

R e v e a l i n g   E l e m e n t s

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and State University in partial fulfillment of the requirements for  
the degree of Master of Architecture.

Approved by:

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M i c h a e l   J .   O ' B r i e n ,  
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J a m e s   R .   J o n e s

Blacksburg, Virginia

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## A c k n o w l e d g m e n t s

Heather Queen, whose love and encouragement has been my driving force.

Rian James who has given me a whole different perspective of life.

Bill Belanger, whose contribution to my education and maturity has had profound influence.

My Committee members for improving my thinking.

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## Abstract

The design and construction of a building presents many conditions where materials must be joined and many opportunities where the workings may be revealed. By revealing the additive process, the joining of the pieces, the connecting of the elements, and the relation of the parts to the whole, one may discover the workings and gain an understanding of the thing. It is within this understanding, this awareness of materials, that we may strengthen our connection with a place.

The vehicle for studying these ideas of architecture is a public library for the town of Riner, Virginia. The building is a construction of elements; base, frame, enclosure, division, and machines. It is in how these things are put together with hierarchy, importance, truth, and honesty where one gets to architecture.

## Pieces

Throughout the construction of a building many pieces must be brought together: nailed, screwed, glued, set upon, welded bolted, or tied to fasten one material to another. All these pieces have inherent characteristics which must be considered in order to achieve architecture. Louis Kahn asked the material what it wanted to be, by this he meant, in what way does a material's properties effect its potential for achieving architecture. A brick "wants" to be in compression yet a wall needs an opening, an arch is the resulting architecture of these two considerations.

A material's characteristics can also imply its construction. To create an arch bricks need temporary support, the centering. A segmented arch develops an outward horizontal thrust. Kahn makes architecture out of this by making a place for the centering which remains in the wall and becomes a beam to contain the outward thrust.



1. Louis Kahn, Indian Institute of Management



2. Louis Kahn, Sher-e-Bangla Nagar; Hospital



## Elements

. base

The relationship of a building to the land is more than just a concrete foundation. How this connection is thought of and executed has great importance to the building's architecture and how its materials, pieces and elements, are brought together.

Two opposite conditions can be imagined: the building rising out of the ground as if it were part of the earth, or the building sitting on top, lightly touching the land, a foreign object within the realm of nature.

The Farnsworth House by Mies Van Der Rohe is a building floating above the land. The consequence of this architectural idea is a lightly constructed building.



The steel frame which sparingly touches the land makes possible the use of a glass facade, making the building open and transparent. This transparent volume echos the transparent void of the base.

It is a machine which has been placed in nature, a temporary residing, not disturbing anything around it. It is constructed of light materials, large panels of glass within a frame of steel beams and columns.

On the opposite end of the spectrum the Ames Memorial Library by H. H. Richardson constructed in 1877 is a building constructed of a heavy masonry mass which rises as an extension of the ground as if some geological event has thrust it from the earth, its layered base tapering inward meets the massive walls. The Ames Library has an imposing sense of permanence, as though it has been there for many years and will continue to do so.



3. Henry Hobson Richardson, Ames Memorial Library

4. Mies Van Der Rohe, Farnsworth House

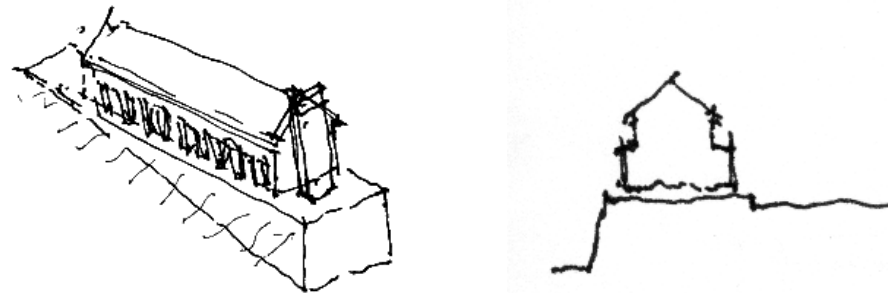
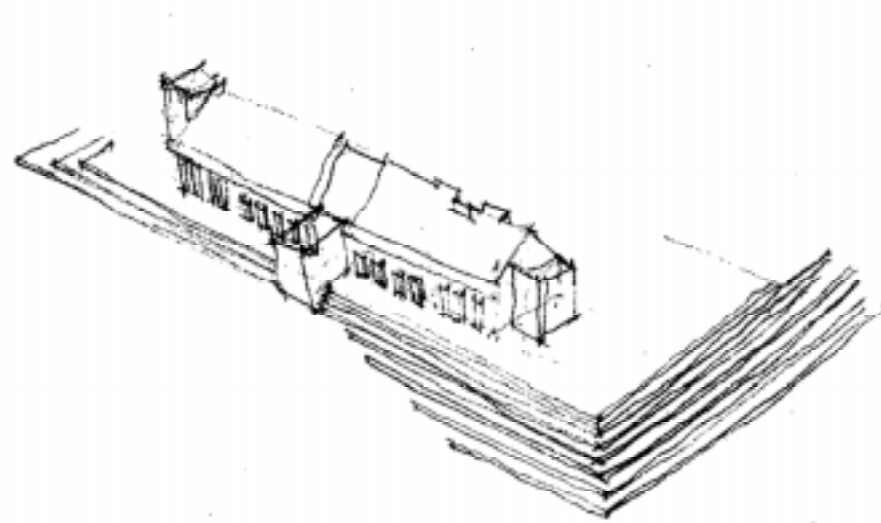
5. David Salmela, Jackson Meadow

. base

A third condition exists somewhere between the two, or perhaps a combination of the two, neither rooted nor floating but presenting a separation of building and land. In the buildings at Jackson Meadow by David Salmela a thick horizontal band with a thin top shadow line makes the separation between the vertical lines of the facade's battens and the blanket of green turf.

The Riner Library seeks this combined condition by making a place in the land to receive the building as well as separating the building from the surface. The mediation of building and land is achieved by a horizontal band of steel. This steel creates separation by visual contrast, color and material.

The building's base is not "of the building" but rather "of the land" - a plinth. This gives the building a place on the site where the site is prepared to receive the building. The plinth is also what gives permanence, if the building were to be removed the terraced earth would mark the place.



Early schemes of the plinth were considered as a stone or concrete mass rising out of the earth. These conditions of the plinth create an "either - or" situation. A person may be either on the top or down at the bottom. The terracing of the land to make the plinth creates more opportunity. One may be at the top close to the building, at the bottom on the lawn, or sitting at any terrace level in-between.



Plinth as vertical concrete wall. The vertical concrete clearly defines the edge between surface for building and surface for turf.



Plinth as sloped concrete wall. The sloping face is more ambiguous in its definition of the edge and adds height to the building visually.



Plinth again as sloped concrete wall but the turf would meet the concrete, giving the concrete no apparent thickness. This condition seems to "shear the land" to make the plinth.



Here the concrete plinth has thickness and appears to be an applied slab holding back the earth.

. base

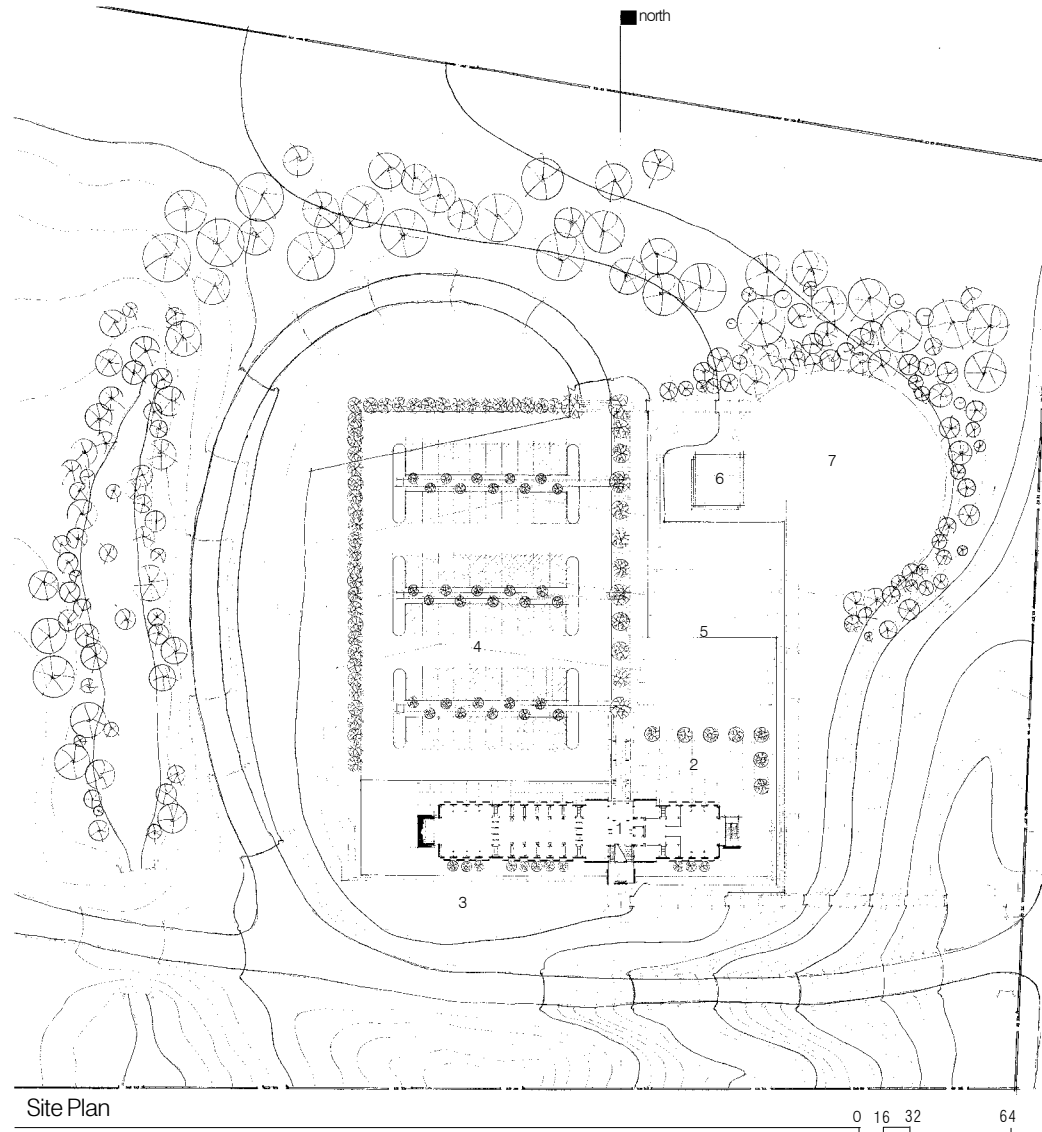
### Site Plan

The Riner Library is located on a hillside site on the corner of route 8 and the driveway to the elementary school. The high school is to the north. Given the proximity to these public schools the site is considered just as important to learning and discovery as the library.

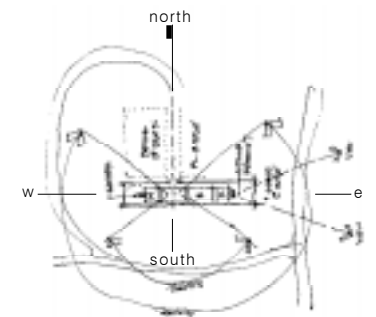
Siting the building and parking at the top of the hill creates an opportunity to capture the rain water runoff. This is done by sloping much of the parking lot to the northeast corner where water is collected in a pond. The long sloping lawn from the gathering space to the pond presents an opportunity for an outdoor amphitheater. A pavilion would make a place for musicians to entertain or school classes to take place.

#### A room for cars

The parking lot is developed as a room with the north and west edges bound by a dense planting of red cedar trees. Entry occurs at the north edge crossing a gravel threshold as a line of Bradford pear trees lead to the entrance of the library. Silver maple trees would line the secondary axis at the parking spaces. The white spring blooms of the pears would extend the white entrance canopy. The fall foliage would also bring accent to the entry axis with the pear trees in red and orange and the parking lot maples in yellow. The gathering space is bound on the south by the building and on the north by Redbud trees which define it as a separate space. On the south side of the building Bradford pear trees are planted to provide shade and help direct wind down into the building.



- 1. library building
- 2. gathering space
- 3. south lawn
- 4. parking
- 5. amphitheater
- 6. pond pavilion
- 7. pond



The placement of the building and the spaces within was given consideration with regard to the movement of the sun. This early sketch shows the linear organization from east to west which allows every space to receive natural sunlight. The entrance on the north side would receive rising and setting sun during the summer and the main stair on the south would receive this during the winter.

Site Plan

0 16 32 64



## Elements

. frame

Often in architecture when we hear the word frame we think of a grid of columns with beams connecting to the columns. This structural condition can enable the wall to be free of structural obligation and become infill. The Yale Center for British Art by Louis Kahn is a good example of this. The beams and columns are constructed of concrete and the void within is filled with a panel wall. This allows the placement of openings within the panel to be considered in a non-structural context. Also, special consideration is given to the joint between the panel and the structure. The Kimball Art Museum is similar. The vault is spanning from one end wall to another, the wall underneath is non-structural. To express this fact of “infill wall” Kahn has placed a thin window along the vault, the joint, separating structure from panel.

Another way to think of frame is as a complete system of beams and columns constructed together to create one element, a bent. This system was often utilized in the construction of many American barns, where the bent would repeat on some module and purlins would span from bent to bent. The bent can be constructed on the ground and simply tilted into place.

In the Thorncrown chapel Fay Jones creates a spectacular density with repeating frames constructed of many 2 by 6 pieces of wood. This density is enhanced by the transparency of the glass enclosure.



6. Louis Kahn, Kimball Art Museum



7. Louis Kahn, Yale Center for British Art



8. Fay Jones, Thorncrown Chapel



9. H. H. Richardson, Winn Memorial Library

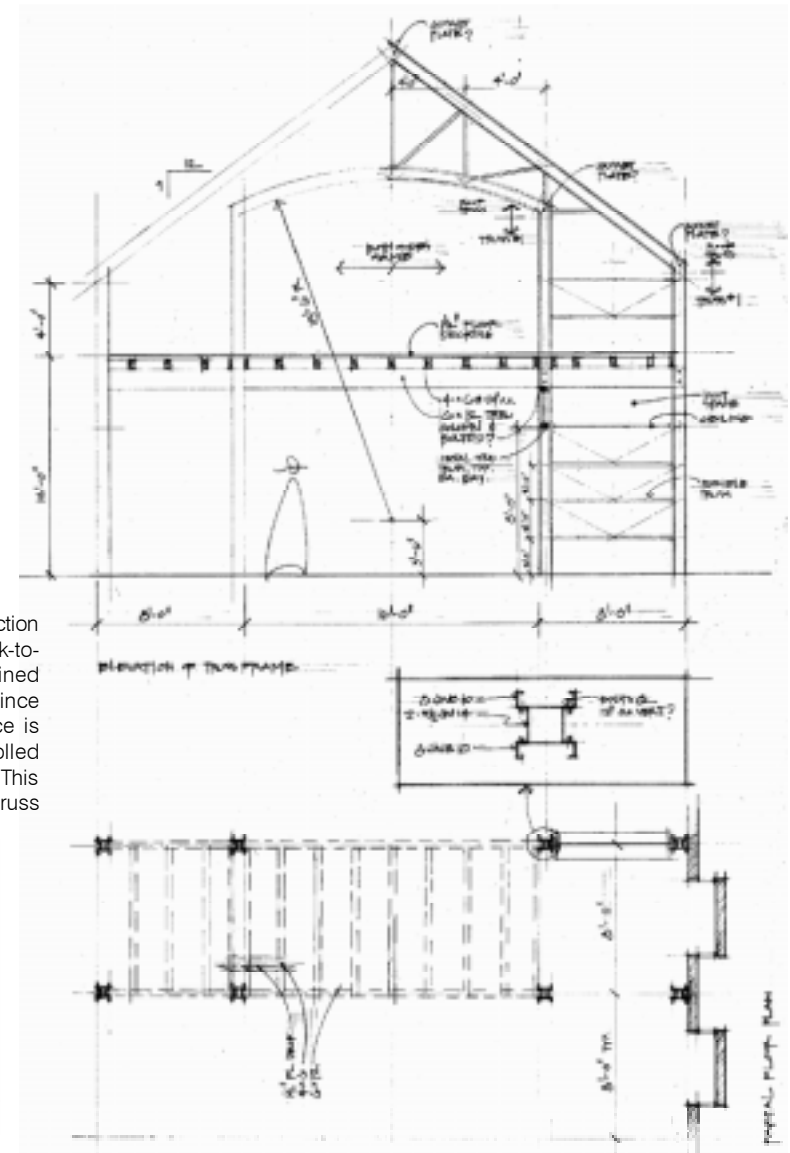
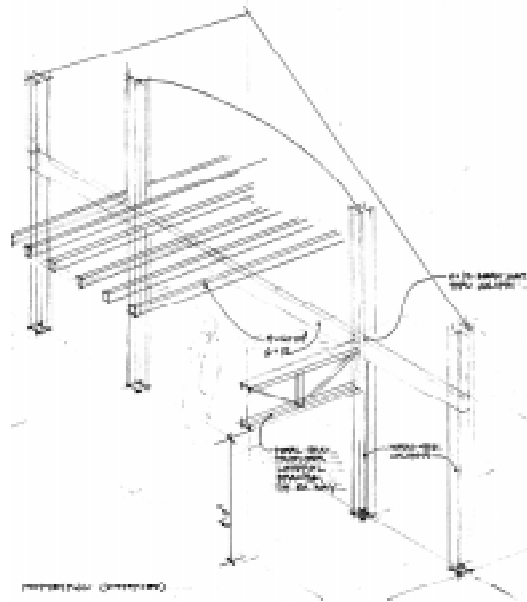
. frame

The structure of the Riner Library is of the frame-bent system. This series of frames on an eight foot increment creates alcoves for the placement of books. The books are contained on shelves within each frame which enables the floor system to be free of the structural requirements of carrying books. The Winn Memorial Library by H. H. Richardson is similar in that alcoves contain the books but its structure is perpendicular to the alcoves. This results in a creation of separate rooms, the main or grand central space, and the book alcove which is entered by passing through the line of columns. In the Riner Library the alcove is considered as a part of the main central space only being defined by material of floor and ceiling. The repetition of the frames also serves to accentuate the axis from entry to inglenook.

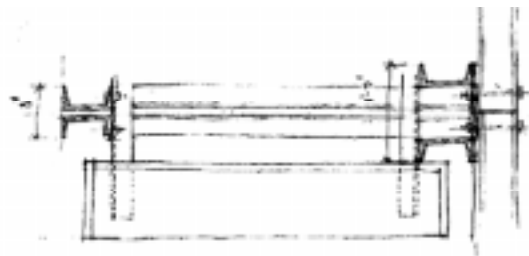


. frame

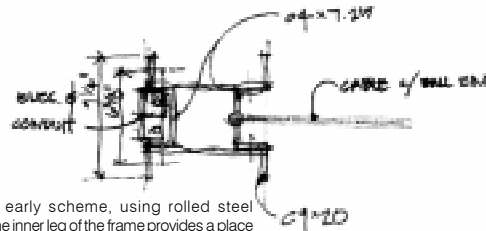
The construction of the frame was initially conceived as being constructed of rolled steel sections, channels and angles. These channels were connected to create inner and outer legs and the bookshelves would be fastened in-between. In order to have presence visually these legs or columns needed to be eight to twelve inches. This meant that the steel was becoming very heavy. A typical library with 20 foot bays can have columns of 40 to 50 pounds per foot. The rolled steel frames which occur every 8 feet were much more than that. In an effort to reduce weight, cold formed metal framing was considered. Because of the small bay size, 8 feet, and the number of frames present, the load on each frame is not excessive and therefore will allow the use of lighter materials.



The frames final design, executed in cold formed metal, is a construction of four members fastened together, two 8 inch, twelve gage back-to-back and two 6 inch, sixteen gage back-to-back. The combined weight of this would be an economical 12 pounds per foot. Since these frames are constructed of many pieces, who's tolerance is minimal, it would be advantageous to build them in a controlled environment and then be delivered to the site for final erection. This would require the frame be constructed in three pieces, the roof truss and the leg trusses.



In this early scheme the inner and outer legs of the frame are 8 inch miscellaneous channel weighing almost 23 pounds per foot. Given the four channels the weight per foot is 92 pounds which translates to a very expensive frame since the cost of steel is based on weight.

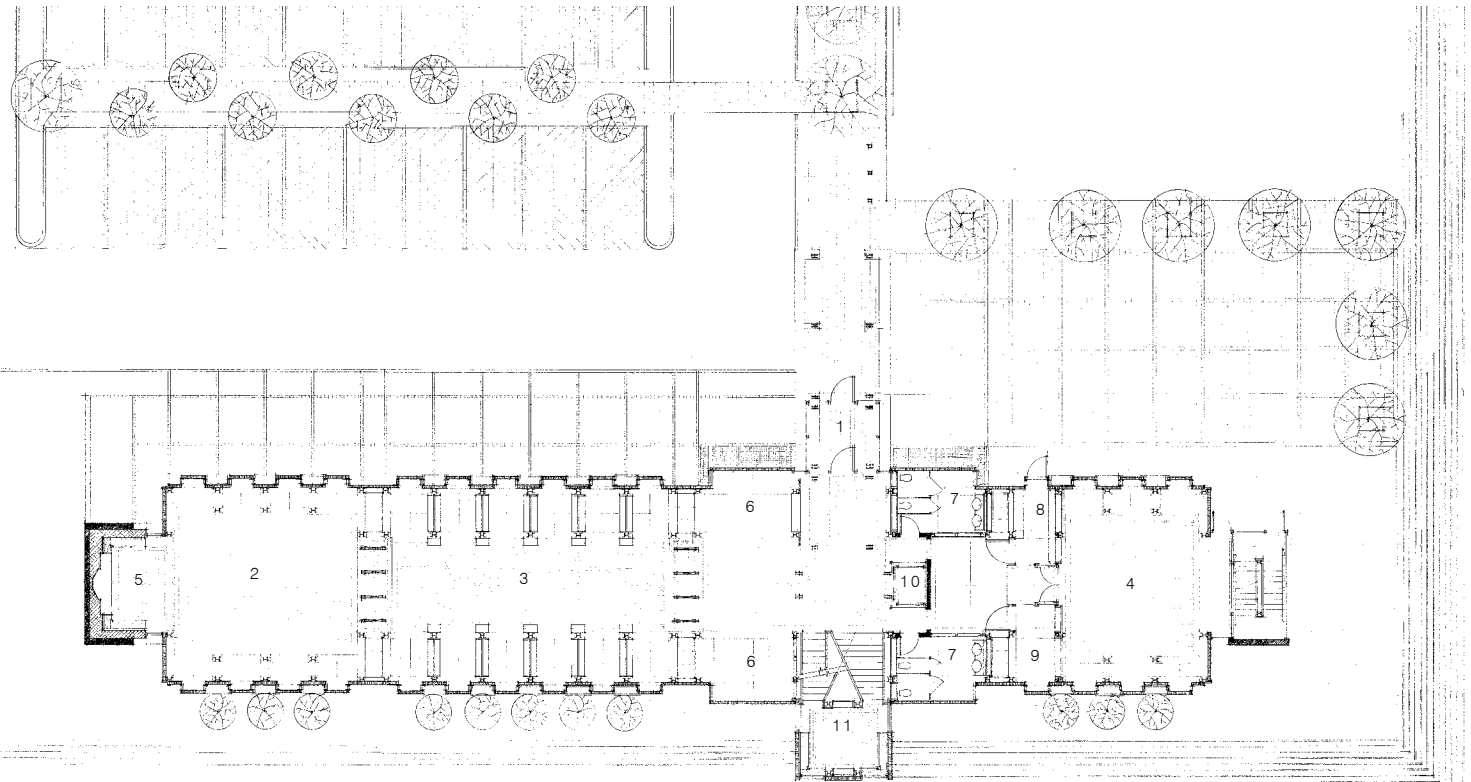


In another early scheme, using rolled steel members, the inner leg of the frame provides a place for the electrical conduit and receptacle box. The "cable with ball end" indicated is for the support of the book shelves.

. frame

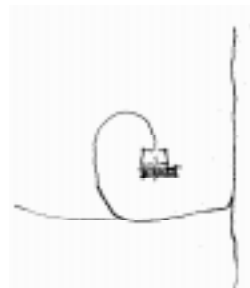
### Main Level Floor Plan

The main programmatic spaces; meeting room, book room, and reading room, are a linear organization which create an east-west axis. Upon entry this axis is evident and heightened by the repetition of the frame at 8 foot increments which presents a dense perspective from the elevator to the inglenook. The floor material, parallel strips of bamboo, also reinforce this condition.

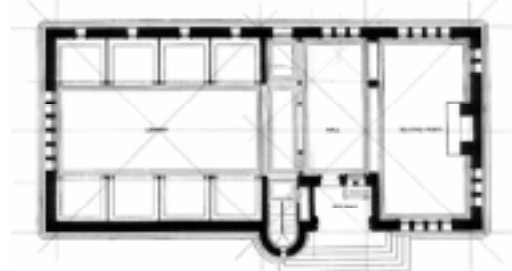


Main Level Floor Plan

0 4 8 16 32



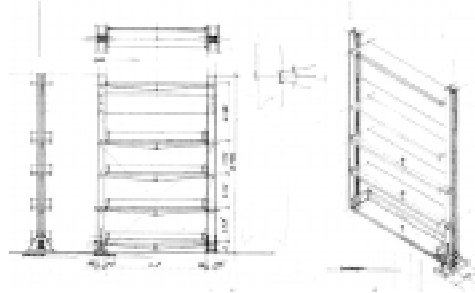
The building sits at the top of the hill on a base plinth. One approaches in a spiral fashion seeing the entire building as the progression winds around the hill and enters the room for parking. The realm of the car is paved in asphalt and where the car comes to rest, the parking space, the material changes to a porous concrete and grass paving, the realm of the person. Now a pedestrian, one exits the car and walks down a shaded secondary axis which is paved in 8 inch by 16 inch concrete blocks. This leads to the main entry axis which becomes a more refined 4 inch by 8 inch concrete brick. The culmination of this progression and the refinement of materials occurs at the entry door where the door handle and lock plate are bronze.



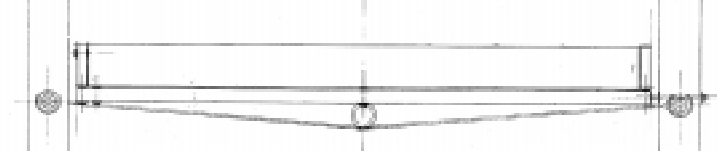
10. H. H. Richardson, Crane Memorial Library

The floor plan of the Riner Library is based on the small public libraries designed by H. H. Richardson. In the Crane Memorial Library the programmatic elements are clearly defined; entry, book room and reading room.

- 1. entry
- 2. reading room
- 3. book room
- 4. meeting room
- 5. inglenook
- 6. librarian
- 7. restroom
- 8. kitchen
- 9. office
- 10. elevator
- 11. main stair



The main volume of the library's books would be kept on shelves fastened to the main frame but there may be a need for some free standing book shelves. These small shelves, 4 feet in width, would also be frames with the shelves occurring in-between. The frame, vertical legs and cross brace would be wood stained black and the shelves would be a clear finished hardwood.

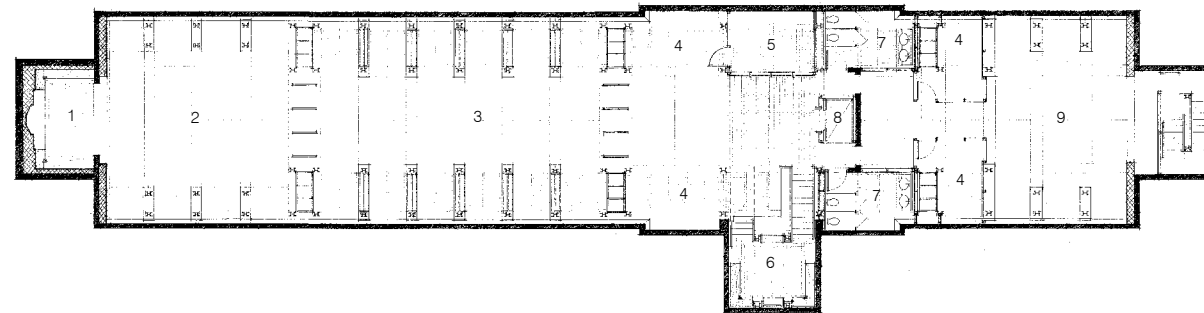


The connection of the shelf to the frame is similar for the main book shelves and the free standing shelves. Compression and tension are developed by the use of a steel cable. As the weight of the books deflects the shelf the steel cable is tensioned, as a result this tension pulls the legs together and puts the wood shelf in compression.

. frame

### Lower Level Floor Plan

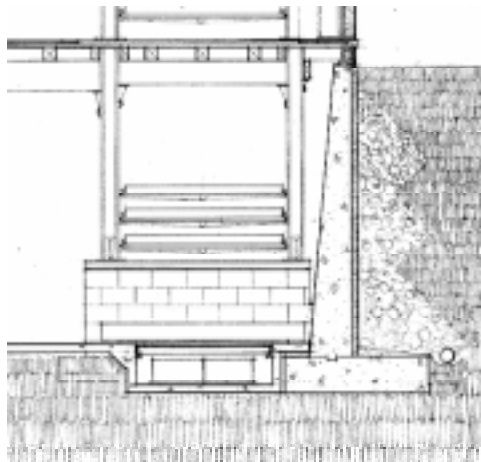
At the lower level the frames sit on piers of concrete block. These piers are at desk height and capped with concrete. Here, as above, the legs of the frame support shelves for books.



Lower Level Floor Plan

0 4 8 16 32

- 1. inglenook
- 2. special collection
- 3. archive
- 4. study
- 5. machine room
- 6. landing nook
- 7. restroom
- 8. elevator
- 9. reading room

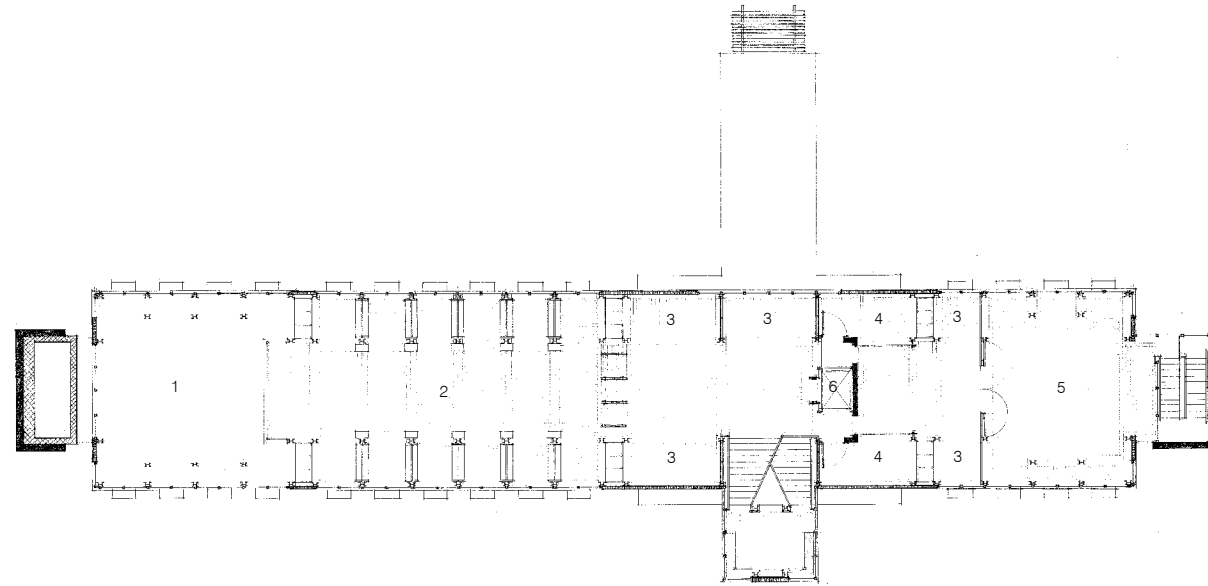


For heating and cooling of the building a geothermal heat pump system is used. The heating is distributed through radiant concrete floor slabs and the cooling and fresh air is distributed through a system of metal ducts. These ducts travel from the center of the building to chase locations on the perimeter. At the lower level these chases occur in troughs in the concrete floor and are visible with wood cover panels which allow access to the ducts and associated dampers.

. frame

### Upper Level Floor Plan

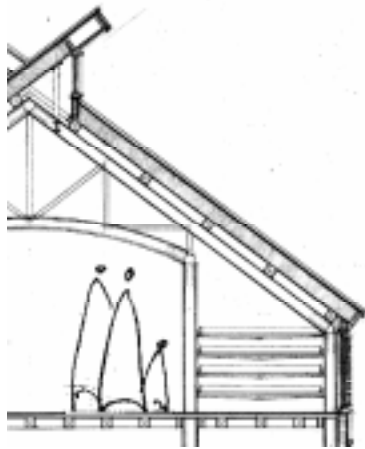
The upper level is for the children's collection. The frame is designed to create low intimate spaces at the perimeter and soar at the ridge where natural light is introduced. The arching bottom chord of the roof truss serves to lower the space and visually connect the perimeter book spaces.



Upper Level FloorPlan

0 4 8 16 32

- 1. open to below
- 2. children's books
- 3. reading
- 4. study
- 5. story telling
- 6. elevator



The upper level is designed to accommodate the height of children with the bookshelves and windows no higher than four feet.

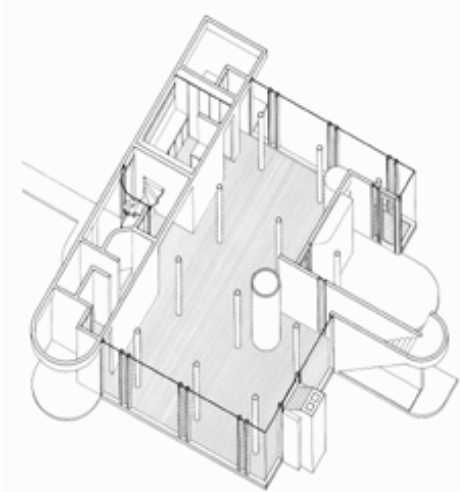
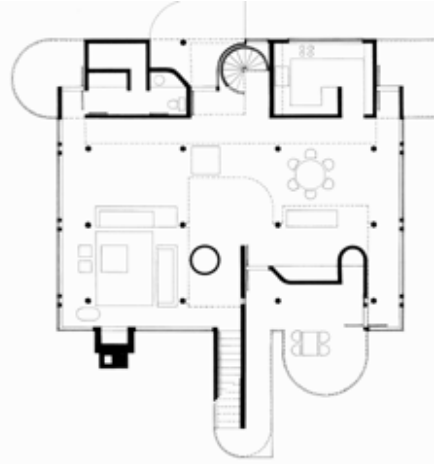
## Elements

. enclosure

A building's enclosure or skin can be thought of several ways; the enclosure can occur inside of the structure, within the same plane as the structure, or outside of the structure.

Some of the work of Mies Van Der Rohe is a good example of enclosure inside of the structure. Crown Hall School of Architecture at the Illinois Institute of Technology exhibits this. The enclosure, roof and glass facade, is hung from the structure enabling the plan to be free of columns and attain maximum transparency.

The work of Richard Meier illustrates the enclosure outside the structure. For the House in Pound Ridge, New York Meier creates an exterior facade unincumbered by the structural grid. By placing the enclosure three feet from the columns the facade has no structural obligation, something which Le Corbusier deemed "the free wall". As a result of this separation a field of columns is present within an enclosed space. These columns serve to define areas within the open plan.



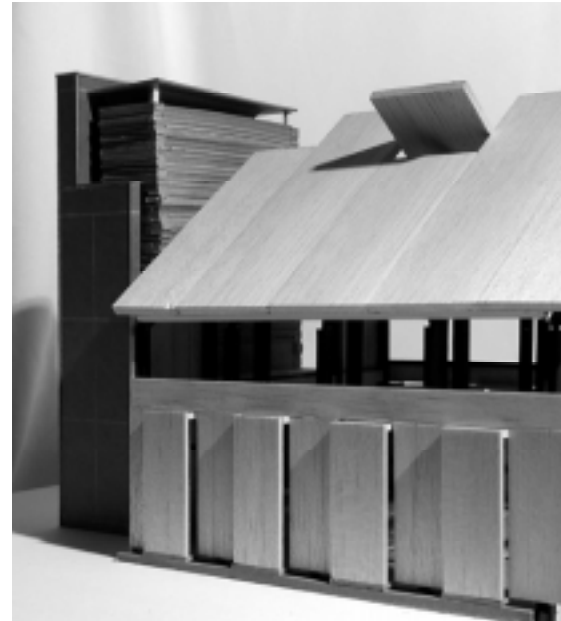
11. 12. Richard Meier, House in Pound Ridge



13. Mies Van Der Rohe, Crown Hall



14. Fay Jones, Thorncrowne Chapel



. enclosure

For an example of enclosure within the structure we can look to the work of E. Fay Jones. In the Thorncrowne chapel the glass enclosure occurs between the frames. This allows the vertical line of the frame to have presence on the exterior as well as the interior. Also the enclosure serves to link the frames together into one long structure.

In the Riner Library, the enclosure is similar to that of Richard Meier, outside the structure. This condition enables the separation of the frame and the enclosure, which clearly defines these elements. The enclosure is a construction of structural insulated panels which are fastened to the steel framing. These panels act as a thermal and moisture enclosure since the lateral stability of the frames is derived from metal truss braces between. The joints of the panels are accentuated by use of a batten. The battens make an honest expression of the panels on the exterior as their shadow is projected onto the white panel's surface as well as an air and water tight joint.



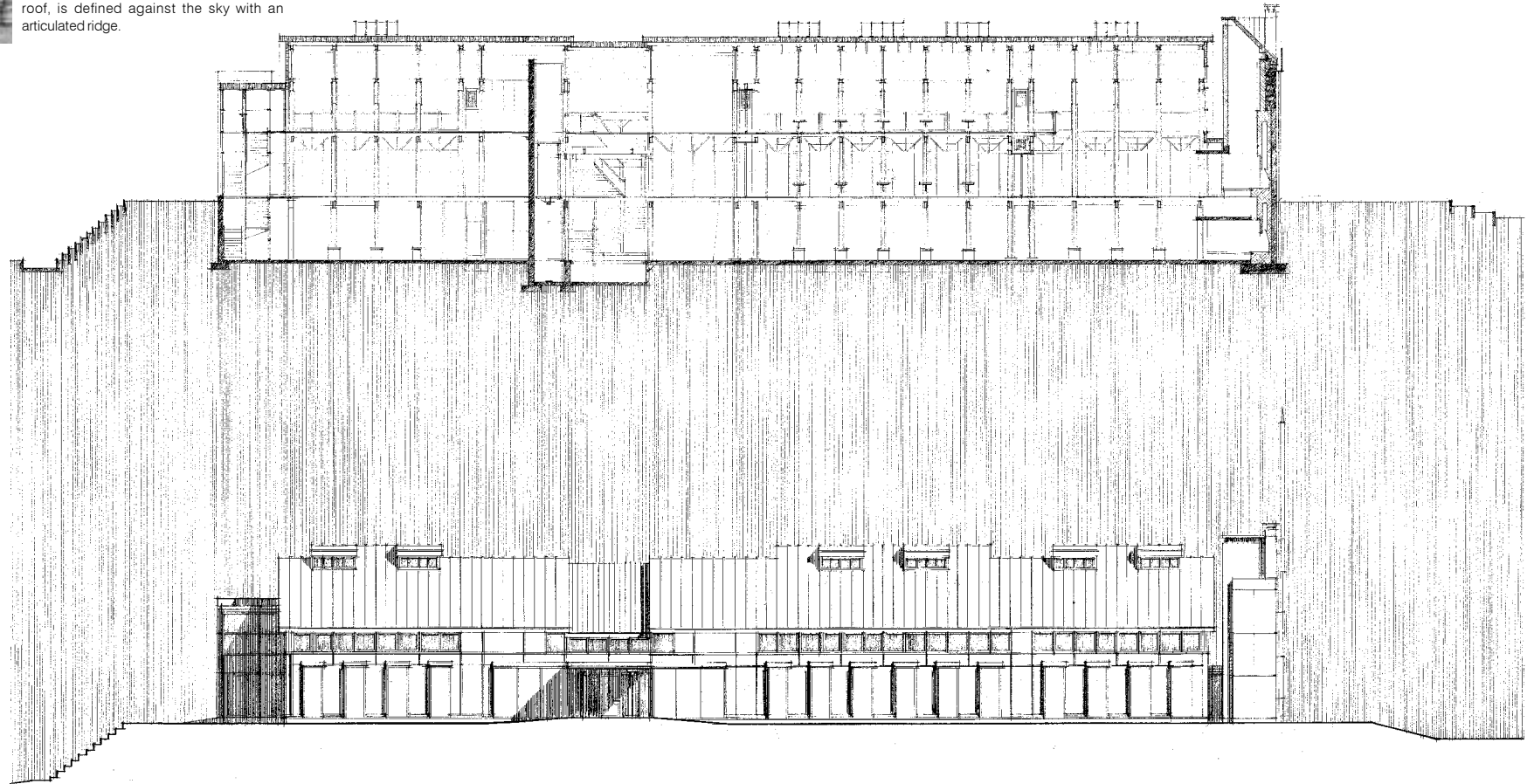


In the small public libraries designed by H. H. Richardson the bookroom wing was a horizontal expression of base middle and top. In the Ames Library in North Easton the base is a mass of rough faced stone which becomes smooth and tapered as it meets the ground. The middle, windows with articulated columns, separates base from top. The top, roof, is defined against the sky with an articulated ridge.

15. H. H. Richardson,  
Ames Memorial Library

. enclosure

In elevation the panels which make the enclosure create three zones in the facade: the base, the middle, and the top. The base is created by the placement of the 4 foot by 10 foot panels, either against the frame or off the frame. This makes an undulating pattern of light and shadow. The middle is a 4 foot high band of windows which separate base from top. The top, roof, is a panel enclosure clad in a batted metal roofing. The three inch battens are spaced at two foot intervals and become standing seams at the entry where the roof ridge breaks.



Longitudinal Section / North Elevation

0 4 8 16 32

. enclosure

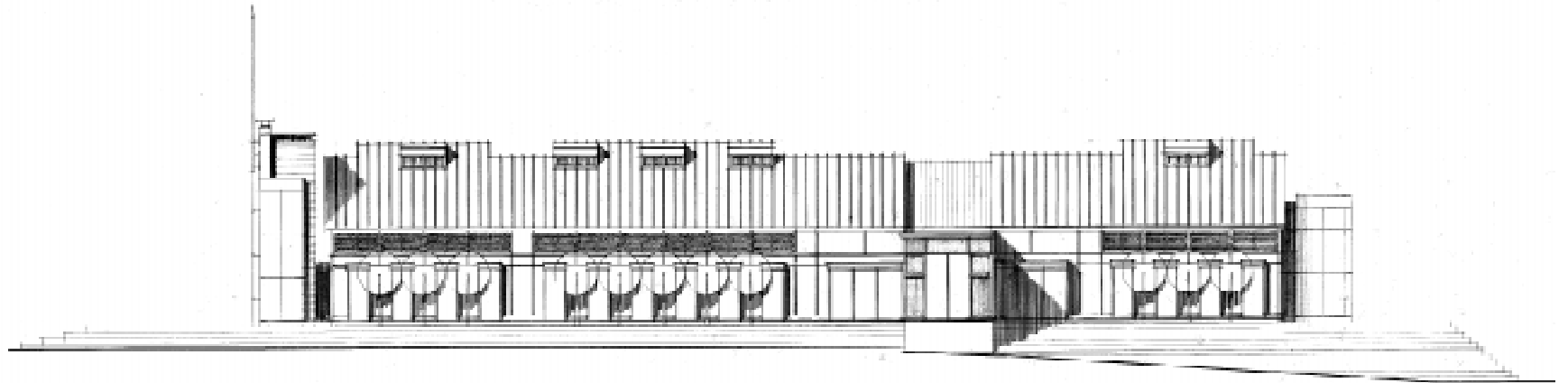
The libraries by H. H. Richardson clearly define building from sky by articulating the roof ridge. The Riner Library proposes the same definition but at a larger scale. As the enclosure panels come to the ridge they “finger” together to create roof wings. This condition, also presents opportunities for sunlight and natural ventilation.



16. Ames Library



17. Winn Library

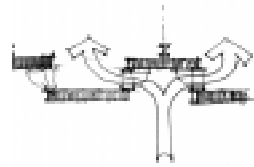


South Elevation

0 4 8 16 32

. enclosure

The use of insulated panels as enclosure presents many conditions for openings where two panels meet.



The staggering of the wall panels makes a place for a person to sit and read a book with natural light coming from the sides. This condition also works well for natural ventilation. As air flows into the wall it is diverted left and right into the open window.



The roof wing windows came about as a result of an architectural idea but subsequent study in the wind tunnel has shown them to be very useful for natural ventilation. The roof wing windows can be opened while all other windows remain closed and the rising warm air will escape out of the building. This is a desirable condition since the warm air rises above the occupants and is allowed to vent to the outside.



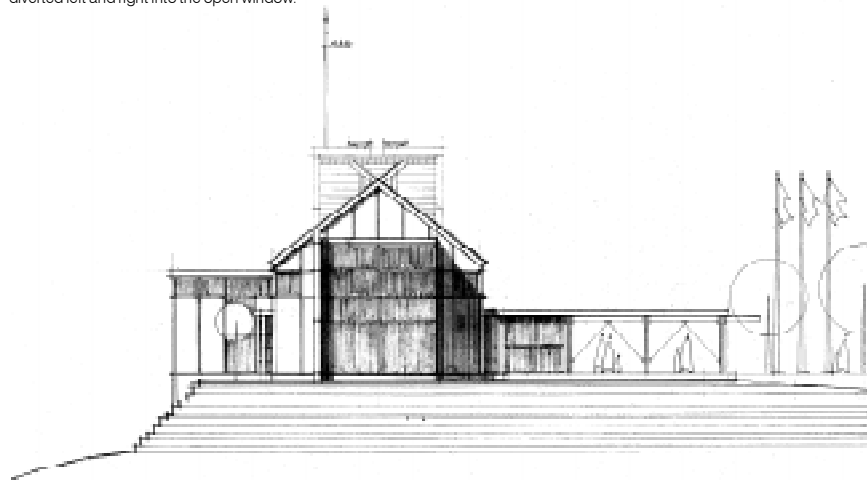
A second operating condition of the building would be all windows, or a high percentage, open and the roof wing windows closed. This would allow for significant cross ventilation.



The third operating condition of the building would be all windows closed except for the upper level leeward side and the roof wing windows on the windward side open. This would allow for the ventilation of warm air at the underside of the roof. This condition may not be completely desirable given the fact that the warm air is being brought back down to occupant level before being exhausted.

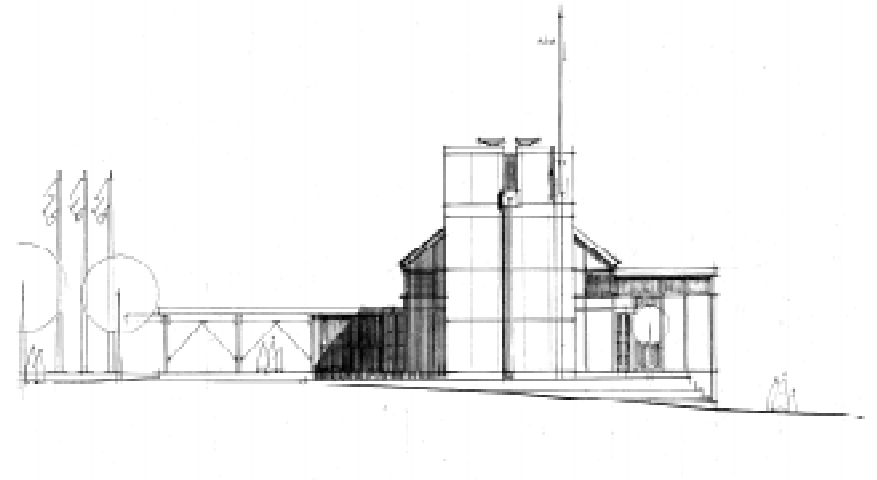


The fourth condition possible would be to open windows on the windward side while also opening the roof wing windows on the leeward side. This would allow air to flow into the main and upper levels and be drawn out the roof wing. The staggered placement of the wings would help to induce a negative pressure which would increase the draw of air through the roof wing.



East Elevation

32 16 8 4 0

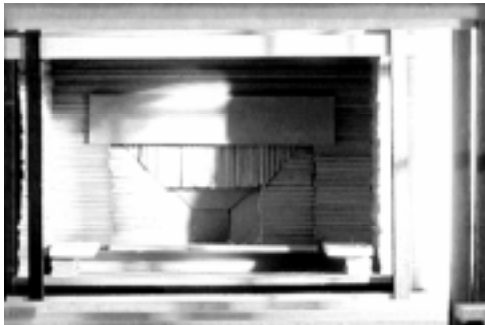
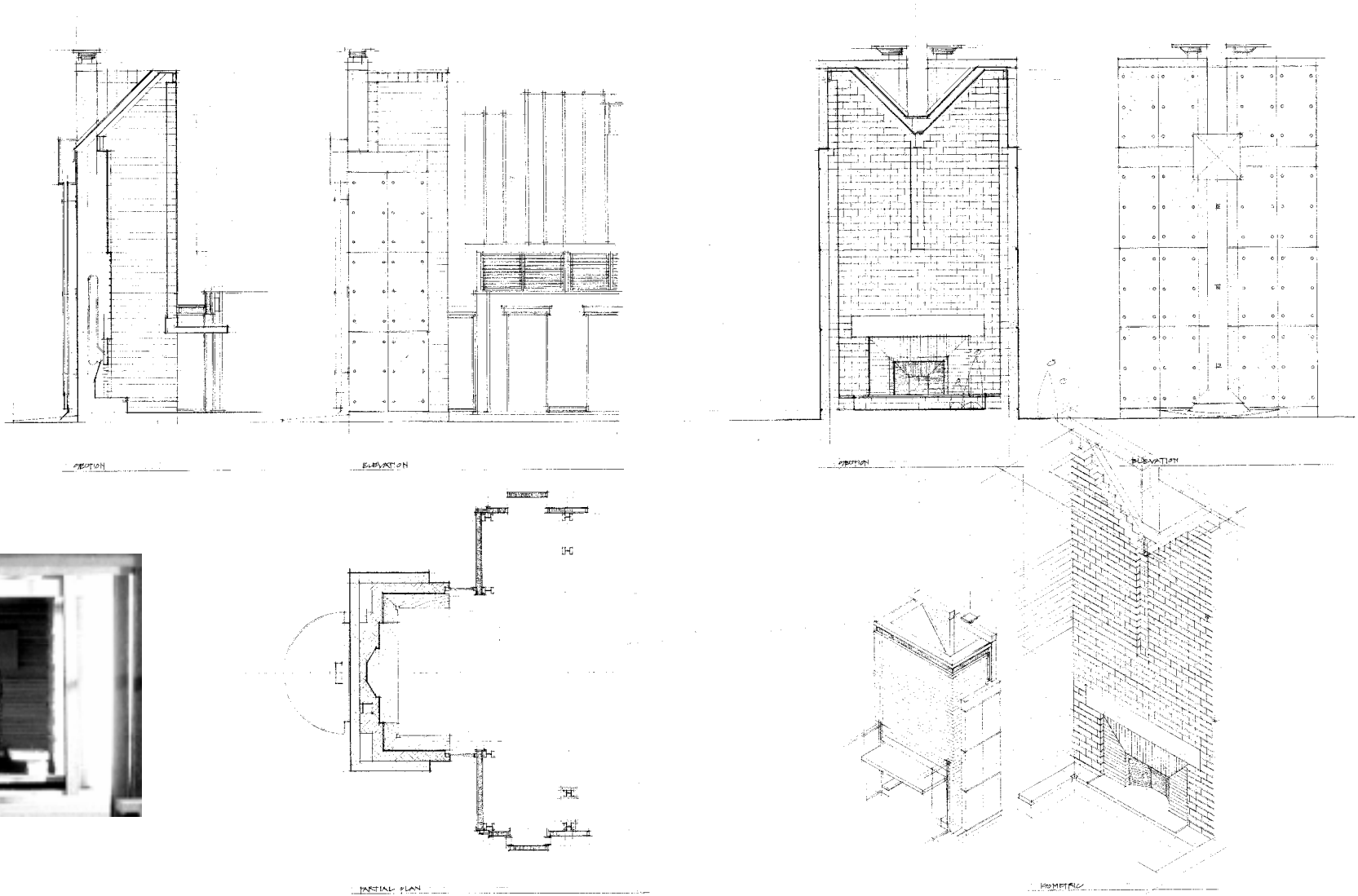


West Elevation

0 4 8 16 32

. enclosure

The western terminus of the building's axis is the inglenook where library patrons can gather in small groups or for individual reading. Its construction is a concrete mass enclosing a masonry mass. This masonry mass acts as a light shaft illuminating the inglenook like the altar of a church.



## Elements

. division

In an architecture of elements, where pieces and connections are exposed, the question arises, how does one divide spaces? Interior partition walls have no structural obligation and therefore can be of any mass and any material. Also, all materials should be exposed, their connections evident.

In the Ledge House by Bohlin Cywinski Jackson, the division is accomplished with elements of built-in furniture and wood frames clad with wood panels. The joining of the wood frame is a stacking similar to the log construction of the exterior wall. The panels are fastened to the frame on one side or the other always revealing their points of connection. There is also a separation of the enclosure, roof and log wall, and the division by use of glass. This serves to clearly define these elements.

In the Yale Center for British Art Louis Kahn uses a wood panel as division between gallery and atrium. To express this division as an element the joints of the wood within the panel are treated differently than the joint of the panel to the structure. There is a difference in scale from one to the other. The division panel is treated as if it were furniture, the entire panel is composed of 4 smaller panels each with rails and stiles which meet at center mullions. The joint between panel, rail, stile, and mullion is small in dimension. These division panels come together at a larger scale to create the wall of the atrium. Here the joint between panel and structure is larger in dimension recognizing the increase in scale and maintaining the separation of these elements.



18. Ledge House, Bohlin Cywinski Jackson



19. Louis Kahn, Yale Center for British Art



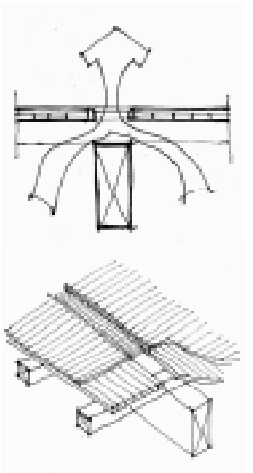
20. Ledge House, Bohlin Cywinski Jackson

. division

The Riner Library has various division elements. Vertical division as walls dividing spaces and horizontal division as floors dividing levels.

The horizontal division, floor, is a layering of beams and decking. The main girder, a 6 inch by 14 inch engineered lumber, spans from one inner leg to another. The purlin beams, 6 inch by 6 inch engineered lumber, then span from girder to girder. A 1 inch by 6 inch wood decking is laid over the purlins to make the ceiling and a thin strip bamboo finish floor is laid on top.

When using natural ventilation an opening is required in the floor to allow for the flow of air from the main level to the upper level. By fastening the purlins on top of the girders a 6 inch space is made where the air can flow. The decking of the ceiling and the flooring leave a 6 inch gap directly above the girder which is then covered with a steel grate.

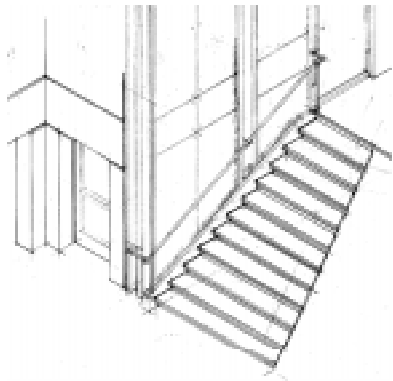


Section through Entrance

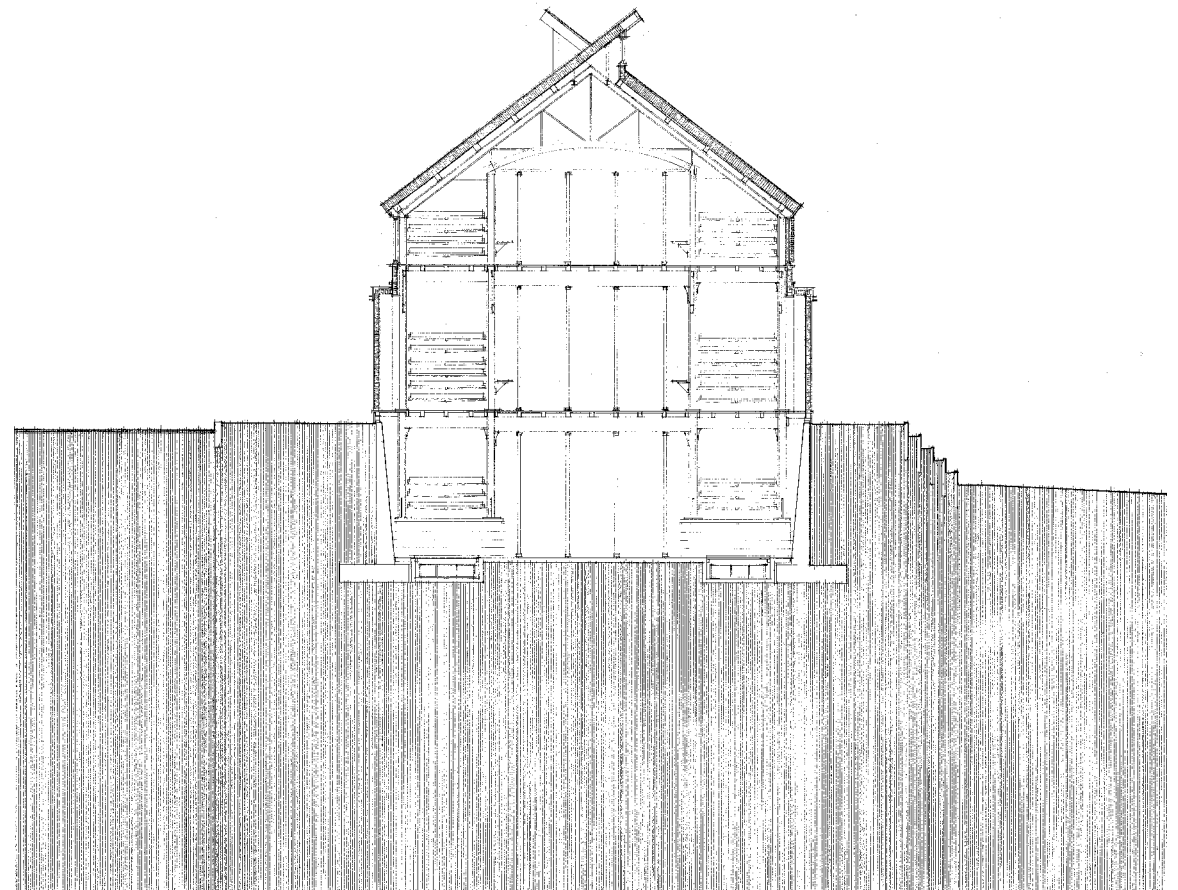
0 4 8 16

. division

The vertical division walls are panels fastened to frames. The material of these panels is dependent on the requirements of the division. The restrooms require a high level of privacy so the panels would be opaque, a plywood fastened to a subframe with considerations for its acoustic performance. The study spaces in the lower and upper levels do not require the visual privacy but need acoustic separation. These divisions would be a translucent panel mounted on a wood subframe.



Here the division between the public stair space and the restrooms is a plywood panel on a metal subframe which occurs between the legs of the frame. A thin eighth of an inch gap is left between panels and the whole division element is set within the frame.



Section through Book Room

0 4 8 16

## Elements

. machines

Machines as an element can be defined into two groups: those which are self operating and those which require people to operate them. The first group, self operating, are things like the boiler, chiller, air handling unit, plumbing and electrical systems and all the related ducts and piping that go along with them. The relationship of these machines to the other elements is seldom given thought and are rarely treated as visual devices. The second group includes things like stairs, elevators, doors, and windows. These are the machines humans come into close contact with and require consideration of articulation, surface texture, contrast, and materiality.

Some notable examples of these machines becoming part of the architecture is Louis Kahn's Library at Phillips Exeter Academy and The Ledge House by Bohlin Cywinski Jackson.

In the Library at Exeter, Kahn uses the ducts not simply to deliver the air needed but as an element which continues the division element between the two brick walls. These ducts also present a change in texture as the smooth concrete ceiling moves toward the wall.

In the Ledge House, the electrical boxes and conduit are allowed to be seen presenting a contrast between the galvanized metal and the finished wood. This heightens the presence of these machines and demystifies the connection from switch to fixture.



21. Bohlin Cywinski Jackson, Ledge House



22. Bohlin Cywinski Jackson, Ledge House

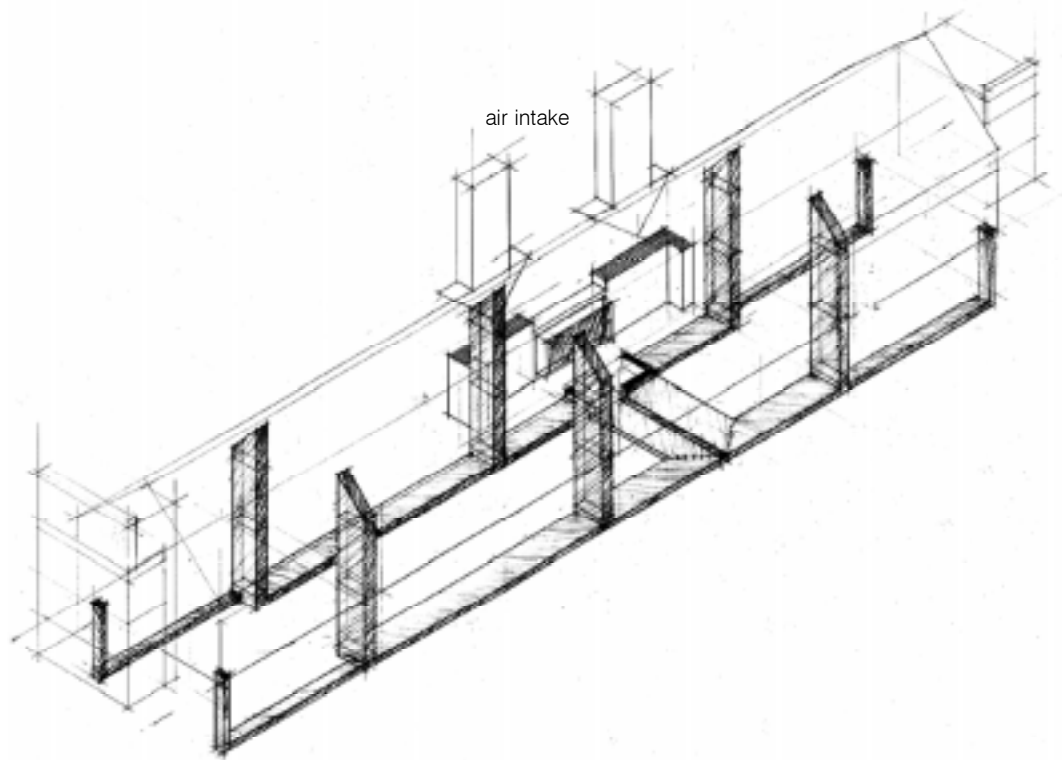


23. Louis Kahn, Exeter Library

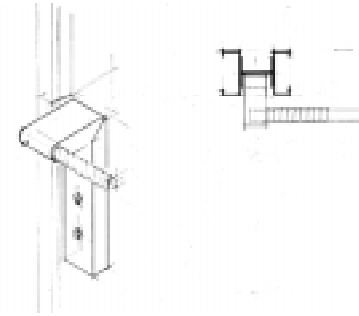


. machines

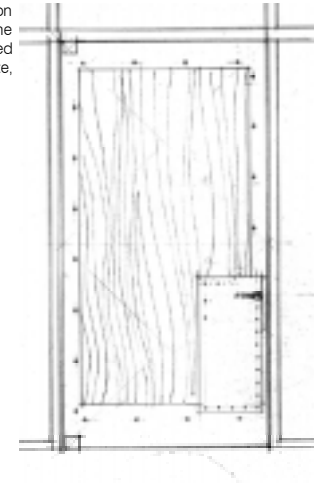
In the Riner Library the self operating machines occur in vertical chases throughout the building. From the machine room on the lower level the chase runs under the floor to feed the perimeter. These chases not only contain the metal ducts supplying fresh air but also the piping for the radiant floor slabs and the conduit trunk lines.



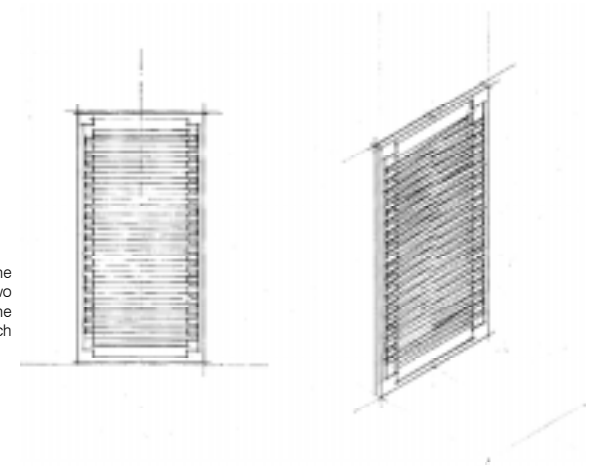
The entrance door is a machine which requires human intervention. It is the culmination of an entry progression which increases in the refinement of materials. The frame of the door is black steel and fastened with half inch lag bolts. The panel is a clear finished marine grade plywood panel. The point of human contact, the door handle and face plate, is bronze and fastened with quarter inch bronze screws.



The handrail is another manual machine. It is probably the thing most touched in a building and therefore should be considered for its tactile properties. The handrails of the Riner Library would be steel pipe wrapped in leather which would terminate at a wood block which receives the rail.



The pivot doors which make the threshold to the bookroom and the reading room are a frame of two by six wood with a steel edge for rigidity. The panel is comprised of interwoven wood slats which prohibit view but allow air to flow through.



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