JOINT OCCUPANCY: THE EFFICIENT USE OF URBAN LAND

by

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ACKNOWLEDGMENTS

I would like to express my gratitude to the members of my advisory committee, especially to Mr. Harold Hill, for their help and guidance throughout my stay at Virginia Polytechnic Institute and State University. Special thanks to my wife, , for her patience and understanding when I needed it the most, and to my friend, , who helped me more than he realizes.

This work is dedicated to two very special people without whom none of this would have been possible--my parents,

and .

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INTRODUCTION

Joint occupancy is not a new idea. It has been widely used throughout history. One of the oldest and most picturesque examples of joint occupancy is Boston's famed Faneuil Hall built in 1742 (Figure 1. Source: "An Old Marketplace Given New Life in Boston," AIA Journal, Mid-May, 1978, p. 132). It was designed to house public meetings on the upper floors while butchers carved up carcasses on the floor below. Boston's English High School began its life in 1821 by sharing a building with the Town Watch and the Hero Fire Engine Company.

Presently there are many complexes in our modern cities where land costs are exorbitant and many users compete for the available ground. In the case of public schools, high construction costs, difficult and expensive credit, and even the loss of revenue when the schools are removed from the tax rolls, all contribute to the taxpayers unwillingness to pay for new schools.

As a result, public schools are looking more and more for a solution which, apparently, rests in joint occupancy. Boston, Massachusetts and Pontiac, Michigan are creating new kinds of environments that link elementary schools to their communities in an attempt to end the traditional isolation of schools from the rest of urban life. The basic reason for this situation is obvious--money. Apart from becoming more and more expensive, urban land is also getting scarce. This has been

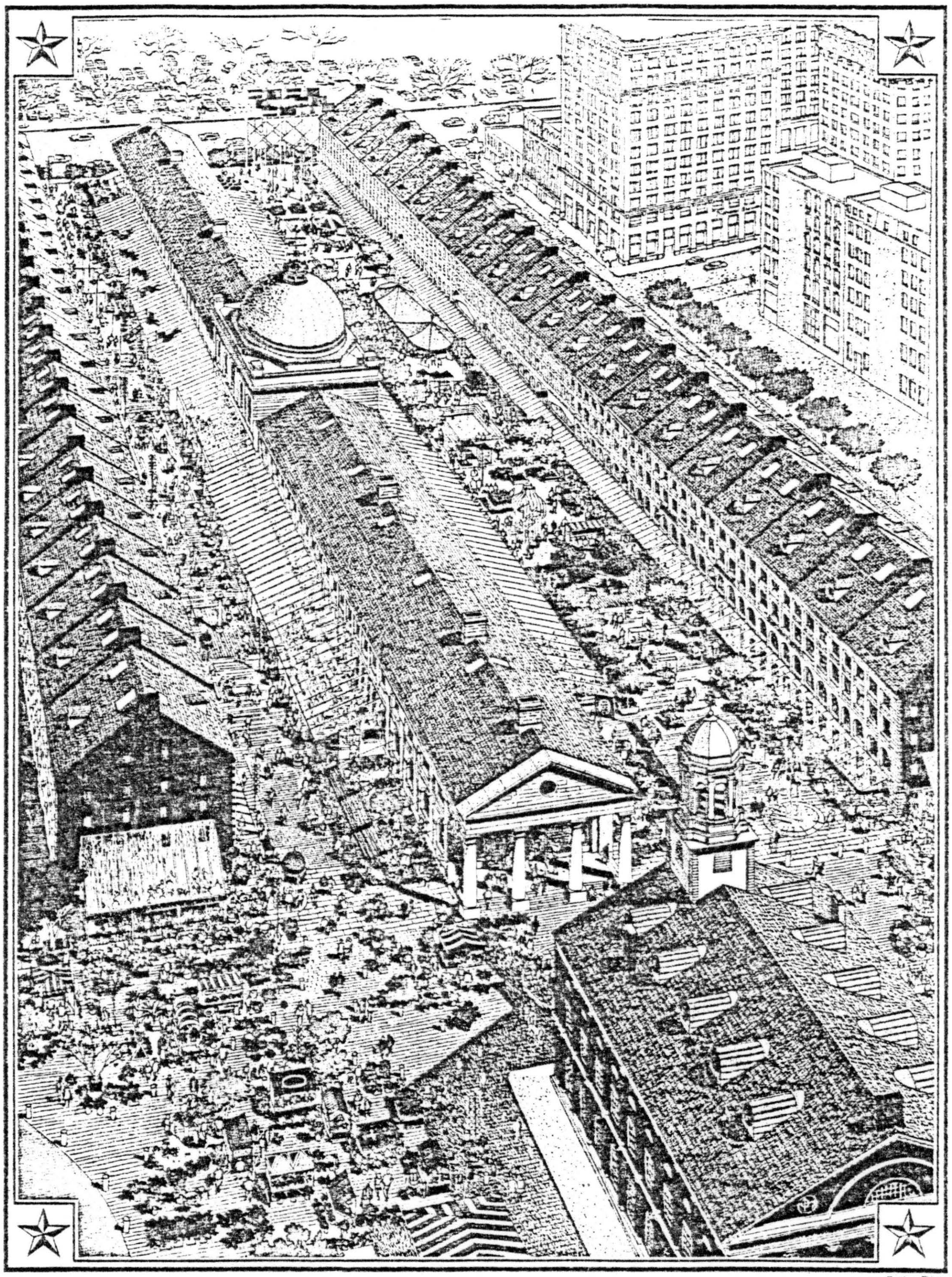


FIGURE 1. FANEUIL HALL

the catalyst in the past few years for the increasing combinations of uses we find in our cities.

> Compounding the land shortage most cities face a frightening fiscal crisis due to a dwindling property tax base. In order to survive cities must increase, or at least maintain, their tax base of revenue-producing properties. In the city of Boston, for instance, about 50 percent of the available land in the city is already occupied by public or private non-profit, and therefore tax-exempt, buildings. Every time a new public school is erected on its own land the tax base of the city is either decreased or a possible piece of revenue is lost for the life of that school building.[1]

Schools are not the only ones affected by these problems. A recent example is the John Hancock Building in Chicago by Skidmore, Owings and Merrill. The site is on Chicago's most famous street, Michigan Avenue. The area is a mixture of good shops, expensive apartments and small and medium size offices. The building consists of apartments over offices. This provides the apartments with uninterrupted views of Chicago.

As in the case of Faneuil Hall, many other old "useless" buildings are finding new life through the process of restoration. In many cases the restoration involves the incorporation of several different functions within the building. The feeling in Boston is that the marketplace could again become a viable commercial center for the downtown area. In addition to providing shops for the food retailers that exist now, there will be outdoor spaces, cafes, restaurants, theatres, covered arcades for pedestrians and cart vendors, as well as retail space for boutiques, night clubs and other shops in the north and south market buildings flanking Quincy Market.

In addition to high construction and land costs, new buildings have to deal with another major problem of overriding importance: energy costs. In recent years there has been an increasing awareness and interest in energy conservation. The architects of John Hancock Center describe it as a "24-hour building" with its consequent reduction of peak loads. The building's energy consumption is more evenly distributed since the peak demand of the housing section is during the night and that of the offices, during the day.

The United States' increasing dependence on foreign oil and ever-increasing energy costs have resulted in government incentives for building insulation and the development of solar energy. There are a few larger scale projects but mostly the use of solar energy has been at the residential scale.

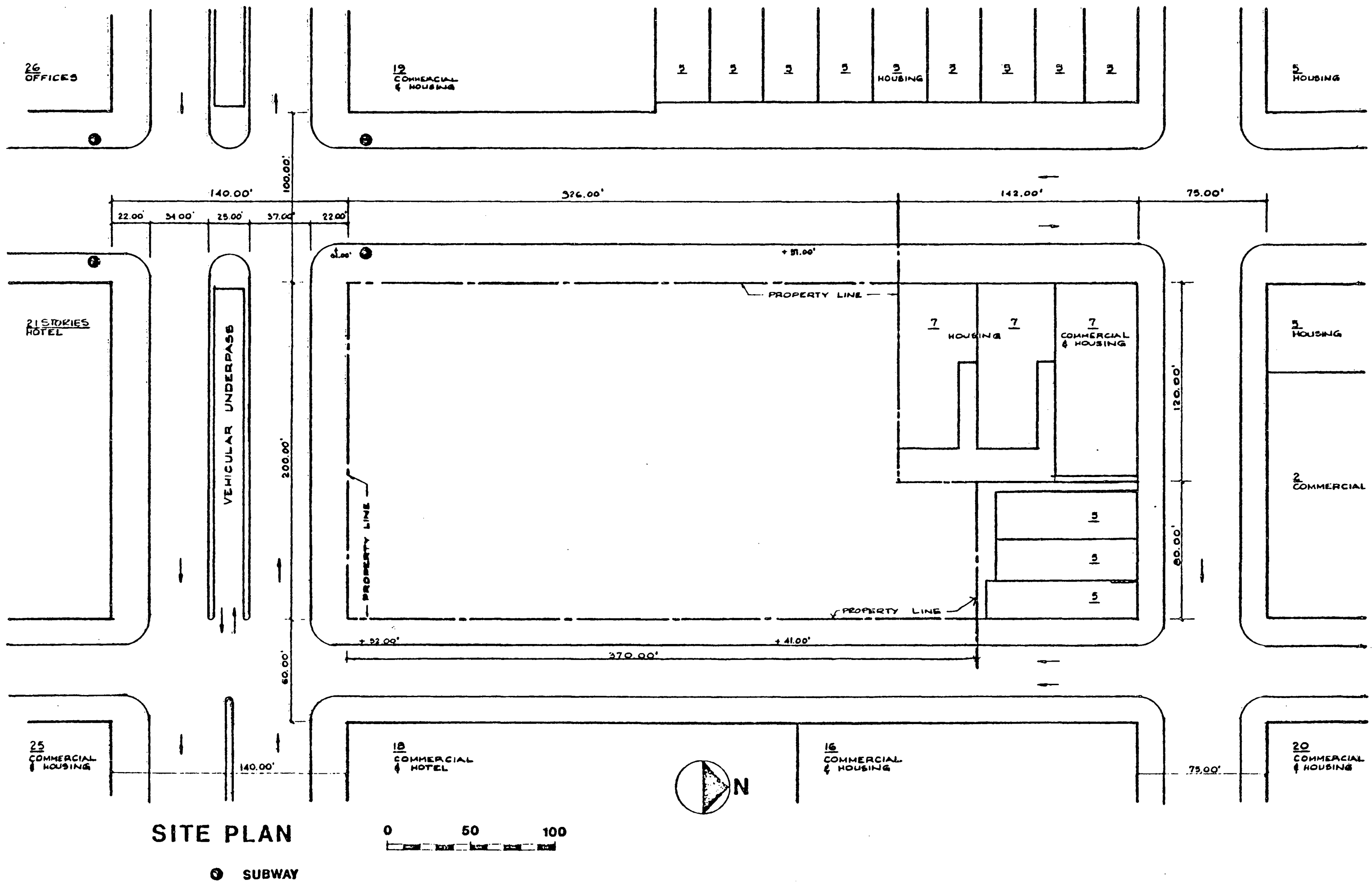
This thesis attempts to provide one solution to a set of cumulative problems. The basic concept for the design is the efficient use of solar energy for a large scale project in an urban setting.

THE PROBLEM

A developer has purchased a site (Figure 2) in a large Northeastern U.S. city. He has hired you, the architect, to design a multi-use, joint occupancy facility which will incorporate a city-operated commercial high school, commercial space, and office space. As part of the scope of your work for the developer you have been directed to prepare a presentation of the high school for the Board of Education. The board wishes to see schematic plans for the school and clear indication of its relationship to other site usages.

Based upon the developer's commitment to provide a minimum of 8,000 square feet of public plaza area, the city planning commission will permit 750,000 gross square feet, of which 250,000 is allocated to the school and 500,000 is allocated to the commercial and office space. The school and commercial/office space must be independent with regard to site entrances, internal circulation, servicing, and mechanical support systems.[2]

FIGURE 2. SITE PLAN



THE PROGRAM

A. Program for Commercial/Office Space

Allocate the commercial and office mix which will best utilize the allowable 500,000 gross square feet. Several restaurants, a bank, and a movie theatre chain have already expressed interest in the project's potential commercial space. A large insurance company needs between 200,000 and 250,000 square feet of office space. In fact, so much interest has been shown in both the commercial and office space that you, as an architect, may want to propose a proper combination of usages which will best realize the economic and aesthetic potential of the site.[3]

B. School

City program for commercial high school (250,000 gross square feet) with 2,500 pupil stations serving 1,800 students.

School/Community Administration:	N S.F.
Counseling Suite	1,500
Student Services Suite	1,100
Principal's Suite	800
Administrative Suite	2,500
Custodian	250
Community Education Suite	600
Student Patrol	250
Program Office	400
Conference	750
Student Government & Club Offices	1,200
	9,350

	N S.F.
Liberal Arts:	
Chairman & Conference (2 @ 400)	800
Social Studies Classroom (2 @ 750)	1,500
Stenography Classroom	750
Divisible Speech Classroom	750
Mathematics Classrooms (3 @ 750)	2,250
Programmed Instruction Classroom	950
Speech Classroom	750
Biology Laboratory	1,200
Biology Prep.	650
Science Classrooms (6 @ 950)	5,750
Physical Science Laboratory and Prep.	1,800
	17,100
Music and Art Facilities:	
Chairman and Conference	400
Art Rooms	3,375
Choral Room	2,000
Instrument Classroom	1,000
Instrument Storage	500
Music Classroom	850
	8,125
Office Skills:	
Chairman and Conference	400
Typewriting Classrooms (11 @ 1,100)	12,100
Stenography Classrooms (7 @ 750)	5,250
Personality Training Classroom	1,000
Dictaphone & Filing Classroom	1,000
	19,750
Language Skills:	
Chairman and Conference (2 @ 400)	800
Foreign Language C. (3 @ 750)	2,250
Typical Classrooms (6 @ 750)	4,500

Language Skills (continued)	N S.F.
Language Laboratory	850
Social Studies Flexible Complex (divisible into 4 classrooms & resource area)	3,750
English Flexible Complex (divisible into 4 classrooms and resource area)	3,750
	15,900

Business Equipment & Procedures:

Chairman and Conference (2 @ 400)	800
Distributive Education C. (6 @ 750)	4,500
Distributive Education Labs. (3 @ 1,500)	4,500
Calculating Machine C.	1,100
Accounting & Business Practice C. (2 @ 750)	1,500
Machine Repair Lab.	750
Card Punch & Tabulating C.	750
Card Punch & Computer C.	1,500
Bookkeeping Machines C.	1,100
Duplicating Machines C.	750
	17,650

Library and Audio Visual Facilities:

Chairman and Conference	400
Audiovisual Center	1,500
Library (Incl. 3 Reading Rooms 1,000 ea.)	5,000
Bookstore	200
Publications Office	750
	7,850

Dining and Classroom Facilities:

Student Dining Area (convertible into 7 C.)	5,700
Teacher Dining Area	1,500
Frozen Food Kitchen	1,500
Sales Store	750
	9,450

	N S.F.
Auditorium:	
Auditorium for 750	6,000
Stage Area	2,500
Makeup Room	400
Dressing Rooms (2 @ 250)	500
Stagecraft Room	1,000
Instrument Storage	500
Costume Storage	500
Coat Room	500
	11,900
Athletic Facilities:	
Chairman and Conference	400
Gymnasium (divisible into 4 areas)	12,500
Instructors Offices	1,500
Boys' Locker Room	2,000
Girls' Locker Room	3,000
	19,400

Miscellaneous Support Spaces:

- Lobby
- Teachers' Restoom & Toilets
- Boys' & Girls' Toilets
- Teachers' Infirmary
- Student Infirmary
- Engineer's Office
- Custodial Workshop
- Book Storeroom
- Furniture Storeroom
- Janitor Supplies Storeroom
- Refuse Room
- School Receiving Docks (2 trucks)
- Receiving & General Supply Room
- Stairways
- Elevators & Escalators (if desired)
- Mechanical Shafts & Support Spaces

THE SITE

The Northeastern United States is characterized by its large population density. As with the location of the site for the thesis project, Faneuil Hall is located in a large Northeastern city. Faneuil Hall and Quincy Markets were once the center of Boston's commercial life. Built on fill land that was formerly harbor, the Quincy Markets were opened in 1826 and were to serve as successor to Faneuil Hall, then already 100 years old. Plans for the market were drawn by Alexander Parris, and lots were sold to individual developers with the stipulation that owners build according to the plans. The Quincy Market began as a sound concept in city planning, the open air market. Its successful restoration will, in part, be due to the thoughtful planning of 150 years ago.

A proposal submitted by Benjamin Thompson and Associates was selected as the most appropriate scheme among several to rescue the landmark area. Circulation is simple but very effective on the large site. Streets between the buildings have been closed to traffic and a park runs the length of the southern portion of the market building, providing areas for public gatherings, parades and concerns. The streets have also been covered with glass canopies to provide year-round outdoor spaces.

As with Faneuil Hall, the site for the thesis project is located in a large Northeastern city. The climate is characterized by long cold winters and large amounts of rainfall and snowfall.

In analyzing the site (Figure 3), an important consideration that arises is the location of subway exits indicating a possible major pedestrian traffic flow from the southwest corner. At this point, a major assumption is made: main access to the building through the use of public transportation. Many large cities are characterized by their lack of adequate parking facilities to handle its user inflow. Thus, a large portion of the public utilizes the subway or bus services provided by the city. Given the existence of public transportation, it is reasonable to assume that the students, workers and patrols who use the building would find public transit the easiest means of access in such an urban setting.

There are two main streets on the West and South sides of the site, indicating possible traffic hazards. The configuration of occupants surrounding the site suggests other possible traffic flows. The Northwest corner of the site is surrounded by a residential area. The North and East sides are surrounded by a combination of commercial and housing uses and the South side is predominantly commercial. It seems appropriate to place the public plaza at the South end of the site in order to provide a welcomed break on a street flanked by high rises. The location of the school should be closest to the residential area.

From the analysis of light and shadows falling on the site (Figure 4), the correct placement of the high rise section of the building is the North end.

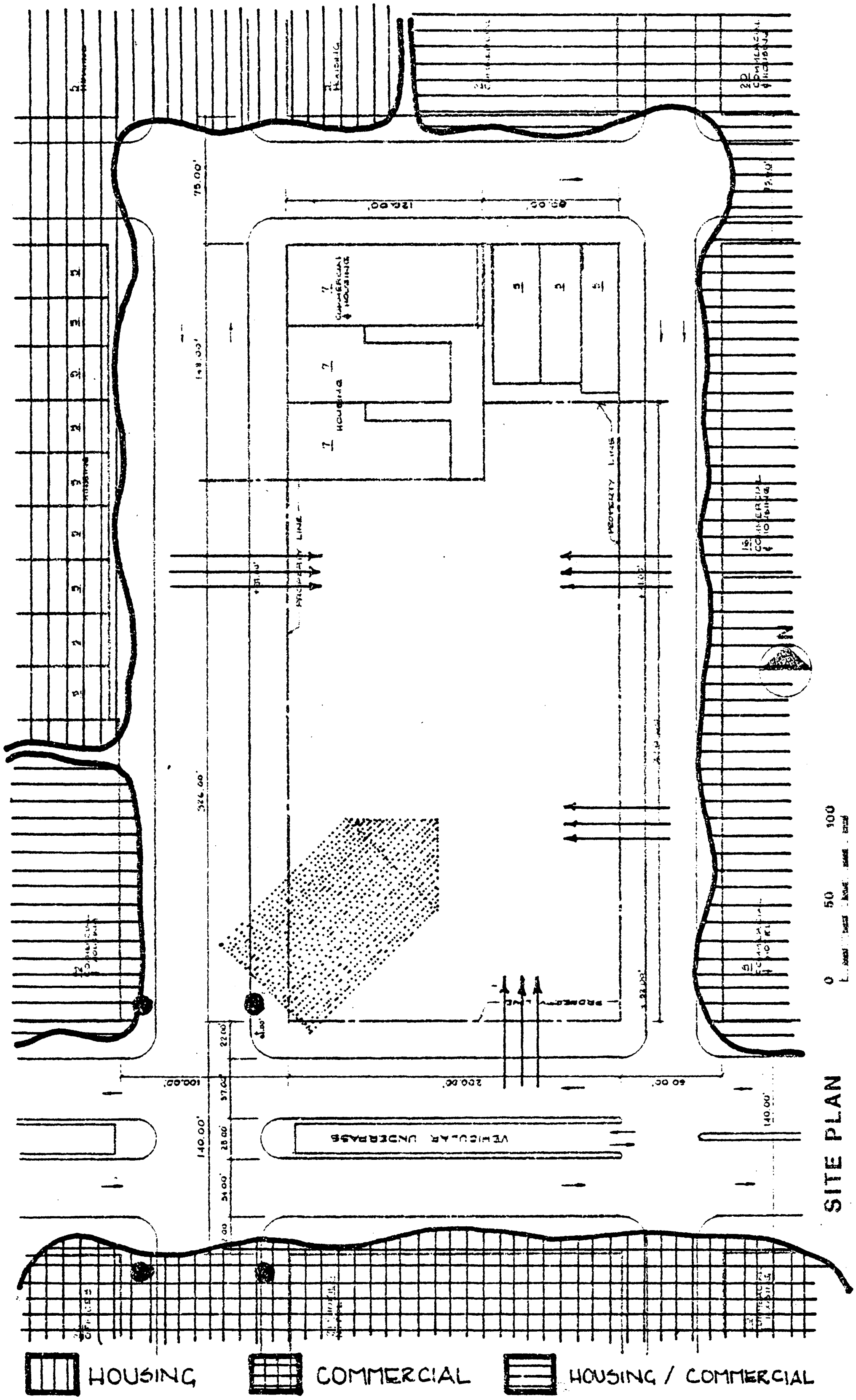
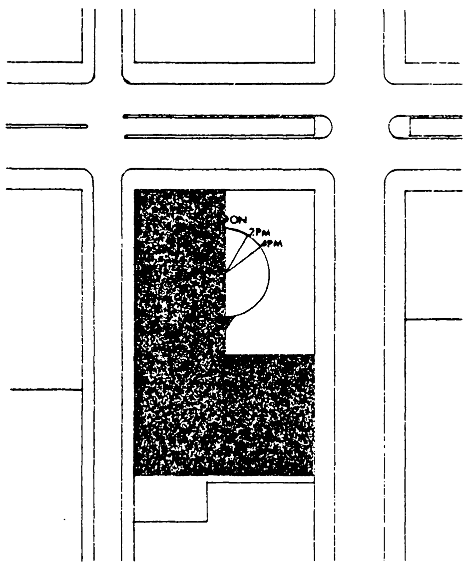
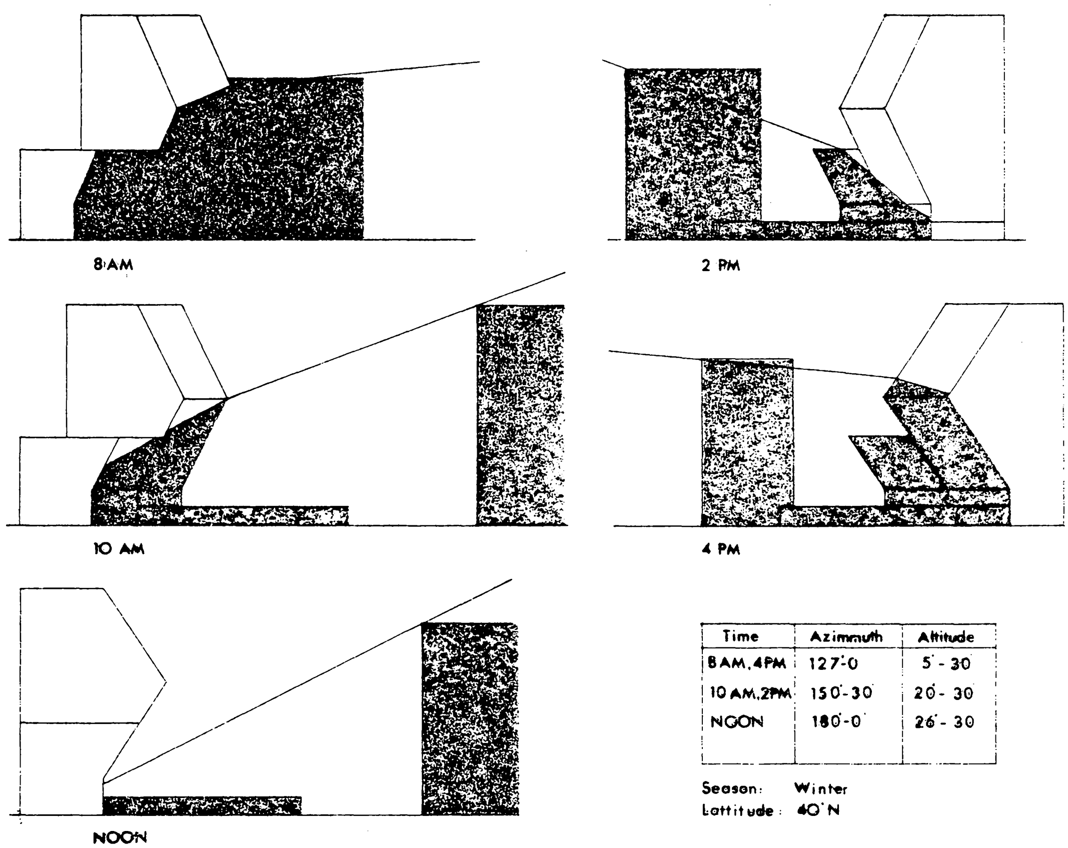


FIGURE 3. SITE ZONING





Time	Azimmuth	Altitude
8AM,4PM	127°-0	5°-30
10AM,2PM	150°-30	20°-30
NOON	180°-0	26°-30

Season: Winter
Lattitude: 40°N

FIGURE 4. LIGHT AND SHADOW ANALYSIS.

The profile of the surrounding buildings (Figure 5) suggests that a most convenient orientation of the site would have been a 180 degree rotation from its actual position, but this not being the case, the path of the sun indicates that the only feasible placement of solar collectors is approximately 10 to 15 stories above the ground at the North end of the site. It might be inconsiderate to place a high rise beside houses, especially because of the shadows caused in winter. The main justification for this decision is the high cost of land and the need for a tall structure. The main advantage provided is a shield from the noise created by the busy street and the cool protection from the sun in the summer. A partial response to this problem is to provide some distance between the high rise and the residences. Another form of response to the surroundings is to conceal part of the building underground in order to keep the scale of the high rise similar to that of surrounding buildings.

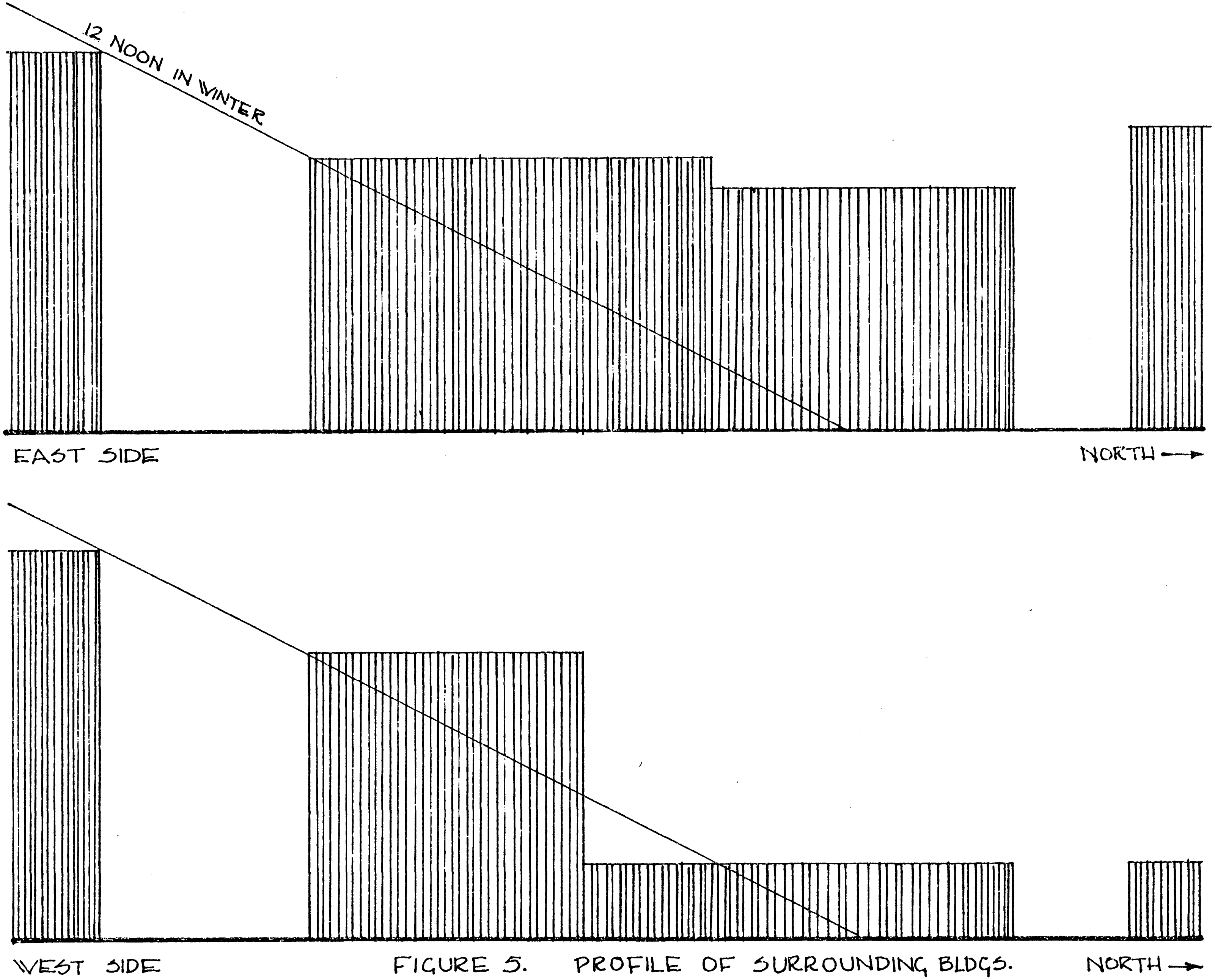


FIGURE 5. PROFILE OF SURROUNDING BLDGS.

SPATIAL ORGANIZATION

Historically, large contained spaces have been some of the most important elements of great architecture. The Galleria allowed natural light to reach more space within a building. The Galleria has also been used as a source of light and grand space in activity centers. Like the other most prominent buildings of the period (1865-77) the vast cruciform Galleria in Milan, by Giuseppe Mengoni, makes its impression by its size and its elaboration of detail. The vast space is created by two glass and steel vaults, over pedestrian streets, that cross through each other with a great octagonal space at the crossing. The Galleria extends from the Piazza del Duomo bo the Piazza Della Scala. Traditionally in church architecture the Galleria is: "An upper story over an aisle opening on to the nave."[5] Mengoni's openings are basically windows facing the large space.

The location and configuration of the commercial space was a prime consideration in this multi-use project. The school is depending on the willingness of clients to occupy the building in order to make use of the several functions provided by it. The location and configuration of the commercial space was intended to enhance and promote its use by the public. This section was to be accessible from as many directions as possible. It was also important that it be easily identifiable as "stores" in order to communicate its function to the user.

In this project the intention is to provide all floors with as much activity as the bottom or main floor. The high skylit Galleria unifies the different functions housed by the building. Special places occur at different levels to create variety in the space. These special places become attractive islands or showrooms. The stairways and bridges become sculptural to add to the quality of the space.

Together these vertical and horizontal components of the circulation network are intended to provide orientation and excitement within the 300-foot long structure, to encourage exploration, to create diversity of tenant spaces and to equalize exposure and location advantage as much as possible.

The extensive use of natural light and vegetation was intended to create an indoor-outdoor quality throughout the commercial space. Zoning is used to separate small spaces from medium and large spaces (Figure 6). Location, exposure and circulation are extremely important interior planning issues. The location of vertical circulation was intended to avoid a single advantageous central location. Horizontal circulation is kept simple and is essentially the same on every floor. When the user enters the building from any direction, he or she is immediately confronted with several sets of stairs. Elevators are readily available but there is always a stairway between them and any of the entrances in order to encourage stairway use. Access for the handicapped was incorporated in all but one of the entries. A handicapped person in a wheelchair can enter the building through one of several sets of ramps.

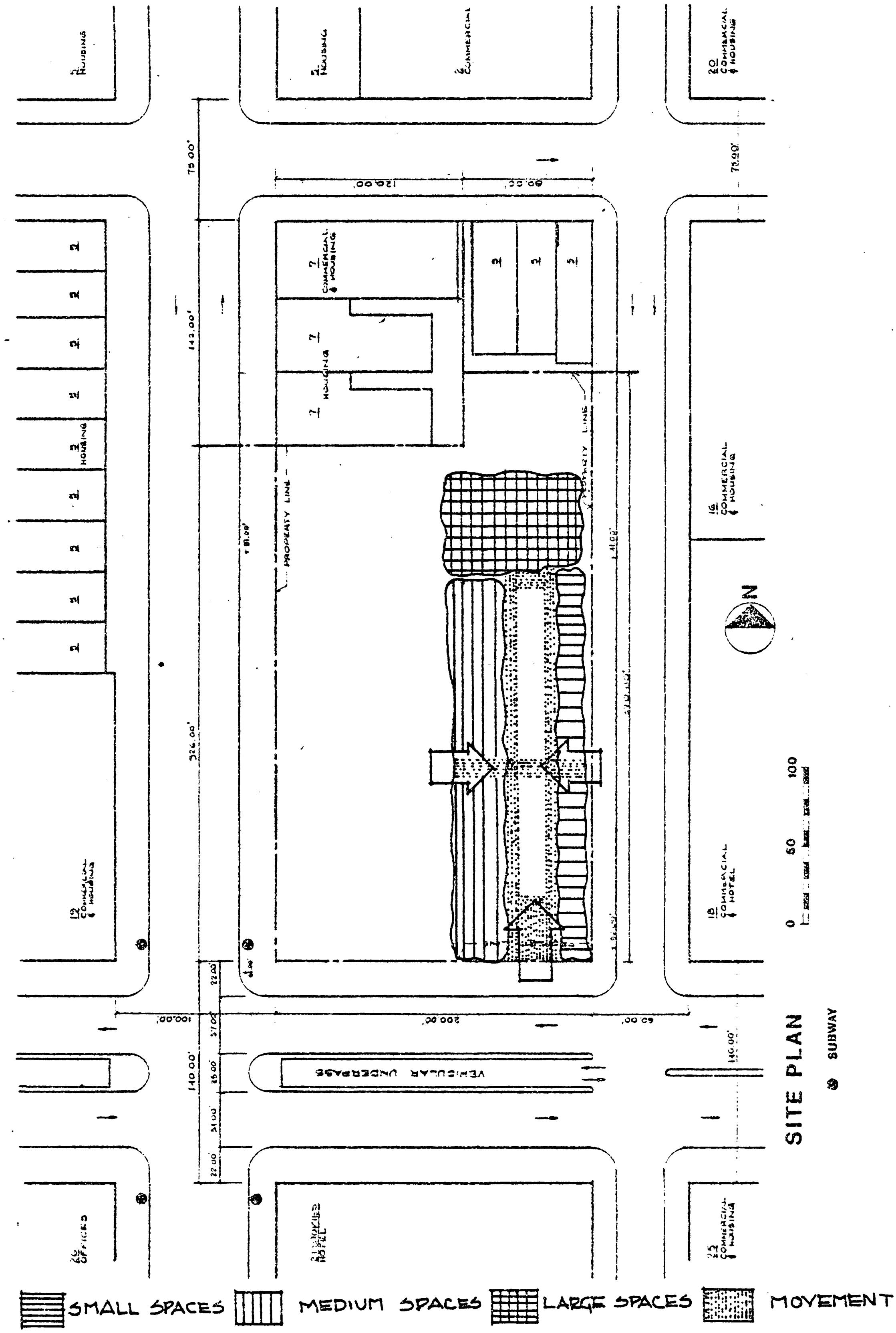


FIGURE 6. COMMERCIAL ZONING AND CIRCULATION

Although not shown in the ground floor plan, there is to be a set of ramps in the plaza space instead of the stairs that go down at the end of the bridge (Ground Floor Plan, p. 40). This will provide the closest access to the elevators from outside the building.

The number of floors was to be kept down to a minimum for easy accessibility. The assumption was made that people in general tend to be more willing to walk down three floors to look for a store than to walk up three floors. The initial entry conditions established by the building to the commercial space are sets of stairs and ramps down one half story or up one half story. The option was given in order to allow the user to decide, even before entering the building, which of the two ways would make it easier for him or her to use the building without having to resort to elevators too often.

Special attention was given to the relationship between the commercial space and the school since the concept demands communal use of some of the spaces within the school. One of the major concerns of joint occupancy is the non-exclusive use of some spaces within the complex. Some of these spaces are the gymnasium, the auditorium, and the public plaza. The relationship between the community and the students could be enhanced or harmed by the fact that the public plaza is actually the top of their school. The plaza also acts as a transition from the street to the building. Even though the school, commercial and office spaces are independent with respect to site entrances there is access from the commercial space to the office building and to some of the school facilities. The incorporation in the design of communal use of these spaces underlines the unity in the design. There are three buildings but it is one.

The location of the school works well in terms of accessibility and function. There is a subway exit at one corner of the plaza. This makes the plaza an attractive transition point from the subway to the street and vice versa.

In important drawback of the spatial organization is the location of the gymnasium above the auditorium. The decision was made by weighing the alternatives. Even though the noise problems created by the situation may be hard to solve, the location of the gymnasium and the auditorium is ideal in terms of function, accessibility, light and relationship with the rest of the building.

As was mentioned in the analysis of the site there are two main traffic arteries on the South and West ends. This led to the conclusion that the best location for the access of trucks to and from the site would be the one way street on the East side of the site. The loading docks are centralized in order to economize on the amount of land used for this purpose.

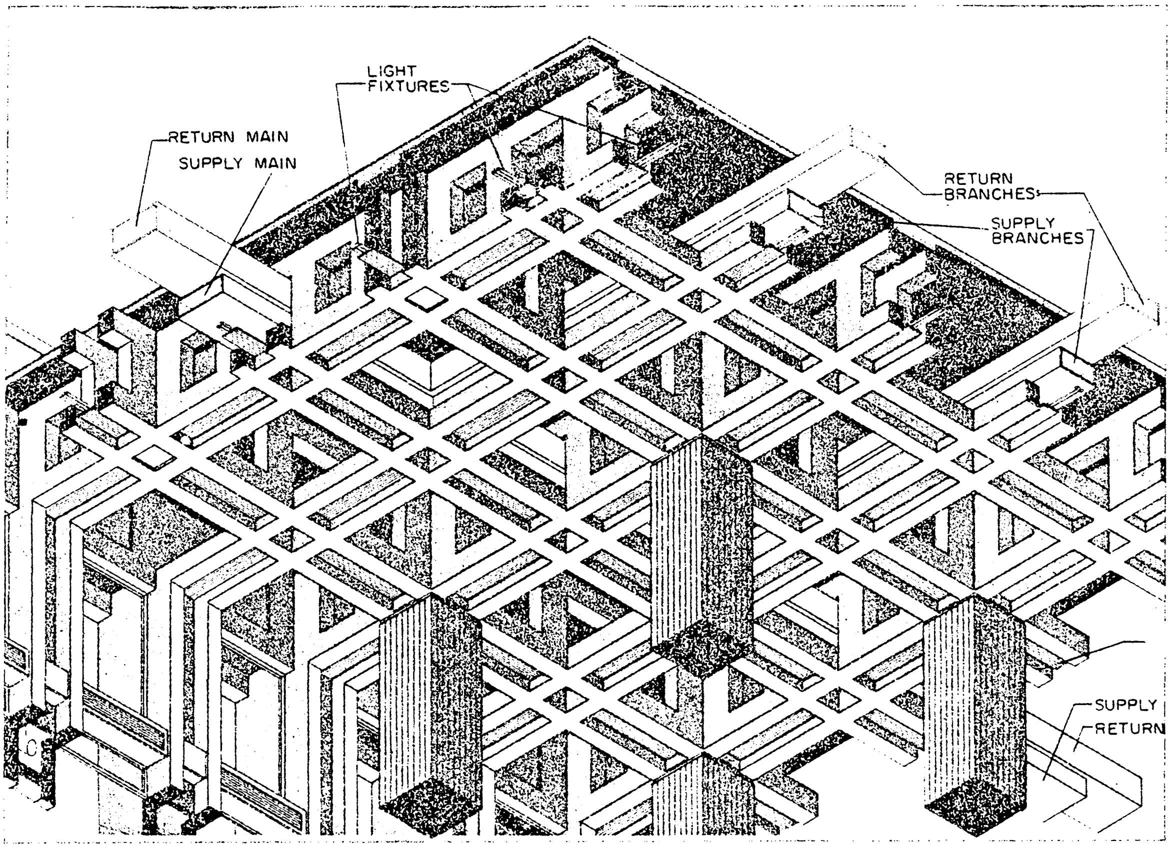
A major assumption was made regarding how occupants arrive at the building. A large percentage of people using the building will arrive by public transportation (subway or bus). A small percentage will arrive from nearby parking. Important executives of the office organization plus security personnel will have parking on top of the commercial space.

STRUCTURAL AND MECHANICAL SYSTEMS

The structural system in a building has often been used by the designer as an effective tool to provide a degree of order in the layout of a building. Mechanical systems are sometimes considered an obstacle to good architecture, many times they are hidden behind fake walls in order to conceal their "ugliness." Their acceptance as an integral part of "modern architecture" has resulted in a different approach by many architectes towards the handling of mechanical systems in their designs. In many cases, mechanical and structural systems have been integrated and in others the importance of mechanical systems is recognized by providing a place where they belong or even by exposing them purposely through the building.

Louis I. Kahn, in the Richards Medical Center (Figure 7B. Source: H. Ronner, S. J. Haveri, and A. Vasella, Louis I. Kahn--Complete Works, 1935-74), West View Press, Boulder, Colorado, 1977, p. 115), employed towers to carry mechanical systems as well as stairways and elevators. The towers were intended as functional elements and not to provide structural support to the building.

Kallman, McKinnel & Knowells, in the Boston City Hall (Figure 7A. Source: "The New Boston City Hall," Architectural Record, February, 1969, p. 132), integrated mechanical systems and other services with the structure.



7A. THE BOSTON CITY HALL STRUCTURAL SYSTEMS

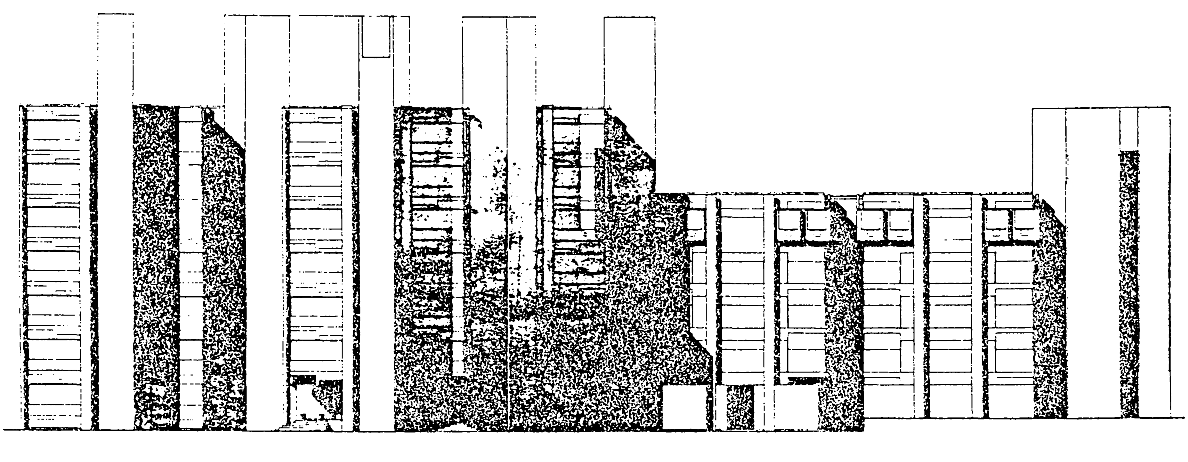


FIGURE 7B. THE RICHARDS MEDICAL CENTER

In the Glasgow School of Art (1904), Charles Rennie Mackintosh used a Plenum ventilation system as an innovative tool to handle foul air:

> In which force fans were used to keep the ventilated volumes under a slight pressure so that foul air would find its own way out through accidental or designed exits.[6]

The School of Art used ventilating ducts on central walls (Figure 8. Source: Reyner Banham. The Architecture of the Well Tempered Environment." The Architectural Press, London/The University, 1969), for both the supply and extraction of air.

In the present project the building separates the service core in two. The vertical circulation is basically provided by the North section. The mechanical services are provided space by the five service towers. The reasons for separating the service core were both structural and functional. From the functional point of view the North wall was intended to be a protective shield, in terms of energy, from the cold North winds.

The service towers become structural and functional at the same time. They provide the structural stiffness needed, the angle desired to include solar collectors and also serve as service cores. They also provide the "natural" return ducts for the exit of used air through the grilles below the ceilings.

The project integrates structure and services. The structural system consists basically of bearing walls, double columns, double beams and

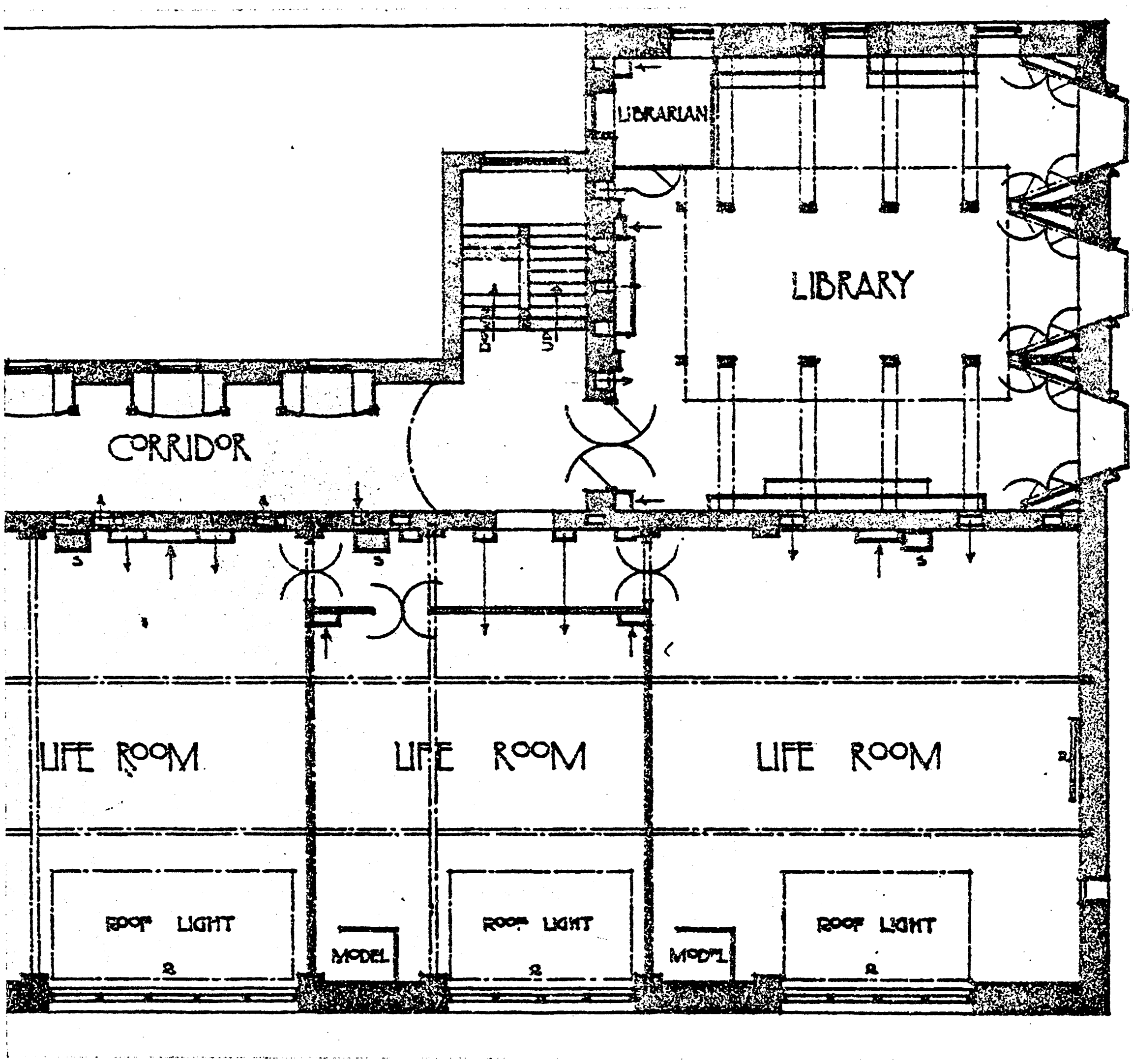


FIGURE 8. THE GLASGOW SCHOOL OF ART

structural double tee floor systems. The mechanical systems feed up and down through the service towers, out in between the beams and into the double tees (Figure 9). The structural material is pre-cast pre-stressed concrete and the enclosure system is also pre-cast concrete. A special place occurs at the gymnasium and auditorium. Here the structure changes considerably and adapts itself to the function needed.

In the first scheme (1st Section BB, p. 34) the service towers deformed themselves as the building grew above the ground. In analyzing the situation somewhat more realistically, it was concluded that the second scheme (2nd Section BB, p.35) is more appropriate since it does everything the first scheme did but, most important, it avoids the structural problems that would have arisen.

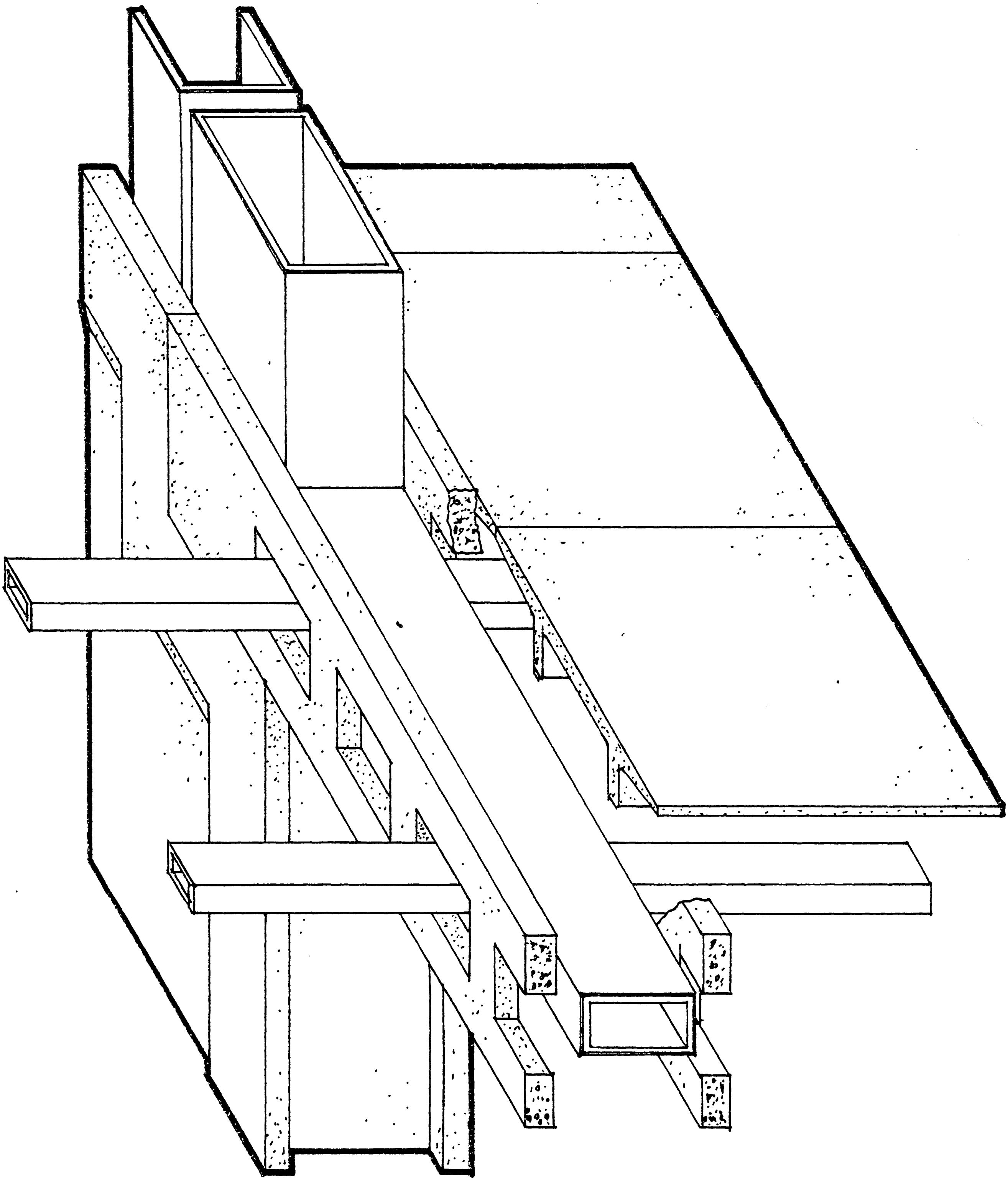


FIGURE 9. STRUCTURAL DIAGRAM

DETAILS AND EXPANSION

The basic uses of solar energy are through the use of light and heat. There are few large-scale urban projects that use an active solar system for the production of heat and air conditioning. This project utilizes solar energy in two ways: reflecting it into the building and heating solar panels with it. The building adapts itself for the better use of sunlight for heating the panels by orienting them towards the Southwest. In this manner the warmer afternoon sun can be more efficiently used. In some warmer climates the use of indirect sunlight on the North side is more efficient since the undesired high solar gain is avoided but, in this particular region, there is more use for the heat provided by the Southern exposure of a building in winter. The solar gain during the summer can be quite efficiently reduced with the aid of shading devices.

The building permits natural light to enter indirectly by reflecting it vertically and horizontally through its openings. The triangular element on the West wall not only reflects the opening, but also shades it (Figure 10A). The right angle triangle is used because it allows more reflected light to enter, and it also allows the lower winter sun to enter more easily.

In the first scheme, the South wall of the office complex uses sunlight for both heat and light. The way light enters the building is controlled

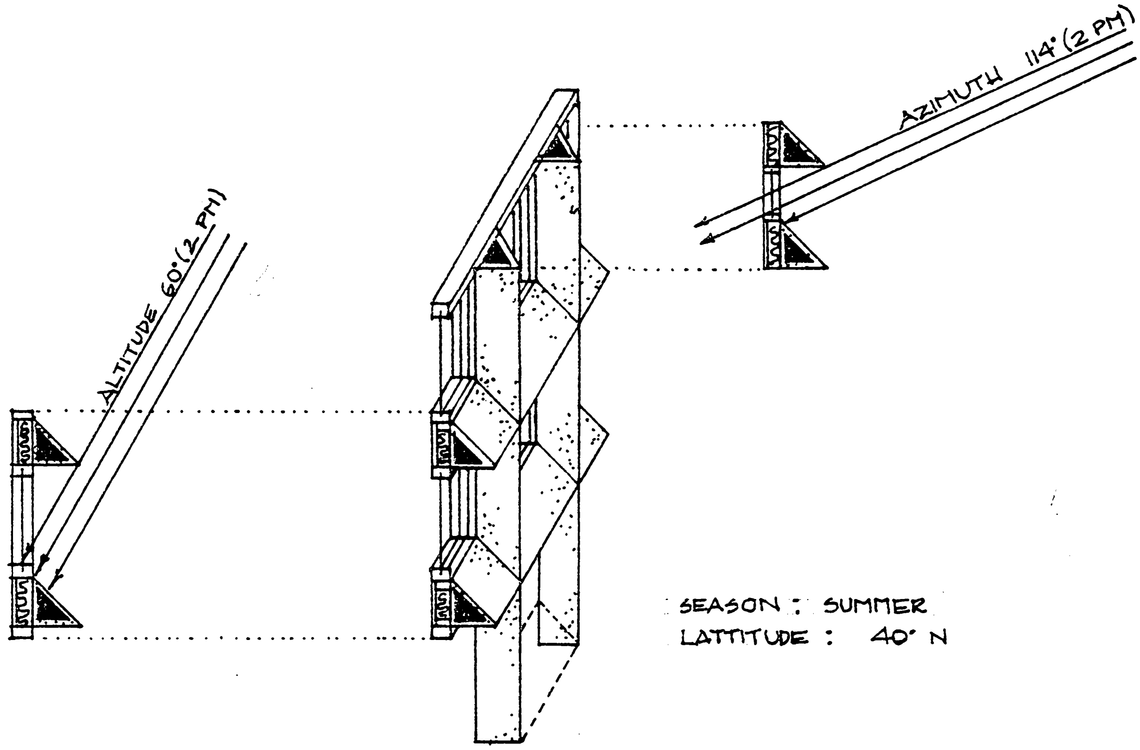


FIGURE 10 A

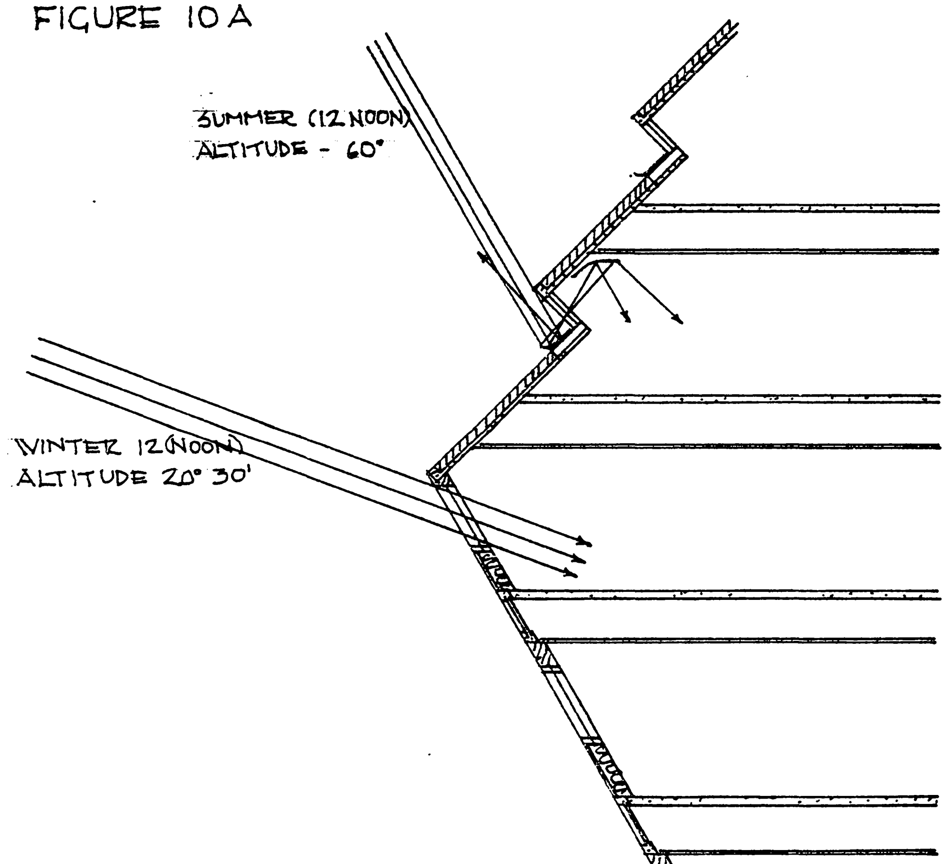


FIGURE 10B. 1ST SCHEME DETAILS

by the angle of the wall (Figure 10B). The opening below each panel permits the entry of reflected light in the summer add direct light in the winter. In the lower section of the wall the summer light does not enter directly into the building. The winter light has easy direct access. In the second scheme both the upper and lower sections of the building use shading devices in order to decrease solar gain during the summer (Figure 11).

The commercial section of the building recognizes the shading effect of the surroundings. This section adapts itself, to some extent, to the hot afternoon summer sun by drawing back its openings from the actual wall surface. The building recognizes the importance of function in this section and the fact that most of the spaces on the West side of the building would be large. In this instance, view from outside and inside is critical.

There are a series of skylights that attempt to draw light down to the third basement level through the use of highly reflective material lining the interior surfaces. Above the gymnasium the skylights also serve to organize the plaza space.

Expansion of the building would essentially be achieved by completing the top of the school section. The analysis of light and shadow falling on the building during the winter season (Figure 4) confirmed the feasibility of providing solar panels to the top half of the addition, since it would not decrease appreciably the overall efficiency of the solar collectors.

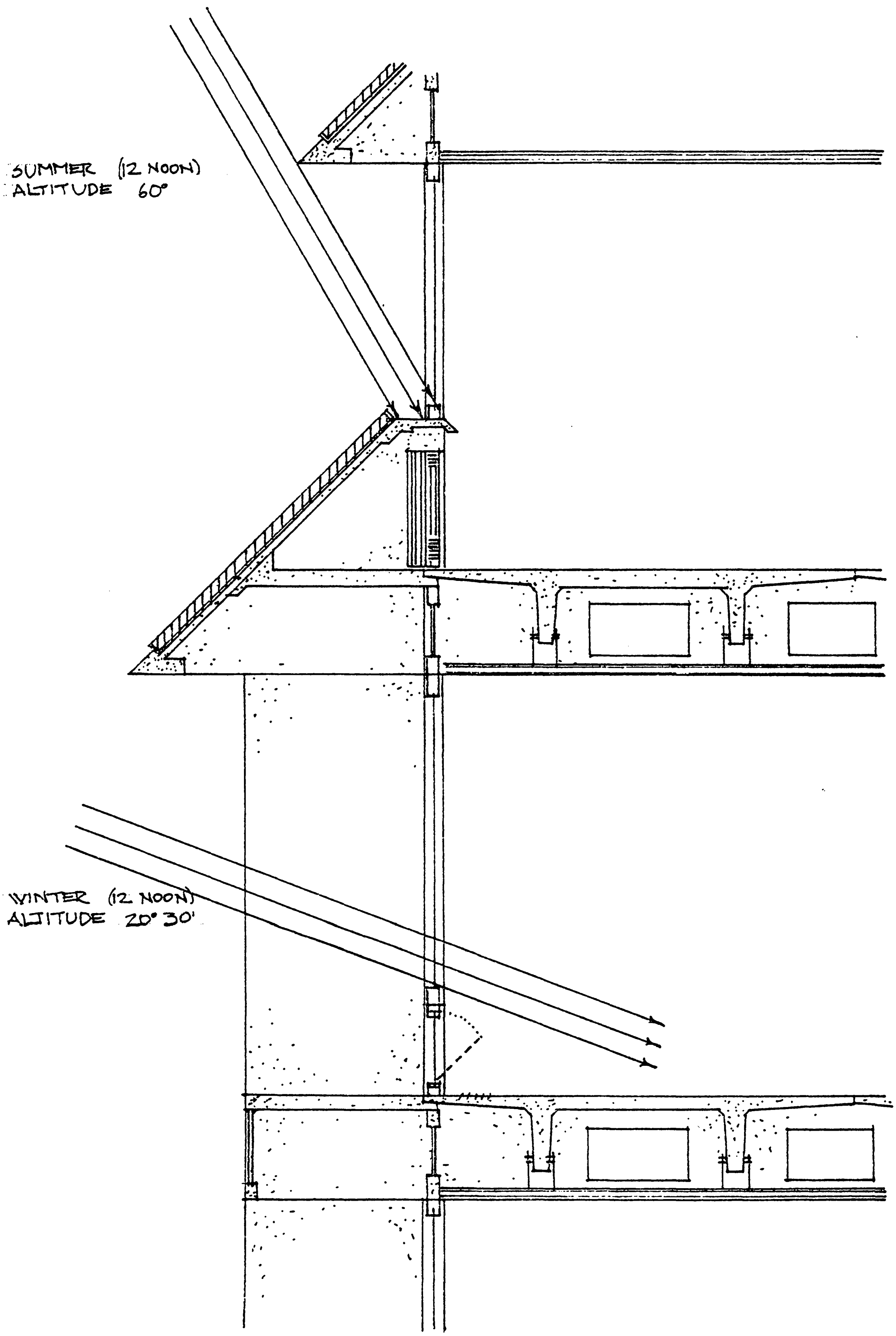
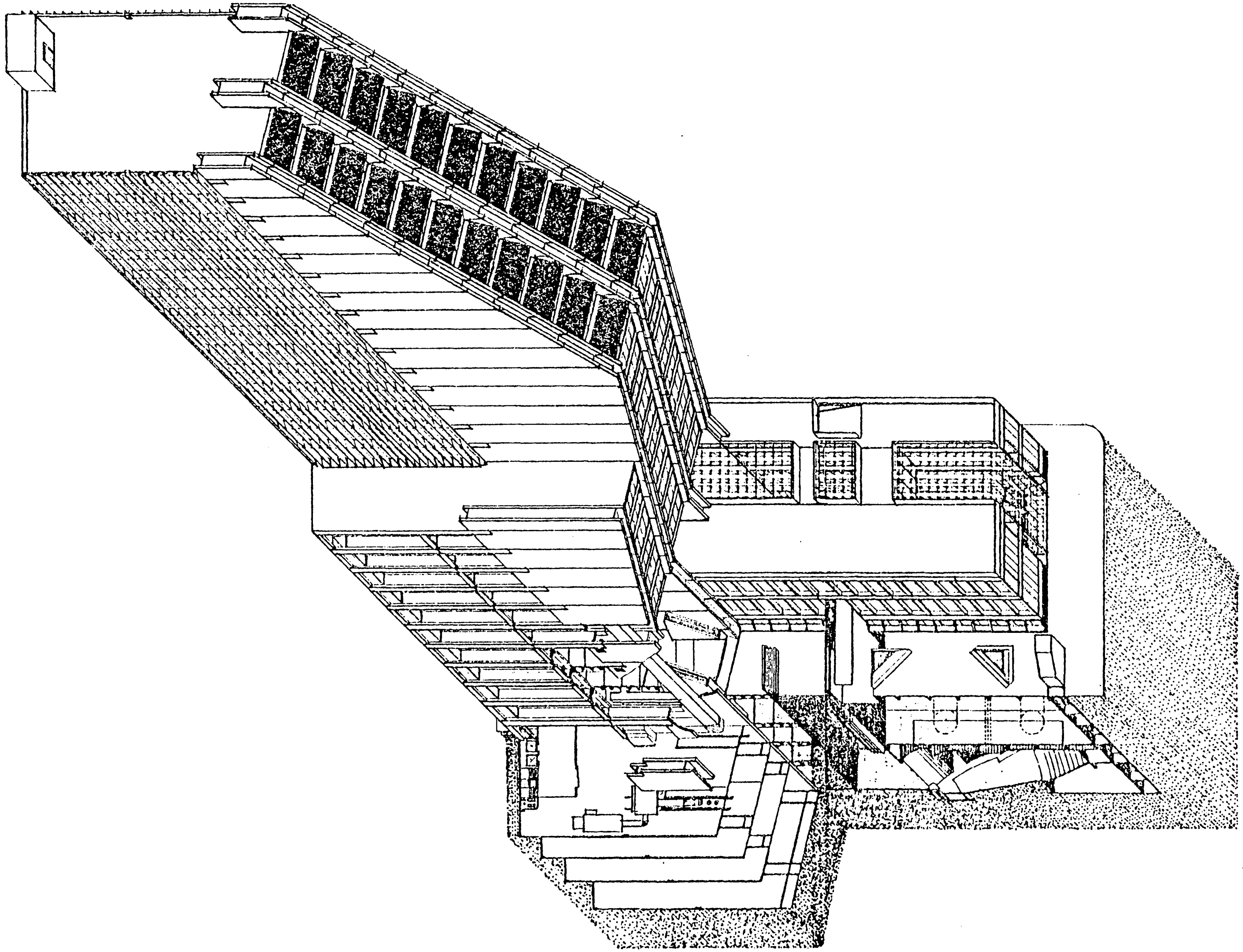
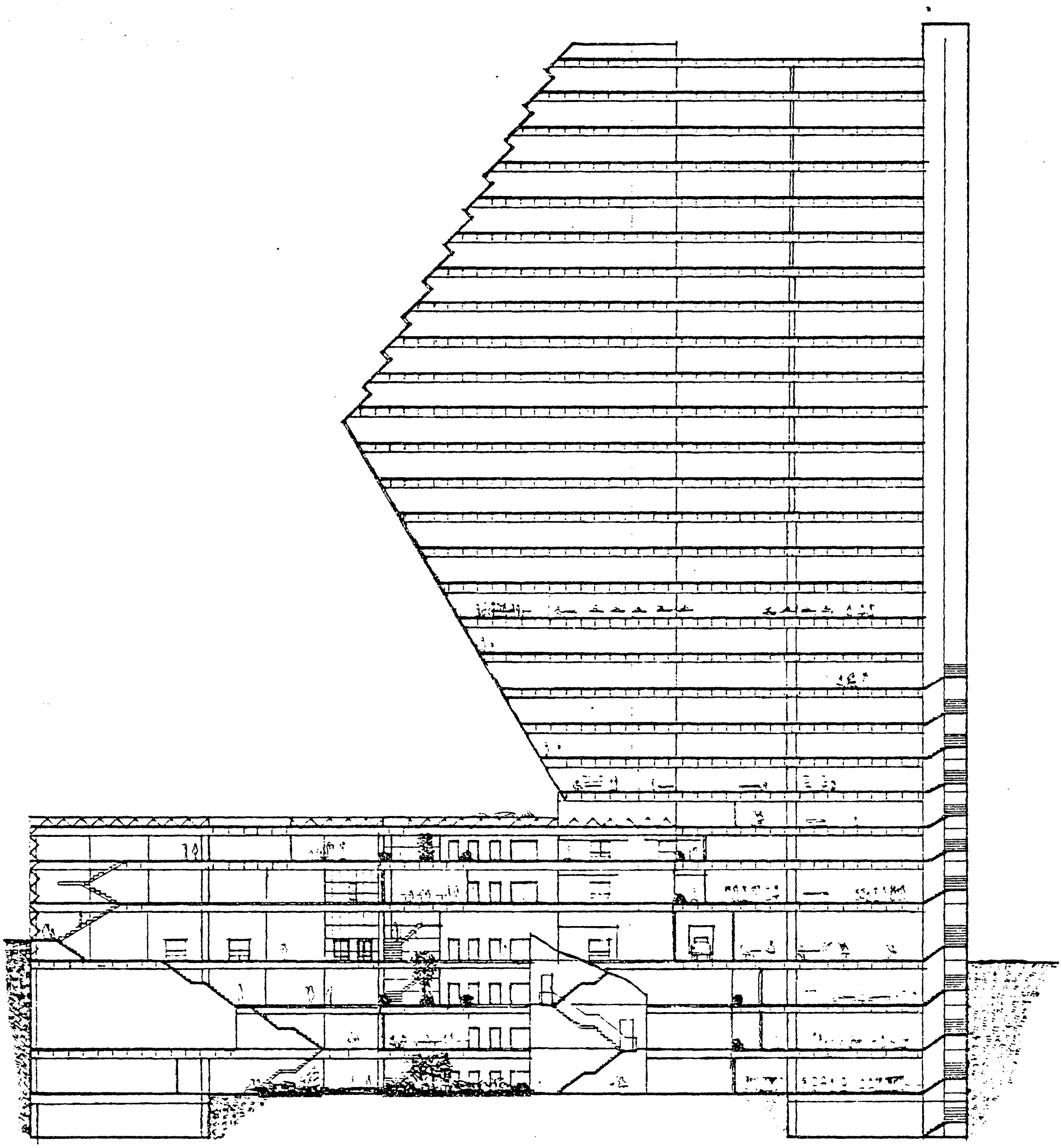


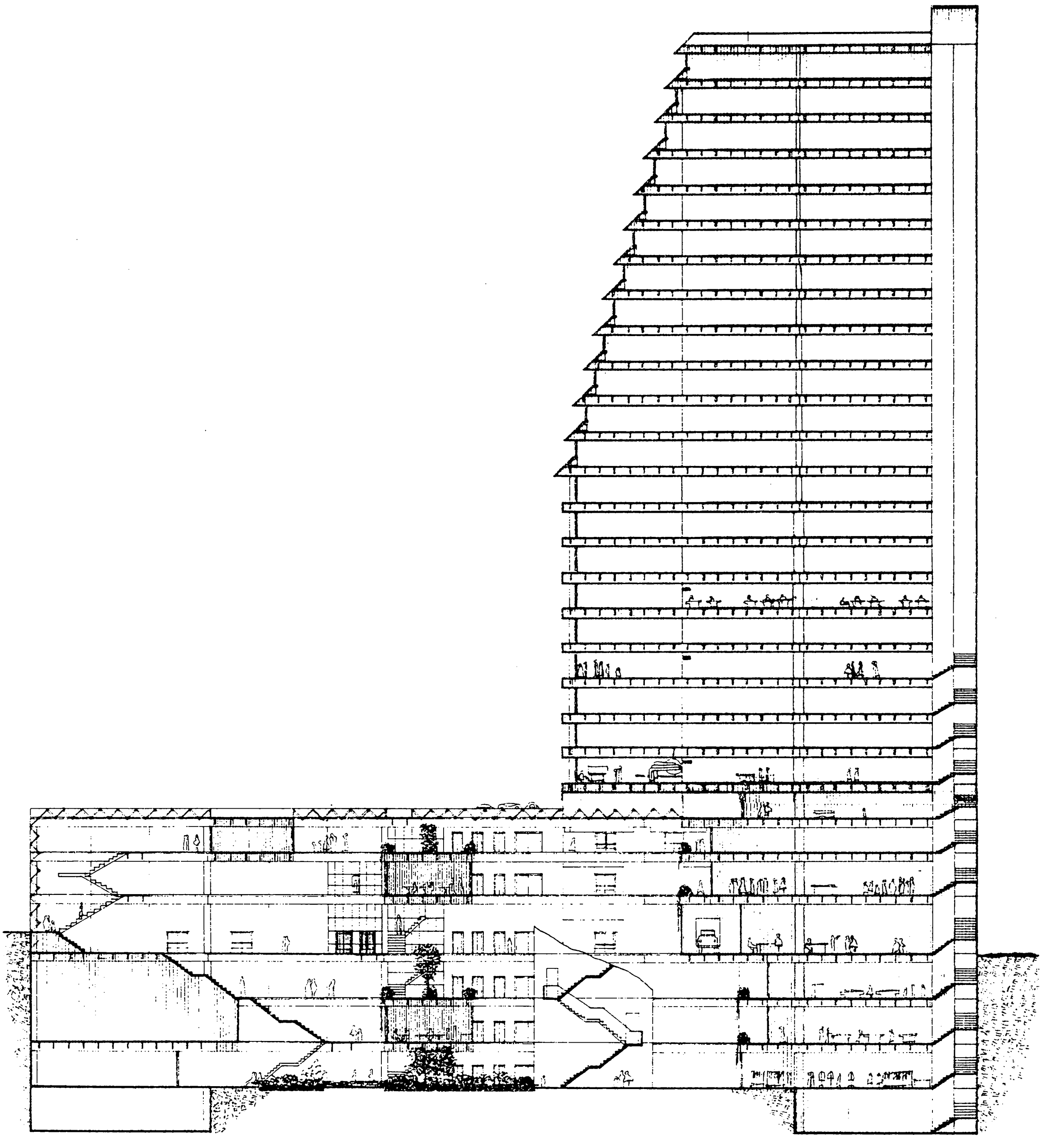
FIGURE 11. 2ND SCHEME DETAILS



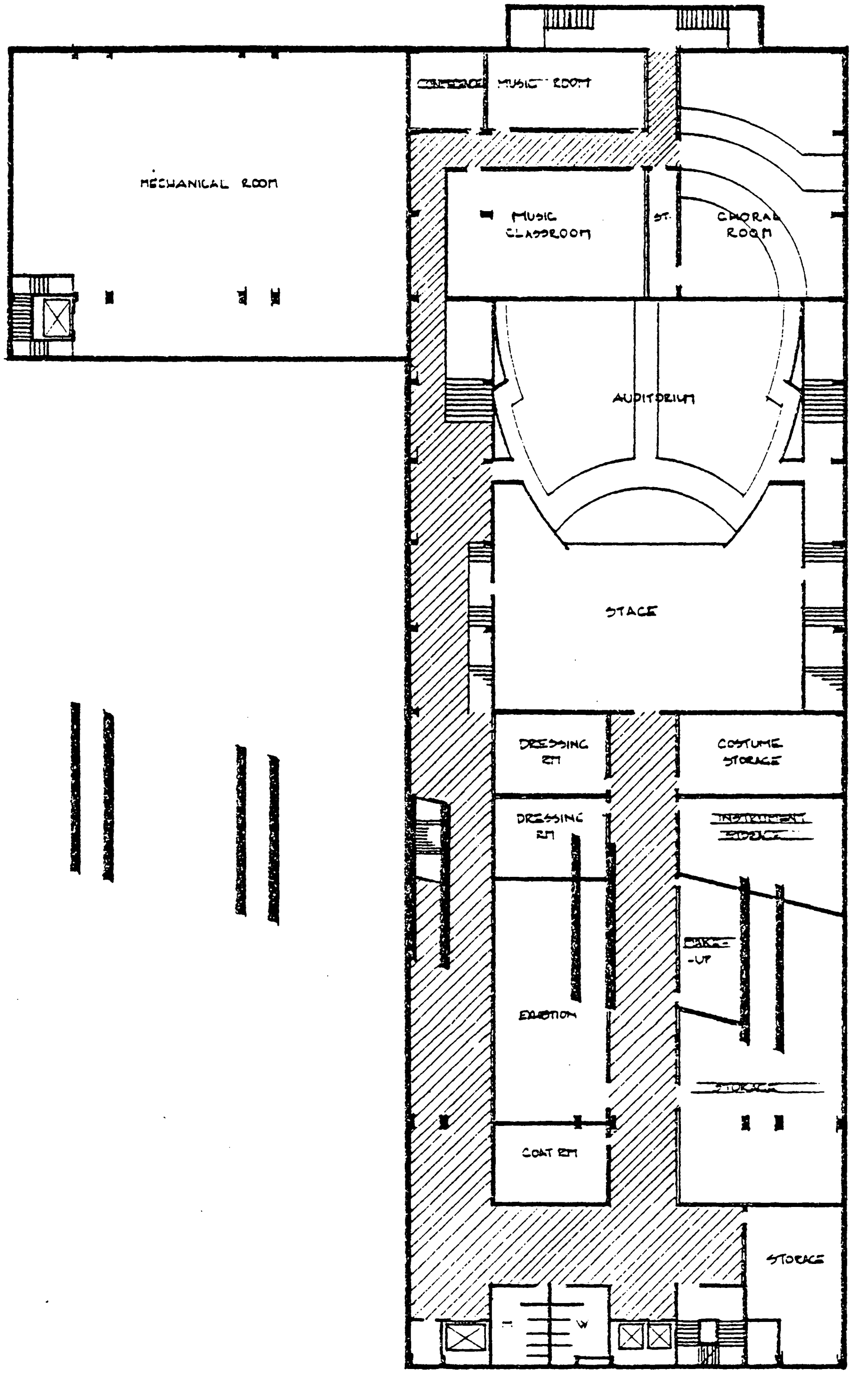
ISOMETRIC SECTION AA



1ST SCHEME SECTION BB

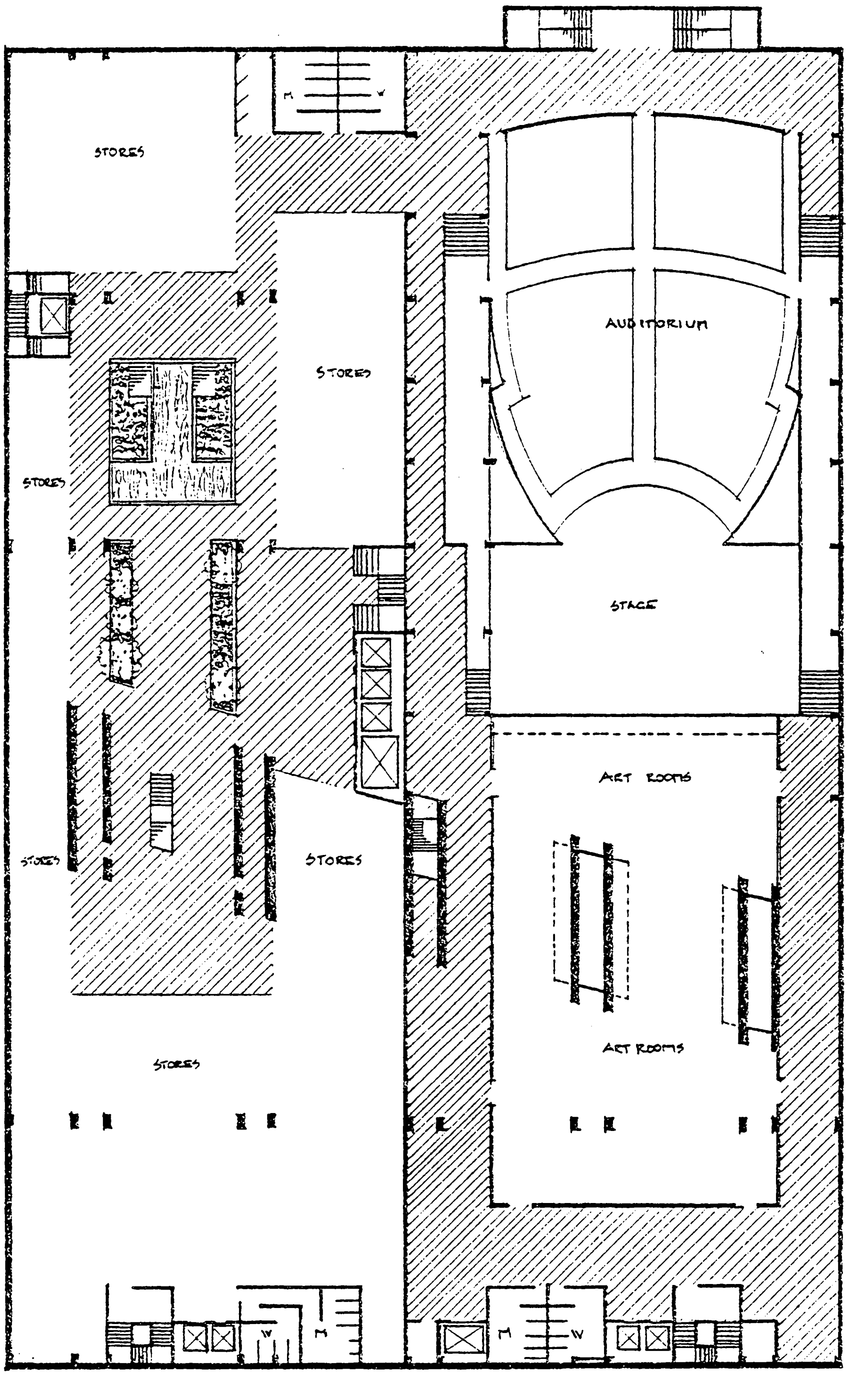


2ND SCHEME SECTION B.B



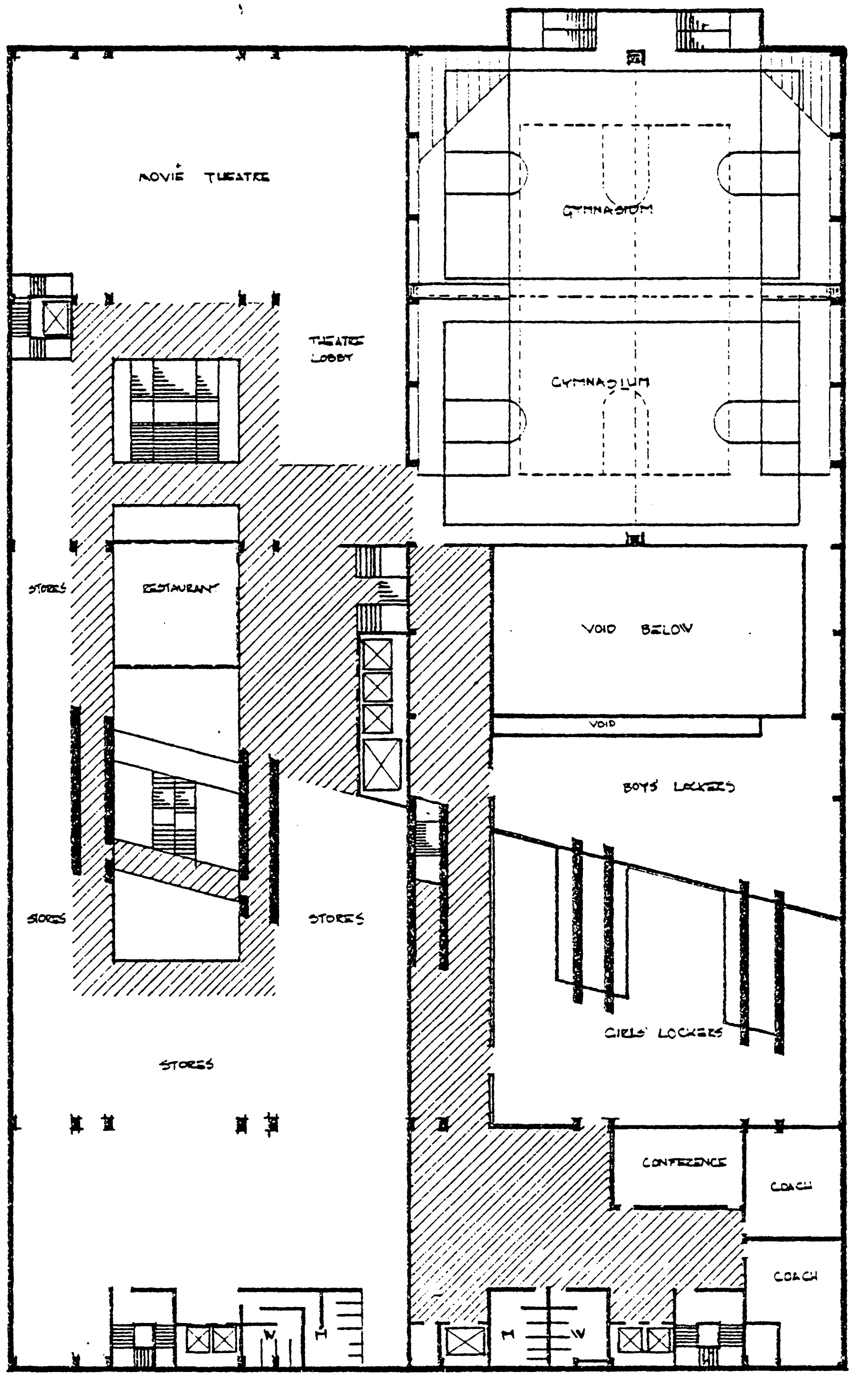
FOURTH BASEMENT FLOOR PLAN

0 10 20 30



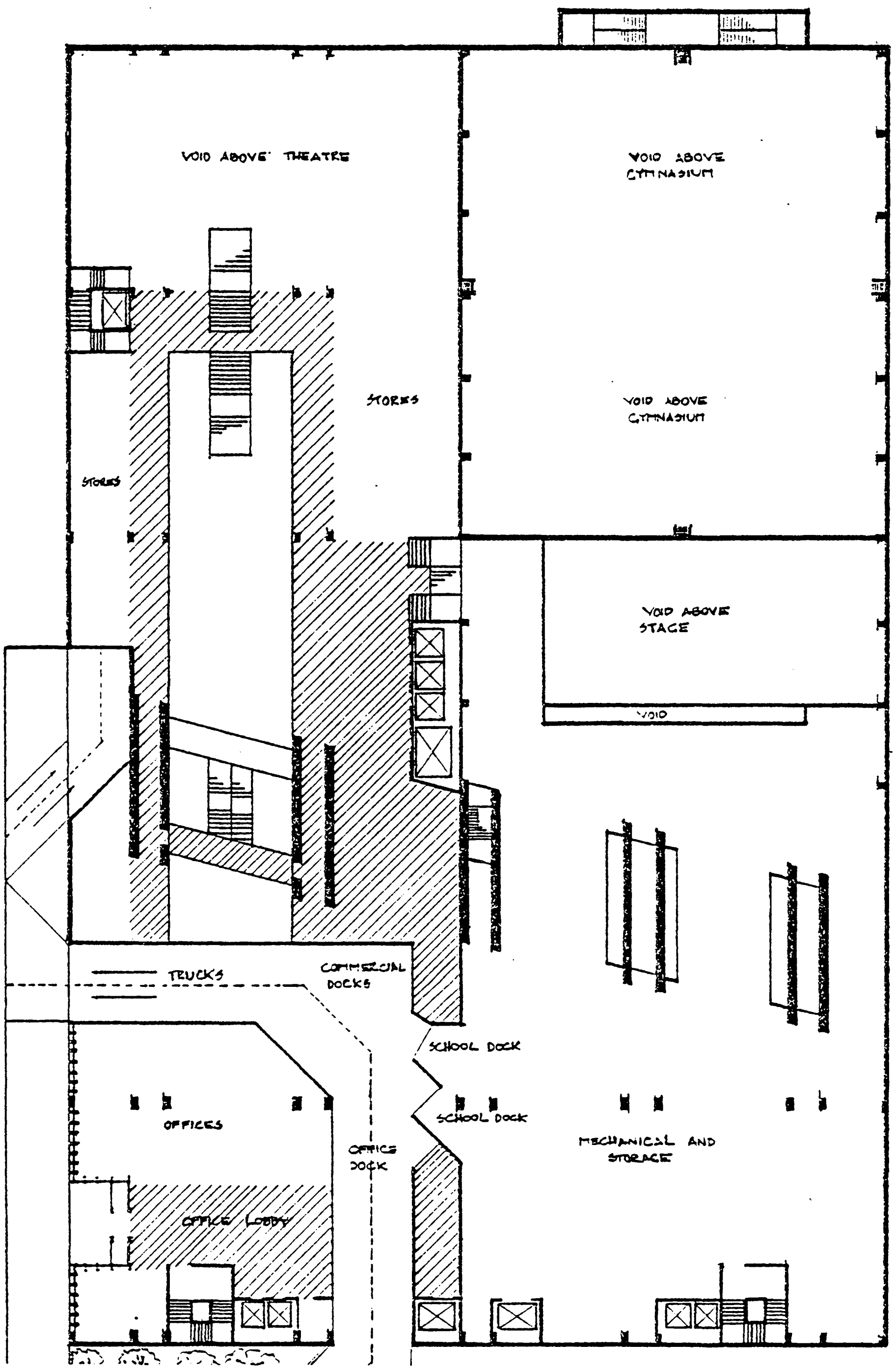
THIRD BASEMENT FLOOR PLAN

0 10 20 30

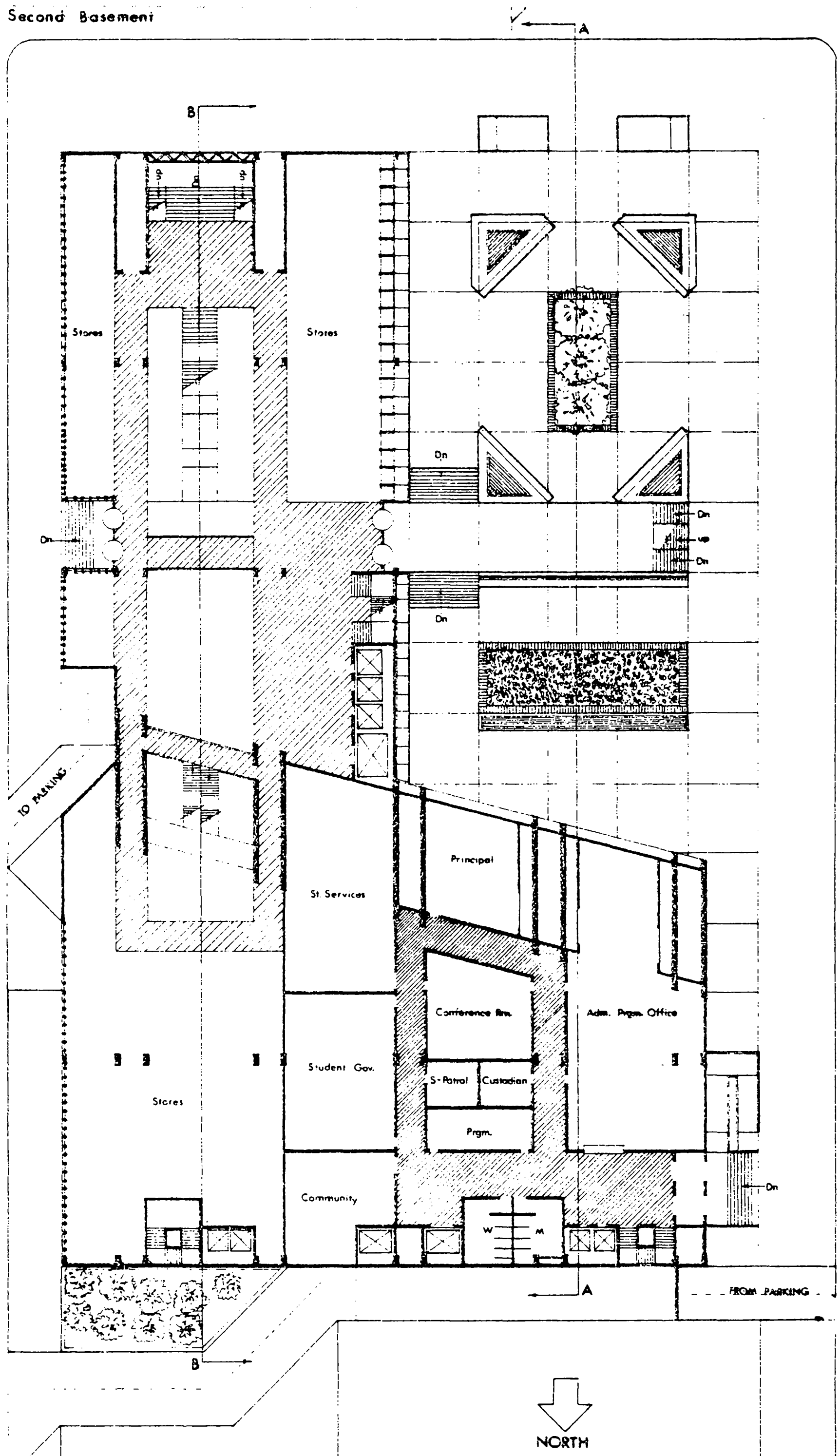


SECOND BASEMENT FLOOR PLAN

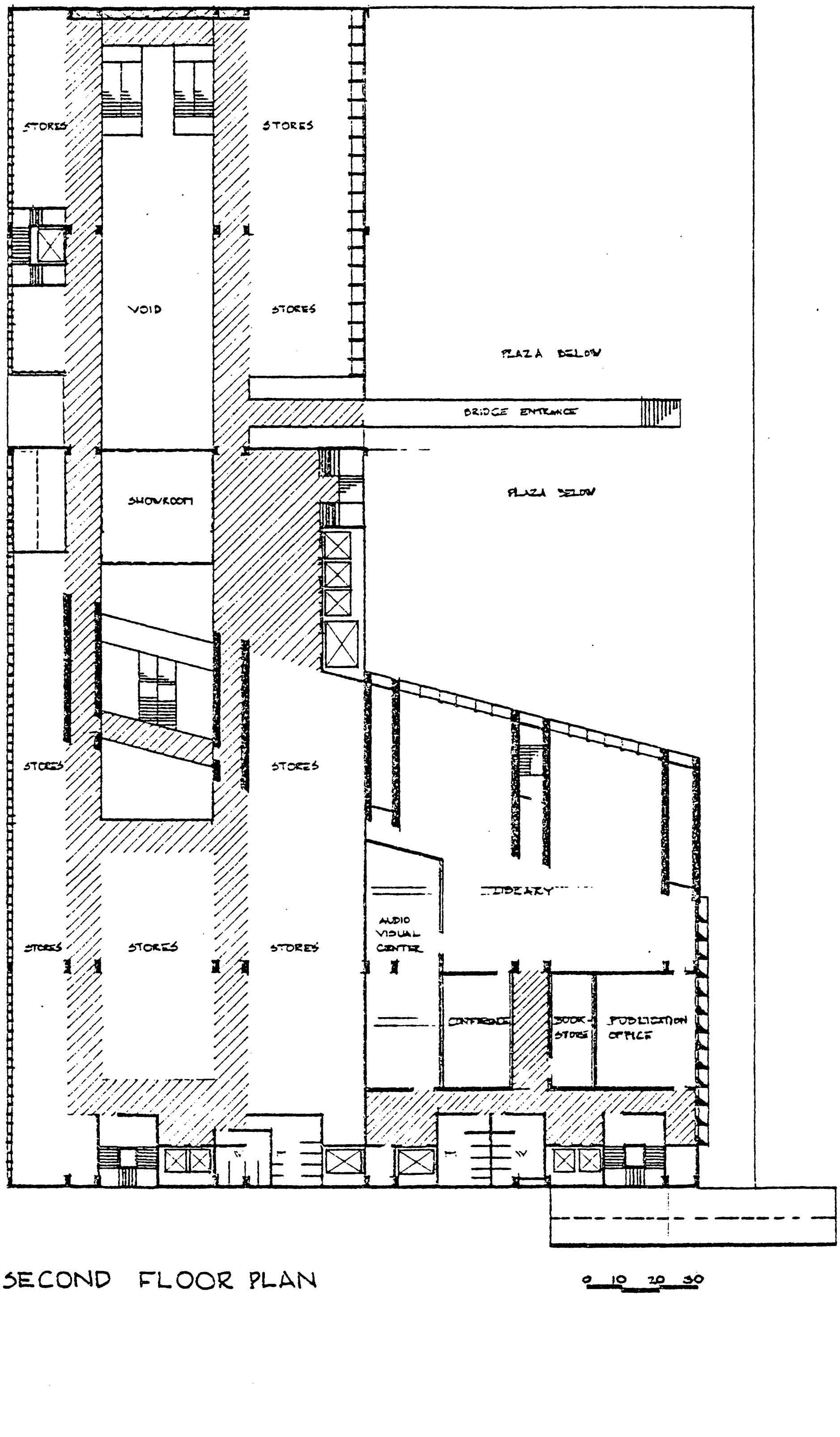
0 10 20 30



FIRST BASEMENT FLOOR PLAN



GROUND FLOOR PLAN



SECOND FLOOR PLAN

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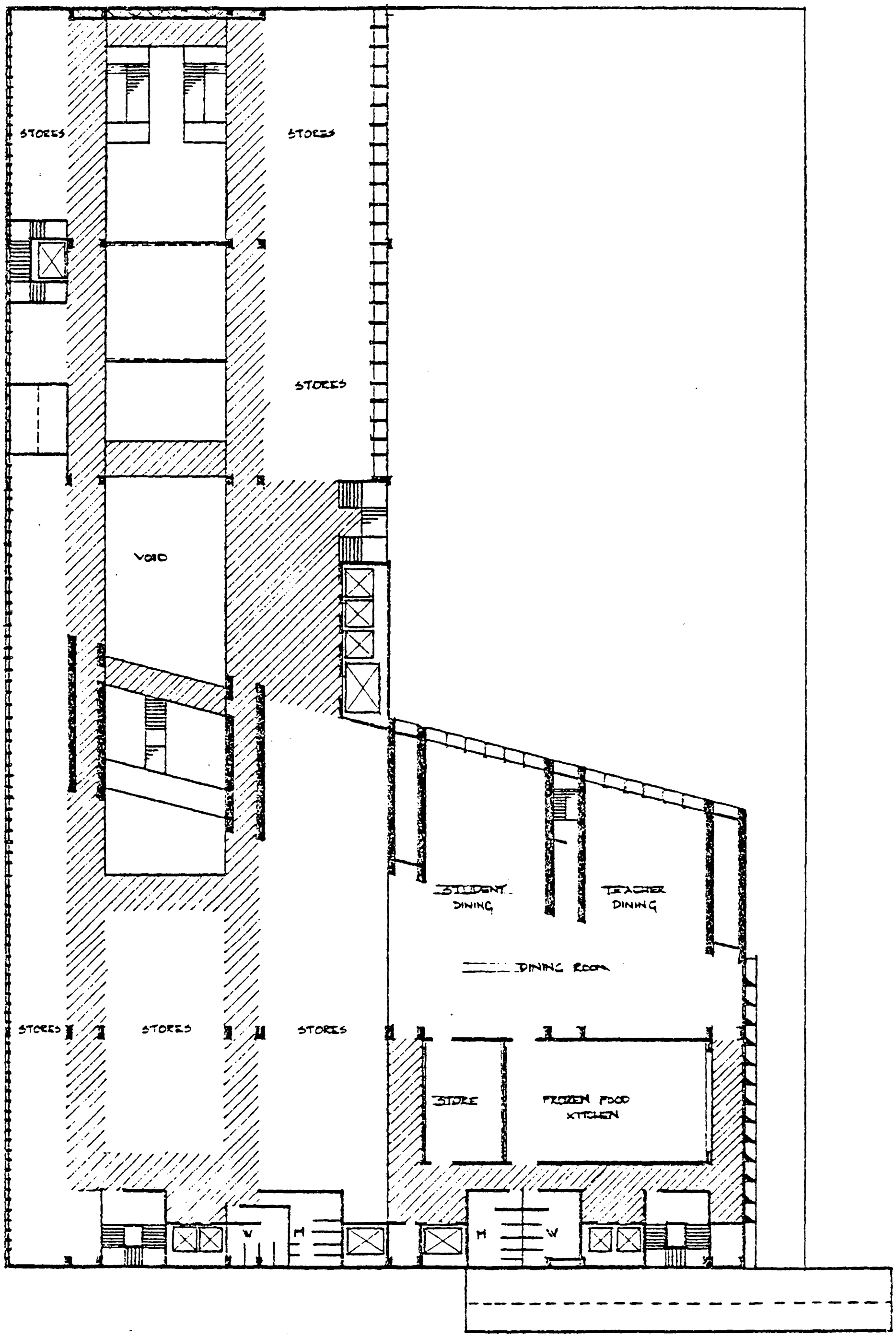
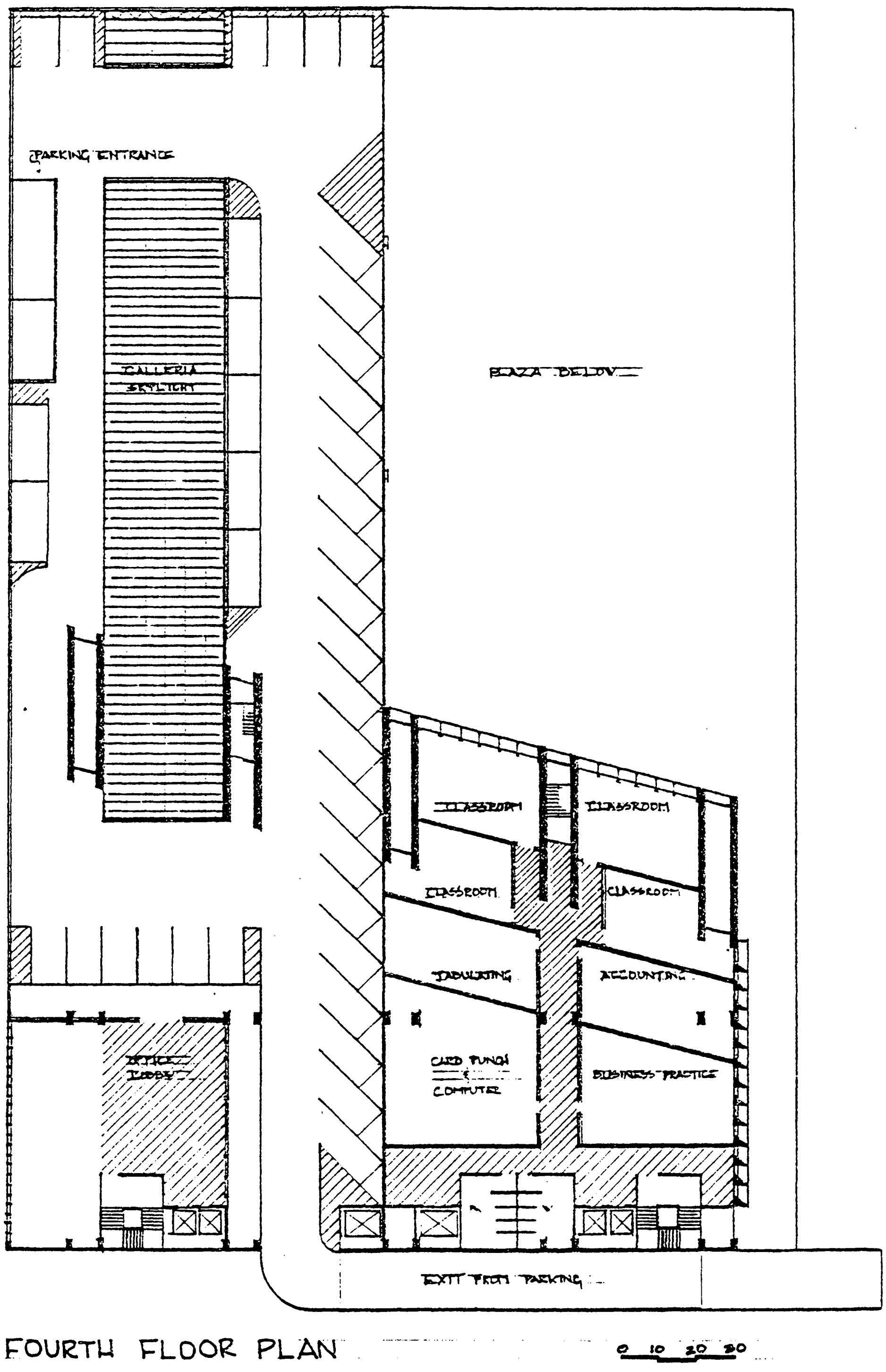
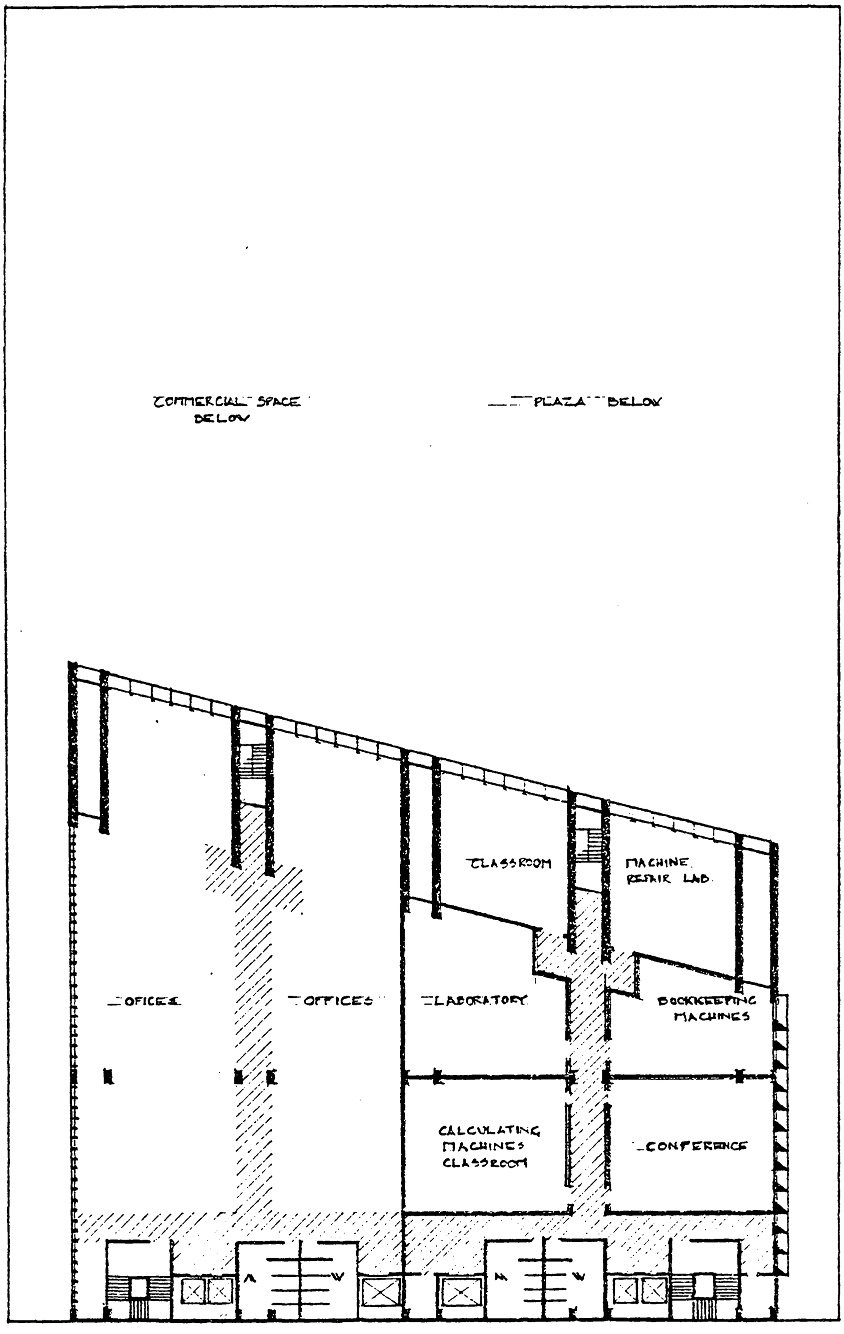


THIRD FLOOR PLAN

0 10 20 30



FOURTH FLOOR PLAN



TYPICAL TOWER FLOOR PLAN

FOOTNOTES

[1] Stonehill, John J. "Joint Occupancy . . . An Efficient Use of Urban Land." Paris Prize Program, 1978.

[2] Ibid.

[3] Ibid.

[4] Ibid.

[5] Fleming, John; Honour, Hugh; and Pevsner, Nikolaus. A Dictionary of Architecture. Penguin Books, Ltd., Harmondsworth, Middlesex, Dngland, 1972.

[6] Banham, Reyner. The Architecture of the Well Tempered Environment." The Architectural Press, London/The University, 1969.

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JOINT OCCUPANCY: THE EFFICIENT
USE OF URBAN LAND

by

Ricardo Francisco Puemape Diaz

(ABSTRACT)

The high cost of land in large urban centers and increasing energy costs have prompted the revival of an old method of construction. Joint occupancy is the sharing of land for different combinations of uses.

There are many concerns in our cities where land costs are exorbitant and many users compete for the available ground. In the case of public schools, high construction costs, difficult and expensive credit, and even the loss of revenue when schools are removed from the tax rolls, all contribute to the taxpayers unwillingness to pay for new schools.

The United States' increasing dependence on foreign oil and ever-increasing energy costs have resulted in government incentives for building insulation and the development of solar energy. There are a few larger scale projects but mostly the use of solar energy has been at the residential scale. This thesis attempts to provide one solution to a set of cumulative problems.