

# LESSONS IN SUSTAINABLE DESIGN: Case Study of a School in Chicago

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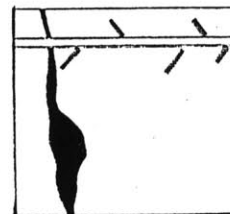
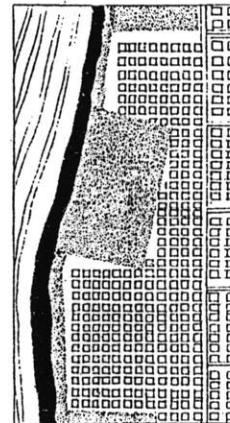
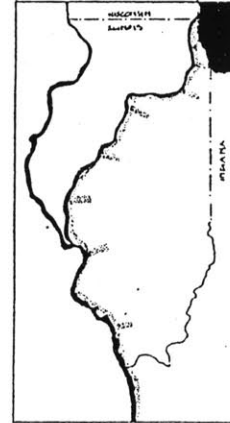
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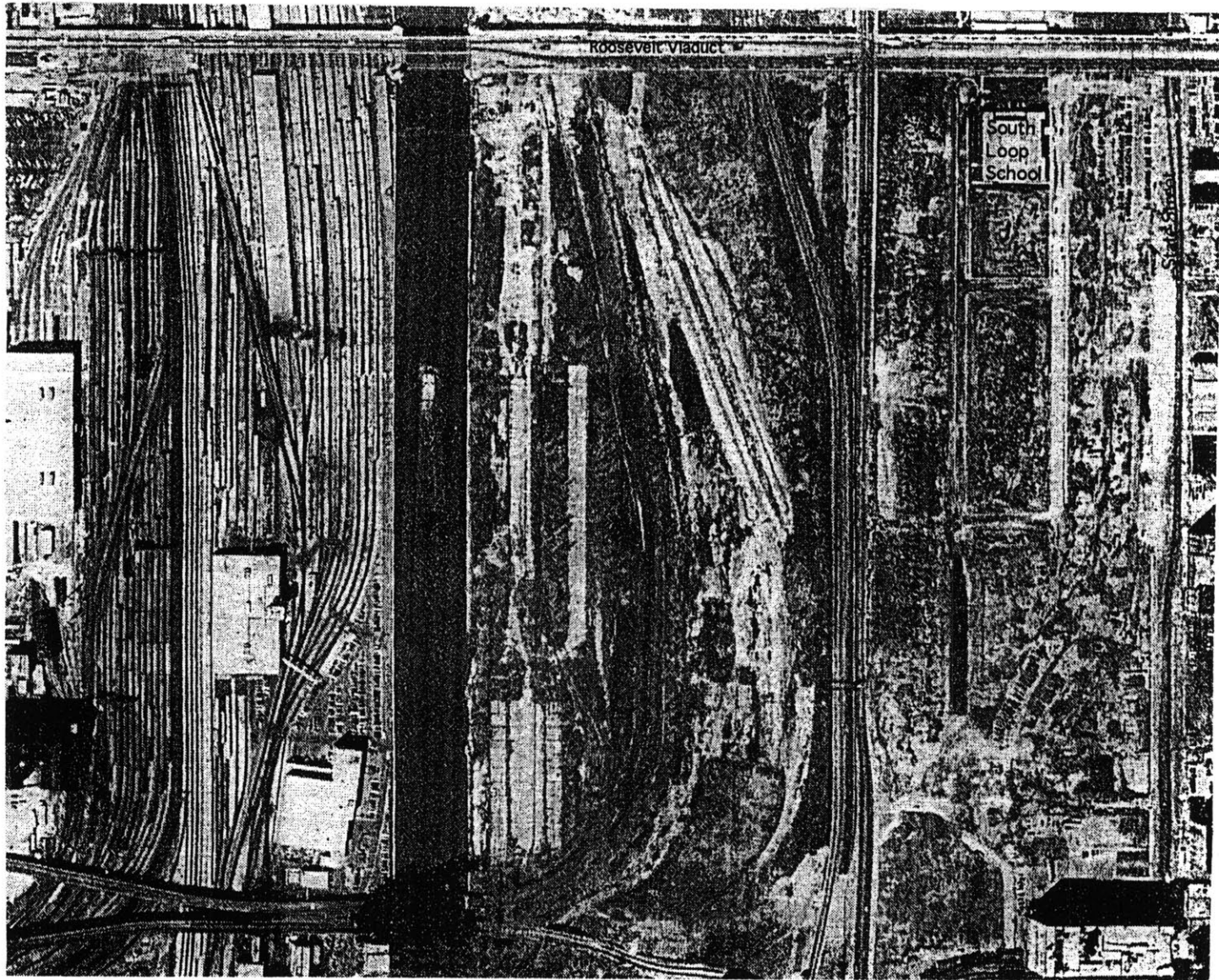
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*Aerial view of the South Loop School just after its construction in 1988 and prior to the intensive housing development that is currently underway in the area. Between the school and the Chicago River, to the West, are abandoned rails tracks.*

# LESSONS IN SUSTAINABLE DESIGN

## Case Study Of A School In Chicago

by Heather Hootman

Submitted to the Department of Architecture on June 1, 1994 in partial fulfillment of the requirements for the degree of Master of Architecture.

### Abstract

This thesis develops an approach to environmentally sustainable design through the hypothetical redesign of the South Loop School in Chicago. Sustainable architecture seeks to reinforce ecological relationships to the greatest extent possible, be they among humans or between humans and other species. Increasingly, pressure mounts in our society to design with such ecological sensitivity. This is especially true in regard to buildings for children— a population vulnerable to environmental problems and significantly influenced by surroundings. The design of an elementary school facility in particular also has the potential to both act sustainably and, on some level, teach sustainability. If, in addition to implementing materials that are nontoxic in ways that conserve energy, the built environment can simultaneously heighten an appreciation of the forces of nature, then it might truly be called sustainable. Thus, this thesis pushes sustainable design beyond its marginalized role of technical implementation by linking it to architectural theory about the relationship between architecture and nature. Sustainable design in this thesis attempts to translate environmentally conscious strategies into active and expressed design elements while fostering an appreciation of natural elements through architectural form.

Thesis Supervisor: Roy Strickland  
Title: Associate Professor of Architecture



## TABLE OF CONTENTS

i. Abstract	3
ii. Acknowledgements	4
<b>1.0. INTRODUCTION</b>	<b>9</b>
<b>1.1. Three Levels of Investigation</b>	
1.1.1. Evaluating the Program in Terms of Sustainability	10
1.1.2. The Expression of Sustainable Technology	11
1.1.3. Sustainable Design to Foster a Distinct Experience	12
<b>1.2 Why The Need For Sustainable Schools?</b>	<b>13</b>
<b>2.0 BACKGROUND TO SUSTAINABLE DESIGN</b>	<b>15</b>
<b>2.1. Environmental Reasons For Building More Sustainably</b>	
2.1.1 Air	16
2.1.2 Waste	17
2.1.3 Water	17
<b>2.2.. An Overview Of Relatively Sustainable Materialsd</b>	
2.2.1 Materials and Macroenvironmental Issues	19
2.2.2 Materials and Microenvironmental Issues	22
<b>2.3 . Definitions Of Sustainability Compared</b>	<b>25</b>

## TABLE OF CONTENTS

<b>3.0 ASPECTS OF SUSTAINABILITY EXEMPLIFIED IN ARCHITECTURAL FORM</b>	<b>27</b>
<b>3.1 Translating Sustainability from Definition to Design Method</b>	<b>27</b>
3.1.1 A Sustainability Matrix with Which to Define Priorities	28
3.1.2 Relationship of the Sustainability Matrix to Architectural Applications	31
3.1.3 South Loop School Issues within the Sustainability Matrix	33
<b>3.2 Designs Demonstrating Social and Environmental Sensitivity</b>	<b>34</b>
3.2.1 Interactive Relationships Between Distinct Spaces	35
3.2.2 Interior Collective Space	40
3.2.3 Exterior Collective Spaces	44
3.2.4 Transitional Layers: the Zone Between Inside and Outside	45
3.2.5 The Play with Light	50
3.2.6 Water as an Architectural Element	54
3.2.7 Incorporation of Plant Life	59
<b>4.0 THE NEED FOR SITE ANALYSES TO RANGE IN SCALE</b>	<b>63</b>
<b>4.1 Analysis of the Regional Context</b>	<b>64</b>
4.1.1 Implications of Regional Climate Sustainability: Sun and Wind	67
4.1.2 Regional Topography Implications	69
4.1.2 Regional Geography Implications	71
<b>4.2 Analysis of the Urban Context</b>	<b>73</b>
4.2.1 History of the River edge Site: Ecological Changes Over Time	73
4.2.2 Where the Grid and Topography Meet	87
4.2.3 Linking City Resources	89

## TABLE OF CONTENTS

<b>4.0 THE NEED FOR SITE ANALYSES TO RANGE IN SCALE (cont'd)</b>	
<b>4.3. Analysis Of The South Loop Neighborhood</b>	91
4.3.1 Identification of Ecological Corridors and Barriers	91
4.3.2 Cultural History of the South Loop Neighborhood	92
4.3.2 Other Proposals for the South Loop Area: The Chicago 21 Plan	93
4.3.3 Assessment of Current Development	95
4.3.4 Sustainable Recommendations For the South Loop Area	96
<b>5.0 DESIGN PROCESS</b>	99
<b>5.1 The Old and New Program Compared</b>	100
5.1.1. The Existing South Loop School Program	100
5.1.1. The Proposed Program for South Loop School and Annex	103
<b>5.2. Proposal For South Loop School Site and River Annex</b>	106
5.2.1 Phase I: Analysis and Remediation	106
5.2.2 Phase II: Building Construction	108
5.2.3 Phase III: Plantings and Animals	109
5.2.4 The Larger Site Plan	110
<b>5.3. Exterior Studies of the South Loop School</b>	120
5.3.1 Study Models	122
5.3.2 Preliminary Drawings	126
<b>5.4 . Interior Studies of the South Loop School</b>	132
5.4.1 Study of Light	134
5.4.2 Drawn Light Studies	135

## TABLE OF CONTENTS

<b>5.5. Final Design Proposal</b>	<b>140</b>
5.5.1 The New Structure	142
5.5.2 The Shift in Geometry	144
5.5.3 The Ground Floor Plan	146
5.5.4 The Second Floor Plan	149
5.5.5 The Roof Plan	149
5.5.6 Sectional Drawings	153
5.5.7 Final Design Description	164
<b>6.0 CONCLUSION</b>	<b>169</b>
<b>7.0 APPENDICES</b>	<b>173</b>
7.1. Range Of Birds Found In The Chicago Area	173
7.2 Sun Path Chart for South Loop Site	174
<b>8.0 THESIS REFERENCES</b>	
Chapter 2 Bibliography	175
Chapter 3 Bibliography	176
Chapter 3 Photo Credits	177
Chapter 4 Bibliography	178



## 1.0 INTRODUCTION

An abundance of information exists regarding the goals of sustainability but rarely does this literature suggest paths by which a designer might achieve these goals. This thesis aims to convert general goals of sustainability into a tangible method through the design of an elementary school in Chicago. As a beginning, Chapter Two casts its net across several fields and presents a spectrum of sustainability definitions, providing a general background for the thesis. Chapter Three then synthesizes and organizes the issues associated with sustainability into a matrix. The matrix is a tool by which one can navigate through the broad array of issues that fall under the heading of "sustainability." This chapter identifies specific aspects of sustainability addressed by the thesis project and provides examples of architectural form that illustrate the objectives put forth. Chapter Four underscores the need to analyze the site from a range of scales (neighborhood, city, region) in developing a relatively sustainable design. Finally, Chapter Five presents the design process with a sample of the exercises undertaken at various levels in the development of the thesis project and concluding with a final design proposal.

## **1.1. Three Levels of Investigation**

The practical application of sustainable design has generally considered the biological and ecological implications of building from a two-pronged perspective. Sustainable design, as conventionally described, has focused on design decisions at the programmatic or technological levels. The design exercises for the South Loop elementary school take a somewhat different tack by exploring sustainability through coordination of the program, the technological and formal expression of the building's environmental responsiveness, and the degree to which the resulting design may foster a particular experience.

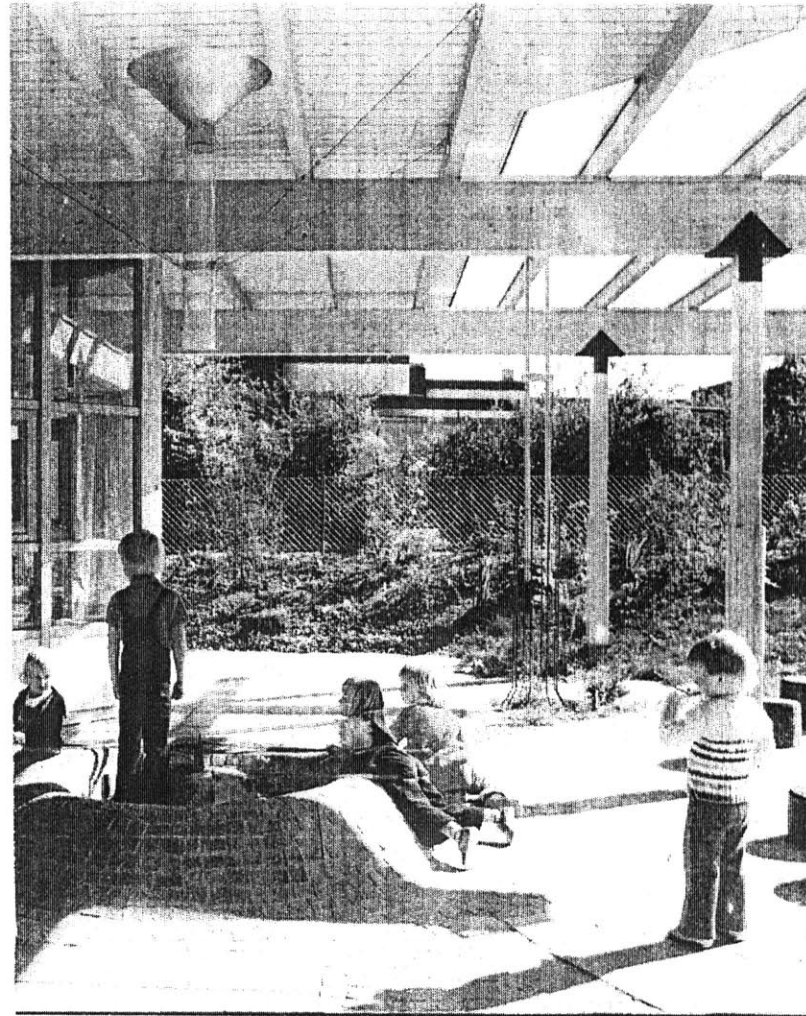
### **1.1.1. Evaluating the Program in Terms of Sustainability**

Schools are typically inefficient buildings program-matically because they are used for only part of each day, week and year, sitting empty for the remainder of the time. This limited program translates into inefficient use of a capital-intensive facility and inefficient energy use because the startup costs of heating a building in the morning cannot be averaged out over the course of a full day. A more mixed program for a school facility therefore offers a more optimal use of resources, both directly and indirectly. A school facility involving mixed uses might be open for a longer portion of the day and could therefore use energy more optimally. In addition, the central-

ization of community services under one roof also has indirect positive energy implications, as people might drive less, consume less energy and produce less pollution. The application of sustainable design in school facilities thus requires a mix of uses rather than the current singular program model. Part of this thesis undertakes regional and urban analyses to best define an appropriate and more sustainable school program.

### 1.1.2. The Expression of Sustainable Technology

Sustainable materials and techniques may combine to offer ecological improvements and unusual design solutions. However, because technology is continuously evolving, identification of the most advanced sustainable technologies is not the focus of this thesis. Rather, the expressed incorporation of technology into design is the emphasis. The design reflects the role of sustainable methods and materials. The sustainable aspects of a building might activate a consciousness about certain issues such as seasonal variation or water flow.

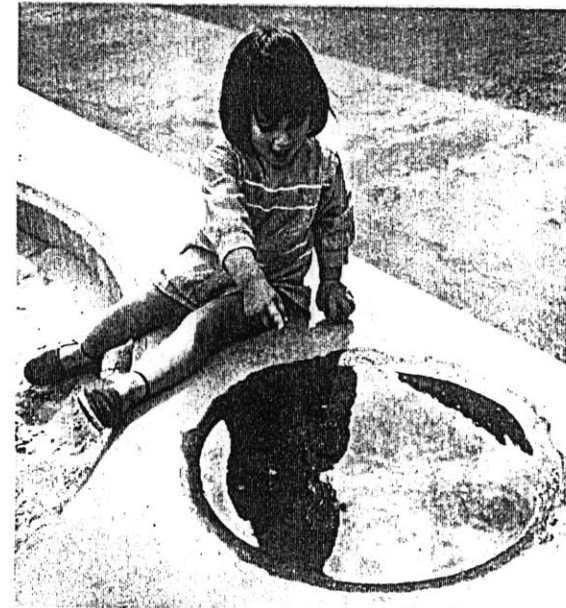


*Behnisch, in the Kindergarten in Stuttgart Neugereut, collects water from the roof surface and visibly delivers water to places of importance. The uses of play spaces that Behnisch designs shifts with the seasons.*

### 1.1.3. Sustainable Design to Foster a Distinct Experience

Historically, architects have approached the relationship between nature and architecture differently, either expressing the relationship between the two in terms of integration or juxtaposition. When consciously carried out, both approaches are effective in emphasizing the relationship between architecture and nature and provide lessons for this thesis.

Sustainable design should not only involve the application of appropriate technologies and materials but should ask the question, "how might the design foster an experience that concurs with the intent behind sustainable building practices?" Materials and building methods can be employed to impart an experience that echoes the intent of sustainable design. Architecture may also be used to emphasize and reinvent rituals which not only remind one of the natural elements but which celebrate the moment in which the human and natural elements convene.



*In the Burgerhuis School, Van Eyck uses even the smallest details- a recess in a sandbox platform- to respond to climate and collect rainfall. Rainfall becomes a valuable resource for sandbox dwellers.*

## 1.2 Why the Need for Sustainable Schools?

*"In the end we will conserve only what we love, we will love only what we understand, and we will understand only what we are taught."*

Baba Dioum, Senegalese conservationist<sup>1</sup>

There are four key issues that make schools a logical focus for sustainable building practices. First, health tests on children have found them to be especially vulnerable to some forms of air pollution, such as ozone. After exposure to ozone, children showed significant and immediate decrease in their lung capacities.<sup>2</sup> (It is unknown how permanent these effects are). Children generally breathe at a rate faster than adults and may therefore breathe in more pollutants in comparison to their body weights. The effects of exposures on children are also of concern because they are still developing physically. Second, sustainable design focuses on comfort as well as health. While symptoms resulting from indoor air pollution may be milder (e.g. lethargy and chronic headaches), they may still be great enough to disturb a child or adult's ability to concentrate and therefore learn or teach effectively. Naturally lit and well ventilated environments may facilitate learning by improving alertness. Third, schools

have the potential to shape priorities and habits of students not just through conventional teaching but also indirectly through the built environment. A student who becomes accustomed to natural lighting, innovative waste or heating processes and a more diverse ecosystem is sensitized to these issues for life. Schools may be one of the quickest and most effective means of transferring information about sustainability to the broader population. Fourth, schools are institutions that belong to a larger network. Thus changes that are instituted (i.e., reduced energy consumption) can have a relatively large impact.

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<sup>1</sup> As cited by Cortese, 1992; p. 1114.

<sup>2</sup> For further explanation, see D.M. Spektor, G.D. Thurston; J. Mao; D. He; and C. Hayes, "Effects of Single and Multiple Day Ozone Exposures on Respiratory Function in Active Normal Children. *Journal of Environmental Research*, August 1991, p. 107.



## **2.0 BACKGROUND TO SUSTAINABLE DESIGN**

Sustainable design has generally referred to building practices that consider the ecological implications of structures and their materials. Sustainability is typically measured both in terms of the direct health effects of a building on its occupants and in terms of broader ecological questions. Health effects directly associated with buildings revolve around the issue of material toxicity and may also be influenced by building methods. Broader ecological implications of sustainable design involve the energy used to produce and transport certain materials. Materials may also be assessed in broader ecological terms on the basis of their relative renewability, as in the case of woods from managed forests versus woods from reduced-growth forests, and in terms of their embodied energy intensity. A sustainable design also attempts to lower the long-term use of energy sources, either directly by reducing heating and lighting needs, or indirectly by considering a building's location and the consequent implications for car usage. Decreased long-term use of energy translates into decreased pollution levels.

## 2.1 Environmental Reasons for Building More Sustainably

The current interest in improving the sustainability of the built environment directly contradicts actions taken by the federal government between 1981-1988 to cut the budget for research and development for renewable energy and energy efficiency between by four-fifths. The mounting interest in environmental sustainability is not a reaction to any single sudden crisis (such as the energy crisis of the 1970's) but rather is a slowly evolving movement that is gaining momentum as more information is disseminated by the scientific and political communities with the aid of mass media. It is a movement characterized less by strong actions or protests of special interest groups than by wide-spread subtle choices, from the election of political officials to consumption of "green" products. Slowly, these values are also pervading the designs and construction methods of buildings.

At this point in history public awareness of the fact that the environment is stressed (to the point of collapse in some places) is commonplace. Nonetheless, we seem to need reminding. The following overview emphasizes the relationship of buildings to these environmental problems

### 2.1.1 Air

Consumption of heat and electricity produced by the combustion of fossil fuels (coal, oil and gas) causes air pollution which has deleterious effects on the health of individuals as well as the on the global environment. Acid rain's link to electricity as a result of SO<sub>2</sub> emissions from coal-fired plants is well documented. More recently, energy has been linked to Global Climate Change due to the carbon dioxide produced by fossil fuel combustion. It is estimated that the energy used to power our appliances, and heat, cool and light our buildings produces 500 million tons of CO<sub>2</sub> per year (Brown, Flavin and Postel, 1990). Averaged over the American population, this means that for every person, two tons of carbon per year is produced as a result of typical energy consumption in buildings. This amount of pollution excludes the emissions produced by automobiles— another source of pollution to which building strategies are indirectly linked.

In addition to global atmospheric changes, other pollutants such as ozone result from energy use and remain in the troposphere, where we all live and breathe, affecting health directly. Other pollutants such as chlorofluorocarbons (CFCs) result from the production of some building materials (e.g. certain foam insulators) and cleaning processes. CFCs



travel to the stratosphere where they linger for a decade or two, eating through the protective ozone layer and increasing the risk for skin cancer among people.

With 24% of the world's population, the developed countries consume 77% of the world's energy and thereby cause at least 77% of the world's pollution. Buildings consume 30% of the U.S. energy supply, amounting to \$200 billion per year. Put in relative perspective, the U.S. spent 10% of its GNP on energy in 1986 compared to Japan's 3% and accounted for about a quarter of the world wide CO<sub>2</sub> emissions.

### 2.1.2 Waste

Americans, on average, produce 3.5 pounds of garbage per day which typically either goes into a landfill or is incinerated (Vale, 1991). It is estimated that almost half the existing landfills will reach capacity in the next 5 years. Other waste is incinerated. Hazardous emissions from incinerators are among the most difficult to control due to the ever changing chemical profiles of the trash being burned; the control of a pollutant flow requires first knowing exactly what its chemical constitution is. While 10% of trash is currently recycled, this amount falls well beneath the potential for 50% recycling rates achieved by some cities. Additionally, composting of domestic organic wastes is still a foreign idea to most Americans despite the fact that Americans on average

enjoy relatively large pieces of land onto which compost could be beneficially deposited (Vale, 1991).

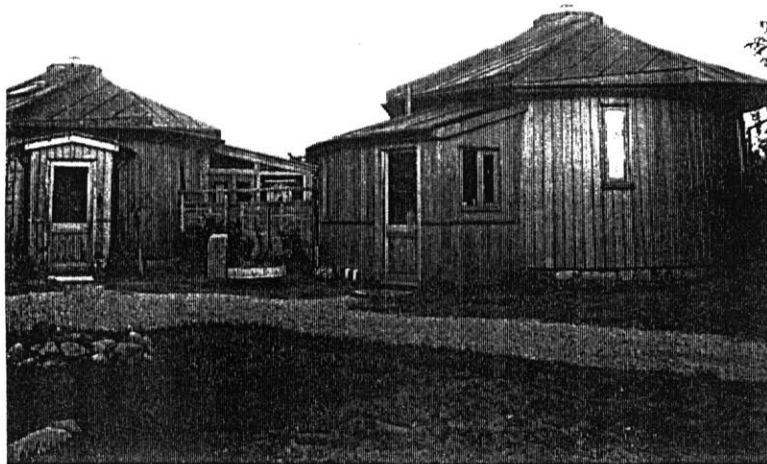
To counter these problems, buildings will increasingly integrate systems to promote recycling. Simple systems to reuse organic wastes must also be considered. Currently much of this matter is typically ground into very fine particles and disposed of via the sewage system. This type of garbage disposal system, however, adds to the load on sewage treatment systems and has consequently been banned in Switzerland because of the inability of purification systems to cope with finely ground matter.

### 2.1.3 Water

The human body requires a minimum of one liter per day (l/d) and the average consumption of water in food and drink amount to about 2 l/d. In contrast, average daily domestic consumption of the U.S. is 220 liters (57.2 gallons) and 160 liters (41.6 gallons) in the UK (Vale, 1991). Flushing of WCs accounts for about a third of these amounts. American households with water intensive dishwashers and washing machines where water is also used to irrigate large lawns can consume over 1,000 l/d per person (Postel, 1985). Moreover, each liter of polluted water discharged untreated contaminates many additional liters of fresh water in the receiving stream. Controlling water pollution has turned out to be terribly

complex and sometimes ineffective. Quality improved during the 1970s for traditional pollutants like suspended solids and oxygen-consuming organic materials, but the problem of "micro pollutants" (including toxic chemicals and metals) and disease-causing microorganisms has not been solved (Vale, 1991).

The energy, environmental and technological information available leads one not only to the question how much longer we can afford to tolerate the inefficiency that is so prevalent in our buildings, but also to question why we would choose to. The inability to explore and implement alternatives runs contrary to every ideal we harbor about progress in terms of humanity and technology.



*The photos above show cottages in the Findhorn community in Findhorn Scotland made from double recycled materials. The oak houses are constructed from huge vats used by whiskey companies. These vats were used to store sherry in Portugal prior to being acquired by Scotch whiskey companies. The wood is well seasoned, lending an oddly familiar scent to the houses. The rear portions (not shown) are glazed and relate to the outdoor patios.*

## 2.2 An Overview of Relatively Sustainable Materials

In addition to the long lasting habits which the building systems promote (e.g. energy use), the environmental sustainability of buildings may be measured in terms of the immediate materials used during construction. Assessment of a material's relative sustainability requires the builder/designer to ask questions such as "is the timber plentiful, is it harvested?", and "Does the production of the insulation release chlorofluorocarbons?" However, often ecological contradictions complicate these issues; timber may be deemed sustainable because it is harvested, but be deemed unsustainable because of the energy required to transport it across the world. The choice of a material may be further complicated by elements used in its manufacture: extruded polystyrene (a denser and more waterproof type of insulation) used as a means of greater energy efficiency requires CFCs, (a substance which depletes the ozone layer) in its production; and the formaldehyde-based glues used to hold chip board together—an otherwise excellent material because it uses pieces of waste wood— is held together with formaldehyde-based glues which can off-gas and be a detriment to indoor air quality. A material may be sustainable in terms of macroenvironmental issues (e.g. energy efficiency and consequent reductions in air pollution) but may be

inappropriate in microenvironmental terms (e.g. human health), as the asbestos fiasco has demonstrated.

### 2.2.1 Materials and Macroenvironmental Issues

Selection of environmentally conscious materials requires consideration of direct environmental impacts associated with its production; is it preferable to fell coniferous forests for timber or to quarry the landscape for stone for building? Such scrutiny aims to support the continued functioning of ecosystems such as rain forests, which if disturbed beyond a critical point may not be able to recover.<sup>1</sup> Then, less direct impacts may be considered such as the energy content of a material. A sample of key issues regarding building materials follows to better illustrate the type of discussion undertaken when attempting to select relatively sustainable materials:

T i m b e r . There has been a call for the use of softwoods in reference to hardwoods because of the damage caused to the rain forests. Tropical forests, especially vital to the functioning of the ecosystem, are currently destroyed at a rate of 39 million

---

<sup>1</sup>Ecologists speak of "dynamic" or "metastable equilibrium" in which there are cycles, disturbances and slowly changing long term variables like climate. The ecosystem, then, is viewed not as a static entity, but rather as a constantly shifting system incorporating change but not "degrading the resource base", or the ecosystem's ability to perpetuate in a broad-based manner.

acres per year and though they only cover 7% of the earth's surface, house between 50-80% of species. (The majority of rain forest damage is through clearance to acquire land for cattle ranching). However, in terms of low toxicity, hard woods are considered better than soft woods (as some people are sensitive to soft wood resins). Some experts encourage the use of hardwoods from managed forests as a way to provide economic incentives for retaining forests (see Vale, 1991).

P o t e n t i a l F o r R e c y c l i n g . Building methods can determine a material's potential for future recycling. For instance, modern cement mortars are stronger than the bricks themselves and so bricks will crack before separating from one another. Soft mortar (used in the 19th Century) on the other hand can be cleaned from bricks. In the case of larger building, a reinforced concrete frame will only be rubble when demolished, whereas a steel frame can be unbolted, re-used, re-welded or melted down and re-formed (Vale, 1991).

B u i l d i n g W i t h R e c y c l e d M a t e r i a l s . In addition to considering the recycling potential of new materials, recycled material can be used very cost effectively. David Del Porto obtained used wood from a brewery going out of business to construct his greenhouse. The Findhorn Community in Scotland has gone one step further, using a

double recycled material, shown in the preceding photos. Other materials formed from recycled products include cellulose insulation, Homosote, Thermo-ply and recycled plastic lumber. However, recycled materials must be carefully assessed for their potential to negatively affect chemically sensitive individuals.

Energy Intensity. Energy Intensity refers to the energy required to produce a material. In general, low energy materials will be the least polluting. However, the choice of a material becomes more complex when the material's use within the building is considered; although plastic insulation in the form of expanded polystyrene is an energy intensive material, within a year it can save five times the quantity of energy that went into its manufacture (Vale, 1991). Mineral fiber, with a lower energy intensity, can save even more energy but cannot be used to insulate under concrete slabs, where the more energy expensive formed plastic insulation is required. A kilogram of mineral fiber insulation is large in volume compared with a kilogram of concrete, and at 3.9 kW per kg, has a relatively low energy intensiveness. Since the energy content of insulating materials is moderate, their use in quantity will not add appreciably to the total energy consumed in making a building, while their incorporation can bring about a 50% or greater decrease in energy use during the

building's lifetime (Vale, 1991). Because manufacturing is very energy-intensive, a product that lasts longer or requires less maintenance usually saves energy. Durable products also contribute less to solid waste problems (EBN, 1994). One estimate ranks building materials according to the energy required to produce them from lowest to highest: lumber, brick, cement, glass, fiberglass, steel, plastic and aluminum (EBN, 1994)<sup>2</sup>of relative energy intensity of various materials (by weight) is as follows:

Little exists in the way of a framework to deal with these paradoxes. One checklist developed by architects in Germany is as follows:

- What is the Relative Energy Intensity of the Product?
- Does Material Contain Questionable Chemical Constituents?
- Are there Large Transportation Costs Associated with the Product?
- What is the Material's Potential for Recycling
- How Durable is the Material; What is its "relative life"?

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<sup>2</sup>Original estimates available in Building and Environment, Volume 17, No. 1.

Consideration of which building material causes the least global damage is a complex. Due to this complexity, no single recipe for "sustainable materials" is possible. Rather, materials must be assessed on a regional and even case-by-case basis. In the case of the South Loop School, microenvironmental concerns may take slight priority over macroenvironmental concerns, as the population served is particularly vulnerable to indoor air quality. People who are exposed to indoor air pollutants for the longest periods are often those most susceptible to the effects of indoor air pollution. Such groups include the young, the elderly and the chronically ill (U.S. EPA, 1993).

### 2.2.2 Materials and Microenvironmental Issues

Issues about materials raised in the previous section can be regarded as macroenvironmental concerns. Also important to the discussion of relatively sustainable materials are the microenvironmental concerns-- the direct impacts that materials have on inhabitants.

Increased Health Problems associated with poor indoor air quality include coughing, eye irritation, fatigue, head aches, allergic reactions and in very rare cases, life threatening reactions. Reduced productivity due to discomfort and increased absenteeism are other problems associated with poor indoor air quality (RILA, 1994). Mechanical systems that

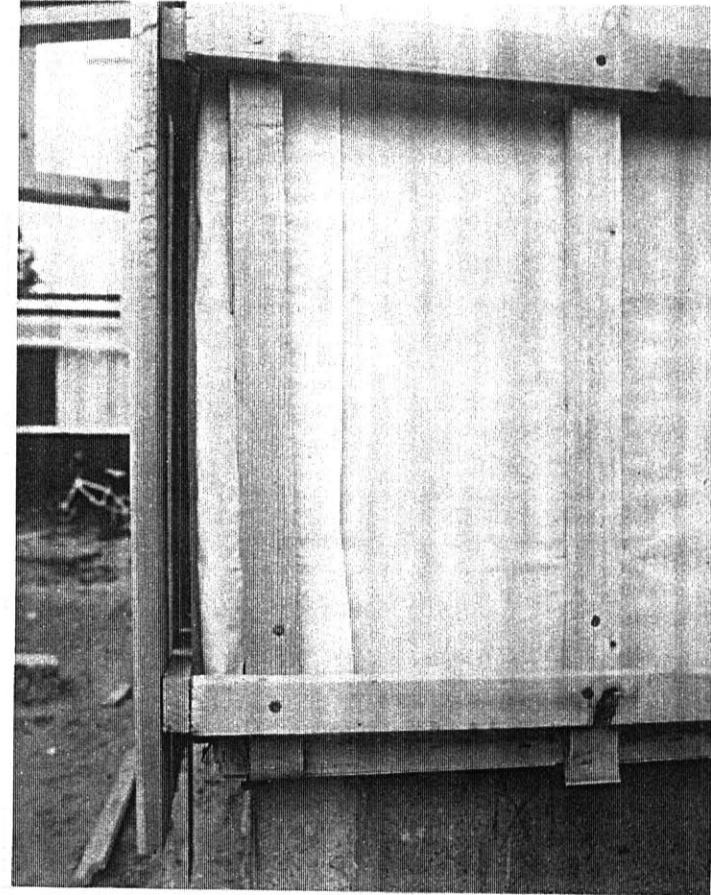
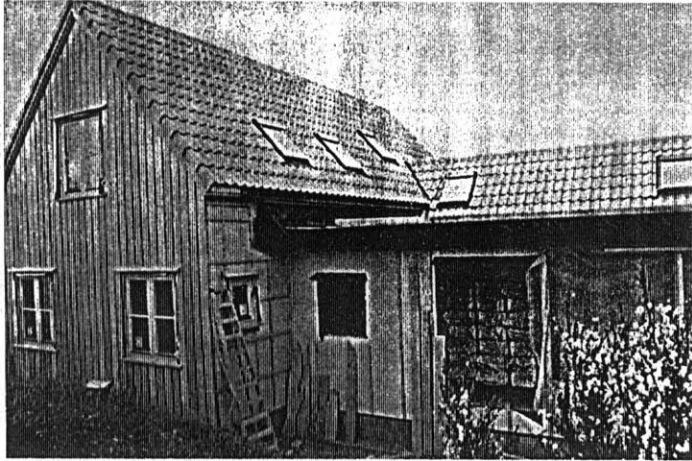
supply adequate air exchanges are helpful but require continuous monitoring and maintenance to prevent microbial contamination. Maximizing natural and adaptable ventilation is therefore a straight-forward strategy with which to improve indoor air quality.

As part of this discussion, toxicity of materials is often the focus. Of common concern are the following materials :

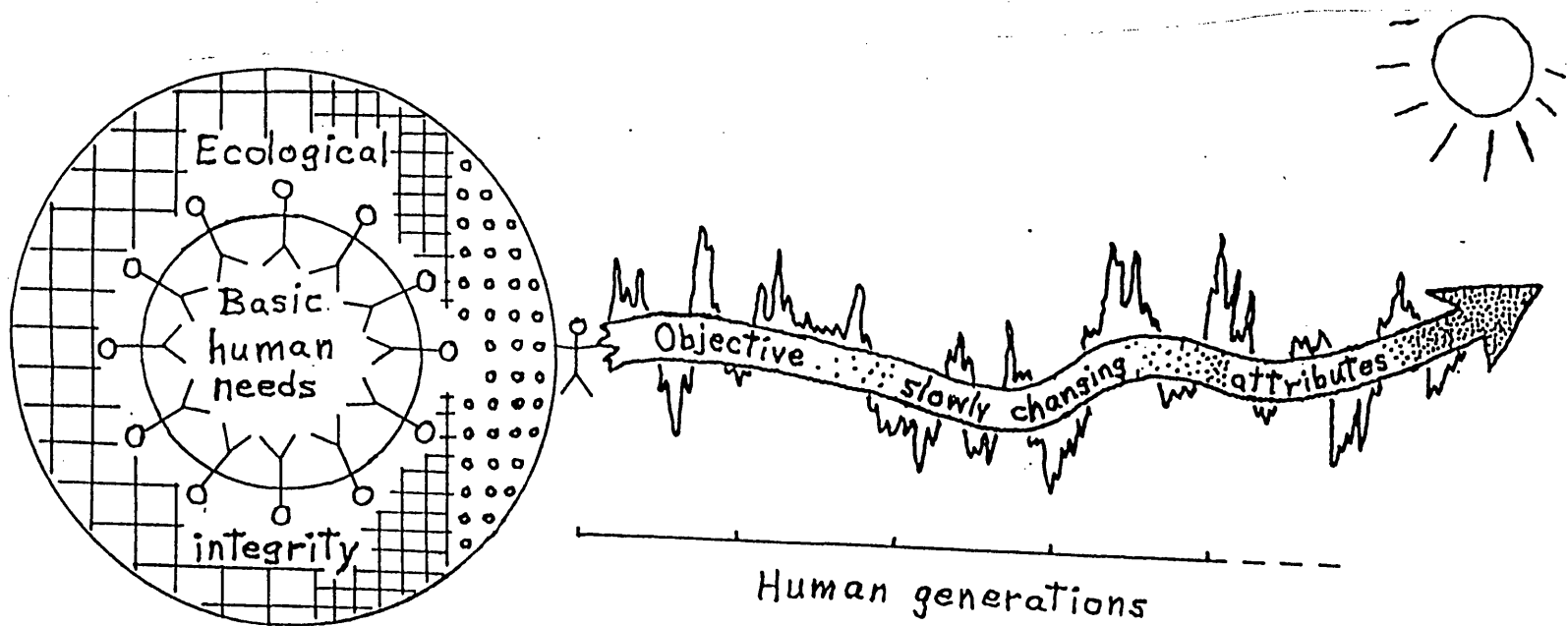
- Carpets offgas many chemicals (from adhesives) and can breed dust mites and molds to which many are allergic.
- Conventional Polyurethane (non water-based) finishes emit volatile organic compounds(VOCs) which are hazardous to the installer and to the environment in general (Kraus and Coldham( 1992).
- Particle Board cabinetry is a major sources of formaldehyde-- a sensitizer, respiratory irritant and suspected carcinogen (Kraus and Coldham, 1992).
- Other pressed wood products (e.g. hardwood plywood wall paneling, fiberboard, etc.) such as furniture sometimes offgas formaldehyde.
- Some Foam insulation may offgas urea formaldehyde.
- Paints, strippers, preservatives, cleansers and other solvents can offgas organic gases<sup>3</sup>

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<sup>3</sup>Effects: of organic gases on humans can include the following: eye nose and throat irritation; headaches; loss of coordination; nausea; and damage to the liver, kidney and central nervous system. Some organics cause cancer in tests on animals.



*Photos above show the Breathable Wall System as employed at the Findhorn Community in Scotland. The wall does not include the typical plastic vapor barrier which can trap toxins inside. Rather it is composed of several layers (paper, insulation, sheathing) which act more like a natural skin, allowing a very limited amount of air exchange while maintaining a controlled migration of moisture. Findhorn has had no condensation or moisture related problems with the system despite Scotland's extremely damp climate.*



Landscape or Region

Visualizing a sustainable environment. The area is a landscape or region. Ecological integrity and basic human needs receive equal emphasis. Cultural cohesion (symbolized by ring of people) is a key bonding force for people to work together. Spatial land planning is required. Time is over human generations. Relative objective assays are selected. Basic slowly-changing attributes, rather than rapidly fluctuating variables, are the focus. The system adapts to change (symbolized by changes in dot density). Sustainability is considered good.

*The diagram above was drawn by R.T.T. Forman to graphically illustrate sustainability (Forman, 1993).*



## 2.3 Definitions of Sustainability Compared

The term sustainability means different things to different people. In the following list of definitions, the term "sustainable" refers to both social and physical (architectural) conditions. This survey of meanings reveals that sustainability is often defined in social terms according to community life, political systems and integration of technology into society. When referred to in physical terms sustainability may refer to energy use, food production, and choice of building materials. The definitions also range dramatically in scope and are listed from the from those with broader applications to those with more specific recommendations.

Brundtland Commission (World Commission on Environment and Development) 1987. Ensuring that the needs of the present are met without compromising the ability of future generations to meet their own needs.

L. Brown, C. Flavin and S. Postel, World Watch Institute (1990).

"A sustainable society is one that satisfies its needs without jeopardizing the prospects of future generations. Inherent in this definition is the responsibility of each generation to ensure that the next one inherits an undiminished natural and economic endowment." Brown et al. refer to sustainability as "intergenerational equity."

Mollison, (1988 )

"Total self-regeneration and cyclical renewal of landscape species and resources."

John Lyle (1985, p.v).

Sustainable landscape requires the "shaping (of) landscape, land use and natural resources in ways that can make human ecosystems function in the sustainable ways of natural ecosystems" (cited by Thayer, 1989).

Jonathan Barnett (1993)

"...Growth boundaries, environmental zoning, planned communities and the restoration will not by themselves create sustainable development. But there won't be sustainable development without them" (Architectural Record, June, p.35).

Council of Educators in Landscape Architecture, 1988:

Sustainable landscapes are those which "contribute" to human well-being and at the same time are in harmony with the natural environment. They do not deplete or damage other ecosystems. While human activity will have altered native patterns, a sustainable landscape will work with natural conditions in its structure and function. Valuable resources—water, nutrients, soil, et cetera – and energy will be conserved; diversity of species will be maintained or increased (cited in Thayer, 1989).

Thayer, (1989)

Sustainability requires neither the disguise nor the elimination of human influence. Quite the contrary; sustainable landscapes merely ask that the forms and spaces we do create be purposeful and supportive of long-term, regenerative values.

Andrew St. John, AIA (1994)

Moving toward a sustainable future means organizing increasingly effective recycling programs, finding markets for recycled products, consuming less at home and at work, teaching what we know about the environment and consumption and involving ourselves in community building.

Jo Robinson, et al.(1990).

Sustainability is defined as the persistence over an apparently indefinite future of certain necessary and desired characteristics of the socio-political system and its natural environment. To ensure sustainability, protect life support systems, protect and enhance biotic diversity. Maintain integrity of ecosystem through resource (e.g. soils and nutrient) enrichment.

Michael Hough, (1990)

[Sustainable development] implies that environmental problems must be resolved within a development and that the products and energy systems of urban processes must be passed on to the larger environment as benefits rather than liabilities [and] that man-made works should be designed to produce a net gain in environmental quality and in the overall quality of life. Sustainability, having its roots in natural process, implies diversity in both social and ecological contexts Sustainable urban environments are place-specific; they belong here but not there. They are rooted in their particular landscape; they establish a regional identity.

R.T.T. Forman (1990 and 1993)

The key scale for sustainability is the landscape or region, as the center linkage between planet and local ecosystem. Furthermore, spatial arrangement in the landscape is critical to attaining a sustainable environment. [In 1993:]A sustainable environment is an area in which ecological integrity and basic human needs are concurrently maintained over generations. Sustainability may be best explained in terms of following five parts:

- 1) cultural cohesion;
- 2) equal balance of ecology and human dimensions;
- 3) system adaptability;
- 4) relatively objective measures (i.e. assays) such as soil depth and water quality rather than politically

determined issues such as access to resources and housing patterns;

- 5) a focus on slowly changing variables rather than rapidly changing variables.

Elizabeth Kline

A more sustainable community is in harmony with natural systems by reducing and converting waste into non-harmful and beneficial products and by utilizing the natural ability of environmental resources for human needs without undermining their ability to function over time. One of the goals of a sustainable community is to produce without polluting and without waste. That is not to say there will be no byproducts...but that every byproduct will have another use.

ARC Design Group for the Northeast Sustainable Energy Association, 1994.

"...Interdependence and interconnectedness are keys to sustainability, and each of these objectives spill into each of the five areas...(1) Spirit, form and voice, (2) Energy, Resources, and the natural world, (3)Economy and Adaptability, (4) Community,(5)Construction.

Anthony D. Cortese (1992)

Economic development and industrial, transportation and agricultural strategies that reduce the consumption of resources, the use of toxic substances and the production of wastes as well as preserve the productivity of ecosystems are essential if we are to meet the basic needs of current and future generations. Such strategies involve changing products and industrial processes; substituting less toxic materials and less polluting fuels; increasing energy water and materials efficiency; conserving natural resources (e.g. sustainable use of renewable energy and natural resources); reusing and recycling "waste" products and maintaining natural parks and biological preserves.

### **3.0 ASPECTS OF SUSTAINABILITY EXEMPLIFIED IN ARCHITECTURAL FORM**

Ideals of sustainability often go unaccompanied by recommendations regarding how to incorporate these definitions into built work. Chapter Three attempts to synthesize the definitions given in Chapter Two into a general organization (matrix) so that they may be realized through design. This chapter then provides examples of architectural form that have dealt with the sustainability issues as delineated here.

#### **3.1 Translating Sustainability from Definition to Design Method**

The following matrix is an attempt to organize the complexity of issues that were put forth in the previous section. Given this matrix, one might better delineate parameters, spelling out exactly which issues of sustainability will be the focus and at which level they will be addressed (i.e. local, national, global) in a given project. If designers can be clearer about their priorities regarding sustainability, then they might minimize the disparities between the all-encompassing ideal of perfect sustainability and the actual result which is never perfect. Rather than deriving from any particular definition of sustainability, the following framework attempts to synthesize

various ideas and provide a composite definition that can be easily broken down into simple categories.

### 3.1.1 A Sustainability Matrix With Which To Define Priorities

(I). Ecological Integrity refers to the maintenance of natural levels of four characteristics: (1) plant productivity; (2) biodiversity and rare species; (3) erosion control and tight nutrient cycles; and (4) water quality and fish populations (Forman, 1993). In general terms, ecological integrity refers to the ability of natural systems to successfully coexist with one another. (A system may range from the organism to the global scale). One system does not dominate at the expense of other systems. Ecological integrity requires that the designer not only look at the parts but also that an analysis be performed on how the parts relate to one another. Support of existing linkages between parts with enhanced linkages where appropriate, constitutes the underpinning of ecological integrity.

a. *At the individual scale*, ecological integrity refers to direct environmental impacts on individuals and organisms. Health of human individuals is typically the focus, i.e., indoor air pollution issues.

b. *At the community/neighborhood scale*, ecological integrity requires the reduction of local forms of ecological disruption that adversely affect the local population, (human and otherwise). Air, water, noise,

and solid waste pollution from local cars, industries/businesses, and dwellings may harmfully affect the relationships between local residents, animals, and plants to their habitats. Sustainability at the neighborhood level requires sensitivity to coordination among human residents and also the fostering of more symbiotic interspecies relationships.

c. *At the city/town scale*, ecological integrity involves reducing waste that occurs in systems at the larger scale and converting it into nonharmful or beneficial products (Kline, 1993).

d. *At the regional/national scale*, choosing materials from one's region is considered preferable in terms of ecological integrity because an awareness about the production involved and possibilities for replenishment may be more likely. Energy required to transport materials is also minimized. At these levels industrial pollution flows from large sources are addressed through policy along with expenditures of public and private funds.

e. *At the global scale*, ecological integrity focuses on how the consumption of a material in one part of the world affects ecologies in other parts of the world. Issues of material replenishment potential (i. e. irreversible depletion of rain forests) are common points of focus (Brown et. al., 1990). Also of concern are the international/intercontinental pollution flows (e.g. acid rain in Canada from sources in the U.S. and the effects of disasters such as Chernobyl on the northern hemisphere, etc.) associated with energy use.

(II). Economic Security. Economic security in sustainable terms relies on decision making based on relatively long term projections (Brown et. al., 1990). (A building may have an assumed life of 200 years or more rather than the typical 50 year- forecast). Longer term economic considerations are more able to consider ecological impacts. Economic security also requires a diverse base that is better able to withstand periods of strain while satisfying a broad set of needs. Sustainable economic security attempts to stabilize flows of wealth in and out of a community (be it neighborhood, city, regional or nation) subtle, avoiding net deficits.

a. *At the individual scale* , economic security is generally discussed in terms of adequate training and education as a way of maximizing the individual's resiliency and ability to contribute to the larger systems. (See Cortese, 1992).

b. *At the local/neighborhood scale*, economic sustainability goes beyond notions of self sufficiency, and instead focuses on community sufficiency, with an emphasis on employing local resources and developing a diverse and locally owned economic base (see Kline, 1993).

c. *At the city/town scale*, economic security is defined in similar terms as at the neighborhood scale, with emphasis on developing resources and maintaining capital within the city/town. Again, priorities are based on long term investments, such as education, rather than short term gains. Cities/towns can make energy

and waste streams more efficient through changes to infrastructural networks (supply side) and to institutions (demand side).

d. *At the regional and national scales*, economic security again focuses on balancing capital in-flows and out-flows; imports are low relative to a nation's total production. Public policy is rooted in long term considerations.

e. *At the global scale* discussions about sustainability focus on international policies which promote economic and political stability among developing nations, namely via education and training. These discussions also discourage taking economic advantage of developing nations which may destabilize the power base of these nations and make peaceful international relations more difficult.

(III). Social Cohesion and Quality of Life. Increasingly, sustainability is defined in social terms. A more sustainable community "... supports peoples' evolving sense of well-being which includes a sense of belonging, a sense of place, a sense of self worth, a sense of safety and a sense of connection with nature, and provides goods and services which meet people's needs both as they define them and as can be accommodated within the ecological integrity of natural systems (Kline, 1993).

a. *At the individual scale*, sustainable social cohesion focuses on the individual's sense of self worth, ability to relate to the surrounding environment and sense of safety (Kline, 1993).

b. *At the neighborhood scale*, social cohesion calls for neighborhood developments to maximize the continuous fabric of the area. Connections may be fostered by the design of streets, parks and plazas, the avoidance of light obstructions, and by interactive housing organization where a sense of safety prevails.

c. *At the city/town scale*, social integration in sustainable terms focuses on the same issues as at the neighborhood scale but involves more complexities, such as interactions between neighborhoods. These interactions may be enhanced by access to public transportation, shared commercial zones and connective street planning.

d. *At the regional and national scales* sustainable social cohesion is expressed mainly through public policy. Promoting the survival of species (mammals, bird, fish, insects, and plants) native to particular regions may help to instill the sense of identity and self-worth, while converging with ideals about ecological integrity (Kline, 1993).

e. *At the global scale*, sustainable social cohesion focuses on the healthy exchange of ideas between and enhanced appreciation for different cultures, termed "tolerance" in its minimal form.

Sustainable design often takes a regionalist approach, with careful consideration of weather considerations (i.e. wind directions, seasonal solar conditions and temperature changes), natural resources (e.g. water) and availability of various materials. In addition to varying from region to region, the meaning of sustainability varies from site to site. The

enhancement of species diversity is one clear example of this local variation; while the potential exists to expand species diversity in urban areas, this potential may be limited relative to less densely populated areas in the same region. Moreover, potential for species diversity may even vary from neighborhood to neighborhood, depending on population density, traffic patterns, proximity to natural amenities, etc. Thus, there can be no single recipe for what makes a project relatively sustainable. Rather, a project's sustainability must be viewed in terms of what questions are asked and the method undertaken in responding to these questions.

TABLE 3.1.(a) **Overlapping Sustainability Issues and Architectural Applications**

	I. ECOLOGICAL INTEGRITY	II. ECONOMIC SECURITY	III. SOCIAL COHESION
a. Individual	F,M,P,T	F,P,T	F,P
b. Local/Neighborhood	F,M,P,T	F,P,T	F,P
c. Town/city	F,M,P,T	F,P,T	F,P
d. Region/Nation	F,M,P,T	P,T	F,P
e. Global	F,M,P,T	P,T	F,P

**3.1.2 Relationship of the Sustainability Matrix to Architectural Applications**

Given the host of experts and the range of fields interested in notions of sustainability, it is helpful to distill which of these ideals can actually be realized through architecture. All cannot. And those ideals which can be fulfilled through architecture may involve different aspects of architecture to varying degrees. Components of sustainability as defined in previously in this chapter have four architectural applications:

- (M) Material
- (F) Architectural form; organization of space
- (P) Program
- (T) Technology Related to Building

As TABLE 3.1.(a) notes, ecological integrity may generally be assisted by all four categories, material choice, architectural or urban planning form (depending on the scale), program and technology. At the individual scale, choice of non- or low-toxic materials can impact health of builders and building inhabitants. Selection of materials can discourage the production of materials which are not replenishable at the larger scale (from local to global). Selection of local materials reduces the transportation of materials and thus reduces local and global pollution associated with transportation.

**TABLE 3.1(b) How Aspects of Sustainability Were Addressed in the Thesis**

	I. ECOLOGICAL INTEGRITY	II. ECONOMIC SECURITY	III. SOCIAL COHESION
a. Individual	F,M,P,T		F,P
b. Local/Neighborhood	F,M,P,T	F,P	F,P
c. Town/city	F,M,P,T	F,P, (coincidental)	F,P
d. Region/Nation	F,M,P,T		F,P.
e. Global	F,M,P		

F=architectural form; M=material; P=program and T=technology.

*The matrix shows that the architectural form is important to all facets of sustainability, with the exception of large scale economic security. Architectural form is accompanied by program in the sustainability matrix, underscoring the need to develop the two in tandem.*

Different programs can affect ecological integrity to varying extents (i.e. is it a recreational area with human disturbances or a preserve?) However, programs change over time and so ecological integrity cannot hinge on program alone. Technologies such as improved ventilation systems, cleaner forms of transportation, and more efficient or renewable energy sources, and devices to filter pollutants can enhance ecological integrity at all scales. Form may also significantly enhance ecological integrity at all scales. At smaller scales architectural form may affect the ability of the built environment to capture renewable energy by reflecting and addressing regional conditions. At all scales, architectural form can respond to movement patterns and thereby reduce transportation

A carefully planned program that advances cultural, ecological, and economic diversity will enhance economic security at all levels. However, for such programs to be successful, they will need to be reinforced by architectural form. The form may reinforce notions about public and private spaces physically, encouraging people to gather near shops and so forth. Technologies may improve energy efficiency, allowing retention of capital for other purposes. Technologies which reduce or filter harmful pollutants out of the system may positively affect the health of all species. The selection of materials affects economic security directly at the levels ranging

from local to global: consumption of local building materials returns capital back into the system and consumers of international building materials can greatly encourage the production types which will survive over the longer term as opposed to nonsustainable production types which often offer developing nations prosperity only over the short term.

Social Cohesion is enhanced primarily through architectural form at scales ranging from the individual to the city. Form may increase interaction between individuals (shared court yards, gardens, parks etc.) and between neighborhoods (i.e. shopping districts, larger parks, etc.). Form may affect exchange between people as well as interspecies interactions (birds, plants, etc.) through the design of visual and access links. Program can affect social cohesion and the quality of life at all levels and is especially stable if reinforced by architectural form. Increasingly technologies such as monitoring devices are being incorporated into buildings (particularly schools) to engender a greater sense of safety- one aspect of social cohesion. However this introduction of technology may be considered reactive rather than proactive and therefore a secondary aspect of social cohesion. A partnership between architectural form and program are primary influences in social cohesion.



**Table 3.1 (C) Sustainability Issues As Prioritized In The Thesis Project's Design Process**

	I. ECOLOGICAL INTEGRITY	II. ECONOMIC SECURITY	III. SOCIAL COHESION
a. Individual	4	7	1
b. Local/Neighborhood	5	7	1
c. Town/city	5	8	2
d. Region/Nation	5	not considered	3
e. Global	6	not considered	n/a

F=architectural form; M= material; P=program and T=technology.

### 3.1.3. The Sustainability Matrix Applied To South Loop School Issues

Without social cohesion, the ecological integrity of a place may mean very little to its human inhabitants. For this reason, social cohesion at every scale was a first priority in making general recommendations for the school's surrounding neighborhood and for specifically redesigning the South Loop School. Once a plan supporting social cohesion was in place, the plan could be tailored to maximize the ecological integrity for humans and other species alike. Schools may also contribute to the economic security of a society, a neighborhood and an individual. Over the longer term, schools may educate and prepare people for productive participation in a society and in

the nearer term schools attract populations (i.e. teachers, staff and students) to neighborhoods and a potential level economic activity that might otherwise not be present and may also affect the city budget through heating and lighting costs. Recommendations to diversify the South Loop Neighborhood (i.e. the introduction of commercial areas and diverse housing stock) are also schematically proposed in this thesis as general ways in which to encourage economic security. In terms of the primary focus of this thesis, however, social cohesion and ecological integrity outweigh economic proposals. The matrix is here again invoked to stress which aspects are addressed proposed design.

The proposed school design strives for ecological integrity at every scale, from the individual to global resource and environmental concerns. The design also relies on form and program to enhance social cohesion and connection to the environment. While the matrix produces three distinct categories for the sake of simplicity, it is important to note that often these categories are closely intertwined and difficult to separate, as in the case of the coincidental economic benefits of implementing ecologically sound strategies that reduce energy use. Similarly, distinctions between applications are also often blurred. Indeed, an objective of the design proposed in this thesis is the integration of form and technology.

### 3.2 Designs Demonstrating Social Cohesion and Environmental Sensitivity

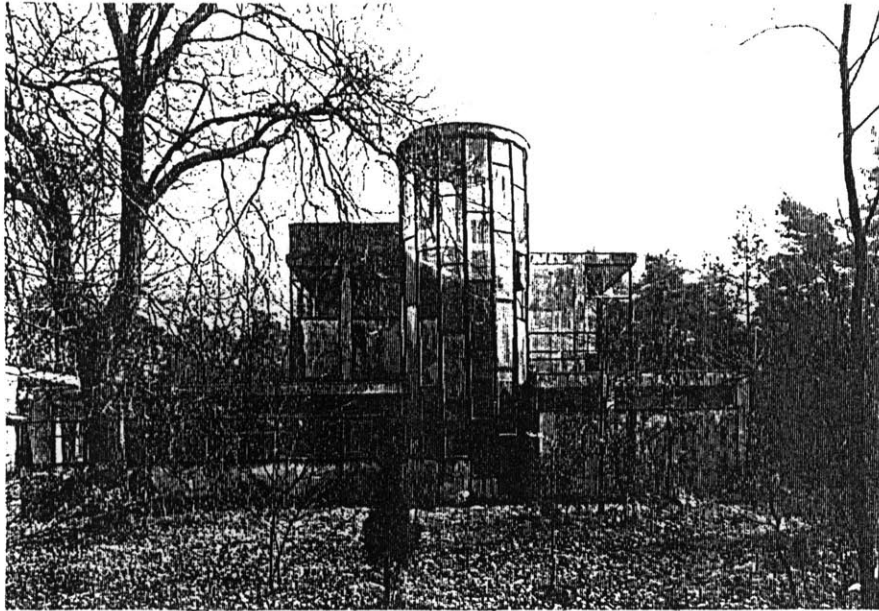
Preceding sections developed a "sustainability matrix" to illustrate topics within sustainable design and to delineate the priorities of this design thesis in particular. The two major areas of sustainability explored here are social cohesion and environmental sensitivity. In developing a design, it was helpful to identify several precedents which, while perhaps not typically called "sustainable," have successfully addressed issues identified in the sustainability matrix.

The following examples demonstrate how sustainable design may be carried out dynamically, expressively, and creatively to encourage social cohesion and respond to the environment. A design that aims to be sustainable might integrate these design tactics. Lessons offered by architectural precedents incorporated into the design process of this thesis project are categorized as follows:

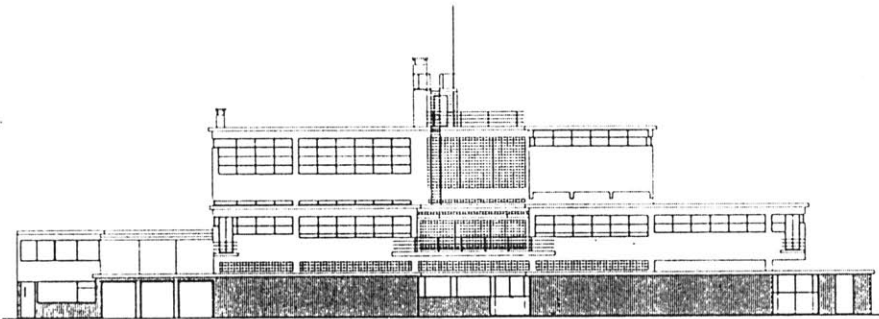
- Interactive Relationships Between Distinct Spaces
- Interior Collective Spaces
- Exterior Collective Spaces
- Transitional Layers: the Zone Between Inside and Outside
- The Play with Light
- Water as an Architectural Element
- Plants as Physical Definition

The first four categories all reinforce the social cohesion described in the sustainability matrix. The last three categories deal with climatic responsiveness and expressiveness, relating directly to environmental sensitivity described in the matrix.

The architectural examples provided in this section illustrate how designers have historically underscored the beauty of basic natural elements in the environment (e.g., Barragon's trees, Corbusier's glorification of water processes, Ando's play with light) and have designed with a dynamism that responds to ever changing local climates and human needs (e.g. Behnisch's expressive awning devices, Neutra's classrooms that turn inside-out and Team Zoo's movable light screens). The following collection of examples is by *no* means exhaustive of the architects who have incorporated social concerns and environmental sensitivity into their designs.



1.



2.

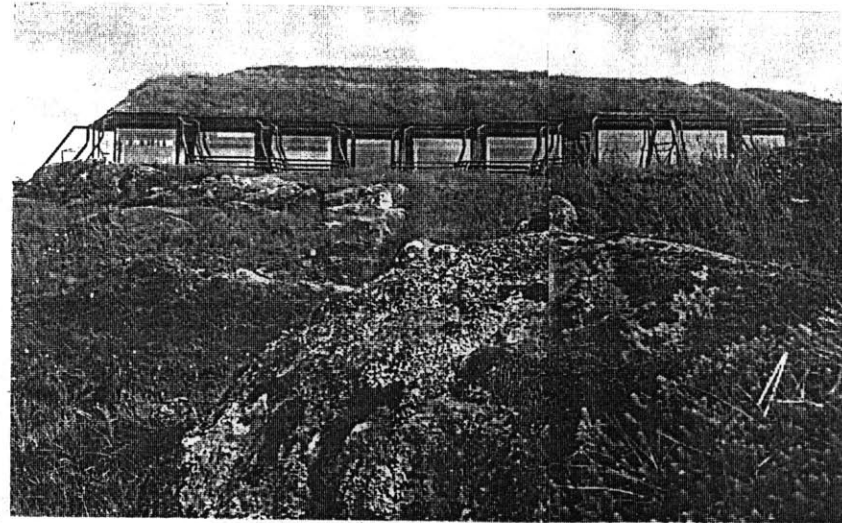
### 3.2.1 Interactive Relationships Between Distinct Spaces

Interactive relationships between the outside and inside are crucial to social cohesion. A building which is understood by a visitor is also more welcoming. The South Loop School, in contrast, reveals none of the activity or architectural form within and is off-putting to visitors.

1. Duiker's "Zonnestraal," with its alternating vertical glass panels, suggests movement upwards. The façade speaks to the person approaching it and indicates the location of the stairs within. The basic organization of the building can be read from the outside and is therefore welcoming.

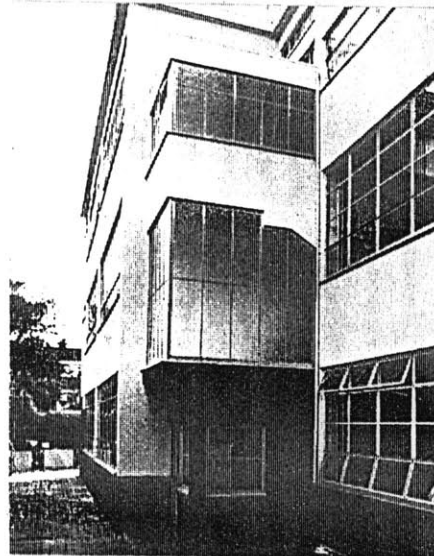
2. Duiker's Schevenigen Technical school uses distinctions between fenestration to indicate location of larger collective spaces and more private spaces. Duiker uses the largest glazed areas (in center of elevation) to help the visitor identify the entrance, located below.

3. Ola Steen and Kolbrun Ragnarsdottir, in the Nordic Cultural Center on the Faroe Islands, use continuous horizontal glazing to show activity within the structure. "I want this building to radiate warmth, and from the outside, the sense that people are meeting within, that children are playing, that there is dance (Steen, 1984; p. 108).



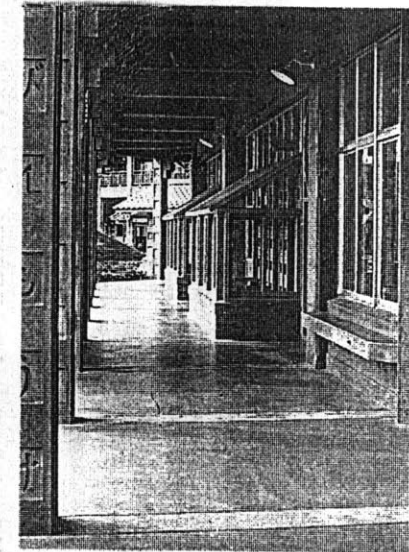
3.

4. Duiker, in the Scheveningen School, uses glazing to indicate different uses, giving classrooms fenestration that allows for individual ventilation needs while expressing the independence of each classroom from the outside.

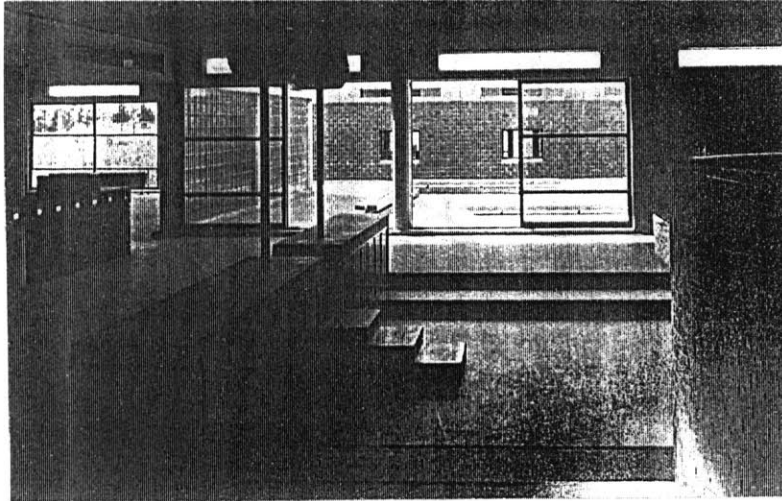


4.

5. Team Zoo, at the Nakijin Community Center, has bays of classrooms that occasionally intersect the arcade space and allow for closer interaction between inside and outside. Extension of sills outward provides opportunities for people to stop and sit.

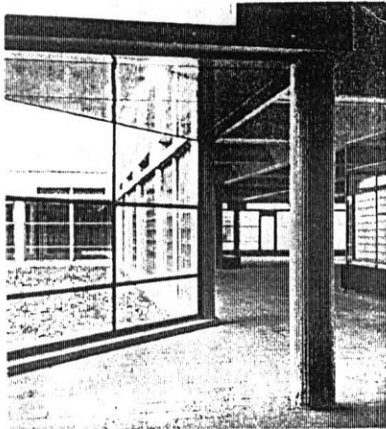


5.



6.

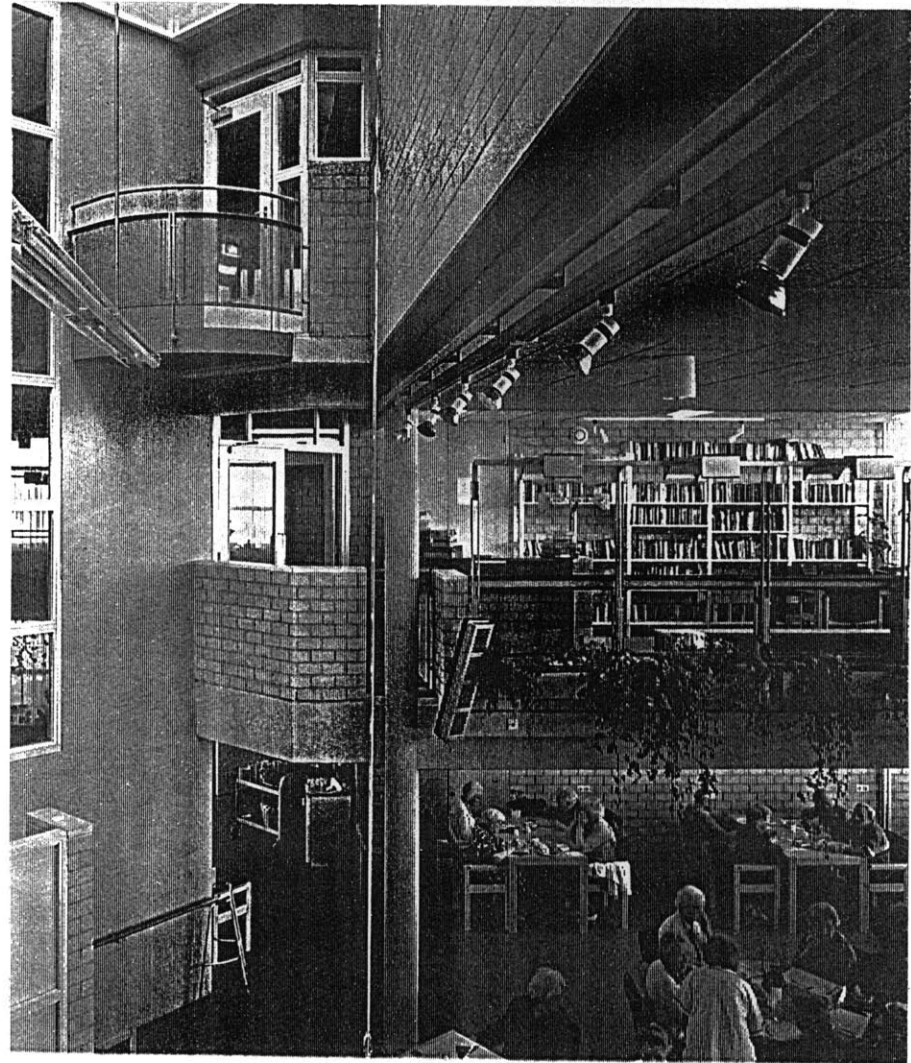
6. In the Burgerweeshuis school, Van Eyck maximizes visual continuity through spaces. A visual link to the outside play space from the interior exists, providing more convenience to teachers and a more engaging place for all .



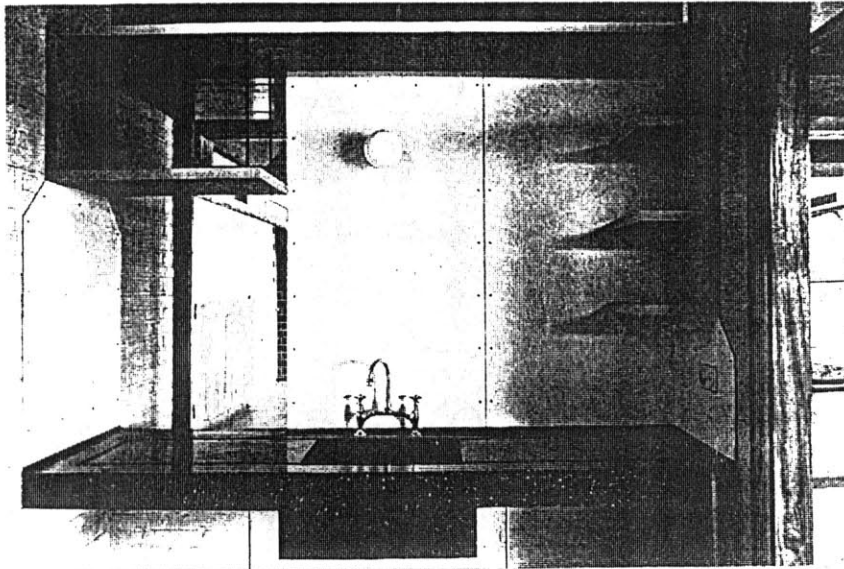
7.

7. Also in Burgerweeshuis school, one may see through adjacent spaces to other spaces beyond. Spaces gain privacy without becoming isolated.

8. Behnish's Administration Building of the Charitable Service of the Lutheran Church (CSLC) in Stuttgart employs balconies of various sizes and interior windows to relate distinct spaces to one another in section. In so doing, one is oriented to the larger collective space below. Natural light reaches different levels and is not obstructed by the structure.

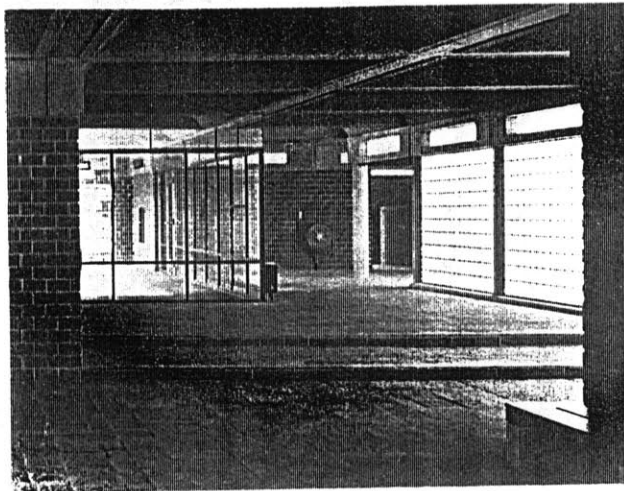


8.



9.

9. Van Eyck's sink with windows in the Burgerweeshuis school allows a person to wash up and simultaneously view corridor spaces beyond the immediate room.

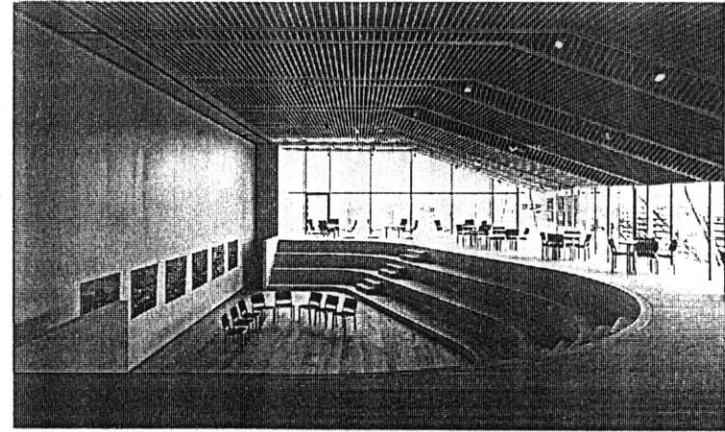


10.

10. Also in Burgerweeshuis, Van Eyck uses careful turns in glazed areas to allow a person to view the entrance from the building's interior.

### 3.2.2 Interior Collective Spaces

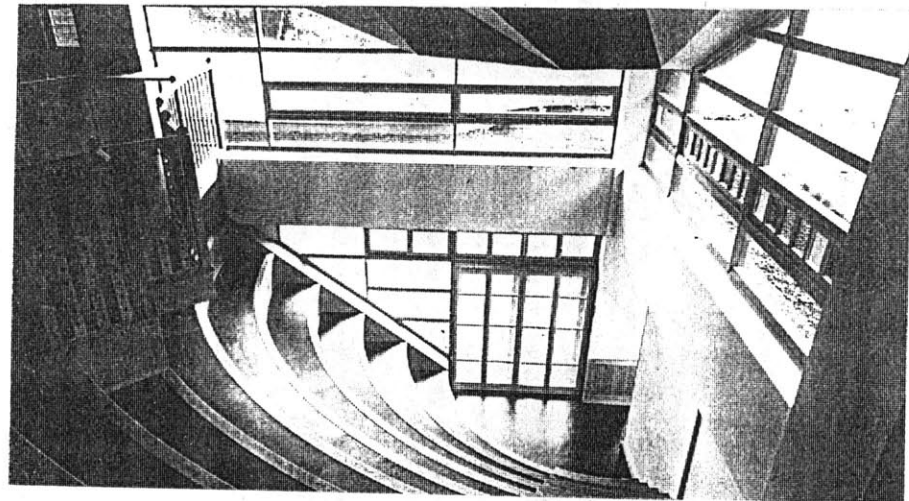
Schools require gatherings for various purposes varying from formal to informal. The 19th century schools used auditoriums for formal gatherings. However, these have proven underutilized on a daily or even weekly basis and often do not support the casual interaction needed for schools uses. Architects more recently have turned to more informal collective spaces that can be activated more readily, especially if naturally lit. Again, these spaces support the social cohesion of a place. The examples shown influenced the approach adopted in the design of collective spaces in the South Loop School.



11.

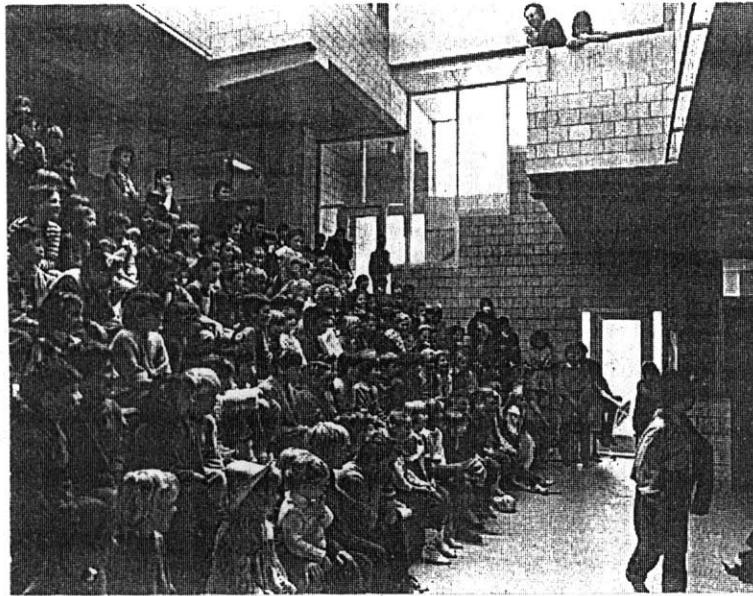
11. Steen and Regnarsdottir's Nordic Cultural Center combines a graceful change in section with a solid wall as backdrop to create a gathering space with potential to support informal and more formal uses. The platform surrounding the gathering pit supports sun-baked tables that invite occupation at all times and serves as a light shelf, bouncing indirect light into the collective zone.

12. Team Zoo in the Okoshita Residence combines typical vertical access (stairs) with terracing to create an informal gathering space. The house, built by a company owner as a retreat for employees, required a gathering space that was not too serious or work-like.



12.

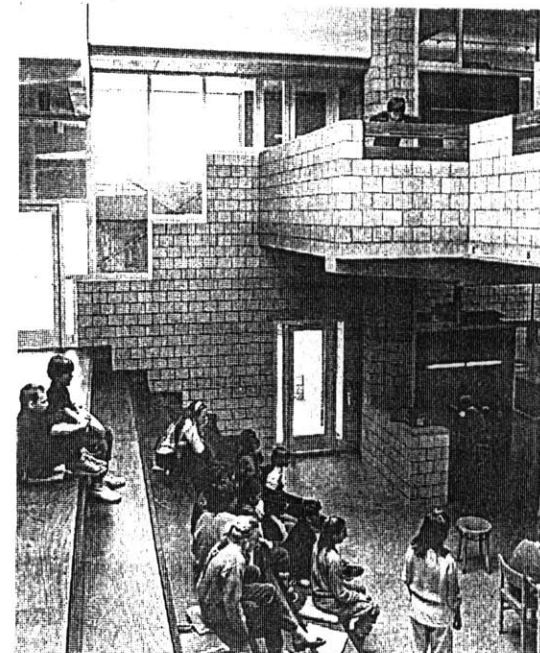




14.

13. Hertzberger's Montessori School employs multifunctional steps and balconies to create a collective space observable from different vantage points. The shift in section at the collective zone also allows natural top lighting to flood down in addition to the natural lateral lighting. This collective space is located next to an access path to allow its frequent use as a stopping point.

14. The same collective space in the Montessori School is shown here with a denser degree of occupation.

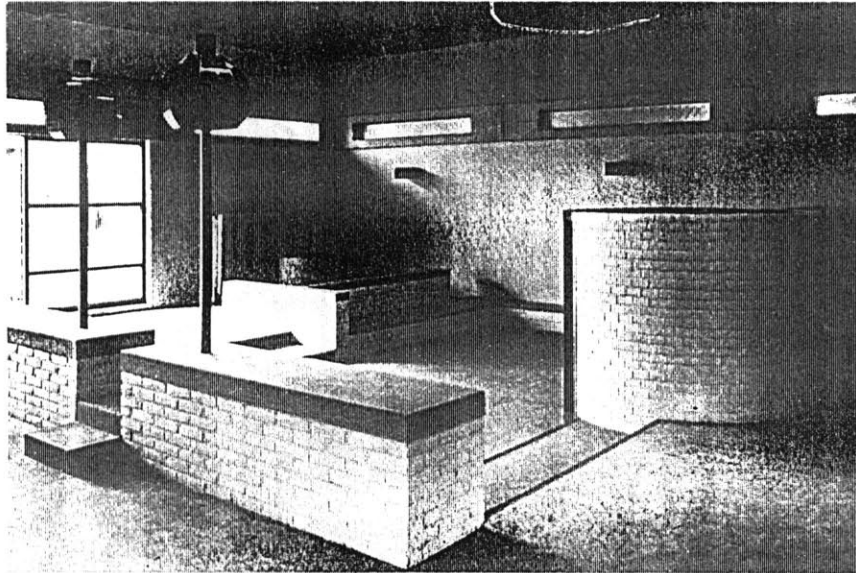


13.

15. Behnisch, in the Schäfersfeld School, provides a lobby combined with the vertical access zone that supports a vast range of activities including the community gathering shown. Openness, in section here, allows skylights to partially illuminate the space.

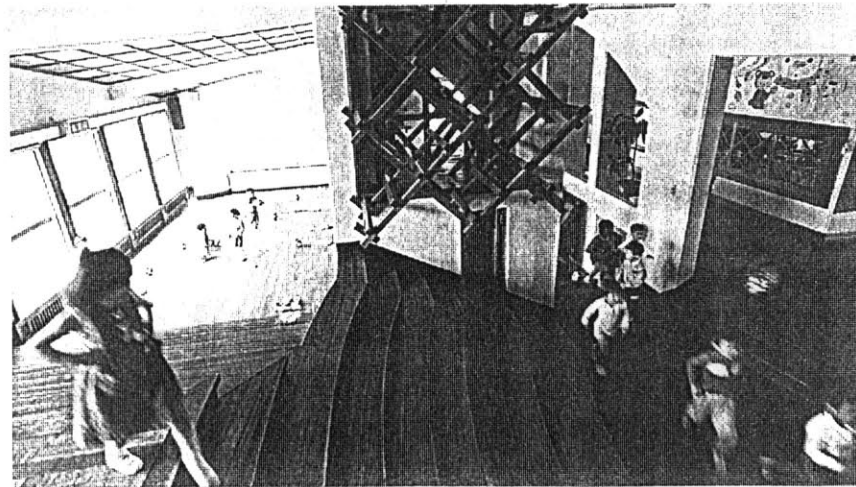


15.



16.

16. Van Eyck's Burgerweeshuis includes informal collective play spaces distinguished in slight sectional shifts from other spaces while connected to them visually.



17.

17. Team Zoo uses shifts in floor levels to create different and informal use zones, while preserving visual connectivity in the Honjo Kindergarten.

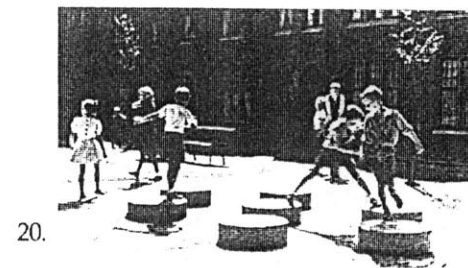
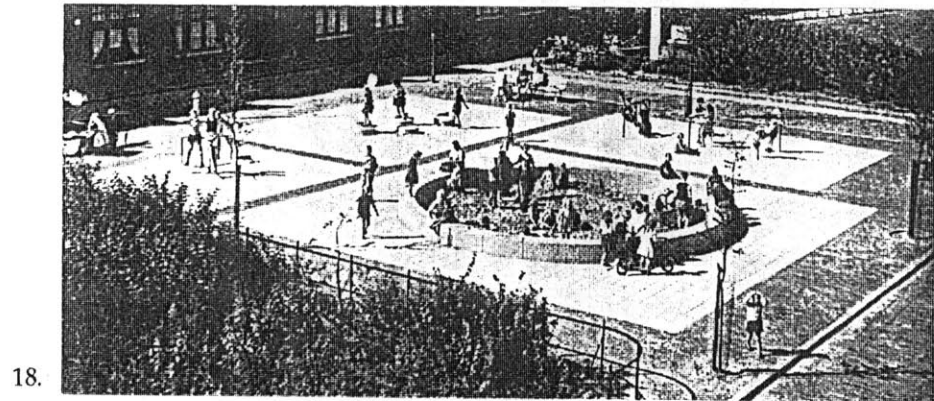
### 3.2.3 Exterior Collective Spaces

It is always difficult to predict how people might choose to use spaces and this is especially true regarding children. The exterior spaces shown lend themselves to creative use. The collective spaces for children also support the accompanying adults. These examples informed the South Loop School design by illustrating how to create exterior spaces that simultaneously support different activities (different age groups) while still being connected.

18. Van Eyck's Zaanhof playground in Amsterdam becomes the element that mediates between the street and the inner plaza space. The sandbox becomes the entrance to the plaza.

19. In Van Eyck's Maanenburgerstraat playground in Amsterdam the walls of the sand box alternate to provide different potentials for occupation by children (as tables) and by adults (as chairs).

20. Van Eyck's Zaanhof playground includes small scale architectural definitions that are appreciated by children.



### 3.2.4 Transitional Layers: the Zone Between Inside and Outside

Transitional spaces (i.e. entrances, porches, overhangs, vestibules, lobbies) enrich the movement of a person from outside to inside and vice versa. They can help a person prepare for the changes involved in moving from place to place, whether psychologically or physically (e.g. shift in temperature or light conditions). Schools, in particular, need such transitions as the activities within are often very different from those outside. Additionally, transitional spaces often provide places for people to stop, wait, and gather. These transitional layers may be crucial in filtering light and buffering a building from harsh wind conditions. Such transitional spaces may also make entrances more clearly understood and therefore more accessible to the public.



21.

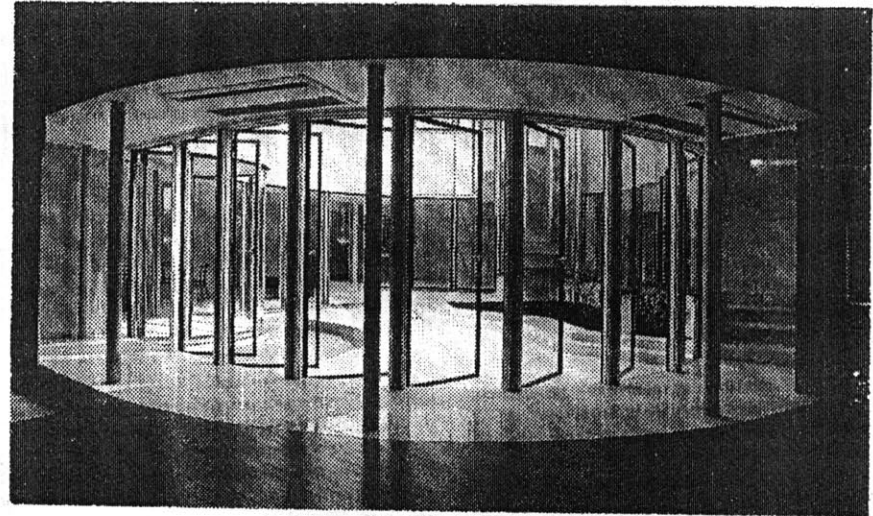
21. In Team Zoo's Yoga Promenade in Tokyo, the terracing to the left becomes a bench while the landscaped form on the right becomes a play space and protective zone separated pedestrians from cars.

22. Hasagawa's House in Higashitamagawa uses a change in floor materials (wood to marble), expression of the structure (columns) and the glazed outer skin (doors) to build a transition between the inside and outside.

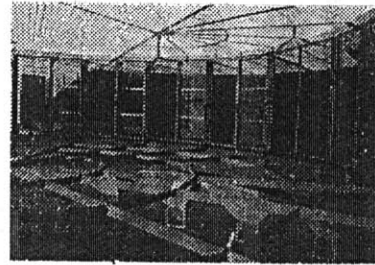
23. In Hasagawa's House in Kumamoto the structure and outer skin comprise the vertical elements that define transition from inside to outside. The overhead structure defines the transition in the horizontal planes (above and at ground in the form of shadows.)

24. Also in Hasagawa's House in Kumamoto, an interior screen is part of the transitional system from inside to out, while shading interior spaces from direct sunlight.

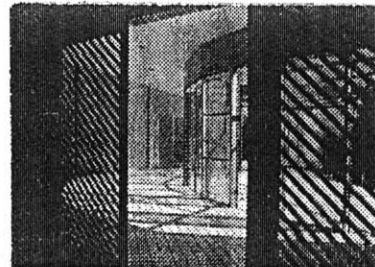
22.

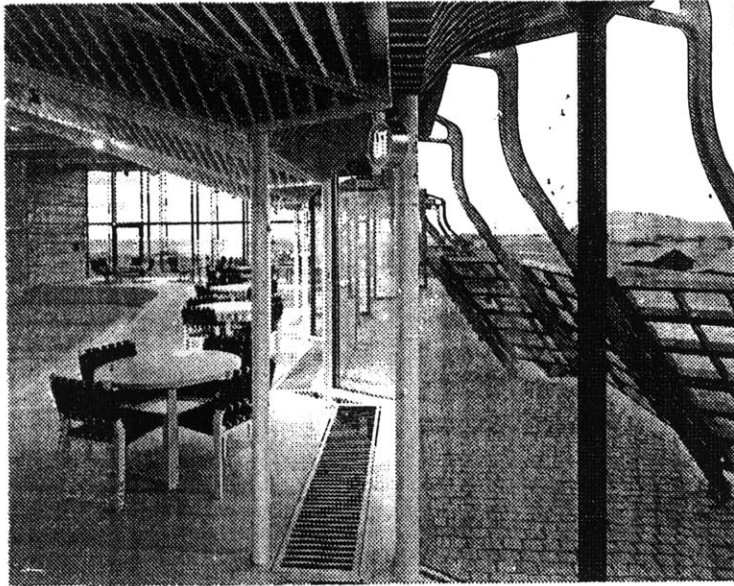


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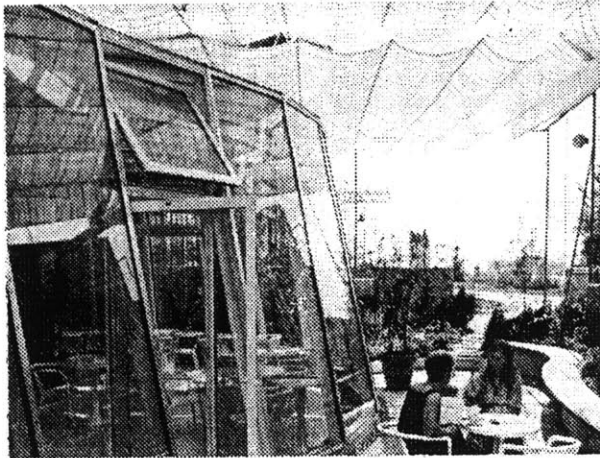
24.





25.

25. Steen and Ragnarsdottir create transitional zones in the Nordic Cultural Center on the Faroe Islands with the following elements (from left to right in photo): a sectional change (stepping), structure (columns), the undulating outer skin (glazing), a change in floor materials (from wood to stone) and the outer iron structure that helps to support the sod roof with its lateral bracing that filters the light. "What I desired was that the transitional zones should create a basis for activities that cannot occur in the adjoining rooms." (Living Architecture, 1984).

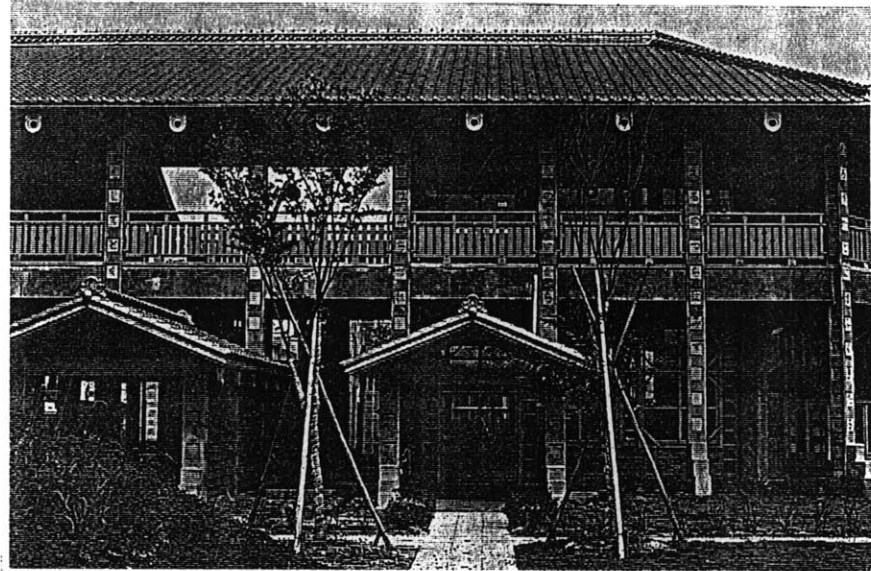


26.

26. Behnisch uses a translucent outer skin, a canopy, a knee wall and landscaping to form the transitional space between the interior and exterior of the Administration Building of the CSLC.

27. As one enters Team Zoo's Kasahara Elementary School, s/he passes through a series of layers that demarcate transitional zones: trees, low entrance roof, the arcade, the extending bays and the building skin.

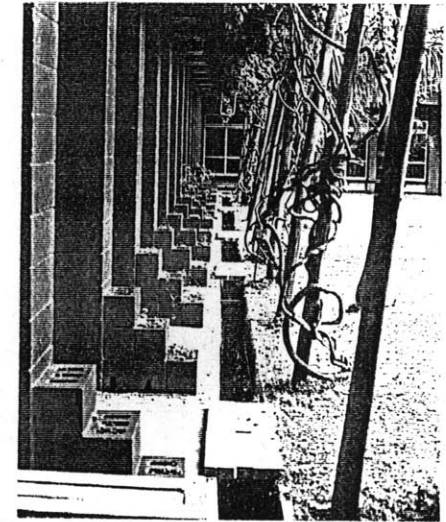
28, 29. Elements demarcating the transition between in- and outside at the Nakijin community Center shown in section (from left to right): the building skin, a change in floor material, arcade columns, cinder block stepping (as planters), the miniature canal (with bridge) and the trees.



27.

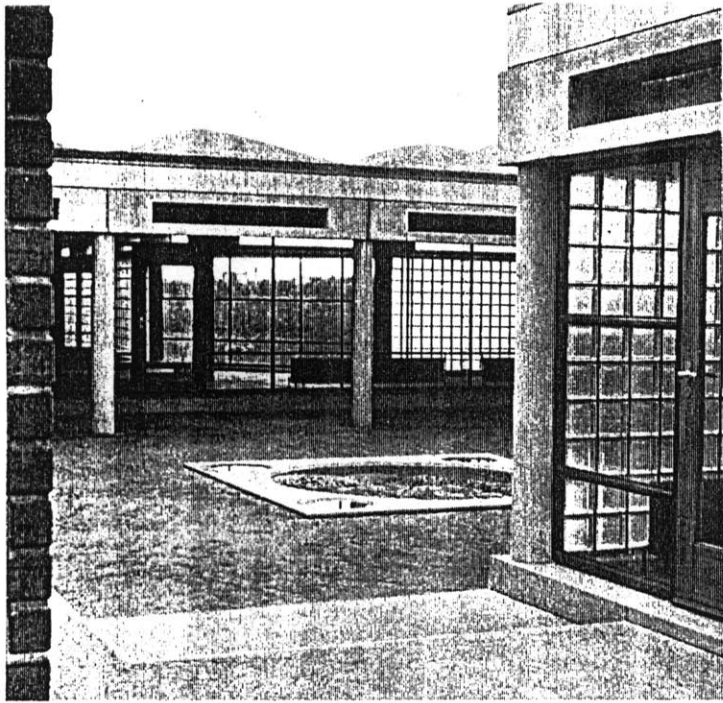


28.



29.

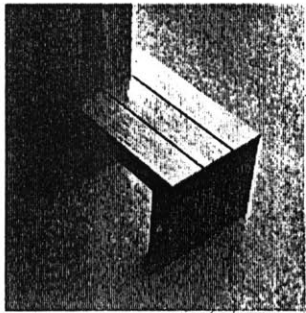




30.

30. Van Eyck plays with the relationship between structure and outer skin in developing transitions. Shown in the foreground is the structure united with the outer skin (glass block and glazing). Across the play yard, Van Eyck separates the structure from the skin, creating an arcade between the two that shields that building part from direct summer sunlight.

31. and 32. Van Eyck uses a low extension from the wall to intensify the threshold and the act of passing through it while creating an opportunity for occupation.



31.

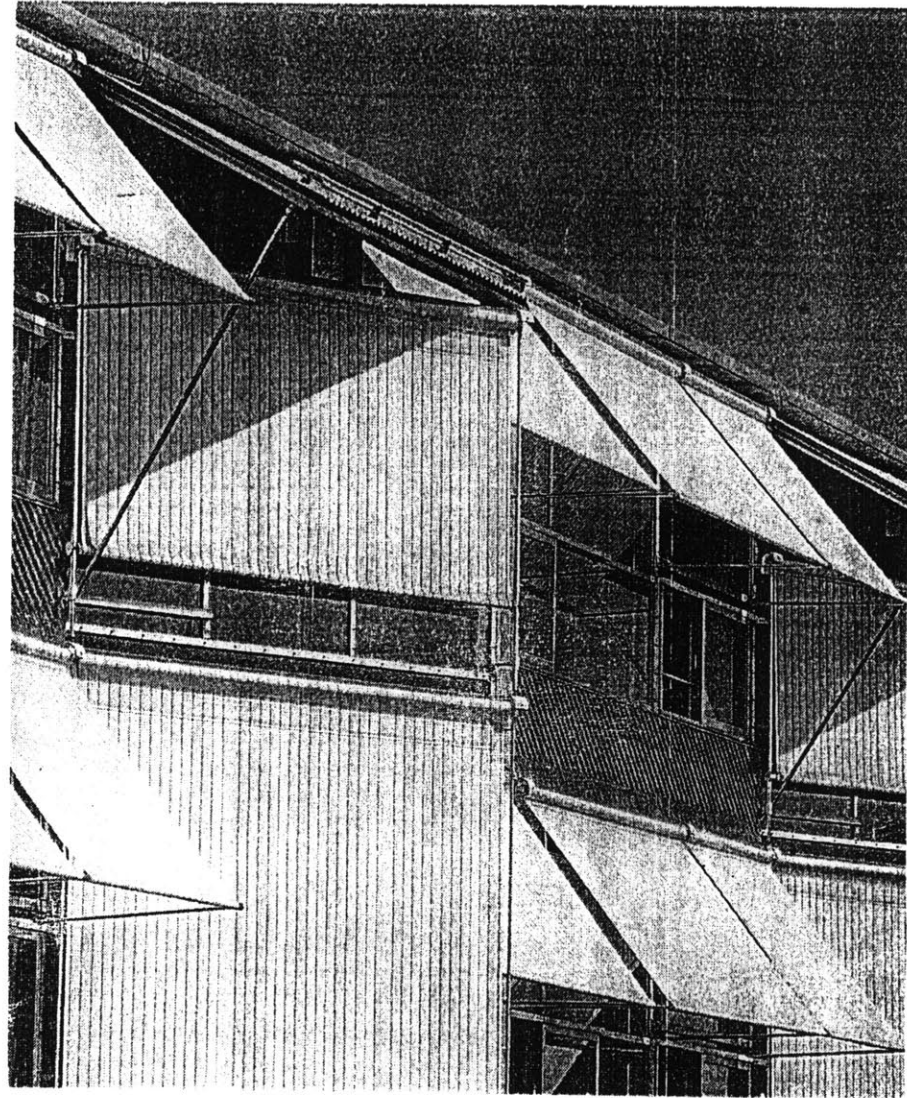


32.

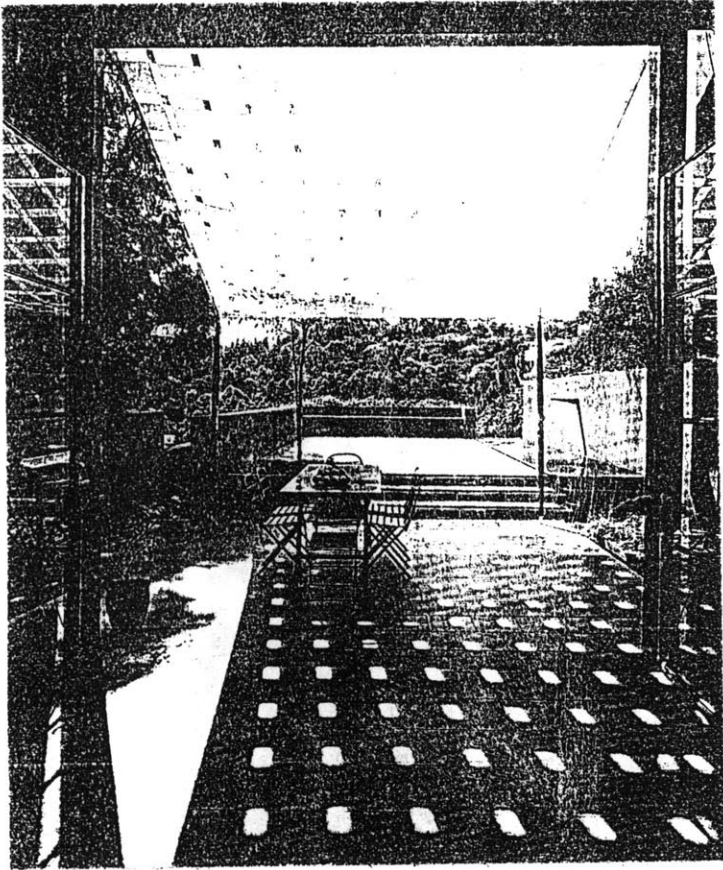
### 3.2.5 The Play with Light

The play with light is an age old architectural tradition that is also a fundamental part of sustainable design. Screens, awnings and overhangs may significantly reduce the energy requirements of buildings. Buildings, comfortable in the summer with such architectural devices, can also have the added benefit of indoor air quality that is superior to that of spaces reliant upon mechanical cooling. Moreover, often these devices create powerful qualities, with geometric shadows, expressions of activity, and heightened articulation of the building's materiality, as the example following examples demonstrate.

33. Behnisch's Schäfersfeld school employs an elegant awning system in the Secondary School on the Schäfersfeld in Lorch that echoes the light weight quality of the façade, while providing each classroom with individual control of entering sunlight. The façade expresses the fact that there are different users, activities and needs inside.

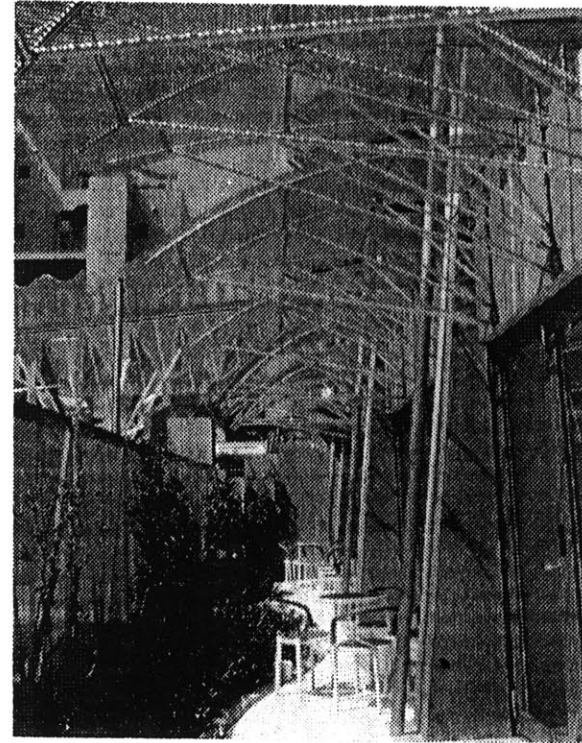


33.



34. Glenn Murcutt's house renovation in urban Sydney Australia uses the awning to create a pattern of light on the ground. The surrounding glazing further reflects this pattern.

34.

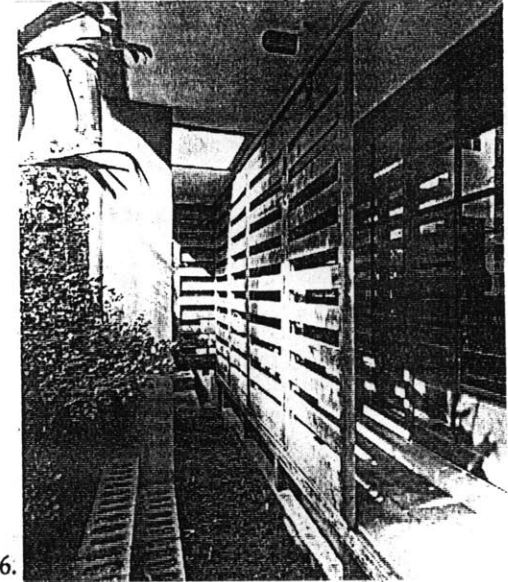


35.

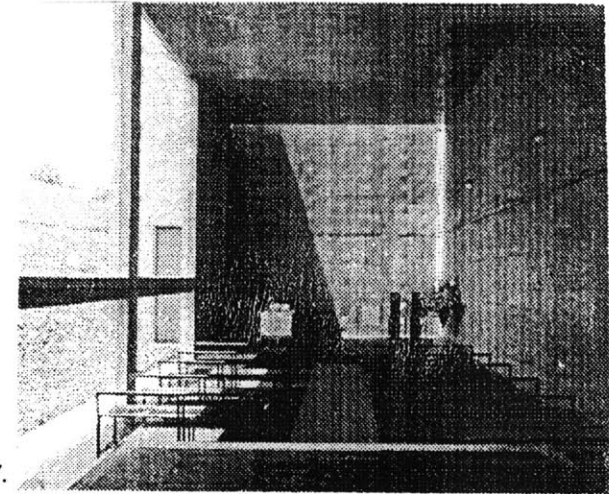
35. Hasagawa uses awnings of aluminum mesh in her low cost housing development, Cona Village, to filter sun light while carrying out expression of the building's materiality in the façade. The awning angles shift from apartment to apartment. "Our strategy was to design a diverse of conditions within the chaos, in order to express the residents as individuals within diversity."

36. Team Zoo (Atelier Gaii) employs wooden-slatted sliding shutters in the House of the Winds and Waters.

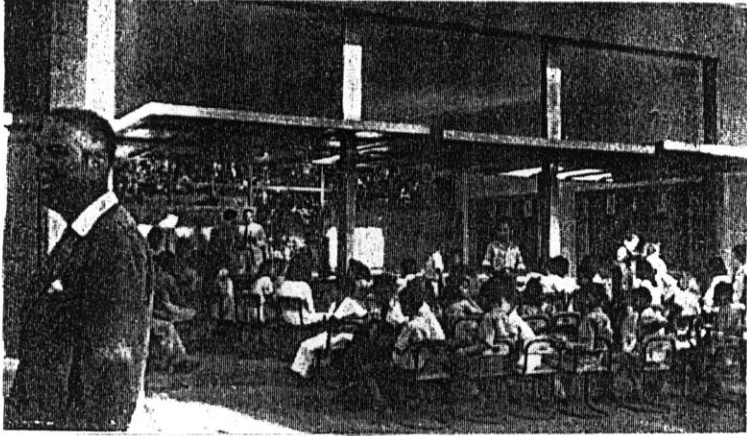
37. Ando, in the Chapel With Light, provides both highly lit and shaded spaces in which to sit. The focal point of the space is the concrete wall with light that washes down it from a strategically placed skylight.



36.



37.

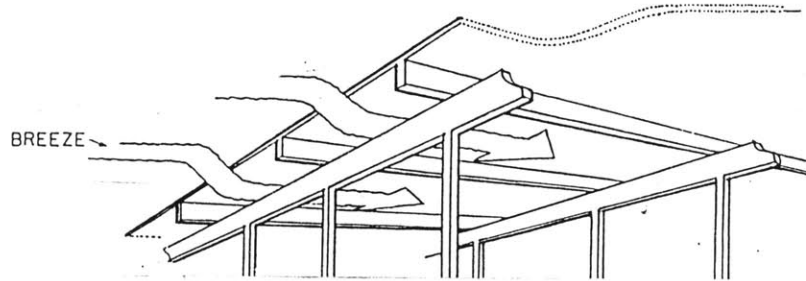


38.

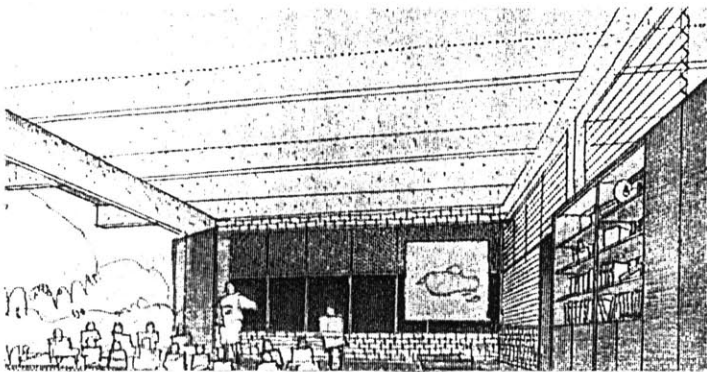
38. Neutra, in his urban schools for Puerto Rico project, includes classrooms which easily convert into outdoor rooms with the use of rotating facade panels. In the horizontal position (shown) these panels act as overhangs to shade areas beneath

39. A schematic from Neutra's Health Center in Puerto Rico shows how his floor systems capture breezes

40. A sketch of Neutra's indoor/outdoor classroom concept.



39.



40.

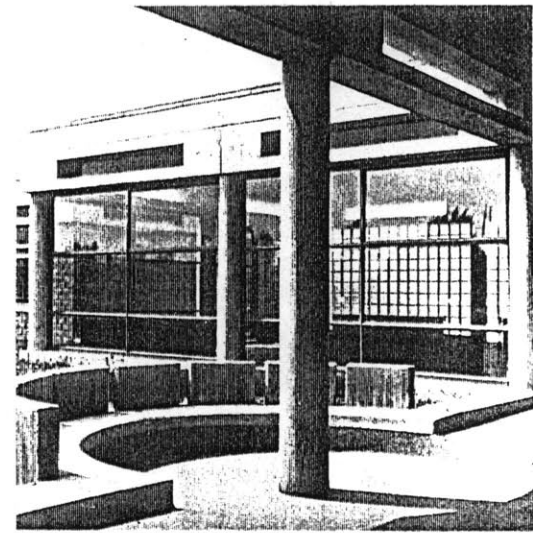
### 3.2.6 Water as an Architectural Element

Water may be thought of as a dynamic architectural element that can reflect light, cool spaces (evaporative cooling) and introduce a pleasant sound quality. Hertzberger has lamented the often lost opportunity to integrate water into architecture more actively:

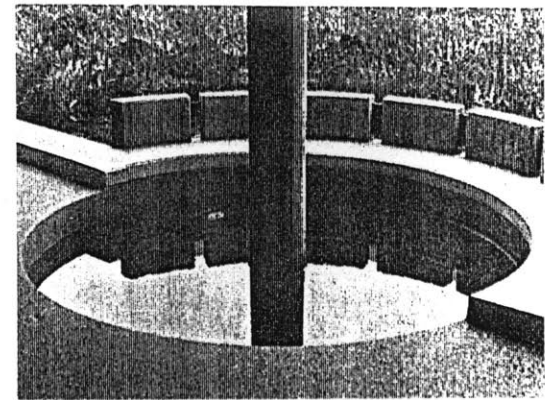
*"Rainwater transported in pipes hidden from view tells us nothing about what is going on, and so this remains an abstract system that can, at best, be expected to function noiselessly... Abstraction of form thus goes together with reduction of information about the way it works... The tendency in architecture to make form more abstract in an effort to achieve simplification always implies the risk of losing expressive force"<sup>1</sup>*

The examples which follow introduce elements that can be interpreted as emphasizing the importance of water in a setting. In some examples the presence of water is dependent upon rainfall, and heightens the awareness of seasonal variations.

41 and 42. Van Eyck's settings in the Burgerweeshuis change with the seasons.



41.



42.

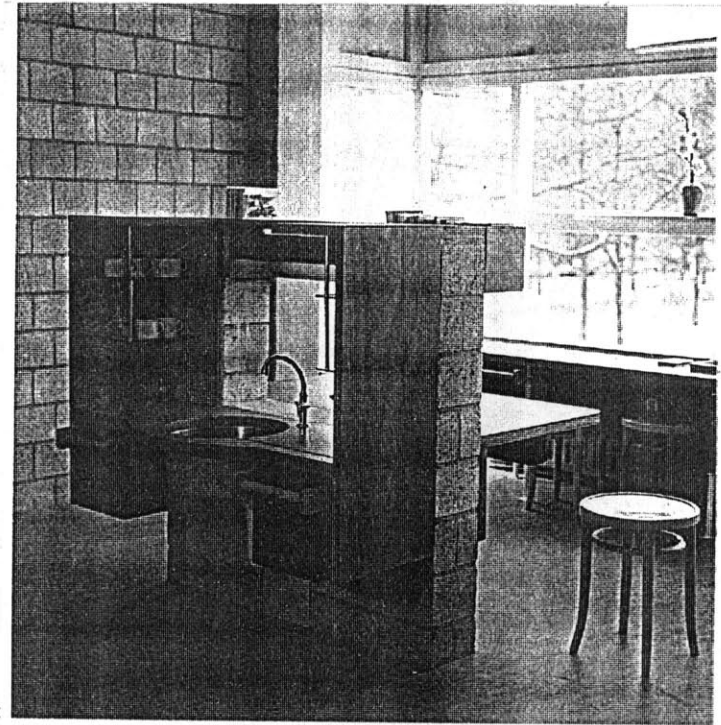
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<sup>1</sup>Herman Hertzberger, *Lessons For Students of Architecture*, p. 235.



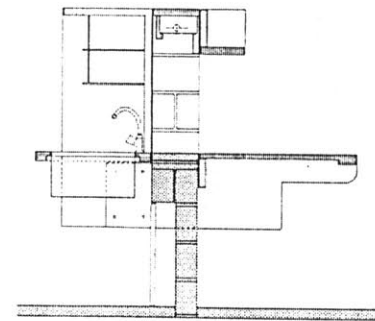
43. Behnisch uses an inverted umbrella skylight in to collect rain at the Vocational School in Herrenberg. Piping is clear to show the water collection system.

43.



44.

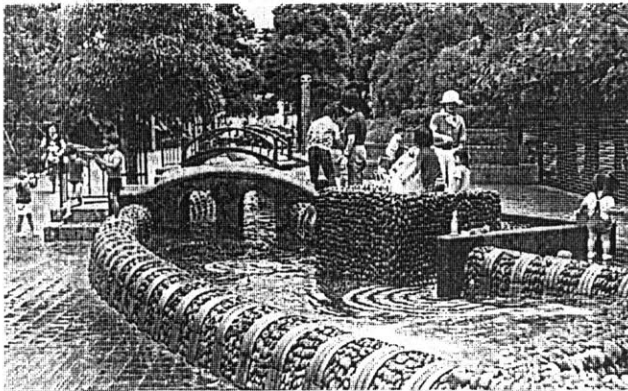
44. Hertzberger in the Montessori school uses a standard element associated with water in an atypical way— as an architectural tool to create different zones within a space (similar to Wright's use of the hearth). The delivery of water becomes a focal point enhanced by exposure to natural light. As the sink acquires heightened importance, so too does the act of using water.







45.



46.

45. Team Zoo uses water canals ("brooks") at a range of scales outdoors. Designed in response to the decline of the street area resulting from "a car-oriented society", the "Alley" section of the Yoga Promenade in Tokyo, includes water that flows lineal as a way to divide pedestrian and car traffic. It may also ameliorate the noise pollution associated with the increase of car use in the area.

46. Team Zoo uses water at the "Hall" section of the Yoga Promenade in a more meandering way to suggest stopping (and playing) more than direct movement. (Pedestrian and car conflict was not an issue in this zone). "It is our dream to bring the street back to life as a place for living" (Team Zoo, 1991; p. 140).

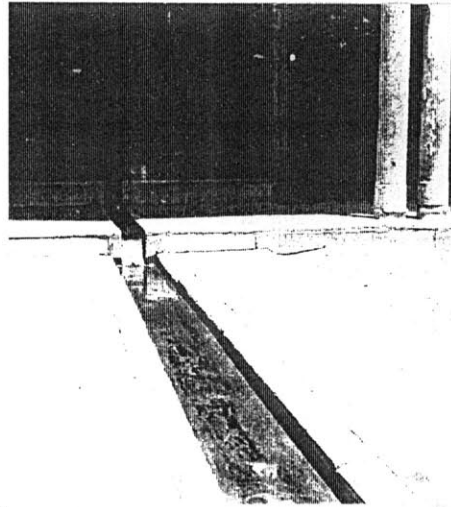
47. The Mosque in Cordoba Spain (786-1009 A.D.) employs a channel to deliver water to orange trees (planted in circular depressions) in the courtyard. Such channels may also affect temperatures through evaporative cooling.

48. The Alhambra in Grenada Spain, (14th Century) employs a similar channel system. Its architectural benefits are described:

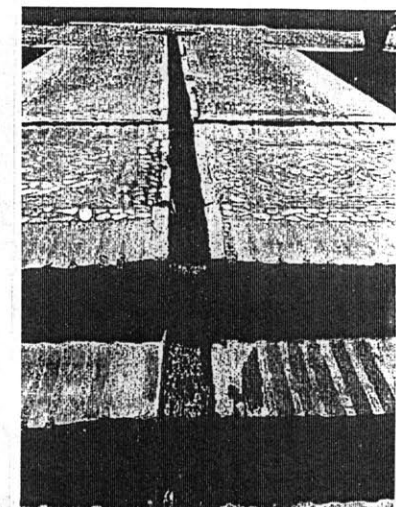
*The light reflected by the surface of the stream as well as the sound intensity the image of a stepped descent ...the phenomenon of water is intensified by this felicitous combination- the same liquid substance that we tend to take for granted cannot escape notice in this pronounced form" (Hertzberger, 1991; p. 233).*

49,50. In Le Corbusier's Chapel of the Notre Dame du Haut France, "the roof is shaped like a basin, from which the water escapes through a single spout... It takes some time for the collected rainwater to drain away after a shower... its fall being broken by pyramid-shaped points in another concrete basin on the ground under the spout (Hertzberger, 1991; p. 233).

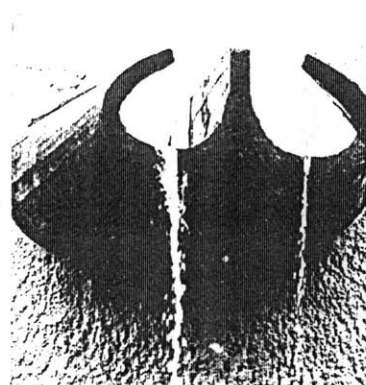
Hertzberger describes figures 54-56 further in Lessons For Students in Architecture, 1991, p. 233-234.



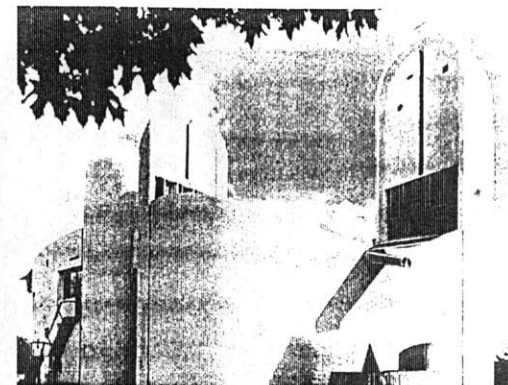
47.



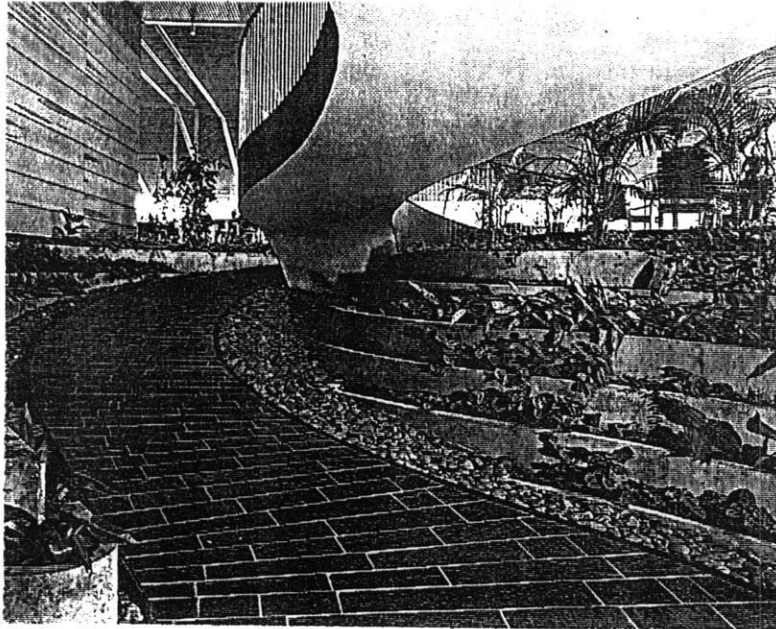
48.



49.



50.

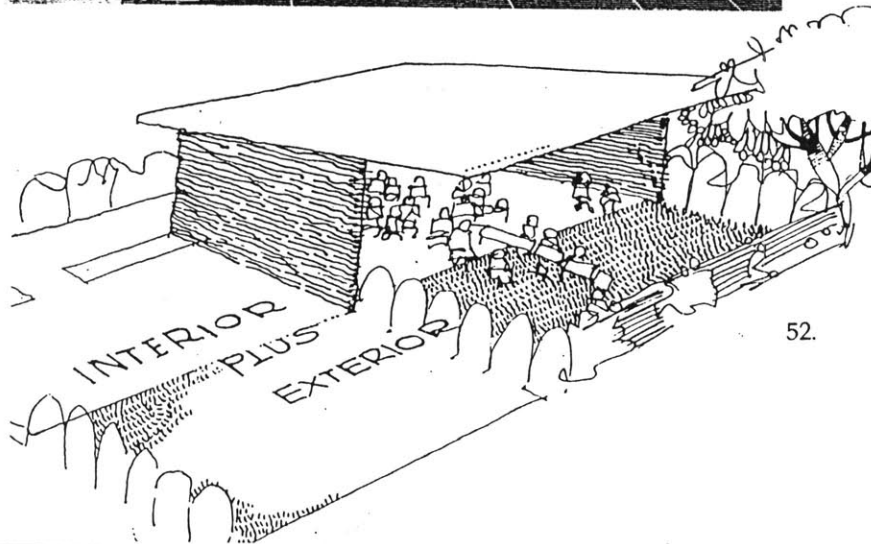


51.

### 3.2.7 Incorporation of Plant Life

Several environmental benefits are associated with plants. Plants produce fresh oxygen, they serve as habitats for other species, they soak up extra water present in areas covered with concrete and they provide shade, thereby reducing energy consumption needed to cool buildings. Unlike walls, plants can also effectively define physical spaces without creating solid barriers that completely divide people from one another. They effectively demarcate paths by providing alternations of light and shadow.

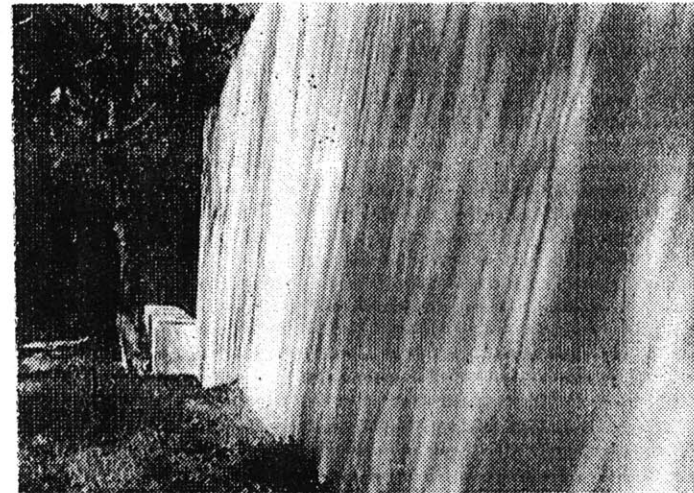
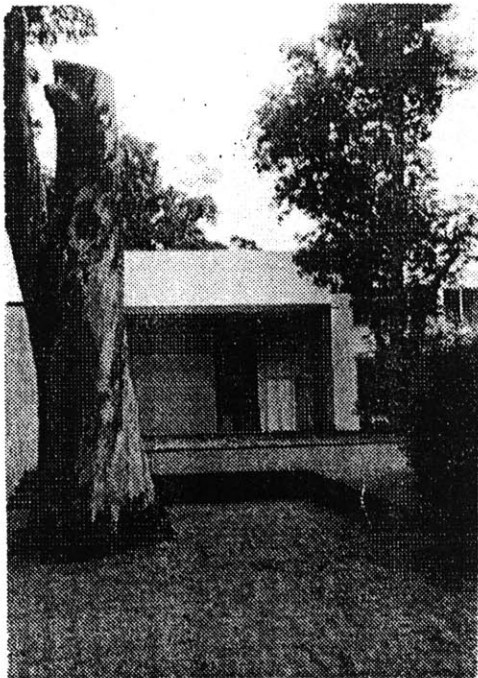
51. Steen's and Regnarsdottir's Nordic Cultural Center includes interior paths lined by plants which both improve air quality and lend texture to the walk.



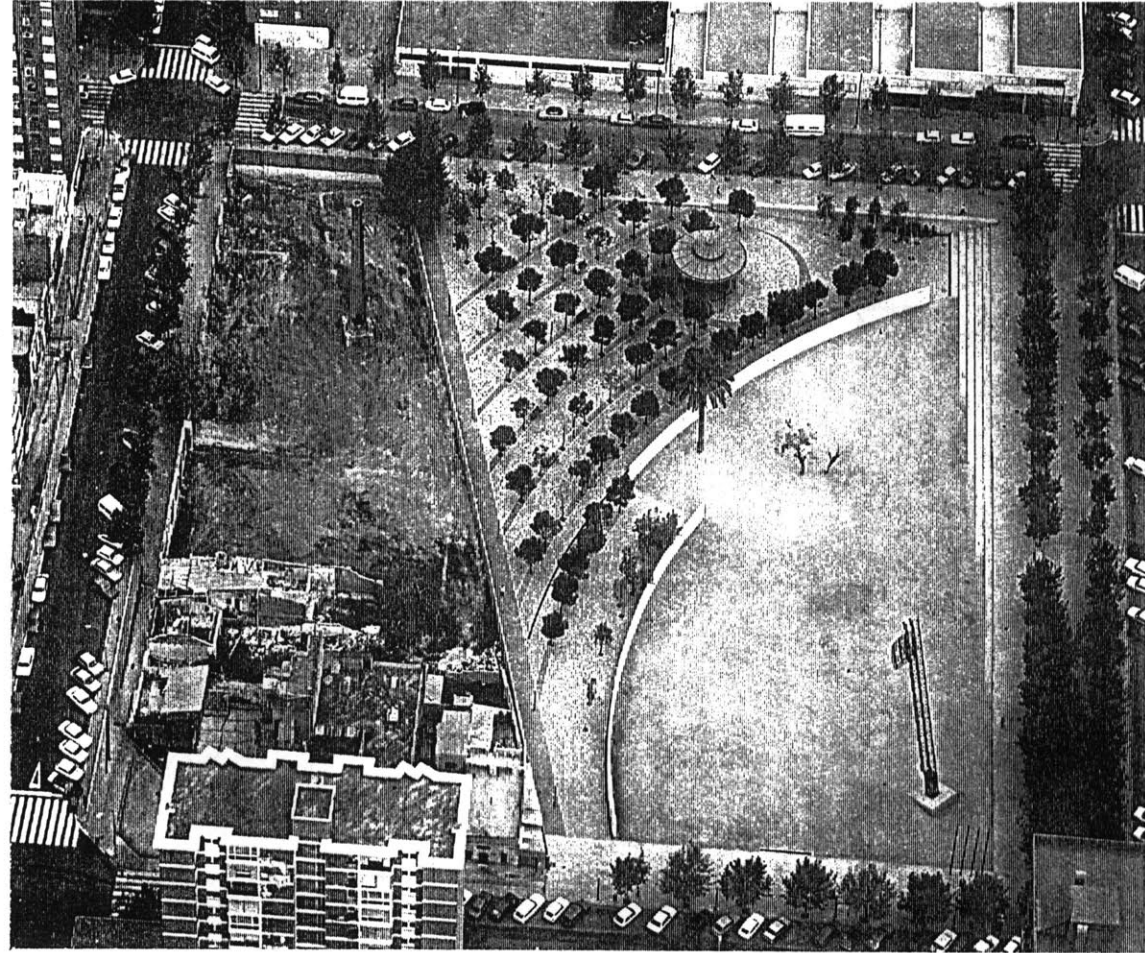
52.

52. Neutra, even in the quickest of sketches, incorporates plant form. In his vision for urban schools in Puerto Rico, the outdoor classroom employs a wall of shrubs and trees to provide adequate privacy. Neutra used plants as architectural form with which to distinguish zones.

53. The relationship between trees and walls is important in Barragon's work. White walls reflect shadows of foliage while brightly colored walls act as backdrops to dark barks. The trees are as much the focus in these designs as are the structures.



54. Photos on page 61 and 62 depict Pedro Barragán's and Bernardo de Sola's use of trees to build public spaces. Barragán and de Sola use the relationship between trees and walls to define different territories for a range of uses in this urban park. (Photos from Barcelona: Architektur and Stadtbau zur Olympiade 1992, 1990; p. 186-9).





#### 4.0 THE NEED FOR SITE ANALYSES TO RANGE IN SCALE

Sustainable design aims to be as sensitive to the relationship of parts as is possible. It also tries to identify not only near term and immediate impacts but also the longer term and indirect impacts. In order to comprehend the complex relationships between systems and range of impacts possible, analysis at various scales is imperative. Analyses of the South Loop School project and the systems affecting it, or affected by it, were done at scales ranging from the regional to the individual.

The first section in part 4.0 analyzes key systems at the regional scale. The second section analyzes this relation of parts at the urban scale, underscoring areas in Chicago that are especially active and applying those elements to the South Loop area. The third section describes the South Loop neighborhood in greater detail, introducing the site's history and current condition and framing the topics of discussion for the revamped school plan. This section suggests a more sustainable local setting in which the South Loop School could operate. To some extent the analyses for the South Loop School design became an experiment in how to merge ecological and architectural analytical methods.

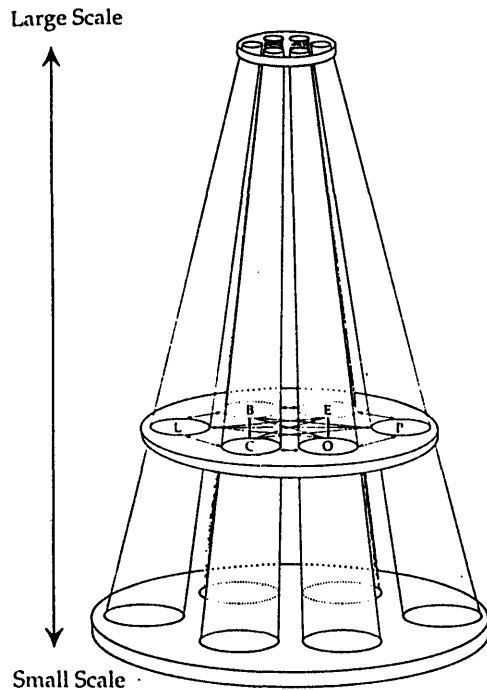


Figure 1.13. The layer cake metaphor for ecological criteria and ecological scale. The wide base indicates a large number of small entities; the narrow top indicates a small number of large entities. The cross-section across the entire cone represents one middle-level scale. Although there is only one here, any number of cross-sections could have been inserted, each at its own scaled level. Each letter indicates a different ecological criterion: O = organism; P = population; C = community; E = ecosystem; L = landscape; B = biome.

*Schematic provided by T.F.H. Allen and T.W. Hoekstra, Toward a Unified Ecology, Columbia University Press, NY, 1993, p. 53.*

## 4.1 Analysis of the Regional Context

As early as the late 19th Century Patrick Geddes called for urban planning based upon an understanding of the regional context. Yet sites in cities are often analyzed in terms of their relationship to the surrounding "urban fabric" with little attention given to their regional context.<sup>1</sup> This approach to the city is limiting and perhaps harmful as it perpetuates historical interpretations of the city which may be class and race biased. Though city scale analyses are complicated and require much attention, understanding the regional context may dramatically reshape the way in which one interprets the city, resulting in different conclusions regarding the appropriate intervention.

The city must be recognized as part of nature and designed accordingly. The city, the suburbs and the country side must be viewed as a single evolving system within nature, as must every individual building and park within that whole. ... Nature in the city must be cultivated, like a garden rather than ignored or subdued (Spirn, 1984, p. 5).

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<sup>1</sup>This tendency may derive from 19th Century pastoral idealism in which the city and the country represented vastly different life styles with no acknowledgment of their interdependence and shared interests. The city represented "the machine" and all the problems associated therewith; the country represented nature as a source of physical and moral rejuvenation to which upper classes could flee. Nature, with its transcendental properties was seen as being delegated solely to the country. For further reading on this topic, see John M. Seitz's S.M. Arch Thesis, "Beyond Pastoralism: Through Community Gardens to a Model of Sustainable Design and a Metaphor of Integration," M.I.T, June 1993.

The city's potential to support varied natural systems is too often ignored. At most, designers acknowledge the presence of "green spaces" – a phrase that rings very hollow to ecologists because it fails to describe the kind of life systems supported by such an area.

To the extent that the regional context is sometimes involved in urban designs it is invoked to create an identity for a place through symbols. At the South Loop Site, and in the Midwest generally, regionalism is often expressed in façade elements derived from the historic Prairie Style of architecture. But this form of regionalism may have its limitations as Le Faivre and Tzonis note:

"How can one be regionalist in a world that is increasingly becoming one global economically and technologically interdependent whole, where universal mobility is taking architects and users across borders and through continents at an unprecedented speed? More pointedly, how can one be regionalist today when regions in the cultural, political sense, based on the idea of ethnic identity, are disintegrating before our eyes? Given this loss of region, how is it possible for regionalist architecture to be anything more than, at best a sentimental cozy indulgence in nostalgia for a bygone era... citing highly typified regional fragments and gluing them together in a fake pastiche, kitsch, good only for commercial facilities, restaurants, hotels, and other emporia; or at worst, a form of atavism, a setting for xenophobic, neotribal racist hallucination? (Tzonis and LeFaivre, 1990, p. 27)



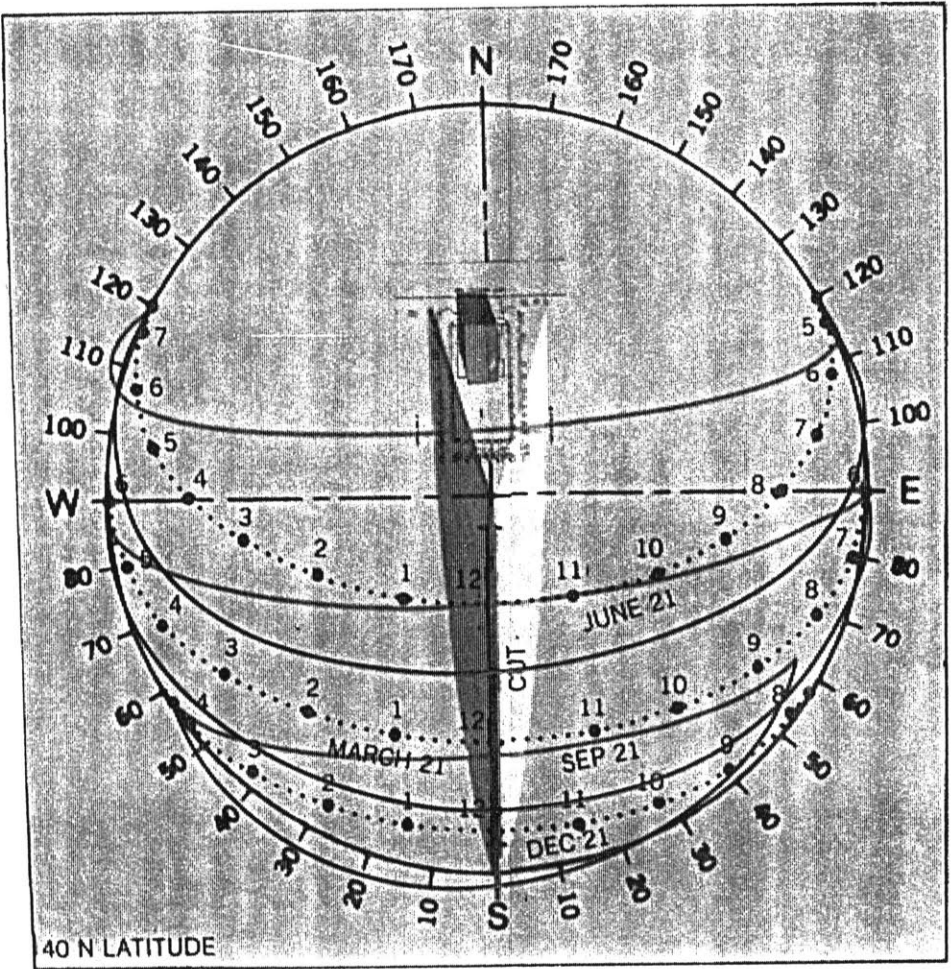
Lack of any regional understanding perpetuates a "heaven and hell" dicotomization of country and city which is helpful neither socially nor ecologically to either area. On the other hand, a literal lifting of regionalist symbols may perpetuate a nostalgia that is exclusive and damaging in social terms (i.e. the Heimatsarchitektur prior to World War II). Moreover, such regional symbolism is often oblivious to ecological concerns. Tzonis and LeFaivre propose that the answer to this quandary resides in a more rigorous form of regionalism that is highly "self-questioning and "self evaluating," referred to as Critical Regionalism. Frampton defines critical regionalism further:

"...the fundamental strategy of Critical Regionalist is to mediate the impact of universal civilization with elements derived indirectly from the peculiarities of a particular place...[It] depends upon maintaining a high level of critical self-consciousness. It may find its governing inspiration in such things as the range and quality of local light, a tectonic derived from a peculiar structural mode, or in the topography of a given site."

Critical regionalism then, defends against the obsolescence of the region, but studies the region with a critical eye. It is this critical eye that serves as the interface between sustainable design and critical regionalism. Sustainable design cannot only be a return to the good old days, for as ecological histories and the more critical social histories reveal, the good old days were

less than ideal. Sustainable design then very much requires a critical eye to discern how connection to the past can be retained while understanding that much of the past must also be undone and a connection to the future built.

Frampton notes that fundamental to this critical eye is the observation of some simple physical facts about a region such as a site's position relative to the sun and topography. Similarly, environmentally sustainable design considers regional weather patterns (e.g. wind), geographic conditions (e.g. soil and water) and native plant and animal species. Moreover, sustainable design has the potential to add a dimension to critical regionalism; the critical eye of a sustainable design scours the region not only for what tradition the design may carry on, but also in terms of what impact the design will have on the region. Sustainable design takes should take the "ask not what your region can do for you, but rather, what you can do for your region" approach—the ultimate self critical act.



*A model of the seasonal and diurnal sun paths specific to the South Loop Site informs the orientation of the proposed design to facilitate natural lighting.*

#### 4.1.1 Implications of Regional Climate Sustainability: Sun and Wind

Designs that are sensitive to the sun and wind are likely to be more energy efficient and comfortable for inhabitants than those which ignore these conditions. The sun is particularly important to the design of the South Loop School on two grounds. First, Chicago's climate makes it important to harness as much warmth from the sun as is possible during the harsh long winters. Improved energy efficiency has beneficial economic implications at the city level and also means a reduction in the levels of air emissions associated with the combustion of fossil fuels, having both local, regional and even global air quality implications. Second, artificial lighting is a primary energy requirement for schools. Natural lighting is simultaneously more pleasant, inexpensive and environmentally conscious than artificial lighting powered by the nuclear plant in the region.

In conjunction with capturing the solar energy, the design must protect against the site's harsh winter winds coming from the northwest while taking advantage of the summer breezes coming from the southwest. A design which is sensitive to these wind conditions can reduce the energy needed to heat the building in the winter and cool it in the summer. Design guidelines based upon the sun and wind observations above are as follows:

#### Lighting

- Introduce a more inviting and translucent facade to the building
- Interrupt and open up the section of the building to allow light to be maximally distributed throughout .
- Reconfigure the original continuous roof line in order to reveal glimpses of the sky and to light corridors naturally.
- Use strategically placed overhangs to let winter light in while shading spaces from the higher summer sun.

#### Heating

- Create sun spaces (classroom and larger spaces) which can collect and store solar heat as well as provide a different light condition to occupants.
- Retain continuous and relatively unbroken façade on the north side to protect from harsh winter winds and noise from nearby elevated road.
- Retain uses that can withstand colder temperatures on the north side of the building as a buffer zone (e.g. kitchen, storage, receiving room, mechanical and electrical rooms).
- Locate trees (conifers) and shrubs strategically to protect building from harsh winter winds.

## Cooling

- Provide flexible structure to the southeast capable of opening up and letting in summer breezes
- Use deciduous trees on the south side of the building to shade spaces in the summer
- Introduce adjustable (interactive) awning devices which can shade spaces with greater control than trees
- Introduce a passive (evaporative) cooling device such as a fountain in collective space.
- Roofs may collect and deliver water to such a system.

#### 4.1.2 Regional Topography Implications

The South Loop School sits near a major topographic characteristic-- the Chicago River. The Chicago River carries the treated outflow of the city's water system as well as cleaner water from Lake Michigan. It flows into the Desplaines River which then flows into the Illinois River which flows into the Mississippi River and ultimately ends up in the Gulf of Mexico. There are two questions involved in considering this topography:

- 1) How may the river potentially benefit the new school plan?
- 2) How might the school affect the river positively?

In other words, is a mutually beneficially relationship between the school and the river (along with its regional implications) possible?

A more responsible and sustainable treatment of the waterway would end exports of poor quality water to other regions. There are a few options for improving this situation:

- Initiate water conservation efforts.
- Return the river bed to a more ecologically diverse state so that it can act more as a natural filter.
- Institute localized water treatment facilities which can treat water without adding huge amounts of harmful chemicals like chlorine.

All three options potentially provide a richer learning environment for the School. Water conservation efforts such as roof water collection devices can sensitize students to the issue of water as a resource and can be interactive. A richer river bed supports a greater species diversity (plants and animals) which, in addition to benefiting the local and regional ecology, can be helpful in science lessons. A local water filtration facility such as the solar aquatic system can act as both a science lab and as a peaceful retreat for students.

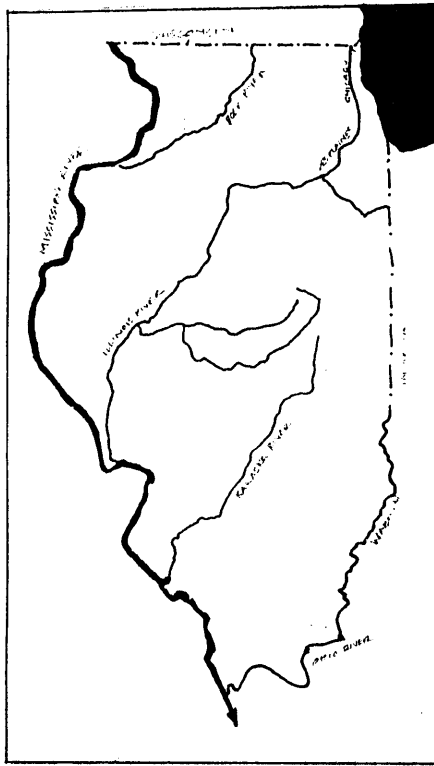
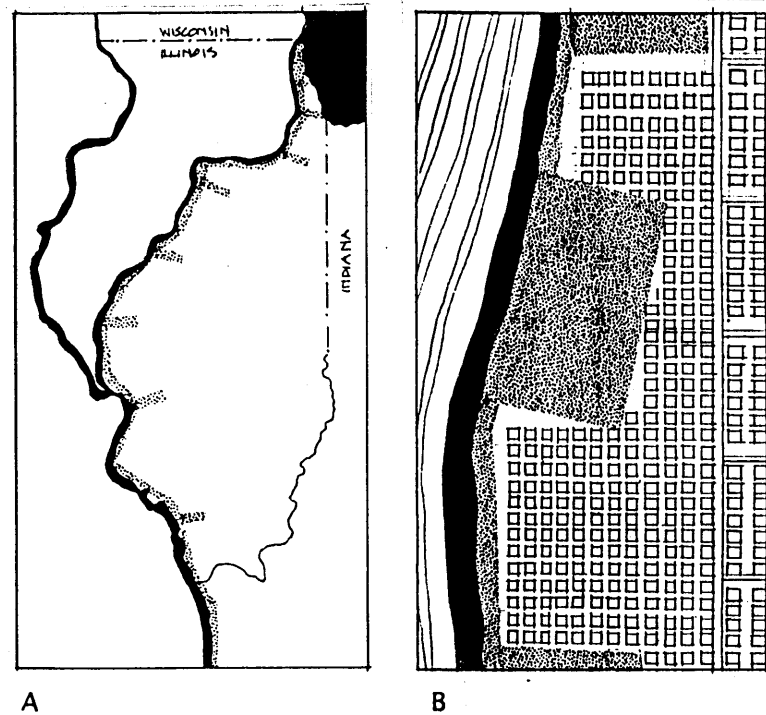


Figure 4.1

Figure 4.1 shows the relationship between the South Loop Site and the regional river system. The Chicago river feeds the DesPlaines which feeds the Illinois which feeds the Mississippi which feeds the Gulf of Mexico.



Figures 4.1(A) and 4.1(B) show the proposed concepts for the school river site scheme at the regional and urban scales. (A) A biopreserve to enhance ecological diversity runs continuously along the river, expanding at points to relate to local environments and support human activities. (B) The biopreserve expands and contracts, meeting the urban fabric to different degrees at various points.

### 4.1.3 Regional Geography Implications

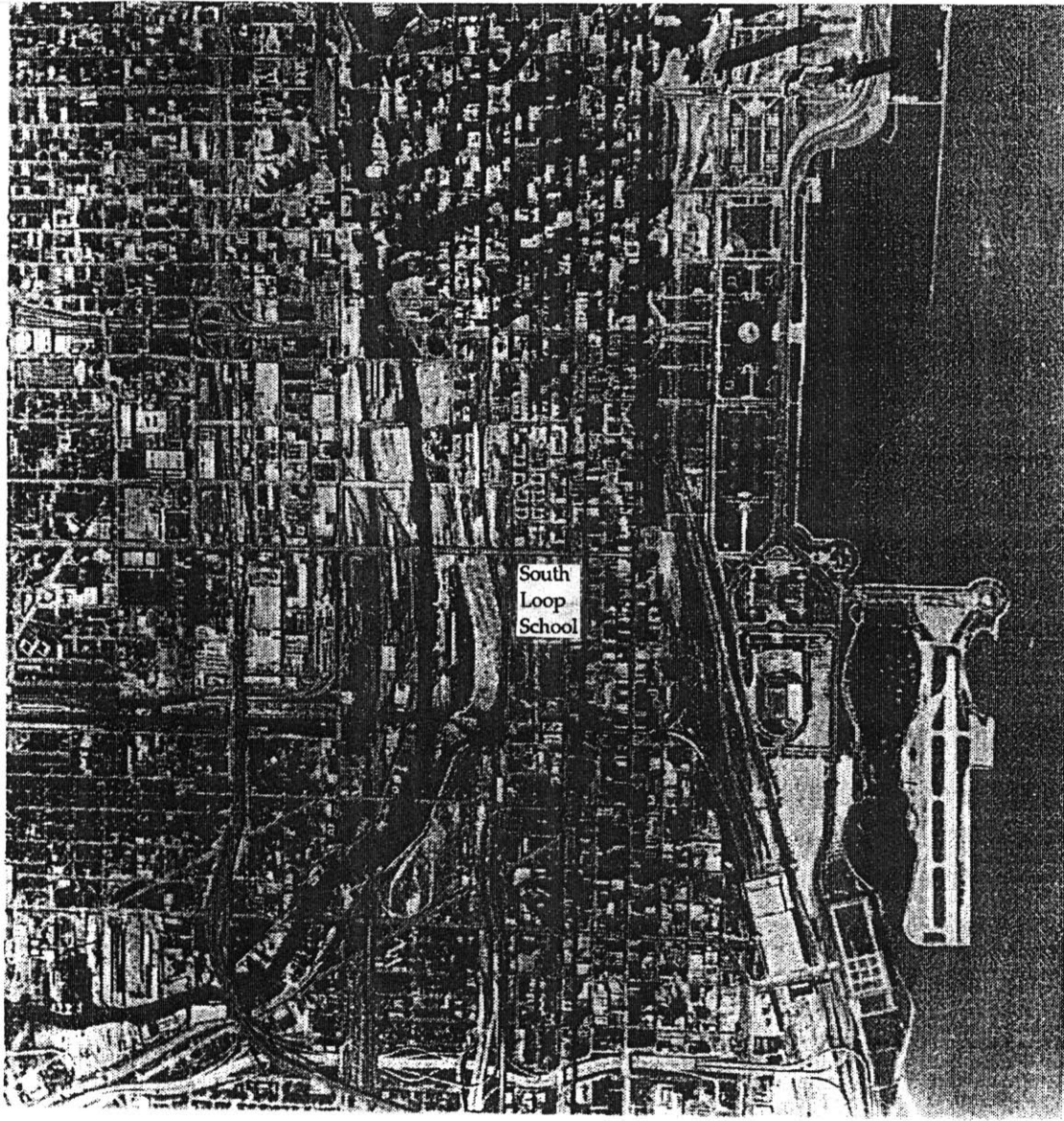
In developing designs for buildings, the geography of a site as it relates to human occupation is often analyzed. Also analyzed is the proximity of the site in terms of travel patterns and resources (social, institutional, commercial, and natural). Less analyzed is the site's relationship to animal habitats and travel patterns. This oversight is especially true of urban areas, commonly considered devoid of wildlife.

Bird populations are particularly important to note at the regional scale because they traverse regions annually. The list of birds sighted in the Chicago area exceeds the list of birds which breed and dwell in the area because many must stop there on their annual migrations from the north (Canada) to the southern hemisphere (see Appendix). In addition birds typically located in regions to the west of the area are found in the Chicago area because Lake Michigan serves as a barrier to their travels eastward (Bohlen, 1989). Once viewed in these terms, the need for expanded tree canopy on and around the school site to support these species becomes apparent. The minimal existing tree cover found in cities may still play a crucial role in the survival of some unexpected bird species despite the fact that the area is urban and is not typically understood in terms of its potential as a bird habitat.

Biodiversity is one of the key issues in discussions about sustainable environments. The greater the diversity, the

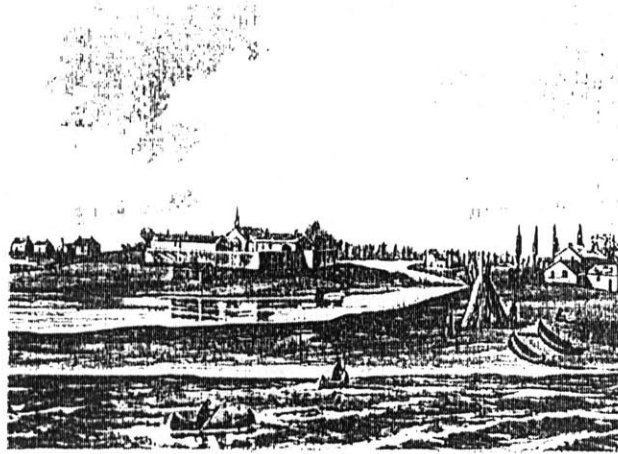
more able a system is to survive shocks. It is for this reason that native plant life is encouraged in plans for sustainable ecosystems. In restoring a native plant population to its region, it is also possible to increase biodiversity. The school site's region supported a mosaic of prairie, woodlands, various species of grasses as well as oak stands before Europeans settled the area (Bohlen, 1989). These species might be successfully reintroduced into the region. Many such species are on the verge of extinction and the lessons their particular ecosystems might teach run the risk of being permanently lost. As Bohlen has noted, what we need now is to find a way not only to coexist with our remaining native environment but actually to revivify the parts we have already damaged.

The regional geography may also inform the selection of relatively sustainable materials. Sustainability studies may focus on these issues in order to define the flows of materials and products such as food so that more localized patterns can be reinforced. In the South Loop School's region, Indiana limestone and local cement quarries have historically provided locally manufactured building materials. There is also a preponderance of glazing manufacturers in nearby Wisconsin. Most wood products are imported from relatively great distances.



*Aerial Photo showing South Loop School in relationship to the business district ("Loop") in Chicago.*





*View of the Mouth of the Chicago River at Fort Dearborn near the coast of Lake Michigan. Figure Reference: Chicago Department of Planning (1973). The Riveredge Plan of Chicago. City of Chicago, Richard Daly Sr., Mayor; p. 6.*

## 4.2 Analysis of the Urban Context

The redesign of the South Loop School site requires that the city be analyzed in two ways. An examination of the site in terms of its urban ecology is part of a more sustainable approach to design. First, the site's proximity to the river requires an understanding of how nature works within the gridded street pattern of Chicago. Second, since the project involves a school, the area must be examined in terms of the potential to forge spatial and programmatic links between other city resources.

### 4.2.1 History of the River Edge Site: Ecological Changes Over Time

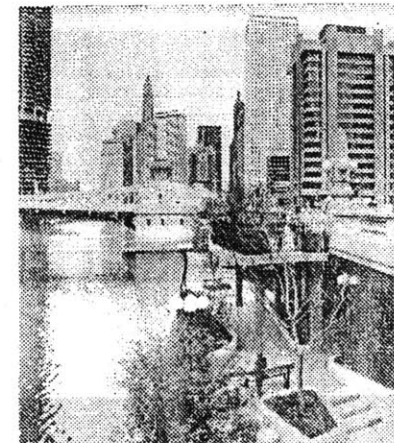
The South Loop School site is located on a patch of land adjacent to the Chicago River and what is now called Roosevelt Road. This section examines an urban site in terms of the changes incurred by its ecological structure over time. Much of the information about the ecosystem specific to the South Loop School site was extrapolated from ecological history of the nearby Chicago River. This look at the area reveals the long history of human intervention on the local ecosystem, spanning from the era preceding European settlement (1600s) to the present. The site has supported hunting/gathering/farming, pre-industrial trading, farming (European) industrial and postindustrial societies. In these

periods its use has ranged from food source to industrial wasteland with intermittent periods of recreational use. Human intervention in the area has been constant , (though not continuous in method) since the 1600s. The river has undergone significant changes in the type of human use, intensity of human use, ability to support other species, and degree to which it has been engineered. With these changes have come drastic changes to the river bed, with ecological shock waves sent inland. Conversely, different land uses have affected the river directly and indirectly. This examination of the site's changes in ecological structure over time results in a proposal for future human intervention.



*Figure Above: Construction of an expressway next to the river, circa 1955. Chicago Department of Development and Planning (1974). Riveredge Plan of Chicago, City of Chicago; p. 31.*

*Figure Below: The park built between the river and the underground expressway at this branch of the river has enjoyed limited success; it is small, discontinuous and not easily accessible from the street level. Photo circa 1973. Chicago Department of Development and Planning (1974). Riveredge Plan of Chicago, City of Chicago; p. 3.*



### **Native American Inhabitation: 1600s**

The area was first visited by Europeans Jacques Marquette and Louis Joliet, in 1673. The picture painted by Lois Wille of the area prior to this visit is as follows:

Eventually [small bands of Potawatomi families] came to the wind-whipped dunes of the southern shores and saw buffalo drinking at the water's edge, deer and wolves racing through the inland woods, turkey and ducks and geese in the marshes. Good hunting...

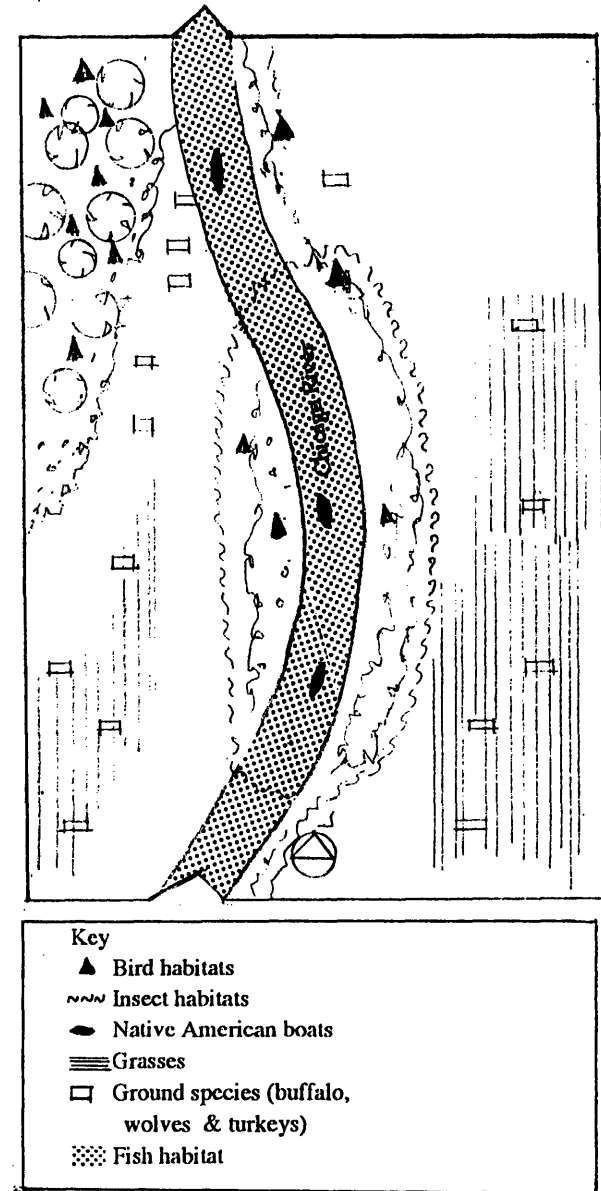
Predecessor tribes, the Miami and the Illini, had moved to the south and west, respectively. The trails they left behind facilitated trade among Chippewa and the Ottawa, neighbor tribes to the north and west. Wille writes:

trails... converged at the spot where the lake took the waters for the little river Checagou, named for the powerful wild onion that grew along its banks. By traveling south on the Checagou and then carrying their canoes on their backs and sloshing several miles through the mud, they could reach the waters of the Des Plaines... the Illinois... and the Mississippi. In the summers they lived a family life in cone-shaped, bark-covered lodges along the rivers and streams. The women grew corn, squash, pumpkins and beans and gathered the wild rice that grew along the banks of the Checagou. In fall the men moved to temporary hunting and trapping camps, and in spring they went west deep into the prairie for the great communal buffalo hunt.

These scenes imply a complex ecosystem that was already undergoing changes associated with human occupation. Native plant species listed included onions and rice. There were wooded lands (oak stands) from which the Potawatomi drew bark to construct their lodges. It is unclear how much this activity affected the tree population. Movement of these tribes along with the farming role of women resulted in the introduction of exotic species like corn, squash, pumpkins and beans to the settlement area along the river. It is likely the South Loop Area supported such activity. Farming techniques, such as burning, preserved native species (i.e. prairie grasses and oak openings). Periodic loadings of ash to the river could have resulted from with these burnings. While Nitrogen and Phosphorous loadings to soil and to the river may have increased as a result of human settlement in the area, the simultaneous reduction of herbivores (e.g. turkeys, bison, elk) through hunting or territorial displacement may have offset this increased level of fertilizer. Wille's description also emphasizes the use of the river for trade and transport. Though boat activity may have been frequent, the small size of the vessels (canoes) probably inhibited any significant disturbance to the river bed and to bird nesting areas.

### Fur Traders and Settlement: 1775

Since the time that native Americans introduced explorers to the Checagou river as a short cut, use of the river as a trade route steadily increased. By 1775, the U.S. government considered the trade important enough to protect and established a military base at the mouth of the river. DuSable, a Haitian-born fur trader established the first cabin nearby in 1779. Thus, a village was born at the mouth of the river and a marked increase and change in the type of human use of the river commenced. With traders and a military base came larger boats delivering imported goods. Larger boats may have caused significant disturbance to the riverbed. However, this damage was probably seasonal, (limited to times when the river level was high enough to support ships), and might have allowed certain species to recover seasonally. Native prairie grasses and oak openings may have been healthy at this juncture. The river flowed into Lake Michigan at this point; waste resulting from human settlement at the mouth probably did not affect the Roosevelt Road site.



### Town and City Status: 1830s

Trade and subsequent settlement (involving cabin construction) greatly expanded in this period, resulting first in the incorporation of Chicago as a town in 1833 and later in its gaining city status in 1837. Building needs within the city were satisfied by harvesting timber from the wooded area. Species in these areas, such as birds, may have fled due to disturbance of nesting areas and competition with European species (e.g. starlings, house sparrows, etc). Farmers drew more heavily on local wooded lands than had the native Americans, as they built larger structures. Native American use of local resources (wood) involved cultivation (a sustainable practice) whereas European settlement involved mining of local resources, where regeneration could not keep up with removal.

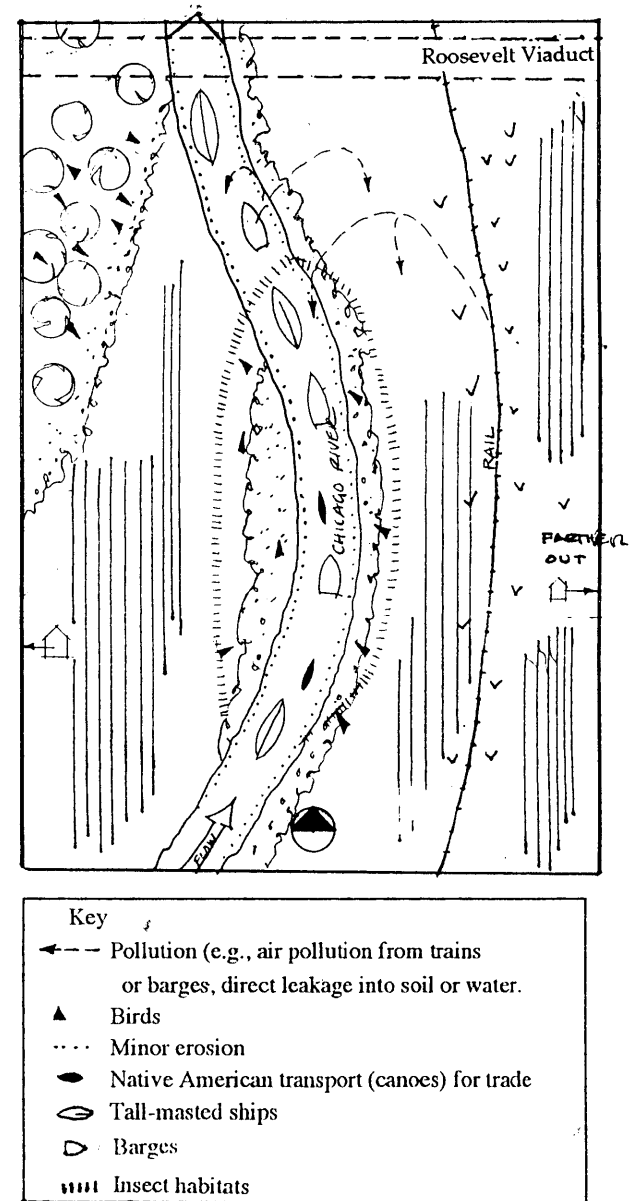
Expansion of European settlers and the parceling of property in outlying areas meant the native Americans were no longer controlling the ecosystem. Though Native American land management techniques (controlled burning) ceased, some have speculated that native grasses survived because the farmers who assumed control brought cows and initiated grazing.<sup>2</sup> Light grazing retarded deterioration of grasses in the absence of fires (Jordon, 1993). Therefore, grasses survived this change.

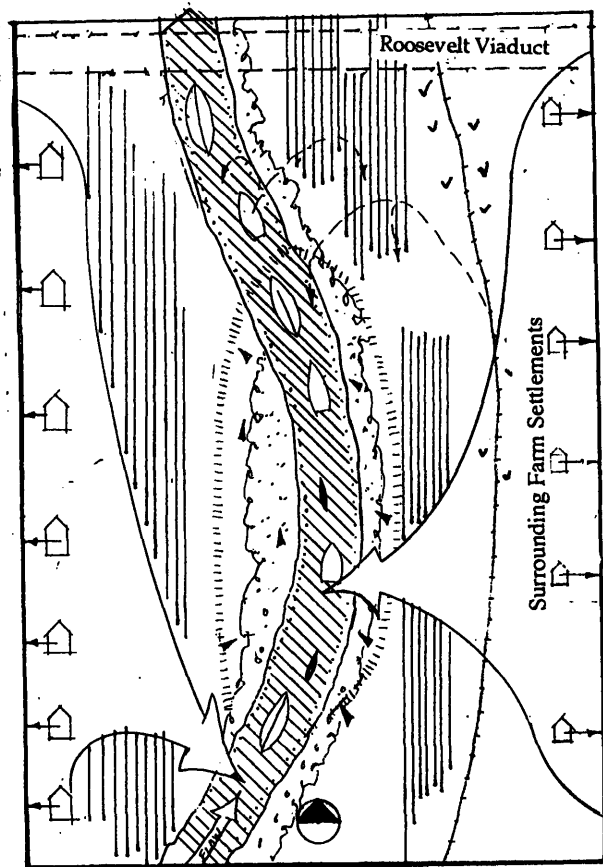
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<sup>2</sup>Burning techniques had supported the persistence of grass species by limiting competition from weeds and trees.

Farm settlements meant increased animal waste loadings for the river, which may have altered its plant and animal life. Waste from human building and occupation was probably dumped into the river at quantities greater than at any time previous. Plant species that could tolerate increased nitrogen loadings from farming along with increased noise, air pollution (resulting in water and soil deposition) and movement from larger and more frequent shipping vessels survived. Amsted ships carrying shipments of grain from the south that came up the river during this period likely caused more disruption to river bed species. Additionally, tug boats probably emitted particulates and other combustion by-products such as SO<sub>2</sub>, thus altering the river chemistry and perhaps the species diversity it supported.

This period marked the first human engineering of the Chicago river; a 200 foot wide harbor was built at the mouth. While this change occurred a couple of miles north of the South Loop School site, it may have changed the flow rate of the river and thus the ecosystem. If increased transport in the river cause riverbed changes, increased flow rates might have further exaggerated the erosion problem. Increased erosion might have encouraged the meandering of the river and its carving into the Roosevelt site. Concurrent development in down state Illinois was burgeoning during this period and pollution loads into the river likely increased.





**Key**

- ←--- Pollution (e.g., air pollution from trains or barges, direct leakage into soil or water.)
- ▲ Birds
- ..... Minor erosion
- Native American transport (canoes) for trade
- Tall-masted ships
- △ Barges
- ++++ Rail tracks
- sewage in flooding

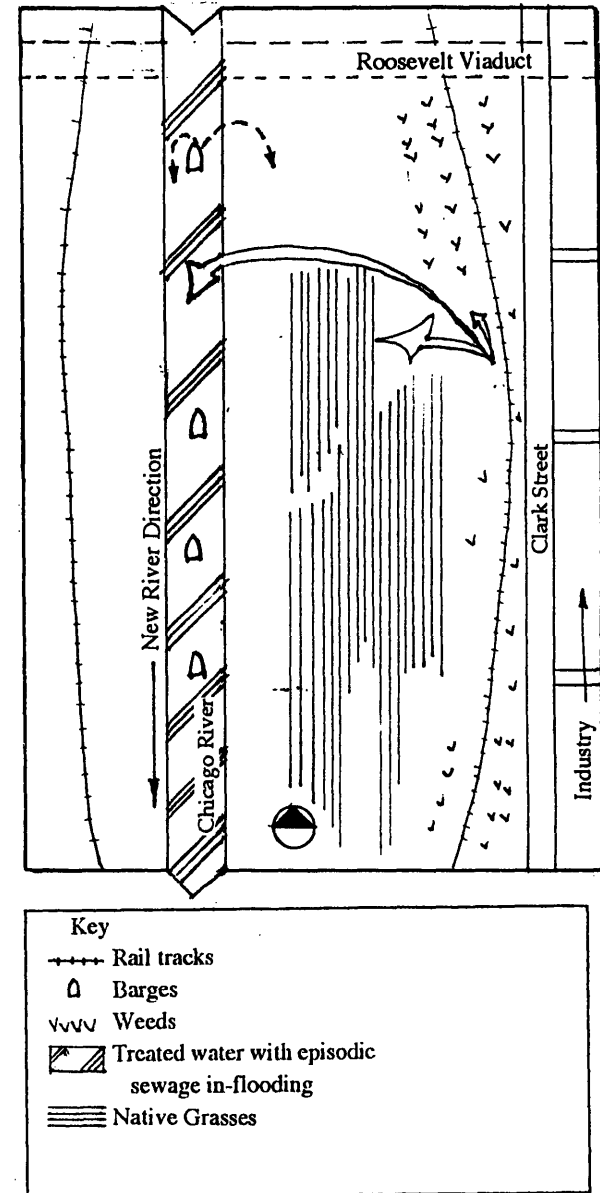
### Waste Disposal Problem: 1850s

By the 1850s, human settlement had increased, expanded and became more dense. By this time, sewage was delivered directly into the river, ultimately ending up in Lake Michigan. Meanwhile, the pollution associated with combustion-powered water transport remained. Only species (e.g. snails) that could survive both the high levels of bacteria and acid loadings could have survived. The river was believed to be a primary source linked to the transmission of cholera .

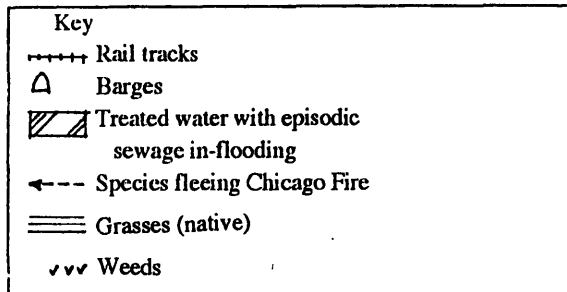
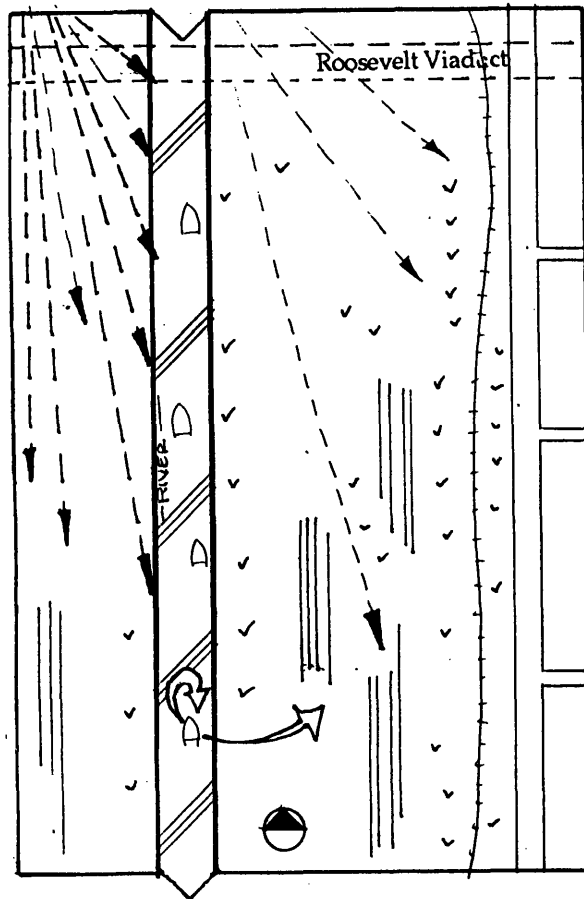
Rail emerged as a major transport source during this period. The laying of rail tracks required the upheaval of soil with consequent effects on ground species of animals and plants. In these early days of rail installations, prairie grasses may have been able to survive, depending on how disturbed adjacent soil area was. (Later the grasses would have more trouble surviving the dispersal of crushed rock over rail right-of-ways that accompanied fear of fires). Air emissions from trains, (i.e. particulates and sulfur) affected land and water indirectly. Noise from trains may have scared animal species away. The South Loop School Site was home to multiple rail lines.

### River Reversal: 1860s

Epidemics of the previous decade resulted in a massive river engineering project. The flow of the river was reversed so that it no longer fed into Lake Michigan. A sewage and sanitation outflow control system was put in place and the riverbed was dredged. The river rate was carefully controlled to allow navigational levels of water that could simultaneously operate the sewage treatment plant. The massive reconstruction of the river destroyed the river bed (along with associated wetlands, flood plains or forests) near the South Loop School Site. The engineering also converted the surrounding area into a drier landscape which may have made it more prone to fire destruction. Instead of being at the end of a river into which sewage and other pollutants had been dumped, the site was now located near the river's mouth, Lake Michigan. However, during periods of flooding, untreated sewage was still dumped into the river. This excessive nutrient input changed from being continual to episodic. Plants and animals sensitive to such episodes could not survive. Even plants and animals that had become dominant in the river because they were tolerant or dependent on previous sewage loads probably also had difficulty adjusting to these sudden influxes of Nitrogen and Phosphorus. Additionally, the river was used for industrial uses with heavy chemical inputs such as tanneries.







Meanwhile rail use increased. The amount of space on the South Loop School Site specifically devoted to rail car storage increased, perhaps increasing the amount of leakage of contaminants like petroleum products to the soil. Remaining plants were predominantly weedy species. Land that had been previously used for farming near the South Loop School site was parceled into smaller pieces and developed for more dense urban settlement. With this beginning of urbanization came pollution loadings associated with boats and human waste at levels most fish and plant species probably had difficulty enduring.

#### The Great Fire: 1871

The fire originated only a mile away from the South Loop School Site and swept through the rest of the city. One ecological result of this episode may have been the addition of debris and other burnt matter to the river. As a result, species sensitive to this carbon and debris loading may have had difficulty surviving. With light less able to penetrate the depths of the river, water plants probably had difficulty surviving, with subsequent repercussions to other species in the food chain (e.g. plant-eating fish). Because the South Loop School Site narrowly escaped the fire, it may have become one of few areas to which species fled, human and animal alike.

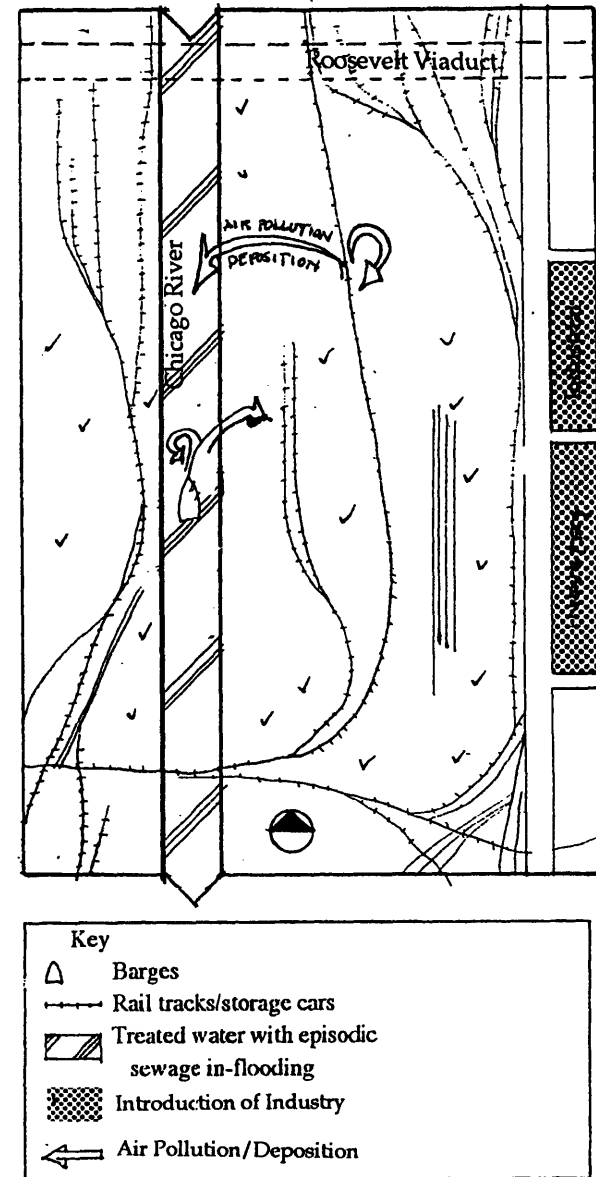
This shift may have caused new competition dynamics among animals for plants and prey in demand.

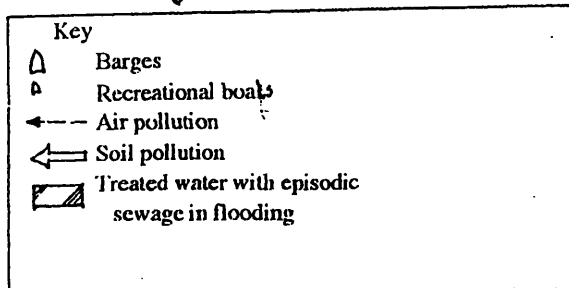
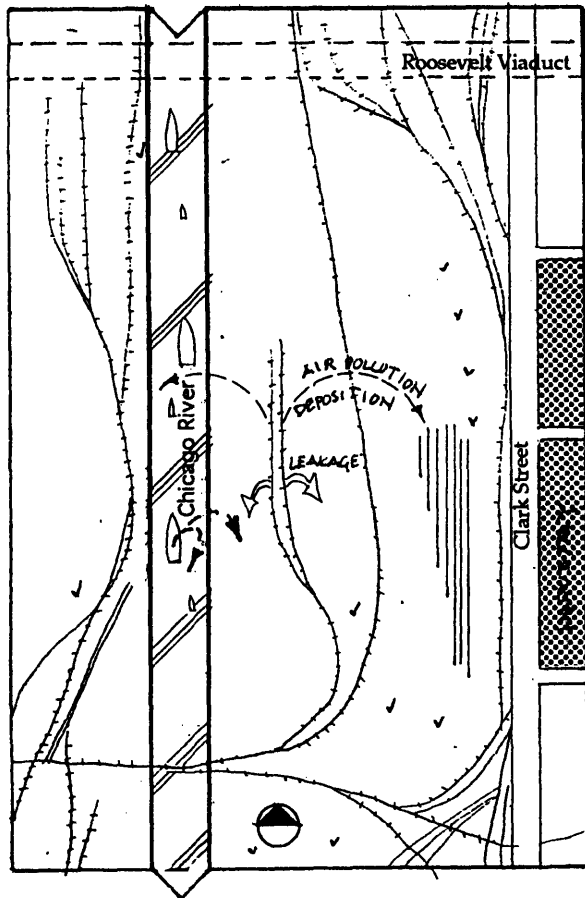
The rail lines took over as a means of transport during this period, spelling a decline in river transport. Consequently, pollution to the river and the surrounding area decreased from boats. Pollution loads from trains probably more than supplanted boat and ship pollution. Trains may have added noise to the type of pollution present in the area.

#### The End of River Transport: 1880

Ship transport on the Chicago River drastically declined by this point, having been replaced by the dominant mode of transportation— the railroad. (Illinois Central filled in 80 acres of land along the Lake at the river mouth). This increase may have meant more direct leakage from storage cars sitting on the site, air pollution (particulates and SO<sub>2</sub>) from moving cars and deposits of creosote into the soil. Episodic in-flooding of sewage into the river continued during heavy storms. With the expanded role of trains, rail roads required more space for both tracks and storage of freight cars. Straightening the river would give more land to the adjacent rail line while making barge navigation easier.

The ecology of the riverbed had been quite disturbed by this time due to the traffic of large vessels that traveled through. In shifting the river however, this project removed





the river bed altogether along with all the life that the natural transitional zone supported. Insects which fed on the river edge plants disappeared and birds along with other predators had to search elsewhere for food.

#### First Recreational Use: 1900-1930

Use of the river for recreational excursion boats became a commercial endeavor during this period. Limited use of barges continued. This increased boat traffic overall may have resulted in more air pollution (and deposition to the river and nearby soils) and more contamination of fuels directly into the river. With recreational use, there may also have been an increase in litter, possibly with the result of attracting some scavenger species like rodents, gulls etc. Soil contamination and air and noise pollution associated with trains continued. Episodic sewage in-flooding of the river also continued.

#### New Means of Transport: 1930-1950

Use of barges was minimal by this point. Train use continued. Economic constraints associated with W.W. II efforts required a cease to the use of the river for recreational purposes. The new noise and air pollution input to the environment during this period came from increased use of motorized road vehicles. Animal species sensitive to air and noise pollution had probably already ceased to exist in the

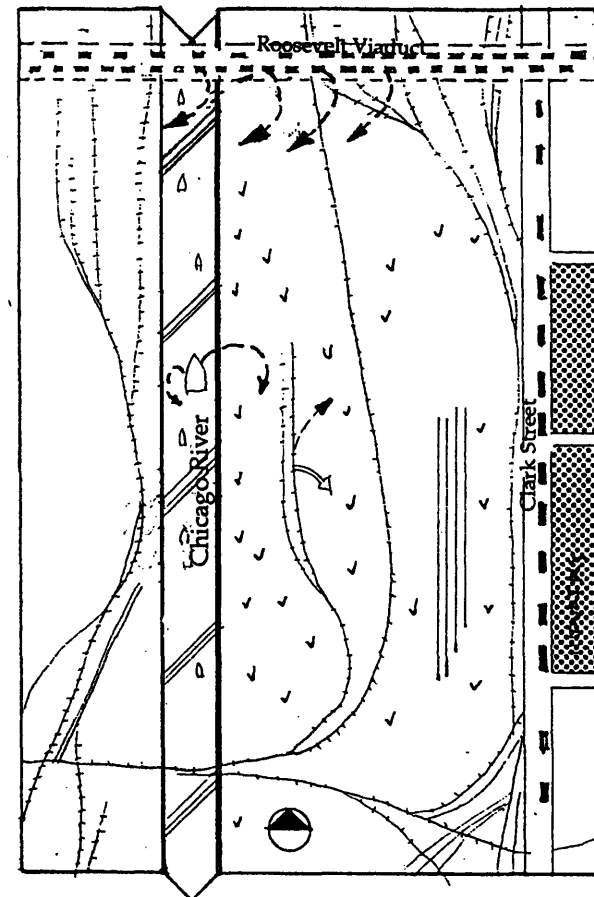
area. For species remaining, the surrounding corridors now carrying faster vehicles might have acted as death sinks. Episodic inflooding of sewage into the river continued.

**More Automobile: 1950-1972**

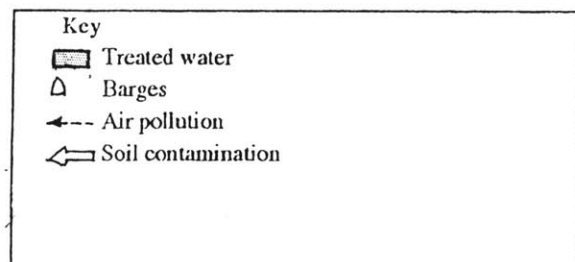
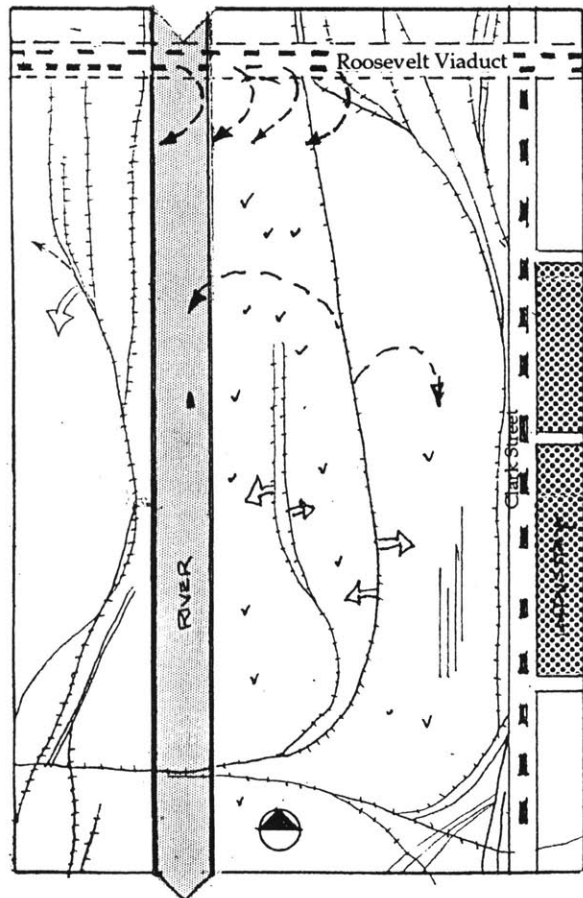
This period experienced dramatic increases in the use of motor vehicles. Trucks now transported much of what railroads previously had, so rail traffic declined. Minimal and specific uses of barges continued. There was a resurgence in use of the river for use by recreational boats in this period. Periodic in-flooding of the river with sewage continued during extreme floods. Between 1957 and 1972 locks to the Lake were opened three times as a result of overflow from storm water, allowing back flow of the river into the Lake.

**Deep Tunnel Project: 1985**

The deep tunnel was constructed to handle flood waters and expand the municipal water system. The effect of the deep tunnel to the river is that period in-flooding of sewage no longer occurs; only treated water (with chlorine) is fed into the river. Species tolerant of this specific water chemistry can take over. Barges still occasionally use the river. Rail use has declined significantly, with tracks running along the east side of the river but not in use. With less air and noise pollution from trains on the east side of the river, land to the



Key	
■	Automobile traffic
△	Barges
○	Recreational boats
---	Rail tracks
←--	Air pollution
←	Soil contamination



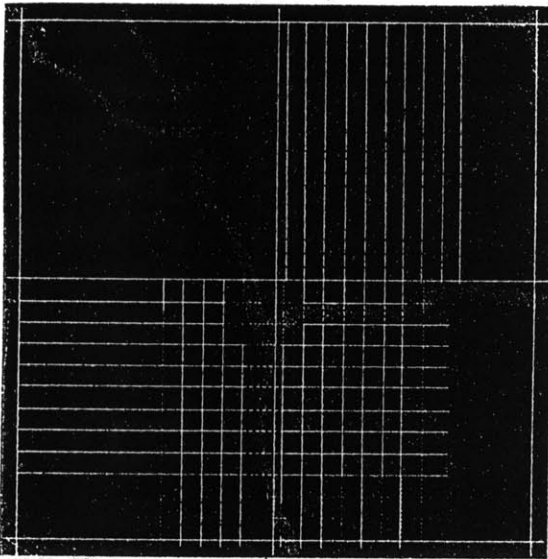
east of this site began to be developed for housing during this period. The introduction of residences with fireplaces may mean deposition to the site of byproducts from the combustion of wood. Air and noise pollution associated with automobile use continues.

**Existing: 1994**

Construction of residences to the east of the site continues. Many rail tracks have been removed but many remain. Removal may allow some plant species to increase. Other pollution loadings continue. Typical to city soils, the soil on this site is probably compacted, with low levels of nutrients and high alkalinity levels associated with construction and refuse. There may still be deposits of lead from historical use of leaded gasoline. And proximity to the street means that there may be pollutants associated with the vast amounts of de-icing salt used (Horbert, 1982).

The 20th century has witnessed a dramatic decline in many of the largest pollution sources (e.g. trains, barges and untreated sewage). However, other sources of pollution have been introduced; there have been periods of recreational use of the river; automobiles increasingly pose noise and air pollution problems; and the river is dependent upon lake water quality changes. From this history, it is reasonable to deduce that the river probably supports only a few resilient scavenger species

(snails) or perhaps species recently introduced (i.e. zebra mussels). The river bed as a riparian buffer zone, with its ability to clean water and act as habitat for a variety of species, is nonexistent at the South Loop School Site. The soil probably has a poor nutrient level, not having had any nitrogen input for over a century. Furthermore, a century of toxic chemicals associated with storage leaks and rail tie treatment (creosote) and deposition from air pollutants (including SO<sub>2</sub>, NO<sub>x</sub>, and lead) have rendered a potentially harmful soil. Nonetheless, through remediation of these chemical inputs and development of the soil's nutrient base, the land may once again support certain native grasses along with a relatively diverse plant and animal population. The proposal (Chapter 5) for the school and its river site annex is rooted in this contention.



Figures from Gandelsonas, 1991; pp. 70 and 73.

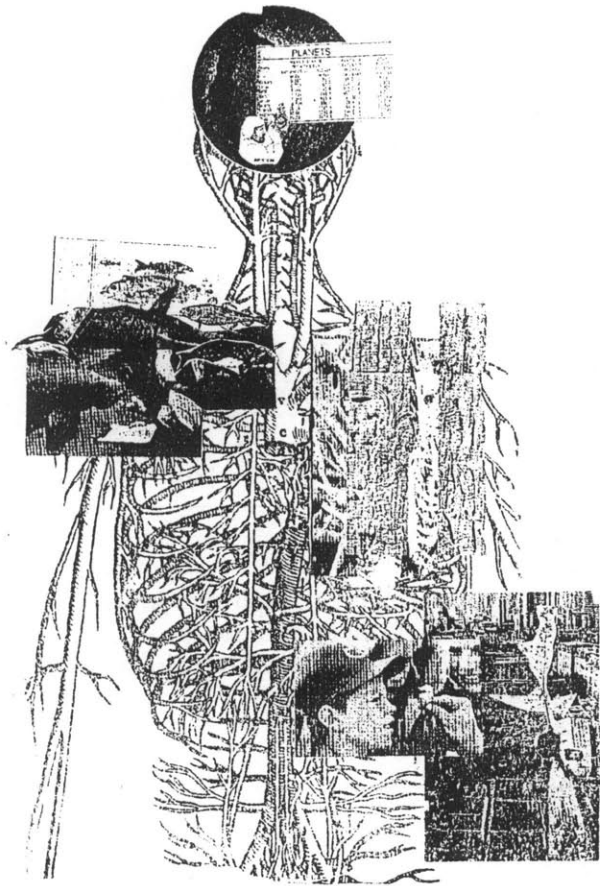
#### 4.2.2 Where the Grid and Topography Meet

Chicago is renowned for its rigid and systematic grid iron layout. Less discussed, however, is the fact that the combination of topographic disruptions and historical paths (Native American trails) cause breaks and shifts in the grid which greatly facilitate movement in the city. Contrary to common belief, the city's layout is not based strictly on the equilateral grid, but rather rectangular, with the length of blocks running parallel to the lake coast. The city runs predominantly north south in conjunction with its largest topographic feature-- the lake coast. The irregular edge of Lake Michigan cannot be tamed by the grid iron street pattern. The result of this meeting is a continuous zone of parks that mediate between the irregular lake edge and the grid iron street patterns. This park zone expands and contracts as is needed to bring the two together. This zone is perhaps Chicago's most vital area as it supports a vast range of activities and people.

The Chicago River generally runs parallel to the Lake coast and similarly plays havoc on the grid iron street pattern. To some extent, parks (though much smaller and disjointed) once again mediate between the grid and the natural topography. There is one point at which a fork in the river actually turns direction, becoming perpendicular to the Lake edge thus connecting the river to the Lake. This area of the

river that has received the brunt of attention in terms of planned development. Other areas of the river have remained virtually ignored throughout the history of the city. There is currently a tremendous amount of activity based in this area where the river meets the lake. Perhaps the strength of a move that connects the river- a significant topographic feature (and increasingly considered a valuable resource)-- and the Lake is one which must inevitable also result in a concentration of human activity. The connection of river to lake is perhaps a link that should be mimicked elsewhere in the city, if not topographically, then institutionally.





*The collage above shows the City Resources potentially linked and incorporated into the South Loop School Agenda: Shedd Aquarium, Adler Planetarium, and the Field Museum of Natural History. These resources are located off of the Roosevelt Road spine.*

#### 4.2.3 Linking City Resources

The South Loop School sits between two very strong topographic features, roughly a block east of the Chicago River and six blocks west of Lake Michigan. Analysis of an East-West relationship linking the river to the lake yields several major educational resources: the planetarium, the Shedd Aquarium, the Museum of Natural History and (to the west of the river), the University of Illinois Campus. These resources all share an emphasis on education and on science. There are already plans underway to create better pedestrian linkages between the three museums at the lake's edge. The city would benefit from extending this linkage farther west to the University Campus. Certainly, the South Loop School could benefit from a relationship between these linkages. And as a sustainable school, how better to reinforce ideas which drove the design of the place, than by using city resources more efficiently and exposing students to science in a more experiential way. First the South Loop School must be better linked to its nearest natural resource-- the river. Then this entire river and school site could become a part of a larger institutional and cultural link between the river and the lake. The South Loop School could simultaneously reinforce the city plan and could benefit from city resources.

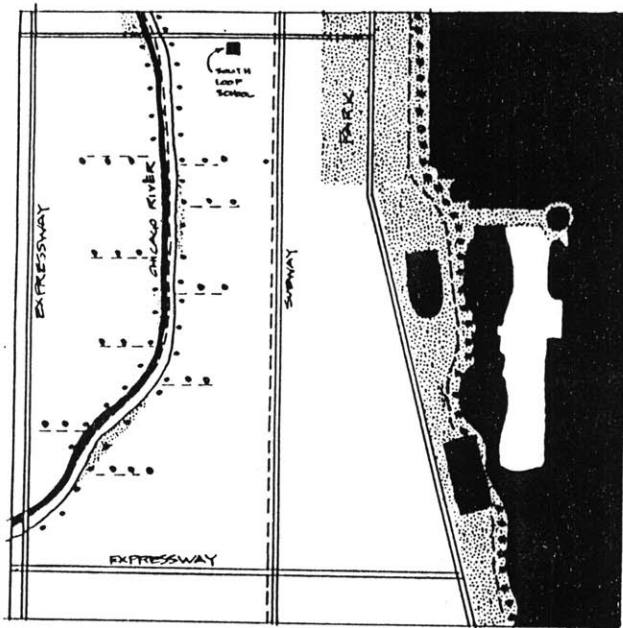
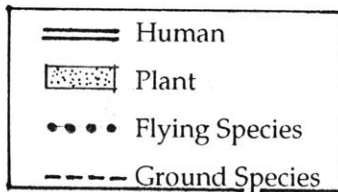


FIGURE 4.3(a). Species Corridors in the South Loop Area.



The diagram locates larger movement paths associated with different species. Human paths shown include subways, elevated trains, and expressways. (Pedestrian paths are not noted as they are generally absent from this area, with the exception of the park along the Lake). Birds and other flying species have the river and the lake as two continuous zones through which they may move. Plants may spread (move) with the airborne dispersal of seeds in areas not heavily trampled and with exposed soil, i.e. the Lake and river. Ground species include animal from worms to larger mammals (commonly squirrels, rodents, cats, dogs, etc.). These species are helpful to the ecosystem in their ability to improve soils (worms) or spread plant seeds (squirrels). It is useful to identify these corridors as a way to either encourage certain species (worms, squirrels, birds, etc.) and discourage other species (rodents). Disturbance of a species movement path may threaten its ability to survive.

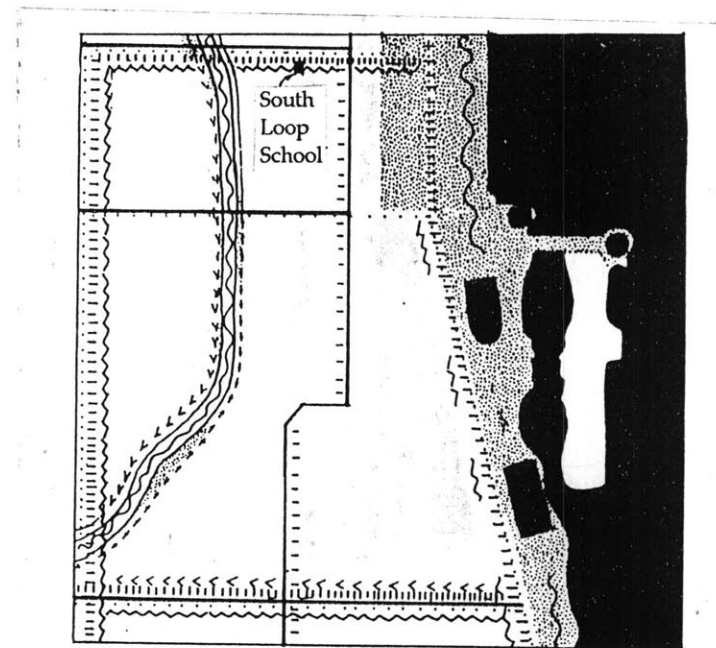
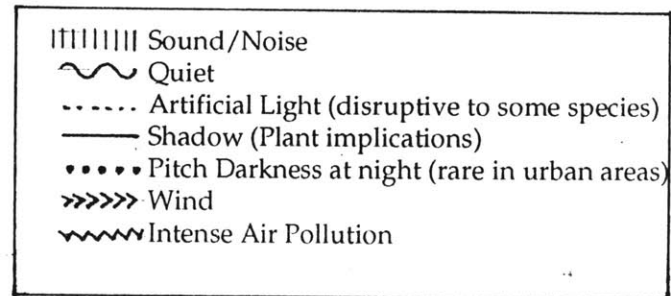
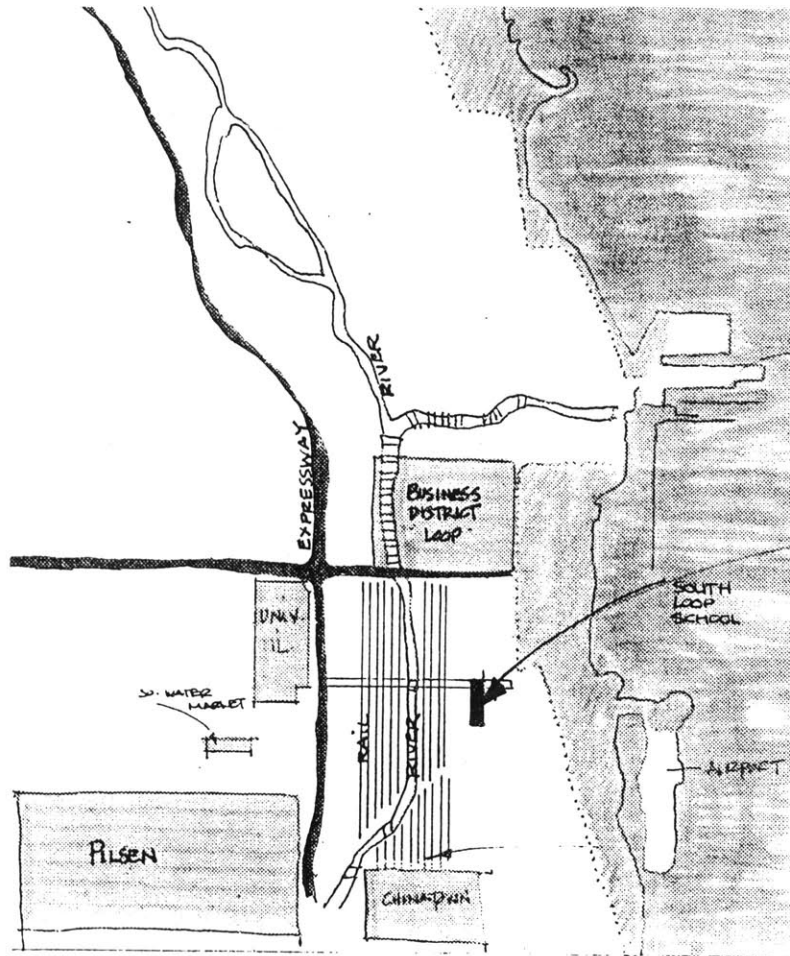


FIGURE 4.3.(b). Kinetic Corridors in the South Loop Area.





The diagram above shows the South Loop School in relationship to surrounding neighborhoods, with Chinatown and Pilsen (Mexican American neighborhood) to the South and the business district to the North..

### 4.3 Analysis of the South Loop Neighborhood

The South Loop neighborhood is currently in the midst of sweeping changes, with large scale housing development occurring in an area that was a post-industrial wasteland until very recently. For continued development to take place most successfully, the neighborhood should be looked at in terms of its role to the larger ecological system and to the larger urban cultural system. Human and ecological diversity should be encouraged.

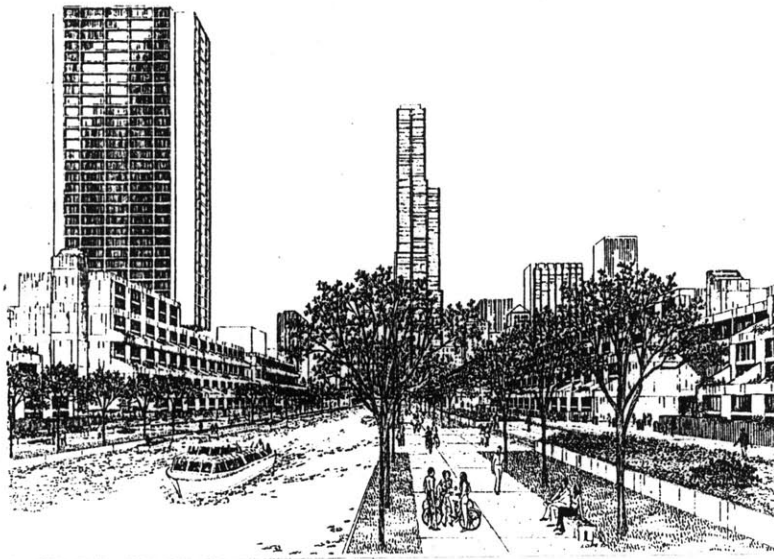
#### 4.3.1 Identification of Ecological Corridors and Barriers

In order to encourage ecological diversity and the survival of species often ignored in the construction of human habitat, it is important to first identify potential habitats. Many land and air species require continuous spaces (in contrast to the scattered and discontinuous smaller recreational parks in Chicago). Ecologists call these continuous strips of habitat "corridors" and seek to maintain their integrity.<sup>3</sup> The diagrams locate potential ecological corridors in and near the south loop area.

<sup>3</sup>The term "corridor" may be confusing, especially to architects, as ecologists do not necessarily mean straight, hard-edged, small scaled spaces. A corridor in ecological terms, often includes habitat "patches", described as "bulges" by some, and can be vast in scale as long as they are directional.

#### **4.3.2 Cultural History of the South Loop Neighborhood**

The South Loop area was a center of activity during the 19th Century, as the center for extensive railway crossings, home to major industry and a survivor of the Great Chicago Fire of 1871. By the middle of the 20th century, however, the area became increasingly severed from the Loop as transportation shifted from trains to motor vehicles. By the 1970s, the South Loop area had become a "wasteland," abandoned by industry, including the rail road companies. Vital business activity shifted either to the North (Central Business District and the Gold Coast) or out of the city completely. Thus the South Loop area effectively became a moat, dividing the Loop from less affluent residential neighborhoods to the south. The construction of major expressways in the area served to further deepen these divisions.



*The drawing above shows a portion of the river as proposed in Chicago 21. Figure Reference: Chicago Plan Commission (1973). Figure 76, "A Plan for the Central Area Communities." Chicago 21, September; p .112.*

#### 4.3.3 Other Proposals for the South Loop Area: The Chicago 21 Plan

In 1973 the blight of the area was recognized in a report by the Chicago Plan Commission, called "Chicago 21". The report proposed a vast development of the area– some of which has been realized. It's primary recommendations called for:

- Residential Communities on the surplus rail yards
- A light rail transit system to serve the area and connect it to the Loop
- "Open Space" development along the River

Despite such alluring recommendations and projections, the South Loop area was left untouched for the remainder of the 70s and for most of the 80s. It became an urban moat between the prosperous Loop area and more marginalized ethnic neighborhoods, including large scale housing projects, to the south. Developers took advantage of the unique opportunity to acquire a large contiguous parcel of land near the city center and have since transformed it into a dense up-scale residential neighborhood.

A couple of the Chicago 21 recommendations have been carried out; old rail areas now support housing and an

extension transit system is planned for the area. Blocks between State and Clark streets are now occupied by a series of mid- to upscale residences that range in size and density. However, many of the objectives "Chicago 21" promoted have either been countered by the current development or not fully implemented. A residential area has been introduced in the old rail area but it does not "accommodate a balanced social and economic mixture of people." Furthermore, the development is singularly residential and so does not "retain an employment base in the South Loop". Blocks to the East of the South Loop Residential Development State Street) remain untouched by developers and are much the same as shown in the aerial photo.<sup>4</sup> These blocks include abandoned industrial shells and commercial businesses, a few marginal businesses (i.e. the omnipresent liquor stores) and a Salvation Army shelter. "Chicago 21" also called for efforts to stabilize existing neighborhoods, but so far the developed area barricades itself from everything outside of it.



*The photo above shows the new housing stock built to the south of the South Loop School. Shown in the background is the old abandoned industrial building type that remains to the east of the school.*

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<sup>4</sup>Much of this old commercial strip to the east of the South Loop Area may not have been available to the South Loop Developers because speculative property owners are "sitting" on the land, waiting for property values to peak.

#### 4.3.3 Assessment of Current Development

Rather than incorporate these more commercial blocks into the development, the South Loop Developers have produced residential blocks which turn their backs to adjacent areas. The new street organization of the South Loop area achieves isolation from less desirable parts by introducing elements such as streets with dead ends (T-shaped rather than X-shaped intersections), and cul de sacs. These street patterns represent an unprecedented departure from the grid iron pattern that organizes the rest of the city and facilitates open access.

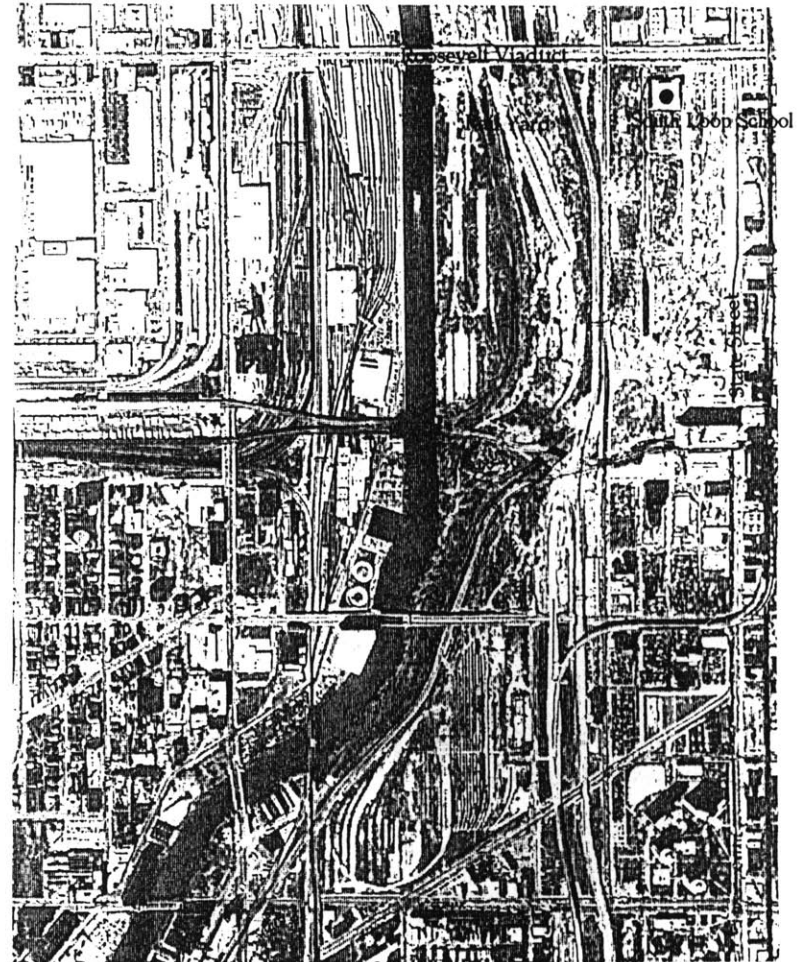
There are two problems with this isolationist plan. First, from the standpoint of sustainability, the housing development method carried out thus far has been typically sector-divisive; planning and development of residences has not been done in conjunction with commercial, institutional and industrial/business developments. Such sector-specific development does not encourage shared (and therefore moderate use of) resources or reduced automobile use. Second, the plan does not promote future changes at the urban scale that might link distinct neighborhoods. In other words it does not acknowledge the neighborhood's connection to the surrounding environment. The South Loop area attempts to build a relationship with the downtown business district, but the plan makes no provisions for relationships to other

adjacent neighborhoods. "Chicago 21" recommended general objectives but did not specify the methods of development by which to achieve those objectives.

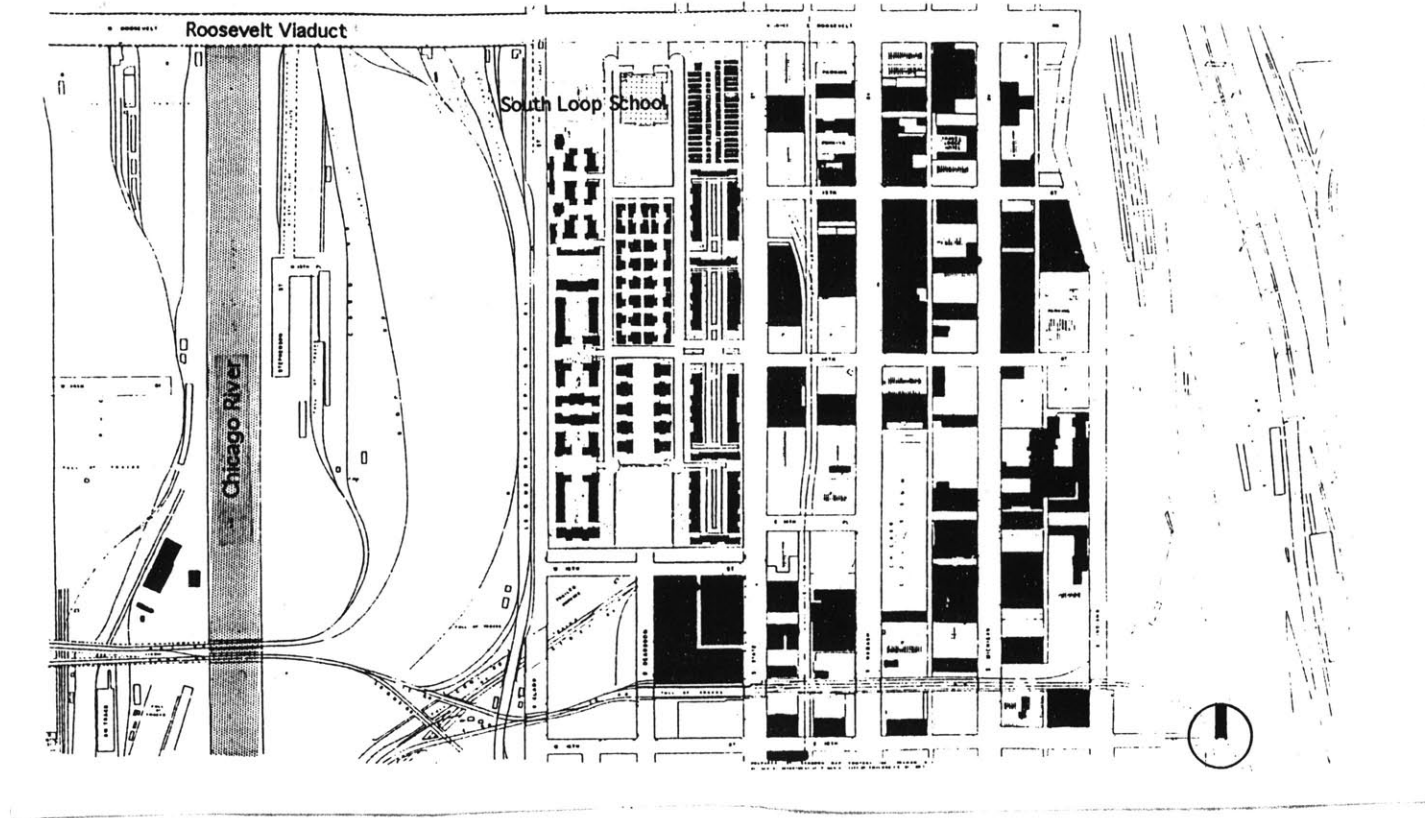
#### 4.3.4 Sustainable Recommendations For the South Loop Area

The focus of the housing development currently being built around the South Loop School is not sustainability. While the scope of this thesis cannot redesign this housing development, it can generally suggest a more sustainable setting to which the proposed school would relate.

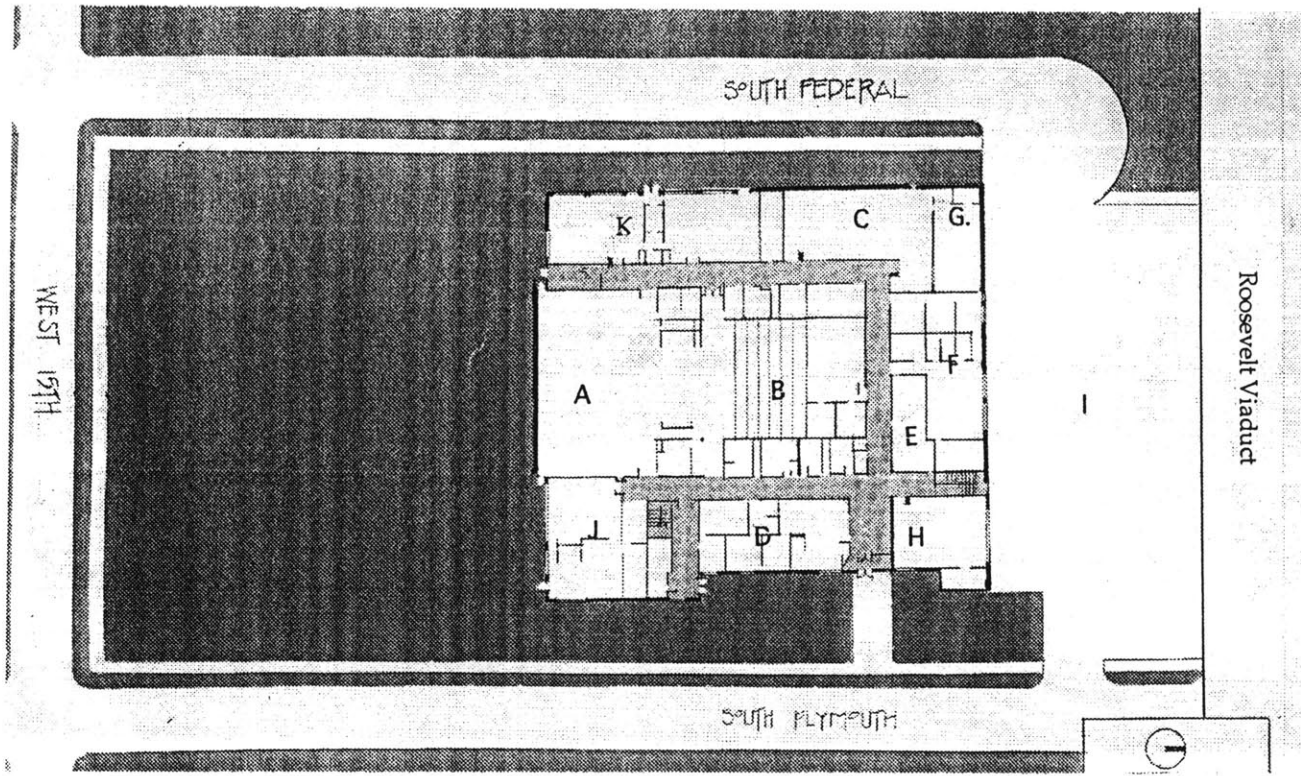
The neighborhood should not be homogeneously residential and should include small to medium resident-owned stores to which residents could walk. People who work in the area, (i.e. teachers, store keepers, etc.) should also live in the area. Rather than ignoring or tearing down old industrial buildings at the fringe of the neighborhood, they should be retrofitted, perhaps as offices or other types of employment centers for nearby neighborhoods. They might become market places or shopping centers. The industrial buildings are the sole reminders left of the neighborhoods history.







*The Figure Ground Diagram above shows the sudden shift in scale from the old Industrial/Commercial Shells (right) to the new housing development around the South Loop School. The abandoned rail yard sits between the school/housing development area and the Chicago River.*



- A. Gym
- B. Assembly
- C. Lunch room
- D. Administration Offices
- E. Teacher's Lounge
- F. Electrical/Mechanical/Storage
- G. Kitchen
- H. Science Class
- I. Parking
- J. Classrooms
- K. Kindergarten

*Ground Floor Plan of the Existing South Loop School.*

## 5.0 DESIGN PROCESS

The first section of this chapter compares the South Loop School's existing program to the proposed program. The second section (5.2) discusses the South Loop School in relationship to its broader site and proposes an annex (including an ecolab station and a water filtration greenhouse) that takes advantage of educational opportunities associated with being near a river while better integrating the river site into the neighborhood. Section 5.3 includes a sample of preliminary plans for the South Loop school, with sketches and models that investigate exterior spatial relationships created by various proposals. Section 5.4 moves inside the school with drawings and models that investigate interior qualities. The final proposal for the South Loop School comprises Section 5.5.



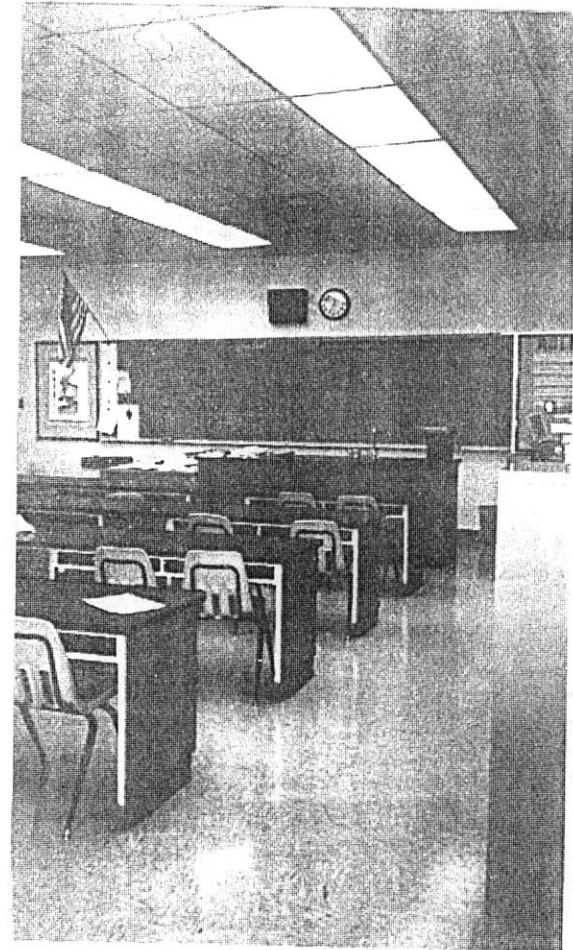
*View from the south of the South Loop School (right), the Roosevelt viaduct (behind the school), and the downtown skyline in the background. In the final design, this southwest corner of the South Loop School became a community plaza space.*

## 5.1 The Old and New Program Compared

Much of the existing program remains in the proposed project. The new program expands some areas to support more flexible and adaptive use of the school building by both school and neighborhood members. Exterior spaces in the proposal are more fully developed in the proposed program to make the school the focal point and collective space for the local neighborhood. The larger site proposal provides the school with an annex in which to practice hands-on learning at the nearby Chicago River. Additionally, the river annex is part of a larger regional plan for ecological restoration. At the urban scale it is a part of a plan to develop relationships between institutions and fractured neighborhoods.

### 5.1.1 The Existing South Loop School Program

While this program appears plush relative to some Chicago Public Schools, many of the spaces do not adequately support the activities for which they were intended. The auditorium is not large enough. Spaces with special ventilation needs do not have windows (i.e. dance studio and science labs). Similarly, the lunchroom is a long narrow windowless room with cinder block walls that exaggerate the already loud noise. Exterior spaces include the parking lot and minimal play ground.



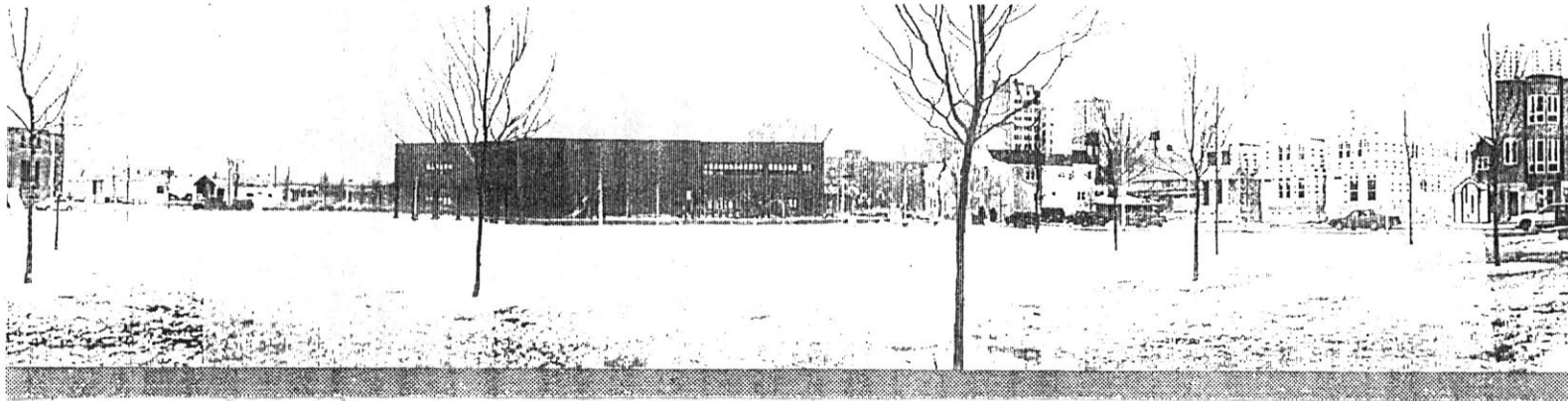
*The photo above shows a windowless science classroom in the South Loop School. The teacher has only a small emergency roof hatch in the storage closet to open when fumes become excessive.*



*^Photo above shows the continuous solid wall of the gym that faces south, blocking natural light, potential solar gains, and visual association between the community and the school.*



*>Photo to the right is the view facing south from the school. This view shows the new housing that surrounds the School.*



*Panorama view from the southwest corner of the South Loop School grounds. The school has relatively few windows that face southward toward the sun and the surrounding housing. New housing under construct*

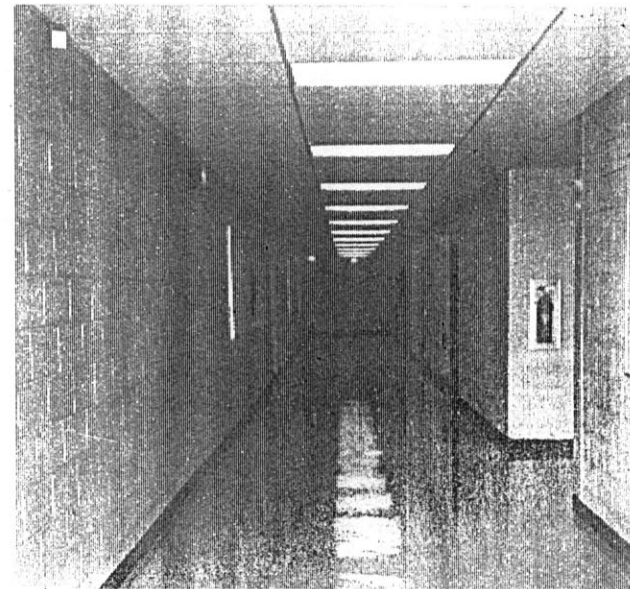
TABLE 5.1(a) Existing South Loop School Program

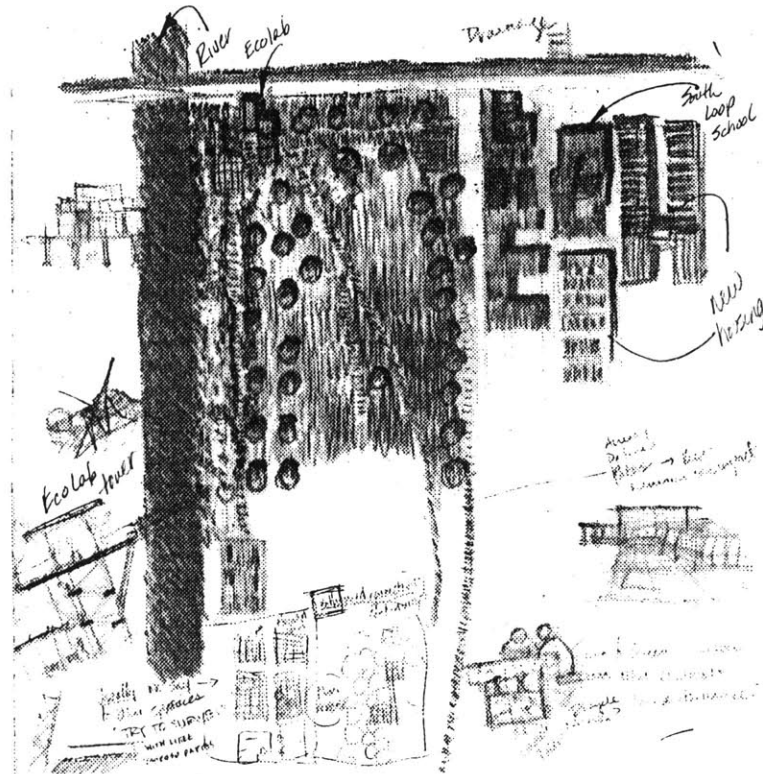
FIRST FLOOR	AREA (FT)	SQ. FT.
School Entrance (Vestibule)	6x18	108
Auditorium ("Demo Room)	50x44	2200
Administration	31 x 63	1953
Offices: 12x14 to 15 x 18		
Conference: 20 x 18		
Reception : 18 x 14		
Gym	50 x 80	4000
Storage	2(20x20)	800
WCs		
Girls	16x14	448
Boys	16x14	448
Men's	16x 10	160
Women's	16 x 10	160
Classrooms: 4	2(44 x 32)	2904
	2( 26 x 32)	
Lab(+ storage)	40 x 32	1664
Office	25 x 15	375
Kitchen	45 x 22	990
Lunchroom	33 x 63	2079
Dance Studio	35 x 24	840
Mechanical and Service	85 x 39	3315
(Cluster includes electrical, receiving area, trash area, teacher's lounge and lockers)		
Other (corridors)		6,401
<b>FIRST FLOOR TOTAL</b>		<b>32,300</b>

*A school or prison? Photo to the right shows a typical corridor in the school. There is no natural light, no view to the outside, and no view to activities within the school (i.e., library, computer room, etc). Though a simple plan, the access system is extremely disorienting.*

TABLE 5.1(a) Existing South Loop School

SECOND FLOOR PROGRAM	AREA (FT.)	SQ. FT.
Classrooms (14)	25 x 32 to 30 x 31	12,891
Music Room	30 x 57 with WC	1,710
Library Cluster	21x 59	
Audio visual		
Office		
Computer Room		
WC		
Girls: 2	13 x 15 and 15 x 21	510
Boys: 2	13 x 15 and 15 x 21	510
Storage (inactive)	15 x 19 and 13 x 11	428
Mechanical	80 x 18	1,440
Other (corridors)		6,039
<b>TOTAL SECOND FLOOR</b>		<b>30,342</b>





An early sketch of the South Loop School in relationship to the river. The sketch proposes the development of an annex lab for hands-on science learning at the river and the scheme involves remediation and replenishment of the old rail yard next to the river

### 5.1.1 The Proposed Program For South Loop School and Annex

The proposed program includes changes which increase the flexibility of certain large format spaces including the gym, auditorium and cafe. The proposed spaces support more types of use among school members and facilitate their use by neighborhood members during after-school hours and weekends. The reconfigured school program emphasizes shared use by the school facility and the surrounding community. Major additions to the program include:

#### Indoor

- River Site Field Science Lab
- River Site Water Filtration Greenhouse
- Informal Gathering Spaces (Atrium and Sunspace)

#### Outdoor

- Small Enclosed Patios (Cafe and Class)
- Community Garden and Plaza
- River Site Preserve

TABLE 5.1(b) Proposed South Loop School

<u>FIRST FLOOR</u>	<u>USER GROUP</u>	<u>SQ. FT.</u>
School entrance: Multi-use space	School/ Community	
Performance Atrium	School/ Community	2500
Administration Offices	School	1953
WC/locker room	School/ Community	768
Gym	School/ Community	5000
Greenhouse	School/ Community	960
Classrooms	School	1400
Lunchroom/cafe	School/limited community	3500
Kitchen	School/limited community	990
Sunspace (Collective )	School/ Community	2080
Patios	School (Cafe; classes)	2208
Edible garden	School/ Community	15,552
Porch Space	School/ Community	3040
Play ground	School/ Community	960
Eco Lab space, (river site ) with water treatment greenhouse	School/ Community /EPA	

TABLE 5.1(b) Proposed South Loop School

<u>SECOND FL.</u>	<u>USER GROUP</u>	<u>SQ. FT.</u>
Teacher's Lounge	School	896
Library	School	756
Offices	School	384
Classrooms	School	1632
Classroom Sun Space	School	750
WCs	School	336

*EPA should expand its support of environmental education and lead an intergovernmental and intersectoral effort to develop a long term societal strategy for environmental education. It is impossible to take environmentally responsible action unless we are motivated and have the knowledge and tools to do so. (Cortese, 1992)*



In the proposed program the green house becomes a place and reason for the surrounding neighborhood and school to meet. In addition the green house serves the following functions:

- Becomes a sun space, collecting solar energy for the school;
- Generates oxygen; improves indoor air quality;
- Acts as a calming transitional space through which a person may enter the school,
- Layers of transparent greenhouse enclosure gives school adequate privacy without walling it in and away from the local environment

The scheme also provides for an outdoor community/school garden space as a summer extension of the greenhouse.

There are many successful precedents for urban gardens. New York City had over 600 community gardens (on record), totaling 143 acres in 1987 (Cooper-Marcu, 1991). Chicago [public] Housing residents reported that gardens became "holy ground", as a place for friendship and closeness.

The positive effects of gardens are so notable that "horticulture therapy" has been integrated into programs in hospitals, geriatric centers, drug rehab centers, schools for developmentally disabled. and prisons (Lewis, 1991). Maurice Seigler, former U.S. Board of Parole, noted that when inmates did violence to the building, they never destroyed the plants they had grown- a gauge of their commitment to the garden

(Lewis, 1991). The garden as an aspect of this program can serve demands of both the surrounding neighborhood and of the school simultaneously. Community gardens result in part from a growing reaction to the privatization of public life and the need for public spaces that support social contact and publicness (Cooper Marcu, 1991). The positive benefits associated with such as sense of achievement and enhanced self esteem, are qualities that are consistent with goals of schools. Gardens are places for activity and contemplation

Also proposed is an annex science lab to the west of the school on land that was once a rail yard. Rather than converting the land into a groomed park, (as the "Chicago 21" plan called for), this scheme establishes a contiguous preserve along the east side of the river. The school might participate in planting, caring for, and monitoring plant species once native to the area. At the urban scale, this lab could help to link area from the area's east (Planetarium, lake front, Shedd Aquarium, Field Museum of Natural History) to the west where the University of Illinois sits.

## 5.2 Proposal For the South Loop School Site and the River Annex

The proposed plan calls for development of the site as an urban bio-preserve, educational center and ecomonitor lab station. The site might be monitored by a collaboration of

- Public agencies,<sup>1</sup>
- Nonprofits,<sup>2</sup>and
- Local institutions

The plan incorporates ecological remediation, conversion of the site into a testing ground for monitoring air and water pollution, implementation of new technologies and the reintroduction of certain native plant and animal species. The extension ecostation lab aims to:

- 1) provide facility for hands-on learning of science; active and participatory format;
- 2) introduce students to the regional history (native plant and animal species);
- 3) heighten general awareness about ecosystem and build sensitivity to the human role herein.

The proposed facility promotes contact between schools and other local resources such as universities, government agencies and nonprofits. It is a meeting point for all.

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<sup>1</sup> Such as the EPA and Illinois Department of Natural Resources.

<sup>2</sup>Such as Audobon, Open lands Project, Center for Neighborhood Technology)

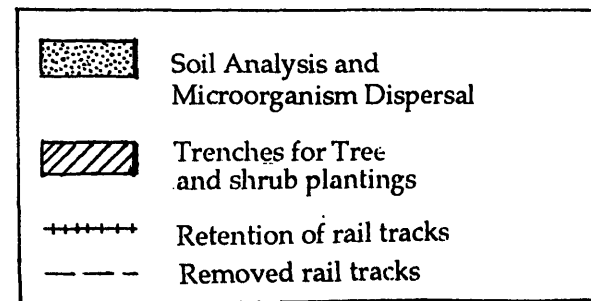
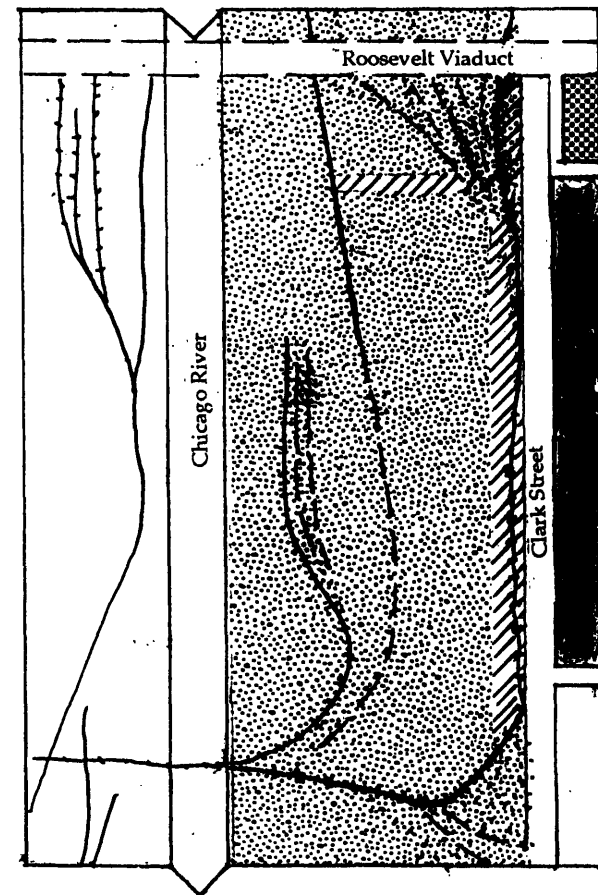
### 5.2.1 Phase I: Analysis and Remediation

The proposal for future development of the larger site is provided in phases that aim to support healthy linkages between species and promote sustained ecological diversity.

The river site with its long history of pollution loading from various forms along with its current pollution loading first must be analyzed to identify contaminants that might harm animal and plant life. Student involvement would make this process educational. Some of the major steps required are listed:

1. Analyze soil for contaminants. Heavy metals (copper, zinc, lead and cadmium) can inhibit growth of plants and eliminate species. Conifers are least resistant to lead and copper (Cotton, 1982).
2. Analyze air and water for current pollution input data
3. Identify soil nutrient levels sustain diverse plant life
4. Remove unnecessary train tracks and debris. (Retain some tracks for future development as preserve paths).
5. Remediate soil: Disperse microorganisms (e.g. Lupin) that devour contaminants.
6. EPA conducts ongoing analysis and monitoring of soil.

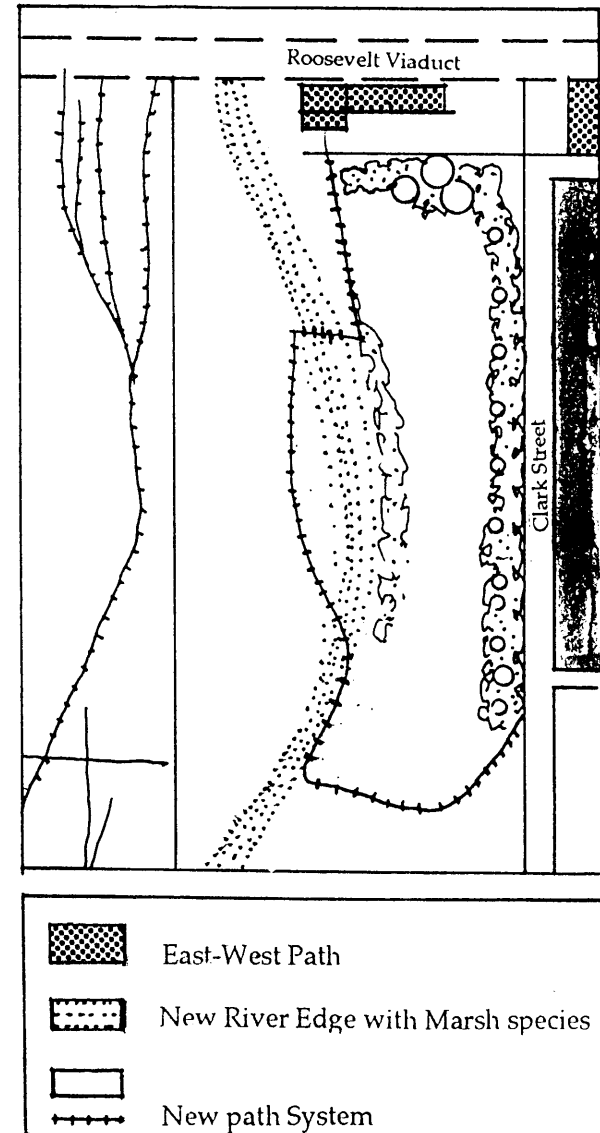
7. Plant trees and shrubs (lineal trenches) to help remediate soil, especially nitrogen -fixing plants like huberaceous and woody plants. Plantings begin physical definition and protection of the preserve territory. Select plant species that are tolerant of specific soil quality. Soil may need to be imported for this phase. Broad leafed species found to have the lowest death rates in presence of heavy metals. *Quercus robar* and *Alnus glutinosa* was found to be most resistant to cadmium lead and zinc (Cotton, 1982).
8. Develop path from school to temporary outpost and future ecomonitor station.
9. Introduce several resilient species (worms, select insects)to loosen and fertilize soil.

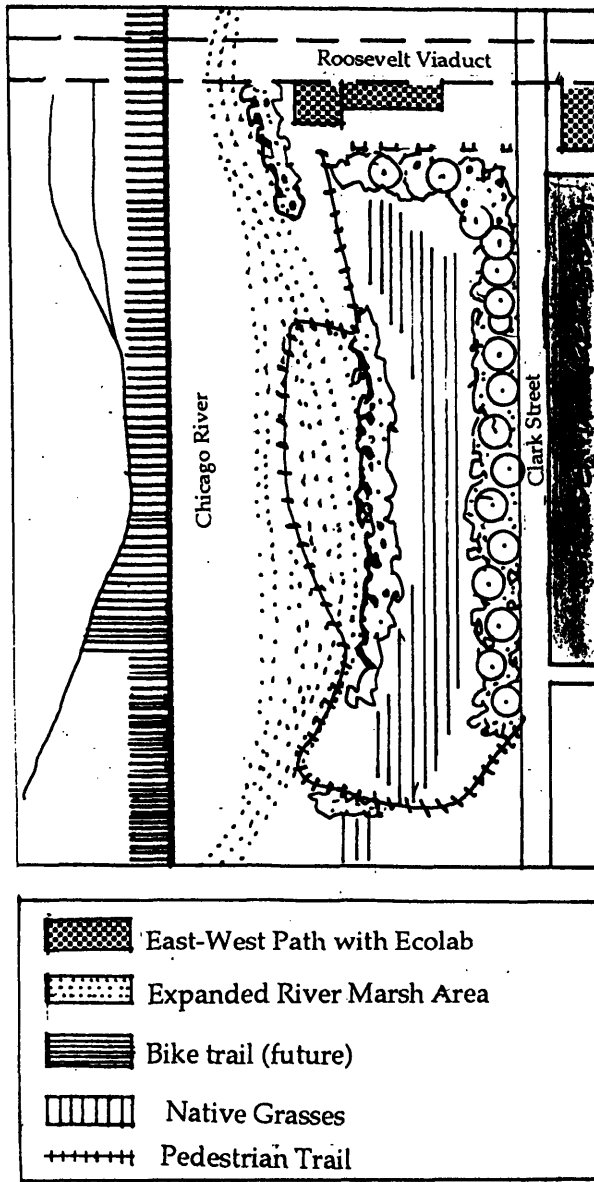


### 5.2.2 Phase II: Building Construction

The second phase of the larger river site plan could focus on building the facilities for experts, students and volunteers. The second phase includes:

1. Develop the zone between school and river.
  - a. Path with information stands about species
  - b. Locate greenhouse with (demonstration water filtration system and seedling incubators) along path between school and ecomonitor station.
2. Remove infill where river was straightened. The new bulge in the river becomes a marsh area capable of sustaining a richer species diversity that is better from educational and ecological viewpoints.
3. Build Ecolab tower near river with potential for students, officials and visitors to view air, ground and water.
4. Transform couple remaining rail tracks into defined pedestrian paths for ground observation through more delicate preserve area.
5. Develop second path connecting residential area near school to the preserve.
6. Maintain trees and shrubs planted in phase I.
7. Continue analyzing soil and dispersing microorganisms.





### 5.2.3. Phase III: Plantings and Animals

The introduction of plant and animal species into the river preserve requires understanding how these species affect and are affected by the particular ecosystem. Needed in the early stages of this site development are species resilient to conditions that can also facilitate increased soil fertility. A brief list of important species and their ecological functions follows:

- Soil movers and looseners (e.g. worms and select insects)
- Birds may help provide nutrients to soil and keep insect populations in check. A plant understory must be established before introducing a variety of birds.
- Resilient plants: certain native grass species intermixed with herbs:
- Plants common to the Chicago with seeds that germinate without special treatment<sup>3</sup>; Prairie Lead plant; Purple Cornflower; Bush Lespedeza and Tickseed.
- Non-native grasses that germinate without special treatment<sup>4</sup>: Windflower; ; Silky Aster; Three-Flowered Avenas; Red Prairie Lily and Clustered Poppy Mallow
- Marsh Plants and animals:

-Grass like plants (Scirpus and Reed Canary Grass) to provide bacterial habitat (grease decomposition and nitrogen cycling) and water hyacinths.

<sup>3</sup>Illinois Dept. of Conservation, 1994

<sup>4</sup>Ibid.

-Snail populations can keep algae levels down if this is found to be a problem.

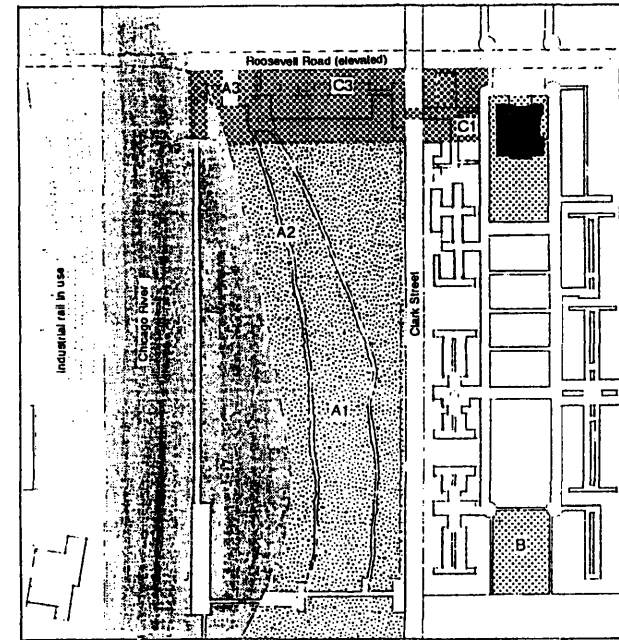
- Other animals to provide fertilizer (nitrogen)

An ecosystem that includes some plant and species diversity promotes ecological stability. Other native species that are more vulnerable than the base species can then be introduced. These species might include more sensitive prairie species and bird life. The potential for increasing nesting sites is provided for in the design through either built structures (working off of the existing viaduct) and vegetation.

#### 5.2.4 The Larger Site Plan

The final larger site plan proposes a neighborhood plan to reinforce the redesign of the South Loop School. At the neighborhood scale, the plan calls for collective spaces for community use such as the preserve and the plaza outside the school. The plan also calls for a more diversified neighborhood environment, introducing a public recreational area, more dense housing, and commercial shops threaded throughout.

At the urban scale the plan links discreet areas through the design of an East-West pedestrian path that is marked by stopping places such as store fronts (off the viaduct structure and large apartment buildings), the school, the community garden and plaza, and the preserve with its water filtration greenhouse and ecolab station. The path is punctuated by rows of Japanese Black Pines that are perceivable from a distance,



#### A. Biopreserve



1. Phased-in Plantings and Introduction of Some Animal Species (e.g. nests and aquatic)
2. Paths for Human Movement Along Old Rail Tracks
3. Extension Lab:
  - Ecomonitor station
  - Class room
  - EPA field Office
  - Outdoor Gathering and Work Space.

#### B. Neighborhood Common Green

#### C. Link Between the School and Biopreserve

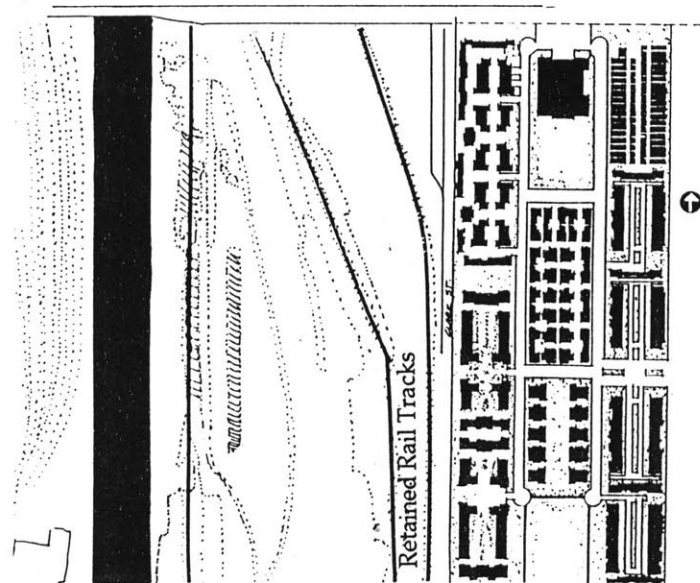


1. Community Garden
2. Preserve Information, benches, row of pines
3. Solar Aquatic Water Filtration Greenhouse

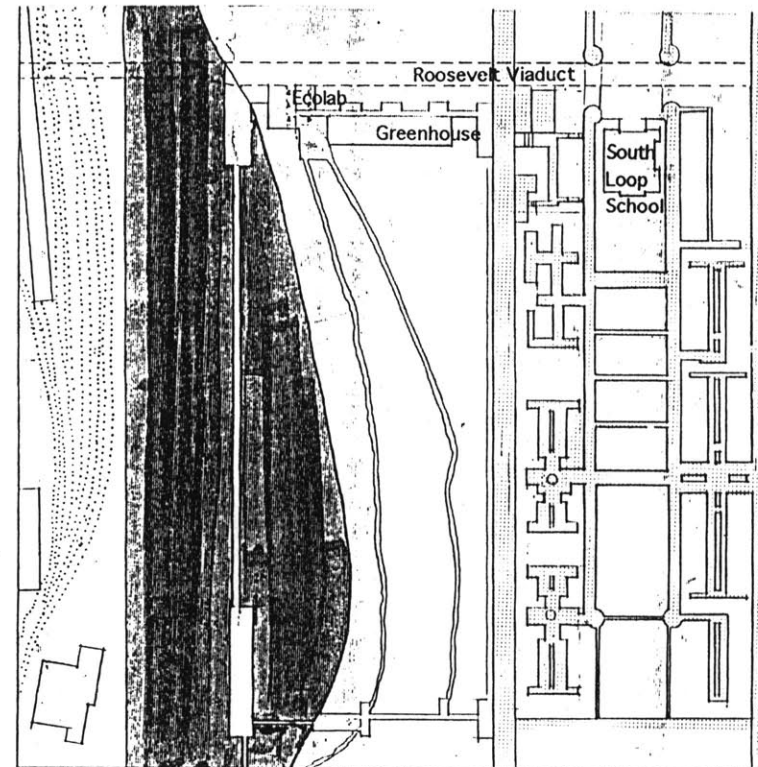
*Diagram of the River Annex Scheme shows link developed between the South Loop School and the River. The South Loop School is noted in black.*

buffer against winter northwest winds and are resistant to salt spray. Development of such a path is consistent with the larger intent to link institutions that exist on the Roosevelt Road axis.

At the regional scale, the plan fits into a larger possible regional scheme of river rejuvenation with a preserve capable of increasing plan species diversity, filtering water in an ecologically sustainable way and serving as an environmental monitoring and learning center.



The diagram shows the South Loop School, the new housing development and the abandoned rail tracks left along the Chicago River. (Some of these tracks were used for storage rather than through traffic) The three areas retained for north-south paths are highlighted with a heavy line in the diagram.



A diagram of the South Loop School in the Larger Site Context. The new housing development in the area introduces a dead-end street formation (dotted) that isolates the neighborhood. The proposed plan develops a link from the school to the river. Planned for the East-West path is the ecolab and the greenhouse. Three rail tracks are retained and built up as slightly suspended trails that run through more sensitive nature preserve areas

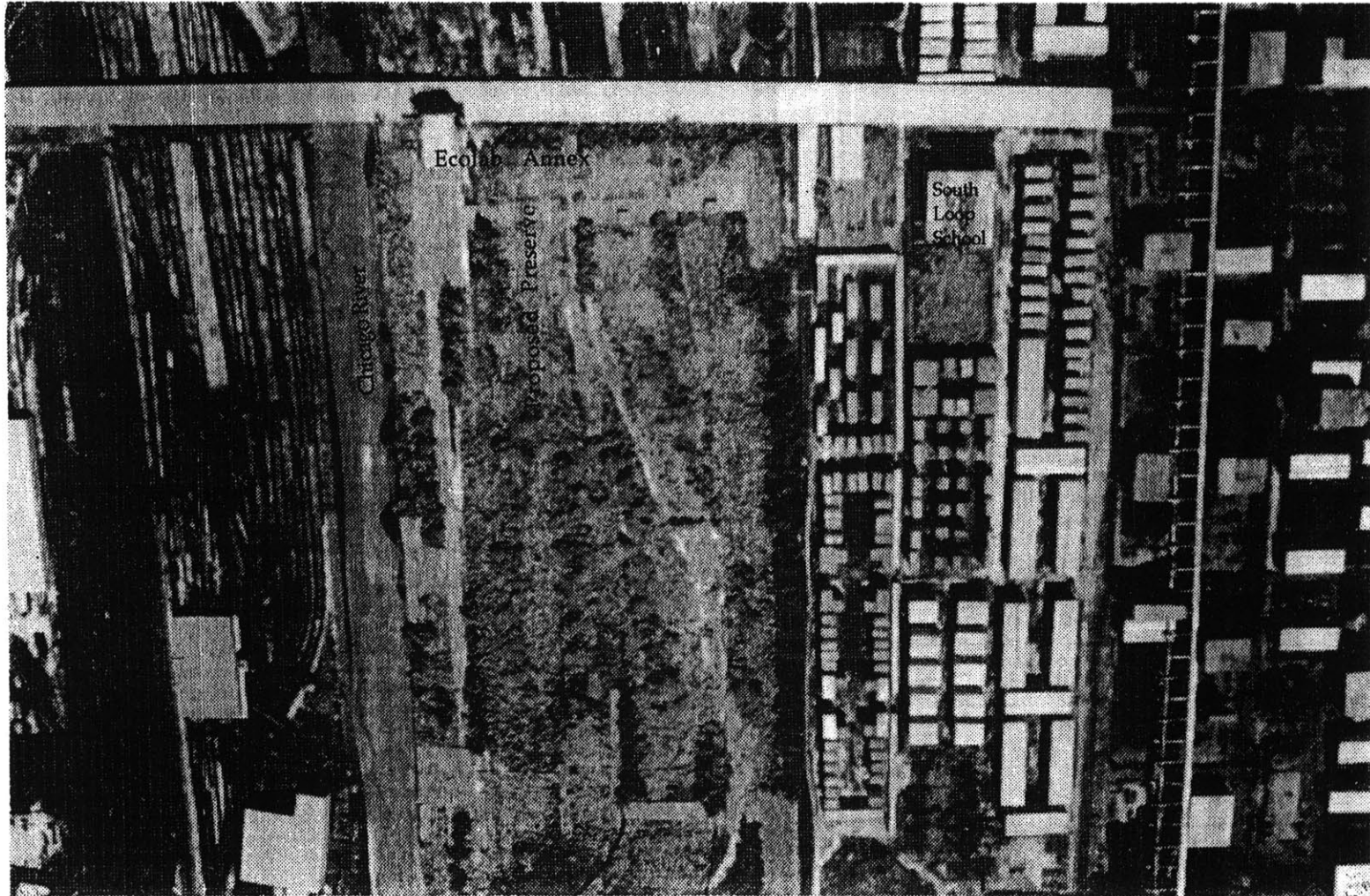
5.2.4 The Larger Site Plan (cont'd)



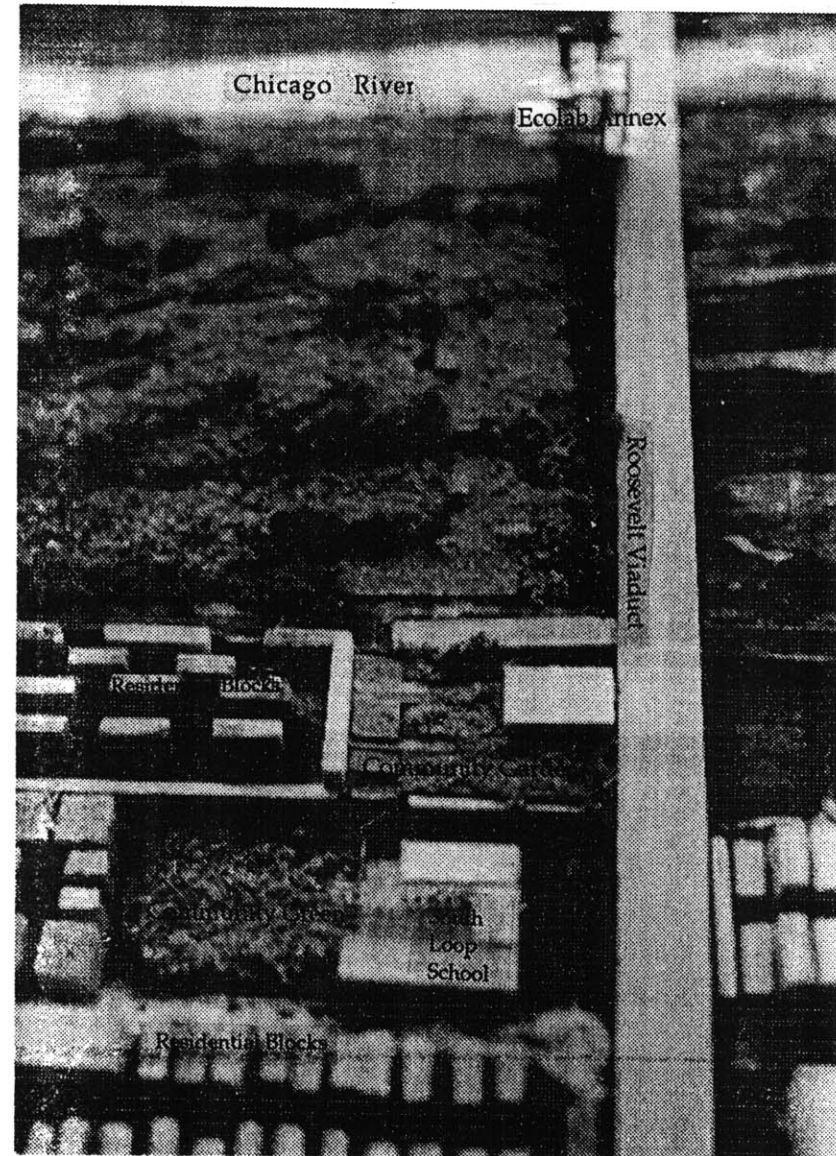
*A neighborhood site model shows the South Loop School relative to institutions in the area, Lake Michigan, the Chicago River, the proposed ecolab annex and biopreserve.*



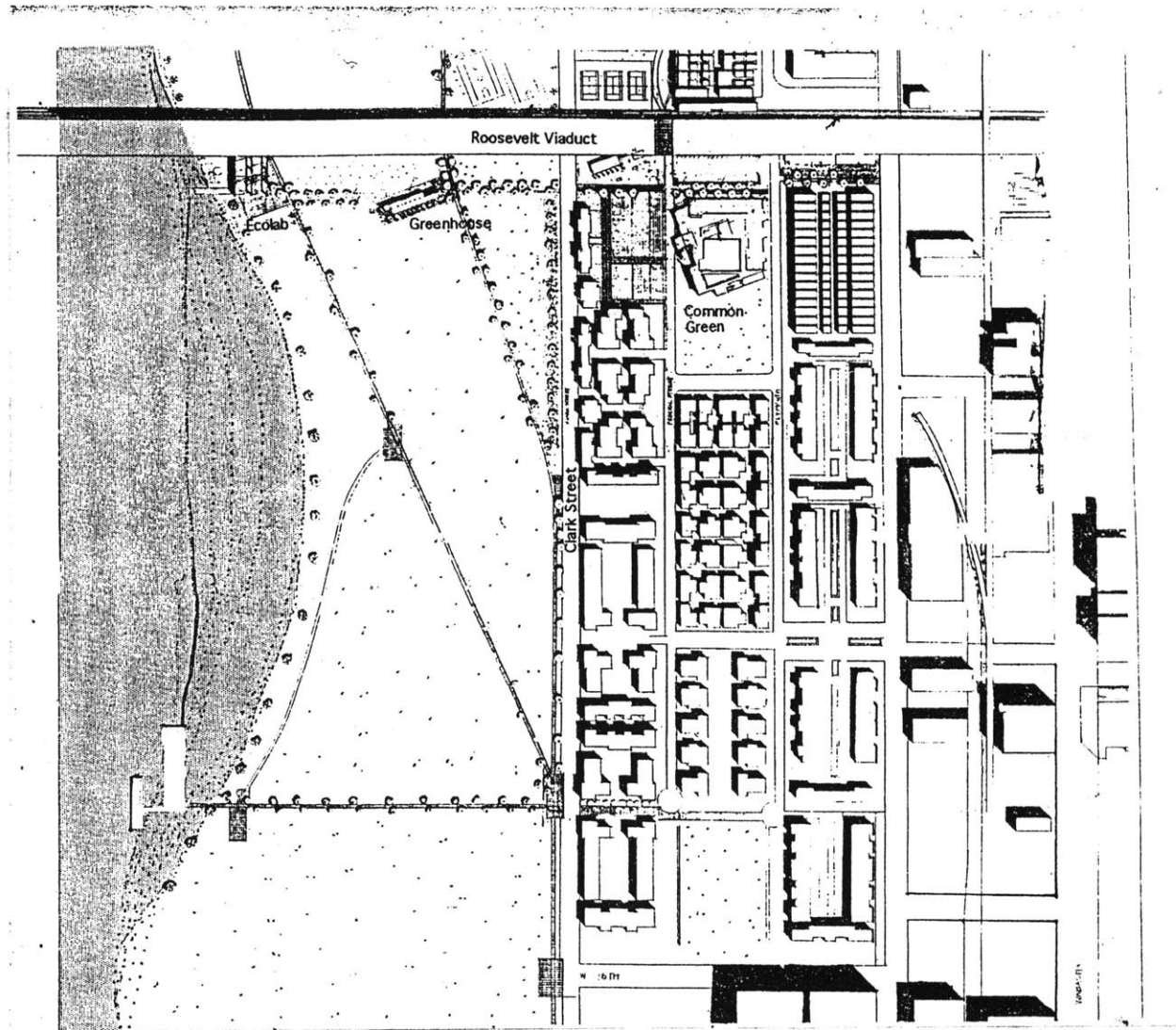
5.2.4 The Larger Site Plan (cont'd)



*Photo of Neighborhood site model focuses on the South Loop School and the Proposed River Preserve Annex.*



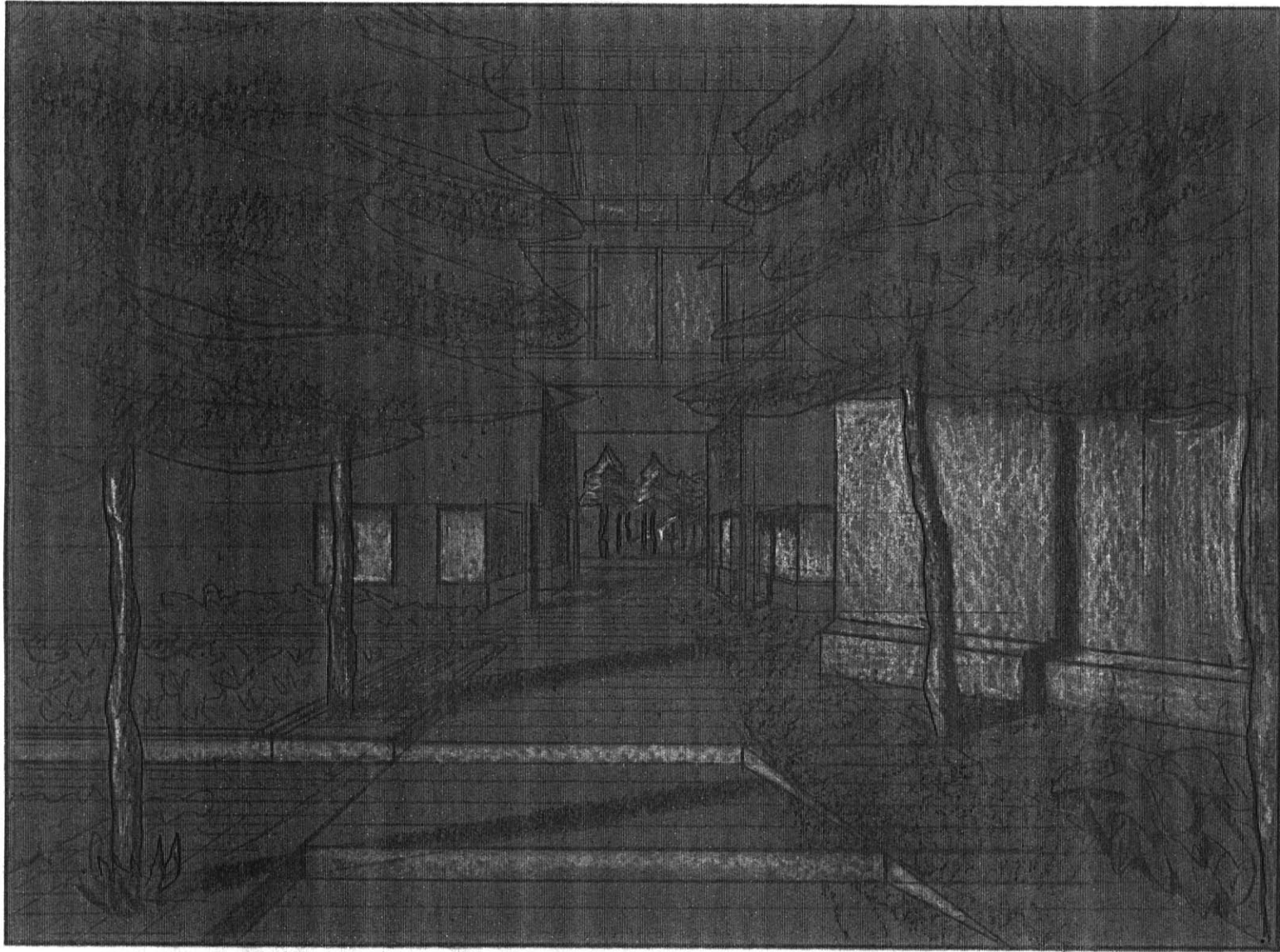
*View west from South Loop School toward the Ecolab and River Preserve on Site Model.*



*School and Larger Site Plan showing South Loop School as it relates westward towards the river site extension, the water filtration greenhouse, and the river preserve (including proposed marsh and suspended trail).*

#### 5.2.4 The Larger Site Plan (cont'd)

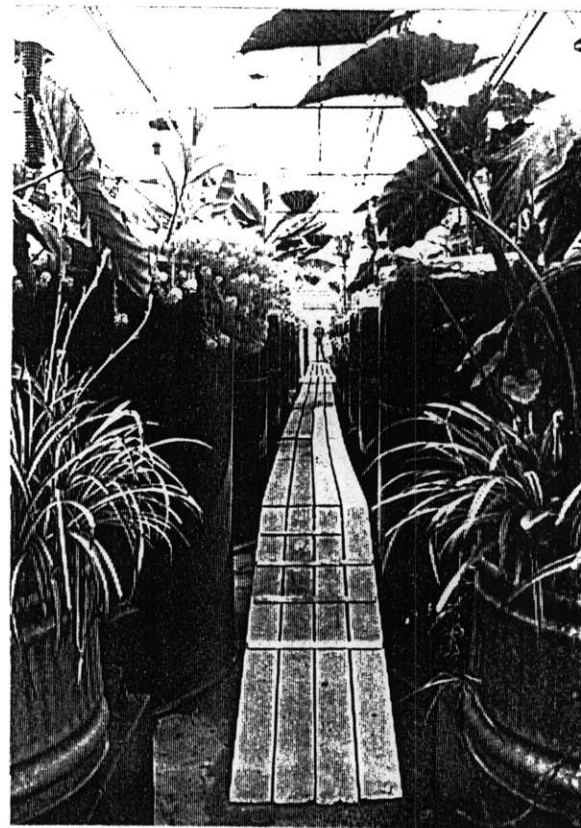
In the perspective drawing (opposite page) the east-west path continues westward toward the river, passing through the apartment building (shown) that has store front space at the ground level. The relatively tall apartment house buffers the Community garden from traffic on Clark Street just beyond and potentially houses school affiliates. Walls are used here as sound buffers against the viaduct to the immediate north (right) and in conjunction with trees to create potential spaces for stopping and sitting. The walls also act as basic infrastructure to support tarps that would shelter temporary community markets.



*A Perspective showing view from community garden (next to South Loop School) toward the River Nature Preserve.*

#### 5.2.4 The Larger Site Plan (cont'd)

The perspective on the opposite page shows the green house proposed for the preserve. In addition to serving as an extension science class and facility for the for the soil remediation project, the green house is also a Solar Aquatic Research facility, like the prototype greenhouse in Rhode Island. The solar aquatic water filtration method is a human-made recreation of marsh ecology, employing a wide variety of plants and some animals (e.g. snails and fish) in a tiered system of water filtration. Once the water has gone through this chain of filtration and it can be disinfected with ultraviolet rays rather than with the addition of chlorine (a potentially harmful chemical to the ecosystem). Such a filtration plant could handle local water flows, thereby relying on localized environmental responsibility rather than the centralized and mysterious method currently in place. The filtration greenhouse could focus on delivering high quality water to the Chicago River and to other regions. Its proximity to the South Loop School would allow students to comprehend water usage and treatment issues firsthand, thereby heightening an awareness about water as a resource to be protected.



*Photo above was taken at the Solar Aquatic Research Facility in Rhode Island, the model for the water filtration greenhouse proposed as part of the river preserve annex to the South Loop School.*



*A perspective from the entrance of the preserve toward the ecolab station, shown at the end of the path and past the water filtration greenhouse.*

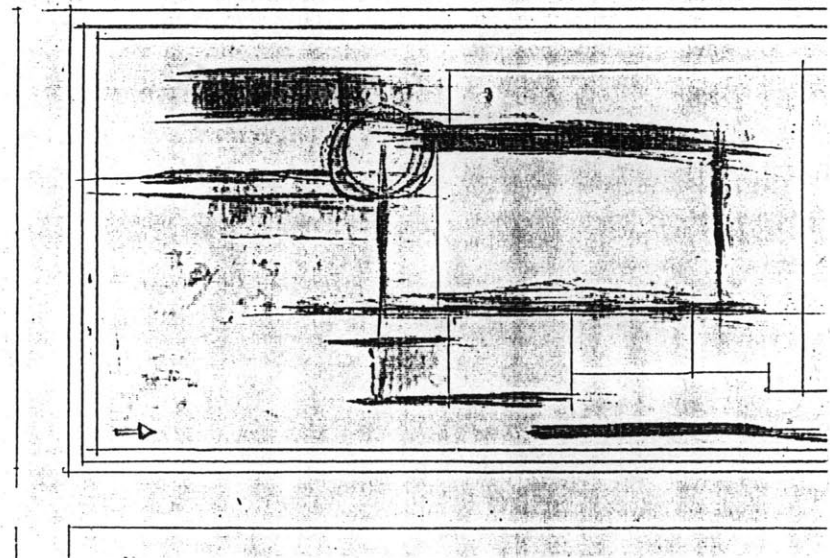
### 5.3 Preliminary Studies of Exterior Spatial Relationships

A series of exercises were undertaken in the early stages of this thesis's development to explore the type of collective spatial relationships created by redesigning the South Loop School. The goal was to design exterior spaces that related to the School interior as well as to the surrounding houses. Just as the revised school program called for making the school building more accessible to the local community, so too did the exterior adjacent spaces need to be supportive of various community activities.

#### 5.3.1 Study Models for the South Loop School

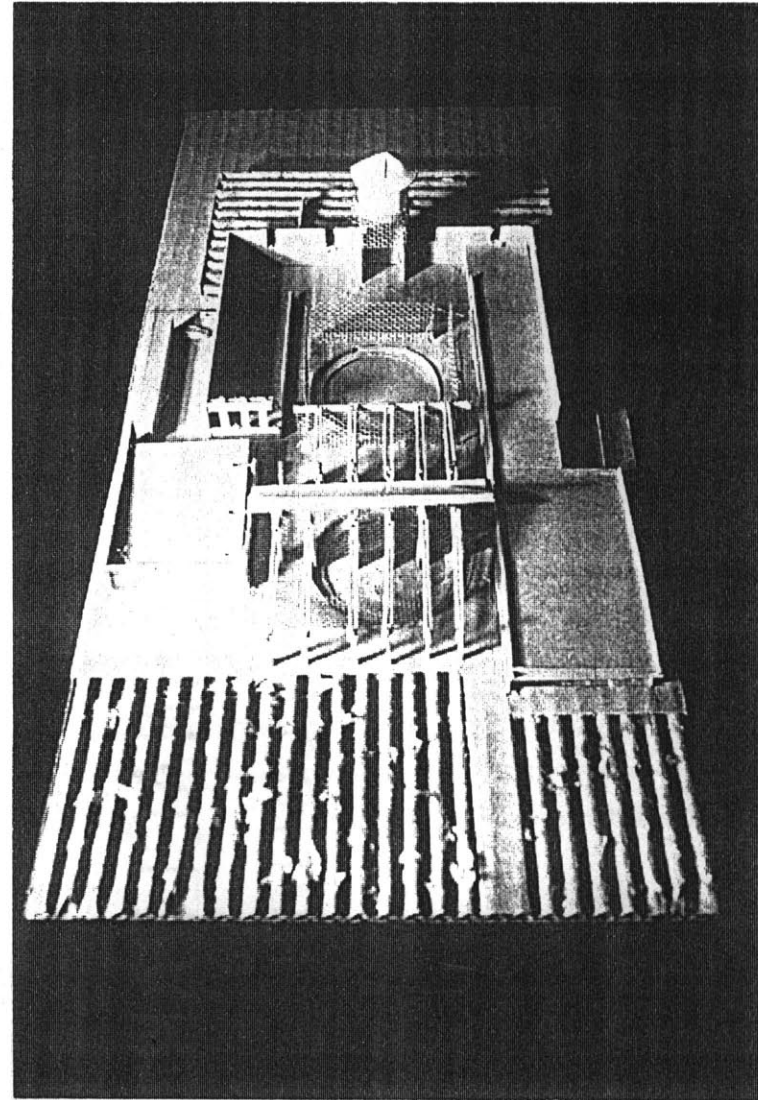
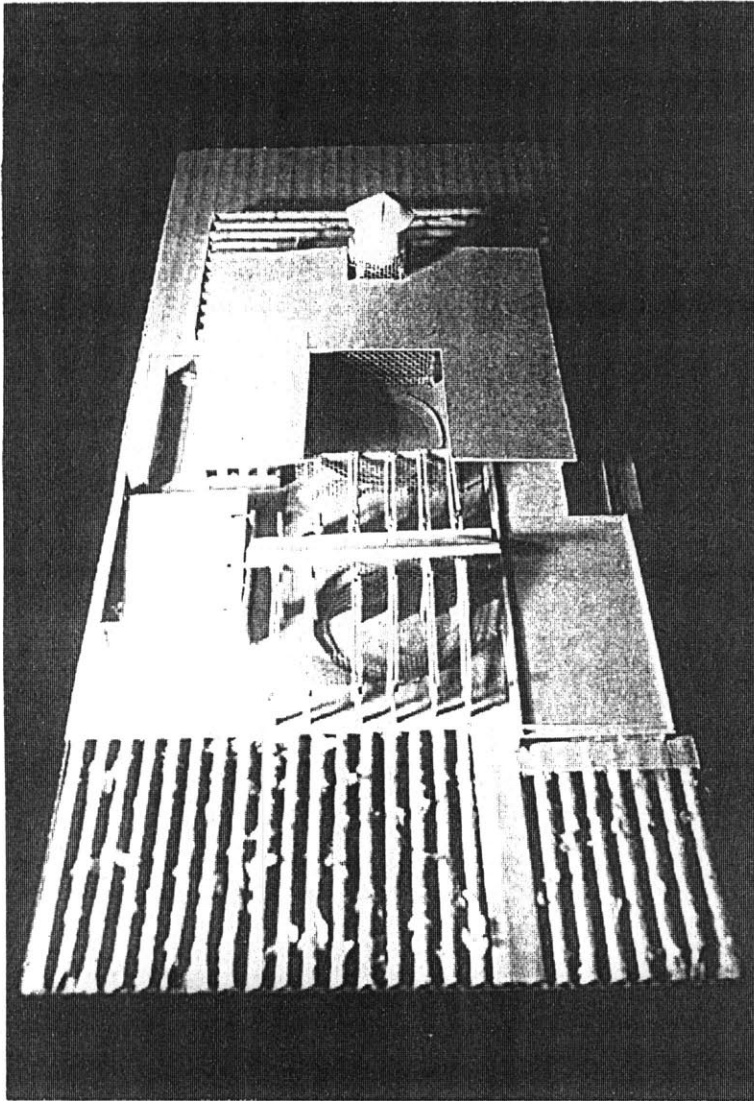
Study model #1 explored ways of lighting the school's core naturally by displacing large format spaces like the auditorium/gym. The model excludes the auditorium/gym from the center of the building, instead locating them at the southern edge, to partially define the outdoor space. The addition of the gym/auditorium to this side of the building helped to establish a more public entrance than the one that is currently tucked away on the east side of the building. An open air courtyard in the core of the school took the place of the original gym/auditorium and permitted natural light to reach the single loaded corridors encircling it. Added to the school was a greenhouse as an enclosed courtyard and a water

tower like the ones so frequently found in nearby industrial buildings. The tower helped to get natural light to a relatively dark area with the school and included outlook points above the school, for students to comprehend their location relative to the surrounding urban fabric and topography (Lake Michigan and the Chicago River).



*The concept sketch above extends the direction of the school southward to define the exterior open space. This sketch identified the southwest corner of the school as a pivotal point at which the school and neighborhood fabric met. Early designs attempted to reinforce this meeting point by extending the building to this area. Later designs responded by leaving the area open.*



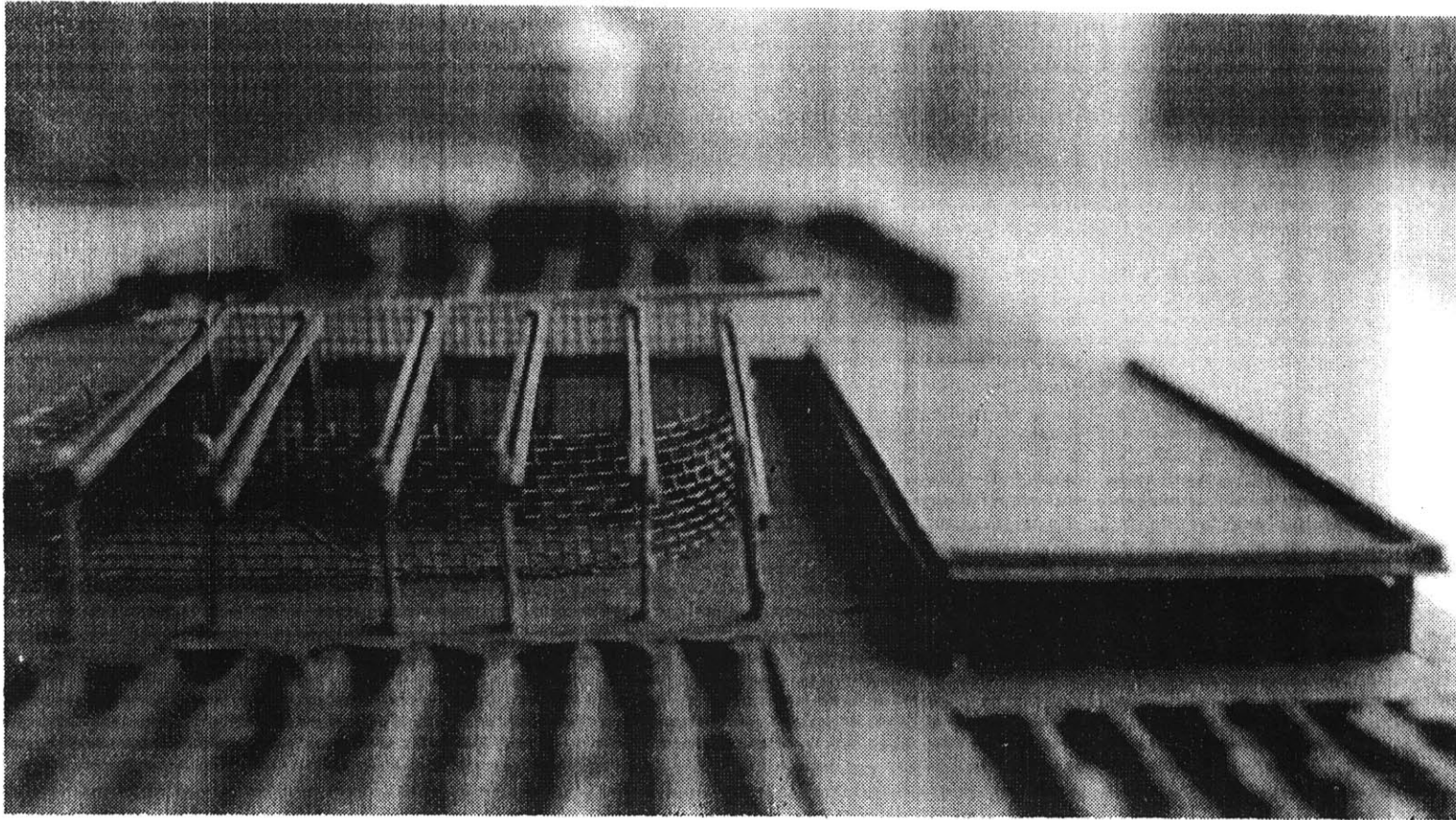


*Model #1 with and without the roof. The original South Loop School access system is retained but the core is removed so that natural light can illuminate the school.*

### 5.3.1 Study Models (cont'd)

The photo on the opposite page focuses on how one enters the school. To the right is the solid of the wall of the gym which counters the rounded transparent wall of the greenhouse on the left. The difference in surface types (continuous masonry and curved glazing) work in tandem to make the entrance obvious to the visitor. While the exact location of the entrance shifted in the final scheme, these characteristics of materials were retained.

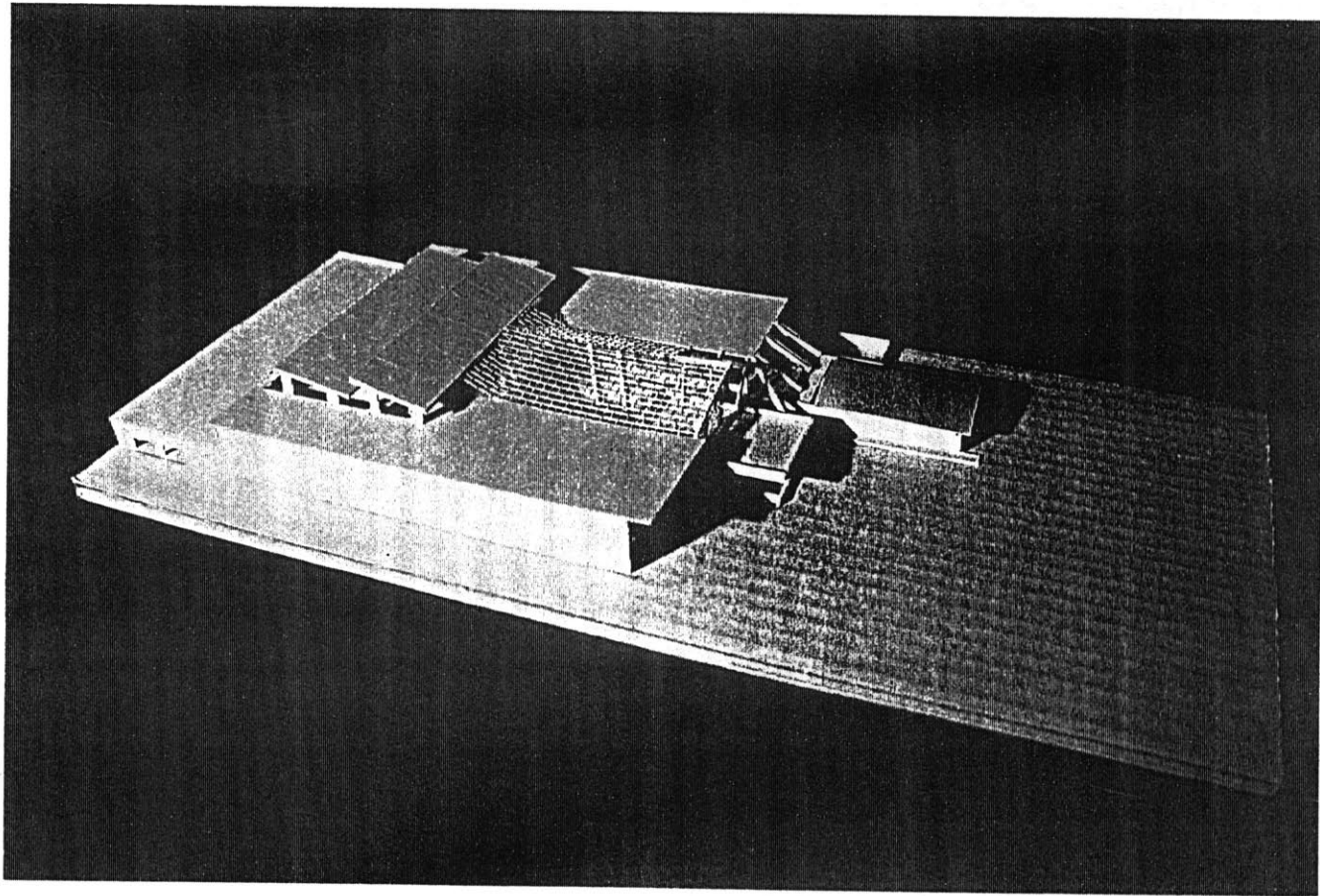
The greenhouse, as the transitional and transparent element between outside and inside allows a person to see through its layers and perhaps spot a friend inside, while sufficiently buffering the inside from the outside. Walking past a lush greenhouse environment might also help to relax students as they make the transition from inside to outside and enter the school world. The greenhouse is also visible to and easily accessed by community members.



*Photo of Model #1 focusing on the entrance to the school. One enters the school here with a solid masonry wall (gym) on the right and the glazed and rounded surface of the greenhouse on the left.*

### 5.3.1 Study Models (cont'd)

Like study model #1, study model #2 focused on delivering natural light to the core of the school. It also removed the gym/auditorium and includes a greenhouse as the center of the building to both provide natural light and oxygen to the school.



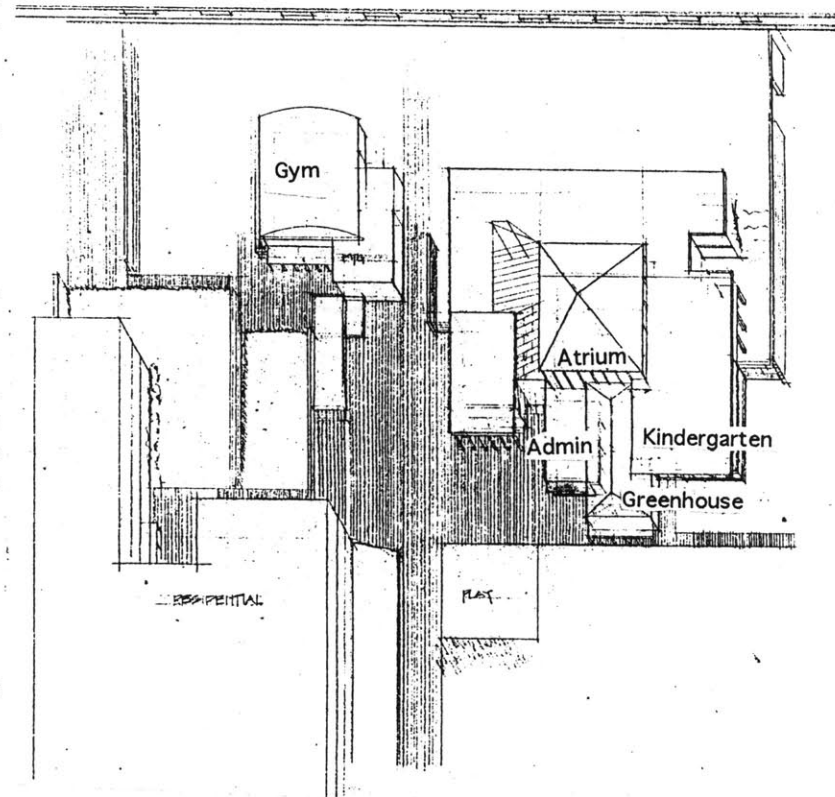
*Photo of Model # 2, with the school entrance again located on the south side of the building and the gym/auditorium extending into the school grounds.*

### 5.3.2. Preliminary Drawings

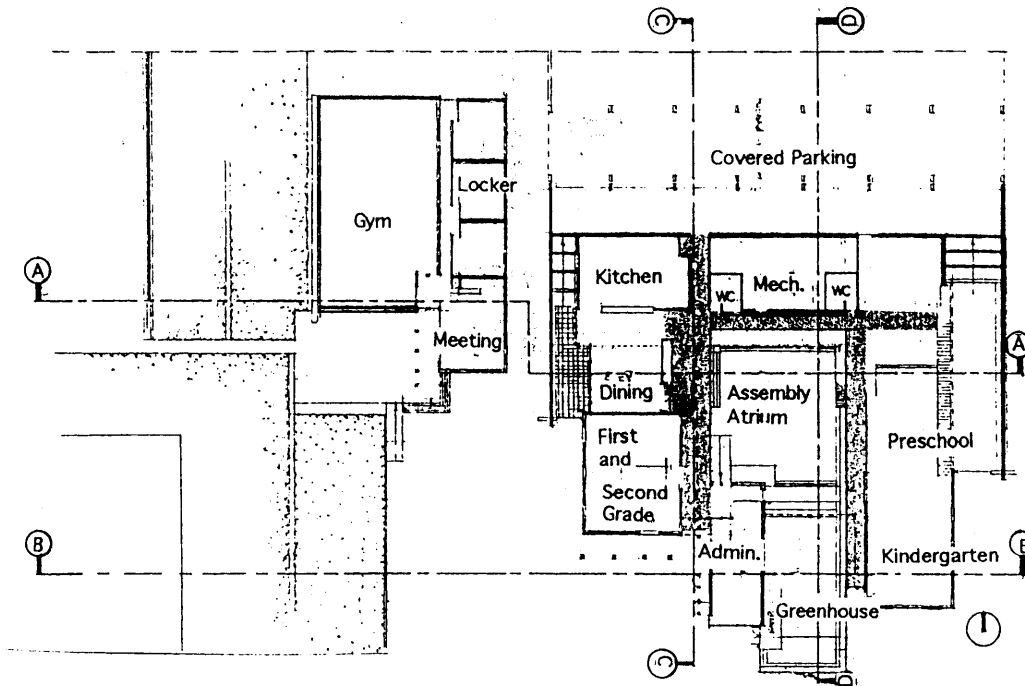
These plans, based on previous model explorations, attempted to open the school façade in places where community access was desirable and where solar gains were possible. The final plan strays significantly from these early plans, but a few major characteristics persist:

- The open small plaza space located at the south west corner of the school
- Location of the community garden
- Removal of the original façade, especially at the Southwest corner
- Displacement of the façade at certain points: the old wall is pulled away from the building and becomes a patio wall. The new school façade can then be glazed to a greater degree since it is protected by the outer patio wall.

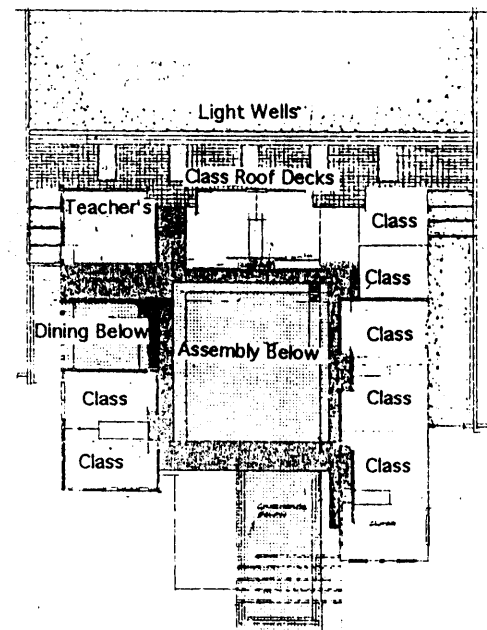
Development of the school's southwest corner as the focal point for the community achieves three goals. First, The building opens up (is more transparent) in this area, consistent with attempts to benefit from solar gains on the south side of the building. Second, this corner can relate to the community gardens and the school grounds to the south simultaneously. (People gardening can see people playing in the park space). Third, this space relates to the path that leads to the River Preserve Annex.



*The sketch above shows the preliminary plan for the South Loop School, where the relationship between the school, the residential community and the path to the River Preserve is reinforced with a community plaza and accompanying garden plots.*



*Preliminary Plans: Ground Floor*

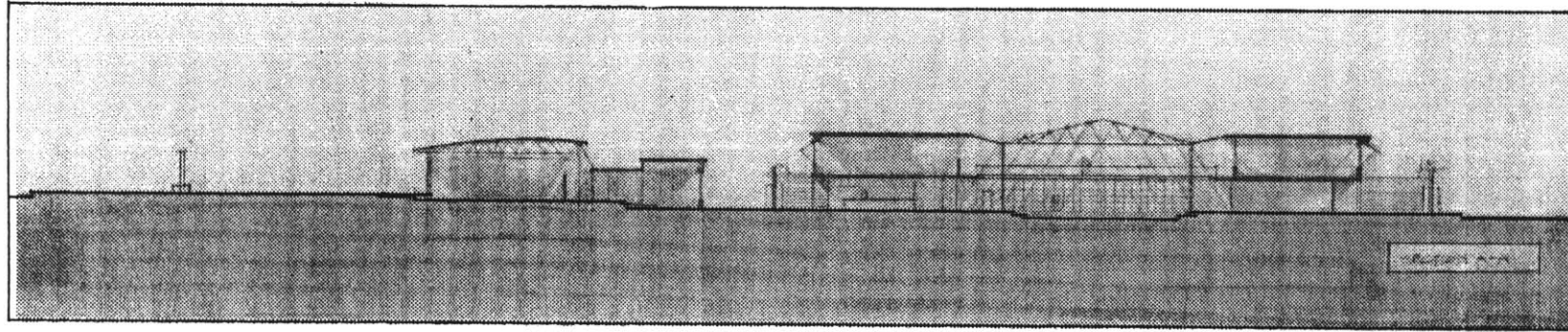


*Preliminary Plans: Second Floor*

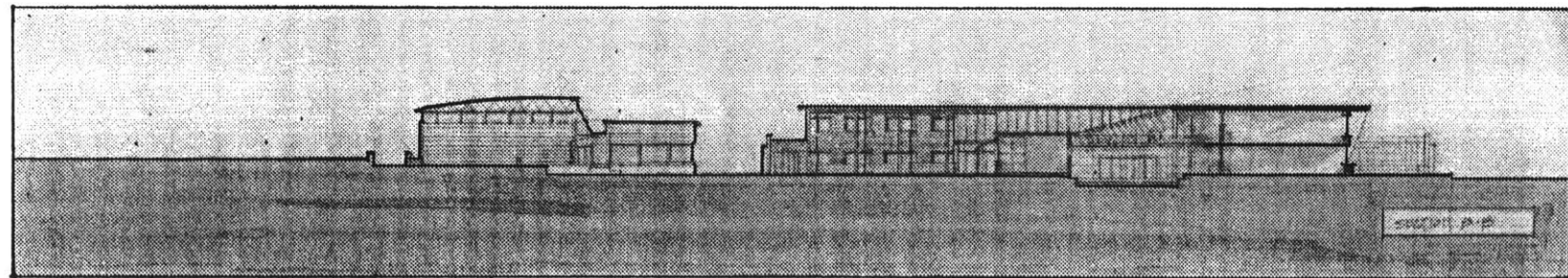
### 5.3.2 Preliminary Drawings (cont'd)



SECTION A-A (east-west)



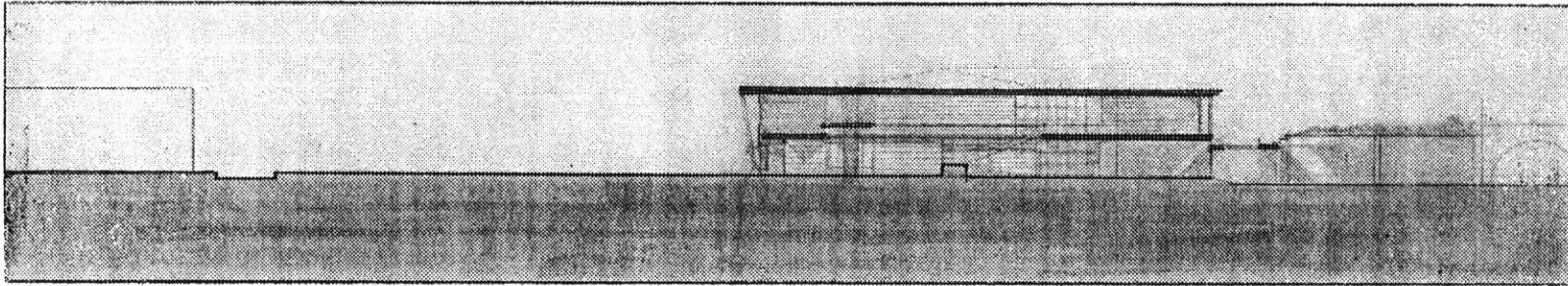
SECTION B-B (east-west)



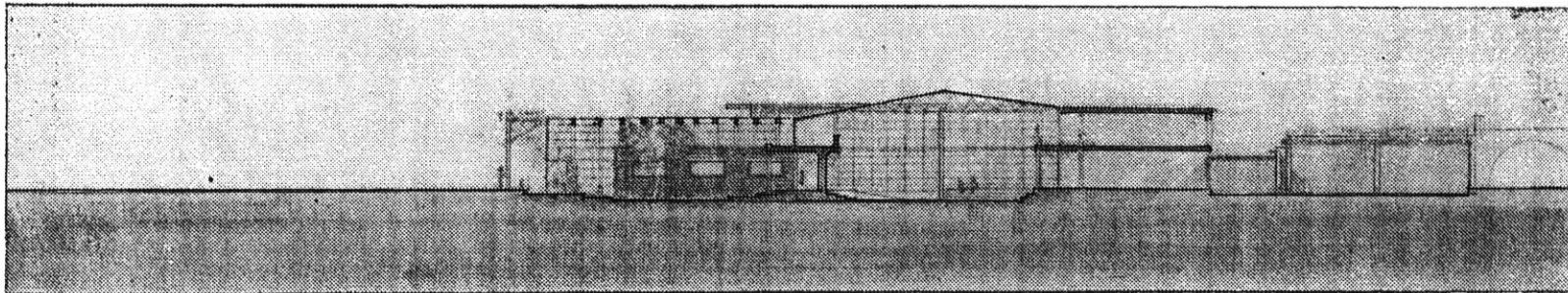
Section A-A cuts through (left to right) the community/school gym, and meeting room, classrooms, the central atrium space, corridors classrooms and the school patio space. Section B-B s shows (left to right) the elevation of the separate gym complex and part of the school. The section cuts through the administration offices, the central atrium, the corridor and classrooms.

### 5.3.2 Preliminary Drawings (cont'd)

SECTION C-C (north-south)



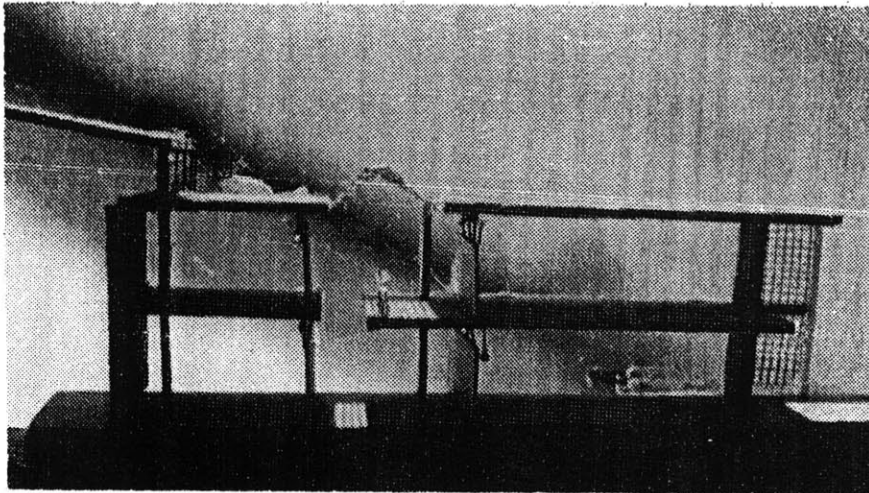
SECTION D-D (north-south)



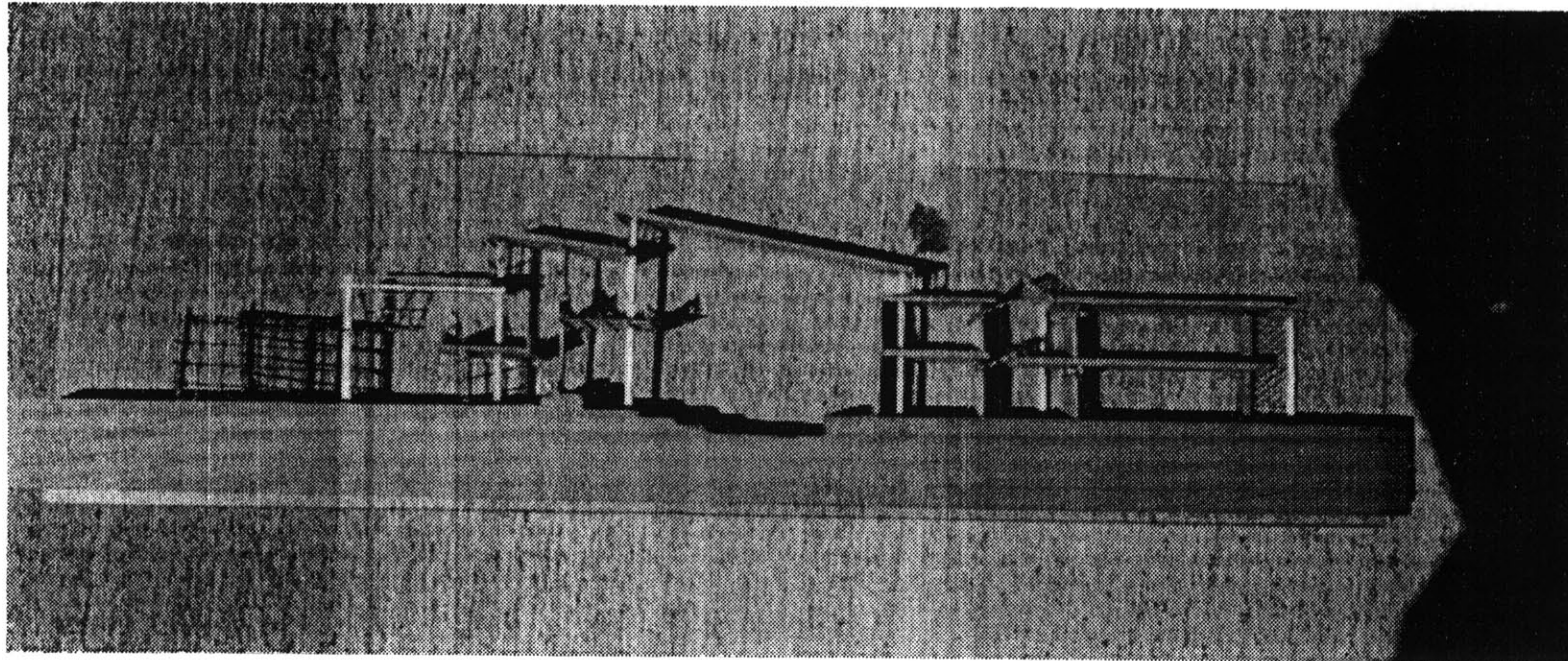
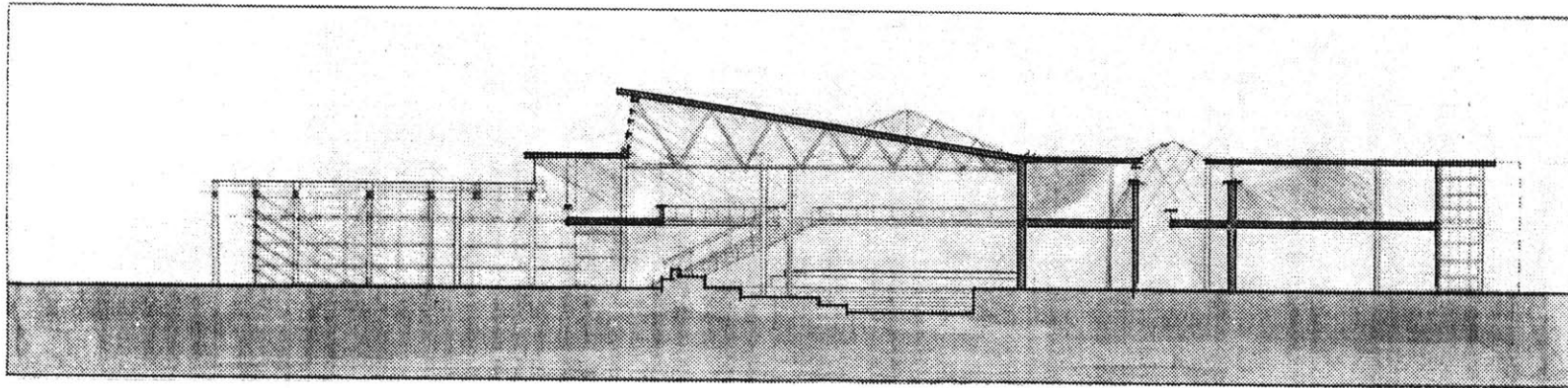
*Section C-C cuts through classrooms atrium, corridor, classrooms mechanical spaces and the sod covered parking connected to viaduct.  
Section D-D cuts through the greenhouse, corridor, the atrium, classrooms and covered parking.*

#### 5.4. Interior Studies

Interior drawn and modeled sectional studies were conducted with an emphasis on lighting. Lighting needs account for one of the most significant demands on energy in schools. Reducing the need for artificial lighting in institutions like schools can significantly reduce the need for energy production thereby reducing pollution associated with the combustion of fossil fuels in the generation of electricity (or in this case, with nuclear power). Natural light also improves the comfort of the school.



*The photo of the study model focuses on the school corridor . Sun light can reach the first level where lateral light is not available.*

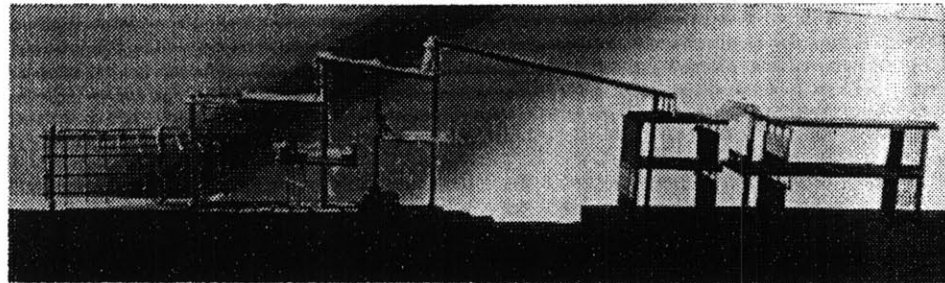
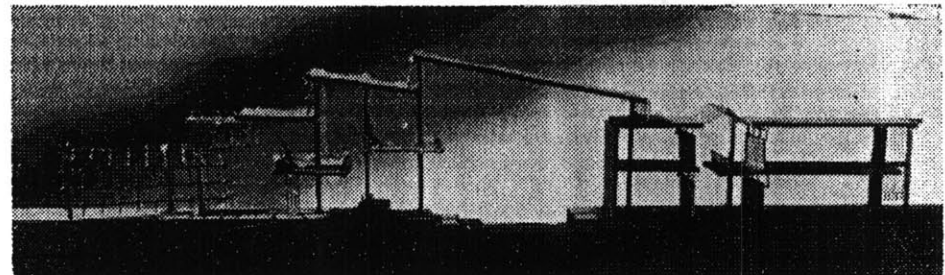
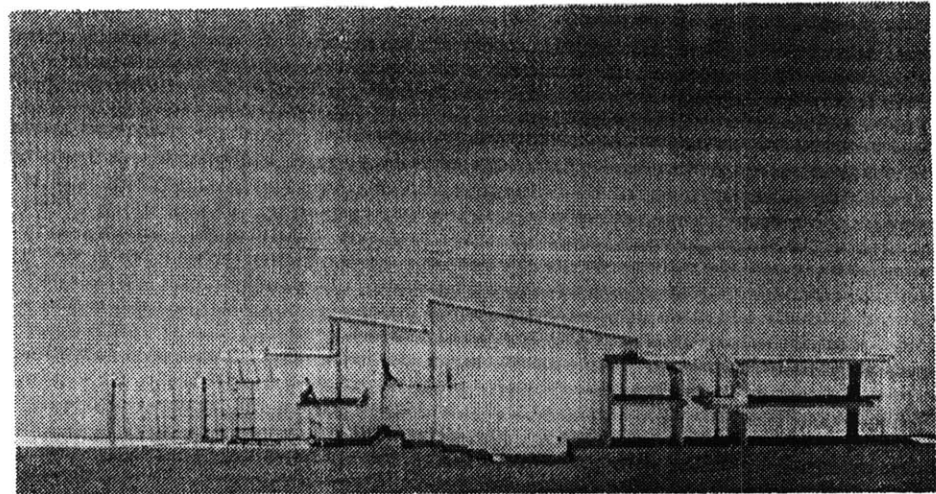


*The sectional drawing studies the effect of winter light on the South Loop School. The corresponding sectional model cuts through (from left to right) the greenhouse, the entrance corridor, the performance/gathering space (central), bathrooms, the secondary corridor and classrooms.*

### 5.4.1 Study Model of Light

This series of photos shows how light moves in the atrium performance/gathering space over the course of a day:

1. When sun is high in the sky, direct light hits the floor of the atrium; indirect light reflects off the ceiling
2. Later in the afternoon, light moves across the floor of the atrium
3. In the early evening, before sunset, direct light hits the strong wall in the atrium space and proceeds to move upward as the sun sets.



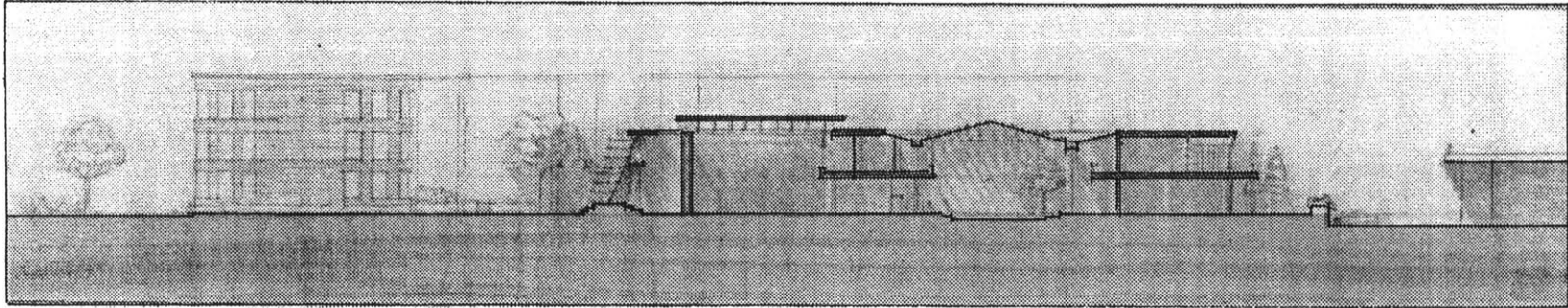
#### 5.4.2 Drawn Light Studies

A series of sectional drawings that examine seasonal light conditions follow. There exists nearly a 30° difference in winter and summer sun paths in Chicago. The winter drawings are based on the angle of the sun in January at 1 PM. The summer drawings are based on a June sun angle also at 1 PM. This exercise aims to manipulate sections (roof overhangs and balcony) in such a way as to block direct summer light while allowing in direct winter light.

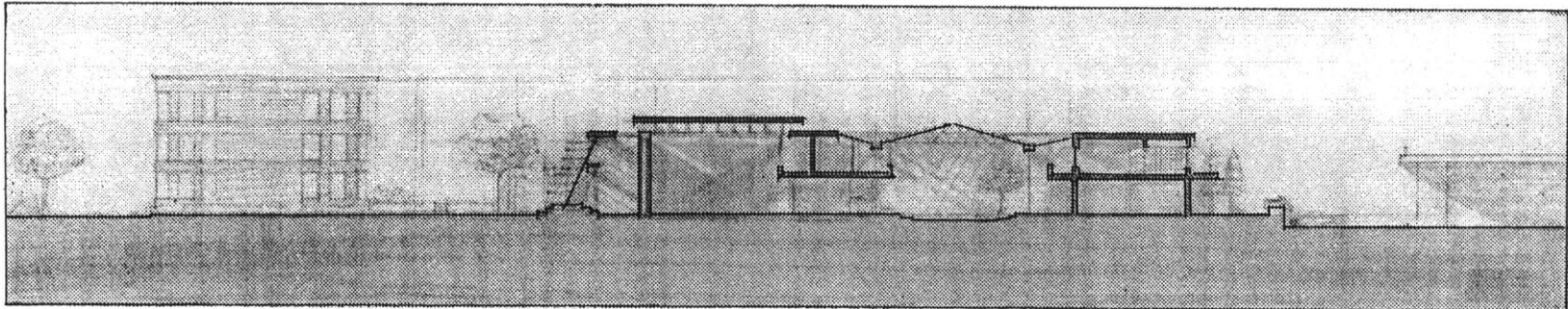
Of particular interest was the collective sun space at the southern edge of the school (to the left in drawings), where the large gym wall is used as a backdrop and as massing to store solar energy over the course of a day. The wall requires access to direct solar heat in the winter. Trees were used as summer time shading elements. The final design incorporates this use of the original continuous gym wall as a solar mass but could not use deciduous trees for shading and instead implements shading devices to keep the space from overheating in the summer.







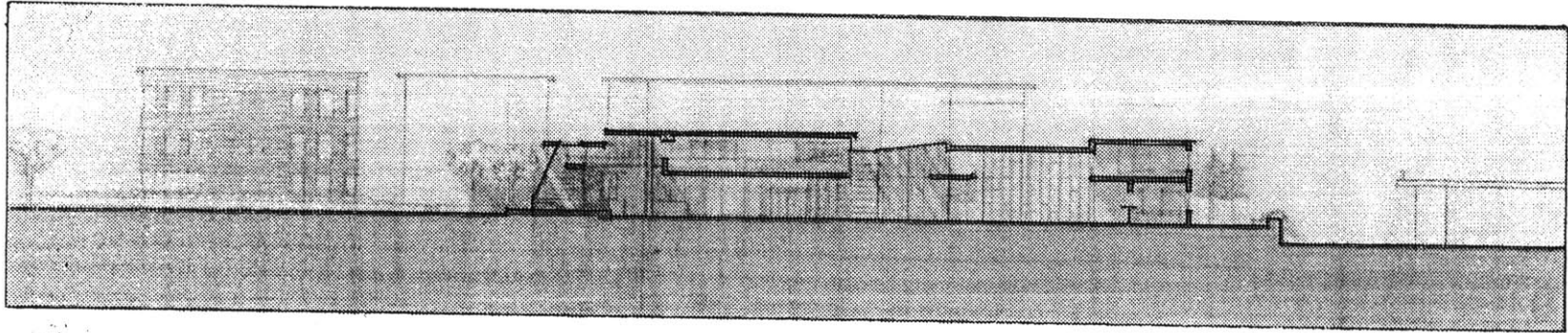
A-A SUMMER



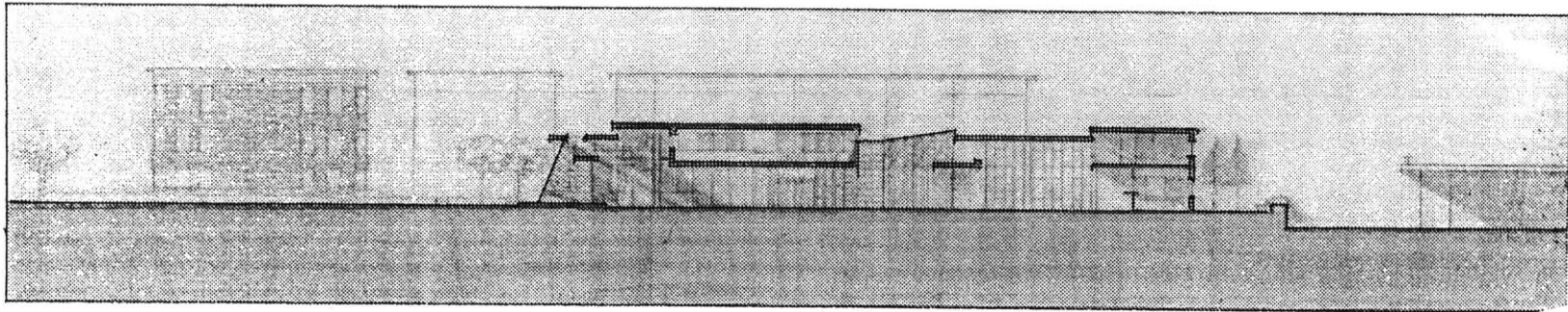
A-A WINTER

*Section A-A cuts through (from left to right) the collective sun space, gym, corridor, atrium/performance space, corridor, and library with its north-facing balcony. The roof and balcony keep most of the sun space shaded in the summer, while allowing winter sunlight to enter.*





B-B SUMMER



B-B WINTER

*Section B-B cuts through (from left to right) the collective sunspace, administration, greenhouse, cafe, and kitchen.*

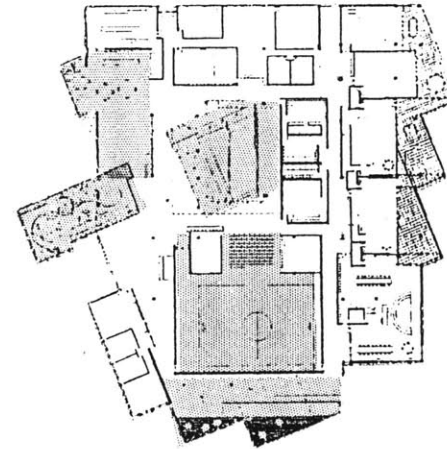
## 5.5 Final Design Proposal

The final design combines elements developed throughout the process. Basic priorities that were retained are listed:

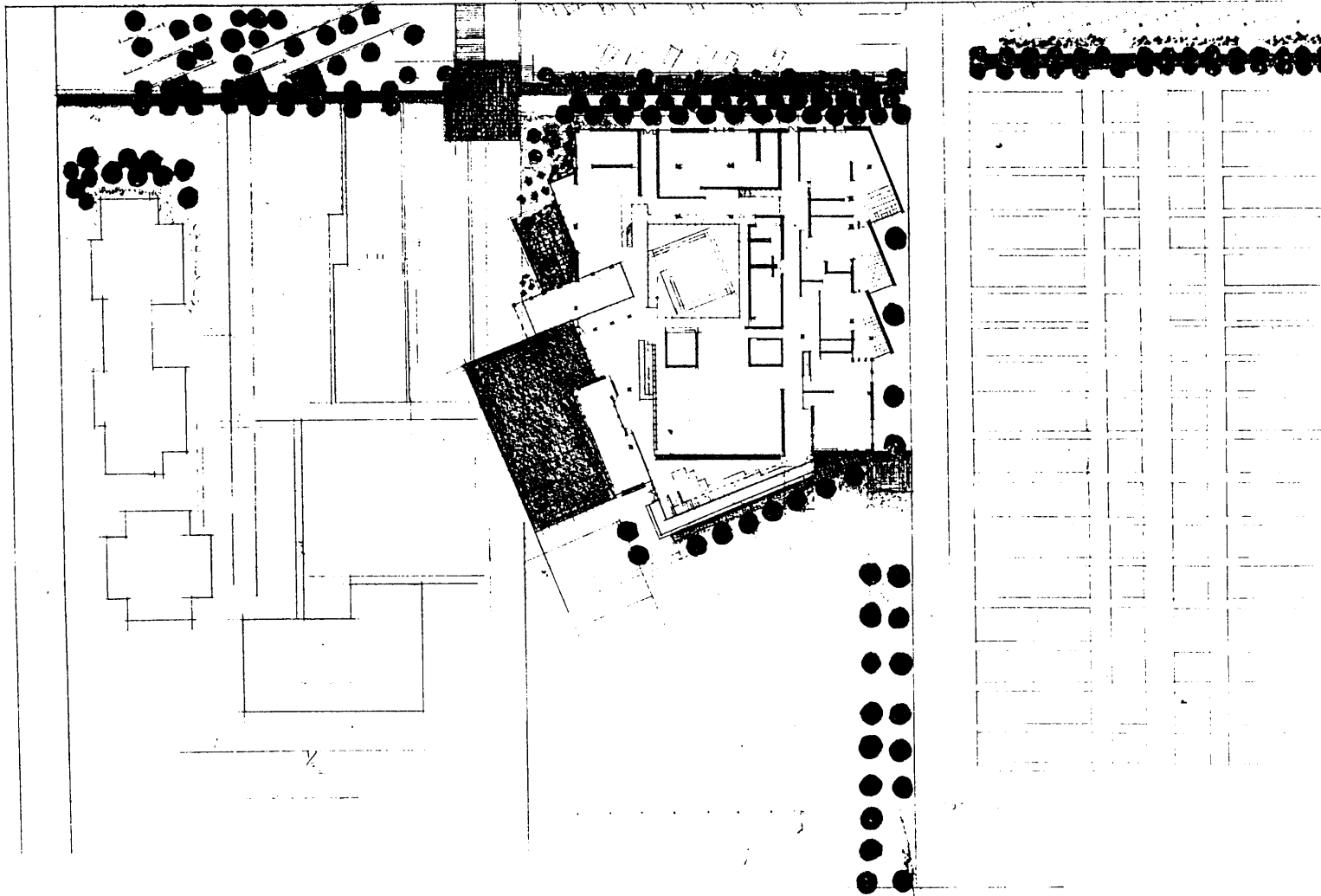
- Open the building up to make it more accessible to the community. Greater degrees of transparency in areas will make it more inviting to community members, more pleasant to school members, and can benefit from solar gains.
- Develop a relationship between the school and the nearby river.
- Add spaces supportive of informal and formal collective use (e.g. gardening, sitting, sports, performance, etc.) during and after school hours.
- Integrate natural elements and processes (e.g. rainfall, sunlight, trees) into the design. Underscore those elements!

There were also several departures from previous design studies. Most notable is the location of the primary entrance to the school and the orientation of the outside community space. The earliest models attempted to reinforce community activity and enliven the "blank space" to the south of the school by bringing the building into it. In contrast, the final design acknowledges that this space may serve as a community common and one of the few open spaces in the immediate area that could support spontaneous recreational activities (e.g. Frisbee, volleyball, etc.).

Previous exercises showed that building on the space only bifurcated it and separated houses to the east side from those on the west side. The final design maintains visual access across the common, while intensifying it for use with Landscaping and ball courts intensify the space for use while keeping it accessible to eyes from all directions. The final design includes the primary entrance on the southwest side, related both to the common space and to the path leading to the river preserve.



*The diagram above highlights the larger format, collective spaces that support school and neighborhood use.*



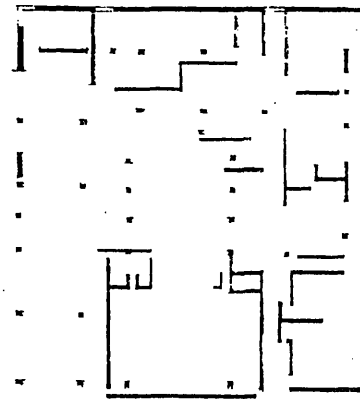
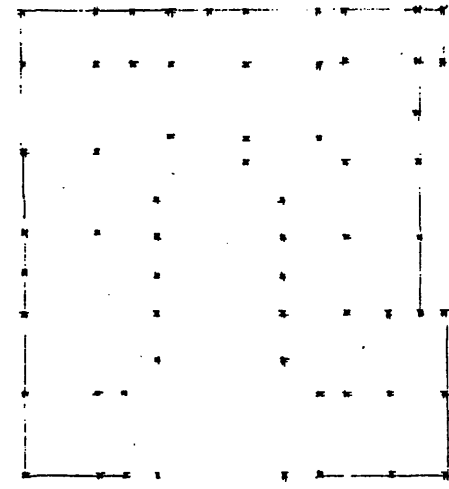
*A plan of the South Loop School in its immediate context with emphasis on the use of trees to organize outdoor spaces. Trees to the north of the school (Japanese Black pines) block winter winds and mark the east-west path from State Street to the river preserve annex. Trees to the south (Birch) form a processional to the school and a penetrable fence-like formation around the common green.*

### 5.5.1 The New Structure

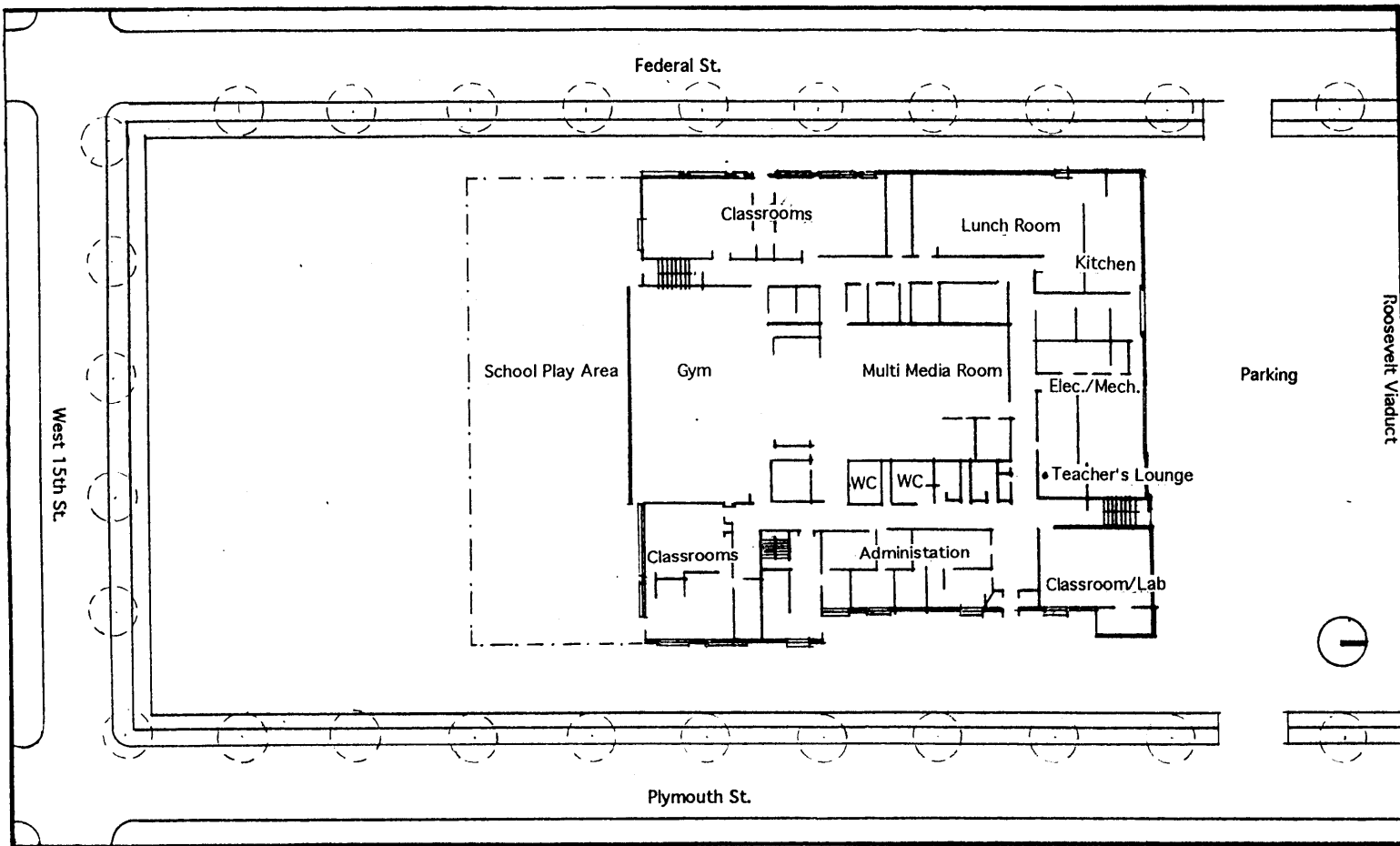
The final proposal retains much of the original school structural system. The original school conveniently located much of the mechanical space on the north and coldest side of the building. The original structure and façade is therefore retained on this side, where winter winds prevail and where generous sunlight and greater association between the exterior and interior is not required.

The proposal disturbs the original structural system and façade to the greatest extent at the southwest corner, where it was necessary to relate the inside of the school to the exterior community spaces such as the plaza, garden and common. The replacement of the original structural system here also increased the amount of natural light and solar energy delivered to the school's interior and captures the summer breezes that come from the Southwest.

The original South Loop School is too small to support the kind of night time and weekend community use deemed necessary to make it socially and environmentally more sustainable. The original structural system was designed to support current loads and no more. For this reason, a new structural system was introduced. In order to be consistent with the larger site plan in which all that is added is done so consciously and expressively, the new structural system does not mimic the old one, but rather carries on a dialogue with it.



*The diagram above shows the original structural system and the diagram below shows the retained elements of the original structural system. The north side is left intact.*



*The Original South Loop School Floor Plan.*

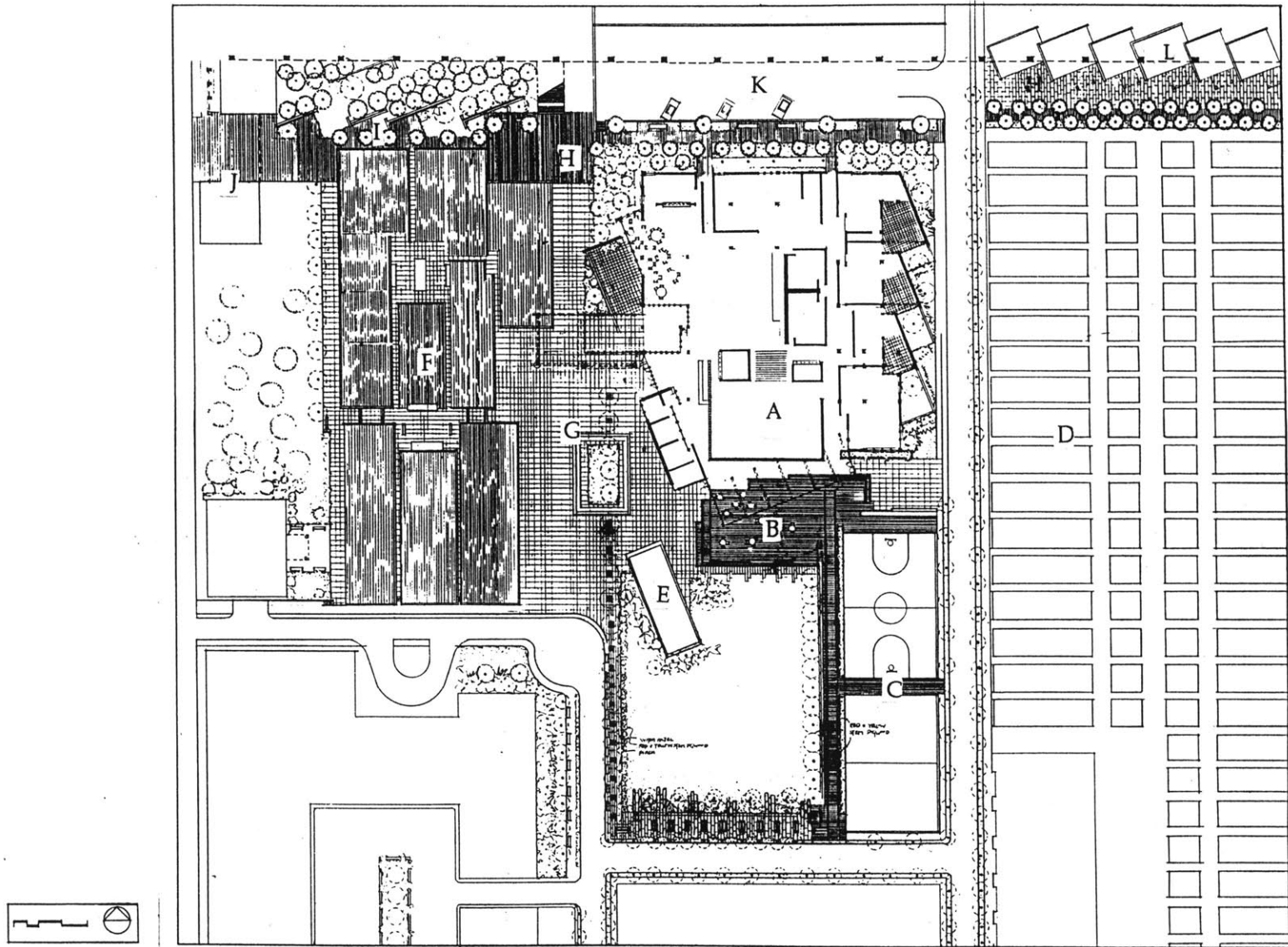
### 5.5.2 The Shift in Geometry

That which is added to the South Loop School is made very clear; it takes on the form of a shifted geometry. The desire to maximize solar exposure to the water filtration greenhouse (river preserve annex) led to experiments that departed from the original north-south grid. This rotation not only increased the south-facing surface area of the greenhouse, but also generated a dialogue (slack space) between the original and new geometry that supported community use. Collective spaces in the new plan generally occur where the old geometry and new geometries meet (e.g. collective sun space, atrium, plaza). The new geometry relates directly to the plaza space created to the south west of the school. This new geometry continues throughout the larger river preserve site, establishing its link to the school. The shift expresses the fact that the entire project is viewed as an element that fans off of a larger spine (Roosevelt Road).

### SCHOOL GROUNDS PLAN (opposite page)

- A. South Loop School
- B. School Porch (Platform) overlooking Community Green
- C. Ball Courts
- D. New Housing
- E. Sand-filled Play Space
- F. Community Garden
- G. Community Plaza (with outdoor greenhouse Extension)
- H. Path to the River Preserve Annex
- I. Walls for Temporary Market; Buffers Wind
- J. Apartment House (10 Stories) ; gateway to preserve and buffers from Clark Street
- K. Parking (slightly sunken)
- L. Store Fronts (integrated with existing viaduct)



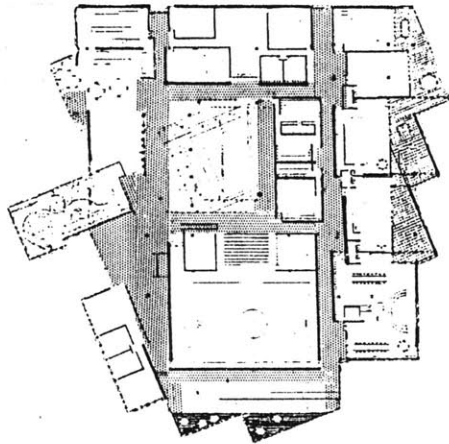


Plan of the final South Loop School Grounds

### 5.5.3 The Ground Floor Plan

The original access system is retained but expanded in the final plan. Rather than being a U-shaped corridor with dead ends and no access to natural light the new access system is  $\square$ -shaped, without dead ends, relates to other spaces (e.g. cafe, the atrium and limited classrooms), and is naturally lit either laterally or from above.

The basic organization of the new plan includes spaces that are to be used commonly by the community on the west side of the building, closest to the primary entrance and to the community plaza. Locations of the greenhouse, the gym, the collective sunspace, the atrium, the cafe and the administrative offices are immediately clear to the visitor.

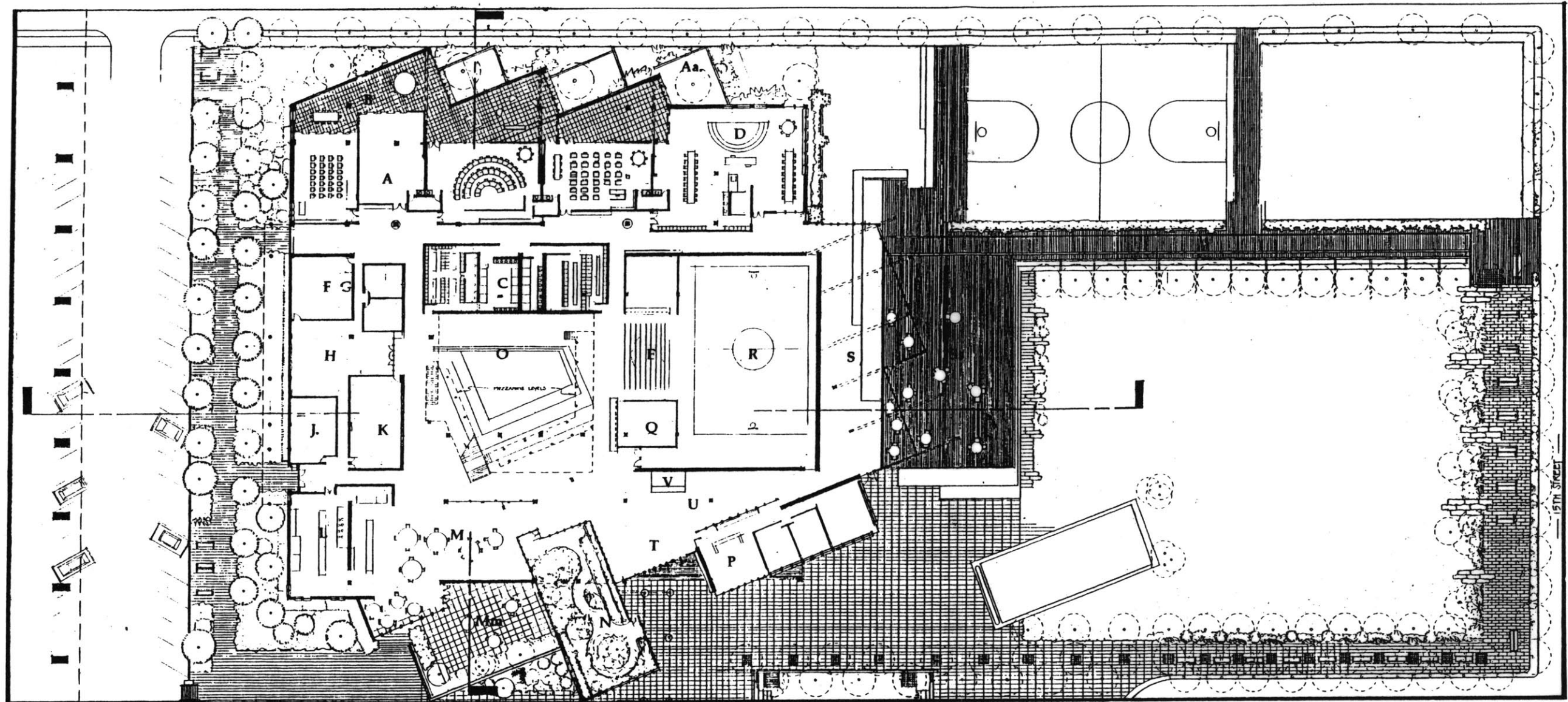


### FIRST FLOOR PLAN (opposite page)

#### USE TYPES

- A. Classroom
- Aa. Outdoor extension space
- B. Adjoining classroom sunspaces
- C. WC and Locker/Shower
- D. Kindergarten and Preschool
- E. Gym
- F. Mechanical
- G. Electrical
- H. Music
- I. Music Practice
- J. Waste Storage
- K. Offices
- L. Kitchen
- M. Cafe
- Mm. Cafe Patio
- N. Greenhouse
- O. Performance Atrium
- P. Administration
- Q. Equipment
- R. Gym
- S. Collective Sunspace (gatherings and talks)
- Ss. Sunspace Porch
- T. Primary Entrance
- U. Lobby
- V. Exhibition/Special Event Bar

*Diagram (left) highlights the access system in the new South Loop School First Floor Plan.*



Ground Floor Plan of the Proposed South Loop School



#### 5.5.4 Second Floor Plan

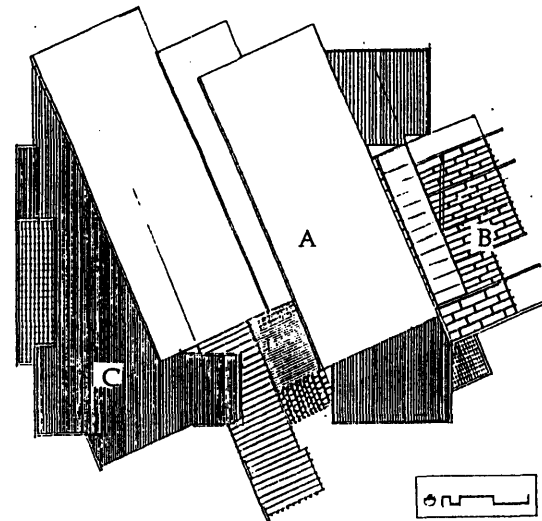
Spaces reserved for school use are located on the second floor. The second floor houses is comprised of classrooms and the school library. The library is located on the north side, with access to a balcony and to limited natural light. Japanese Black Pines surround this balcony. The teacher's lounge is located next to the library and has access to the exterior balcony and to an interior balcony overlooking the cafe.

#### 5.5.5. Roof Plan

Just as the plan fans outward in places to collect natural light, so too do roof planes shift to allow top lighting. The two largest roof shifts occur over the larger format spaces, (the atrium performance space and the gym). These planes are sloped to support solar panels.

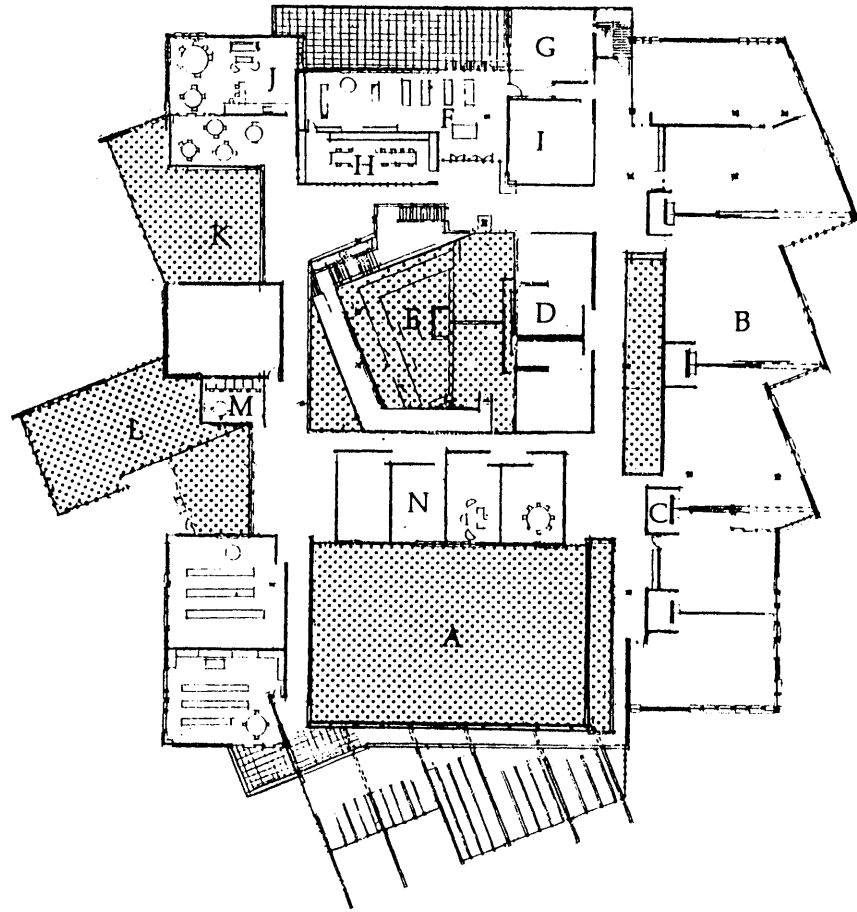
#### ROOF PLAN

- A. Solar panel Support Planes
- B. Sloped Glazing
- C. Flat (original roof plan)



SECOND FLOOR PLAN

- A. Gym below
- B. Classroom
- C. Classroom WC
- D. WC
- E. Atrium Below
- F. Library
- G. Library Offices
- H. Computer
- I. Audio-Visual
- J. Teacher's Lounge
- K. Cafe Below
- L. Greenhouse Below
- M. Study Carrels
- N. Offices



*Plan of Second Floor*



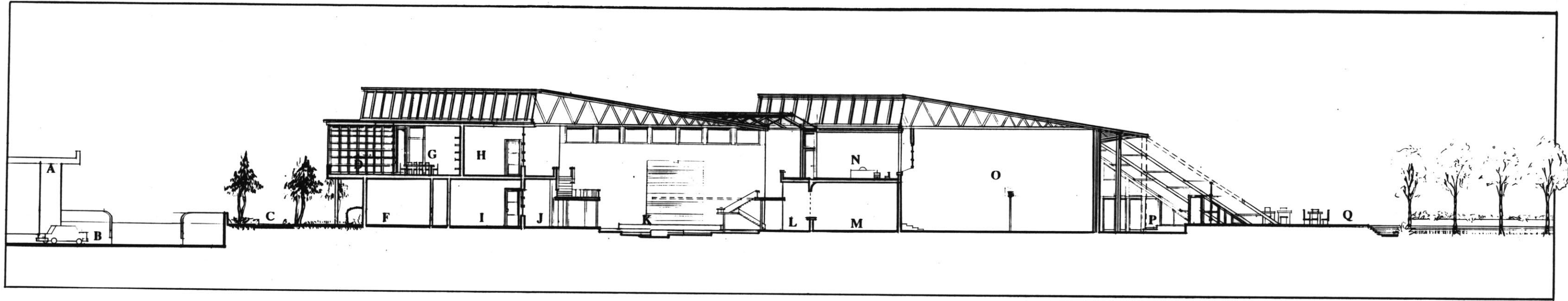




### **5.5.6 Sectional Drawings**

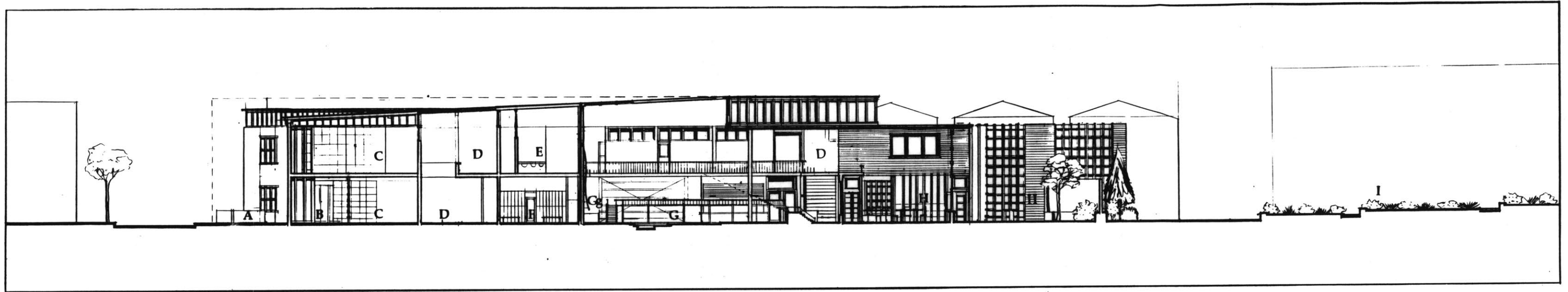
The following sections show the dimensions of collective spaces relative to more private spaces and the relationship between the access system and the central atrium.





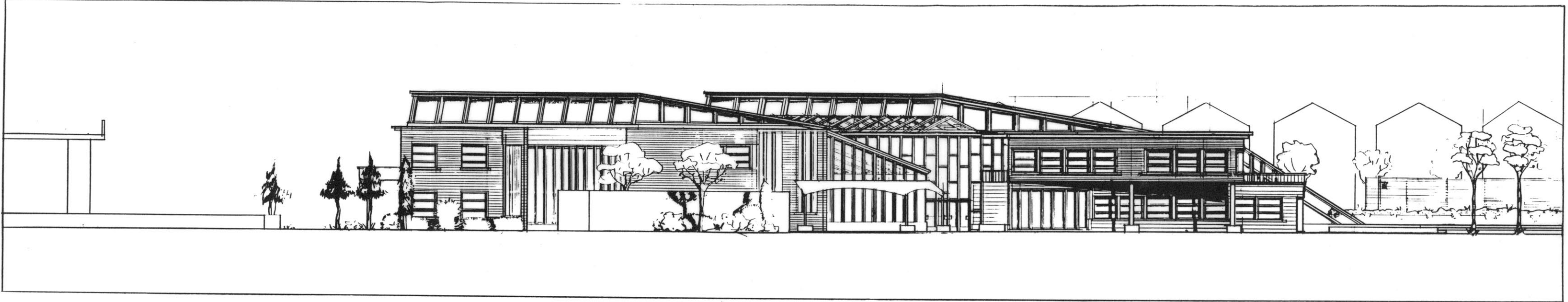
**SECTION A-A.** From left to right: (A) Roosevelt Viaduct, (B) Parking, (C) Path to Biopreserve Annex (D) Library Balcony, (F) Storage Room, (G) Library, (H) Computer Center, (I) Office, (J) Access Zone (Hallway), (K) Atrium Theater, (L) Access Zone, (M) Gym Equipment, (N) Office, (O) Gym, (P) Sunspace, (Q) Porch Facing Common Green





**SECTION B-B.** From left to right: (A) Classroom Patio, (B) Classroom Sunspace, (C) Classroom, (D) Access (Hallway), (E) WC, (F) Locker Room, (G) Atrium Theater, (Gg) Roof Drain Fountain, (H) Cafe (looking toward greenhouse), Cafe Patio, (I) Community Garden.

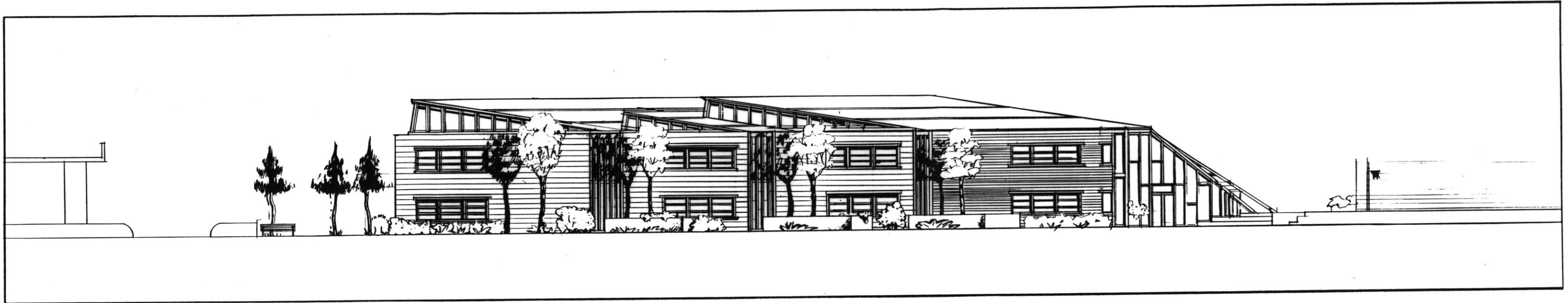




*EAST ELEVATION shows the exterior of classrooms with the extending sunspaces and garden walls for exterior instruction. Trees and walls work with one another: deciduous trees shade the sunspaces in the summer and enhance the view while tree types alternate with material change. Trees with dark bark grow in have lightly clad walls as a backdrop and trees with light bark (Birch) has the original dark brick wall as a backdrop.*







*WEST ELEVATION shows (from left to right) the exterior of the kitchen, the cafe, the cafe patio wall, the greenhouse (with canopy) the entrance, the administration offices and part of the collective sunspace.*





*View of the Proposed South Loop School looking north from the community plaza and approaching the school entrance To the right are administrative offices and to the left is the community garden.*

### 5.5.7 Final Design Description

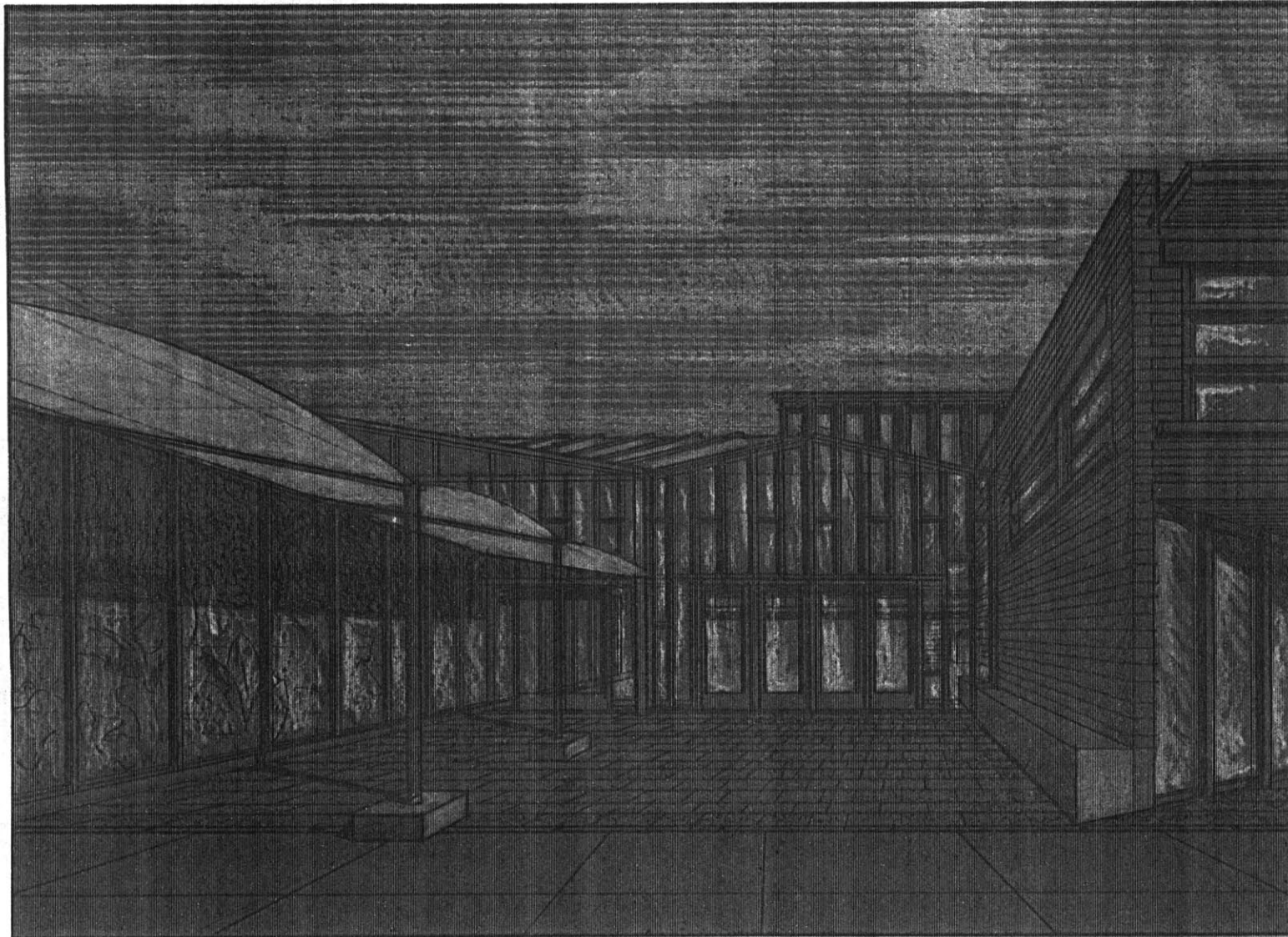
The South Loop School design presented in this thesis has focused on social cohesion and environmental sensitivity in developing an approach to sustainable design. These issues have been examined and addressed at a range of levels, from regional to individual implications in an attempt to combine ecological and architectural methods.

The design addresses social cohesion by the creation of collective spaces at the city scale (i.e. the biopreserve and ecolab) that reinforce relationships between city resources and that serve as a convening points for people from the varied surrounding neighborhoods. At the smaller community scale, social cohesion has been the primary concern driving the design of the school grounds with its plaza, its community garden and its common green. As a way to make these spaces more public and inviting, they are visually linked to one another while supporting different uses (i.e. the relationship of the common green, the plaza and the garden to one another).

These exterior spaces are more public through their relationship to a school building. The proposed South Loop School opens itself up to the exterior community spaces both in material (transparent layers) and in its shifted form. The school's large format spaces (e.g. the gym, the performance atrium, the sunspace, the cafe and kitchen) support community use during nonschool hours such as sports

events/classes, meetings and performances. Social cohesion is also vitally important within the school to support healthy working relationships between school members and to secure a sense of safety. Spaces that serve different needs and yet are somehow related to one another reinforce social cohesion within the school. In plan, walls with windows are used between small format spaces (classrooms and offices) and the access system to provide visual connections but maintaining necessary privacy. In section, the access system relates to larger format spaces: from the halls on the second floor one may peer down at the performance atrium, cafe, gym and entrance lobby. The design also attempts to provide for social cohesion among teachers by improving the teacher's lounge and by linking classrooms together with sunspaces that may be used for alternative classroom activities. Rather than locating the teacher's lounge in a windowless space next to the electrical room, the scheme places the teachers lounge on the second floor where it relates to the student cafe, the library balcony and overlooks the community garden.

The South Loop School design pursues environmental sensitivity on levels ranging from regional to the individual. The incorporation of the river site as an educational and recreational facility is a response to the need for not only examining what the school can derive from its region but also what impacts the school design will have on the region. The



*View of the proposed South Loop School entrance, showing the greenhouse on the left and the administration offices to the right. Casual places to sit are built into the structure. Brick paving (recycled from portions of the original facade) commemorates the location of the original school walls and intensifies the transition from outside to inside.*

River Annex plan, including an ecolab tower, water filtration greenhouse, and biopreserve trails, provides students with a place in which to practice hands-on science work, (with a focus on environmental remediation). Here students might be introduced to their daily impacts on the regional and even continental environment through an enhanced connection to the Chicago River. The introduction marshland, of a more diverse ecological setting, and of a natural water treatment facility has local, regional and even continental implications on this river that ultimately feeds the Gulf of Mexico.

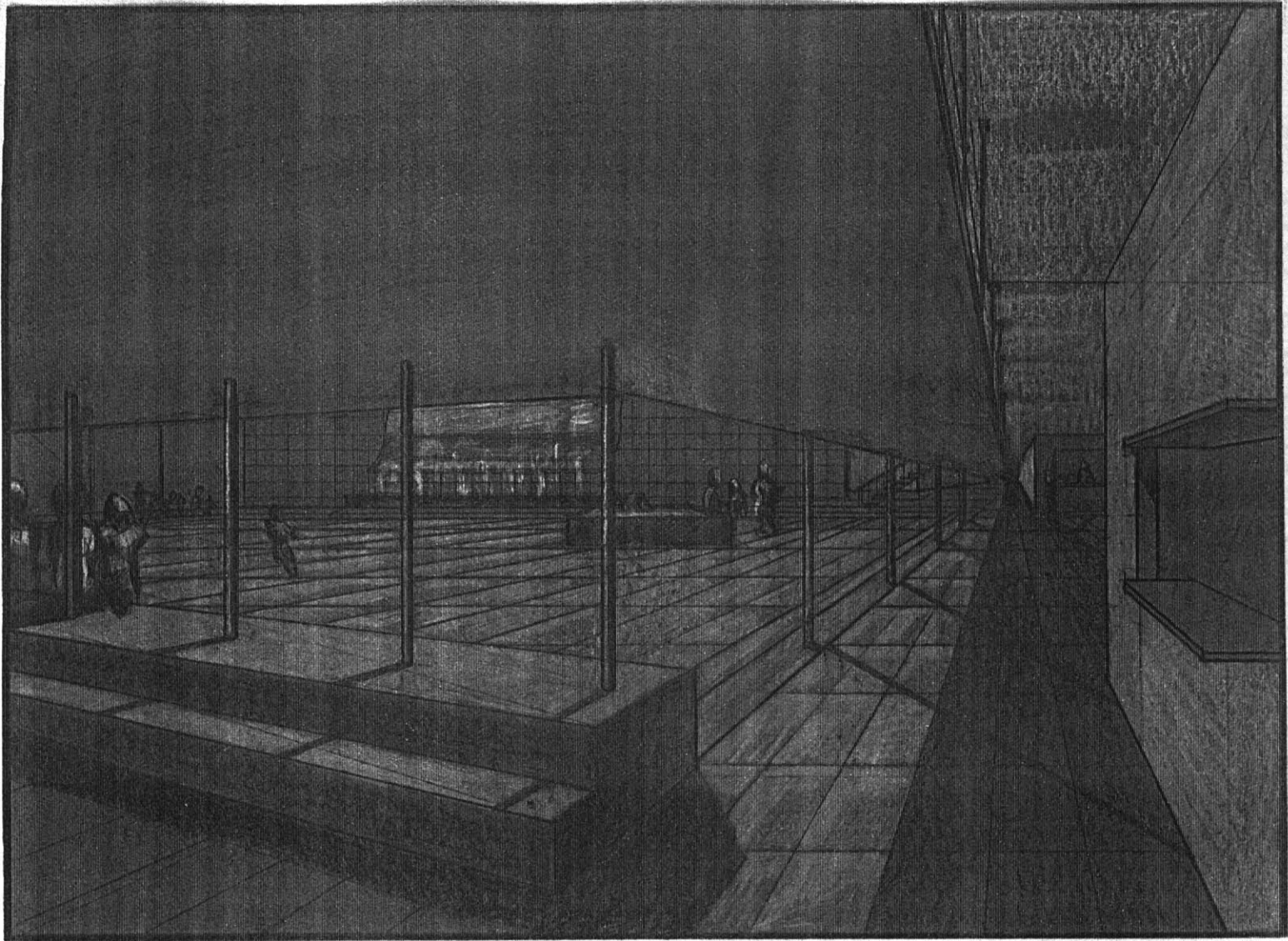
The school grounds include a community garden that potentially provides lessons in plant production (i.e. edible and native) to students and can bring community and school members together. The school grounds are landscaped to protect the building from the regional climate, with walls of pines to the north to protect against winter winds and strategically placed deciduous trees to the south to protect against overheating in the summer.

The school building itself also relates to the regional environment by responding to the local seasonal sun paths and by making use of precipitation (rain and melted snowfall). Translation of environmentally conscious strategies such as water conservation into expressed design elements offers not only lessons for students but also a richer architecture. The performance atrium's backdrop wall is also a wet wall,

collecting rainfall from the roof and delivering it either to the fountain at the wall's base in the atrium or to WCs on the other side of the wall, depending on the school's preference from day to day. This water conservation measure focuses on enhancing the atrium space, providing it with the soothing and cooling properties of a fountain and that makes the atrium a more desirable space in which to take a break when it is not in use as a formal gathering spot. Similarly, rainwater is collected at the south side of the school, employing an ancient irrigation technique to water the common green and to enrich the path that leads to the school. It is in moments such as these that human and natural elements convene.



*View of the South Loop School from the south. To the right are the ball courts and to the left are the birch trees that mark the path toward the school and help to define the common green. Along the left (west) side of the path are troughs that carry rainfall from school surfaces to the green for irrigation purposes. Movement of water and people correspond here.*





## 6.0 CONCLUSION

This thesis originated from the notion that sustainable design can be pushed beyond its marginalized role as simply a confluence of applied technologies if with it develops an architectural form that embraces natural elements and processes (e.g. rainfall, sunlight, plant form, etc.). Sustainable design can be more than a tacking together of technologies and can reflect a deeper set of influences driving its form. Behind this notion of sustainable design is the contention that the expression of environmentally conscious strategies into active and expressed design elements is a means by which the building can teach sustainability. In other words, a more tectonic form of sustainable design is consistent with values initially driving it- those values being rooted in the desire to develop a heightened consciousness about the environment and our impact on it.

The redesign of a school offered the opportunity to see how a building might both act sustainably and teach ecological sustainability. Furthermore, the redesign of the South Loop School provided an exploration of sustainability's meaning in an urban setting as opposed to the bucolic settings that so often accompany sustainable designs.

Upon researching the range of discussions about sustainability and reviewing examples of sustainable design, it becomes clear that a gap exists between the articulated goal of

sustainability and actual design method– How are the goals achieved in practice? An important objective of this thesis is therefore the development of a method with which to approach a sustainable design. This thesis therefore tracks the development of the project to underscore how architectural design method can expand to accommodate environmental issues. The design method developed in this thesis breaks down into four general parts:

- 1) Frame Sustainability Priorities
- 2) Seek Architectural Precedents
- 3) Analyze the Site at a Range of Scales
- 4) Perform Multimedia Design Checks

Some of these parts are typical of the design process in general Others, however, are often not part of the design process. The atypical design exercises derive from a merging of ecological and architectural tools of analysis (e.g. regional and interspecies analyses). Without the development of analytical tools, design cannot evolve; new (or recombined) tools identify new problems and thus new solutions.

1) Frame Sustainable Priorities. Sustainability and sustainable design are met with a certain degree of skepticism today because the terms are widely used across fields to mean many different things. It is therefore

imperative that a designer be precise about what s/he means by “sustainability” and how s/he intends to satisfy this definition through architectural form. The sustainability matrix developed in this thesis results from a compilation of sustainability explanations. The matrix organizes the range of definitions into a simplified system and breaks sustainability down into three basic topics: economic security, ecological integrity and social cohesion. The matrix then defines each of these major categories according to the scale of analysis, ranging from individual to global. With this tool one can communicate the parameters of a project and then test design ideas against those parameters. Ecological Integrity and Social Cohesion are the two categories receiving the greatest amount of attention in the South Loop School Design.<sup>1</sup>

2. Seek Architectural Precedents. Once aspects of sustainability are identified and issues specific to the project are prioritized, it becomes necessary to seek examples of built form that physically address the issues of concern. Because no single work is likely to satisfy the

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<sup>1</sup>The lines between these categories often blur, as the overlap between economic benefits and energy conservation proves. Nonetheless, as a tool by which to prioritize issues, the simplified matrix is helpful.

range of goals associated with sustainable design, an array of architectural work informs the South Loop School Design. Architectural precedents for this project included designs that promote social cohesion through the design of adaptive collective (gathering) spaces, transitional zones, and interactive spaces, and that reinforce ecological integrity through designs that celebrate natural processes and forms (e.g., the play with light, water as an architectural element, and plants as physical definition).

3. Analyze the Site at a Range of Scales. Many of the site analyses undertaken for the proposed South Loop School design are representative of standard architectural design methods. However, in attempting to design more sustainably and reinforce healthy ecological relationships, there are two ways that the site analysis expands beyond traditional methods:

- Identification of the existing and potential urban ecology present and
- Examination of the site in its regional context.

The ability of cities to support a diverse set of animal and plant species is generally not acknowledged. Without acknowledging urban ecologies it is difficult to protect, support, and encourage them. Analyses associated with

urban ecology in this thesis include the identification of kinetic corridors (light, wind, pollution, sound) and corridors supporting movement of other species. The analyses also trace the ecological history of an area within the city.

Often, site designs in cities undertake analyses that range from the individual to the urban scale, as does this design. Yet, because the city has historically been viewed as a complete entity that is divorced from its surroundings, architectural analyses rarely go beyond the urban scale. However, The city, however, is more than a concrete jungle; it simultaneously belongs to a larger ecological system and supports many smaller ecological systems. The city is not ecologically severed from its region and analyses for more sustainable design must acknowledge this fact. A relatively sustainable design incorporates the regional conditions, (e.g., seasonal sun paths, and winds) and flows (e.g., animal movement, resource movement, water movement). It is also important to understand the city's role in the survival of nonhuman species that traverse regions (e.g. birds)<sup>2</sup>

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<sup>2</sup>The South Loop site illustrates one case in point: the number of birds spotted in this area is vastly larger than one might expect in such a densely populated urban environment. Many of the bird species spotted there are en route from Canada to the Southern Hemisphere (rain forest) and the city is a stopping point.

4. Perform Multimedia Design Checks. The process of redesigning the South Loop School, begins with schematic diagrams that identify the access systems and collective spaces, with decisions about how public or private a given space should be. These diagrams evolve into plans which are then checked by sectional studies (drawn or modeled) to analyze light and visual connections between distinct spaces.

Sketch models explore how the school's exterior relates to the surrounding spaces such as the gardens, housing, play area, plaza and patios. The models explore how different materials relate the inside of the building to the outside as a way of building social cohesion among school and community members. The building surface is also explored for its ability to light the interior naturally and benefit from solar energy.

Drawings, including plans, elevations and perspectives, explore how a formalized landscape can define zones of use outside, protect the building from excessive winds and heat, and buffer visual and aural noise.

Perspectives examine how the design impacts the individual who is experiencing a particular place; they focus on the adjustment of details. These processes are employed iteratively, with one form of media testing the prior design form work. Like kneading dough, a constant shifting of media is necessary to undo the knots and develop coherence among the many parts involved in sustainable design.

Environmentally sensitive design thus requires that a scheme respond to issues far larger than the building itself or the technologies employed within it. The need for regional analysis is particularly important in placing the building in its environmental context. However, sustainable design cannot stop there; a simultaneous reading of the design as ecologically responsive at the larger scale and sensitive to the individual is necessary. This twin reading is possible not by submerging or hiding one aspect (e.g. the environmental technology) but rather by expressing it in the design and by finding where it can offer ancillary benefits to the individual. By looking at the problem in this way, one can begin to bridge the gap between the goals of sustainability and the experience that one encounters in a sustainably built environment.

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Understanding that the city's role in sustaining these migrations has implications for increasing tree canopy cover.

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## 7.0 APPENDICES

### APPENDIX 7.1 Birds Found in the Chicago Area

#### Common and Unusual Birds That Breed in the Chicago Area

Blackbird, red-winged and yellow-headed  
Bluebird, Eastern  
Bobolink  
Bobwhite, Northern  
Bunting, Indigo  
Cardinal, Northern  
Catbird, Gray  
Chickadee, Black-capped  
Coot, American  
Cowbird, Brown-headed  
Crow, American  
Cuckoo, Black-billed and yellow-billed  
Dickcissel  
Dove, Mourning and Rock  
Finch, House  
Flicker, Northern  
Flycatcher; Acadian Great Crested, Least, Willow  
Goldfinch, American  
Goose, Canada  
Grackle, Common  
Grosbeak, Rose breasted  
Gull, Herring and ring-billed  
Hawk, broad-winged and Red-tailed  
Heron; Black-crowned night, Great Blue, and Green-backed  
Humming bird, Ruby throated  
Jay, Blue  
Kestrel, American  
Killdeer  
Kingbird, Eastern  
Kingfisher, belted  
Mallard  
Martin, Purple  
Meadowlark, Eastern  
Merganser, Red-breasted  
Nighthawk, common  
Nuthatch, White breasted  
Oriole, Northern and Orchard  
Wol, Barred, Eastern Screech and Great Horned

Parakeet, Monk  
Pewee, Eastern Wren  
Pheasant, Ring-Necked  
Phoebe, Eastern  
Robin, American  
Sora  
Sparrow, Chipping, House, and Song  
Starling, European  
Swallow; Bank, Barn, Northern Rough winged and Tree  
Swift, Chimney  
Teal, Blue-winged  
Thrasher, Brown  
Thrush, Hermit and Wood  
Titmouse, Tufted  
Towhee, Rufous-sided  
Vireo, Warbling  
Warbler; Yellow, Yellow-rumped,  
Waxwing, Cedar  
Woodpecker; Downy, Redbellied, Red-headed  
Wood-Pewee, Eastern  
Wren, House and Marsh  
Yellowthroat, Common

#### Illinois Endangered Birds That Breed in the Chicago Area

Bittern, American and Least  
Blackbird, yellowheaded  
Crane, Sandhill  
Falcon, Peregrine  
Grebe, Pied-billed  
Heron, Black-crowned Night  
Night-Heron, Black-crowned  
Tern, Least

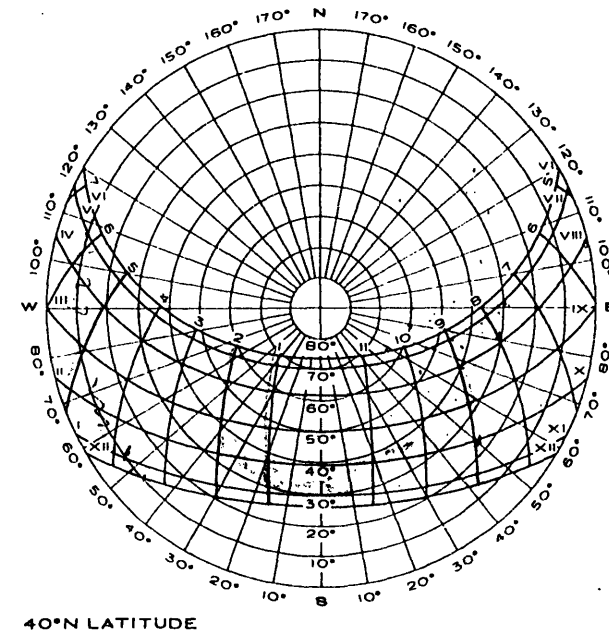
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APPENIX 7.2 Sun Path of South Loop Site

SUN PATH OF SITE				
Month	9am	1pm	5pm	Hrs. of daylight *
Jan.	17°	28°	0	9:39
Feb.	25°	38	5°	10:43
March	32°	48°	12°	11:55
April	40°	59°	19°	13:15
May	47°	66°	23°	14:23
June	49°	69°	28°	15:10
July	47°	66°	23°	14:45
Aug.	40°	59°	19°	13:46
Sept.	32°	48°	12°	12:28
Oct.	25°	38°	5°	11:11
Nov.	17°	28°	0	9:59
Dec.	14°	25°	0	9:21
Avg. Winter	42.5	61.2	20.7	
Avg. Summer	27	34.2	3.6	

Note: Sun paths derived from Horizontal Sun Path Diagram given.

\*Hrs of daylight based on 15th day of each month



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