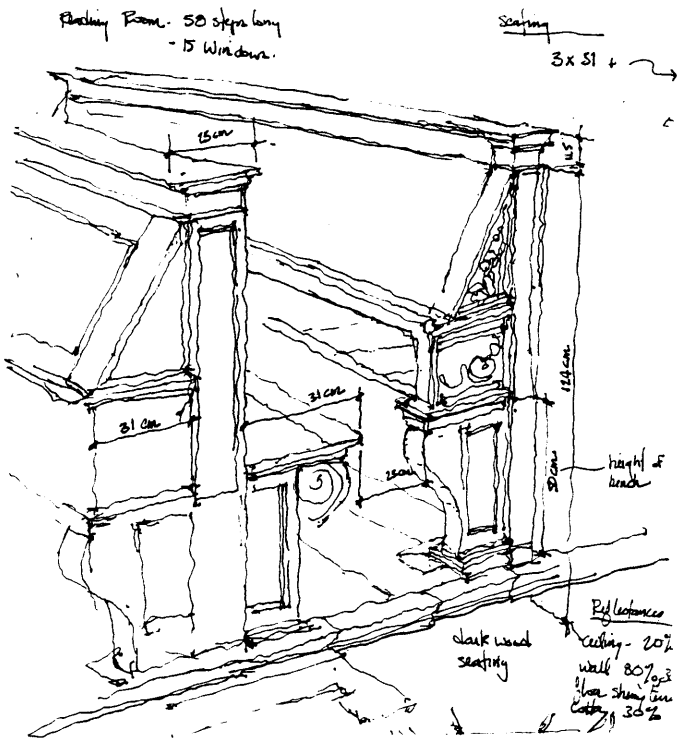
A PATTERN OF LIGHT:

A New Library for Newton and an Analysis of the Building Type



by

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June, 1980

SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE DEGREE OF MASTER OF ARCHITECTURE AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

FEBRUARY 1985

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A New Library for Newton and an Analysis of the Building Type

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Submitted to the Department of Architecture on January 18, 1985 in partial fulfillment of the requirements for the Degree of Master of Architecture.

ABSTRACT

Natural light can add clarity to the organization of buildings by distinguishing areas of occupation with varying quantities and qualities of illumination. Libraries are good to study in this regard because of their varying requirements for light: reading areas must be brightly lit, while bookstacks should have little light for preservation. In responding to these needs, many libraries establish a pattern of light that relates to the buildings' use.

Natural light is basic to the organization of four libraries studied: the Laurentian, Florence; Sainte Genevieve, Paris; the Seinajoke, Finland; and the Phillips Academy, Exeter. The buildings are analyzed through plans, sections, and perspective sketches.

The understanding of light gained from these references is applied to my design of the Newton Public Library. In addition, I go one step further and try to use natural light to establish a continuity between different functional areas of the library.

Thesis Supervisor: Imre Halasz

Title: Professor of Architecture

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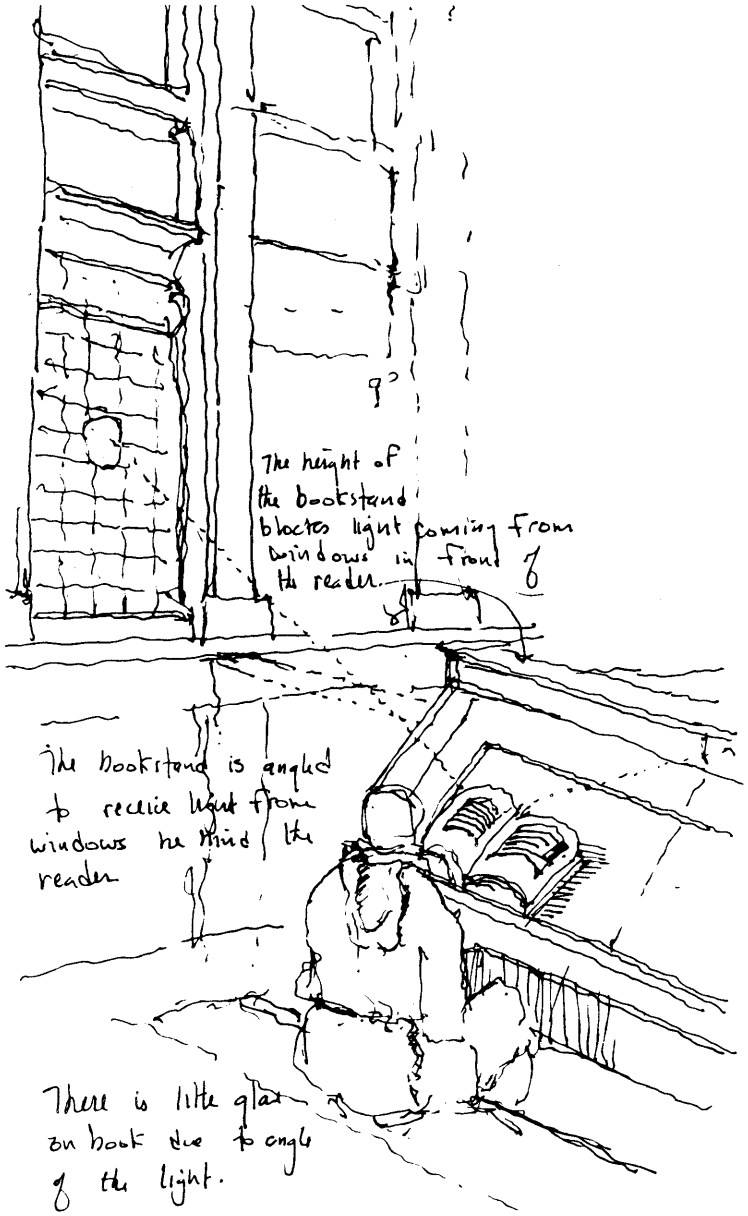
1. Introduction

The history of architecture before the turn-of-the-century has been described as "the struggle for light."[1] Architects relied almost entirely on natural light because artificial sources such as oil lamps and candles were poor substitutes. The need to bring daylight into the building was a powerful force in shaping architecture.

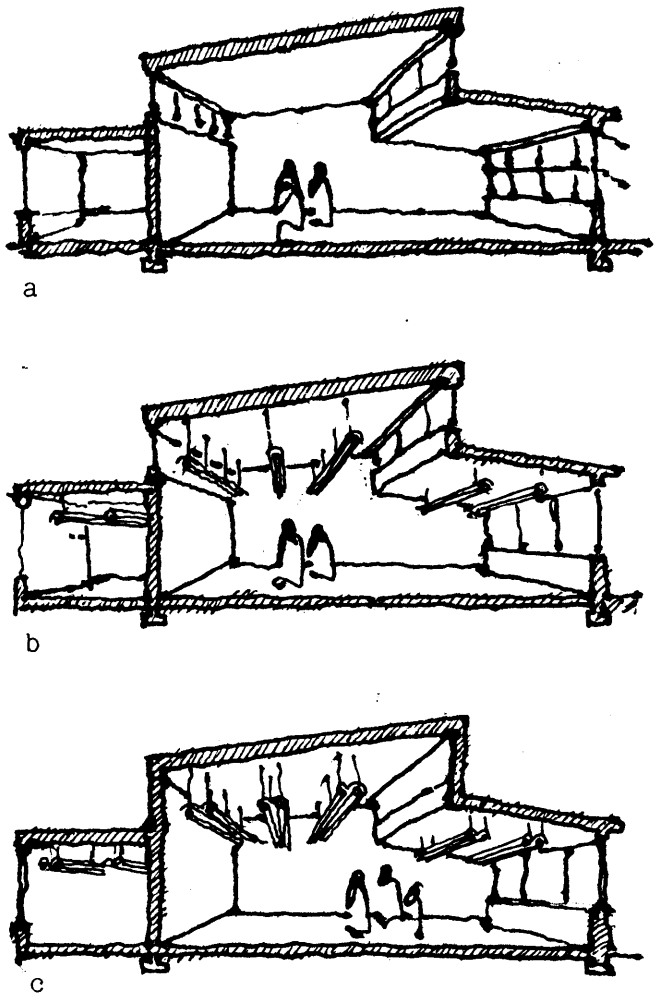
The requirement for light helped determine window sizes and location, building width, ceiling height, and interior materials. Building methods were another limitation in the struggle for light. Most larger buildings were constructed of masonry, where the walls of the building provided the primary support structure. Window sizes had to be kept relatively small for the wall to retain its strength. The small windows of course limited the quantity of light inside the buildings.

Designers developed ways to modulate the precious commodity of natural light in such a way as to heighten its presence in a building. In most monastic libraries in Italy, for instance, a monk reading at a table would receive light over his shoulder. The potentially glaring window was out of his sight, and the light was reflected away from his eyes after striking the book, making the most of the light that was present (Fig. 1).

Since the turn of the century, improvements in electric lighting have helped make it a primary source of interior light. No longer is the need to obtain sufficient and pleasing daylight considered a primary aspect of building design. Buildings have become much thicker and window design has become more arbitrary. Moreover, advances in steel and concrete technology have freed the perimeter walls from



1. Laurentian library. Seating pews. The angle of reading surface catches light from behind and to the left of the reader.



2. California school. Cross section.
(a) Natural lighting scheme before alteration.
(b) Fluorescent lighting added.
(c) Windows covered up, more fluorescent lighting added.

load-bearing requirements, allowing for much larger windows. In many office towers, for example, the perimeter walls can be all glass. The careful design of windows in the past to heighten the quality of light has too often been replaced with broad expanses of glass that produce an even, unmodulated, and often boring light.

Widespread reliance on electric lighting has in many cases resulted in buildings where natural light is not treated sensitively. An example demonstrates this point (Fig. 2). In California, many schools were designed in the 1930's and 1940's to rely largely on natural light, with a minimal supplement of incandescent lighting, for cloudy days and nighttime use. The lighting levels were relatively low, but the location, orientation, and size of windows was so thoughtfully conceived that the dimness was more than compensated for by the lack of glare. In fact, these buildings have been well documented as examples of the creative use of natural light.[2] The natural lighting was supplemented with more electric lighting in the 1950's in response to new recommendations of higher lighting levels. Heat generated by the electric light made the classrooms too warm in the summer, and air conditioning was added. To make the air conditioning more efficient, the windows that originally provided light were covered up. As a final step, more electric lighting was added to compensate for the loss of natural light. This ironic series of events show how strongly the emergence of cheap electric lighting, coupled with absolute lighting requirements, affected attitudes towards natural light.

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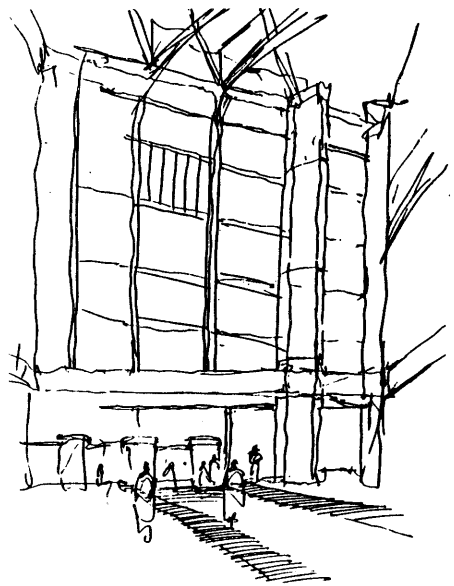
In the 1970's and 1980's there has been a resurgence of interest in naturally lighting buildings. In many instances, however, the natural light is treated as an amenity and added to a building in much the same way that a higher quality carpet or wall covering might be added. The increasingly popular atrium spaces of many office, hotel, and shopping center buildings typify this attitude. In One Financial Center in Boston, a huge glass enclosed volume was added to an office tower to appease the planning authorities (Figs. 3 and 4). Steel construction of the atrium permitted large areas of glass. Heating and cooling advances could keep the space habitable that in a previous era would have been an environmental control nightmare. The light is unmodulated by architectural devices that might heighten the sense of light by creating light and dark patterns. Instead, the only modulation of light comes from the low transmission glass, giving a quality of light similar to that of an overcast day, where the sky is the brightest object in our vision. Highlights and sparkle that come from direct light are absent.



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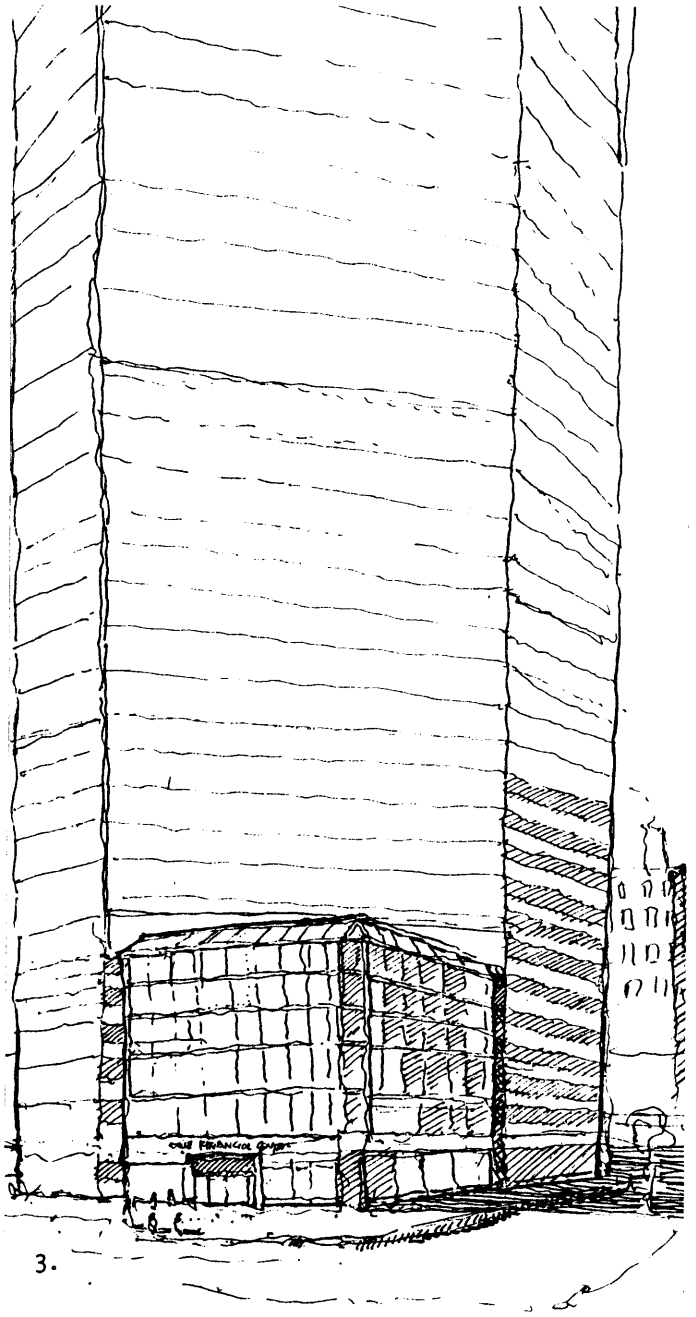

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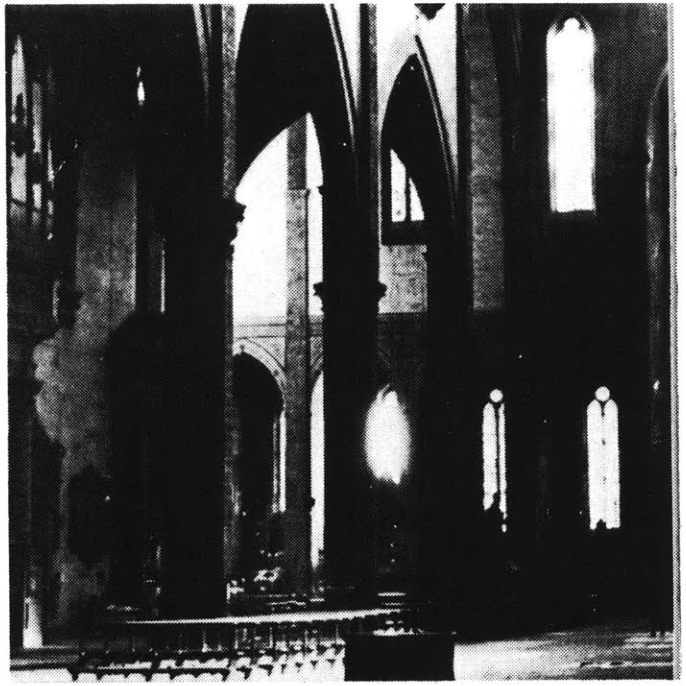


5. Cathedral in France. The presence of light is emphasized by the contrast between bright stained glass and the darkness of the stone structure. Contrast this image with Fig. 4.

3. One Financial Center, Boston. Exterior sketch, showing entrance atrium added to design.

4. One Financial Center, Boston. Interior view showing wall of low transmission glass facing street. The louvers shown in the roof above have little effect in modulating the light because the glass wall is so bright.

In the past, when designers relied on natural light as the primary source and worked with smaller apertures, the light entering the building was modulated in such a way as to heighten its presence. We live in a time when such skills are not an absolute necessity, so it is helpful to look carefully at buildings of the past to learn how they achieved such beautiful results.

The value of observation lies not only in seeing creative solutions to difficult lighting situations, but also in predicting the quality of light in a proposed lighting scheme. Therefore, building observations should be recorded in plan and section at the same scale used in design. A connection can then be made between a quality of light observed and a quality of light the architect is trying to bring to his own design. The methodology in this thesis is to make observation and design drawings at the same scales of 1/16" = 1'-0" and 1/8" = 1'-0".

Another component of analysis is to consider the appropriateness of the light in a building. The natural lighting should reinforce other meaning and use in architecture. In medieval religious architecture, for example, the glow from small leaded glass windows gives a spiritual light, as if from the heavens (Fig. 5). The light is appropriate to the use of the building. In contrast, many recent atrium buildings are brightly lit with unmodified sunlight which seems only to celebrate itself and does not reinforce other associations in the architecture.

Four library buildings are analyzed in this thesis. The buildings range from a small monastic library in Italy to a larger public library in Finland, built in 1965. The quantity and quality of natural light varies between the buildings. A pattern can be observed, however, that helps explain how the differing qualities of light relate

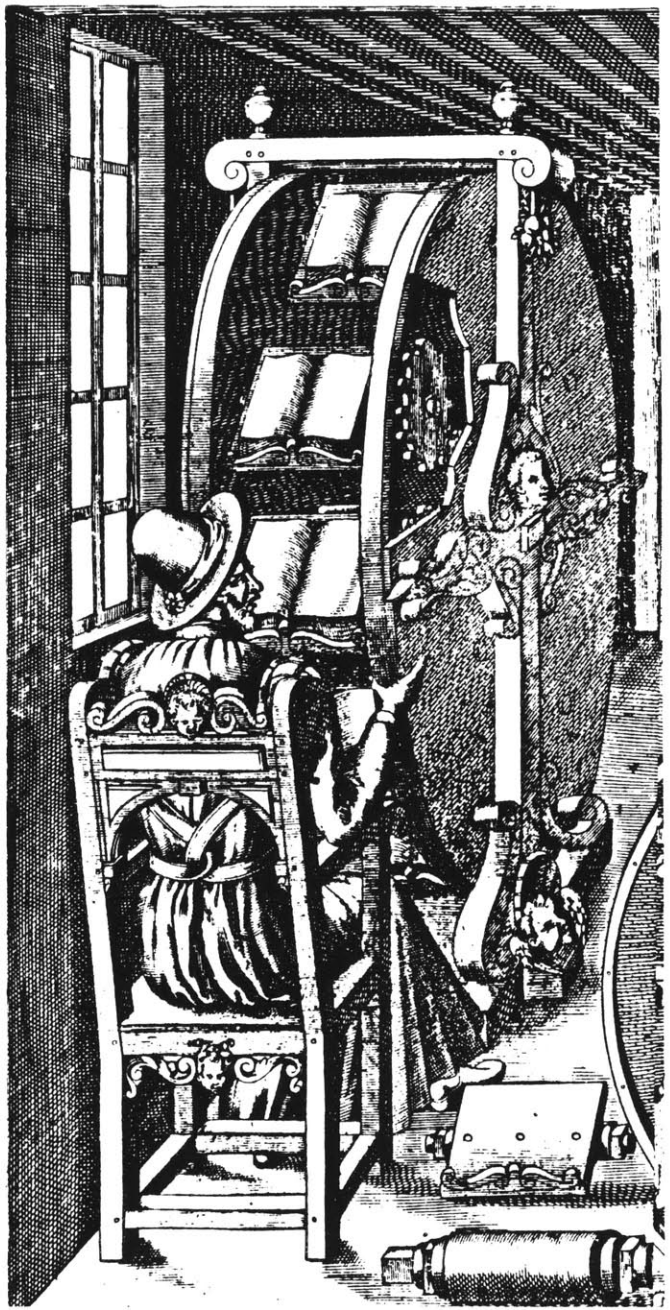
to the use and meaning of the libraries.

Book storage areas in libraries are planned to have as little natural light as possible, to preserve the books, while reading areas require higher quantities of natural light (Fig. 6). The natural lighting schemes of the libraries looked at respond to these needs. The size and location of reading and storage areas vary from building to building and the natural light changes accordingly.

The natural lighting of libraries also varies in regard to the nature of the institution. In public libraries, a high quantity of light, particularly near the building's entrance, emphasizes that all are welcome. In private libraries, low levels of light emphasize that the building is open to a smaller group.

The character of the natural light found in libraries must be judged in terms of the overall intentions of the architecture. There cannot be, therefore, a generic "good" natural light for libraries. The four libraries looked at show a wide range of qualities of light even for specific tasks such as reading.

My design for a public library in Newton, Massachusetts follows this analysis. The natural lighting scheme is a departure from the designs observed, but they were important in formulating my design by helping develop a sense of the performance of windows and apertures depending on size, location, etc. In addition, the appropriateness of natural light to other aspects of the architecture in these examples provides a strong direction for my own work.



6. Ramelli, Scholar at his Book Wheel. The reader can turn the revolving book rack so only the book being read is exposed to light. A whimsical solution to the light requirements of libraries.

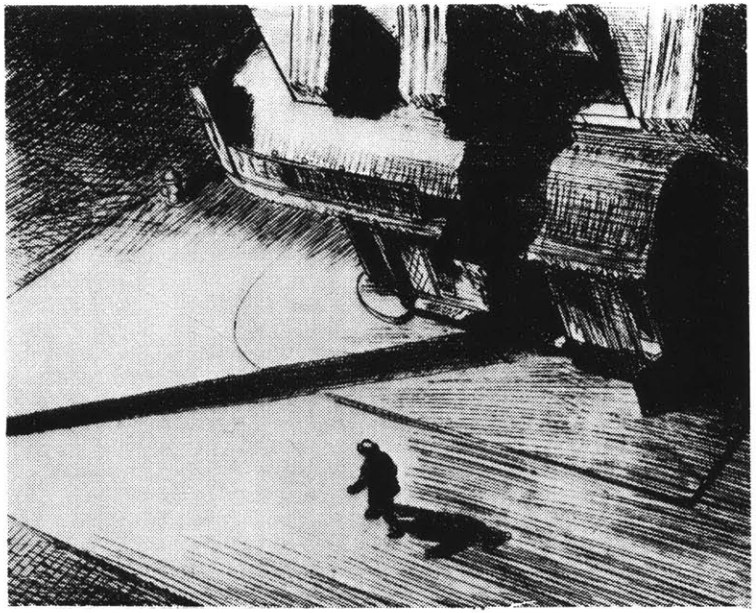
2. Perception of Light

Light originates from the sun as a direct beam (specular) source. This light is modified by both natural and man-made means to have a diffuse and reflected component. The relative quantity of direct, diffused, and reflected light determines the visual perception of architecture. By discussing these qualities I will provide a framework for appreciating natural light.

Direct Beam Light A point source of light from the sun on a clear day, a light bulb, or flame. This light makes bright highlights and lightless shadows when no reflected light is present (Fig. 7). Light from a point source is emitted equally in all directions: a light bulb suspended in the middle of a room. The light from a point source appears to have directionality the farther away the receiving object is located because it receives only a narrow beam of the total light emitted. Direct rays from the sun are parallel to one another when they reach earth because of the distance between the bodies (Fig. 8a). The light from an electric lamp can be made more directional through the use of glare reducing reflectors or louvers. A parallel directional quality of light gives a strong point of reference because all objects in the light have light striking them in the same way. A suspended light bulb can give disorienting shadows because objects receive the light from different directions depending on where they are located (Fig. 9).

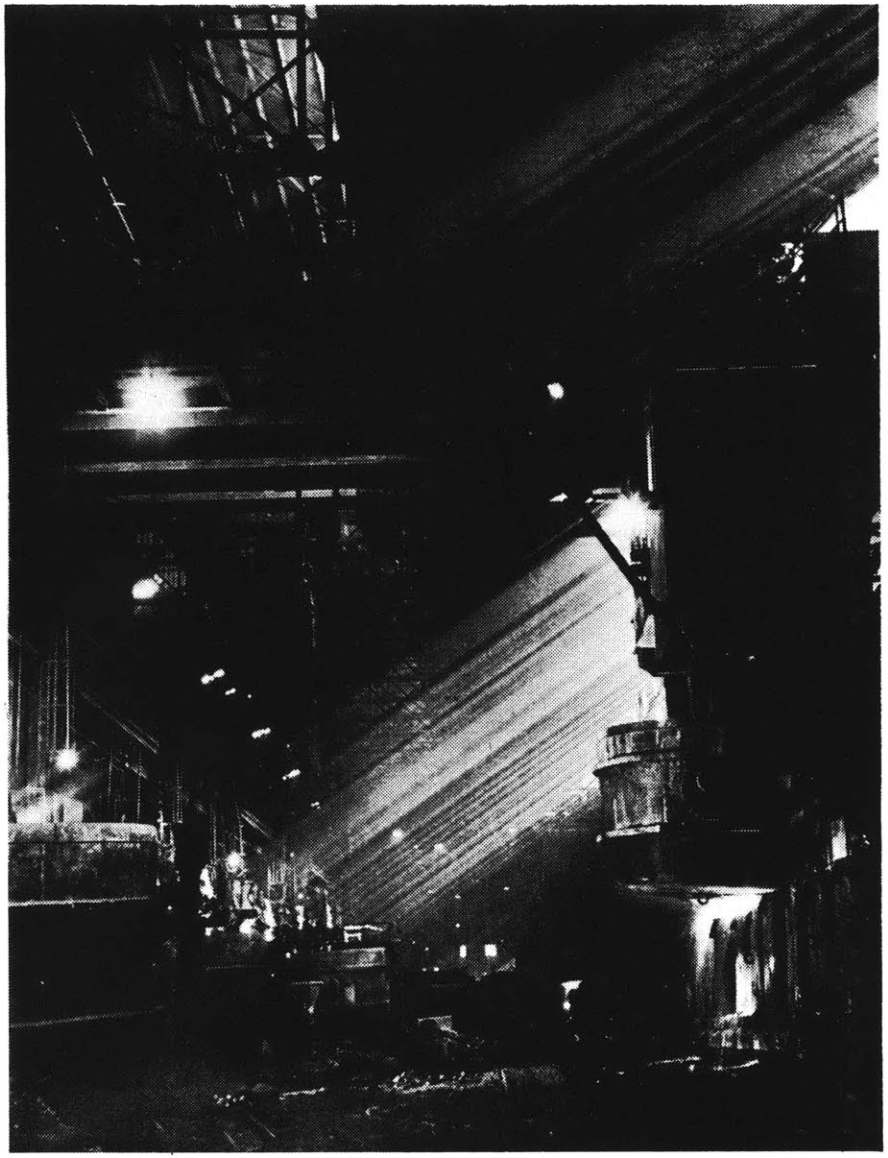
Diffused Light A direct source of light can be diffused in many ways. Direct sunlight is diffused by particles of water and dust in the atmosphere. In Fig. 8b, beams of sunlight are made visible by the particles of dust in the air of the steel mill. The same holds true for a sunny day

7. Vermeer, Theater of the World. The women's faces are lit by the candle. Their backs are completely dark because no reflected light is present.



9. Hopper, Night Shadows. The shadows of the street light pole, fire hydrant, and figure go in different directions. In sunlight, the shadows would be parallel.

8. Feininger, Open hearth furnaces.
(a) The beams of sunlight enter from the right side of the photo and are parallel.
(b) The direct sunlight is diffused by the dust. The dust particles become a light source in an analogous manner to the sky.



outside, although the effect is less dramatic. A typical fluorescent light fixture is a diffused light source, with light emitted over the surface of the plastic lens.

Diffused light produces a gentler shadow than direct sun (Fig. 10). Despite its softness, diffused light can still have directionality, although it is less marked than direct sunlight because it appears to come from a larger surface area. For example, the surface area of a bright ceiling seems larger than the surface area of the distant sun.

Reflected Light Reflected light is formed when a direct beam of light or diffused light strikes a surface. The nature of the reflecting surfaces, shiny or dull, light or dark, determines the spectral quality and amount of reflected light. For example, if a beam of sunlight strikes a mirrored surface, a beam of light will be reflected. If

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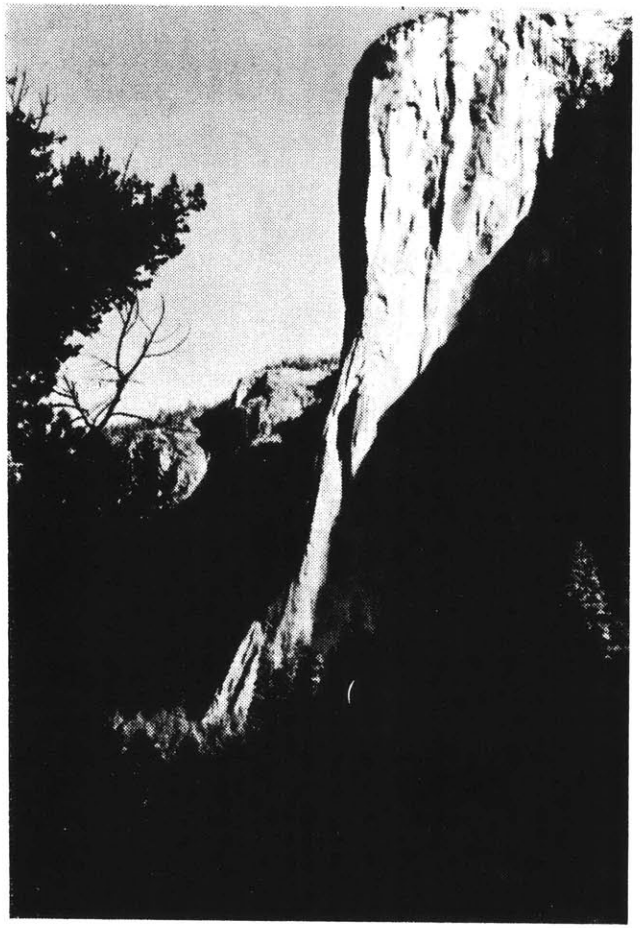
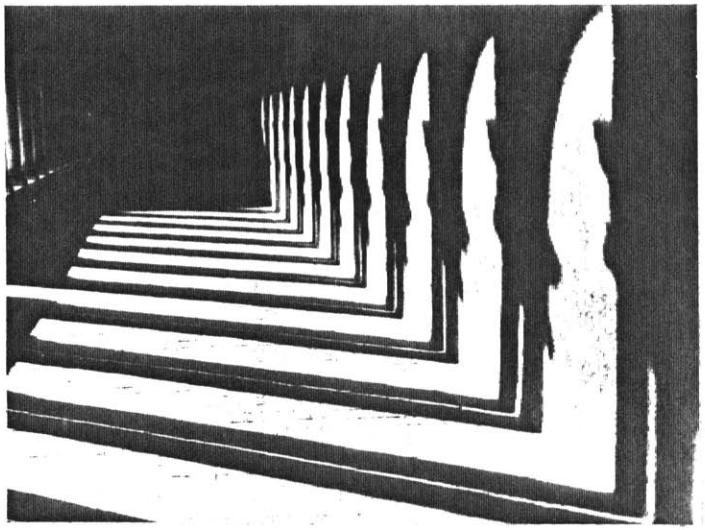
10. Vermeer, The Astronomer. Diffused light from the leaded glass windows light the figure and his tools. Facial features are easily read in this light.

12. Adams, Yosemite. The highlight of the rock face is brighter than the sky. Reflected and diffused light keep the shaded part of the rock from being completely dark. Contrast this with Fig. 7.





13. Springer, Colonnade.

16. McCullen, Bradford, Lum Lane. The sky is bright in contrast to the buildings and figure. Only the sky's reflection in the damp pavement is as bright.

the same light strikes a flat grey surface, the reflected light will be diffused. Reflected light also produces gentle shadows and often has directionality.

When direct beam, diffused, and reflected light are present, visual perception is heightened. On a sunny day, for example, the deep blue of the sky is relatively dark in contrast to the landscape (Fig. 12). Three dimensional form is easily read by the highlight and shadow created by the sun. The shaded areas receive enough light reflected from the ground and diffused by the sky so that detail is still visible in them. The directionality of the sun's light gives us another perceptual clue. In Fig. 13, even though the arches of the colonade are outside the frame of the photograph, their form is revealed by the shadow.

These three qualities can also be present inside buildings. Figs. 14 and 15 respectively show a preliminary study and finished painting by Edward Hopper. The room depicted in the painting shows direct and diffused light entering from the window to the right. The light is reflected from surfaces in the room to make detail visible in the shadows. In the preparatory sketch, Hopper has carefully noted the various types of light incident on the woman's figure.

In contrast to sunny days, we often perceive overcast days to be dull (Fig. 16). The overcast sky becomes an even source of light, brighter than the landscape itself. The phototropic sense of our eyes continually draws our attention towards the sky. The diffused light form the sky, without a direct component, creates an almost shadowless light and the important perceptual clue of light and shadow is lost. Some atrium spaces built recently have a similar quality. They are glazed with low transmission glass to avoid overheating and, as a result, the light entering is dull.

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14. Hopper, preliminary study for Morning Sun (notes redrawn for clarity). Direct, reflected, and diffused light are noted, apparently because the painting was to be done later. The notes make explicit the qualities of light present on the figure and what caused it.

15. Hopper, Morning Sun. Reflected light from the far wall and bedcover minimize the contrast between shaded and unshaded areas in the painting.

17. Vermeer, Lady and Gentleman at the Virginals. The window is located adjacent to the far wall, making it a secondary light source. Contrast this image with Fig. 10, where the window is not near a wall.

18. Mackintosh, Glascow School of Art. Two views of the principal staircase.
(a) The railings to the right are seen in silhouette.
(b) Seen from this angle, the railings are reflecting light onto the stairs.

17.

18.

Screens and Reflecting Surfaces Buildings can modify the natural light outside to a quality suitable for habitation inside. Orientation of the building, size and number of apertures are key determinants of how much light will enter a building. Reflectors and screen inside the building can also enhance the quality of light.

Inside light can be made more apparent if vertical surfaces are placed so they reflect the light, as opposed to letting the light strike the floor and overlooking it. In Fig. 17, the sunlight is reflecting from a large surface area, making it visible. The lighter the surface, the more light will be reflected. The surface introduces an indirect component to the light entering the room. These surfaces can be an opaque solid like a wall or large beam.

Alternatively, the surface can be broken up to have a more screen-like quality. A screen allows some of the light to pass through directly, while the rest is reflected. Also, the semi-transparent material of a screen allows the continuity of a space to be preserved without breaking it up with a solid wall. Interior screens in Mackintosh's Glascow School of Art work both in silhouette and as reflectors (Fig. 18).

A catalog of screens on the following pages shows how they can affect natural light (Figs. 19 to 26).

The types of light addressed here form a background for looking at natural light in library buildings. In the following chapter, I discuss how these types of light relate to patterns of use and meaning in four libraries.

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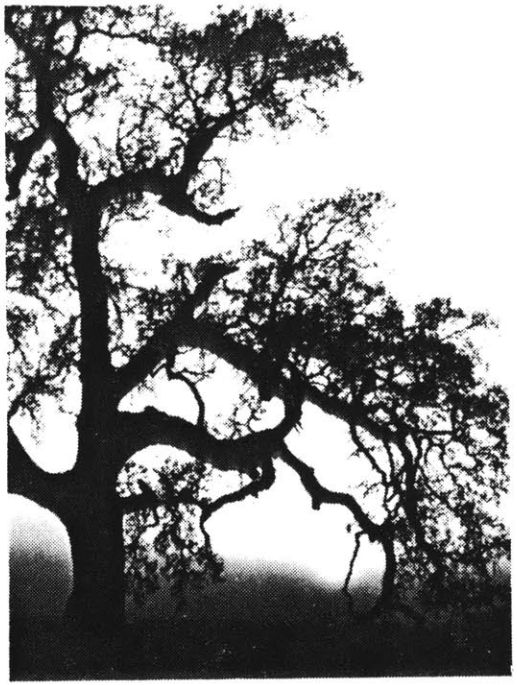

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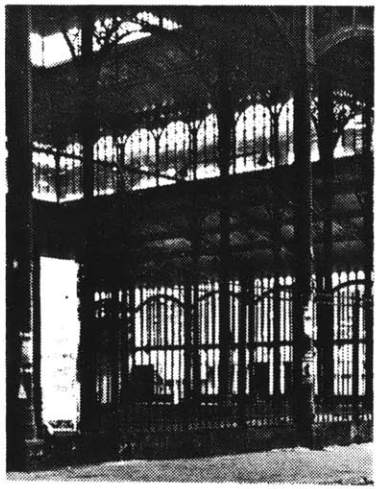

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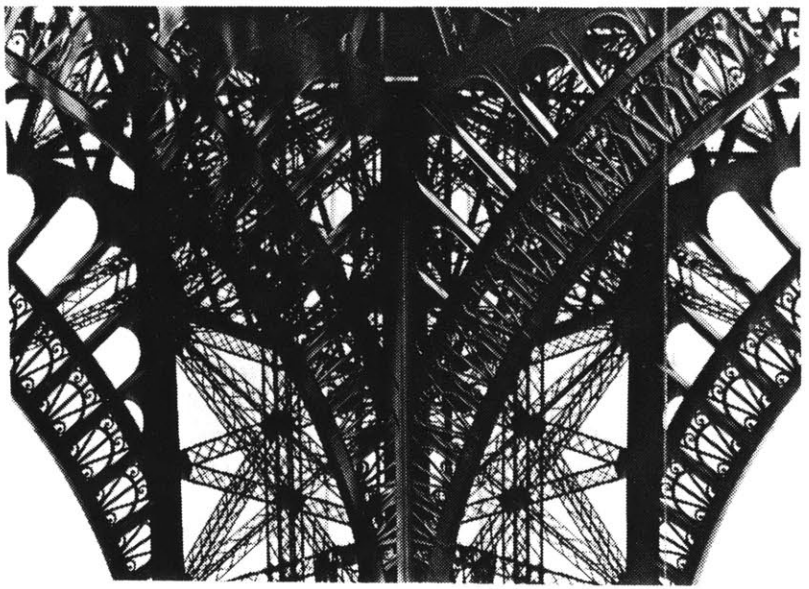

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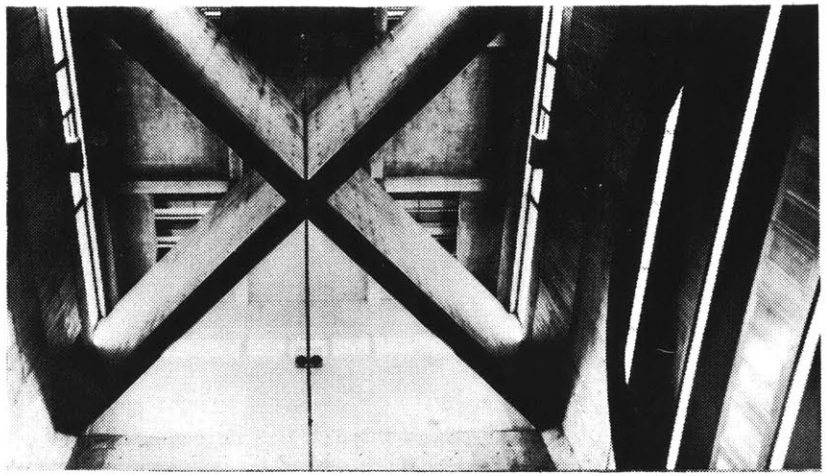
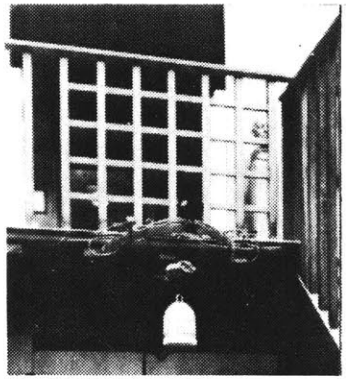


The images show a progression from left to right of the ways in which screens can heighten the perception of light. The oak tree on the far left (Fig.19) is seen in silhouette to the sky beyond. Moving to the right, the images show how a screen can also become a reflector. A detail of the Eiffel Tower (Fig. 22) shows a layering effect, where the ironwork closer to us reflects light, while the rest is seen in silhouette. On the far right (Fig.26), the trees reflect light and stand in contrast to the darkness behind. This is a reversal of the light in Fig. 19.



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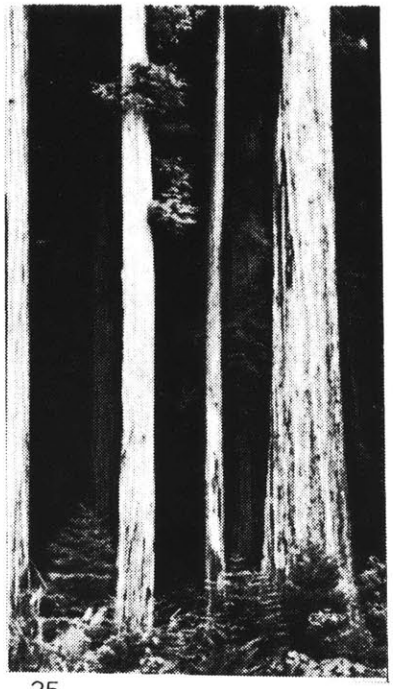

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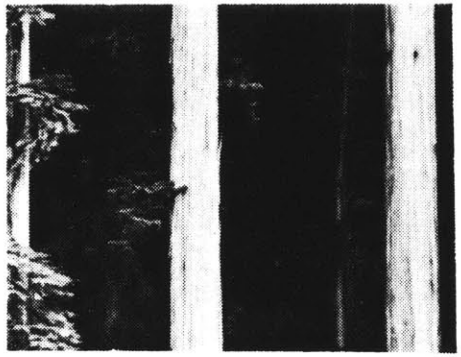

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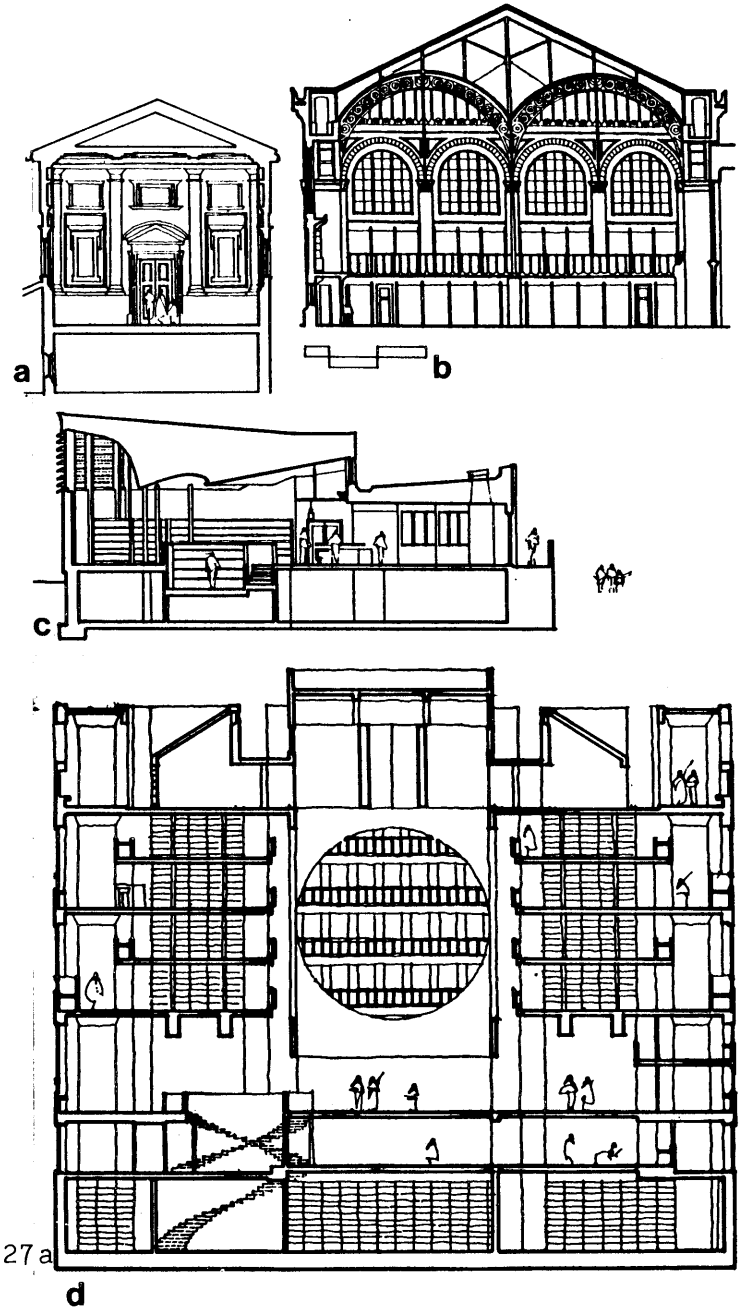
3. Analysis Introduction

In this section, an analysis is made of four library buildings: the Laurentian, Florence; Sainte Genevieve, Paris; the Seinajoke, Finland; and the Phillips Academy, Exeter. These buildings are chosen for study because each demonstrates a distinct and different strategy for natural lighting. The purpose is first to provide an understanding of the four lighting strategies, followed by a quantitative and qualitative measure of light in the buildings. I hope to use the results of these insights in my own design of the Newton Public Library. Second, a method of natural light analysis is presented which can be applied as a tool for architectural design and projections in general.

In observing the four library buildings, I discovered that the quality of natural light is strongly influenced by two factors: the spatial relationship between book storage and readers in the building, and the type of library -- public or private. Books and readers require very different qualities of natural light, readers in general wanting a high amount of glareless light, while books should have very little light for preservation. It follows then that the degree to which book storage and readers are placed together or apart will encourage different lighting strategies.

Over time, the physical relationship between books and readers has changed, encouraging different natural lighting schemes. In medieval and Renaissance libraries, before the advent of mass book printing, the books and readers could be accommodated in the same room. For example, the monastic libraries of Italy include storage as part of the seating (Fig. 26). In addition, the meaning of a monastic library has changed from how we think of a library building today.



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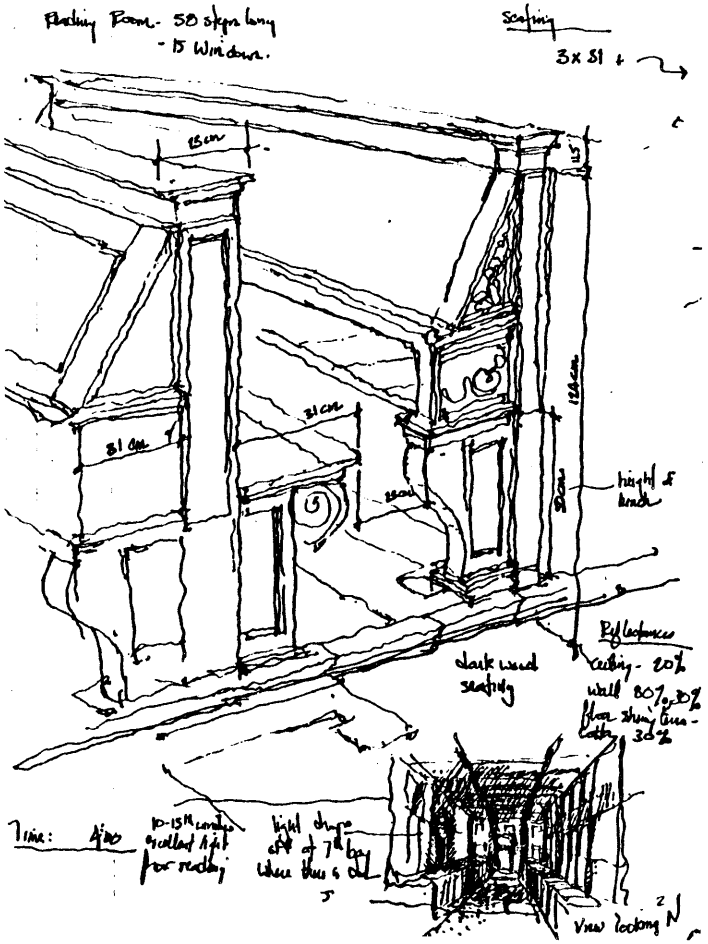


26. Seating pew. The books are stored below when not in use.

27a. Cross sections of four buildings studied. Scale: 1" = 40'.
(a) Laurentian.
(b) Sainte Genevieve.
(c) Seinajoke Civic Center.
(d) Phillips Exeter Academy.

The books were very rare and an intimate, almost secretive ambiance surrounded reading in the library. As can be seen in the idealized painting, "Saint Gerome in His Study," by Antonello da Mersina (Fig. 27b), the darkened interior finishes in the room, with highlights on the monk reading heighten the intimacy of the scene.

Separate accommodations were used for book storage and reading, as book collections grew. The prototypical example of the separation of these two is the Sainte-Genevieve Library, University of Paris (1848). A separation between the reading room and book stacks is achieved by placing the reading room on the second floor above the book storage.

The Sainte Genevieve is a private university library. The private, club-like atmosphere is emphasized because one does not discover the grandeur of the light until one has climbed a flight of stairs and entered the great reading room. The low light level in the entrance discourages the general public. The relative uniformity of light inside the great hall of the Sainte Genevieve underlines the collective spirit.

A new problem was introduced with the open access stack public library, introduced in the mid-nineteenth century in America and in the early twentieth in Europe. The relationship between library building and general public and between book and reader changed dramatically. The intention for the lighting was no longer to illuminate a single monk reading, but an entire collection. This is beautifully illustrated in Alvar Aalto's public library at Viipuri, where 57 circular skylights transmit diffused light over the main collection of books (Fig. 28). This even and relatively high quantity of light breaks the aura of mystery that surrounded libraries and welcomes the general public.

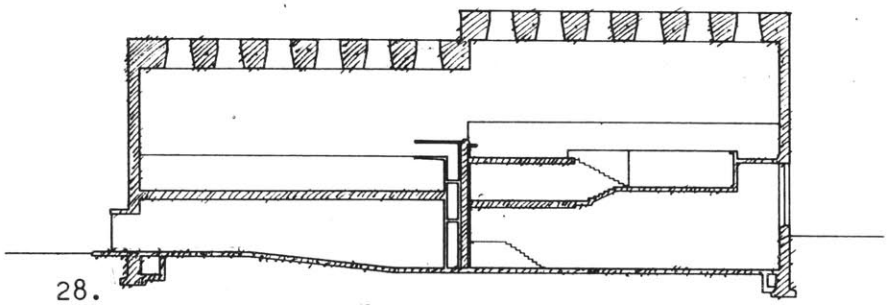
Analysis Introduction

A very different approach to the open stack library can be seen in Louis Kahn's Phillips Academy library. The focus of the library is a central hall rising 70 feet to the roof. It is surrounded by five stories of bookstacks. This is a formidable building similar to Sainte Genevieve library. The light of the main hall is not revealed until one is well within the building. The library was built, in part, to celebrate the power and prestige of Phillips Academy.

Each of the four libraries analyzed is described in a written text followed by graphic illustration in photographs, perspective sketches, and measured drawings. The sketches give a sense of what one would see entering the building. A 1/16" = 1'-0" floor plan and 1/8" = 1'-0" section are shown to facilitate comparison of the buildings. These scales are also commonly used in design. In Chapter 1, an Edward Hopper drawing shows a method of analyzing light. I followed a similar method which examines an interior photograph of each building. A sketch adjacent to the photographs shows how that quality of light was achieved.

27b. Mersina, Saint Gerome Reading in His Study.

28. Aalto, Viipuri library. Cross section showing skylights.



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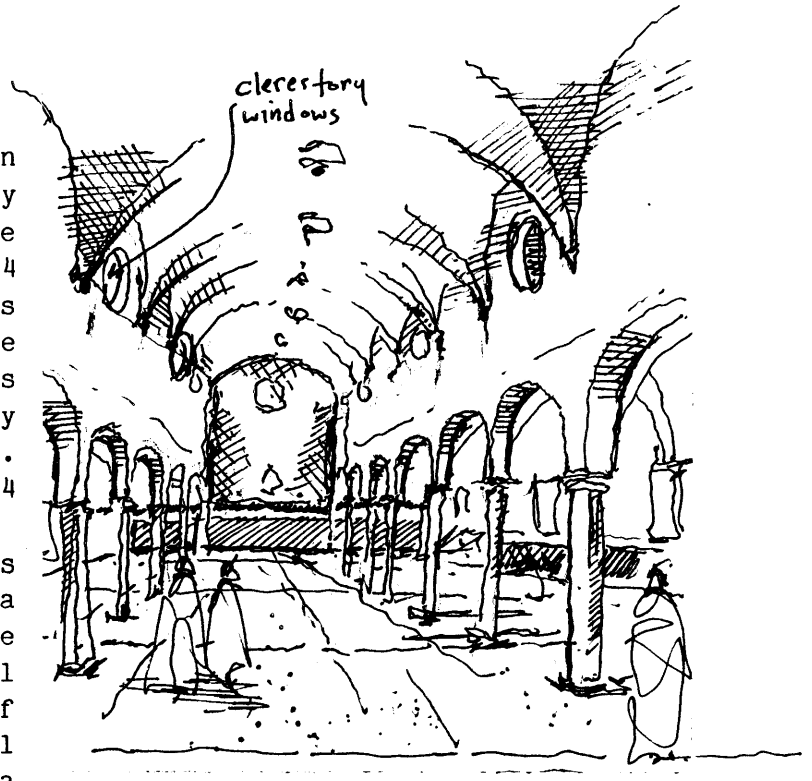
4. Laurentian Library

This library was designed by Michelangelo in 1524 as an addition to the San Lorenzo church and cloisters started by Brunelleschi and Michellozzo in the previous century. The library is composed of a single room measuring 151 feet by 34 feet and is located in the west wing of the cloisters (Fig. 29). This large room is unobstructed by intermediate supports. It has a flat ceiling. A vaulted ceiling was impossible because the third story location of the library would have toppled the walls of the building below. Intermediate supports were unnecessary due to the narrow 34 foot width of the existing building.

These features are important in marking this building as a turning point in the design of the monastic library as a hall. Previously, the monastic library was designed on the basilica plan with a continuous vault over the central passage, and intermediate supports allowed a displacement of the roof plane for clerestory lighting. The additional supports and clerestory lighting worked in concert to allow a deeper section. An example of the basilica plan library is the San Vittore al Carpo in Milan (Fig. 30).

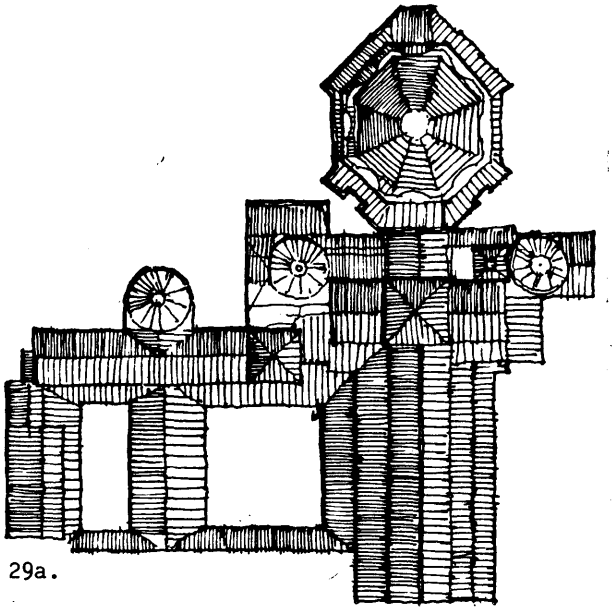
The Laurentian library is located on the third floor of the monastery. A second or third floor placement is typical and advantageous for monastic libraries as this means unhindered exposure to light. A church pew seating arrangement with a center aisle defines access in the library, given the absence of interior walls and columns. Book storage was incorporated into the design of the seating and, because the collection was small, all books could be accommodated in the same room. The books are protected from daylight by being located on shelves under the desks.



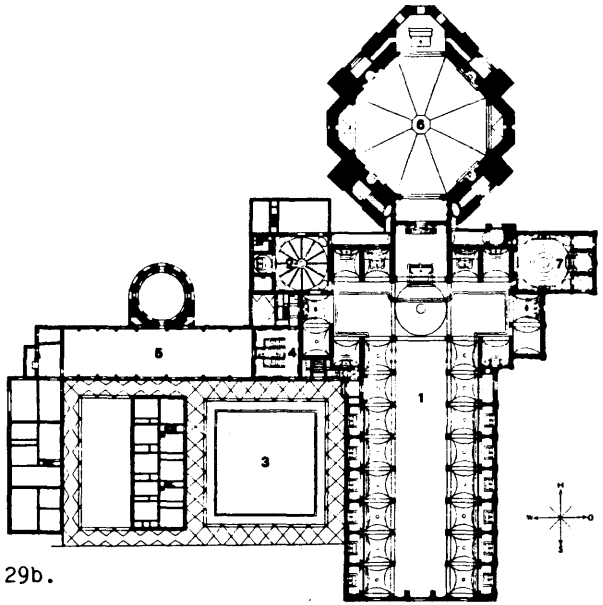
30. San Vittore al Carpo, Milan. Circular clerestory windows bring daylight into the room. The interior has been altered from its original state.

29a. San Lorenzo. Roof Plan.

29b. San Lorenzo. Overall plan. The relationship between the library (5), church (1), and cloisters (3) is shown. The rigidity of the library plan is tempered by the additive quality of the overall building complex.



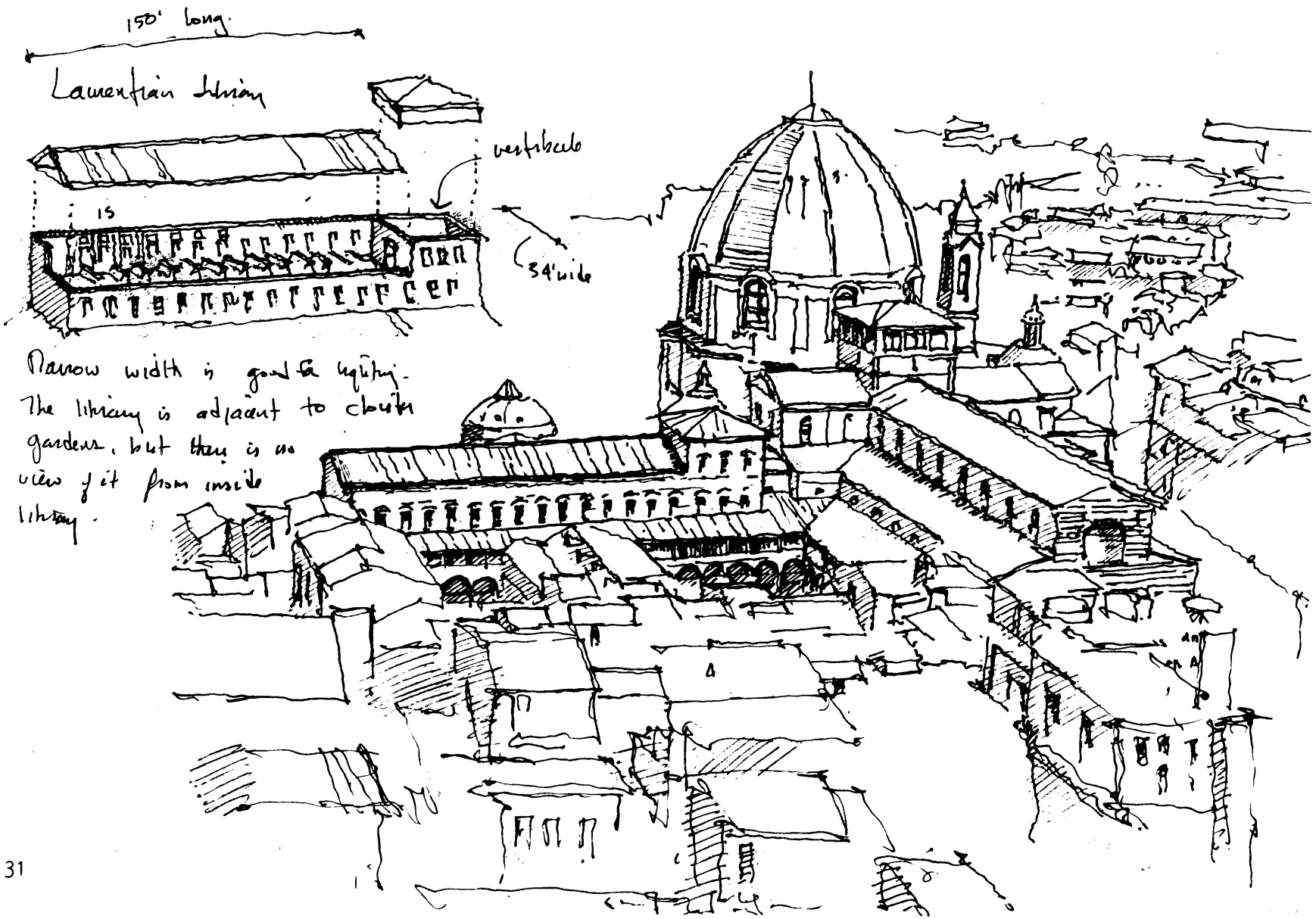
29a.

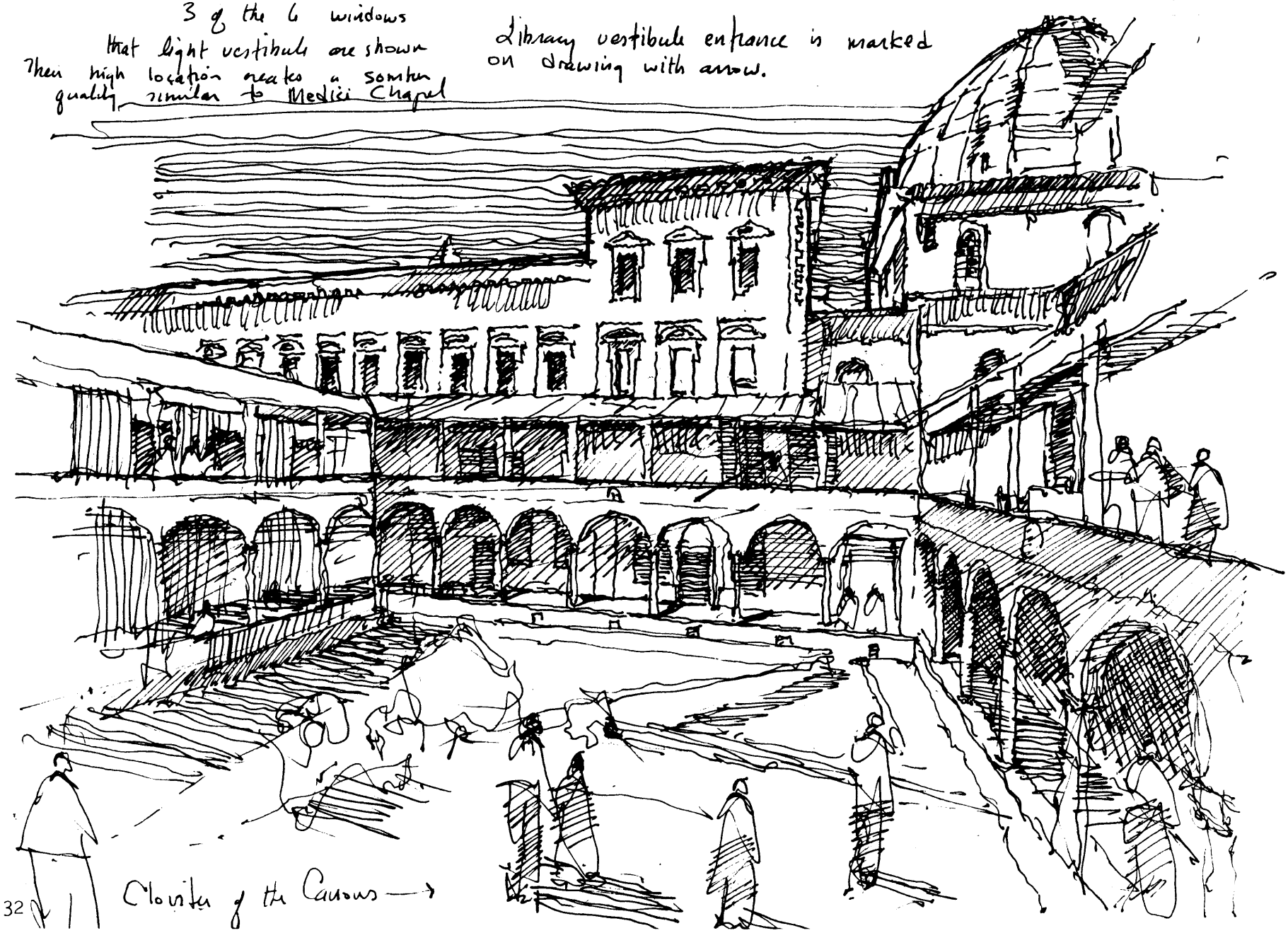


29b.

The room is bilaterally lit by twenty nine windows located on either side of the room, each measuring 2'-9" by 6'-6" and located 8 feet from the floor. The dimensions are critical to the lighting scheme. To provide adequate light, each book placed for reading must be able to "see" at least one window. This establishes the relatively high locations of the windows. If the window extended lower, part of its light would be obscured by adjacent seating pews, casting uneven light across the book's page. Since the interior materials of the building are darkly finished, they do not act as secondary light fixtures. Michelangelo responded to this by placing translucent leaded glass in the windows so that the window the book "sees" becomes a brighter light source. This is particularly important in the Laurentian library where there are more seating aisles than windows. Another advantage of the translucent glazing is that it lessens contrast within the window itself. The reader sees the average brightness of the outdoors and not the highlight of the sky or the darkness of a portico's shadow. Glare is also reduced by painting the wall around the windows a light color, lessening contrast with the window itself.

26 Laurentian Library




3 of the 6 windows
that light vestibule are shown
Then high location creates a somber
quality similar to Medici Chapel
Library vestibule entrance is marked
on drawing with arrow.
32
Cloister of the Canons →

Laurentian Library

35

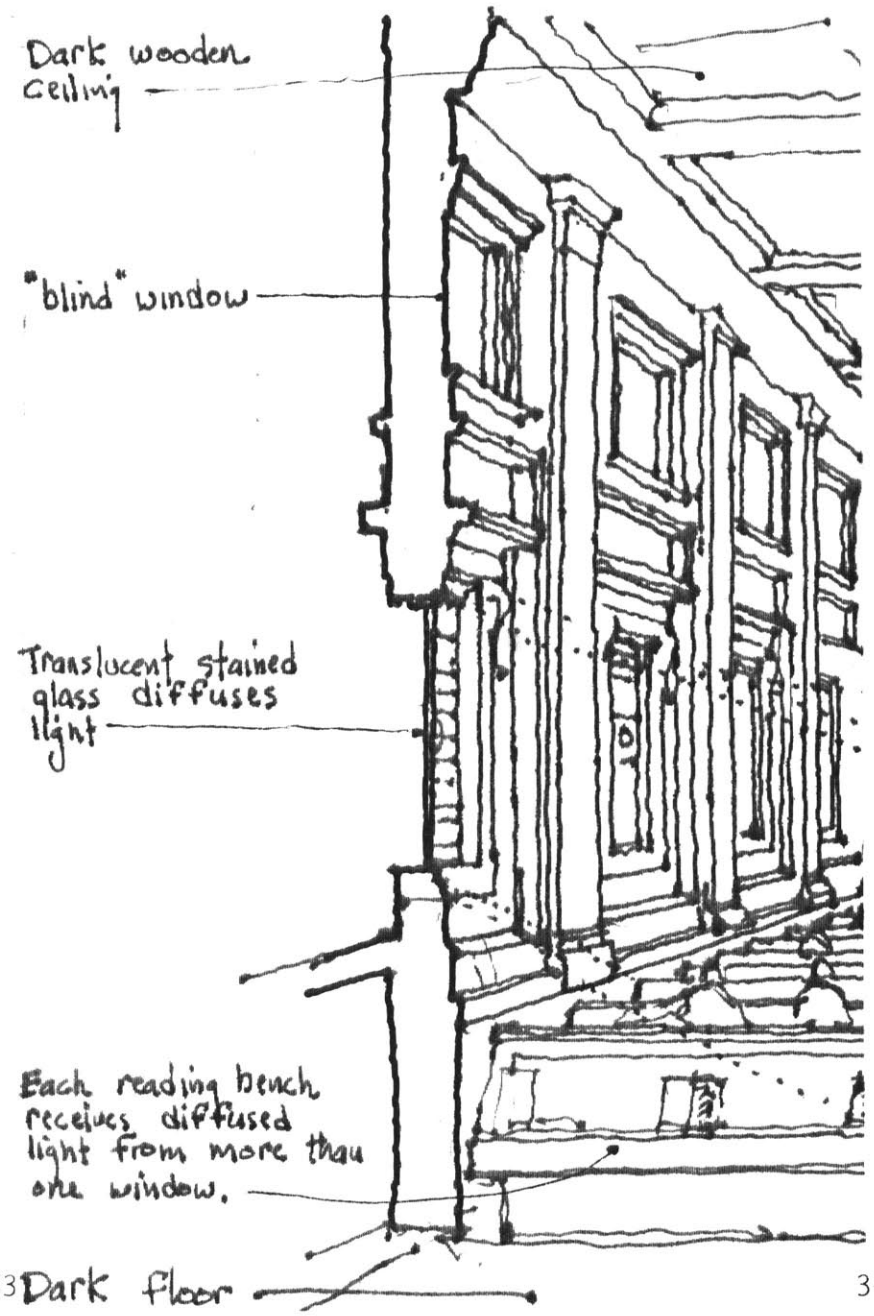
31. San Lorenzo. Sketch with cut-away detail of library.

32. Laurentian Library. Sketch from cloister. The high location of windows above arcade gives no view of cloister.

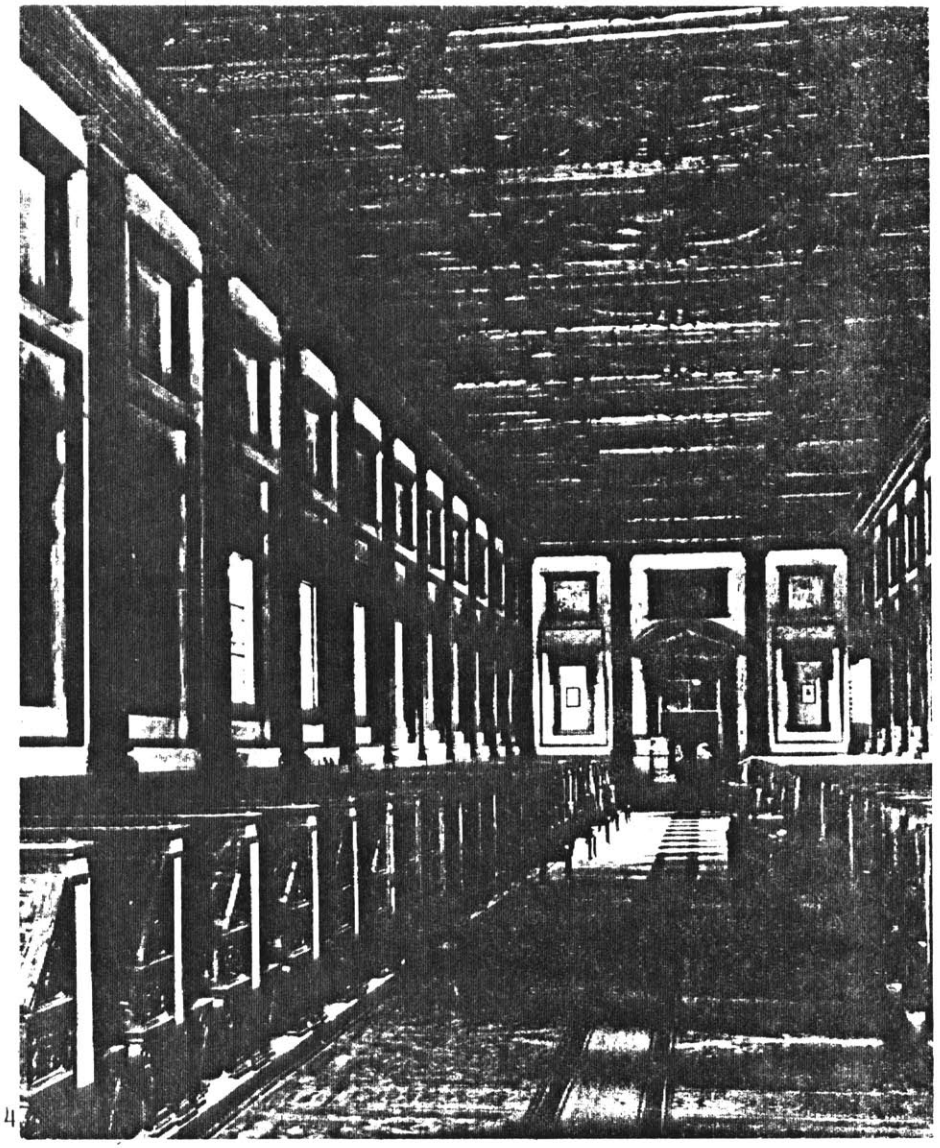
33. Interior sketch showing how edge design and interior finishes affect the quality of light.

34. Alinari. Interior photograph.

35. Vestibule entrance. View towards library.


Dark wooden ceiling
"blind" window
Translucent stained glass diffuses light
Each reading bench receives diffused light from more than one window.
Dark floor

33



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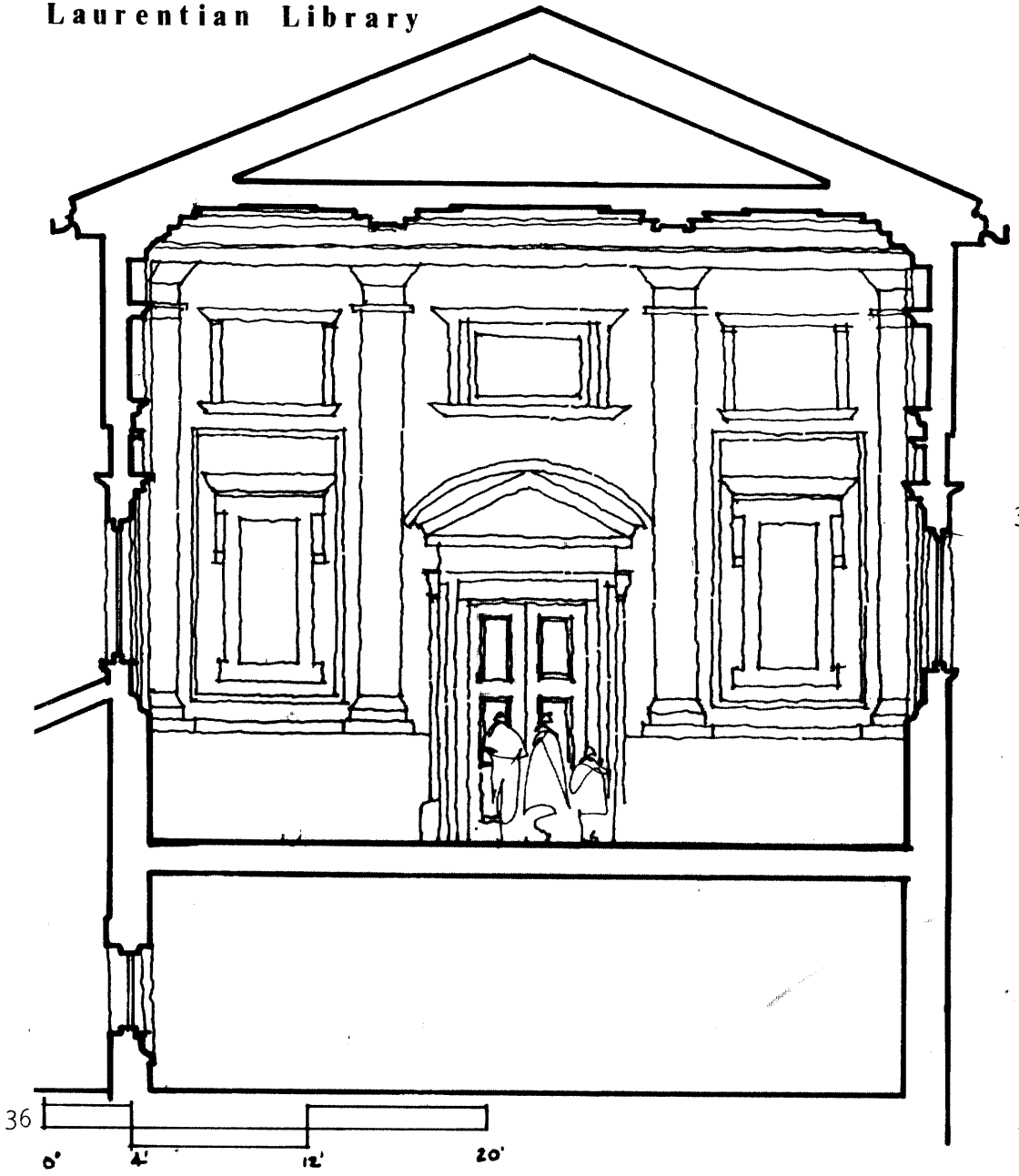
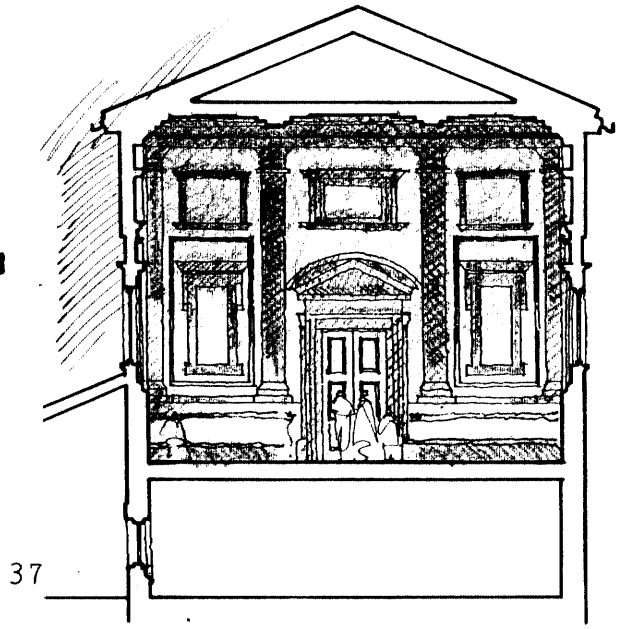

36
0'
4'
12'
20'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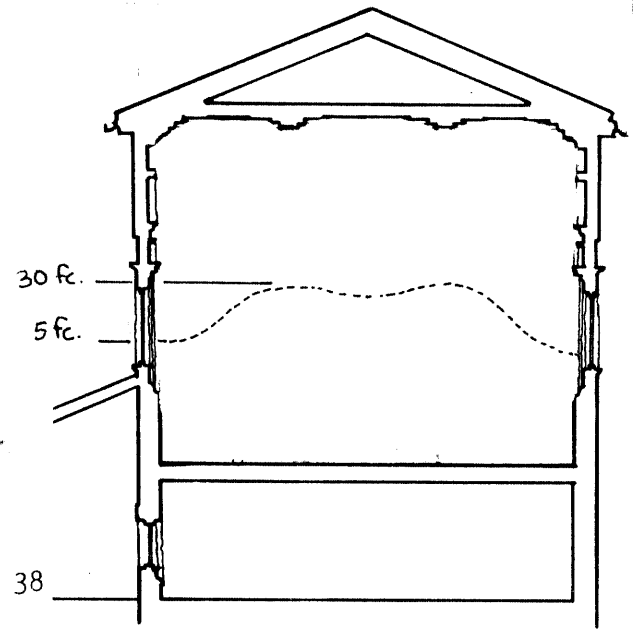
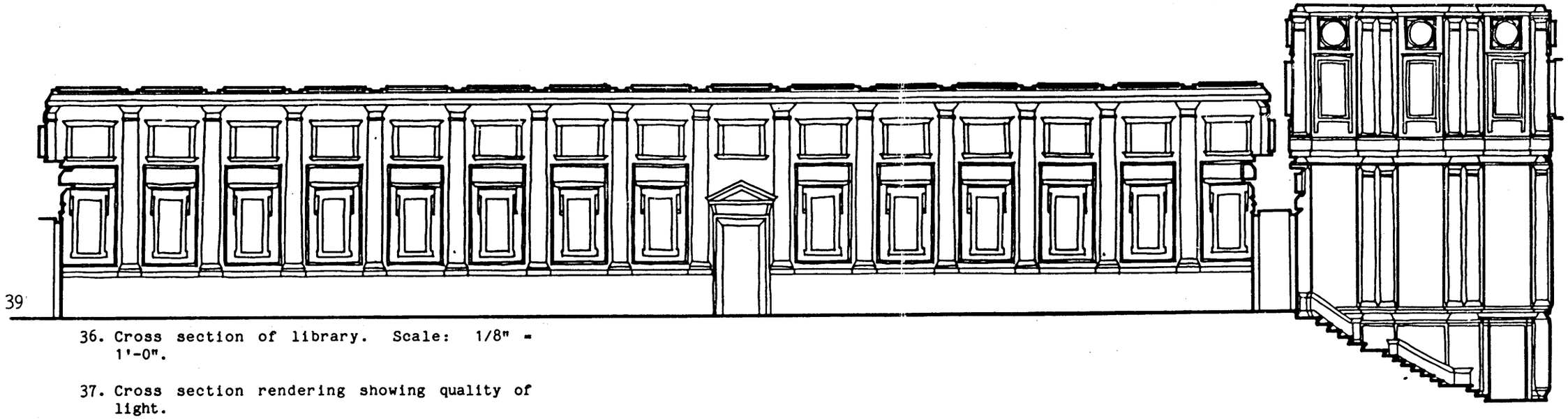

30 fc.
5 fc.
38

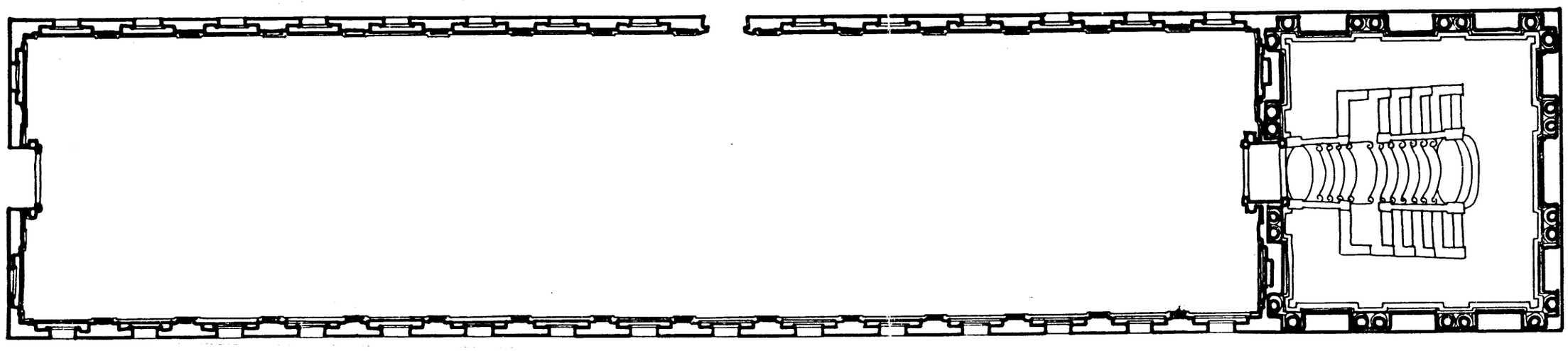


39

36. Cross section of library. Scale: 1/8" = 1'-0".

37. Cross section rendering showing quality of light.

38. Estimated interior light levels measured in foot-candles at reading height.



40

39. Library and vestibule. Long section. Scale. 1/16" = 1'-0".

40. Library and vestibule. Plan. Scale: 1/16" = 1'-0".

5. Sainte Geneviève

The Sainte Genevieve was among the first libraries to respond to the problems of large-scale book storage first encountered in the mid-nineteenth century. The first floor is devoted almost entirely to book storage, and the reading room occupies the second where it has greater access to natural light.

The magnitude of the 600 seat second floor reading hall gives it an entirely different feel from the Laurentian library. It is roughly three times the square footage of the Laurentian, measuring 272 feet by 66 feet. The use of structural iron enables the roof of the reading room to have a large span with only one line of structural columns down the center (Fig.46).

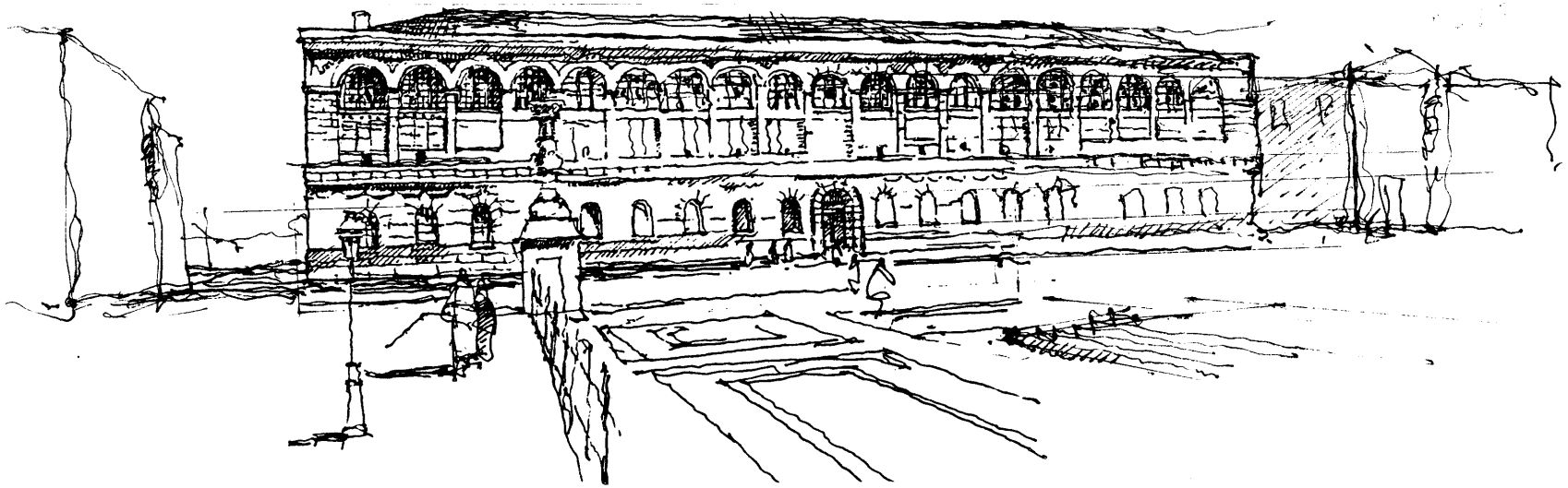
The experience of light in the reading room is heightened by the entry sequence. The entrance hall is at the midpoint of the building, directly under the reading room. This dimly lit space is defined by massive columns that suggest the weight of the floor above. The stairs to the reading room are located at the far end of the entrance hall. Natural light from above falling on the steps beckons us. The weight and dimension of the reading room are accentuated in the entrance sequence that moves under the main floor and then ascends in back of it.

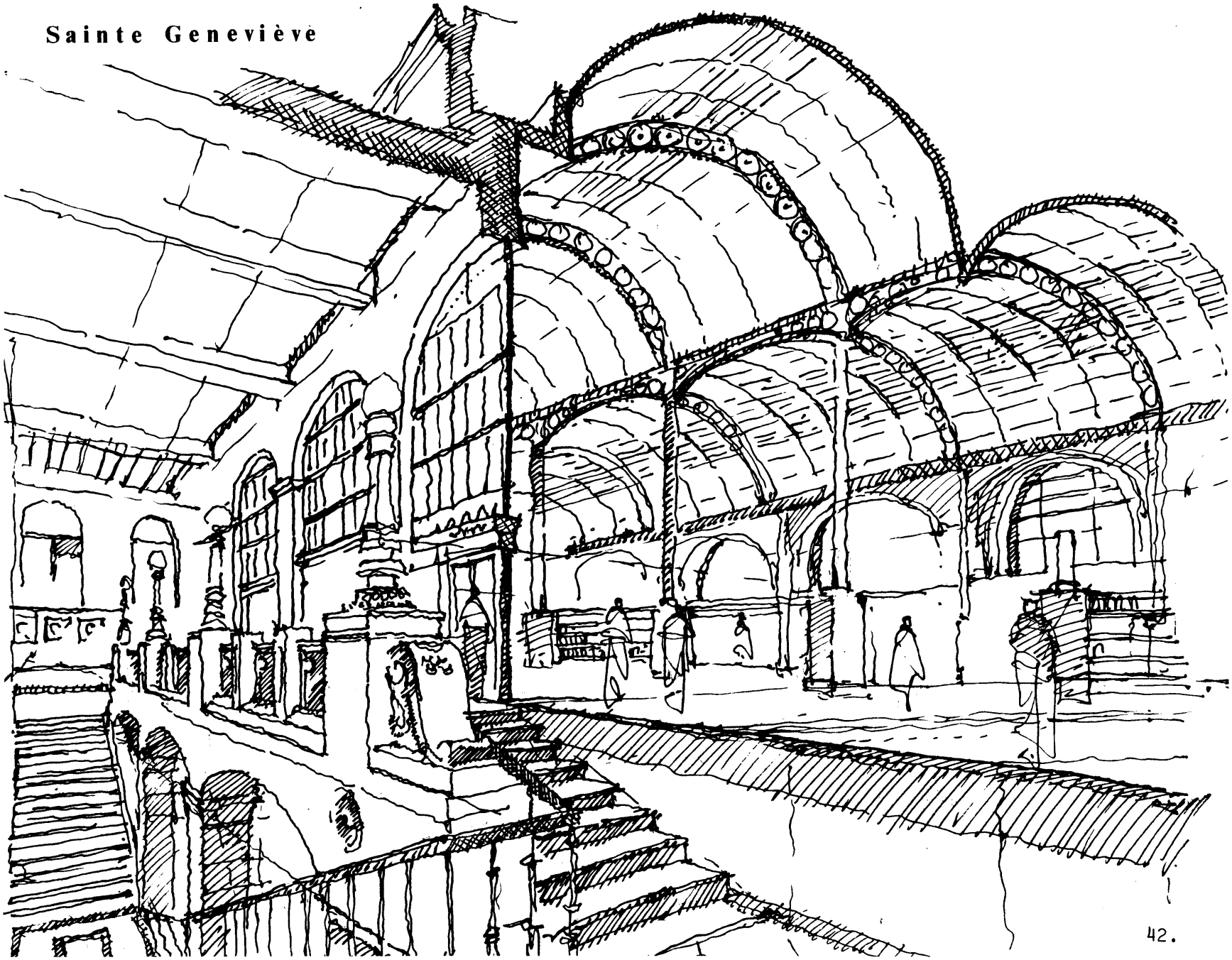
The lighting scheme is analogous to that of the Laurentian. The room is bilaterally lit by thirty eight windows located on either side of the room. A primary difference is one of window size. Each window measures 6'-0" by 8'-6" and is located 19 feet from the floor. The windows are located in 4'-6" deep reveals that reflect light into the room (Fig.48).

The perimeter of the room is occupied by 7'-0" bookcases. Above the bookcase is a mezzanine level, with more books surrounding the windows. Bookstacks are also located in the center of the room, between the columns. As a lighting strategy for preserving the books, this layout is effective. The perimeter bookcases receive little light because they face inwards and are shielded by the mezzanine. Light levels are low at the central bookstack because of its distance from the windows.

The brightest natural light occurs between the central bookstack and the windows, where reading tables are located. These reading areas are emphasized by the arched ceiling above. The light-colored arches reflect light down to the reading areas. The mezzanine at the edges makes the scheme even better by bouncing light deeper into the room. The beauty of the scheme lies not only in its clarity but also in the way that structure and light work together to reinforce zones of inhabitation.

41. Sainte Genevieve. Facade. Sketch from cafe adjacent to Pantheon.





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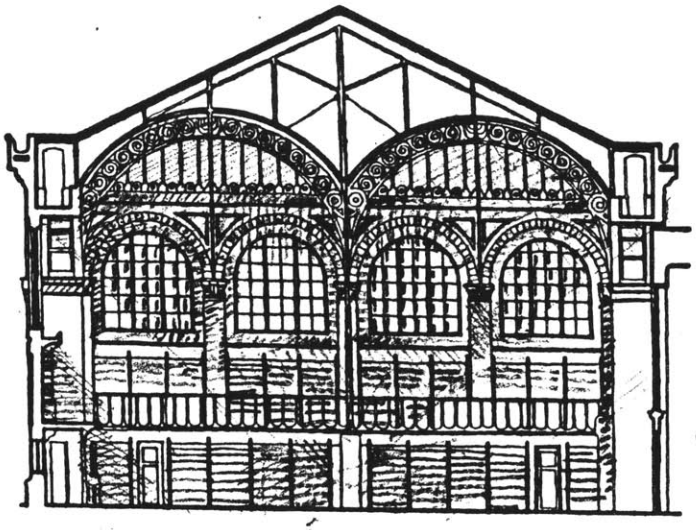

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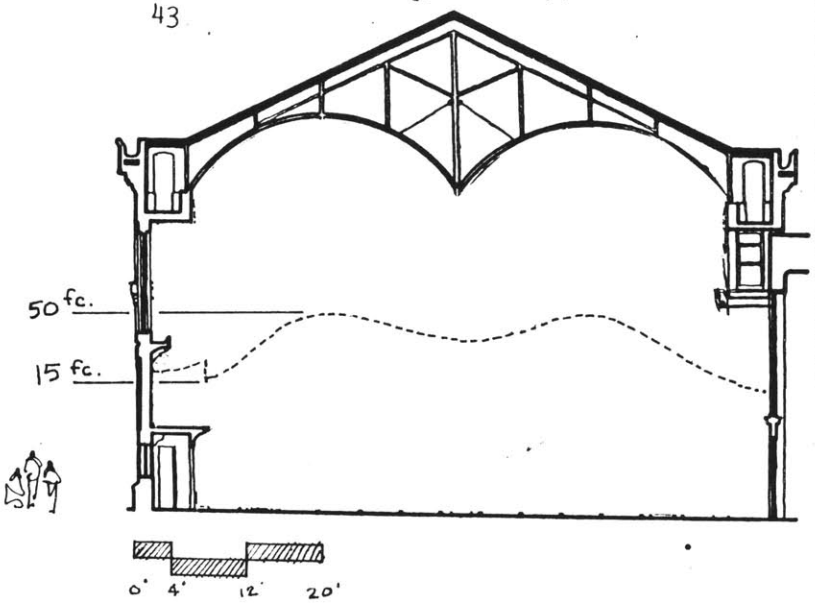


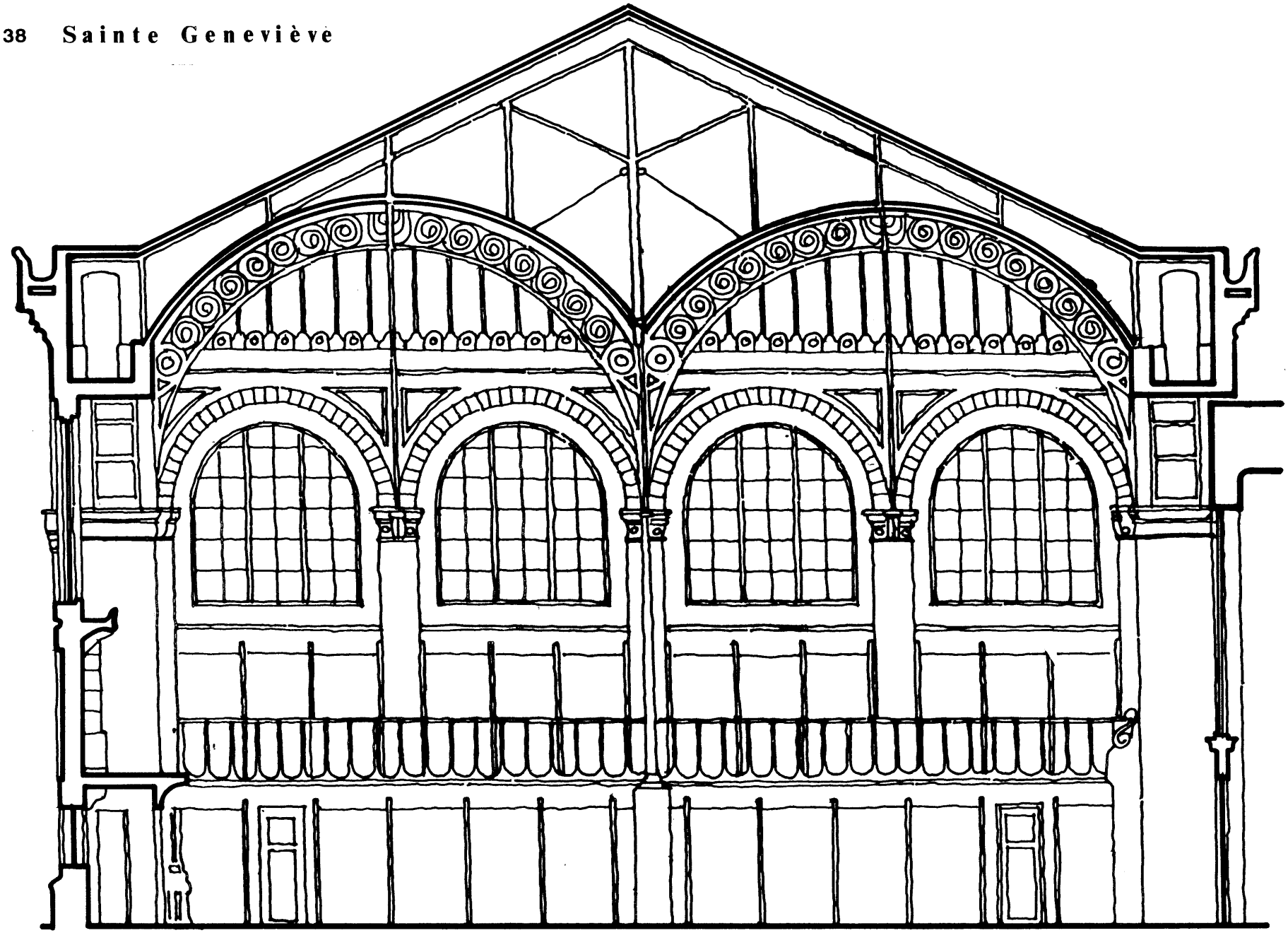
44.

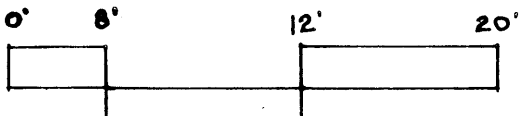
45. Austin, interior view.

44. Estimated interior light levels measured in foot-candles at reading height.

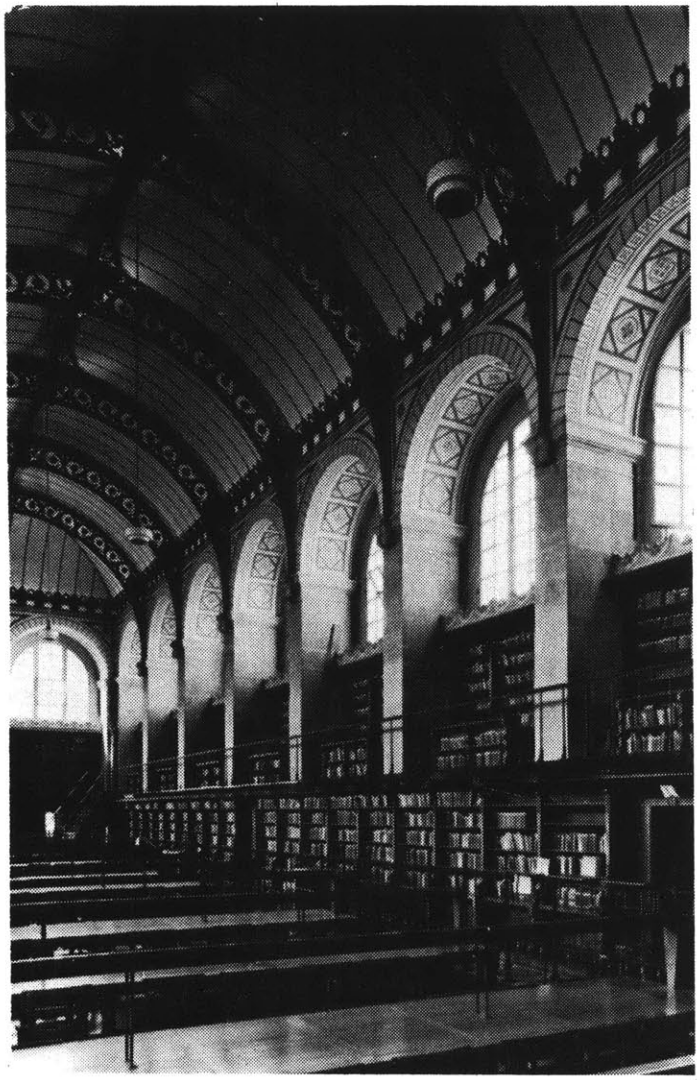
43. Cross section rendering showing quality of light.

42. Entrance stairs at back of reading room. Sketch shows load-bearing masonry wall cut away, revealing iron roof structure.





46. Sainte Genevieve. Cross section. Scale: 1/8" = 1'-0".



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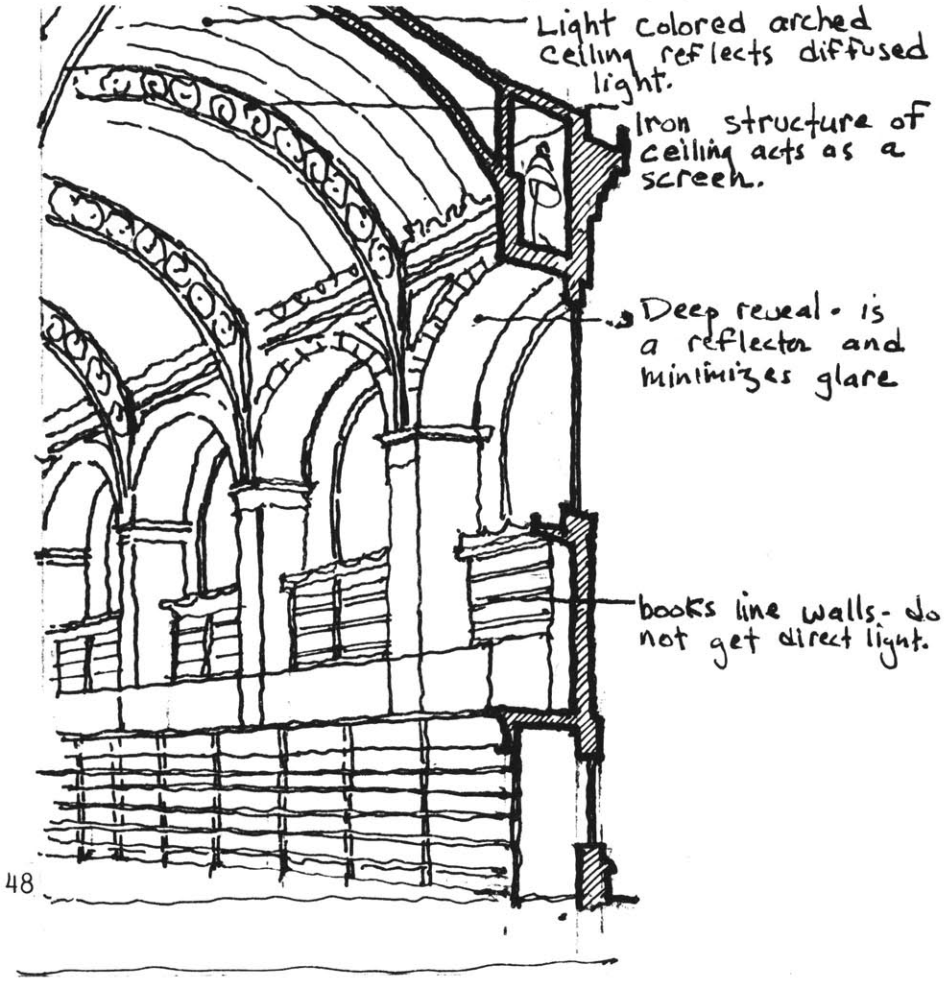
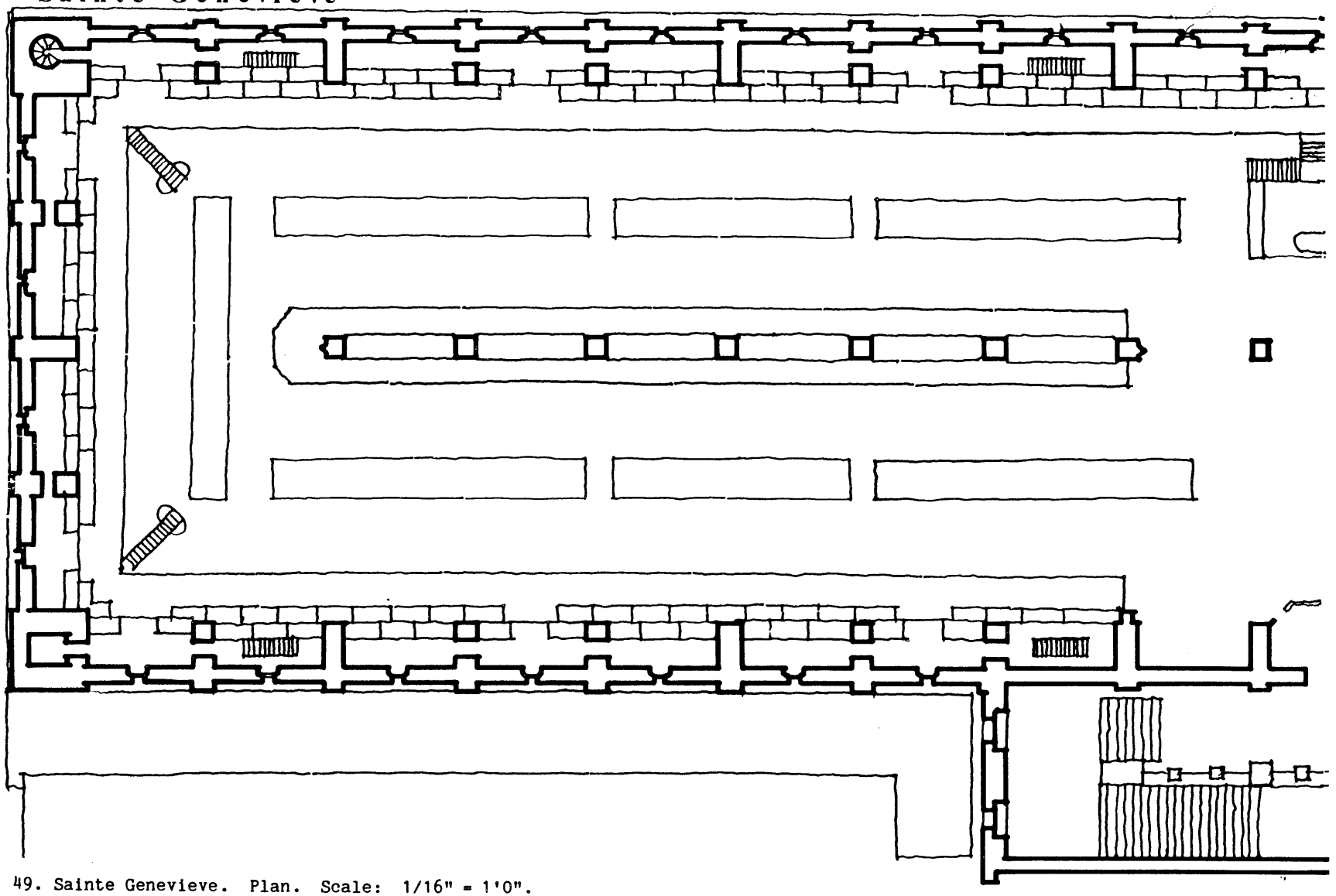


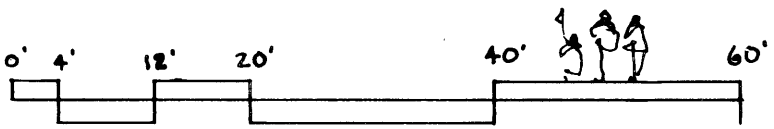
48

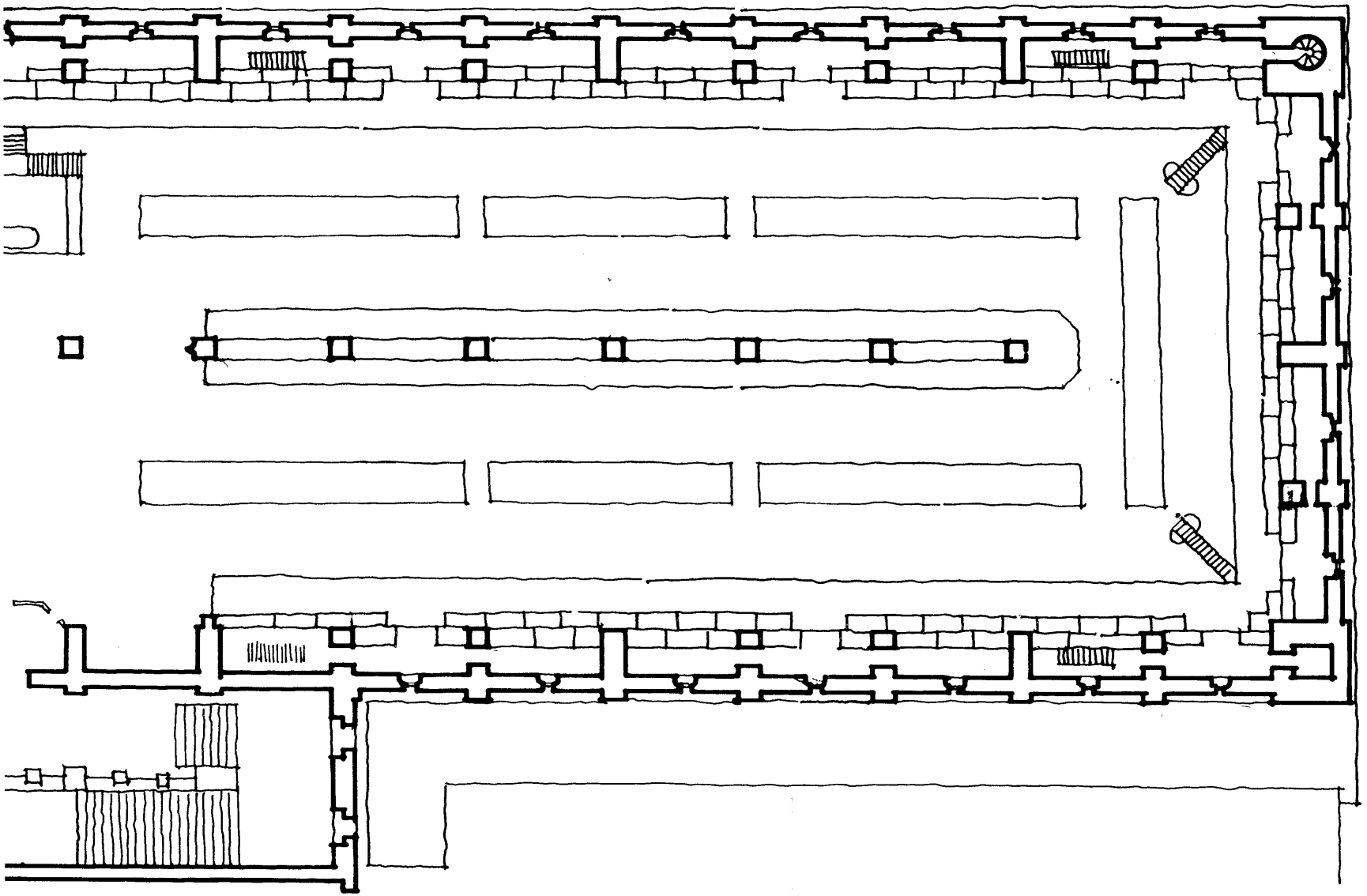
47. Austin, interior view.

48. Interior sketch showing how edge design and interior finishes affect quality of light.



49. Sainte Genevieve. Plan. Scale: 1/16" = 1'0".



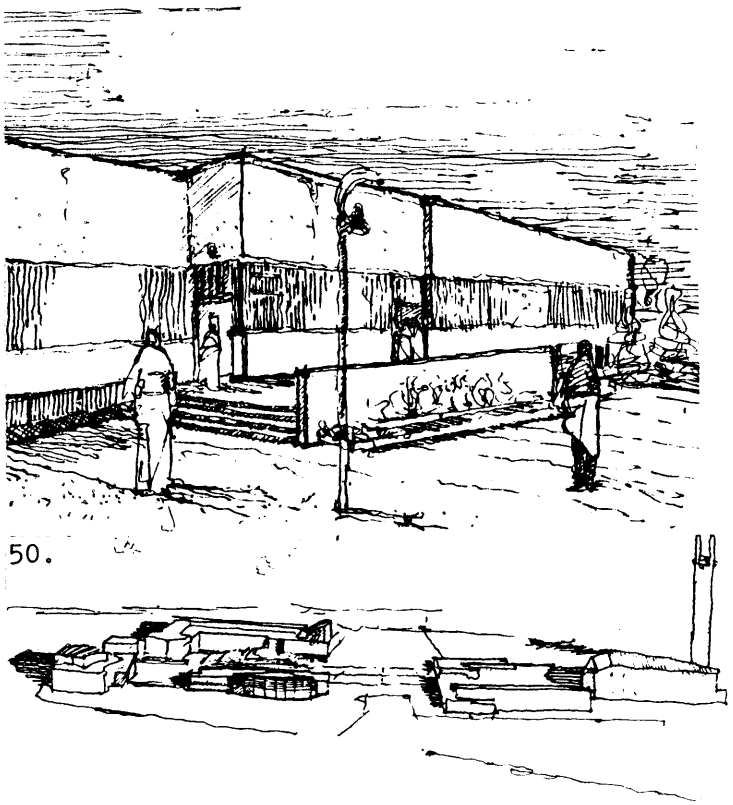


6. Seinäjoke

The Seinajoke Civic Center library was designed by Alvar Aalto as part of his town center plan that also comprises an office building, a theater, a church, and town hall. The library is organized around a double-loaded corridor that runs east-west in the building. The walls of the corridor are terminated near the entrance to the library. A larger space is thereby formed that houses the main public functions including circulation desk and fan shaped stack and reading area (Fig. 59).

The entrance sequence of the library is designed so that the larger space is immediately visible after opening the door. This area welcomes the visitor and establishes the public nature of the building. Aalto achieves a relatively even level of illumination in this 50 foot deep volume by placing a 9'-0" by 120'-0" band of clerestory windows high on the south fan-shaped edge and a smaller band on the north side. The location of bookcases along the outside edge assures that they primarily receive diffused light reflected from interior surfaces and minimal direct light from outdoors.

The natural light entering the library from these clerestories is modified in various ways to enhance its quality. Nine thin metal bands are placed horizontally to form a screen outside the large south-facing clerestory windows. They are angled so that most of the light entering the library is reflected from them. Narrow beams of direct sunlight can pass through, however, giving a mottled quality of light inside similar to that found under a canopy of foliage (Figs. 52 and 53). The light reflected from the louvers is directed up towards a deep curve in the



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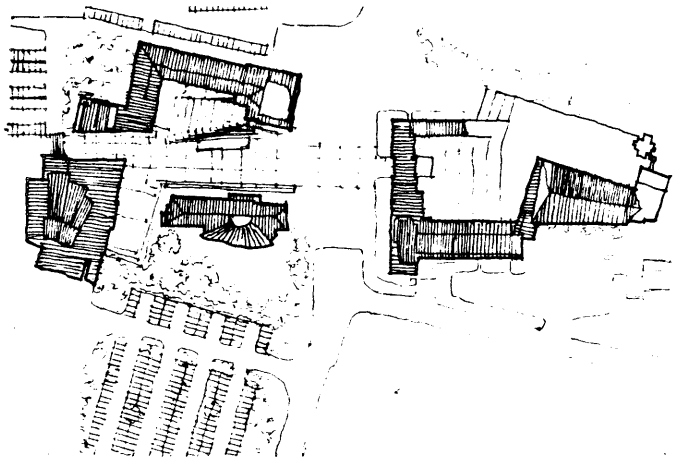

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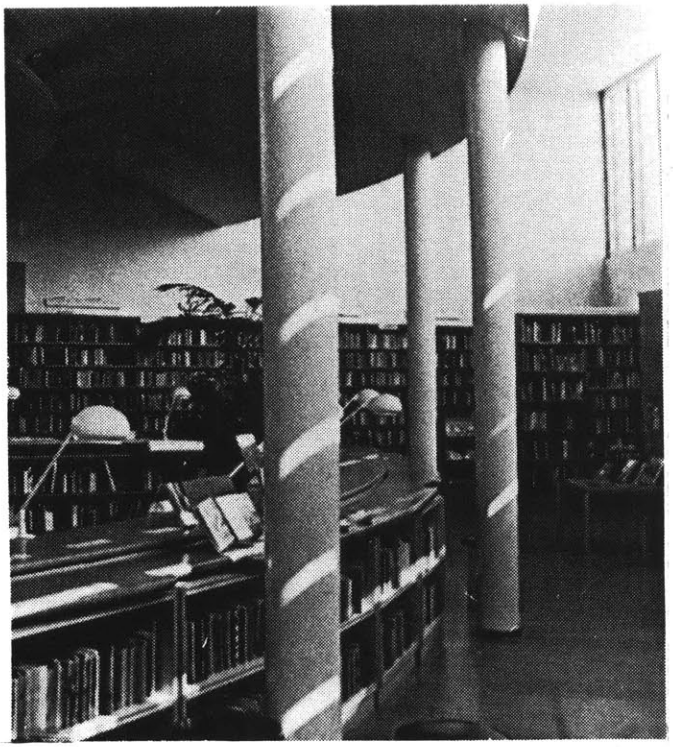


52.

ceiling and reflected again towards the bookstacks. This assures that the books are receiving natural light that is reflected twice and is therefore less damaging. The curve of the ceiling also minimizes glare at the reference desk by blocking a direct view of the windows (Fig. 58).

The smaller clerestory windows to the north are only exposed to diffused light and therefore do not need outside louvers. A lattice-like framework is built below them inside the building to hold electric lights and acts as an interior screen (Fig. 60). The screen is seen in silhouette against the windows and by contrast accentuates the light from the outdoors.

In the Seinajoke library, Aalto's natural lighting scheme achieves an elegant mix of diffused, reflected, and direct natural light. Reading light is bright and nonglaring while preservation standards for the books are maintained. The size of clerestory windows is related to the orientation of the sun. Interior and exterior screens and diffusing surfaces modify the light to make it appropriate for a library where many uses occur within the same space.

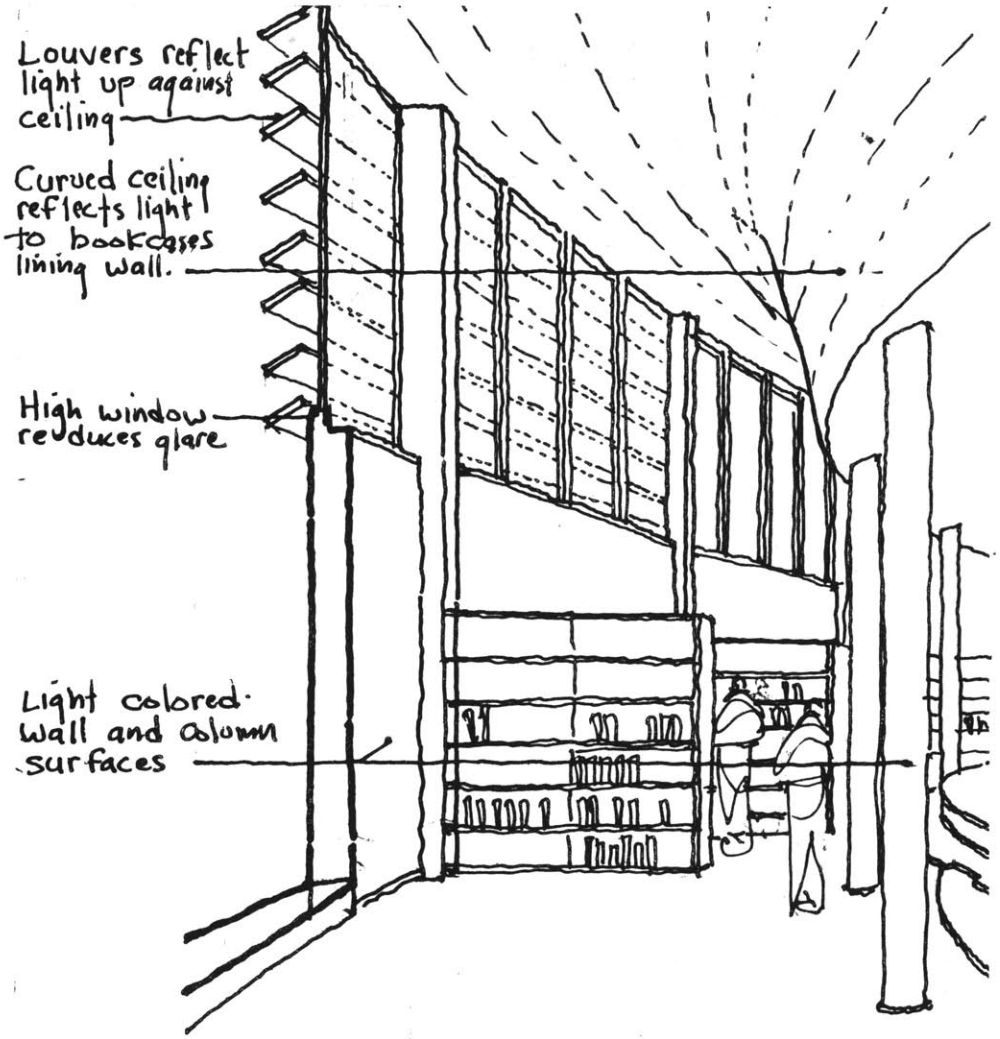
53.

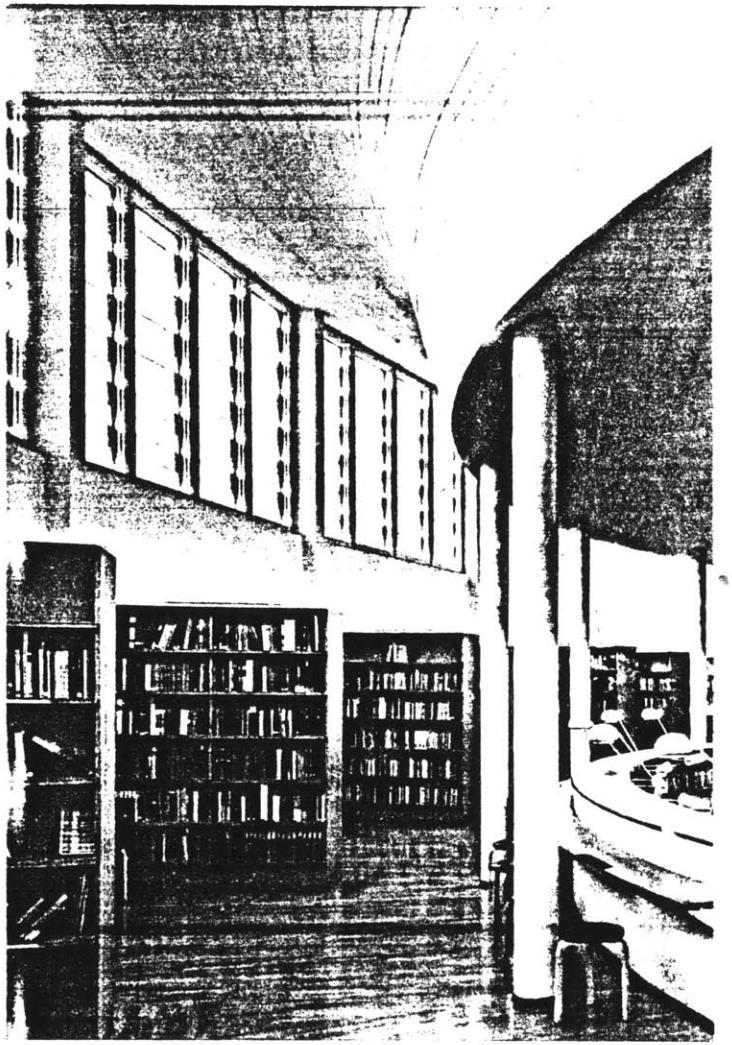
50. Entrance sketch.

51. Site plan.

52. Groak, interior view. Narrow bands of sunlight are visible on columns.

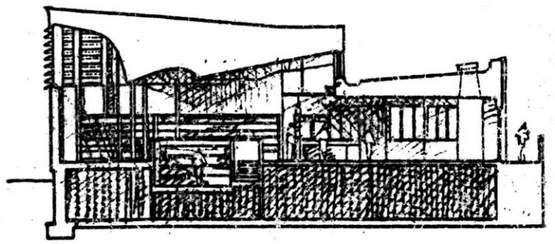
53. Yamagiwa, oak tree and shadows. Analagous quality of light to that found in Seinajoke library.





54. Interior sketch showing how edge design and interior finishes affect quality of light.

55. Interior view. Stacks are to the left and reference area is to the right.



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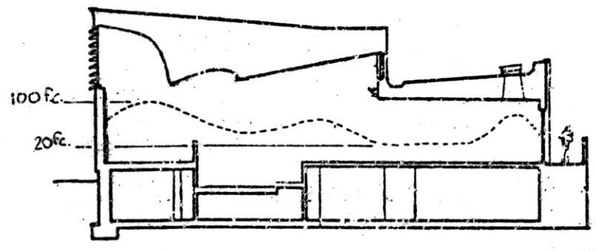

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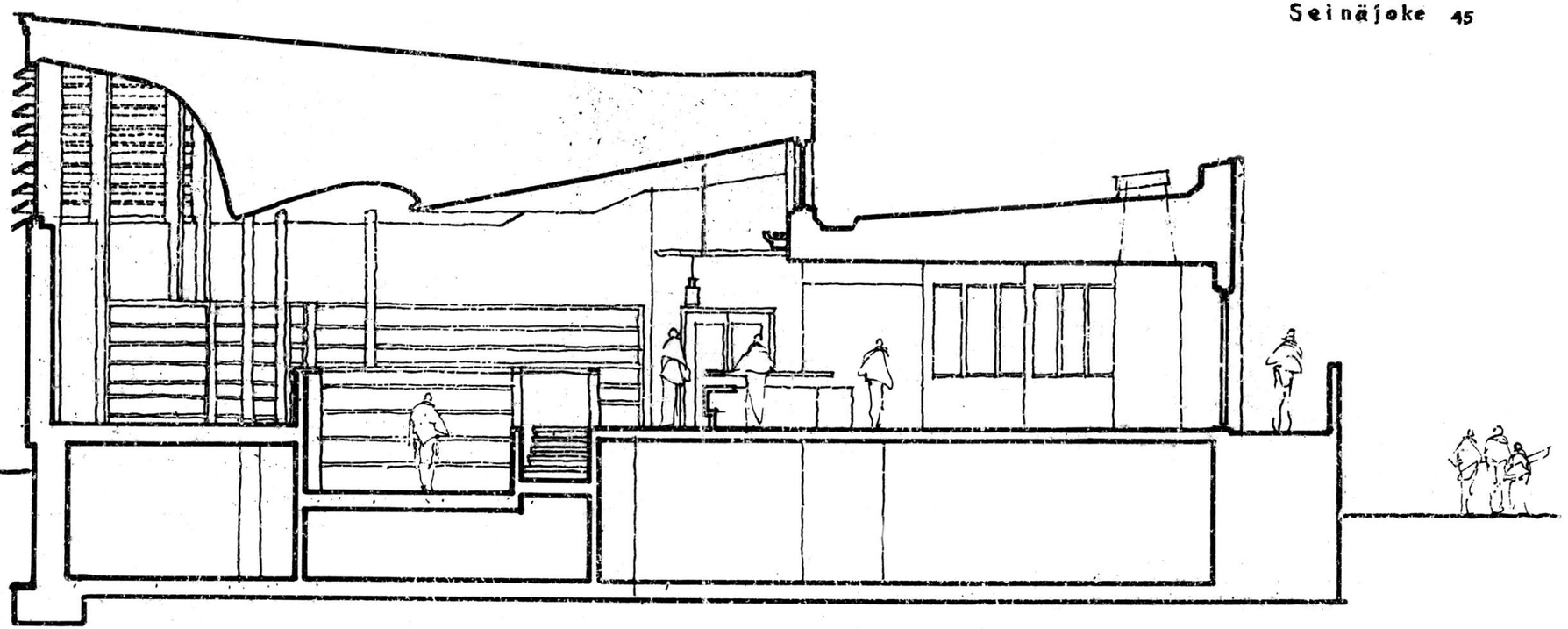


58.

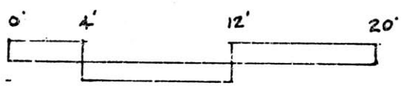
54. Interior sketch showing how edge design and interior finishes affect quality of light.

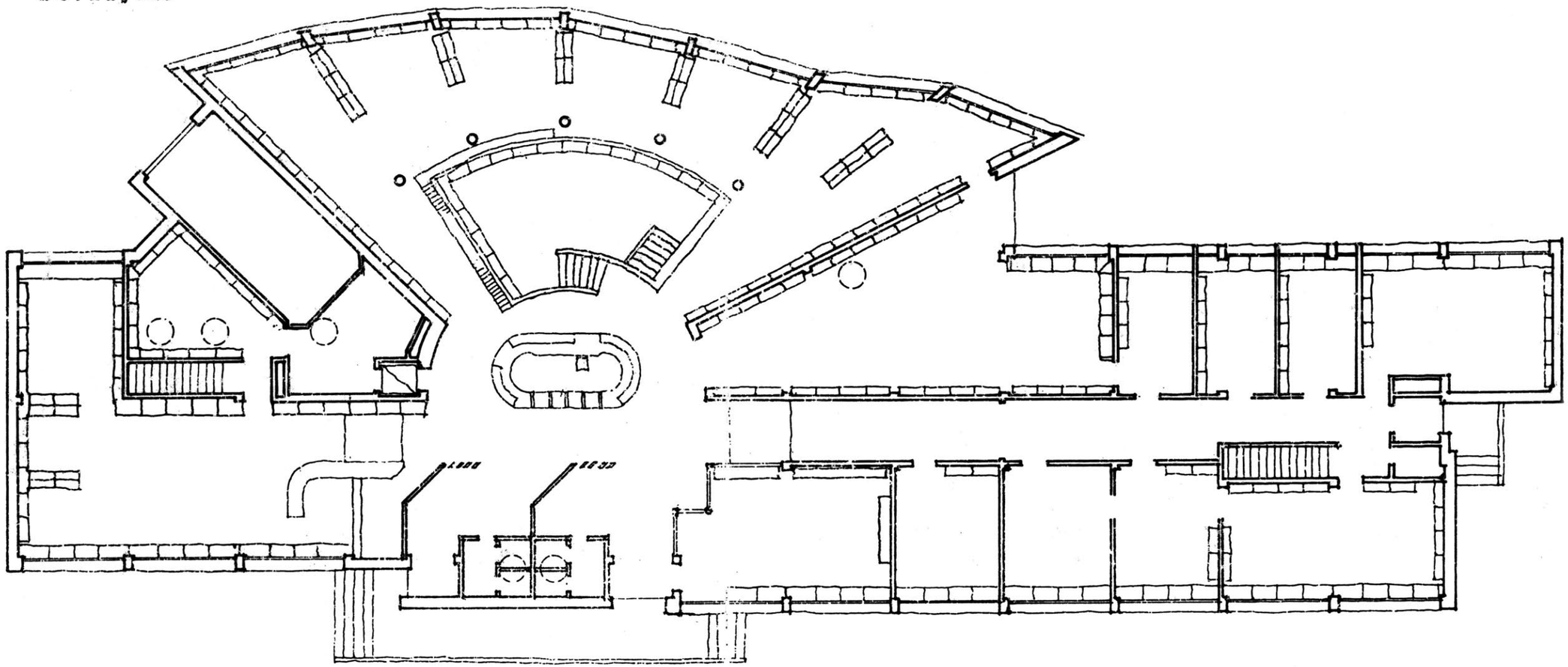
55. Interior view. Stacks are to the left and reference area is to the right.

56. Cross section rendering showing quality of light.

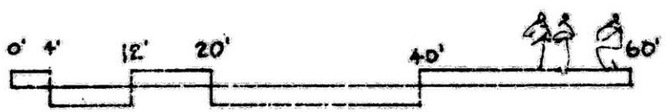
57. Estimated interior light levels measured in foot-candles at reading height.

58. Seinajoke. Cross section. Scale: 1/8" = 1'-0".





59. Seinajoke. Plan. Scale: 1/15" = 1'-0".



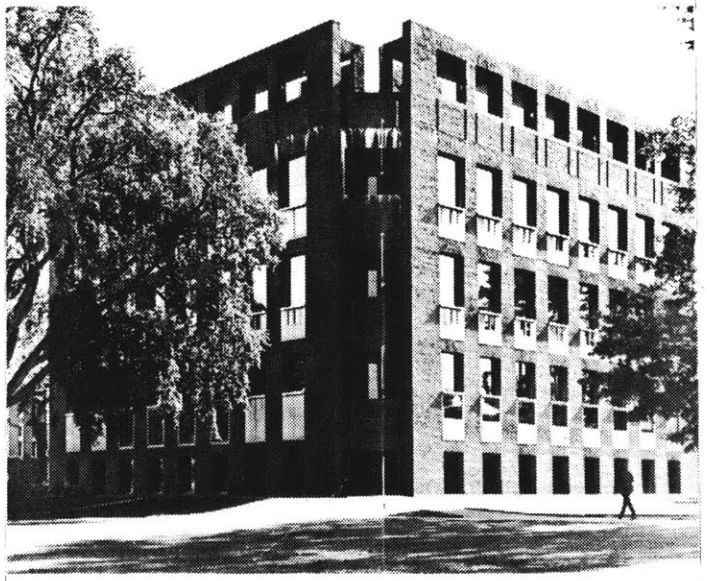
7. Phillips Exeter Academy Library

The Phillips Exeter Library has a very different building organization than that of the Seinajoke, despite the fact that both have open stacks. The building consists of three concentric volumes of space. Fig. shows the central hall surrounded by a core of bookstacks. Reading areas are located between the stacks and the building's perimeter. The three locations have different qualities of natural light, reinforcing their uses.

Central Hall The main entrance is located in an arcade that surrounds the base of the building (Fig 61). The arcade's uniformity makes the entrance hard to find, reinforcing the private nature of the library. Inside, a pair of curved stairs abruptly rise to the central hall. Only once inside is the grandeur of the building revealed. The hall is square in plan and rises 70 feet to the roof. The volume devoted to this central space represents approximately fifteen percent of the building's total. The hall provides access at the main floor and acts as a central point of reference for the building. The extravagance of devoting such a large part of the building to serve these goals emphasizes the wealth of the Phillips Exeter Academy.

The hall is lit by a band of clerestory windows measuring 4'-0" by 26'-0". The windows are located adjacent to huge concrete beams supporting the roof structure. Direct sunlight is diffused on the beams, accentuating their presence and casting a gentle meditative light into the central hall. Unfortunately, the natural light is overpowered by spotlights that have been added to the space.

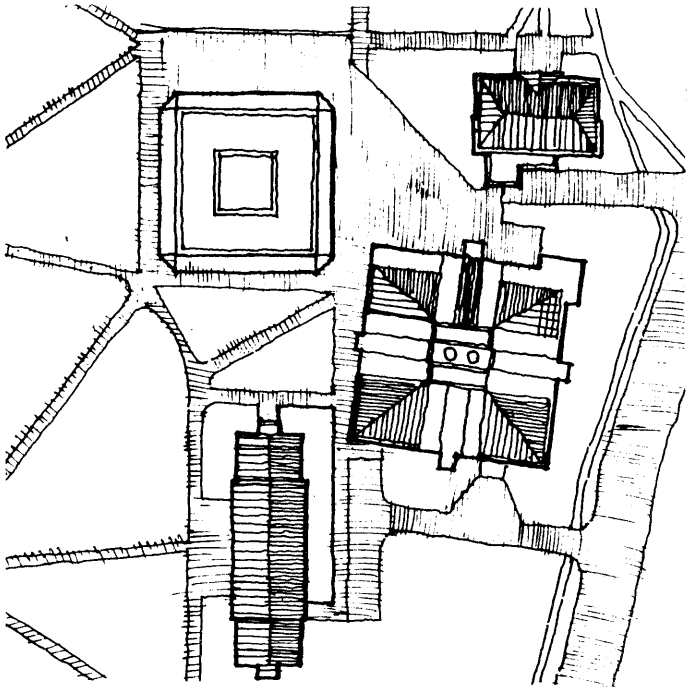
Bookstacks Five stories of bookstacks are located around the central hall. The books are visible from the



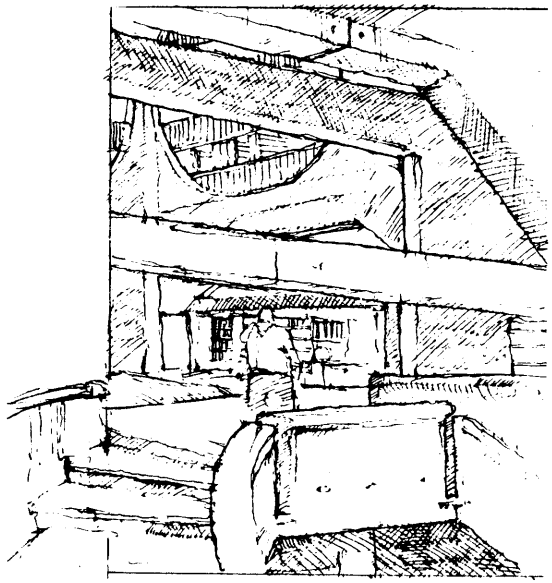
61. Futagawa. Exterior view. Arcade at the base is the same on all four sides.

62. Sketch of Central Hall made from stairs. Book stacks are visible through circular cut-outs in the concrete frame.

63. Site plan.



63.



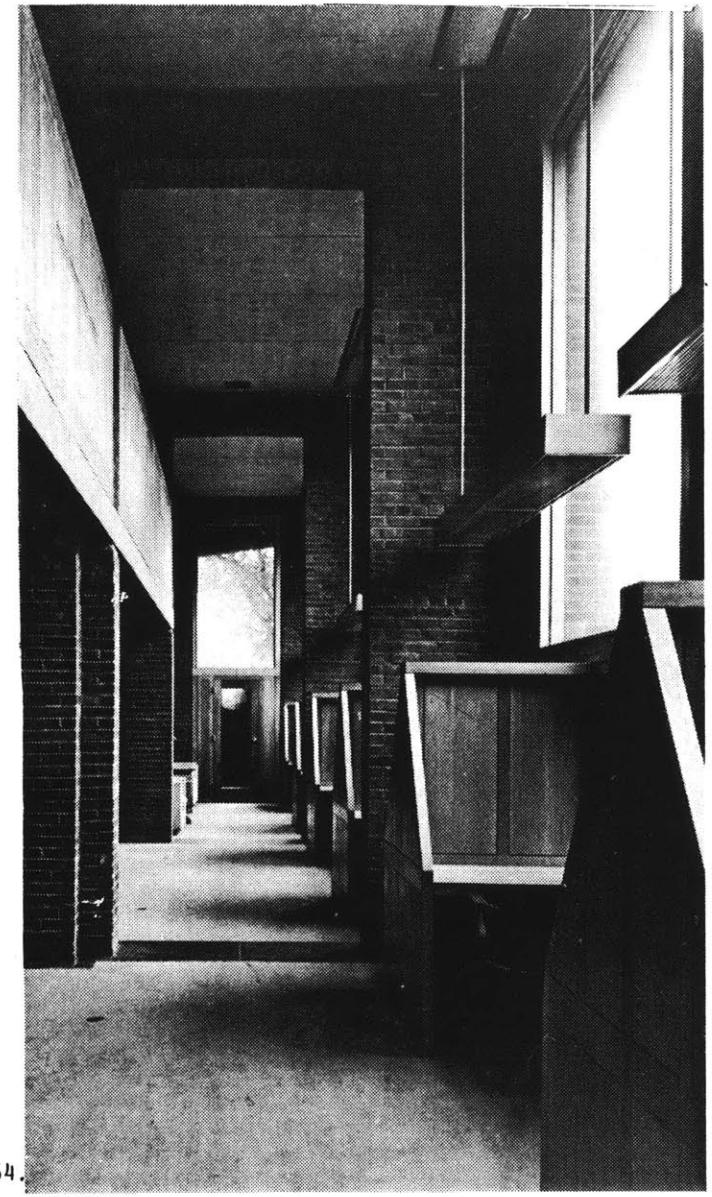
62.

floor of the main hall, identifying the building as a library. The stairs to the books, however, are located in the corners, making physical access to the books more difficult. The problem is made worse by a lack of natural light on the stairs.

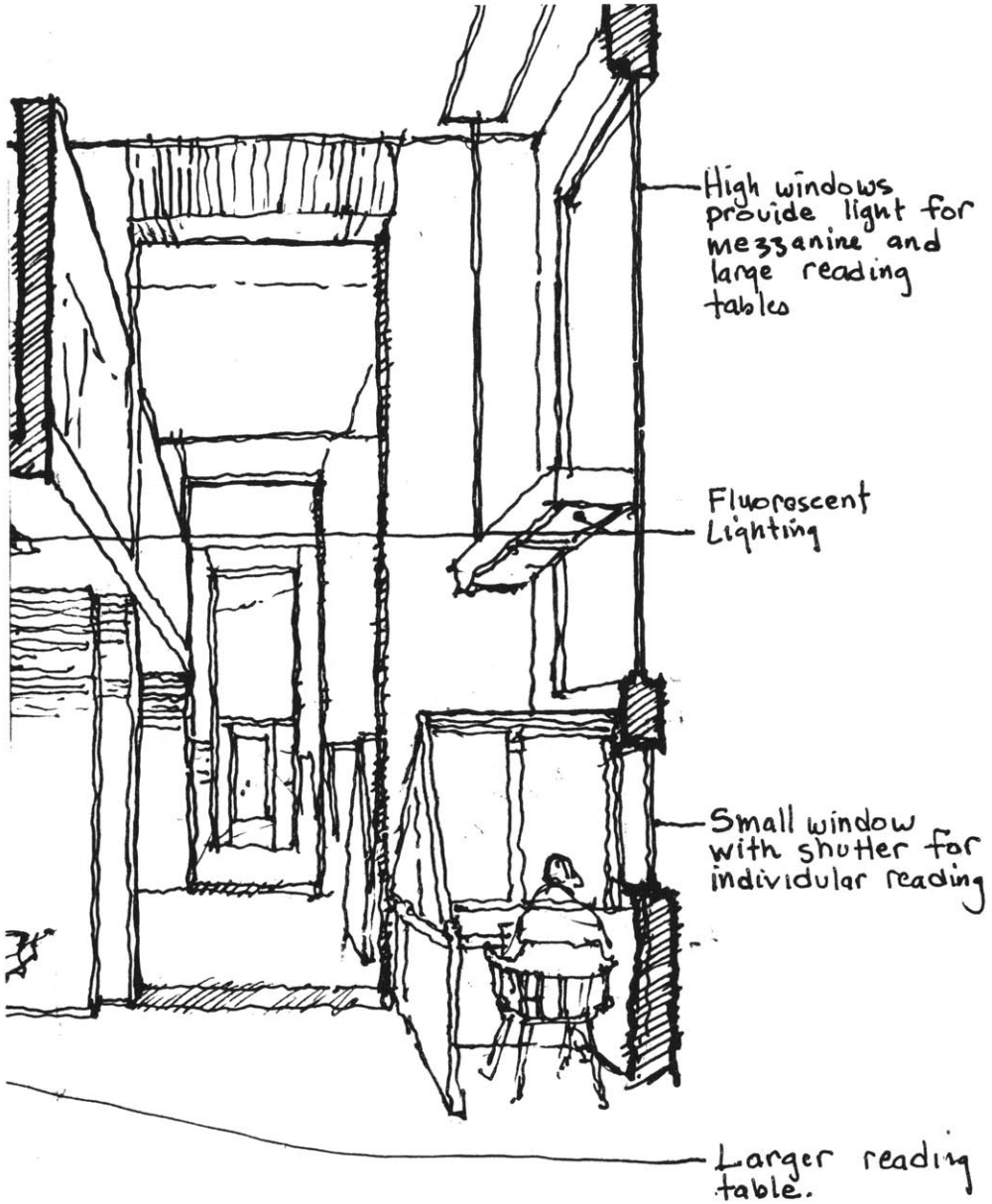
The location of the books between the dimly lit central hall and perimeter reading area assures they will receive minimal natural light. In addition, the low 7'-0" ceilings in the stacks also block light.

The design of reading areas in the Phillips Exeter Library is very different from those of the other three buildings. Rather than providing a central or dominant reading room, Kahn has located reading areas along the perimeter of four floors of the building (Fig. 64). Study carels are located at the edge and each has a small window equipped with a shutter that the student can use to control light. Larger reading tables are located between the study carrels and the stacks. They receive light primarily from the large windows extending up into the double-height space (Fig. 64).

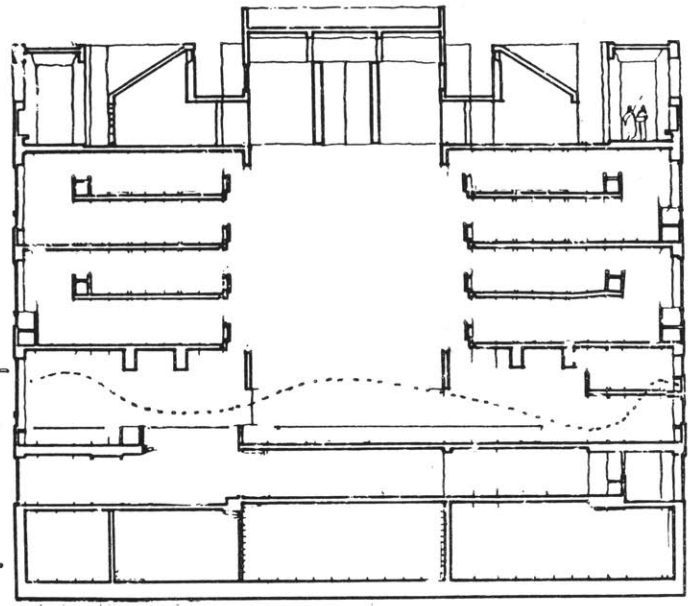
The natural lighting scheme is successful in achieving appropriate lighting levels for reading and book storage without separating them on different floors. This promotes a continuity between the two activities. The natural lighting scheme, however, does not provide a continuity from the floor of the central hall to the bookstacks and reading areas. The design could have been improved by relating the stairs to the hall and emphasizing them with light.



64.


High windows provide light for mezzanine and large reading tables
Fluorescent Lighting
Small window with shutter for individular reading
Larger reading table.

65.



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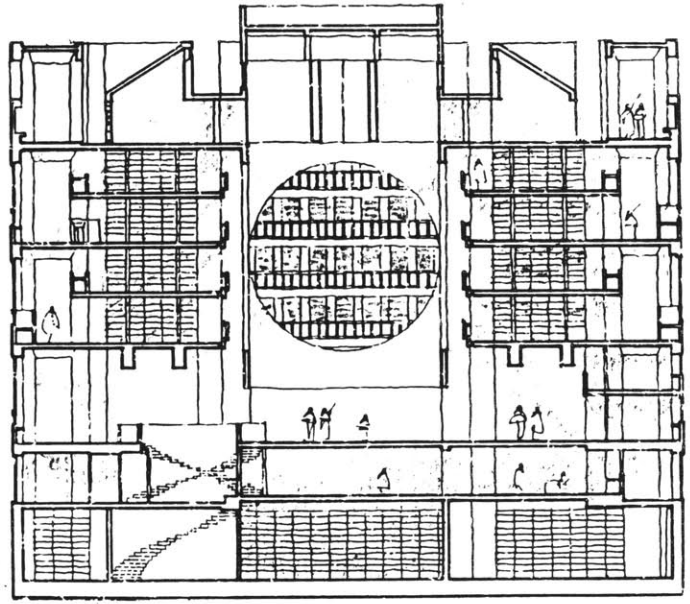

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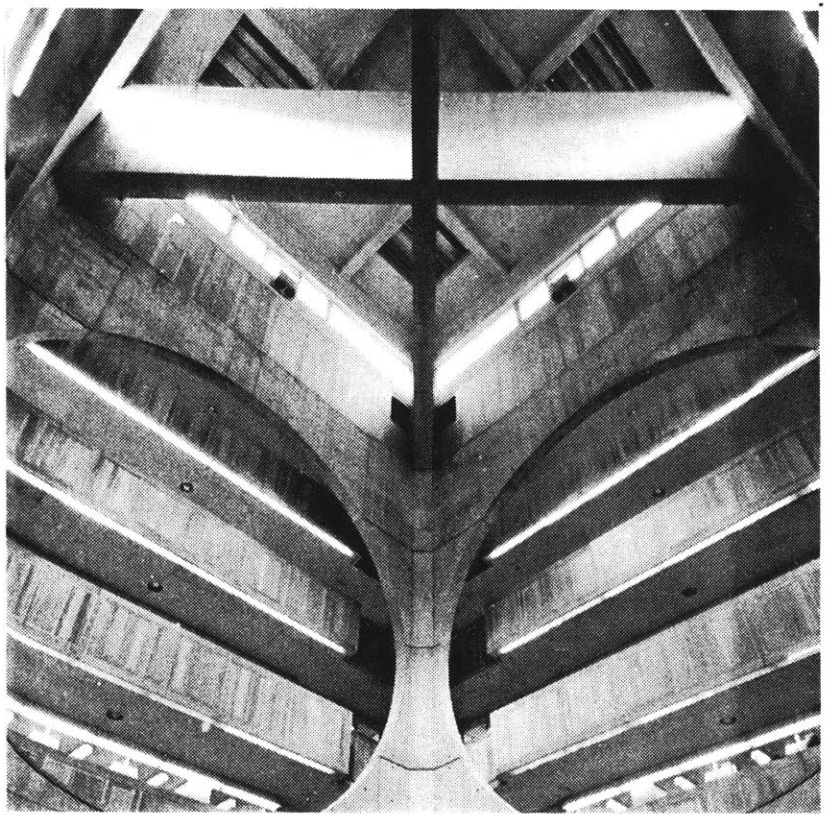


68.

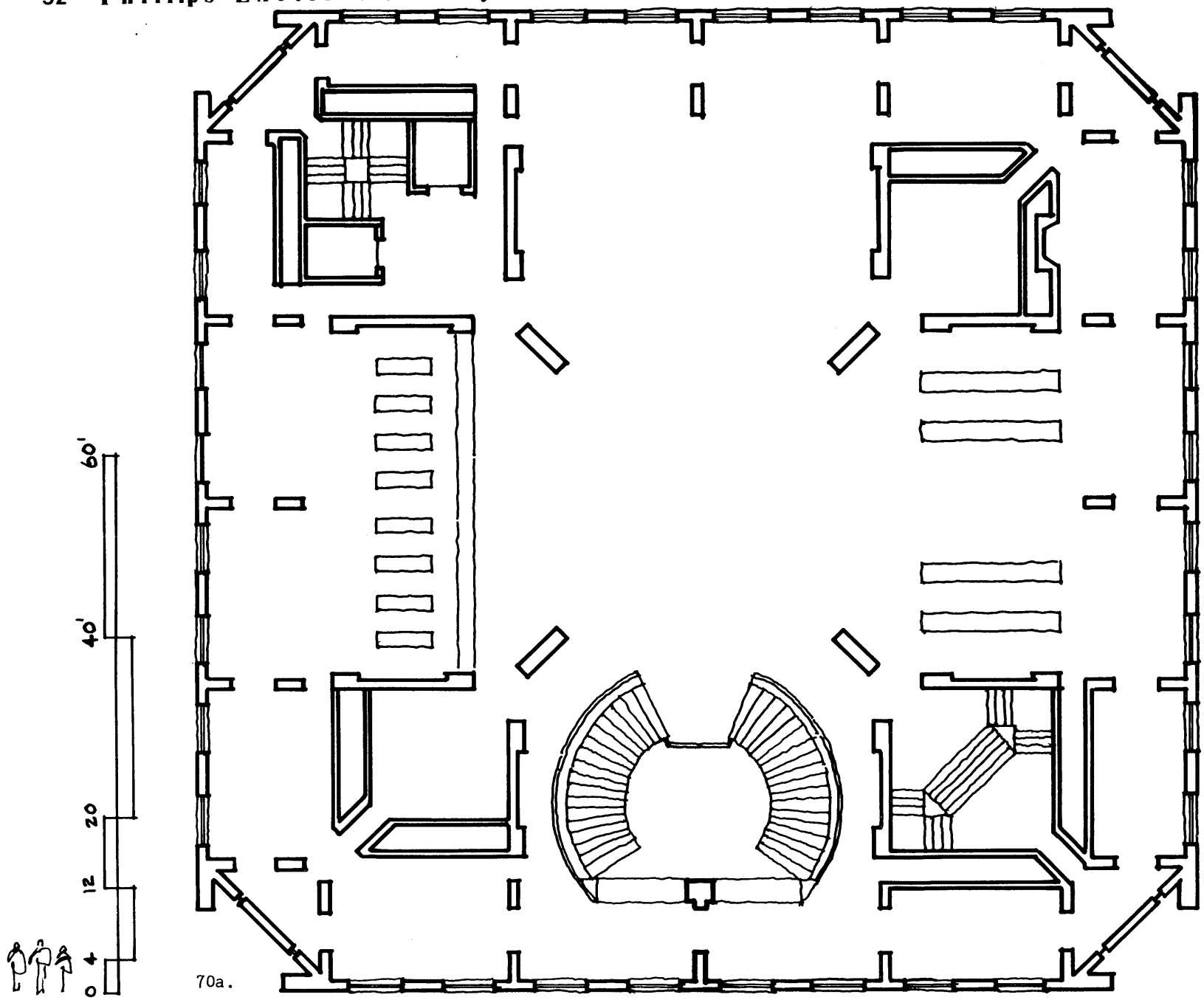
64. Futagawa. View of reading area. Large tables are to the left (not shown). Study carels are to the right. Compare this study carel with the seating pews in the Laurentian library.

65. Interior sketch showing how edge design and interior finishes affect quality of light.

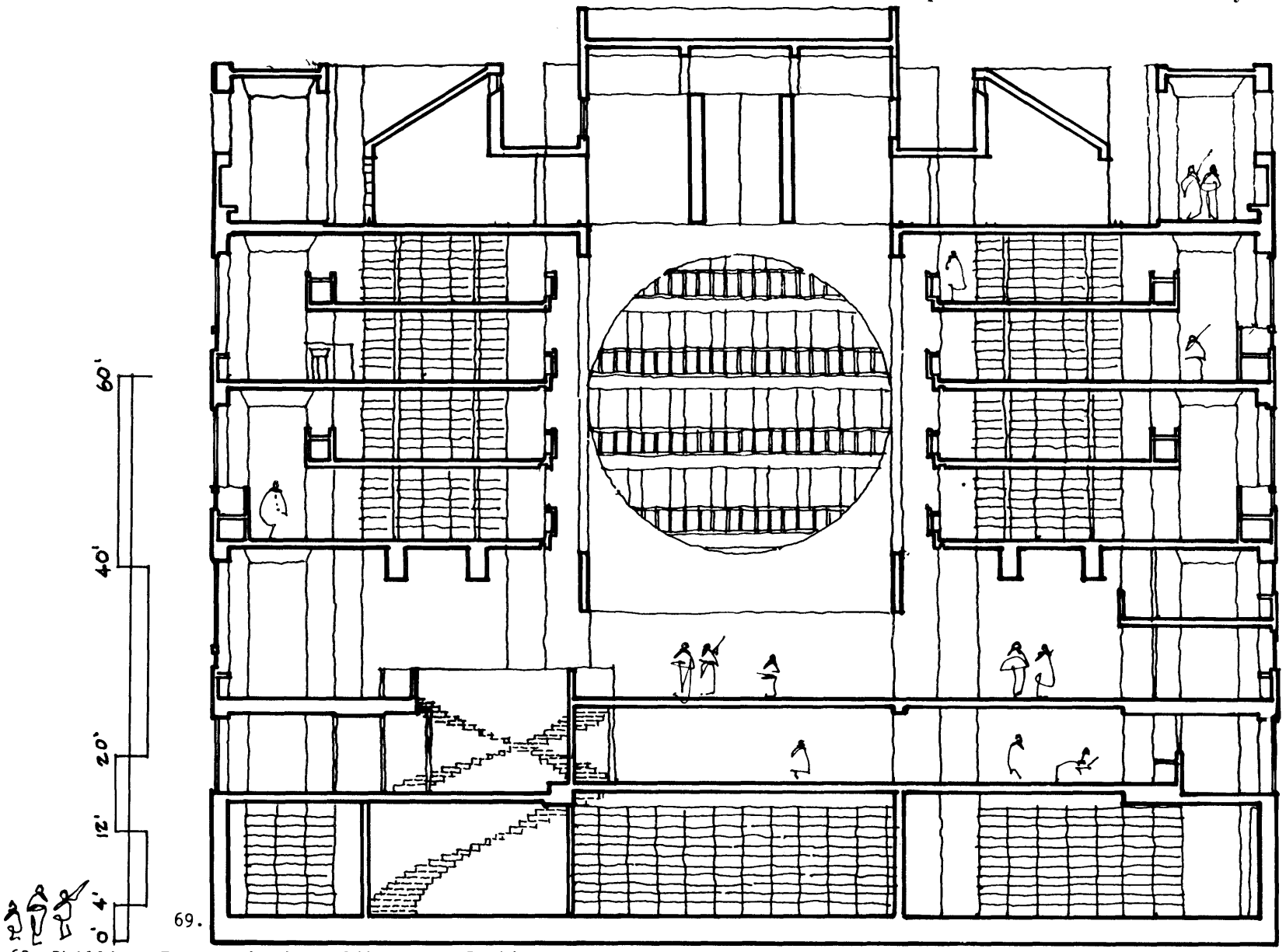
66. Cross section rendering showing quality of light.

67. Estimated interior light levels measured in foot-candles at reading height.

68. Futagawa, view of clerestory windows and concrete beams.



70a.



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69. Phillips Exeter Academy Library. Section through entrance. Scale: 1/16" = 1'-0".

70a. Phillips Exeter Academy Library. Plan, main floor. Scale: 1/16" = 1'-0".

8. Newton Public Library Design

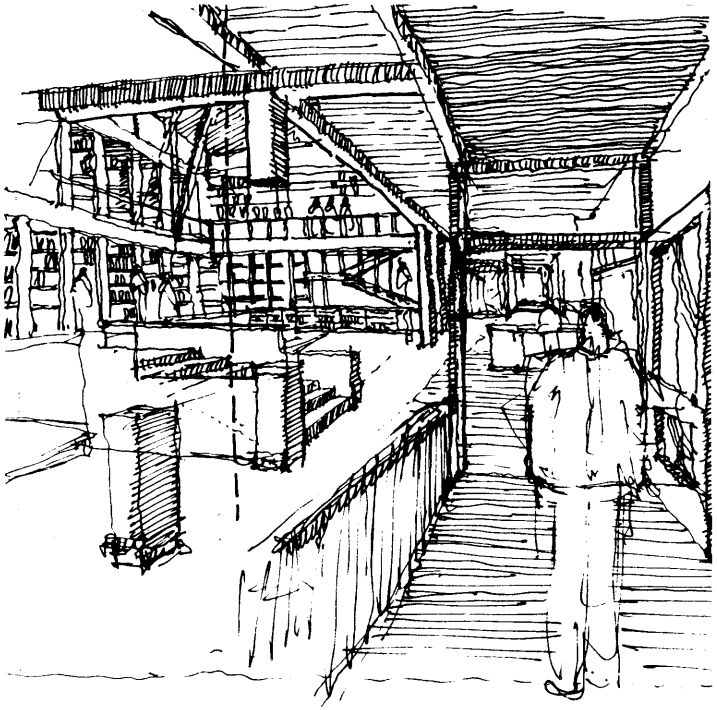
Project Goals

I had two goals in designing the Newton Public Library: to offer an innovative solution to the programmatic needs of the library and to use natural light as the primary source of illumination in the building.

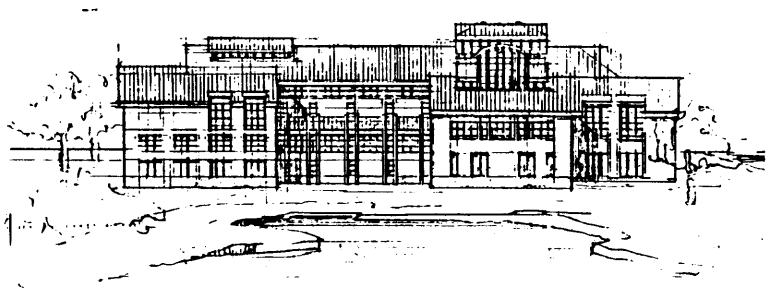
The City of Newton has a well-documented need for a main library to supplement its branch libraries. A program statement (see Appendix) has been written by Jay Lucker of M.I.T., in conjunction with Virginia Tashjian, Head Public Librarian in Newton. It calls for a building of approximately seventy thousand square feet of floor area. Program requirements are similar to those of many medium-sized public libraries. In addition, the program emphasizes a large fiction stack area, popular with Newton readers, and a large children's room.

A ballot initiative to finance the new library was rejected by Newton voters, and the Board of Trustees are currently raising funds from other sources. This design is intended to encourage that effort by helping them visualize a new library. In addition, I hope my design can establish guidelines of site planning, building organization, and natural lighting to be followed when the library plans are finally realized.

The analysis of four libraries in the previous chapter was informative in my design of the Newton Library. A common thread among the four was how the natural lighting scheme is responsive to the diverse functions of a library. The lighting also helps establish whether the library is public or private. The design and location of apertures, surfaces, and screens is used to alter incident natural light to give



76. View from entrance vestibule looking towards circulation desk. Early sketch drawn before model was built.



adequate quantity and quality of light, depending on the need. These observations are central to my natural lighting scheme for the Newton library. By relating light to the uses of the building, hopefully natural light becomes an integral part of the architecture.

The design method used for the project is also influenced by the analysis of the four libraries. Plan and section drawings are at the same scale as those used for analysis. This facilitates the comparison of design drawings with familiar buildings.

The following section describes three important aspects of my design: the site plan, building organization, and natural light.

Siting and Organization

The siting for my library design follows the general recommendation of the study prepared by the Architects Collaborative that the library should be located across Homer Street from the City Hall. This still left a wide range of possibilities for its exact location and orientation.

My design places the new building as close as possible to City Hall and orients the long axis north-south, parallel to City Hall drive. Three principles figured prominently in this siting.

(1) There should be a short and direct access between City Hall and the new library. The south side of City Hall is the "working" side of the building where most people arrive. The new library should capitalize on this by placing

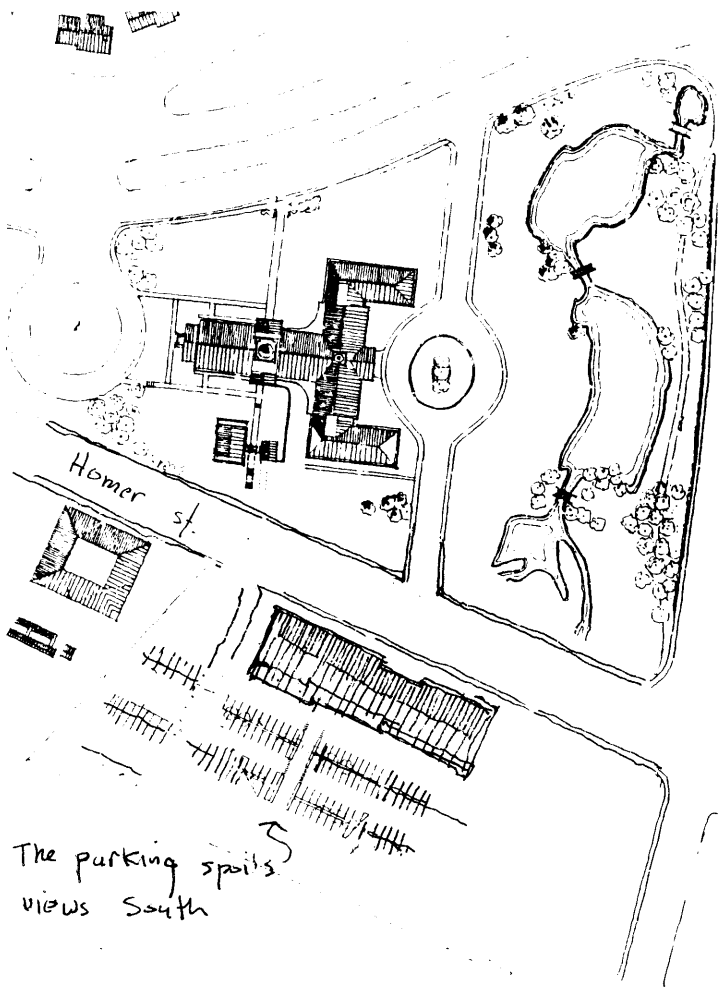
its entrance as close to there as possible (Fig. 71). By placing their entrances adjacent to one another, the two buildings can work together to form a civic complex.

(2) A strong "front-back" orientation for my library project is achieved by placing the long direction of the building in a north-south orientation (Fig. 71b). The west side of the building faces the power plant, and here a loading dock as well as parking for 140 cars can be accommodated. To the east, the building overlooks the park, which is screened from the service by the building. This continues the pattern established by the City Hall where the loading dock is also on the west side. To understand the logic of this scheme, it is useful to look at a scheme that builds parallel to Homer Street (Fig. 70b). The building encroaches on the parkland, and parking must by placed to the west and south of the building harming views in that direction.

(3) The existing Olmstead park in front of City Hall is a beautiful natural resource and must be respected and strengthened by the new library building. The location I propose next to City Hall with a north-south orientation provides the opportunity for the park to be expanded across Homer Street to the vacant city-owned land. The water course already there could be transformed into a pond similar to the one in front of City Hall.

This building is organized around a courtyard facing east towards the park. This courtyard provides a strong frame of reference for the library visitor. On the first floor the courtyard provides an outdoor play area for the children's library.

In a three story open stack library such as the one envisioned for Newton, the entrance should be at the second floor. That way, the circulation desk, card catalogs, and fiction stacks, which must be located near the entrance, are



70b. Site plan study showing the effect of a building mass parallel to Homer St. The continuity of open space is interrupted.

centrally located. I have adopted this scheme in my design where one climbs a short flight of stairs outside the building and enters at the second floor. This allows the children's library, which is on the lowest floor, to have direct access outside to the courtyard.

A compact plan is important for the efficient use of a library building, where adjacencies between one use and another must be maintained. Compactness can be easily achieved by making the building box-like. However, one pays a price in lack of natural light and outside views and a disorienting sense for the visitor. In my design I tried to achieve both good natural light and a compact plan. The diagram of the building consists of two overlapping rectangles. Compactness is offered and natural lighting is accessible at the edges. This overlap happens adjacent to the entrance and houses three important functions of the library: the fiction stack, card catalogs, and children's library below (see Fig. 80).

Natural and Electric Lighting

The four libraries discussed in Chapter III were successful in providing different qualities of natural light for entrance transition, reading, book storage, etc. In addition, my design also uses natural light to achieve two other objectives: to provide orientation for the visitor, particularly important while moving from one part of a large building to another and to emphasize the working heart of the building: the fiction stacks and card catalogs. This

section discusses natural light in six distinct parts of my design as a way of looking at these objectives.

A large-scale lighting model of the library forms the basis for this discussion. Models remain the most accurate tool for testing natural lighting in a design, short of actually building the project. Windows, screens, and walls were modeled to determine the total amount of light entering the building. Interior surfaces, including floor paving, ceilings, walls, and furniture, were accurately modeled for color and reflectivity to determine how they would modify light entering the building.

The design relies on electric light to supplement the natural light during the day and to provide all lighting at night. It was also important, therefore, to include electric lighting in the model. The lighting included in the model gives a sense of the quality my design requires . The quantity of light shown in the model, however, is less than what is recommended.

Entrance and Circulation Desk The entrance area borrows light secondarily from the bibliographic center and corridor-reading room area (see Fig. 80). These are the two main destinations for the visitor, and the light will emphasize their presence. The low level of natural light is supplemented with electric light located in the soffit of the dropped ceiling (see Fig 80). The soffit is lowered at the circulation desk for emphasis. Two lanterns provide light for the desk.

Fiction Stacks and Bibliographic Center These are located together, adjacent to the entrance and circulation desk (see Fig. 78). They form an important part of the library, both as a decision-making point and as destination. Their importance is emphasized through the placement of a monitor in the roof above (see Fig. 80). The third story

is opened up to let light down to the entrance level. Two different designs for the monitor were tested in the model to determine which could give the greatest sense of light while allowing a minimum of direct sunlight for book preservation. The design chosen uses louvers similar to those in Aalto's Seinajoke library. The louvers diffuse most of the natural light, while allowing a little direct sun to enliven the space.

The fiction stacks are located around the bibliographic center. Low ceilings in the stacks assure minimal natural light.

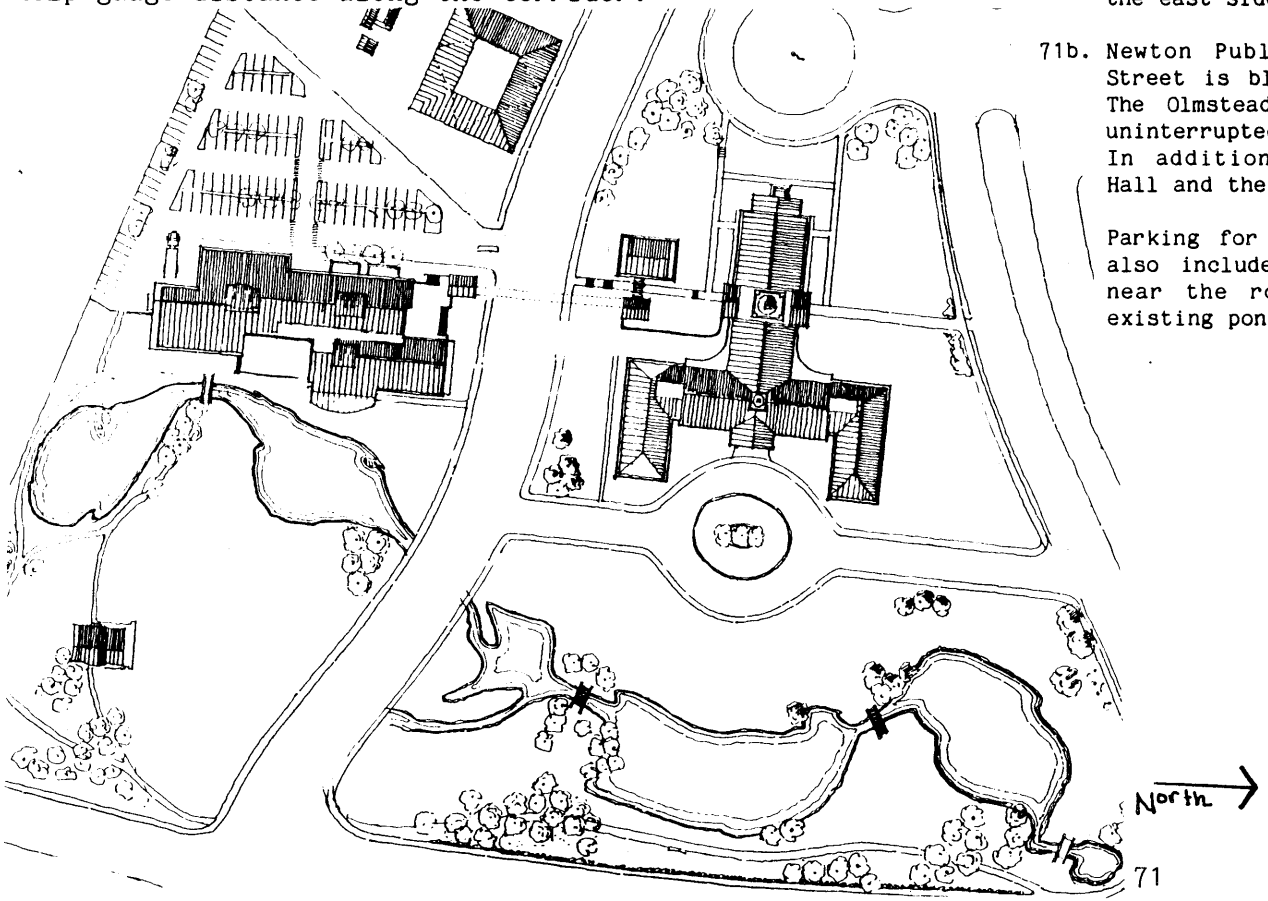
Light for Reading There are three types of reading rooms in this design, giving a range of size and quality of light for the reader.

(a) Two large, more traditional reading rooms are located in the quieter back of the building overlooking the park (see Fig. 72). The windows and natural lighting in these rooms reinforce the collective spirit of reading with others. The windows are large and high, casting a relatively even light through the room. This general lighting is supplemented with individual reading lights on the tables.

The Children's Library The children's library needs to be accoustically separated from the rest of the library while at the same time be centrally located so the children do not feel isolated. The organization of my building satisfies these criteria by locating the children's library directly below the fiction stacks of the first floor. A glazed opening in the ceiling allows a hint of natural light from the monitor to peek through. A sense of connection with the rest of the library is thereby reinforced. The primary source of natural light to the room is through large windows similar to those described for the large reading room.

Access Efficient movement between different parts of a

library building is important for its proper functioning. This path can be reinforced if it is at least partially lit by natural light. A higher quality of light is achieved and the visitor is oriented in relation to the outdoors. The main access corridors have been designed to receive natural light through clerestory windows facing east. The clerestory windows are not continuous so that a pattern of light and dark is made. This accentuates the presence of light and helps mark distance along the path. The small reading rooms are entered from the main corridor. Each entrance is marked by brighter electric lighting. The entrance lights also help gauge distance along the corridor.



71

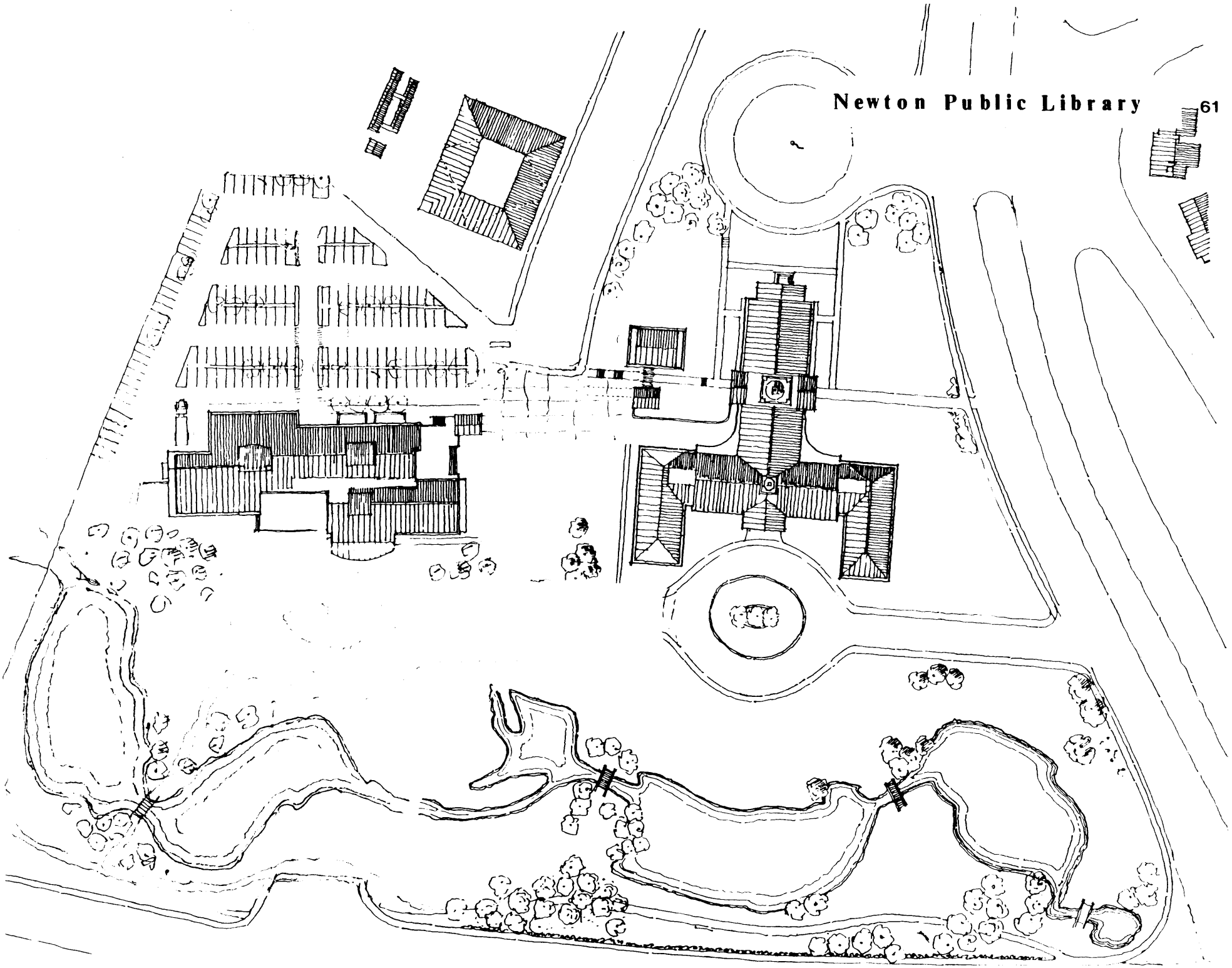
71. Newton Public Library. Site plan A. In this scheme, Homer Street is curved so that the library can be placed closer to City Hall, making a stronger connection between the two buildings. This scheme is still viable if Homer Street is not curved. The library would have to be moved slightly south.

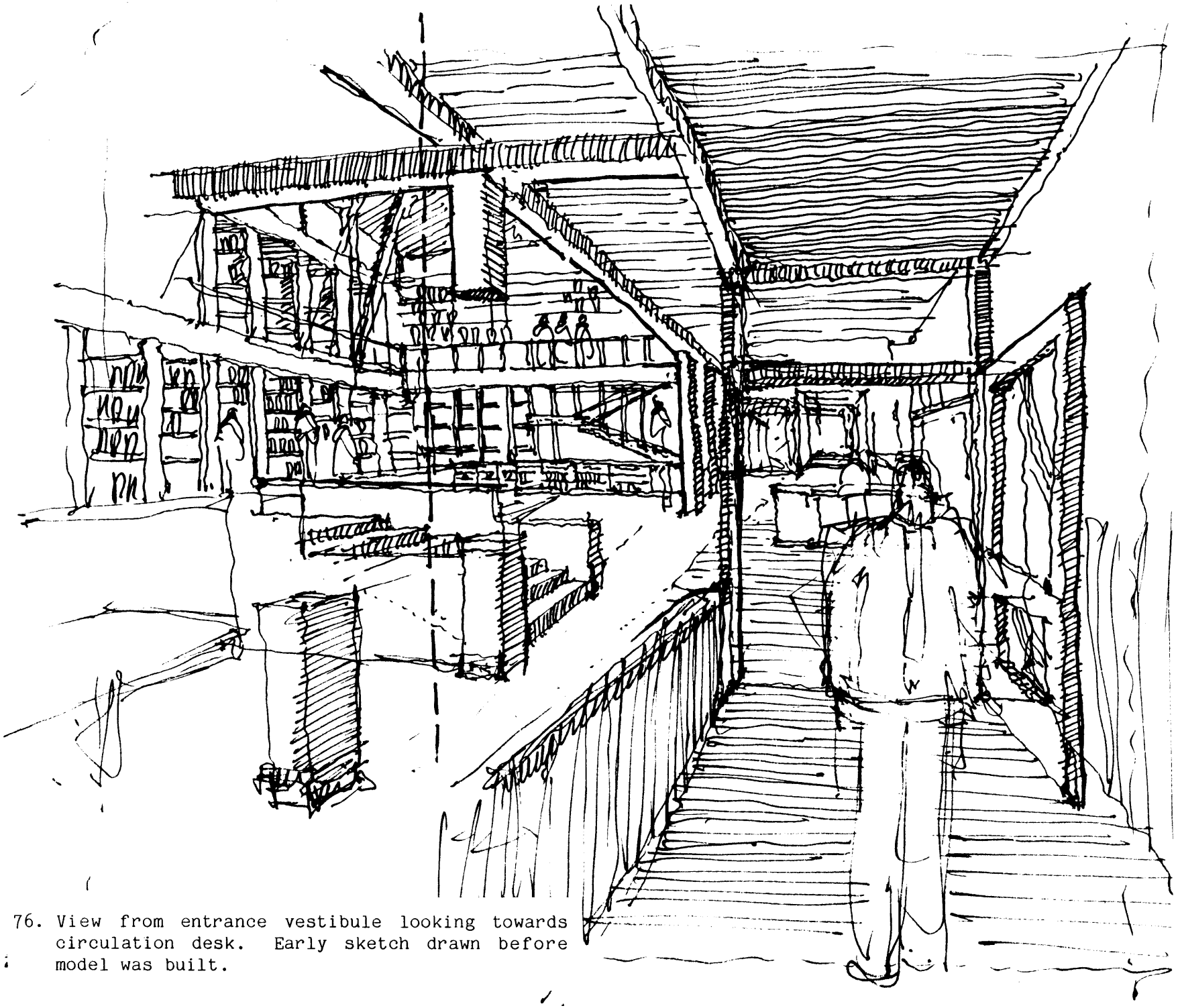
Parking for 101 cars is provided. A net gain of only 60 cars is realized, however, because the scheme requires removal of an existing parking lot.

The water course already present on the site is transformed into a pond, and is located along the east side of the library.

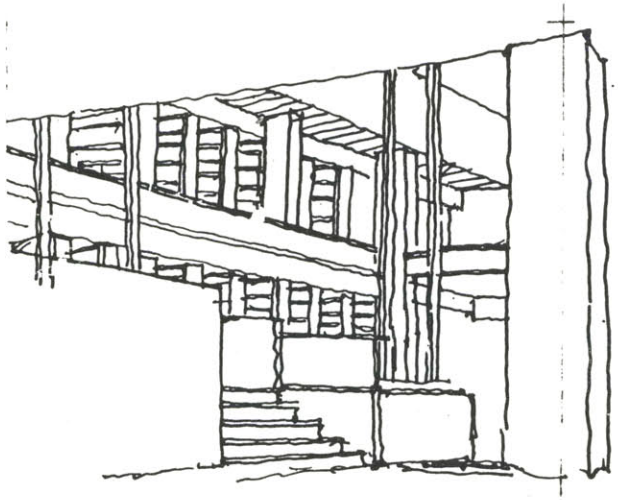
71b. Newton Public Library. Site plan B. Homer Street is blocked off in front of City Hall. The Olmstead landscape can then be continued uninterrupted south in front of the library. In addition, a pedestrian path between City Hall and the library is possible.

Parking for 140 cars is provided. A pond is also included in this scheme and is located near the road in a similar manner to the existing pond.


Newton Public Library
61

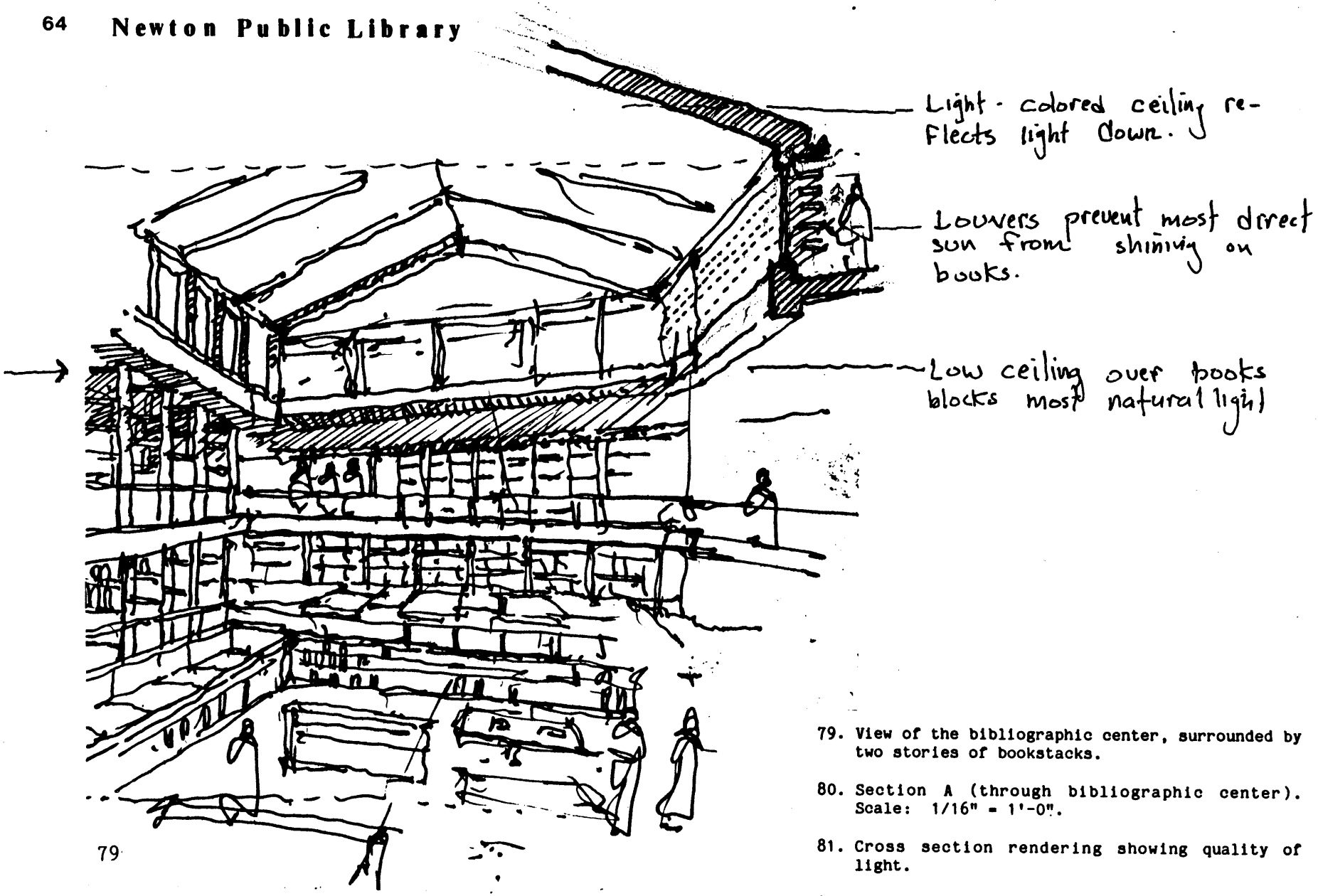


76. View from entrance vestibule looking towards circulation desk. Early sketch drawn before model was built.



77. View of bibliographic center. Early version.

78. Model photograph. Taken near entrance looking towards fiction stacks. Bibliographic center is to the right.



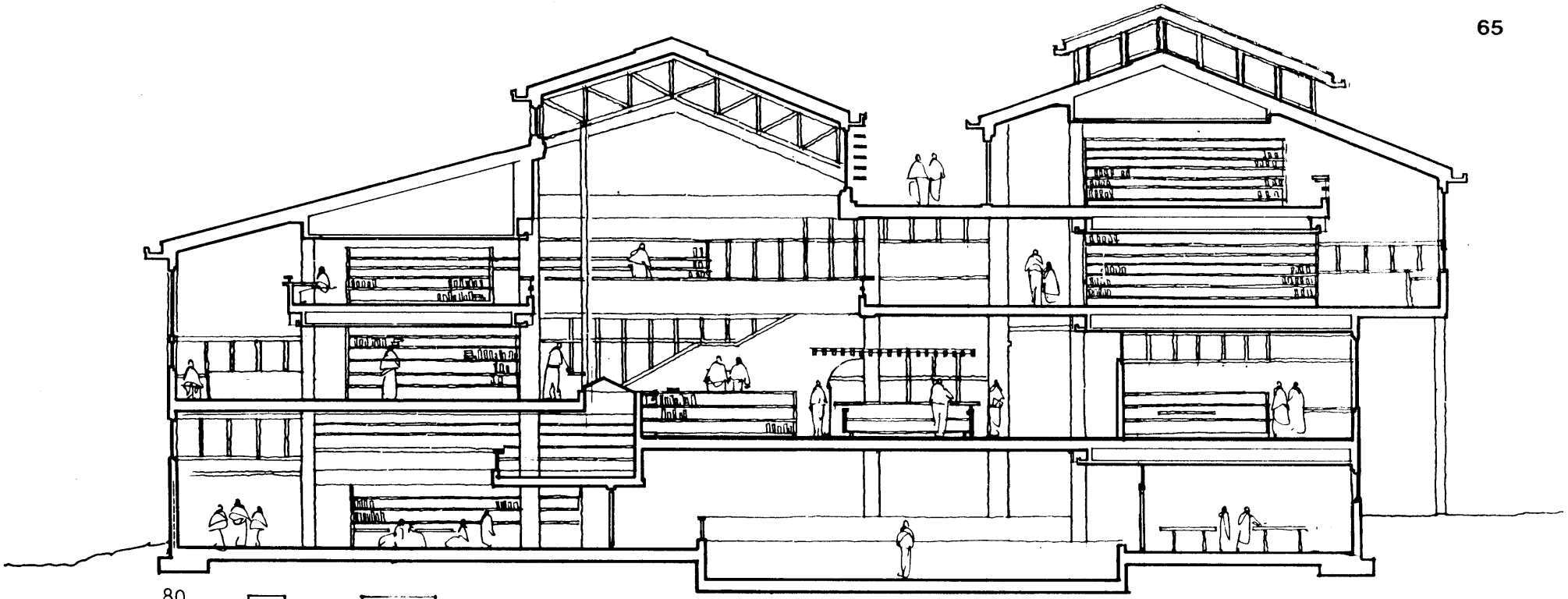
79

79. View of the bibliographic center, surrounded by two stories of bookstacks.

80. Section A (through bibliographic center). Scale: 1/16" = 1'-0".

81. Cross section rendering showing quality of light.

82. Estimated interior natural light levels.



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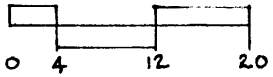
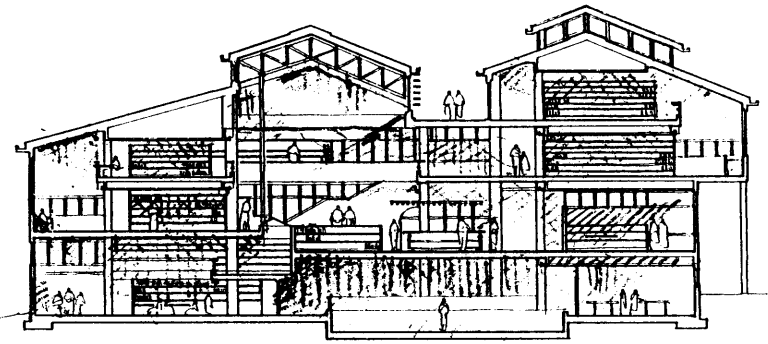


scale: 1/16" = 1'-0"



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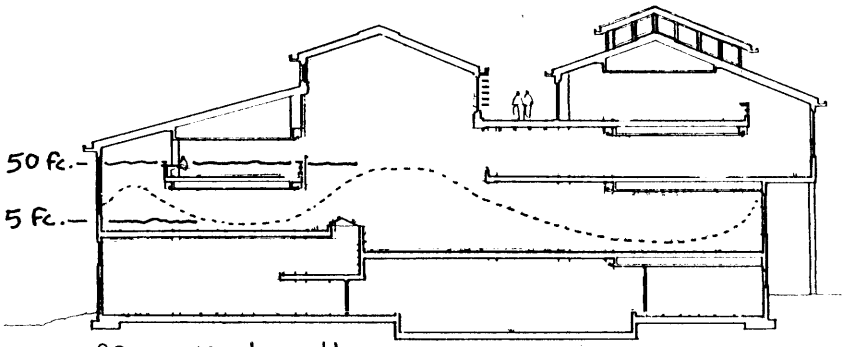
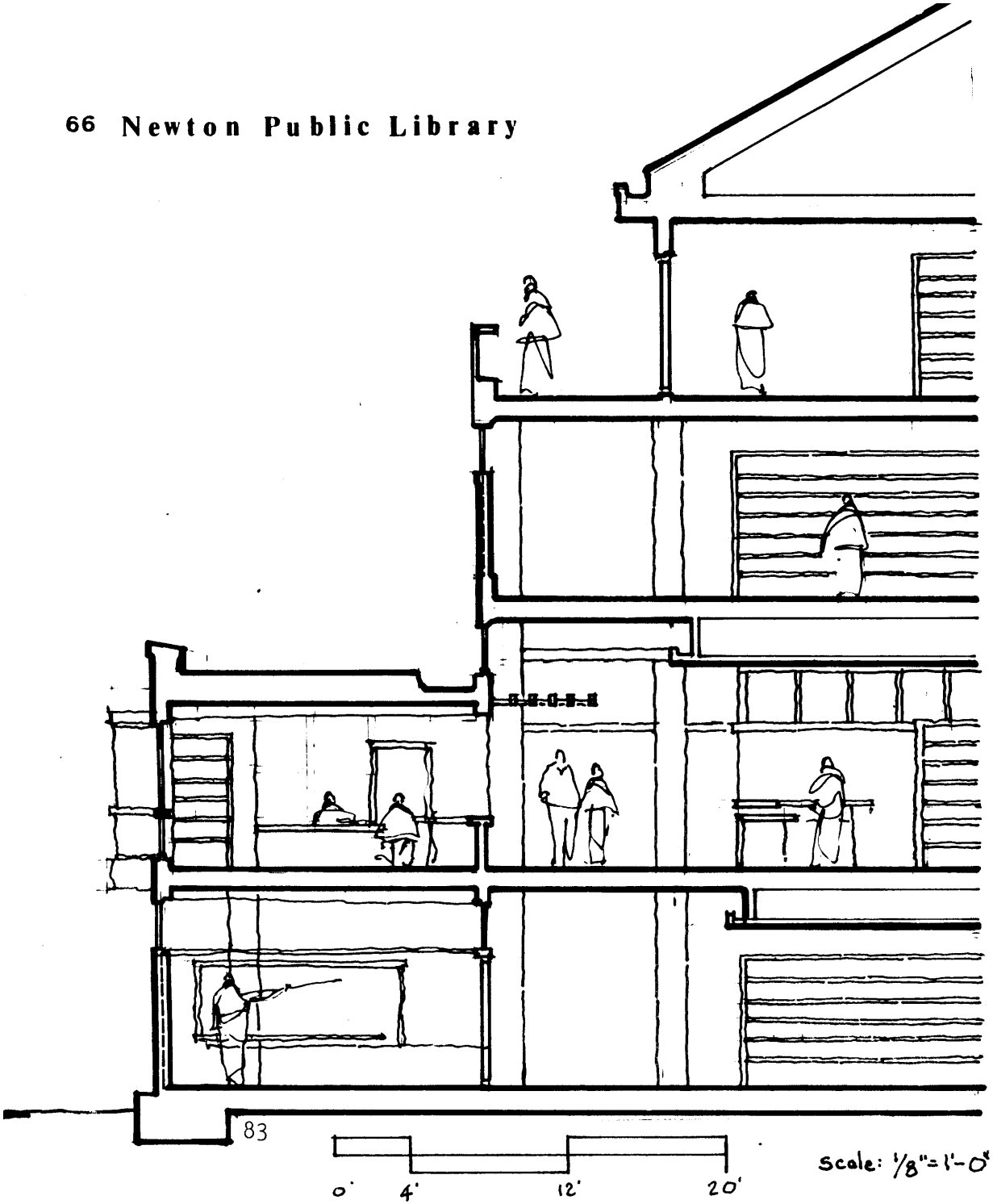


82 Footcandles



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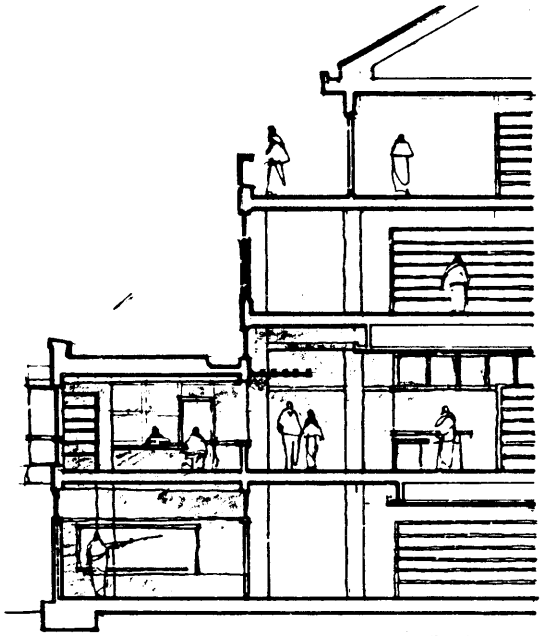

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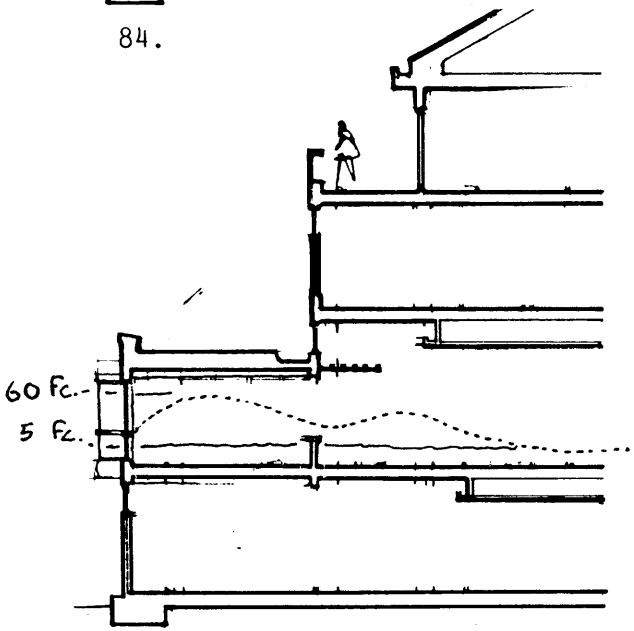
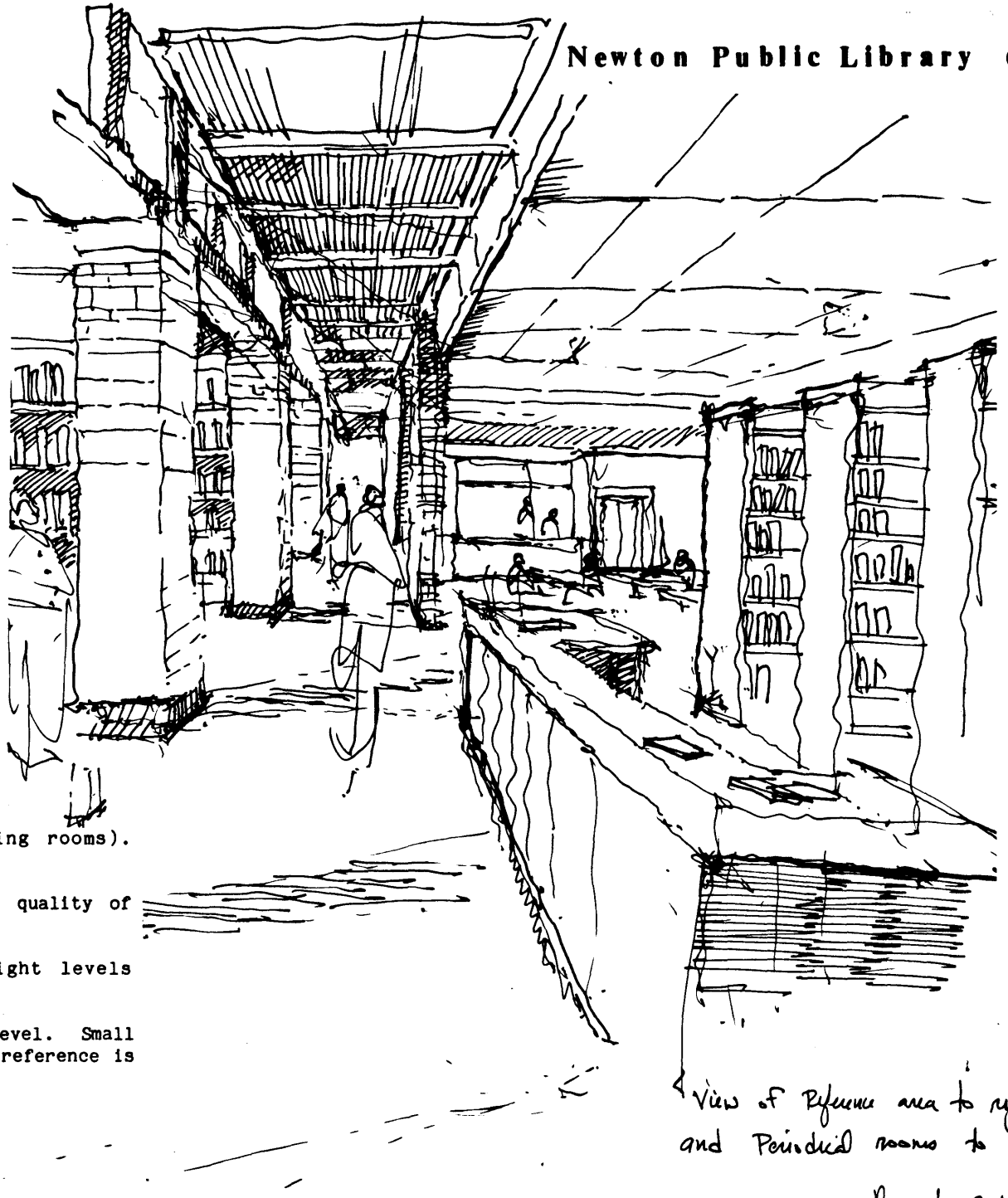


85. footcandles

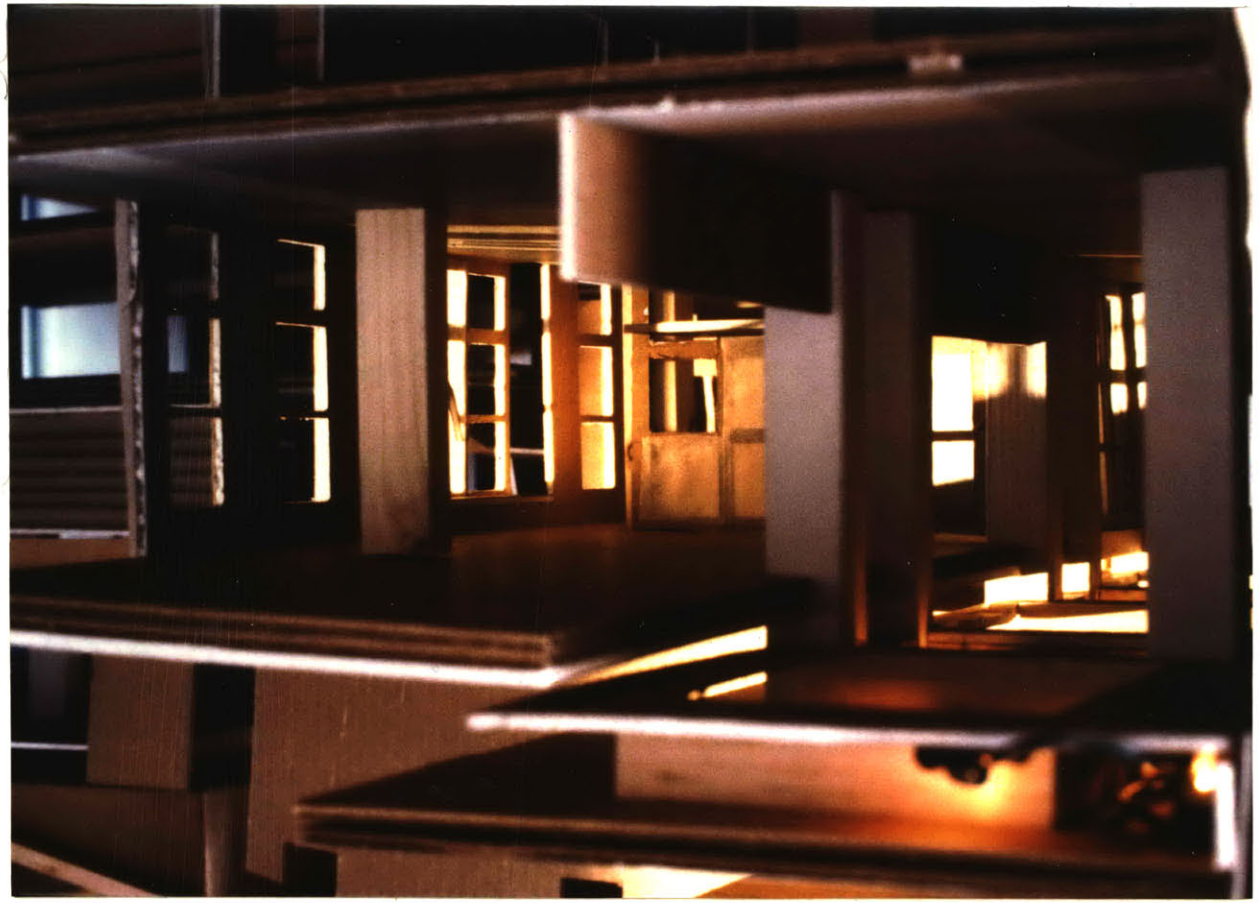


83. Section B (through small reading rooms). Scale: 1/8" = 1'-0".

84. Cross section rendering showing quality of light.

85. Estimated interior natural light levels measured in footcandles.

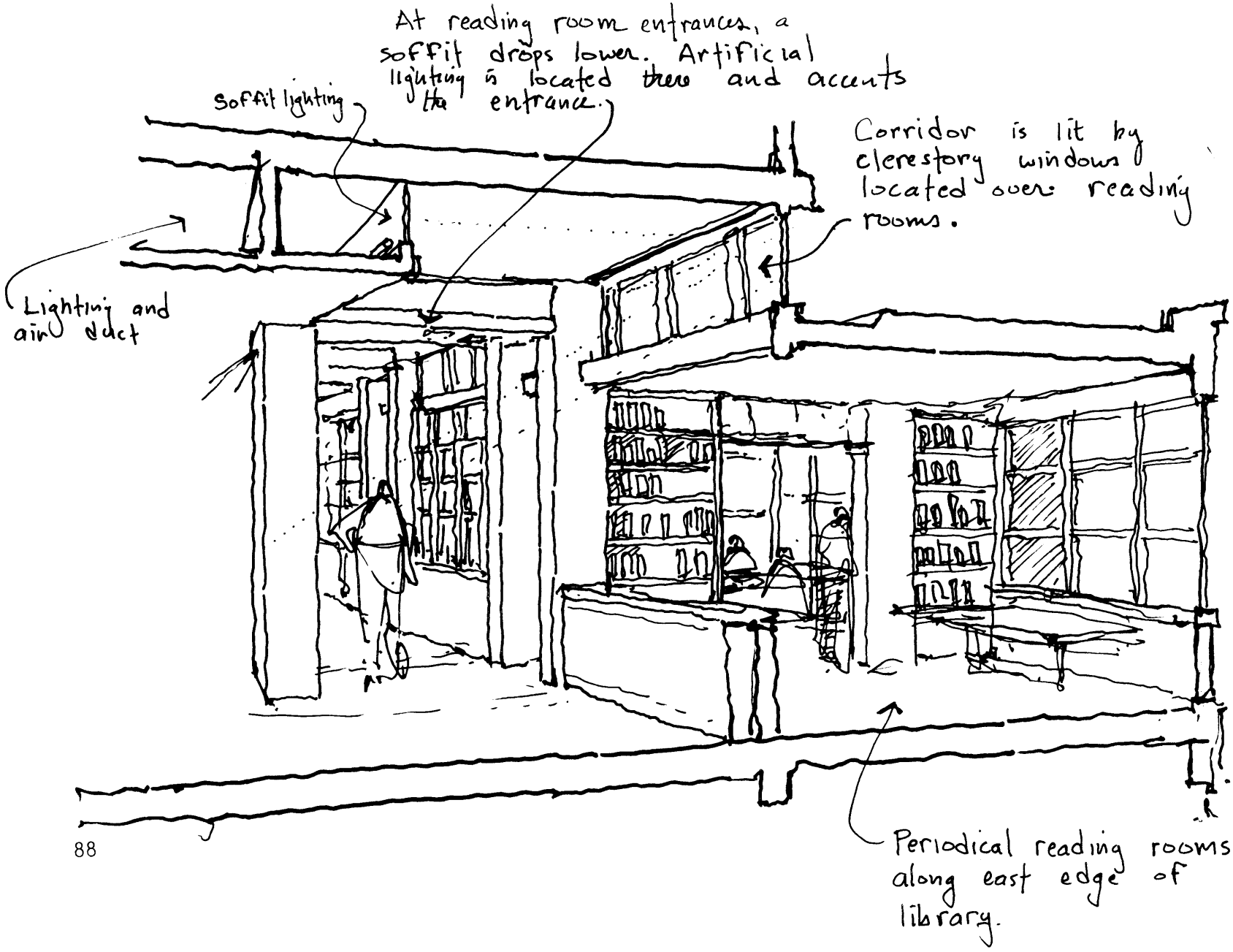
86. View of main corridor on entry level. Small reading rooms are on the left and reference is on the right.



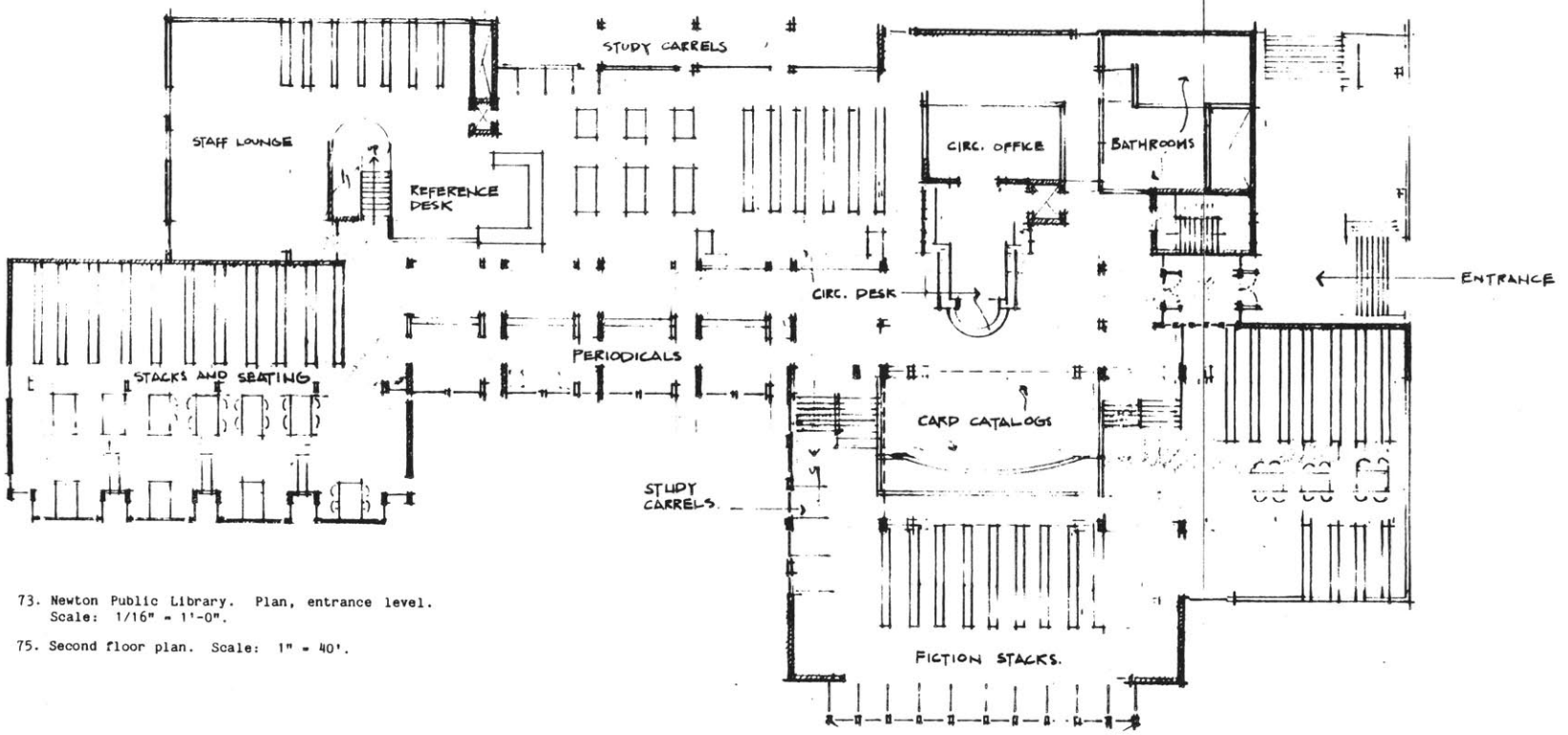
87

87. Model photograph. Corridor is on the left and small reading rooms are on the right.

88. Interior sketch showing how quality of light in Fig. 87 was achieved.


At reading room entrances, a soffit drops lower. Artificial lighting is located there and accents the entrance.
Soffit lighting
Corridor is lit by clerestory windows located over reading rooms.
Lighting and air duct
Periodical reading rooms along east edge of library.

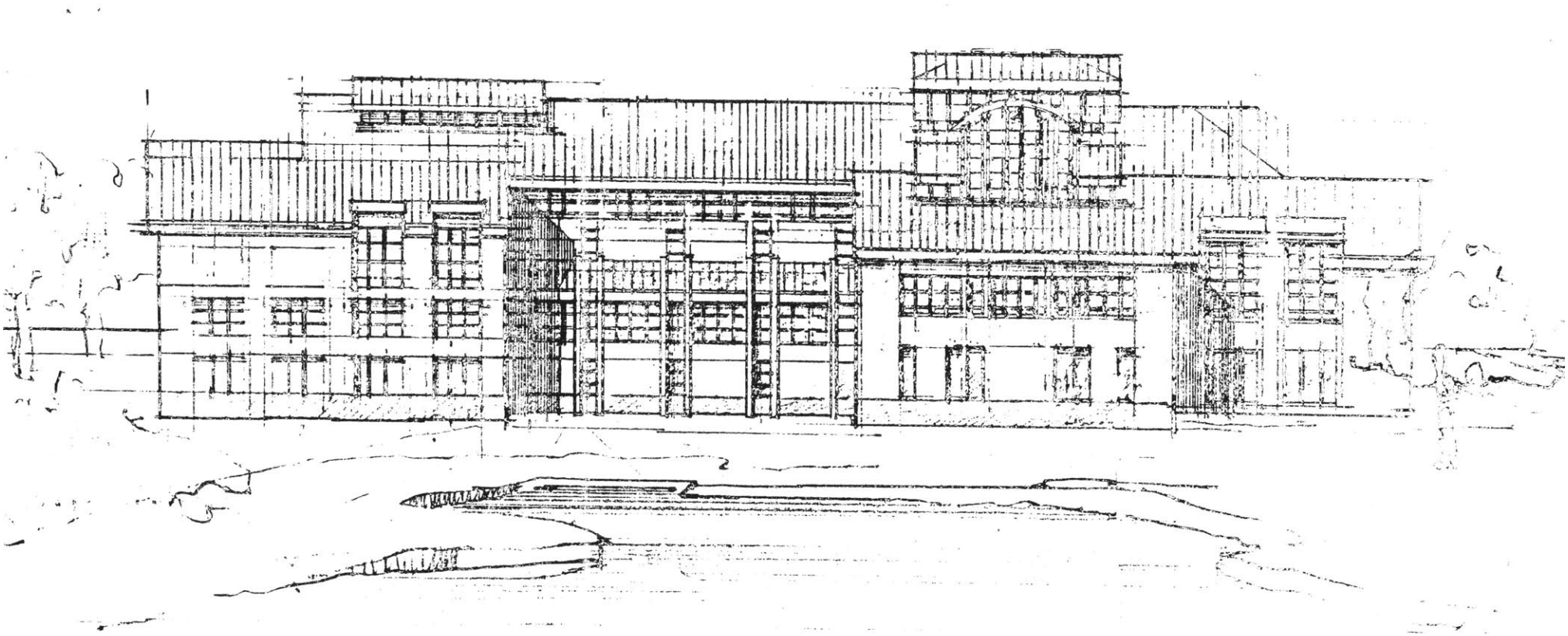
88



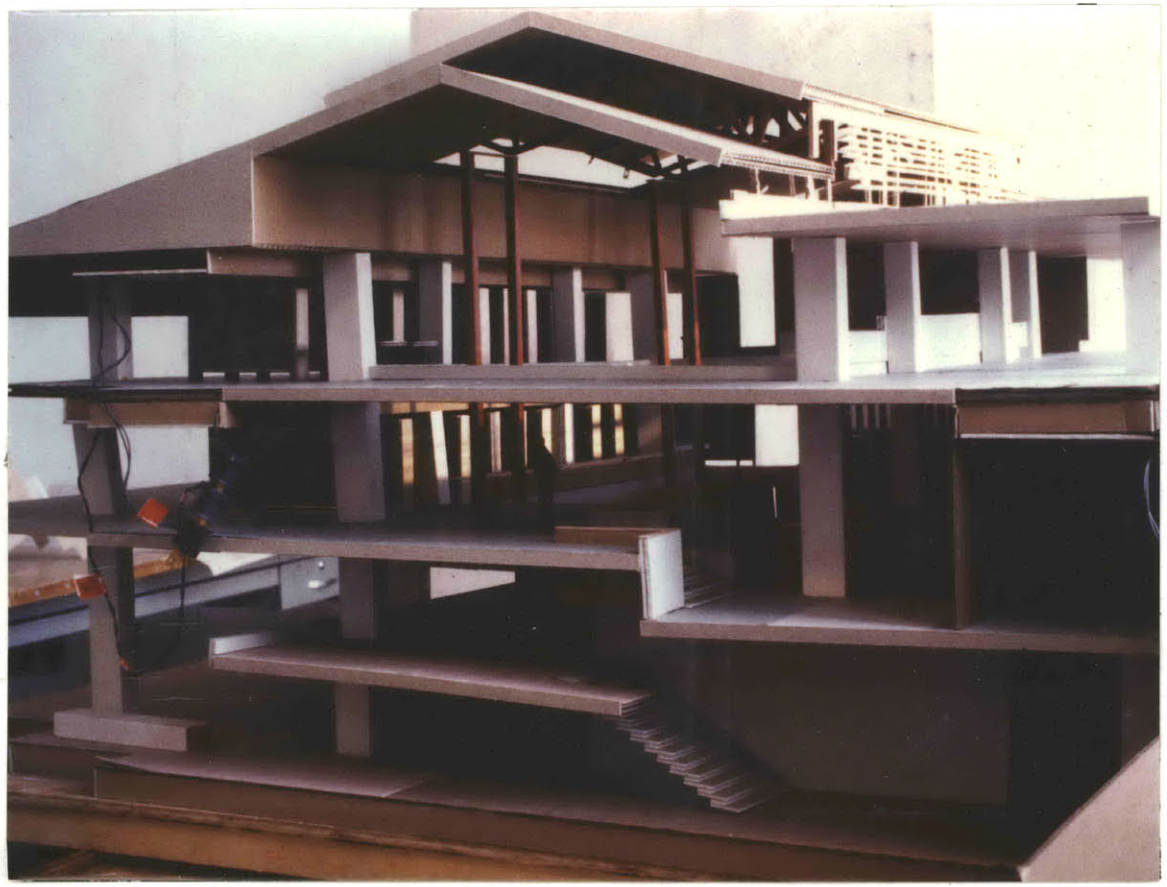
73. Newton Public Library. Plan, entrance level. Scale: 1/16" = 1'-0".

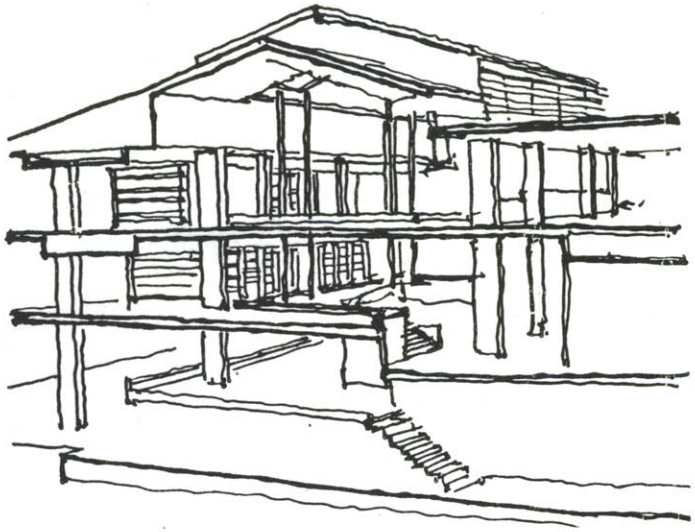
75. Second floor plan. Scale: 1" = 40'.

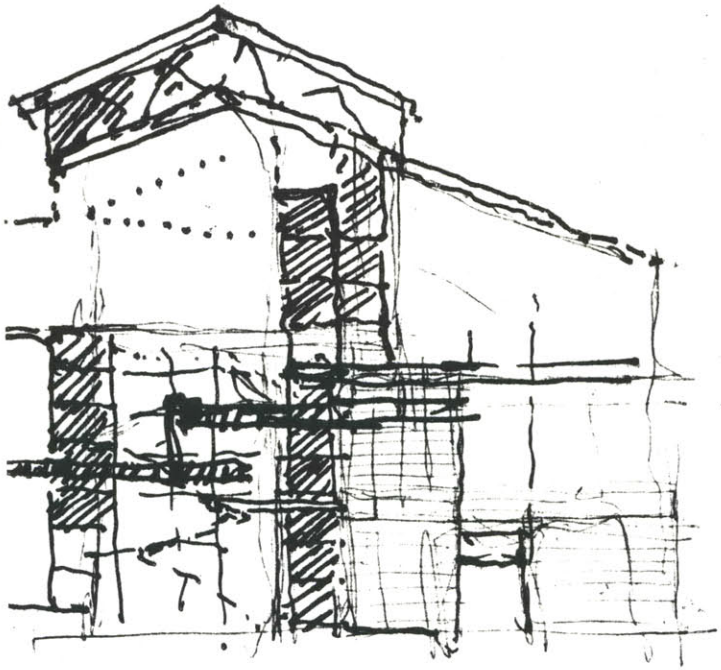
72 · Plan. Entrance level.



89. South elevation. Pond is shown in foreground.

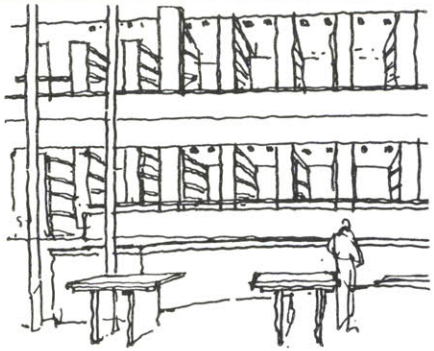






91. Model photograph. Overview.

93. Model photograph. Bibliographic center and fiction stacks.



94. Model photograph. Exterior of reading rooms.

Acknowledgements

For contributions and assistance in the preparation of this thesis, I would like to acknowledge the following people:

Imre Halasz -- for bringing clarity to the design.

Shun Kanda -- for teaching me how to work with design references and for words of encouragement.

Fernando Domeyko -- for his enthusiasm in the project and for emphasizing the importance of dimensions.

Virginia Tashjian -- for her advice on technical aspects of the design.

Nancy Rappaport -- for editing the text and being my best friend.

Appendix

Service areas	No. of 3 ft. shelves	No. of books	No. of seats	No. of sq. ft.
I. Areas Near Entry				
1. Entry, lockers, display, public phones, water bubbler, sales area				1000
2. Circulation desk including staff and public space around; security panels	(60 ft.) 20			500
3. Circulation Department Office	(30 ft.) 10		(8 desks) 8 seats	1400
4. Book sorting room	14			200
II. Areas Near Entry				
5. Front stairs and elevator (estimated 2 floors)				
6. A-V area (gallery -- 1100 sq. ft.) (art and music -- 1500 sq. ft.)	(600 ft.) 200	records etc. 20,000	10 lounges 10 stations 1 booth practice area; desk	2750
7. Bibliographic center; card catalog, terminals, etc.	25 (1500 ft.)	500	stools	1500
8. Reference Dept.; desk and reader's advisory desk; 25 wet and dry carrels	500	10,000	50 mixtures of tables and carrels	2500
9. Reference Dept. Office; terminals	(150 ft.) 50		(9 desks) 9 seats	1400
10. Magazine and newspaper area; indexes, microform, machines, storage, etc.	(1200 ft.) 400		50 and 1 staff	2500
III. Areas More Remote From Entry				
11. Book shelving and seating for adults		261,000	200	24,000
12. Book shelving for reference storage and bound serials		10,000		700
13. Paperbacks (mass uncat.)		20,000		1000
14. Room for special collections: Newton hist., N.E. collection and geneology, rare books		12,000	12	1300
15. Children's room, office, storyhour, craft room		50,000	50	6000
16. Social Service Department (deaf, blind, talking books, etc.)	(300 ft.) 100	2000	6 plus one staff	600

Service areas	No. of 3 ft. shelves	No. of books	No. of seats	No. of sq. ft.
IV. Meeting Rooms (upper floor)				
17. Multipurpose meeting room			150-200	1550
18. 5 smaller conference rooms (movable partitions)			for 25-15-10-6-5	1200
19. Kitchen near meeting room				
20. Conference chair and table storage area				200
21. Meeting room foyer and exhibit area				
22. Cable TV studio				
V. Extension Services: Receiving/Mailing/ Sorting				
23. Freight and delivery loading area				1000
24. Branch room with bins				
VI. Administrative Grouping (upper floor)				
25. Technical Services Department	(500 ft.) 3000		10 desks 10 seats	1700
26. Library supply storage				200

Service areas	No. of 3 ft. shelves	No. of books	No. of seats	No. of sq. ft.
VI. Administrative Grouping (upper floor)				
27. Exhibit display preparation/ duplicating room				500
28. Staff lounge, kitchen, dining, lockers, and rest rooms				1000
29. Director's office with rest room and pullman kitchen				250
30. Secretary's office and waiting room area				200
31. Assistant Director's office with space for secretary				300
32. Bookkeeper's office				200
VII. Mechanical Architecture Space				
33. Rest rooms on each floor for public use				
34. Walls, halls, ducts, back stairs, elevator, etc.				
35. Custodial supply, shop, and equipment storage			1 desk	200
36. Heating and air conditioning				

Service areas	No. of 3 ft. shelves	No. of books	No. of seats	No. of sq. ft.
VII. Mechanical and Architectural Space				
37. Computer room				500
VIII. City Hall Use (remote from entry)				
38. Archival material				1000
IX. Parking Areas				
39. Garage for 3 vehicles (2 vans, 1 sedan)				
40. Parking for 100 cars (both staff and public)				
			TOTAL NET:	57,358
			TOTAL GROSS:	76,500
			(Add 25% for total gross)	

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20. Rotch Visual Collections, photo by James Austin.

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29a. By Author. Based on site observations and Fig. 29b.

29b. Chiarelli, Renzo, San Lorenzo and the Medici Chapels, Florence, Scala, 1984, p. 7.

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41. By Author. Based on site sketch and photo in Rotch Visual Collections.

42. By Author. Based on photo in Rotch Visual Collections.

43. By Author.

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45. Austin, James. Rotch Visual Collections.

46. By Author. Based on photo in Rotch Visual Collections.

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