To the Graduate Council

I am submitting herewith a thesis written by Ellen Bronté Lake entitled " Between City and Neighborhood. The Design of a Center for Sustainable Education and Living " I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Architecture, with a major in Architecture

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We have read this thesis
and recommend its acceptance:

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Accepted for the Council

Associate Vice Chancellor and
Dean of the Graduate School

# BETWEEN CITY and NEIGHBORHOOD:

# THE DESIGN OF A CENTER FOR SUSTAINABLE EDUCATION AND LIVING

A Thesis

Presented for the

Master of Architecture

Degree

The University of Tennessee, Knoxville

Ellen Bronté Lake

August 2000

# ACKNOWLEDGMENTS

*I will lift up mine eyes unto the hills,*
*from whence cometh my help.*

So wrote the psalmist to comfort the Israelites as they embarked upon their journey I, too, found those words to be comforting throughout my thesis experience. My help came also from the encouraging words of professors, family and friends.

I would like to acknowledge the commitment of my thesis committee who gave so generously of their time and knowledge. Matt Altwicker, Jon Coddington, Tracy Moir-McClean and Stroud Watson. Their guidance helped me to crystallize my thoughts in order to make my thesis work possible.

I am always grateful for my parents, Barbara and Benito Lake, Sr. who lovingly support me in all my endeavors. They gave me such a wonderful start in life and nurtured my understanding of perseverance. I would also like to thank my Grandmothers, Aunts, Uncles and Cousins for encouraging me to do my best no matter how difficult the task They all share in my success.

I am indebted to a host of friends and colleagues who where there in the late hours to offer their assistance and show their confidence in me. Their friendship has enriched my life. I would also like to thank the City of Chattanooga Parks, Recreation, Arts and Culture Department and the Chattanooga-Hamilton County Regional Planning Agency for their valuable assistance and support It was truly a pleasure to have worked with them.

# ABSTRACT

This thesis proposes that the ideal place for institutions of environmental learning is between the neighborhood and the city. Through the shaping of urban space, the architect's task is to discover how the built environment can be ecologically conscientious while encouraging environmental stewardship The need for shelter and its diversity are based on human experience, imagination and climatic effects that are specific to place Through the design of a program for a *Center for Sustainable Education and Living* the thesis explores the tectonic relationship between ephemeral architecture and the permanent conditions of architecture as they respond to natural and human forces that shape the built environment and affirm a sense of place.

Architecture is an art form that allows visual, tactile and emotive experiences. Through tectonic expression, the architect is able to reconcile both natural processes and human purpose. Tectonics can be defined as the science or art by which implements, vessels, dwellings or other edifices are constructed both agreeably to the end for which they are designed and in conformity with artistic sentiments and ideas. These processes, in addition to natural land patterns, provide the basis for the shaping of the built environment. Responses to natural and human forces are potential form generators of edifice and place. Building design and placement as a response to site and contextual conditions have potential to affirm a sense of place while demonstrating solutions for local policies of environmental responsibility. Natural as well as man-made patterns of the site and surrounding neighborhood not only inform placement of human intervention but also activities that can be accommodated.

By focusing on urban development, the thesis explores opportunities for community sustainability through reclamation of abandoned urban space, social cooperation and affirmation of place. Reclamation and affirmation of place helps revitalize the city by making it more attractive as well as productive for both residents and visitors. Social cooperation as proposed by the thesis presents new patterns of urban living that repair, enhance and sustain the city in order to create a new urban form and image. The thesis investigation explores design issues pertaining to patterns: urban, structural, adaptability, and edification. In addition, the proposed thesis investigates sustainable design based on local conditions of place as opposed to more regional or global scopes.

Chattanooga, Tennessee has been selected as the urban site for this thesis. The design investigation provides a means of engaging, informing and inspiring the citizens of Chattanooga to become stewards of their environment. In addition, the design investigation proposes diverse spatial opportunities for local responses to environmental responsibility through design, demonstration, discussion, education and observation of the existing urban context An investigation of urban patterns both existing and potential is explored as a means to integrate the proposed design into the existing urban infrastructure and context of the neighborhood. The design investigation proposes activities that allow social gathering, participation, demonstration, experimentation and production Each proposed activity generates a spatial condition that provides a comprehensive experience to affirm a sense of place while teaching local practices of environmental stewardship through adaptation of new living patterns. Each proposed activity will generate a spatial condition that provides a comprehensive experience to affirm a sense of place while teaching local practices of environmental stewardship through adaptation of new living patterns.

# Table of Contents


| SECTION | | PAGE |
|---|---|---|
| I. | **INTRODUCTION** | 1 |
| | *Thesis Statement* | 1 |
| | *Focus of Exploration* | 13 |
| | *Supporting Argument for Thesis Statement* | 15 |
| | *Thesis Issues* | 16 |
| | *Design Investigation Proposal* | 17 |
| II. | **DISCUSSION OF THESIS ISSUES** | 21 |
| | *Introduction* | 21 |
| | *Patterns* | 27 |
| III. | **DESIGN INVESTIGATION** | 32 |
| | *Introduction* | 32 |
| | *Context* | 34 |
| | *Site Planning* | 36 |
| | *Site Inventory* | 39 |
| | *Site Analysis* | 48 |
| | *Design Response Summary* | 75 |
| | *Program* | 77 |
| | *Precedent* | 82 |
| | *Diagrams* | 88 |
| | *Architectural Drawings* | 96 |
| **BIBLIOGRAPHY** | | 111 |
| **APPENDIX** | | 116 |
| **VITA** | | 118 |

# I. Introduction

***Thesis Statement***

In general, people have become removed from nature and its processes If the actions that cause environmental harm are to change, then our understanding of the environment must increase. To become better stewards of the environment, the public must be educated in a manner that heightens ecological conscientiousness and encourages ecological responsibility. As an architect, I have the responsibility to maintain a cooperative relationship between the built and natural environments

Understanding of environmental responsibility on a neighborhood scale is an important step in understanding environmental responsibility regarding the city. The neighborhood is an essential component of the larger whole. Neighborhoods develop educational values based on their specific cultural needs and interests By contrast, the city reflects the collective values of its supporting yet diverse neighborhoods Unfortunately, because of the scale of the city the importance of indi-

vidual responsibility regarding the environment is more difficult to understand and relate to on a daily basis By linking the daily environmental responsibility of the individual and his or her neighborhood to the city, individual and collective responsibility is established between the part and the whole. The purpose of environmental education is to reach the masses of people while stressing the impact and importance of individual actions

This thesis contends that the most appropriate location for an institution promoting ecological responsibility and environmental stewardship should be a place where the collective and individual can engage, learn and inspire the other. The architects's task is to discover how the built environment, through the shaping of urban space, can be ecologically conscientious while encouraging environmental stewardship.

This thesis proposes that the ideal place for institutions of learning is between the neighborhood and the city. The thesis program, *The Center for Sustainable Education and Living,* explores the tec-

tonic relationship between ephemeral architecture and the permanent conditions of architecture as they respond to natural and human forces which shape the built environment and affirm a sense of place

The Greeks were the first to realize the difference between the city (*polis*) and the neighborhood (*settlement*). The word city implies a large center of population organized as a community City is derived from the Latin word *civitas,* which denotes a community that administers its own affairs. The city evolved from agrarian settlements developed by nomadic people who settled in a specific geographical region. These early settlements were organized for protection and communal support The city became self-sufficient and diversified in economic activity as well as employment opportunity. In addition to government, industry and commerce, the city further developed its identity and culture through art and education.

The neighborhood is the simplest form of communal living where people in a particular district or area engage in social and cultural relationships Social and

physical patterns of the neighborhood influenced the form of the city. "[The neighborhood] is the basic unit of human scale with which to weave the urban pattern into a workable whole" (Gallion 1986, 297) The neighborhood unit represents the collective needs of the individual family. security, service, recreation and education. It is a unit in which institutions, service districts and recreational areas are grouped within a .25 mile walking radius (Gallion 1986, 299). The neighborhood is the necessary component which sustains the structure of the city.

> To have a polity [city] there must first be a settlement [neighborhood], because only when people are secure and are fed and clothed and when those who need assistance receive it can they build a polity in which the good life is available to all
> (Westfall 1991)

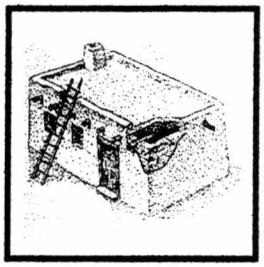
The city is developed through an understanding of the structure, goals and patterns of the neighborhood It's planned use is intended to sustain, encourage and enhance the goals of the neighborhood. According to Westfall, the purpose of a

neighborhood determines the shape of the city and the form of its architecture The purpose of the neighborhood is utilitarian while the city's purpose is utopian Facilities within the neighborhood should be adaptable in order to accommodate the ephemeral conditions that occur with the passing of time. Facilities within the city should affirm civic ideas and be permanent reminders of a collective purpose. "Arrangements build settlements while institutions build polities" (Westfall 1991, 67)

The built environment has the task of serving both the ephemeral and the permanent needs of society. There are also tasks which are shared by both the neighborhood and the city. One common task is education—that of the individual which begins in the neighborhood and that of the citizen which happens in the city. Education is necessary to sustain the life of both the city and the neighborhood The ideal location for institutions of learning is not situated in either the neighborhood or city but the common ground found between the two.

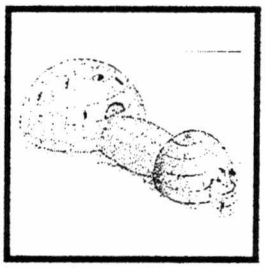
The thesis explores the dynamics of ephemeral and permanent conditions of architecture as they exist both independently and interdependently. This relationship is directly influenced and shaped by responses to climatic, topographic and human forces. Climatic conditions have a significant impact upon man's settlement of a place and the selection of materials that provide adequate shelter. The need for shelter and how that need is structured have diverse solutions and expressions which are based on human experience, imagination and climatic effects specific to place.

History reveals that adaptation to regional climatic conditions was a fundamental component of architectural design. By utilizing the natural forces acting upon a specific place, the architect can provide opportunities for formative and productive use of wind, rain and sun that are environmentally responsive as well as responsible. Architecture can be flexible to accommodate the changing needs of the city while celebrating tradition and consistent habits which are particular to place.



Source: Marcus, T.A. *Buildings, Climate and Energy*

Desert House: massive flat roof gives high thermal capacity



Source: Marcus, T.A. *Buildings, Climate and Energy*

Igloo: low profile deflects wind and takes advantage of insulating value of surrounding snow



Source: Marcus, T.A. *Buildings, Climate and Energy*

Mongolian Yurt: lightweight portable structure made of fabrics, skins or felts

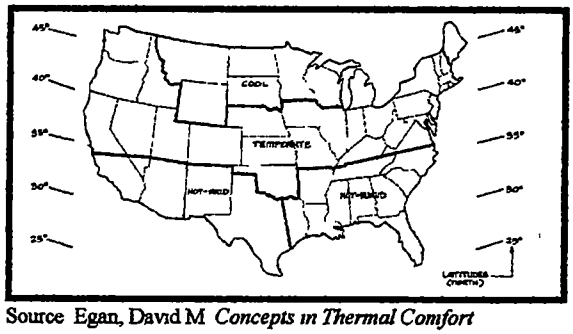


Source: Marcus, T.A. *Buildings, Climate and Energy*

Timber Hut: lightweight structure, roof has low thermal storage and steep pitch for rainwater runoff, large roof overhangs give shade, elevated floor kept dry from air circulation

The responses to bioclimatic conditions have become a design strategy for addressing the critical effects of wind, rain and sun upon the placement, construction and spatial quality of human intervention Building design and placement as a response to site and contextual conditions have the potential to affirm a sense of place while demonstrating solutions for local levels of environmental responsibility Natural as well as man-made patterns of the site and surrounding neighborhood not only inform the siting of human intervention but the activities that can be accommodated on the site as well.

Basic bioclimatic design strategies for *Cool Regions* are: maximize solar heat gain and minimize cooling effects of winter winds; *Temperate Regions*: maximize solar heat gain in the winter and shading in the summer, while minimizing cooling effects of winter winds and permitting summer breezes; *Hot-Arid Regions* maximize shading and minimize wind effects; and *Hot-Humid Regions*· maximize shading and cooling effects of the wind.

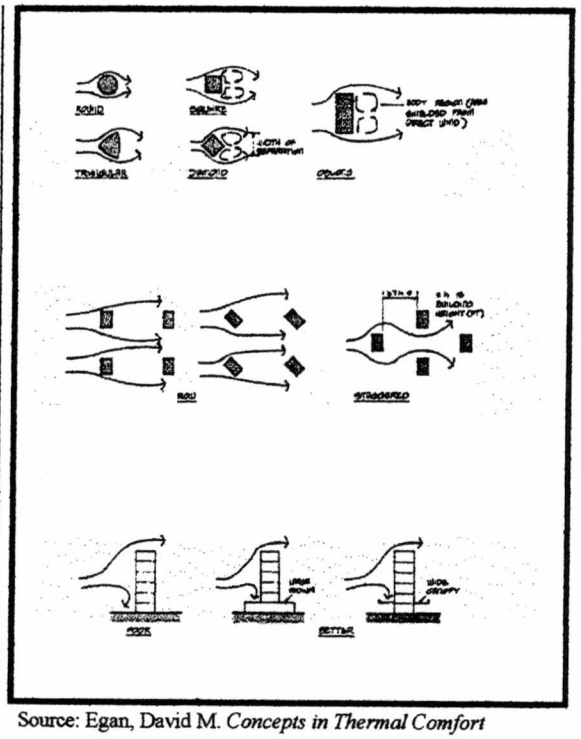



Source Egan, David M *Concepts in Thermal Comfort*

Climate Regions Chattanooga, Tennessee is located in the Hot-Humid Region

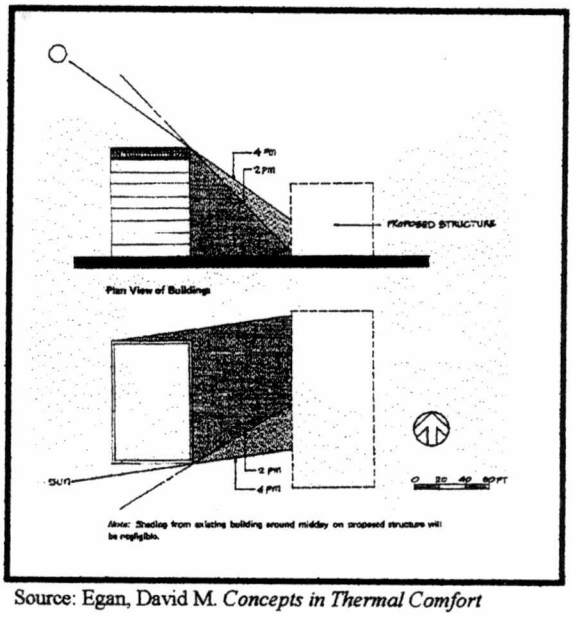
For example, a defensive response for protection against wind velocity can affect the siting and orientation of the structure. Orientation can be beneficial in reducing the need for mechanical control of human comfort when the design permits fall and spring breezes to travel through the spaces. Wind also affects the placement and size of openings for natural ventilation. High ceiling heights can provide increased air flow and ventilation if wall openings are placed both high and low (stacked ventilation).

In temperate and hot regions, cross ventilation will remove heat from interior spaces during the day, but air movement is decreased at night. Stacked ventilation can provide supplemental air movement at night and increase flow rates by 10% when combined with cross ventilation systems (Brown 1985, 107). Outdoor activities can be proposed for spaces that are shielded from winter winds. In addition, strategic placement of landscaping can create barriers which reduce the damaging effects of wind while directing air flow across the site and into the building.



Source: Egan, David M. *Concepts in Thermal Comfort*

Wind Movement



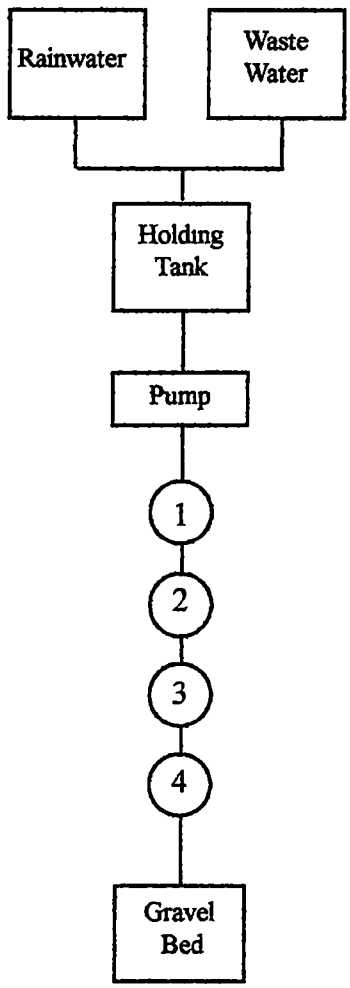

Source: Egan, David M. *Concepts in Thermal Comfort*

Sun Shading

The shape of the building can be manipulated to avoid trapped water and allow proper water runoff management. Design responses to a significant accumulation may propose a water handling network to systematically remove water from the roof to be collected and stored with minimal change to the site or adjacent property. The rainwater can be collected by disposal pipes separated from supply pipes and recycled into purified water for use again. Rooftops may also be designed to collect and evaporate water which reduces air temperature

Another strategy for water runoff management and erosion control is to design pedestrian paths and parking areas with permeable surfaces that increase the diversity of the urban landscape. Other innovative measures can transform engineered retention ponds and stormwater drainage systems into learning tools to demonstrate the natural urban pattern—water storage and disposal. The demonstration area becomes both functional and

**Waste Water Recycling: The Living Machine**




Tanks 8'-10' deep
3' above ground
10'-14' diameter

Gravel Bed 3' deep or in ground

Tank 1 Bacteria begin break down of waste
Tank 2 Snails
Tank 3 Rock and bacteria, aeration occurs
Tank 4 Fish and snails

Gravel bed Hydroponic plants filter out nitrogen and phosphorus

recreational while providing an educational experience that engages the community with its surroundings.

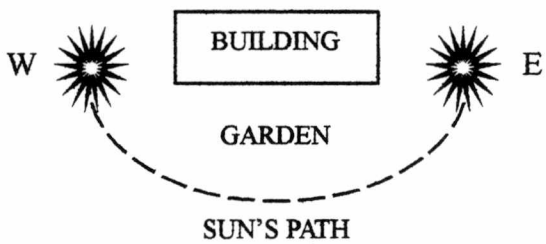
Existing buildings can provide useful shade on the intervention and may be addressed when determining the siting of the center—provided the existing buildings possess a significant architectural image and need for preservation. Buildings receive maximum solar gain between the hours of 9:00 AM and 3:00 PM. Solar shading devices and photovoltaics are potential design tools for innovative responses to the effects of solar gain. Sun orientation has direct bearing on the spatial design—the quality of light within, hierarchy and relationships of integrated spaces, thermal comfort and connection to the natural environment. To utilize daylight and minimize heat gain, buildings should be elongated in the East-West direction. To receive maximum solar gain and adequate sun light in the winter for outdoor areas and gardens in the northern hemisphere, a building should also be located in the northern most area of the sun zone. Interior service areas which require minimal



Source: Hough, Michael. *Cities and Natural Process*

LeBreton Flats, Ottawa: Retention Pond

**Response to sun's path**



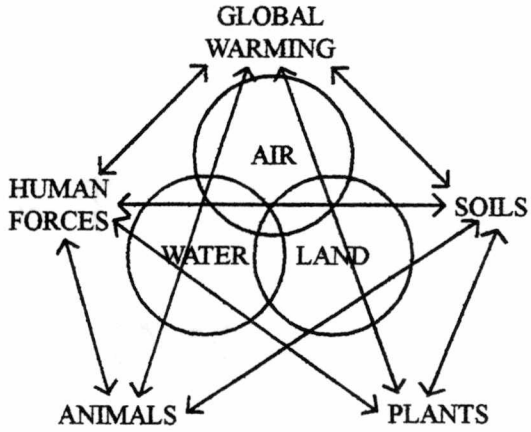
heating and lighting can be placed to the north to serve as a thermal buffer zone between the cooler north side and heated spaces on the south side

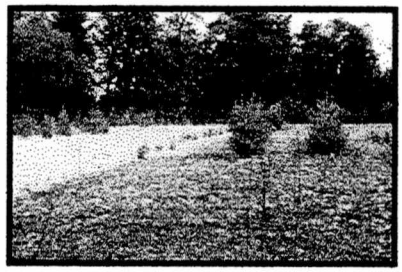
Tectonics provides a potential means of expressing bioclimatic effects upon human intervention. Tectonics can be defined as the science or art by which implements, vessels, dwellings or other edifices are constructed both agreeably to the end for which they are designed and in conformity with artistic sentiments and ideas (Frampton 1990, 21). To understand tectonics, one must understand the relationship between structure and construction. To construct is to make a composite form by assembling elements in a logical order or system based on set principles. Structure, on the other hand, is the order or system in which elements are arranged to respond to the forces at work on the form According to Eduard Sekler, tectonics is the visible expression of the play of forces and the ordered relationship of parts—"a relation of form to force"

Architecture is an art form which allows visual, tactile and emotive experiences. Through tectonic expression the architect is able to reconcile both natural processes and human purpose. Bioclimatic conditions of wind, rain and sun are natural processes that help determine the human need for shelter. These processes in addition to natural land patterns provide the basis for the shaping of the built environment. The type of system which expresses structure and construction of the built environment has potential to respond to bioclimatic forces while providing a means of understanding the principles of the form's assembly. Through its proposed use, tectonics expresses the relationship between the city and urban nature. According to Vittorio Gregotti, the tectonic act is developed through transformation of the built and natural environment's context into form (Frampton 1990, 23).

Sekler also reminds us that the concept of tectonics was used to understand the relationship between Greek architecture and early nineteenth century neoclassicism. When describing the built environ-

**HUMAN AND NATURAL INTERACTION**



**Benefits of Vegetated Areas**

- Increases water storage
- Reduces glare
- Decreases carbon dioxide
- Increases oxygen
- Provides food and habitat for wildlife
- Noise reduction
- Pollution reduction
- Provides natural cooling for structures
- Provides aesthetic pleasure

ment, the architect uses techniques of design, assembly of materials and methods of construction to create an emotive experience. The visual and tactile aspect of tectonic expression forms a potential basis for an architecture that is didactic. Tectonic form becomes a dichotomy of: heavy (sterotomics) and light (tectonics); earth and sky; opaque and translucent; constancy and change which is articulated through an architectural vocabulary that relates form to principle. The relationship between form and design principle revealed as a tectonic expression is a potential means of teaching and encouraging environmental responsibility through the shaping of urban space.

***Focus of Exploration***

The exploration of the thesis and design issues focuses on urban development and potential responses to the forces of wind, rain, sun and the natural environment which impact the form of urban architecture. The proposed responses explore the potential contribution of architectural tectonics to support social unity and a heightened sense of place.

Choice of architectural tectonics demonstrate local solutions for environmentally friendly design as a direct result of local climatic and environmental conditions.

Proposed solutions teach through demonstration and, hopefully, encourage environmental stewardship on a community level. By focusing on urban development, the proposed exploration present opportunities for community sustainability through reclamation of abandoned urban space, social cooperation and affirmation of the civic node. Reclamation and affirmation of the civic node can revitalize the city by making it more attractive to both residents and visitors. Social cooperation as proposed by the thesis exploration presents urban residents with new patterns of urban living that repair, enhance and sustain the city in order to create a new urban form and image The thesis investigation explores design issues such as pattern, adaptability, and edification. The proposed thesis also explores sustainable design based on local conditions of place as opposed to more regional or global scopes

***Supporting Argument for Thesis Statement***

Architects, by definition, are master builders of the built environment and have a responsibility to maintain a cooperative relationship between the built and natural environments. The thesis explores the potential of architectural tectonics and spaces shaped by a response to local climatic conditions, because there is a growing concern in both the profession and community for energy conservation and the impending depletion of natural resources. The thesis asserts that architecture can assist in society's present need to exist without compromising the ability to meet the needs and aspirations of the future. The thesis exploration provides opportunities for environmental education in a manner that encourages the local patterns of urban and natural environs to coexist for the good of all

If the actions that cause environmental harm are to change, then our understanding of the environment must increase. One of the problems facing environmental education is the scale at which we present the crisis When the environmental crisis is

presented on a global scale, the common citizen can have difficulty grasping and understanding their contributing actions and the consequences that result. Only when the crisis relates to a specific town, community, block or house is the urgency for recognition and action apparent. Environmental education conducted on a community level creates a baseline of understanding and agreement that reflect the goals of that community It is the architect's task to design an architecture which speaks of climate, place and urban fabric.

***Thesis Issues***

I will limit my thesis investigation to the effects of wind, rain, sun and the natural environment upon the built environment through an exploration of the following relationships and questions.

*Urban Patterns*

- How will the scale of the intervention support the existing and planned civic nodes of the community?

- How will the intervention support existing residential and business districts?

*Structural Patterns*

- What is the connection between earth and structure?
- What is the optimum siting of the facility with regard to climate of place (solar gain, light, air, rain collection and wind)?

*Adaptability Patterns*

- How can the design explore reclamation of abandoned urban space?
- How can the use of indigenous and/or green materials and native planting materials demonstrate local responsibility for the environment?
- How can traditional methods of construction be construed to demonstrate environmentally friendly design?

*Edifying Patterns*

- How can the intervention present local environmental issues and potential solutions?
- How will the intervention encourage the sustainability of the city?
- How can the intervention demonstrate new patterns of living?

***Design Investigation Proposal***

To pursue and give form to the related issues, this thesis explores as a design investigation a *Center for Sustainable*

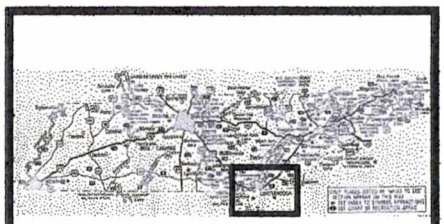
*Education and Living*. The design investigation is intended to provide a means of engaging, informing and inspiring the citizens to become stewards of their environment. The design investigation also proposes diverse spatial opportunities for local responses to environmental responsibility through design, demonstration, discussion, education and observation of the existing urban context. The program for this design investigation is generated from four proposed activities: *Gathering*, *Learning*, *Living* and *Working*.

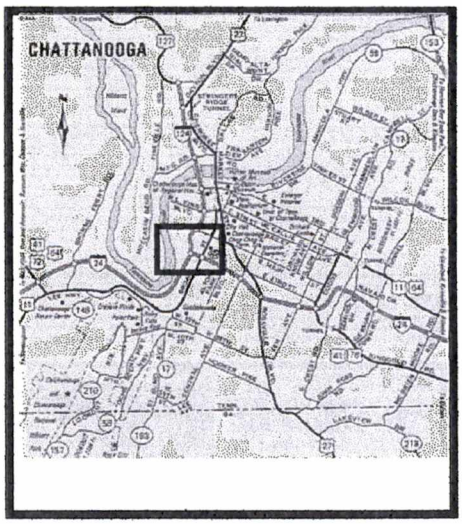
A site in the southeastern region of the United States is used to explore the effects the natural environment has upon the built environment. The specific urban site is located in Chattanooga, Tennessee and is in close proximity to downtown, the interstate, the greenway system and historic landmarks.

An investigation of urban patterns both existing and potential are used as a means to integrate the proposed design into the existing urban infrastructure and context of the neighborhood. In addition to hotel facilities, a convention and trade



United States of America


**Tennessee**

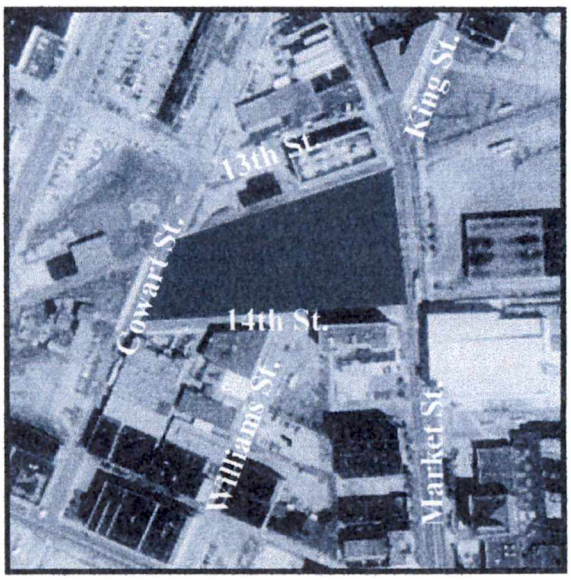


center are within a .25 mile radius of the selected site. The surrounding service facilities and the proposed *Center for Sustainable Education and Living* can cooperatively function to support the economic growth and enhance the community's image as one of the most liveable cities in America.

Restaurants, entertainment, recreation, residential and retail are within a 1 mile radius to provide opportunities for a vibrant street presence. The selected site has pedestrian accessibility and is along the city's public transportation route. The adjacent greenway has the potential to support alternative transportation systems linking areas which are outside the city's civic center. The site can accommodate on-site parking while additional parking can be provided by off-site facilities and adjacent street parking. Parking becomes a component of an adaptability investigation which explores various means of surfacing for multipurpose functions. The site's visibility within the city also offers opportunities for the intervention to enhance and affirm a sense of place.

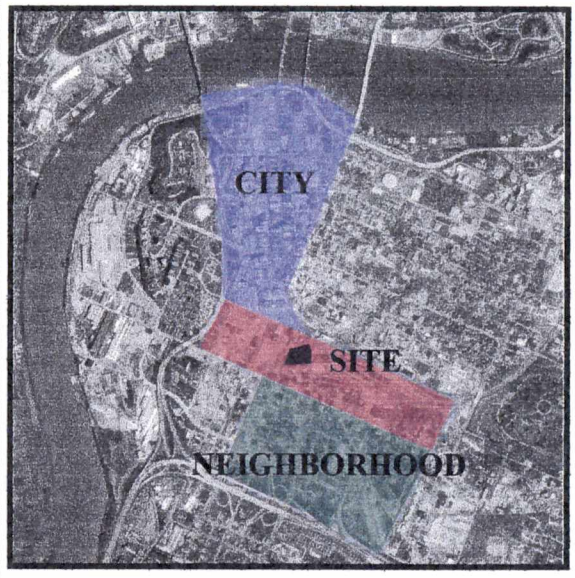


Chattanooga Nightscape



In order to engage, inform and inspire the citizens of Chattanooga, this design investigation proposes activities that allow social gathering, participation, demonstration, experimentation and production. An exploration of local urban patterns support the interior and exterior spaces that are formed as a response to bioclimatic and environmental conditions. These spaces provide opportunities for public meetings, passive recreation, and learning. Local responses to bioclimatic forces provide spatial opportunities to demonstrate use of native planting materials and to observe environmentally friendly construction materials—their application, maintenance and durability.

A variety of activities aimed at promoting stewardship of the local environment allows both informal and formal areas for teaching, recycling, research and retail of environmentally friendly products. To engage the public in environmentally sustainable activities, spatial consideration are given to allow for hands-on gardening and product installation workshops. Each activity proposed by the design investiga-



tion provides a comprehensive experience which affirms a sense of place while *teaching* local practice of environmental responsibility through *adaptation* of *new living patterns.*

*Gathering* activities provide an opportunity for individuals to interact and develop common interests. *Learning* activities provide an opportunity for formal and informal means of educating the public on matters of environmental responsibility and stewardship. *Living* areas are programmed to be multifunctional studio/ housing spaces. Commercial/Retail (*Working*) activities provide opportunities for public service and neighborhood enterprise.

# II. Discussion of Thesis Issues

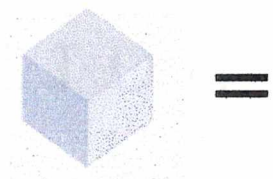
***Introduction***

The physical form of the city is shaped by both natural and human forces These forces and their effect upon the built environment indicate that there are recur-

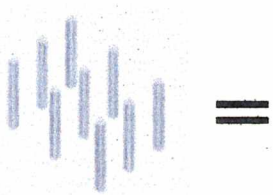
ring conditions that can be resolved through a synthesis of natural and architectural patterns and forms. These natural and architectural conditions contain within them design responses and solutions. The dynamic between these conditions and the local design response become intrinsic characteristics that are particular to a specific culture and place. Recurring conditions are innate and can be derived from topography, climate and human interaction. They are permanent conditions embedded in the idea of place and manifested through architecture. Each problem can be revisited to produce the best possible solution or model for quality of living.

A neighborhood or city's character is determined by the events and patterns which continually occur. Ultimately, architectural responses to natural and human forces begin with an acute understanding of place (*genius loci*). The impact of these responses, based on this thesis, is anticipated to become a catalyst for connection and urban renewal.

**Architectural Tectonics**



Sterotomic
Permanent
Mass
Solidity
Institutional



Trabeated
Ephemeral
Frame
Lightness
Adaptable

The thesis investigates the ephemeral and permanent conditions that exist in architecture and how these conditions can give shape to the built environment by responding to the forces of man and nature. There is an obvious dichotomy between ephemeral architecture and architecture that is permanent; but a less apparent notion is that the two also occur interdependently to shape an environmentally responsible architecture. Traditional architectural ideology associates permanence with mass and solidity—words associated with images of institutional and monumental architecture. Permanent architecture is conceived and designed for utility and longevity. In contrast, ephemeral architecture considers the changing needs of society and the adaptability of the built environment to satisfy those needs.

The reality of architecture is that conditions and structures can never remain unchanged but exist in a state of constant change A structure should not be designed without some consideration for current and future utility. There are some spatial conditions and service functions within a

building that can be considered relatively permanent and necessary in order to define its purpose. Other spatial conditions can be made adaptable to extend the life and utility of that structure. The relationship between indoor and outdoor conditions, location of public and private spaces, structural systems—load bearing or beam and column—circulation and HVAC systems determine the building's potential use and purpose. Ephemeral and permanent architecture as either a concept or form possess a necessary interdependency for the sustainability of both the built and natural environments.

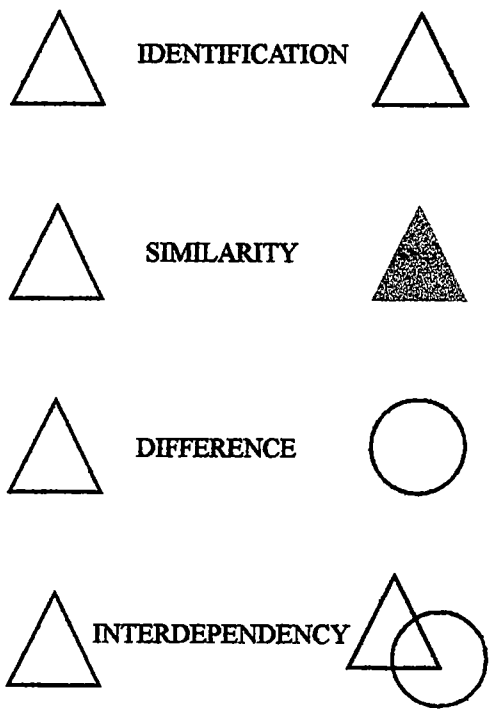
Exploration of the thesis and design issues will focus on urban development and potential responses to the natural forces of wind, rain, sun and man which shape the built environment. Bioclimatic design as a response to site and contextual conditions has the potential to affirm a sense of place while demonstrating solutions for local levels of environmental stewardship. Affirmation of place is achieved through an observation, understanding and analysis of contextual patterns

both visually and environmentally. Conclusions may be drawn which produce an architectural language that supports the character of the neighborhood and city by exact identification, similarity, difference or interdependency (Turner 1996, 110)

An *Identification* relationship between infill development and its surrounding context requires a detailed survey of existing materials, construction methods, roof slopes, openings and street or building edge conditions. In order to provide responsible and competent design, there should be an understanding of cultural resources to know what should be considered when establishing the community's character.

*Similarity* between infill development and its context provides a homogeneous effect and continuity between the old and the new. In contrast to an identification relationship, similarity does not copy but reinterprets architectural character and context in new ways

**Contextual Patterns**



*Difference* in the relationship between infill development and its context proposes a new epic in the history of place. For one reason or another it breaks away from tradition—usually due to technological advancement or social and cultural changes. Infill interventions that are totally different from their surroundings disrupt continuity but also create needed transitions between old and new development or disparate scales. Difference may be viewed as a means to establish a new set of living standards to sustain future generations.

*Interdependency* attempts to combine the other three relationships to form alternatives that preserve the old while providing opportunities for new development. The individual relationships exist as components of an integrated whole.

For this thesis, Turner's strategy of identification, similarity, difference and interdependency will be extrapolated to apply not only to urban patterns of city and neighborhood but also to the natural patterns of place. The thesis investigates the tectonic relationship between ephem-

eral architecture and the permanent conditions of architecture through an exploration of patterns.

***Patterns***

Urban patterns are revealed in two forms: formal and informal (Hough 1995, 6). Formal patterns of the urban environment may be experienced in urban places, on streets and on pedestrian thoroughfares. Informal patterns are experienced in abandoned or altered areas that are allowed to function spontaneously Both formal and informal patterns are the direct result of the natural and human forces that act upon them Urban form, therefore, reveals the history of human attitude towards the natural and built environment.

Over time, each pattern is grafted and layered, one upon the other, to shape social, natural, aesthetic and structural characteristics which are specific to place. Patterns evolve into tried and tested solutions to repeated design problems and, in turn, form the foundation of an architectural prototype The challenge this investigation presents to designers of the built

environment is to create a link between or weave the patterns of need and utility with those of technology and the environment.

For this investigation, patterns are classified into primary, secondary, tertiary and quaternary groups. *Primary Patterns* are those found in nature, *Secondary Patterns* are formed by human behavior and adaptation to place as a result of survival requirements; *Tertiary Patterns* are established by creativity and aesthetic appreciation of place; while *Quaternary Patterns* are the combination of evolved patterns that have proven to be successful solutions or prototypes for design problems

> Each pattern can exist in the world, only to the extent that it is supported by other patterns the larger patterns in which it is embedded, the patterns of the same size that surround it, and the smaller patterns which are embedded in it. This is a fundamental view of the world It says that when you build a thing you cannot merely build that thing in isolation, but must repair the world around it, and within it, so that the larger world at the one place becomes more coherent, and more whole, and

**Primary Patterns**
Sun
Wind
Rain/Snow
Parks/Open space
Mountains
Water
Caverns

**Secondary Patterns**
Roads
Bridges
Railways
Tunnels
Pedestrian travel
-sidewalks
-shortcuts
Shelter
Markets
Institutions
Monumental Structures
Civic Facilities

**Tertiary Patterns**
Theatres
Museums
Art Galleries
Sculpture Gardens
Aquarium

**Quaternary Patterns**
Architectural Codes
Materials
Fenestration
Zoning

the thing which you make takes
its place in the web of nature,
as you make it.
(Alexander,1977)

Primary and Secondary patterns consist of various components which work together to form an interdependent relationship. Both humans and other natural populations possess the ability to accommodate and adjust to changes in patterns of their environment. Usually, change and adaptation can occur during a sudden change in conditions (physiological) or during a slow course of time (evolutionary) Those populations that cannot adjust to change become extinct

Physiological adaptation caused by bioclimatic forces require acclimation and behavioral changes Evolutionary adaptation forms behavioral, physical and functional changes These changes have two distinct outcomes: beneficial or detrimental. To survive evolutionary or physiological changes, primary and secondary patterns must possess regenerative behavior that perpetuates conservation, preservation and growth

Tertiary and Quaternary patterns illustrate the factors that give a particular physical space its unique presence and distinctive character. They measure cultural values and the quality of life that are present within the city as well as the neighborhood. These patterns also demonstrate how humans engage in social and cultural relationships which accomplish their collective and desired goals for living together.

"Would you tell me, please, which way I ought to go from here?" asked Alice
"That depends a good deal on where you want to get to," said the Cat
"I don't much care where—"said Alice
"Then it doesn't matter which way you go," said the Cat

*Alice's Adventures in Wonderland*

Having a direction or goal requires an analysis of past and current events In order to meet the needs of society without compromising the ability to meet those of future generations, an architect should acquire an understanding of the relationship between the built and natural environments. Natural processes are regenerative and essential to survival The built environment can mimic nature's regenerative qualities through design concepts of adap-

tation, flexibility and reuse. In *Architectural Principles*, Carroll Westfall concludes that the best built forms approach the natural as closely as circumstances allow Natural forces that create change and adaptation can influence human behavior and give shape to the architectural forms that support human activity

There exists a sequence of patterns, both formal and informal, that allows us to experience and understand the need for positive change that will support sustainable living. Formal learning experiences are obtained from institutions such as schools or universities, but informal learning experiences are passed on from one generation to the next by word of mouth, demonstration and art Environmental education, whether obtained formally or informally, is essential to the survival of humans and nature.

By making natural processes and ecologically responsible human patterns visible, the built environment has the opportunity to demonstrate, encourage and inspire environmental stewardship. Architecture can become a didactic experience

to illustrate the interdependent relationship between the built and natural environs and their ability to coexist without comprising the needs of future generations. When responding to natural and human forces that are specific to place, the architect has the potential to create a new urban form and image while presenting new patterns of urban living that repair, enhance and sustain both the neighborhood and city

# III. Design Investigation

***Introduction***

A *Center for Sustainable Education and Living* is used for the design investigation, because it will allow diverse spatial opportunities for sustainable design demonstration, discussion, education and observation within the existing urban context The southeastern region of the United States is used to explore the interdependent effects between the built and natural environments. Southeastern Tennessee will serve as the model for exploration of a Hot-Humid Region

The design investigation proposes a means of engaging, informing and inspiring the citizens of Chattanooga to become stewards of their environment. An investigation of urban patterns both existing and potential is explored to integrate the proposed design into the city's existing infrastructure and neighborhood context. The surrounding service facilities and the proposed *Center for Sustainable Education and Living* can cooperatively function to support the economic growth and enhance the community's image as one of the most liveable cities in America.

The specific site is located in Chattanooga and is in close proximity to downtown, the interstate and local historic landmarks. Tourist who visit the selected site are within a 5 mile radius of hotel facilities, a convention and trade center. Restaurants, entertainment, recreation, residential and retail are within a 1 mile radius. This diversity of the neighborhood provides opportunities for a vibrant street presence to support the center's proposed program.

## List of Thesis Issues

### Patterns

| | |
|---|---|
| Geographical | Residential |
| Solar | Commercial |
| Wind | Industrial |
| Precipitation | Institutional |
| Vegetation | Cultural |
| Streets | Views |
| Parking | Land Use |
| Building Type | |

## Architectural Tools/Strategies

Material
Space
Diversity
Interlocking/Overlapping
Constancy/Change
Position/Location
Datum

## Urban Design Strategies

Figure-ground
Linkage
Place

The selected site has pedestrian accessibility and is along the city's public transportation route. An adjacent greenway has potential to link areas outside of the city's urban center by supporting alternative transportation such as: trolley cars, bicycles and rollerblades. In addition, the site can accommodate on-site parking while additional parking can be provided by off-site facilities and adjacent street parking. Parking will become a component of an adaptability investigation. The site's visibility within the city also offers opportunities for the facility to enhance and affirm a sense of place.

***Context***

I have established the following criteria for site selection in order to explore my thesis issues in combination with potential building typology, activities, and program.

- Location between the city and the neighborhood
- Ability to enhance residential scale and create feeling of closeness with the environment
- Near historic landmarks
- Relative proximity to urban areas, interstate highways and airport
- Access to public transportation

- Pedestrian accessibility
- Alternative transportation accessibility
- Proximity to city services
  - -restaurants
  - -entertainment
  - -retail
  - -recreation
- Parking
  - -on site
  - -off site
- Adaptability
  - -site size
  - -site utilities
  - -materials
  - -spatial
  - -usage
- Ability to enhance community image
- Visibility within city
- Ability to affirm a sense of place

The selected site is bordered on the north by an abandoned railroad line, the east by Market Street—a main thoroughfare into and from the city; the south by 14th Street; and on the west by a secondary artery, Cowart Street, which leads to the new Southside Development Area. Current use of the site as a parking lot presents opportunities for urban development and community sustainability through reclamation of abandoned urban space.

The historic Southern Railroad Terminal Station (Chattanooga Choo-Choo Vacation Complex) and newly renovated

Grand Hotel (Tea Shop and Housing) are adjacent to the site and provide precedence for renewal efforts within the downtown area. The selected site is a relatively flat brownfield and has evidence of both managed and natural plant growth Views from the site provide visual connectors between the built environment—commercial district to the north, industrial district to the south—and the natural environment of Lookout Mountain to the west.

***Site Planning***

"Site Planning is the art of arranging the external physical environment to support human behavior" (Lynch 1971, 3). There is no prescribed list for studying sites Each site is unique and presents its own set of problems and amenities that will determine what to inventory and analyze For this investigation, I have chosen to utilize Roger Trancik's "Finding Lost Space: Theories of Urban Design".

Trancik categorizes three design strategies for urban design as: Figure-ground, Linkage and Place theory Each of the theories must be incorporated collec-

tively to reflect the layering quality of the urban fabric and to achieve a meaningful spatial experience. *Figure-ground* theory studies land coverage and the relationship between solid mass (figure) and open space (ground). It assists in determining scale and the configuration of building edges. Existing solid/void patterns expose the organization of the urban fabric and weaknesses in spatial ordering The purpose of a figure-ground study is to explore spatial design as an additive, subtractive or geometrical process in which hierarchy and ordering of spatial relationships are achieved.

The *Linkage* theory studies connection and movement. It identifies existing and potential access to and from the site A system or network of lines link elements of the city to one another. Lines may be generated from streets, pedestrian thoroughfares, linear green spaces or architectural elements to connect various areas of the city The purpose of a linkage study is to establish a spatial datum that forms a relationship between the natural and built environments A spatial datum can be obtained from visual lines, movement

patterns, building edges or organizational axis to create an architectural language and design.

The *Place* theory studies human, cultural and historical patterns that give character to a specific physical space. Character is obtained tactilely (materials and texture), visually (shape and color) and intangibly (emotive experience and utility) The purpose of place theory is to add richness and presence to a specific physical space in order to affirm its origin, intention an aspirations. It identifies important contextual elements that can link new and old, permanent and ephemeral.




FIGURE/GROUND

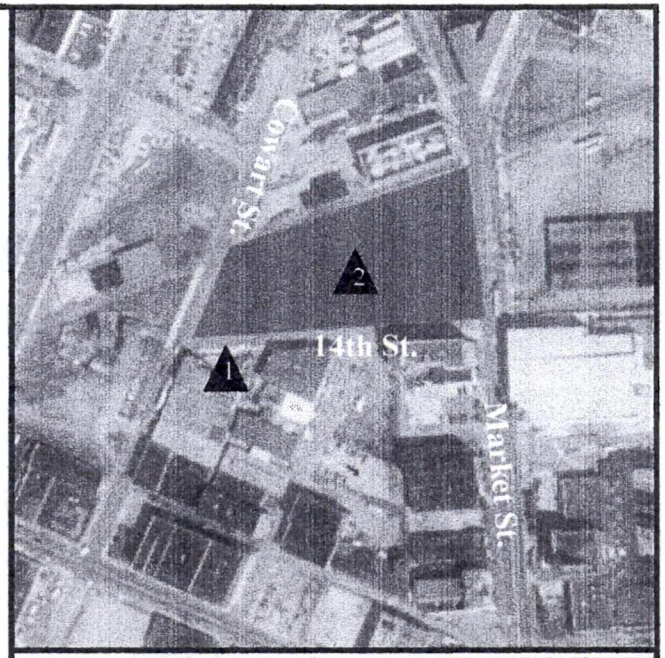
Site Inventory



1



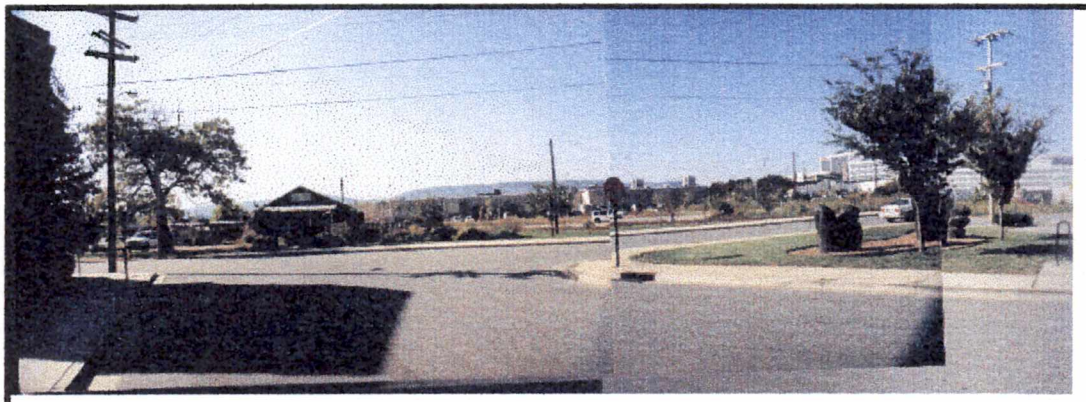
2




1. 14th Street looking North

2. Site looking North

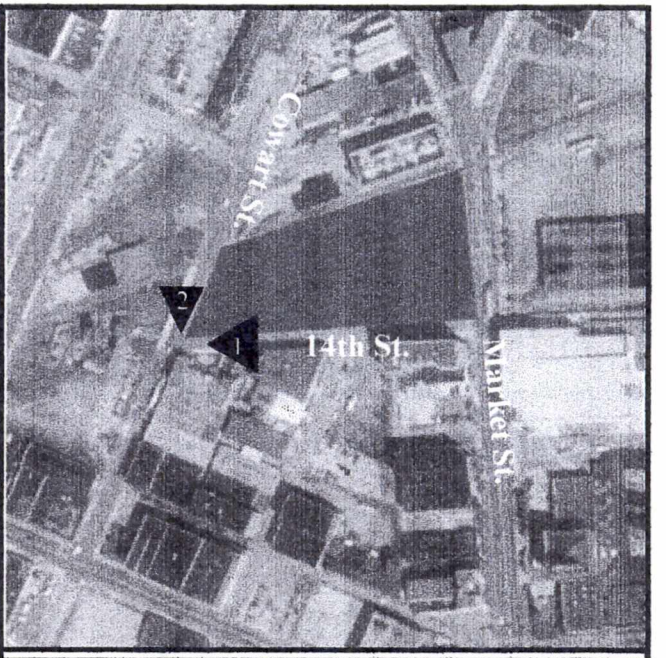
**Site Inventory**



1



2



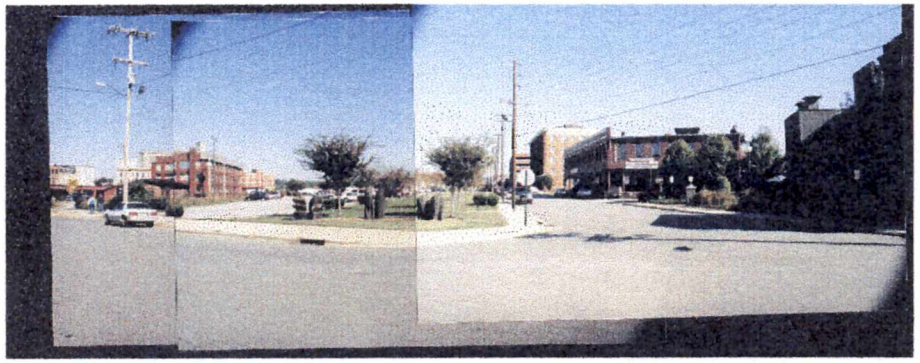

1. 14th Street looking West

2. Cowart Street looking South

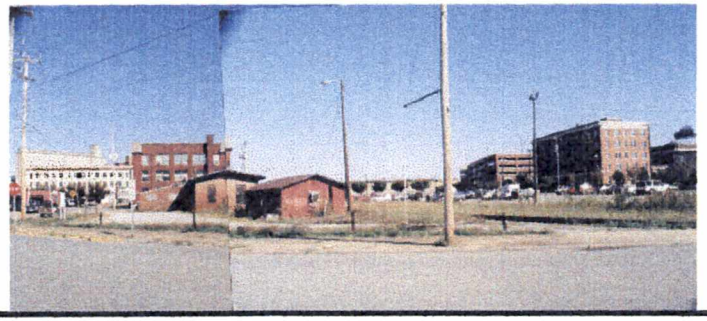
## Site Inventory



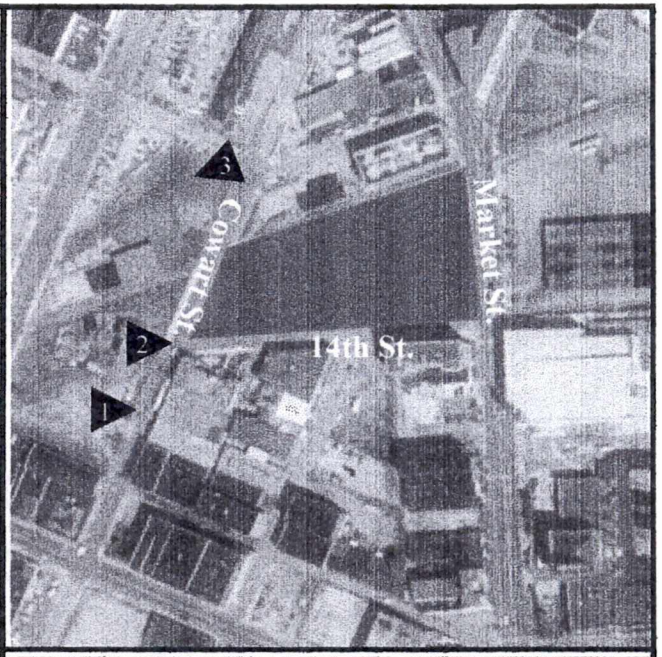
1



2



3




1. Cowart Street looking East (south of site)
2. Cowart Street looking East (through site)
3. Cowart Street looking East (north of site)

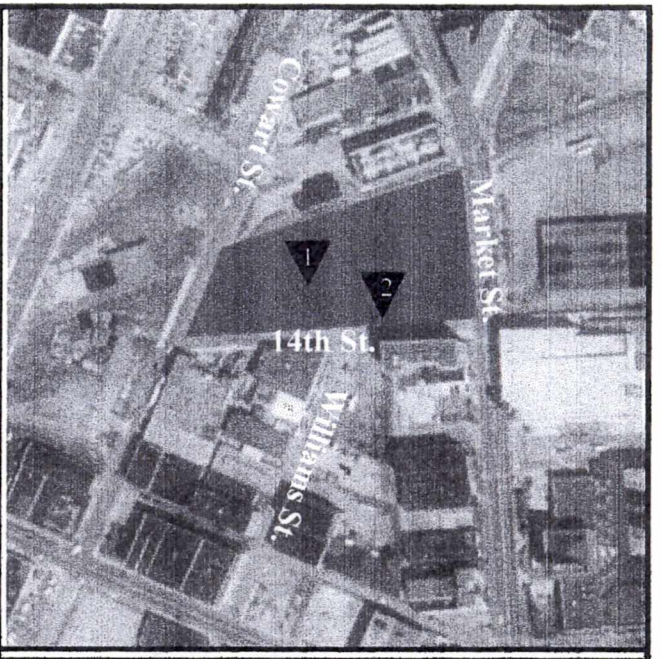
**Site Inventory**





2






1. Site looking South

2. Site looking South (through Williams Street)

**Site Inventory**

1

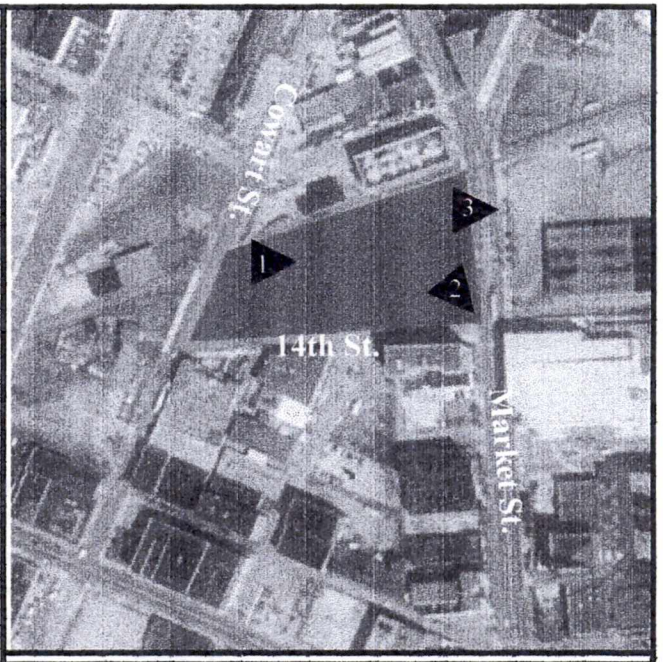


2



3






1. Site looking East

2. Site looking South

3. Market Street looking East

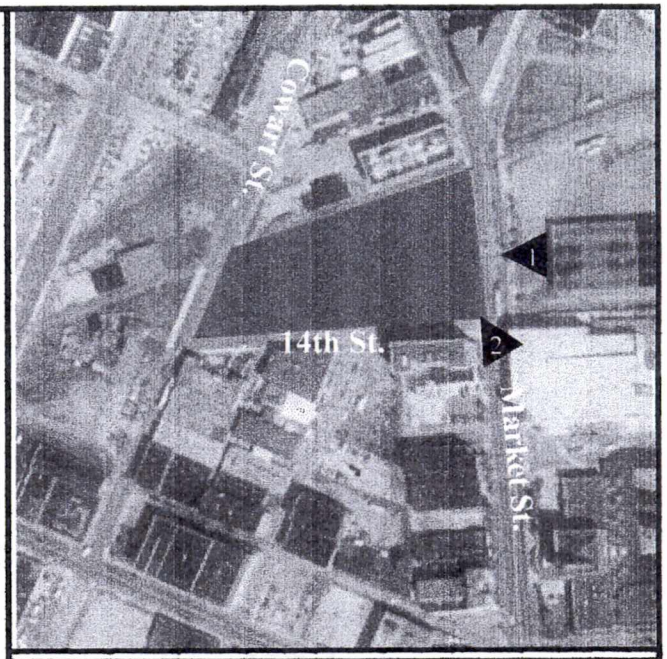
**Site Inventory**



1



2




1. Market Street looking West (through site)

2. Corner of 14th Street and Market Street looking North (south of site)

**Site Inventory**



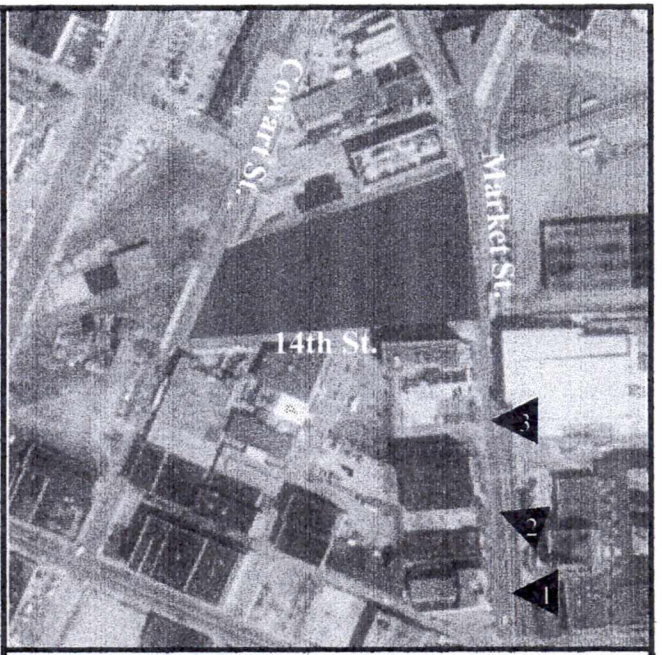

1




2




3




1. Market Street looking West
2. Market Street looking West
3. Market Street looking West

**Site Inventory**



1



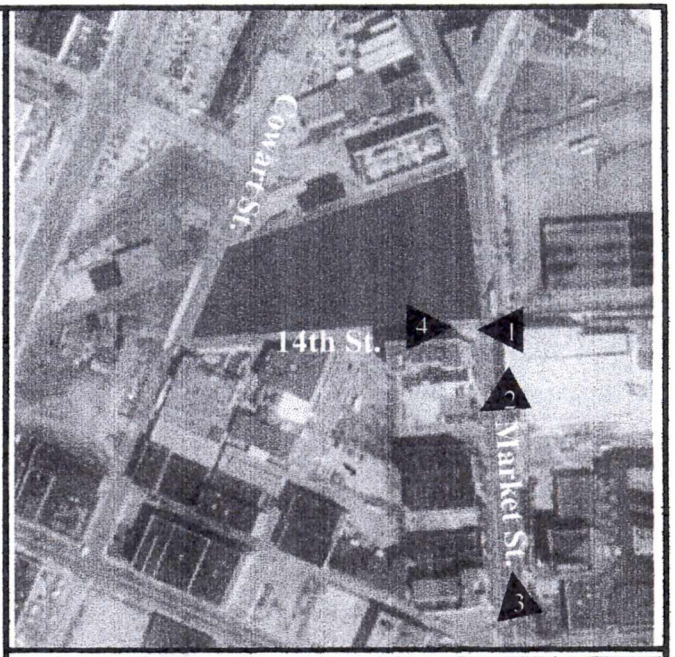
2



3

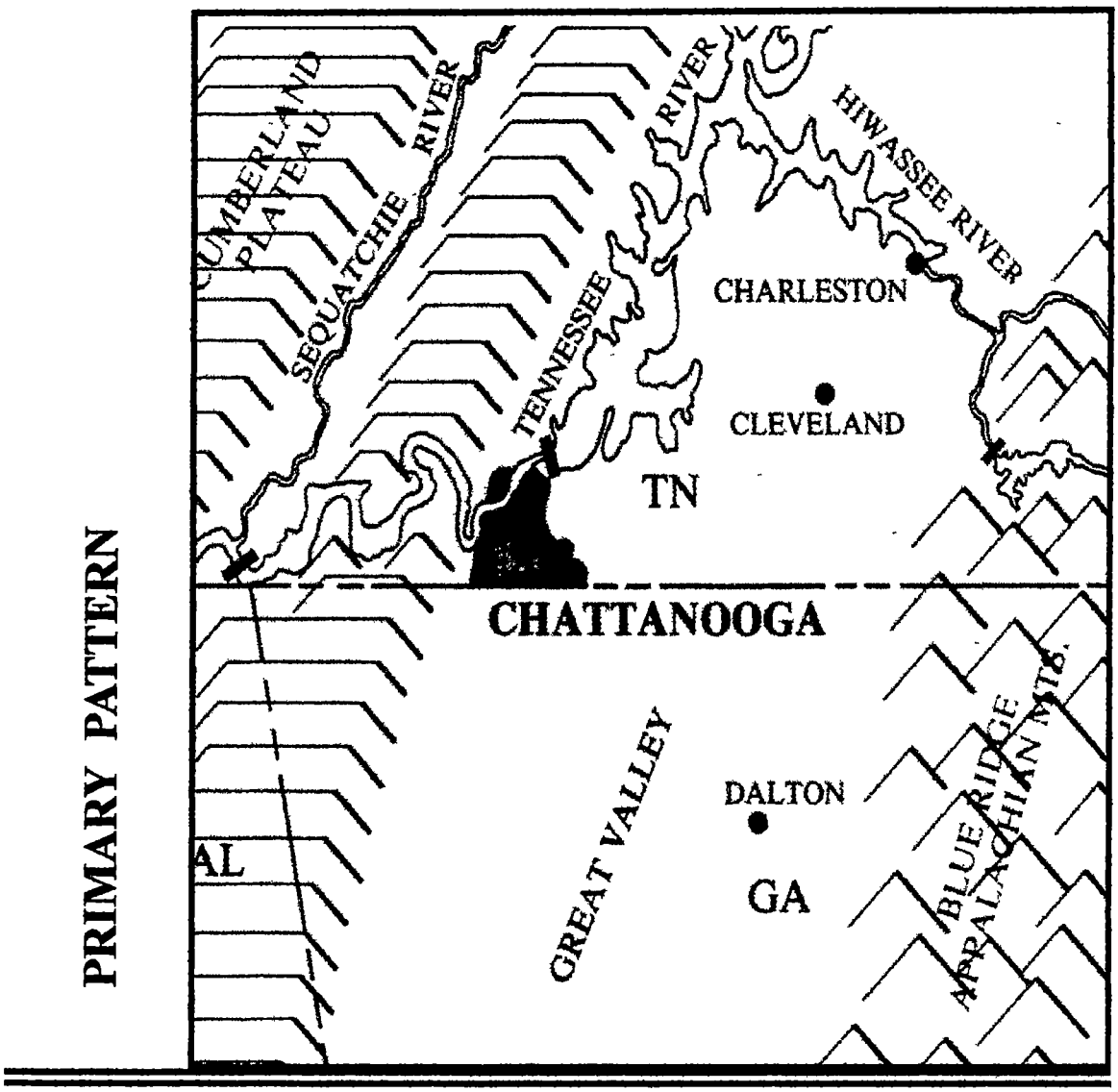


4




1. Market Street looking West (through 14th Street)
2. Market Street looking West
3. Market Street looking North
4. Corner of 14th Street and Market Street looking East

## Site Inventory




## Geographical Forces

Source Tennessee Valley Authority, Architectural Design Branch
*Climatic Data Base Vol I, Great Valley/Zone II Chattanooga, TN*

**Survey**

Hamilton County, Tennessee

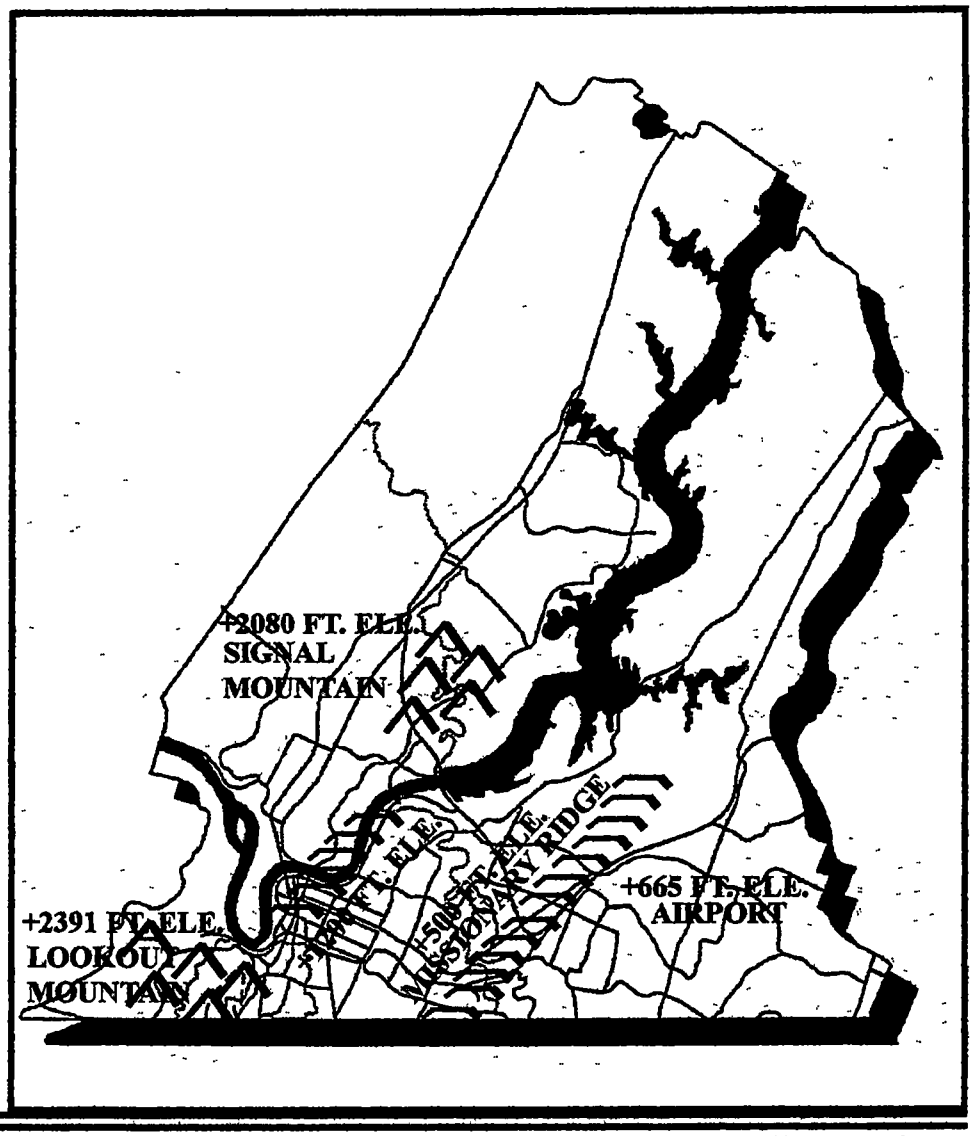
**Analysis**

Hamilton County is zoned in the Hot-Humid region of the United States and is located in the southern portion of the Great Tennessee River Valley It is bordered on the west by the Cumberland Plateau, east by the Blue Ridge region of the Appalachian Mountains and south by Missionary Ridge. The Cumberland Plateau retards and redirects cold air flows from the north and south

**Design Response**

A design strategy should be developed to reflect the tectonic relationship between natural and human forces that shape the built environment and affirm a sense of place. The site and building design should provide opportunities for environmental education in a manner that encourages sustainable patterns of living and building

PRIMARY PATTERN




## Geographical Forces

Source Tennessee Valley Authority, Architectural Design Branch.
*Climatic Data Base Vol I, Great Valley/Zone II Chattanooga, TN*

**Survey**

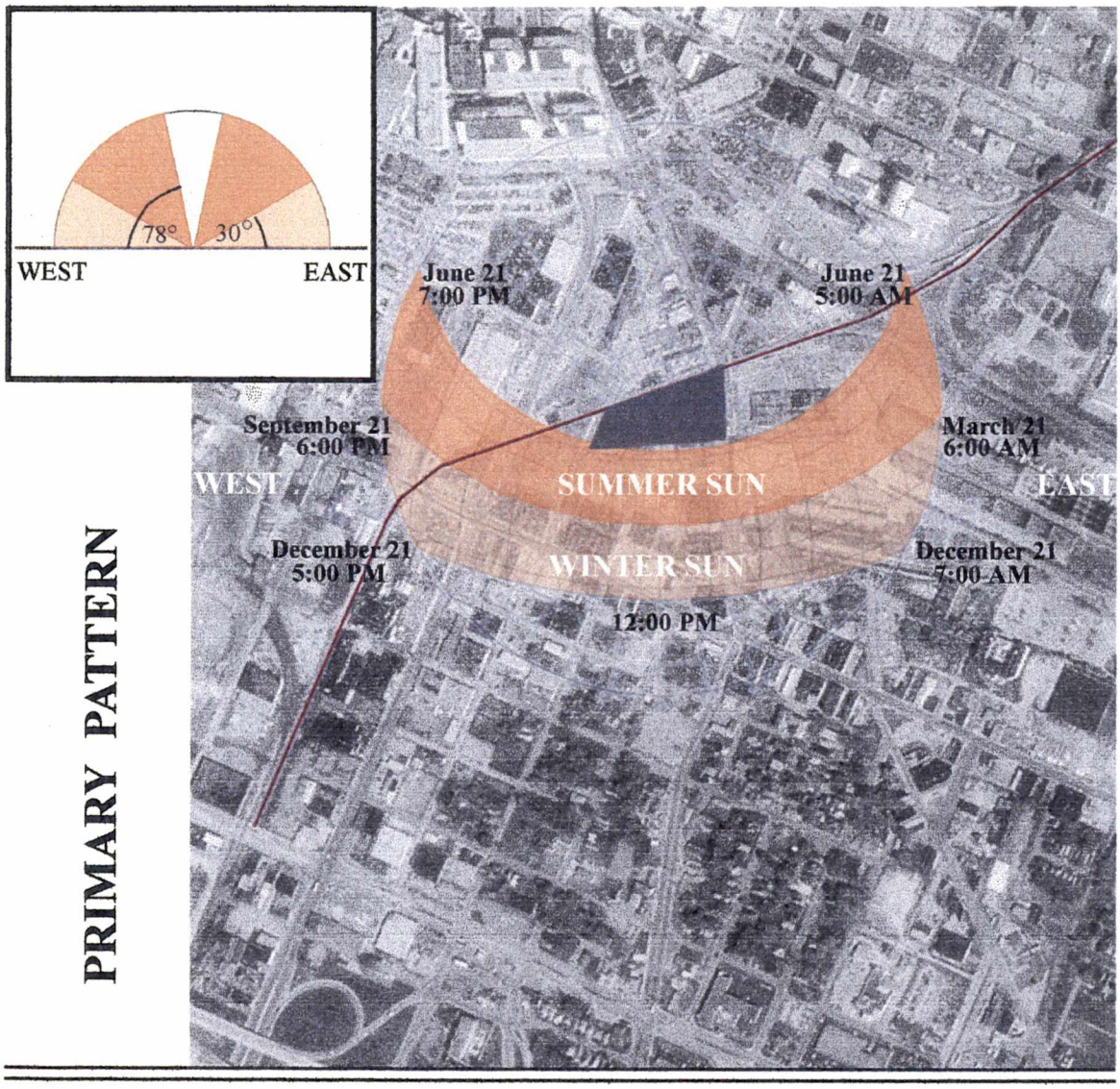
Chattanooga, Tennessee 85°12' W longitude, 35°02' N latitude

**Analysis**

There are minor valleys and ridges in Chattanooga which vary as much as 500' Chattanooga has a moderate climate with mild winters and hot humid summers There is an abundant accumulation of rainfall with snowfall varying from year to year Predominant winds are from the north and south From September to November fair weather occurs with low wind speeds, minimum precipitation and maximum sunshine January through March has the highest monthly average of rainfall

**Design Response**

The site should be zoned for hot and cold weather conditions Deciduous trees should be used to shade in the summer and drop leaves in the winter allow solar heat gain Structures should be elongated in the east-west direction to allow maximize solar heat gain The topography should be manipulated for water management and erosion control, to emphasize important views or axes and to indicate areas for informal and formal activity The design of the site and facility should engage, inform and inspire the citizens of Chattanooga to become stewards of their environment




## Solar Path

**Survey**

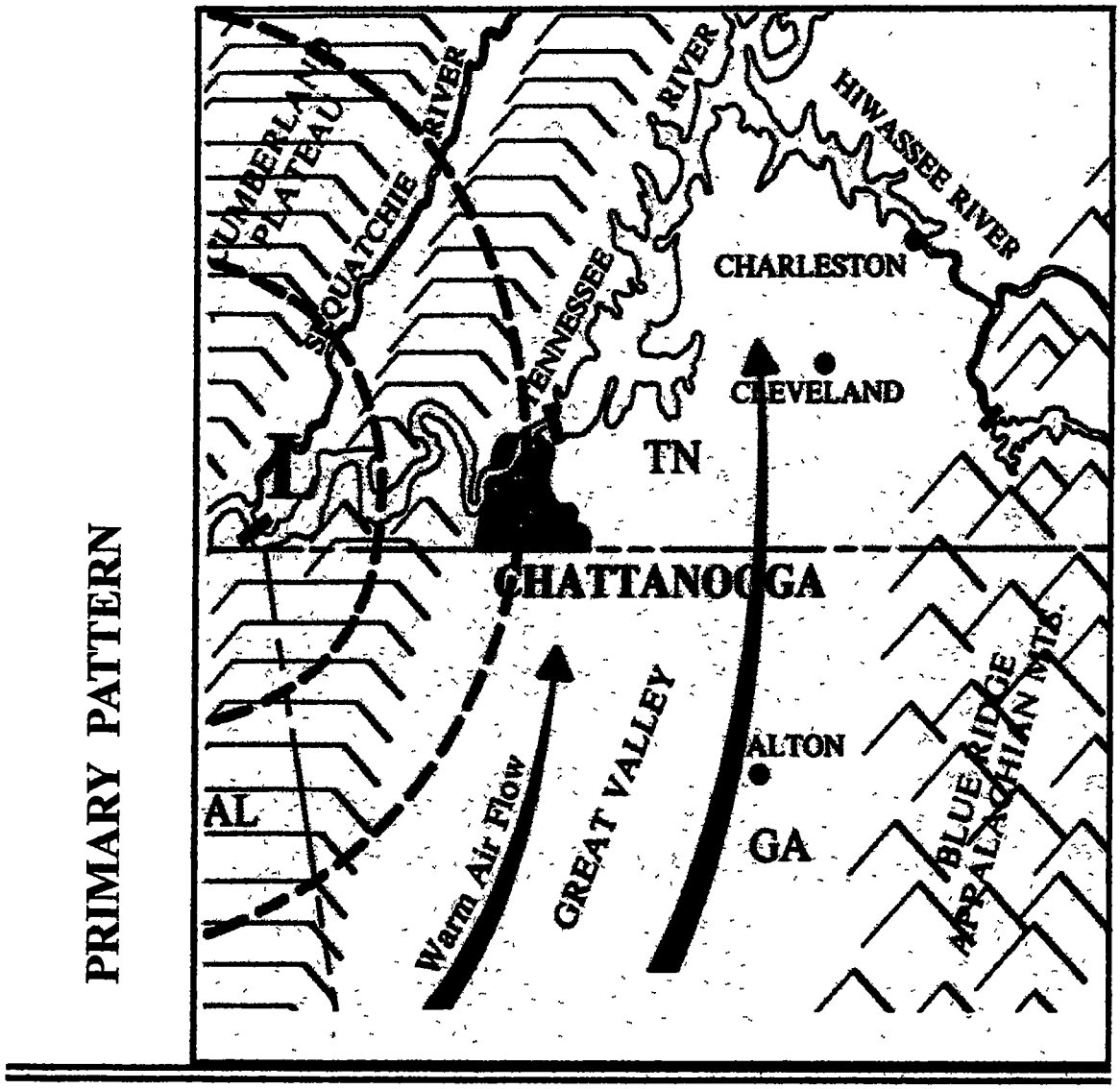
Chattanooga, Tennessee 35°02' latitude

**Analysis**

Maximum solar gain occurs between 9:00 AM and 3:00 PM. The sun reaches an altitude of 78° in the summer and 30° in the winter. The highest summer altitude will be on June 21 and the highest winter altitude will be on December 21. During the summer, the sun will travel 120° from north-northeast at 5:00 AM to north-northwest at 7:00 PM.

**Design Response**

Design of the site and facility should incorporate natural ventilation to cool by air movement, thermal mass materials to store heat during the day to radiate at night or evaporative cooling which uses water to lower air temperature. Interior spaces can be used for solar heat gain to be distributed to other areas. South facing walls should be glazed to collect heat from the sun in the winter, but shading devices should be angled 12° to block direct summer sun. Photovoltaics can be used to convert light energy directly into electricity.




**Winter Winds (Warm)**

Source Tennessee Valley Authority, Architectural Design Branch
*Climatic Data Base. Vol I, Great Valley/Zone II Chattanooga, TN*

**Survey**

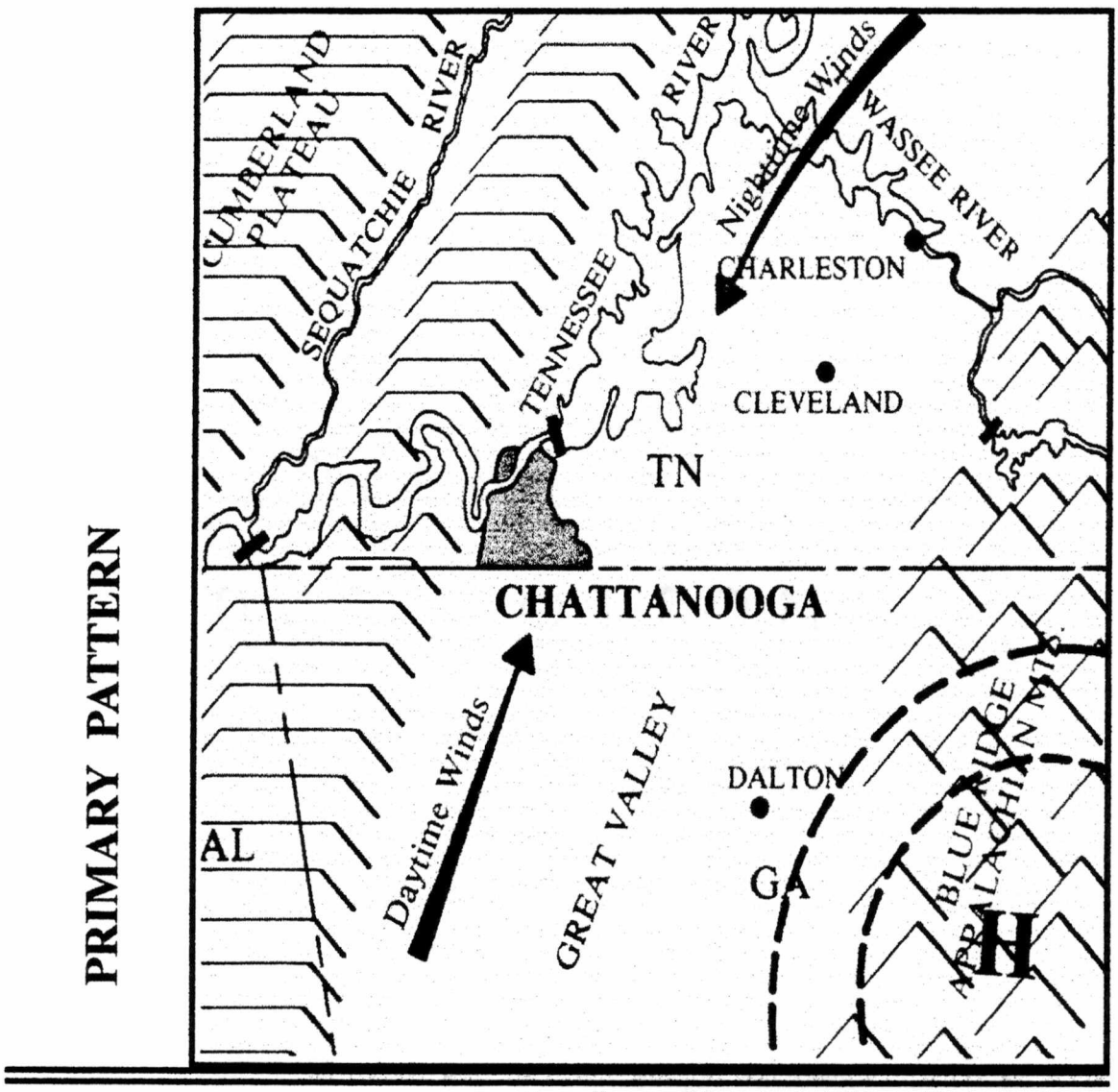
Chattanooga, Tennessee

**Analysis**

Warm front winds follow high pressure systems and are the most predominant. Warm moist air from the Gulf of Mexico forms clouds which prevent radiated heat reflecting from the earth's surface Low to moderate winds come from the south. Warm winter wind patterns produce an abundance of rainfall.

**Design Response**

The *Center for Sustainable Education and Living* should provide wall openings on its south elevation to take advantage of warm air flow in the winter Landscaping should be designed to direct the flow of winter winds




**Summer Winds**

Source: Tennessee Valley Authority, Architectural Design Branch. *Climatic Data Base. Vol I, Great Valley/Zone II: Chattanooga, TN.*

**Survey**

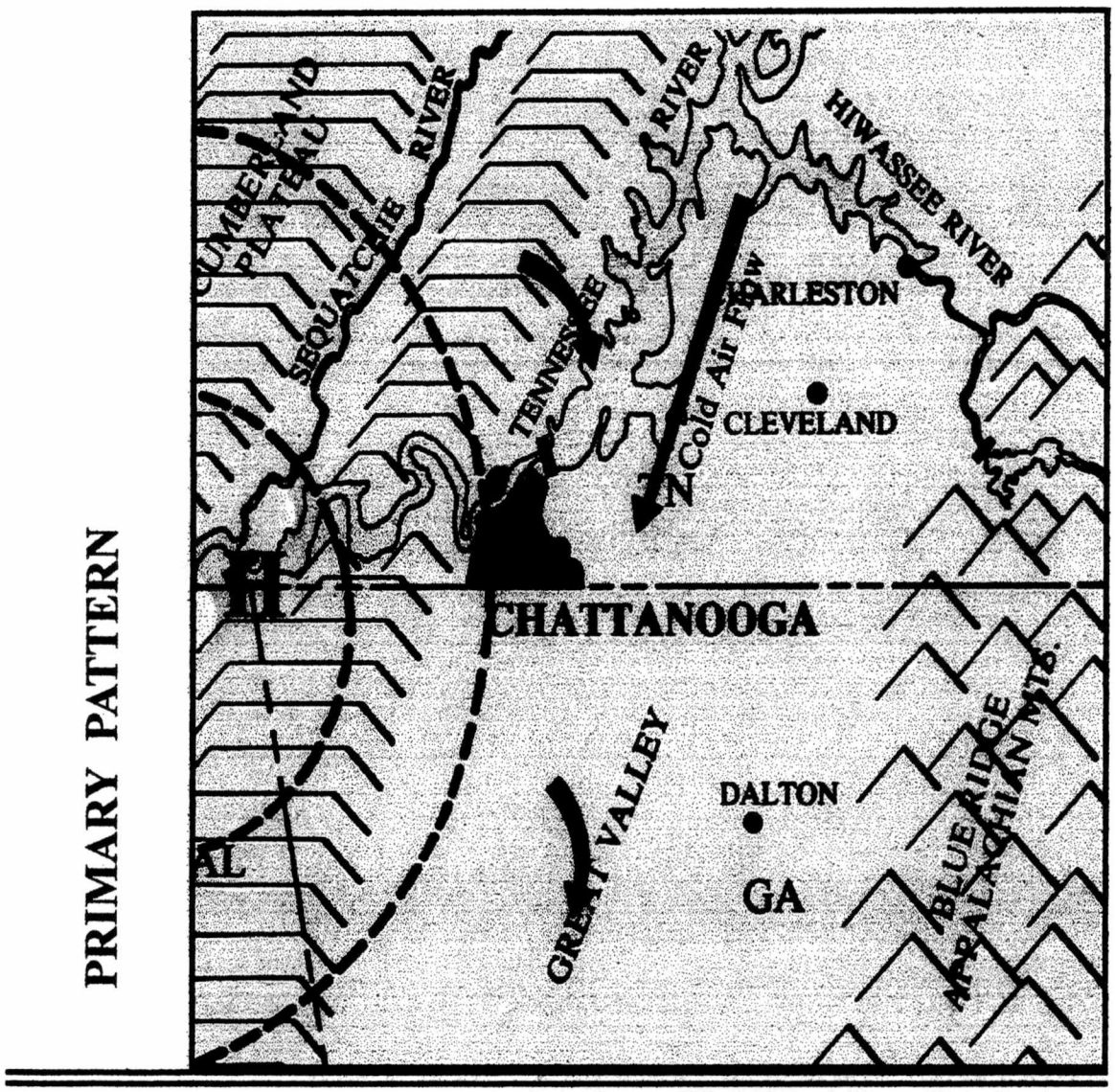
Chattanooga, Tennessee

**Analysis**

Low wind speeds inhibit the movement of air pollutants from the valley. Predominantly high pressure systems move clockwise through the valley to bring warm air from the Gulf of Mexico. High pressure systems and solar gain cause a continuous increase in temperature and humidity.

**Design Response**

The site should provide vegetated areas to decrease air pollutants. Landscaping and siting of the *Center for Sustainable Education and Living* should be manipulated to increase air flow. The design should provide opportunities to maximize cooling and natural ventilation through strategic window and door placement which create stacked or cross ventilation conditions.




**Winter Winds (Cold)**

Source: Tennessee Valley Authority, Architectural Design Branch. *Climatic Data Base. Vol I, Great Valley/Zone II: Chattanooga, TN.*

**Survey**

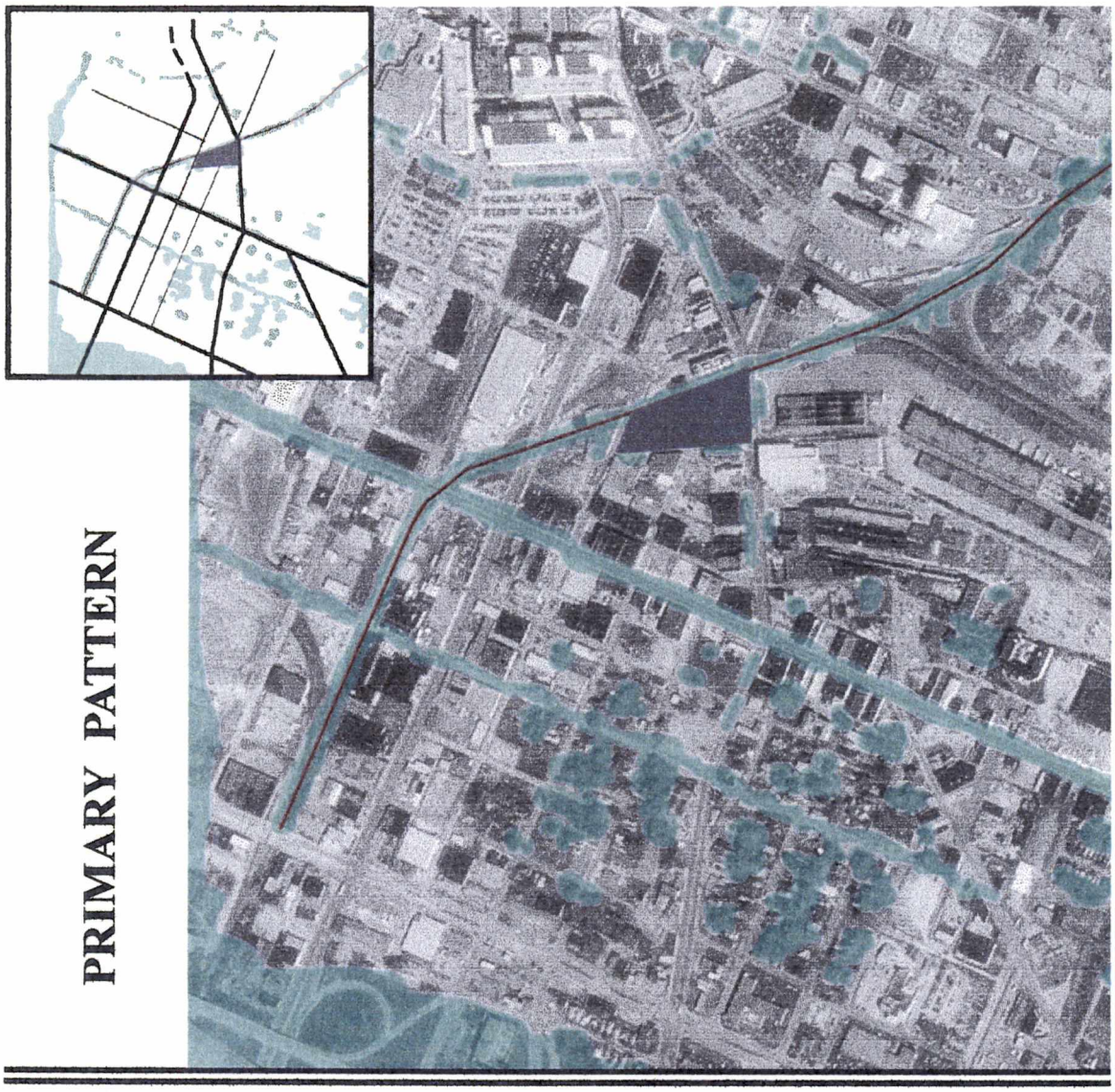
Chattanooga, Tennessee

**Analysis**

Cold front winds move south from Canada and are the least predominant. The cold air interacts with the less dense warm air and forces it upward to form clouds, rain or snow.

**Design Response**

Interior spaces that require minimal heating and lighting should be located on the north side of the *Center for Sustainable Education and Living*. Wind blocking and redirecting devices such as landscaping and walls should be used to reduce the cooling effects of winter winds. There should be a minimal number of openings on the north side of the building. The *Center for Sustainable Education and Living* should provide a rainwater collection system to harvest water for irrigation or reuse.




## Vegetation

**Survey**

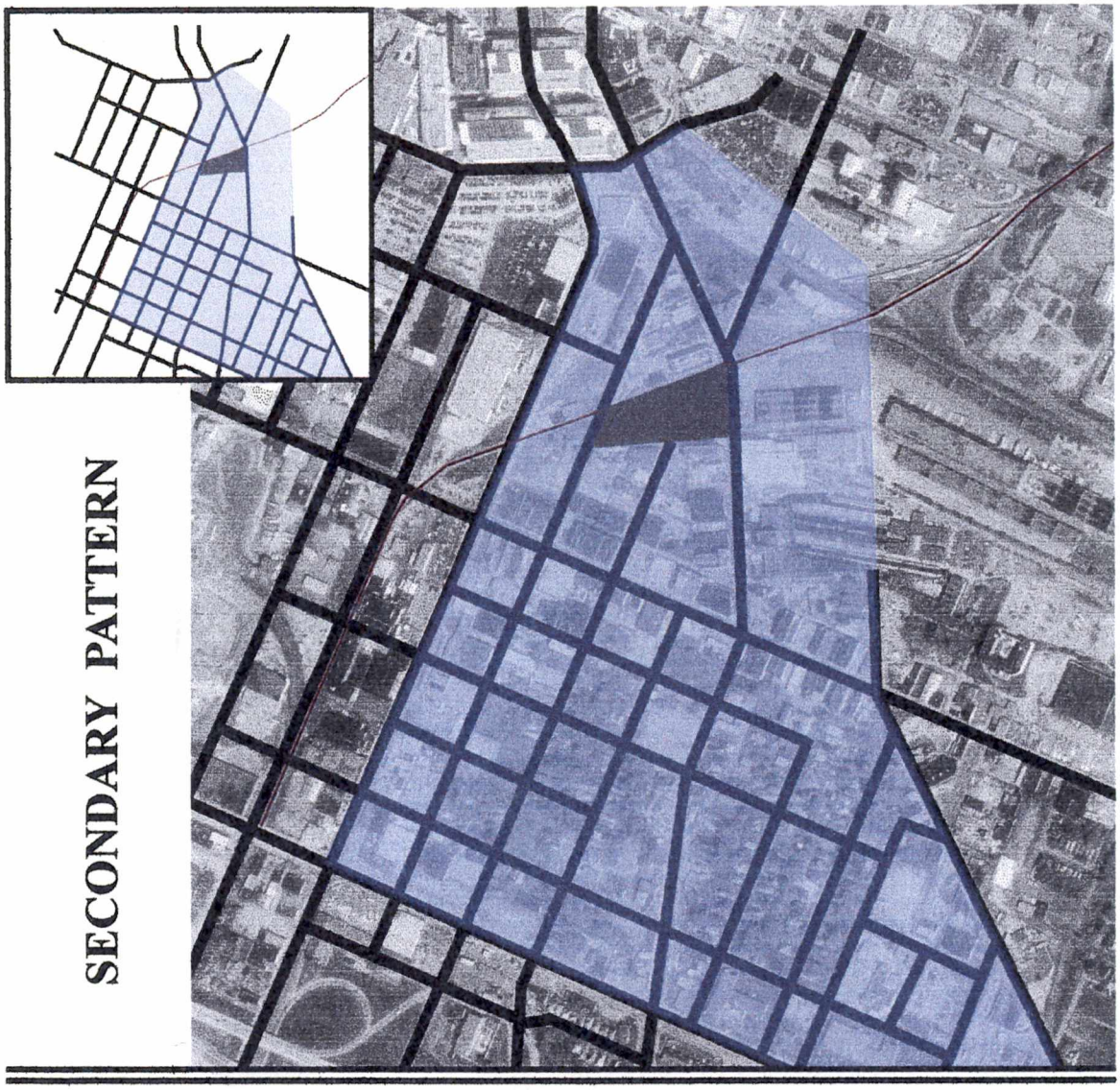
Vegetated areas are limited north of the site. Vegetation south of the site is located in residential areas.

**Analysis**

The city lacks sufficient green space to provide adequate air quality. Vegetated areas add color and variety to the built environment. Natural processes in the urban area are hidden from sight and hinder understanding of the relationship between the natural and built environment.

**Design Response**

The *Center for Sustainable Education and Living* should promote the use of native planting materials for erosion and noise control, soil conservation, natural cooling, wind control and support of natural habitats. Vegetation on the site should also be used to reduce air pollution from vehicles and industrial areas as well as to provide green space for the city and neighborhood. The site should demonstrate natural and landscaped areas of vegetation.




**Design Investigation Boundary with Street Grid**

**Survey**

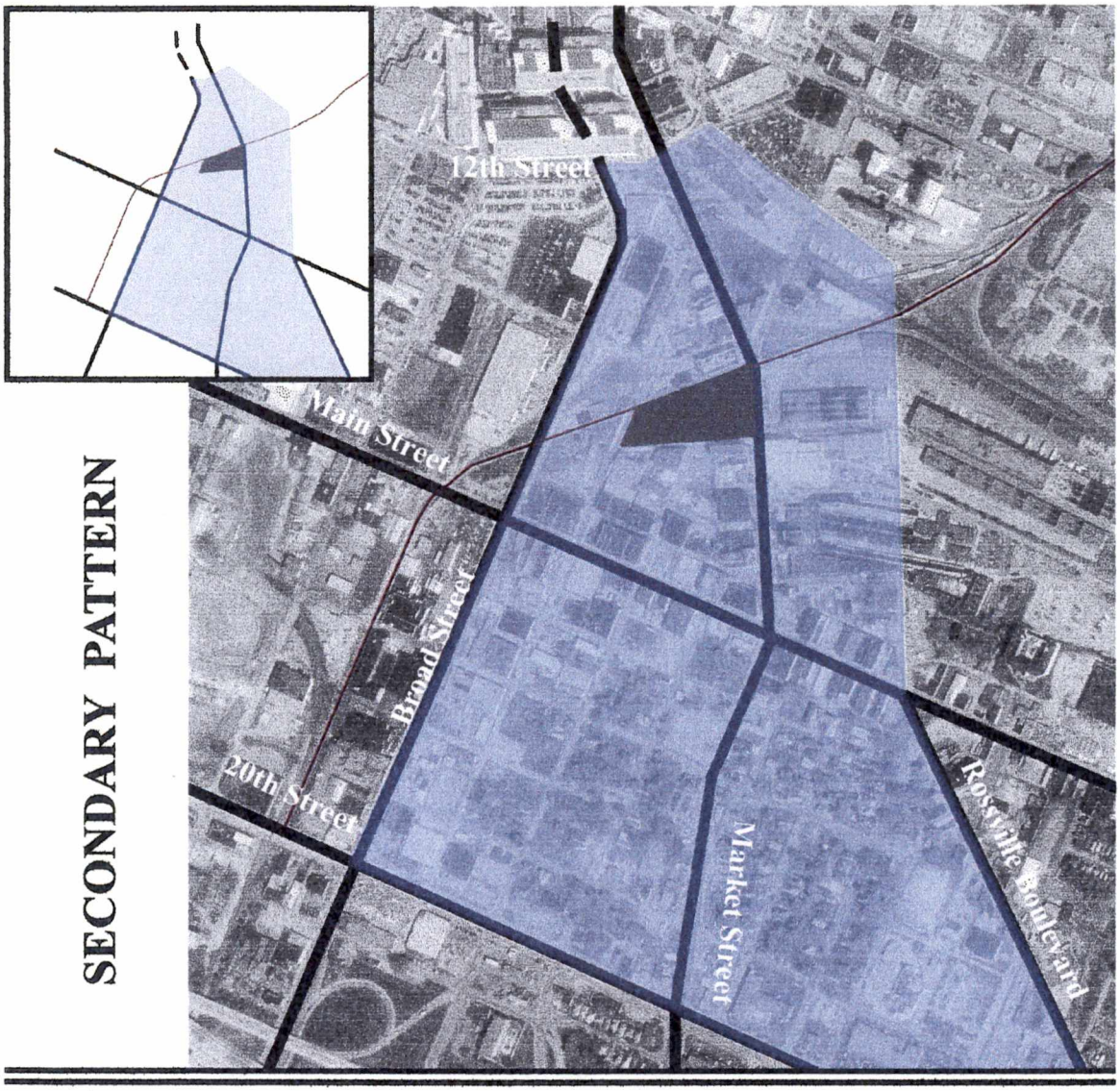
The network of streets indicates the merging of two grids—city and neighborhood. City blocks are longer and produce little opportunity for interaction between streets or alternative modes of transportation. The neighborhood blocks are narrower with slower traffic patterns and have shorter distances to traverse.

**Analysis**

Residential, work and service areas have been fractured by natural and human forces. A definite break between development of the city and the neighborhood has occurred for one reason or another. There is no sense of outdoor enclosure created by a definite street edge, nor a smooth transition between city scale and neighborhood scale. Several deteriorating buildings and infill areas have caused blighted conditions and a lost sense of identity with the image of the city.

**Design Response**

The *Center for Sustainable Education and Living* should become the ideal location for transition from city to neighborhood and easily accessible to all. The facility should present opportunities to integrate the two disparate scales and create a place of gathering and sharing which is beneficial to both.




**Design Investigation Boundary with Primary Streets**

**Survey**

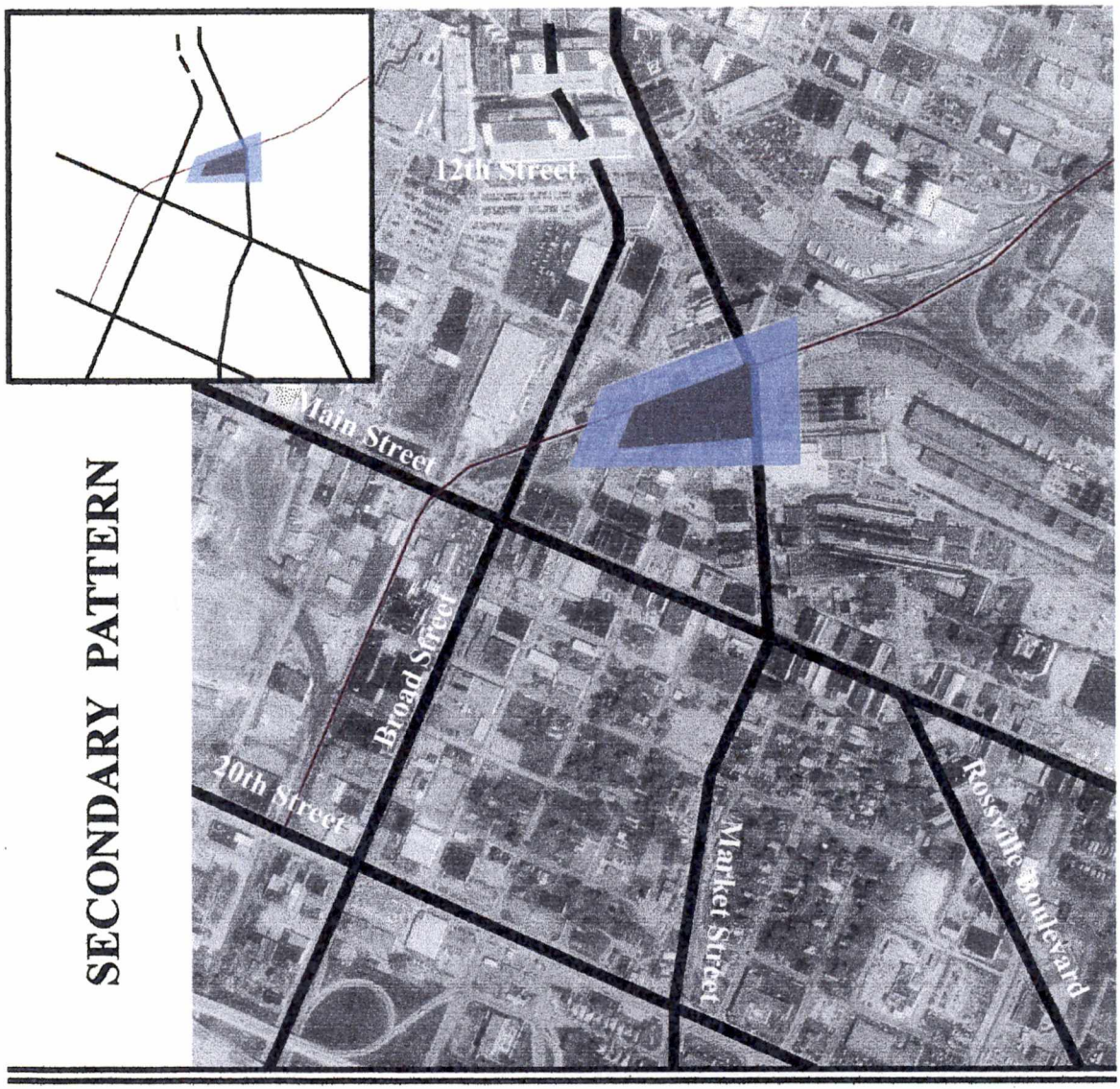
The Neighborhood Boundary is bordered on the North by 12th Street, East by Rossville Boulevard, South by 20th Street and the West by Broad Street. The Neighborhood supports a mixture of manufacturing and service industries, commercial and retail venues as well as opportunities for low to middle income housing. Public transportation is provided and includes a downtown shuttle fleet of zero-emission electric busses.

**Analysis**

A neighborhood or city's character is determined by the events and patterns which continually occur. The built environment can assist in supporting the neighborhood's present need to exist without compromising its ability to meet the needs and aspirations of the future.

**Design Response**

The *Center for Sustainable Education* and Living should be a catalyst for urban development and support Chattanooga's economic base. To affirm the neighborhood's sense of place, the facility's design and location should be in response to site and contextual conditions while also demonstrating solutions for local levels of environmental responsibility.




**Site Boundary with Primary Streets**

**Survey**

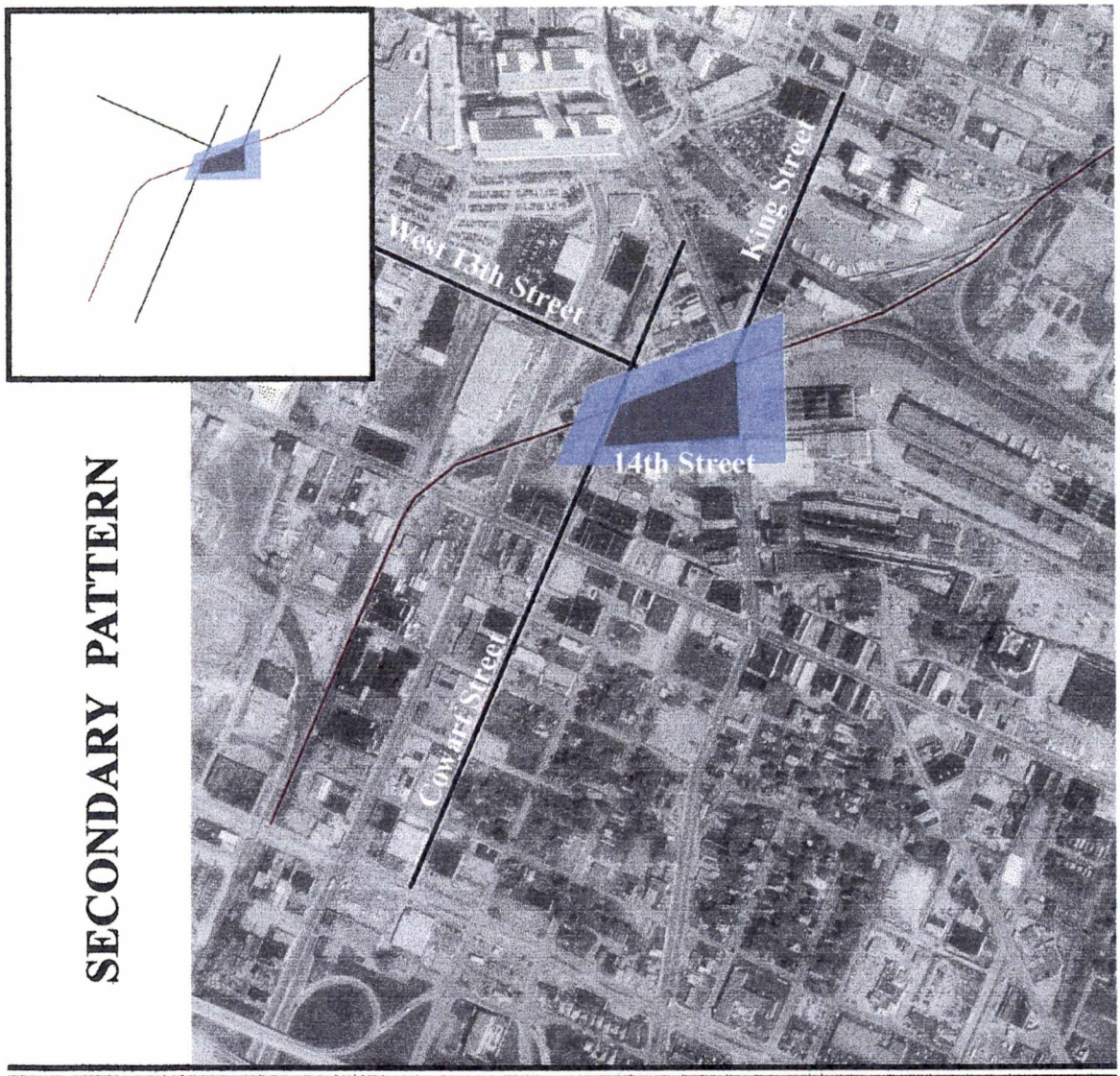
The site is serviced by two of the major thoroughfares into the city. Broad Street is heavily trafficked, while Market Street gives direct access to the facility from I-24. Market Street begins its boulevard condition just south of the site.

**Analysis**

The location of the site has potential as a gateway into the downtown area. Introduction of a vegetated median offers opportunities for the site to become additional lungs of the neighborhood and city. The facility will be viewed by pedestrians and motorists.

**Design Response**

The *Center for Sustainable Education and Living* should present opportunities for city and neighborhood quality of life through reclamation of abandoned areas and social cooperation. The facility should present a balance between built and natural environments. It should demonstrate to residents and visitors new patterns of urban living and building that repair and enhance the form and image of both the city and neighborhood.




SECONDARY PATTERN

**Site Boundary with Secondary Streets**

**Survey**

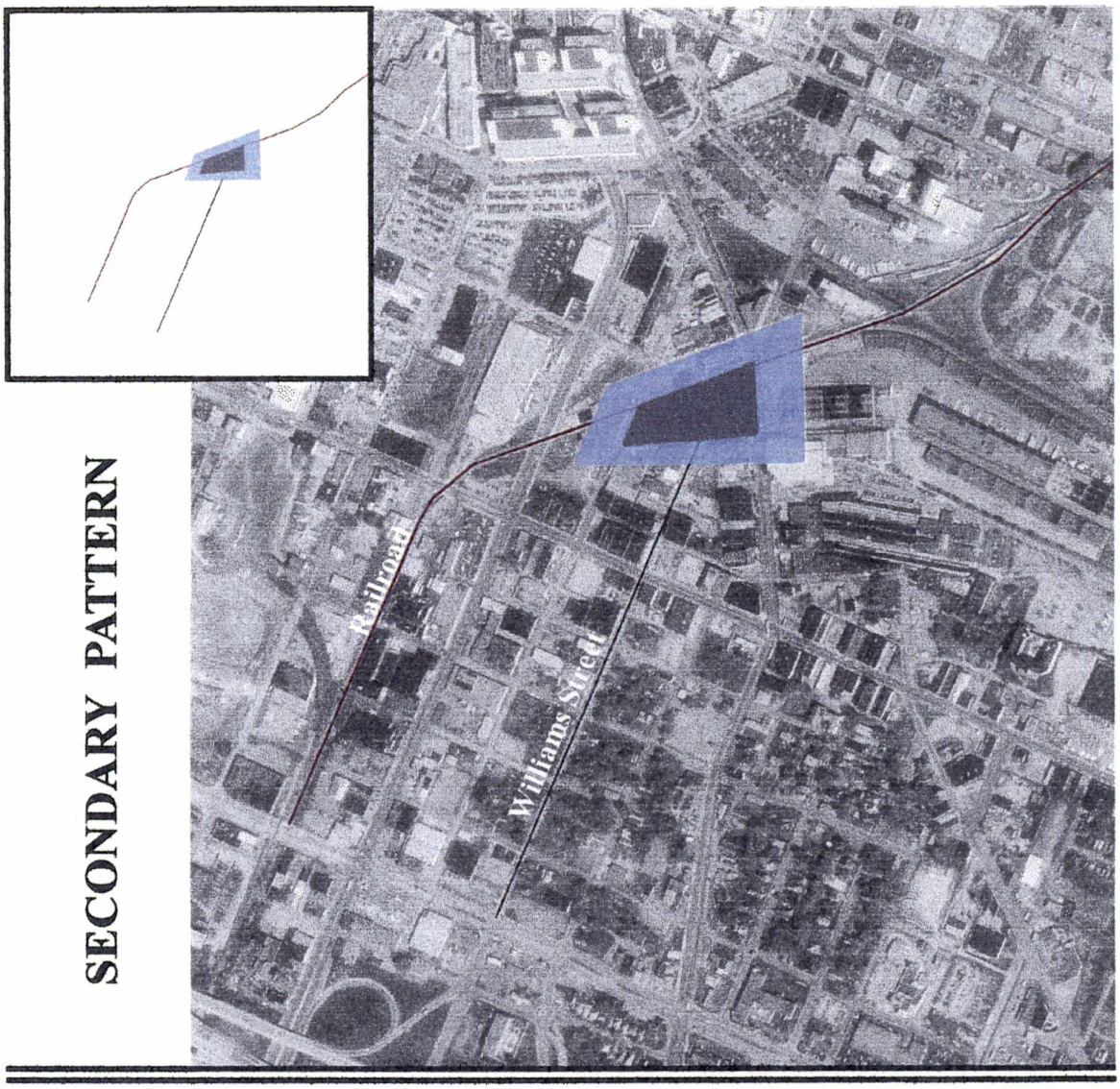
The site receives moderate traffic from West 13th Street, Cowart Street, 14th Street and King Street. The secondary streets are two lanes wide with two-way traffic patterns. On-street parking on either side is also permitted.

**Analysis**

Secondary streets provide slower traffic and a more intimate approach to the site. They become overflow means of commuting to and from work. Specialty shops, service oriented businesses, restaurants and small-scale activities are generally supported by these streets and provide a 24-hour street presence.

**Design Response**

The site should provide focal points for secondary streets. In addition to providing scenic beauty, vegetated demonstration areas can be planned along these routes to become air filters and safety buffers between street and site. The facades of the facility should be in direct response to the slower traffic speed and in contrast with that of major thoroughfares.




**Site Boundary with Tertiary Street**

**Survey**

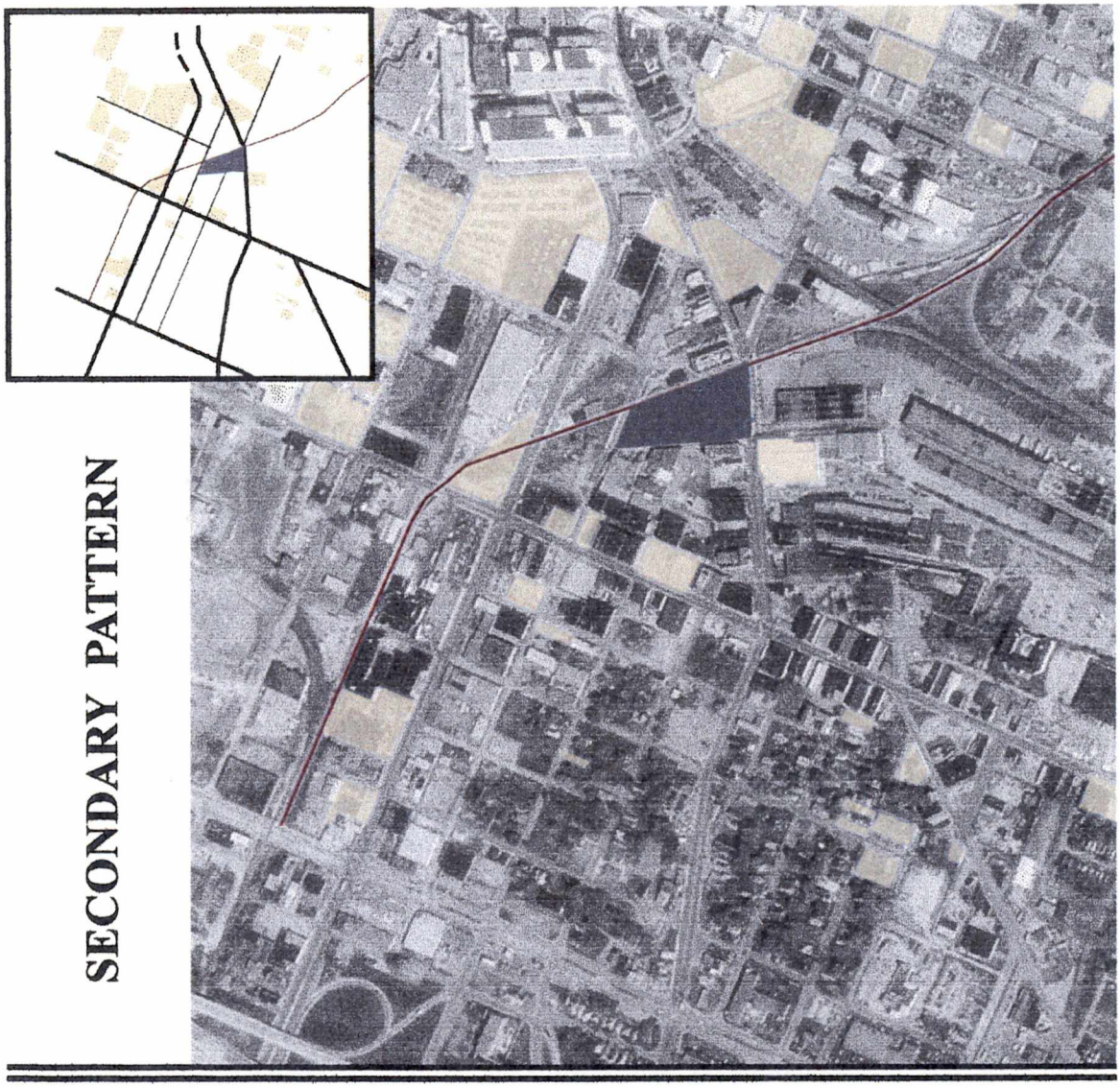
Williams Street provides access from the residential area of the neighborhood. The abandoned railroad track connects several neighborhoods across the city to the industrial area.

**Analysis**

Tertiary routes provide a safer means of accessing the site by foot and are more likely to be used by mothers with small children, unsupervised children and seniors. The abandoned railroad is an existing infrastructure which forms part of the city's greenway network to connect the site to various parts of the city.

**Design Response**

The *Center for Sustainable Education and Living* should locate entrances to be accessed from predominantly pedestrian thoroughfares. The facility should provide outdoor activity areas for passive recreational activities and gathering areas to receive passersby from tertiary routes. These areas should also be located visually and physically in line with access from tertiary streets.




## Parking Areas

**Survey**

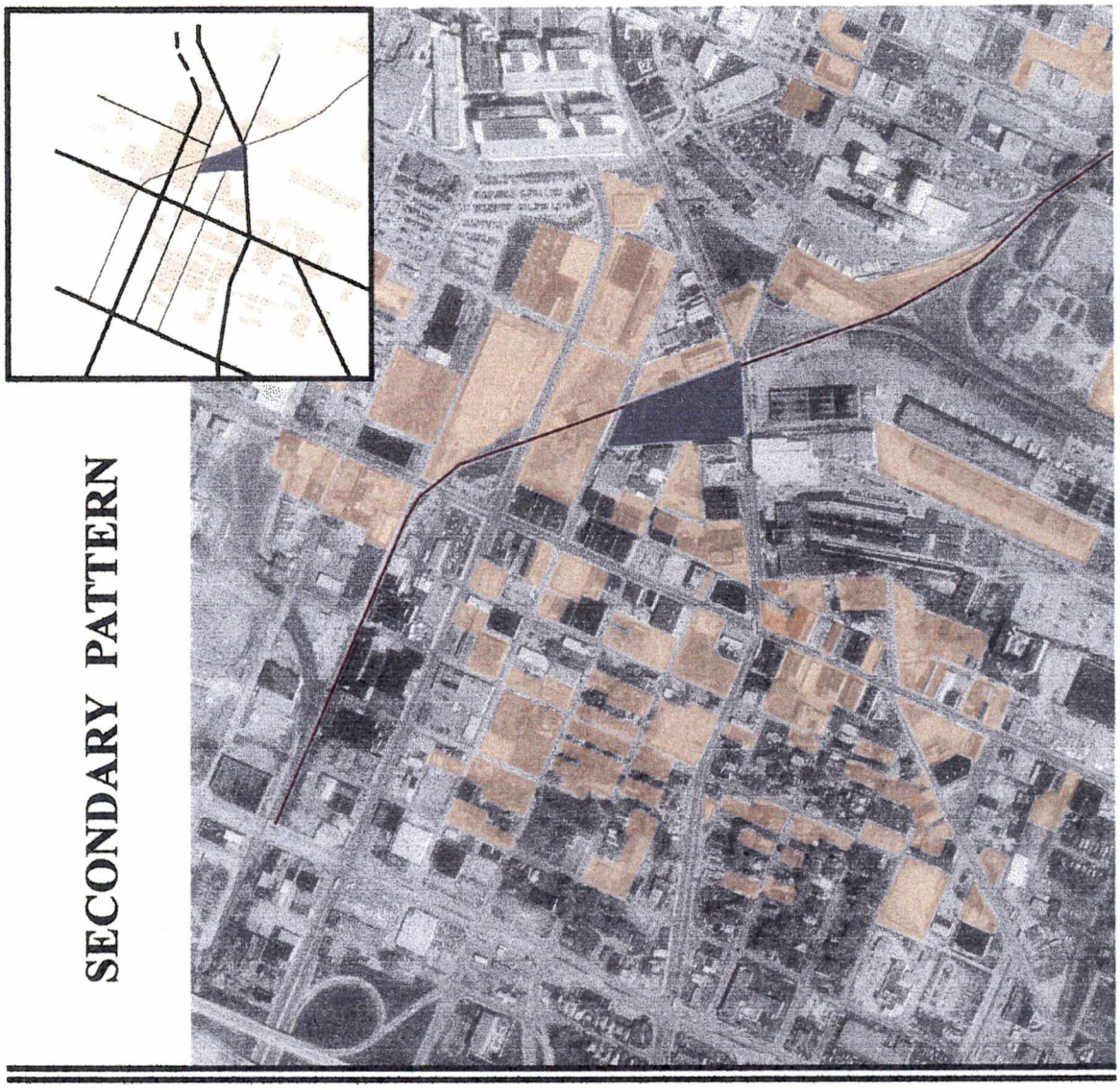
Surface parking is provided for the public and private commercial or industrial areas.

**Analysis**

Hard surface parking lots are not visually appealing and render the landscape useful for one purpose--parking. Impermeable surfaces increase erosion, water runoff and heat gain.

**Design Response**

The *Center for Sustainable Education and Living* should demonstrate design methods that provide diversity and adaptability of the landscape. Parking surfaces as well as pedestrian paths should be permeable to allow water drainage and harvesting for irrigation of vegetation during the dry season.




## Vacant Lots and Buildings

**Survey**

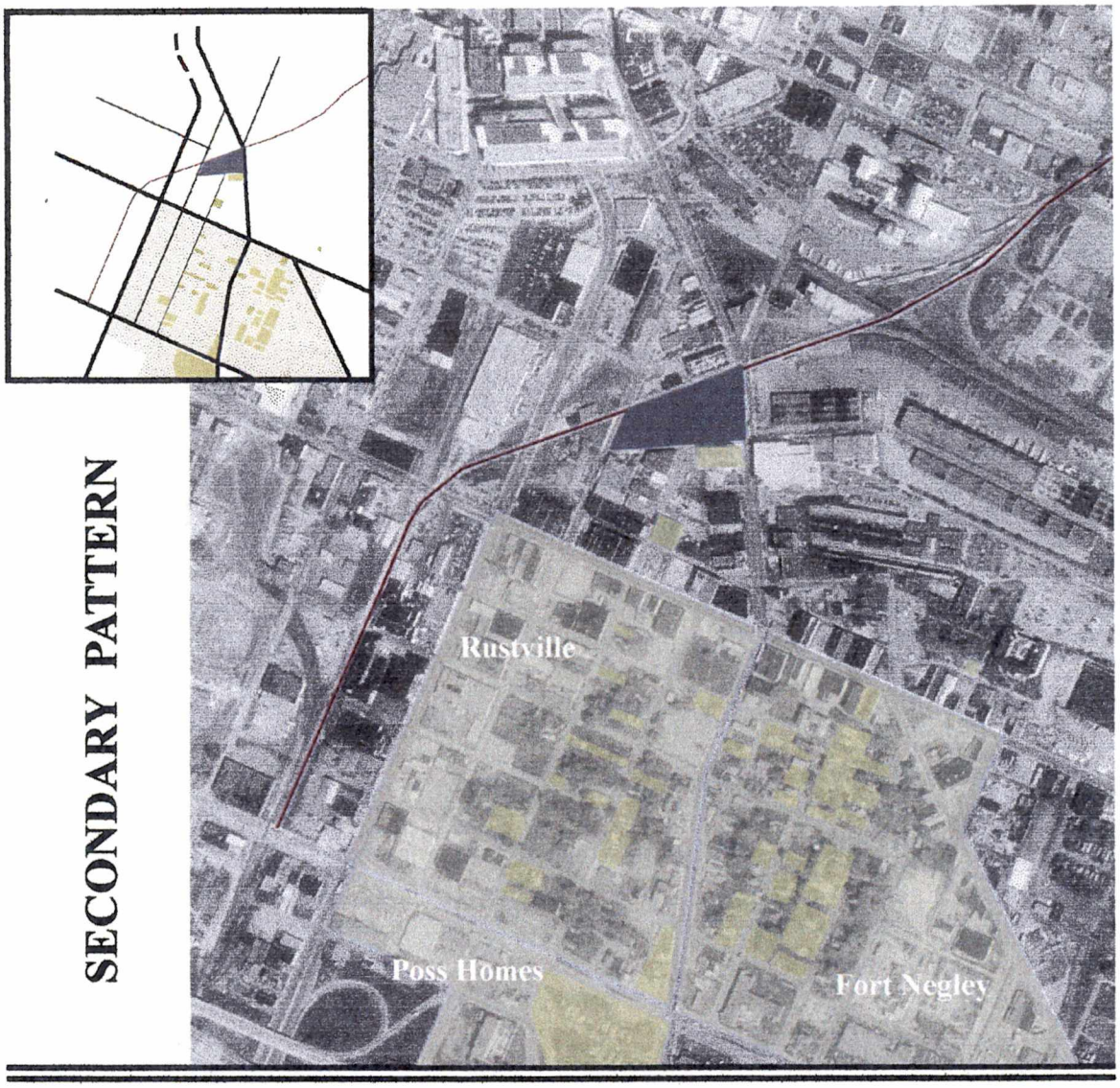
Vacant lots and buildings occur within every block of the surrounding neighborhood.

**Analysis**

Vacant lots and buildings contribute to the blight of the city and neighborhood. They indicate low income areas and their economic disenfranchisement from the city. With existing service infrastructure in place, these areas can provide opportunities for reclamation as commercial service incubators and housing.

**Design Response**

The *Center for Sustainable Education and Living* should provide spatial opportunities for a variety of uses and adaptability for future needs. The facility should accommodate commercial and retail on its ground level and support artist studios or housing on its upper levels. Spaces for community engagement, education and service should be provided at the ground level as well.




## Residential Areas

**Survey**

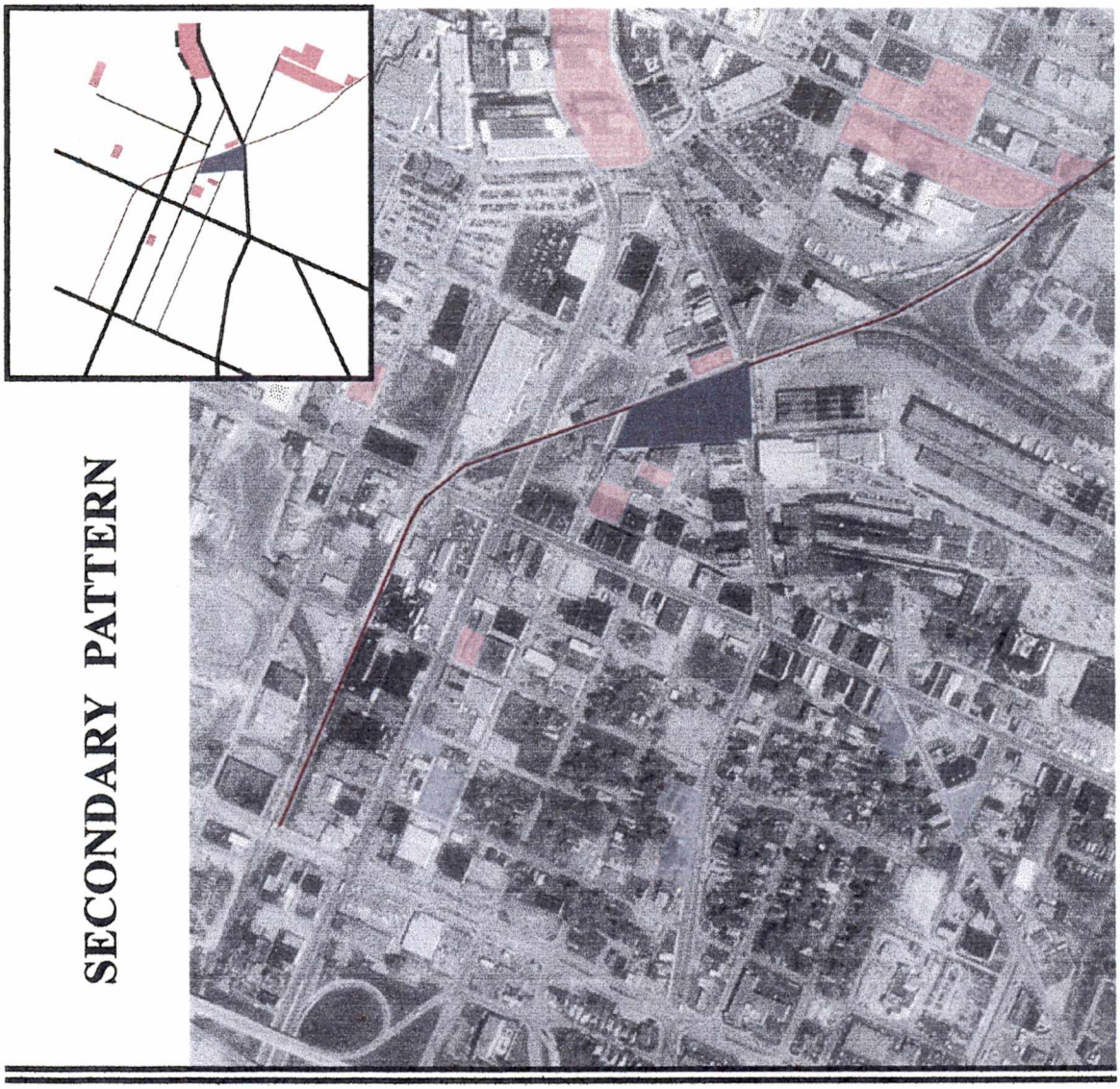
Residential areas provide single and multifamily housing for low to moderate incomes. New construction for housing is currently being planned and implemented.

**Analysis**

Housing is located south of the site. Three neighborhoods Rustville, Fort Negley and Poss Homes are within walking distance of the site. Renovation of abandoned buildings for housing has also occurred within a block south of the site.

**Design Response**

The *Center for Sustainable Education and Living* should promote the neighborhood's sense of place and provide spatial opportunities for families to gather. The facility should demonstrate economical design and construction methods to conserve energy. It should also provide demonstration areas which make the natural processes of the urban environment visible. The *Center for Sustainable Education and Living* should provide spatial opportunities for education and hands-on learning which enable residents to become stewards of their environment.




## Commercial Areas (Office)

**Survey**

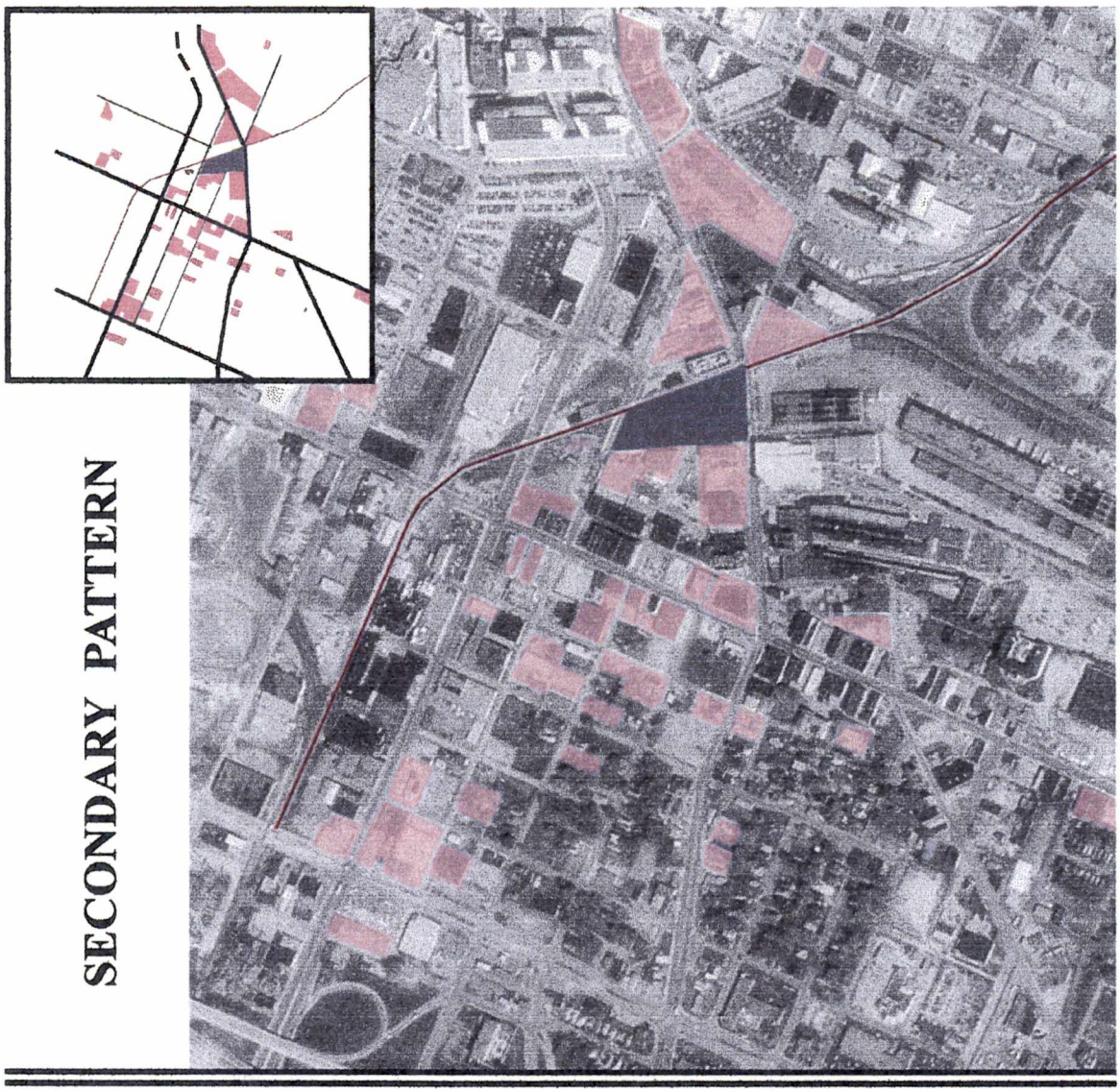
Very few offices are located south of the site.

**Analysis**

Attraction as an office location is poor because of a lack of economic development and connection to downtown and support services. There are very few opportunities available for residents to live and work within their neighborhood. The neighborhood's makeup changes during the course of the day to reflect school and work responsibilities.

**Design Response**

The *Center for Sustainable Education and Living* should provide activities and spatial opportunities that cater to the changing needs of the community. It should create a sense of place and identity to revitalize growth in the neighborhood. The facility should provide residents with an opportunity to work and live within their neighborhood. The site should also be easily accessible to downtown workers.




## Commercial Areas (Retail)

**Survey**

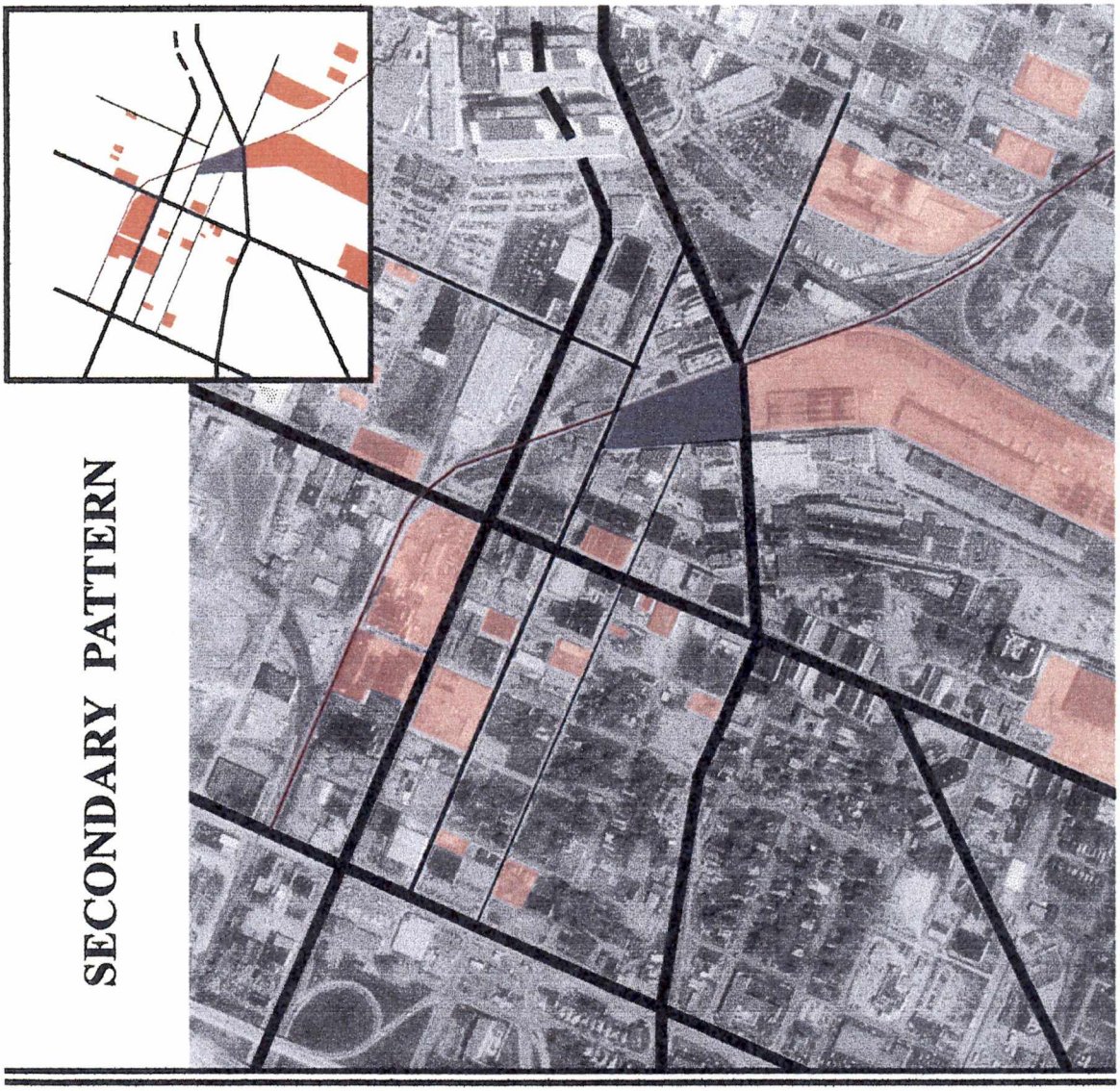
Convenient retail and specialty shops are located throughout the neighborhood.

**Analysis**

The success of neighborhood retail depends upon consumer availability. Unfortunately, there is a low residential support base due to insufficient housing and economic diversity. Residents who live in the area will shop at these locations because of convenience. Services can be specialized and cater to the unique needs of the neighborhood.

**Design Response**

The *Center for Sustainable Education and Living* should provide spatial opportunities and activities that attract residents from other areas of the city as well as tourist. The attraction will bring new consumer dollars to the neighborhood. The facility should provide flexible space as incubators for fledgling retail venues and nurturing of neighborhood enterprise.




## Industrial Areas

**Survey**

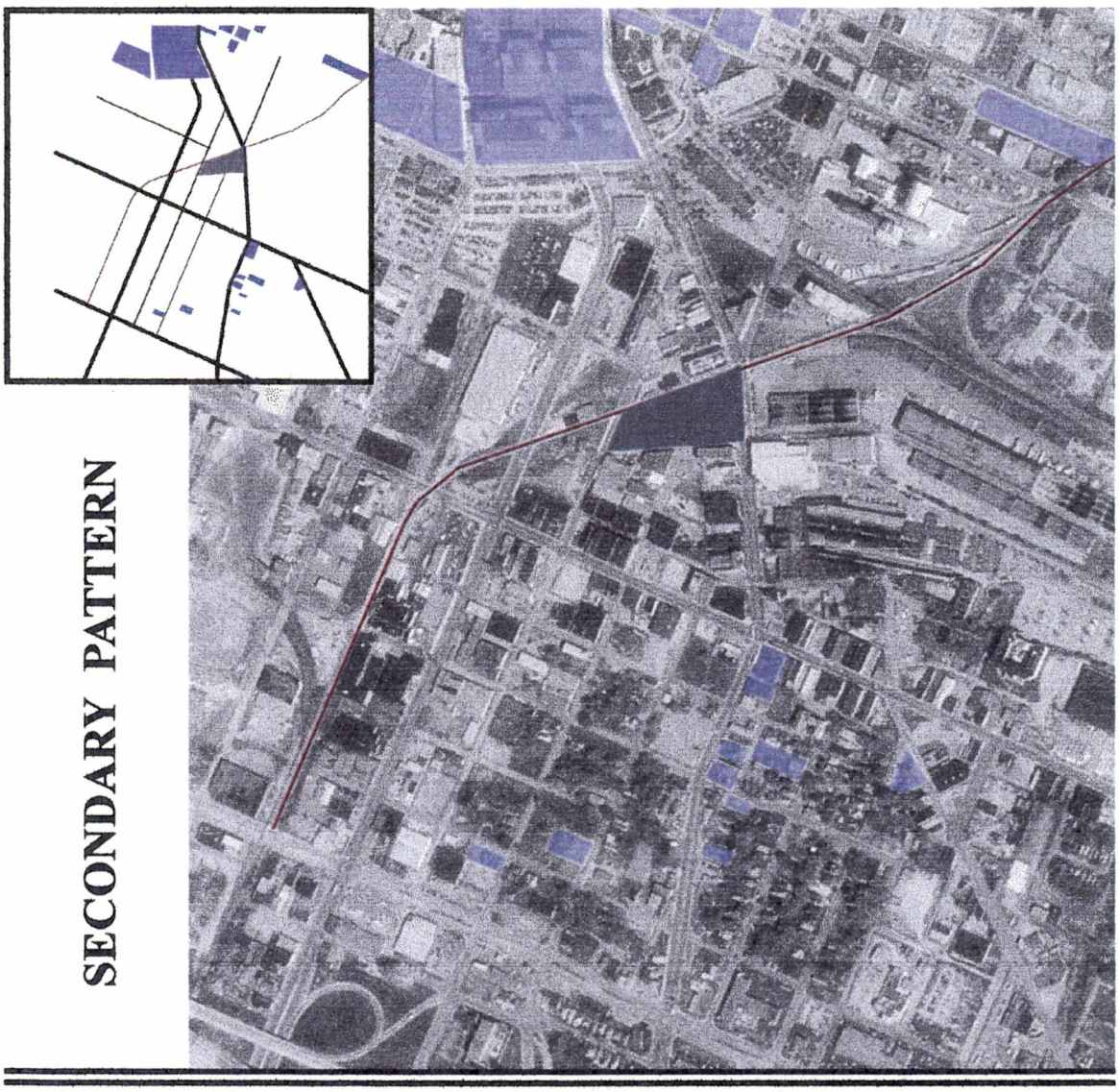
Both manufacturing and service industry is located in close proximity to the site.

**Analysis**

Industry and local government have been working together to maintain Chattanooga's goal as a model sustainable city. They have taken measures to clean up contamination produced by waste and by-products. The city and several of the industries have devised a network for reuse of waste products.

**Design Response**

The *Center for Sustainable Education and Living* should be constructed of locally manufactured materials and promote reuse of waste products where possible. Spatial consideration should be given to areas for display of local products and their reuse processes.




## Institutional Areas (Government, School and Religious Facilities)

**Survey**

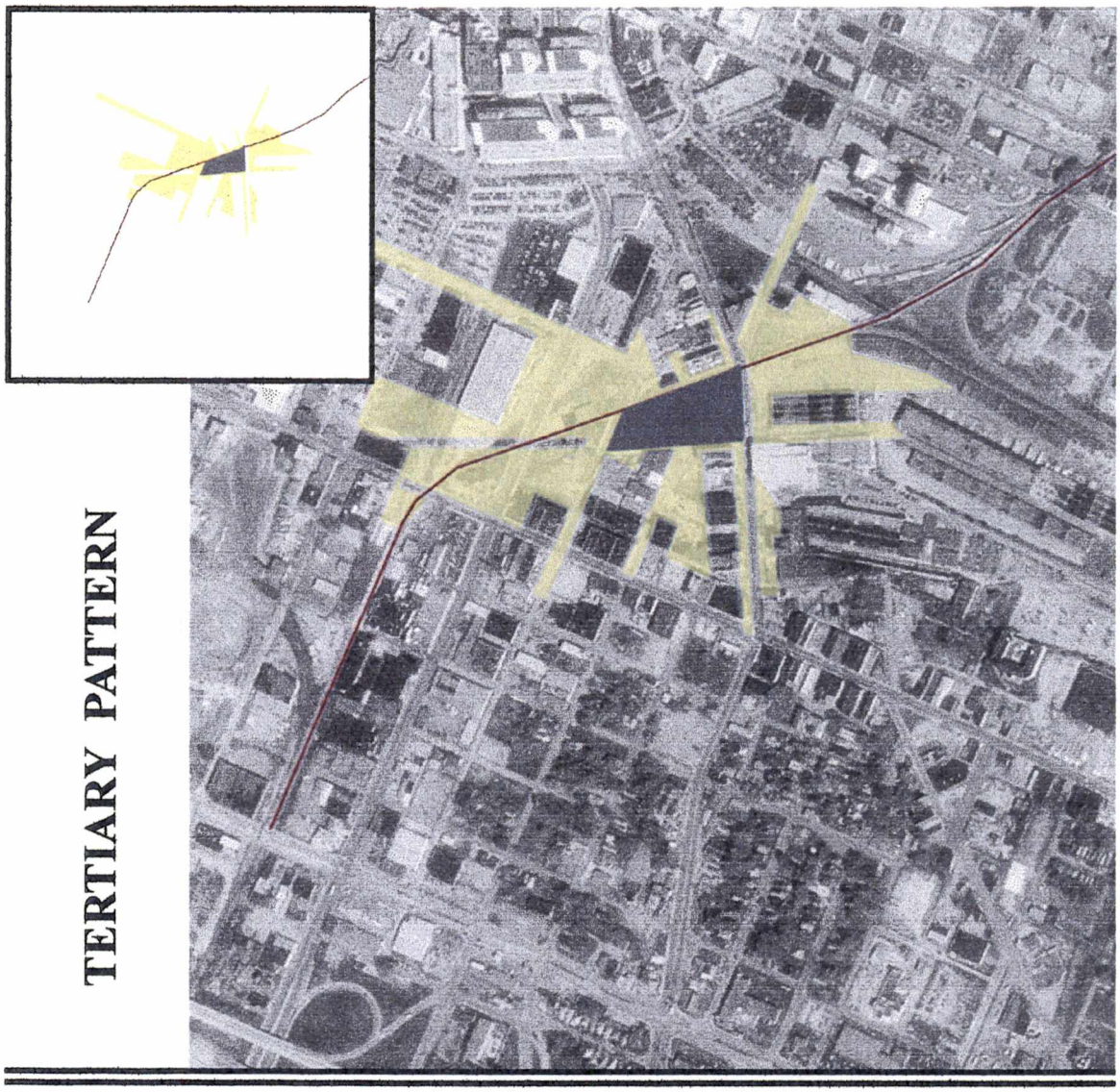
Government and school facilities are located north of the site while religious facilities are to the south.

**Analysis**

Government and religious institutions have independent functions. Governmental facilities are located in the city to meet civic needs and religious facilities are located within the neighborhood to meet the needs of residents. But, places of institutional learning can be found on common ground to meet the needs of both city and neighborhood.

**Design Response**

The *Center for Sustainable Education and Living* should be located between the city and neighborhood. It should provide a place for civic gathering and exchange of ideas that promote both the city and neighborhood's quality of living. The facility should provide opportunities for educating residents and visitors about environmental stewardship through planning, design and construction methods.




## Views

**Survey**

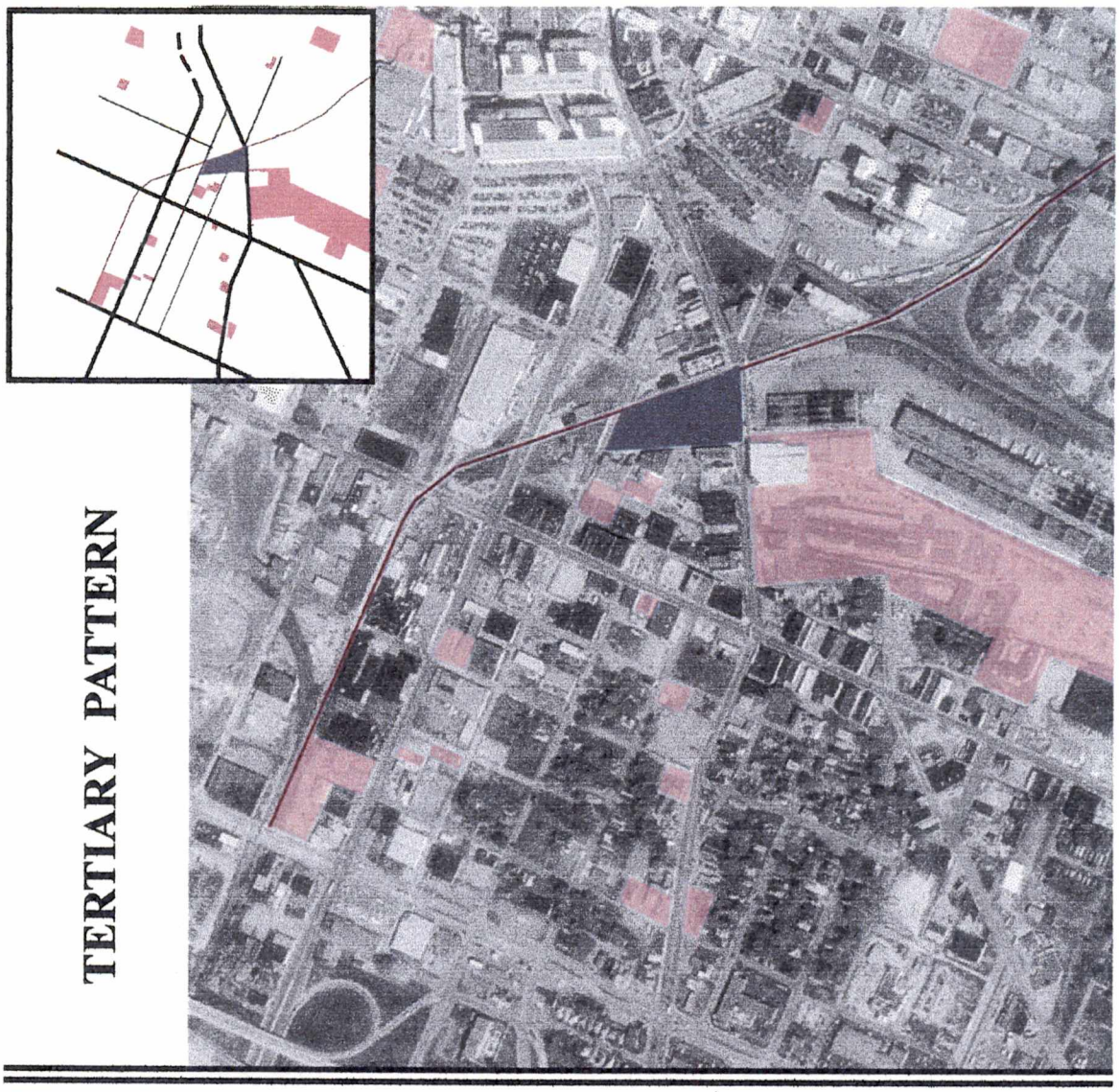
The site is unobstructed to the West, East and South. There are historically significant structures on the North side of the site which block views to downtown.

**Analysis**

Views offer connections between the built and natural environments. Consideration should be given to views to and from the site in addition to those views which may be blocked by future development.

**Design Response**

The *Center for Sustainable Education and Living* should provide spatial opportunities and structural openings which capture or frame important views to the city, neighborhood and natural landscape. Views to the site should indicate which facades are to maintain the public image. Blocked views should be opportunities for service entrances or filtered by vegetation. The roofscape of the facility should be designed to be viewed from higher elevations and to allow unobstructed views from the facility.




## Commercial (Cultural Attractions)

**Survey**

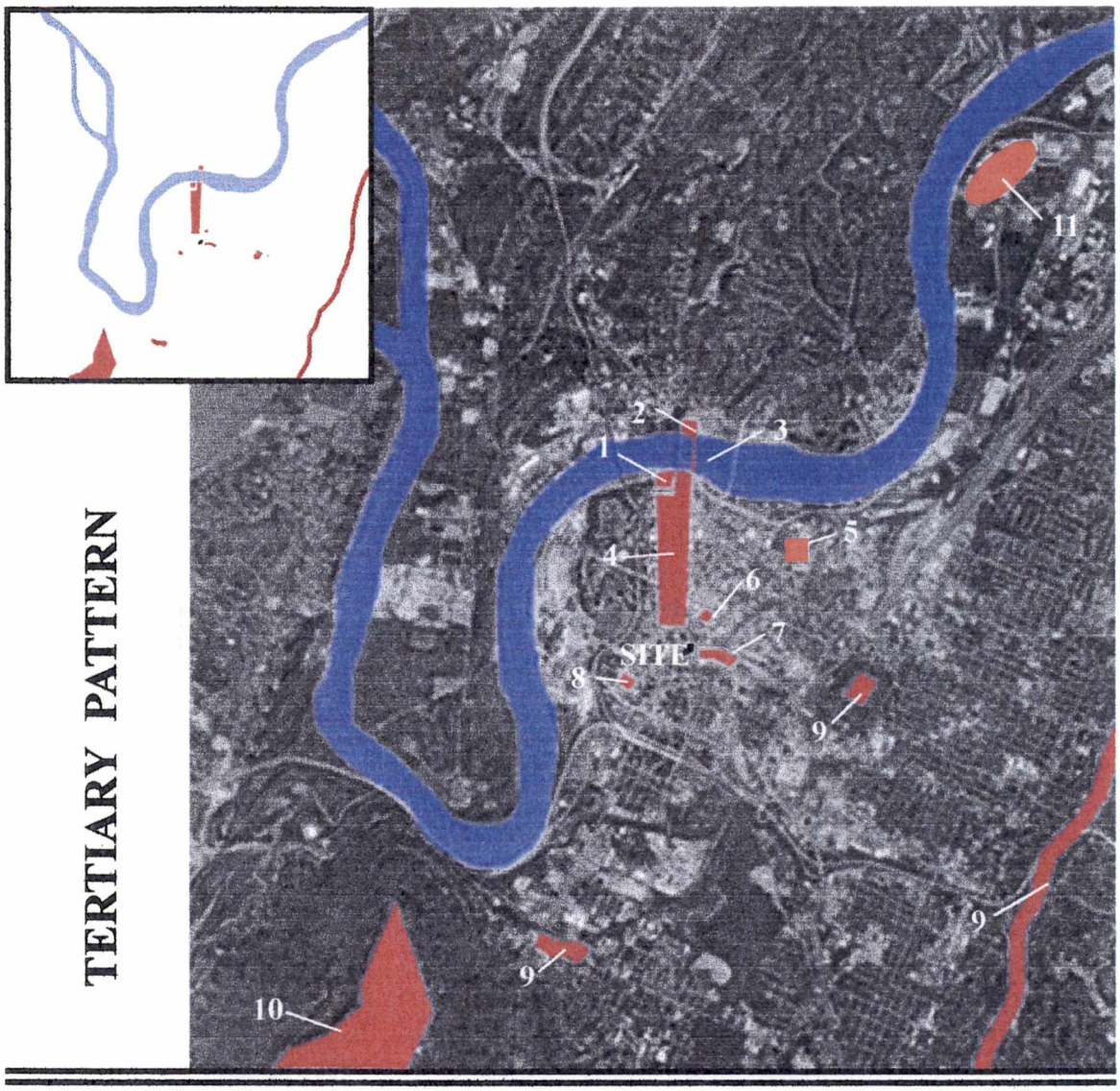
The area provides a variety of hotels, motels and entertainment facilities.

**Analysis**

Cultural attractions have not capitalized on their potential because of the neighborhood's poor visual and socioeconomic image

**Design Response**

The *Center for Sustainable Education and Living* should enhance the neighborhood's image and provide experiences and spatial opportunities for cultural interaction and exchange. The facility should foster social cooperation by demonstrating new patterns of urban living which will sustain the existence of the neighborhood.




**City Boundary with Cultural Attractions**

**Survey**

1) Tennessee Aquarium, 2) Coolidge Park, 3) Walnut St. Pedestrian Bridge 4) Downtown, 5) UTC Roundhouse, 6) African-American Museum, 7) Chattanooga Choo-Choo, 8) Max Finley Stadium, 9) Civil War Battlefield Site, 10) Lookout Mountain, 11) River Park

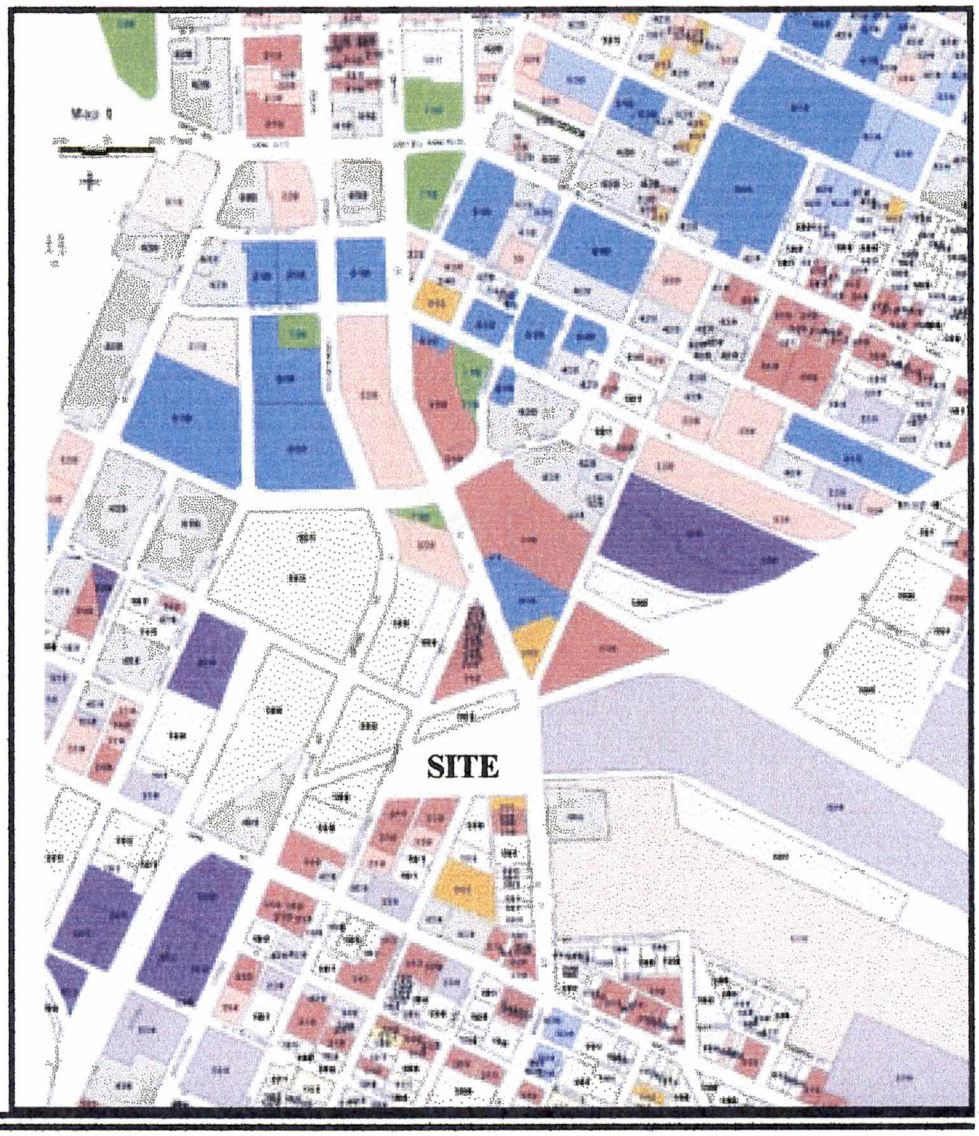
**Analysis**

Chattanooga was formed by mountains, forests and the Tennessee River. It is located in Southeast Tennessee near Georgia's border and the intersection of four interstate highways. It's scenic beauty, cultural attractions and quality of living offers great opportunities for visitors and residents. Chattanooga has won three national awards for outstanding livability.

**Design Response**

The *Center for Sustainable Education and Living* should continue the goals and aspirations of the citizens of Chattanooga to have one of the most livable cities in America. It should also be a means to engage, inform and inspire residents and visitors to become stewards of their environment. The Center for Sustainable Education and Living should cooperatively and interdependently function to support Chattanooga's economic growth and community sense of place.

QUATERNARY PATTERN




## Building Type

**Survey**

Building Type map provided by Chattanooga Regional Planning Agency

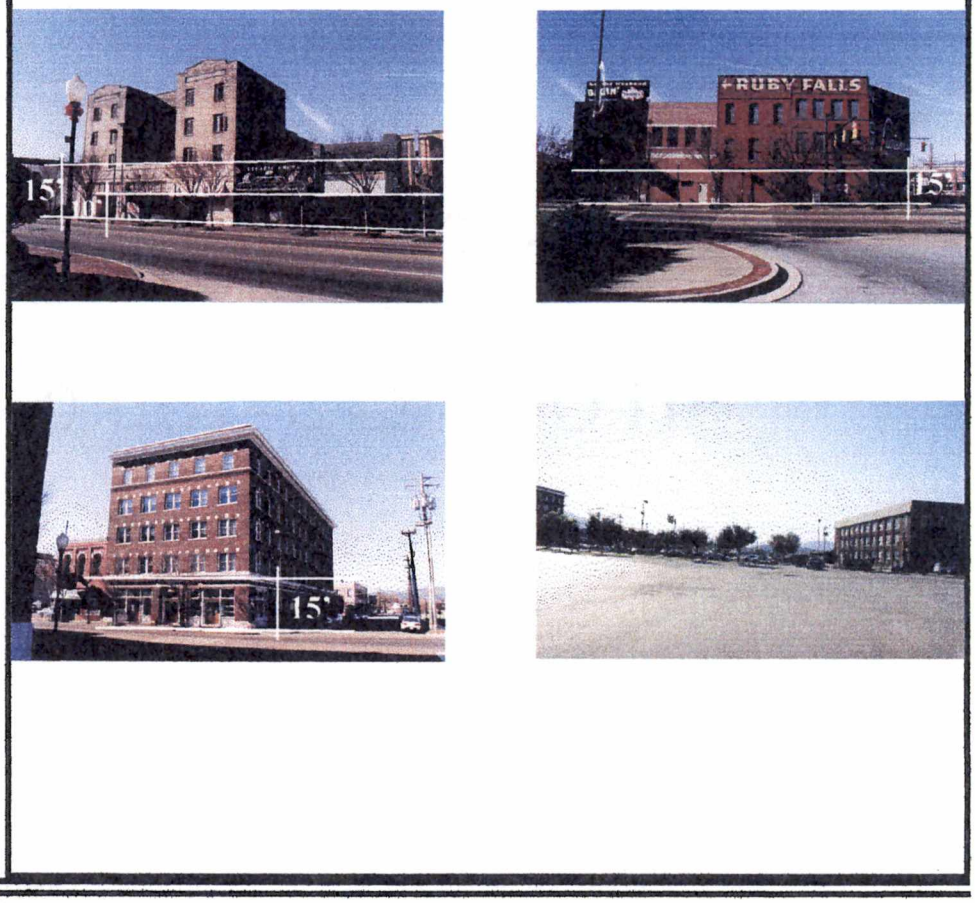
**Analysis**

- Agriculture
- Single Family
- Duplex
- Multi-Family
- Mobile Home
- Mobile Home Park
- Manufacturing
- Warehouse/Wholesale
- Storage
- Retail Sales/Service
- Office
- Hotel/Motel
- Trucking
- Parking
- Utilities
- Institutional
- Day Care/ Preschool
- Religious Facilities
- Hospitals/Clinics
- Cemeteries
- Parks, Plazas, Recreation
- Vacant
- Unknown

**Design Response**

The site should become the transitional zone from city to neighborhood. *The Center for Sustainable Education and Living* should provide visual and physical connections from the built environment to the natural environment.

QUATERNARY PATTERN




**Market Street looking West**

**Survey**

Compare building heights, facade proportions, window patterns, projections, roof forms, horizontal or vertical emphasis and scale. Also compare spacing, proportions of entrances and door openings, landscaping, materials, textures and colors.

**Analysis**

The buildings have a tripartite composition and heights respond to the larger city scale. Building heights are limited to 45' except for historic Union Hotel which is 50'. A 10' registration height marks the transparent and permeable zone, while a 15' height becomes the base height or datum for the elevations collectively. Trees form a vertical layer or threshold between vehicular path and pedestrian. Buildings maintain the city's hard street edge. Windows of individual buildings are of a singular type except for historic Union Hotel which introduces an A/B rhythm to emphasize its significance. When compared collectively, window openings have similar proportions.

**Design Response**

The *Center for Sustainable Education and Living* should not be taller than the historic Union Hotel. The facade on Market Street should maintain the hard street edge of the city but create visual variety for motorist. Vegetation along Market Street should be used as a vertical layer between street and pedestrian. The *Center for Sustainable Education and Living* should interpret datum lines as permanent design features which connect the various facades, while a sense of the ephemeral is achieved through individual treatment of window openings, sill lines and relief elements.

# QUATERNARY PATTERN




**Site looking South**

**Survey**

Compare building heights, facade proportions, window patterns, projections, roof forms, horizontal or vertical emphasis and scale. Also compare spacing, proportions of entrances and door openings, landscaping, materials, textures and colors.

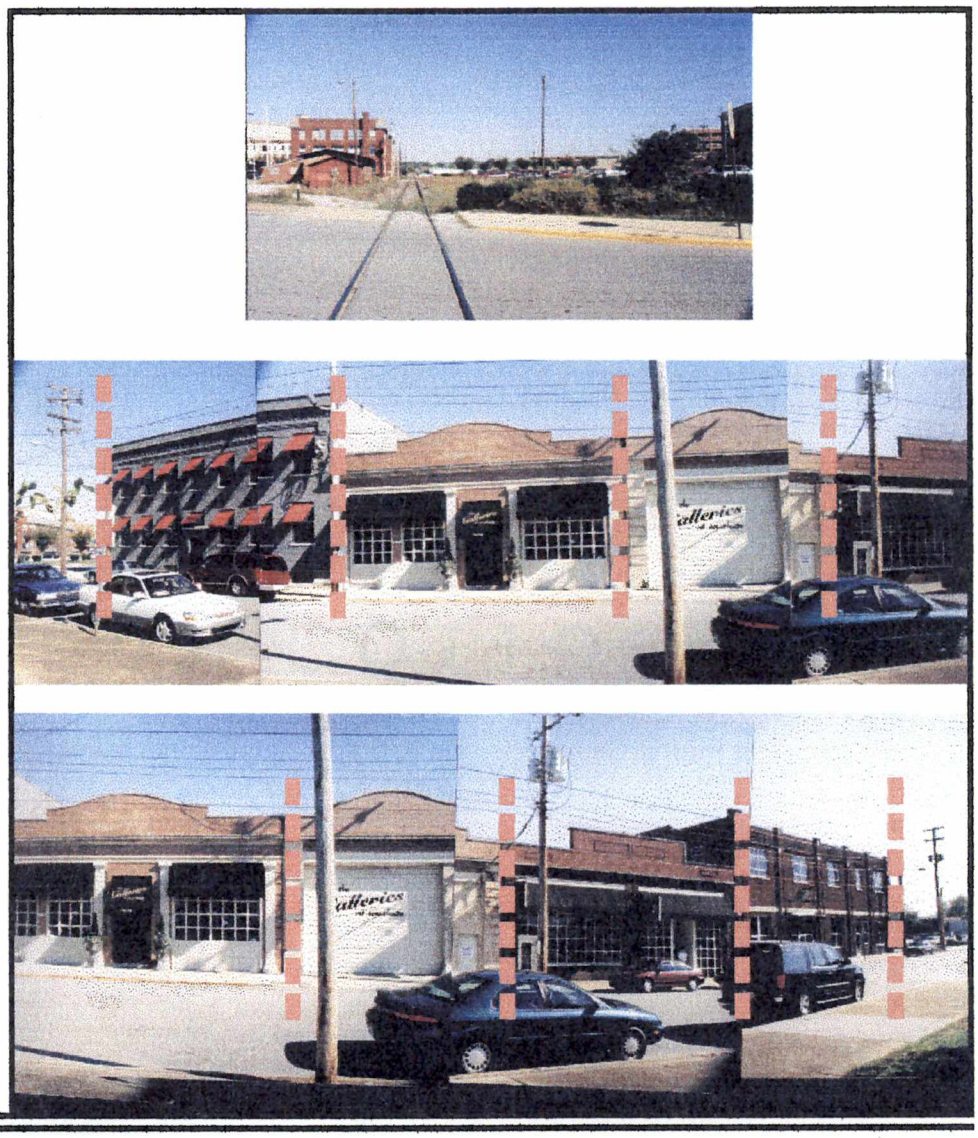
**Analysis**

A 40' building height is maintained except for historic Union Hotel which is 50'. The buildings have a tripartite composition and a 15' base height is carried over from the Market Street elevations. A heavy cornice line is established on all facades and window openings are marked by projecting sills. Openings on two of the buildings are also marked by quoins. Buildings do not maintain the street edge and are setback to allow a front yard/porch condition in response to the soft edge character of the neighborhood. Vegetation forms a vertical layer or threshold between street and entrance.

**Design Response**

The *Center for Sustainable Education and Living* should not be taller than the historic Union Hotel. The facade on 14th Street should be set back to maintain the soft street edge and create a front yard/porch condition. Vegetation along 14th Street should be used as a vertical layer between street and entrance. Window openings should be marked by projecting sills and quoins.

QUATERNARY PATTERN



**Cowart Street looking East**

**Survey**

Compare building heights, facade proportions, window patterns, projections, roof forms, horizontal or vertical emphasis and scale. Also compare spacing, proportions of entrances and door openings, landscaping, materials, textures and colors.

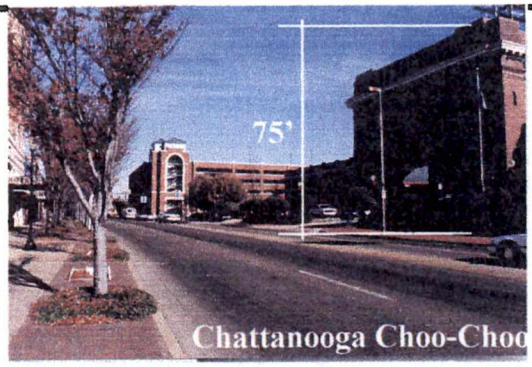
**Analysis**

Windows of individual building are of a singular type, but collectively window sills are emphasized and proportions vary. Individual building heights vary but collectively they respond to a smaller neighborhood scale. Buildings have a tripartite composition where the base height has been reduced to the height of a stoop. Middle buildings have horizontal emphasis while end buildings have a vertical emphasis. Buildings vary in color and texture of brick but collectively they maintain a common running bond pattern. Awnings on several facades maintain a common height and are in response to western sun.

**Design Response**

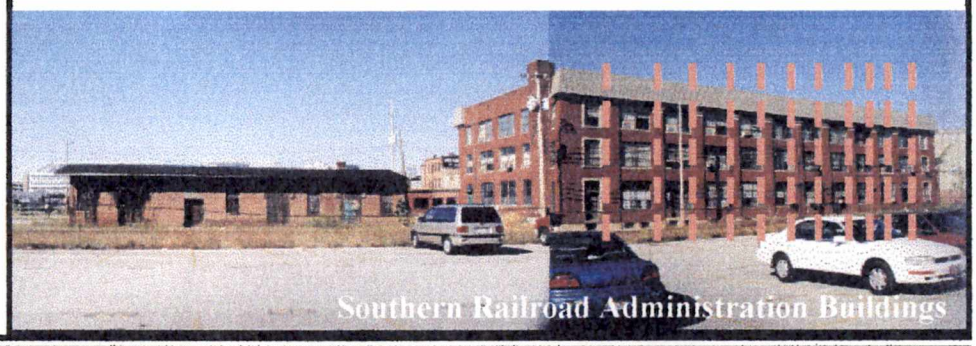
The *Center for Sustainable Education and Living* should maintain the running bond pattern of the bricks and respond to the scale of the neighborhood on Cowart Street. Awnings can be used as shading devices which are permanent fixtures but have an ephemeral effect upon the facade as the sun's path changes.

QUATERNARY PATTERN










## Significant Structures

**Survey**

1) Chattanooga Choo-Choo 2) Union Hotel 3) Southern Railroad Administration Buildings

**Analysis**

Historic and significant structures maintain their importance visually by being the tallest buildings in the neighborhood. They are all massive red brick buildings with a common running bond pattern. The Chattanooga Choo-Choo and Union Hotel place emphasis on the cornice line and window openings. The Southern Railroad Building emphasizes its structural rhythm.

**Design Response**

The *Center for Sustainable Education and Living* should use structural rhythms to visually and architecturally connect with the existing architecture in the neighborhood and city. The facility should not exceed the height of historic or significant buildings.

***Design Response Summary***

*Building Heights*: Development should not exceed 50' in height or the height of the tallest historic/significant building in the block. Buildings should be a minimum of 2 stories.

*Façade Proportions*: Façades on primary streets should have zero lot lines. Facades on secondary or neighborhood streets should have a building height to setback ratio of 1:1 from the property line.

*Window Patterns*: Window openings should have a width ratio of 5:8 respectively.

*Projections*: Cornice lines should be emphasized on primary streets and facades with flat roof lines.

*Roof Forms*: Flat roofs should provide usable roof top space such as gardens and terraces Pitched roofs should be limited to secondary or neighborhood streets.

*Horizontal or Vertical Emphasis*: Base heights of buildings should not exceed 15' in height and provide variety, transparency and permeability at ground level

*Scale*: Development along primary streets should maintain the larger scale of the city, but provide a datum which relates to the human scale Development along secondary or neighborhood streets should maintain a smaller human scale.

*Spacing*: Bay widths along primary streets should be no less than 20' or greater than 30'. $20' < X < 30'$, where X= structural bay width.

*Proportions of Entrances and Door Openings*: Entrances and Door Openings should relate to the human scale. They should be located on axis with pedestrian access from the city and neighborhood and allow permeability from one zone to the other

*Landscaping*. Use of native planting materials is encouraged to maintain an ecological balance. Landscaping should be used as a buffer zone between vehicular traffic and pedestrians but should not block views to or from the sidewalk.

*Materials*: Use of locally manufactured masonry materials is encouraged. Use of recycled materials is

also encouraged.

*Textures*: Use of masonry, natural wood products and steel are encouraged.

*Colors*: Colors should be characteristic of the architectural period or style.

***Program***

The program for this design investigation was generated from four proposed activities: *Gathering, Learning, Living* and *Working.* The *Center for Sustainable Education and Living* is intended function as a mixed-use facility. The user group identified for the design investigation provides 24-hour use of the facility and a variety of interactive opportunities. Users of the facility include:

- Researchers
- Schools
- Special Interest Groups
- Administrative Staff
- Tourists
- Residents
- Retailers

The interior program is divided into permanent and ephemeral spaces. Permanent spaces support the stability of the city, while ephemeral spaces are designed to be

flexible to accommodate the changing needs of the neighborhood. Structure of the permanent spaces is sterotomic and defined by a load bearing wall system The mechanical services are located within the wall's chase area Structure of the ephemeral spaces is tectonic and identified by columns and beams. The mechanical system is made visible to provide additional learning opportunities. The facility's mechanical load is reduced by use of various passive solar techniques: thermal mass, stacked ventilation, water walls and photovoltaics.

The exterior program is divided into winter and summer zones. In a hot-humid region like Chattanooga, the south side of the facility receives winter and summer sun. The north side of the facility provides shade during the summer. Deciduous trees are utilized in the winter zone. They allow sunlight to enter spaces in the winter and shading to occur in the summer. Landscaping is also used to direct wind currents. A retention pond demonstrates harvesting of storm water for irrigation as well as an evaporative cooling process.

*Gathering* activities provide an opportunity for individuals to interact and develop common interests. The proposed program provides indoor as well as outdoor spatial conditions for gathering through the design of the following:

- Roof Terraces
- Amphitheatre
- Auditorium

Gathering areas are determine by views to and from the site as well as pedestrian patterns of arrival.

*Learning* activities provide an opportunity for formal and informal means of educating the public on matters of environmental responsibility and stewardship. The program also allows indoor and outdoor spatial conditions for individual and collective education. The following spaces provide diverse learning experiences:

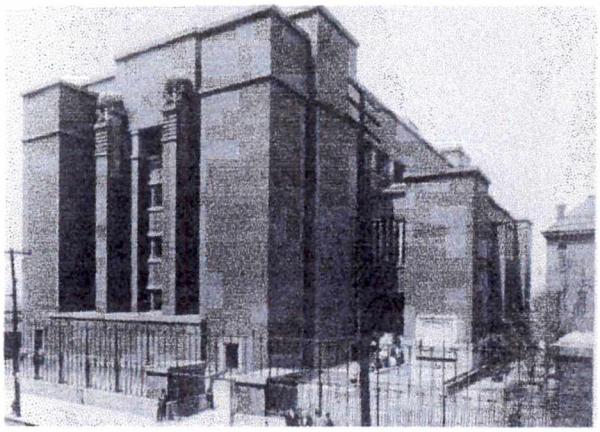
- Library
- Workshops
- Exhibit
- Research
- Outdoor Demonstration
- Living Machine
- Classrooms

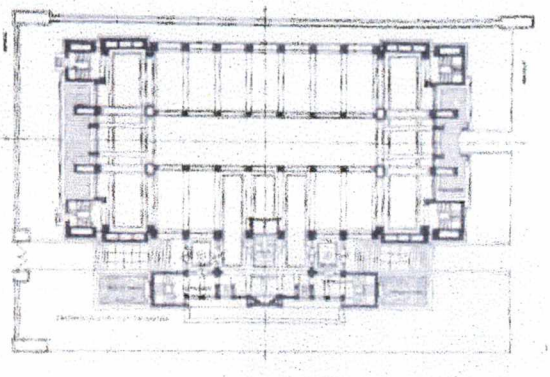
Classrooms are designed to open to the outdoors to allow an unobstructed threshold between the natural and built environment. Workshop and Exhibit areas are transparent in order to be viewed by passersby. The Outdoor Demonstration areas highlight natural processes, use of native planting materials for soil conservation and wind control and stormwater management. Throughout the facility, wall space, floors and exposure of the mechanical systems are used to provide additional learning opportunities. Roof Terraces provide access to photovoltaic panels to educate the public about sustainable building technology.

*Living* areas are programmed to be multifunctional studio/housing spaces. They are designed to have the studio area visible from the city street and private living spaces accessible from the neighborhood. A Care Taker's Suite is also provided

Commercial/Retail (*Working*) activities provide opportunities for public service and neighborhood enterprise. These areas are located at ground level. In addi-

tion, they are transparent to allow visibility from the city street and permeable to allow access to the neighborhood. The commercial/retail spaces are designed to be flexible with a common mechanical service zone





**Larkin Building**
**Buffalo, New York**
**Architect: Frank Lloyd Wright**

Precedent Relevance: Mechanical service and circulation zones

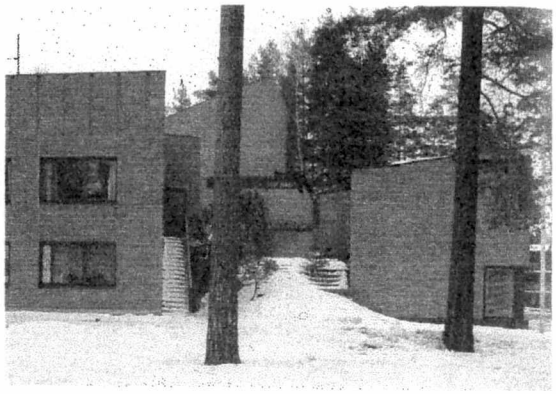
Wright set the stairs and ventilating equipment in tall towers to the corners of the building. The towers supported the interior structure and gave a monumental character to the exterior. They provided vertical emphasis and unified the smaller parts to make the overall form coherent.

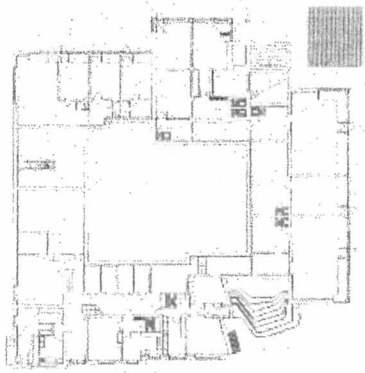


**Taliesin West**
**Scottsdale, Arizona**
**Architect: Frank L. Wright**

Precedent Relevance: Architectural tectonics reflecting context

Wright celebrated the American landscape by combining two desert archetypes into a single idea—the half-buried "pit-house" (sterotomic) and the nomadic tent (tectonic).

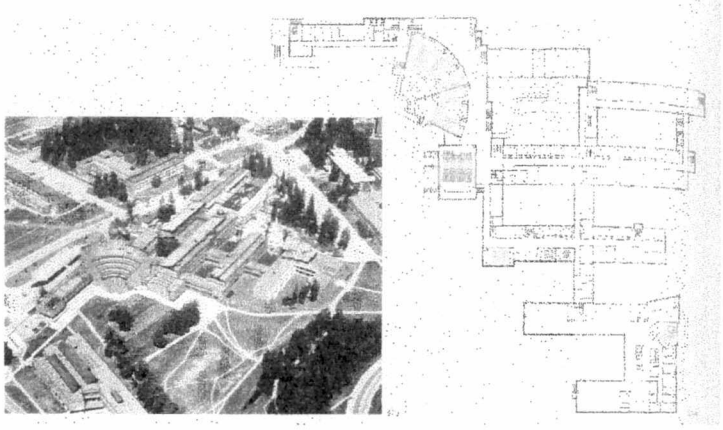




**Town Hall**
**Säynätsalo**
**Architect: Alvar Aalto**

Precedent Relevance: Architecture responding to site and human behavior

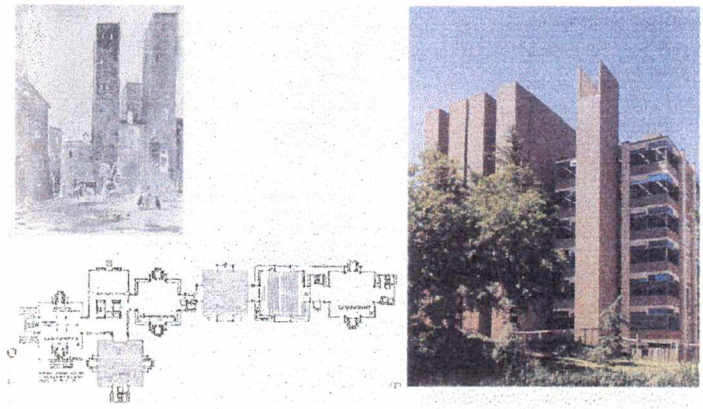
Aalto located the facility in the heart of the community to become a focal point of the entire local society. Shops were located at ground level and designed to be transformed into government offices once the need arose. The Town Hall was civic without being monumental and lived between urban and rural worlds.



**Helsinki University of Technology**
**Espoo**
**Architect: Alvar Aalto**

Precedent Relevance: Public gathering space used as connector between building wings

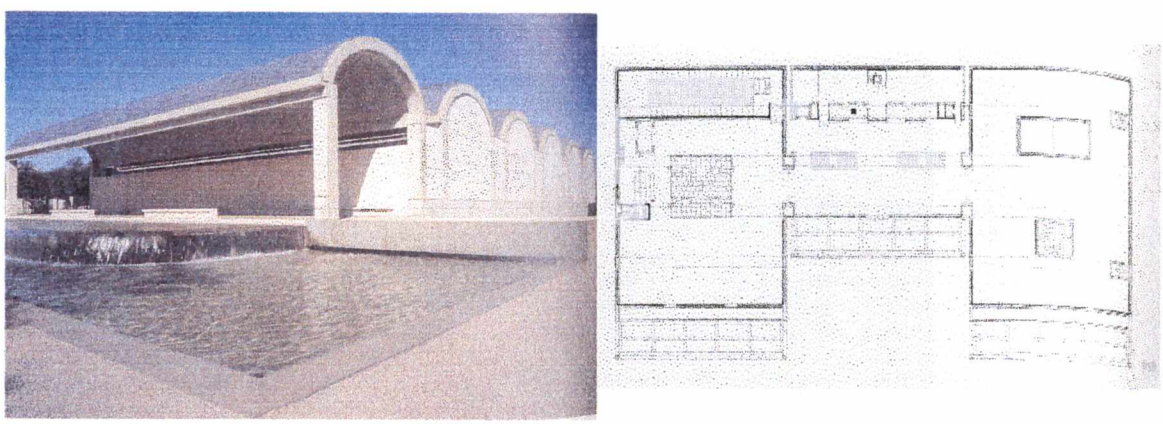
Aalto placed the main auditorium in a prominent position and used it as the focal point for the group of buildings. The auditorium served as a ceremonial center and pivot between the two directions of parallel, extendible bars containing classrooms, offices and laboratories. The wedge shaped auditorium also functioned as an outdoor theatre which gathered up the surrounding landscape with its stepped form.



**Richards Medical Research Laboratories**
**University of Pennsylvania, Pennsylvania**
**Architect: Louis I. Kahn**

Precedent Relevance: Permanent and ephemeral qualities of Architecture

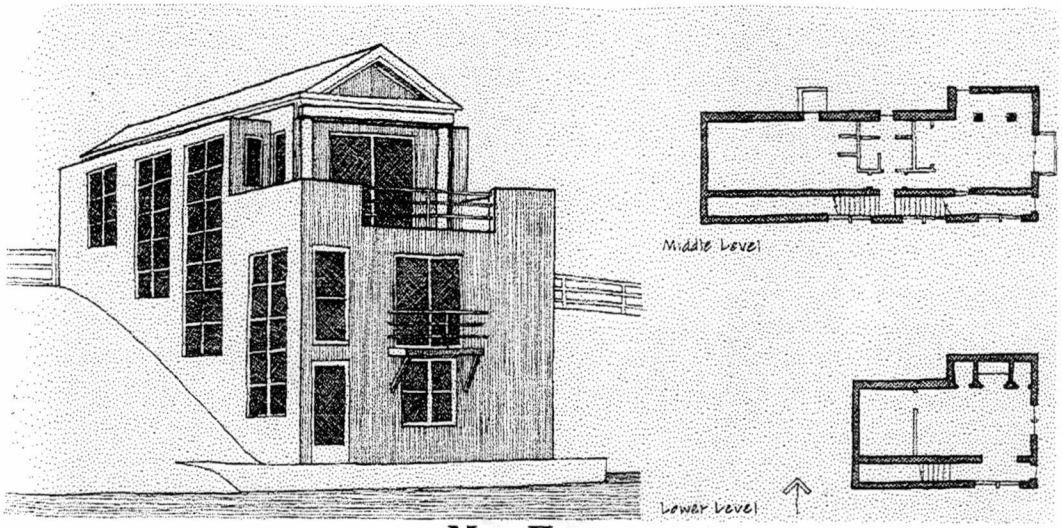
Kahn expressed the distinction between the fixed and the variable, the serving and the served through the monumentality of service and stair towers. The laboratories required flexible interiors and were treated as cellular elements attached to the towers. The combination of linear and cellular created interstitial spaces between the buildings and landscape to provide a gradual shift in scale from small to large parts of the design and context to individual details.



**Richards Medical Research Laboratories**
**University of Pennsylvania, Pennsylvania**
**Architect: Louis I. Kahn**

Precedent Relevance: Transparent and Permeable qualities of architecture

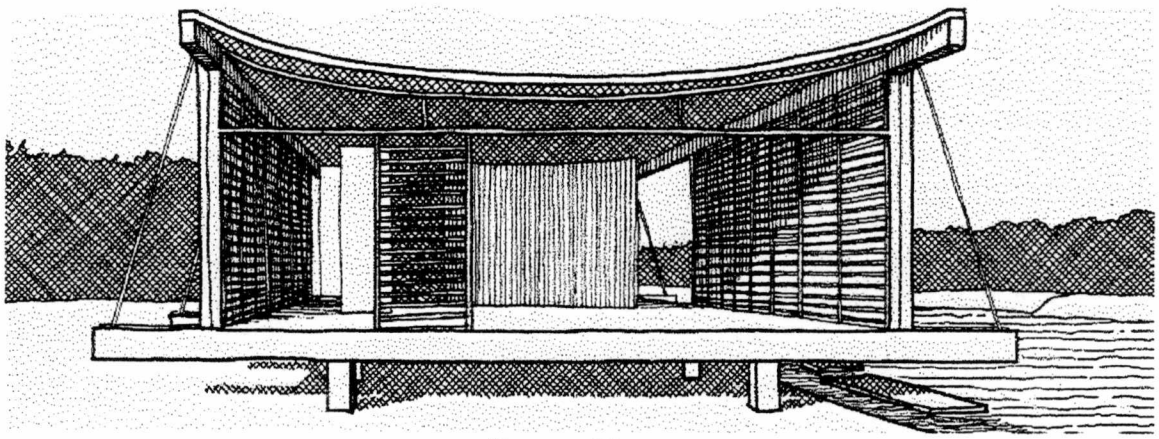
Kahn arranged the structure to be a series of parallel concrete vaults which acted as long beams to allow free flowing space from bay to bay. The structural system also allowed long diagonal views across a standardized rhythm of columns.




**Mere House**
**Flint Hill, Virginia**
**Architect: Bumpzoid**

Precedent Relevance: Heat Storage

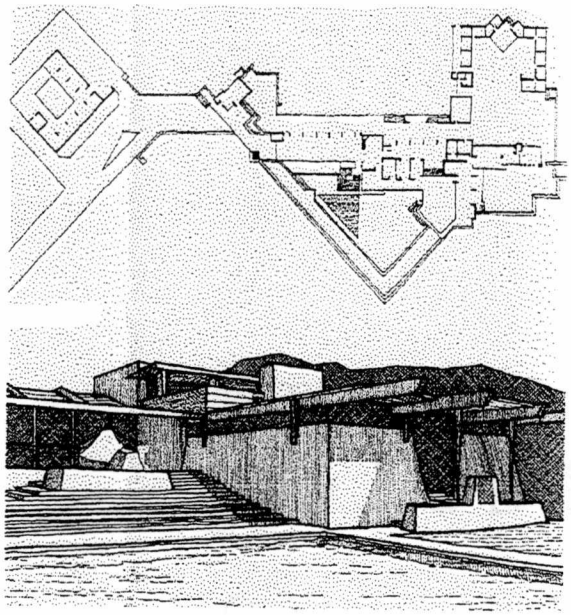
Bumpzoid increases southern exposure of its major rooms by elongating structure in its east-west direction. A masonry stairway that runs the length of the south wall serves as a place for heat storage.



**Cacoon House**
**Sarasota, Florida**
**Architect: Paul Rudolph**

Precedent Relevance: Orientation based on prevailing winds

Rudolph treated almost the entire house as a single room oriented to the prevailing winds in order to increase the effectiveness of cross-ventilation as a cooling effect.



**Taliesin West**
**Scottsdale, Arizona**
**Architect: Frank L. Wright**

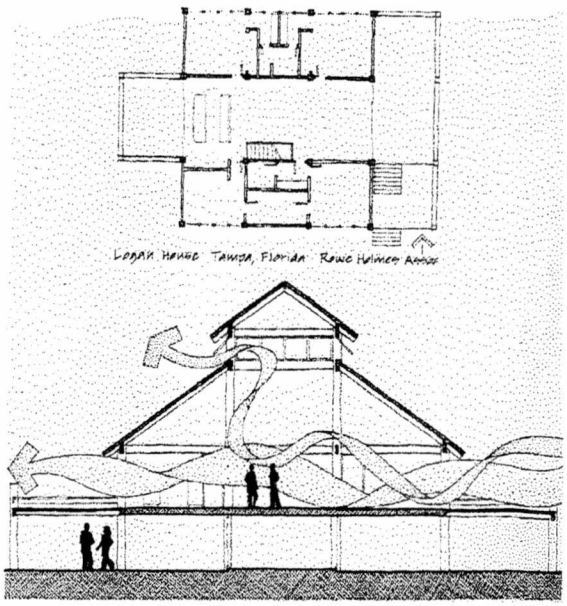
Precedent Relevance: Cooling by water evaporation

Wright used fountains in protected areas to provide a cool oasis from the hot desert air and pools to cool the air moving through the building.

**Logan House**
**Tampa, Florida**
**Architect: Rowe Holmes Associates**

Precedent Relevance: Cross and Stacked ventilation

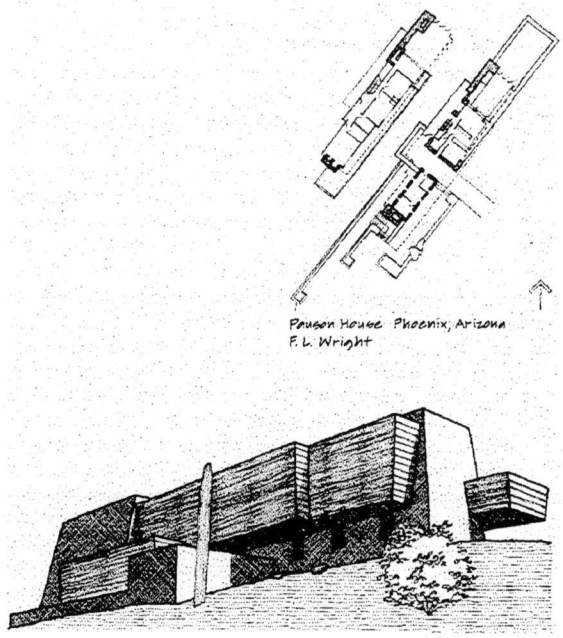
Rowe Homes Associates organized rooms and wall openings to increase cooling effects from cross ventilation and stacked ventilation.

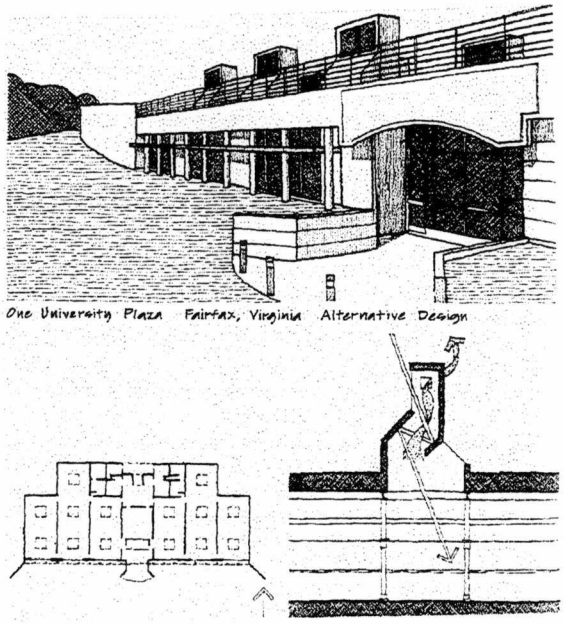


**Pauson House**
**Phoenix, Arizona**
**Architect: Frank L. Wright**

Precedent Relevance: Rooms used as buffer zones against heat or cold

Wright designed a virtually unglazed circulation and storage space to be a buffer zone against the sun.



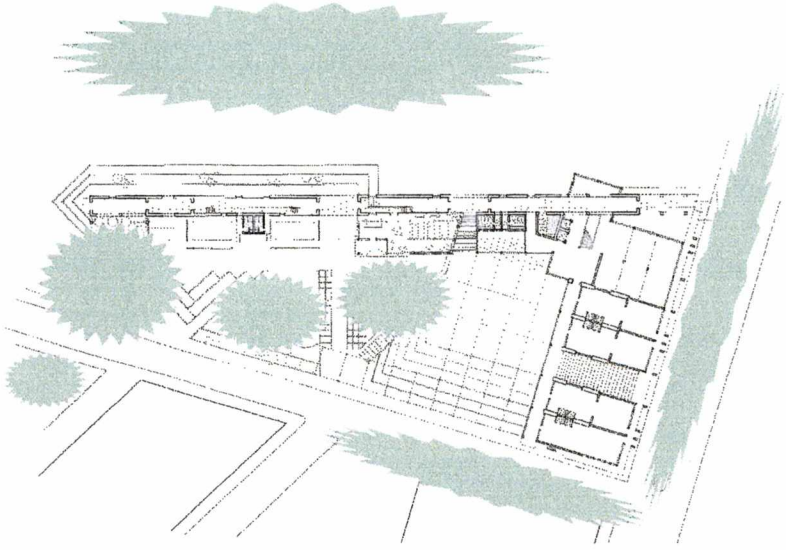

**One University Plaza**
**Fairfax, Virginia**
**Architect: Alternative Design**

Precedent Relevance: Solar heating, day lighting and ventilating

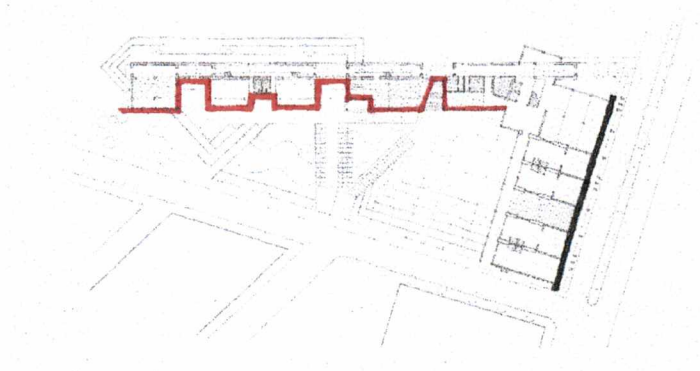
Alternative Design combined tasks of heating, day lighting and ventilating. The monitors change their role seasonally by providing solar heating in the winter and day lighting and stacked ventilation in the summer.



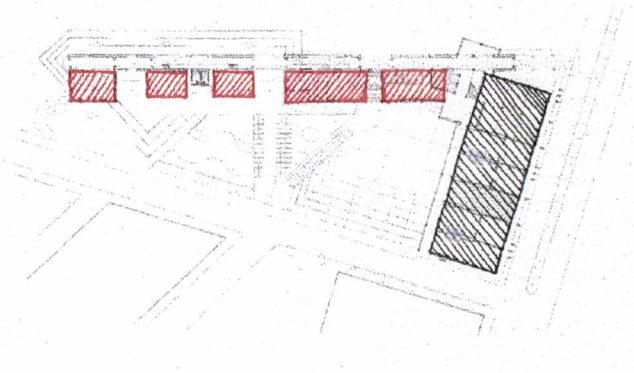

**CLIMATIC ZONES**



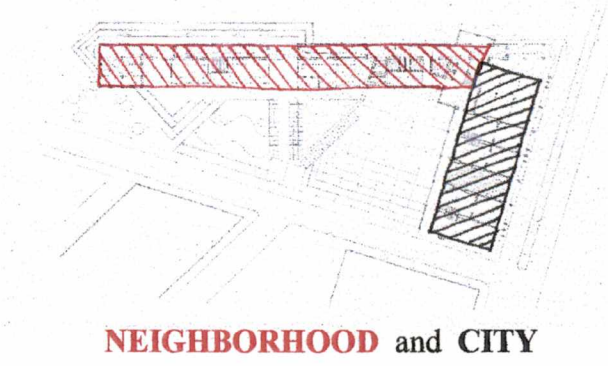
**VEGETATION**



**NEIGHBORHOOD SCALED EDGE** and **CITY SCALED EDGE**

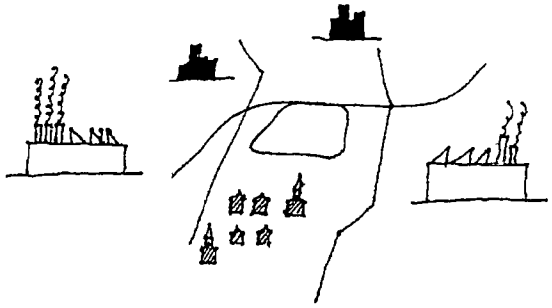


**INDIVIDUAL** and **COLLECTIVE**



**NEIGHBORHOOD** and **CITY**

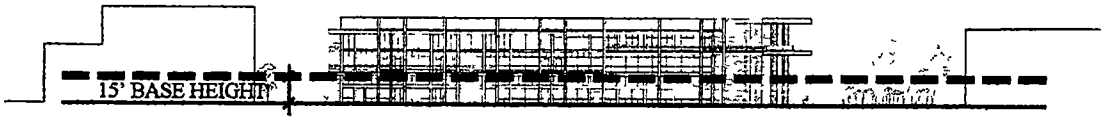
GARDEN
RETENTION POND
AMPHITHEATRE
GALLERY



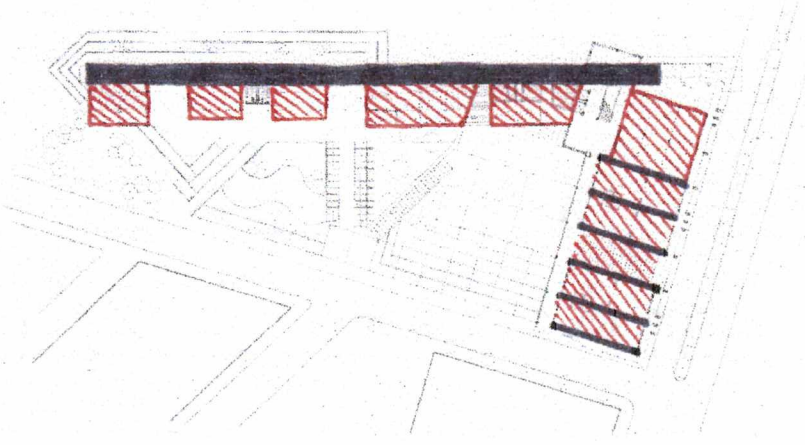
**BUILDING TYPE**



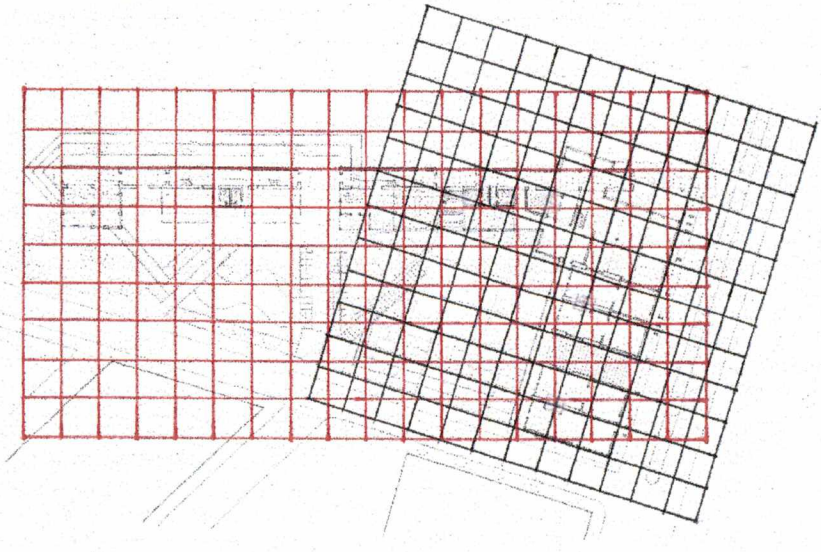
**APPEARANCE**
(Industrial)




**APPEARANCE**
(Commercial)

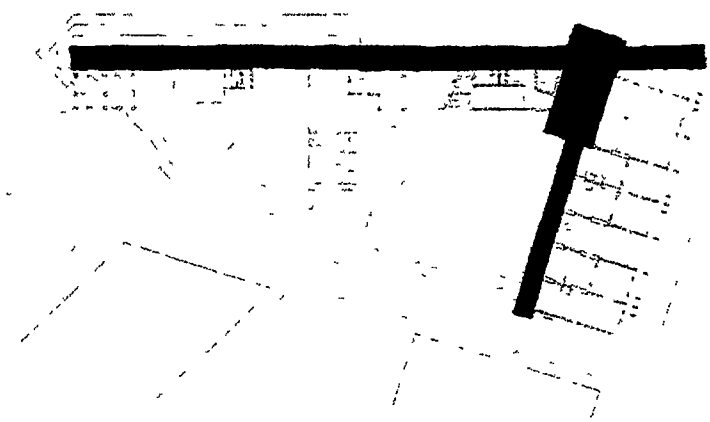


**EPHEMERAL AND PERMANENT**

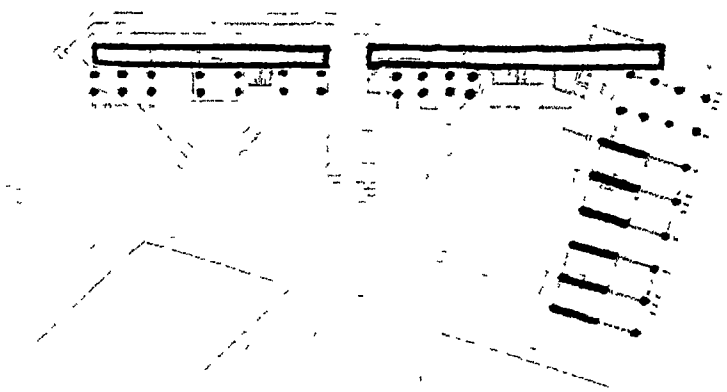


**DYNAMIC GRIDS**

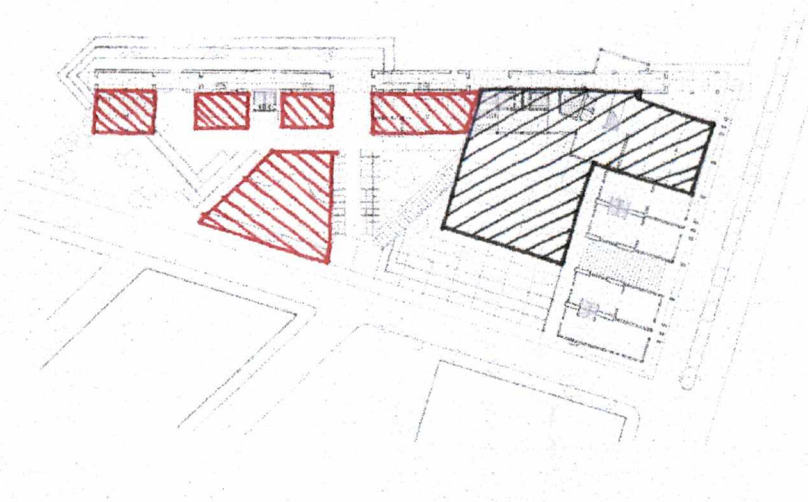
**SOLAR and CITY**



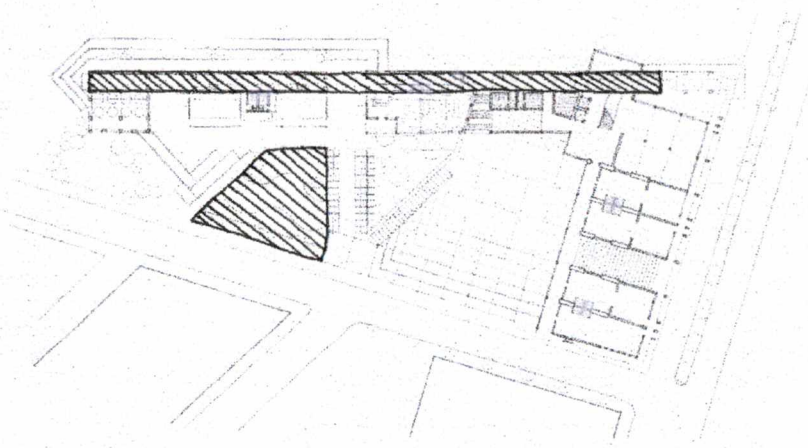
**CIRCULATION**



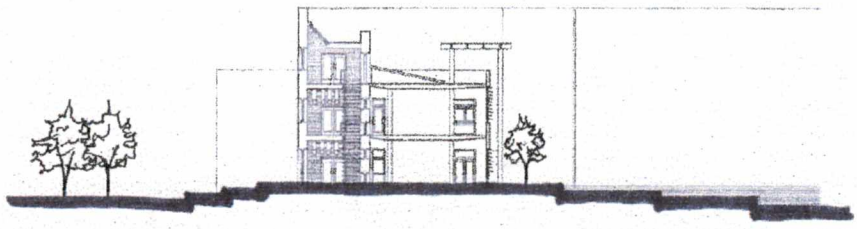
**STRUCTURE**



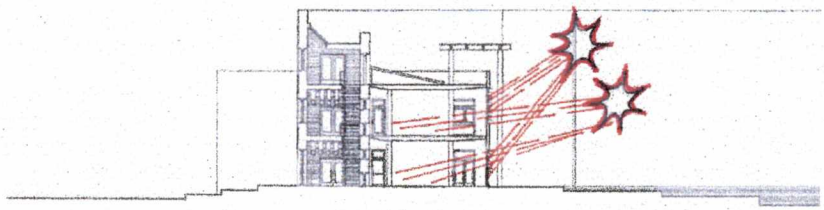
**LEARNING and GATHERING**



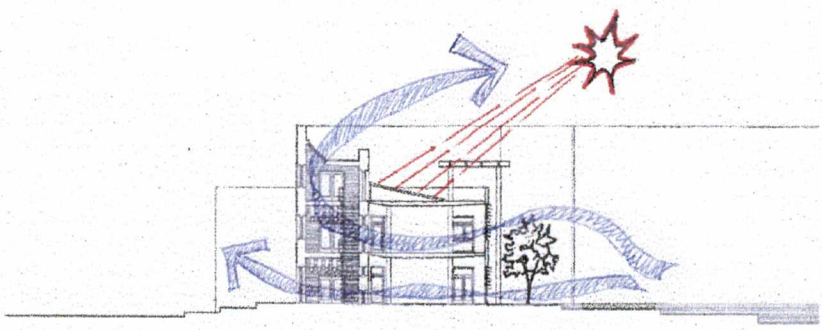
**WATER COLLECTION**



**TRANSFORMATION OF LANDSCAPE and FLOOR PLANE**



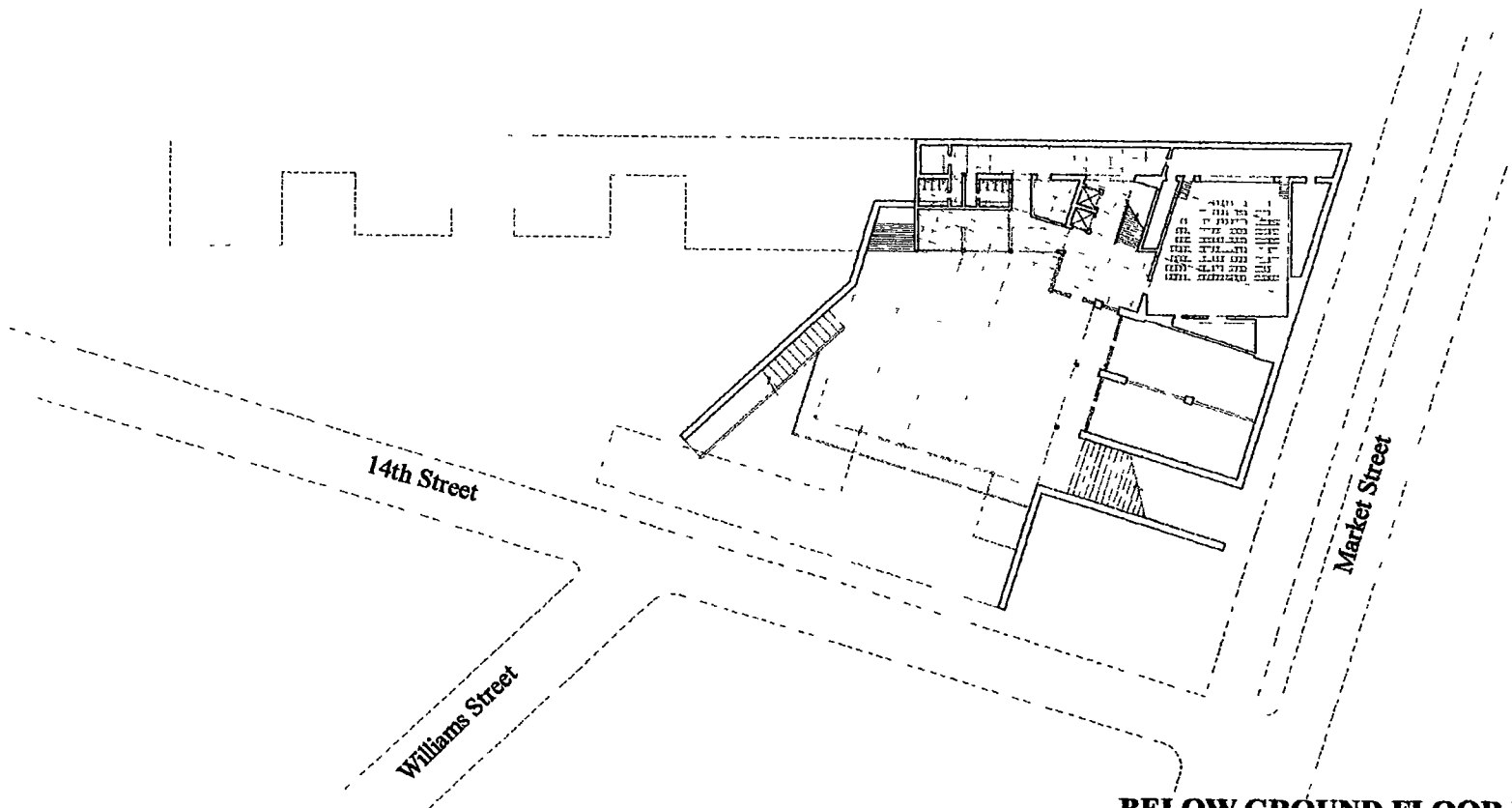
**WINTER SUN and SUMMER SUN**



**SOLAR COLLECTION**
**STACKED VENTILATION**
**CROSS VENTILATION**

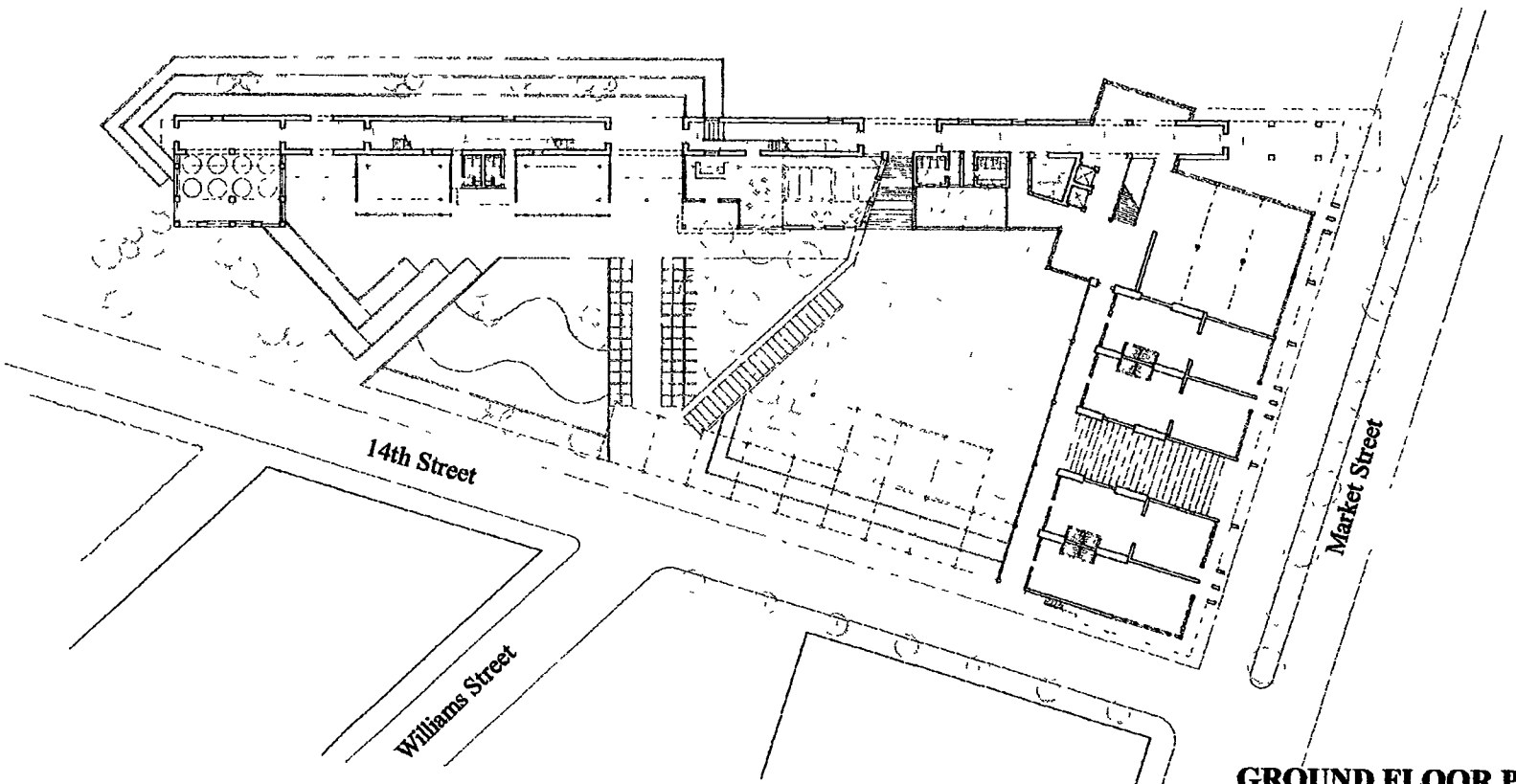
SITE PLAN

SITE AXONOMETRIC



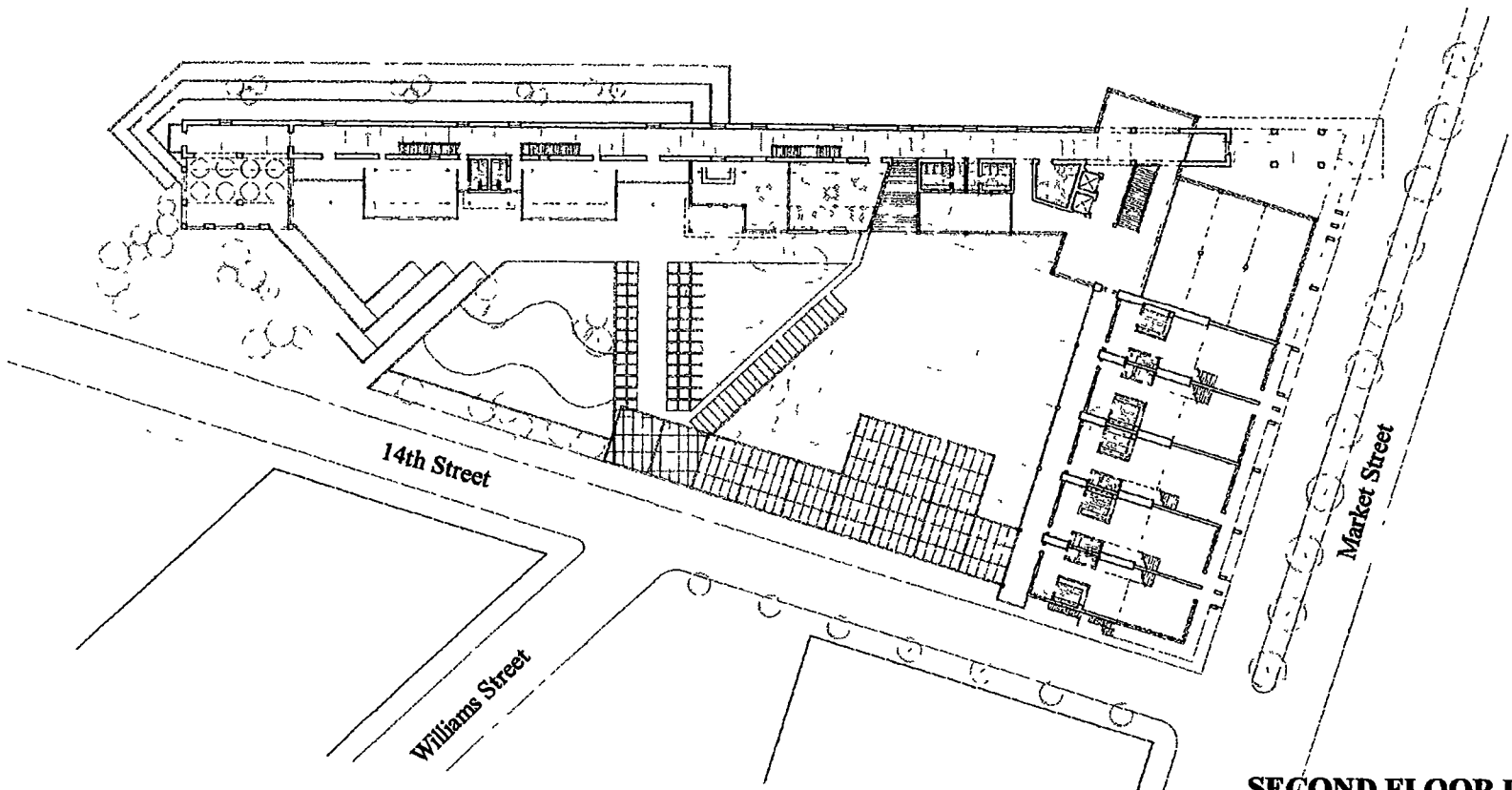

**BELOW GROUND FLOOR PLAN**

SCALE 0 16' / 4' 12'



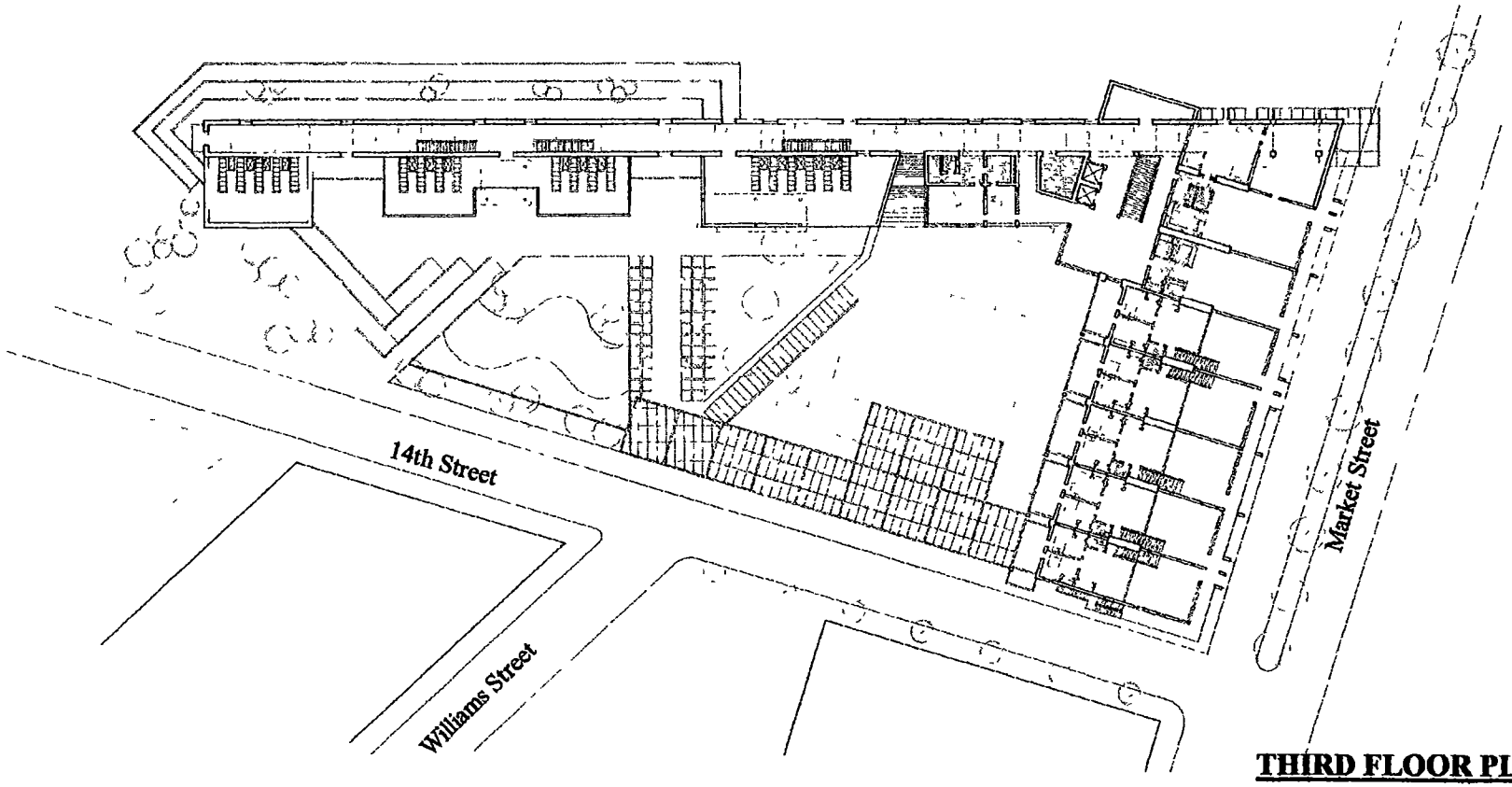

**GROUND FLOOR PLAN**

SCALE 0 16' / 4' 12'



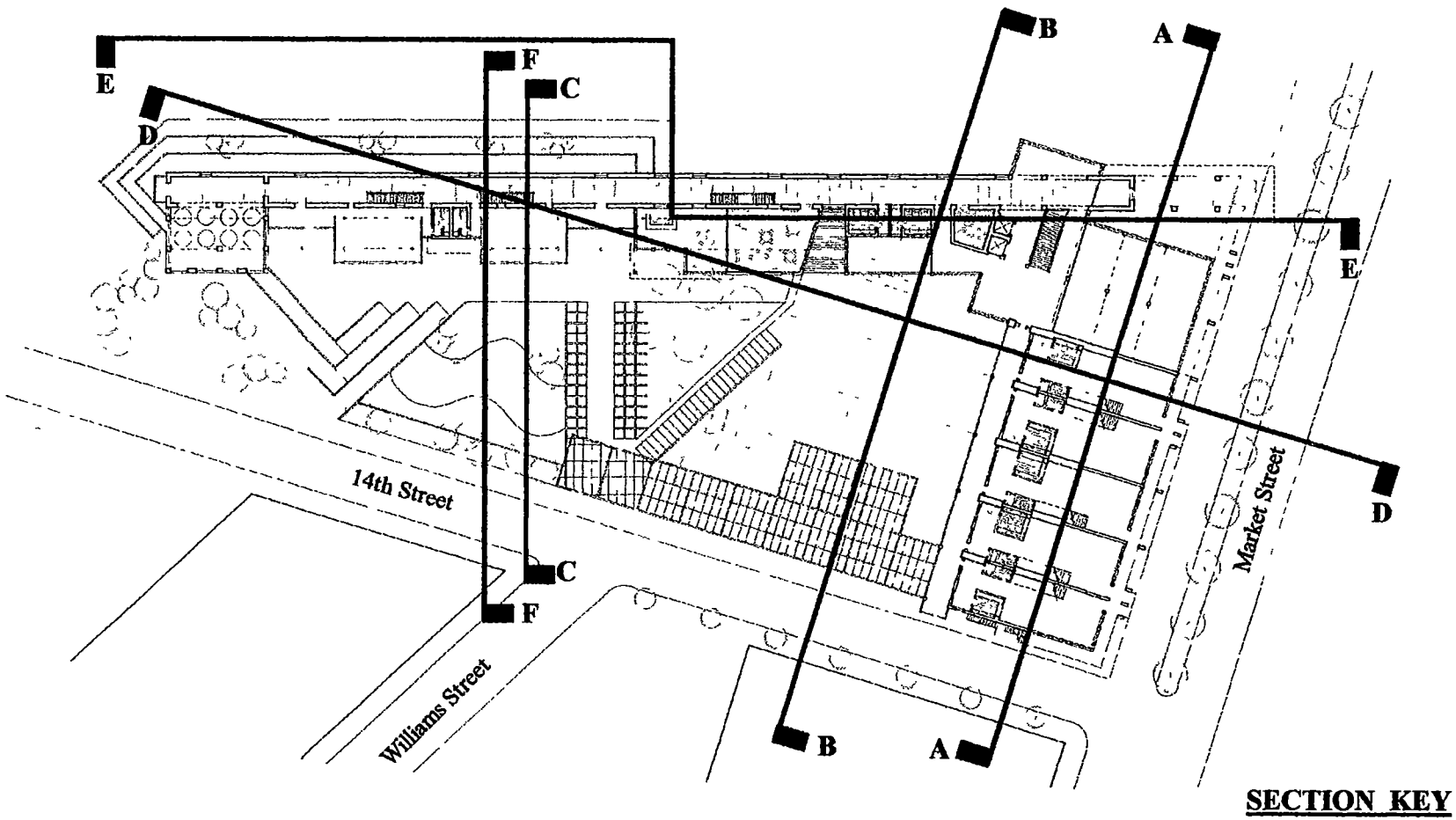

**SECOND FLOOR PLAN**

SCALE 0 16' / 4' 12'

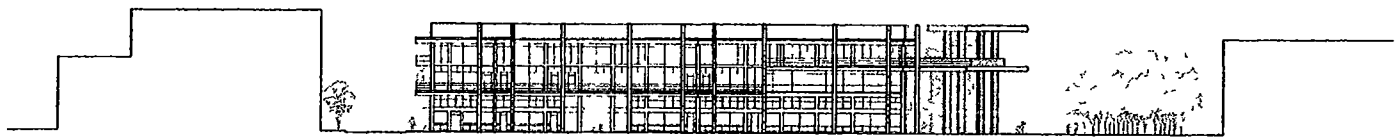



**THIRD FLOOR PLAN**

SCALE 0 16' / 4' 12'

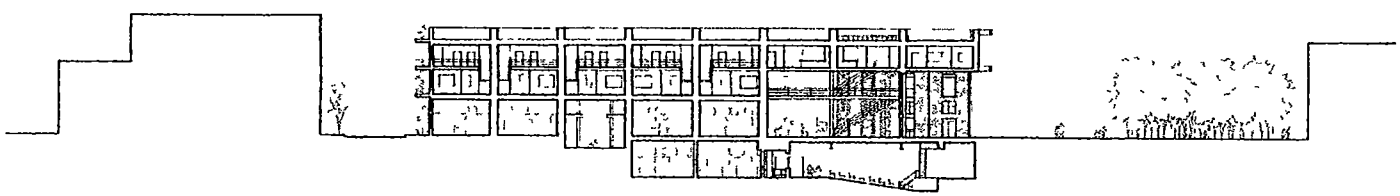



**SECTION KEY**



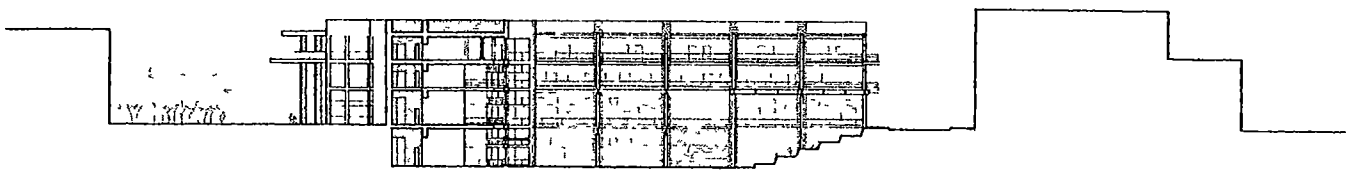
**MARKET STREET ELEVATION**

SCALE 0 16' / 4' 12'



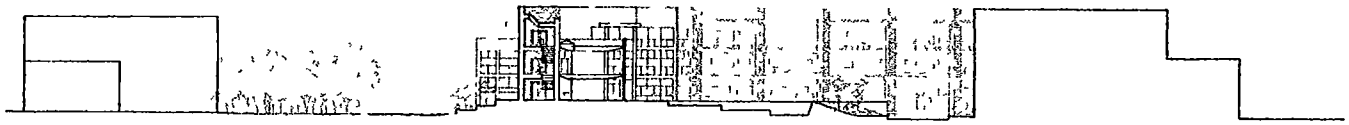
**SECTION A-A**

SCALE 0 16' / 4' 12'



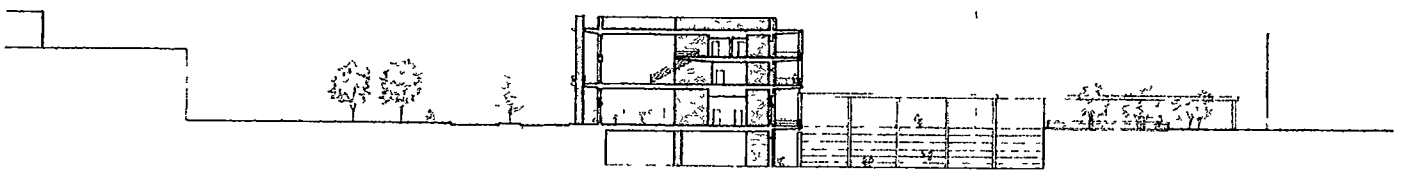
**SECTION B-B**

SCALE 0 16' / 4' 12'



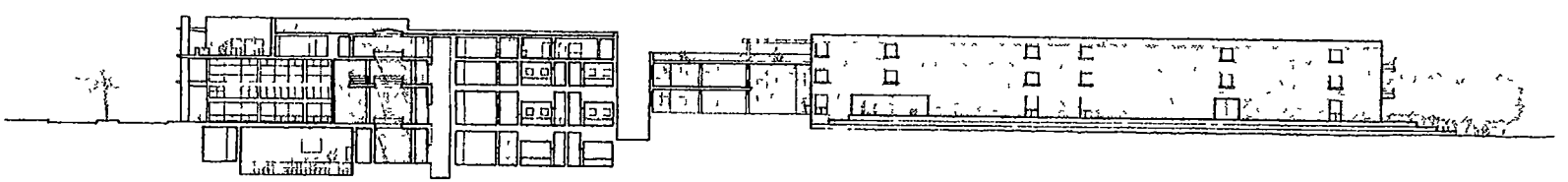
**SECTION C-C**

SCALE 0 16' / 4' 12'



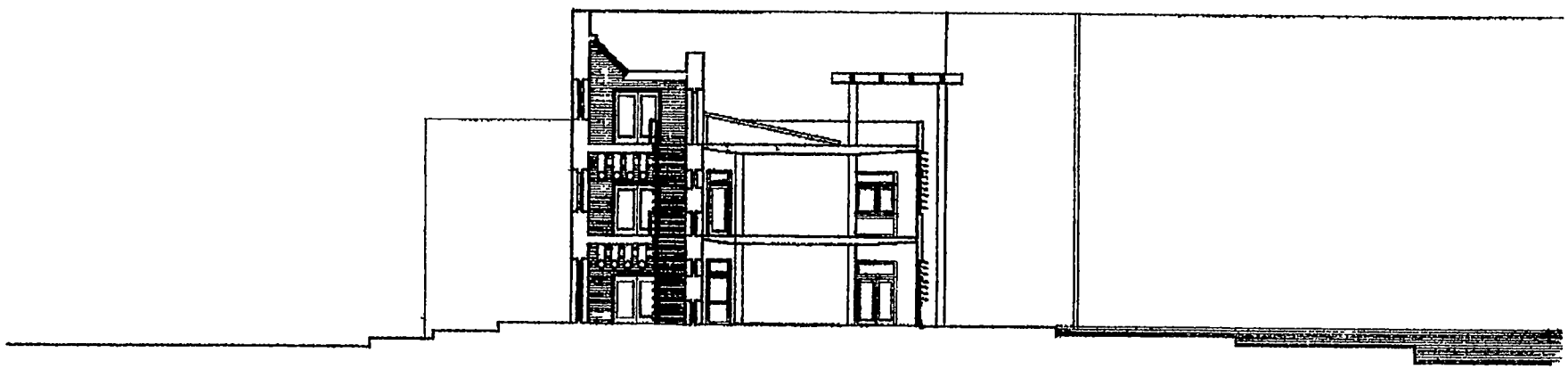
**SECTION D-D**

SCALE 0 16' / 4' 12'



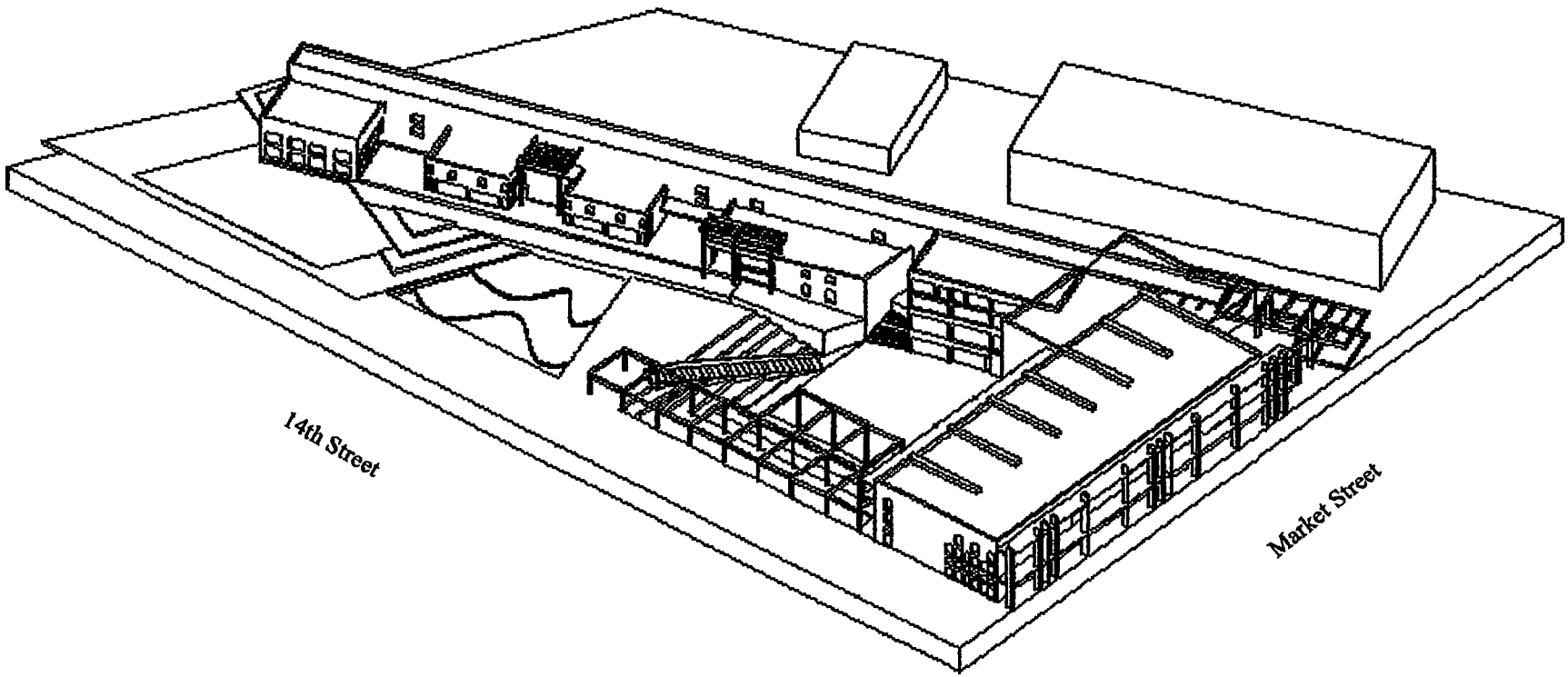
**COMPOSITE DRAWING E-E**

SCALE 0 16' / 4' 12'

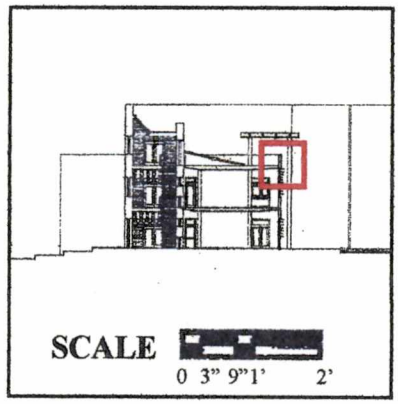


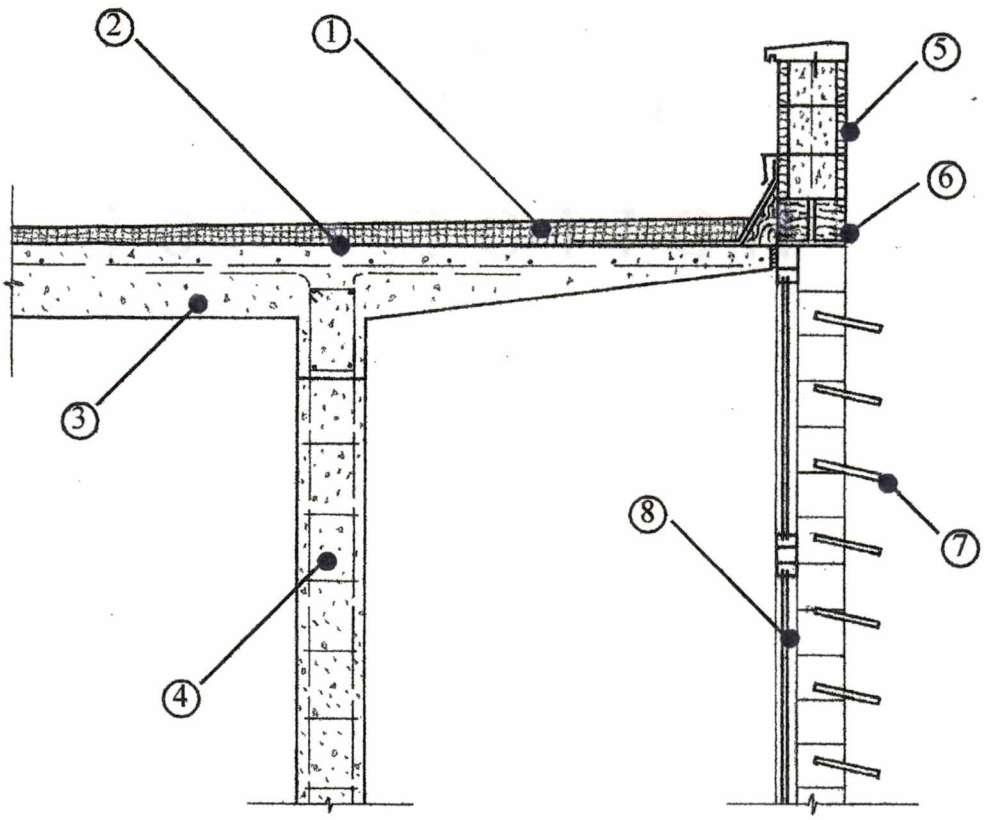
**SECTION F-F**

SCALE 0 16' / 4' 12'



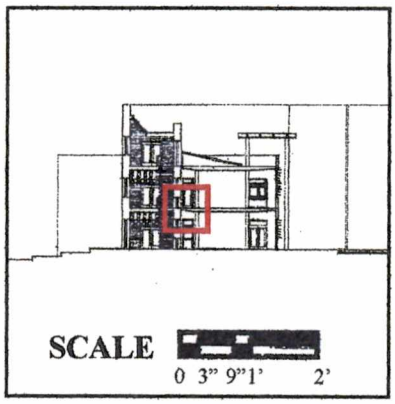

**SITE MODEL**

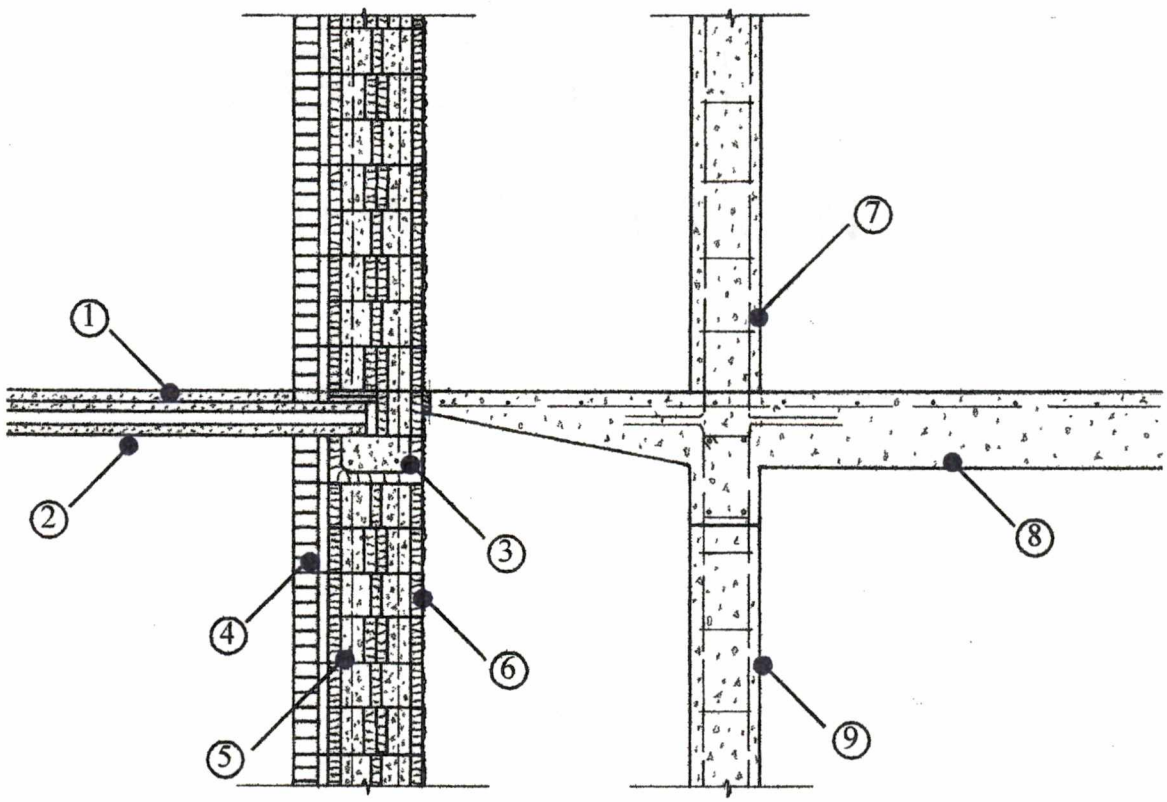



**KEY**

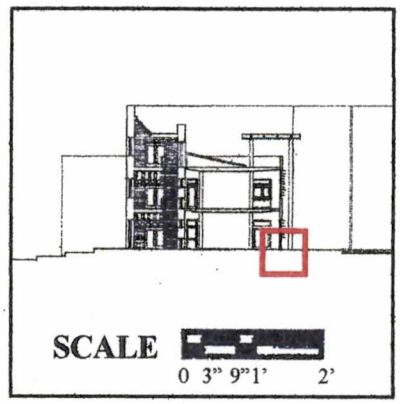
1. Gravel top cover over roofing membrane and rigid thermal insulation; slope 1/4" per foot
2. Vapor barrier
3. Poured-in-place concrete roof slab with welded wire fabric temperature reinforcing
4. Reinforced concrete column
5. 8" reinforced concrete block
6. Reinforced concrete bond beam
7. 1" x 12" fixed shading devices; placed @ 12° angle and spaced 12" apart to block high summer sun but allow winter sun
8. Double glazed awning type window

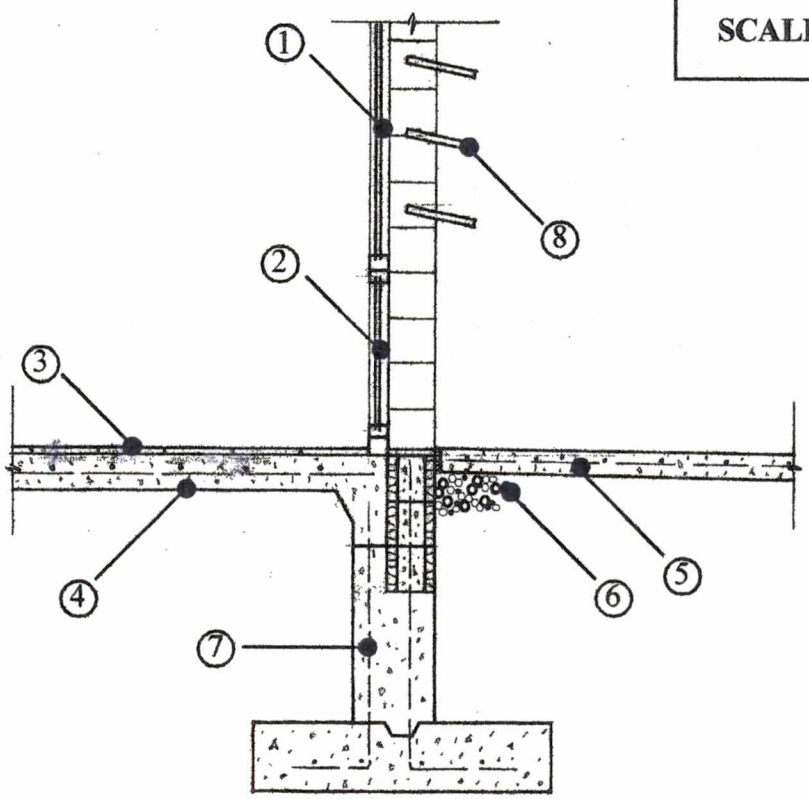



## KEY

1. Poured concrete topping with welded wire fabric temperature reinforcing
2. Precast concrete hollow core slab on bearing plate
3. Reinforced concrete bond beam
4. Brick facing with 2" air space
5. Wire ties and joint reinforcing
6. Textured 8" reinforced concrete block
7. Tie rods
8. Poured-in-place concrete floor slab with welded wire fabric temperature reinforcing
9. Reinforced concrete column




## KEY

1. Double glazed fixed type window
2. Double glazed hopper type window
3. 12" x 12" ceramic tile on 1 1/4" reinforced mortar bed and cleavage membrane; tile should be dark color for solar heat storage
4. 6" thickened edge concrete floor slab with reinforced welded wire fabric temperature reinforcing
5. 4" thickened edge concrete floor slab with reinforced welded wire fabric temperature reinforcing
6. 6" gravel base
7. Poured-in-place concrete floor foundation wall
8. 1" x 12" fixed shading devices; placed @ 12° angle and spaced 12" apart to block high summer sun but allow winter sun

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# APPENDIX

# Glossary

**Bioclimatic** — the relationship between climate and living matter

**Bioclimatic Design** — recognition of the influence climate has in shaping architecture

**Climate** — the average weather conditions experienced at a particular place over a long period (usually more than 70 years)

**Conduction** — the process by which heat energy is transferred through materials (solids, liquids or gases) by molecular excitation of adjacent molecules

**Convection** — the transfer of heat between moving a fluid (liquid or gas) and a surface; or the transfer of heat within a fluid by movements within the fluid

**Place (*Genius Loci*)** — a space which has a distinct character and contextual meaning derived from cultural or regional content

**Photovoltaic Power System** — cells consist of at least two layers of a semiconductor material such as silicon. In a two-layer cell, one has positive charge characteristics, the other, negative. When particles of light energy (photons) enter the cell, some photons are absorbed by semiconductor atoms. This frees electrons in the cell's negative layer, which then flow through an external circuit and back into the positive layer. This electron flow is an electric current, and can be made to perform work in the external circuit.

**Radiation** — the direct transport of energy through space by means of electromagnetic waves

**Roof Pond** — the thermal mass (water) is located on the roof. In winter the ponds are exposed to sun light during the day and then covered with insulating panels at night. The process is reversed in the summer.

**Sun Space** — a room that doubles as a solar collector and shares one common wall with an associated building.

**Sustainability** — development that seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future

**Thermal Mass** — the amount of potential heat storage capacity available in a given assembly or system designed to adsorb solar heat during the day for release later when heat is needed. Water walls, concrete floors and adobe walls are examples.

**Trombe Wall** — a masonry thermal storage wall placed between the solar aperture and the heated space. Heat is transferred into the space by conduction through the masonry and, if vents are provided, by natural convection.

# VITA

Bronté Lake was born in Cambridge, Maryland on February 18, 1963. She attended public school in Cambridge and participated in summer school programs for the gifted and talented across the state as well as Choate Rosemary Hall in Wallingford Connecticut. Bronté graduated from Cambridge-South Dorchester High School in 1981 and entered the University of Maryland, College Park. She received a Bachelor of Science in Architecture in 1986 and began work as an Intern Architect with MXDesign, Inc. in Chattanooga, Tennessee.

Bronté developed an interest in martial arts and became an Assistant Instructor and Office Manager in 1986 with Hanner International School of TaeKwon-Do. In 1990, she became a Recreation Director with the Chattanooga Parks and Recreation Department. After three years as Recreation Director, Bronté became Assistant Planner and in 1996 became Planner. She continued work in martial arts and was selected as a member of the 1993 USA Women's Global TaeKwon-Do Federation Team that competed in the European Championship Games in Moscow, Russia Bronté opened her own martial arts school, Chattanooga Academy of TaeKwon-Do, in 1995.

Bronté entered the Master's Program in Architecture at the University of Tennessee, Knoxville in August 1997. She received certification as a Leisure Professional in 1998 from the National Recreation and Parks Association Her Master of Architecture degree was received in August 2000.