

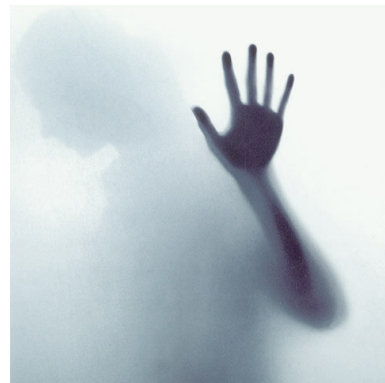


## Discourse on Lightness

Virginia Polytechnic Institute and State University

## Abstract

This thesis is an attempt to inquire into the interrelationship of transparency and structure. It focuses on the unveiling the layers of transparent and translucent materials which alternately obscure and reveal a sequence of views. The project aspires to create spaces with interplay of vision and blockage by exploring the correlations of light, transparency, translucency, opacity, diffusion, reflection, floatation and lightness. It explores the crucial relationship of its bold tensile structure with the habitable spaces.



Discourse on Lightness

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Thesis submitted to the faculty of the Virginia  
Polytechnic Institute and State University in partial  
fulfillment of the requirements for the degree of

Master of Architecture

August 2003

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Professor Heinrich Schnoedt: Chairman

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Professor William Brown

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Professor Frank Weiner

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This book is dedicated to my supportive and determined grandmother

## Lightness

Conventionally 'lightness' is considered to make a building or a structure appear weightless through 'de-materialization', transparency or floatation. We feel the sense of lightness when a building is transparent or exposed to nature. One way to achieve lightness is to free the building's structural system of traditionally used heavy materials. Modernists dreamt of "light and airy" sense of space, no longer tied with earthy materials. Koolhaas refers to 'Lightness' as "the release of freer space from the unnecessary loads that tradition asks us to bear."

While these strategies have subtle distinctions, both place architecture, in opposition to gravity, materiality and permanence. According to Greg Lynn's conception of differential gravities, "Lightness is an idea that makes architecture's assumptions about the simplicity of gravity more complex". So a building can float or appear to be light, while its not de-materialized but suspended or obliquely grounded. The principle of suspension surrounding an object with a diffused field of structure that is roughly equivalent to its mass and density suggests that in order to become 'light', structures need not be increasingly dematerialized but must instead become diffuse.

Lightness is not the elimination of gravity but is instead an equalization of gravities

The quest for evermore weightless and evermore luminous aspects of architecture is continued in the contemporary architecture. Contemporary architecture is leading to exploitation of use of materials like stone, brick and wood with modern materials like glass, concrete and steel where each material is used for a specific action or to create a specific atmosphere. Here, the simplicity appears to be a central idea with the use of simple geometrical or minimalist forms. There may exist a possibility of balancing between the gravity, permanence and the quest for achieving ideal immateriality- the absolute minimum condition of architecture.

"They have redefined the relationship between the observer and the structure by interposing elements that both veil and illuminate. In this architecture of lightness, buildings become unstable, dissolving into often luminous evanescence."

-Terrence Riley, Light construction



Architects often are interested in the image of lightness, than in lightness itself

## History of Light Architecture

For a long time there has been an effort to confine architecture to the hard materials of permanent structures: steel, reinforced concrete, stone and granite. This artificial confinement some times appears to be unnecessary and stubborn.

The word 'Light' represents both transparency and purity, and here, the use of light is emphasized as a 'material' to make spaces. Purity can be expressed in terms of structural clarity and minimalistic approach in making of architecture.

Light architecture has the possibility of acting on a city, modifying it through "micro-interventions of urban surgery" In Europe, and particularly in Italy, modern architecture has produced very little and what remains is the devastating architecture of 1960's. There being no system at present, light architecture is seen as a rapid and effective remedy for carrying out the "make-over" projects that cities need.

-Gianni Ranaulo. New Edge City, Light Architecture. Birkhauser, 2001



Massive ashlar exterior of Gothic cathedral contrasting with lighter Interior



Heavy church building of Gothic revival period

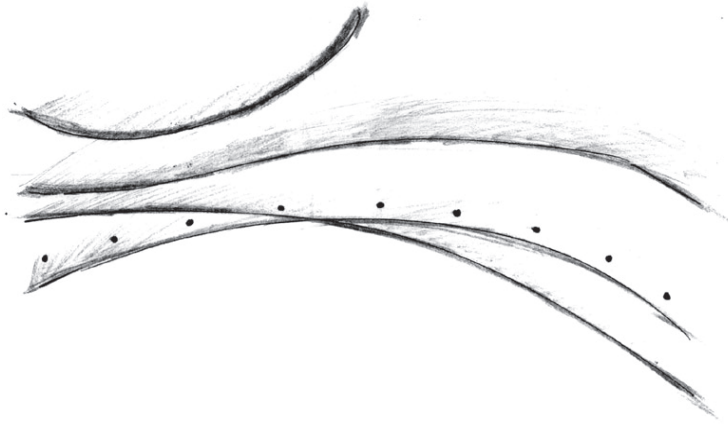


The first evidence of light architecture: Crystal Palace

S i m p l i c i t y      a n d      l i g h t n e s s      a r e      d i f f i c u l t      t o      o b t a i n

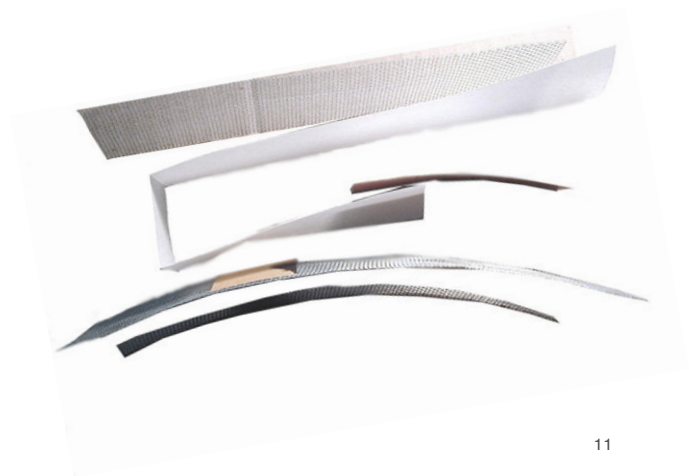
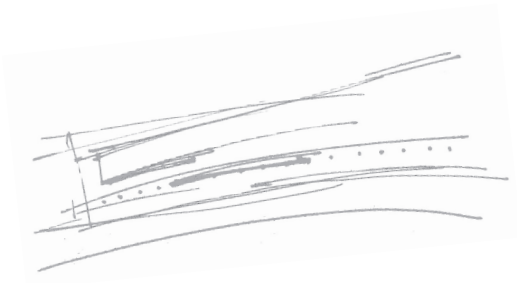
In all its different expressions, light architecture could be a key element in changing and improving the parameters of habitation: it allows us to design with different, lighter tools like sprays of water, photovoltaic glass composite materials and inflatable materials with the possibility of new forms of projects.

The transparency of light architecture is one of the modern means of spectacularization of monuments without disturbing or degrading the monuments or their impact on the surroundings.

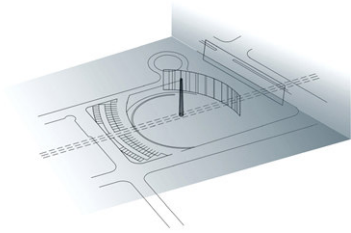


## Lightness by Means of Constructive Layers

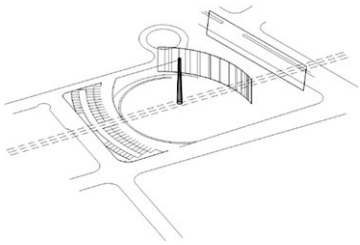
The project unfolds as an exploration of various layers hinting, responding to and revealing the various spaces with varied functions within. These layers unfold in the form of tangible and intangible elements such as facades, walls, screens, spaces, structural members. A layer, in the form of a wall constitutes an interface between the unbound and enveloped spaces. The space created between these layers becomes a threshold that transforms the idea of a layer into an architectural dialogue, in the form of manifold overlapping planes with diverse materials and systems.



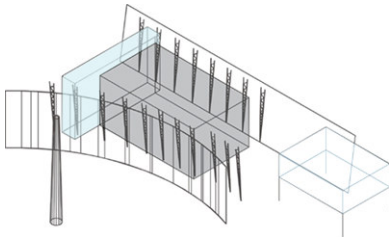
## Building Layers



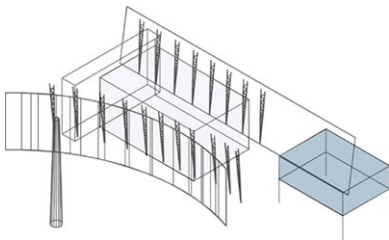
Site: a layer



Formation of public plaza

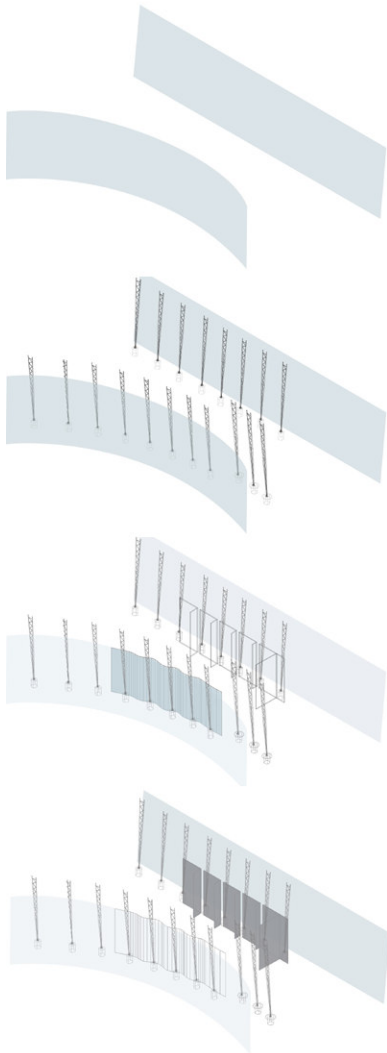


Theater and service zone



Educational spaces





Two facade walls

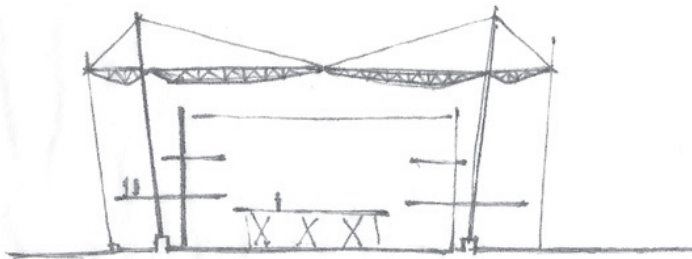
Layer of columns

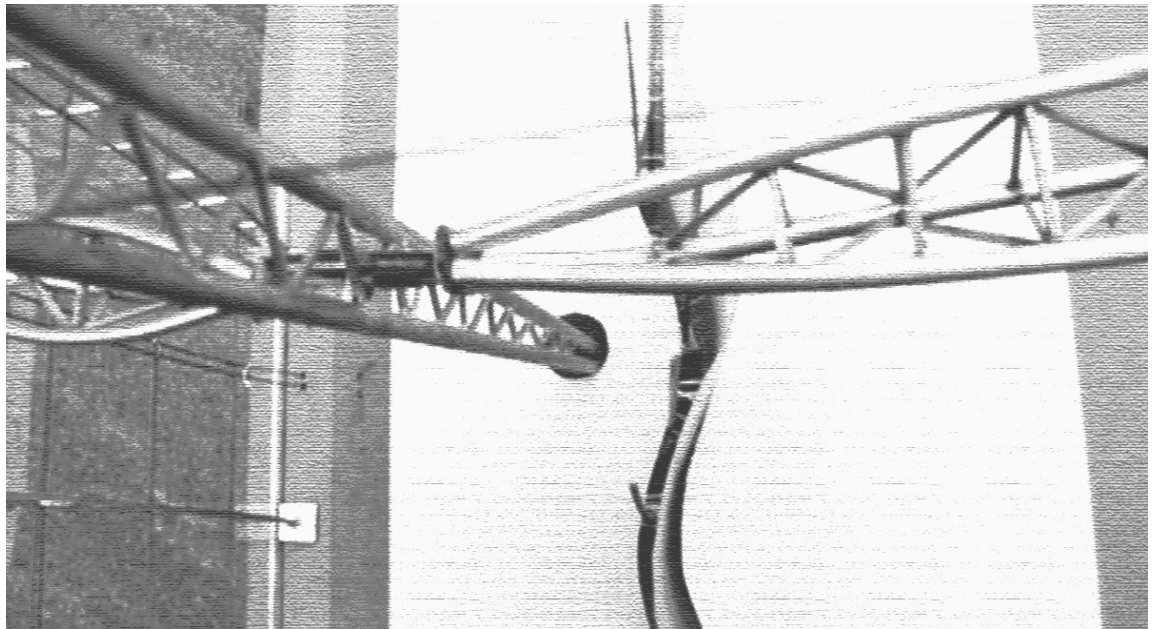
Wavy glass theater wall

Concrete theater wall

## Structural Steel: Primary structural material

Structural steel's low cost, strength, durability, design flexibility, adaptability and recyclability continue to make it the material of choice in building construction. It offers the ability to span great distances with slenderness and grace. The thinner sections of steel can carry incredible loads because of its tensile strength. Steel can be shaped to achieve curved forms and can be raised quickly to meet tight construction schedules in almost any weather conditions. Steel can be easily modified to satisfy changing requirements. As virtually all of today's structural steel produced in the USA is made from recycled cars and other steel products, it is the environmentally sound choice for a building material.





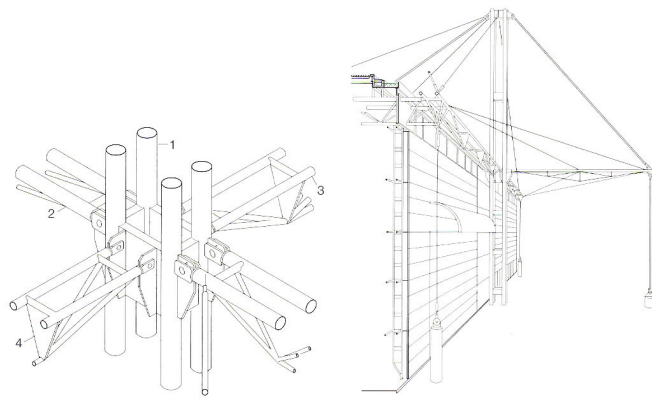
## Tensile Structures

Conventional building structures have to meet two challenges: gravity and rigidity. In tensile structure, gravity and rigidity are not available as the critical structural properties. Slender compression members when loaded tend to fail by buckling, regardless of their material strength. Conversely, structures made of tensile members become more stable with increasing stress levels. "The stress puts each member into line making the structure taut. Thinner tensile members are better at adapting their shapes to the load pattern. Making full use of their high material strength, tensile members will carry the load by most direct route, in uniform, concentric tension. The load acts along the centerline of a rope or cable. Each fiber of the rope or each strand of the cable carries its equal share of stress."

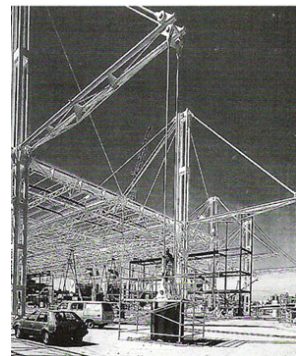
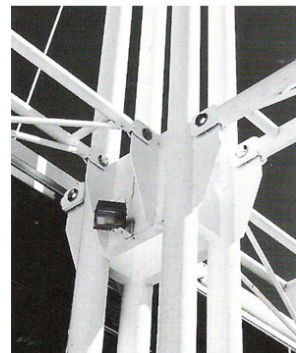


Horst Berger. How tensile structures work. Light structures Structures of Light.

A tensile structure can withstand the changes in magnitude, direction or distribution of load



only when a number of tensile members together make the structure



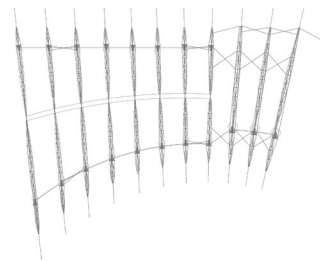
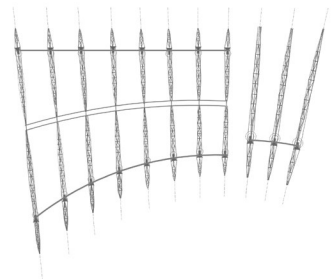
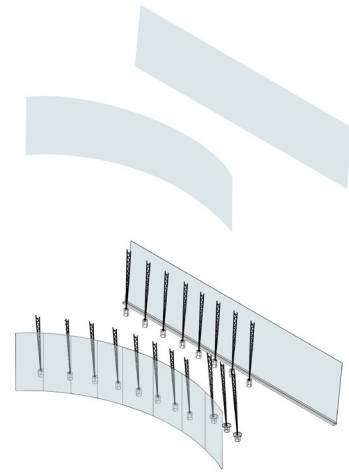
Exhibition center, Sydney, Australia

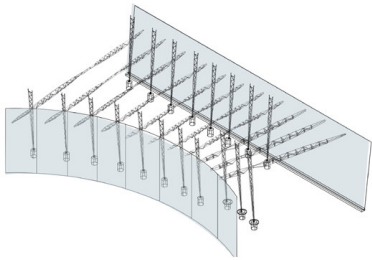
## Layers of Construction

A crane-like, 19 column-beam superstructure denotes the primary elements of this theater complex. 16 of those members work in concert to span 40' each to cover the space of the theater from either side.

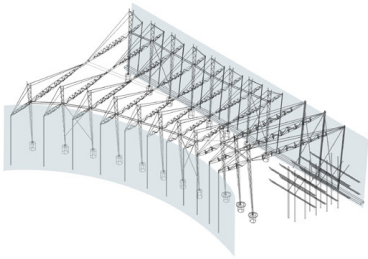
However, three of those members span over 80' to allow an unencumbered view from the lobby to the river.

The structure is a dialog between vertical truss, horizontal truss, and tensile cables where needed, to ensure the integrity of the system. Skylights illuminate important intersections of this structure.

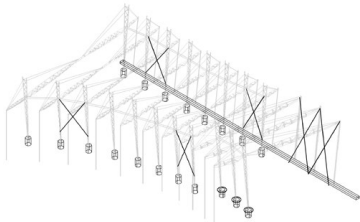




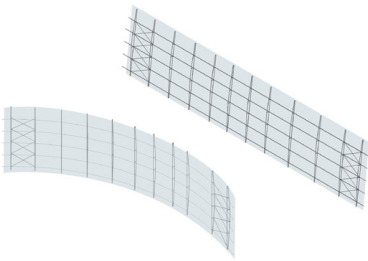
Horizontal truss members



Tensile cables



Cross bracings



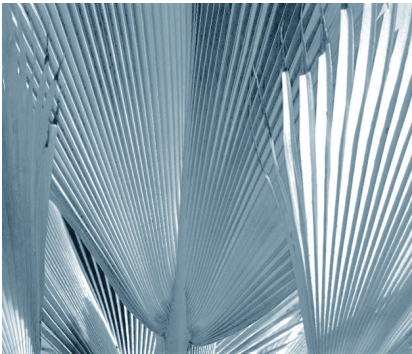
Structure of facades

This thesis is an attempt to express lightness in various modes: lightness as a concept, lightness of an image, lightness as transparency, lightness as translucency, lightness as diffusion, lightness as 'slowing of light' and lightness as opacity. Here in all of these cases, we continually experience transparency, which is not always apparent....



## Modes of Lightness

### Transparency



Overlapping of multiple layers with different degrees of visual passage



Transparency of structure and skin apparent through layers

Lightness can be experienced with the presence of “Transparency”.

“Transparency means a simultaneous perception of different spatial locations. Space not only recedes but fluctuates in a continuous activity. The position of the transparent figures has equivocal meaning as one sees each figure now as the closer now as the further one.”

Gyorgy Kepes: The Language of Vision, Paul Theobald, Chicago 1944, p.77

Generally, transparency in architecture is associated with the transparency of the material. Colin Rowe and Robert Slutzky differentiate between the “Literal” and “Phenomenal” transparency in their book “Transparency”, published in 1964. According to them, “Literal Transparency is an inherent quality of a substance, like a glass curtain wall; while Phenomenal Transparency may be the inherent quality of an organization”.

The phenomenon of transparency refers to space, depth and organization resulting into an interesting spatial complexity. Rowe and Slutzky explain these ideas with the help of cubist paintings. “Literal transparency, we notice, tends to be associated with the trompe l’oeil effect of a translucent object in a deep, naturalistic space; while phenomenal transparency seems to be found when a painter seeks the articulated presentation of frontally displayed objects in a shallow, abstracted space.” They propose “phenomenal transparency” as an abstract, theoretical sense of transparency derived from skillful formal manipulation of the architectural facade, viewed frontally, as opposed to the more straightforward “literal transparency” ascribed to the curtain-wall architecture.



Bauhaus . Picasso.



Transparency means simultaneous perception of different spatial locations

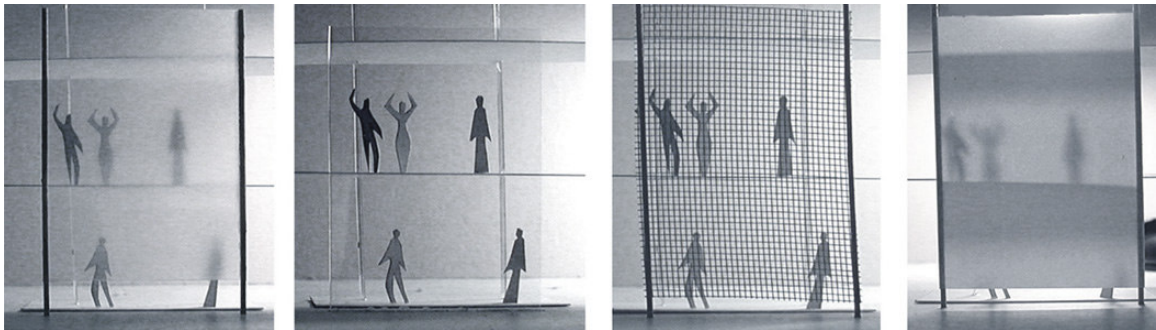
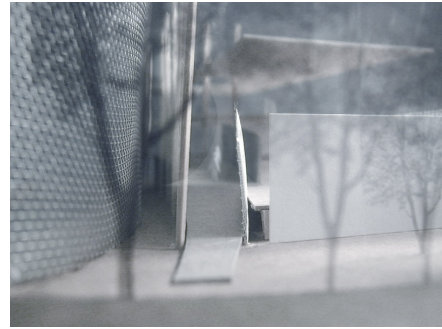


Interpenetration without optical destruction

## Transparency Experiments

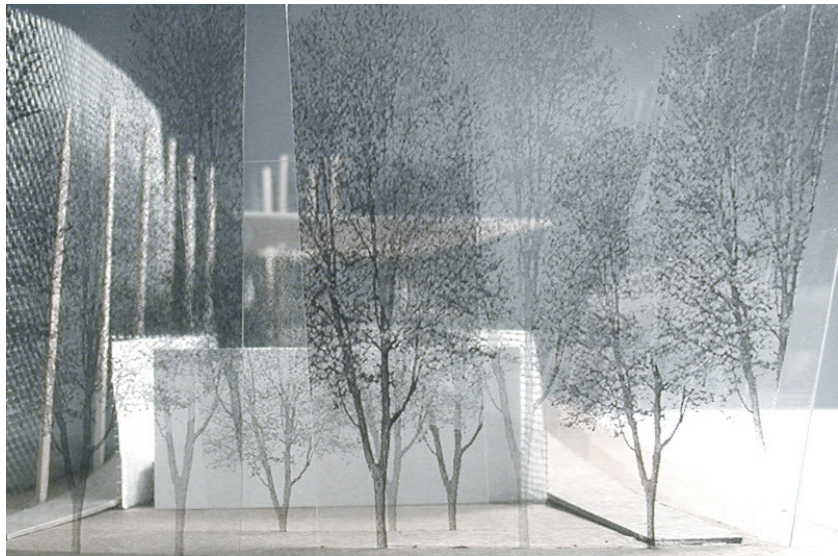
"Transparency arises wherever there are locations in space which can be assigned to two or more systems of reference- where the classification is undefined and choice between one classification possibility or another remains open."

Bernhard Hoesli, Commentary, Transparency.



Literal transparency: A positively transparent figure standing in a relatively deep space

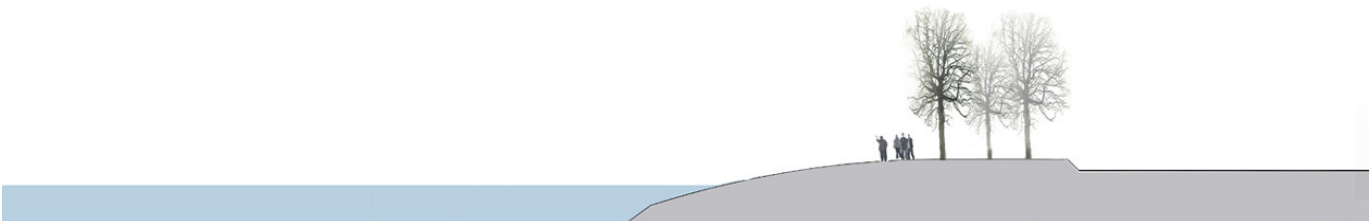
The transparent ceases to be that which is perfectly clear and becomes instead that which is clearly ambiguous

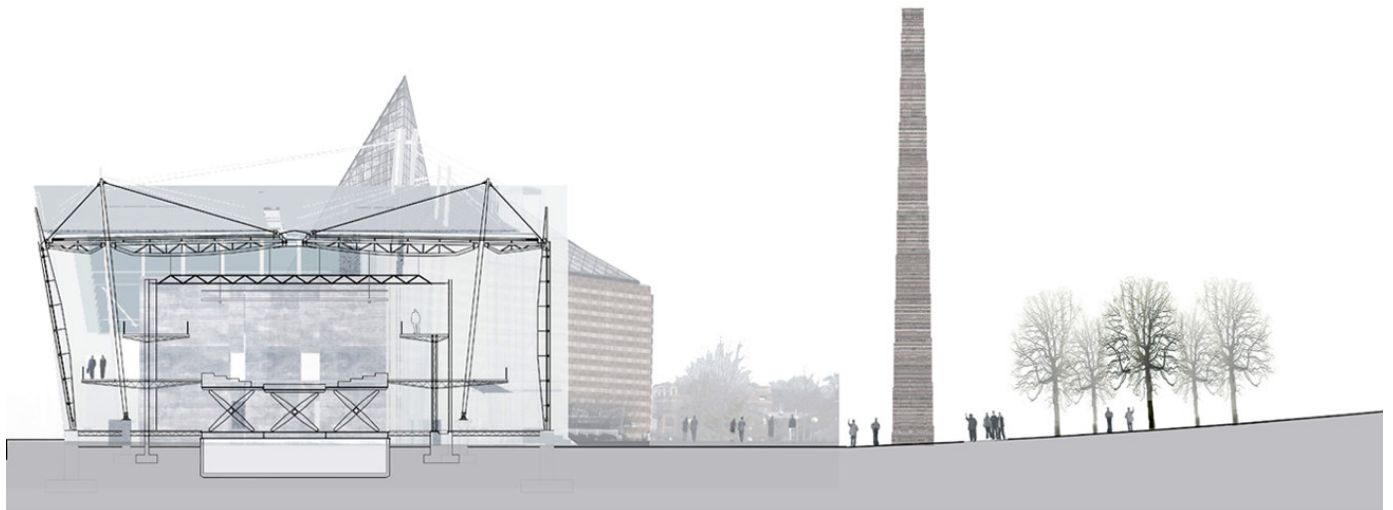


The reality of deep space is constantly opposed to the inference of shallow space

## Facades and Transparency

The idea for the building stems from two façade walls having different degree of transparency. The plaza-side façade becomes a semi-transparent curtain that alternately reveals and conceals the spaces and the murky silhouettes both the inside and outside. The river-side façade is a clear continuous glass curtain, gives unobstructed view of the serene river. At night, the façades present the lit interiors of the Performing Arts Center to the outside.



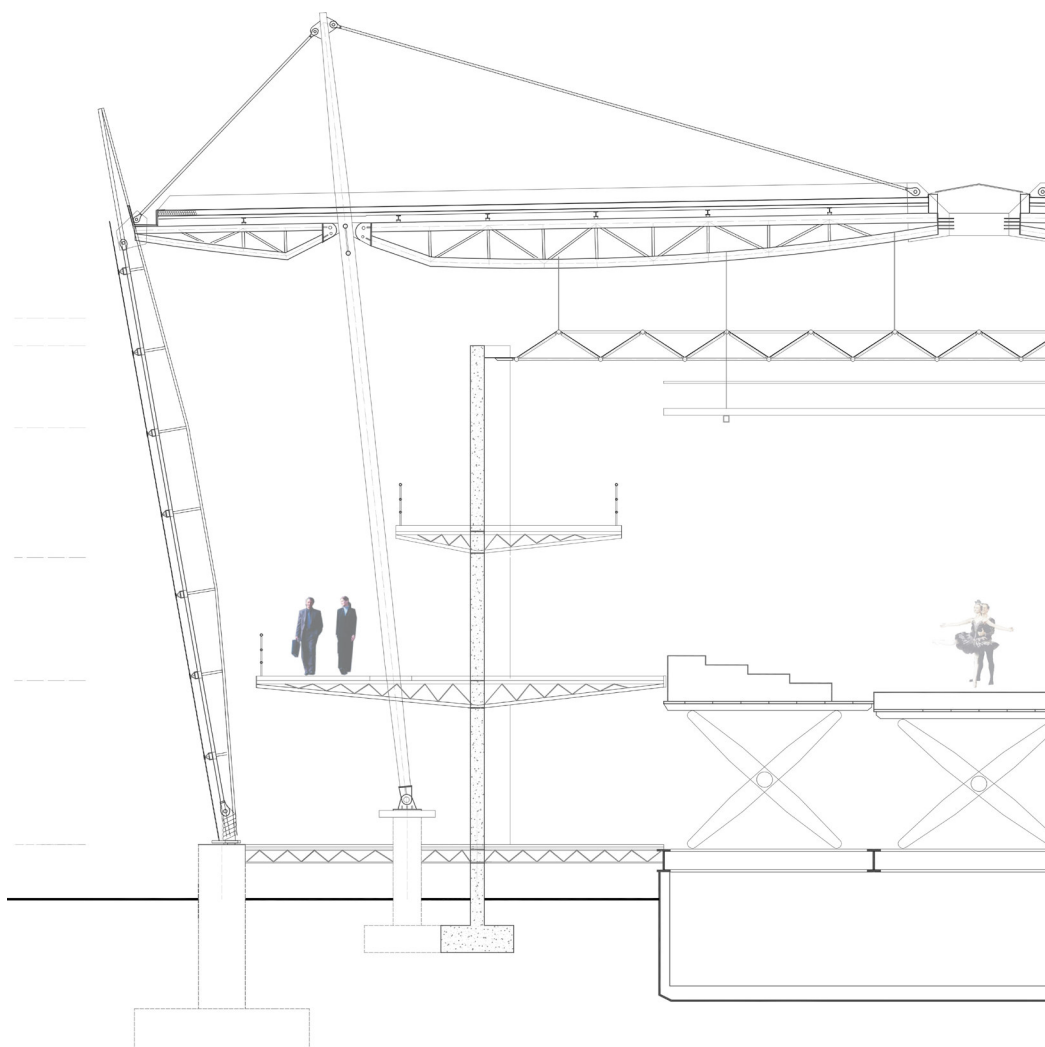




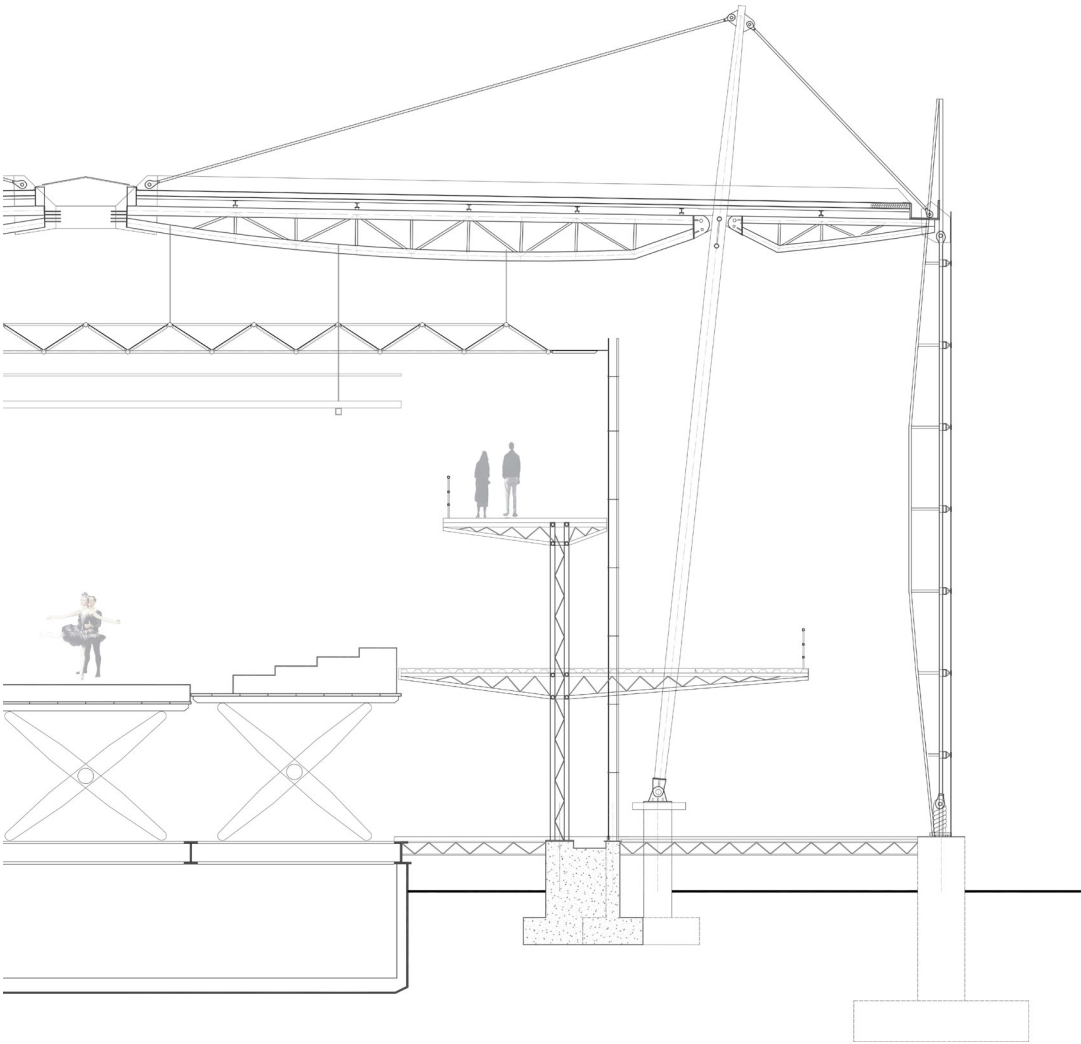
## River-side Facade







Plaza-side Facade

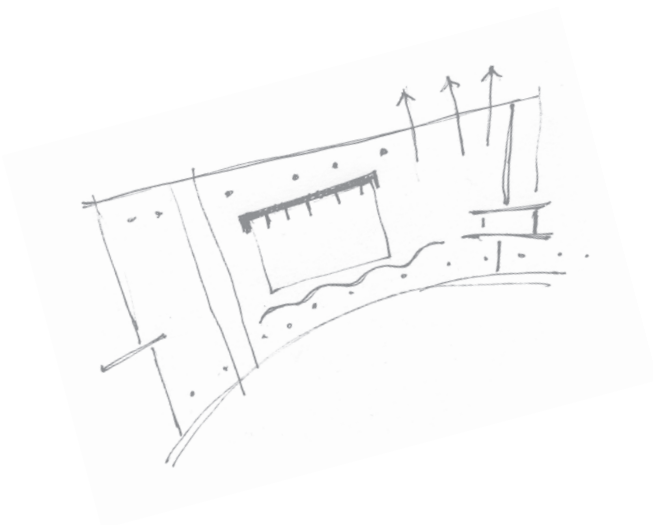
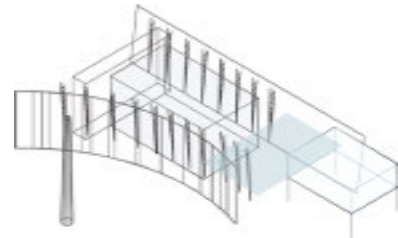


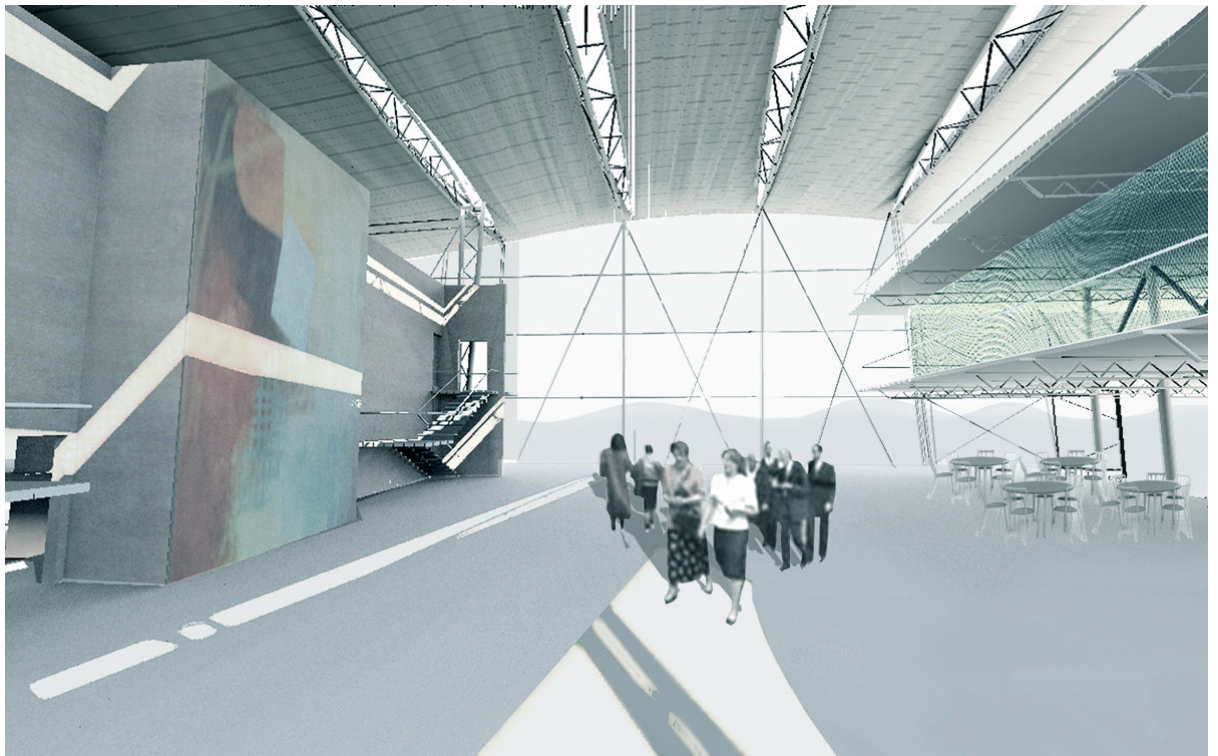


## Lobby: A Gathering Threshold

Theater lobby is a space for gathering of people and various spaces. It stands for utmost transparency. It forms a connection between the ramp, the theater and the balconies converging into theater lobby. Educational spaces are inside a box that cantilevers out towards the river, while overlooking into the theater lobby.

Three of the column-truss members span the entire lobby, pointing out towards the river. The clear glass façade forms a huge window to view the river.







Theater lobby and the transparent river-side facade

## Translucency



Translucency of diffused body against the contrast of the opacity

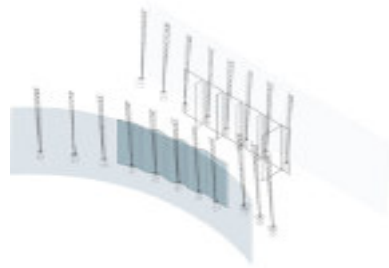


Solidity of foreground against the diffused background

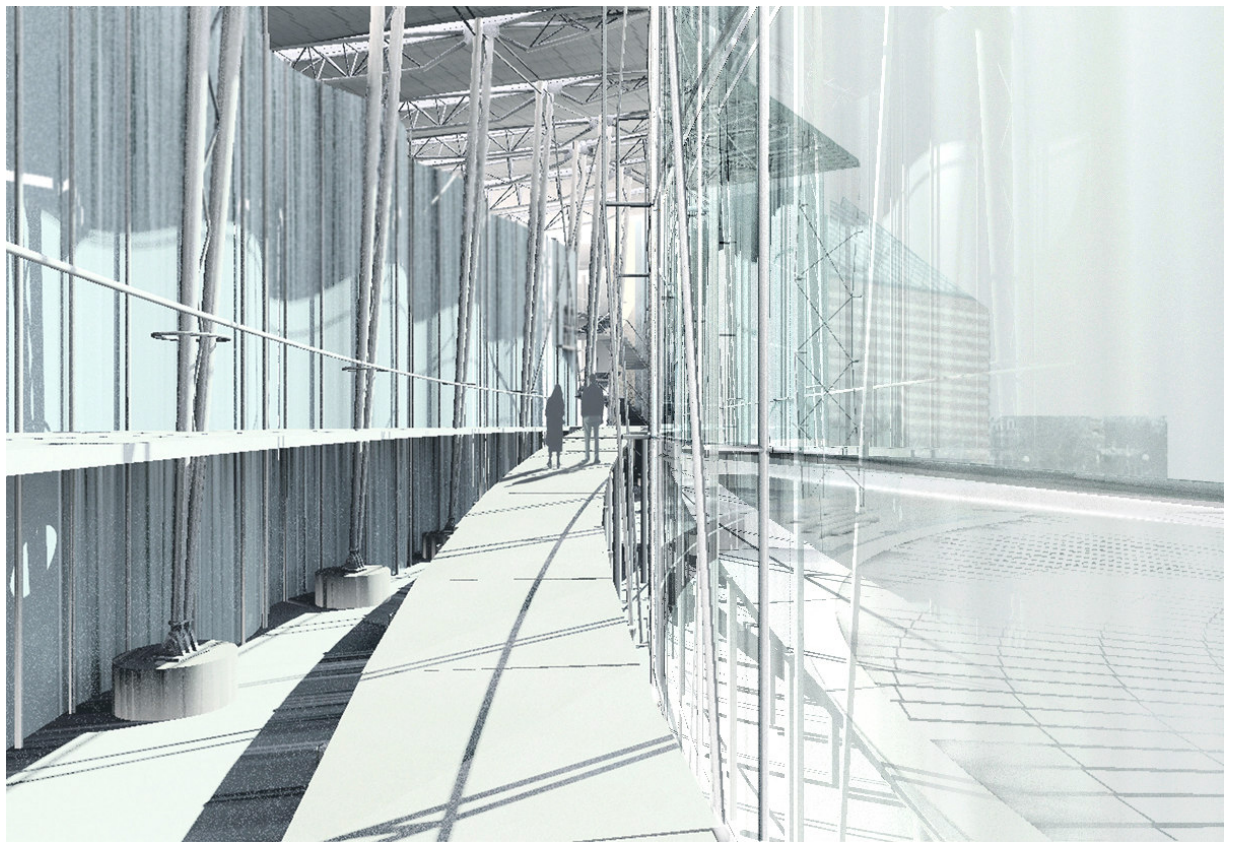
## Two Translucent Walls

A ramp takes one from the plaza to the theater lobby, allowing the movement of people. One can walk through across the length of the building and through the connecting balconies- 'the viewing galleries of the city'.

This narrow ramp space between the façade wall and the wavy theater wall is a transition space that belongs to both 'inside' and the plaza 'outside'. It is the threshold between the interior of the building and the plaza, a space where urban fabric merges. This four story high space inside the plaza-side façade stands for a perceptible connection between the rhythmic curvature of the layer of columns, the connection of horizontal truss meeting with the vertical façade and the cantilevering viewing galleries overlooking the plaza.





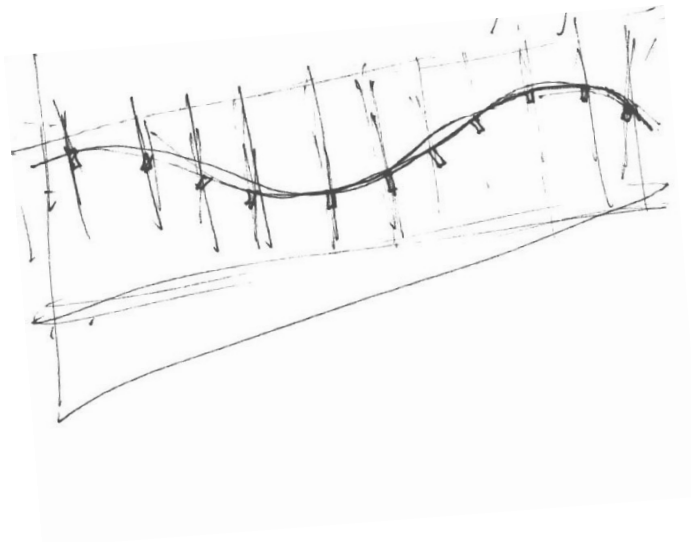
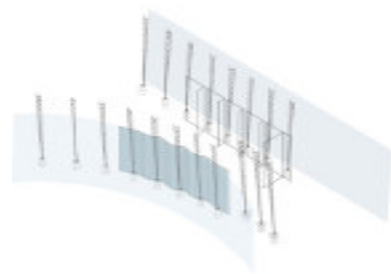


## Wavy Glass Theater Wall

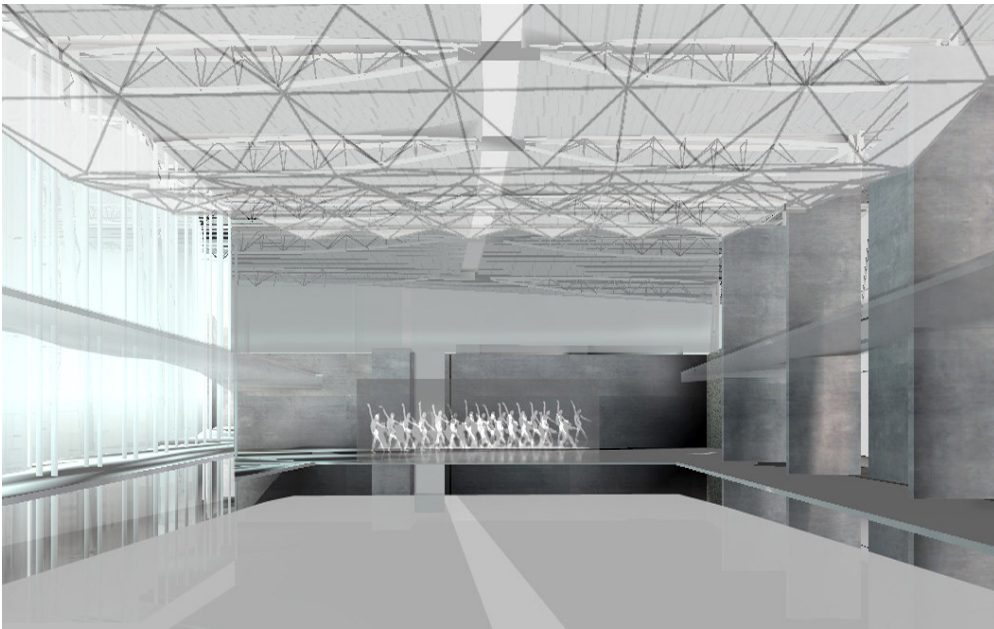
A theater needs to embody a range of intangible and relatively indefinite architectural qualities such as mood, intimacy, excitement, ecstasy and memory. Two opposite walls of the experimental theater create a unique condition enclosing the space for performers and spectators.

Experimental theater is the center of the building with the 'service wall' separating the support areas from the public spaces. Service wall houses the storage on multiple levels.

The translucent wavy glass wall is a transition between the curvilinear geometry of plaza-side façade, originating from the stack and the linear geometry of river-side façade. The wall diffuses light inside the performance space. It changes the theater into a lit glowing box during the night, bringing the silhouettes of the inside to the plaza outside.





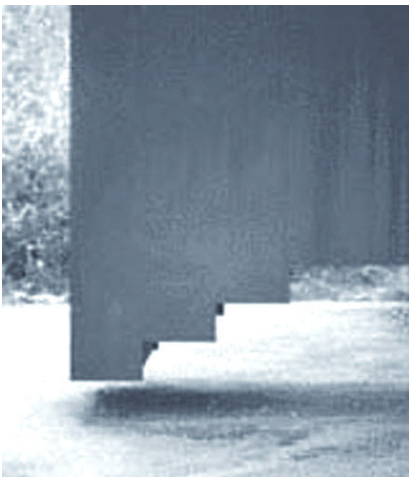


Inside the theater with the contrasting walls

## Opacity



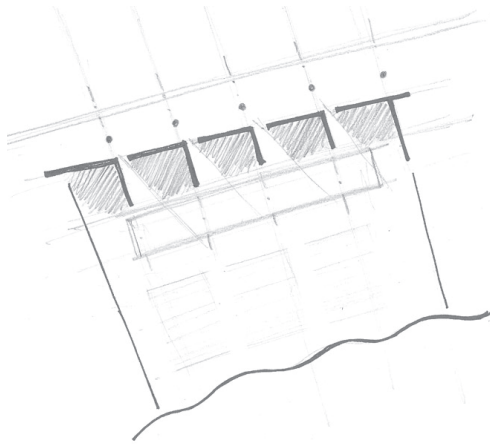
Opacity of the walls conspicuous against the contrasting translucency



Lightness expressed through floatation: a sense of tension in the atmosphere

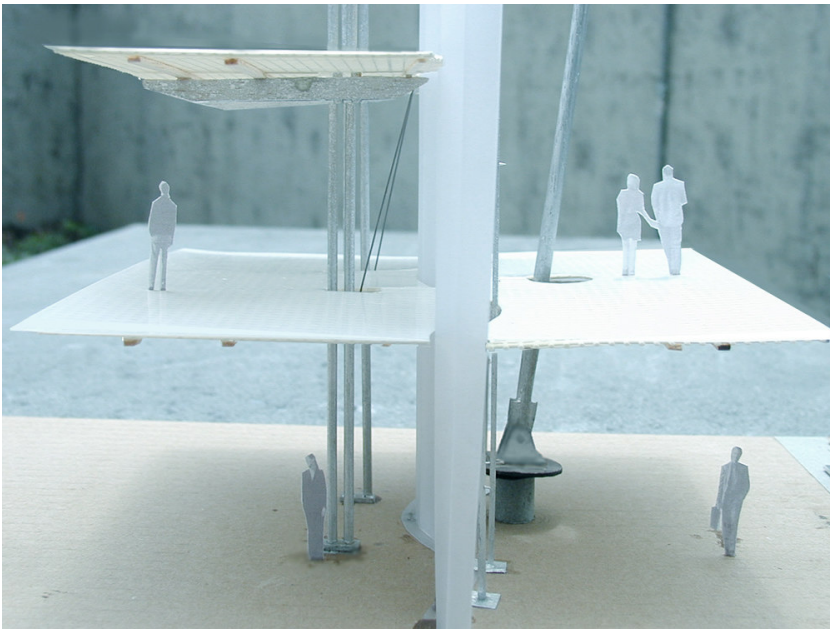
## Concrete Walls: A Backdrop

The concrete wall of the theater on the 'river side' is an opaque backdrop to the other wavy translucent glass wall on the 'plaza side'. Concrete walls also accommodate the theater galleries and concurrently, provide a backdrop for performances.









Cantilevering balconies attempting to create a feeling of floatation



## Diffusion



The effect of diffusion with the use of semitransparent glass facade

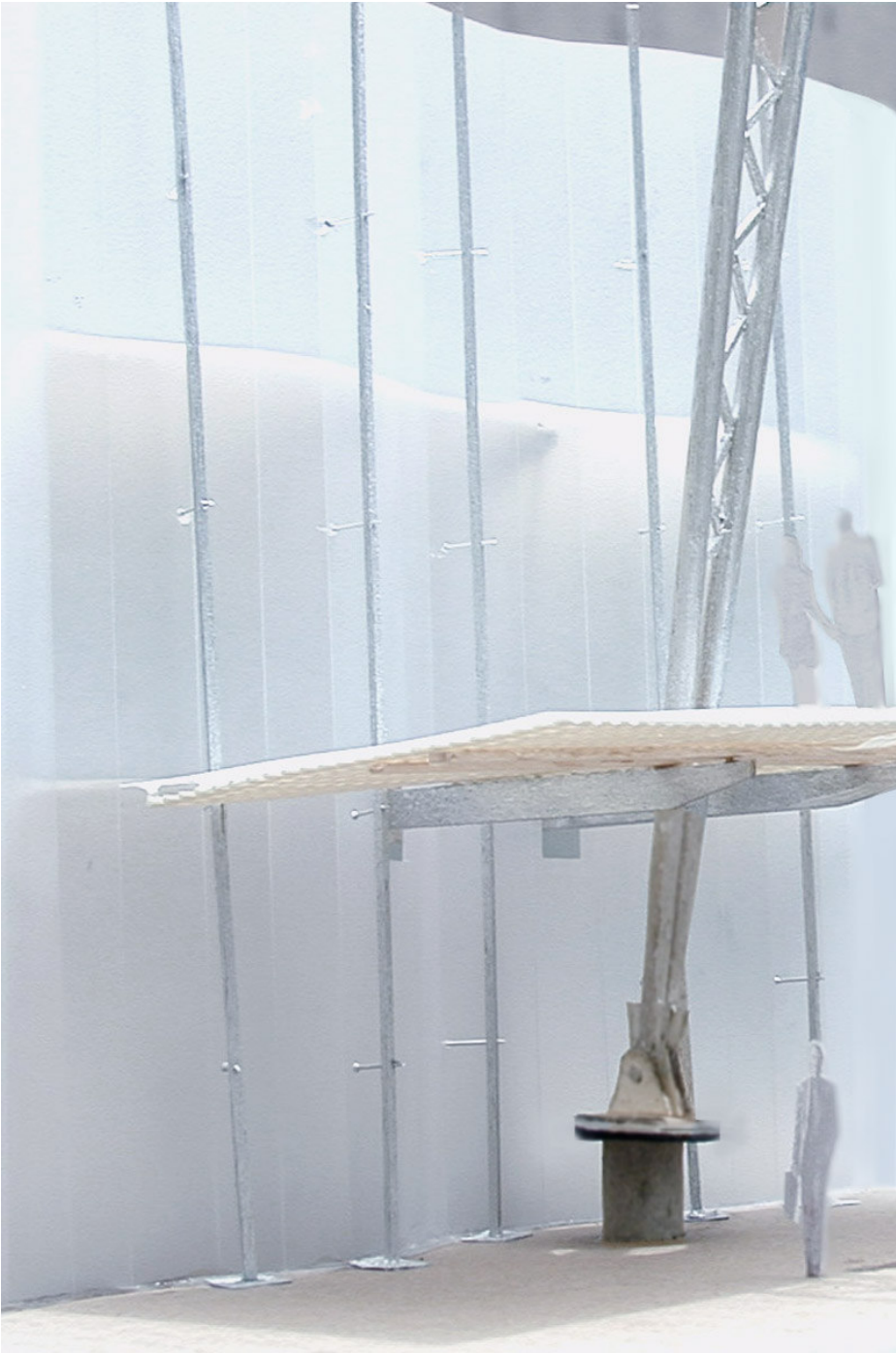


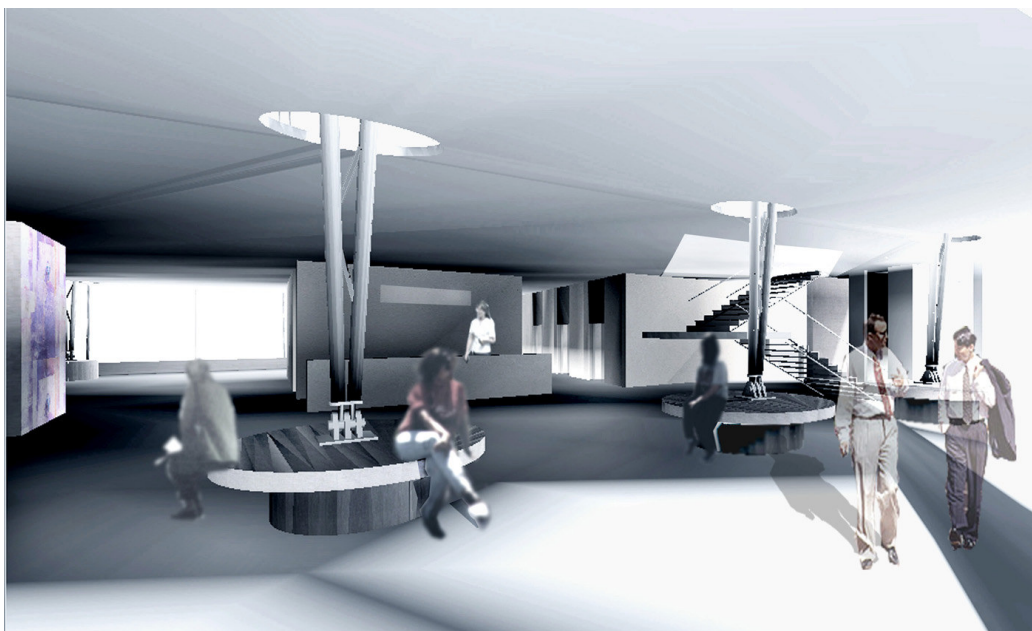
Multiple reflections of diffused light on the reflective surfaces

## Light and Diffusion

The light present corporeally inside the building changes in different spaces. It filters through the transparent and translucent layers of the facades, diffusing inside which creates 'slowing of light'. The superimpositions provided by reflections of light playing upon the translucent wavy theater wall, further disperse the light into the interiors.

Light trickles down from the skylight through the interlaced crane trusses, illuminating the structure. The ends of two trusses meet at point, which is a unique position for a skylight that creates a band of light running across the length of the building.





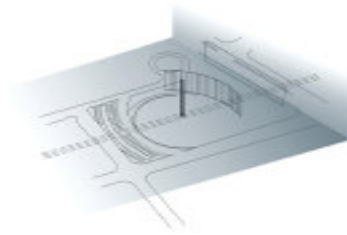
Entrance lobby and reception area

## Site: As a Constructive Layer

Site as a origin forms the first layer. The natural elements-sky, river, mountains and trees can be constantly felt from the inside of the building. They are almost corporeally present as a material, as they are manifested through the transparency of the skin, becoming an integral part of the building.

The site for the Experimental Performing Arts Center building is located in downtown Chattanooga, Tennessee between the Tennessee Aquarium and the IMAX 3D Theater. One way to achieve a lively and vibrant Downtown Chattanooga throughout the year is to promote movement of people and traffic from the Broad Street towards the riverfront. The Performing Arts Center building is designed to be a landmark at the edge of the city and the river.

Site: A Layer







Industrial Stack to be preserved for its historical importance



IMax 3D Theater: A glass tower



Tennessee Aquarium: A brick building with glass roof merging with the sky

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Development is along the Broad Street- the spine of the Chattanooga downtown

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There is a need to increase density of buildings along the Riverside Drive

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Development of river-front facade is proposed by Rivercity Company and currently is in progress

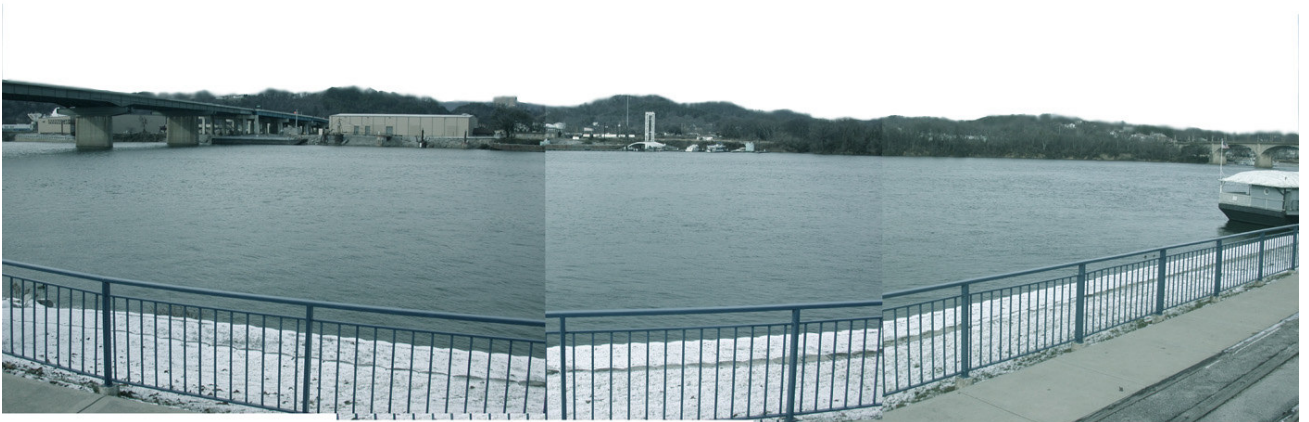
## Water

The Tennessee River is one of the greatest assets of Chattanooga. The site abutting the river possesses a potential for getting a best view of the river from the proposed building.

Movement of people along the riverside can be encouraged by creation of public places at the banks of the river.



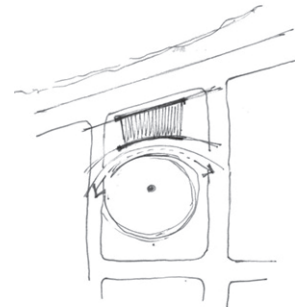
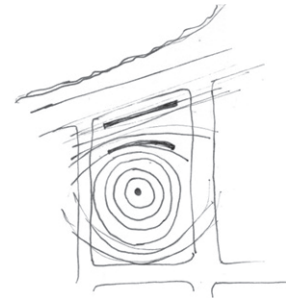


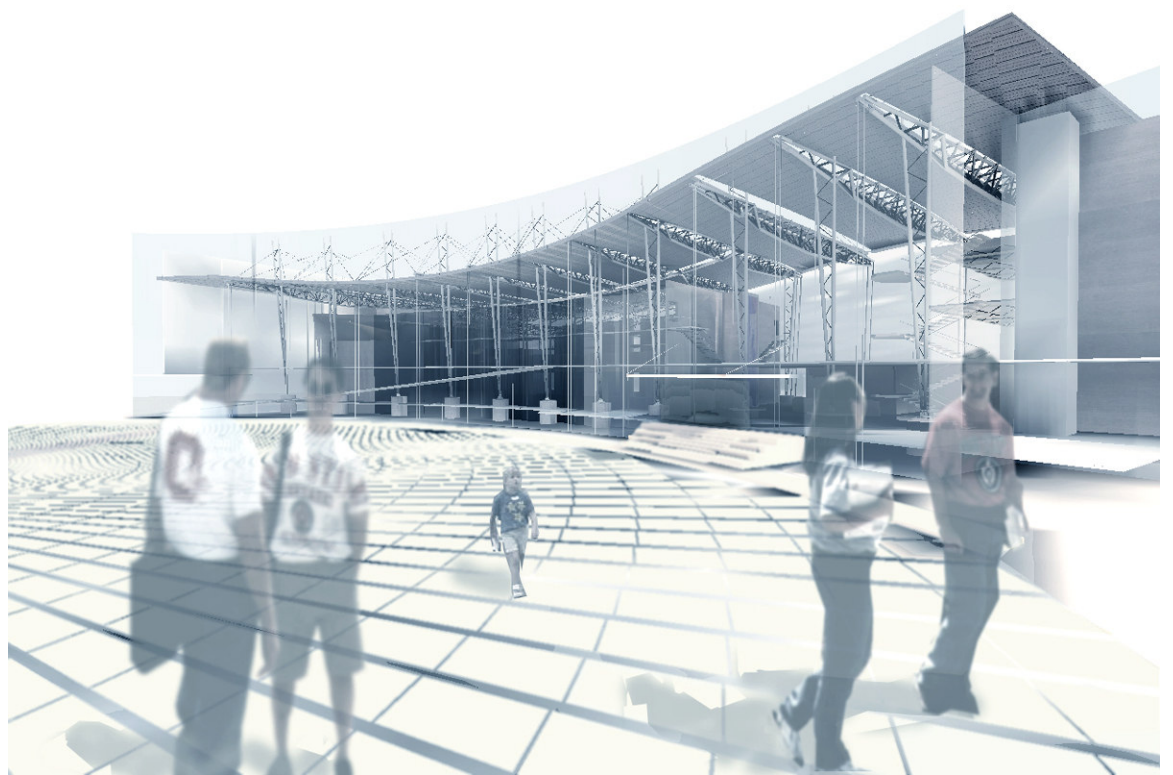


## Public Plaza

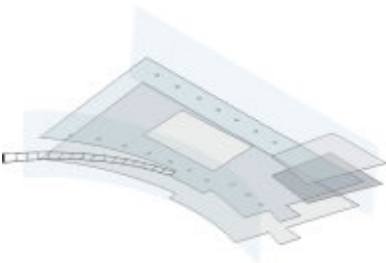
The project order develops from the geometry of the site and the intention of creating a public plaza. The two main axes form the footprint of the building: 1. the riverside façade develops parallel to the Riverside Drive and 2. The radial axis of plaza originates from industrial stack: the center of the site.

The public plaza circling around the industrial stack forms a link between the surrounding public buildings. The glass facade of the Performing Arts Center provides a subtle backdrop to the stack, attempting to preserve its historical importance.



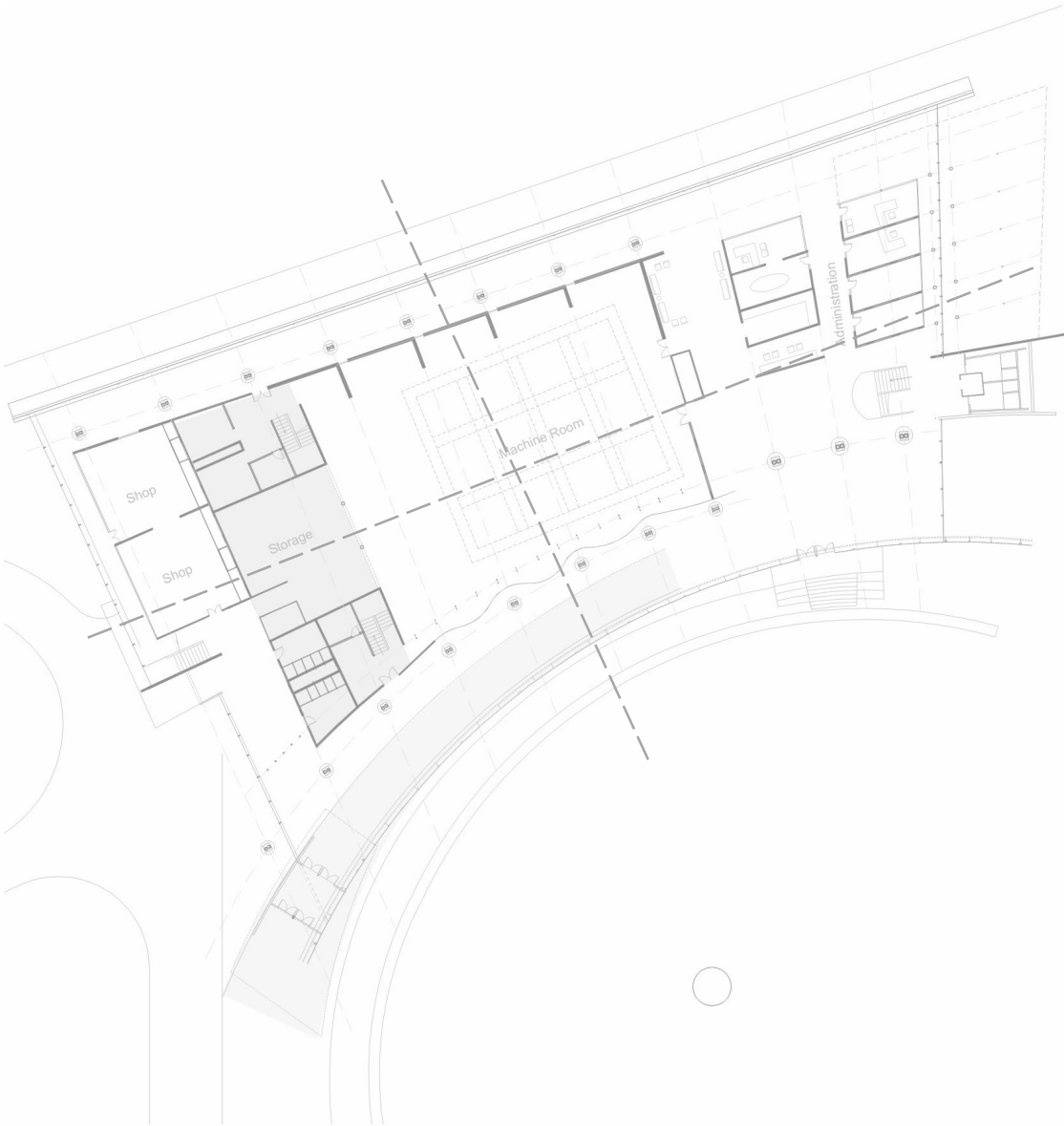


Floor Plans



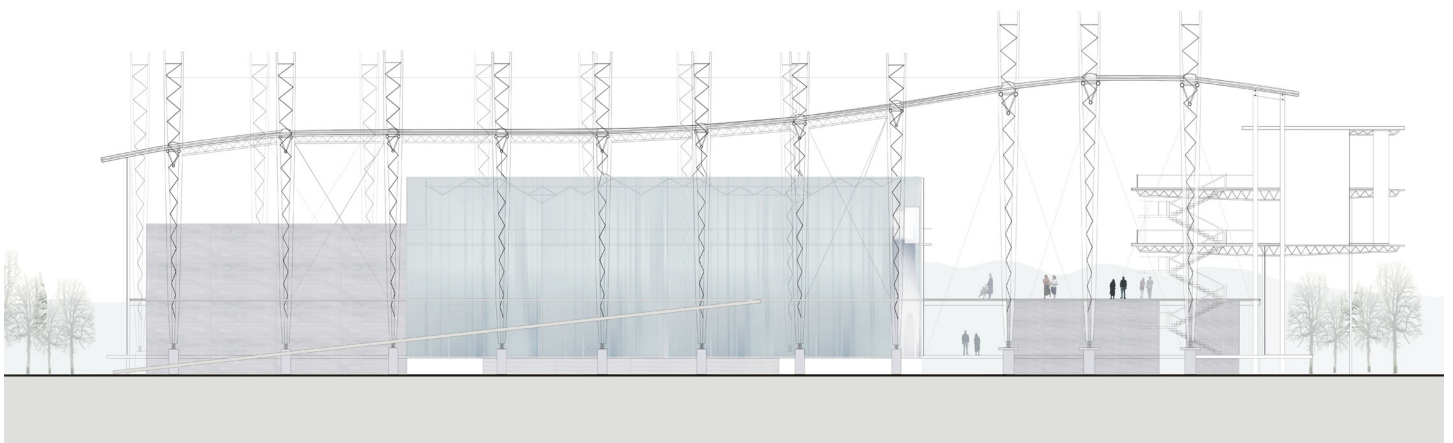
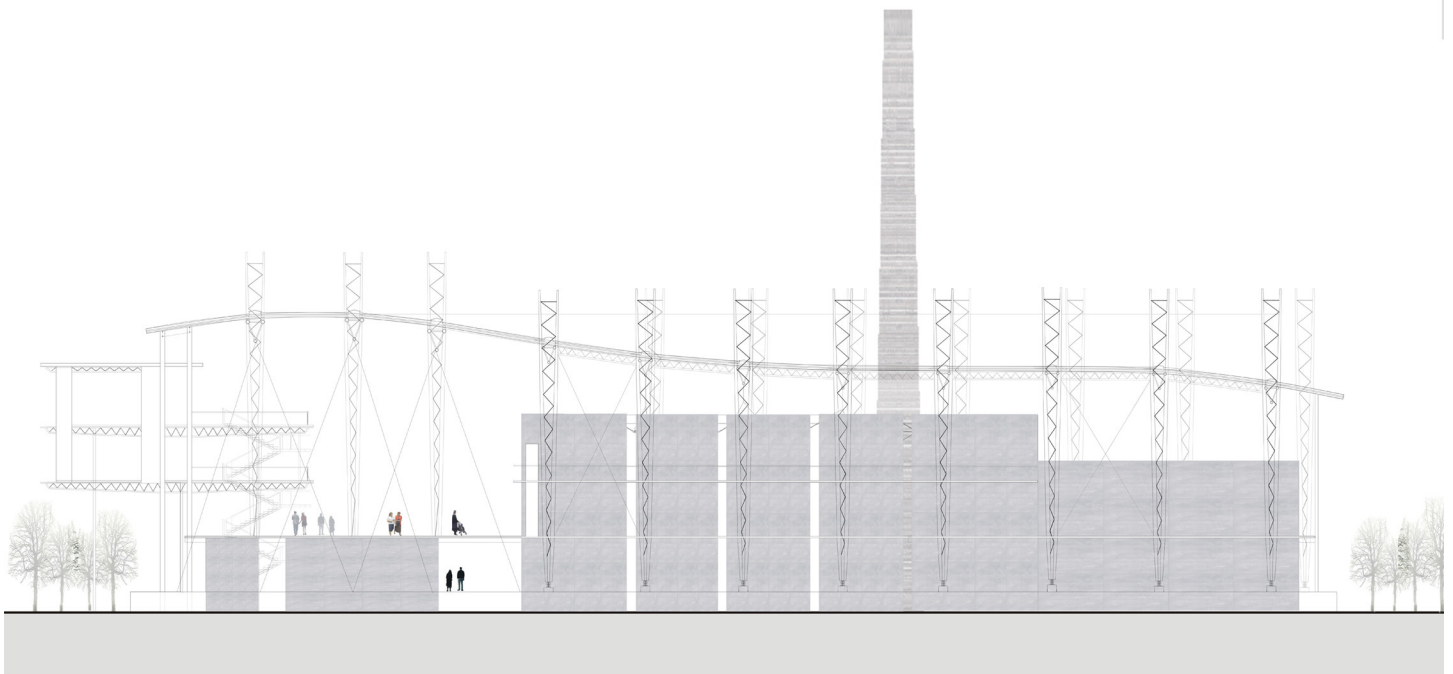


Elevations / Sections

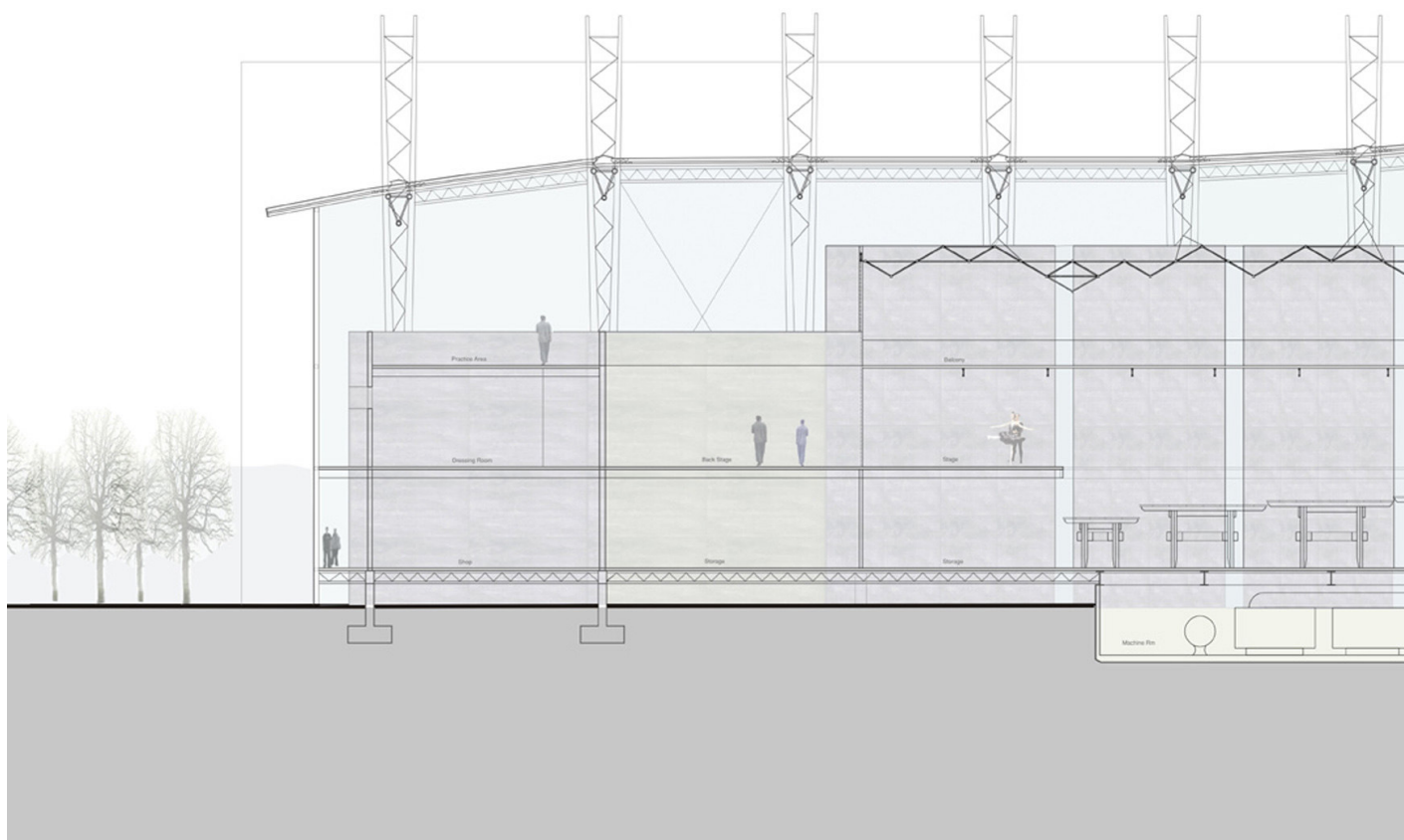


River-side Facade \_\_\_\_\_

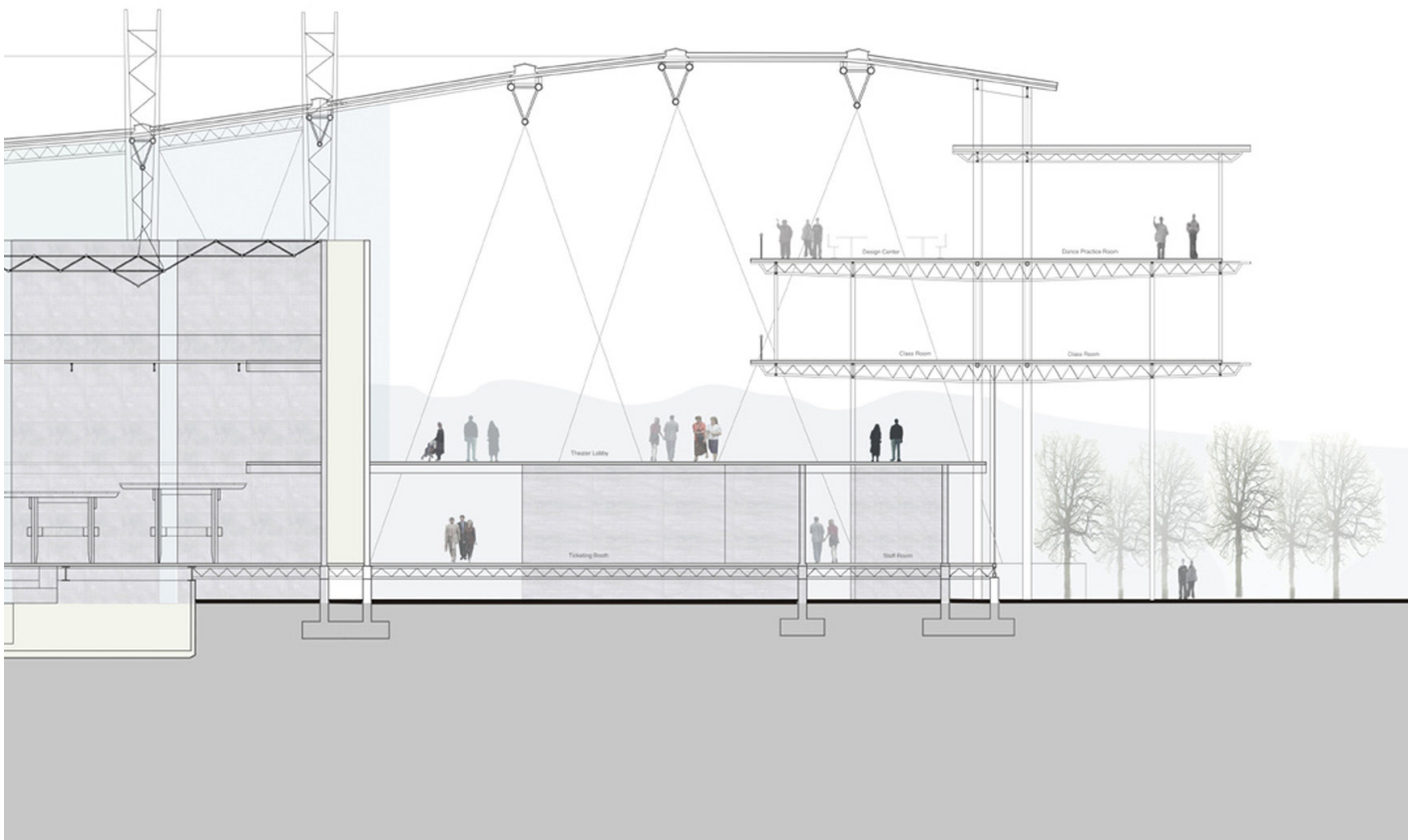
Plaza-side Facade \_\_\_\_\_

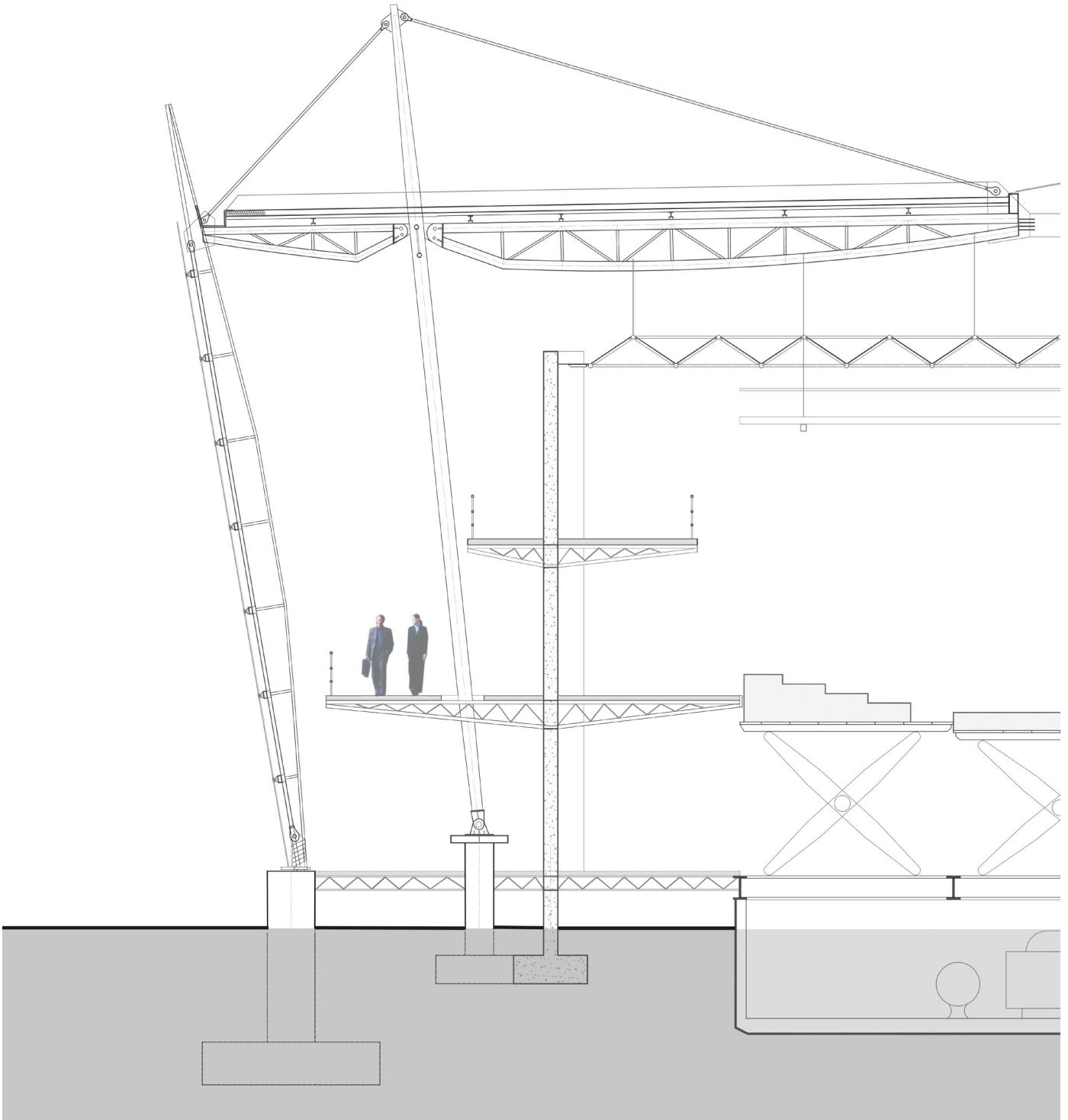


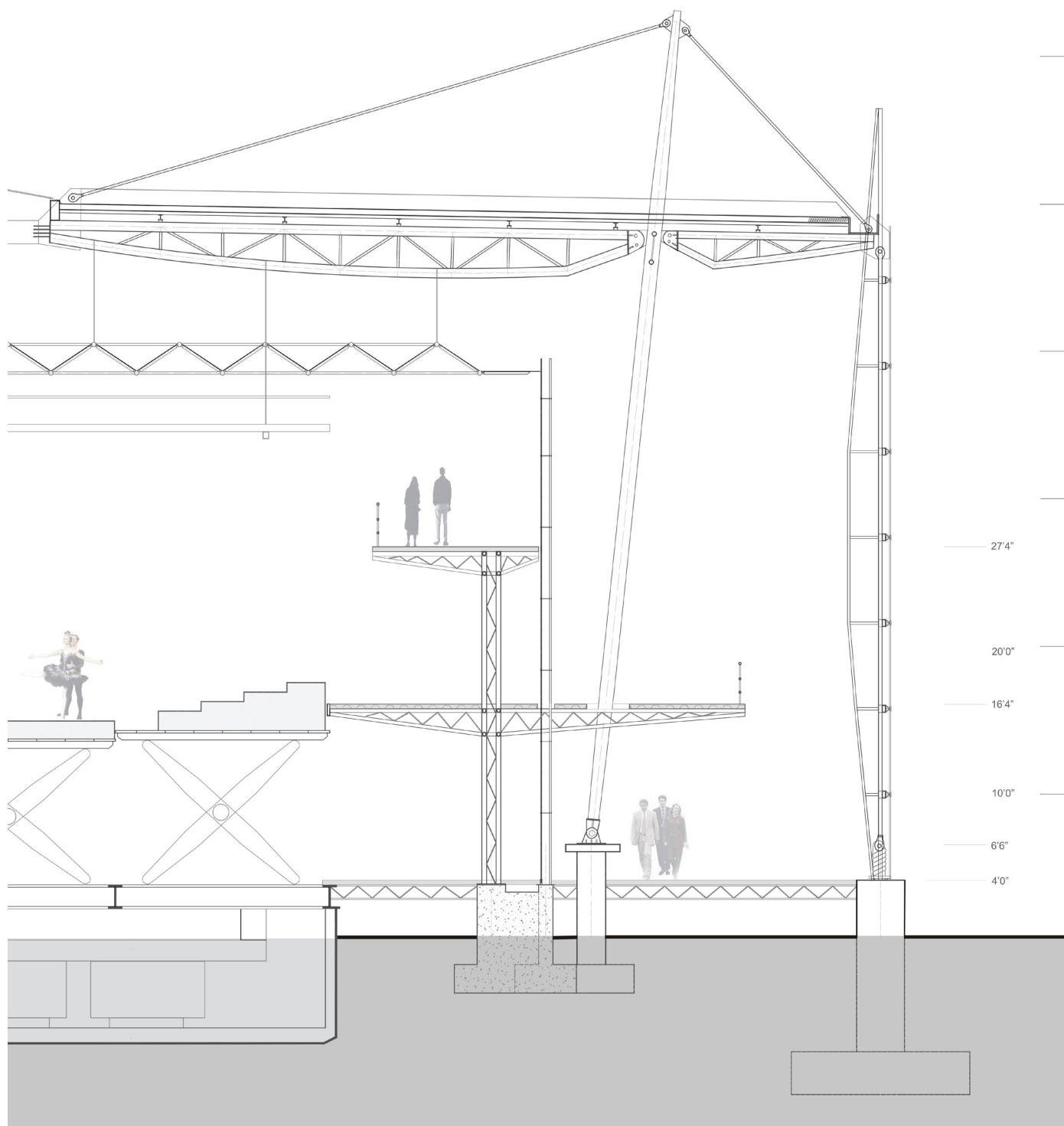












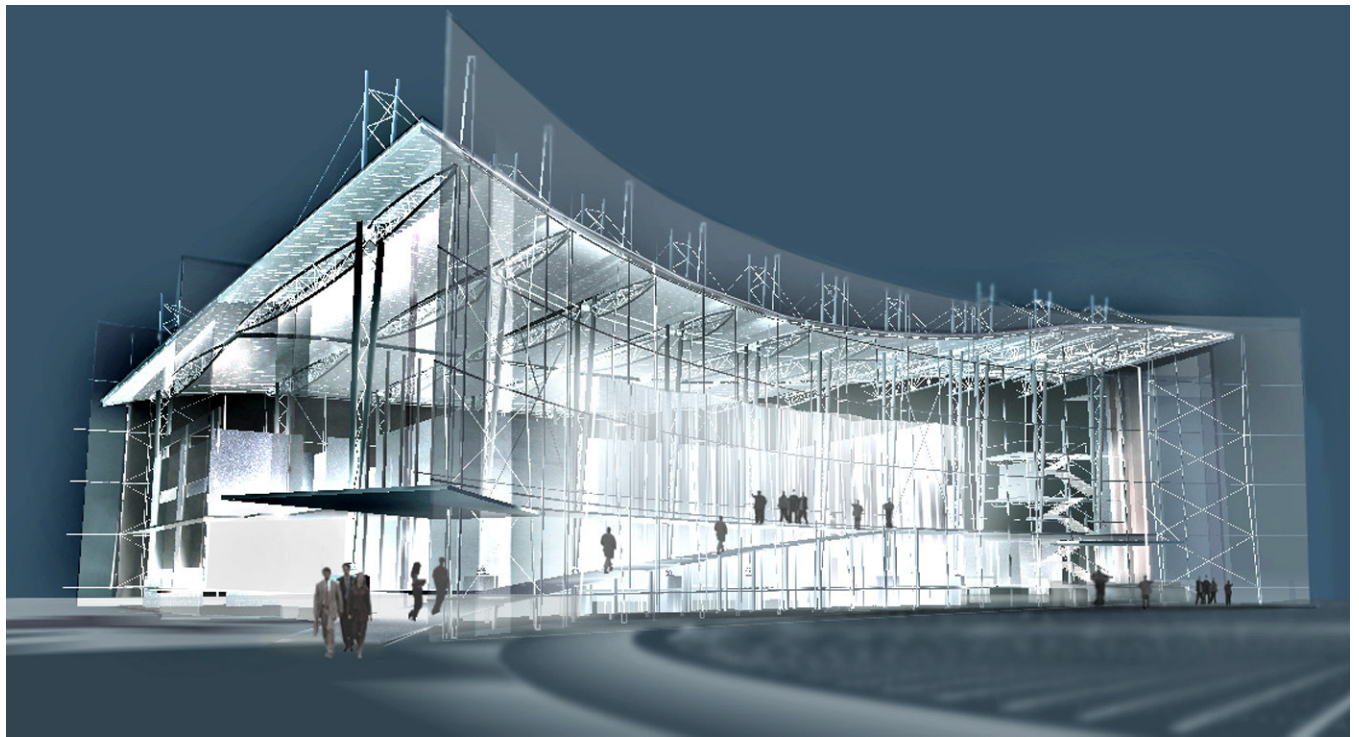
## Conclusion

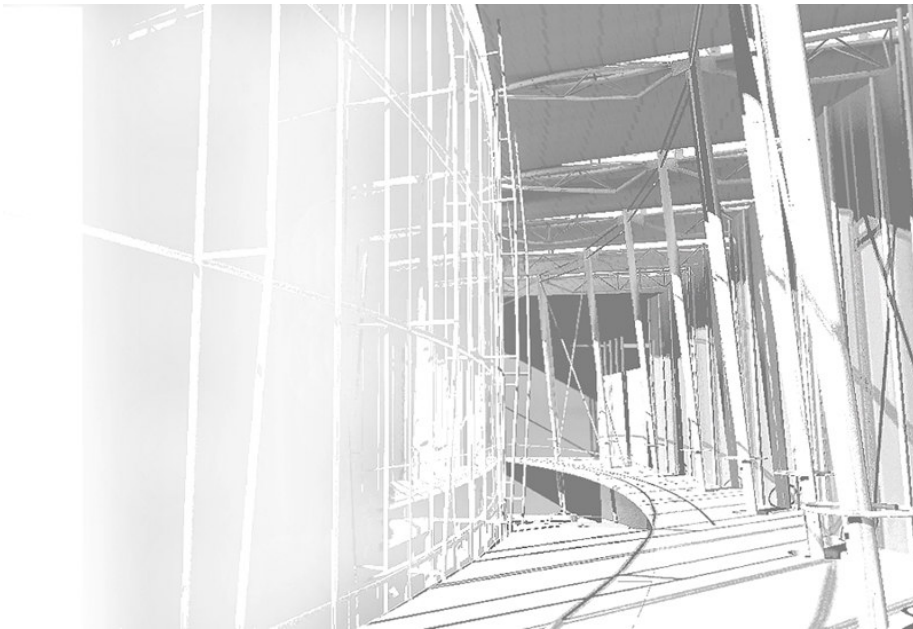
The process of conceptualizing architecture can be approached in a variety of ways. One of the approaches is having programmed ideas about the desired qualities of resultant space. Here, the conceptualizing begins with pre-determined ideas about a specific notion: 'Lightness'.

In the quest of achieving lightness, the **process of layering** is one of the important methods. Layering, overlapping of planes in 3-dimensional space can attempt to create the desired complexity resulting into an experience of lightness.

Lightness can also be achieved through the presence of **transparency**. Transparency offers a possibility of re-integrating city-dwellers with their environment. In the attempt of expressing lightness in its **various modes**, one can continually experience transparency, which is not always apparent.

An architecture based on a specific concept began with disparity of ideas. Ultimately, it elucidated the singularity of the specific situation.....**an attempt to achieve Lightness.**





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