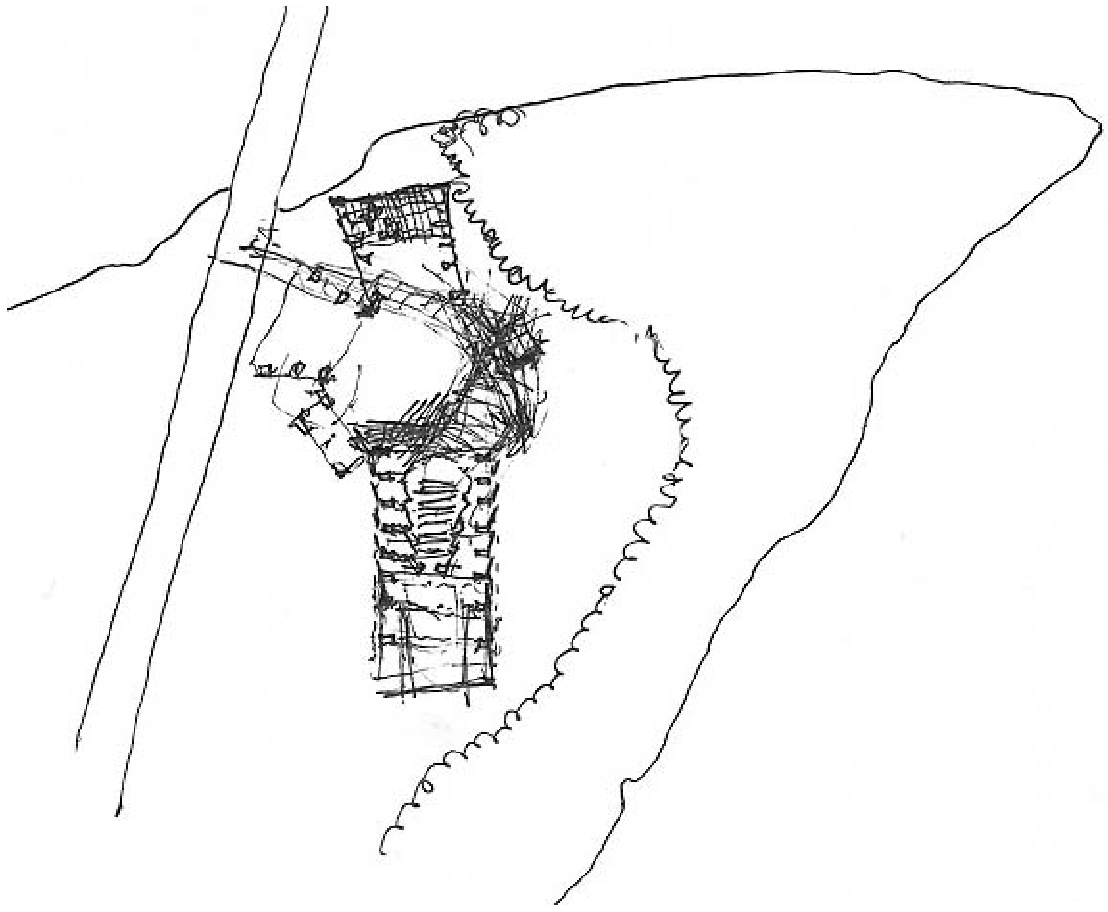
The conceptual sketches and models are a study of the qualitative experiences on the island. Sketches of picnic shelters and benches illustrate skeletal structures that provide places to rest and enjoy the views across the river as when one walks along the nature trails of the island. The sketches are an attempt to add an architectural layer to the rich textures of the island without disturbing its existing character.

The concert hall is made of concrete. Ribs spring out of the rocks and protect the auditorium. Dark, cavern-like passageways, lit by wall sconces, wind around the auditorium. The restaurant is a lighter concrete rib structure facing the river and downtown. The space sinuously winds through the structure. Alternating of light and shadow colour the space.



Sketch of concert hall passageways

Concert hall study model



Conceptual plan of concert hall complex

Concert hall complex study model

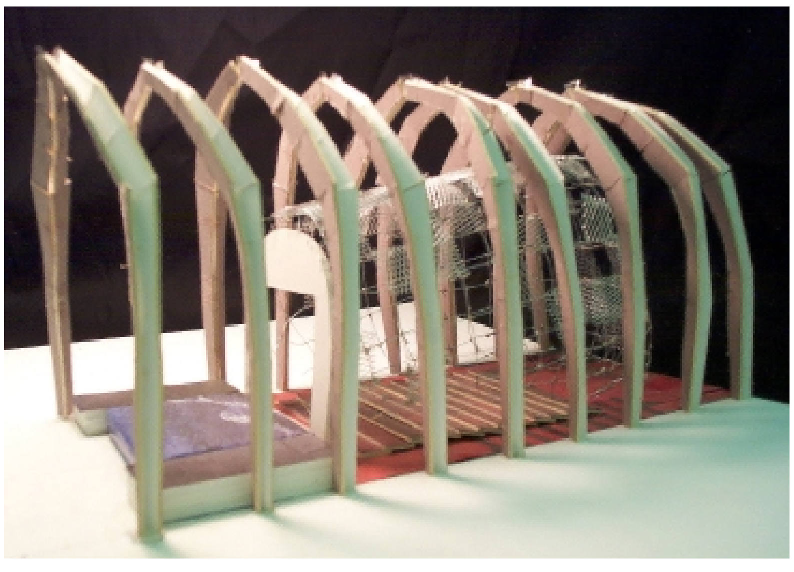
All of these sculptural pieces must be joined to form a whole. Study models explore a hierarchy of structural elements similar to the formal hierarchy within the concert hall complex. The joint between the structural members differentiates the loads carried by these members. The structure is a tripartite scheme. A steel member that transfers the loads to the main concrete structural layer carries the roof. Cables from the concrete structural layer suspend the concert hall shell.

Front view of concert hall study model

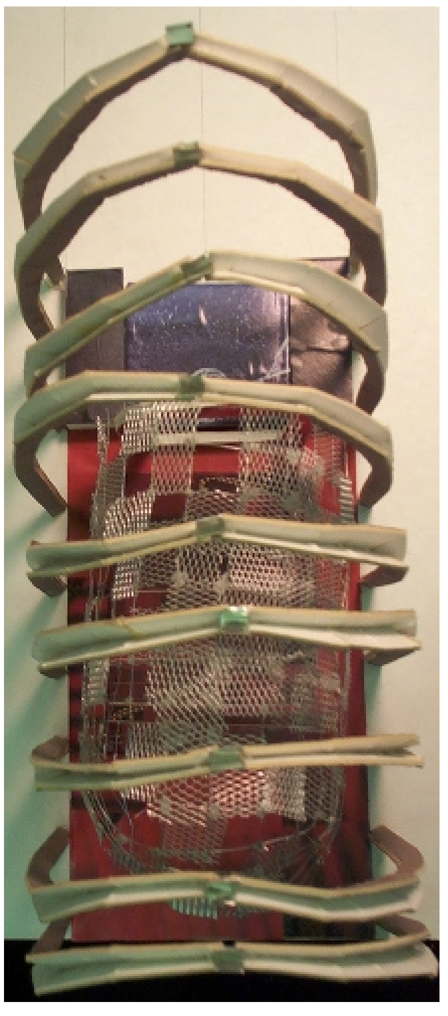
The form of the structure, the arch expresses the concert hall auditorium shape. The same form is then utilized throughout the entire complex. It became apparent through building study models that although the arch was a rational choice for the concert hall; it was not appropriate for all the pieces of the complex. It lost its structural purpose.

To make progress beyond a conceptual stage, it was essential to make a decision as to what role the structure would play. Two options were emerging in the study models. The structure could be individual, highly sculpted pieces; or, one structural element could be developed and then used in repetition.

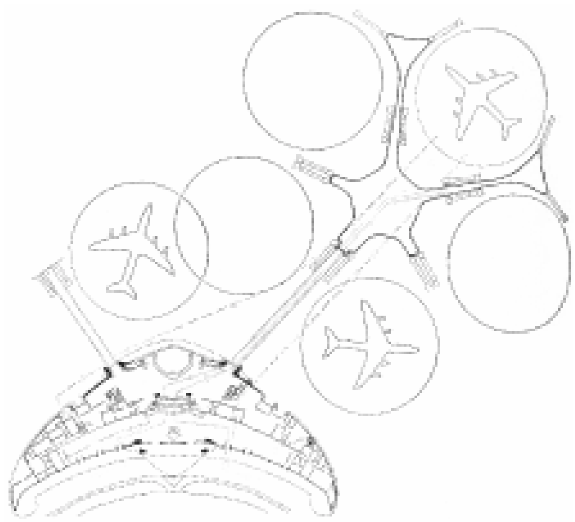
Three buildings are applicable as precedent – The TWA Terminal at John F. Kennedy Airport, the Dulles Airport Terminal, and the Stadelhofen Railroad Station. Although utilized in different manners, the structure is a dominant feature in all three buildings.



Side view of concert hall study model



Ariel view of study model



TWA Terminal Site Plan

Precedent Study

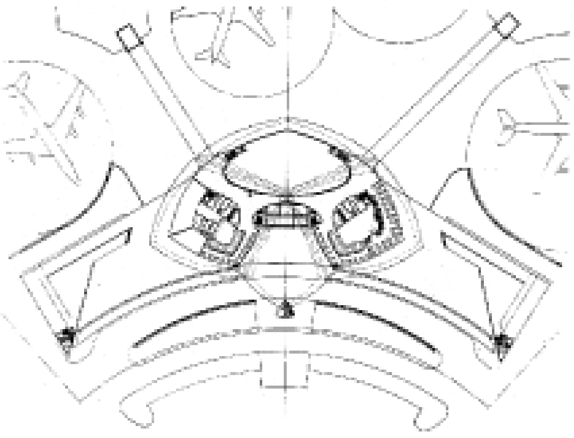
Trans World Airlines terminal building
John F. Kennedy Airport, New York, New York
Eero Saarinen

The TWA terminal building is an example of sculpted modern space. In 1956, Eero Saarinen was commissioned to design a terminal for Trans World Airline at the existing Idlewild Airport. The lack of an architectural masterplan allowed Saarinen to explore the possibility of a nonstatic building. The TWA terminal was intended to express the drama of air travel, through a form constantly in motion.

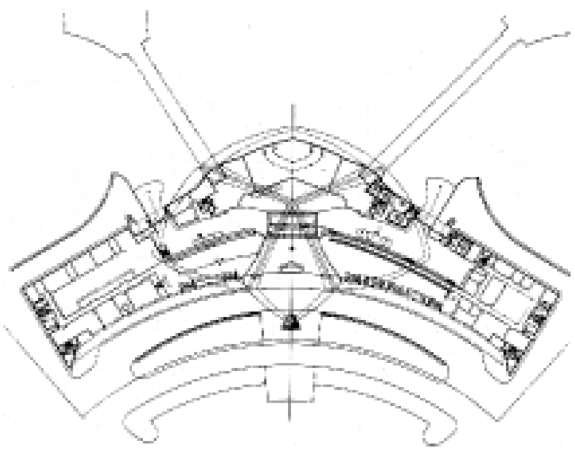
Although mistaken by some as a Mendelsohnian representation of a bird, it was an abstraction of spatial freedom. There is continuous movement beneath a soaring roof. Such sculptural structures cannot be designed in two dimensions. The space was modeled with cardboard, wire, and other materials before translated into plan and section.

The structure consists of four Y shaped columns that support four interconnecting barrel vaults. The different shaped vaults form a vast concrete shell that is 50 feet high and 315 feet long. The terminal is a fluid form, curving and circling within itself.

The flowing space is hierarchically more important than the structural expression in the TWA terminal. Concrete is utilized because of its plasticity. The act of pouring concrete emphasizes the nonstatic nature of the space.

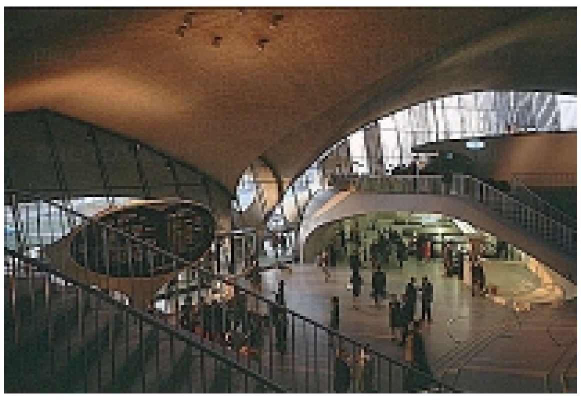


Upper Level Plan



Lower Level Plan

Front Elevation



Interior view of main level of terminal

Precedent Study

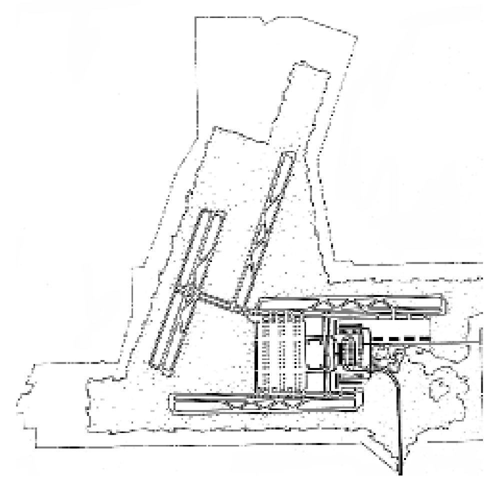
Dulles International Airport
Chantilly, Virginia
Eero Saarinen

Dulles Airport is designed from the point of view of jet aircraft operation. In 1962, the prototype of an airport was a fingertip plan. Long corridors lined with airline gates radiated from a central entry check-in and baggage claim area. As air travel became more popular and economical, the scale of the airport had increased. The prototype was being stretched beyond is limits, exemplified in Chicago's O'Hare Airport where airline passengers might have to walk as far as a mile to gates. Like most people who habitually travel by air, the interminable corridors irritated Saarinen. His schematic plan for Dulles was a centralized terminal with mobile lounges that transported passengers to the jets parked at strategic places in the airfield.

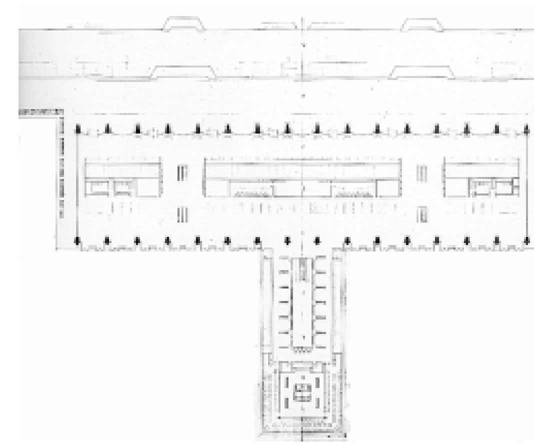
Saarinen envisioned a linear terminal that could expand in either direction without altering the form. With a suspended *parti*, he designed a cross-section and then repeated the section, delineating the 600-foot façade into bays. The entire structure acts with rhytmic consistency. People are welcomed, and elevated rather than crushed by it force. Every carefully controlled detail is scaled for humans similar to the scale of a Gothic cathedral. The impression of size is constantly reinforced by the comparison of details like doors, canopies, and balustrades with the grand composition of enormous pylons and soaring roof.

Saarinen was not deterred in his vision of a linear composition that rests between earth and sky by the engineering truth that a suspended roof is best suited to a circular building, maximizing the structural efficiency. The necessity of large pylons became an opportunity, not a limitation. Saarinen made the pylons even heavier than structurally necessary. The contrast between the weight of the pylons and the seeming weightlessness of the roof enhances the nonstatic quality of the terminal.

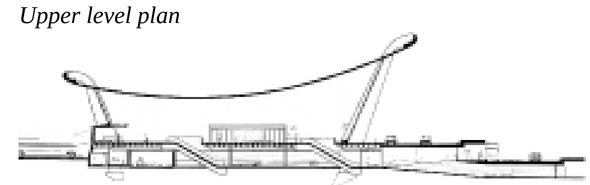
The structural cross-section creates a large room. It is the quality of the space moving uninterrupted through the room that makes the building an exceptional airport.



Dulles Airport site plan

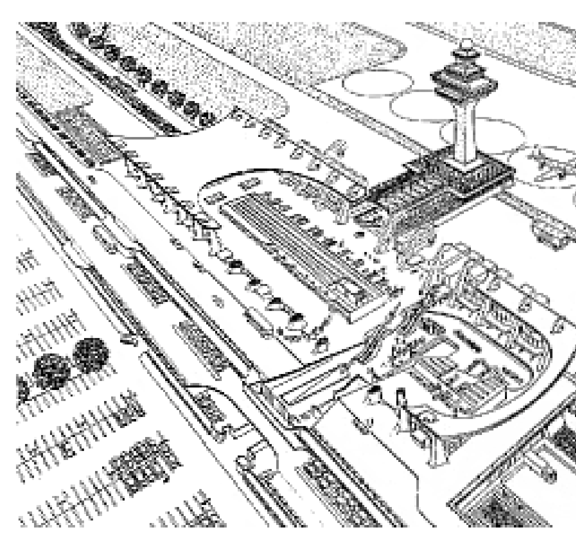


Upper level plan

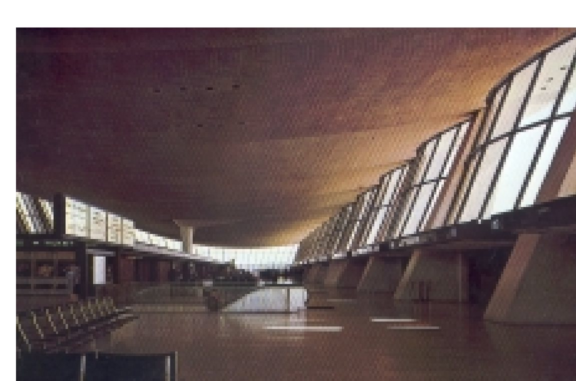


Section through terminal

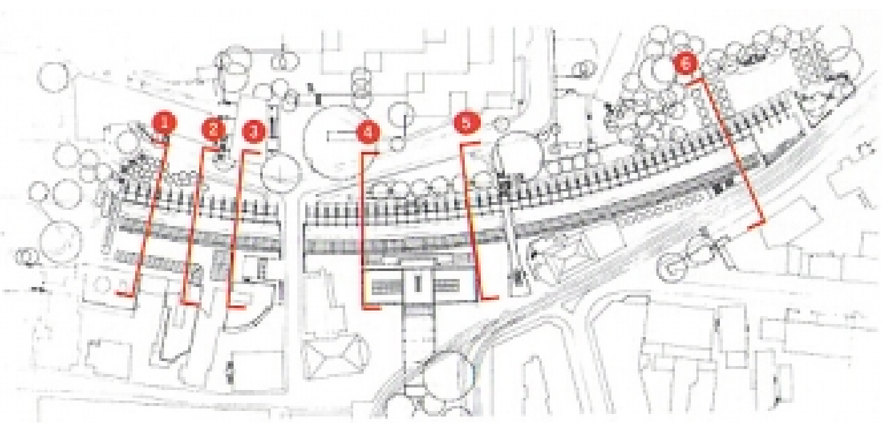
Main terminal under construction in 1962



Axonometric Cutaway of main terminal and control tower



Interior of main terminal



Plan of Stadelhofen Railroad Station

Precedent Study

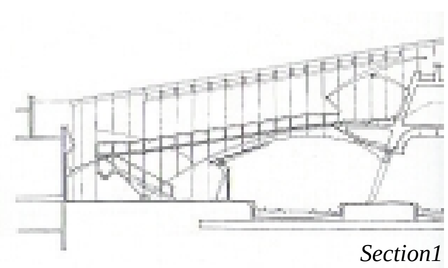
Stadelhofen Railroad Station
Zurich, Switzerland
Santiago Calatrava

The Stadelhofen Railroad Station is an example of the return of civil engineering integrated with architecture. In 1982, the city of Zurich held a competition to enlarge the existing railroad station to meet growing traffic requirements. The setting across from the Opera plaza, in an area where construction normally consists of gutting and refitting the existing structures, demanded sensitive treatment.

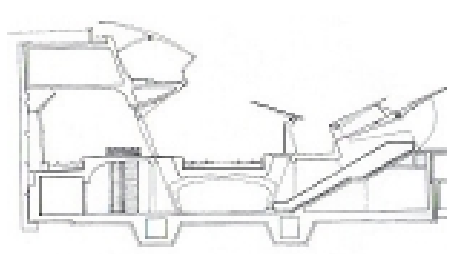
The amount of vegetation found in Zurich impressed Calatrava. In the urban environment a tension exists between the manmade and natural. Calatrava utilized this tension in his competition entry. The station is a strongly horizontal tripatite scheme consisting of two systems, the system of buttresses and shelters and the system of bridges. There is an underground shopping area underpass which links the station to the Opera plaza. The intermediate track, half veiled with a glass canopy, is at street level. The inner platform with a pergola promenda links the upper street.

Calatrava restricted his material palette to steel, glass, and site cast concrete. The structural cross section of each level responds to the traffic levels. Material is only provided where it is needed, allowing the structural members to be amorphous and highly sculptural. Yet, the force flow is easily traced in the section. The detail of connections are critical to the project; here the structure is revealed.

The cross section is almost identical throughout the entire 270m. area. The force flow is resolved in section and used in repetition to create architectural space.



Section1



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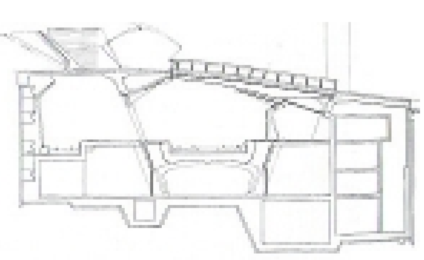

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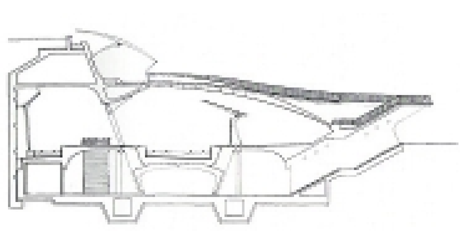

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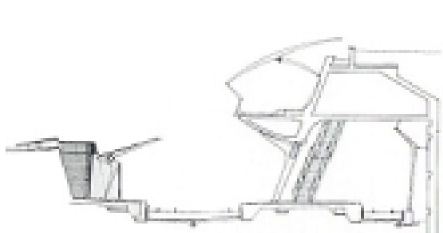
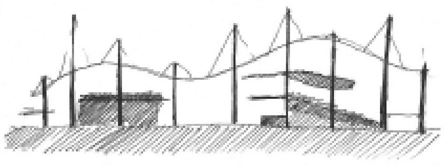


Section 5

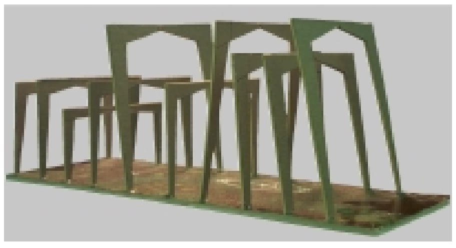
View of pedestrian passageway

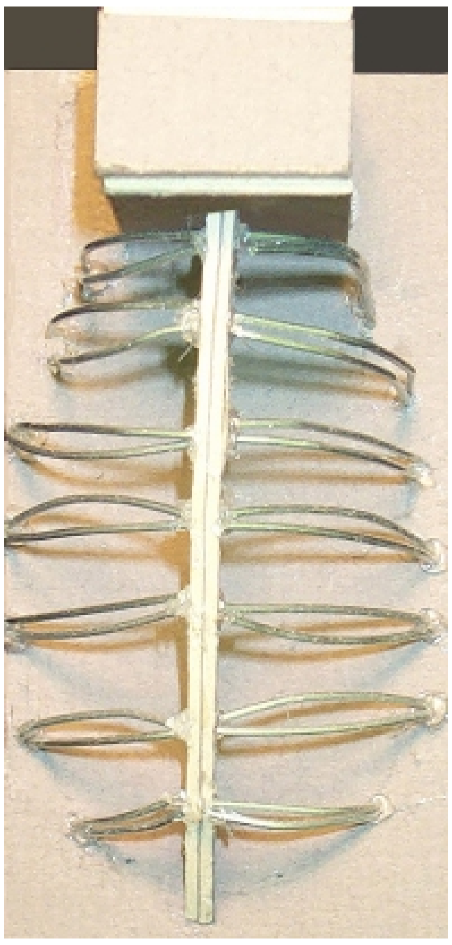
The precedent studies help answer the question of order. A question of economy also arises. The TWA terminal for John F. Kennedy Airport in New York City explores the sculptural qualities of poured in place concrete. Each element is unique. In contrast, Dulles Airport and the Stadelhofen Railroad Station utilize a structural bay in repetition. The possibilities for the concert hall are examined through study models.



Study Model 1

Investigation of varying frame heights in accordance with object/element placement.



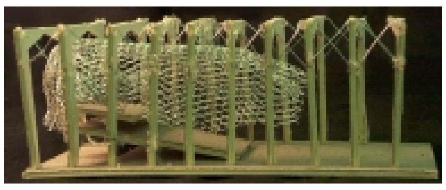


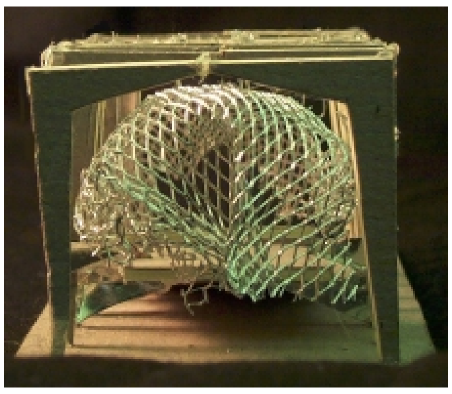
Study Model 2

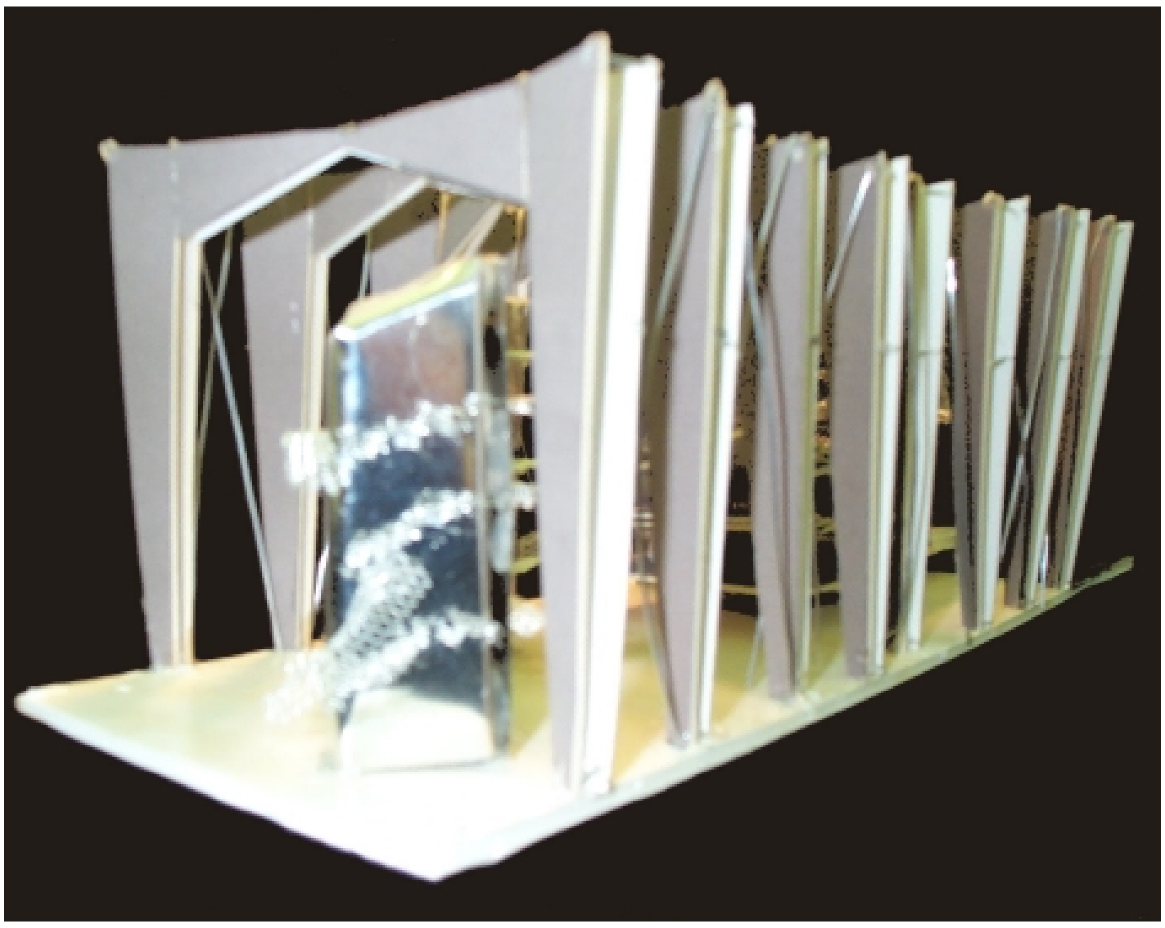
Organic concert hall structure set into a regular/ orthogonal complex.

Study Model 3

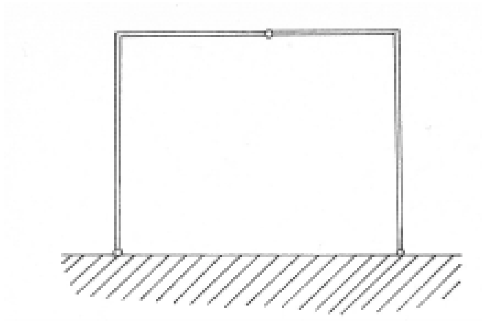
Identical structural members provide an order against which the object/element can vary.






Conceptual three hinge frame

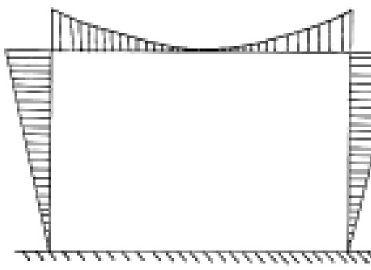
Repetition of an element has potential both as an ordering device and an economy of means. One element can be highly developed, and then used repeatedly. To develop a multitude of pieces to the same level of detail becomes extremely expensive. The repetition of elements also establishes a uniformity against which other elements can deviate.



Structural diagram

When a structural bay has architectural importance, the path of force flow must be legible. The superstructure of the concert hall is a system of three hinge frames that sit upon a sandstone clad concrete base. Structurally, the three hinge frames have pin connections at the bottom where it meets the base and in the center.

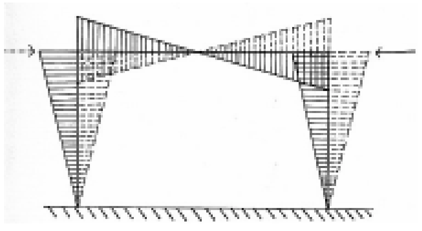
The material distribution of the frame superstructure alters in accordance with the moment diagram; more material is needed at the corners where maximum moment occurs, and less material is required at the pin connections. Triangulation within the frame provides the required stiffness and minimizes the dead load of the superstructure.



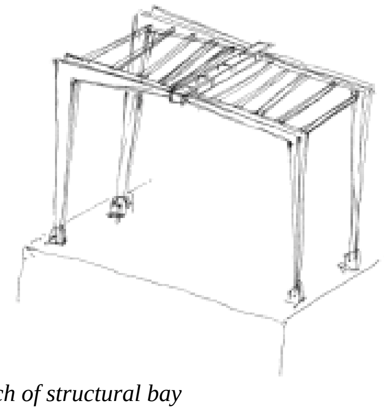
Uniform Load Moment Diagram

Articulation of the connections reveals the structural character of the three-hinged frame. A sliver of sky separates the massive steel frame, emphasizing the hinge point of the frame. The nature of the structure cannot be mistaken for a trabeated construction technique. Where the frame meets the base, a cast steel foot mediates between the two realms of earth and sky.

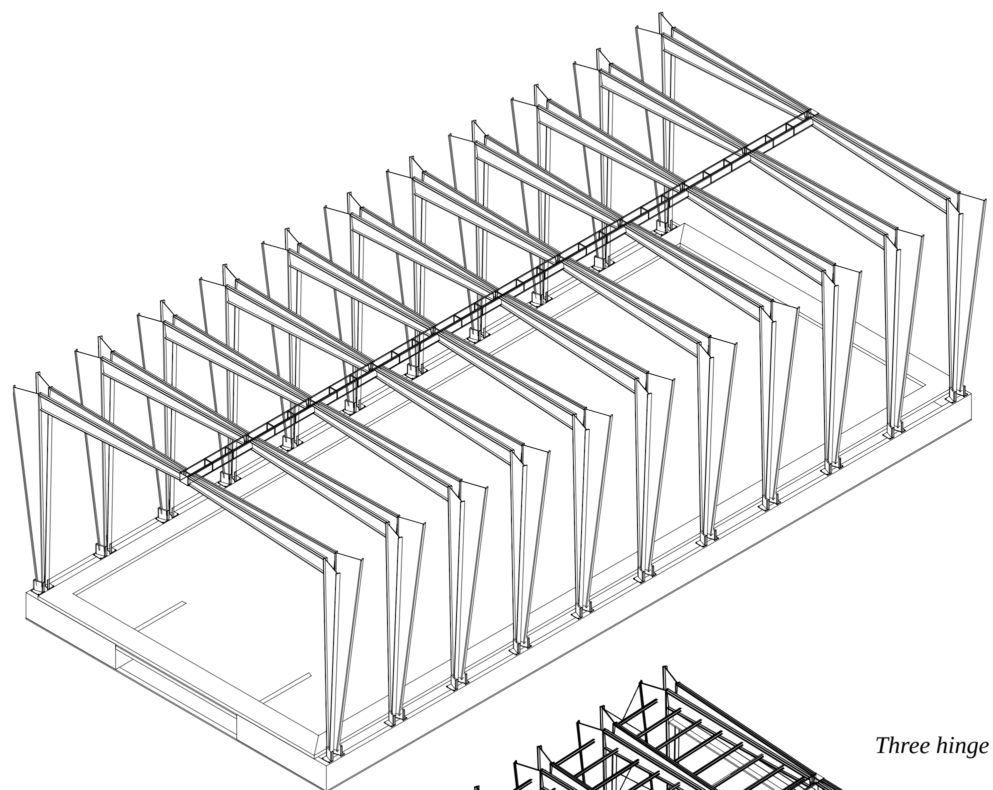
Secondary members transfer the loads that occur within the span of a by to the frames. The profile of the outermost secondary member adjusts to serve as a compression strut to prevent wracking due to lateral loads.



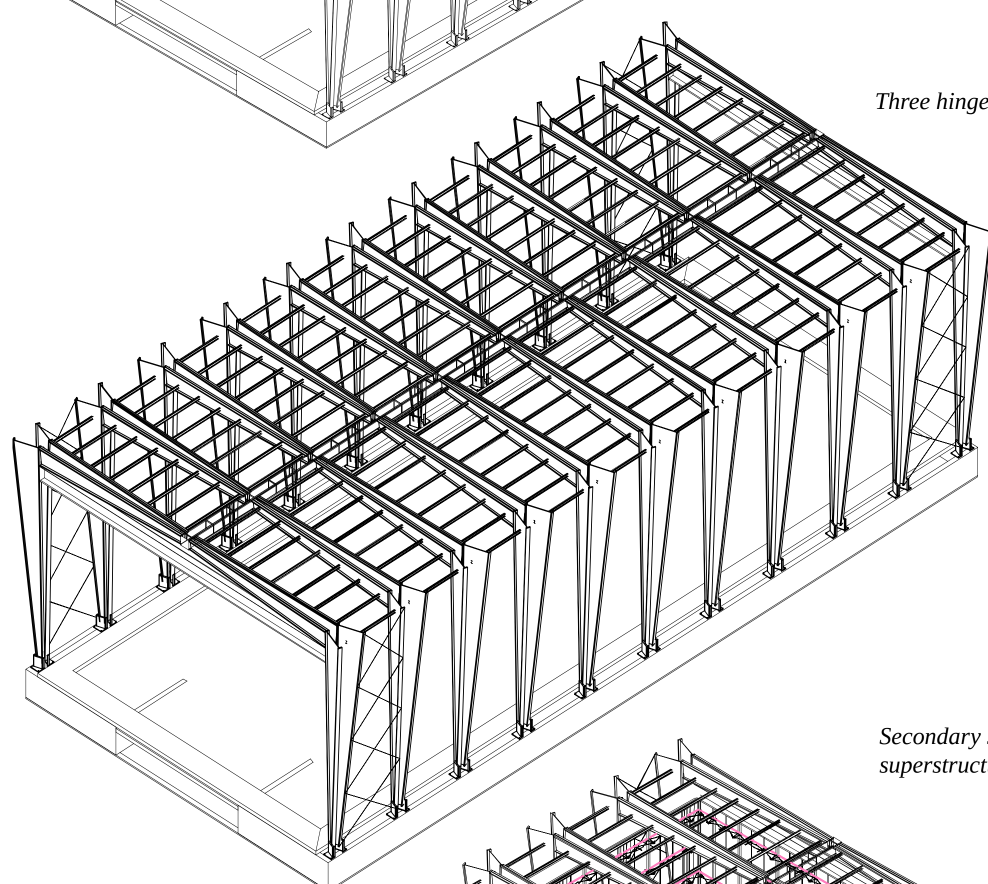
Lateral Load Moment Diagram



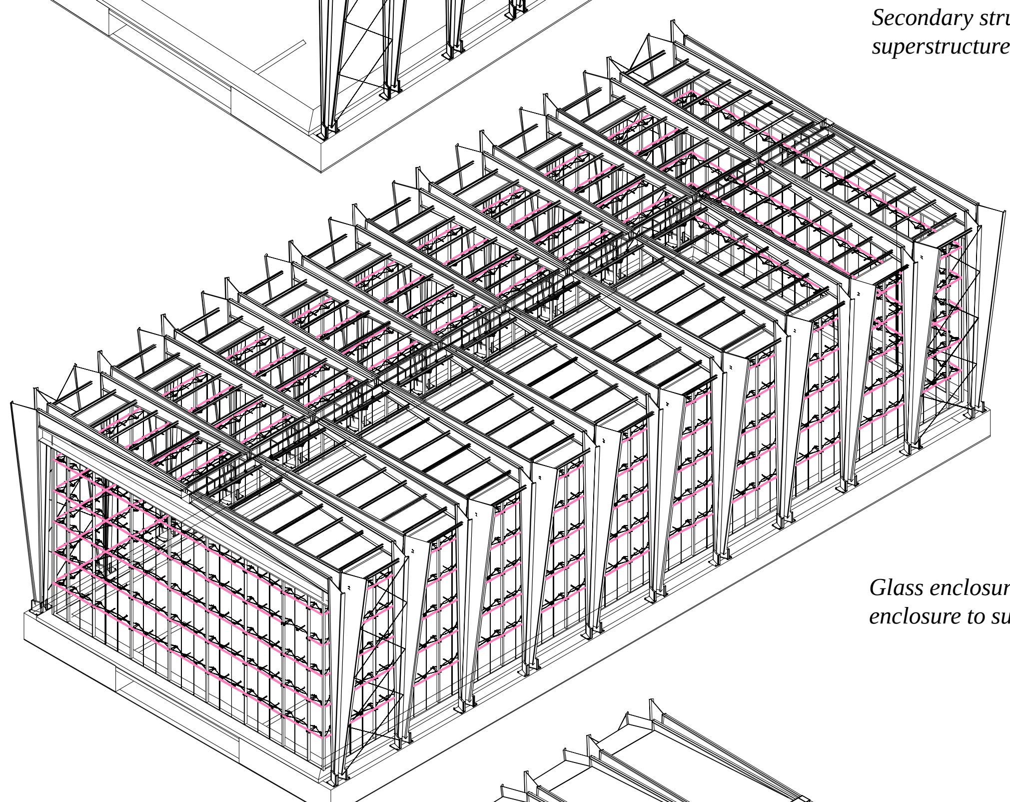
Sketch of structural bay



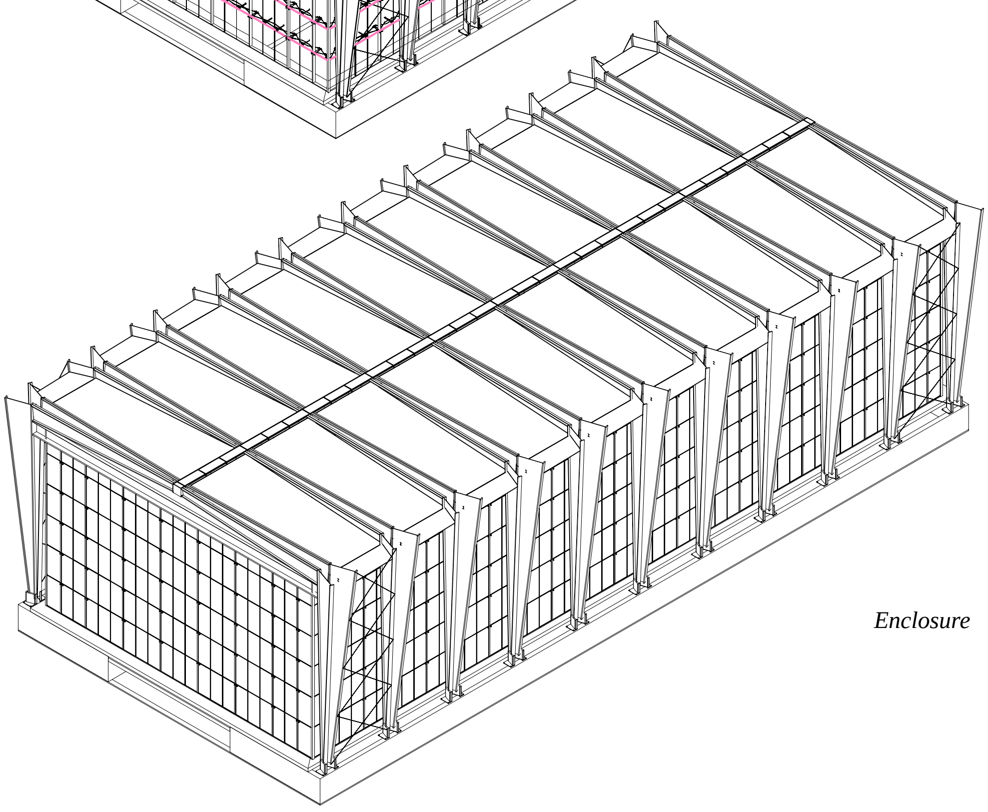
Three hinge frame superstructure on base



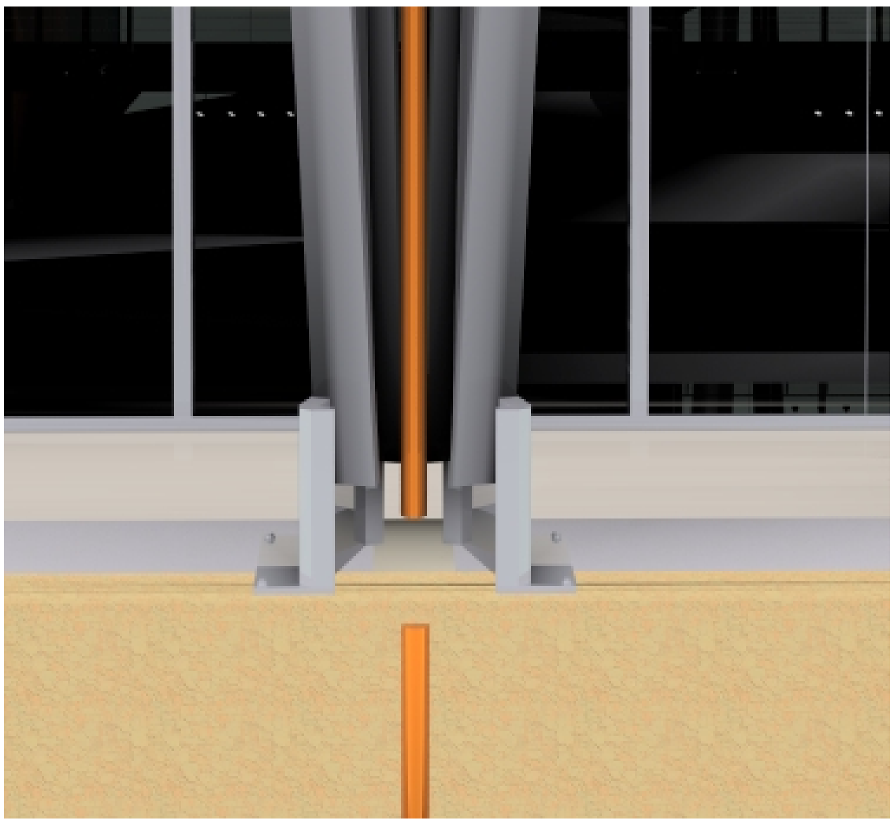
Secondary structure to transfer loads to superstructure



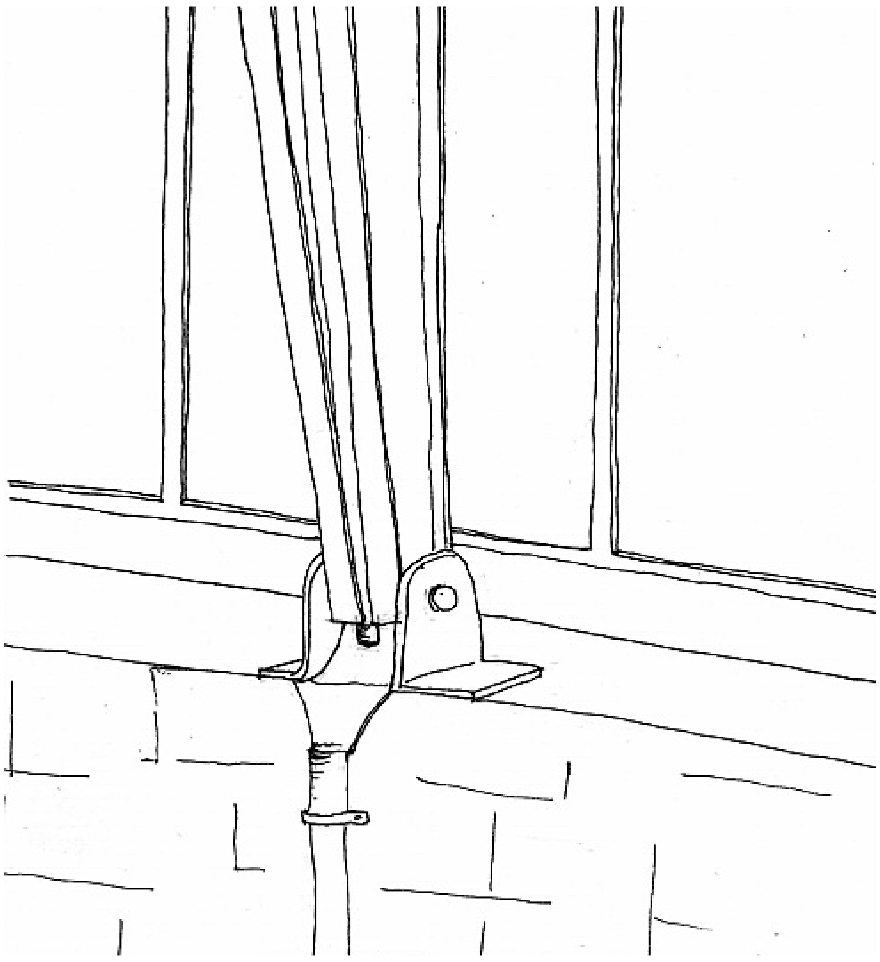
Glass enclosure support system connecting enclosure to superstructure



Enclosure



Superstructure pin connection



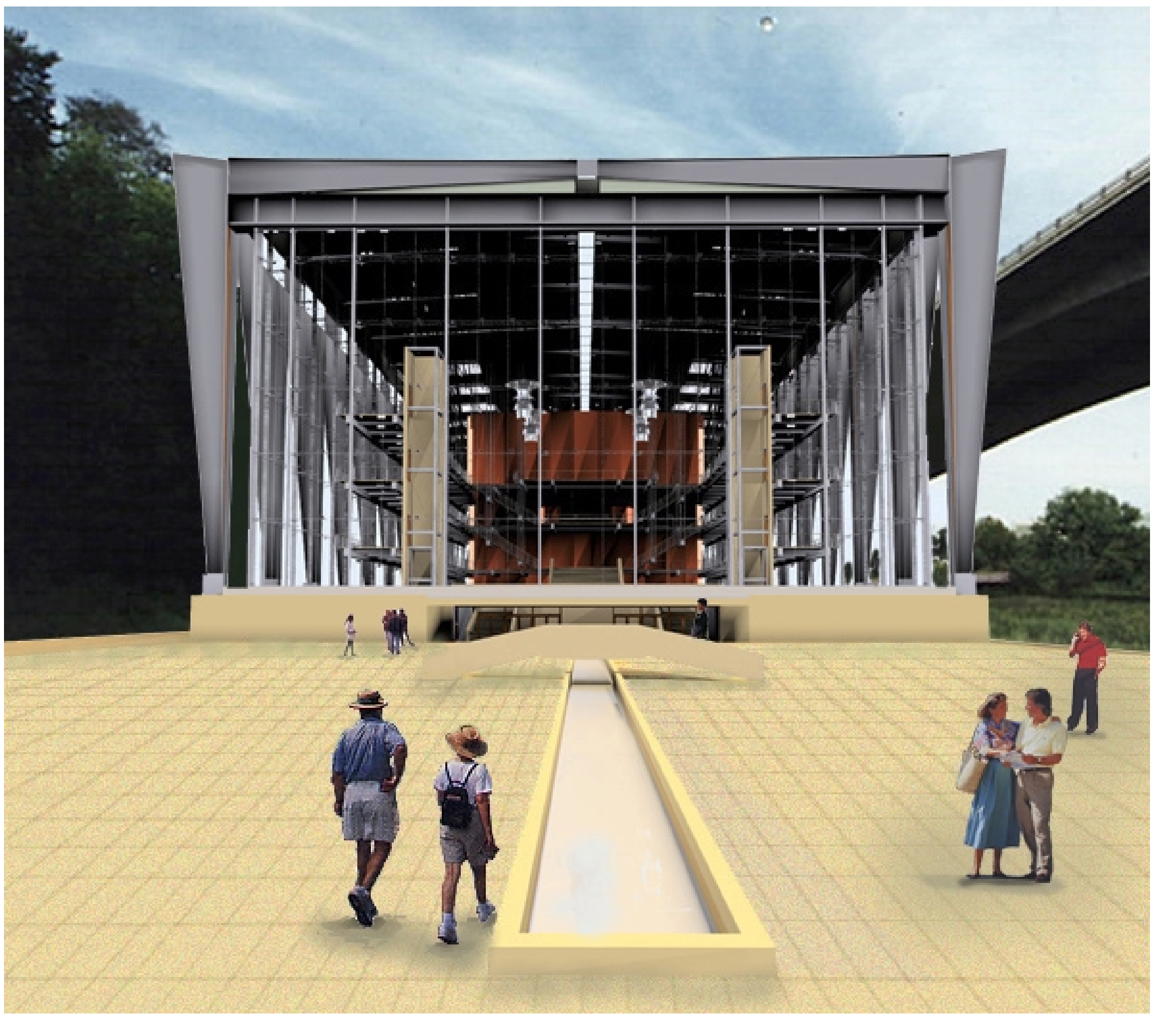
The introduction of a repeating bay determines the scale of the building. The structural bay affects more than the span between the main structural members. The bay provides an order against which other elements can vary. The bay imparts a rigor to the elevation. The structural mullions, lateral bracing, and even the individual panes of glass fit into the rhythm of the bay. This rhythm of pieces and their subsequent need for support aid the development of subsidiary structural systems. A layering of structural systems and enclosure occurs. Due to the relationship of individual elements to each other, the size of the building can only change in set increments.

The site bears the imprint of the iron and steel industries in Richmond. It seems logical to carry on the tradition in the choice of materials for the concert hall. The superstructure is made of enormous, hot rolled steel sections. Protected from fire and weather by spray-on fireproofing and fiberglass casing, the steel has a smooth, highly refined surface in contrast to the rough steel structural skeleton that remains of the Tredegar Iron Works warehouse. The similarities remain to establish a contextual relationship between the concert hall and the site. The three-hinge frame is the dominant element structurally and visually in the concert hall.

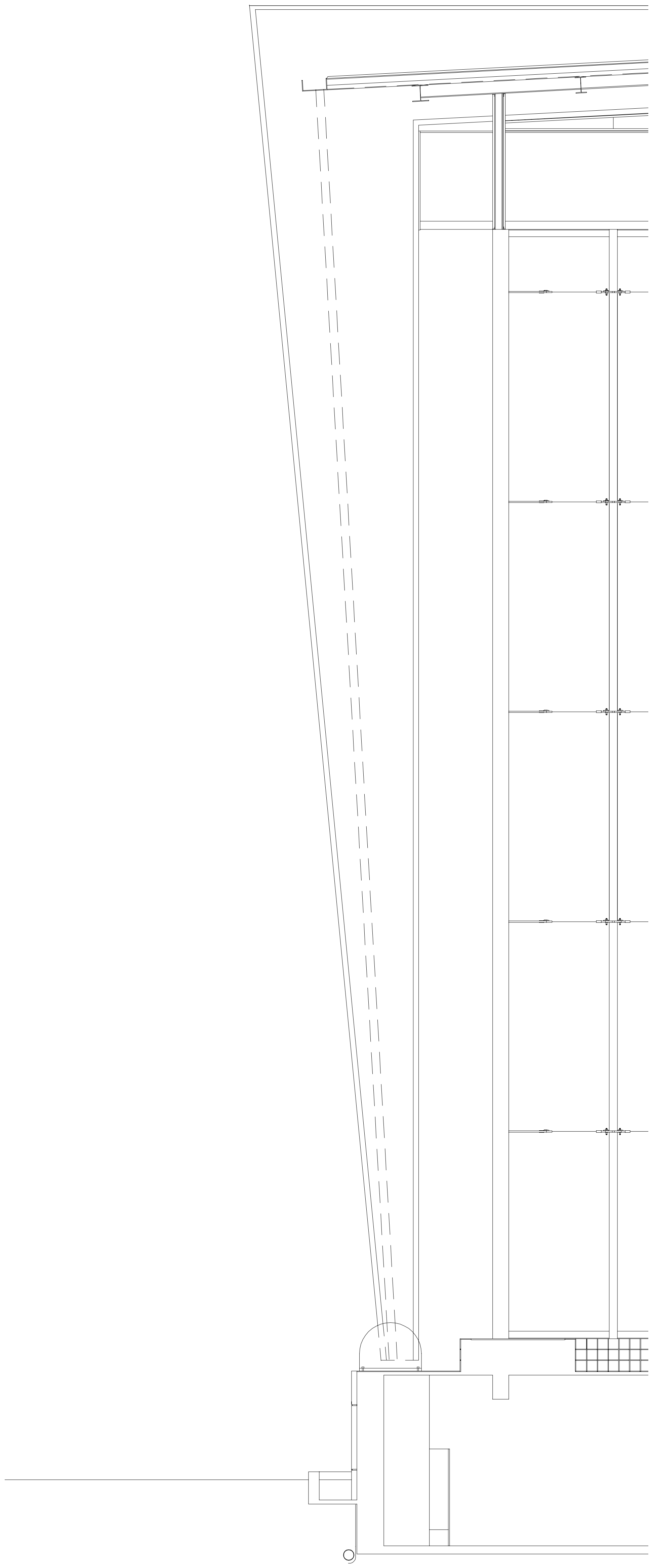
As a result of the conceptual thought that the concert hall is a pavilion, there is a desire for an autonomous enclosure. The enclosure presents the entire 360-degree panorama with equal importance, not filtering out the less desirable views. Certain views attract people to different areas of the atrium. Plotting the gathering points aided in developing the architectural elements and processional paths throughout the space.

Using study models, three ways of handling the weather enclosure were explored. The glass could be attached to the outside of the structural frame. The glass could be attached to the inner flange of the structural frame. Or, a separate structural system could be introduced. The nature of the three-hinge frame offers challenges in resolving the question of enclosure. On the east and west elevations, there is support every thirty feet. The end walls, because of the large span, require a structural system to support the enclosure. If the sidewalls depend upon the structural frame, there is a critical detail at the corner. How does one change from one structural system to another structural systems when the desired result is uniformity? Although all four walls are glass, they are not equal. The diagram is not a glass box within a superstructure.

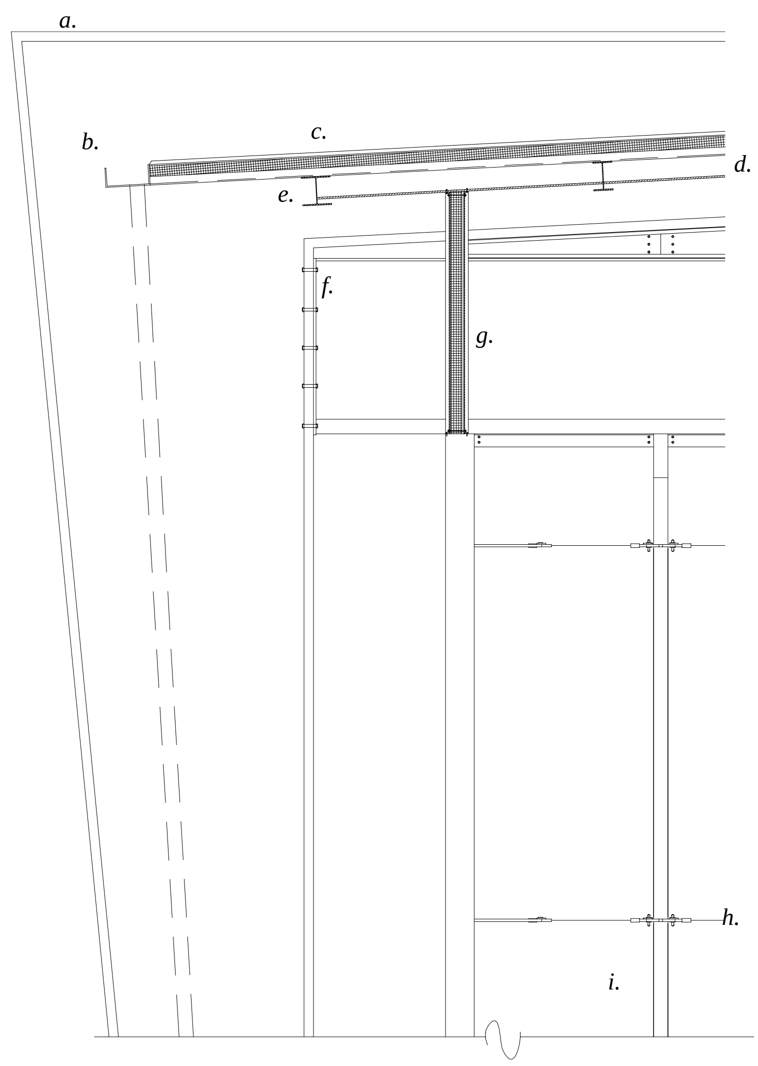
In order to maintain the diagrammatic separation of structure and enclosure, the enclosure is pulled away from the superstructure. A tiercerary system of structural mullions and tensile bow trusses support the glass wall. The layering of systems provides clarity as to what is structure and what is enclosure. The enclosure is not completely independent from the superstructure. The height of the enclosure necessitates additional support. This connection to the superstructure determines the placement of the enclosure within the frame.

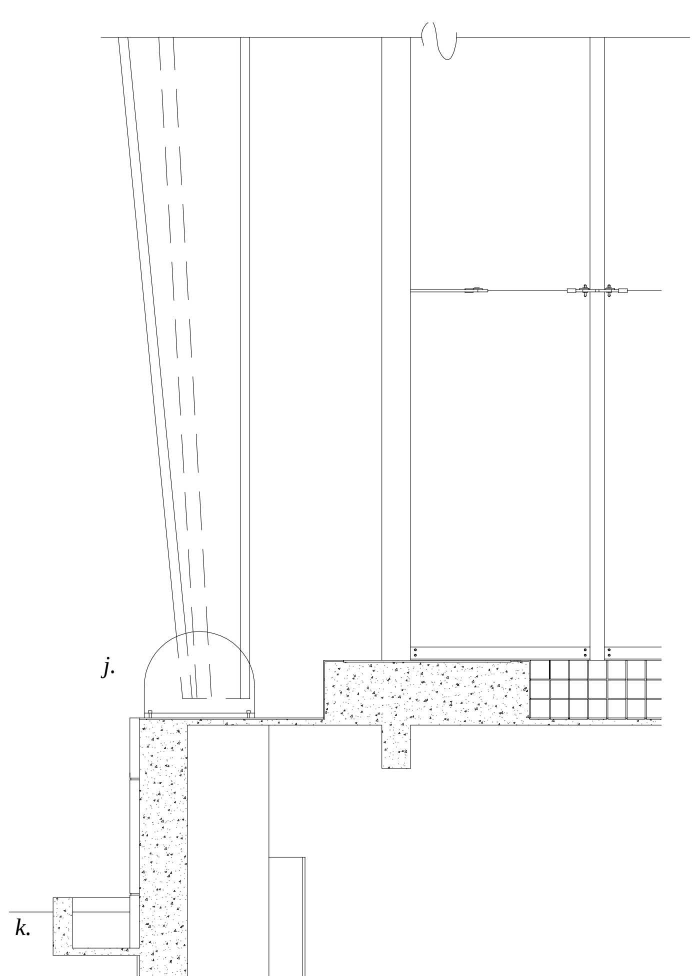


Front Elevation seen from Plaza

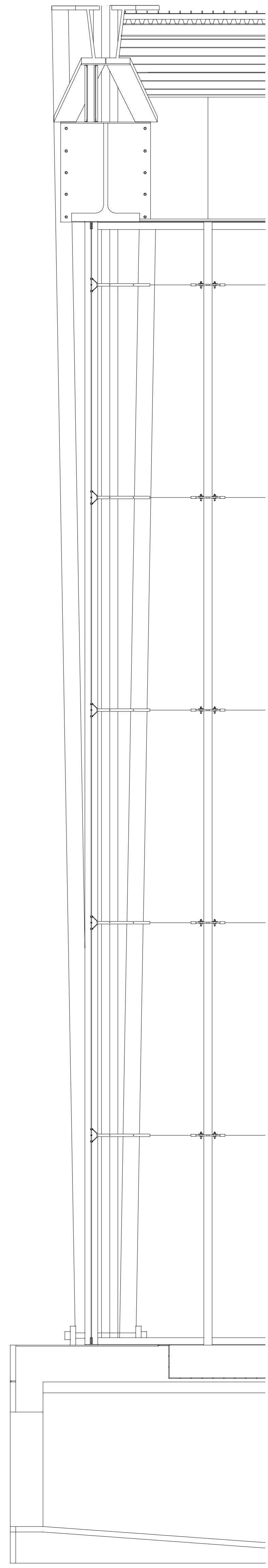


Wall section through side facade

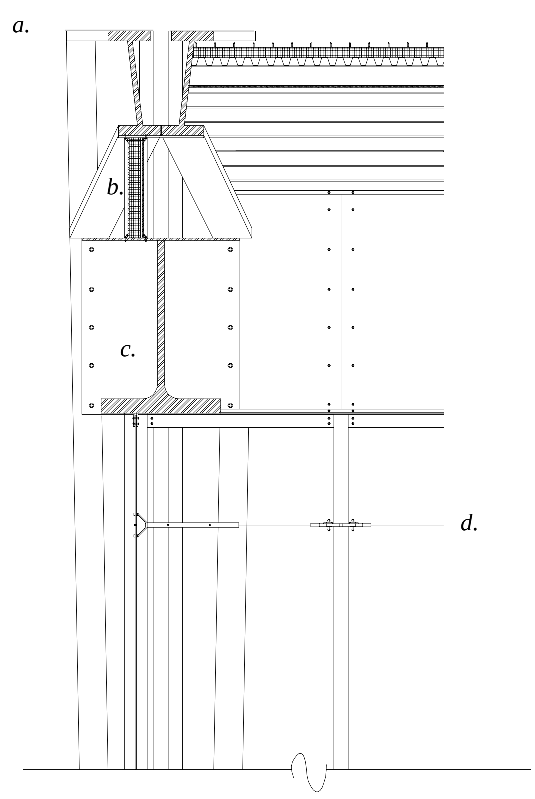


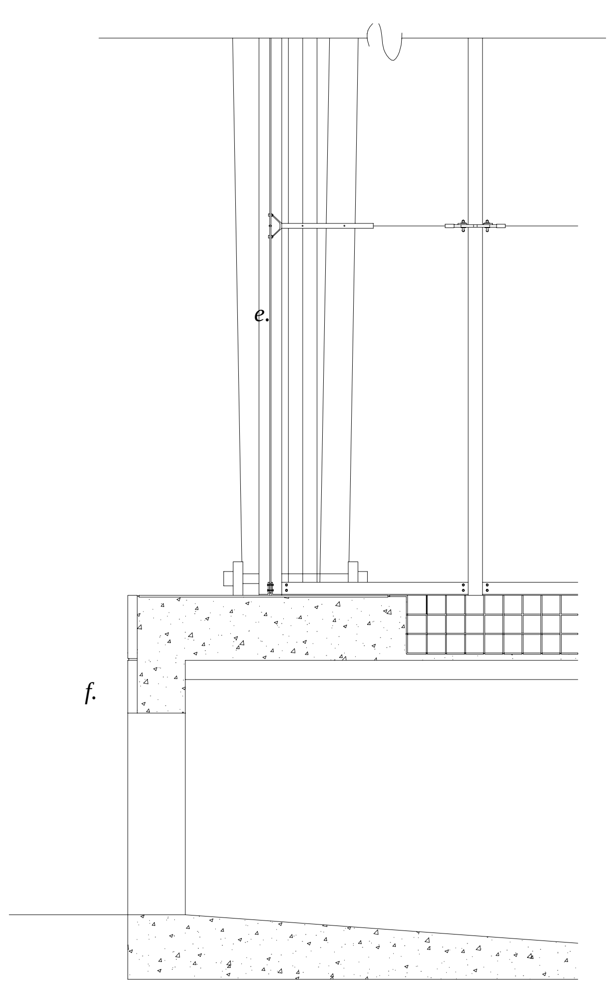


a. Three hinge frame superstructure
b. Roof drainage housed in frame
triangulation
c. Standing seam metal roofing
d. Secondary structural members
e. Secondary structural member that acts
as a compression strut
f. T-beam
g. Metal panel connection of glass enclosure
and supserstructure
h. Cable truss supports for glass enclosure
i. Structural mullion
j. Cast steel pin connection for hinge frame
k. Water drainage collection
l. Concrete base clad in sandstone veneer

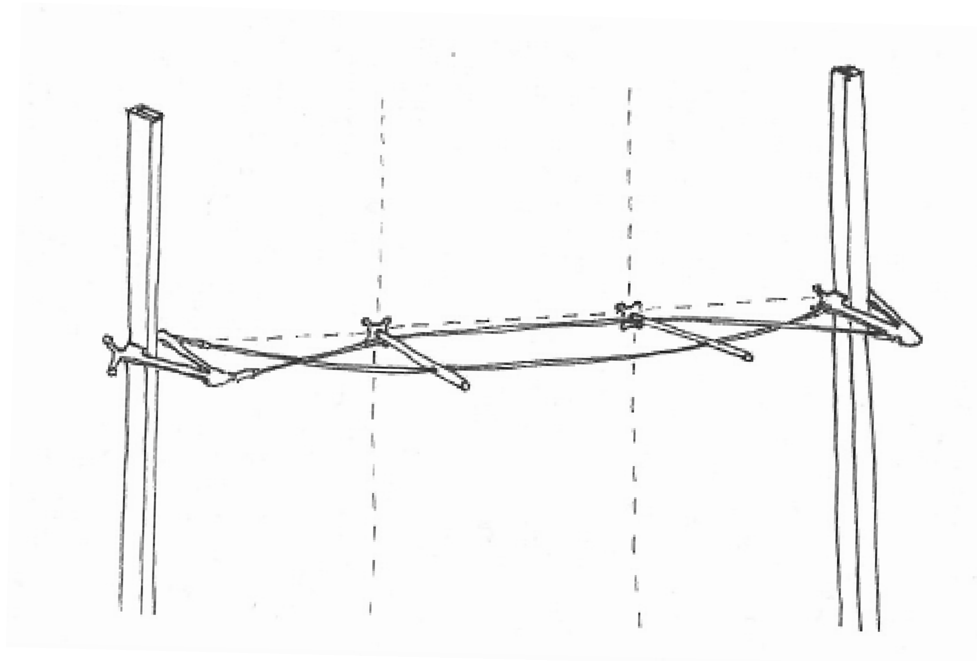


Wall section through front facade





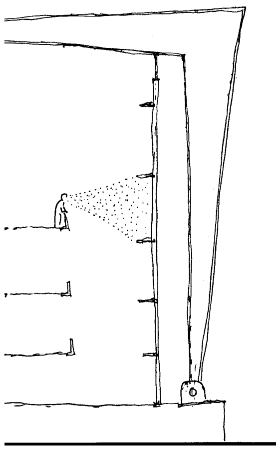
a. Three hinge frame superstructure
b. Metal panel infill between beam and superstructure
c. T-beam to prevent wracking from lateral loads
d. Cable truss supporting glass enclosure
e. 13'x 6' glass panel enclosure
f. Concrete beam supporting entry span



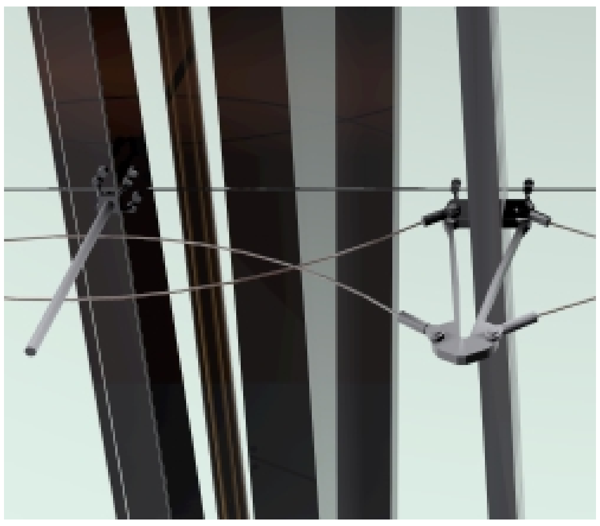
Sketch of glass enclosure support system

Cable truss supporting glass enclosure

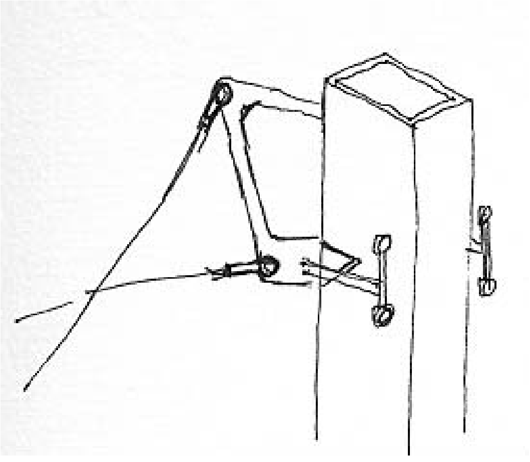
The modular quality of the repeating bay develops a kit of parts. Although a public building like a concert hall generally has a more forgiving budget than strictly commercial spaces, there is a limit to the monetary resources. The modular construction offers the opportunity to design critical pieces such as the cable truss attachments and the handrail supports.



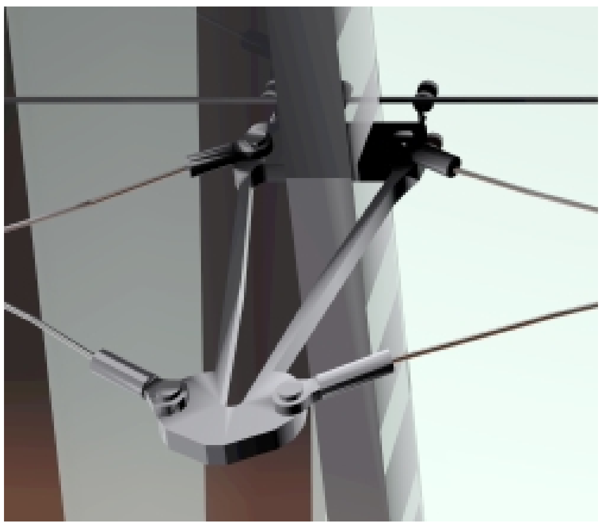
Perspective location



Detail of cable truss connection



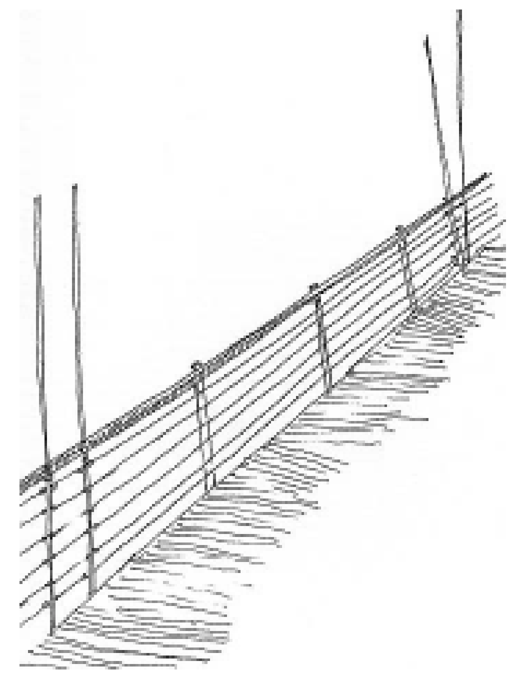
Sketch of cable truss connection to structural mullion



Detail of cable truss connection to structural mullion

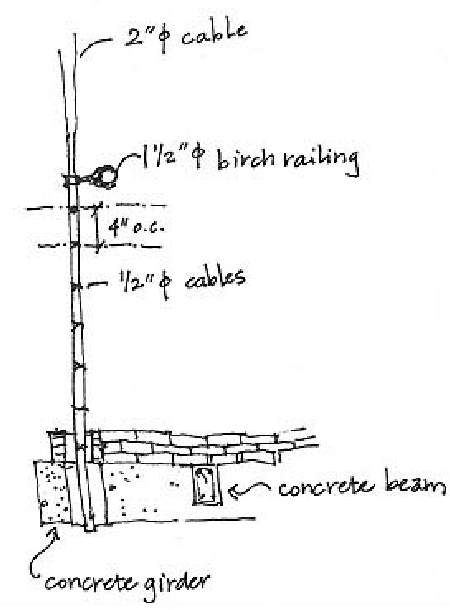
Atrium observation area

One of the benefits of the superstructure is the opportunity for large interior spans. Not restricted by structural requirements, the atrium concentrates on spatial qualities. The glass enclosure visually connects the inside of the atrium to the site. The view across the river towards downtown is hierarchically the most important view. The main lobbies and their stairways orient the visitor in this direction. Balconies permit people to get close to the superstructure and tensile system supporting the glass enclosure. Defining the edges of the atrium, the balconies allow interaction between all levels of the concert hall and the atrium. Views up and down the river are only significant during the day. In the evening, the audience arriving for a concert directs the focus internally. Because the procession is of such importance to the type *theater*, it must be addressed not only in the arrival to the concert hall, but also within the space. The balconies provide areas to interact with the flow of people.

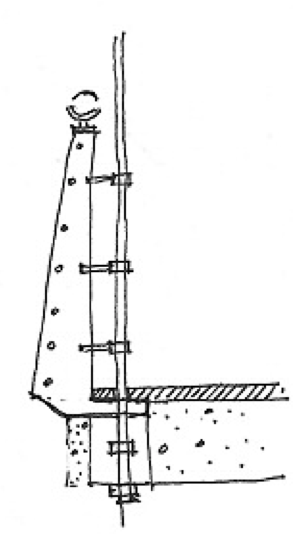


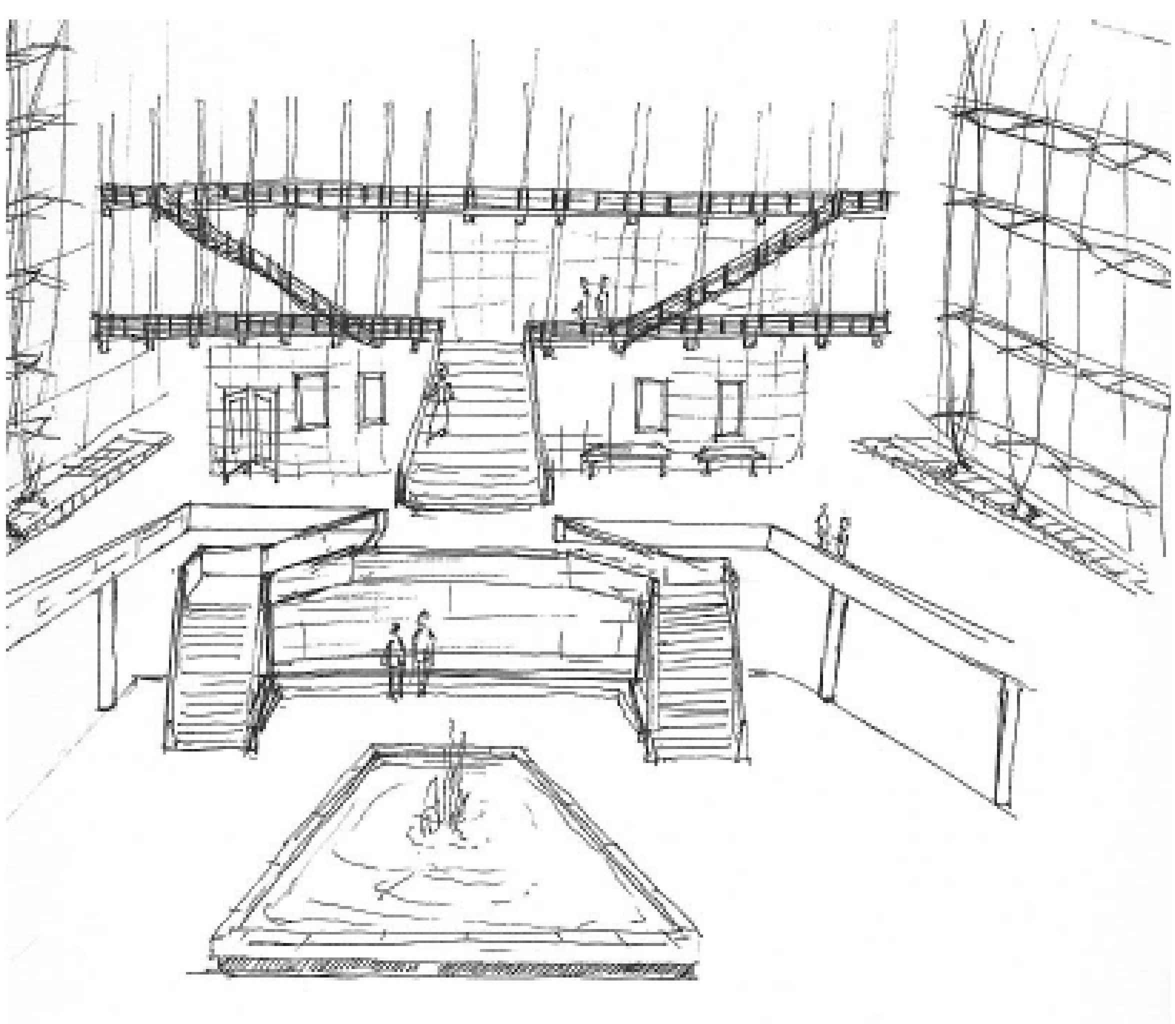
There is an ascending movement from a heavy, earth-bound base to a skeletal steel frame structure. The balconies and stairs are constructed to emphasize the perception of floating in the air. The balcony construction layering of beam, surface, and suspension cables recalls the suspended footbridge used to access Belle Isle.

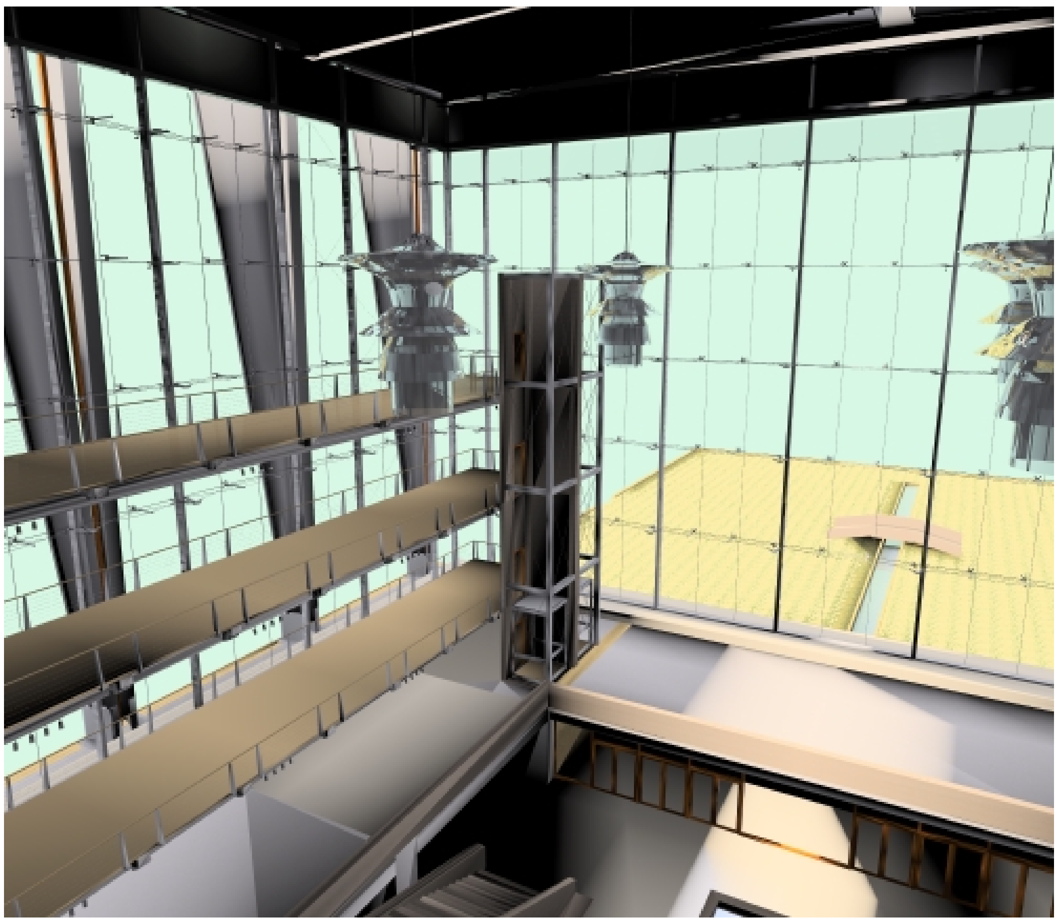
The railings are critical elements in the design of the balconies. Juxtaposed are the needs for lightness and restraint. The railings must relate to the language of the suspended balconies. Ornament is derived from articulating the construction. The layering of railing elements is generous enough to create a place for the suspension system. Steel cables form a delicate net anchored by stainless steel posts. In contrast to the icy precision of the steel, where the hand rests is smooth birch railing.



The application of cladding within the building is carefully considered. Where cladding is applied, the joints are constructed to reveal the structure behind the veneer. The use of marble in the base is in keeping with the perceived grandeur necessary for a concert hall. Yet, the marble is limited to the processional sequence, where the hand most often rests. Everywhere else, polished concrete denotes the construction of the base. The most drastic use of cladding is the copper paneling on the concert hall. For acoustic reasons, the concert hall is structurally independent from the frame and base. Massive walls of poured-in-place concrete isolate the auditorium from noise coming out of the atrium lobby. The object quality of the concert hall requires more refined qualities than could be achieved in concrete. Copper has an inherent ability to reveal the human interaction with the material. As people touch the panels, the oils from their hands tarnish the paneling. The patina varies on the concert all in relation to the places for human contact.

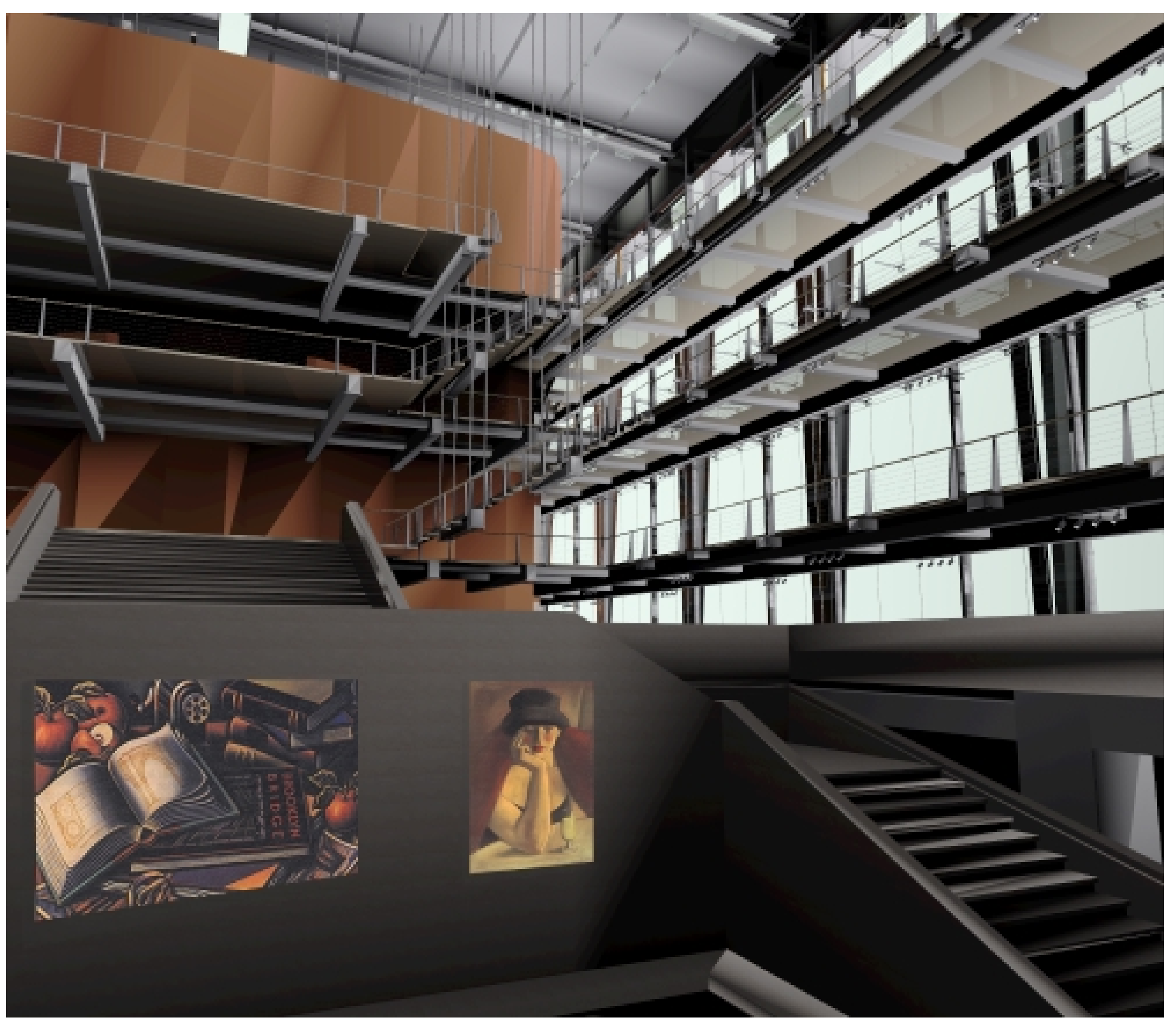




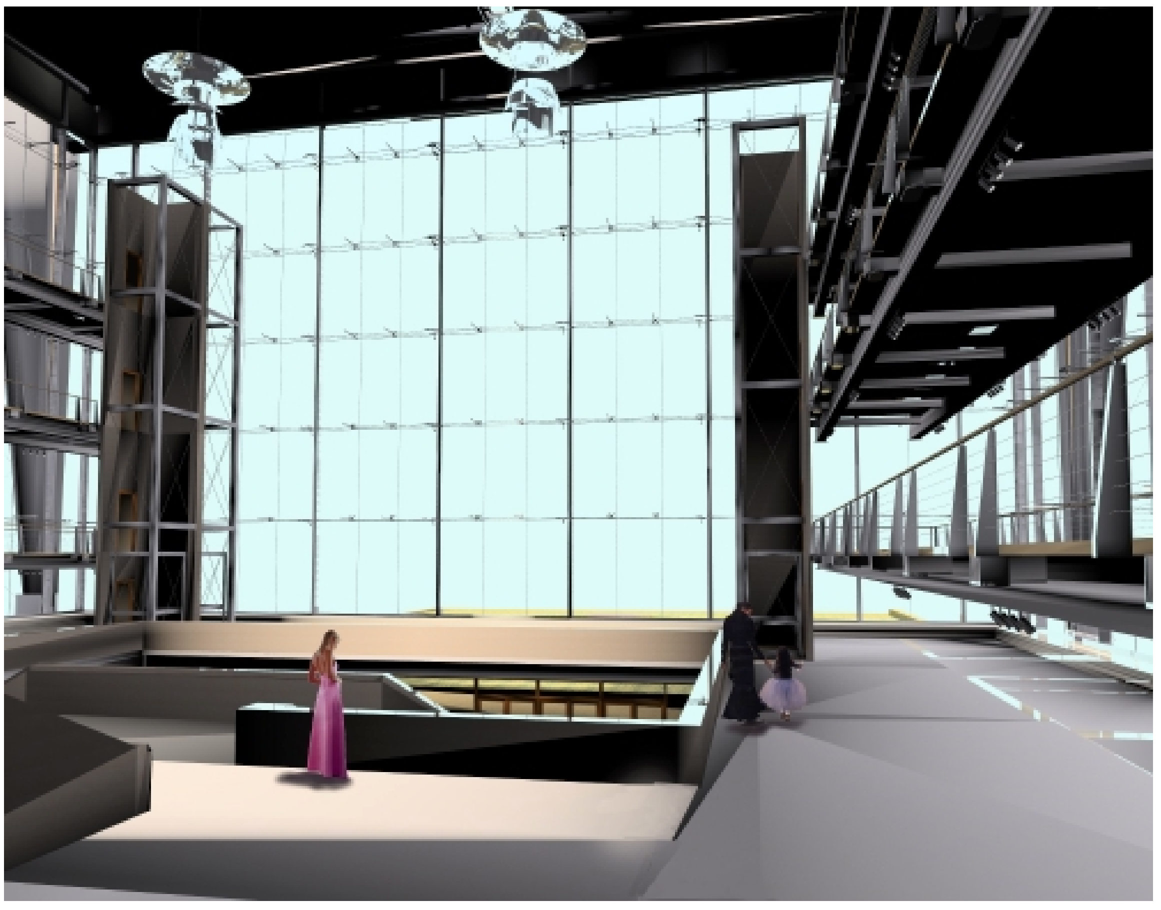


View of entry into atrium from grand tier level

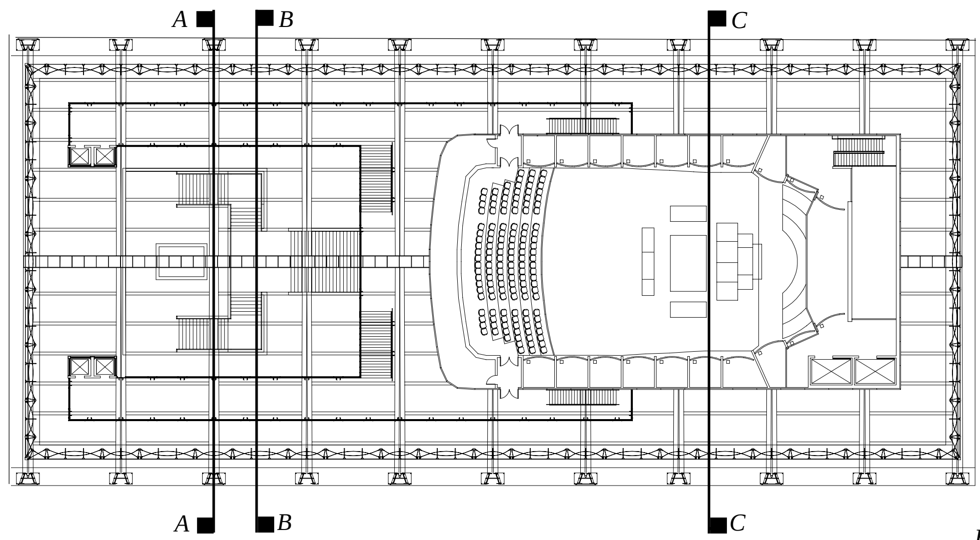
View north on grand tier level balcony



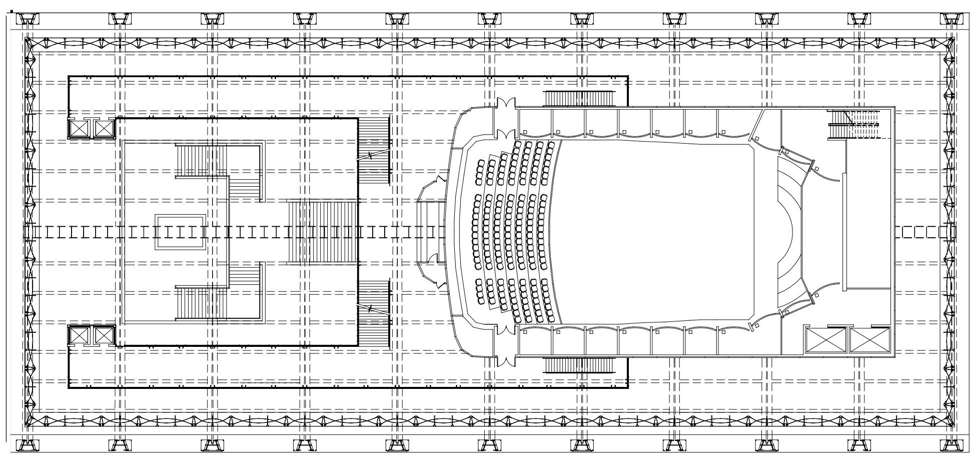
View of concert hall from entrance



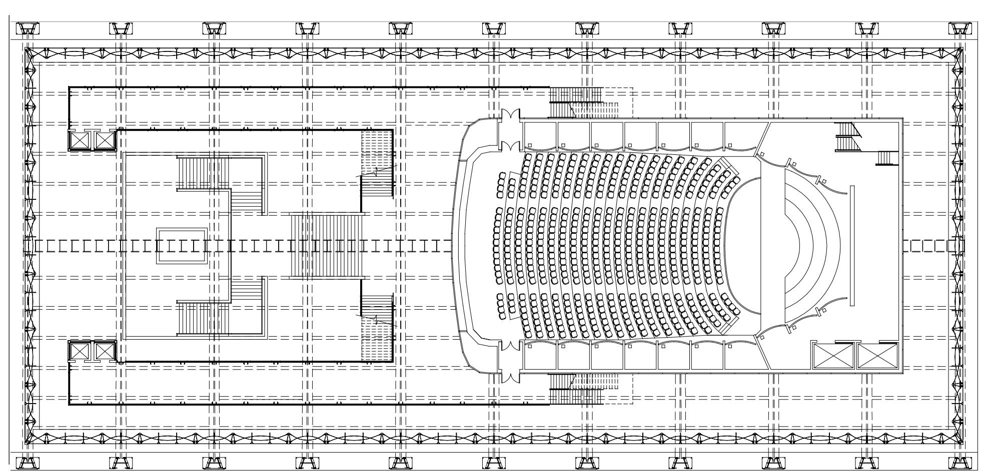
View north from lobby atrium



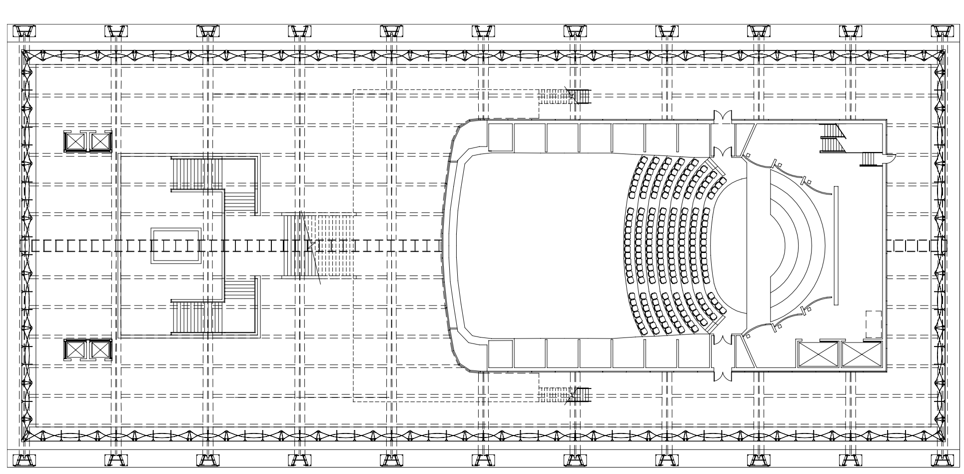
Balcony Level Plan



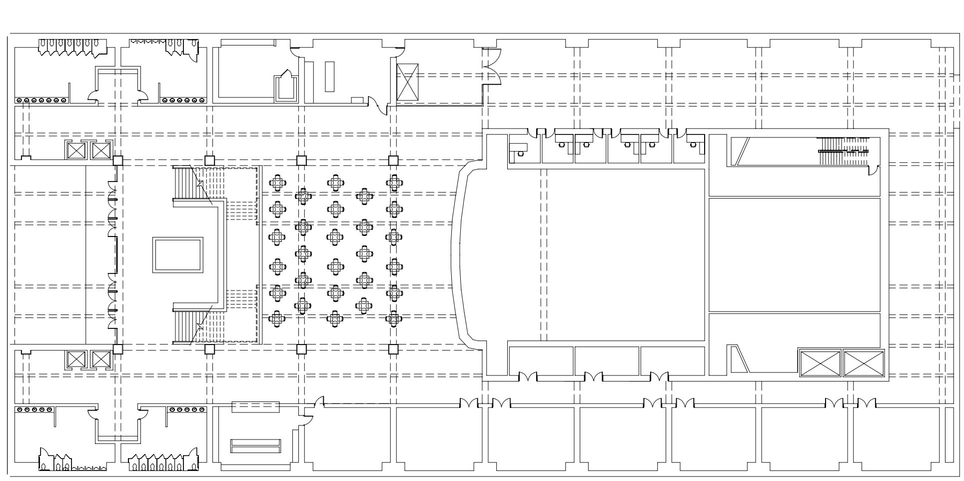
Grand Tier Level Plan



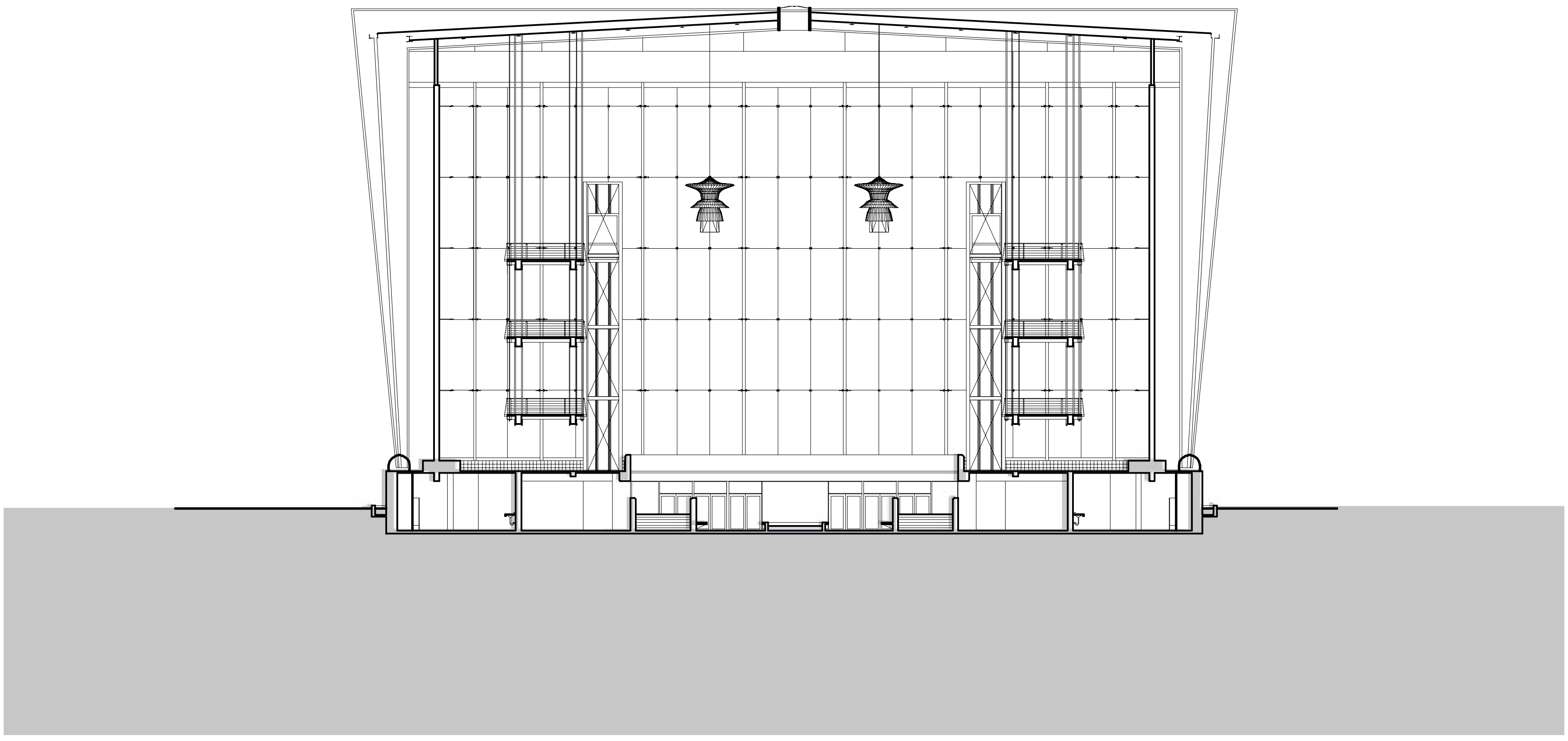
Stall Level Plan



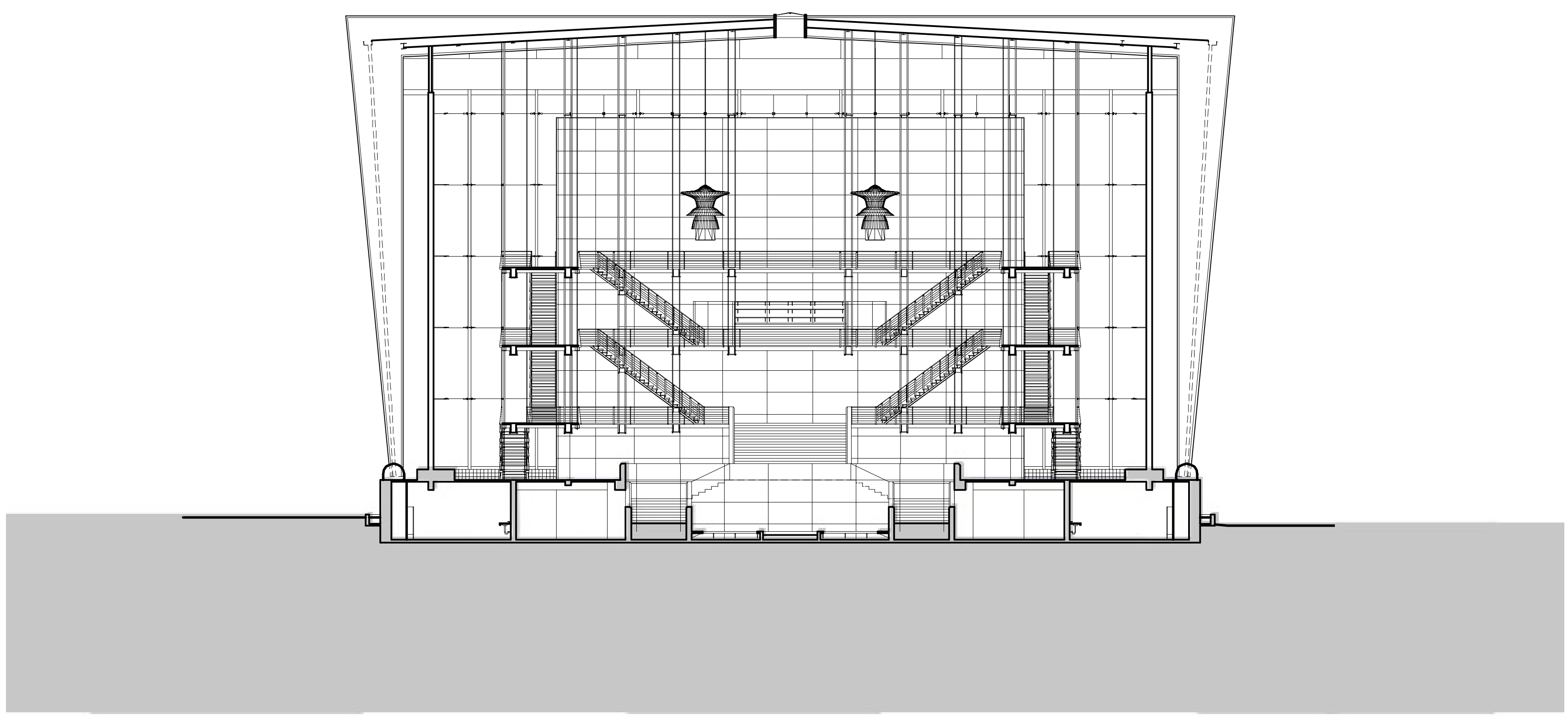
Plinth Level Plan



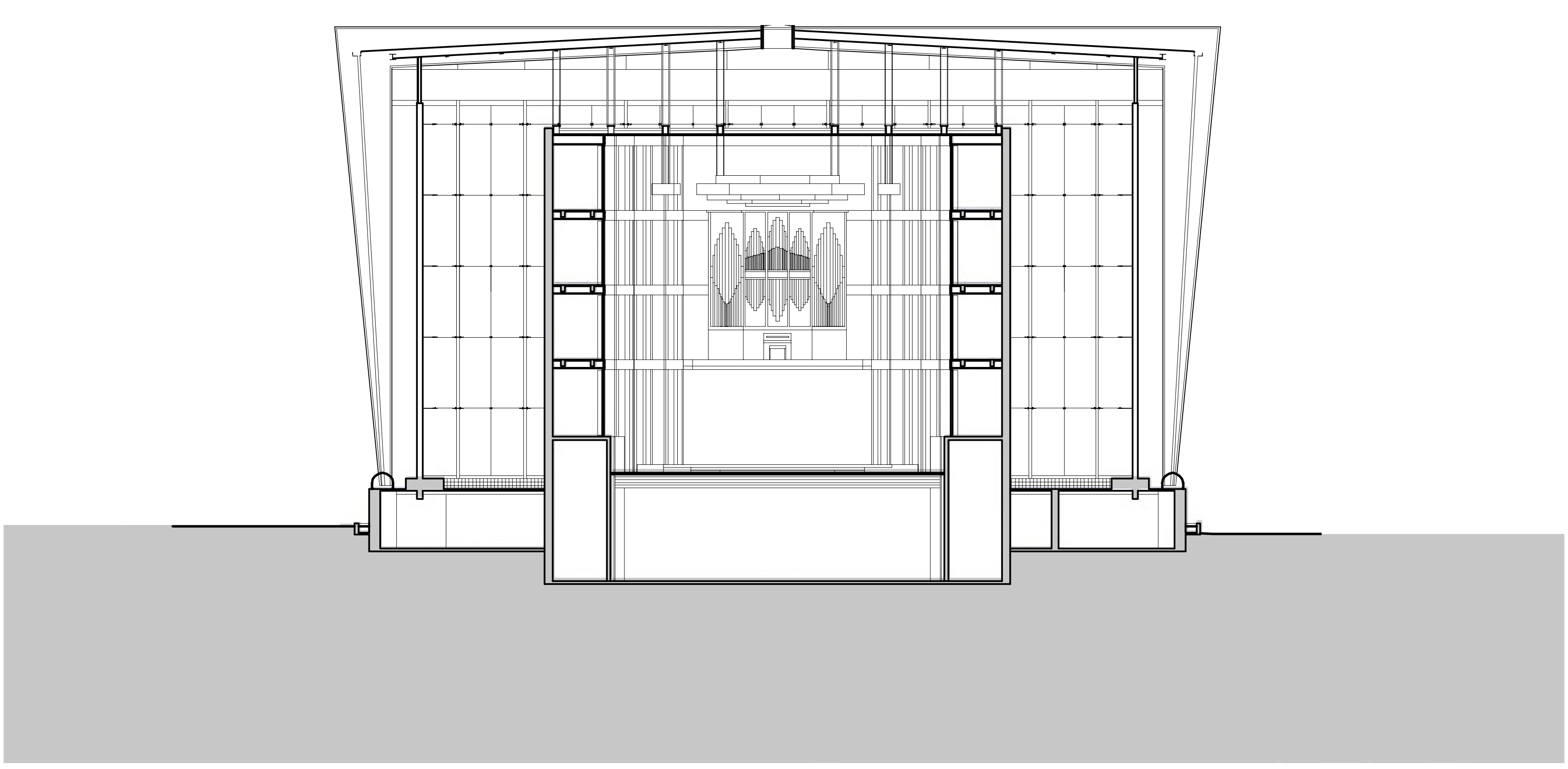
Base Level Plan



Section A-A



Section B-B



Section C-C

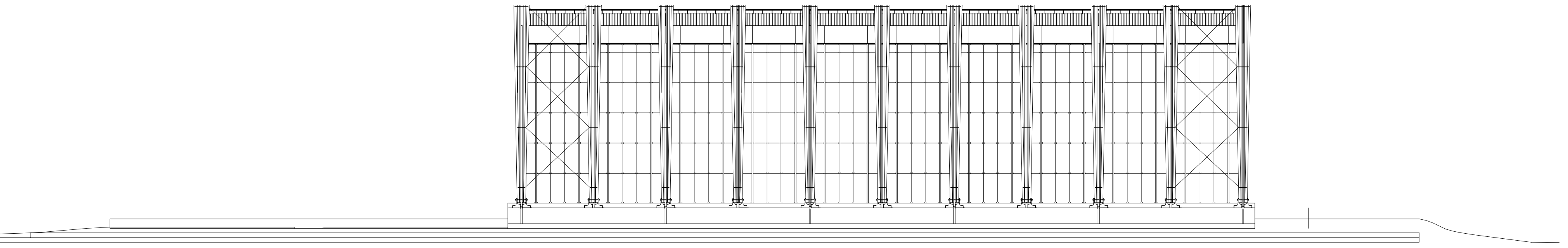
Even at the end of this thesis exploration, many questions remain unresolved. Every design builds upon the next. The unresolved questions of a project inspire greater achievements at the next opportunity, if they are used as a learning device.

A pivotal moment of the thesis exploration was the debate between structure as highly crafted individual pieces that sculpt space and a detailed structural cross-section repeated many times. In construction the small conceptual model of the concert hall complex, it was critical that a decision be made. If one has many sculptural pieces, what establishes the hierarchy that produces the coherent whole? The precedent studies were an invaluable toll in studying the architectural potential of the structure despite the differences in systems. If I were to pursue the “organic” element, each piece must be carefully investigated to determine the correct ratio of what is structural and what is sculptural. The TWA Terminal exploits to a greater extent the plasticity of concrete. The projects of Dulles Airport and the Stadelhofen Railroad Station rely on the repetition of a single bay. A structural cross-section is highly articulated, and then iterated. The decision is tied to a question of economy.

Inherent within the repeating bay is the articulation of an end to an infinite “modern” space. The question is not fully resolved here. Perhaps a structural bay outside of the conditioned enclosed space could react with the base, the plaza, and the site to define an end or at least manifest the reality of infinite space.

The auditorium itself is a sculptural object set against a background of repeating bays. The development of the auditorium is restricted by the rectilinear nature of the bays. The potentially preferable seating arrangements where the concert hall is a free-standing object conflict with the structure. Resolving the ideal form was a study of the tensions between a musically perfect acoustic room and limitations imposed by the structural order. The placement of a single object in a uniform repeating bay system is difficult, the possibilities are seemingly endless. The inclusion of other elements, for example, elevators, balconies, and stairs, inform and strengthen the placement of objects.

The development of the concert hall progressed from the conceptual sketches and models that directly translate into construction desired spatial conditions to a system of bays that separate the spatial conditions from the structural conditions. The use of repetition permitted a high level of development of one bay. The variety came not from the structure, but rather the movement through the building. In this case, architecture is a product of the relationship between the spatial experience of the building and its supporting structural framework.



EVELYN E. STRONG

3327 West Grace Street Richmond, Virginia 23221 (804) 359-4477 estrong@bytes-bits.com

Education:

MASTER OF ARCHITECTURE
Virginia Polytechnic Institute and State University
Graduated December 2000

BACHELOR OF SCIENCE IN ARCHITECTURE *(Design Concentration)*
University of Virginia
Study Abroad, University of Bath, England
Graduated May 1994

Experience:

Virginia Polytechnic Institute and State University
Blacksburg, Virginia
August 1999 - May 2000

BUILDING STRUCTURES I & II GRADUATE TEACHING ASSISTANT:
Aided student comprehension of building structures through one-on-one tutoring sessions, upkeep of course website permitting students to download homework problems and solution sets as well as corresponding with the faculty, and marking homework sets. Assisted Professor Mehdi Setareh by preparing homework problems and as a substitute lecturer when necessary.

Virginia Polytechnic Institute and State University
Blacksburg, Virginia
January 1999 - May 1999

RESEARCH ASSISTANT:
Created, in conjunction with Professor Mehdi Setareh, the Building Structures (Concrete) website for on-line AIA sponsored continuing education course offered by Virginia Tech.

Dewberry and Davis
Richmond, Virginia
September 1997 - August 1999

INTERN ARCHITECT:
Worked on projects in all phases, schematic through construction documents and writing specifications, either as a team member on large projects or as sole designer on small projects. Construction administration experience in reviewing shop drawing submittals, on-site inspection, and meetings with construction supervisor and client.
Experience in meeting requirements for Virginia Commonwealth funded projects.
In adaptive re-use, designed new Telecommunications Center for Virginia Community College System.
Member of design team for Graduate and Commuter Center, Mary Washington College, Fredericksburg, Virginia.
Member of design team for Virginia State Police Training Center Master plan, Fort Pickett, Virginia.

Design Consortium Architecture, Inc.
Richmond, Virginia
August 1996 - August 1997

INTERN ARCHITECT and PROJECT MANAGER:
Design and project management of new construction and adaptive re-use commercial and residential projects in the Greater Richmond area from design development through construction document phases.
Researched and submitted Historic Preservation Certification Application for the Cokesbury Apartments as an adaptive re-use of the Methodist Publishing House “Cokesbury Bookstore” in downtown Richmond recommended by the Commonwealth of Virginia Department of Historic Resources to be listed on the National Register of Historic Places.
Provided City of Richmond landscape plans with detailed plant lists for approved Plans of Development and zoning special use permits.

David Powell & Associates, Inc.
Huntersville, North Carolina
November 1994 - July 1996

INTERN ARCHITECT: Land Planner and Project Landscape Designer
Design responsibilities for commercial, residential, and mixed amenity oriented development projects in the Charlotte/North Mecklenburg area.
Managed project for the Home Builder Association of Charlotte’s PARADE OF HOMES 1995, which included approximately 100 renderings and plan layouts.
Preparation of project schedules, client presentations, contracts, budgets, invoices and orders. Liaisons with clients and contractors. Graphic renderings in various media which were instrumental in landing accounts with area developers.

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