



Play of light on planes: A Kindergarten for Blacksburg,  
Virginia.

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

MASTER OF ARCHITECTURE

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Date of Defense : August 28,2008  
Blacksburg, Virginia  
Spine, classroom, light, planes

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## Abstract

This thesis explores the variety of spatial conditions that can be created with simple planar elements by modulating light. The result is an architectural space in which children better comprehend natural phenomena through the constellation of architectural elements.

## Acknowledgments

I would like to thank all my teachers at CAUS Virginia Tech for making this year so wonderful, fulfilling and challenging for me.

I would like to express my sincere gratitude to my graduate committee for their valuable guidance, inspiration and time. Jim for tirelessly imparting knowledge and helping me achieve my aims. His dedication and zest towards architecture has inspired me to a great extent. Patrick for teaching me to be positive and for having confidence in me. Heiner for his amazing attitude towards design and for influencing and refining my thinking towards architecture. Hans for his knowledge, wit and presence during my defense. Steve for his constructive critique during studios and defense. Peggy for the admission process.

I would like to thank my family and friends.

Mom for her constant love, faith and teachings which keep me going. Dad for his unconditional support, encouragement, confidence, for inspiring me to pursue my dreams and making this all happen.

Shubhangi, Isha, Prachi and Reshma for their love and time to time boosting.

Sarang for being my pillar of strength and determination throughout.

Lastly, I would like to thank my studio friends Shashank, Satish, Asif, Railesha, Girisha, Manidipa, Dhara, Jeff for all their inputs, co-operation, help during defense and making my experience at Virginia Tech so memorable.

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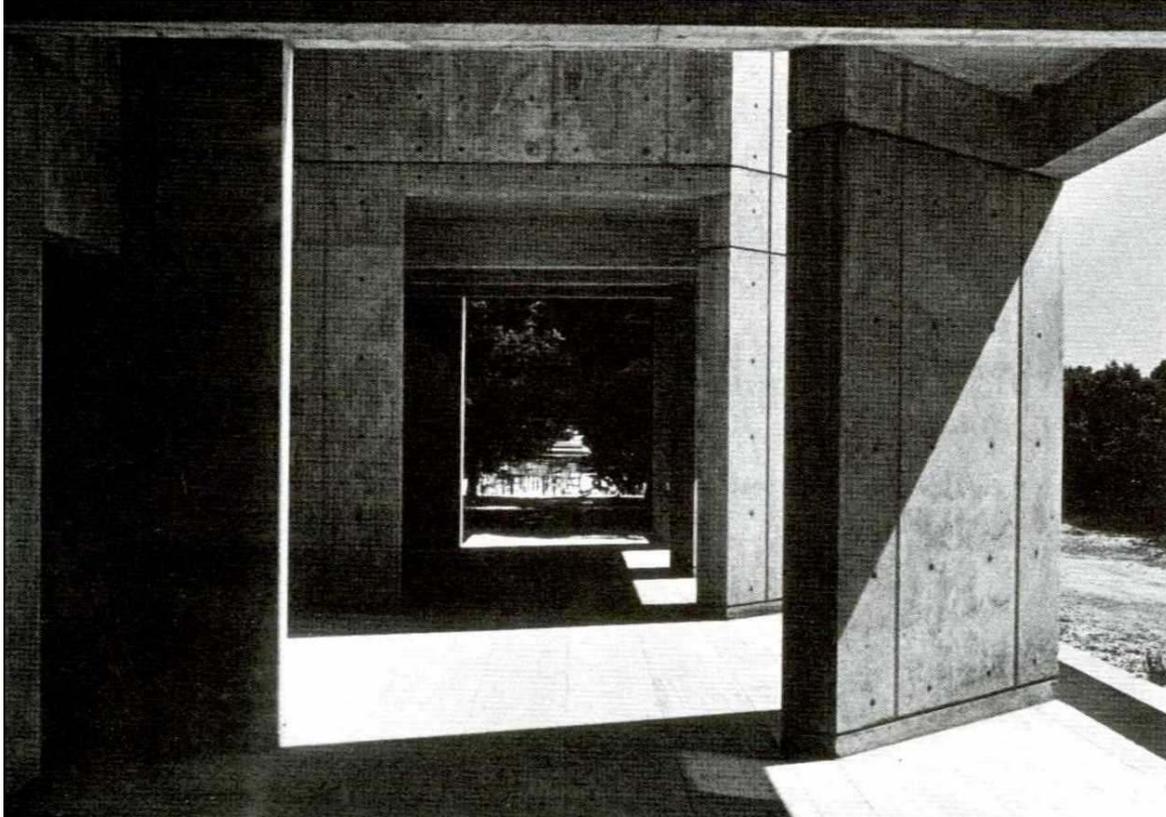
## Introduction

This thesis is a proposition for the play of natural light and planes through the design of a kindergarten. The concept of a kindergarten was proposed in 1840 by Friedrich Froebel and since then many subsequent propositions have been put forward for the design and purpose of a preschool/daycare. The kindergarten is derived from the notion of the school as a metaphorical garden where children are unfolding plants.

Too often it seems that the design of kindergarten and pre-school is focused on the programmatic and physical realms while undervaluing the psychological benefits of indoor and outdoor connections. A kindergarten is where children develop first impressions about the built environment. Learning happens mainly through bodily sensations and experiences. Light, texture and nature have impact and inspire the minds of children.

*Suggested by Tadao Ando, "Light gives objects existence as objects and connects space and form. A beam of light isolated within architectural space lingers on the surfaces of objects and evokes shadow from the background. As light varies in intensity with the shifting of time and changes of season, the appearances of objects are altered. The expression of nature changes constantly. Sunlight changes its quality with the passage of time. It may gently pervade the space at one moment and stab through it like a blade at the next. At times as if one could almost reach out and touch the light."*

This thesis explores the variety of spatial conditions that can be created with simple planar elements by modulating light. The result is a proposition concerning how these conditions help in cultivating the relation between children and outdoor the environment.



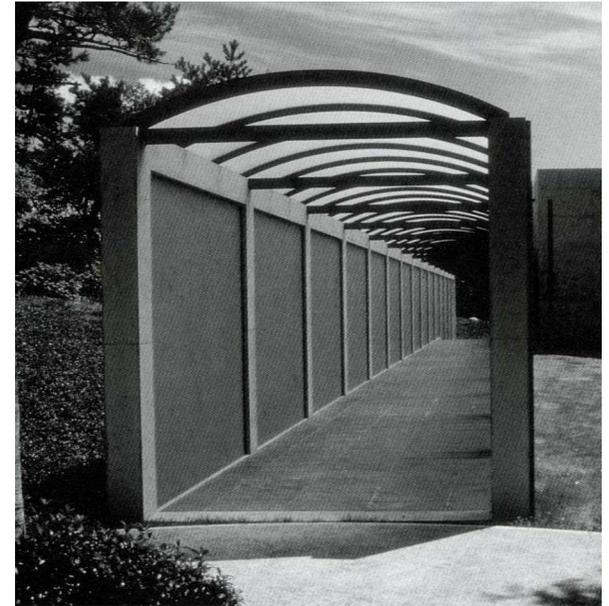
(i) Between Silence and Light  
*Walkway Salk Institute-John Lobell*

## Concept : Light and Planes

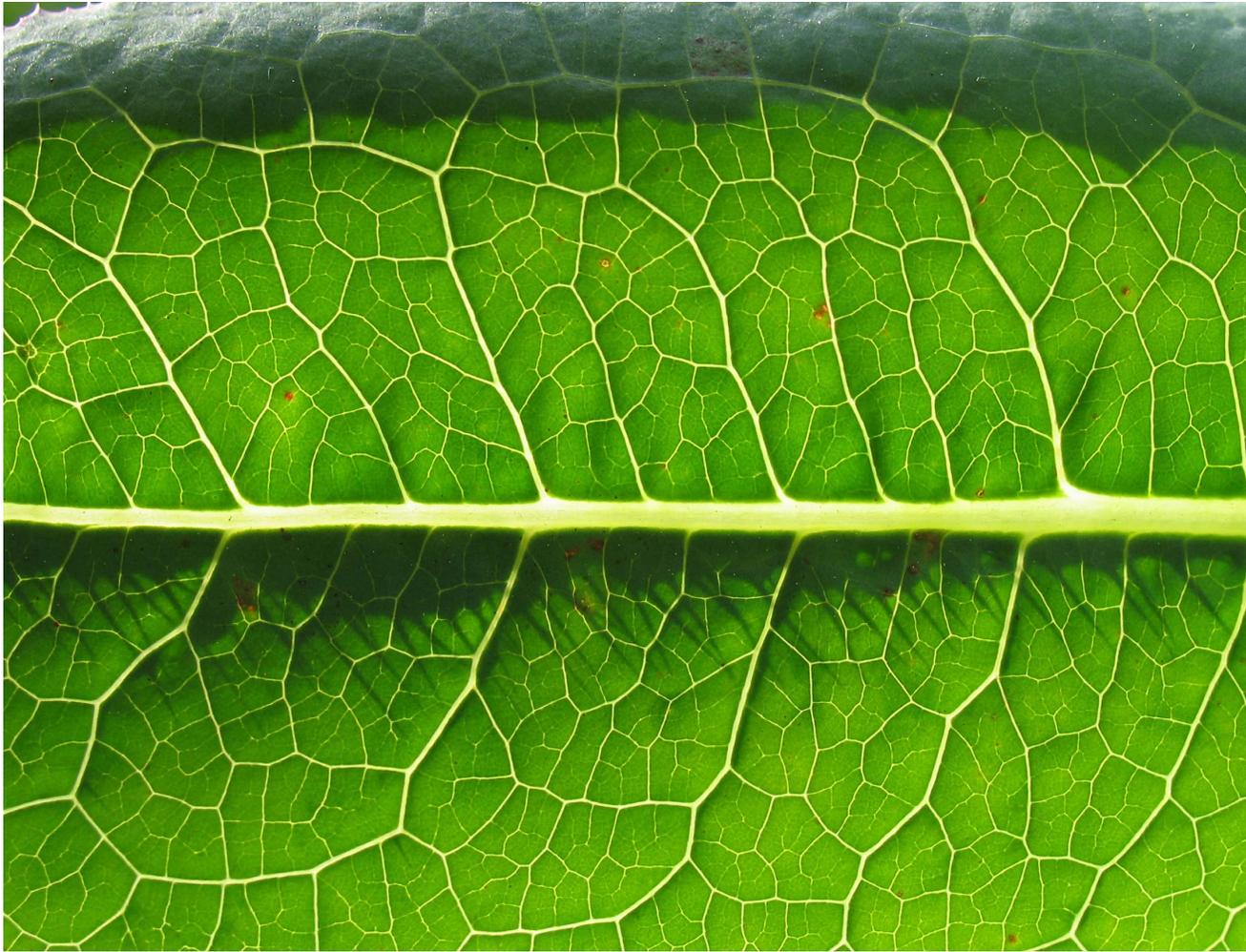
Light interacting with architectural planes is ubiquitous. A central question for this thesis is how can the different qualities of light influence the ambience of a space?

For example; In the Salk Institute designed by Louis Kahn, light and the absence of light create a pattern on the floor while giving rhythm to the space.

In the the entrance to a church by Tadao Ando the light in the covered passage is uniform and diffused resulting in a less interrupted spatial sequence.



(ii) Tadao Ando : complete works / Francesco Dal Co  
[ed. ; contributors, Vittorio Gregotti ... et al.]  
*Church on Mount Rokko*



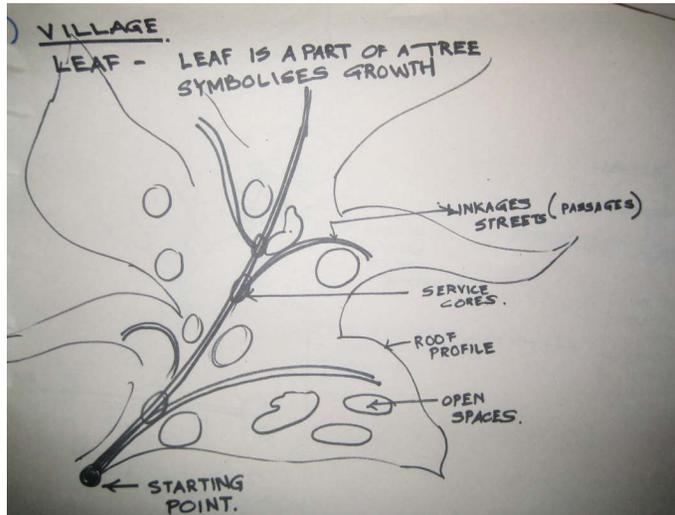
The image shows the structure of a leaf with the stem and veins.

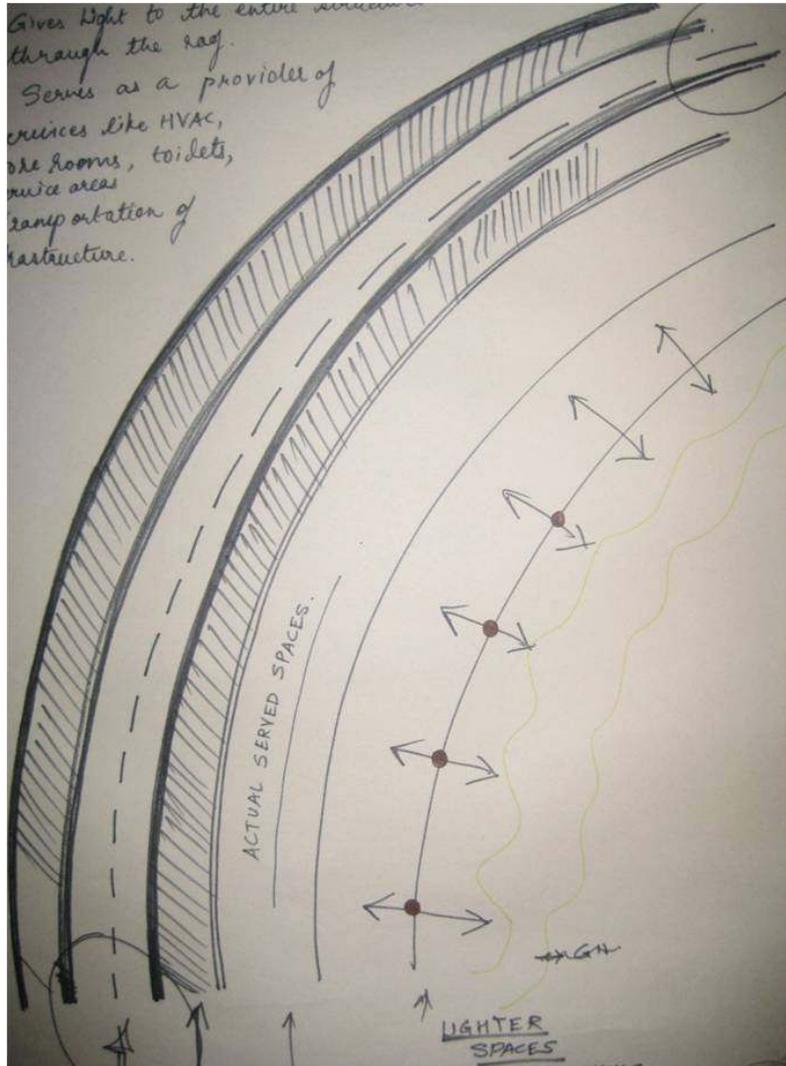


## The Leaf; An Initial Concept

The initial organizational idea for the kindergarten was derived from the structure of the leaf. Whether it be a tree, a shrub or a flower the garden would not be without a leaf. The stem and the veins of the leaf provide light, infrastructure and nutrients to the leaf. In a leaf, the body is dependent on the stem. Similarly, in the kindergarten the stem provides light, services and infrastructure to the other spaces.

With the leaf as the analogy for the building, the central corridor acts as the stem while the passages serve as connectors to the adjacent spaces. The stem is heavy, massive and rigid forming the primary structure. The adjacent spaces are light, free flowing and interact with the surroundings.

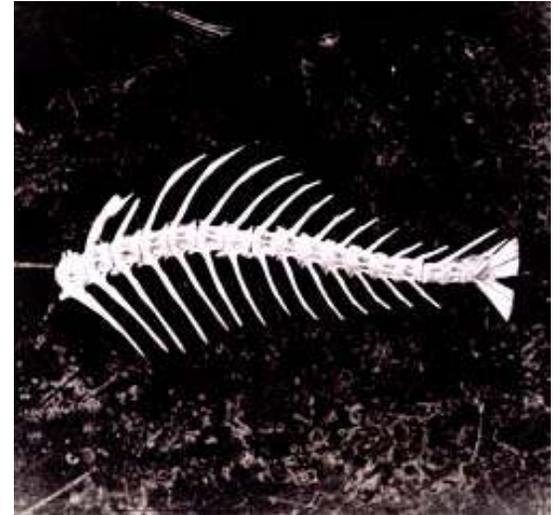


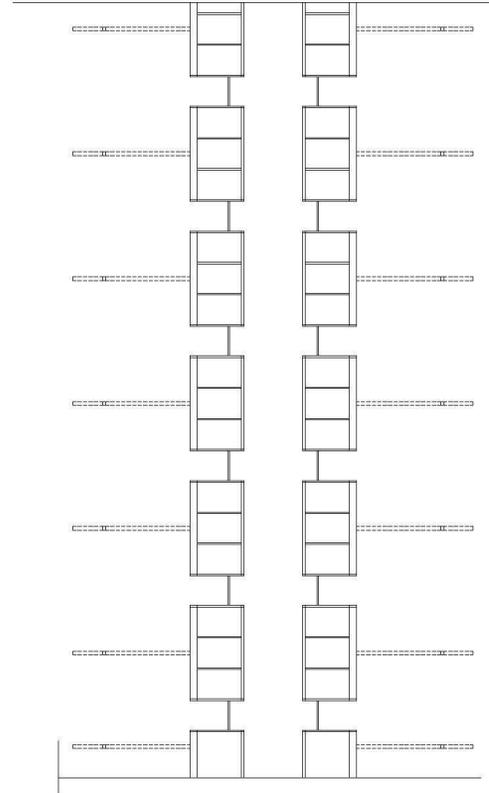
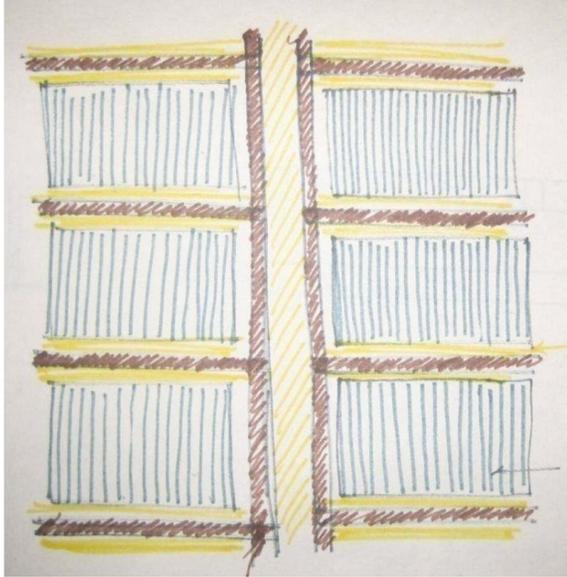


## Stem

Evolution of the stem;

The analogy of a leaf led to the investigation of other similar metaphors such as biological spines. For example; The skeleton of a fish is a similar spinal organization but is simpler in its conception than the stem of a leaf. The spine of the fish is made of elements which are interlocked as the ribs project symmetrically to the sides.



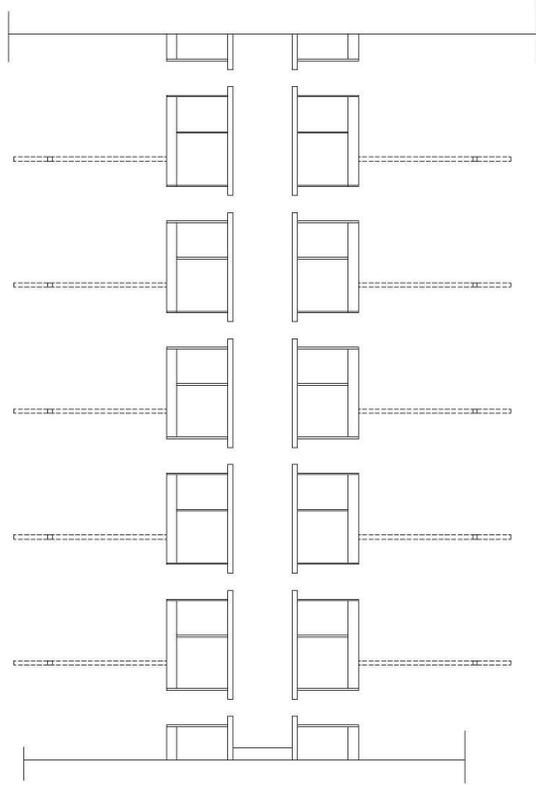


(a)

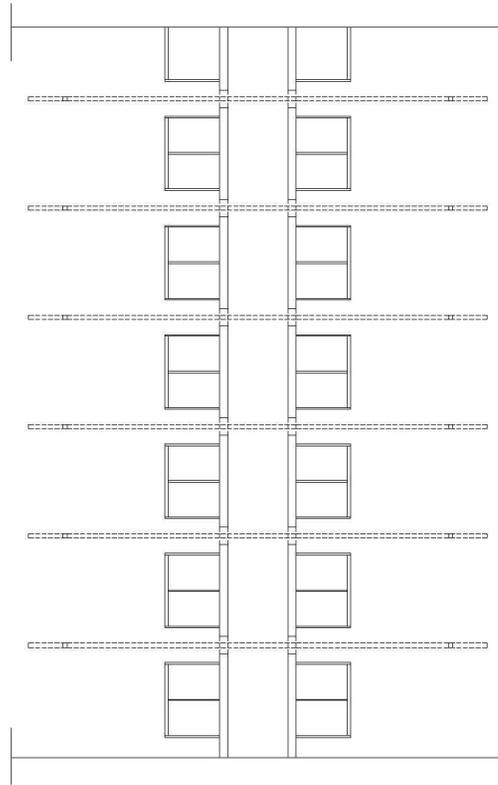
As the stem of the leaf is a conduit for the flow of nutrients to the body of the leaf the stem of the building gives light to the adjacent spaces and leads one towards the garden and outdoor spaces. In the sketch to the left, the brown color denotes the main structure and the blue areas show the dependent spaces.

I decided to follow the concept of the stem acting as a servant and its structure guiding the formation of rooms which are the served spaces. The stem supports both the flow of occupants and of light, connecting inside with out.

In the first case (a), the opening is recessed thus emphasizing the rhythm of the planes. The wall housing the beam is treated differently. The beam has an important presence in the interior and determines the structure of the roof.



(b)



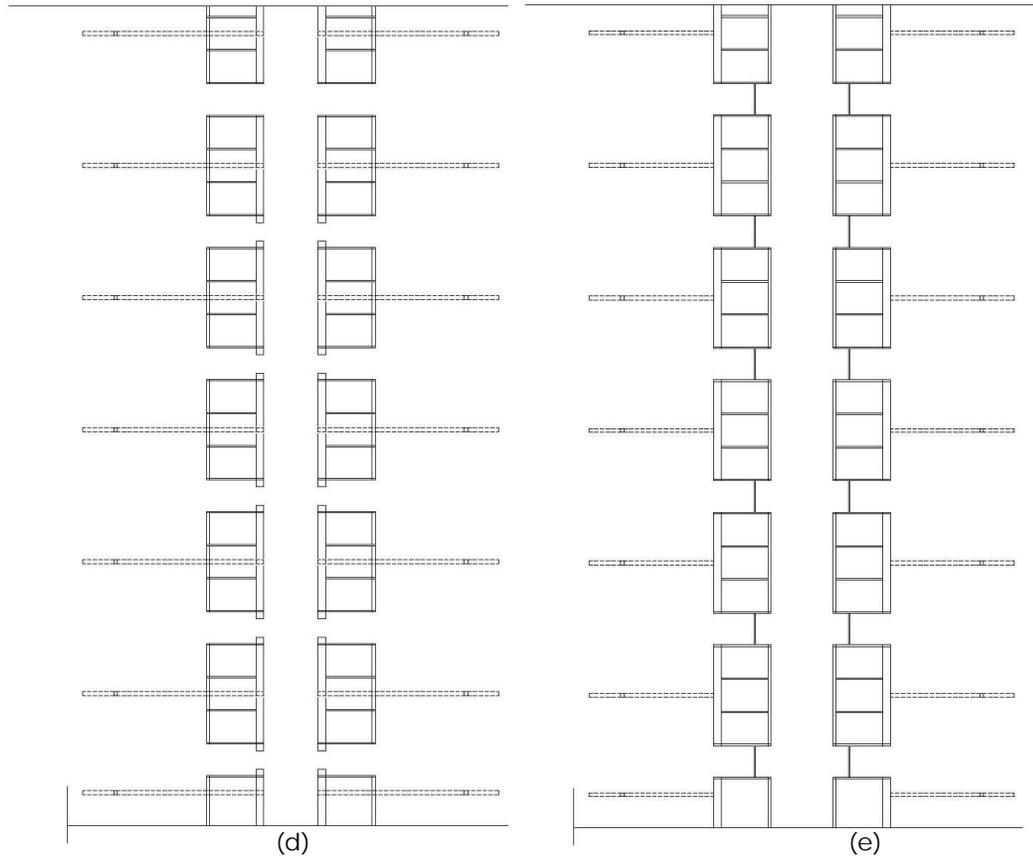
(c)

The openings act as pauses or interruptions in the plane of the wall.

In the second case (b) the beam is the dominant element in the organization of the stem. The beam informs the roof and also carries the eye toward the adjacent spaces. In (c) the beam marks the entry to the classrooms while being an artery of light.

In example '(d)', the rooms are symmetrical with one of the bays acting as the entry to the classrooms. The beams play an important role in the circulation and guides or directs flow towards the classrooms.

In example '(e),' the outer walls are structural member while the inner face of the service rooms can be treated in various ways. There is a distinction between elements belonging to the stem and those belonging to the plane space. Here the beam is elevated in importance for the classrooms and influences the structure.

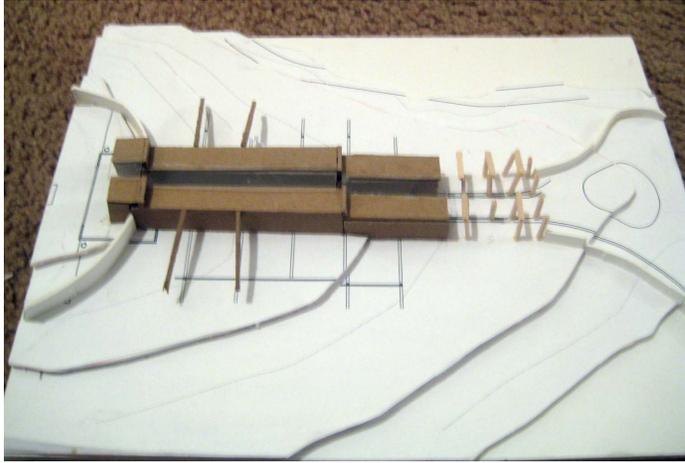




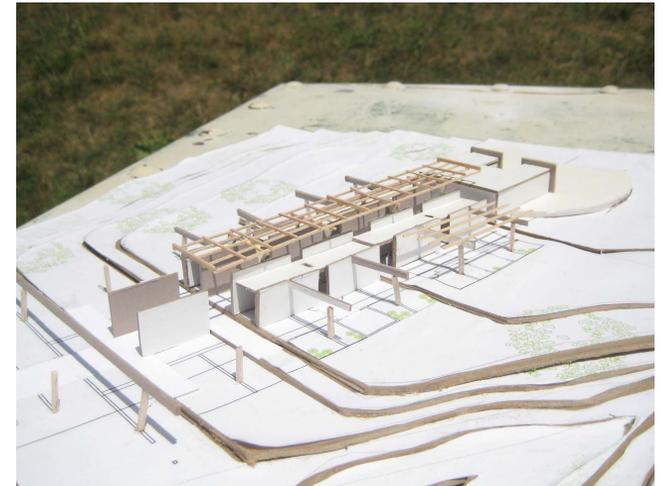
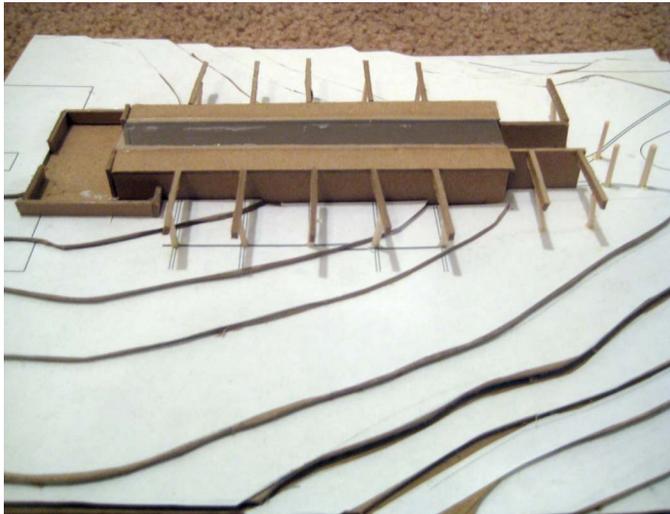
## Organization of the Stem

The stem consists of two elements, planes and beam. The space between two planes acts as a service area. The column, roof and the façade of the rooms form the secondary structure which is light and in contrast to the heavy stem. The stem provides a spatial sequence of perspective to the space. It forms a series of spaces with varying light conditions. Passages and entrances are marked by sheaves of light piercing the planes. As light makes its way through different openings, it reveals the thickness of the planes and highlights their edges.





An early consideration was the dialogue between the stem and the site. The upper left model shows the stem following the sloping contours and merging with the site. The lower left model shows the planes of the stem at the same level and the roof forming a plane reinforcing the horizontality and hovering above the planes.





The adjoining image depicts the dialogue of the building with the site.

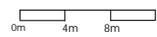


Site Plan

It was important that the strength of the axis of the stem be retained. The entrance driveway is oriented along the axis enabling visitors to see the building along the stem.

The driveway forms a cul-de-sac that provides the parents an option to drop off their children and circle back to work or go forward to park the cars, and access the building.

The organization of spaces around the stem includes four classrooms oriented towards the southwest. At the end there are two multipurpose rooms. The office space does not have a boundary wall to the undivided garden. These spaces merge with the outdoor surroundings.

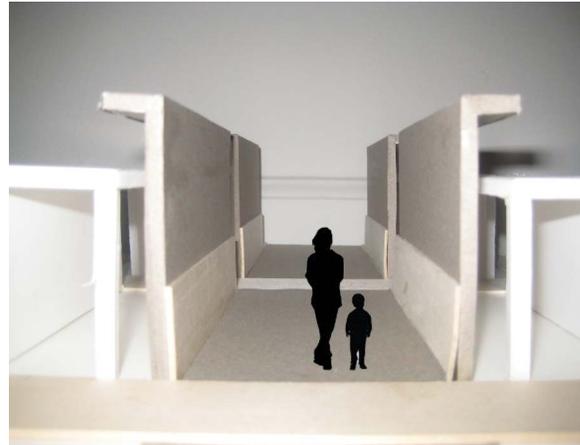
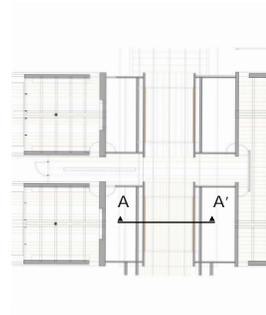
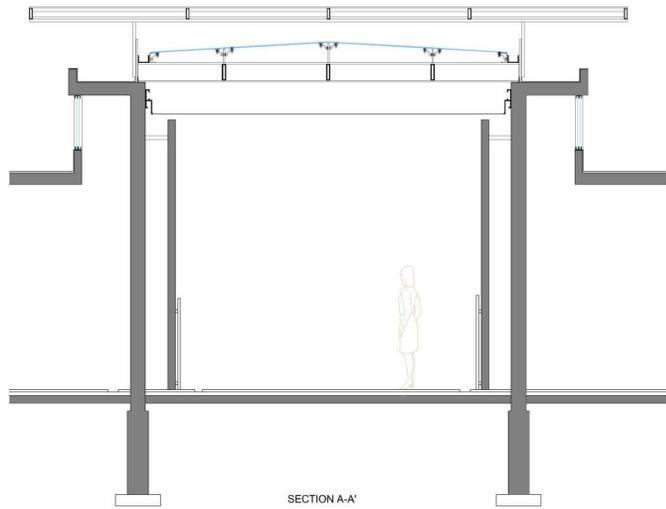


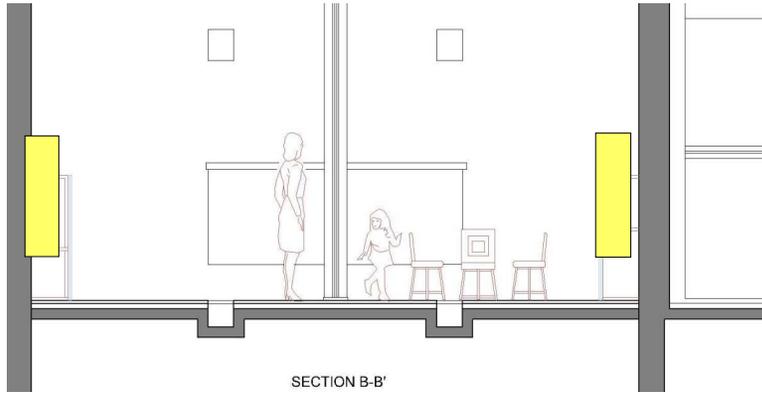
Ground Floor Plan

## Light, Planes and Materials

The intended character of the play of light on the planes and the resulting dialogue with the outdoors was a primary factor in determining the choice of materials.

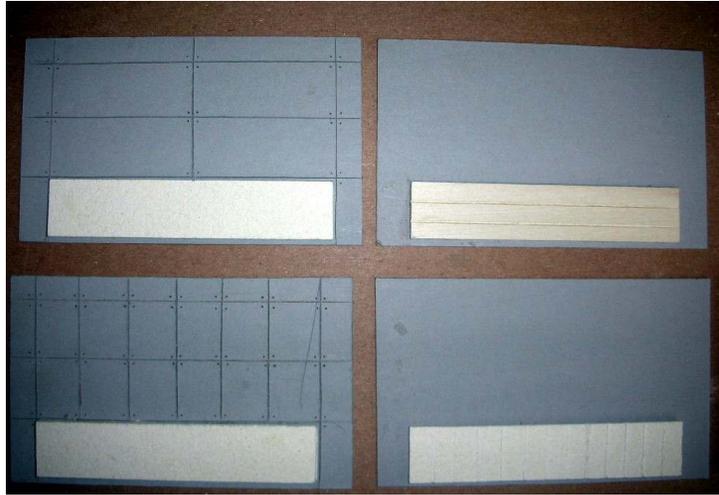
Role of wood- In the stem wood is introduced as a secondary material. The wood is planar, setting off of the concrete revealing its edge. The wood extends only partially up the wall creating a datum the height of the child. The wood is soft and inviting to the touch while providing a tackable surface for display of work and art. The wood grain reinforces the directional perspective toward the outdoors.



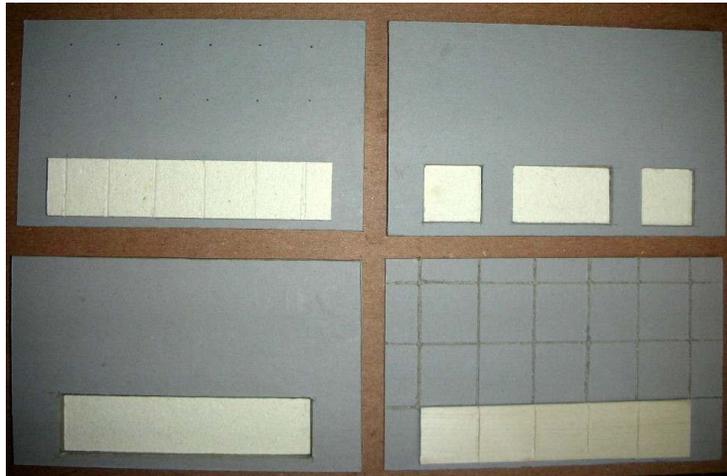


In the classrooms, wood bonds the child's world. The wood floor turns up to become shelves for toys and the child's belongings. As in the stem the wood grain provides a directional flow from inside to out and the tactile qualities are inviting to the touch.





The primary planes are concrete. The planes create a strong spatial perspective that leads the eye to the outdoors and a water event at the end of the stem. The concrete is smooth creating a neutral pallet to receive the light through the roof plane. The images to the left show the various alternatives for the design of concrete planes with wood paneling. The concrete is mainly employed to form the stem enclosure and intercept the light.

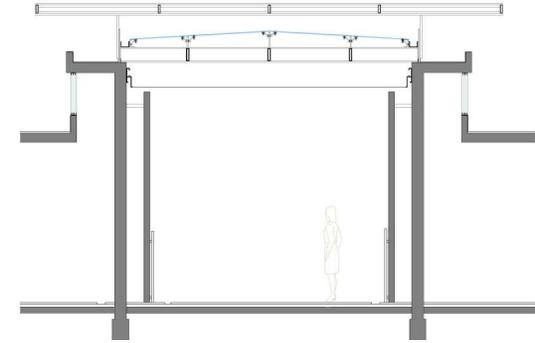
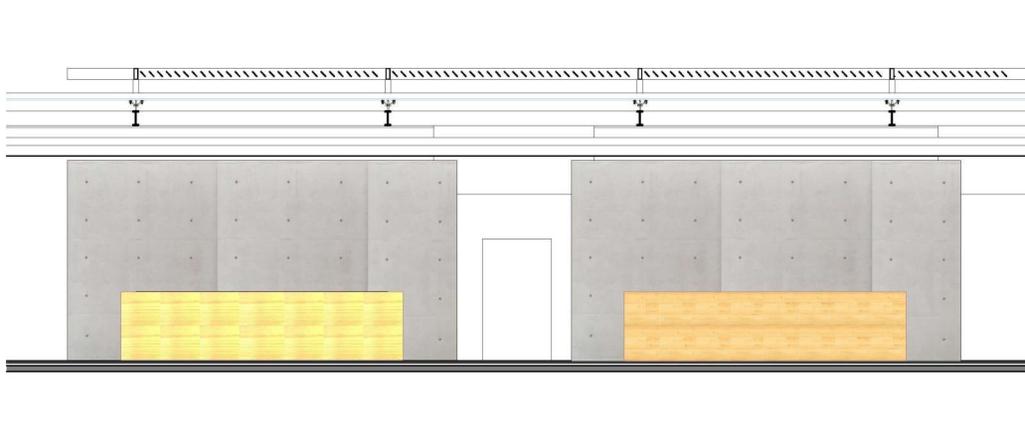




### The Roof: Initial Proposition

The images to the left show the initial proposition for the roof of the stem. Here a space frame sits on the edge of the concrete planes. However this solution was rejected because the direct light casts sharp shadows on the walls causing distraction from the desire for the roof to read as a floating overhead plane while competing with the spatial perspective to the outdoors.

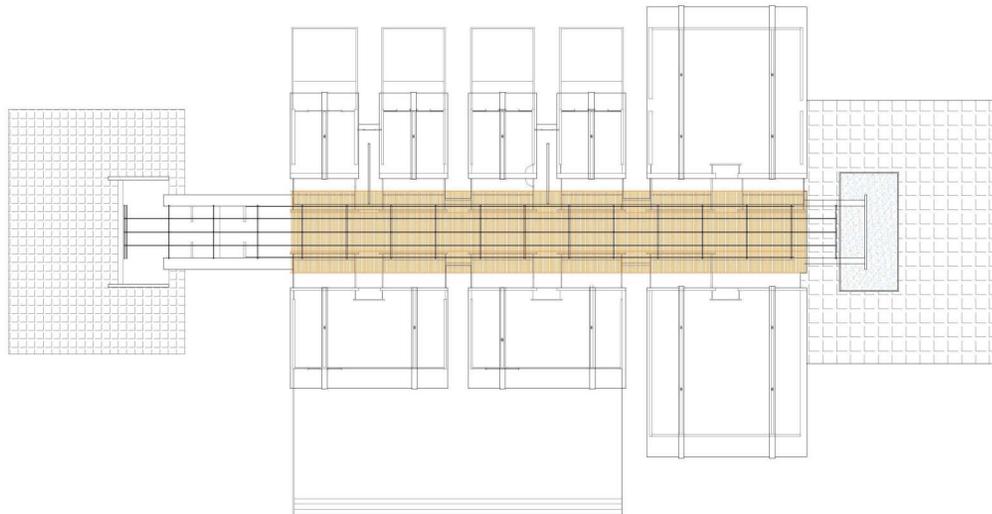




#### Roof of the stem:

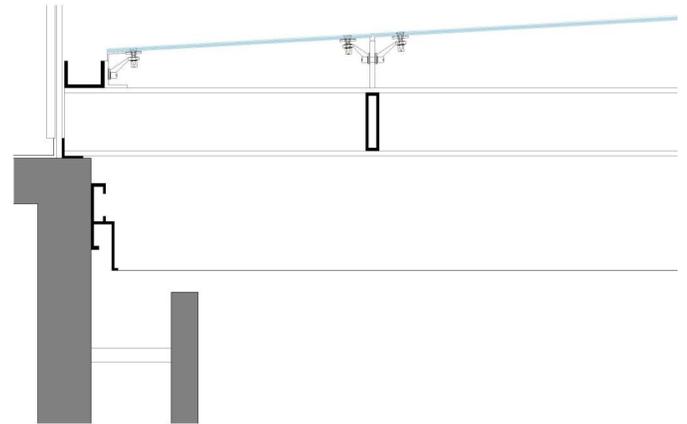
The final roof of the stem has three layers. The first layer visually hovers above the wall planes and extends towards the sides. The louvers filter the light reducing glare. The second layer forms the structure of the roof. The steel members with glass panes act as a thermal control layer and moderates the intensity of the light. This layer extends on both sides of the stem. A translucent stretched fabric forms the final layer diffusing light.

The roof visually hovers above the stem wall planes maintaining their profile. It extends out towards the non-built environment trying to establish a relation with the site.

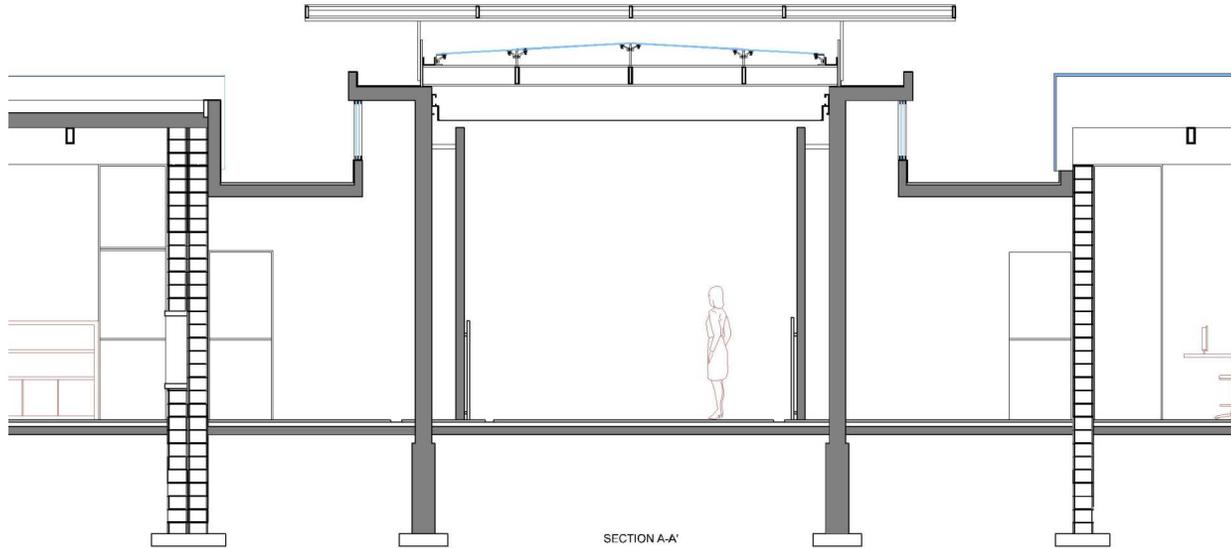




A translucent white fabric is stretched to form the ceiling of the stem. The fabric is stretched over a track which is fixed to the structural plane. The main purpose of the ceiling is to diffuse the light while avoiding sharp shadows. The image at the lower left shows a similar quality of light in Renzo Piano's Twombly museum. The moderated light is appropriate for the exhibits. This soft white light bathes the concrete planes reinforcing their planar appearance.

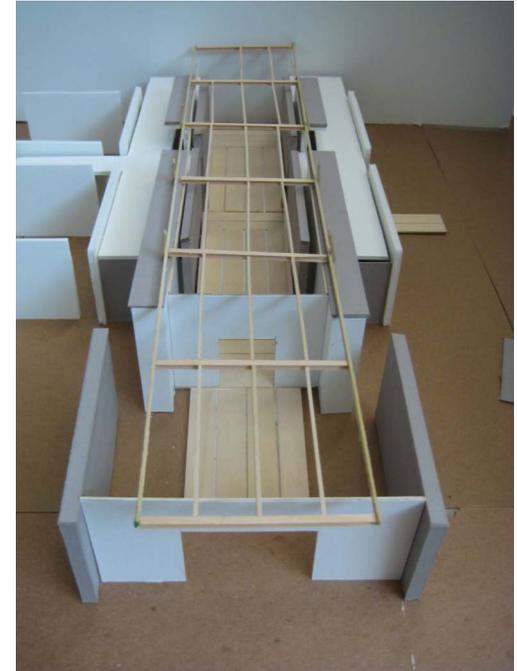


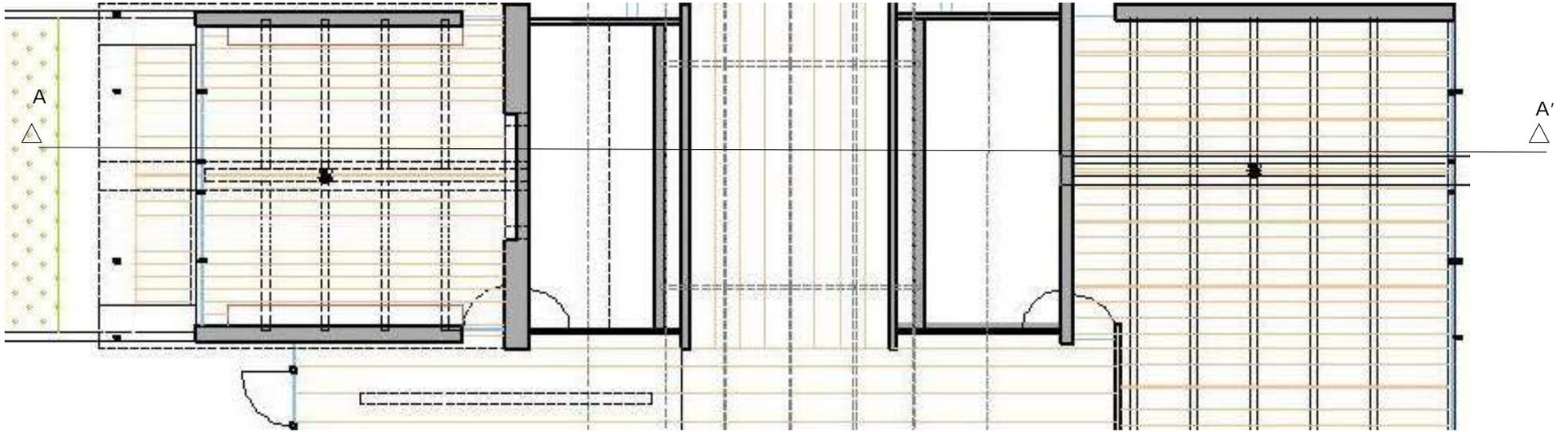
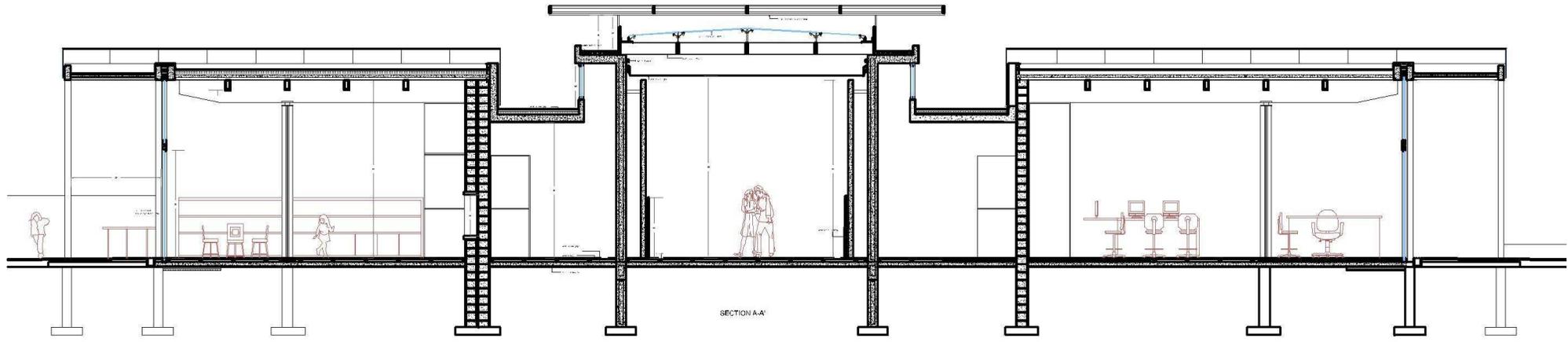
(iii)Renzo Piano museums / essay by Victoria Newhouse)



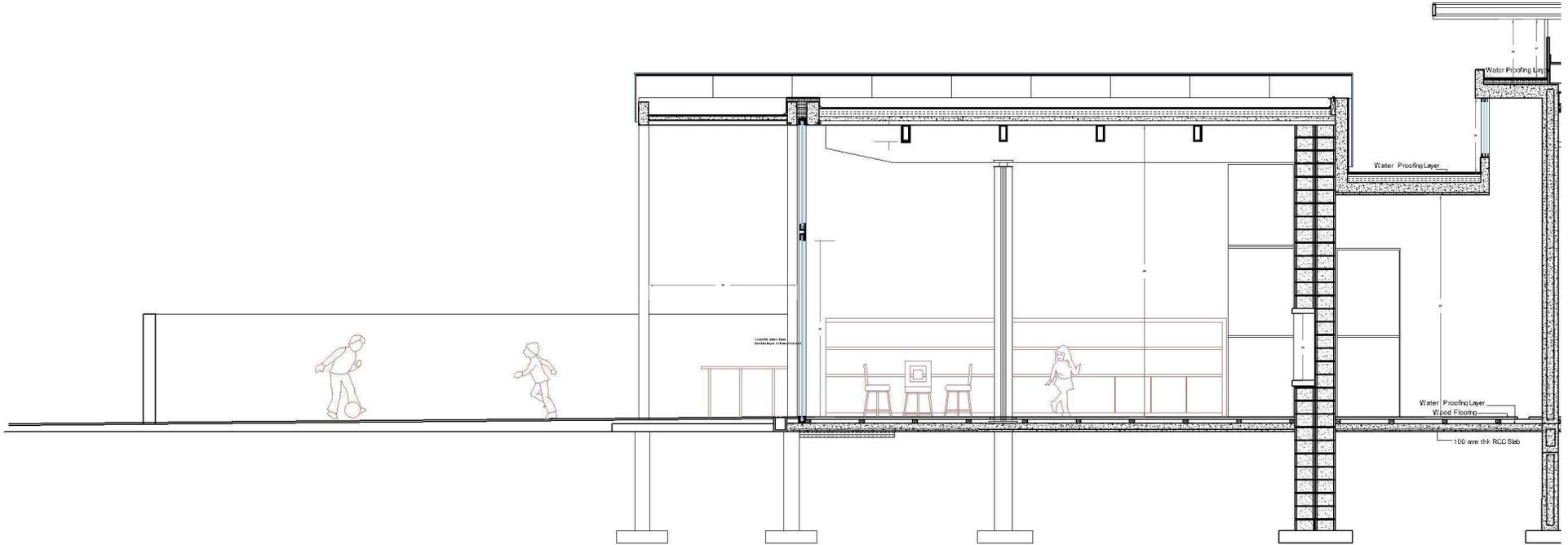
### Structural planes and wall planes:

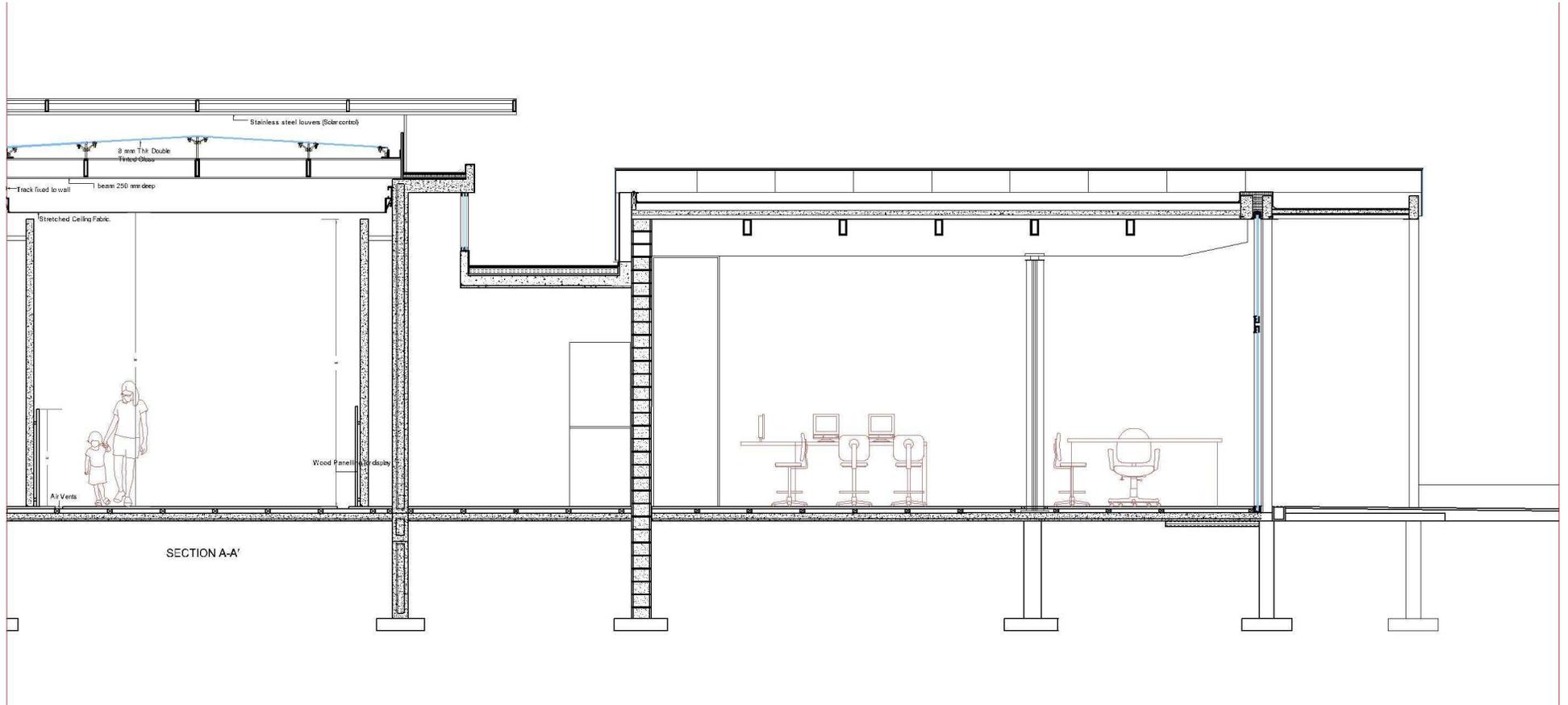
The wall planes are independent from the structure and roof and appear floating. The structure of the roof is carried by the secondary planes that set back from the wall planes. The connection between roof and structural wall is concealed. The base of the structural planes widen to admit daylight to the service spaces. The cavity between the two planes acts as a service duct. The air is conditioned by a heat pump system. Cool air is introduced through the vents in the floor of the stem. The steel frame of the roof extends out to form a semi-open canopy at the entrance.





PART PLAN







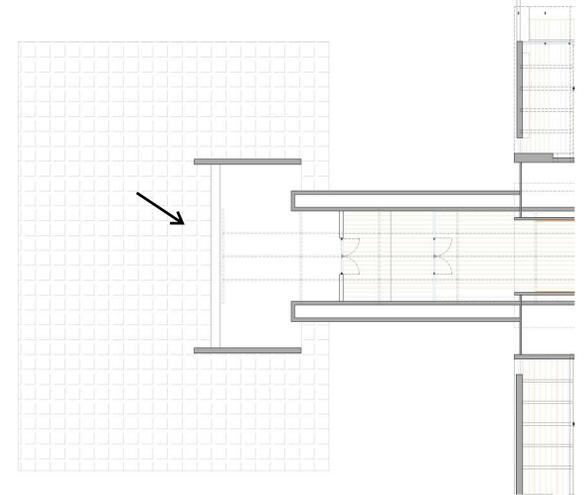
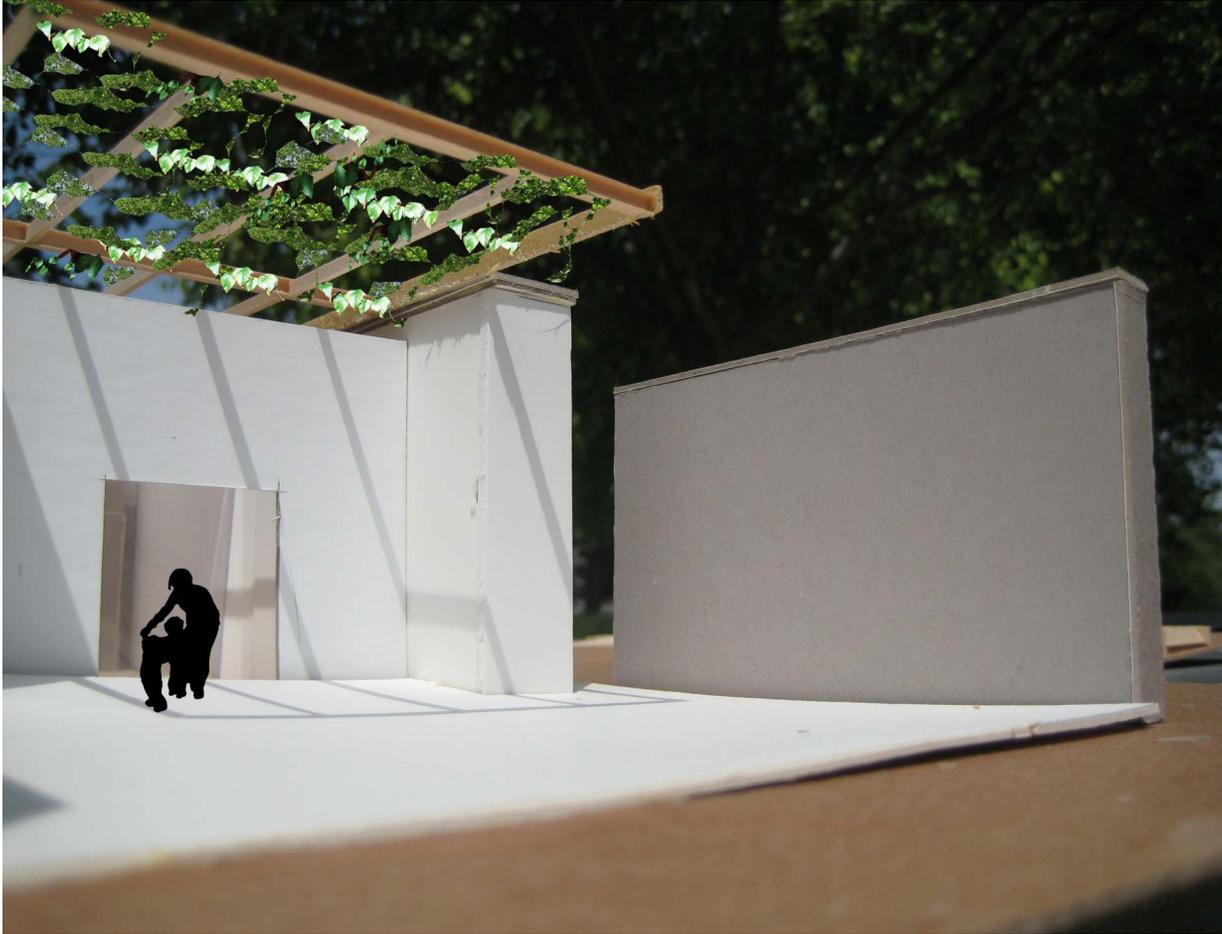
The wall planes of the stem along with the wood paneling and structure of the ceiling form a strong perspective leading the eye outdoors.

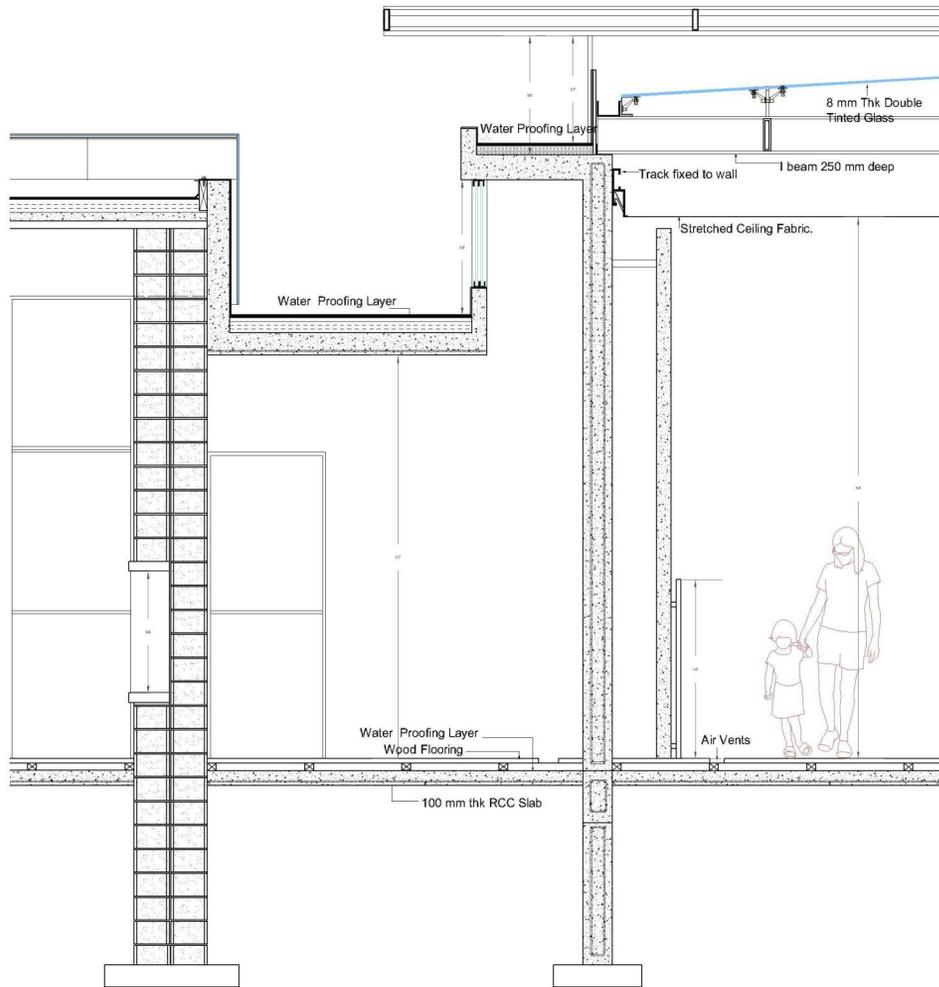
The stem is much more than a passage, it is an exhibit area to display the creativity of the children. It serves as a window capturing different qualities of light and surroundings throughout the day and across seasons.

## Conditions of Light

### Light at the entrance

Two free standing concrete planes greet the people at the entrance. The light falling on the planes is direct and dynamic. The steel structural frame of the roof is exposed and extends out casting shadows on the planes. As one proceeds towards the lobby the quality of light changes. The intensity of light is modulated by the solar louvers. The light is further diffused by the ceiling fabric. The lobby acts as a buffer between the exterior and interior. The inner entrance is transparent enabling one to see the profile of the planes.





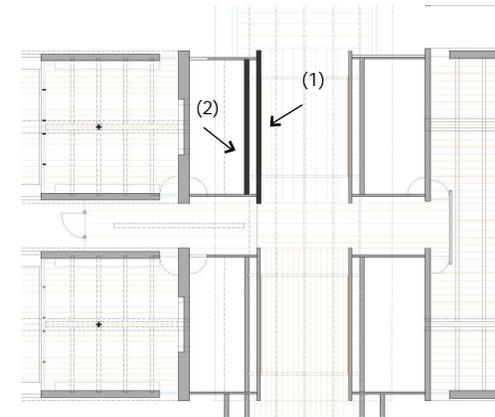
## Light conditions in the Stem:

### Light on the service planes:

The structural planes widen at their apex and allow daylight to enter the service space that is directly adjacent to the stem. Light enters the service space from the clerestory window, falls on the concrete plane and diffuses into the room. The service areas enjoy a hint of daylight that seems to be cut off from its source.

### Light on the Stem wall planes:

Soft, white diffused light through the three layers of the roof bathes the planes of the stem. This light quality enhances the viewing of art work on the wood panels.

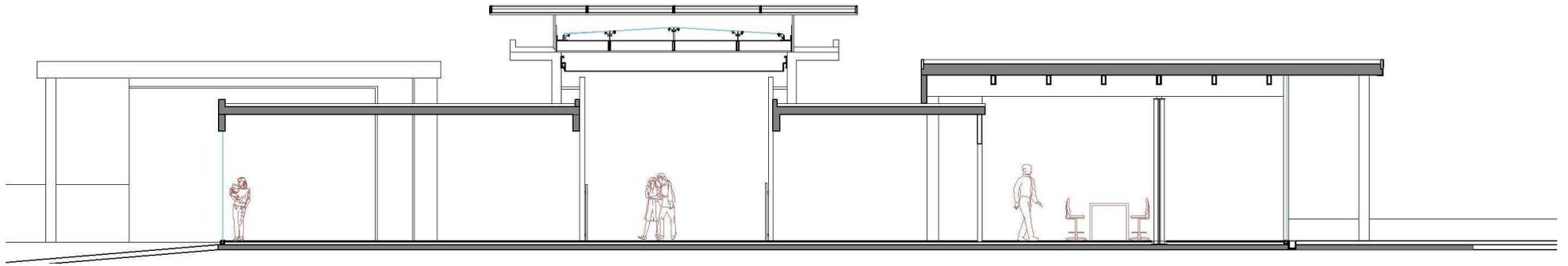




(1)



(2)



Cross Section through passages showing the connection of the stem with the outdoors.



Light at the end of the stem;

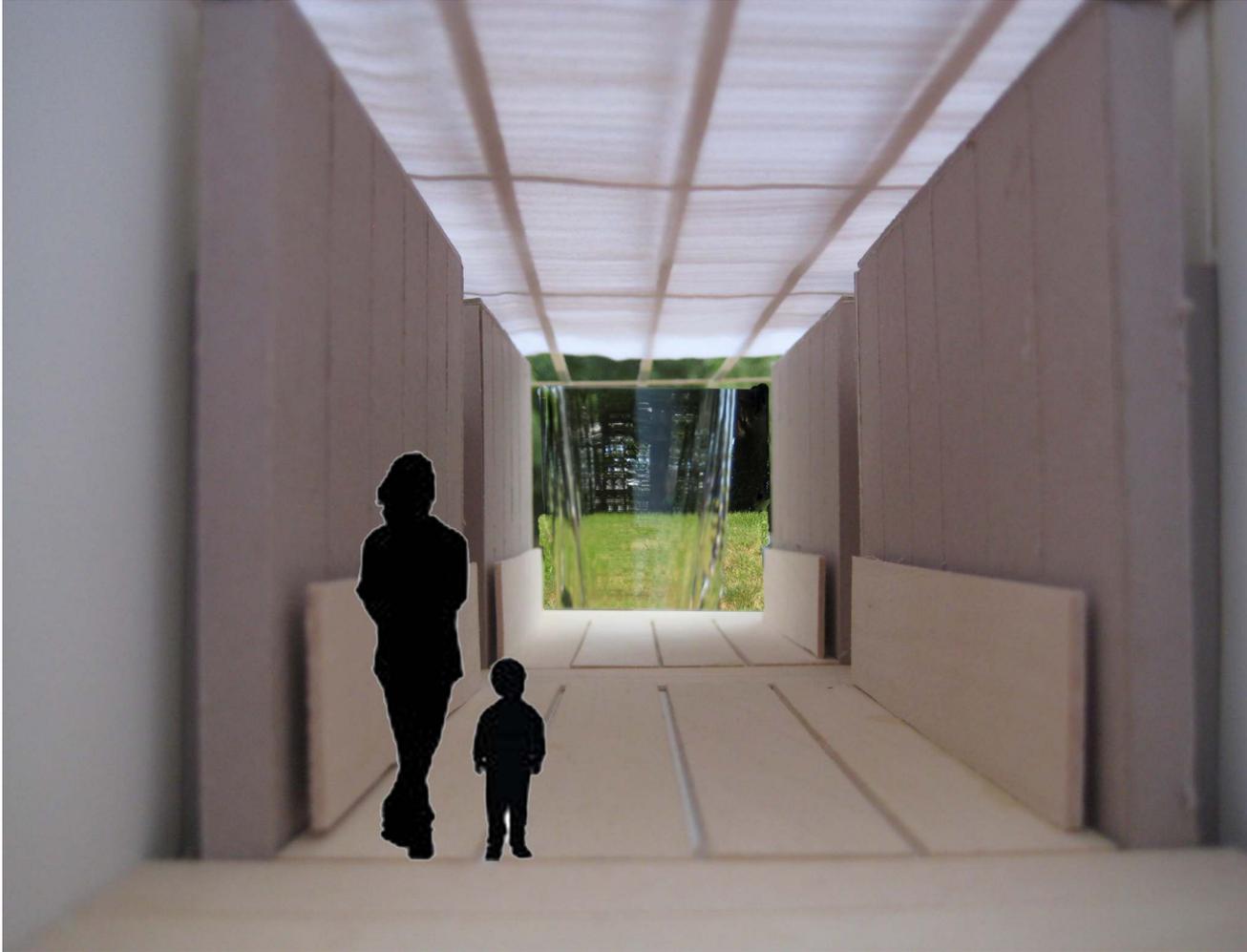
The planes of the spine and the wood panels form a strong perspective. The rainfall from the roof is collected and forms a water wall at the end of the stem. The bright daylight of the garden is seen through a thin film of water. The view of the garden through the water wall keeps changing as one approaches the garden. The reflections and slight glimpses of the surroundings through water arouses interest.





The planes of the stem along with the wood paneling and structural lines of the ceiling plane form a strong perspective leading the eye outdoors.

The spine is much more than a passage. It is an exhibition area to display the creativity of the children and a window capturing different colors of light and surroundings throughout the day and across the seasons.



The image shows the stem culminating into a water wall.



The light conditions in the passages:

As one turns from the stem to the adjacent spaces the light changes. Daylight from the full height windows in the passage enters the stem. The perspective formed by the stem wall planes and the classroom planes frame a view of the trees on the site.



A view of the administration space along with its relation to the outdoors from the stem.



A small splash of light announces each passage in the stem guiding circulation to the classrooms. The change in direction is reinforced by the reorientation of the wood grain in the floor.

